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History, conservation and maintenance of the colonial King´s bridge of Panamá

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Abstract

The King's bridge or Puente del Rey is located in the original settlement of Panamá city, today known as Panamá Viejo. Panamá was the first Spanish city in the American Pacific, founded in 1519 over a small fishermans village. The city was designed surrounded by rivers to the east and west, and the Pacific Ocean to the south. Therefore, the main entrances were two bridges. The most important one, the King's Bridge, is a great masonry construction that is representative of colonial times, built between 1619 and 1634.
In 1671, a pirate army attacked and plundered Old Panama. The city was reduced to ruins and parts of it were used as a source of cut stone quarry for the building of the new settlement located in "Ancón". The King´s bridge remained in use until the 20th century. With the densification and growth of the metropoli, puente del Rey started to suffer the neglect and lack of maintenance, until the end of the 20th century.
After several reports of the state of conservation of the bridge, it can be said that its structure per se is in good conditions, but the Río Abajo - the river flowing underneath its vault – has a greater volume than it had in the past when the bridge was built. In addition, every time there´s a flood, its waters carry a lot of solid debris.
At the beginning of 2005, a mayor consolidation project of the bridge took place and the maintenance and surveying continues until today. These works have ensured its mechanical stability, but not the problems it may present in the future due to the Río Abajo (the river itself).
The purpose of this presentation will be to portray the history, the construction and the consolidation and maintenance works done to protect and conserve Puente del Rey or the King´s bridge.

Masonry, bridge, Panamá, 17th century.

Introduction: the archaeological site of Panamá Viejo

Panamá is located in the center of the American continent, acting as a bridge between the north and the south, with a prominent geographic position. This topic is fully explained by Cooke and Sánchez (2004: 3): "Panamá is a small tropical territory of special importance, as it acts as a bridge between North and South America. The existence of this isthmian 'corridor' had repercussions in the dispersion of people, agriculture and technology throughout the American continent" (See images 1 and 2).
Panamá Viejo is the first city founded by the Spaniards in the American Pacific coast over a small fishermen village. The pre-Hispanic occupation dates to the year 500 of our era. Archaeologists have found several burials, material remains and excavations permitted to find marks left by pillars, the first remains of pre-Hispanic houses made mostly of wooden and other perishable materials (See image 3).
The Spaniards founded the city in 1519 and became a strategic point of interest in the region. In its climax moment, the city had a total surface of 50 hectares and around 6,000 residents. Pedro Arias Dávila, its founder, brought instructions from the King of Spain to design the city. Panamá Viejo was built incorporating new urban theories, comprising of wider geometric streets, which were a development from the existing medieval cities. The city had an odd shape (with an "L" form) and was adapted to the conditions of the terrain, located between two rivers, with a central square in which the cathedral was built.

Image 1: Map of the Republic of Panamá, Panamá Viejo is located at Panamá City (Zonu).

Image 2: Aerial photograph of the archaeological site and Puente del Rey or the King´s Bridge -highlighted in red- (Google Earth).


Image 3: Pre-Hispanic remains found near Puente del Rey (Patronato Panamá Viejo).

When the Spaniards arrived, they built on wood, the main construction material of the city. Stone was used towards the end of the 16th century, but only in government buildings, churches, convents and in the finest houses. They also used a mixed construction type, with a lower level in stone and wood in the upper ones. The remains of some of these masonry buildings are the ones that can still be seen today at the archaeological site (See image 4).

Image 4: Hypothetical model of Panamá city at the 17th century.

The Panamá Viejo architecture was austere and relatively simple. Its style was based on traditions of the south of Spain. Generally, the buildings were not constructed by architects, but by carpenters or masons.

The city continued to prosper and influence interchange in the region, until 1671 when pirates attacked Old Panamá. The city was reduced to ruins, and parts of it were used as a source of cut stone quarry for the building of the new settlement in Ancón (today the historic district or Casco Antiguo). The site was abandoned.

During the 18th century, it became a reference point for travelers and around 1720 the site took the name "Panamá Viejo" or "Panamá la Vieja". In the 19th century it maintained its abandoned status and became interesting to visitors for its romantic images.

In 1912 Panamá Viejo became the first "Public monument" of the Republic of Panamá. In the following years, the modern city continued to grow until it surrounded the archaeological site as you see today.

During the 20th century, the site has been administered by different institutions, until Patronato Panamá Viejo was founded: "a non-profit, mixed organization [public private partnership] that has the mission of preserving the monumental complex. It handles multiple tasks including a program of archaeological research, a maintenance program of the historic ruins, projects for the recovery of the monuments for their public use, and a plan for disseminating the conclusions of the researchers and the results of the architectural work".


Image 5: aerial view of the archaeological site of Panamá Viejo, 2014 (Félix Durán Ardila).

Patronato Panamá Viejo developed a Master Plan which came to be the guideline for the administration and conservation of the site. It is inscribed as a World Heritage property since 2003, as an extension of the Historic District of Panamá. It comprises 28 hectares, less than the original 50, and among its importance are its urbanism and architecture. The philosophy of conservation of Panamá Viejo is to preserve the site's ruinous image. It is part of the history of the site and we avoid all kind of reconstruction (Patronato Panamá Viejo, 2006: 13-82; Arroyo, 2016: 46-168).

History of the King´s Bridge

As mentioned, Panamá Viejo was occupied probably around the year 500 of our era. The first material remains of the old inhabitants, called votive pottery, were found in the decade of 1960 near Puente del Rey (King´s Bridge), as you can see in image 3. This was because in the pre-Hispanic period, villages were in the lower parts of the rivers on the Pacific slope, such as the Abajo River (Río Gallinero, today Río Abajo). The area was ideal for use, the residents took advantage of the great richness of natural resources that exist in the bay and the surrounding mangroves (Patronato Panamá Viejo, 2006: 13-21).
With the arrival of the Spaniards, soon everything changed. Pedro Arias Dávila, the founder of the city, brought instructions from King Ferdinand the Catholic, that ordered that the new settlements be located, preferably, in the coast (or at the banks of some river, if they were inland), in "healthy and not prone to flooding" sites that would be easy to supply. The reasons that lead to the foundation of Panama at this specific site, which was unhealthy and did not have a good water supply, are not known with certainty. Apparently, it was due to the availability of indigenous labor for obtaining food and other basic needs towards the survival of the new settlers. Another important factor must have been the existence of the San Judas cove (the mouth of Abajo River), which served as port during the first years (Patronato Panamá Viejo, 2006: 32-33; Arroyo, 2016: 74-80).

The layout of the city its known because of two maps from the colonial period that remain in existence and the in-situ survey of the archaeological site in the last decade. The maps, one credited to engineer Bautista Antonelli and drawn in 1586 (today at Museo Naval de Madrid, Spain) and the other, drawn by Cristóbal de Roda and dated 1609 (at Archivo General de Indias in Seville, Spain). The city was designed with two exits, crossing both rivers (Algarrobo River and Gallinero River, today Abajo River): the first one, which crossed the Matadero Bridge, led to the interior and to the port of Perico; the second one, which crossed the King´s Bridge or Puente del Rey, led to the Atlantic through the Royal Road or Camino Real (Patronato Panamá Viejo, 2006: 34-40; Mena García, 1992: 87-89; Tejeira Davis, 1996: 52-53).

Images 6 and 7: left, enlargement of Panamá city map from 1586 accredited to Bautista Antonelli (Museo Naval de Madrid) in the area of the King´s Bridge; right, enlargement of Panamá city map from 1609 attributed to Cristóbal de Roda (Archivo General de Indias) in the area of Puente del Rey.

The historic documentation describes interesting information about the construction of the two bridges. The Matadero Bridge was built around 1567, when the Spanish Crown started to collect taxes for the construction of a bridge located in the river that is "between the city and the slaughterhouse" because "the tides and the alligators make it impossible to cross" (AGI Panamá, 236, L.10: F.101V).

The Spanish Audiencia, or Hearing, made a written description of the city in 1607, located between "two small rivers without name": one to the north and with a wooden bridge -the King´s Bridge- and the other to the west with a masonry bridge -the Matadero Bridge- (1607: 29-30 in Jaén Suárez, 1986). A couple of years after, another description of the city is sent to the Kingdom of Spain mentioning the two bridges (1610: 18 in INAC, 1975).

Around 1617, the Spanish Crown begins to collect another tax to erect a bridge over a river that it is mandatory to cross when leaving the city (today Abajo River). The mentioned bridge (the King´s Bridge) was an ordinary wooden bridge that the current torn down occasionally. The building of a masonry bridge or a "perpetual bridge", as mentioned in the documents, was needed because "the ordinary tides and the many floods of the streams make the river grow so much that it is impossible to cross" (AGI Panamá, 17, R.1: N.4). It is assumed that the construction started when the tax was made official, in 1619. The works were organized by the master builder Cristóbal de Armiñán, who also constructed the Portobelo customs

building in the Atlantic side of the isthmus, where the famous Portobelo fairs were celebrated (AGI Panamá, 17, R.3, N.39; Sosa, 1919: 93; Castillero Calvo, 2004, Vol. I, Tomo I: 127).

Image 8: enlargement of 'Carta marítima del Reyno de Tierra Firme…' of 1785 (Palacio Real de Madrid).

Both bridges survived the pirate attack of 1671. The Matadero Bridge was the one Henry Morgan and its army crossed to enter the city. The King's Bridge is mentioned in a map of 1785 named 'Carta maritima del reyno de Tierra Firme ú Castilla del Oro: Comprehende el itsmo y provincia de Panamá; las provincias de Veragua, Darien y Biruquete' (Palacio Real de Madrid) and drawn by the spanish geographers Tomás and Juan López. These maps show the name 'P. del Gallinero' probably referring to puente del Rey as the "p" stands for puente or bridge and the Gallinero River is called Río Abajo from the end of the 18th century onwards. This probably means the King's Bridge was still in use.

Image 9: The King´s Bridge around 1876 by Eadweard Muybridge (California Digital Library).

During 1875, the British artist and photographer Eadweard Muybridge visited America and Panamá, taking pictures of Panamá city and Panamá Viejo. Back in San Francisco (United States), Muybridge combined the negatives and included his work in a publication from 1876. This publication included three images of Panamá Viejo, comprising one from Puente del Rey or the King's Bridge (California Digital Library, 2009).
In 1912 Panamá Viejo became the first "Public monument" of the Republic of Panamá. At around the same time, the north American journalist and writer Willis J. Abbot (1914: 77) publishes the book 'Panamá and the canal', mentioning the history of Panamá, hence, with documentation about Panamá Viejo and another image of the King´s Bridge. The structure was used as an access to the monumental complex until 1920, when a paved road and a modern concrete bridge were constructed ((Memoria Obras Públicas, 1920: 274).

Conservation of the King´s Bridge

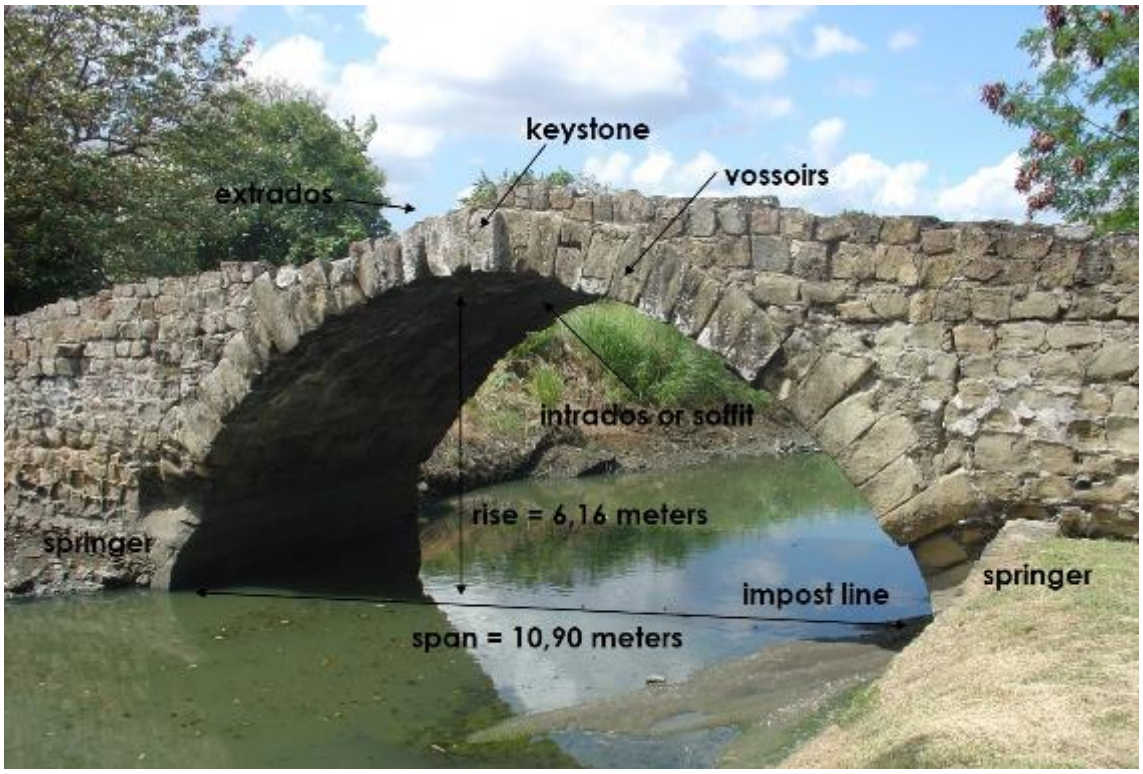

Image 10: The King´s Bridge today (Patronato Panamá Viejo).

The King´s Bridge is a typical masonry bridge made from a barrel vault that starts with a recessed bow. It has a span of around ten meters and its rise is around six meters. The approximate size of the vossoirs is 40 to 70 centimeters. It is constructed with the same stone material used in other monuments of the archaeological site and the surrounding areas, usually related to marine and volcanic sediments (Arroyo, 2005: 2-3; Ciantelli, 2016).
According to previous reports, Puente del Rey or the King´s Bridge is affected by advanced erosion due to the current of the river, especially around the springers. Its structure is intact, but presents fractured vossoirs and material loss at the joints (Law Environmental Caribe, 1999: 100-101).
From its beginnings, the Patronato Panamá Viejo has studied in depth the problematic of the King´s Bridge. Below, a summary of three reports from different experts who have addressed the issue with the help of Agencia Española de Cooperación Internacional.

José María García de Miguel (2001) in his report mentions the same problems presented above: erosion around the springers, fractured vossoirs and material loss. He also remarks that the temperature changes weaken the materials and the soil is unstable and can cause problems as well. De Miguel proposes to start with simple conservation procedures and continue with stronger ones: starting with gabions to safeguard the bridge from the water impact, protect the extrados and secure the fractured vossoirs.
Santiago Huertas and Gema López Manzanares (2002) remark the same problems than the previous report. The experts specify that the structure of the bridge is in overall good condition, and it can support up to 10 Tons (scaffolding can be installed over the bridge).
Finally, José Luis de Miguel (2003) uses Huertas and López report as reference, assuring the state of conservation of the King´s Bridge is fairly good and some repairs have to be made in the vossoirs and springers.
After these reports on the state of conservation of the bridge, it can be said that its structure per se is in good conditions, but the Río Abajo -the river flowing underneath its vault- has a greater volume than it had in the past when the bridge was built. In addition, every time there´s a flood, its waters carry a lot of solid debris that may include anything from full trash bags to car parts (Arroyo, 2005: 6-7).

Maintenance of the King´s Bridge

From the late 1990s, the Patronato Panamá Viejo has been working with different institutions to improve the state of conservation with consolidation and maintenance of the King´s Bridge. The work started with the installation of gabions around the bridge, the roadway surface of the extrados was covered and the masonry was cleaned from the vegetation covering the stone walls (Arroyo, 2005: 6).
Starting from 2004 and following a strict plan of preventive conservation or maintenance of monuments, the Patronato Panamá Viejo carries out monthly works on the bridge that go from simple inspection to the cleaning of the vegetation and surveying the structures and in Puente del Rey as well (Arroyo, 2005: 6).

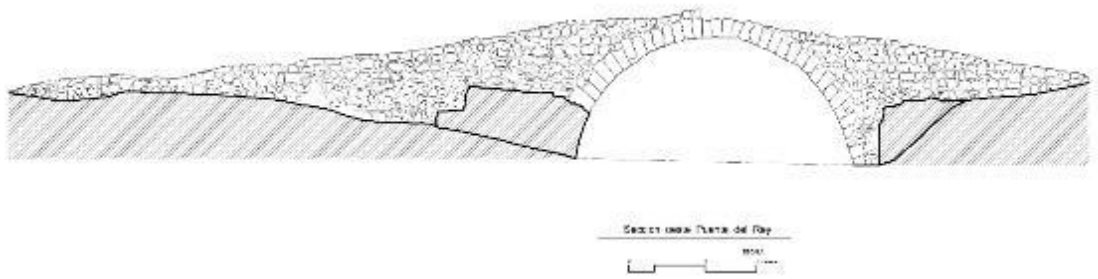

Image 11: Architectural survey of Puente del Rey (Patronato Panamá Viejo).

In addition, consolidation works started in 2005, considering the following: the bridge is in overall good state of conservation; it is recommended to work on specific areas of the bridge: for example, the springers and the vossoirs; the consolidation must combine modern and traditional techniques; scaffolding can be installed over the bridge for the consolidation (Arroyo, 2005: 7).


Images 12 and 13: left, installation of scaffoldings; right, replacement of joint material (Patronato Panamá Viejo).

The work started at the intrados of the bridge, and included the repair of fractured voussoirs, joint sealing and repair, the consolidation of the springers, and the cleaning and protection of the vault itself (intrados and extrados). The materials used in the consolidation of the King´s Bridge were a combination of modern and traditional. Such as: lime mortar, local stone, acrylic emulsion polymers in very low proportions and fiberglass bars made in situ (Arroyo, 2005: 8).


Images 14 and 15: left, repair of fractured vossoirs; right, consolidation of the springers (Patronato Panamá Viejo).


Images 16 and 17: consolidation and protection of the vault, intrados and extrados (Patronato Panamá Viejo).

The fractured vossoirs were repaired with fiberglass bars, the joints were sealed with lime mortar and acrylic emulsion polymers, the springers were reinstated with stone and lime mortar. Finally, the intrados of the vault was plastered with lime mortar to prevent erosion, and the extrados was also protected with lime mortar and limestone gravel, eliminating the previous covering (Arroyo, 2005: 9).

Every two years the scaffolding on the bridge is installed again to monitor the state of conservation and do preventive work, if needed (the last time in 2012). Consolidation and enhancement of the roadway surface (or extrados) was made during the summer of 2013. In this same year, with the construction of the new road, a water runoff system was built to diminish the difficulties on the riverbed, but it has not solved the problem completely.

The actions of unplanned urban development, climate change and garbage blocking the sewers have created conservation problems for the bridge. The community must be aware that even with the consolidation work, the structure of Puente del Rey will remain in danger until the problem of the Abajo River is solved.

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Beyond engineering achievement: Heritage New Zealand's recognition of why bridges are important

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As the national heritage organisation, Heritage New Zealand Pouhere Taonga (HNZPT) has a responsibility to identify and celebrate the place of bridges in New Zealand's historic and cultural heritage. In this paper I discuss how this has developed since HNZPT's establishment in 1955, including acknowledgement of Geoffrey Thornton's (1922–2017) influential role advocating for the recognition of bridges.

In 1973 the Springvale Suspension Bridge became the first bridge accepted as a HNZPT property. The relatively humble 1920s rural suspension bridge could be thought a surprising choice. However, its acquisition demonstrated willingness to look beyond engineering achievement when considering the heritage value of New Zealand's bridges and set a precedent for future assessments. HNZPT subsequently added another bridge to its properties portfolio and has acknowledged over 100 bridges as historic places on the national statutory schedule of heritage places, the New Zealand Heritage List/Rārangi Kōrero (the List), with many others included as places contributing to the heritage values of historic areas.

The List has been closely examined to explore what HNZPT has typically recognised as important in bridges. In this paper I contend that New Zealand's historic bridges are appreciated for being more than indispensable utilitarian structures or exemplars of engineering prowess. Common themes are discussed, including bridges as: symbols of safety and progress, conveyors of message, representing this little island nation's desire for international connection, and valued town- and landscape elements.

HNZPT's early recognition of bridges

The beginnings of New Zealand's heritage movement date to the late 19th century. However, as noted by O'Brien (2012: 3) it was not until the mid-20th century, following the passing of the Historic Places Act (HPA) in 1954, that a centralised heritage agency was established. The National Historic Places Trust was later called the New Zealand Historic Places Trust and its name changed again under the eponymous Heritage New Zealand Pouhere Taonga Act 2014 (HNZPT Act).

An early task for the organisation's Board was defining the types of buildings and 'objects' it would concern itself with. Consideration of bridges was initially limited to highway bridges, but the parameters were softened slightly to 'mainly' highway bridges - seemingly due to historian William Parker Morrell (1899–1986) and New Zealand's Government Architect F. Gordon Wilson's (1900–1959) insistence (Minutes, 1956). Despite this, the Board rarely discussed bridges. McLean (2000: 35-36) explains that the focus was on recording, marking, and providing maintenance and restoration grants for Māori heritage and pre-1900 buildings. Most additions to the properties portfolio also happened between 1965 and 1975.

The Board's first bridge-related advocacy was promoting the Alexandra Bridge's retention (List No.349). A new Clutha River highway bridge in this Central Otago town meant the obsolete suspension bridge was slated for demolition. HNZPT's role was mainly endorsing local luminary Sir William Bodkin's (1883–1964) work to save the bridge and liaising with the National Roads Board. Bodkin, a retired local lawyer and Member of Parliament, seems to have held a lot of sway with the Board. However, not all Board members were convinced. Prominent historian John Cawte Beaglehole (1901–1971) abstained from voting on a motion regarding Alexander Bridge because he 'doubted that the retention of the old bridge alongside of the new had aesthetic merit' (Minutes, 1959).

While still dealing with the Alexandra Bridge issue, in 1961 the Board was approached about the preservation of another by-passed Central Otago bridge, the Kawarau Gorge Suspension Bridge (List No.50). The Board rejected the request, citing financial constraints and, it also seems, they believed advocating for one bridge at a time was sufficient recognition of this type of structure's importance. A shift in thinking is evident by the late 1970s because when the question was raised again HNZPT contributed $3500 towards preservation work. This later became the first bridge to be recognised with HNZPT's highest historic place classification.

It was the debate around the Springvale Suspension Bridge's (List No.7535, Figure 1) future in the early 1970s which appears to have prompted the Board to take the heritage values of bridges more seriously. Completed in 1925, this single lane bridge has concrete towers and crosses the Rangitikei River with its 61 metre span. It is a characteristic example of a popular late nineteenth and early twentieth century bridge type in New Zealand. However, in 1970 when the Springvale Suspension Bridge was replaced in the road network by a Callender-Hamilton bridge, this once common form of structure was becoming rare, not only locally but nationally.

Figure 1: Springvale Suspension Bridge, July 2013. Karen Astwood, Heritage New Zealand.

As was the case with the Alexandra Bridge, a determined resident, Tony Batley (1923–2004), pursued saving the Springvale Suspension Bridge on behalf of the local farming community. The other important personality was Thornton, a high-ranking Ministry of Works architect

who was their department's representative on the Board. Thornton visited construction sites with his father, a Public Works Department (PWD) district engineer, and developed a passion for engineering structures. In later life this was demonstrated through his HNZPT work and published surveys of New Zealand's industrial heritage (1982), concrete constructions (1996) and Bridging the Gap: Early bridges in New Zealand, 1830–1939 (2001). His contribution to the field of engineering heritage was recognised in 2000 with a Honorary Fellow award from Engineers New Zealand.

At Thornton's first Board meeting in 1971 it was decided to notify Batley that 'while the Trust is sympathetic towards the preservation of the [Springvale Suspension] bridge it is not prepared to accept responsibility for its future maintenance' (Minutes, 1971a). Thornton recalls the Board's definition of heritage was limited at this time. However, Thornton consistently spoke up for the historic and social value of bridges and within eighteen months the Board's initial position had reversed. They decided to take ownership of the structure in November 1973, with a motion seconded by Thornton.

The acceptance of the Springvale Suspension Bridge into HNZPT's select group of properties can be seen as a statement of the organisation's new position regarding the importance of bridges to the country's historic heritage. By the time the bridge's acquisition was formalised in the late 1970s the Board was also considering the Clifden Suspension Bridge's (List No.4921) future, eventually accepting this Southland bridge into the property portfolio 'with alacrity' in 1984 (Thornton, 2010). Assessing pre-1900 bridges and adding them to HNZPT's fledgling List (originally known as the Register) also began in the late 1970s.

In his introduction to New Zealand's Industrial Heritage, Thornton noted this aspect of heritage was still a 'much neglected field in this country' (1982: ix-x). This statement illustrates the importance of not overstating the Springvale Suspension Bridge milestone. HNZPT's guiding legislation pointed strongly to the primacy of buildings in the definition of historic places and this translated into the organisational focus. Rather, the recognition of bridges seems to have been symptomatic of a gradual organisational broadening of definitions of what constituted the country's historic heritage, consistent with international trends and acted upon by an enlarging pool of staff, albeit still mostly volunteers. It should be noted that both the Springvale and Clifden Suspension Bridges have recently been transferred into the Department of Conservation's management.

Perhaps the Springvale Suspension Bridge's acquisition by HNZPT in the 1970s was simply timely. Arguably, HNZPT's commitment to recognising the heritage value of bridges may have been slower coming if not for a few passionate local advocates and Board members, like Batley and Thornton. However, the development of the List gave HNZPT an opportunity to prove that its interest in celebrating the heritage significance of bridges was more than just serendipitous.

From bridge to historic place

Identification, assessment and classification of bridges as historic places and contributors within historic areas only began in earnest with the establishment of a specialist Board sub-committee in 1971. Known as the Buildings Classification Committee (BCC), it was

appointed to identify and classify 'buildings and objects of historical and architectural interest' (Minutes, 1971). Thornton was a BCC member from 1972, and it's Chair from 1976 until he retired from the Board in 1989. This was a period when the core work developing significance criteria and populating the List was done.

The List was formally created under the HPA 1980 and is primarily an identification and information tool. HNZPT's current legislation states it can add two categories of historic places as well as historic areas to the List. The List also includes wāhi tapu and wāhi tapu areas and wāhi tupuna, which are sites of particular significance to Māori. Since the List's inception, HNZPT has recognised 141 bridges as historic places or structures central to a historic area's importance. These form a diverse collection of historic bridges, covering a range of construction periods, bridge types and functions. This is exemplified by comparing the tiny masonry arch bridge in Kohukohu, Northland (List No.7741) which is thought to be New Zealand's oldest remaining bridge, to the most recently built, the Hapuawhenua Viaduct. This towering late-1980s curved pre-stressed concrete railway bridge is part of the North Island Main Trunk (NIMT) Historic Area (List No.7793).

The majority of bridges were formally added to the List (48), or identified as warranting inclusion (29) on it, in the 1980s (Figure 2). Subsequent decades saw fairly consistent numbers of around 40 bridges added to the List, which included completing the List entries of some identified earlier. Specific projects and the completion of historic areas boosted these numbers. For instance, celebrating the centenary of the NIMT's completion with a List entry project during 2008 and 2009 resulted in four new historic places as well as nine additional bridges recognised as contributing to the historic area's values.

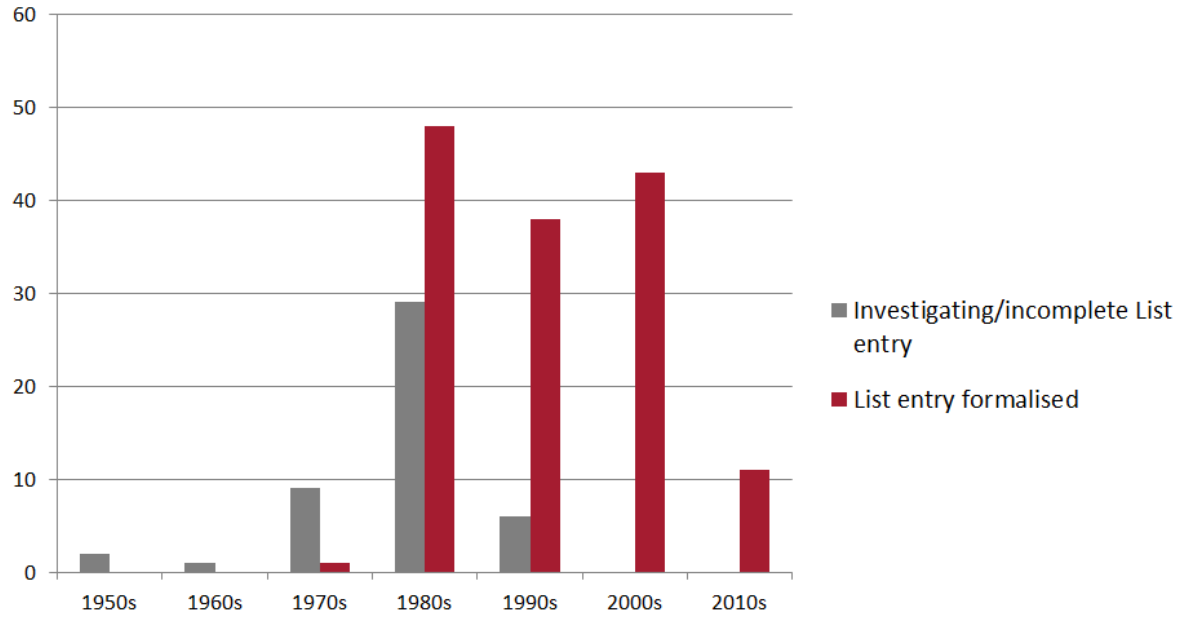

Figure 2: Heritage New Zealand's recognition of bridges, 1950s–2010s.

Over half of the bridges recognised on the List are road bridges, with most being pre-1900 structures, although 1900–1940 bridges are well represented (Figure 3). The balance of identified historic bridges are railway structures, again proportionally weighted towards pre-1900 bridges, and small groups of pedestrian and dual function bridges are also included. The wealth of mid-to-late 19th and early 20th century bridges reflects the BCC's initial focus on pre-1900 buildings and structures. This was later expanded to pre-1940. However, on a few occasions during the List's early phase this date-range guideline was ignored. One example is Nelson's Collingwood Street Bridge (List No.1551), a welded steel bridge completed in 1955 and entered on the List in late 1982. Since the beginning of the 21st century consideration of mid to late 20th century bridges has increased, but they are still underrepresented on the List compared with earlier bridges.

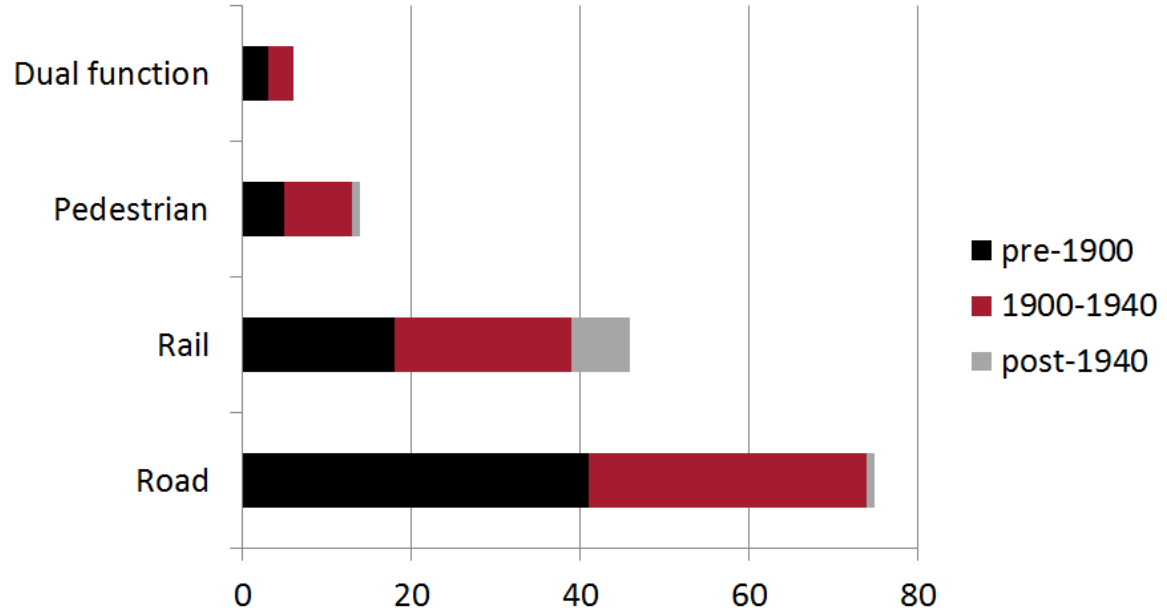

Figure 3: List entry bridge's functons and construction eras.

Despite the List's initial threshold language seeming to define a narrow focus on historic and architectural values, in practice these terms were applied liberally. For example, the Waianakarua Bridge's (List No.348) Board citation alludes to this North Otago bridge's aesthetic and technological importance. It was among the first bridges added to the List in late 1981 and in addition to possessing 'superior visual qualities', this road bridge's 'two large squint arches with vermiculated voussoirs' were considered innovative in the New Zealand context (Board Paper, 1981). A few years later the Waiau Ferry Bridge's (List No.269) citation highlighted the 1887 wrought iron cantilever truss bridge's social value because it provided an important transport link to the healing properties of North Canterbury's Hanmer Springs and enabled an associated tourism industry to develop.

Significance themes

Arguably, the historic bridges which immediately spring to mind tend to be examples of engineering expertise – the highest and longest bridges, or structures representing the most innovative techniques and materials of their age, such as Auckland's Grafton Bridge (List No.16), the NIMT's Makatote Viaduct (List No.7778) or Mohaka Viaduct (List No.4418) in northern Hawke's Bay, which are all Category 1 historic places.

However, the Springvale Suspension Bridge, recognised primarily for its historic and social importance, seems to have set a precedent for HNZPT's List entry work. No examples of bridges considered to be New Zealand's preeminent engineering achievements have been added to the List solely on the basis of their engineering merits. Some bridges, such as the Tane Hemp Company Suspension Bridge Remains (List No.9619) in Manawatu – one of New Zealand's longest span suspension bridges – were ruins when added to the List and therefore only a monument to technical achievement rather than direct examples of it. In this case, the structure's historic, aesthetic and social significance contributed strongly to it meeting the Category 1 historic place threshold.

Unfortunately, a definitive analysis of common significance criterion for the List's bridges is not possible because reporting standards and requirements have changed as the List and its legislation has developed. However, common themes can be drawn out to explore what HNZPT has typically identified as being the important characteristics New Zealanders, past and present, appreciate about bridges. The predominant themes are discussed in this section and include the interwoven ideas of safety and progress, bridges as platforms for political and social messages, ways to connect and compete on the world stage and as significant features in the landscape.

Safety and progress

A bridge's basic function is to cross an impediment, but to become a reality there needs to be sufficient motivation to invest the time, effort and cost of construction and to commit to on-going maintenance. Among New Zealand's historic bridges, big and small, this justification is usually associated with ideas of safety and progress. Indeed, 90 per cent of the bridges entered on the List have some historic and/or social values connected with this theme.

In the early colonial period, drowning in New Zealand's fast flowing and flood-prone rivers was a common cause of death and was termed 'the New Zealand death'. Especially in rural areas, people advocated long and hard for local and central government to build road bridges to replace fords, ferries and punts. When reporting on the completion of the Hyde Bridge (List No.2251), a Central Otago wrought iron truss structure which replaced a Taieri River ford, in December 1879 the Mount Ida Chronicle stated that because of:

…the annual amount of destruction to property committed, and the serious loss of life which the ravenous waters effected [sic] at every periodical increase in the river, and…the growing settlement in every direction around the bridge, we must recognise this work as an absolute imperative want to the necessities of the district.

Here, people's physical and economic welfare seems to have been a primary concern, but because the bridge provided safe passage it also had positive spin-offs for local development. For other structures progress is the predominant aspect of their importance, although because of a bridge's function safety is still implicit. An overt example of the link between bridges and economic progress is the highway bridge at Kawarau Falls (List No.7448, Figure 4), Central Otago, whose dual original function in 1926 was as a gold mining dam.

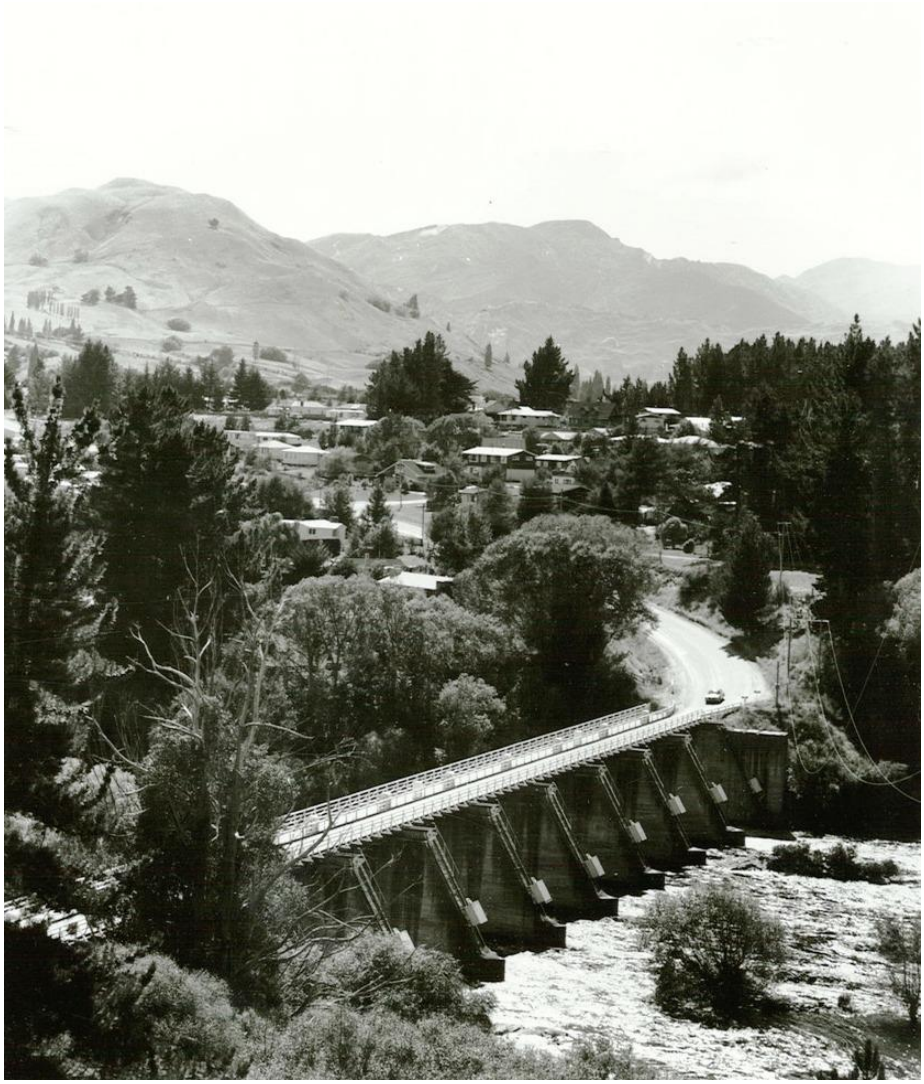

Figure 4: Kawarau River showing the Kawarau Bridge control gates, Frankton in the background, Mar 1981. S. Haynes, Archives New Zealand, R24845387.

There are also structures on the List recognised because they serve as reminders that significant investment in facilities and infrastructure, like bridges, does not guarantee progress. One of these symbols of 'what might have been' is the Mangapurua Bridge (List No.7168), built to provide access to a government World War One soldier resettlement scheme which failed within a decade of the bridge's construction. The resulting orphaned concrete arch bridge was appropriately nicknamed the Bridge to Nowhere.

The connection between bridges, public safety and progress is not restricted to the countryside. Around 20 per cent of the structures fitting this theme are located within city or town limits. With a few exceptions, such as some pedestrian railway over-bridges, they are identified as sources of civic pride and physical representations of urban progress. For example, in 1931 Wellington's Kelburn Viaduct (List No.3333) replaced a timber trestle bridge which could not cope with the capital city's traffic needs. The new concrete bridge allowed more traffic to flow to and from the suburbs which, according to the Evening Post on 2 May 1931, meant that city workers would have time to pop home for lunch if they wanted to, and the bridge was also heralded as a 'work of art'.

Platforms for message

Due to the personal safety and development benefits they offered, road bridges in particular were often counted among the most significant local buildings or structures. Correspondingly, this high profile is also a reason why road bridges were good platforms for making political points and social messaging. Only one of the listed structures representing this theme is not a road bridge.

It was common for the completion of road bridges, especially in the 19th and early 20th centuries, to be celebrated social occasions involving bunting, christening the bridge with champagne and events such as special dinners and balls. Even in rural areas, impressive attendances presented politicians with the perfect opportunity to promote their agenda to constituents. One of the numerous examples of this was an event marking the opening of a Central Otago steel bowstring arch bridge, the Millers Flat Bridge (List No.5217, Figure 5). On that joyous day, Member of Parliament Charles Rawlins engaged a cheering crowd by appealing to their vanity and then embarked on self-promotion about the government's huge contribution to the area's future in building the bridge. In this way the bridge was an excellent public relations tool.

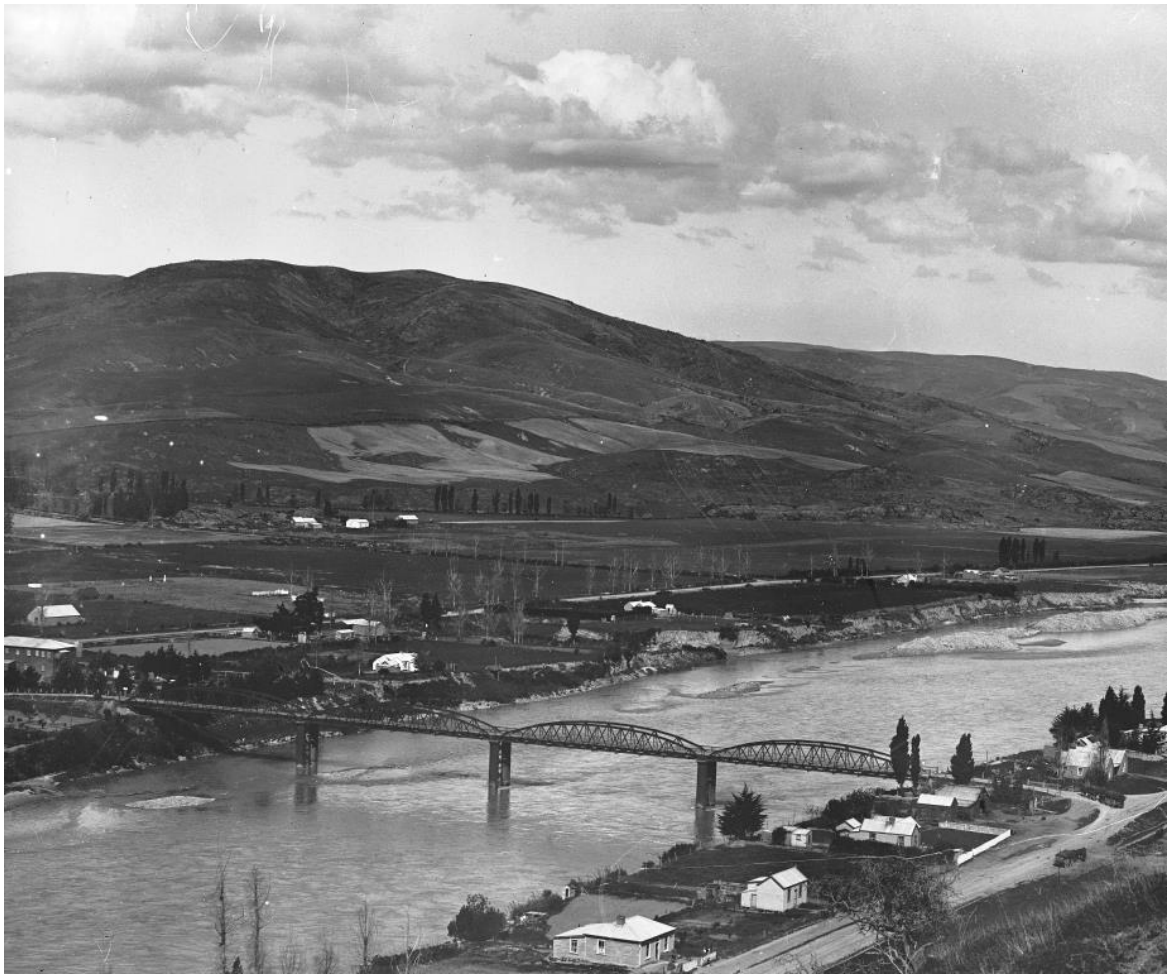

Figure 5: Millers Flat, circa 1905 (detail). Muir & Moodie studio, maker unknown, Te Papa, C.013671.

A small group of structures within this theme demonstrate how the prominence of bridges can be used to convey specific messages. The Daniel O'Connell Bridge (List No.338), another Central Otago suspension bridge, is unique within this theme because it is commemorative but also carries a political message. Completed 33 years after its namesake died, settlers in the area were predominantly Irish Catholics who felt the structure was a fitting monument. O'Connell (1775–1847) was a politician and Irish nationalist leader known as The Liberator. Naming a bridge after O'Connell was a pointed remark about locals' identity and affiliations even though residing overseas and in yet another British colony.

Connecting and competing internationally

Most of the historic bridges on the List have had some international input, many because their engineers were nineteenth or early twentieth century immigrants who trained overseas. Bridge construction materials, such as iron and steel, also needed to be imported to New Zealand. Even in this timber-rich country, Australian hardwood is a common material among

the 38 timber bridges entered on the List. However, there is a small group of the List's structures which are specific attempts to metaphorically bridge the oceans separating New Zealand from the rest of the world. They are indicative of New Zealanders looking out from these islands at the bottom of the South Pacific, acknowledging important overseas connections, and keeping up with international developments.

The construction of several structures involved international teams for fabricating materials and providing additional engineering expertise. An example is the 1907 Victoria Bridge (List No.772) in the Waikato town of Cambridge. Its designer, James Edward Fulton (1858–1928), an early New Zealand-born engineer, consulted with John Alexander Low Waddell in the United States of America and his company, the American Bridge Company, fabricated the bridge's steel components. Although located on Victoria Street, the bridge was specifically given its name in commemoration of Queen Victoria, making a statement about New Zealand's connection with Britain and its place in the Empire. Furthermore, on 21 December 1907 the Waikato Independent highlighted that while Victoria Bridge was smaller than structures of a similar design around the world, at least 'Cambridge has the distinction of introducing the first braced arch bridge in Australasia'. This quote highlights another aspect of the theme - New Zealanders' pride when structures measured up on the international stage.

The outward-looking tendency is also suggested by bridges which demonstrate an awareness of international events, trends and news, such as war memorial structures. An example of a bridge dedicated to someone with no known direct connection to New Zealand is the Edith Cavell Bridge (List No. 4371, Figure 6), near Queenstown. Cavell was a World War One nurse executed by the Germans in 1915 for helping Allied soldiers escape from occupied Brussels - a story widely published in English-language news media. This concrete arch road bridge was constructed between 1917 and 1918, with no commemorative function in mind. However, a local man, Jack Clark, was determined it would become a tribute. Despite the local Council rejecting the idea, he painted Cavill's name on the bridge and it quickly became synonymous with the structure.

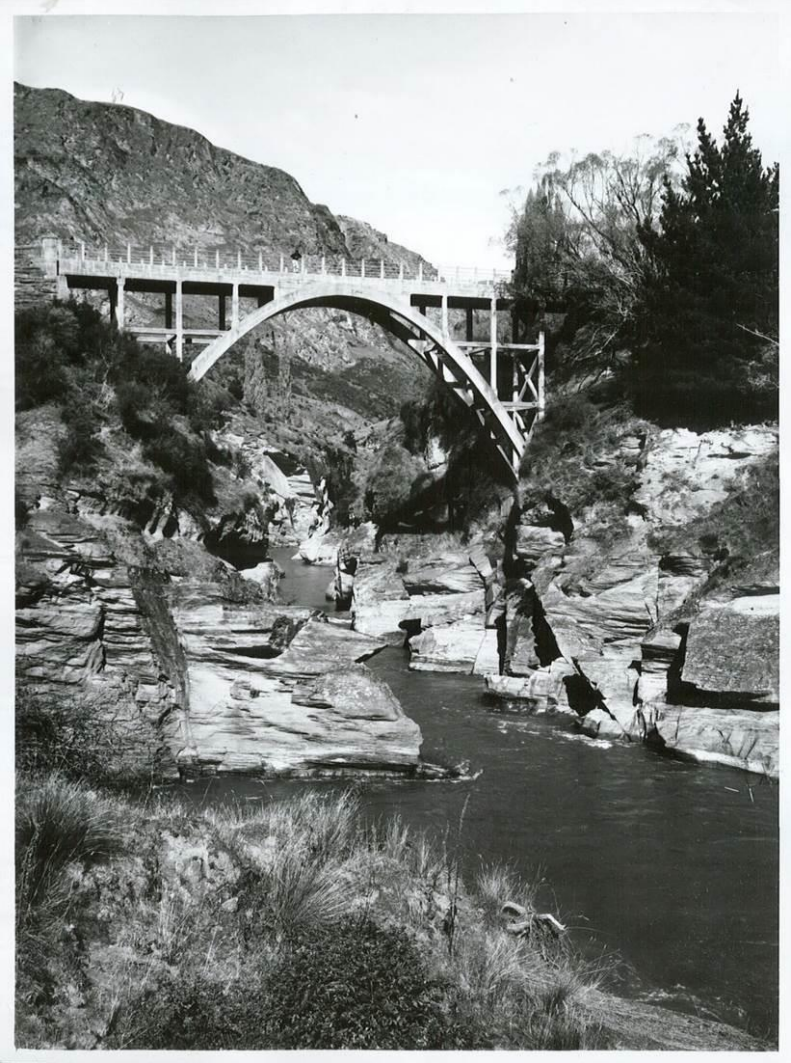

Figure 6: Autumn Scenes - The Edith Cavell Bridge over the Shotover River, Apr 1965. Mr Nicholl, Archives New Zealand, R24460040.

Enhancing their environment

New Zealand is known for its spectacular landscape and beautiful scenery and over half of the List's historic road and pedestrian bridges are valued as contributing to their surroundings in a positive way. Almost a third of the railway structures on the List also fall into this category and the majority are easily viewable from the road or walking tracks. This suggests the more contact people have with New Zealand's historic bridges the more they are appreciated for their visual qualities.

Thornton (2001: 17) questioned whether visual appeal has ever been considered by New Zealand bridge designers to the same extent as basic structural and cost aspects. However, it seems that a conscious effort was made particularly when it came to urban structures, with a considerably higher proportion than rural structures within this theme. The aesthetic appeal of concrete bowstring arch bridges was clearly behind the choice of this type for a series of provincial town bridges at: Balclutha (List No.5180), Blenheim (List No.241), Hamilton (List No. 4161), Pahiatua (List No.4029) and Palmerston North (the demolished Fitzherbert

Bridge, Figure 7). This bridge type, particularly in the 1930s, seems to have been viewed as an especially befitting way of announcing entry to towns.

Figure 7: Western end of Fitzherbert Bridge, 12 Jun 1936. Leslie Adkin, Te Papa, A.006681.

There are many examples of historic bridges with aesthetic values because they are integrated features within their environments. Grafton Bridge is an early impressive reinforced concrete arch bridge, said to have had the world's largest span (97.6 m) of this type at the time it was completed in 1910. However, this fact only received fleeting mention at the structure's opening. Instead, emphasis was on the visual appeal of the 'handsome' and 'magnificent' structure within, and as a vantage point for viewing, the landscape. On 29 April 1910 the New Zealand Herald recorded the bridge committee's chairman's comments that:

…it was a fine structure, and the luxurious gully of tree ferns and exotic scenery on the one side and the comprehensive views of our beautiful harbour on the other should appeal to the aesthetic tastes of everyone who had a sense of the beautiful.

In addition, most of the modest road or rail bridges included in this theme are noteworthy points of interest within their setting.

Aesthetic values associated with bridges as symbols of human endeavour conquering nature are also encompassed by this theme and illustrated by structures such as the Makatote Viaduct. This is one of New Zealand's most photographed bridges primarily because of the aesthetic appeal of it being an impressive structure within the dramatic setting of a deep stream gorge. It has several vantage points accessible by road which has helped it become a tourist attraction.

Conclusion

The Springvale Suspension Bridge's acquisition in the 1970s was an important step for HNZPT in acknowledging the place of bridges within the country's built heritage. This coincided with the List's development and many similar examples of modest, but historically and socially important, structures are recognised on it. What this analysis of the List's bridges has shown is that, while engineering achievement is given its due, the significance of New Zealand's historic bridges is generally based on people's interaction with them and the associated aesthetic, historic and social values.

This research has highlighted main trends and themes among the List's bridges, and exposes underrepresented aspects. For instance, a clear focus has been on assessing 19th and early 20th century structures, including examples from a range of characteristic bridge types which were becoming rare by the 1980s. I suggest HNZPT should take an active approach, through survey projects, to identify typical mid to late 20th century bridge types before network upgrades and other factors put them at risk and significantly reduce the pool of the most suitable List candidates. Some types to consider, which are not currently represented on the List, would be New Zealand's ubiquitous standardised reinforced concrete PWD road bridges which date from the 1930s and Callender-Hamilton truss bridges, like the structure which replaced the Springvale Suspension Bridge in the road network. The List's entries are also notably lacking in places representing connections Māori have with bridges. Structures like the Auckland Harbour Bridge, which featured prominently in Māori rights protests from the 1970s onwards (Figure 8), are opportunities to acknowledge contested aspects of New Zealand's history and begin to address this imbalance in the List.

The collection of bridges already recognised on the List is diverse but there is room for further development. Because bridges are an important part of New Zealand's built environment, HNZPT needs to continue identifying structures for List entry and, particularly, look to recognise bridges which go beyond the aspects and themes highlighted in this paper as being traditionally associated with the country's historic bridges. It will be through this expansion of the List's collection of historic bridges that our understanding of what makes bridges important will continue to evolve in step with New Zealand society.

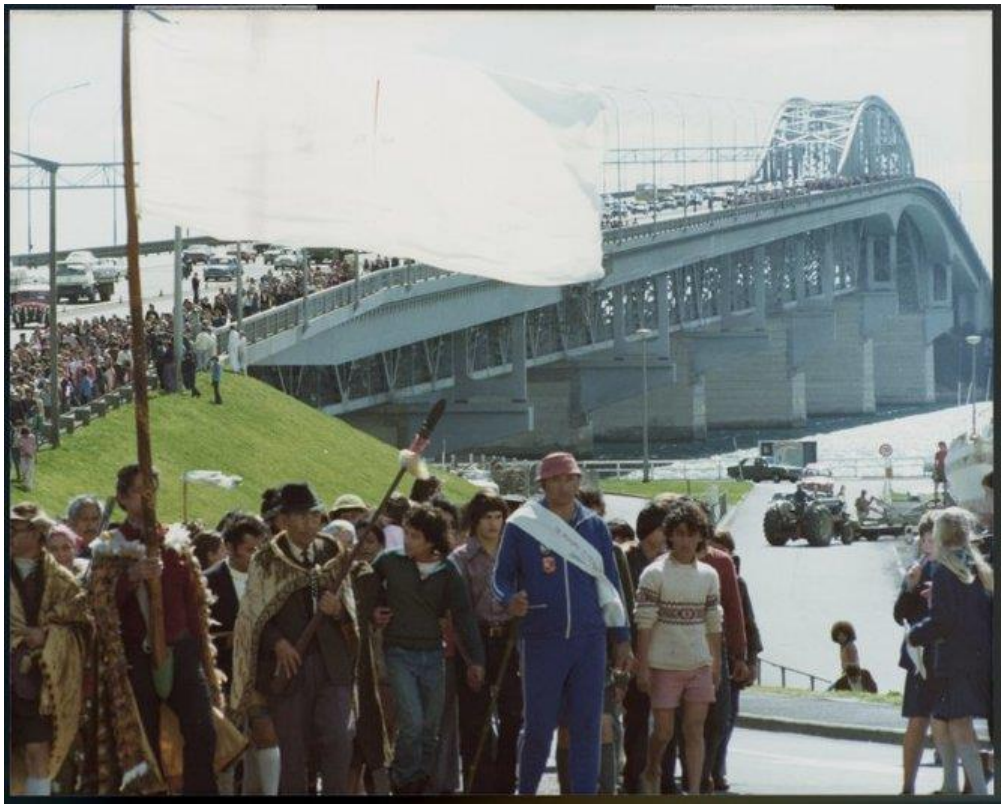

Figure 8: Māori Land March demonstrators crossing the Auckland Harbour Bridge [25 September 1975], Ref: PA7-15-19, Alexander Turnbull Library, Wellington, New Zealand, http://natlib.govt.nz/records/22886218.

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The New Zealand Heritage List/Rārangi Kōrero can be searched online at: http://www.heritage.org.nz/the-list.

The Network of the 19th c. Stone Bridges in the Mountainous area of Zagori, Epirus, North Western Greece.

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Introduction

In the mountainous area of Pindos in North Western Greece (Epirus), lies a geographical area known as Zagori or Zagorohoria which includes 46 traditional villages. These villages were first mentioned in texts of the 14th century AD (Vranoussis, L., 1962, p.54). Mountains and rivers form a natural border around these villages, which consists of rough, rugged terrain with deep, steep ravines and gorges.
This paper describes and analyses the unique network of pathways and arched stone bridges forming links between villages, settlements and nearby towns. Forceful rivers and streams made the construction of bridges an essential part of infrastructure, allowing the daily movement of people and the development of commerce in the wider area.
A brief description of the historical evolution and the importance of bridges will be presented.
Finally, conclusions will be drawn about the current condition of the bridges and ideas will be presented regarding their contemporary use, enhancement and sustainability.

The Zagori area in the region of Epirus

Geographical description

The region of Epirus is situated at the North-West side of Greece, opposite the isle of Corfu at the border with Albania.

Figure 1: Map of Greece depicting the region of Epirus and the area of Zagori

Epirus is a region with a diverse natural environment, where one can find high mountains with gorges, forests, rivers as well as beautiful beaches, pasture lands and vineyards. However, this small region of Greece, is mostly known for its mountainous part which offers abundant attractions for all types of visitors.
The “backbone” of Epirus is the mountain chain of Pindos with peaks over 2.000 m high and numerous rivers and streams which flow towards the coast, forming a very rugged terrain with difficult routes. This quite complicated system of rivers, streams, mountains, gorges and

other geomorphological characteristics has affected many other factors, such as communication, commerce, the settlements and the occupation of the inhabitants.
To the north of the city of Ioanninai lies the area of Zagori, among the peaks of high mountains and includes 46 villages at an altitude ranging from 650m to 1.340m above sea level (Christides V., 2004, p.25). On the following map (Figure 2), the Zagori area is indicated by the orange line and covers approximately 1.000 km2. The topography of the area forms a natural border for these 46 villages which are also categorized geographically as East, West and Central Zagori.
Historical sources (Aravantinos, P., vol. II, 1857, p.54-55) indicate that these boundaries have not been altered for many centuries, while the number of villages varies through time.

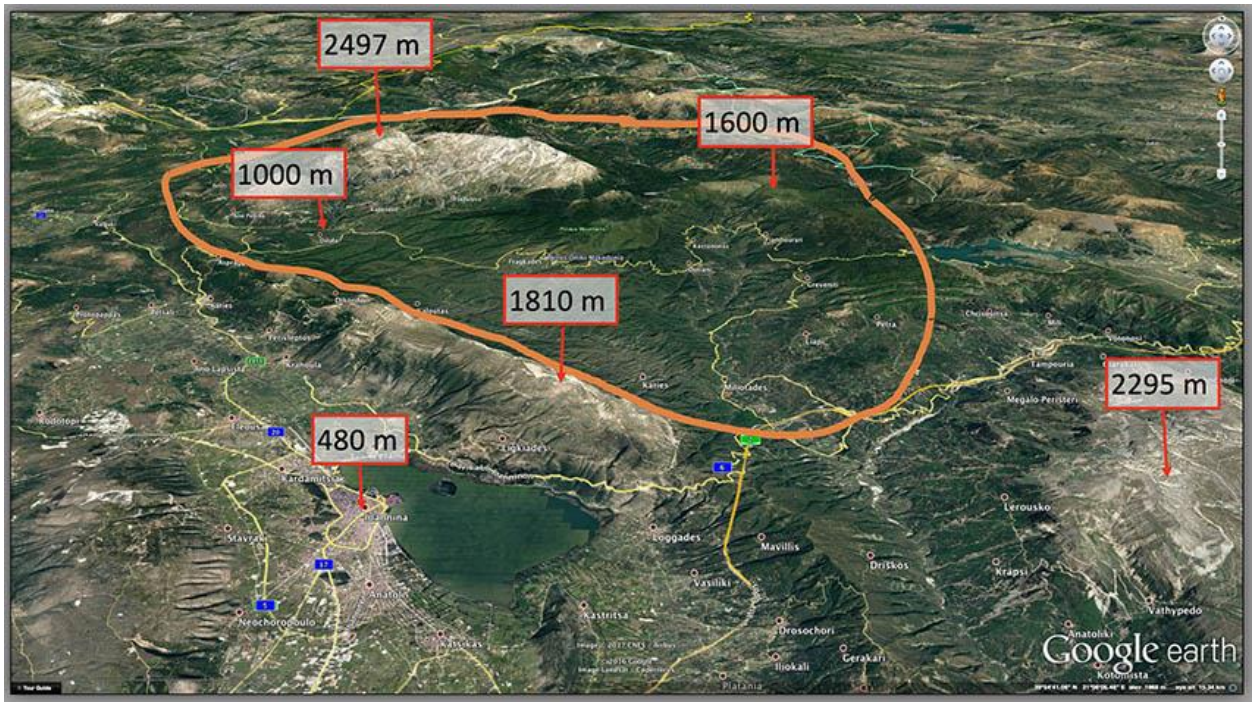


Figure 2: The Zagori area from Google earth (accessed:03 June 2017)

Historical evolution

Archaeological excavations in the area, have dated inhabitance from he prehistoric years. During the Paleolithic era Epirus used to be one of the best pasture lands in the Balkans. Excavations near the village of Vitsa have revealed an ancient Molossian settlement and graveyard, proving thus that the area was inhabited from the 8th to the 4th c. BC, at least during summertime (Hammond, N.G.L., 1997, p.34 and p.42).
Until the Roman occupation in 167 BC, Epirus was ruled by Greek tribes, the Molossians, the Thesprotians and the Chaonians (Sakellariou M.B., 1997, p.10) . After the departure of the Romans (3rd c, A.D), the area became part of the the Byzantine empire. In 1204 Zagori is part of the Despotate of Epirusii (Vranoussis L.,1990, p.1365) and in 1319 the first written evidence of the villages, appears on a Golden Bull of Emperor Andronicusiii (a Golden Bull or Chrysobull was a decree issued by Byzantine Emperors). Documented history begins in 1430 when the Ottoman occupation commenced. At least 14 villages existed in 1431 in central and eastern Zagori as they are mentioned in the Voiniko Treaty iv.
This treaty which lasted for approximately 200 years (Dalkavoukis V.,1999, p.17) was very beneficial for the Greeks, as it allowed for the opening of the routes towards the trade

markets in the Balkans, thus favoring the evolution of their commercial skills and influencing positively their prosperity and education (Dalkavoukis V.,1999, p.21).
Through time, the number of villages in the area of Zagori varies from 14 to 60 (Papageorgiou G., 1995, p.21) and finally settles to today's number of 46 at the beginning of the 19th c. Even though they were under foreign occupation for so many years and living on a land that was difficult to cultivate, many of the inhabitants managed to become capable merchants and a few became doctors and scholars. They travelled and a significant number of them became successful in commerce. Because of that, they started having the means to reconstruct their villages, the stone pathways and bridges of the area. Most of the important built heritage surviving today, is from those years.
In 1913, the Ottoman occupation of the area comes to an end and Epirus is incorporated into the Greek state. The prosperity of the people of Zagori lasts until WW II and the following Greek civil war (1946 - 1949). As in the rest of Greece, due to the financial crisis, people start abandoning their villages and the countryside in order to immigrate to the big towns seeking work.
Today the inhabitants that have remained are either elderly or involved in tourism, while a large number of houses are abandoned or used only during the summer months.

The 19th c. Network of roads and bridges in epirus - the outer network

As mentioned in the geographical description, the area of Zagori is quite isolated and difficult to access because of its natural boundaries (mountains and rivers).
Therefore, one can clearly distinguish the road network around Zagori, in the broader area of Epirus (outer network), and the road network in the Zagori area (inner network).

Figure 3: Road networks - routes of commerce

During the 19th c., commerce in the Ottoman occupied Balkans, was thriving and commercial routes were connecting all the big towns which had trade markets or were commercial centers. Ioannina (capital of Epirus) was one of these so, as shown in Figure 3, the road network in Epirus was a very busy one, but as mentioned above, it did not enter the area of Zagori. This outer network had roads and bridges which could support the travelling needs of big commercial caravans /convoys. Travelers would come across many Khaniav where they could rest, eat and take care of their horses.
The bridges on these routes were usually wide and long with plenty of arched spans aiming to avoid muddy terrain and make a safe passage for the merchants and their animals (Figure 4). They mostly passed from areas of low altitude, unless it could not be avoided as in the case of the route towards central Greece where the travelers had to go via the Zygos Passagevi (Leake W., 1835).

Figure 4: The bridge of Arta, (1602 or 1606)

In the following picture (Figure 5) is a map of Epirus created in the 19th c. by two monks - teacher and student - and depicts the main routes and bridges of their time.

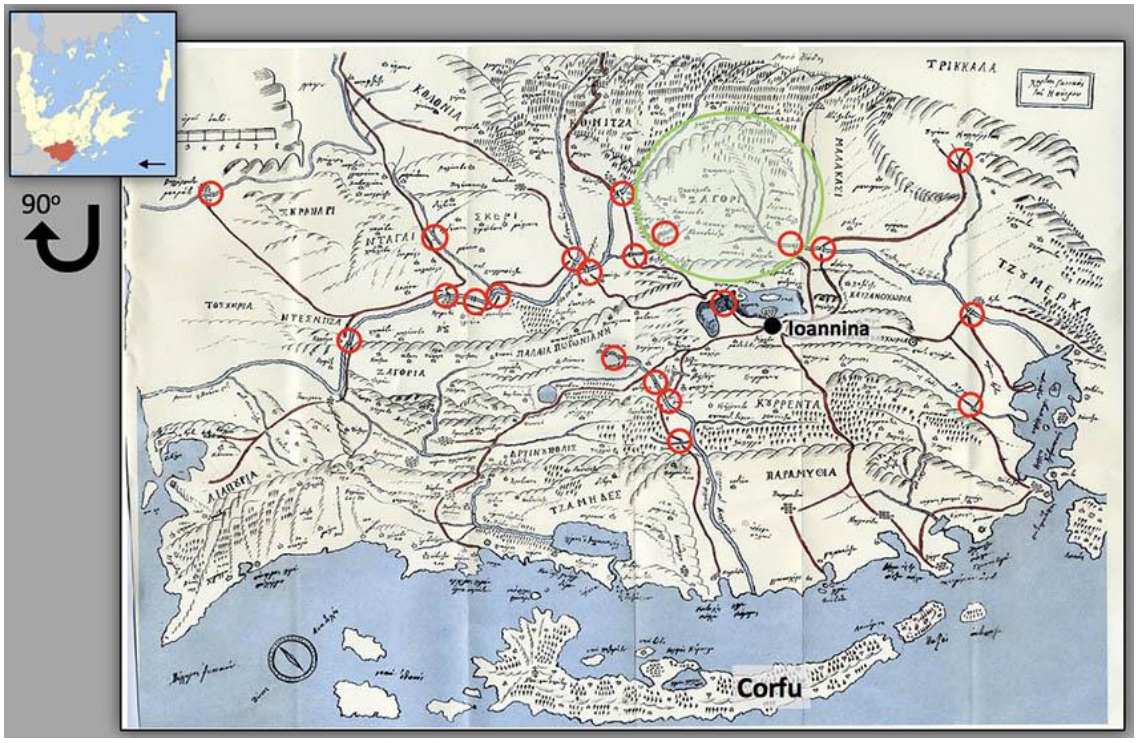


Figure 5: “19th c. General map of Epirus”vii,K.Thesprotos and A.Psalidas, Geography of Albania and Epirus, Ioannina 1964

The 19th c. Network of roads and bridges in the area of zagori - the inner network

Routes to Zagori - the connection between the Outer and Inner network

Even in our days, where every village in Zagori can be reached by car, the entry points to the Zagori area are still limited and very similar to the ones of the 19th c. By studying the maps and reading the texts and journals of authors and travelers from the19th c., the pathways that lead into Zagori can be identified and are marked on the following map of Figure 6.
Each geographical area had one or two entry points, mostly narrow pathways which passed through the mountains and were quite steep and curvy. Some were paved (Lambridis, I. 1880, p.79) but generally they were left in their natural state.
These entry points were connected to the main road leading to the city of Ioannina, which was the big commercial center and also to other nearby towns.

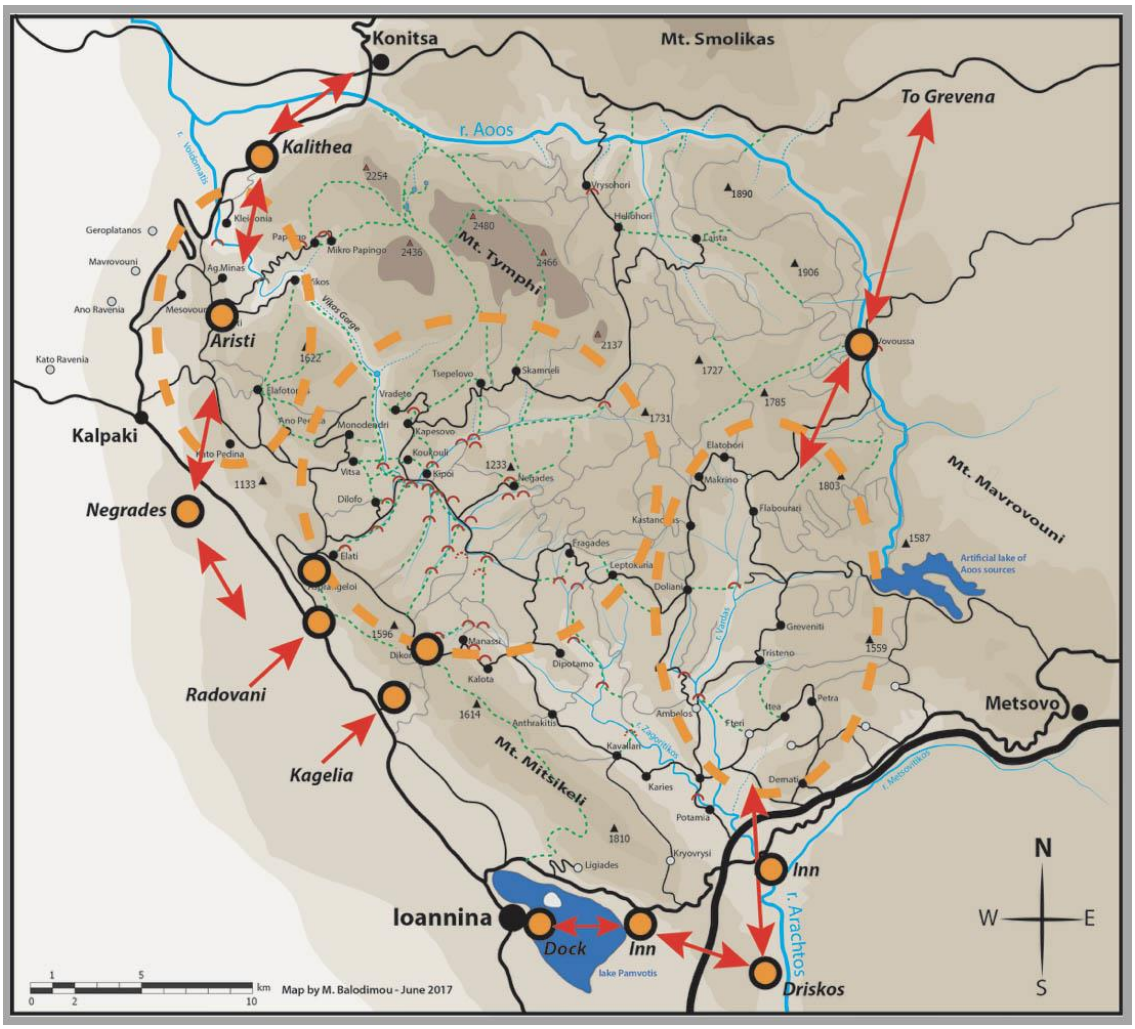


Figure 6: Map of Zagori and its entry points

Entering the Zagori area, one comes across a unique network of paths and arched stone bridges, of a small scale, which link villages, settlements, pasture lands, water mills and cultivations. The inhabitants had to find ways to survive and travel in and out of the area, all year round, so the construction of the stone bridges was imperative for them in order to achieve all the above functions and have a tolerable life in this difficult mountainous area.

The villages and the pathways

All 46 villages were linked to each other and at least one path led to each village. Depending on the geographical position, size and importance of the village one could see two or three paths leading to it. Some paths terminated at villages and some passed through them in order to continue to the next one.
After WW I, the first roads to central Zagori were opened and until 1940, when WWII extended to Greece, the road had reached the bridge of Kokkoris which stands between the villages of Dilofo and Koukouli (Figures 7 & 8). Just before the war, the Greek army managed to open a very basic road branch from the village of Asprangeloi towards the village of Elafotopos (Papavranousis S., 1988). The road to all the other villages was constructed after 1955 with the exception of the highest village, Vradeto (1340m), to which the vehicular road reached in 1972-1973.

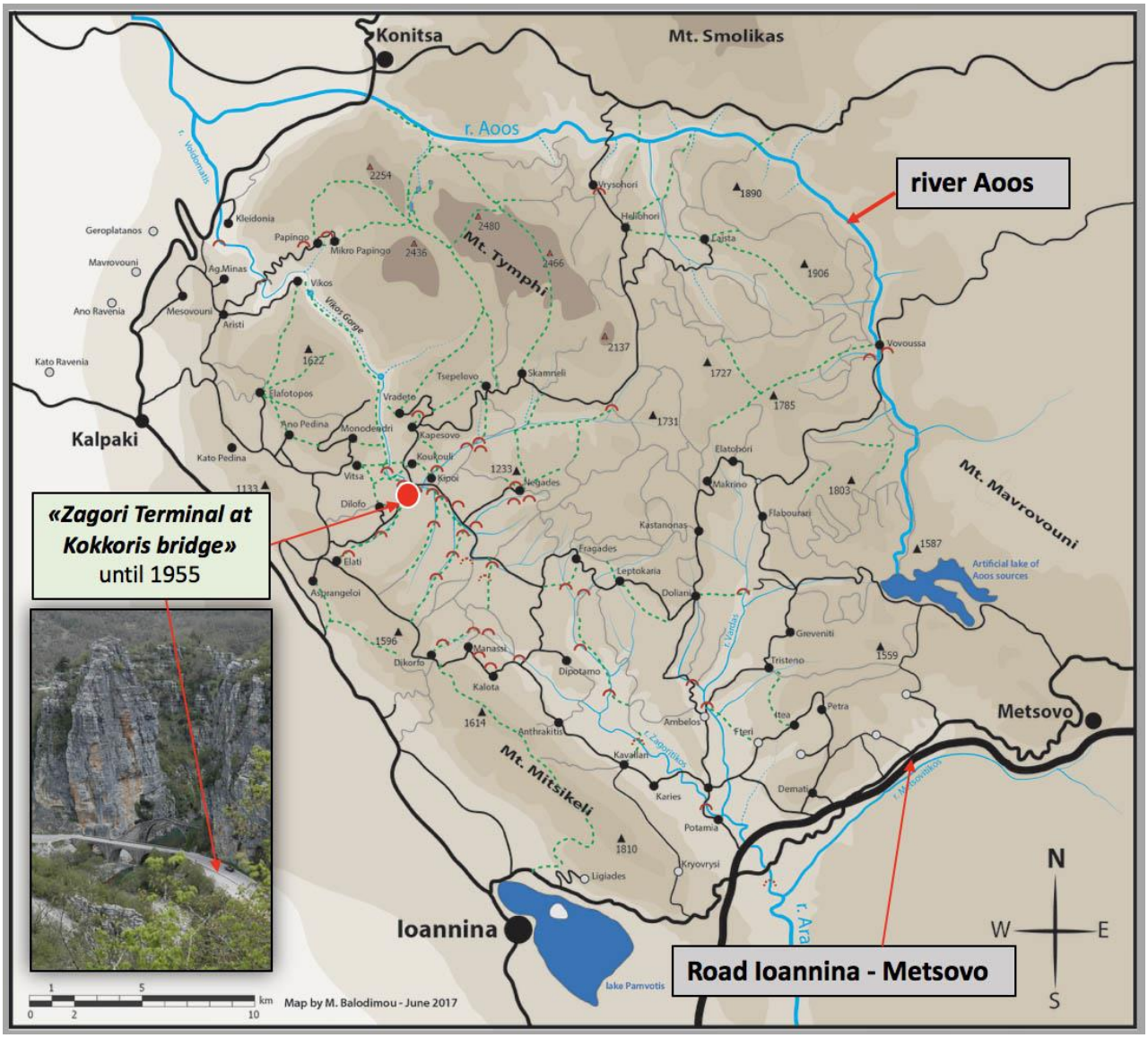


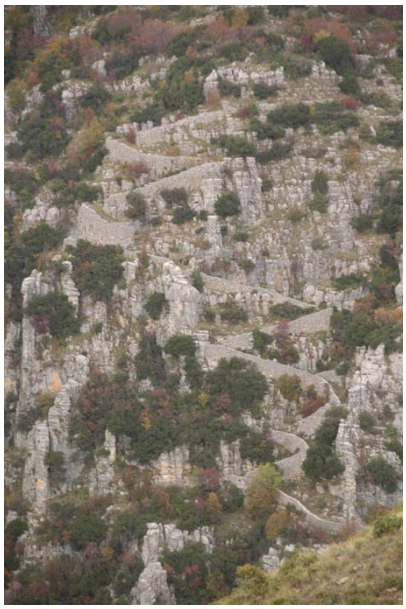
Figure 7: Map of Roads and villages in Zagori

Figure 8: Village of Dilofo, November 2008

Until all these 20th c. interventions took place, the communication between the 46 villages of Zagori and towards the big towns, was achieved via the paths and the stone bridges, on foot or on mule-back. Carts were not able to circulate in the area because of the geomorphology of the terrain and also, the narrow and steep arched bridges were impossible to cross. This network of paths and bridges is unique and has existed for many centuries serving the needs of the inhabitants. The new vehicular roads were constructed, either on the traces of old mountain paths, where the inclinations allowed it, or they followed new traces with milder inclinations. As a result to this, the old paths that were not close to the new roads were abandoned and gradually lost into nature. Some of them crossed stone bridges which are now found standing in the middle of nowhere and one wonders, why they were constructed at that site.

Part of this research is to identify the traces of the lost paths and a very helpful factor for achieving this, are these bridges that are found without obvious paths linking them. It is assumed that the existence of a bridge proves the existence of a path.

Luckily for us today, some of the paved paths have lasted through time and are exemplary stone constructions perfectly adjusted to the natural curves and inclinations of the ground. Figures 9a and 9b depict the unique “Steps to Vradeto”, one of the steepest paths in Zagori, literary carved on the rocky mountains like a staircase. The stones are implanted vertically into the ground in order to avoid slipping and to be able to walk on such inclinations. Figure 10 depicts the path which leads to Misios bridge and is an example of a path construction on a ground with milder inclinations.



Figures 9a and 9b: The Steps to Vradeto

Studying the manuscripts of the 19th c. can also be helpful, as the scholars such as I.Lambridisviii and P.Aravantinosix left us their valuable writing in which they mention historical facts and have given information about the public works and deeds of charity in Zagori. These include the construction of bridges and paved paths.
One would also expect to find valuable information about the Zagori area from the European travelers of the 19th c. such as W.M.Leakex and F.Pouquevillexi who traveled around Epirus and left a number of manuscripts, but unfortunately they visited only villages which were close to the main roads and never entered deep into the heart of the Zagori area (Leake, W.M., 1835).

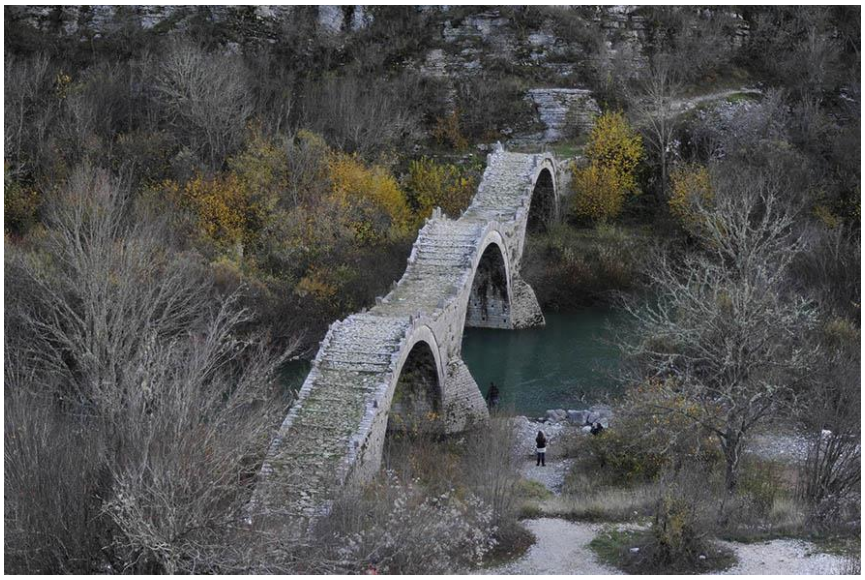
Figure 10: The stone path to Misio's bridge

Figure 11: The Misios bridge, 1748

The stone bridges

Paths and bridges are linked to each other as part of the infrastructure. Rivers and streams made the construction of bridges necessary allowing the daily movement of people and cattle. Most bridges surviving today were constructed from mid-18th century to the beginning of the 20th. There are written testimonies (Lambridis, I. 1880, Vol. I, p.53) stating that some stone bridges were constructed in locations where there were previously timber ones like the Kalogeriko or Plakidas bridge which was constructed in 1814 after the timber one collapsed (Figure 12).

Figure 12: Plakidas or Kalogeriko bridge, 1814



In the area of Zagori the routes linking the stone bridges were narrow mountain paths or established mule trails. The majority of the stone bridges were narrow and steep, therefore not suitable for carts and convoys. There are no identical bridges as the construction of each one was adapted to the geomorphology of the site and the stability of their river banks.
Most of them were constructed using the initiative of the local community. Sponsorship was provided through the community or donations from wealthy patrons and in some cases from the Ottoman governors (Petronotis, A., 2001, p.244). The aim was to serve the local needs and improve the connections with other villages and nearby big towns.
During the governance of Ali Pasha xii (1788-1822), a large number of bridges was constructed and existing ones were restored. The routes formed by the paths and bridges were essential to oversee and monitor this very remote area of his territory. Following this period, the conservation and construction of bridges was carried out by the locals, the church and emigrants, often as a charity - in aid of their community. It must also be noted that during the 18th and 19th c. trade was booming in the Balkans, Central Europe and Egypt, so the financial prosperity of the merchants from Zagori led to the need for reconstruction and amelioration of the living standards (Dalkavoukis, B., 1999, p.21).
Unfortunately for us today, during the years 1878 and 1879 a lot of unusual floods occurred (Lambridis, I. 1880, Vol. I, p.16) having as a result the collapse of many bridges which were never reconstructed.

Additionally, a large number of bridges has been destroyed due to other natural disasters – such as earthquakes, or neglect - when parts of the network stopped being used following the construction of contemporary vehicular roads and bridges in the 20th century.
The arched stone bridges were usually constructed by groupsxiii of builders specialized in stone bridges, who in other areas of Greece are called “Kioproulides”xiv, word which means in Greek Bridge Men and derives from the Turkish word “Kopru” meaning “bridge”(Petronotis, A., 2001, p.248). They had their own secret language in order to protect their techniques and skills which was called “Koudaritika” (Mammopoulos A., 1973, p.17).
The leader or head of the group was a craftsman, (a practical architect engineer) whose responsibility was to find the job and design the structure. He was the supervisor of the works on the site and responsible for paying all the members of the groupxv, which had a very strict hierarchy. Under the leading craftsman were the stone craftsmen and the carpenters, followed by the younger members and apprentices whose job was to make mud, mortars, break and carry stones and timber. The secrets of the craftsmanship stayed in the group and were passed from father to son (Mammopoulos A., 1973, p.14).
Bridges were usually named after the sponsor or their location. In many cases they take the name or names of the person who paid for a later repairing or restoration, but very rarely the name of its constructor.

The form and size of the stone bridges was related directly to the location (topography), the quality of construction and the funds available. As Zagori is a mountainous area, one does not come across bridges which are very long and have many arches, as the ones in lowlands. The majority of the bridges have only one main arch.
In order to begin the construction, the optimum site had to be located. Narrow river passages with rocky banks were the ideal spots for the foundations of the trusses. If a base pier was needed in between or one of the banks of the river was not of stable ground, the foundations had to be carefully constructed in order to securely support the heavy load of the stone arches.

After the construction of the trusses, the scaffolds were placedxvi which supported the timber framework. The building of the arch began simultaneously from both sides and when they reached the top of the arch the whole construction was “locked” with the placement of the last central stone called the “key”.
They used very strong lime mortars which they reinforced with animal hair and ground ceramic in order to make it hydraulic. Bridges with large openings had a second arch constructed on top of the first one in order to secure its stability as well as metal ties between the two sides of the bridge (Figure 13). After the arches were completed they started constructing the side walls which were usually filled with debris and finally they laid the stone paved path (Petronotis, A., 2001, p.192-194).

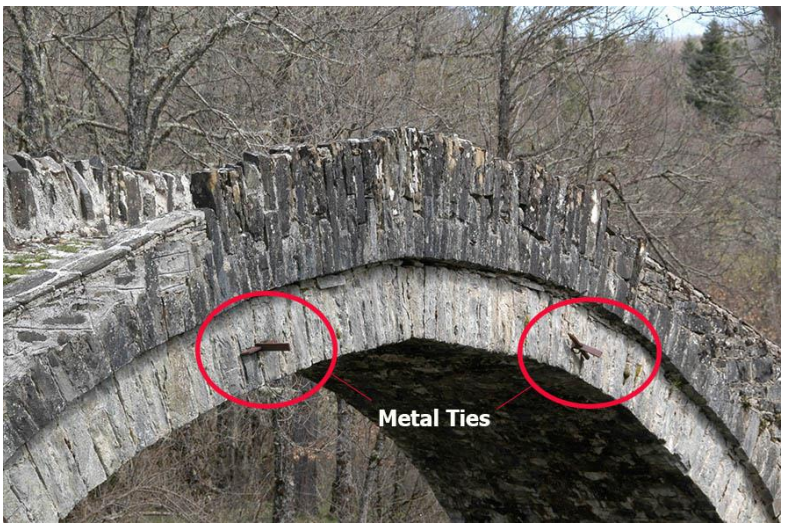


Figure 13.: Detail of metal ties

The span width and the number of arches always depended on the width of the river, the quality of its banks and the skill of the master craftsman. It is very difficult to categorize morphologically these bridges because each one is unique, adapting and perfectly integrating to the nature that surrounds them. Some are considered masterpieces and are admired for their quality of construction and the ingenuity of their creator.
Even though these structures are admirable, this does not mean that they are always easy to walk on, especially if on mule back or with heavy load. They are steep and narrow with low barriers or none at all, making the passage difficult and sometimes dangerous, especially if there are strong winds. Travelers often preferred to walk in the river bed if it was dry than crossing the bridge, especially during summer when most of the small rivers had no water (Figure 14).

Figure 14: Kokkoris Bridge (1750), photo (unknown) early 20th c. (K. Papazissi collection)

A very famous example is the Kokkoris bridge (Figures 14 & 15) which has become a tourist attraction because it happens to have all the above-mentioned characteristics as well as being located next to the 20th c. vehicular road, thus visible when driving past.

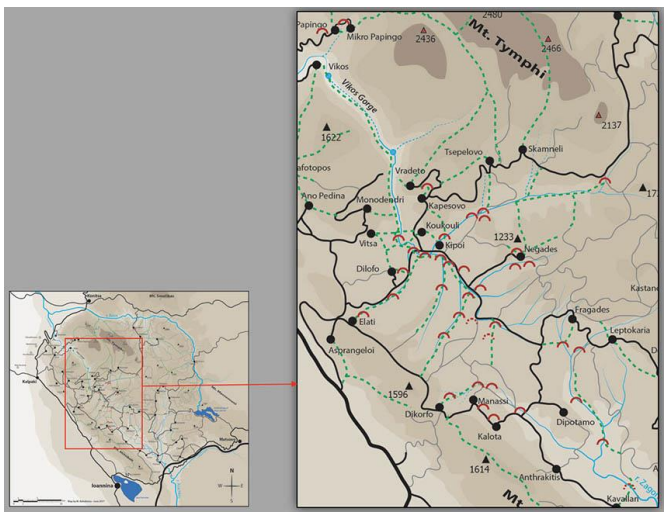
Figure 15: The bridge of Kokkoris, 1750

Other bridges which are not situated near the new road cannot be easily seen and sometimes it is not even possible to approach them, especially during summer when nature is overgrown. People have stopped using the old paths and these bridges have fallen into disuse. One of the aims of this research is to try and find bridges and paths that used to be active before the construction of the 20th c. vehicular road, by searching in the area and with the aid of the documentation from the19th c. reveal the old path network. By discovering bridges that are lost in nature today, the old paths are also revealed because the presence of a bridge proves the existence of a path.
A bridge inventory and hopefully future database, is under construction which will help record the location, use, type of bridge and identify the routes they linked (Figure 16).

	NAME	ARCHES	RIVER	VILLAGE	LOCATION	DATE	SPONSORS	PHOTO
7	**Petsioni's**	**2**	Arachthos tributary / **Zagoritikos**	Fragades	**Central Zagori** Near Fragades village	**1818**	Theodore Pitsionis from Dilofo	
8	**Kalota's**	**3**	Arachthos tributary / **Zagoritikos**	Kalota	**Central Zagori** Between Kalota and Dipotamos	**1812(?)**	Priest N. Chatziioann oy (?)	
9	**Vovoussa's**	**1**	Aoos	Vovoussa	**East Zagori** In the village of Vovoussa	**1748**	Alexis Missios	

Figure 16: Sample page of bridge inventory

Trying to answer the question why so many bridges in this specific area (Figure 17), one could definitely say, to make peoples' lives easier.
The area is full of small rivers and streams, which can become very dangerous for people and animal stock during winter because it rains a lot and also snows up in the mountains thus, the rivers become forceful. One must also keep in mind that the construction of bridges and stone pathways, showed the wealth status of the sponsors, who did not want to miss the opportunity to be remembered.
Figure 17: Detail from the general map depicting the stone bridges



Old and new road network - problems and maintenance

Many bridges have survived through the years to reach finally the 20th c. when modern infrastructure and new materials replaced the traditional approach and techniques. Unfortunately, their blending in the surrounding environment was not always successful (Figure 18). When the new roads were constructed, the unique values of these vernacular masterpieces were not appreciated as they should have been, which had as a result the collapse of many bridges, due to neglect or natural disasters.

Figure 18: New road and old bridge in Central Zagori

The damage that has been caused in the near past unfortunately cannot be reversed. The aim today is to preserve and protect our heritage that has survived to reach the 21st c. The everyday life today is completely different from the 18th and 19th c. when all this infrastructure was created. However, modern needs and activities such as mountain tourism, eco-tourism, hiking, mountain sports etc., are spreading rapidly and bringing many visitors to the area. It is thus imperative that the built and natural environment have to be protected and preserved. Some areas of Zagori are part of Vikos-Aoos national park and thus protected, but there are still areas which need attention although characterized by law as sites of special natural beauty and architecture.
Support and financing from the state are required as well as educating of those who still do not appreciate and respect the value of our heritage. We will never stop trying to preserve, save and restore as much as possible of this unique and extraordinary legacy.

Figure 19: The 3 arched Kalota Bridge, photo by F.Boissonnas 1910 (collection K.Papazissi)

Notes

[i] The city of **Ioannina** is the capital of the region of Epirus.

[ii] The **Despotate of Epirus** was an independent Byzantine state ruled by Michail A' of the Komninon family.

[iii] **Andronikos II Palaiologos** was a Byzantine emperor from 11 December 1282 to 23 or 24 May 1328.

[iv] **Voiniko treaty**: In order to avoid a war, both sides agreed to a treaty in which the Greeks would declare their submission to the Ottomans by sending a number of men from each village for a few months every year as well as money, to the Sultan in Constantinople in order to serve as stablemen in his army. In return they would keep their self-administration and the privilege to practice their religion.

[v] **Khan**: an inn, usually built around a courtyard with a well, where convoys may rest for the night.

[vi] **Zygos:** A very dangerous passage in the mountains of Pindos near the town of Metsovo which connected the east and the west sides of Greece. A guide was needed to pass it and during winter it was very often impervious.

[vii] In order to avoid any confusion, it is noted that the map is drawn facing up East and not North as usual.

[viii] **Ioannis Lambridis** (1839-1891): Physician and scholar born in the village of Ano Pedina, author of six volumes about the history, the traditions and the deeds of charity in Zagori.

[ix] **Panagiotis Aravantinos** (1809-1870): Scholar, history researcher and writer specialized in the area of Epirus.

[x] **William Martin Leake** (1777-1860): English military, antiquarian and topographer. Sent by the British Empire on a diplomatic mission at the court of Ali Pasha of Ioannina. Travelled all around Greece and Epirus and published his work. He wrote a four volume book about his travels in Northern Greece which was published in 1835 and gives us valuable information about Epirus in the beginning of the 19th century.

[xi] **Francois Pouqueville** (1770-1838): French diplomat, writer, explorer, physician and historian who travelled throughout the Ottoman occupied Greece, as Napoleon Bonaparte's general consul at the court of Ali Pasha. With his diplomacy and writings, he contributed to the liberation of the Greeks. In his books he describes his travels all over Greece.

[xii] **Ali Pasha** (1740-1822): Ottoman Albanian ruler who served as pasha from 1788 to his assassination in 1822, after being declared a rebel from the Ottoman central government. His court was in Ioannina, but he governed a large territory of Greece including Epirus, western parts of Thessaly, Macedonia and Moreas.

[xiii] These "groups" of builders were called in Greek **bouloukia** and they were travelling all over Greece constructing sometimes real masterpieces whose fame spread rapidly throughout the Balkans *(Mammopoulos A., 1973, p. 11&17).*

[xiv] According to Prof. A. Petronotis, although Epirus has so many stone bridges, the name **"kioproulides"** was not known in the area *(Petronotis, A., 2001, p.248).*

[xv] Very often they were members of the same family.

[xvi] The scaffolds were usually fixed on the trusses that were already constructed and sometimes in the river bed.

All pictures and maps, unless mentioned, are produced by the author

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The Impact of Bridge and Road Developments on Rural Communities in the United States (1920-1950)

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Abstract

The advent of the automobile sparked major changes in infrastructure planning and development in the 20th century yielding unanticipated impacts on the rural United States. The nation's adaption to the automobile was principally implemented between 1920 and 1950 in response to increased use of the automobile and the pressing need to replace transportation facilities originally designed for comparatively slower moving horses and wagons. This paper specifically examines the rural changes to bridge and road infrastructure during this time period within rural communities in the United States. A comparative case study approach was used to highlight the differences in infrastructure development and its impact on two rural communities. The two cases for this study were the US Route 340 corridor in Virginia and the small town of Ritchey, Missouri. Primary sources, including original Department of Transportation road and bridge plans, annual reports, maps, personal interviews, photographs, written memoirs, and a collection of 180 personal letters were used to document both the governmental action and individual impact of rural infrastructure changes. In rural communities, bridge construction and replacement projects represent significant community investment and are critical elements to the provision of continuous travel corridors that connect communities and individuals. In both of the explored case studies, local bridges are the most visible and documented of the changes to the localities. This paper reveals the different short and long term effects on each community that experienced different approaches to infrastructure development during the same time period. This paper also demonstrates the impact of other factors that mitigate or affect influences of infrastructure. Infrastructure, with its foundational connection to the economic, cultural, and social function of a society, inevitably impacts all aspects of a community.

Introduction

With the introduction and increasing popularity of the automobile in the first two decades of the 20th century, the infrastructure to transport those vehicles became more important. It was not until the late 1920s that much of the infrastructure underwent technological and visual changes as a reaction to the changing demands of the automobile. This paper will explore the changes to automobile infrastructure development, and the impact of that development, in the rural United States from 1920 to 1950.

For this research, the time frame of 1920-1950 was selected to encompass the primary period of reaction in infrastructure development. There were times of infrastructure improvements and new technologies throughout the 19th and early 20th century, but there were no examples of major re-alignments and bridge replacements designed specifically to accommodate alternatives to foot and horse traffic using the roads and bridges, especially in the rural parts of the nation. This began to change in the 1920s with more significant infrastructure projects geared toward automated vehicles. The end of the research period, 1950, was chosen to encompass the majority of these initial infrastructure changes, yet not include any changes resulting from the Eisenhower Interstate System. The Interstate System, which had its own significant impact on both urban and rural America, was not a direct reaction to the creation of the automobile.

Two types of impact from the infrastructure development will be explored. The first is how infrastructure impacted the public nature of society and culture. Public, in this case, is referring to primarily large scale changing of patterns and populations resulting from larger scale

government involvement. The second is individual impact. This small scale view looks at the impact of infrastructure on the daily lives of families and small communities. Both of these will be used to provide a more comprehensive understanding of the role of rural infrastructure in the thirty years following World War I in the United States.

Methodology

The United States is a diverse nation, comprised of a significant amount of rural landscape. The social norms and cultural realities of each individual community will be different across the nation. Therefore, a comparative case study was used to provide an understanding of these differences by examining specific details and infrastructure projects within two localities. In order to understand the pertinent priorities and goals of the time, as many primary sources as possible were used. These include original drawings, letters, photographs, and personal interviews.

Therefore, two locations were chosen that both demonstrate infrastructure development during the determined timeframe. The two locations highlight differences in culture, geography, geology, history, and research focus to compare and contrast the impact of development on these two localities.

The first location is Route 340 in the Page Valley of Virginia in the United States. In its modern form, Route 340 was predominantly constructed in the 1930s. The focus of this paper will be on the portion of Route 340 between Waynesboro and Front Royal, Virginia. This road section was an early major project of the Virginia Department of Highways (Miller, 1999). The resources for this include original road and bridge plans, as well as other government documents and publications regarding the development of Route 340. These sources will show the public type of infrastructure impact being explored by this paper.

The second location is a small town in the southwest corner of the U.S. state of Missouri known as Ritchey. While on a smaller scale, this agriculturally based locality also saw infrastructure developments during the 1930s and 1940s. In an effort to explore the individual impact of infrastructure on a population, the research will follow an individual family through their time living in Ritchey. This family's documents as well as personal interviews, modern site photos, and some related government documents will all be used to piece together the role of infrastructure in this family's daily life and how the family and the town reacted to the infrastructure changes. A collection of personal letters, the highlight of the family's collection, will be used to develop a unique perspective on the role of infrastructure in the lives of these individuals as they navigate a more rapidly changing world in the 20th century.

Research and results

Current state of infrastructure: 1920

In order to fully understand the impact of changes during the period from 1920 to 1950, it is important to understand how the existing infrastructure was organized and perceived in each of the two cases, Virginia and Missouri, during the time up to the 1920s. These states have

significantly different histories, and these histories influenced the existing infrastructure and dictated the development of future infrastructure.

Prior to 1920, some precursors to today's Virginia Department of Transportation (VDOT) were implemented in Virginia. Specifically, in 1906, the Virginia State Highway Commission was established. This body was designated to give monetary assistance to counties for bridge design and construction funds, in exchange for the roads and bridges being constructed at a certain standard (Miller, 2014). Figure 1 is an image of the first bridge in Virginia to be constructed using these aid funds.

Figure 1: 1909 Whiskey Creek Bridge

The bridge, built in 1909, still spans Whiskey Creek in Augusta County (Miller et al., 2001). As the county roads and bridges were less regulated and maintained at this time, there was little incentive to build quality structures, especially considering the counties often did not have adequate funds for the projects. The Virginia State Highway Commission provided that incentive. Over the next several decades, the Commission expanded the availability of standard plans for roads and bridges, in the hopes that bridges in Virginia would be built with adequate load carrying capacities (Miller, 2014). This expansion included standard plans ranging from small wooden trusses, to riveted metal trusses, to concrete beam structures. The funding and expertise required to construct safe bridges was more available at the state level.

The standard plans were begun by the Virginia State Highway Commission after 1906 and continued even after the creation of the Virginia Department of Highways (precursor to the Virginia Department of Transportation) in 1928 (Miller, 1999). While not all counties chose to participate in the State Aid program, the availability of the funds set the stage for more significant infrastructure changes in Virginia during the period from 1920-1950. While Route 340 still did not exist, the precedent of the State funding in infrastructure projects and the existence of standards plans would have significant impacts on the development of Route 340.

The story in Ritchey actually begins several miles away on a farm outside Pierce City, Missouri, on a busy harvest day in the fall of 1919. Here, underneath the shade of several oak trees, Erle Smerdon and Ada Davidson first met (Barlow, 2013). This was the start of a love story that

would last the rest of their lives. Between their first meeting and their marriage in 1924, they communicated through written letters. Over 180 of these letters survive today. Within each multi-page letter, there begins to form a picture of the daily life in Ritchey in the early 1920s. The detail provided in the writing is a perfect resource for understanding the role of roads and infrastructure in their lives, before any significant changes were made.

The rough state of the roads was comparable to the rough state of automobile technology at the time. In late 1919, Erle wrote to Ada that he and his brother Willie fight over who didn't get to drive the family Studebaker, as it was so unreliable that no one wanted to use it for fear that it would break down. The following is an excerpt from a letter from Erle to Ada written on January 14, 1924 that explains some of the problems the lack of infrastructure caused (Smerdon, 1924):

Wednesday afternoon Uncle Sam and Ralph came by on the road to Ritchey and stopped and ask [sic] papa if he wanted to go. Papa and I both went. We got as far as the creek about six miles from home and in the middle of the creek Uncle Sam's car stopped. The engine would run but the clutch slipped. We couldn't get out of the creek neither backwards or forewards [sic]. We were monkeying with it to see what was the matter and couldn't fine out for sure. We couldn't go to the place where the trouble was while we were in the middle of the creek. So Uncle Sam and papa went to a man's house and got him and a team [of horses]. We were close enough to the bank so we could get from the car to the bank without wading. We pulled the car to the man's house and left it and phoned for Willie to come after us in his trusty Ford. Uncle Sam was afraid to run his car until he found out what was the matter. So we didn't get to go to Ritchey after all.

From this excerpt, it is obvious that the road simply went through the creek, with no bridge of any kind. This would likely have been common at the time, with it equally common to have a neighbor help pull the vehicle out of the creek, as the mechanics of a vehicle would not have worked well passing through a creek. For this reason, other modes of transportation were used. In order to get the approximately 10 miles from Pierce City to Ritchey, Erle would take the train to go back and forth on a weekly basis. When a car was not available, horse and buggies were still commonly used during the time.

Yet, even with these alternate methods of transportation available, the increased reliance on the automobile was evident, even in just the five short years the letters spanned. Erle went from fighting with his brother to not drive the car in 1919 to borrowing money to purchase his own Ford Touring car in 1924 (Smerdon, 1924). Erle then sent a final letter to Ada to be before he embarked on the 350 mile, two full day journey in his new car down to Chickasha, Oklahoma, to make Ada his bride (Smerdon, 1924). In the 1920s, automobile infrastructure was in place in rural southwest Missouri, but it did not have the capability to be useful in winter weather and could not be counted on to reliably take the traveler to their destination.

Beginnings of change and reaction to the Great Depression

Like the rest of the nation, Virginia was hit by the economic woes of the Great Depression that started in the 1930s. In 1932, the General Assembly passed the "Byrd Road Act," which allowed the counties the option to transfer ownership of the secondary roads to the state. From the county's perspective, there were few negatives to this option. All of the liability and funding for the roads would be shifted to the state, freeing up the already strained budgets of the counties for other programs. The counties would lose the decision making power they had retained since the colonial days, but the economic system left them little choice.

This dramatic shift in ownership was centralization of government authority on a large scale that directly impacted the lives of every Virginian. The Virginia State Highway Commission, in one year, went from having responsibility of 8,000 miles of roads to 48,000 miles of roads. Most of these roads were unimproved dirt roads. The State Highway Department had a daunting task of incorporating these roads into the system and systematically improving them to be functional for year-round automobile use (VDOT, 2006).

The state would have been unable to finance any of the maintenance and construction in its newly expanded inventory had it not been for federal aid. In 1932, federal funds from the Federal Aid Act, the Emergency Act, and the Reconstruction Finance Corporation totaled more than $8.2 million. Other income for the State Highway Commission came from the Motor Fuel Tax and Auto License Collections. The federal aid constitutes a significant percentage of the Commission's budget for the 1932 fiscal year (Shirley, 1933). These changes in the system set the foundation for the state government of Virginia to improve the transportation through the Page Valley in the reconstruction of Route 340.

While changes were happening on the governmental level in Virginia, the young marriage of Erle and Ada Smerdon was not without its own joys and changes. Between 1925 and 1935 Erle and Ada had four children (Smerdon, 2008). Like any family living through the Great Depression, times were definitely tough. As the young family's hard work allowed them to weather the Depression, there were a few changes that began to occur around Ritchey as the decade of the 1930s progressed.

Through the center of the small town, there was spring-fed creek known as "The Branch." Several town roads cross this creek. When the newly married Erle and Ada moved to Ritchey, the majority of these crossings would have been fords through the small creek that horses and wagons would have crossed with ease (Barlow, H.S., 2014; Barlow, H.D., 2014). There may have been a rudimentary wooden bridge at the crossing in the middle of town, but it is impossible to determine when a structure like that would have been initially constructed. In the 1930s, local and county funds would have been used to build and upgrade culverts that allowed automated vehicles to more easily navigate Ritchey. The two primary culverts in town were built in the 1930s (Barlow, H.D., 2014; BridgeHunter.com, 2009). One of these culverts was just north of town on the only road that left town travelling north. The other was located right in the center of town on Route W, the main highway passing through town.

The first culvert, located north of town, is an entirely concrete structure. Based on the extant formwork markings, the concrete of the structure was poured in place. Figure 2 is a modern view of the entire culvert. Figure 3 shows detail of the culvert's concrete, which shows the faint formwork lines.

Figure 2: 2014 photograph of culvert north of Ritchey (Courtesy: Harold Dale Barlow)

Figure 3: Detail of culvert concrete (Courtesy: Harold Dale Barlow)

Also shown in this Figure 8 is the poorly graded aggregate in the concrete mixture. This is evidence of local materials and local workers who were not skilled with concrete work constructing the structure. Given the rocky nature of the bed of the creek, prior to the construction of this culvert, there was likely no structure here, and the vehicles would have had to cross through "The Branch" (Barlow, H.D., 2014). Therefore, during periods of heavy rain and high water, it would have been difficult to access some lands north of town.

The second culvert in the center of town, appears to have a more unique history. Figure 4 is a view of the culvert looking south. As can be seen in this image (and more clearly in Figure 5) the concrete portion of the culvert was placed over top of an existing stone abutment-pier system.

Figure 4: 2014 photograph of culvert in Ritchey (Courtesy: Harold Dale Barlow)

Figure 5: Detail of concrete capped stonework ((Courtesy: Harold Dale Barlow)

Based on a United States Geological Survey (USGS) benchmark located on the concrete portion of the structure, this part of the culvert was constructed during (or previous to) 1940 (Barlow, H.D., 2014). The stonework is more challenging to date just from the photos. It is likely that the original culvert had wooden beams spanning the creek, while the 1940 upgrade replaced the wood with concrete. In contrast to the first culvert, the concrete in this culvert was more carefully mixed and formed. This is not surprising given the location in the center of town. The town of Ritchey made it through the Great Depression with only a few infrastructure changes, but these changes allowed for more effective automobile use even during an economically difficult time.

Major changes and the effect on the local landscape

The infrastructure development in the Route 340 corridor was undertaken for several reasons. First, as has been described, the road conditions in Virginia in the early 1930s were not appropriate for the increased use of the automobile. Second, as the primary infrastructure improvements began in 1935 and 1936, the work was used to provide work for those who needed it most during the later years of the Depression. Third, as the primary north-south corridor in the Page Valley, the route connected several key mountain passes that provided access between the Shenandoah Valley and the Piedmont area of the Commonwealth of Virginia. Finally, the route provided an economic thoroughfare connecting several towns in Warren, Page, Rockingham, and Augusta counties (Miller, 1999). All of these factors combined constituted the necessity of a modern route through the Page Valley, and in the late 1930s, the Virginia State Highway Commission responded by allotting funds for several significant projects along the corridor.

In order to make the roadways a complete system and due to a measurable standard for the extremity of horizontal and vertical curvature on the route, a variety of bridges would be necessary to cross several small creeks. Route 340 generally parallels the South Fork of the Shenandoah River, and it therefore crosses the tributaries that feed into the main river. The terrain along the Route 340 corridor dictates that not only a variety of bridge lengths be used, but also a variety of bridge types to efficiently maintain the design standards of the route.

The first type of bridge was a simple two-span concrete girder bridge. Built around 1942, this bridge crosses Big Run in Rockingham County. Build from a standard plan design, this bridge was representative of the smaller, fully concrete structures that are the most prevalent along the route (Glidden, 1940). Figure 6 is a modern image of the Big Run Bridge.

Figure 6: 1942 Big Run Bridge

In order to cross some larger creeks, simple concrete structures could not achieve the desired spans, and metal truss elements were introduced. Most impressively, a twelve-span steel deck truss built in 1941 spans the South Fork of the Shenandoah River and its floodplain for a total length of 1,900 feet. Figure 7 is a 2014 image of the bridge showing the construction of a replacement bridge that is scheduled to be completed in 2017 (VDOT, 2014).

Figure 7: 2014 photograph of the 1941 South Fork Bridge (Courtesy: James Johnston)

These bridges and roadway improvements constituted a modern roadway by the time the majority of the projects were completed in the early 1940s. The next sixty years would see few changes to the infrastructure of the route, an endorsement of the routes ability to effectively transport automobile traffic through the Page Valley corridor.

In Ritchey, the infrastructure developments came much slower, as the town was not as economically important to the region as Route 340 was to the Page Valley in Virginia. Yet, eventually the improvements came to the little town. Erle and Ada, watched the developments from their expanded farmhouse that sat proudly on the corner of town. Another primary landmark just outside town was the Ritchey truss bridge. The town of Ritchey was located just outside of the floodplain of Shoal Creek. Before the railroad passed through town, Shoal Creek was the lifeline of the town, as the mill was located at the creek. The highway passing through Ritchey, Route W, crossed Shoal Creek on its way to intersect the main local highway, Route 60. When Erle, Ada, and their family lived in Ritchey, the creek was the leisure area of the town. Picnics down by the mill were common, and the area below the mill dam was a popular swimming hole (Smerdon, 2008). While there is no known photograph of the original Ritchey truss bridge, another truss in the same area, the Jolly Mills Bridge, would have been very similar to the Ritchey Bridge. Figure 8 is a photograph of the restored Jolly Mills Bridge.

Figure 8: 1926 Jolly Mills Bridge (Courtesy: Harold Dale Barlow)

This is a pin-connected through Pratt truss. More specifically, this means the joints are held together with pins and the truss forms a tunnel-like system by going over the travel lane. The configuration is the type patented by Pratt in the 1840s (Deibler, 1975). It is likely that the Ritchey bridge would have been of a similar configuration. More details about the former Ritchey bridge can be determined by the site where the bridge was located. While the truss is gone, the stone pier and abutments are still extant. Based on Figure 9, it can be determined that the Ritchey Bridge was a two-span truss, supported by a stone pier in the center (Barlow, H.D., 2014).

Figure 9: Existing stone pier of the Ritchey Bridge (Courtesy: Harold Dale Barlow)

However, by the 1940s, bridge engineering technology had rendered this type of truss bridge obsolete. In order to be able to continue to effectively serve Ritchey, the bridge needed to be replaced. However, a project of this scale was too large to be funded by the county. In order to

complete the project, the county turned over ownership of Route W to the State of Missouri. From here, the Missouri Department of Transportation used federal funds to do a major bridge replacement and road realignment (Brown, 1949). Figure 10 is a modern image of the Route W Bridge over Shoal Creek.

Figure 10: 2014 photograph of current Route W Bridge (Courtesy: Harold Dale Barlow)

This project was likely the largest infrastructure project the town had seen since the railroad came through the town, and no infrastructure project since has matched it in scope.

Conclusions

In looking at Erle and Ada's lives in Ritchey, Missouri, and the Route 340 improvements in Virginia, the two different types of cultural and social impact can be seen. The individual impact on Erle and Ada and their children can be seen as the developments in Ritchey provided the infrastructure for an effective farm town. The public impact can be seen in the towns along the improved Route 340 route. The roads in both of these locations influence the lives of the citizens, both in an individual sense by dictating and providing an avenue for travel and in a public sense by providing connections within and between communities.

The modernization of the Route 340 corridor was meant to have consequences. It was meant to provide the opportunity for economic development in the region. With this goal, the development was successful. Areas of both commercial and industrial development are evident along the route. There are pockets with heavy commercial development, especially in towns and near intersections. There are also large industrial facilities like Merck and MillerCoors Brewery that are located along the route. These facilities rely on Route 340 and the railroad to sustain themselves.

While these impacts were encouraged with Route 340, there were other consequences that may not have been predicted. When the realignments occurred in the 1930s, several small towns were bypassed. Where the main route had once gone through the center of these towns, the new route, in an effort to achieve more efficient travel and improve motorist and pedestrian safety, passed by on the outsides of the towns. Without the main route, the towns along the route struggled to survive economically. They had become economically irrelevant to the Route 340 corridor, and people moved away as a result. Figure 11 is modern image of the locality of Port Republic, a town bypassed by the realignment of Route 340.

Figure 11: 2014 photograph of Port Republic

This town was once on the main route of the collection of roads that comprised what is today the Route 340 corridor. Today, while there are indications of their former grandeur, only the few individuals understand what the towns once meant to the region.

Today, as one drives into the town of Ritchey, the town sign indicating arrival in Ritchey shows that the once thriving town is now all but dead, with a population of only 82. When Erle and Ada began their lives together in this town, the population was a bustling 300 (US Census Bureau, 2014). While the Depression had a negative impact on the town, several major road and bridge projects came to the town in the two decades after the Depression began. Despite these projects providing the resources for a future, more than one single factor contributes to economic growth and sustenance. In the case of Ritchey, two factors stand out that negated the positive changes in infrastructure.

The first was the closing of the railroad station. This economic lifeline saw its decline as the roads improved. The second was the departure of the Smerdon family from the town. Erle Smerdon passed away in 1964, marking a departure of the man who had become the town's patriarch during the forty years he lived there. Erle, with his farm at the corner of town constituting the major landmark in Ritchey, served as the town's Justice of the Peace and was a member of the school's Board of Education for thirty-two years. The rest of the family sold the farm and moved from Ritchey (Smerdon, 2008). Infrastructure played an important role in the lives of Erle and Ada, as well as the rest of Ritchey, as it allowed them to sustain a family and

provided opportunities for the children to move out of the town to find new opportunities. Ultimately, while infrastructure can directly affect economies and people, it is individuals that hold a town together, and even if all the supports are around them to preserve the town, if the sense of community is lost, the town itself is lost.

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Painting the Trestle: Adolescent Negotiation of Space and Place

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Figure 1. Sydney River Trestle Bridge (Eastern approach), 26 May, 2008. Photo by Philip Hiscock, used with permission.

Folklorists study the expressive culture of small groups, precisely those sorts of artistic creations that are simultaneously of extreme importance for the participants and yet are often overlooked, unintelligible, impenetrable, uninteresting, or misunderstood by those outside. Whereas it has its origins in the study of "The Folk" writ large—non-literate, rural, largely isolated people operating in a subsistence and trade economy—and their face to face performances, that conception has withered away over the past two hundred years to any group that recognizes its own sense of distinct character, using whichever medium is at their disposal. The modern folklorist studies the Slender Man phenomenon, rap battles, the jokes Jesuits tell each other, the pranks veterinary students play on each other, the stories diplomats share, stand-up comedy, rugby songs, World of Warcraft leagues, Internet memes, and—yes—the occasional Morris dancer.

Context: industrial Cape Breton

This paper is about a local folk art phenomenon among adolescents in an industrial city in Eastern Canada. Sydney, Nova Scotia, sits at the eastern end of Cape Breton Island. It was established in 1785 as Cape Breton's capital when, in reaction to the American Revolutionary War, Nova Scotia was divided into three separate provinces. Never having established much actual self-governance, Cape Breton was reabsorbed into Nova Scotia, a point of tension that remains between 'Islanders' and 'Mainlanders' for almost 200 years (Brodie and MacKinnon 2015).

Thanks to the region's coal reserves, at the turn of the last century Sydney was selected as a site for what was then the largest integrated steel mill in the British Empire, and the city experienced a population explosion. Sustained labour activism in both coal and steel slowly raised wages and expanded the middle class which, alongside the rise of the automobile and a bus system, allowed for the beginnings of suburbanization and mobility as a form of leisure. With the post-war economic boom and the province of Newfoundland entering Confederation in 1949, the Canadian Federal government, in conjunction with the provinces, embarked on the Trans-Canada Highway to provide a coast-to-coast road network. Starting in the 1930s, Nova Scotia had also heavily promoted itself as a tourist destination with the automobile presented as the best way for the individual to encounter the natural unspoiled beauty of the landscape: the expansion of the road system was thus of benefit to resource and tourism industries alike (McKay and Bates 2010:162). These factors all contributed to the replacement of the old Sydney River Bridge in the late 1950s.

Sydney was chosen as a defensible peninsula jutting out into Spanish Bay, a large natural harbour at the estuary of the Sydney River. There has never been a fixed link across the bay:

the closest was five kilometres to the south in the community also named Sydney River. By mid-century the bridge comprised a 160' fixed steel span built in 1884 and an 89' swing steel span built in 1900. The single lane could not sustain the weight and intensity of post-war traffic: indeed, a bridge of similar vintage and construction collapsed in October of 1949. Moreover, the road leading up the bridge from Sydney crossed rail tracks at grade, causing both delays and frequent accidents. In 1958, a new bridge was built, which at the time of its opening was the third longest in the province. This bridge is not quite the topic of my paper today: rather, my focus is on an ancillary piece of construction.

The Sydney river trestle

With the new bridge came a new road, later called Keltic Drive, which would meet the main road to Sydney at a perpendicular intersection and, just as importantly, go under the rail line. To accommodate that, an overpass was built, burrowing into the rail embankment. A rather plain piece of design, it became an inevitable landmark along the new Route 5, connecting the Island's most populous area to the Trans-Canada twenty kilometres to the north, which was the connection to both Newfoundland and Mainland Nova Scotia. The construction of Cape Breton's first department store and the suburbanisation of neighborhoods on the west side of the river further exacerbated use.
One significant population passing beneath The Trestle, as the overpass became known, were the students of Riverview Rural High School, which had opened its doors in 1950. The Nova Scotia Rural High School Act allowed for unincorporated communities to co-operate in the construction of schools for secondary education outside of incorporated municipalities: for almost sixty years students from throughout Cape Breton County were bused or driven to school via Keltic Drive. Even when a controlled-access highway was built at the end of the 1960s, handling much of the traffic to communities further north, there was no exit proximate to the school and commuters still needed to take the Keltic Drive route. A song written on the occasion of the fiftieth anniversary of the school by a former student puts it plainly.

In from Mira way and from out East Bay
All the yellow buses came
And the South Bar crowd and from Grand Lake how
We would gather every day
Johnny's bus came in from Westmount and Point Edward right on time
And the kids from all the county learned their lessons: life was fine

There's a place outside the city where the County kids do go
Turn left off Keltic Drive, down Coxheath Rd. a block or so
Where we'd spend three years from grade ten to twelve
To prepare us for the test
All the challenges of the world outside
We all thank you R.H.S.
("If Your Walls Could Talk," Wayne Burke, Class of 1977, used with permission)

It may seem an odd turn to employ a locally composed verse as data, but as a folklorist I have as my area of focus the small, informal group and how its members make meaning and reaffirm their sense of group identity through performance. The movement of adolescents from throughout the county converging to a single route is a marker of the Riverview school experience and one that therefore becomes prominent in its expressive products, whether that be song or material culture.

Folklorist Simon Bronner suggests that the landmark is a feature that serves to locate and orient ourselves in the cultural landscape. It need not be de facto unique or 'special' in and of itself, merely something that is recognizable and becomes part of the fabric of our everyday lives (2004:12). Through exposure, use, and familiarity, the mundane can accrete meaning. Although for some it may remain what Marc Augé termed "non-spaces" (1995; Moran 2005), blank homogenous spaces produced by the accelerated movement of people and goods in supermodernity, for others it takes on an almost preternatural characteristic. Multiple interpretations of the same landscape are possible.

As a landmark it also serves as a boundary. Like all passages, the liminal nature of the route under the trestle bridge is an interpretation, not a given. But the descent, the darkness, and the emergence into light, however brief, does lend itself to the idea that one is leaving one place and entering another. The trestle bridge serves as a boundary between city and suburb, or suburb and exurb, or industrial and pastoral, or working class and middle class, or any number of physical and conceptual pairings. Irrespective of "official" boundaries divvying up the area, the trestle serves as a boundary of the mind. One of the key boundaries it forms is that of Riverview High School and elsewhere.

Painting the trestle, 1981 to today

It began at the formal dance for the graduating class of 1981, when Riverview Rural High School student Tom Davis snuck out to write classof'81 in the ten steel squares that make up the trestle span. The letters were in luminous orange, in spraypaint his father had brought home from the steel plant. He had practiced painting upside down in his basement, and he was happy to have paid the extra dollar for insurance for the tuxedo rental.

In an interview, he knew his motivations. He had toyed with a simple "Tom Davis was here", but, apart from the likelihood of becoming a suspect, he settled on "Class of 81" for his message based in part on some issues that had been raised that year. A contest was being held to create a logo for the school, which prompted class discussions about the nature of symbol and the idea of mark, landmark, and legacy, and that there is a connection between both the figurative and the literal sense of the expression "making one's mark." At the same time, students were encouraged to think of themselves as "the class of '81", a common factor that would forever bind them together through a shared sense of identity.

Whether an act of school pride, an act of self-aggrandizement, an act of defacement, an act of street artistry, or however one chooses to interpret his initial trestle paint, by rendering it anonymous Tom had effectively ceded authorship over to the collective. One of the classic hallmarks of an item of folk culture is that ownership, perhaps better expressed as proprietorship, of an expressive performance is by the group and not the individual. With the trestle, the deliberate anonymity of the author turned painting into a communal act. The next year, the 81 was changed to an 82, then slowly repaintings occurred. Quoting Tom:

It was probably early June of the next year when the kids from Class of 82 just wrote over the 1 made it into a 2. But that kind of started off the kids from Riverview saying we have to paint this bridge for prom. And then it became well we gotta paint it for prom, and we gotta paint it for Red Cup [an ice hockey tournament hosted by the school]. Pretty much any excuse we could think of is a good excuse to go down and paint the bridge, paint the trestle. And the kids of Riverview took it upon themselves that that's their trestle. And then we gotta paint it for prom and Red Cup and Winter Carnival, and going back to school and Christmas break and Easter Break and Valentine's Day. (Davis 2011)

The practice of painting thus entered a process of transmission and, while in a line of continuity from Tom's paint, also adapted with new techniques, and a developing aesthetic. Like all street art and graffiti, the painting of the trestle is a way of claiming ownership of and control over the anonymous landscape of Augé's non-spaces.
In addition to the cycle of school life and matters more esoteric, the bridge has been used to promote causes. There was frequently a bridge for Armistice Day (called Remembrance Day in Canada), and one supporting the Riverview team participating in the Run for the Cure fundraiser for breast cancer. When a retiring principal was up for a national award in 2001, the grads of that year painted "R.A. MacKenzie, You're the Best, We Love You." In 2004 students painted it to protest a proposed quarry in Coxheath. Local musical acts have also used taken a turn, from Mastadon Ridge to Skullface to the organizers of the Gobblefest alternative music festival.

Over the years, the bridge has also been used for memorialisation. Like roadside crosses, painting is used to mark a death that falls outside of the flow of expectations, principally road accidents (Everett 2002). But unlike roadside crosses, which tend to mark the place of the accident, the bridge is understood as the appropriate public marker for grief because of its centrality to the cultural geography of adolescent Cape Breton. Most of the time these painters are no longer high school students, but return to their painting ways. They will coordinate a memorial bridge paint, often wearing the same clothes and experiencing the same sense of event and performance as they would have in their painting years. There is also a shared understanding that a memorial bridge will go without repainting until an appropriate time has passed, usually about a month.
Frequently, there has been pressure from the community for a cessation to the practice. In 2005 the city councillor for the neighborhood surrounding Riverview framed the paint as a criminal activity and the painters as criminals. Given how this school attracted much of the wealthy suburban population, several prominent personalities—doctors, lawyers, the chief of police—whose children were or had been painters – came to a vocal defense of the practice: and the bridge was painted as a form of protest.
In 2009, some underage drinking students at a start-of-year paint got into an altercation with police: typically, police had turned a blind eye to the practice (and even to the drinking), but the students' actions forced them to react, and more severe calls ensued. This time, the practice was expressly forbidden. Since that time all bridge paints have done under threat of punishment, either from the schools or from higher authorities. Despite the ban on the practice, the bridge has been regularly painted. The furtiveness with which they must act means that some of the aesthetic flourishes of the past are gone, but the desire to express a claim to the landscape persists.

"Tradition"
The gradual evolution of bridge painting style is a classic illustration of the conservative and dynamic tensions that exist within folklore. In essence, any performance is marked both by aspects intentionally repeated from iteration to iteration and by adaptation to immediate circumstances. For the trestle, changes when they occur stem from the repurposing of the bridge beyond marking graduation to include marking key events on the school calendar, social action and protest, and memorialisation. New technologies changed the aesthetics of lettering, as spray-cans gave way to paint rollers. New linguistic conventions change the messages fit into the ten squares: CLASSOF[last two digits of year] was replaced by RHSGRADS[last two digits of year] sometime in the mid 1990s, and in the last year social media hashtag conventions prompted #RHSGRADS with the two digits squeezed into the last square. And the shifting status of the activity from unsanctioned to sanctioned and back again

allowed for varying levels of detail dependent on how furtive the painters needed to be: we appear to be back to spray-cans. The photographic evidence suggests this general dynamic: a conservative sense of what a bridge ought to be mixed with experimentation with the form as context allows.

Figure 2. Sydney River Trestle Bridge (Southwest retaining wall), 21 Oct., 2010. Photo by Ian Brodie.

Students employ the term tradition to describe the practice, and the word appears frequently in paints. In Cape Breton, which since the decline of industry has turned to cultural tourism as one of its primary possible economic salvations, and which has long maintained a reflective identity that is steeped in concepts of the traditional (particularly of the Scottish Diaspora), the word "tradition" is a loaded term. And, if a pat definition of folklore is "the study of traditions," a folklorist finds debates over the term tradition fascinating. Again, one of the implied definitions of tradition is something that has persistence over time, and usually that time depth is significant. But significant to whom? I believe that time is a chronically overlooked element in the study of children's, adolescent, and student folklore. Although not an insignificant period, 35 years is hardly an "old" tradition. But if we locate ourselves within the adolescent community at Riverview and think in terms of "generations," and specifically generations defined emically with respect to how long it takes for a group to replenish, we are now considering over thirty generations, something that feels seven hundred years old, like celebrating Pancake Tuesday or singing "Ring Around the Rosie." That sense of equivalent time-depth is esoteric and easily contestable and yet, to participants, so palpable that it can not be dismissed too lightly. At the very least it serves to contextualize such claims among students that trestle painting is something that has "always" been done.

Most of the work on street art and graffiti, and much of the work on yard art and other forms of aesthetic embellishments to landscape, attest to an impulse to render the anonymous and

impersonal environment more personal, to claim a place amid non-spaces. In most instances the act is subversive since the creation of an idiosyncratic place is inherently breaching expectations: street art and other forms are expressly subversive as they are non-legal activities. For the most part, the community of Cape Breton had turned a blind eye to the issue of legality. Most of the participants come from families that constitute the local establishment: small business owners, Rotarians, lawyers, dentists. With graduated licensing, many of these students needed to be driven to a bridge-paint by their parents. Until very recently, schools had more of a 'don't ask don't tell' policy towards painting, which students would often flout by arriving at school the next day in their painting clothes, still covered in the colours of the latest bridge.

The completion of a school year—and high school graduation especially—have always been big events in industrial Cape Breton. I have yet to come up with a satisfactory reason for the intense emphasis on grade completion and graduation. I have heard explanations concerning the intense poverty of Cape Breton, but similar activities do not arise in other impoverished areas of Atlantic Canada: no such activity matches this intensity in either Newfoundland or the Acadian shore of Northern New Brunswick, which have arguably been historically far more economically disenfranchised than Cape Breton. Rather, I think the celebrations came about because of the economic opportunities, to provide incentives to stay in school until completion rather than leaving to work in the coal mines and steel mill.
But the mill and the mines closed in the late 1990s. Today the threat comes not from the draw of local industrial work but from outmigration: people go to Halifax, Toronto, and Fort McMurray to look for work, work impossible to find at home. People, especially young people, leave, as their options are so few. Graduation and the intense celebration of it might best be understood within the context of a collapsing local economy, infrastructure, and population.

And I return to the trestle bridge: it was built in part because of the confluence of an upwardly mobile population and the flow of finished steel from the mill to places west. In the 1950s, during the day, train traffic was so heavy that several different plans were drawn up to completely alter the downtown to elevate tracks and create underpasses and thoroughfares all in the name of alleviating the congestion. But that never happened, and the train traffic dwindled as the industries shut down. Today, the train that runs across this trestle comes once a week. It is about twnety cars long. It is owned by an American firm, RailAmerica. And it can only run based on the heavy provincial subsidies it receives.
Soon after the closure in 2000 the Sydney Steel Mill and all its buildings were razed to the ground as if to wholly erase them, especially as the dump site from the old coke ovens had created Canada's most polluted site, the Sydney Tar Ponds. Only now is the city coming to terms with its industrial legacy. The trestle is one of the most prominent legacies of an industrial time in Cape Breton that is no more. As a piece of design it is a feature tolerated because it serves a greater function. With hardly any traffic, that function is basically gone: no one complains about all the other places in Sydney where the trains cross the roads, because it happens so rarely. But by the students painting the trestle they made it personal, made it prettier, and, in many ways, made it optimistic.

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‘Borderlands, Bridges and Belonging: the Tamar Bridges as a vehicle for cultural heritage valorisation’.

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Introduction

This paper will explore the signification of the physical and psychological human construction of place and spatial identity through bridges. The bridges in this case being the Tamar Bridges, spanning the cultural, historical and geographical borderlands of Cornwall and Devon in the United Kingdom. Crossing the Tamar bridges also represents the symbolic, tangible and intangible crossing of borders.
Borders are more than territorial, geographical, and political, but also cultural and metaphorical. The idea of belonging can help to explain the complex geographical concept of borders. The crossing of border bridges changes identity from a previous state, whether it is becoming a migrant, a tourist or an exile.

Heritage has a role in helping us understand the experiences of those who live on or cross borders and it can be mobilised when there is a crisis or threat to cultural identity. A crisis is, however, emotional and capturing this mean-making needs new approaches in heritage practice. Heritage as performance is an effective process, a dynamic social and cultural vocalisation of self and a move away from passivity. This shift to alternative valorising processes may itself be a bridge between heritage seen as a panacea for economic growth and regeneration towards centralising heritage as a social value or moral good promoting inclusiveness and belonging.

The Tamar bridges (road and rail) are wonderful examples of technical innovations and significant monuments. The Royal Albert (railway) Bridge is a culmination of design, signifying Isambard Kingdom Brunel's final project. September 1st, 1857 the day of the 'fixing 'of the Royal Albert Bridge across the Tamar was heralded by a general holiday. Rolt (1968) describes a fitting scene that signified this event. Church bells pealed, flags hung from every house in Saltash and crowds filled both banks of the Tamar. One eyewitness describes Brunel, like the conductor of an orchestra; platform mounted demanding an impressive silence. 'As by some mysterious agency, the tube and rail, bourne on the pontoons, travelled to their resting place, and with some quietude, as marked the building of Solomon's temple'. Rolt (1968: 130).

The "Author"-ised Heritage:

Bridges are more than just monuments. Crossing bridges are gateways to an experience. Daphne Du Maurier described, as a child, closing her eyes as she went over the Tamar Bridge, passing into this magical 'Neverland'. She writes 'All was anticipation and it was unbearable to wait. The adults smiled mysteriously. The train drew out of the station…soon after there was a strange rattling sound as the carriage wheels ran upon the bridge. The governess whipping up our fever held up a warning hand. 'Shut your eyes, quick and keep them shut until we come to Cornwall'. Du Maurier, (1967:4).

In later years, Marsh (1993) suggests Cornwall provided Daphne Du Maurier with both a source of inspiration and a refuge from her London life as she actively set out to acquire houses and surroundings that suited the way she wanted to live. In return she provided a rich literary heritage to Fowey and surrounding areas.

The Cornish landscape shaped her work, providing the inspiration and setting for her most atmospheric novels Jamaica Inn (1936) and Rebecca, (1938) and these novels build a relationship between author and reader. In Vanishing Cornwall she writes 'Memories crowd

in thick and fast…the seepy tread of a moorland bog. The tall chimneys of Jamaica Inn. The splendid solitude of a grey manor house set deep amongst tall trees and rhododendrons growing' (1967:7).

The cultural landscape gave inspiration to the writing of these Gothic novels, providing a 'semiological realization of space' Busby et al (2000: 197) and a place of make-believe to escape to on holiday, Tunbridge et al (1996). As readers of Du Maurier have sought the origins of her writing, the region has gained a literary geography and heritage, a public legacy known as 'Du Maurier's Cornwall' Busby et al (2000). The detail in her books, describing the landscape as wild, romantic, rugged and windswept with ungovernable people has tempted and inspired people to visit this Cornwall, a landscape that Marsh (1993) claims has changed little since the writer breathed her literature into it.

This "author"-ised heritage, which Robinson et al (2002) describe as an emotional engagement with the author, provides the strong response to landscape, which mediates a sense of place. Further, Marsh (1993) suggests that readers may then even revisit her literature with a renewed vision and excitement. Hardyment echoes this, he writes 'Du Maurier tuned into a rare degree to the spirit of the place' (2000: 212) and added that her vivid descriptions closely relate the literature with her fictitious county, providing a wonderful journey for the literary tourist.

Hendrix suggests that 'novels are the primary condition of memory of literary place' (2012:94). Cornwall provided the space to romanticise the past (Horner et al 1998), the canvas that Du Maurier needed for the imaginative art of composition and to establish her own independence from her father. Du Maurier writes of Cornwall's landscape as a creative, poetic space. 'Places, houses whispered to me their secrets and shared with me their sorrows and their joys. And in return I gave them something of myself, a few of my novels passing into this ancient place' Hardyment (2000:212). The ancient legends of smuggling and the fiery stubborn pride of the Cornish Celt resonated with Du Maurier's need to have freedom to write walk and be inspired. 'I walked this land with a dreamer's freedom and with a walking man's perception' Hardyment (2000:212).

This wild, romantic escapism, where landscape mediates 'sense of place', is part of the economic value of tourism outlined by Robinson and Anderson (2002). Literary pilgrims have long sought 'a physical body to enable their senses to connect with objects read' Robertson and Anderson (2009:206) or a desire to extend the relationship with a literary canon or their text, Watson (2006).

Dinah Craik, in 1884, was one of the first travel writers, describing her journey through Cornwall as an outsider. On seeing the Tamar Bridge she reflects 'the magnificent bridge reminded us of the one over the Tay…but this Saltash Bridge, spanning placidly a smiling county, how pretty and safe it looked'. She goes on to describe 'there was a general turning to carriage windows and then a courteous drawing back, that we the strangers, should see it' (1988:4)

The cultural construction of place from a literary perspective has led to imagined spaces, where interests and ideologies compete and overlap (Watson, 2006; Hardyment, 2000). Fuelled by decline of industry it has led to once real occupational mining communities becoming imagined communities (Dicks, 2009; Anderson, 1991). The Cornish Revivalist movement in the late nineteenth century reinvented a romantic Cornwall, one that connected

with ancient Celtic landscapes and Arthurian legends, one at odds with industrial mining and the Methodist culture. This revivalist movement is criticised by Chapman (1992) as creating a Cornish cultural identity by the outsider, particularly literary writers like D.H. Lawrence and Daphne Du Maurier, who were seeking a place to escape to – a geographical and cultural 'other'. The re-invention of Cornwall by this collective of literary imagination and artists picturesque, is seen by Thorton (1995) to frame the tourist industry, spurred on by Great Western Railways branding of the Cornish Riviera in their posters and by easier access to Cornwall by the building of the Albert Bridge crossing the Tamar River.

This construction of the Cornish Revival as purely literary or constructed from outside of Cornwall is however questioned. The Cowethas Kelto-Kernuak (Cornish Celtic Society), formed in 1901, is described by Rayne (2016) as a determination to recognise the Celtic nation. She relates to Henry Jenner as the leading light in this movement. He recognised the Cornish language as a badge of the Cornish nationality in his book in 1904. In addition Payton (2004) refers to Jenner's speech at the Celtic Congress in the same year as instrumental in Cornwall's acceptance as a Celtic country.

The cultural assets and evocative landscapes have proved a popular choice for Cornwall's visitors from all target groups both in the high and low season. Industrial heritage can, however, conflict with a romantic Celtic past. Cornwall's mining heritage, however, has seen a recent increase in popularity following the BBC's adaptation of Winston Graham's "Poldark' from 2015. Malcolm Bell (Visit Cornwall) claims 'film and television has proven to have a significant influence on holiday decision-making, so Poldark has been an incredible gift to Cornwall' (Western Morning News, 2015). This promotion to a mass market has increased the concept of this Cornish heritage as 'felt-history' and escapism, blurring fact and fiction (Prat, 2009).

The mass appeal of film adaptation and literary treatments of regions do however raise questions about the relationships between places and people and how a sense of place develops, including 'the role played by geographical landscapes in our imaginative understanding of ourselves and our communal identity' Bradshaw (2012: 33). The cultural construction of place from a literary perspective has led to imagine spaces, where interests and ideologies compete and overlap. Potential conflicts however arise from perceived values versus rural dynamics and the fossilisation and preservation of landscapes as touristic spaces. (Herbert, 1995; Robinson and Boniface, 1999). Holt raises concerns over these communities being peripheral in decision-making and the omission of a counter or layered narrative, she writes of being 'systematically neglected by outsiders' (2017:2). This peripheralisation is criticised by some as part of essentialising the Cornish identity, glorifying and sentimentalising the sea, moors and smuggling. Hamilton-Jenkins (1970) argues to the Cornishman, the latter was vital to the very existence of people in extreme poverty, reliant on the precarious occupations of fishing and mining.

Crossing the Tamar bridges also has a wider symbolic value, rooted in identity and belonging (Convery et al, 2012), reflecting Cohen's psychology of borders (Cohen, 1986; Cosgrove, 1984). Yuval–Davis's work (2014) on the concept of belonging (2014) illustrates how belonging is an interconnecting web of domains that encounter and construct each other in her concept of belonging, describes emotional bonding and intergenerational familial networks.

Marsico (2016) sees that relationships with others and the environment are all unavoidably linked to the border itself. Living in a borderland, therefore, affects the mean-making process of identity and belonging.

Heritage is seen by Ashley and Frank (2016) as 'one social imaginary used by people to define identity in relation to ideas about the past' (2016:501). Cornwall and West Devon's border, through the Tamar Valley, draws on a shared occupational identity linked with specific sites of memory. Ingold (2011) suggests this contextualised lived practice, creates an informal loose space. The mining landscapes, were made by the Cornish and Devon ancestors and provide an everyday, spatial identity heritage or social monument. Heritage, the social and cultural construct of identities is seen by Robertson and Webster (2016) as this relationship with land but one made more meaningful when a sense of inheritance is applied.

In contrast to viewing borders as a divisive, Milden's (2012) analysis of the oral histories of those living on both sides of the Tamar bridges, suggests a dynamic spatial identity for kinship and trade. In this way belonging through a national or familial identity is affirmed, recognised and reinforced in an everyday performance of roles (Smith, 2017; Denzin, 2003). Robertson (2012) sees heritage as an expression of identity and an everyday act of life. This runs counter to the authorised dominant heritage discourse.

Landscape memory is constituted from the community who live in it and define it, as an embodied practice and as heritage from below (Robertson and Webster, 2016; Waterton, 2005). Heritage landscapes and rural sense of place have a wider symbolic significance, sense of difference; as a repository of cultural meaning giving a sense of localised identity (Waterton, 2005; Harrison and Rose, 2010; Nora, 1996).

Through performative activities, woven into discourses, particular positions/identities, signification of place and rooted territory are co-constructed (Convery et al, 2012; Yuval-Davis, 2014). Bender reflects this, saying that 'landscape and heritage are never inert; people engage with it, re-work it, appropriate it and contest it. It is part of the way identities are created and disputed, whether as individual, group or nation-state'. (1993: 3). The performance of 'crossing the Tamar' validates identity, articulating and constructing cultural memory and a sense of place in this heritage landscape.

Performative heritage is seen as a reflexive, effective process where values and symbolic meanings are seen in action, Smith (2017) adds that through emotions identity is affirmed. Turner (1966) suggests that cultures are most fully expressed through performance. In Cornwall, cultural heritage valorisation is powerfully symbolised on crossing the Tamar bridges – 'Welcome to Cornwall' in the Cornish language 'Kernow a'gas dynergh', occupational identities of the fisherman and miner flanking the proudly displayed Cornish coat of arms and a towering, contemporary Celtic cross monument sitting on the border.

Heritage in this sense is a dynamic, living cultural process of communication that engages with an act or performance of cultural social valorisation and identity. The cross was erected in 2013 and coincidentally saw Council of Europe recognising Cornish as a national minority in 2014. This articulation and construction of a national identity (real or imagined Celtic community), with symbolic markers of nationhood, is seen by Smith (2006) in other Celtic nations and post-imperial aristo-ethnic groups like the Anglo-Irish.

The cultural and social, valorisation of place signified by the Tamar bridges, is political and economic too. Convery et al (2012) suggest that the geo-politics of territory and borders are increasingly found at the center of the politics of heritage and identity, playing a complex role in society. Mason and Baveystock, (2009) however, argue that signification of cultural heritage, as a medium to foster identity, social cohesion and tackling disempowerment, is complex, concerning and controversial. Waterton (2010) argues that that heritage has, however, become a tool for governance and cultural policy. Smith (2017) argues that authourised heritage discourses have ignored the wider contexts remaining a-political, she argues that heritage is, however, about politics and power.

The concept of bordering is, therefore, not only about geographical borders but also about the ability to take part in decision–making or the heritage valorising process. Pink writes that borders are about 'the position of control of movement of both 'hard' and 'soft' borders and has become a central role in everyday life, the essence of who we are and our location in the world' (2012:143). Denzin (2003) further relates this to the everyday, performative character of identity, however, its meanings and values are socially constructed and negotiated by the power in play.

Democratisation of heritage has emerged as a central concern from a critical heritage perspective (Ashley and Frank, 2016; Smith, 2006; Mason and Baveystock, 2009). Yuval-Davis (2014) suggests that State power is a neoliberal process of social inequalities made legitimate by governance. This decision-making process is, however, a system of ideas or knowledge, often with its own vocabulary, which results in power monopolising views and debates. This can lead to marginalisation, exclusion and elitism (Smith, 2012; Littler and Naidoo, 2005; Naidoo, 2015; Swensen et al, 2014;).

Culture and heritage has been increasingly valued by governments and agencies as an economic resource linked to sustainable development and part of the 'cultural turn', legitimised though cultural policy (Garner, 2016). Governments have moved to more indirect or induced economic effects, promoting the attraction of localities by increasing the creative workforce and producing a 'lifestyle' (Florida, 2002; Kennedy, 2016). These fast policies have mixed blessings for rural regeneration, fuelled by the locating of creative workers to diversify the economic base

Regeneration programmes, in post-industrial regions like Cornwall are seen by Payton (20012) as a new regional distinctiveness and identity - but now in the realms of heritage tourism. More recently, different projects of belonging are framed around Cultural distinctiveness as part of the UK Government Devolution Deal (2015) termed place-based policy, British Academy (2016). Kennedy (2016) calls for caution around cultural distinctiveness. He argues that, in the past, the language and symbols of cultural identity, have been politicised and commodified as tools for the economy and the tourism industry.

The concept of 'borders in motion', Konrad, (2015), is also of relevance to critical heritage studies, particularly when changes are perceived as a threat to cultural identity and belonging. Yuval-Davis (2014) suggests that the emotive aspect of belonging, is activated when an individual or group is feeling threatened.

In Cornwall this idea of a crisis is vocalised by Deacon et al (1988) as a threat to the Cornish cultural identity. The building of the two Tamar Bridges, ensuing mass tourism and gentrification to Cornwall are cited by some as the fuel that led to this crisis (Deacon et al (1988, Kennedy, 2016). In addition, there is a historical and contemporary feeling of being

peripheral to decision-making. The Cornish identity was shaped by its peripheral location, which made them, geographically and politically, outsiders.

Celtic nations or cultures, often territorially, politically and culturally isolated, tend to fit the center-peripheral model (Rokkan and Urwin, 1982). This is not just historical, as there is an on-going threat to the demarcation of the historic boundary between Cornwall and Devon in a cross-Tamar constituency (UK Government Policy 2011 Boundary Review Process).

This threat to cultural identity has led to signification of the Cornish mining industry as 'world heritage', UNESCO (2006) and in 2014 protection as a National Minority (Council of Europe, 1995). Both have safeguarded and reclaimed Cornwall's cultural identity. This valorisation of Cornwall and Cornishness as a special heritage in need of institutionalised management is recognition that the Cornish are culturally different and that this difference should be recognised. This echoes Nancy Fraser's (2000) politics of recognition, but questions whether the promotion of dynamic cultural identity should be within a Western dominant framework of designation and safeguarding.
Ashley and Frank (2016) suggest that global flows of people, with diverse ideas and technology, are challenging established community/group/national identities. It is important for heritage studies to question the power relations that constitute this 'puzzling assumption of difference' (2016:501). The term 'difference' is used to define 'inside' and 'outside' positionality to valorising in heritage (Hall, 1991; Littler, 2005; Naidoo, 2015) and questions whose values are privileged within the use of this heritage framework.

In conclusion, heritage has a role in helping us understand the experiences of those who live on or cross borders and bridges. As an elusive geographical construct, 'borders in motion' reflects a discourse, in cultural heritage, of 'temporarily' Harvey (2001). Materials and their diverse symbolic meanings change over time, underpinned by political, economic, social and cultural values. This engages with debates about the process of heritage production including identity, power and authority.

Crossing the Tamar bridges is a human construction of place and spatial identity. Heritage is about identity and rapid changes may be seen as a threat to cultural identity. Critical heritage has widened to include the role of heritage when it is mobilised by communities in such a crisis. Further, effective practice in heritage is seen as part of enabling identity making and engendering emotions.

In Cornwall a crisis has emerged from the building of the Tamar Bridges and a threat to cultural identity from regeneration programmes, ensuing gentrification and being peripheral to decision-making. . The cultural construction of place, from a literary perspective, has inadvertently led to imagined communities in Cornwall under the tourist gaze. In addition, the increased mobility of 'the outsider' facilitated by the building of the bridges and regeneration policies, may have driven this need to become a protected minority. Safeguarding a minority, however, may not necessarily have a positive outcome.

There are alternative valorising processes in the everyday performance of identity. Heritage studies are now engaging in wider trends in public history and cultural memory, seeing an emphasis on community values. Memory plays a crucial role in the transmission of culture and identity; therefore, mass participation is key to preserving selective collective memory.

UNESCO Cornwall and West Devon chose a performance for their 2016 celebration of the 10th anniversary of World Heritage designation through a popular performative heritage event, the 'Man Engine'. This huge mechanical puppet made a pilgrimage across the landscape to reawaken the Cornish mining spirit at the old mining sites (one of pride in creativity and innovation). This provided an emotive, multisensory experience. Heritage performance as a dynamic social and cultural process and vocalisation of self is a move away from passivity (Smith, 2006).

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Misperceptions of bridges

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Introduction

One of the dominant issues in the touristic narratives regarding the North German city of Hamburg is the large number of bridges distributed all around the city. Whereas rational arguments are provided to justify the high record of bridges, the public perception of these numbers – testified by visitors, or traceable among the locals – reflect a different impression, or even a surprise when confronted with the official statistics.

The present study approaches the deviating perceptions from a perspective combining urban history, history of technology, and cultural anthropology. The study argues that the creation of the limited-access area of the Free Port of Hamburg (since 1883), the diversification of the uses of space in the urban and the industrial areas, the shifting of the port and trade activities beyond the borders of the city, as well as the traffic focus upon three or four major bridges render the bridge multitude diffuse and invisible – except for the specialist who is interested in counting them all. This counting, however, presupposes recognition patterns and categories of the counted bridges – and these criteria turn up to be ambiguous and lacking a consensual basis.

A further aspect is related to the perception of space in the Hamburg area from the point of view of the person travelling by car, train, or the subway (which in Hamburg partially runs above and not below the ground). Several areas (such as Wilhelmsburg, Wandrahm or Brook) were (or are still) islands on the river Elbe – but very few travellers would recognise this fact during travelling. The feeling of connection is so perfect that the bridge as medium of this connectivity becomes unrecognisable. Thus the technologically high-tech bridge constructions become perceivable rather in case of malfunction, repair or demolition.

Hamburg: European capital of bridges?

Focusing on and counting the bridges of Hamburg, with 1,800,000 inhabitants within its limits the largest German city after the capital, Berlin, has become a major issue in tourist guides as well as in several special publications (e.g. Grundmann & Zapf, 2004; Bradua, 2009/2011; Bönig, 2016; Duffé *et al.*). The mainstream claim compares Hamburg with famous European port cities such as Venice, Amsterdam or London – always in favour of Hamburg. “I couldn’t imagine that Hamburg has more bridges than Venice.” The above statement – attributed to the actor Robert Redford, who has been frequently visiting Hamburg (Bönig, 2016: 66) – could be provided by practically any visitor or even inhabitant of Hamburg. It contrasts with the official statistics, quoted in tourist guides as well as in the specialised literature, according to which Hamburg, with its “more than 2500 bridges”, surpasses the united records of Venice, Amsterdam and London, and can be thus considered as the European capital of bridges.

The following considerations will try to explain both the rational basis of the official records and touristic claims as well as the background of deviating perceptions and misperceptions.

Defining and counting the bridges of Hamburg

A major geographic particularity which has been constitutive for the history of Hamburg is its position at the crossing of the minor rivers Alster and Bille with the major river Elbe which

flows from East to West towards the North Sea. The large number of the still existing side channels crossing the urban structure is one of the reasons for the thick network of bridges. A further reason is certainly related to the port activities. The fact that the metropolitan railway network in Hamburg since 1913 is not a real *sub*way but rather an over-ground *high*way/"Hochbahn" is the reason for a further amount of bridges (Bradua, 2009/2011: 9).

Counting the bridges in Hamburg is a controversial issue. Grundmann & Zapf, 2004: 6 mention 1172 street bridges, 383 port bridges, 517 rail bridges, and 407 bridges for the over-ground metropolitan train network/"Hochbahn" – a total of 2479. Bradua (2009/2011:15) refers to statistics of 2004 according to which Hamburg has 1256 street bridges, 354 port bridges, 477 rail bridges, and 409 bridges for the over-ground metropolitan train network/"Hochbahn" – a total of 2496.

Several reasons could be responsible for the deviations between such statistics. Besides the different date of the statistics, an important factor is the authority which considers itself responsible for the specific bridge (hence for its being counted) or the specific category of bridges. Such responsibilities could change, and certain bridges could have been in a transitory responsibility status at a certain time. The statistics mentioned above refer to the City authority (Landsbetrieb Straßen, Brücken und Gewässer, LSBG), Hamburg Port Authority, Deutsche Bahn AG, and Hamburger Hochbahn & AKN Eisenbahn. This fact implies that bridges beyond the responsibility of the above authorities are not taken into consideration in the statistics – e.g. private bridges, bridges in industrial plant areas or in private zoo parks (such as Hagenbeck Zoo). Furthermore, the question of defining a bridge can have several answers depending on the criteria used by the administration authority. For the Deutsche Bahn AG a bridge must have a minimum width of 2 m. According to this criterion, several signal cable bundles passing beyond the railway lines are counted as bridges. LSBG uses different criteria when defining and counting bridges for vehicles (minimum width 2 m) or for pedestrians (minimum width 5 m). Further confusion rises in the distinction between bridge and tunnel in the statistics of LSBG. Under such conditions, a change of the authority responsible for a certain bridge may imply a change in its being defined as such. The question of rationally defining a bridge becomes a combination of philosophical considerations, construction details and administrative criteria – eventually far away from common sense and public perception (Bradua 2009/2011:15).

Discrepancies and contradictions in rational, more or less bureaucratic attempts of defining bridges in Hamburg go beyond the scope of the present study. Instead, the focus lies on patterns of public awareness towards and perception of the bridges in the city, as well as on uncovering historical processes and conditions that lead to such deviations. Much more than through rational narratives, public awareness and public perception are conditioned by medial representations of urban traffic infrastructures, as well as by historically induced social interactions and individual experience settings.

History matters: bridging rivers and islands

It is a common *topos* among historians that the particular geomorphological formation of the marsh areas at the confluence of Alster and Elbe in the North German plain has motivated and conditioned the human settlements in that area. Relics of a fisher settlement can be traced back to ca. 700 CE. A fortified site under the name Hammaburg – a name mentioned in later historical sources and alleged etymological justification of the name of the later town – is supposed to have existed up to its destruction in the 9th century; *hamm* means fluvial plain,

burg stays for castle. A mercantile settlement with a harbour at the site of the confluence of Alster and Elbe should have been established by the 12th century (Brenken & Kossak, 2013: 7-23).

One of the pertaining misperceptions of the landscape in and around Hamburg in relation to the bridges regards the way in which the minor rivers, Alster and Bille, flow into the major river Elbe. In the case of Alster, the needs of using it as much as possible as a navigable side river of the main river Elbe lead to the construction of a dam just before the confluence site as early as the beginning of the 14th century with the side benefit of using the power of the Alster instreaming water for driving a watermill. The dam construction, however, resulted to the formation of a lake-like water reservoir that has influenced the public perception of that part of the Alster river considering it a "lake" – actually two communicating "lakes", the Outer and the Inner Alster "divided" by a bridge which is necessary for establishing the West-East passage over the water since the 14th century till today.

Further misperceptions regard the Elbe islands of the confluence area. Their existence is well documented in several maps since the 17th century. However, the urban development in the 19th and the 20th centuries included several of these islands by connecting them to the (mainland) urban nucleus. The latest act in this process is certainly the shifting of Hamburg's new administration centre (Neue Mitte) on one of these islands (Wilhelmsburg) – a major political issue in the 2010s that accentuated the traffic connectivity by dimming the public awareness of the geomorphological insular character. Indeed, very few present-day travellers would recognise Wihelmsburg as an island during travelling. The feeling of connection is so perfect that the bridge as medium of this connectivity becomes unrecognisable. The technologically high-tech bridge constructions become perceivable only in case of malfunction, repair or demolition.

Further developments that influenced the perception of bridges in the urban landscape were the erection of a huge fortification ring in the 1620s and its demolition after the Napoleon wars, the Great Fire of May 1842, and the rearrangement of the channels accompanying the confluence of Alster into Elbe after several bombing raids during WWII. The site of the city fortification walls was transformed to a huge park ring with several bridges connecting natural and artificial hills. The Great Fire of 1842 and the interventions after the air raids of 1943 initiated long processes of canal filling – thus changing the sense or need of several bridges. Many of these still exist as bridge constructions – in the current public perception of their use, however, they appear as common street segments.

Leading and misleading perceptions: Bridges of pride

The master narrative and prototype of bridge icon in the context of Hamburg is certainly the Köhlbrand bridge over the Elbe (Duffé et al.: 160-163), a 3618 m long cable-stayed bridge. Before its inauguration in September 1974, the traffic between both sides of the river Elbe was effectuated by ferryboats. Therefore the Köhlbrand Bridge had from the very beginning the symbolic value of linking for the first time the road and rail networks of Hamburg and Schleswig-Holstein with those of Lower Saxonia (Niedersachsen).

Inside the city, the Lombard and Kennedy bridges over the river Alster just before the dam constitute another iconic bridge couple that separates Inner from Outer Alster. Already in 1651 a wooden bridge existed linking East and West of the "lake"-like formation. The last wooden bridge of 1827 was replaced in 1860 by a stone bridge. The current Lombard Bridge

was inaugurated in 1953. Since it proved to be not sufficient for the heavy East-West traffic, an additional bridge (Kennedy Bridge) was constructed 10 years later (Stephan 1987: 103).

Actually, both bridges of pride have proven to be insufficient to fulfil their purpose – they just remain iconic examples and symbols of a specific period of economic growth in Germany (1950s-1960s). In fact, most inhabitants of Hamburg would avoid using them because they are generally jammed. To cross the river Elbe they would prefer to use the under-river tunnel, whereas for the East-West axis they would prefer either the dam road in the South or the circumventing ring road beyond Outer Alster.

Misleading perceptions (I): Walking through the Warehouse City

Another source of misleading public perceptions considering bridges in Hamburg is related to the history of the Free-Port area. The creation of a Free-Port area on the river Elbe was a condition for Hamburg's joining the customs union of the German Reich in 1881. The German customs union was a Prussian initiative before 1871 that was intensified after the creation of the German Reich in 1871. The Free Hanse City of Hamburg refrained for a long time from joining the customs union since that would imply that any trade commodity entering the port should pay tax for entering German customs territory, even if it was supposed to leave the port by being shipped again – a perspective that would diminish the attractiveness of Hamburg for the international trade. The compromise achieved in 1881 was the creation of a Free-Port storing area which would be exempted from incoming taxes. The Senate of Hamburg decided to locate the Free-Port warehouses on two islands of the river Elbe, Wandrahm and Brook/Kehrwieder, just opposite the Old Town. Both were densely inhabited at that time. Ca. 20,000 persons were dislocated for the sake of the Warehouse City project – by 1885 all former housings were demolished (Brenken & Kossak, 2013: 115-23).

The Warehouse City (Speicherstadt) was erected as a red-brick Neo-Gothic complex with historicist facades in three phases: 1885-1888, 1891-1896 & 1899-1927. For that purpose the port and islands' infrastructure had to be rearranged. New canals were opened on the Brook/Kehrwieder island to ensure both land- and water-access to the warehouses. At the same time new bridges had to be constructed over the canals of the Warehouse City. However, the Free-Port status limited the accessibility to the area and conditioned from the very beginning the public perception of these bridges which, after all, were not intended for living, strolling etc., but for work.

After decades of decline in the traditional, old-fashioned use of the storing facilities, the Warehouse City was deprived from Free-Port status in 2003. Free spaces were filled with new buildings, several old constructions were demolished, and new concepts of mixed commercial and housing use for the new buildings, or new commercial uses for the historical ones (uses that were not allowed during the Free-Port era) were developed and implemented letting new groups of duelers, professionals and visitors come into the area.

The new look of bridges and galleries in the rearranged area is a mixture of former bridges and new galleries constructed in order to fulfil the requirements of evacuation and rescue of inhabitants, professionals and visitors in case of flood – a frequent phenomenon in this era of the river Elbe. For the common visitors these constructions may be misinterpreted as (private) balconies, or solutions permitting them to cross streets without paying attention to the traffic (Fig. 1).

In June 2015 the historical Warehouse City of Hamburg was listed as UNESCO-World Cultural Heritage. The new buildings are not included in the list. Since then the public perception of the (old) bridges and (new) galleries between the Warehouses and the new buildings becomes increasingly confused due to the fact that the touristic exploitation of the cultural attraction inevitably uses the accessibility facilities of the new area arrangement.

Fig. 1: Bridges and galleries in the Warehouse City after the removal of the Free-Port status: What is a bridge? What is a rescue gallery? (Photo: C. Canavas)

Misleading perceptions (III): Walking along the canals (Fleete)

Fig. 2: Zollenbrücke (Customs Bridge) (Photo: C. Canavas)

The several canals (Fleete) that accompany the confluence of the river Alster with the Elbe have created the need of constructing a large number of bridges. The oldest stone bridge in Hamburg, the Customs Bridge (Zollenbrücke), was constructed in 1633 and widened for the new traffic needs in 1854 (Fig. 2). The heavy motorisation of the traffic crossing the bridge inevitably shifts the public awareness regarding the water. In several cases the former canal has been filled or "closed" – the bridge as construction is still there, but its function is that of a mere street. In other cases the canal is vanishing under a building constructed on the original bridge – who can still pay attention to the bridge?

The rearrangements in the canal area are often characterised by several concessions to the adjacent market. The recent installation of expensive stores on the river side and the subsequent pressure on the authorities by the owners to obtain a pedestrian passage on the canal side – where no such a passage existed in the past – motivated the construction of galleries which imitate or continue bridges (Fig. 3). Whether the pedestrian perceives the bridge as a gallery or the gallery as a bridge depends on the circumstance that motivates him or her to look at the shopping window – or at the canal.

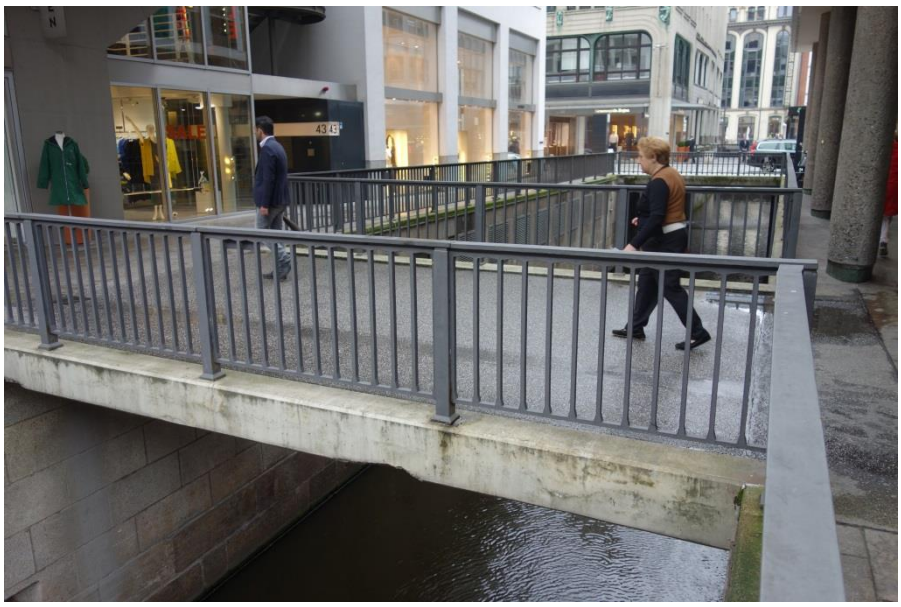

Fig. 3: Imitating bridges for the adjacent market (Photo: C. Canavas)

Concluding remarks

In the above considerations on bridges in Hamburg we tried to trace in what extent the public perception of the bridge depends on its historically volatile function, as well as on changing perceptions of public space and of its use.

Expert bridge perceptions include those of architects and those of administrating authorities or institutions. The perception of architects is attached to the planning and construction moments. Public administration uses more rigid and bureaucratic, sometimes controversial criteria.

Legal responsibilities (planning maintenance etc.) condition expert perception differently than that of the public layman. Public “misperceptions” of bridges can be as reasonable as the definitions used by the administrating authorities – in most cases they are just deviating understandings or assessments of the bridge as implied by its modified use.

Finally a closing remark: Visitors of the Warehouse City of Hamburg heading to the new Concert Hall (Elbphilharmonie) may have a surprising experience: A road leading to the new icon of Hamburg turns out to be just a bridge – with a connecting function that can be interrupted unpredictably for the public, e.g. for security reasons, by raising the bridge like the bridge assuring the entrance to a medieval castle.

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Building Bridges Through Culture: the role of arts festivals in Lille (France) and Belo Horizonte (Brazil)

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Abstract

Questions related to identity, place attachment and belonging are being put under reconsideration in the context of a globalised world and are elements being increasingly considered by cultural policies. In this article we will analyse two examples of cultural events organized by Lille (France) and Belo Horizonte (Brazil), leading-cities in the Agenda 21 for Culture (UNESCO), where cultural manifestations are being used as factors of social and territorial integration, constituting as bridges to cross politically demarcated borders. Those events are playing a key-role in democratising the local community access to culture (both in the production and consume ends) and promoting tourism.

Key-words: cultural events; Lille; Eurometropolis Lille-Kortrijk-Tournai; Belo Horizonte; city marketing

1. Introduction

Understanding culture as everything that is constructed and understood in the collective experience, integrating body and mind, in addition to new creations and outputs for everyday problems (Meneses, 2006; Ingold, 2001), one can understand the "(...) inestimable role of intangible cultural heritage as a factor of approximation, exchange and understanding between human beings "(UNESCO, 2003, p. 3). When studying the cultural heritage of a society one should not separate an object from the other elements and subjects to which they belong, such as the environment in which they live and their conception of the world, since it is the set of the human condition in time and space that allows an understanding of the culture of the other, of discoveries or affirmation of identities (Alfonso, 2001). The lifestyles and consumption patterns of postmodernity expose the individual to the various possibilities of identities, sometimes fragmentary, temporary, ephemeral (Hall, 2015). However, these identities create opportunities for new articulations that can be perceived as bridges to narrow the gap between those who are well integrated with society and those who are not (Laclau, 1990).

The present research follows this lead, as we investigate how cultural manifestations are being used as factors of social and territorial integration, constituting as bridges to cross politically demarcated borders. With this purpose, a bibliographical search about the concepts of culture, identity, image and urban marketing was carried out, as well as a qualitative research on cultural events that occur periodically in two different places: the Eurometropolis Lille-Kortrijk-Tournai (ELKT – France and Belgium) and in the metropolis of Belo Horizonte (Brazil). This choice is justified by the fact that both Lille and Belo Horizonte are references in cultural policy based on the guidelines of the Agenda 21 for Culture; the two cities have a common past of bi-lateral international cooperation in the cultural sphere and the festivals are perceived by the governors of both cities as a trigger for social and cultural integration, as well as a tool for promoting a sense of belonging and also to consolidate identities.

2. Literature Review

UNESCO (2002) reaffirms that culture should be considered as a set of distinctive spiritual, material, intellectual and affective traits that characterize a society or a social group and which encompasses – in addition to arts and letters – ways of life, ways of living together, value systems, traditions and beliefs. The Agenda 21 for Culture (Ajuntament de Barcelona, 2004), in its first principle, considers that: "Cultural diversity is the main heritage of humanity. (...) Culture takes different forms, which always respond to dynamic models of relationship between societies and territories" (p. 2). Calabre, Zimbrão, Siqueira and Libânio (2014) recognize several factors that

encompass the dimension of culture, including education, information, cultural production and fruition, and access to knowledge as factors of human development and a bridge to the appropriation of the city.

This contributes to the integration and exchange in the urban space and favours the expansion of access to the city through public policies that advocate cultural democracy and sometimes cultural democratization[1]: it is initially hypothesized that, in fact, the dimension of existence is (or may be) an important tool, vehicle and process for the inclusion of the popular classes in urban space and expansion of real access to the city (Calabre *et al*., 2014). Teixeira Coelho (2008, p. 63) adds that "The city is the first and decisive cultural sphere of the human being and translates culture into a vector of everyday life".

In turn, the identity – explains Stuart Hall (2015) – is an issue of discussion which gained new variables, especially in the last two or three decades, due to the intensification of a disruption process of "classic identities" caused by globalization. These changes are fragmenting social conceptions that once seemed solid, unshakable, and giving new tone to class cultural landscapes, gender, sexuality, ethnicity, religion and nationality today. A gradual change in the cultural traits of particular societies can be considered.

The changes observed in the world and in lifestyles and consumption patterns expose the individual to the various possibilities of identities, often contradictory to each other. This process "produces the postmodern subject, conceptualized as having no fixed, essential, or permanent identity" (Hall, 2015, p. 11). The subject starts to assume different identities at different moments, identities that are not unified around a single and coherent "self". It consists in the denial of uniformity for the valorisation of diversity (Faria & Monte-Mór, 2016).

The societies exposed to these changes are characterized by 'difference', argues Hall (2015), based on Laclau (1990); this is because they are crisscrossed by different visions and social antagonisms that produce a variety of different "subject positions" (or *identities*) for individuals. What prevents such societies from complete disintegration is not a will or project of identity standardization, but rather the acquiescence that, under certain circumstances, these different identities can be articulated.

Although this is a rather provisional conception of identity, one should not see it fearfully: this displacement of references, Laclau (1990) argues, has positive characteristics; it disarms the stable identities of the past and creates possibilities for new articulations. In this context, local identities can be seen as "hybrid identities": local re-readings of global and globalizing cultural inputs, serving as the "lowest common denominator", the core of what ultimately binds them together.

This type of identification is essentially political: it unites individuals – despite ethnic and cultural differences – from the social reality to which they are subjected by a process of cultural hierarchy. The intrinsic differences between the different ethnic groups that compose it do not cancel each other out, but are suspended – at least for a moment – while claiming social equality. This appeal to social equality is what validates this type of identification: they start from countless particularisms (ethnic, racial, gender issues) that alone – or alienated from the universal values – would not find validation. In other words, this validation is found only when those particularisms connect to the universalism of social equality (Laclau, 1992).

Fontanille and Zilberberg (1998) point out that there are cultures that see themselves as unity and others as a mixture. This means that there are at least two mechanisms to govern them: the principle of *exclusion* and that of *participation*, which create two major regimes of cultural functioning. The cultures regulated by the first regime, that of exclusion, confront the *pure* and the *impure*. The second regime leads to the comparison between the *equal* and the *unequal*. Equality presupposes interchangeable quantities; inequality implies magnitudes that oppose themselves as superior and inferior, an engendered hierarchy not always surpassed.

Considering that culture is the way of life of a society, expressed in different ways, revealing traces of its identity and considering cities as privileged *locus* of cultural making, how to intervene in cities with the purpose of stimulating the surge of identities, which by their turn, make possible new articulations between individuals?

According to Erick Braun (2008), city marketing is the coordinated use of marketing instruments endorsed by a philosophy oriented towards the creation, communication and exchange of urban offers that have value for the city's clientele (generally, private capital) as well as for their community and other stakeholders. The opening of the world to the reproduction of capital raises a locational war, which also follows the basic law of supply and demand. The more cities are sold (the greater the supply), the greater the competition between these places for capital. For Erick Braun (2008), it is precisely this competition – and the complexity that this brings to the challenges of regional development – that calls cities to adopt territory-centred marketing policies and practices: city marketing.

However, city marketing responds to one main goal: to work and rework an image and identity of a city. For Noisette and Vallerugo (1996), these two terms – image and identity – are not equivalent and come into tension in territorial communication operations: the *real identity* transmutes into *projected identity* (i.e. *image*), a desired representation of the territory that has monetary value (Thiard, 2007).

The festivals, as cultural manifestations held in different cities, have become an attractive alternative for governors and planners, since, besides being a recurrent form of diffusion of the culture – process by which the elements or systems of culture spread (Ortiz, 2000), festivals are used to bring countries closer together, to improve the flow of tourism and, consequently, the economy. According to Leguizamón, Moreno and Tibavizco (2013), in the contemporary times, the great cultural festivals seek to satisfy three objectives, namely: (i) the attraction of a large contingent of people; (ii) to conceive a new image to the place of the event and (iii) be a factor of creativity and progress for society. In this sense, festivals encourage the cultural traditions of a particular place, the development of tourism resources and the competitiveness of destinations. Bernick and Boo (2013) confirm this ability of festivals by mentioning that festivals provide a unique experience that exists only in real-life experiences and so they differentiate the places, revive the image and thus attract visitors, investors and sponsors. The attraction of different audiences makes it possible for festivals to play a different role: to build a bridge of understanding of the cultural diversity of different places.

Based on these concepts, two major cultural festivals will be analysed in the cities of Lille-France and Belo Horizonte-Brazil, based on the principles contained in Agenda 21 for Culture, emphasizing the role of culture as an agent of development, social justice and inclusion, "guaranteeing an active and not only contemplative city" (Pascual, 2008, p. 49), placing culture at the centre of local policies.

Chapter Notes:

[1] Cultural democratization aims to increase the supply of cultural services to motivate the cultural demand of the population, increase the number of spectators, visitors, readers, listeners, etc. Finally, to broaden the field of culture receptors. Cultural democracy aims to expand the cultural capital of a community. The public policy problem that must be addressed in the field of culture is not the expansion of the consumer population base, but who controls the mechanisms of cultural production and the viability of access to the production of culture. Public policies of cultural democracy would, then, not rely on cultural services to be provided to the population but on the broadening of the cultural capital of the community. Cf. Teixeira Coelho (2008).

3. Cultural bridges: A closer look at *NEXT* and *Virada Cultural*

3.1. Eurometropolis Lille-Kortrijk-Tournai

The Eurometropolis Lille-Kortrijk-Tournai (ELKT) is a bi-national metropolitan area centred on the French city of Lille and the Belgian cities of Kortrijk and Tournai. It covers the Hauts-de-France region (Lille is its capital), the province of Flanders (Belgian region with Dutch as the main language) and Wallonia (where French predominates as a language). There are 147 municipalities in total and in 2008, when ELKT was officialised and institutionalized, it had 2,155,161 inhabitants (Figure 1). ELKT is considered a *European Grouping of Territorial Cooperation* (EGTC), a cooperation mechanism created in 2006 and coordinated by the European Parliament and the European Council.

Figure 1: Map of the Eurometropolis Lille-Kortrijk-Tournai with its main cities highlighted. The white line delimits the border between countries.

Source: adapted from Ducuing (2008)

The Eurometropolis was born with the intention of promoting the development and reconversion of the regional economy, departing from a past related to mining and metallurgy industries towards a service economy. In addition, it seeks to improve cross-border collaboration, bring together the actors and institutions involved in the project, develop a common development strategy and responding to everyday problems. Convinced that the creation of a transnational metropolis would be the best engine for local development, the political and economic actors of the three regions involved decided for the creation of the ELKT.

Durand (2015) points out in his study on the ELKT that the complete integration of a cross-border metropolitan area depends on a multidimensional integration: (i) structural, (ii) functional, (iii) institutional and (iv) ideational. Of these four dimensions, the one that most interests us in this paper is the last one – the "ideational" one, since it includes culture, language and symbolism, three of the main vectors of the conformation of an identity (Löfgren 1991; Cuche, 2010). The ideational dimension of cross-border integration is evaluated by the representation of its inhabitants and their impressions regarding the sharing of common elements (cultural, linguistic and symbolic).

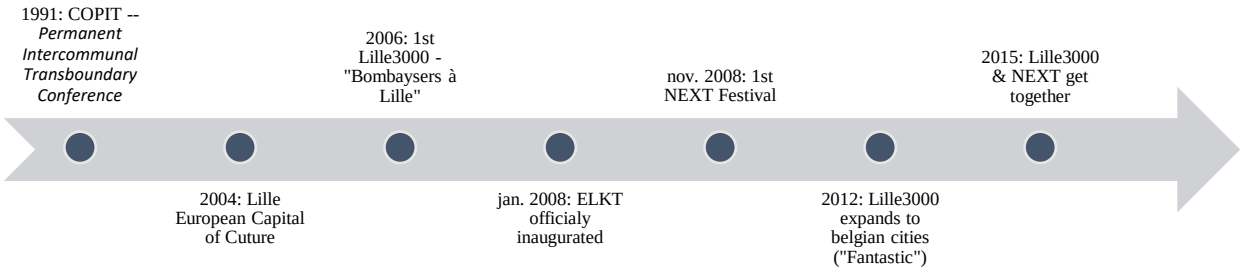
Furthermore, Durand (2015) indicates that, since 2001, some efforts have been made to create a sense of communion, of belonging, in the imagination of the population, especially from cartographic creations, due to their symbolic representativeness. We include in the same category the major artistic festivals: it is through them that the formation of an identity that provides certain social cohesion to the inhabitants of the ELKT (Siffert, 2016) is glimpsed. Therefore, we will analyse the major festival that contemplates the Eurometropolis and its surroundings: NEXT International Arts Festival.

3.1.1. NEXT International Arts Festival

Among the original political themes proposed by the Franco-Belgian parliamentary committee involved in the creation of the Eurometropolis, no major action in the cultural field had been envisaged.

However, artistic and cultural collaboration between organizations and actors on both sides of the border was something that had existed unofficially for many years, even preceding the formalization of ELKT's creation, encouraging international and interregional integration, though in a sporadic fashion – relatively dispersed and less systematized. Among these initiatives preceded the creation of NEXT, we can highlight *Lille2004—European Capital of Culture* and the *Lille3000 Festival*. Figure 2 presents a timeline of ELKT developments and related festivals.

Figure 2: Concurrent evolution of ELKT and the Lille2004, Lille3000 and NEXT festivals



Source: developed by the authors

Convinced that culture is an important instrument for strengthening the identity of the Eurometropolis Lille-Kortrijk-Tournai, five cultural enterprises have decided to organize an annual large-scale festival of contemporary art and to encourage an increase in the circulation of the spectators and artists within the cross-border areas of ELKT. Such cooperation was only possible with the ratification and legal assistance of Interreg IV[2], a mechanism developed by the European Parliament to create political, institutional and economic bases to facilitate the management, integration and development of cross-border territories: “Therefore, and to contribute to the aforementioned purposes, NEXT Festival was created” (NEXT, 2008a, n.p.).

According to the brochure of the first edition of NEXT (2008b), the Festival presents itself as a totally new initiative, being "the first festival that laugh of the borders" (p. 3). In it, the audience is invited to cross the borders unlimitedly, as they are nothing more than attributes "inherited from history", and to overcome the barriers of language, considered "invisible borders of cultural differences" (NEXT, 2008b, p. 3) between the three regions.

In addition to this cultural and artistic ambition, NEXT was conceived, above all, as an important vector for "promoting the cultural identity of the common territory, both for its inhabitants and those outside the cross-border zone" (Interreg, 2011, p. 1). After all, "culture is one of the most efficient vectors, the most visible and spectacular related to the feeling of belonging to a common territory, to a common identity" (idem).

NEXT spreads through the entire Eurometropolis and, between 2008 and 2016, it offered 235 spectacles on both sides of the border in 25 structures (including theatres, museums, cultural houses, etc.) distributed among 12 component cities of ELKT (in addition to Valenciennes). Regarding the number of participants, between 2008 and 2016, there was a total audience of 89,320 (it can be observed an increase between the editions of 2008 and 2015, for example: in the first, there were 7,034 participants, in 2015 there were 16,391 – more than twice as high as the start in 2008) (NEXT, 2016).

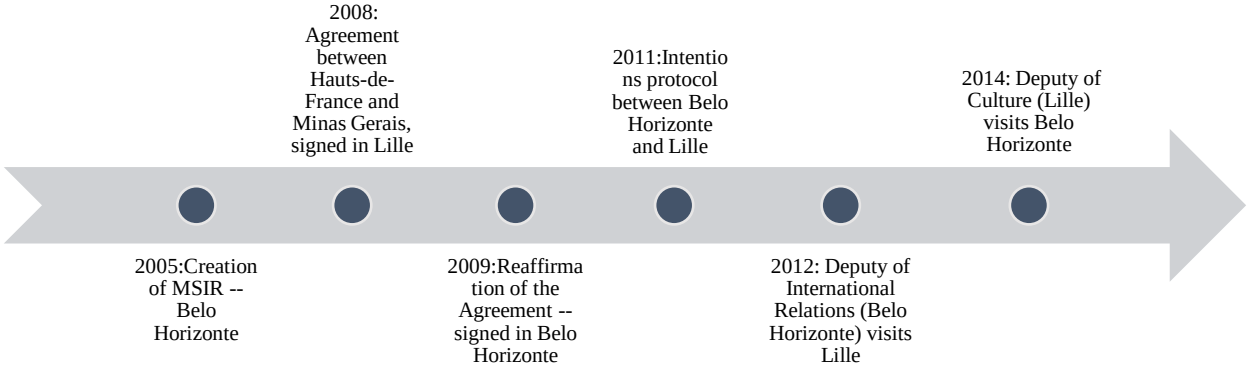
As important as offering the shows is ensuring the interurban (and inter-regional and international, in this case) transit of the festival audience. The displacement between cities is also a way for the inhabitants to know the region of the Eurometropolis and gradually create a sense of belonging. That is why, since the first festival, 23 buses were made available to the public free of charges, transferring between all cities that had NEXT events (NEXT, 2008a). In 2013, the number of free buses made available to the public jumped to 36 (NEXT, 2013). The 2014 numbers represent an advance: 13 cities were contemplated and – the most expressive number for our argument – 38 buses made available (NEXT, 2014).

3.2. Virada Cultural – Belo Horizonte

Belo Horizonte and Lille are considered leading cities in Agenda 21 for Culture, which proposes actions that correlate cities and cultures with a new idea of public policy, placing culture as a bridge for conviviality in cities, starting from a set of initiatives that respond to the demands of the different languages and visions of culture.

The international cooperation between the two cities influenced the public policies of Belo Horizonte and was the result of two actions that converged: on the Lille side, since 2004, when the French city was named European Capital of Culture, the cooperation initiatives with other localities aimed at implementing programmes, events and activities geared towards culture. On the other hand, the city of Belo Horizonte, at the same time, was in the process of strengthening its internationalization policy, which culminated in the creation of the Municipal Secretary for International Relations (MSIR). Several agreements and protocols of intentions were then signed by public authorities of both cities in the period between 2008 and 2014 (Figure 3).

Figure 3: Timeline showing the agreements between Lille and Belo Horizonte, 2004-2014



Source: developed by the authors

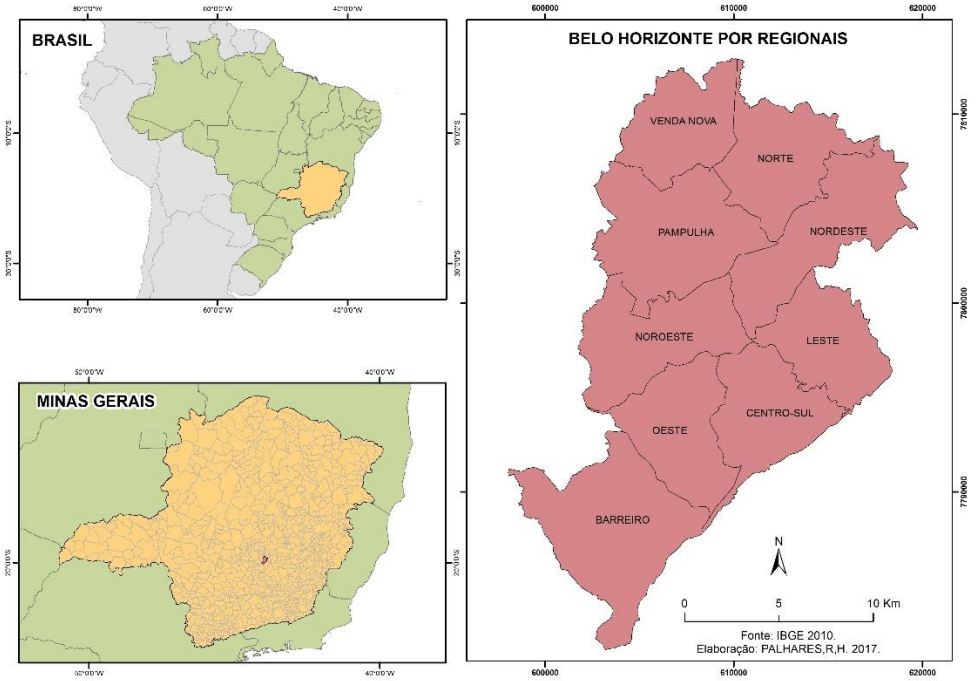
Like Lille, Belo Horizonte also invests in major festivals, such as the *International Theater Festival* (FIT, in Portuguese), whose first edition in 1994 established the format that currently exists, institutionalized in 2008 (in the form of a Municipal Law), the *Black Art Festival* (FAN, in Portuguese), which since 2003 has become biannual, and *Virada Cultural*, with its first edition in 2012, aiming to promote and stimulate culture. Those festivals were created to honour the commitment expressed in Article 37 of Agenda 21: "To endorse the public and collective character of the culture, promoting the contact of the public in the city in all the manifestations that facilitate the conviviality: live shows, cinema, parties, etc. " (Ajuntament de Barcelona, 2004, p. 7).

Belo Horizonte is located in the state of Minas Gerais, Brazil, with a population estimated at 2.5 million inhabitants for the year 2016 (IBGE, 2017). This is a population similar to that of the metropolitan region of Lille. Aiming to facilitate the planning and management of the city, the public authority divided the municipality into nine administrative regions, which contains approximately 300 thousand inhabitants in each of them (Figure 4). Furthermore, the metropolitan region of Belo Horizonte contains 34 municipalities and roughly 5 million inhabitants

The *Virada Cultural* festival was created in 2012 by an Organic Law of the City Hall of Belo Horizonte, having public and private agents as partners. The event runs through 24 hours of uninterrupted cultural artistic programming: music, theatre, dance, circus, literature, visual arts, performance, fashion, gastronomy; it also proposes discussions on topics related to the daily life of the city: use of public space, sustainability, mobility, accessibility and new experiences. Its programme involves guest artists (local or not), selected by projects approved by the Municipal Culture Law, free

presentations on various stages of the city, associated programming in theatres, museums, cultural centres and open spaces. The intention was to preconize the experience in the city, encouraging its use by those who inhabit it.

Figure 4: Map showing the localisation of Minas Gerais State in Brazil (top left), Belo Horizonte in Minas Gerais (bottom left) and Belo Horizonte divided by administrative regions (right)



Fonte: Palhares (2017)

The event privileges decentralization, promotes the democratization of culture and enables new forms of coexistence and appropriation of urban space. An important milestone for *Virada Cultural* and the city was set when it became a Municipal Law. The festival promotes public notices to select part of its local attractions, collaborating with cultural democracy. The initiative is growing year by year in public and in cultural production (as shown in Table 1).

Table 1: Informations about Virada Cultural in Belo Horizonte, 2013-2015

Virada Cultural Festival – Some Numbers			
	2013	**2014**	**2015**
Spectators	**200.000**	**400.000**	**500.000**
Attractions	**439**	**461**	**600**
Official Stages	**6**	**8**	**8**
Associated Spaces	**16**	**20**	**70**

Source: Adapted from Municipal Foundation of Culture – Belo Horizonte (2016)

Concerning the spatial dispersion of the festival in the city of Belo Horizonte, some regions of the city absorb most of the attractions and resources of *Virada Cultural* and attract, consequently, a larger audience. Although there is an effort to decentralize the attractions, there is a lack of participation of peripheral regions. Those attractions considered of greater value remained in the most valued areas of the city (*Centro-Sul* region), demonstrating preference for areas already consolidated in the 'game' of cultural supply and demand. According to the researcher and consultant of the Cultural Diversity Observatory, Oliveira Júnior (2016), factors such as accessibility, adequate infrastructure, artists' demands, visibility, among others, corroborate to the fact that most attractions focus on the most valued regions of Belo Horizonte, as shown in Table 2.

Table 2: Cultural attractions by Administrative Region of Belo Horizonte, 2014 and 2015

Virada Cultural Festival - Activities		
Administrative Region	**2014**	**2015**
Barreiro	**3**	**-**
Centro-Sul	**290**	**592**
Leste	**5**	**-**
Noroeste	**3**	**-**
Norte	**8**	**-**
Oeste	**1**	**-**
Pampulha	**21**	**17**
Total	**331**	**609**

Source: Adapted from Municipal Foundation of Culture – Belo Horizonte (2016)

The *Centro-Sul* region is conformed by the central area of the city and more upmarket neighbourhoods, presenting supremacy in the offer of cultural activities during the festival. For this region there are several transport modes, there is a greater offer of parks and cultural facilities (theatres, cinemas, cultural centres), easy access and adequate urbanization. In second place is the *Pampulha* region, known for housing the lake of the same name and buildings designed by the architect Oscar Niemayer, constituting an architectural complex inscribed in 2016 as a World Heritage Site by UNESCO and known as "the postcard of the city".

In 2016, in its fourth edition, the *Virada Cultural* four other municipalities in the metropolitan region of Belo Horizonte (Vespasiano, Pedro Leopoldo, Lagoa Santa and Betim), in an attempt to fulfil its goal of cultural decentralization.

3.3 Discussion

Two researches conducted with local political actors in the years 2000 and 2001 (Tetra, 2000; 2001) sought to study their perceptions of what would become the Eurometropolis[3]. The conclusions indicate that, at that time, there were two quite different visions of the whole ELKT project, and these followed the nationalities of the actors involved. For the French, the Eurometropolitan project represented the possibility of gradually achieving the status of "international metropolis". However, for the Belgians, the results were more complex: it existed fear for the creation of a strong France-Wallonia axis, resulting in a lack of recognition mainly for Flanders, which would relegate the region to a background position.

In addition, the 2001 survey (Tetra, 2001, p. 61) suggested that the sense of belonging – on both sides of the national border – to the ELKT was "weak or non-existent." For Durand (2015), the lack of a strong symbol of cross-border integration (such as the *Øresund Bridge*[4]) plays a major role in this, hampering the development of a common identity with which the inhabitants could identify; and, as Kobena Mercer (1994) reminds us, "identity becomes an issue only when it is in crisis, when something that is supposed to be fixed, coherent and stable is displaced by the experience of doubt and uncertainty" (p. 43). Similar historical and cultural roots on both sides of the Franco-Belgian border facilitate collaboration and exchanges between the two populations. However, the linguistic barrier between Francophone and Flemish tends to pose obstacles both at the level of individual perceptions and spatial practices vis-à-vis neighbours (Hamez, 2004).

Also in the case of *Virada Cultural*, a strengthening of the regional metropolitan identities is sought, with the intention of creating a great tourism product and the consequent increase of investments in the cities of the metropolitan region: the festival begins to expand beyond the limits of Belo Horizonte, incorporating other municipalities in the area. The borders, be they international or

municipal, are crossed by the bridges built by the cultural expressions and an occupation of the public space in both endings of the bridge is encouraged.

However, the intention of a spatial decentralization of cultural events is a constant challenge. Although this is a desire of public authorities, Herrero-Prieto (2011) points out that factors associated with the economy of agglomeration and externalities make the most populous places, especially large cities, the preferred sites for the accomplishment of cultural manifestations, be it because they concentrate the demand (i.e. spectators), or they hold the best cultural facilities available, or host the companies specialised in the infrastructure arrangement for the shows and also because of the interaction between agents, artists and companies. Therefore, the concentration of attractions in the city of Lille, the most populous of the ELKT, or the *Centro-Sul* region, in Belo Horizonte, with its superior transport structure and cultural facilities, is not surprising.

The cultural proposal of the ELKT is a project of delineating a new identity, common to its inhabitants. Based on three different cultural matrices, we are led to conclude that the process of the Eurometropolitan identity project is intended to amalgamate differences – and avoid value judgments about what is *pure* or *impure* – in favour of a new cultural reference (to be marketed in the form of an image); is what Fontanille and Zilberberg (1998) call "culture as a mixture" – and this is also the case of the *Virada Cultural*.

Chapter Notes:

[2] One of the mains objectives of Interreg is not only to stimulate international cooperation, but also to reduce the influence of national borders in favour of equal economic, social and cultural development of the whole set of territories within the European Union (Hamez, 2004).

[3] Despite being institutionalized in 2008, the ELKT conformation process dates back to 1991, when the *Permanent Intercommunal Transboundary Conference* (COPIT, in French) was created.

[4] The Øresund Bridge crosses the Øresund strait and links the cities of Malmö in Sweden and Copenhagen, the Danish capital, forming another transnational metropolitan region.

4. Conclusion

To what extent do these major events reduce the cultural distances of different social spheres, where socially heterogeneous individuals aim to live together and affirm themselves? Would not cities treated as stage shows be masking their social reality, their discrepancies and demarcating their borders? "Are we transforming cities through knowledge and culture, or have we turned cities into cultural spectacles without modifying structural disorders? "(Canclini, 2008, p.19).

Calabre *et al*. (2014) declare that culture is a primordial and fundamental element for access to the city and question how culture can contribute to integration and exchange in the metropolitan space. At one point it can be understood that festivals are part of this response when they are able to promote a sense of belonging: the "belonging through consumption of place" (Calabre *et al*., 2014). The major cultural events held in different parts of Lille and Belo Horizonte are cultural products that provide for the strengthening of the sense of belonging of the individuals towards the city through its consumption, promoting a recognition through the cultural diversity. However, they also contribute to strengthening or even re-creating the image of the cities, promoting opportunities for new investors for cultural tourism to foster different economic sectors (Braun, 2008).

There is a distance between "image" and "identity" (Noisette & Vallerugo, 1996), where the urban image produced seems intangible, always referring to a “temporal and spatial elsewhere”. The effects of distortion between representation and reality, previously meticulously avoided, seem to be

systematically sought after in marketing projects, since it is precisely the image of the city that is the saleable part of the urban product (Thiard, 2007).

Although permanent cultural initiatives have a preference in public policies (Oliveira Jr. 2016), the major events mobilize the various spheres of the city, and several initiatives have become visible, opening new fronts for discussion. The forms of cultural expressions used as a means of claiming the city and the democratization of the public space inspired the methodology used in the realization of the major cultural festivals. Events that grate the population with varied artistic performances, which conform various identities, should corroborate for social cohesion and dissemination of localities, as well as promoting the valorisation of local artists, their plurality of expressions of artistic genres and also the dialogue between artistic vocations.

However, in the NEXT festival and *Virada Cultural*, there is no information to corroborate these statements, due to a lack of research that contemplates the audience, in order to gauge the motivations for going to the festivals and the results perceived by the visitors. In this sense, the speeches prevail over the facts, and there is a need to deepen the knowledge about the effects and impacts of the festivals both on the image of the cities, as well as on the motivation and perception of their goers. However, a visible legacy of festivals is the use of public spaces by residents and visitors in a non-everyday or usual way, a greater appropriation of different points of the city by its regulars.

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Wordspree viaduct,
spanning with bridges or words

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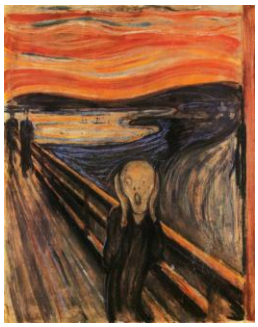
Wordspree viaduct, spanning with bridges or words

Introduction

When the word 'bridge' arises, invariably a concrete entity comes to mind, one that spans space, enabling users to cross over an obstacle. However, many, many more bridges we avail ourselves of in daily life are non-physical entities. Thus, if told, "we'll cross that bridge when we come to it" the idiomatic bridge indicated is unspecific; the speaker's mindscape incorporates a fanciful structure, which nonetheless evokes bold graphic qualities, as well as representing a means of passage, of action. It is surely for these reasons that bridges of diverse structures recur in other cognitive constructs than idiomatic expressions.

In part one I will look at three paintings, Edvard Munch's The Scream, William Turner's Rain, Steam and Speed, and Georges Braque's Le viaduc à l'Estaque, before turning to my own, Wordspree Viaduct; in all four works a free rendition of a bridge features. Bridges are present in numerous other evocative paintings, as well as diverse other artistic works, such as poems, films, or songs. In the blockbuster, Bridge over Troubled Waters the bridge also metaphorizes two people coming together, and getting people connected is the very essence of language. Words have been compared to bridges, as we will see in part two. Speaking, by getting a message across, makes it possible to traverse the obstacle of non-communication by using words. In addition, words themselves can have an emotional value for the speaker. Furthermore the stock of words in a language alters; in periods of major change, word formation surges. Amongst recent coinings, "slacktivist", "ransomware" and so on, one has become omnipresent, Brexit - a term with bridge-like associations. In our final part we will unravel the cognitive dynamics of the neologism and some of its ramifications.

1. **"Like a painted bridge within a painted notion"** i



In Edvard Munch's The Scream, (1893-1910) of which there are several versions,

Bridges can structure or add clarity to a painting; even notions of otherworldliness can become more decipherable if a bridging device is incorporated in the image. It can be vertical, such as a ladder ascending into the skies or descending into the depths, or horizontal, for instance a boat-bridge with ferryman crossing from earth over Lethe; whichever, passages between this world and another gain pictorial legibility with the presence of a bridge-like structure. Similarly in annunciation paintings a shaft of celestial light or the connecting flight of an angel or dove can serve to span two worlds. That said, the three paintings we shall open with are more earthbound, although their message is intense.

The wooden, plank bridge with tiered railing, not only structures the painting, giving it depth by receding into the background, it offers a devised setting for the principal human interactions. The two individuals in the middle ground, who seem to be walking away, turn their backs on the third user on the bridge - we would add that they also turn their backs on us, the viewer - whereas the main human figure, whose distraught visage personifies the title, faces the viewer. John Sweetman in The Artist and the Bridge, notes, Munch "is often linked with Van Gogh in terms of spiritual crisis, and his anxieties are funnelled into perspectives over water..." (p.180). In a quote of Munch's, given in Wikipedia, the painter attributes the crises to nature, "I stopped and looked out over the fjord —. I sensed a scream passing through nature; it seemed to me that I heard the scream. I painted this picture, painted the clouds as actual blood. The color shrieked. This became The Scream. » Munch placed his personification of nature screaming on a pontoon-cum-bridge structure, which offers a stage-like setting for the unfolding of a crisis. Munch's bridge as it runs in the direction of viewers widens, seemingly approaching dry land, thus constituting a way out, an exit, for this distraught figure, whose escape is possible by continuing in the direction of dry-land and us, the viewers. There is interplay between the bridge-stage, with the distraught person on it, and the "shrieking", blood red sky, as the latter is reflected in the wooden railings. The depiction by a painter of spiritual tension that incorporates a bridge deserves further discussion, as other paintings likewise illustrate. Bridges have an inherent quality as a parenthetic space, which in this example is neatly illustrated by the sides of Munch's construction (sides or railings are common to most bridges; likewise the length of a bridge is often marked, by for example toll gates, plaques or decorative elements). The blood red sky infuses the whole scene, including the railings of the bridge, but it is the specific bridge construction that provides the focal setting for a revelation in Munch's painting; the artist situates his personification of a crisis on it. As a general rule we can say that bridges being entities that are set apart they require a heightened degree of caution or awareness on the part of users, who need extra vigilance because the constructions are artifices with vulnerabilities. It is this concern that sharpens users' wits. Being on a bridge requires extra care; users should remain alert and in a state of heightened awareness. Thus bridges offer two qualities they have a stage-like characteristic, as well as being parenthetic spaces that lend their users extra insight into their surroundings.

In Turner's Rain, Steam and Speed (1844) there are in fact two bridges; the one carrying the train, dominates the canvas, belittling the other one. John Sweetman notes in his

analysis of the painting, how Turner, "includes Taylor's old bridge on the left and sets his crowd of onlookers close to the new, making them acclaim the spectacle of train and passengers sweeping by at high level over Brunel's great construction." (p.121). We would add that Turner has made Taylor's older bridge, which we can equate with a former way of life, leave the canvas in middle ground, so constituting not only its mid-way exit from the image but also history. Whereas the new railway bridge, which radiates at a different angle

from the old, leaves the canvas in the foreground, so giving it predominance. Further it merges into the viewers' space of location, as they stand in front of the canvas. One of the first things that viewers notice is the widening railway bridge, crested by a train hurtling in their direction, seeming to serve them with innovation, which cannot be stopped. As with Munch's painting in which the bridge is foregrounded, Brunel's railway bridge occupies a prominent place in the bottom, right corner. Furthermore viewers in front of Turner's painting can also notice the onlookers depicted in the painting as they gaze up at the train speeding on above them, and which in fact is heading towards them, the viewers. In this triangular dynamic - painted onlookers / hurtling train / unspecified viewers in front of the work of art - it is the viewers who scan the scene from a vantage point, that of hindsight.

Turner by choosing two bridges wove historical transition into his masterpiece; the two bridges amount to two stages-sets, in masonry, as in a theatre, suspended above the landscape of history. Doubtless the human emptiness of the old bridge suggests that the lifestyle of its (former) users is already out of mind. The two bridges are indicative of two successive periods with their respective lifestyles. The railway bridge connotes major changes, which extend far beyond the initial transport revolution experienced by the passengers on that particular train. Indeed railways were part of what is loosely called, the industrial revolution. By bringing the new bridge right up to the viewer Turner invites the viewer to surmise the extent of changes into the present. The turbulence that accompanies major change is reflected in the meteorological turmoil of the painting, and the unquiet sky, unless it echoes the disquiet of juxtaposing epochs, and implicitly having to rate them. In which case we should note that the old bridge is brighter, and the new one, with its puffing train signifying drive and industry, is darker.

Once again bridges (in Turner's case the juxtaposition of two) are used to embody an expression of awareness, in this case historical, connoted with ethical appreciations of the transition as experienced by the observant artist. Bridges not only connect but because of their parenthetic quality they also signify a state of greater (momentary) alertness. Furthermore they stand for action as Munch's personification of crisis and the hurtling train with its passengers proceed towards some sort of outcome.

Turner made the new railway bridge dark; unlike Braque's cubist rendition of a railway viaduct poised above a town in Le viaduc à l'Estaque (1908).

Braque structures his work around the viaduct. Set horizontally across the canvas, it dominates the horizon and our eye is drawn to it perched above the unpretentious buildings. Viewers, in a low angle position, contemplate the loftiness of the viaduct, which seems to have its rightful place in the sky, reduced to a minimum. The viewers' gaze can follow the viaduct from side to side of the canvas, following its rhythmic arched lines, but also on under its arches into the distance, making the painting a space in which to roam. The connecting function of the viaduct is accentuated as it straddles the tree-dotted vale, indeed trees seem to serve as end-gates, and its dominant position high above its surroundings suggests the

prominence of a significant 'other' (perhaps the status of the artist, or the need by human beings for a force of elevation) so endorsing the notion of a parenthetic space that symbolises a quest for something more significant. Braque's symbolic bridge is not a parenthetic expression of empathy with nature in crisis, such as we see in Munch's The Scream, or the dilemma of historic change, visualised by Turner, but the translation of a need for an aesthetic force that uplifts, or the strength of (artistic) creation.

The pleasing, cubist geometry of buildings and trees gains from Braque's harmonious choice of colours, not least the yellow glow of the viaduct, a glow, which combined with it being the focal point, suggests a place of veneration, such as a classical temple or arrangement of standing stones, crowning its surroundings. However railway viaducts have a secular function, consolidating urbanisation and industrialisation. We may wonder if Braque sets functionality on a par with spirituality? No human beings are visible in the painting, yet their enterprise is felt through the rhythmic arched viaduct connecting the two sides of the dip and the interlocking community at its feet.

Factors such as the graphic interest of a viaduct as well as its symbolic value as a means of connecting explain the presence of one in Wordspree Viaduct. Nor is the parenthetic quality of bridges, for instance as a site of revelation, inspiration or self-examination, to be overlooked. A hint of Braque's viaduct in of Estaque, backgrounds Wordspree Viaduct,

although the main prompt of my painting was transmission, in a wide sense. I wanted to paint the appeal of using words because of their vitality, and the attachments, not least emotional, individuals have for them, as well as their strategic importance in bringing people together. I opted for balloons sparkling in a setting, which references cultural delights, as well as featuring simple pleasures, such as coffee in cups and a daily newspaper. The parenthetic quality of the viaduct, with its rhythmic arches, interlaced by coloured balloons is suggestive of the way words not only connect but also confer on those who enunciate them a feeling of being bolstered up by them, giving them greater ease in relation to their surroundings. But a focal point of the painting was the changing means of transmission.

My painting engaged with the importance of transmitting heritage in the face of change; for instance when I set the twitter bird in dialogue with the nightingale immortalised in Keats' poem. Moreover the nightingale is perched on a volume labelled "passages", which with its multiplicity of meanings reaches out in so many individual and socio-cultural directions and at so many levels. The Stonehenge postcard and envelope addressed to Keats alongside the more up-to-date items on the table continue the time-related dialogue. In the following section I will consider more closely the balloon-words, which materialised after I asked friends, family and acquaintances two questions:

What is your favourite word?
What colour would you attribute to this word?

The balloon-words chosen for Wordspree Viaduct do not claim to be representative of any particular group(s); they were the favourite words chosen by a handful of people who were willing to share their preferences, in an art class, a letter (electronic or handwritten), over a meal or a chat, during a session at the hairdresser's, and so on.

2) Words for getting across

Words are basic for communicating in the world; through them we decipher, interact, interpret and record. They have been equated with bridges, so it is easy to understand the etymology of pontificate, pontifex or pontificare, from the Latin, meaning bridge (pons) and make (facere). Of course a speaker can choose other ways of speaking than pontificating and still make bridges! For Michel Serre, in L'art des ponts, Homo pontifex, language bridges our space, writing our time, and music our time-space, "Le langage pont notre espace" … "L'écriture pont notre temps" and "La musique pont notre espace-temps." (p. 111) We shall try to elucidate how "language bridges our space" by starting with a quote from John Berger's Confabulations, in which he outlines the stimulating process of communicating with a word, "The satisfaction of identifying a live bird as it flies over, or disappears into a hedgerow, is a strange one, isn't it? It involves weird, momentary intimacy, as if at that moment of recognition one addresses the bird – despite the din and confusions of countless other events – one addresses it by its very own particular nickname. Wagtail! Wagtail!" (p. 17).

For Berger naming has multiple satisfactions. It involves the mental exhilaration of identification or recognition along with finding the right term, also there is intimacy with the thing named (in this case a bird) by addressing it, and thirdly there is pleasure of utterance, "Wagtail! Wagtail" – exclaimed twice. The mental satisfaction of recognition and recalling the right word is indeed a key part of establishing a connection with the world around. Not least when as Berger infers the surroundings can be hostile because of "din and confusion". The speaker makes a claim on the disregarding environment. Coming up with the right word in response to the stimulation of searching, turns the frustration of uncertainty into the positive feeling of recognition. Besides in many cases naming prompts familiarity with the object named. Connecting by naming establishes a bond between the person doing the naming and what is named. And finally in numerous cases the sounding out of the syllables can be pleasurable. Speaking offers a means of apprehending our surroundings and tackling disconnectedness. We find echoes of the elements sketched by Berger if we look more closely at the balloons in Wordspree Viaduct.

A simple analysis of people's preferred words points to three categories - some were chosen mainly for their sound, others labelled a human value or state of being, and a third category included words for more material elements in life. Examples of words preferred for their sound include "coquelicot", mellifluous, mellow, and onomatopoeia. Just as with John Berger's "wagtail" there is pleasure of utterance, glee with vocalisation. Amongst the words for states of being or human values we find, "amitié", "famille", love, marvellous, "paix", "paradis", serenity, and serendipity. And lastly, examples of words for more material elements include, Beaujolais, food, "fleur", and seaside. Whatever the preferred word, uttering it was like addressing the thing named, and it constituted intimacy. In some cases

intimacy partly came from a longstanding appreciation of the item. Thus the person who chose "fleur" worked as a florist all his working life and gets pleasure from arranging flowers. Or it could come from a certain expertise; the person who chose onomatopoeia is a keen linguist; for her the word should be sounded out like thrusting a shuttlecock into the air in a game of verbal Badminton. As for the teenager who chose marvellous, she also enjoys using words and vocalising as a way of engaging in social game play; she uttered the word with the relish some people experience when wine tasting. An activity the man who chose Beaujolais indulges in with ritualised pleasure. The three divisions I have outlined are not mutually exclusive. Indeed many words contain more than one quality for the user. Who could deny that the term "coquelicot" not only clicks neatly out of the mouth, also poppies delight - not least poets and painters, Monet being an example. When using the word the person could well see in her mind's eye a field of the flowers or a painting by Monet. Similarly we know that mellow glides its way out of the mouth, but the precision of the word doubtless explains its place in one of Keats' sublimely crafted poems, An Ode to Autumn.

Whilst John Berger's remark focussed on the spoken naming of something in an everyday situation, satisfactions can also be obtained when naming in writing; furthermore the recorded nature of writing introduces the possibility of memorising, learning by heart; for instance learning words, expressions or whole poems to be used without constraint when reciting or even informally speaking. Building up this stock of words gives the speaker increased assurance in relation to the world. If a poem uplifts above the tribulations involved in coming to terms with things the support given by language is substantial. When Virginia Woolf writes of Orlando, at a stage of the novel (when the protagonist is a she), "she thought now only of the glory of poetry, and the great lines of Marlowe, Shakespeare, Ben Johnson, Milton began booming and reverberating, as if a golden clapper beat against a golden bell in the cathedral tower which was her mind". (p. 157) Orlando's fervour at using words is clear. We will pass over Woolf 's irony when she compares Orlando's mind to a cathedral tower, but we do think that the stock of poems at Orlando's disposal would have constituted strengths when communicating with her surroundings. Her utterances would bear the fervour of the words resounding in her head, like John Berger's delight at uttering "wagtail".

It is worth pointing out that when I asked the questions about people's preferred words very few people declined to give a word, and those who gave one did so willingly. As if choosing was as pleasurable and spontaneous, as responding to a greeting. Nor was anybody at a loss for choosing a colour. In some cases the colour given was doubtless dictated by the person's preferred word; hence for the man who chose Beaujolais his word-balloon had to be wine colour. And for the person who chose seaside it had to be blue. In other instances reflection was required before linking word and colour, especially when the word given referred to a state of being or a value - such as yellow for tranquillity, green for "paradis" or blue for "paix".

The bridging quality of words is epitomised by translation. In an essay available on-line, entitled, Translation: the magical bridge between cultures, Ketaki Kusheri Dyson, who works in Bengali and English asserts, « Translated literature has a great potential to bridge cultures and bring different segments of humanity closer to each other. » Adding about inter-cultural people like herself, «We are … ourselves living bridges between continents, and translation is at the heart of our very existence, … » ii By equating translations with bridges K. K. Dyson pinpoints the function of words to cross over obstacles. And bringing different segments of humanity closer is a challenging mission. Bridging with words can involve overcoming ruptures of any sort, personal, social or whatever.

For Michel Serres crossing the bridge of translations one sometimes has a toll to pay, in the shape of losing the odd consonant or voweliii. Indeed translating is more than equating words in two or more languages; there is a strong cultural dimension to good translations. One thing is certain a bad translation fails to get the message across; interference disrupts the bridging process, perhaps even aggravating an existing gap.

Words whether an individual one that a person is fond of or a whole poem learnt by heart and recited, help us to face the world around; they give support and offer a space of perception or inspiration. They are vital instruments when trying to tackle or avoid ruptures because of their bridging quality. We saw in part one how bridges offer a stage on which to set a visual story. In this section we have seen how with words the stage can become animated with dialogue. Further, words themselves become bridges, so that in a way one could say, "all the words a stage!"

3) "They have their exits and their entrances", their Brexits and …
As You Like It, Act II, Scene VII, 141

The steady flow of neologising in languages, illustrates the constant updating of its stock of words. It is hoped that the creation will fill a terminological void, which constitutes an obstacle for getting messages across. Recent examples of coinings include, ransomware, slactivist and Brexit, a neologism that has become omnipresent in record time. A BBC site informs us that the word is attributed to Peter Wilding who used it in May 2012. One example that illustrates how Brexit has permeated everyday aspect of British culture is its appearance in some cultural basics, such as the 2016 publication of a Famous Five volume, Five on Brexit Island. The cover mentions Enid Blyton, but we are told that the text is by Bruno Vincent. The cover image is worth looking up on the Quercus site to see how the neologism has been inserted into the spirit of the series, the first of which appeared in 1942. The suggestion that Brexit matches "island" points to the insularity of the enterprise.

Brexit is an example of blending, and as The Oxford Handbook of the Word explains, "Blends are created by combining the first part of one word with the second part of another word." In this instance it is not the second part but the whole word itself. This uniting of two components resembles bridging itself; two language elements are fused together in a new combination intended to fill a terminological void. When the term Brexit is uttered, the sound is crisp, which has doubtless contributed to the rapid way the neologism has gained widespread use; as the Famous Five adaptation illustrates. The blending process can go a step further with the addition of prefixes and suffixes. A word such as Brexiteer, is an example of a third part being added; illustrating how language can serve its bridging purpose with structural additions, and in style; if there is need for an extra arch it is added to the bridge!

The word, from which the first half of Brexit originates, Britain, is clear enough. But the second, namely exit, is less so; having more than one usage. Exit can mean, "way out", as we see on numerous signs inside buildings, but it can also mean "quit the stage", such as we can read in stage directions: "Exit Banquo" or in the plural "Exeunt plebeians with the body". In this paper I have already drawn a parallel between bridges and stages. Furthermore bridges and stages are places of recurring, even repeated passage. I suggest that for what is happening between Britain and the European Union currently, the use of exit as it is more commonly employed to mean quitting, is less relevant than in its theatrical sense. Brexit is less is about

Britain giving up its membership of a club, known as the European Union, and going outside, than it is about a theatrical performance. Not only do we have actors on the Brexit stage, with the lead roles being played by politicians, who, it cannot be denied, indulge in oratory, speech making, and pontificating; they play their parts, exits and entrances, with the relish of theatrical actors. Analysts of how politicians use and misuse words include the perspicacious George Orwell, in his essay Politics and the English Language. Moreover the whole performance of Brexit is reported in the media with as much evaluation as one finds in the review of a theatrical performance. Only time will tell if the play in question is more of a tragedy, comedy, morality play, Whitehall farce or whatever. If Brexit is happening on a stage cum bridge, such bridging as part of political exercise is not new. Sweetman points out how Thomas Paine in the 18th century talked about The Rights of Man as his political bridge.iv

In a recent article in The Guardian, entitled, Brexit Britain has the deepest faultlines of any country I have known, Anna Lehmann writes how owing to the referendum results, "... the British will be occupied with rebuilding the bridges to the EU that they are just about to tear down." When Lehmann describes the process as "Tearing down" what is already built and then "Rebuilding", the steps are the same as recommencing, or similar to coming and going, or exiting and entering the stage in a play. Reflecting on Lehmann's image of Brexit as an exercise in bridge breaking versus bridge building, we are reminded of Turner's painting that contains two bridges. We noted how in Rain, Steam and Speed Turner, by juxtaposing two bridges, made it possible to include a historical comparison. The older bridge Turner painted was brighter but it was belittled by the bigger, yet darker, new railway bridge bringing with it industrialisation. If we apply the same approach to the bridges Lehmann has just outlined we can wonder if the one that has linked the UK to the European Unions since its entry in 1972, with the passing of the European Communities Act, is brighter than the one that will be erected after Brexit. Turner in his juxtaposition worked with light and dark to convey a comparison, but for two purely cognitive bridges connecting nations, such as Anna Lehmann describes, we would suggest that other attributes be selected, such as how welcoming, spacious, attractive or accessible the bridges are. A bridge with restricted access and high tolls is more hostile to freedom of movement than one that is open, wide, spacious and inviting. If making the "Brexit Bridge" narrow, which would be seen as reflecting the narrowing of minds, or cluttering it with tollgates or barriers, which suggests restricted access, a comparison could be visualised.

Brexit as a neologism illustrates how coining words can serve communications by getting over the obstacle of the unavailability of a suitable word. An example of blending, the neologism illustrates the creative spirit at work in English. Its widespread adoption seems to make it a success. However the life changing nature of Brexit as a force of rupture, one that destroys decades of bridging between mainland Europe and the Bristish Isles is prompting strong debates.

Conclusions

Bridges help structure our ways of perceiving things, including through idiomatic expressions and metaphorical uses. They likewise structure landscapes in paintings, supplying a place, resembling a stage, for a narrative to be enacted. Further, by their very nature, they constitute a parenthetic space of heightened awareness or elevation.

Words are so many bridges enabling individuals and communities to get something across to others, both practicalities, but also ideas or immaterial things, including in translations. Words also give users satisfaction, and when well chosen they are for use as one fancies. Choosing the right word and using it can be a source of considerable pleasure – learning poetry by heart and reciting it is a heightened example. Wordspree Viaduct confirms the affectionate relationship individuals can have with some words, which illustrates how language is more than a simple tool.

The word Brexit is a neologism that results from blending and has become omnipresent, beyond the mass media. The second part of the term, 'exit', is better understood in its theatrical sense. Those who occupy the Brexit stage, building and rebuilding political bridges, are also proficient at pontificating. Their ability to put on a performance is neatly illustrated by the existence of persons who a few years earlier campaigned for Britain to remain in the European Union and who are subsequently manoeuvring for (a hard) Brexit.

Getting across thanks to language, like getting over an obstacle thanks to a bridge, is an act of passage that can be repeated ad infinitum. The above examples of how we use different sorts of bridges in life, prompt us to conclude that bridges are an engineering and cultural construct that steals the show. And words play a lead role.

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[i] Coleridge's exact words in the « Ancient Mariner » are, « As idle as **a painted ship**. **Upon a painted ocean** ».
[ii] Ketaki Kusheri Dyson is a writer and translator ; more details about her life and work can be found in the internet.
[iii] « En passant le pont des langues, la traduction, parfois paie-t-elle un octroi, en laissant consonnes ou voyelles » p. 84, *L'art des Ponts Homo pontifex, p. 84*
[iv] As Sweetman notes about Thomas Paine the « literal bridge builder (p.1) « referred to his *Rights of Man* as his 'political bridge'. » (p.58).

The Red bridge of Surabaya: a bridge to a new world order

Dr Joost Coté

As a child growing up in the country I had to cross a fragile footbridge over a fast flowing river on a daily basis. I grew up impressed by how slight the cables were that suspended our 'swing bridge' (and me) over the torrent that our river could become in winter; and the convenience it provided on a daily basis to enable me to cross from my side of the valley to the services only available on the other side.

Bridges can be real or metaphorical landmarks, identifying crucial moments in a journey, trajectory, or history. At the same time, real or metaphorical, bridges can only faciliate a way forward; they do not in a sense, act in their own right, but merely make it possible for what precedes it to continue from a new starting point along a pathway, to allow a crossover, in fact or metaphorically in an historical trajectory, in a conversation. In history, bridges are often associated with dramatic moments in military campaigns. Bridges become key components in campaign strategies, to be defended, taken, blown up; soldiers are commended for their bravery in defending 'bridgeheads'. The Latin Bridge in Sarajevo, is an example of a bridge that has become forever associated with the shooting Austrian Archduke Franz Ferdinand, generally taken as the act that led to the World War One. Or, a bridge itself might be the focus of a particular turning point within a war, or recognised retrospectively as such, as for example, the destruction of the Mostar Bridge in Bosnia in 1993, destroyed during the Balkan Wars. Dramatically captured in film and often revisited its destruction has taken on metaphorical significance as a wilful act of cultural destruction, its rebuilding as a symbol of the restoration of peaceful co-existence.

This paper draws on both the 'real' and the metaphorical characteristics of 'the bridge' in relation to one which played a prominent role in an historical moment that became of global significance. It attempts to advance the materiality and the historical reality of events related to a particular bridge to anchor a series of broader metaphorical claims that might be made relating to its significance in global historical terms. It argues that events that took place in Surabaya on the evening of 20 October 1945 had an impact whose reverberates shaped the future histories of the countries involved and the later global culturo-political environment historians refer to as postcolonialism.

The Red Bridge in the Battle of Surabaya

Central to the narrative of the Indonesian struggle for independence between 1945 and 1949 was the battle waged in the Javanese city of Surabaya, population about 600,000. It was between over 100,000 largely, variously armed largely untrained contingents of highly motivated, young Indonesian nationalists – the Pemuda i– against a well armed but ill prepared, newly arrived British Indian military force initially numbering 4000. The flash point for the deadly three week 'Battle of Surabaya' which followed ten days later as a consequence - and which in turn, was merely the curtain raiser for the 1946 – 49 Indonesian War of Independence – was the shooting of the commander of these British forces, General AWS Mallaby. This occurred on the approaches to the Red Bridge – the Jembatan Merah - on the evening of October 30, 1945.

Jembatan Merah, 1920s, entry to the main commercial district.
(Source:http://kotawisataindonesia.com/melihat-sejarah-jembatan-merah-di-surabaya/jembatan-merah-surabaya-tempo-dulu/)

The photograph of Mallaby's burnt out car on the Red Bridge, cabled to news agencies around the world two days later, was perceived as a provocative Indonesian act. In Allied countries, the photograph of the 'unlawful' death of a senior British officer by a young (believed to be teenaged) urban guerrilla spoke to their public of the barbarity of Indonesian revolutionaries and the justice of British and Allied attempts to restore colonial rule. In Java it provoked the rapid reinforcement of British troop numbers, a deadly three week battle in the streets of the city, and its wholesale bombing by British war ships. The three week battle, and in particular the shelling by the British navy, destroyed much of the city and caused the death of a conservatively estimated 6000 – 10,000 Indonesians (Vickers 2005) and 600 mainly Indian British army troops, Springhall 1996) an unknown number of the recently surrendered Japanese army of occupation, and hundreds of Dutch ex-Japanese internees who had only recently emerged from three and a half years of internment.

As in the case of Sarajevo's Latin Bridge, the Red Bridge of Surabaya on 30 October 1945 provided merely the location of an event. Still recognisable today by its bright red paint, in itself unremarkable, this bridge became memorable by providing a solid permanent material marker of a momentary act significant for the consequences of what occurred on its approaches. The bridge – as a real and existing structure given permanent significance by its historical, autobiographical, photographic, artistic and cinematic portrayal - anchors the remembrance of this event. As well as figuratively featuring in Indonesia's popular national narrative, its continued material existence continues to reinforce a shared memory of an iconic battle which for local and visiting Indonesians effectively symbolises the beginning of the nation's final struggle for freedom – merdeka – from Dutch colonialism. Now the site of

regular historical re-enactments, the battle ignited by the Mallaby incident is remembered annually on November 10, as Indonesia's National Hero's Day, the anniversary of the day the real battle began.

The events inaugurated by what happened on the Red Bridge can lay claim to a significance beyond the particularity of Indonesian independence, significant, as that is. It represents the first of a series of nationalist wars against European imperialism in Asia, and thus can be said to mark the beginning of the end of European imperialism. Specifically, it marked not only the end of Dutch imperialism, but also, as has been convincingly argued by McMillan (2005), the beginning of the end of British imperialism in Asia. For Indonesia, and more generally in terms of global history, the events inaugurated by a single act associated with the Red Bridge marks the turn to a postcolonial world order and postcolonial cultural revolution. Almost forgotten in this global, postcolonial perspective, the event also led to the loss of a homeland for European East Indies settlers and their dispersal throughout the world, and, indirectly, the emergence of Australia as an active participant in post-imperial international diplomacy. Thus, with some degree of hyperbole, it could be said that the Red Bridge represents a metaphorical bridge from the imperial/colonial to a postcolonial era.

The Red Bridge: the historical event

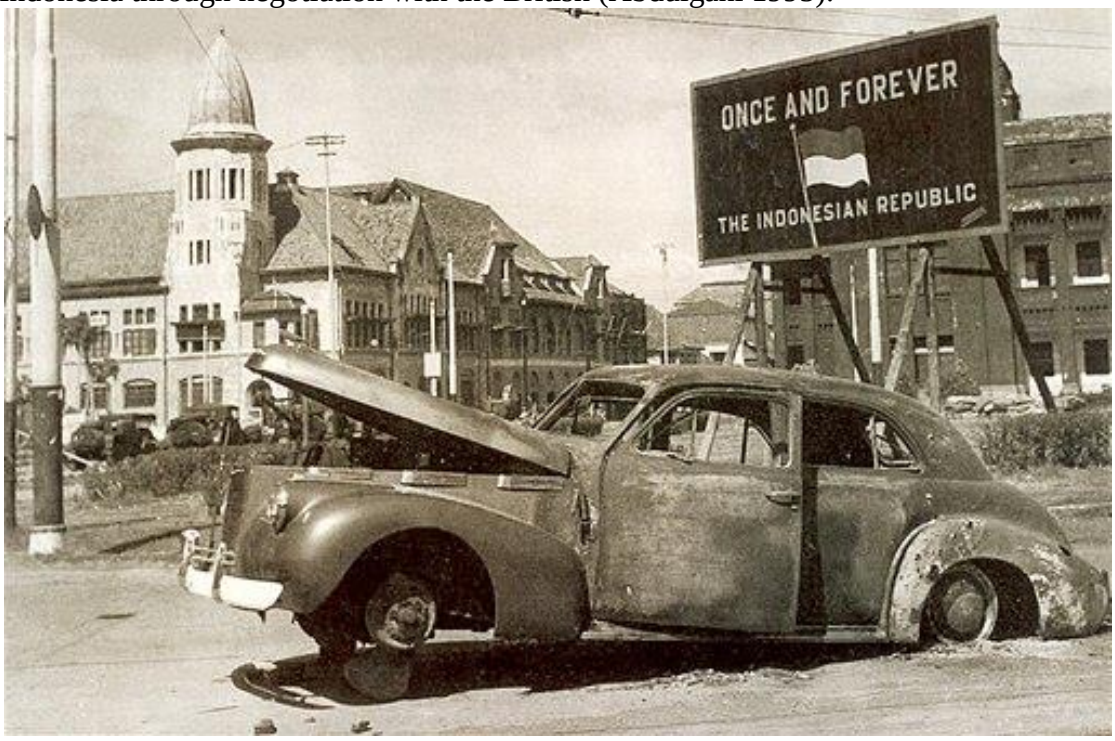
The 'incident'

The events leading to the death of General Mallaby on the approaches of the Red Bridge form part of well-known historical narrative of events in the Dutch East Indies following the Japanese surrender on 15 August 1945. (Frederick 1989; Bayly and Harper 2007; see also Ricklefs 2008; Vickers 2005). General Macarthur, the Commander of Allied Forces in the Asia-Pacific War, assigned the British under General Mountbatten, to take charge of affairs in Southeast Asia following the Japanese surrender. His mandate was to receive the Japanese surrender, evacuate POWs and civilian internees, restore colonial rule and return Japanese troops to Japan. Mountbatten, who had little personal knowledge of the situation in the Dutch East Indies, nevertheless recognised that the immediate return of the Dutch would incite fierce opposition which would be difficult to control, and thus delayed the arrival of Dutch troops. Until British – substantially Indian - forces began arriving in mid September1945, the surrendered Japanese commanders had been ordered to maintain law and order. Mallaby and the British Indian forces he commanded had only arrived in Surabaya on 25 October to formally receive the surrender of Japanese forces there. In the meantime however, the Japanese military in Surabaya (but not elsewhere) had been ordered to barracks by a representative of the Dutch authorities who had arrived some days earlier without military support (Han Bing Siong 2003). He had authorised former Indonesian employees of the Dutch colonial government to resume their pre-war functions. This had enabled local Indonesian nationalists to build up an effective militia and ignite revolutionary civilian groups to establish control in the city. In the process, largely through the force of crowd intimidation, they had succeeded in overwhelming scattered Japanese garrisons to appropriate large quantities of arms, heavy amoury and and transport vehicles (Han Bing Siong 2001; Frederick 1989).

The events related to Mallaby's death in Surabaya have been carefully scrutinised by historians (Parrott 1975; Springhall 1996; Macmillan 2005; Bayly and Harper 2007), recalled in memoirs, (Abdulgani 1995) and in at least two instances, recorded by contemporary (near) eye-witnesses (Padmodiwiryo, 2016; Groom n.d. [1946]) but numerous alternative

Indonesian accounts persist. Historians mulling over this moment ascribe Mallaby's killing to his inexperience as a field officer, his ignorance of the circumstances of post-Japan surrender Indonesia, and of the Indonesian nationalist movement, and of his stiff formalistic personality. As in-coming commander in October had, argue these historians, Mallaby made a crucial initial blunder of distributing his 4000 men across the city, instead of consolidating them in the defended port area (Parrott 1975; Springhall 1996). Totally underestimating the size of the now self-confident, city-wide Indonesian, militia led, civilian resistance,ii and failing to take account of the weaponry it had accumulated, meant that his British force was itself fragmented and threatened by crowds of now well-armed Indonesian militias. Attempting to rectify this situation, to enable his troops to consolidate their position, and to carry out evacuation of thousands of internees and Japanese troops, Mallaby arranged to meet Indonesian leaders at their headquarters to negotiate a temporary truce. He went by car, accompanied only by three officers and a delegation of senior Indonesian Republicans. Immobilised by Indonesian crowds on the approach to the bridge, he decided to go further on foot, but was disarmed and forced back into the car by 'the angry crowd' (Springhall 1996: 435). With his companions, he remained in the car until, suddenly, a young pemuda, shot him through the car window.

Mallaby was, by all accounts, the victim of a 'mob', rather than of military forces. This 'mob' effectively constituted the majority of the city's population of an estimated 600,000 people, enhanced by incoming fighters and now armed with weaponry and transport appropriated from surrendered Japanese forces.iii Their main strength lay, not in weaponry but in their sheer numbers and a willingness to physically surround and confront the enemy. Senior Indonesian officials with whom negotiations were being conducted were equally at a loss of how to control the mass movement of citizens and youthful street fighters if no less committed to resisting the return of the Dutch and achieving recognition of the Republic of Indonesia through negotiation with the British (Abdulgani 1995).



Mallaby's burnt out car. Photograph attributed to Sergeant D Davis and Sergeant D MacTavish, No. 9 Army Film and Photographic Unit. [Public domain], via Wikimedia Commons (https://commons.wikimedia.org/wiki/File%3AIWM-SE-5865-Brigadier-Mallaby-burnt-car-194511.jpg)

They were highly articulate and politically experienced, western educated, Dutch speaking, urbane figures. They included Sukarno, the nationalist leader and self-appointed first president of the newly announced Republic, who flew to Surabaya prior to this moment in a failed effort to calm the local militia; chief local negotiator, Sudirman, governor of the city, (later honoured as a national hero in memory of whom today every Indonesian city has at least one street named after him), Suryo, Governor of East java, and Ruslan Abdulgani, the 'go between' and later diplomat and author of the most detailed Indonesian history of the war in Surabaya (Abdulgani 1995).

Eyewitness accounts

Several (near) eyewitness contemporary accounts and later memoirs exist of the 'bridge incident'. The only detailed Indonesian eyewitness account of 'the everyday events of the days leading up to, and immediately after, the 'Mallaby incident' is claimed to be the account by Suhario Padmodiwiryo (Padmodiwiryo 2016). As far as can be ascertained there is no specific contemporary Dutch or Japanese account. The first accounts, however, were provided by Mallaby's companions at the time, reporting to their superiors.

The 'official' cabled account

The most direct (brief) account of the shooting of Mallaby was recounted in an official cable by Captain Laughland, a fellow passenger in the ill-fated car, sent the following day. It stated:
We crouched in the car hoping not to be hit. Indonesians came beside car fired shots through window. We thought Brig was hit. He crouching on knees with head between hands. He said nothing some time. Then he spoke and we knew he was alive. We all lay or sagged as if dead. There was coat under me. Indonesians came and pulled it away. [About two hours later] …firing died down and we heard Indonesians moving away from area but two men came to car. Brigadier spoke asked to be taken to party leaders. One man shot him and he died instantaneously. We lay still. We prepared hand grenade I kept hidden in trouser pocket. I threw grenade. Don't think it went outside car. There was a terrific explosion. We thought must be injured. Found we alright. (cited in Springhall 1996:437).iv

A second accompanying officer, Captain Smith, provided an longer official account several days later (cited in Parrott 1975:95-99), which categorically stated the grenade exited the car, but neither made clear whether Mallaby's body was removed before or after the car burned. Both statements imply the car was burnt out as a result of the grenade.

Suhario's memoirv

A member of one of the many groups of Surabaya militia, the translator of his memoir clams this is the only Indonesian eyewitness contemporary account of the days in which the 'Mallaby incident' took place. While not an eye witness to the death, the general 'atmosphere' it created is reflected in this brief extract.vi

Mas Hassanuddin [militia group leader] then astonished me by casually adding: "The Englishman killed was General Mallaby." I asked who had killed Brigadier Mallaby, but he responded impatiently: "Enough! It is not important. The thing is the British general is dead."
I had heard the grenade explosion that had killed him, and later saw the convoy of vehicles had been burned. […] I had no comprehension then that Brigadier Mallaby's death would become such an international incident, and we would be accused of barbaric methods in our fight to win independence. That night all our units were withdrawn to rest, and to prepare for emergencies we expected to arise in the coming days. (Padmodiwiryo 2016:149-150).

Ruslan Abdulgani

Abdulgani was a member of the senior 'official' Surabaya Republican leadership that had accompanied Mallaby in his attempt to negotiate a truce with the leadership of the popular militia leaders to enable an orderly withdrawal of scattered British forces and evacuation of Japanese and European internees to the consolidated port area of the city. His memoir, originally published in 1975vii is recognised as providing the most comprehensive account of the events that took place in Surabaya. The Republican delegation was unable to exercise any authority over the crowds and they too had to escape random but serious cross fire between the British forces trapped in its headquarter building near the bridge by the surrounding Indonesian militia and civilian crowds. After recounting the arrival of Mallaby and the senior Republican delegation to the bridge, Abdulgani describes how the Indonesian representatives escaped to safety to a nearby riverbank. He writes:
...there were several other pemuda who were able to escape from the British fire. One of them came to the edge of the Kali [River] Mas near [Abdulgani and colleagues] then whispered to us: "It's been fixed, Pak [sir]." "What's been fixed?" asked Tjak Doel Arnowo. "The British General, Pak. His car has exploded and has been burnt out." "Who blew it up?" we asked straightaway. "Don't know. There was a grenade which exploded in the car but there were some people from the car side who fired at the car," continued the pemuda. […] Indeed, a moment before the pemuda had jumped to the edge of the Kali Mas where we were sheltering, we all heard an explosion and firing near us …. (Abdulgani cited in Parrott 1976:99)

Groom memoir

Unnown in the established historical record is an account of the days preceding and following the 'Mallaby incident' by a lone Australian, Wing Commander Alan Groom. Officially there was no Australian military presence in Surabaya. But Australian forces did participate in the British controlled immediate post war transition period in implementing RAPWI functions in East Indonesia. As in Java, this effectively included suppressing signs of Indonesian independence. Groom, however, was in Surabaya at the time of the Japanese surrender because, as member of the British RAF, which he had joined in 1936, he formed part of the squadron that had been assigned to Java after the fall of Singapore in 1942. There, after forfeiting his seat on the last plane out before the Japanese take over, he had been captured and interned. Accused of attempting an escape, after having been tortured he had been imprisoned in a Japanese prison for (anti-Japanese) Communist Indonesian political prisoners in Surabaya (Groom [1946] n.d.).

In his account, Groom claims to have got to know 'local Indonesian leaders and their language' - and presumably developed a degree of sympathy for the Indonesian cause.

Although unarmed, he had been able 'for thirty-six hours [to resolve] a number of violent engagements' thus saving the lives of 'many British soldiers'. In returning to his command some months later, he provided his commander with a lengthy report of his activities in Surabaya for which he had had no official authorisation. Groom justified his activities on the grounds that, being unable to leave and understanding Indonesian and the Indonesian cause, he believed he could be of benefit to British forces in Surabaya by acting on his own initiative to be 'helpful' where he could. His claimed 'helpfulness' was of particular value in the days between the arrival of Mallaby and a few days after the 'incident', as the British forces withdrew to regroup and prepare for the all-out offensive.

Groom recounts:

Perhaps the most interesting day occurred while attempting to call off an attack where several thousands of well-armed Indonesians were attempting to wipe out a company of Rajputana Rifles. One or to of the mob leaders called off about a thousand of the attackers and paraded them with a great show of authority and made them listen to Soekarno's instructions. The atmosphere was quite good until one of the less pleasant Indonesians asked in a loud voice how I could prove that I was not a spy or a Dutchman in disguise; and answer came from behind me, from an Indonesian Communist agitator well-known in Soerabaya, who told the mob he had been in prison with me for some years and knew they could trust me. The communist came to several other trouble spots and gave a considerable amount of help in putting an end to the fighting.
This was a bad day for 49th Brigade because after the conference between the Divisional Commander, the Brigade Commander, Dr Soekarno and the Indonesian leaders, all the British officers concerned in the conference were murdered and Colonel Pugh was left in a very tricky situation without definite knowledge of the results of the conference and it was only by careful conversation with a number of Indonesians that it was possible to find just what had been agreed.
Brigadier Mallaby had been murdered when attempting to put a stop to fighting that had broken out not far from Brigade Headquarters, and hi death can only be attributed to the half-hearted attitude of the Indonesian Officers who accompanied him and who deserted him when the mob was out of control.
Brigadier Mallaby was shot dead doing what he considered to be the only thing possible to save the Brigade, and his death played a very important part in the successful withdrawal of the rest of the Brigade the following day. The governor of East Java and several more decent leaders were so shocked by his death that they agreed to proposals which, considered in the light of subsequent events, seemed fantastic.
The attitude of the mobs on the day following Brigadier Mallaby's death was still very hostile but I could always find enough acquaintances amongst them to fill my car and they acted as unwitting 'safe conducts' and made it possible to move freely and arrange for Indonesian armed forces to keep the mob under control while the various units were moved from their isolated positions either into the strongly held dock area or into the equally well defended evacuation area in the south of the town. (Groom, [1946] n.d. :8.).

While critical of 'the mob', Groom in his account remains respectful of the Indonesian cause. He also indicates his awareness of the fact that by then in Australia, a significant degree of support had been expressed for the Indonesian cause, most prominently by port labour unions which had commenced a boycott of Dutch shipping to Java suspected of carrying arms to support the Dutch return (Lockwood 1975).viii While the Australian government had firmly supported imperial powers against Japan, and the Australian press and public, were initially

sympathetic to the plight of Dutch civilian internees revealed by reports from the International Red Cross and offered Australia as a temporary refuge, general public opinion soon began to change.ix An incoming Chifley Labor government, together with the newly independent India, in 1947 supported the embryonic Republic in an international campaign for international recognition at the United Nations (Fetlin:2013).

Emerging bridges to a post-imperial world

Surabaya inhabitants,

The bravery of the citizens of Surabaya, and their militia, in defending their fragile two month independence, symbolically enacted in this one historic moment, can be said to have that formed a bridge from three centuries of foreign rule to an era of independence. For them, the shooting of Mallaby was of little significance. They had a clear sense of having achieved at least a moral victory more than two months earlier with the declaration of Independence; now they were in full command of the city. Spearheaded by ad hoc revolutionary bands of youth, the pemuda, variously armed with homemade weapons, more organised militia with a goodly supply of conventional fire power and some regular formations of previously Japanese trained auxillary forces, and former Indonesian members of the colonial army (KNIL), their power lay in numbers and fearless willingness to die for the cause. A more meaningful moment for them – and the image that they carried in their head and recorded for posterity by Indonesian press journalists – was an event two days prior, where a similar mob surrounding Dutch headquarters at the Oranje Hotel, once a salubrious colonial era luxury resort, had watched a youth shimmy up the flag pole, to bring down the Dutch flag, tear off the bottom strip of blue, and raise it again as the red and white flag of the Indonesian republic! The Dutch, trapped inside, dared not take it down (Padmodiwiryo 2016:145-6).

Senior Indonesian Republican leaders recognised that the shooting dead of a British general by a revolver-carrying 16 year old local youth would be the trigger for a wholesale British attack which had been looming ever closer in the course of October, and already threatened in a leaflet drop the day before the Red Bride incident warning of a British response unless order returned. They prepared their forces accordingly to defend Surabaya streets, while simultaneously preparing for their inevitable retreat into the safety of the East Javanese hinterland. While, after ‘100 days’ this finally left the British in charge of the destroyed city (to be handed over to Dutch authorities), it led to the consolidation of Indonesian Republic control of the Javanese countryside. Here up to 50,000 Dutch civilians were re-interned in a series of internment camps, (Beekhuis et al 2009) and waged a four year battle against Dutch attempts to reassert colonial control which hey eventually won on he battlefield and at the diplomatic table.. The scale of atrocities perpetrated by Dutch forces during this war – traditionally described in Dutch histories as Politionele Acties’ (Police or civil actions) - are only now being revealed in new Dutch historical research (Oostindie 2015; Limpach 2016) and have so far led to three formal government apologies and some financial compensation to victims’ families.

The Japanese

The Japanese, who had effectively rounded out their Greater East Asian Co-Prosperity Sphere when they had defeated the Dutch in March, 1942 to take over the East Indies, had surrendered on 15 August. They had then been ordered to maintain law and order until Allied forces arrived. In Java, the centre of Republican sentiment, this placed them in a tricky

position of both following this directive to maintain order and not offending Indonesian aspirations which they themselves had for three and a half years been promising, and having to defending themselves against Indonesian nationalist attack (Goto 1996) Some Japanese – accounts suggest up to 2000 - genuinely supported Indonesian independence and joined the Indonesian side, some garrison commanders voluntarily submitted to, while others were unable to defend themselves against, Indonesian requests to handover armoury (see Coté and Akagawa 2014). Some Japanese commanders, as in the case of Batavia and Semarang, successfully fought against Indonesian militia to retain 'order' until British forces arrived (Han Bing Seong 1996)

In Surabaya, however, about 30,000 Japanese military had been ordered to retire to barracks prior to the arrival of British forces. Here they had increasingly been subject to massed crowds of Surabaya residents armed with spears and knives who surrounded and invaded smaller Japanese garrisons. Not only humiliated by having to surrender, they had therefore become another group dependent upon British protection, like civilian internees, unable to make it to the port to evacuation ships.

In the bigger picture, of course, the Japanese surrender in 1945 brought to an end a Japanese vision of a new Asian Empire which had been instituted at the end of the 19th century and rapidly (and briefly) expanded in the Asia-Pacific war. However, its successful penetration and overthrow of Europe's Southeast Asian empire in 1941 had heralded the end of European imperialism in Asia which the so-called 'forgotten wars' (Bayly and Harper 2007) by Southeast Asian nationalists, such as those in Surabaya, then began to bring to a conclusion. Arguably, moreover, as David Williams asserts, the Japanese challenge to the cultural and geopolitical dominance of European imperialism inaugurated the 'post-White age' (Williams 2004) and thus a bridge to a new world order.

The Indian troops

Effectively, the British military presence in the East Indies between Septmber 1945 and November 1946 (later augumented by einforcements) was constituted by battle-hardened Indian soldiers. In Surabaya initially, these were the 4th Battalion Mahratta Light Infantry, the 6th Battalion Mahratta Light Infantry and the 5th Battalion Rajputana Rifles and support companies amounting to about 4000 men (Parrott 1975 :111). Where India was itself in the throes of a national movement, unsurprisingly when close quarters fighting between Indian and Indonesian forces began to escalate, there was increasing disquiet within Indian ranks in being involved in the suppression of an anti-colonial nationalist movement. Considered to be the most severe and sustained fighting seen in wartime Java - and certainly more significant than the earlier Dutch attempt to fend off the Japanese in March 1942 - the bravery of former colonial subjects fighting in defence of their freedom must have resonated with the British Indian army in the course of 1946. The revisionist British historian of the British campaign in the East Indies (Macmillan 2005) has argued that a combination of reports reaching the British public about atrocities perpetrated by British forces and, more importantly, internal military assessment of the possible threat of revolt by Indian troops who wanted to go home to fight their own anti-colonial battle against the British, and were increasingly disinclined to shoot at nationalists opposing colonialism in the Indies, hastened a Britain's withdrawal. (Also Springhall 1996:438). This was achieved under the cover of the hastily arranged and ineffective Linggajati Agreement negotiated in November 1946 . Significantly it was the newly independent Indian government which, in 1947, co-sponsored with Australia a UN resolution in support of Indonesian Independence. Several years later, after Australia had

become partisan in the Cold War, India with Indonesia co-hosted the Asia-Africa Conference, the first international meeting of a gathering of newly independent Asian an African nations symbolic of a the new post-imperial era (Lee 2010).

Australia

Groom's activities in Surabaya, representing neither British, Dutch or Indonesian nationality or interests provided, to utilise the bridge metaphor, a neutral bridge between two hostile parties. Soon this role would be replicated on the world stage. Post war, an Australia now finally 'freed' from the empire, now emerged to stand between the old imperial world it once formed part of and the new postcolonial word of free and independent emerging nations. Australian diplomacy provided a bridge between old European imperial interests and the new post-colonial nations in taking the Indonesian independence cause to the United Nations. Its stance was, of course, largely symbolic since for another two decades Australian officials, with popular support, held tightly to a discriminatory racial anti Asian immigration policy (Tavan, 2005) and Cold War stance which also was to have relevance for the history of the Indonesian revolution and later relation with the Republic.

Dutch civilian internees

There were some 16,000, mainly European civilians, a majority women and children, and ex POWs in several camps in Surabaya, (Springhall 1996; Beekman et al 2009) awaiting RAPWI (British) protection and evacuation via the Surabaya port to safety – to British held Jakarta, Singapore Colombo, Bangkok and Australia. For these Dutch subjects the period between the Japanese surrender and Indonesian proclamation of Independence and the arrival of the British and their evacuation is referred to as the 'Bersiap', a reference to an Indonesian militia war cry – 'Be Prepared!'. They had largely remained trapped in their former internment camps after the Japanese surrender for protection against roaming bands of young Indonesian revolutionaries – now protected by Japanese guards. Although Eurasian youths also prominently went on the rampage against the Indonesian peers, the bersiap is seared into their memories and the 'Indo' historical record, as a period of brutal massacres, looting, kidnapping and trauma occasioned by Indonesian youths and militia. For the civilian women and former children I have interviewed the bersiap was more frightening and dangerous than period of Japanese internment. By November some had already been forcefully re-imprisoned by Indonesian Republican forces and conveyed to Republican-held East Javanese countryside.

Like the Japanese troops, these internees, a majority of whom were women and children, were awaiting the outcome of, initially, Mallaby's negotiations, and thereafter, the British retaliation before they could be extricated from this war zone. The full horror of the experience of ex-internees and European Indische residents of Surabaya between 1942 and 1949, recorded in dozens of diaries, memoirs and Dutch language histories, interest in it has recently been reactivated, as it were, in a shocking 'factional' account, a piece of historically based pseudo-autobiographical Dutch fiction (Birney 2016) and with the return to this period by revisionist historians. It is, in other words, a live issue in contemporary Netherlands as much as the Revolution and its realisation in the city of Surabaya, is still 'real' for Indonesians and central to national identity One more bridge

The incident of the Red Bridge represented the beginning of the end of Dutch colonialism – if not British colonialism in Asia, Australia's emergence as a promoter of decolonisation (despite its own White Australia Policy) and the beginning of the Indonesian Republic –

although this formally had to await the December 1949 Round Table Conference. While this marked the formal international recognition of Indonesian Independence, arguably it was not till the nationalisation of all Dutch enterprises and the eviction of the last of the Europeans in 1957, that Dutch interests were finally expunged. In so doing, just as the Indonesian revolution inaugurated an era of difficult nation building, the Europeans abruptly evicted from a de-colonised Indonesia and thrust without warning into a post-imperial Netherlands, ushered into that country a new category of cultural tension that has continued to manifest itself in modern Dutch social history, and most markedly in the recent Dutch elections.

While History has not concerned itself with colonial settlers made homeless as a result of anti-colonial nationalist movements, the Indisch Dutch, representing the largest European imperial settler society in Southeast Asiax – outside, that is, the Anglo Saxon colonies of Australia! – experienced a hostile reception in the Netherlands to which they were evacuated. Where many had never previously been to the Netherlands, their reception in war-ravaged Netherlands was far from welcoming (Willems 1996; Bosma 2009). The 1949 accord with Indonesia had, however, allowed the Netherlands to retain control of Dutch New Guineaxi and a group of politicians and Indisch Dutch leaders sought to persuade the Dutch government to facilitate the transformation of New Guinea as a new homeland for Indisch Dutch. This group lobbied the government to make funding available to facilitate the migration to this new homeland.xii Since neither the Dutch public nor officialdom wanted them or believed these people themselves wanted, to settle in the Netherlands this, while mixed race Eurasian Dutch were prevented from emigrating to the post-white Anglo migrant receiving countries, such as Australia, due to racialist immigration restrictions. It was hoped that New Guinea would solve the problem of a homeland for the tens of thousands of displaced, now homeless, particularly 'coloured' Indies born, mixed race, European colonial settlers (Meijer 198 – 301).

For this purpose advocates founded a journal, intentionally employing the concept of 'bridge' as a metaphor for its title - De Brug. It existed, briefly as this group's mouthpiece for advocating the new homeland and encouraging Indisch Dutch to settle there. They too, literally evoked the metaphor of 'bridge' to envisage Dutch New Guinea as these people's 'bridge' to a future on the other side of the traumatic post-colonial moment marked by the events that had been initiated at the Red Bridge. For them, however, it was a metaphorical bridge from the postcolonial/post imperial world into which they had been thrown back to a colonial past. This pathway existed briefly between 1946 and 1960 before a UN sanctioned plebiscite handed the Dutch protectorate to Indonesia in1962 to be renamed Irian. Finally, then, the Indonesian Republic had control of its historic territorial patrimony.

Conclusion: The Red Bridge as metaphor

Broken down into its national silos as the above has attempted to do, the implications that ripple out from the 'Mallaby incident' connects a number of separate national histories for which the Red Bridge becomes an iconic marker. It provides, therefore, a metaphorical bridge, as it were, to these separate histories while in each case, pointing to a common reference to a new post-imperial world and postcolonial global history. While images, like that of General Mallaby's burnt out car on the Red Bridge, may have heartened Indonesian revolutionaries and, circulated by the international Press across the Allied World several days later, spoken of the barbarism of the Indonesian Pemuda, fighting youths, to Dutch internees, and politicians in the Netherlands it spoke of British incompetence and betrayal and the inevitability of loss.

As time capsules, photographs can convey their transcendent meaning across history and into larger historical narratives. Like the better known photograph of Vietnamese girl, Kim Phuc, the so-called burning 'Napalm Girl', that continues to define the horrific saga of the American war in Vietnam, or the body of Alan Kurdi, the three year old Syrian refugee child, washed up on a Turkish coast, the horrific experience of refugee flight, typically, such images in themselves are not innocent or incidental – the interpretation the viewer is meant to extract is already indelibly embedded in the framing of the photograph and able to survive time travel. Such photographs, then, can also become bridges connecting the past and the present. In this way, as recent Dutch studies of that nation's colonial past indicate, (Bijl 2014; Oostindie, 2015; Limpach 2016), photographs that have long lain buried (and sometimes officially locked away) in archives, allow the present to cross back over the bridge to 're-see' a 'present past' that preceded the post-imperial present.

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[i] No numbers are definitive. Parrott (1975 :93 fn 25) references one source which lists 15,000 civilian armed force, 800 police,, 'mob' 75,000 armed with rifles, 25,000 with spears plus a further 5000 'reservists.

[ii] Parrott (1975:93) concludes 'the situation [of the 4000 strong Indian] 49th Brigade rapidly deteriorated until it was faced with possible extermination.'

[iii] Indonesian militia amassed an armoury estimated at 300,000 weapons, various items of artillery, army vehicles and one army tank (Han Bing Siong 2003).

[iv] Springhall states the photograph of the burnt out car was taken the following day by an Indonesian press photographer (Springhall 1996:438).

[v] Palmos, the translator, admits this is an 'enhanced translation' of the Indonesian version published in 1994.

[vi] Frederick's (1989) is a detailed reconstruction of events and equally vivid.

[vii] *100 hari di Surabaya yang menggemparkan Indonesia Kisah singkat tentang kejadian-kjadian di kota Surabaya antara tanggal 17 Agustus s/d akhir November 1945,28 tahun berselang*
Jakarta Yayasan Idayu , 1975). This was translated as *One hundred days in Surabaya that shook Indonesia*·

[viii] Vickers cites reference to actions by Australian communist soldiers aiding Indonesian nationalist organisations in Borneo (Vickers 2005: 97).

[ix] As also experienced by this author's family.

[x] Precise numbers are difficult to calculate but Willems (1996) estimates a total of 300,000 recognised Europeans departed the East Indies.

[xi] Meijer (2004:300) states it was a non-negotiable and essential condition for the final agreement to independence, together with Republican acceptance of a 'federation' in which the Republic would form an element in a United States of Indonesia'. This was quickly set aside by Indonesia's president, Sukarno the following year.

[xii] This proved an embarrassment to authorities, however, when it became clear that no facilities existed to receive the first party of 1400 prospective migrants preparing to leave Netherlands to settle there (Meijer 2004: 300).

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Galata bridge as a physical and social construct in the collective memory of Istanbul residents

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Galata bridge as a physical and social construct in the collective memory of Istanbul residents

Introduction

The city of Istanbul has a unique geographical location. The Bosphorus separates the European and Asian sides of the city, and the central parts of the European side of the city are further divided by the Golden Horn, a drowned estuary forming the northern flank of the Historic Peninsula. Both ends of the Galata Bridge offer vistas of very important architectural monuments. Standing on one side it is possible to view historic landmarks such as Topkapı Palace, Hagia Sophia, the Blue Mosque, Süleymaniye, the New Mosque, and the old Spice Market (Figure 1). From the other side, the imposing Galata Tower, the Golden Horn and the first Bosphorus Bridge also stand out. Starting in the mid-19th century, five bridges have been built to connect Galata and Eminönü. This very distinctive and multi-functional crossing, 490 meters in length, is used by pedestrians, vehicles, and the city's most important tram-line, as well as supporting dozens of restaurants, and hundreds of anglers, commuters, and sightseers. It remains at the very heart of the city. The aim of this paper is to assess the diverse roles of this iconic bridge in the lives of Istanbul residents and foreign visitors, as a continuing and developing social and physical construct, through analysis of books and Internet sources.

Figure 1. Viewing Galata Bridge from Pera

Source:http://yourholidayhomes.com/things-to-do/landmarks-and-monuments-/galata-bridge_329.html

The history of the bridges over the golden horn

The Golden Horn is a drowned estuary forming the northern flank of the Historic Peninsula. Here, the Greek and Roman cities of Byzantium and Constantinople flourished before the Ottoman conquest of 1453. In historic times there have been many bridges built to connect both sides of the Golden Horn. The first bridge was built along the Golden Horn in the 6th century by Justinian I. Its location is unknown (http://www.degisti.com/index.php/archives/6515).

In the 14th century merchants from Genoa were given permission to set up their own trade centre there. The district was called 'Galata' and the entire area was referred to as Pera – in Greek 'outside'. Venetians also had their own quarters in the city. Then came the French, the British and the Dutch and others (Mak, 2009: 48).

Sultan Fatih Mehmet dragged a fleet of ships into the Golden Horn, avoiding the Great Chain which enclosed it, during the siege of Constantinople in 1453. Sultan Beyazıd II asked Leonardo da Vinci to build a bridge along the Golden Horn in 1501. Leonardo da Vinci made a sketch of a 240-meters long, single span bridge that was to be built over the Golden Horn. This was the first time that such a long single span bridge had been proposed (http://www.amusingplanet.com/2013/11/leonardo-da-vincis-golden-horn-bridge.html).

In his letter to Sultan Beyazıd Leonardo proposed:

"I, your faithful servant, understand that it has been your intention to erect a bridge from Galata (Pera) to Stambul… across the Golden Horn but this has not been done because there were no experts available. I, your subject, have determined how to build the bridge. It will be a masonry bridge as high as a building, and even tall ships will be able to sail under it … I plan to build a suspension bridge across the Bosporus to allow people to travel between Europe and Asia. By the power of God, I hope you will believe my words." (Atalay, 2013)

However, the bridge was never built. Leonardo's "Golden Horn" Bridge was an ambitious design, but, the Ottoman authorities didn't believe it would work. For years, the two peninsulas continued to exist without a fixed link across the water. Michelangelo was eventually asked to design a bridge for Istanbul–he rejected the idea however; and the idea of building a bridge across the Golden Horn was shelved until the 19th century (http://www.degisti.com/index.php/archives/6515)

In the 19th century, building a bridge over the Golden Horn was part of an effort to ease mobility and accessibility in the city. The first bridge, a wooden one 600 meters in length and 10 meters in width, was between Unkapanı and Azapkapı, due to the presence of the shipbuilding yard in Azapkapı (Çelik, 1998: 72-73). Also at that time there was not any socio-economic or commercial need to connect Karaköy (Galata-Pera area) and Eminonu. However, after the 1838 trade agreement with the British, Galata rapidly grew into an important commercial centre (Çelik, 1998: 73). Therefore, the first three bridges to be built were the product of the rapid commercial and cultural expansion of the Galata and Pera districts, and were in use on the same site - between 1845-63 (wooden, lasted 18 years),

1863-75 (wooden, lasted 12 years); and 1875-1912 (iron, lasted 37 years); the fourth, built by Germans, lasted 80 years (iron, from 1912 to 1992) until it was destroyed by a fire in one of the shops located under the roadway (https://1001istanbul.com/halic-kopruleri/).

During these years, this bridge had its own special place in the collective memory of locally-born Istanbulites, through various films, paintings, photographs, novels and poems. The fifth and last was concrete, and completed in 1994, and has been in use since then.

The First Galata Bridge

The first bridge was built in 1845 and financed by the mother of the Sultan Abdulmecit. This was used between 1845 and 1863. It was called the Valide Köprüsü (Dowager Bridge), or the New Bridge (Cisr-i Cedid). It is called 'new', because there was another bridge located between Azapkapı and Unkapanı and it had been built 9 years before than this one. Cisr-i Cedid was a toll bridge. There was no charge for military and public officials, firefighters on duty, and priests. Pedestrians, pedestrians with packages, loaded animals, horse-drawn vehicles, sheep, goat and other animals were all charged with varying prices (http://www.hayalleme.com/ilk_galata_koprusu/).

The Second Galata Bridge

The first wooden bridge was replaced by a second wooden one. This bridge was used for an even a shorter period, 12 years, between 1863 and 1875. It was built on the orders of the Sultan Abdulaziz in readiness for the visit to Istanbul of Napoleon III. In order to meet the maintenance expenses, pedestrians and carters were asked to pay tolls. No trespassing at night was allowed, and smoking was banned on the bridge (Çelik, 1998, p.73). 'In those days the water of the Golden Horn was still so clean that dressing cubicles for bathers were erected on the pontoons' (Mak, 2009:56).

The Third Galata Bridge

In the early1870s, to replace the second bridge, a contract was made with the French company Forges et Chantiers de la Mediteranee. However due to the war between Germany and France, the contract with the French firm was nullified and the work was given to the British firm G. Wells in 1872. The bridge was completed in 3 years (in 1875).This bridge completed in 1875 was 480 m long and 14 m wide and rested on 24 pontoons. It was built at a cost of 105,000 gold liras.

(http://www.greatistanbul.com/galata_bridge.html)

As Mak (2009: 56) has pointed 'in 1878 a row of coffeehouses, restaurants and shops was added beneath the bridge: this combination of elevated roadway and underhanging

entertainment district would characterise all Galata Bridges that followed'. The pedestrian traffic on the bridge was massive, and the pavements were not wide enough to carry this traffic. People, vendors, porters, etc., had to to find their way among a constant flow of carts and carriages (ibid). The German orientalist Max Müller, describing the hubbub on the bridge in 1897, was also struck by the number of women in what he expected to be an almost exclusively male crowd: 'the Eastern women, dressed in white, red, blue, green and purple garments, walk calmly and without fear across the bridge; their greatest beauty is their dark eyes, which shine from their transparent veils' (Mak, 2009: 64). Around 1890, approximately 150,000 people passed over the bridge daily (http://tarihkurdu.net/galata-koprusunun-tarihi-fotograflari.html). After 37 years of service, in 1912 the 3rd Galata Bridge was towed up to the north of the Golden Horn.

The Fourth Galata Bridge

Among these bridges the 4th bridge, in particular, has kept a special place in the collective memory of locally-born Istanbulites, through various films, paintings, photographs, novels and poems. The early years of the 1900s saw great demand for a replacement bridge. The bridge was to be the acme of modernity, everyone was in agreement about that - but what kind of modernity? The French? The British? or German? The French design was rejected because it did not allow shops or coffeehouses. There was a growing fear in London that agitation by the Young Turks might influence Muslims within the empire, and support was therefore lukewarm, at best. Only the Germans, therefore, remained. In 1910, the 'Vereinigte Maschiner Fabriken, Augsburg-Nürnberg' began construction. On 14 April 1912 the new structure was opened (Mak, 2009, pp.68-69), and this fourth Galata Bridge cost 350,000 gold lira. This bridge was 466 m long and 25 m wide (http://www.greatistanbul.com/galata_bridge.html).

The bridge was made up of 12 pieces; six pieces (219 m), each of which were on the Karaköy side and five pieces (184 m) on the Eminönü side. In the middle there was a 63.5 meter-long piece opening like a door with the help of an engine of 150 horse power. Through this opening small boats (less than 12 meters width) could pass, whereas the big boats had to wait for the early morning for the bridge to open (Tutel, 2002, p.83).

On this bridge 'Müruriyeci' people collected tolls from both pedestrians and vehicles. These were big strong men who stood at both ends of the bridge to collect tolls from passers-by. They wore long coats, without pockets (to prevent them pocketing the cash). They hung yellow, metal tins around their necks. Toll collection on the bridge stopped on 1 June 1930; however, until the early 1940s, there was still a charge collected on the Bridge from people using the tramways (Tutel, 2002, p.82).

A well-known journalist Oktay Akbal, in 1955 described people's relations with the bridge: 'at either end of the Bridge, people are lined up, waiting for those returning from work. Small children selling water, nuts, fruit and sweet wafers. They have all become part of the bridge in such a way that the bridge is unimaginable without them' (Şumnu, 2002, p.60). Regarding interaction under the Bridge, Şumnu (2002, p.64) says that there were a lot of activities (shopping, eating, drinking, sailing) which were not actually related to the bridge, and involved greengrocers, pubs, coffeehouses, restaurants, etc. However, being located under the bridge made them a part of the bridge, and people created their memories and experiences.

Therefore these places were to be mentioned in films, poetry, books and paintings countless times (See Figures 2 and 3).

Figure 2. Shoeshine boys on the Galata Bridge, 1930

Source: http://tarihkurdu.net/galata-koprusunun-tarihi-fotograflari.html/ayakkabi-boyacilari-galata-koprusu-istanbul-1930-3

Figure 3: Paintings of the Galata Bridge by the artists, Fikret Otyam, Ninno Pippa, and Ömer Muz

Apart from serving different functions for visitors, in the early 1940s the Bridge was also used as an embankment (or landing stage) for the Kadıköy and Haydarpaşa ferries, using the pontoons (Tutel, 2002: 82). In 1954, the Bridge went through a wholesale renovation and all

pavements and iron supports underneath were changed. In the 1960s, the tramway on the bridge was pulled out and then in the 1970s, the pontoons serving as landing stages for the ferries were transferred to Eminönü (ibid: 84). However, because of the multitude of functions, the Bridge deteriorated and became more worn-out as the years passed. In 1987, it was decided to replace it with a new structure, which was going to be constructed by a big Turkish construction company, STFA. During the building of the fifth bridge, in May 1992, there occurred a fire on the fourth bridge because of an electrical short-circuit due to carelessness. After that fire, the (fourth) Galata Bridge was moved further along the Golden Horn.

The Fifth Bridge

The building process of the fifth bridge was accelerated after the fire in the fourth bridge, and in December 1994, it was completed. The new bridge was 490 meters in length, 80 meters of which can be raised-up (very occasionally) for ships to pass. It is a bascule bridge. Its width is 42 meters, there are 3 lanes in both directions, with two lanes for the tramway. This is one of the few bascule bridges in the world which also has tramlines passing across it. Restaurants and markets were also opened in 2003 (http://www.degisti.com/index.php/archives/6515).

The vividness of the daily life on the Bridge together with the attractiveness of picturesque views on both sides of the Bridge have made it a very popular setting for films. As Köksal (2011: 6) mentioned in her book World Film Locations: Istanbul, 'the preferred location of entry to the city for western film-makers, has been, and still is, the Galata Bridge as the audience is often introduced to the city with an aerial shot of this bridge'. The fourth Galata Bridge was chosen as a suicide scene for a Turkish film, 'Oh Beautiful Istanbul' (1981), in which two lovers separated from each other (Çiçekoğlu, 2011: 30). Again, 18 years later, the fifth Bridge became a suicide scene in a French film, The Girl on the Bridge (1999) (Gürata, 2011: 25).

The fifth bridge has her prominent place in the lives of Istanbul residents, after all it is the bridge which connects Karaköy and Eminönü – two important historic areas as well as busy transfer points. The fifth bridge attracts foreign authors, travellers, bloggers, and journalists. This is reflected in their writings, blogs, and photos. There are a lot of blogs created by foreign travellers and Turkish people. A search in the google search engine with the keywords of "galata bridge youtube" brings 29 short films made by visitors and bloggers who visited, and were enchanted, by the Bridge.

Conclusion

The fourth bridge served through the greater part of the 20th century - 80 years. In this period, the Ottoman Empire fell, and the Turkish Republic was established (1923). In 1938 the founder of the Turkish Republic Atatürk died, and his remains were carried in a procession across the bridge on the way to their final resting place in Ankara. Waves of rural migrants then began to flow into the city – changing both themselves and their new home.

Two coups occurred (1960 and 1980). Galata Bridge, throughout these years, served as an important connection between the historical peninsula (the traditional) and Pera in Beyoğlu district (the modern). Therefore, the Galata Bridge both literally and metaphorically connected two different worlds. In addition to this connection/linkage function, the Galata Bridge also hosted hundreds of anglers, peddlers, restaurant, beer-and coffee-shop customers every day and night for a hundred years at least.

The fifth bridge replaced the revered fourth. However, for Istanbul citizens who are old enough to remember the 4th bridge, 'the good old days' feeling is common and some yearn for the old bridge. But there are also others enjoying this fifth bridge. A blogger, asks in this blog in 2010; "is it possible to think of an Istanbul without the Galata Bridge ? This bridge had an indispensable role in our lives ... You could not think of an Istanbul without the Galata Bridge. Not only yesterday, but also today!" (http://yunusemre0.blogspot.com.tr/2010/04/eski-galata-koprusu.html). Therefore, it might be said that the location of the bridge, in the very heart of the city connecting both modern and pre-modern Istanbuls, has given it a central role in the lives of the great city's residents.

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Bridging the Border Cities: A History of Windsor, Ontario and its Twentieth-Century Cross-Border Relationship

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Introduction

The city of Windsor, Ontario, Canada began the twentieth century ready to embrace its urban future. Described as the future "metropolis of Canada," Windsor, as part of a larger geographical association known as the Border Cities, was in a very advantageous position for its close proximity to American industry, its million dollar building permit record, and its sense of urban pride. With the hiring of expert planners, such as Thomas Adams, the Border Cities embraced a future of an amalgamated "Greater Windsor" that anticipated a population of one million people. Situated alongside the Detroit River directly opposite to Detroit, Michigan, USA the cross-border relationship between the two cities is at the heart of the history of the region. As each of the Border Cities developed its own planning models as independent towns, the need to bridge the gap and connect to the United States was a necessity for their economic success.

This paper analyzes the social construction behind the Ambassador Bridge and Detroit-Windsor Tunnel. By focusing particularly on this period between 1920 and 1930, this paper argues that Windsor's imaginative identity was directly linked to Detroit, Michigan not only for its economic success but as an inherent element of its culture and society. The 1920s marked a period of a serious public discussion regarding unification. As the municipalities looked inward, they also extended their gaze more officially toward the United States. The desire to build a bridge and a tunnel was an attempt at progressive infrastructure that built upon a history of ferry systems, row boats, and foot crossings. Examining this region around the turn of the twentieth century, this paper focuses on the construction of geographic identities, the planning history of the area, the influence of public opinion, and the resulting amalgamation of the Border Cities.

A concerned Windsor, Ontario, Canada resident writing into the editorial section of The Border Cities Star on September 24, 1925 on the subject of the Fleetway Tunnel vs. the Ambassador Bridge declared "what the Border Cities would do without Detroit, I hardly can venture to say" ("Tunnel Vs. Bridge," 1925). A self-styled "everyday river crosser," he claimed to voice the border crossing concerns of the average Windsor worker employed in Detroit, Michigan, USA. On the surface, he seems to be weighing in on a popular transportation debate that had engrossed the border region over the past century: how best to circumvent the natural barrier of the Detroit River, dividing Canada and the United States, to connect the Border Cities (later Windsor) to Detroit. However, while the 1920s finally showed some promise on building a solution, by 1925 both the Bridge and Tunnel projects had been bogged down in political, financial, and logistical issues. To the dismay of the border residents who desired a convenient option for their daily routine, all levels of government across two countries were represented in a seemingly local matter.

While the history of the Ambassador Bridge and the Detroit-Windsor Fleetway Tunnel is one of architectural feats and international firsts, it is essential to consider why they were even built in

the first place. This paper is a brief examination of the social construction behind these projects, one that places the community and its complexity at the center of the study. The difficulties of defining that border community is much like that of placing it in a historical context. It can easily contribute to local, regional, national, and international frameworks especially as one considers the place of Detroit in Windsor's imagination.

Yet, that is what makes the urban history of Windsor such a compelling study as its residents were cognizant of their unique situation and frequently manipulated these identities when they felt their community, with all its malleability, was threatened. The construction of the Bridge and Tunnel in the 1920s and 1930s is like a climax to decades, if not centuries, of the region's coming together. Residents on both sides of the river viewed these developments as moments of progress, symbols of friendship, and models for the world. Its resolution was the aftermath of the border's reality. To live along the border at this time was to experience moments of tension, progress, and vice in your own everyday routine.

H.J. Dyos (1968, p. 7) defines the study of urban history as an investigation into the "broader historical processes and trends that completely transcend the life cycle and range of experience of particular communities." While this paper only considers a snapshot of two decades of Windsor's history, the themes of progress, community, protest, and border culture have endured before the city's founding and continue to the present. With Windsor's proximity to the United States, to consider cross-border and transnational approaches is fitting once one realizes how fundamentally entwined Detroit and Windsor were during this period. To this day, no photograph of downtown Windsor is complete without a view of the Detroit skyline.

However, Windsor's place within transnational history is only a recent development. Early histories of Windsor written in the 1920s to the 1940s frequently discussed the Windsor-Detroit relationship, and particularly their upper-class residents, as fundamental to the city's development. However, they typically examine the two cities in a vacuum; embodying the cross-border element but failing to grasp the complexity of a transnational approach. The early 1990s marked a beginning of considering Canada within a borderlands context. For the majority of historians who study America's borders, much of their attention has been on its southern with Mexico. To justify their study of the Canada-US border, historians frequently challenged the stereotype of "the world's longest undefended border" to explore how its physical, legal, and cultural properties had impacted not only the development of the two countries' relationship but the countries themselves, or lack thereof.

In the past decade or so, historians have built upon these borderlands theories to consider, as Randy William Widdis (2005, p. 154) describes it, how to "illustrate the multiformity of borderlands' links, networks, and relationships." Books such as Crossing the 49th Parallel and Permeable Border attempt to put the approach into practice, even mentioning Windsor-Detroit in their broad studies of migration, identity, and nation along the US-Canada border. While this paper does not offer any definitive solution, it does pose an alternative. By looking specifically at

one urban area along the border at a particular moment, it can explore a depth of complexities that a broader study cannot.

However, in order to discuss Windsor's perceived relationship with Detroit, it is first necessary to examine Windsor itself. The city's current geographic location was once known as the Border Cities. A popular name used to communally describe the small towns and cities that developed along the border of the Detroit River officially in the mid-1800s. Windsor, Sandwich, Walkerville, Ojibway, Riverside, and Ford City developed independently from each other, usually around a particular industry, but frequently worked together on broader community initiatives. The province of Ontario officially amalgamated them as the City of Windsor in 1935, but not without opposition.

Regardless of political will, the Border Cities were rather dependent on each other. As the alcohol distilling and automotive industries built up the area, they attracted major transportation infrastructure that turned the area into a hub for both Canadian and American enterprise. Three major railways, multiple ferry systems, electric street trams, and automobiles easily connected the Border Cities to each other and to the rest of Canada and the United States. As transportation cemented the physical ties, the Border Cities were also culturally connected to the region. In the 1890s English-Canadians were among the most popular of choices by native white Americans in Detroit desiring a foreign spouse and 29.3% of English-Canadian males in Detroit married Americans (Ramirez, 2001, p. 32). The local newspaper called itself The Border Cities Star and, while acknowledging the independence of the municipalities, did foster themes of unity and community. In solidarity with the amalgamation, it too changed its name to The Windsor Daily Star with its first edition reinforcing the sense of celebration and encouraging themes of progress and modernity.

Yet, while the Border Cities were looking inward they never stopped extending their gaze across the river. As early as the 1870s, officials from both countries' governments were considering tunnel and bridge solutions to transportation issues. The Detroit River was vital to the two economies with an estimated forty percent of U.S. foreign trade, about 27,000 vessels, already traversing the river in 1873 (Mason, 1987, p.25). The U.S. Secretary of War with the Chief of Engineers submitted a report to the U.S. Congress describing a need for a tunnel as at least one thousand cars crossed daily by ferry (Proctor, 1890). A few of the independent railway companies were able to build cargo transport tunnels in the early 1900s, but it did not solve the daily commuters' issues. While Detroit's population in 1900 was twenty times greater than the Border Cities' 15,000 (Morrison, 1982, p. 177), the two seemed just as dependent on a viable solution as some 30,000 people crossed the river every day for work by 1913 (Karibo, 2015, p.19). A transportation survey conducted by Charles Evan Fowler in 1920 found that approximately 10,585,000 passengers and 521,950 cars crossed the river each year (Mason, 1987, p. 50-51). Already by 1925 a daily average of 20,259 passengers travelled by ferry (Klug, 2010, p. 404). Clearly, the future would need an alternative.

However, the 1920s also marked a shift in the perception of the Canada-US border. National efforts to control immigration, monitor security, and curtail illegal smuggling enacted legislation to defend the border as a political boundary. Their ramifications directly impacted the local community for the border residents as Windsorites adjusted to, but also frequently challenged these federal policies that impacted their way of life. For example, fears of an attack on Windsor coming from Germans hiding in Detroit during WWI led to the federal government increasing military presence at major Windsor landmarks (Dimmel, 2014, p. 413). When one bombing did occur in June 1915, the Canadian government established tighter restrictions and monitoring of movement across its international border. Windsorites were quick to protest such measures like PC1433 which prevented Canadian men of military age to cross international boundaries without government administered photo identification (Dimmel, 2014, p. 417).

Alongside military protests, historian Brandon Dimmel demonstrates that Border Cities residents were also quick to protest when their cultural ties to Detroit were challenged. While Windsor did eventually succumb to Ottawa's order on the grounds of patriotism, the city was adamant in refusing to adopt daylight saving time in 1918 as it would disrupt their commercial dealings with Detroit (Dimmel, 2011, p. 206). In 1916 the city was steadfast in refusing to abide by the provincial Lord's Day ban of foreign Sunday newspapers. They simply crossed the Detroit River to purchase The Detroit Free Press themselves (Dimmel, 2011, p. 203-204). These early events fostered a feeling that the higher governments were intruding on their way of life.

However, some residents of the Border Cities did give federal customs cause for concern. Smuggling was a major issue that extended beyond the infamous rum-running of the 1920s and it seemed to transcend all class of citizen. For example, by 1915 female Windsorites failing to declare their Detroit purchases to avoid customs' duty had become so rampant a special female agent was brought in for a surprise inspection. The Windsor Evening Record described Martha White's visit on the front page of the newspaper, setting the scene as one of accosted screaming Windsor women as victims for the "profit to the Canadian government" ("Crusade on Smuggling," 1915). Yet, Windsor's location also attracted a far more dangerous enterprise. In 1926, The Border Cities Star ran a full page article on the human smuggling ring in Windsor. With the implementation of immigration quota laws in the United States, it was an extremely lucrative business that seemed to take advantage of every mode of transportation available from ferry to railway tunnel to walking across a frozen Detroit River ("Alien Smuggler," 1926).

This river was the inspiration for many erratic methods of border crossing, but none so much as for rum-running. When the United States enacted federal prohibition on alcohol in 1919 and its enforcement with the Volstead Act, Windsor became the prime location for smuggling and was even renamed the "Windsor-Detroit Funnel" (Mason, 1995, p. 39). It was an activity that everyone from the fisherman to the big-time gangster could take part in. Smugglers attempted everything from underwater torpedo systems to personal concealment to outsmart the border patrol. The New York Times reported that from 1927 to 1928 at least $20 million worth of liquor had travelled by rail into Detroit (Mason, 1995, p. 43-44). Even the Border Patrol guards were

caught up in the schemes and in 1928 one hundred out of one hundred and thirty were discharged for corruption (Karibo, 2015, p. 37).

Yet, it is important to remember that while much of this history is noted in anonymous statistics, these border activities were the everyday lived experiences of the community. The newspapers frequently ran stories on federal liquor policies. However, it could not be avoided that these smugglers were a part of that very same community. For example, like many preceding it, in 1932 The Star reported that "James Morris, 56, of 455 Dougall Avenue" was arrested for operating an illegal still and fined according to the federal department of customs ("Comes Home and is Nabbed," 1932). They could even have left lasting legacies in the community, like notorious bootlegger Harry Low whose home was featured in a newspaper collage entitled "Just a Few of the Beautiful Homes which Dot Greater Windsor" ("Windsor – Canada's," 1935). Yet, the murder and gun violence of smuggling were daily reminders of the danger of living so close to an international border.

The installation of the federal Immigration and Naturalization Service at the border in the late-nineteenth century was both a welcome reprieve and a further government hindrance. Thomas Klug (2010, p. 399) best describes the situation as the INS being "responsible for national law enforcement in borderland contexts that often required accommodation to local realities." However, its main issue in realizing its goal was low staffing. For example, Detroit only had one guard in 1901 which increased to sixty-five by 1926 (Klug, 2010, p. 399). Remembering the daily crossing rates, the man power was just not adequate. Federal efforts to enforce systems such as photo identification, designated lines, and more intimate inspections were met with major resistance and usually required alterations before being accepted in Windsor. For example, policies intended to profile single women with children were criticized, even by the border officers, as they failed to grasp just how integrated the border culture was in everything from shopping to national holidays (Klug, 2010, p. 399).

However, in the days leading up to the momentous occasions of the opening of the Ambassador Bridge and the Detroit-Windsor Tunnel, the contempt felt by border residents was cast aside. The history of the two projects followed much the same pattern. Joseph A. Bower, a New York financier relying on a previous bridge endeavour led by Charles Evan Fowler in the early 1920s, spearheaded what would be the successful project. In 1925 he purchased the rights to the American Transit Company which had previously negotiated deals with the two federal governments (Mason, 1987, p. 61). However, Bower faced strong opposition from local officials who believed the recently proposed tunnel project in 1925 would be a better solution to a bridge (Mason, 1987, p. 63). When the American government placed a deadline on the project at 1927, Bower faced an additional issue that would require financial backing and expedited local approval. To mark major milestones in the development, Bower was wise to include the public in various commemorative ceremonies.

At the same time, Fred W. Martin was the main supporter of the tunnel project, purchasing the necessary real estate and acquiring funding for the Detroit & Canada Tunnel Company. While his project initially received more public approval than the bridge, his company was frequently required to publically defend its engineering. Technical and very detail oriented articles appeared in the newspapers describing the mechanics of the tunnel with particular focus on air ventilation. Both projects cost around $20 million each to complete but offered much that Windsor could be proud of. The tunnel, opened in 1930, directly connecting Windsor's and Detroit's downtowns, was the first vehicular subway to connect two nations ("First to Link Two Nations," 1930). While the bridge briefly held the record of the longest single span suspension in 1929, its physical presence continued to have a major impact on the physical and cultural development of the city. The Border Chamber of Commerce proudly declared in The Border Cities Star a day before the grand opening that the two infrastructure projects had created the "New World's first Bi-National Metropolis" where the Border Cities "becomes Detroit's Canadian south" as "a world city under two flags" ("The Border Cities Were Great," 1929).

The Border Cities Star was in fact a major historical actor when it came to changing perceptions of the border. A special seventy-one page edition dedicated to the Ambassador Bridge appeared on November 9, 1929 to commemorate the November 11th opening. They even informed their readers to "read it carefully and preserve it" (1929). The newspaper attributed a wide range of symbolism to the bridge by publishing opinion and editorial pieces. It was described as "a gigantic monument […] to this everlasting peace and goodwill. […] it will unite the very hearts of two countries. It will stand there a structure of steel and concrete, a great tribute to engineering skill, but a greater symbol of a new creed among nations […built] upon their progressive spirit" (Green, 1929). William Lyon Mackenzie King called it a testimony "to the growth of industry and trade upon their continent, to one hundred and fifteen years of the international peace between the British Empire and the United States" (King, 1929). However, that was the exact intention. The decision to name the project The Ambassador Bridge and to dedicate it on November 11th, Remembrance Day, was meant to evoke feelings of "friendship" and "goodwill" (Bower, 1929). Ideas of "progress," "civilization," and "modernity" were attributions after the fact.

However, the regular Windsorite was not to be forgotten. Several editorials were included that described a "feeling of elation" and claimed Joseph Bower "as one of our own" who seemed predestined to realize the bridge project ("Editorial: The Bridge," 1929). A year before, the paper published an editorial by Don Cameron that was like an ode to the Windsor steel workers as real builders of the bridge ("Steel Men," 1928). To have had any part in building the bridge or tunnel seemed a point of pride as local businesses purchased congratulatory notices in the paper that also promoted their involvement.

Yet, the most obvious demonstration for the public was the dedication ceremony. 100,000 Detroiters and 50,000 Canadians appeared at either end of the bridge for the joint celebration. While most of the pomp and circumstance was successful, at the moment the crowds were

allowed to walk the bridge, but only up until a quarter way rope barrier, everyone stormed the barricades until they reached the gates of the international boundary line. While this clearly, even at this point in time, would have been quite a border control emergency, the newspaper reported it as one of victory, for the people were "contented because they had, for the first time in their lives, been able to walk and run high over the river, to the boundary which they had heretofore crossed only aboard boats" ("150,000 Storm Bridge Barriers," 1929). Another described the scene as "these people of Canada, in spite of all barriers, were sweeping on across a structure uniting two countries, to meet the people of another great nation" ("Human Torrent," 1929). Additionally, to be the first of anything, man/ woman/ child/ pedestrian/ driver, to cross the bridge or tunnel were points of pride that won you a picture in the paper and a commemorative plaque ("Mrs. Meloche," 1933). Clearly, the bridge and tunnel were meant to be experienced.

Thus, one is left to wonder if these two projects changed anything. Of course there were the noted increases in border crossings. A year after its opening, the year-end numbers found that about 5,500,000 passengers, not counting children, travelled by tunnel alone in the year ("6,500,000 Travel Tube," 1931). The Border Cities banded together to try to capitalize on greater transport accessibility by forming a tourism association. Already capturing forty-two percent of Ontario's tourism quotas for Canada, the Border Cities believed they could promote their historical nature to drive further American traffic ("Border Leaders," 1935). The economic connection continued strong, despite labour cutbacks during the Great Depression, as the first half of 1935 already saw $7,384,968.70 worth of goods declared across the border ("Windsor – Canada's," 1935). Detroiters and Windsorites continued to cross the river for leisure activities and to celebrate each other's holidays like the 175,000 Americans who enjoyed Canada Day in Windsor in 1932 ("U.S. Crowd Goes Home," 1932). Engineers around the world did see these projects as models to study like the Belgian scientists who visited in 1930 ("Europe Looks at Tube Here," 1930). New city planning now had to directly address the needs of the international crossings, like famous planner Thomas Adams' scheme for Windsor did in 1930 ("Thomas Adams," 1930). These infrastructure projects were such a point of pride that they were listed as among the city's greatest assets when it came to unifying the community leading up to the 1935 amalgamation ("Transportation," 1935).

However, there were other aspects to border life that did not change either. Windsorites believed that with greater crossing competition tolls would decrease, but with such expensive projects that was not the case ("Letters to the Editor: Thinks Bridge," 1930). With the end of U.S. Prohibition not in sight until 1933, smuggling continued, now with even more options. The Star continued to run stories on federal liquor policies like President Hoover's statement to Congress that directly spoke to the border's issues by attempting to implement more procedures ("Obey Law," 1930). Yet, corruption among the border patrol did continue as rum-runners and customs officers were tried side-by-side ("Officers tried with Smugglers," 1930).

While the bridge and tunnel may not have drastically altered the Border Cities' way of life, they do mark an acceleration of its development. The area seemed so invested in paving its own

progress and defining its community that these projects became symbols of the moment. They characterized that moment as one of friendship, goodwill, ingenuity, and modernity that seemed to cast aside the realities of border life. It did offer valuable crossing alternatives, ones that mark the foundation of Windsor today, but when the ceremonies had ended life continued on in the same way. Windsor had changed. It was united politically, challenged economically, and forced to reinvent, but above all it was defined by its border.

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Perception of ownership of Most na Adi in Belgrade

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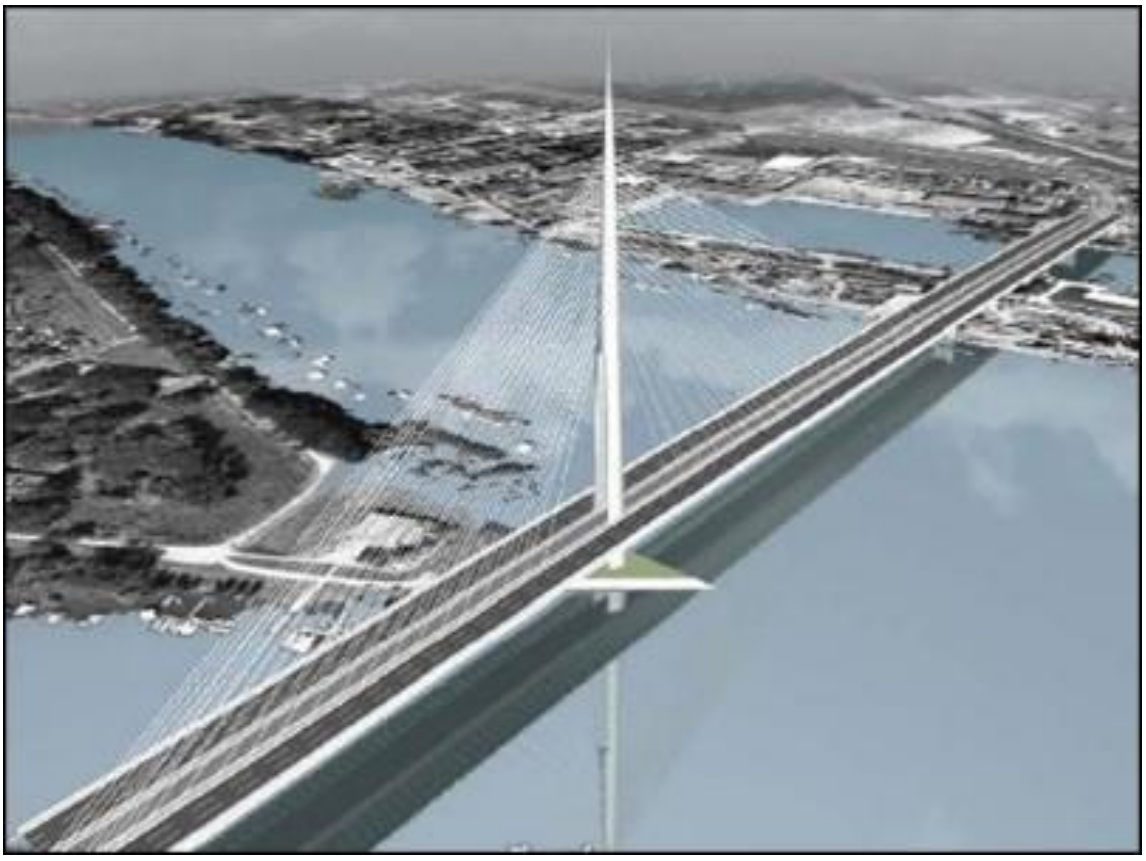


Picture 1 Projection of the future appearance of the bridge, made by Ponting, Slovenia

"There are no buildings that have been built by chance, remote from the human society where they have grown and its needs, hopes and understandings, even as there are no arbitrary lines and motiveless forms in the work of the masons. The life and existence of every great, beautiful and useful building, as well as its relation to the place where it has been built, often bears within itself complex and mysterious drama and history." (Andric, 1977)

In this paper, we have tried to illustrate perceptions of ownership of Most na Adi in Belgrade, the emotional connection felt by those involved in the project1 and the way that that the views of the bridge changed over time. In doing so, we look at the stages of project development and compare them against historic descriptions from the Serbian novelist, Ivo Andric, who wrote "The Bridge on the Drina", which concerned the construction of a bridge across the River Drina in modern day Bosnia in the mid-16th Century.

We look at parallels between the descriptions in Andric's book and the controversies during development of the colossal new bridge over the River Sava. The bridge and related infrastructure were often used to support political agendas2. The citizens of Belgrade conducted a lively discussion over the cost of the bridge, with an ongoing debate centred around whether Belgrade needed such a "fancy" bridge, rather than a simpler, more utilitarian structure3.

In preparing this paper, we have conducted informal interviews with around twenty direct project participants, to obtain personal recollections of the bridge. Also, we have used our own experiences of bridge construction in the analysis of the topic.

Belgrade is Serbia's capital and home to 1.7 million people, nearly 20 percent of the country's population. The city is located at the confluence of the Sava and Danube Rivers and has expanded geographically throughout its history, with recent growth to the north of the Sava River in an area known as New Belgrade. In response to the population growth, city leaders initiated a program to construct a new crossing over the Sava River, at the tip of Ada Ciganlija. Ada is an oasis within the city, an island in the River Sava 4 km to the south-west of the City Centre, beloved by the residents of Belgrade not only as a place to escape the urban environment and relax, but also as a place where freedom of speech flourished (Гајић, 2012).

The Most na Adi (Bridge on the Ada) is a unique, asymmetrical single-pylon cable-stay bridge, and the first new bridge to be built in Belgrade in 40 years. The 376-meter long main span carries six lanes of traffic and is supported by cables connecting to a 200-meter-tall pylon. The main span is constructed from steel, whilst the shorter backspan is made of heavier concrete sections, to balance the loads. This main pylon is open in the centre, to accommodate two light rail tracks.

Story of Ada Bridge

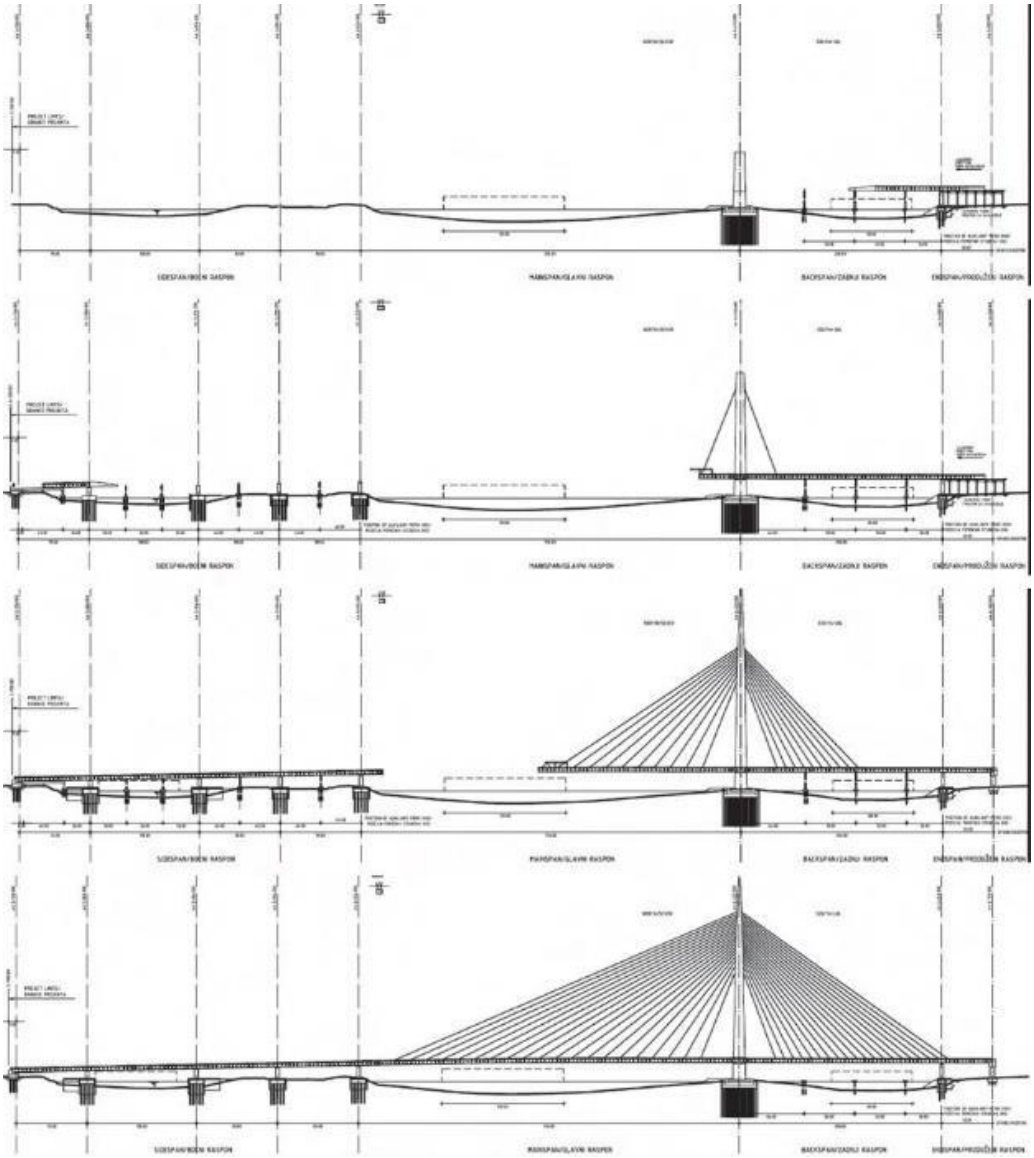
Early stages – Planning.

Picture 2 View of the future location of the bridge

"Now we must go back to a time when there was not even a thought of a bridge at that spot, let alone such a bridge as this." (Andric, 1977)

The story of Ada bridge from the very beginning attracted controversy4. Some of the criticisms were politically motivated, some were technical. Most related to the potential cost of the structure.

Pros and Cons, believers and sceptics



Picture 3 Erection stages of the bridge. Design detail

"The rumour that the bridge would never be finished spread far afield. Both Turks and Christians spread it and little by little it took form as a firm belief." (Andric, 1977)

The public was consulted from the early stages of the design process. Some believe that this is one of the main sources for opposing opinions of the bridge construction. A poll was commissioned and the people of the City were asked what sort of bridge would be preferred. In spite of the fact that the traffic jams in travelling from New Belgrade to old Belgrade were often terrible, many people opposed the new bridge. One factor in the opposition to the project was the connection to Ada Ciganlija and the thought that the bridge had no place there. There was also scepticism that Serbia at the time didn't have the technical and financial capacity to build such a bridge. The political opposition5 led a strong campaign against the bridge, mainly criticizing the price, but also highlighting any flaw that could be exploited.

Picture 4 Pylon during construction

The shape of the pylon was disputed. Other landmarks of Belgrade are more rounded, such as the dome of Saint Sava temple or the city fair. The Sava Bridge pylon stands out not only through its height, but also by its contrasting form.

The size and scale of the bridge was subject of extensive discussion. Many thought it too big for Belgrade, city of small buildings and narrow streets.

Construction

"That very same year, by the Vezir's order and at the Vezir's expense, the building of the great bridge on the Drina began. It lasted five years. That must have been an exceptionally lively and important time for the town and the whole district, full of change and of events great and small. But for wonder, in the town which remembered for centuries and discussed every sort of event, including all those directly connected with the bridge, not many details of the commencement of the operation were preserved.

This hard and long building process was for them a foreign task undertaken at another's expense. Only when as the fruit of this effort, the great bridge arose, men began to remember details and to embroider the creation of a real, skilfully built and lasting bridge with fabulous tales which they well knew how to weave and remember". (Andric, 1977)

Picture 5 Visit to site by the then President of Serbia (left) and the Mayor of Belgrade (right), late Nemanja Ćalić, Deputy Resident Engineer for the Bridge (in the middle)

The tender for the bridge was successful and construction began in May 2008. The feeling amongst the project team was that the start of construction represented the end of a long journey. For the people who were the driving forces behind the project, it was seen as a moment of victory. In comparison, the general public saw the construction on site as a beginning, the commencement of the project proper, still with risks and uncertainties. Many of the individuals working on the project saw this only as the moment when they were sure the project would go ahead. Many of the general public remained sceptical, with works on site in the preparatory phase, such as piling and foundation works, generally being hidden from view.

Picture 6 Foundations of the pylon

“It was already being said that the foreign maestri were preparing to leave and that there would be no bridge there where no bridge had ever been before and where it should never have been begun. All these tales blended and spread quickly.

The common people easily make up fables and spread them quickly, wherein reality is strangely and inextricably mixed and interwoven with legend.” (Andric, 1977)

Picture 7 Erection of the steel deck segment

“What was now been done on the Drina was so complicated, all the works so interlocked and complex, that the loungers in the town, who watched the building work from the two banks as if it were some natural phenomena, could no longer follow it with understanding.

…..

Maestro Antonio brought from Dalmatia especially skilled cordwainers and collected all the hemp even from the districts around. In special buildings the master workmen twisted ropes of exceptional strength and thickness. Greek carpenters, according to designs of their own or drawn up by Tosun Effendi, built huge wooden cranes with pawls, erected them on rafts and thus, with these ropes, raised even the heaviest blocks of stone and transported them to the piers which, one by one, began to rise out of the bed of the river. The transport of each one of these huge blocks from the banks to its position in the foundations of the bridge piers lasted four days.” (Andric, 1977)

The international nature of the project gave rise to specific issues related to construction and management. Steel for the main span was fabricated in China. Deck segments were transported by ship, from China to Rotterdam and thence by the Rhine-Main-Danube canal to Belgrade and the site. There was genuine concern that delivery might be disrupted by piracy off the Horn of Africa. The stay cables came from Japan and were installed by a Swiss company. Specialist teams of workers from Bosnia worked on scaffolding brought from Austria.

Milestones

Picture 8 Launching yard and the back span of the bridge

“At first they had all been proud of the great bequest which the Vezir was to erect in their district. Then they had not realised, as they now saw with their own eyes, that these glorious buildings involved so much disorder and unrest, effort and expense.” (Andric, 1977)

Several milestones were selected by our interviewees as the most significant.

For those working on the project, everything related to the pylon and stay cables was memorable. This was not so much a milestone for the public but rather for participants themselves, signified by their first trip to the top of the pylon. This is the tallest structure in Belgrade and at first, you

could climb it by using a lift on its side and then, by a crane, and later using the steps inside. The first crane ride was a very exciting one, one of those moments that cannot be repeated and which causes an adrenalin rush at its remembrance. In a way, this crane ride was seen as a privilege, confirming entry into an exclusive membership.

Picture 9 Pylon and the back span

For some, a clear milestone was the addition of the approach ramps to the main bridge contract, as the dynamics of construction did not initially provide for these in the first stage. This could have become a political issue and would have significantly delayed the start of the use of the bridge by citizens. There was a caricature of the bridge published in the media, with no access ramps, but stepladders from each side leading to the deck. Such publication reflected the continued close general interest in the bridge construction process, as well as the continued opposition to the project and lingering doubt over the result.

Picture 10 Front page of a magazine “NIN”. Writing in Serbian means “Mayor’s nightmare: A bridge in the air”

“Watching all this, day after day, year after year, the townspeople began to lose count of time and of the real intentions of the builders. Men who do not work themselves and who undertake nothing in their lives easily lose patience and fall into error when judging the work of others.” (Andric, 1977)

Symbolic identity

Bridge as a part of Belgrade

The history of a city is written by the community. To be a success, a major bridge as a new part of the city has to be incorporated into the life of its citizens, needs to enter into the vision of the city and to become a part of individual networks of daily movements. In short, it has to be socially accepted. (Мароевић, 1993.)

In the case of the new bridge across the Sava in Belgrade, it had to overcome concerns with regard to its location. After the bridge was opened to traffic, it became evident that the pollution and the noise associated with it were more remote than feared. The bridge was seen as being compatible with the vision of Belgrade as a city of the future and as a major European capital.

The path to the acceptance of the bridge was turbulent but it seems to have been reached relatively quickly after completion. The bridge has become a new focal point of the city, as evidenced by its use as a symbol of the city alongside the more traditional landmarks.6

Picture 11 Old and new symbols of Belgrade (Western Belgrade gate, Usce tower, Gardos tower, Ada Bridge, the Victor, Cathedral Church of St. Michael the Archangel, St. Sava temple, "Beogradjanka", Eastern Belgrade gate). Taken from the site https://www.miross.rs/sr/dogadjaji/iii-kongres-gastroenterologa-srbije representing Association of Serbian Gastroenterologists (accessed on 27/10/2017)

New symbol of the city

The bridge is increasingly used to designate Belgrade. Its image is to be found on fridge magnets, along with the older Belgrade symbols, on shirts and other souvenirs. It is used in TV drama series during the introductory montage to confirm the setting, in political shows when they discuss Belgrade matters, and by commercial companies in their logos. The image of the bridge is used in music videos, commercials, popular talk shows, and morning programmes. It was selected as a logo for Belgrade Pride 2016, with stay cables represented in the colours of the rainbow.

Picture 12 Logo of the Belgrade Pride (http://parada.rs/ accessed on 27/10/2017)

To our knowledge, there were no official requests or initiatives to include the bridge image in souvenirs, logos and on television shows. Rather, the adoption of the new structure as an image of the City grew organically. Even after the governing political party changed, the use of the bridge as a symbol of the city continued to expand, it being viewed as independent of political affiliation.

Beograd je svet7

The bridge construction was an international endeavour. Not only were people from all over the world involved, but the materials and equipment came from across the globe. It was said and felt by some that for the first time, after Yugoslavia's and Serbia's turbulent recent history, including sanctions and NATO bombing, Belgrade was once again felt to be at the centre of everything, returning to its rightful place in Europe. It felt like things were changing for the better, that Serbia was once more part of wider international community, an integral part of Europe. The construction of the bridge was seen as a positive sign for Serbia. Belgrade was again a good place to be, a desirable working environment. It was our symbolical bridge to Europe.

The bridge construction was also symbolic of the re-joining of former Yugoslav people, in that representatives of all former republics were involved in the construction and all worked together. This was seen as one of the most significant impacts, in that people artificially separated by politics came together to create something new.

The bridge is seen as symbolizing positive change, modernity and prosperity. It showed that Serbia was on the right track, exiting previous troubles, and gave energy to the whole city. The bridge had a bigger meaning, beyond that of just a piece of needed infrastructure, giving a new image, a new face for Belgrade.

Who does the bridge belong to?

Specific efforts were made by the City to involve the citizens of Belgrade in the project, to promote interest and ownership. Some of the most important and most visible activities included

organising a public poll to select the name of the bridge, organising “Bridge Open Days” during construction and arranging the Grand Opening on New Year’s Eve of 20128. These events are considered significant in assessing perceptions of ownership of the bridge.

Bridge open days

Picture 13 Completed main span and the pylon

“Quick to respond to good or evil, the people of Visegrad were now ashamed of their doubts and lack of belief. They no longer tried to conceal their wonder or restrain their enthusiasm. Passage across the bridge was not yet permitted, but they collected on both banks, especially on the right one, where the market-place and the greater part of the town were, and watched the workers passing across it and how they worked at smoothing the stones of the parapet and the raised seats of the kapija.” (Andric, 1977)

Shortly after the bridge was joined above the Sava River, the City organised a two-day event where all citizens could walk over the unfinished bridge9. The interest exceeded all expectations. The atmosphere was described as “hysterically positive”. People came to not only see and photograph, but also to touch the bridge. This was perhaps originally perceived as a political event but some noted it felt more like a spontaneous celebration, with people being there from interest, rather than being forced or required to be there due to political affiliation.

The Grand Opening

Picture 14 View of the bridge on New Year's Eve 2012

"In general all those early days, the people crossed the bridge countless times from one bank to another. The children rushed across whilst their elders walked slowly, deep in conversation or watching from every point the new views open to them from the bridge. Even the least of the townsmen felt as if his powers were suddenly multiplied, as if some wonderful, superhuman exploit was bought within the measure of his powers and within the limits of everyday life, as if besides the well-known elements of earth, water and sky, one more were open to him – to go over the water and be master of space."

The bridge was opened to traffic on the New Year's Eve of 2012 with a spectacle of fireworks and a countdown to midnight displayed on the pylon. The president of Serbia and Mayor of Belgrade were the first to cross the bridge. An amazing amount of people decided to spend their New Year's Eve in the line, waiting to be amongst the first to cross the bridge. It seemed that the eyes of all of the citizens of Belgrade were directed at the bridge that night.

It was somewhat unexpected to see the interest of the majority of citizens of Belgrade in the bridge, considering all the negative reviews of it and the strong campaign against it by opposition parties. It seemed that the interest in the new bridge was stronger than its association to politics and individual views on the use of tax revenue. Even though the opening event was designed to be a political promotion, in retrospect it was seen as the beginning of the depoliticising of the project. That night it became the bridge of all citizens.

"Of all the things created and built by humankind as a part of life's effort, nothing in my mind is better or worthier than bridges. They are more important than houses, more sacred, and more universal than temples. They belong to all and treat all alike; they are useful, always built for a purpose, at a spot where most human needs entwine; they are more durable than other buildings and serve no secret or evil purpose." (Андрић, 1981.)

For some of interviewed project participants, the opening was a very emotional moment, combining feelings of pride and sadness. Before, we were those with privileges to use it, it was only ours, now it belonged to everyone. Some compared it to the sensation when you have to accept that your child has grown and you have to let go, but you are proud of the part you played in his or her growth.

Picture 15 View of south approach ramps

“But at last the people had wondered enough, walked enough and had listened to the verses of the inscription to their hearts’ content. The nine days’ wonder became a part of their everyday life and they crossed the bridge hurriedly, indifferently, anxiously, absent-mindedly as the tumultuous waters that flowed beneath it, as if it were only one of the countless roads that they and their beasts trod beneath their feet.” (Andric, 1977)

In the days and weeks following opening, the bridge was a major attraction for the people of Belgrade, and one traffic lane on each carriageway was used as a parking space for those who visited and wanted to take pictures of the bridge. Gradually, the cars and trucks ceased to slow down as they crossed it and the initial sense of wonder dissipated, as the bridge took its place in the everyday life of its citizens.

Conclusions

To the direct question of ownership of the bridge, the unanimous response seemed to be that it belongs to citizens of Belgrade. Those involved in the construction were proud of their role but they always saw themselves as representatives of the wider community. Interestingly, rarely is the bridge seen as belonging to Serbia as a whole – the perception is that it belongs primarily to the city of Belgrade and the citizens therein.

During the construction period, the bridge was used for political purposes by both the governing and opposition parties. One side pointed at the costs and flaws whilst the governing party used the accomplishment to conceal mistakes made in other areas. For the citizens, from the start of its use it was quickly depoliticised and assumed a place in the cityscape, as a natural continuation of Ada and the progress of the city.

During the preparation of this paper, the authors were struck with the similarities between the Sava Bridge project and others described in literature, particularly the "Bridge on the Drina" by the Serbian author, Ivo Andric. These similarities were reflected in the comments made by the interviewees and the text of the book, extracts from which have been included in this paper. A bridge is an emotional structure, more so than a new highway or public building. This is reflected in the level of interest shown by everybody affected by the project, be they politician, construction worker or taxpayer. Both the book and the experience point to four distinct stages during the development of any major project. The first of these is controversy over the need for the project, the location, the estimated cost. Sides are taken, which often depend on one's political affiliation, rather than on the intrinsic merits of the project. As the project moves forwards, the opposition often translates into pessimism of the success of the project, with uncertainty being expressed over whether such a structure can be or will be completed. Minor setbacks, which are usual for any project of this size, are seized upon. However, as the bridge takes form and nears completion, there is a renewed desire to be associated with the success of the project. Previous doubts are denied, replaced with a celebration of the achievement of construction. This is seen in the huge interest in both the open days and the actual opening itself, with seemingly the whole of the city wishing to take part in the celebration, to be able to say they were a part of it. And the final stage, which takes place more quickly than anticipated, is the absorption of the bridge into the general cityscape and the daily lives of its citizens, who no longer slow down when they cross it.

And this brings us back again to the original subject of the paper, perceptions of ownership of the bridge. It is clear that any major bridge crossing, particularly one in the middle of a town or city, creates much discussion and often controversy. Our position is that this reflects the shared sense of community ownership of such structures. Most of the citizens of Belgrade had an opinion on the bridge, both during the development stage, during construction and after completion. Regardless of whether people were for or against the bridge, there was always a sense of shared ownership, of feeling they were participating in some way in the decision making and construction process. From the viewpoint of the interviewees, the bridge was always seen as belonging to the citizens of Belgrade, as distinct from the City. Whilst those involved directly with the project had a sense of responsibility for the bridge, this did not extend toward ownership – they generally felt that they were always working on behalf of the people within the city.

In conclusion, we would like to thank our employer, Louis Berger, for giving us both the chance to work on the project. We would also like to thank all of the other major project participants, in particular the City of Belgrade, the Belgrade Land Development Public Agency, as well as the designers and contractors who gave form to the bridge. And finally, we thank the citizens of Belgrade, for the level of interest and involvement they showed throughout the project. The bridge belongs to them.

“However, one thing is clear; that between the life of the townsmen and that bridge, there existed a centuries old bond. Their fates were so intertwined that they could not be imagined separately and could not be told separately. Therefore, the story of the foundation destiny of the bridge is at the same time the story of the life of the town and its people.” (Andric, 1977)

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SOURCES

Interviews with project participants

Technical documentation developed during the project was used for all technical details and chronology of events. Documentation is property of Louis Berger

NOTES

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[1] Both authors of this paper work for Louis Berger, who acted as the Project Manager and Engineer throughout the construction of the new Bridge over the River Sava in Belgrade, Serbia.

[2] examples of political use of the bridge http://www.b92.net/biz/vesti/srbija.php?yyyy=2011&mm=08&dd=08&nav_id=530736 ("President of Serbia stated that Ada Bridge is Serbia's pride"), http://www.vreme.co.rs/cms/view.php?id=1005401 ("First walk over the Ada bridge"), http://www.nspm.rs/hronika/dragan-djilas-most-na-adi-je-najlepsi-u-evropi.html ("Ada bridge - the most beautiful bridge in Europe"), accessed on 20/10/2017

[3] "Umesto da Beograd, glavni grad Srbije, dobije nekoliko mostova (najmanje tri) … svedoci smo … izgradnju dela mosta preko Ade..." ("instead of building several (at least 3) bridges in Belgrade, capital of Serbia … we are witneses of… Ada bridge construction") http://www.pecat.co.rs/2011/09/jos-o-mahinacijama-oko-mosta-preko-ade/ accessed on 20/10/2017

[4] Examples of opinions opposing the construction of the bridge http://aas.org.rs/protiv-rasipnickog-mosta-na-adi/ ("against squandering money on the Ada Bridge"), http://www.kurir.rs/vesti/beograd/807399/arhitekta-bacicemo-24-milijarde-evra-na-dilasov-most-na-adi ("we will throw away 24 billion euro on the Ada Bridge"), http://www.pecat.co.rs/2012/02/most-preko-ade-most-koji-razdvaja-srbiju/ ("Ada Bridge dividing Serbia"), http://www.pecat.co.rs/2011/08/ko-nam-gradi-lepoticu-na-adi/ ("who is constructing the 'Ada beauty'") et al. accessed on 20/10/2017

[5] http://www.blic.rs/vesti/politika/vucic-najavio-krivicne-prijave-zbog-mosta-na-adi/5gve26x („Vućić (opposition leader at the time, currently president of Serbia) to sue because of Ada

Bridge construction“), http://www.glas-javnosti.rs/node/17895/print (article describes how Ada bridge is used to gain more votes by who can finish it faster), accessed on 20/10/2017

[6] http://www.gradjevinarstvo.rs/tekstovi/2406/820/drugi-pogled-na-most-preko-ade (“a second glance at Ada Bridge”), accessed on 20/10/2017

[7] This is a pun, originating from demonstrations in 1996/1997, meaning both Belgrade is the world and Belgrade is holy (https://en.wikipedia.org/wiki/1996%E2%80%9397_protests_in_Serbia accessed on 27/10/2017)

[8] https://www.youtube.com/watch?v=acFiahK-_wM Bridge opening, accessed on 20/10/2017

[9] https://www.danubeogradu.rs/2011/08/obidite-novi-most-na-savi-i-predlozite-ime/ (“visit the new Sava Bridge and propose its future name”), accessed on 20/10/2017

Hawai‘i’s Hāna Belt Road:Seventy-Four Bridges, Fifty-Five Miles

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Introduction

The Hawaiian Islands feature an enticing array of historically significant roads and bridges. Notable examples are Maui's Haleakalā Highway, Volcanoes National Park roads on the island of Hawai‘i, remnants of O‘ahu's Old Pali Road, and the North Shore section of the Kaua‘i Belt Road. The Hāna Belt Road is, without doubt, Hawai‘i's most unique and best preserved historic road. This winding thoroughfare runs along a narrow strip of Maui's northeast coast from central Maui to the remote community of Hāna, then onward to Kīpahulu. The Hāna Belt Road is renowned for its rich cultural landscape; breathtaking scenic vistas; a narrow, sometimes precipitous roadway; and its one-lane bridges, which are the road's most prominent, character-defining feature. In a fifty-five-mile stretch of road, there are seventy-four one-lane bridges and culverts, most of which were built between 1908 and 1947. Three of these historic bridges have been replaced since 2011 and reflect the historic character of the original structures.

The Hāna Belt Road passes through some of Hawai‘i's most rugged topography and rainiest climate. East Maui is the dormant volcano Haleakalā, which rises to 10,023 feet above sea level. Haleakalā's lava flows created the jagged coastline upon which the Hāna Belt Road is aligned. The mountain's wet, tradewind climate promoted the growth of dense forests and facilitated stream erosion that carved a rough terrain of great sea cliffs and deep, v-shaped valleys. These conditions made East Maui one of Hawai‘i's most isolated and inaccessible districts.

Figure 1: The Hāna Belt Road near Honomanū. (Photograph by author.)

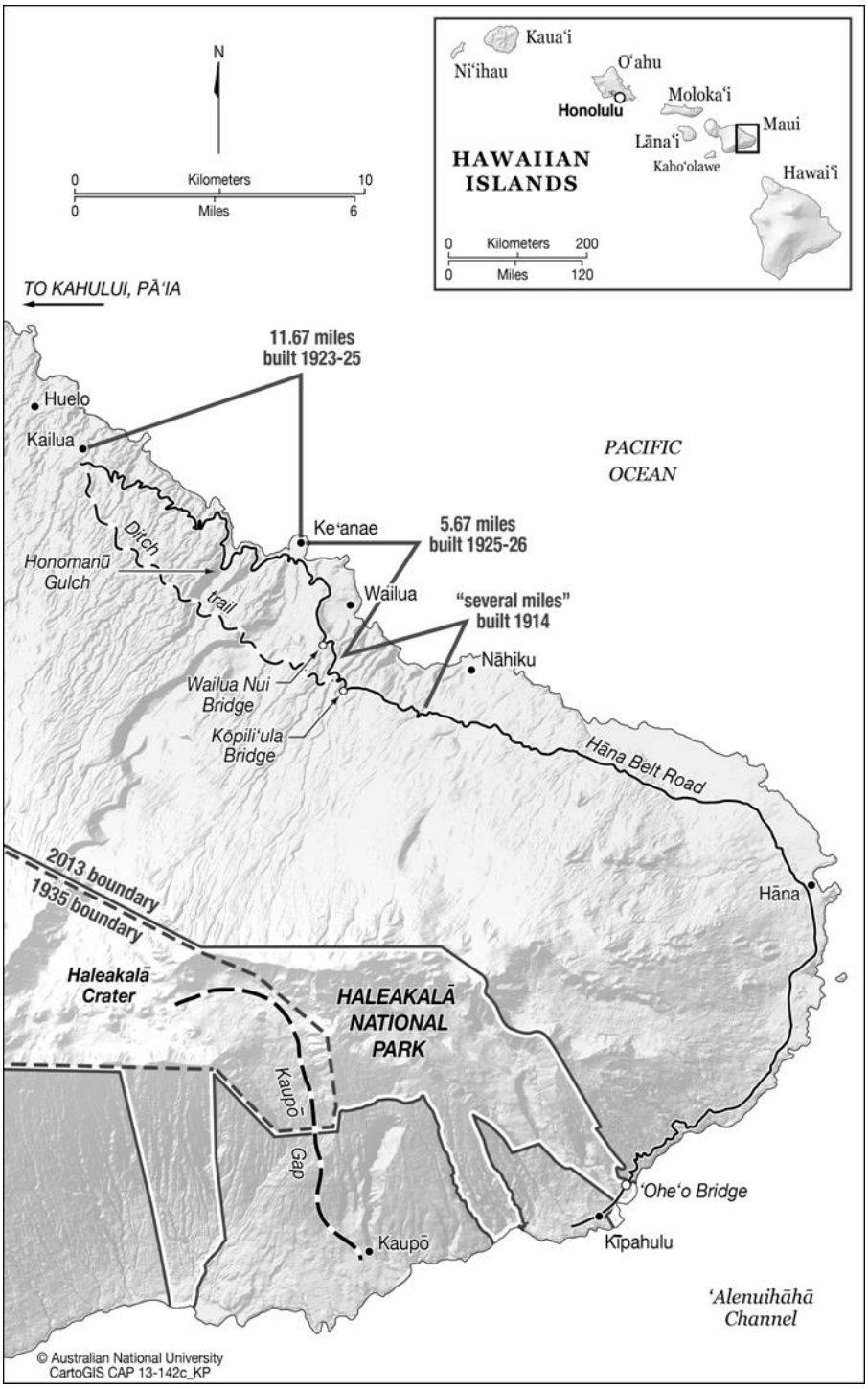

Figure 2: Hāna Belt Road, Maui, Hawai'i. Extending for nearly fifty-five miles along East Maui's coast, the Hāna Belt Road required seventy-four concrete bridges and culverts to span the area's gulches and streams. Although frequently considered part of the 'Hāna Highway', the road between Hāna and Kīpahulu is properly called Pi'ilani Highway. Haleakalā Crater was part of Hawai'i National Park when the Hāna Belt Road was completed in 1926. Haleakalā National Park was declared in 1961.

This paper examines the Hāna Belt Road and bridges as a remarkable civic achievement and an engineering feat that substantially influenced Maui's economic and social history. The road was a tremendous financial and technical undertaking for a small county government on an isolated Pacific island in the early 1900s.

The majority of Hāna's bridges are simple flat-slab and concrete-deck girder structures that feature solid parapets or balustrade walls. A handful of bridge parapets are unique. Five concrete-arch bridges grace the road, as do two masonry-arch bridges built of native rock. Many of the bridges are only 13 to 16 feet wide; the longest structure is Waikani Bridge at 108 feet.

Figure 3. About half the Hāna Belt Road bridges feature a reinforced-concrete parapet of simple vertical balusters and a square concrete rail cap. (Photograph by author.)

It may seem an exaggeration to claim that these simple one-lane bridges and narrow road are a remarkable civic and engineering feat. From our globalized perspective of 2017, it is difficult to imagine how disconnected and secluded Hawai‘i and its Hāna coast were in the early 1900s. The Hawaiian Islands are one of the world's most isolated archipelagos. Furthermore, East Maui was one of the most isolated districts in Hawai‘i. Before the road was built, it was if Hāna were on another island. A horse trip involved several days' travel—perhaps a week if the weather was bad—through rough country, sometimes in torrential rain and through raging, flooded streams. Steamer service was unreliable and uncomfortable.

Figure 4: Hāhālawe Bridge is one of two masonry-arch bridges on the road south of Hāna. Built of cut basalt blocks, the structure displays fine details and workmanship. Its solid parapets of reinforced concrete are typical of about half of the Hāna Belt Road bridges. Masonry-arch bridges were common in late nineteenth-century Hawai‘i, but by 2013 only nine remained in the islands. (Jet Lowe. HAER HI-75-136, Library of Congress Prints and Photographs Division.)

The Hāna bridges are obviously not landmark structures like the Ironbridge, Golden Gate Bridge, or Sydney Harbour Bridge. If the Hāna bridges are considered individually, they are nothing more than dinky bridges. Together, however, this collection is the greatest concentration of stylistically consistent historic bridges in the Hawaiian Islands, a distinctive and rare historic resource—not just for Hawai‘i. It is extraordinary that this road and its bridges, which were designed and built to carry horses and Model Ts, maintains its historic character while carrying about 900,000 vehicles annually. The road is one of Maui’s most popular tourist attractions.

Until the late 1990s, the Hāna Belt Road was remarkably unchanged. I first drove the road in 1989 and was astonished. It was as if I had been transported back to another era. I had never seen anything like it: mile after mile of tiny one-lane bridges—a few barely ten feet in length—connected by narrow, substandard roadway. In the early morning with no traffic, it was as if I was driving in a time warp. I recall being in a hurry on my return journey, and a bit irritated because I wasted so much time pulling aside to let oncoming cars pass. I wondered how this relic from the past had survived into the modern age. That, however, is another story.

The Hāna Belt road's early history

For Hawaiians, the outrigger canoe was frequently the preferred 'bridge' from one place to another. Hawaiians traditionally relied on their highly-developed navigational skills and traveled by canoe to other locations on their own island as well as to other islands in the archipelago. Until 1781 the Hāna District was politically connected—not to Maui—but instead to the neighbouring island of Hawai'i located across the sometimes perilous 'Alenuihāhā Channel. The Hawaiians also traveled overland and were skilled engineers. In the 1500s they built a belt (around-the-island) trail that completely encircled Maui, part of which was the predecessor trail to the Hāna Belt Road. Missionaries touring Maui in 1829 reported that a 'paved' track extended more than thirty miles along the coast and helped them ascend and descend the coastal mountains to Hāna. (Missionary Herald, 1829.)

The Hāna Belt Road's modern history dates to the 1840s when the Kingdom of Hawai'i's first constitutional government was established. By the 1850s district road boards were improving trails and building bridges to meet western standards and expectations. Although few tourists visited Maui in the nineteenth century, as early as 1869, their travel accounts demonstrated the need for a good road to Hāna. Visitors revealed the enchantment of East Maui, with its 'wild and ever-changing panorama' of steep precipices, frequent cascades, tropical vegetation, and the Pacific Ocean. Many were fascinated by their encounters with Hawaiians and their culture. Travelers also described the impenetrable forests and swamps that hampered their progress, lamenting that the so-called 'highway' was 'wretched' and 'abominable', a disgrace to the government, and the worst road in the Kingdom of Hawai'i. Travelers nevertheless claimed that East Maui was 'just the country to delight the tourist', claiming that the 'paradisiacal' scenery in 'the Switzerland of Hawaii' more than compensated for the discomforts of the rough track and rainy weather (Whitney, 1869; Bowser, 1926; Clark, 1888: 93, 95). The government nevertheless refused to extend the wagon road to Hāna, emphasizing the extreme difficulties of maintaining the Hāna District's bridges and seventy-eight miles of road. It asserted that the region was too extensive and too sparsely populated to justify much expense on a road (Minister of the Interior, 1886, 1890).

The Hāmākua Ditch, completed in 1878 to carry water from East Maui's rain forests to central Maui sugar plantations, was probably the catalyst for initiating more regular travel along the Hāna Coast. To facilitate construction of the ditch, the government road was improved, and new access trails were built (Clark, 1878). These trails, as well as others constructed for subsequent ditches, became useful horse paths for the traveling public.

Initiating a Bridge program for Hāna

Hawai'i was organized as a United States territory in 1900, and the new territorial government assumed the responsibility for roads and bridges. On Maui, businessmen and politicians demanded a good wagon road through to Hāna in order to open land for farming and small industries. They claimed that this road was just as crucial for Maui's

development as the Panama Canal had been for the Hawaiian Islands and America's West Coast. The territorial superintendent of public works acknowledged the road's importance but explained that because the Hāna trail ran through 'very rough country', it was being built 'as narrow as possible in order to construct, with the money available, the maximum length of road'. At this point, district road taxes levied on adult males financed most maintenance and construction projects; occasionally special appropriations were available. For the most part, Hāna's sparse population meant that funding and labour were always inadequate. New construction in the Hāna District was therefore limited; routine maintenance and repair were often impossible. In ideal conditions, wood bridges might last twenty years. In East Maui, wood bridges were constantly damaged or destroyed by floods, insects, and/or rot. Freshets during the winter rainy season sometimes made travel impossible, as in 1902 when mail carriers could not complete their rounds (Duensing, 2015: 141-142).

In 1905 the Territory of Hawai'i initiated a system of local county governments and assigned them the responsibility for public works. The territorial government, however, retained the power to tax. As a result, county governments were forced to finance most public works through loans subject to the approval of the territorial and federal governments. The new Maui County Board of Supervisors (BOS) was progressive and proactive, which proved to be a great leap forward in obtaining infrastructure. The BOS set a precedent in Hawai'i when it hired a county engineer, Hugh Howell, who had previous experience in surveying the Hāna Road. Despite the limited funding, Howell endeavoured to be economical and keep the road passable to traffic (Maui News, 7 April 1906; 6 January 1906).

By 1908 the Maui BOS, in cooperation with the Maui Loan Fund Commission, which was charged with prioritizing Maui's infrastructure needs, embarked on a program to modernize the island's road system and build reinforced-concrete bridges in East Maui. Twenty such structures were built from 1908 to 1913. Building concrete bridges followed the territorial superintendent's directive to build 'permanent improvements' and represented a major step forward (Holloway, 1904: 4-5). Howell had his work cut out for him: East Maui had forty-seven bridges in 1908, all of which needed maintenance, and preferably, replacement. County engineers designed mostly flat-slab and concrete-deck girder structures, which followed the pattern set in America, where roads and bridges were being upgraded to accommodate the automobile. On Maui flat-slab and concrete-deck girder bridges were both economical and efficient over short spans.

Howell also designed more technologically advanced structures, including Koukou'ai Bridge in 1911. This open-spandrel concrete-arch bridge was sophisticated engineering for its time. It demonstrated that although Maui was physically isolated, it was not backwards: its engineers were aware of advances in technology. John Waddell, writing in his 1916 engineering manual, observed what Howell already knew: concrete-arch structures were 'eminently proper and economical' for deep gorges with rocky cliffs that could serve as natural abutments (Waddell, 1916: 618). Robert McCullough, writing about the state of Vermont's historic bridges, asserted that concrete-arch structures were durable and graceful, and 'symbolized progress in the quest for good roads' (McCullough, 2005: 171).

Maui's concrete bridge program was well underway during the 1910s. It may seem odd that authorities focused on building bridges before a good road was built to connect them. There were likely several reasons for the strategy. First, the new concrete bridges were safer and stronger, and less likely to wash away in floods. It was sensible to quit wasting money on high-maintenance wood structures. In addition, bridges were cheaper, easier projects compared to road construction. It was less complicated to design, get approval for, and obtain loans to construct a $2,000 bridge as compared to a more complicated $150,000 road project. Maui's bridge-building program was vital because it paved the way for future road construction projects when money became available.

Justification for the road

Concurrent with the drive to build permanent concrete bridges was a new development that justified road construction on Maui, especially in the Hāna District, where the 'Ditch Trail' had become one of the island's most popular tourist attractions by 1913. Six articles in the Mid Pacific Magazine raved about East Maui's trails in 1915 and 1916, using superlative terms to prove that the windward coast's scenery was 'unequaled in grandeur'. An unidentified author praised Honomanū Gulch as having beauty that 'baffled' description, claiming that if its attractions were publicized, 'tourists in plenty would assuredly visit it to gaze down its two-thousand foot depth, and to feast their eyes on the wonderful vistas which it affords' (Mid Pacific Magazine, February 1915). Another sightseer enthused that the panorama was so stunning that the journey should be walked, in order to enjoy it longer and not miss anything (Walker, 1915). Novelist Jack London was exuberant about his thrilling encounters through this 'Maui Wonderland' (London, 1915).

A Maui News editorial claimed that a scenic road along the Hāna Coast was the 'key to progress' that would put Maui on the 'tourist map' (Maui News, 16 May 1914). Perhaps as a result of visitors riding the 'Famous Ditch Trail' and the publicity generated in periodicals like the Mid Pacific, the argument for a road shifted from the utilitarian purposes of commerce and opening land for homesteads to the profitable advantages of building a scenic highway to attract tourists and start a new industry on Maui.

In 1912 loans were approved to build a road between Nāhiku and Keʻanae. John Wilson and Lou McCandless were awarded the contract, which included building Kōpiliʻula Bridge. Although the road was not much more than a dirt track, the bridge was one of two unique structures on the Hāna Belt Road. It featured two-foot-thick, solid concrete parapets, a road deck approximately 17 feet wide and 77 feet long. Wilson's firm was plagued by heavy rain but completed the project in 1914. Unfortunately, the new road was useless because it ended in the middle of the forest (Maui News, 25 July 1914; 14 November 1914).

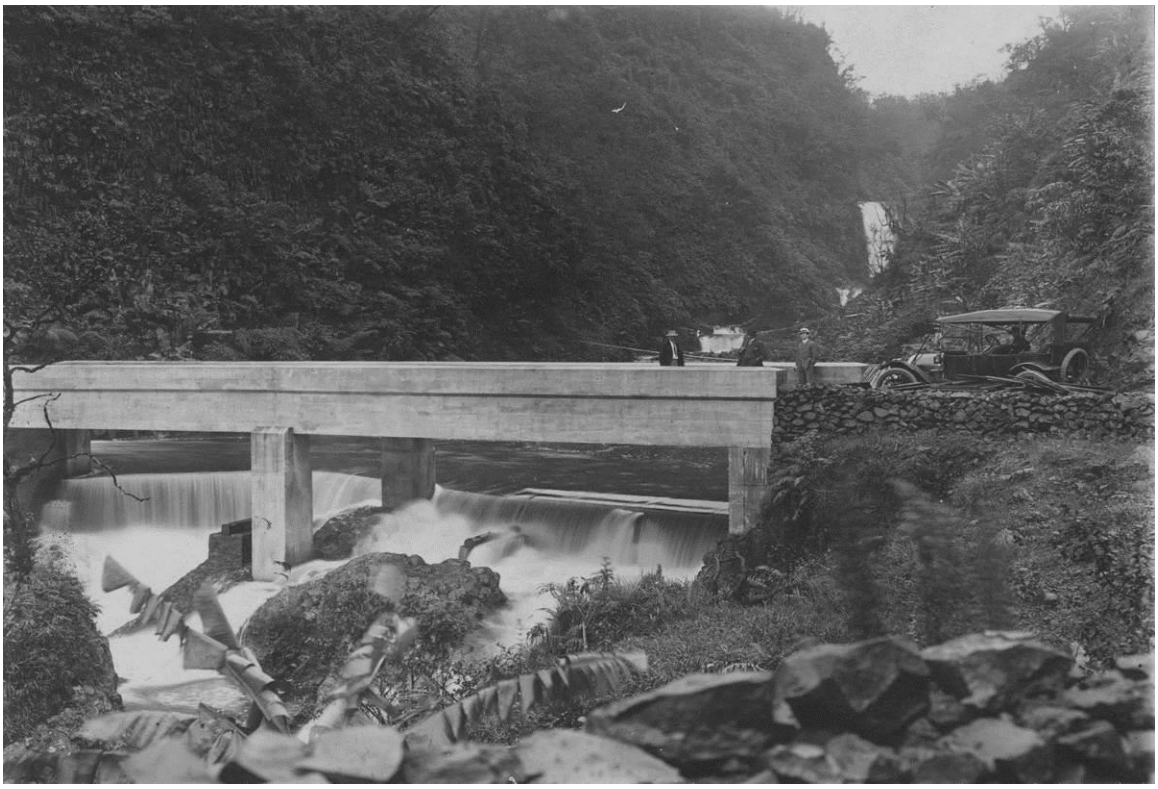

Figure 5: ‘West Kopiliula Gulch, McCandless & Wilson Contract’. Kōpili‘ula Bridge is one of two structures on the Hāna Belt Road that featured two-foot thick solid concrete parapets with peaked railcaps. The Hawai‘i Department of Transportation Records note that this bridge was built in 1926, but it is likely, according to the photograph label, that it was constructed about 1914, in conjunction with Wilson’s Nāhiku road project. (Courtesy Hawai‘i State Archives.)

Maui officials subsequently proposed spending $135,000 to close the gap and extend the road into Ke‘anae. Territorial Governor Pinkham vetoed the funding, emphasizing that the work was ‘entirely beyond the means of the Territory or the County of Maui’. He surmised that a more accurate price tag for the project was $300,000. Pinkham was a fiscal conservative concerned about the precarious economic situation during the First World War. He moreover objected to the road because he believed it had no utilitarian purpose; Pinkham saw no potential for tourism along the Hāna coast. Politics was likely a factor, and Pinkham declared that if Maui wanted this road, there were people ‘rich enough’ to finance it. This method, in his view, was appropriate: residents should build ‘Maui improvements with Maui money’. He encouraged Maui officials to instead concentrate on building roads to Maui’s other popular tourist attractions, Haleakalā and ‘Īao Valley. (Duensing, 2015, 144-145).

Road building stalled, yet the county continued its bridge program. In 1916, a new local contractor, E. C. Mellor, built a concrete barrel-arch bridge at ‘Ohe‘o Gulch in Kīpahulu (Maui News, 25 August 1916). The second of five concrete-arch structures built on the

road, ‘Ohe‘o Bridge, like nearby Koukou‘ai Bridge, demonstrated not only the Maui engineers’ expertise in applying modern technology but their fine aesthetic sensibilities.

Figure 6: ‘Ohe‘o Bridge, Kīpahulu. (Photograph by author.)

Building the road

In 1923, civic and business leaders finally obtained loans to build the Hāna Belt Road. Their success was due to tenacity, politics, and the improved postwar economy. Hawai‘i shared in the good fortune of America’s prosperous 1920s, and its territorial and county governments spent heavily on capital improvements. It also helped that Hawai‘i now had a Republican governor, Wallace Farrington, that Maui’s solidly Republican board of supervisors could work with.

County Engineer Paul Low prepared surveys and estimates, relying on some of the earlier studies completed by Howell and other engineers. Low’s decision to handle the job as two projects probably reflected the need to work in manageable units as far as difficulty and cost were concerned. Low planned to build twelve miles of road to Ke‘anae first, which was only four miles as the crow flies. This road would provide an access track for construction and when completed, a direct road link between Ke‘anae and communities on the other side of Maui. The second phase entailed building nearly six miles of roadway and twenty bridges between Ke‘anae and Nāhiku. Low estimated the total cost at $692,000, including macadam surfacing (Maui News, 19 January1923).

There is little archival evidence regarding the construction of the project’s first phase, which opened with fanfare in June 1925. Governor Farrington led a celebratory procession of about 1,500 persons in 250 cars to Ke‘anae and boasted that the road marked a new era in Maui’s history. Farrington predicted that this scenic road would be a

‘tourist paradise’ that would start a new ‘industry’ as valuable as sugar and pineapple — not just for Maui — for all of Hawai‘i (Maui News, 13 June 1925).

Many participants in the automobile procession were probably local residents, who drove the road and enjoyed vistas they had never seen. Honomanū Gulch, which had thrilled adventurers on the Ditch Trail, was the journey’s climax. A superb piece of engineering, the serpentine roadway descended down a steep mountain cliff, through the valley floor, and across several bridges before climbing up another steep cliff to exit the valley. From high points along the road, motorists could gaze back across Honomanū Bay to see the road they had travelled across.

The second phase of the project, although less than half the distance of the first, proved to be much more difficult. An analysis of the work underway from August 1925 until the road opened in December 1926 highlights the challenges in building the final miles. It demonstrates the perseverance and skill of Maui’s leadership, engineers, and labourers.

Two steam shovels were apparently the only heavy equipment used to build the Hāna Belt Road. The machines worked from both ends of the road alignment and were sometimes out of service due to mechanical breakdowns, mishaps, or landslides. One time a steam shovel fell upside-down into a gulch when an embankment collapsed. Workers had to disassemble it piece by piece and take it to central Maui for repairs. Soon after this accident, the other machine broke a gear. Another time a landslide trapped a steam shovel with tons of rock and dirt. The shovel was extracted from the mess the same day, but progress was halted by another landslide the following day (Maui News, 25 November 1925; 9 January 1926; 13 March 1926).

The Hāna Belt Road and bridges were built primarily by hand labour, especially in the more inaccessible locations. Three crews of fifty men each built the road. In order to save on expenditures, two of the crews were prison labourers. In some locations, the men worked against solid rock that required considerable blasting. To accomplish this, workers with thick ropes tied around their waists were lowered over the steep cliffs. They dug footings in the rock, set their drills, bored holes in the rock, and set the powder and fuses that blasted the new roadbed.

Above Wailua there was a solid wall of rock 110 feet long. It is a remarkable piece of engineering and scenery where the road is literally a bench on the precipice. To build it, men hung from the cliffs, tunneled into the rock in ten locations, and placed large charges of dynamite to blast out the rock. After the blasts, the steam shovels moved in. In many other places, workers used hand tools to clear the path for the steam shovels (Maui News, 15 May 1926).

Among the impressive accomplishments of the final year of work was bridge construction. An examination of various records indicates that that twenty, perhaps twenty-one, bridges were built in 1926. This is an extraordinary achievement considering the working conditions and environment. Access was usually a challenge as there was sometimes no road to haul materials to the bridge site. Sometimes materials could be delivered by pack animals over horse trails or the new track of the road. In other cases supplies were shipped to the nearest beach and then hauled up the cliffs and valleys to the construction site. Concrete was mixed on site and poured by hand using simple form work. Masonry bridge abutments and retaining walls were hand-laid using rock from

excavations and blasting. From start to finish, all the work was complicated by heavy vegetation, torrential rains, floods, and landslides.

Figure 7: Assistant county engineer A. H. Wong designed West Wailua Iki Bridge for one of the coast's most spectacular settings. Charles Bailey supervised the construction of this elegantly curved three-span structure in 1926. (Photograph by author.)

In light of the challenges, it may seem surprising that Low delayed the opening of the new road by only a month. After a year of digging through mountains and blasting through solid rock, the steam shovels finally met at the foot of Waikani Falls above Wailua in August 1926. Waikani Bridge was scheduled to be built as one of the project's last tasks so that the new roadbed could be used to deliver materials to the bridge site.

Moses Akiona, a Chinese-Hawaiian from the nearby village of Keʻanae, was awarded the contract to build Waikani Bridge. Designed by Low and Maui architect William D'Esmond, the open-spandrel concrete-arch structure featured two rib arches and was 108 feet long, 17 feet wide, and 90 feet high. The bridge was strategically located for maximum scenic effect in front of Waikani Falls. It gracefully spanned the deep gorge at the end of the mile-long elevated bench that Low himself had described as 'without comparison'. Driving along the cliff for a mile towards the end of the valley, motorists would enjoy the view of a graceful arch bridge framed by the stunning scenery of Wailua, its lush vegetation, waterfalls, and steep cliffs (Maui News, 11 August 1926; Low, 1926).

Akiona's crews made excellent progress in building Waikani Bridge: they poured the arch ribs and erected the forms for the superstructure. The bulkhead walls and both end spans were nearly completed. Despite everyone's best efforts, East Maui's notorious weather interfered with the timely completion of the bridge. The same day that the Maui News announced the Hāna Belt Road's opening date, heavy rains washed out the bridge's formwork and scaffolding. Six-hundred bags of cement were washed into the stream below, and landslides covered the roadbed near the structure (Maui News, 17 November 1926). Despite the setback, within three weeks of the flood Akiona's team had completed the superstructure and was finishing the bridge railings. Waikani Bridge carried traffic on opening day, although archival photographs showed that the scaffolding had not been dismantled (Wailua Nui Bridge Photograph, 1926).

The Hāna Belt Road opened on 18 December 1926 as 'somewhat of a Christmas present to the people of Maui'. The BOS declared a public holiday on the island to celebrate the event that would open up the 'practically unknown end of Maui'. This long-anticipated connection, according to the Maui News, was a milestone that would 'unite Maui in fact as well as in spirit' (Maui News, 13 November 1926). The day's activities included a 200-car motorcade over the road to Hāna and a lūʻau (Hawaiian feast) that served about 3,500 guests (Maui News, 22 December 1926). Hāna's visitors that day surely exceeded its population as the entire district consisted of only 3,100 residents in 1920 (Schmitt, 1977: 13).

Challenges continued. The night the road opened, rain caused a small landslide, which closed the road for several hours the next morning. Future work included widening the roadbed as well as replacing the remaining wood bridges with reinforced-concrete structures. In 1927 all the bids to build Kūhiwa Bridge exceeded the budget, so Low assembled a crew from his county engineer department to erect the concrete-arch structure for less than his estimated cost (Maui News, 12 November 1927). More bridges were built in 1928 and 1929; the last two wood bridges were replaced in 1947. Although

the road was opened to traffic in 1926, much remained to be done to improve it to the standards expected by the average tourist: widening, improving grades, and surfacing. The road was finally paved in the 1960s

Conclusion

The Hāna Belt Road was an outstanding civic and engineering achievement that influenced Maui's economic and social history by ending centuries of isolation for East Maui residents and paving the way for tourism in the Hawaiian Islands.

Maui County supervisors—especially William Pogue, a descendent of American missionaries and Samuel Kalama, a popular Hawaiian politician—supported this project for decades and tenaciously pushed it through to completion. They led Maui during a critical period in the island's history, when county government was in its infancy and assumed authority for building roads and other infrastructure. The two men were largely responsible for assembling the project's financing, work crews, and a team of capable, talented engineers. Between them, Kalama and Pogue chaired the Maui BOS for nearly the entire duration of the Hāna Belt Road campaign and construction. The men doggedly pursued their goal despite naysayers like Governor Pinkham, who had declared that building the road was well beyond the resources of any government in Hawai‘i.

Maui financed the entire road and bridges on its own—in stark contrast to today, with local governments heavily dependent on state or federal appropriations for infrastructure projects. Maui County borrowed more than $388,000 for the Hāna Belt Road from 1921 through 1925. In sixteen years, the county borrowed more than $1.5 million to build the island's belt-road system, much of this was spent on the Hāna road and bridges (Hirashima, 1939: 40). More loans were obtained to finish the remaining bridges, the last of which was built in 1947. This was a substantial investment for a road through almost uninhabited rain forest and for an island population of only 38,000 people, the majority of whom were low-paid agricultural labourers who lived in company housing and did not even own car.

The engineering talent that contributed to this project over the decades was exceptional for any small community of the era. Hugh Howell obtained an engineering degree from the University of California and came to Hawai‘i in 1894 to work for the sugar industry. He surveyed the Hāna Road as early as 1897, worked several stints as the county engineer, and thereafter embarked on a successful career in the private sector (Nellist, 1921: 211). Paul Low and A. H. Wong, both Chinese Americans born in Honolulu, earned engineering degrees from Stanford and Purdue universities respectively, at a time when most Hawai‘i citizens of Asian ancestry could only dream of higher education, much less completing a course at a prestigious university. Low had extensive experience working on public infrastructure projects both in Hawai‘i and overseas before he became the county engineer in charge of building the Hāna Belt Road. Low later became the first Chinese American elected to the territorial senate (Newton, 1939: 65). Wong worked on various infrastructure projects with local, territorial, and federal government agencies during the course of his career and was involved in several major work-relief

construction projects during the Great Depression (Maui News, 4 December 1945). Architect and civil engineer William D'Esmond designed and supervised a wide variety of civic and residential projects on Maui; he was trained at the British Army Engineering School (Nellist, 1925: 398).

Considered individually, the Hāna Belt Road's bridges are unremarkable and commonplace. Viewed as a collection, however, the bridges present a consistent and simple design that complements a spectacular landscape. Built to access scenery, the historic Hāna Belt Road is now part of the scenery, a tourist attraction in its own right, and an integral element in East Maui's treasured cultural landscape.

Hāna's one-lane bridges are the speed bumps in modern life, causing drivers to slow down and reflect, be courteous, and enjoy the journey as well as the destination. While landmark and iconic bridges easily capture our attention, it is essential that we also pause to appreciate the artistry and beauty of these local monuments to our heritage.

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The Knowledge of a Three Arched Stone Bridge in the Alpine Region Based on the Comparison between Historical Analysis and Diagnostic Data

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Introduction

Ganda Bridge at Morbegno is located in the north of Italy, across the Adda river, about 15 km upstream from the Como Lake, in the very heart of the Alpine Chain. The original bridge was built during the Renaissance by the famous architect Johanne Antonio Amadeo, chief engineer of the Duke of Milan. However, during its lifetime the bridge was damaged by numerous river floods and war episodes, until in 1772 it was so badly damaged by a river flood complete reconstruction was necessary. At Ambrosiana Library in Milan many documents are filed dealing with this work of reconstruction, allowing a detailed knowledge of the design specification of a bridge construction work dated during the late XVIII century.

Recently a careful inspection was carried out on the bridge with the purpose of assessing its structural conditions. The geometric survey, that allowed also the detection of crack and deformation pattern, was done through laser-scanner. Operation by rope access and positioning furthermore allowed the execution of a close visual analysis of the state of conservation of the structures. The diagnostic on site tests were then performed both by Non Destructive Test and Slightly Destructive Test methods.

It was therefore possible to acquire a great deal of information about geometry, materials and construction techniques; which were then matched with historical data, thus pointing out similarities and differences between the original design specifications and the current bridge, both in geometry and construction.

Historical summary

In the XIV and XV centuries, the Valtellina area made up the Northern border of the Milan duchy and despite being protected by the Alps on one side, was very vulnerable to attack. In 1486/1487 the Grigioni (allied with the Swiss confederates that lived in the area currently named Canton Graubünden) invaded a large part of the duchy reaching the northern shores of Lake Como. The invaders quickly withdrew but it was a clear indication of how vulnerable the area was.

Ludovico il Moro, that at the time was governing on behalf of his nephew Gian Galeazzo Sforza (and in 1994 became Duke of Milan) began a renewal programme of Valtellina's fortifications (Scaramellini, 1981) building the walls of Chiavenna and Tirano, the defensive wall of Serravalle and the Piattamala castle. Bridges and streets damaged during the invasion were then repaired. The most urgent repairs were carried out on the valley roads in Desco and Sassella and on the bridge over the Masino creek;

furthermore it raised the necessity to build a bridge connecting Morbegno with the road along the right bank of the Adda river, not far from Traona (Fig. 1).

Bridge construction

From historical documents, it is clear that right up to the final decades of the XV century, there was no bridge spanning the Adda river between Morbegno and Traona; yet in 1477 the two banks were connected only by a wooden walkway (Grigioni, 1981).

The first records of bridge building arrive in 1489 due to a dispute between the inhabitants of Morbegno and Traona concerning where the bridge should be built. In the same year, the visit to Morbegno of the master architect Johanne Antonio Amadeo (note 1) is recorded who should give indications concerning how and where to build. Due to continued local resistance, Duke Ludovico il Moro sent also the ducal engineer Stefano Bascapè, known as "Buratto" to Morbegno, to agree on a final project. He confirmed the position located by Amadeo. Work began, very slowly, so much so that by 1497 the exact location for the bridge was put back under discussion, showing just how little had been achieved. Once more Johanne Antonio Hamadeo reviewed the project and once more confirmed the bridge's original position.

Fig. 1 *Ganda bridge in its natural setting*

In the year 1499 we have the first indication of the bridge being used, so that year we can consider the construction completed.

In 1566, the bridge was destroyed by a flood, rebuilt two years later and reinforced in 1597. The 7th August 1620 it was again damaged during a battle between the inhabitants of Valtellina and Grigioni, that occurred during the 30 years war.

XVIII century reconstruction.

In 1772, another flood almost completely destroyed the bridge. In 1775. The Morbegno and Traona council decided to rebuild it opening a tender for the project: the master builder Antonio Nolfi from Como was selected.

Records show that the project foresaw the demolishing of the two old piers, the reinforcement of the foundations with iron nailed oak poles and the construction of

three new arches at least three arm's lengths wider than the previous structure, thus creating a bridge 113 arms in length and 9 arms in width (note 2).

In 1776 however, Francesco Bernardino Ferrari, an engineer expert in hydraulic questions coming from Milan, was called to "analyze the stability and solidity of the foundations laid by Nolfi". Doubts were raised owing to Nolfi's decision to place the new piers onto the old foundations rather than create entirely new foundations, as had been originally foreseen. Ferrari evaluated the right column as structurally sound but not the left one, built over the old foundation; he was particularly concerned about the absence of oak poles used in setting up the base. His suggestion was therefore, to demolish the bridge and rebuild it according to his specific proposal about the placing of the poles.

After that, work was halted and Ferrari was nominated site director. By October 1776 the new "Chapters for the factory of the bridge" (meaning constructive specifications) were ready with an extra appendix in November that was necessary to set up a seal system allowing work below water level to eliminate the old foundations and embed completely new ones. The end of October 1778 represents the successful conclusion of works for Ferrari, with, however, two anomalies. Firstly the lateral arches were wider than expected in order to narrow the central arch and increase stability. The second being the lowering of the columns and abutments and raising the central arch making the slope of the bridge less acute. A technical drawing of the bridge was also attached to the final documentation (Fig. 2).

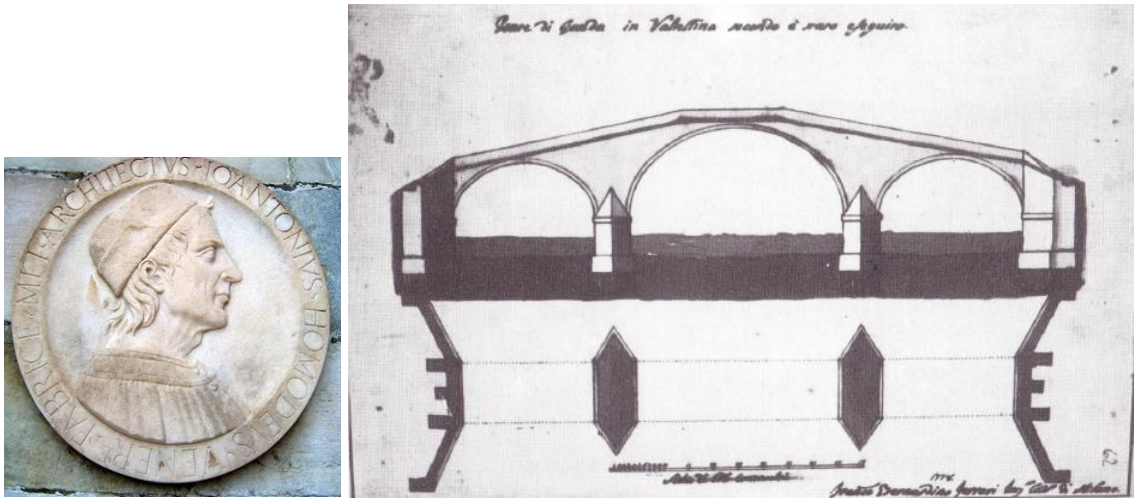

Fig. 2 portrait of J.A. Amadeo on one of the spires of the Milan cathedral (XV-XVI century); sketch of Ganda bridge at the end of the works (1778)

"Chapters" for the construction

The history of the reconstruction of the Ganda bridge is an exemplary case as the Ambrosiana library in Milan, in the Ferrari collection, contains all the historical documentation, henceforth be referred to as the "Chapters" (Grigioni 1980). These documents are of great precision in terms of measurements and technical description and allow the comparison between that defined in the "Chapters" and effective work carried out. Due to space limitations, in this paper there is no reference to the construction of the seal system, described in the appendix of the "Chapters".

Foundation structures as described in the "Chapters"

The bridge will be formed of three clearly distinct arches of 27 - 45 - 27 arms (*13.63 – 22.72 – 13.63 m*) and two columns of 7 arms (*3.53 m*) for a total length of 113 arms (*57.06 m*).

All construction will be carried out using cut stone blocks except for buttresses and infilling of the arches where irregular and river stone can be used. Mortar shall be made of lime and sand of the best quality.

Foundations shall be wider than columns with excavations arriving at 4 1/2 arms depth (*2.27 m*). Poles shall be inserted at the base of the excavations with 5 arms long (2.53 m) iron nailed oak poles tipped with 4 branch elements (Fig. 3) placed at 1/2 arm distance (*25 cm*) from each other. The poles will be sunk into the foundations in such a way that their heads will be just above the level of excavation.

Then, foundations will be raised to the level of the heads using bitumen made with lime and fresh mortar and above this will be laid stone blocks squared on the top and sides, all of the same thickness and perfectly laid down (Fig. 3).

Above this layer squared stone blocks, 5 face slabs of 9 ounce (*38 cm*), laid head to shoulder will be bound with iron ties made sound with lead. Foundation will be built up uniformly, layer by layer, including water breaks.

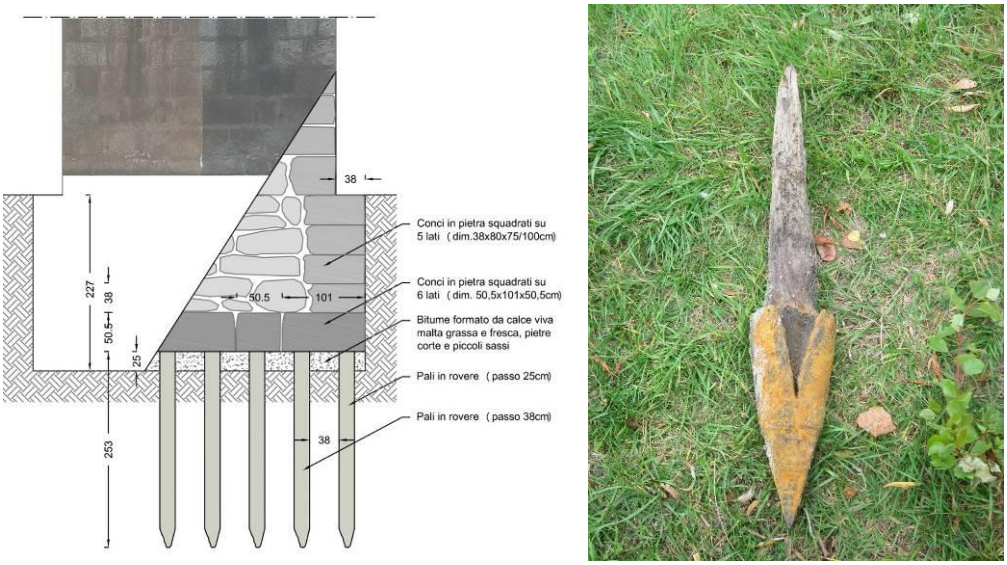

Fig. 3 foundation construction in compliance with the "Chapters"; nailed poles recovered at Bassano bridge site (XVI-XVIII century)

Elevation structures as described in the "Chapters"

Piles will be 10 arms length (*5.05 m*) with two water breaks of 5 arms and 9 ounces (*2.90 m*), for a total length of 21 1/2 arms (*10.86 m*) (note 3). The width of the piles will be 7 arms (*3.54 m*) and their height 10 1/2 arms (*5.30 m).* Above this height, water breaks will form a pyramid.

The abutments will be as long and high as the piles and have three back buttresses. The abutments and spurs will rise above the arch level to create the vaults. Bridge parapets will be proportioned to needs.

Arches will be made of well chiselled and smoothed stone. The central arch will have span of 45 arms and a raise of 15 arms (*22.72 m – 7.58 m*), the lateral arches will have span of 27 arms and a raise of 10 arms (*13.63 m – 5.05 m*). In the Chapters the ratio raise/span equals 1/3 for the central arch and 1/2,7 for the lateral arches.

It is interesting to compare these dimensions with the ones which can be found in Palladio, 1570. In the book III chapter. XIIII a plan for “another bridge of my invention” is shown. The bridge is not well identified but, due to its dimensions, it can be hypothesized it refers to the first design for a stone bridge in Bassano; this bridge was later built with wooden frame as shown in book III chapter IX. It is significant to note that this bridge has a central arch span very similar to the Ganda bridge (21.31 m vs. 22.72 m), albeit with an almost double width. The ratio raise/span used in the Palladian arch is 1/3: 20/60 feet for the central arch and 16/48 feet for the lateral ones (note 4), the same as foreseen by Ferrari in his “Chapters”.

It is also useful to note that Palladian pile width is 12 feet, that means 1/5 central arch span and 1/4 smaller arches; Palladio declared to have "changed and increased ordinary measures" of the piles "in order that they resist river flow strength as well as debris flowing down the river". Ganda bridge piles were designed with smaller width, 7 arms equal to 1/6.4 of central arch daylight and 1/2.8 of smaller arches (which in this case are very narrow). Clearly Ferrari believed that in the case of the Adda river it was not necessary to conform to the criteria carried out by Palladio for the Brenta river.

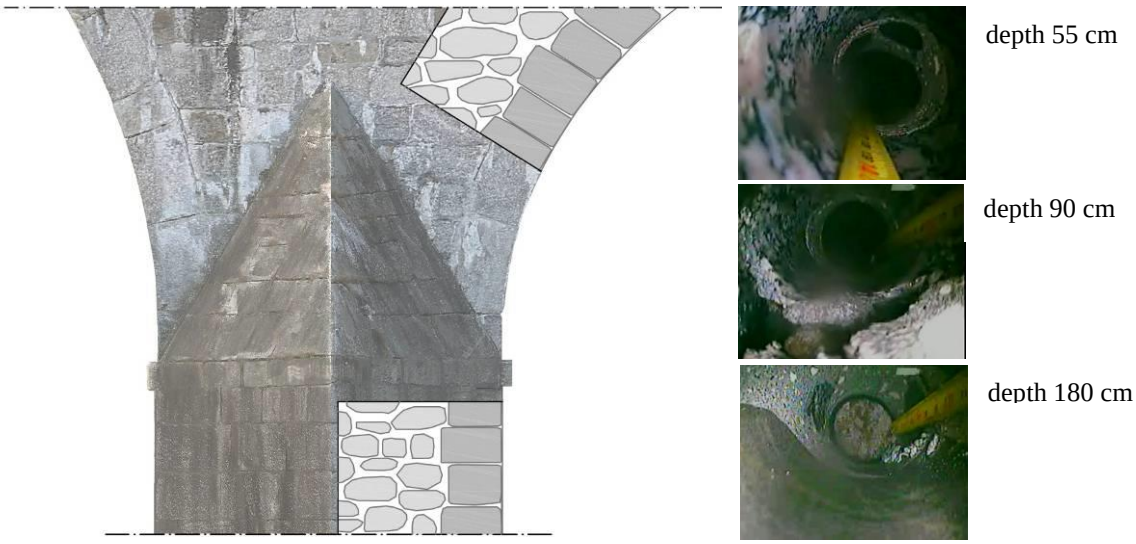

Fig. 4 a pile as shown in the Chapters; images coming from coring holes inspected with endoscopic video camera

At the end of his description Palladio specifies that external arch moulding must be 1/17 span for the central arch and 1/14 for lateral arches, larger than that specified for the Ganda bridge. In this case it has to be observed that on Ganda bridge, the voussoirs are equal to the thickness of the arch, while Palladio’s structures saw external moulding probably not corresponding to structural thickness because it has merely decorative function.

In the “Chapters” a thickness at keystone of 15 ounces (*63 cm*) is recommended, as is the thickness of the voussoirs. Arches will be constructed of natural stone, of 15 ounce

(*63 cm*) size and reinforced with 17 iron bars as long as the width of the bridge. Infill will be in masonry, raising the abutments and buttresses using squared cut stone connecting the crown of the vaults to the height of the wings.

In the "Chapters" there are further references to the building of parapets with half egg decoration, but these are not relevant for the present discussion.

Surveys and inspection

Operative methods

Geometric survey of the structure was carried out with laser scanner enabling the quick and precise results required and the collection of sufficient data for the successive structural analysis as well.

The HDS 7000 (Leica Geosystems) scanner was used for 3-dimensional scanning which enables the creation of point cloud models at 1 million dots per second at an accuracy of +/- 1mm at a range of 1m-50m. Single scans were correlated and fully geo-referenced to describe the complexity of the structure in a single point cloud model (fig 5). Using the Cyclone programme (Leica) the geo-referenced calculation makes use of both topographic target points and surface super imposing guaranteeing a correct correlation across scans. Autocad was then used to vector the following phases creating a skimmed point cloud model depending on the sections chosen – an essential operation to manage the vectored model with sufficient agility.

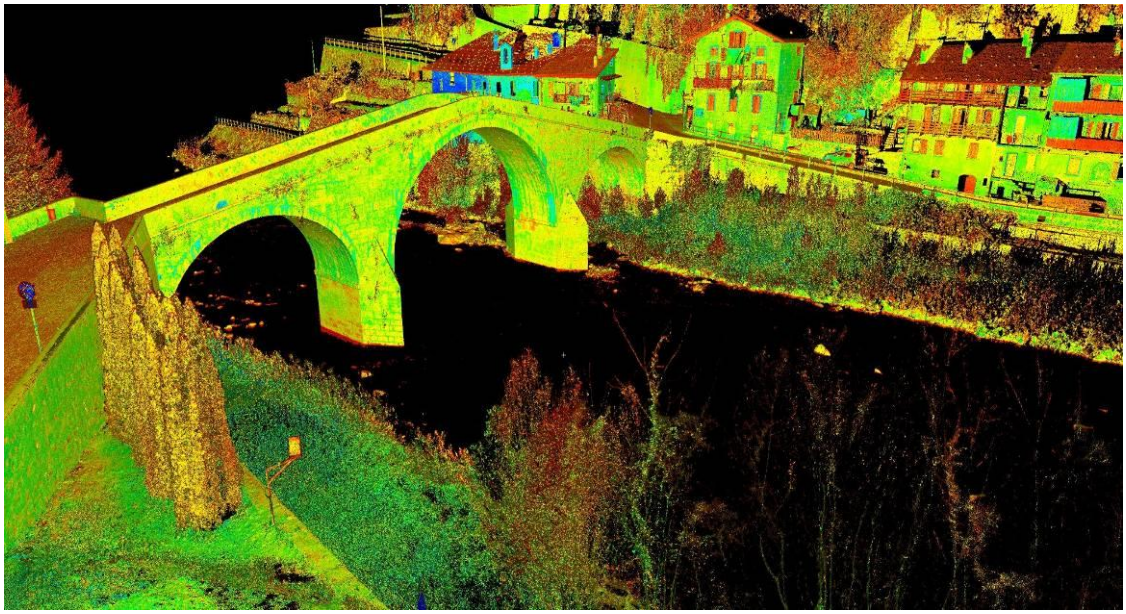

Fig. 5 point cloud model coming from laser-scanner survey of the bridge

Cracking and deformation conditions were analyzed through direct surface inspection: for this purpose access and positioning methods by ropes were chosen as the best and safest procedure (Fig. 7); this choice also proved to be the fastest way to gather relevant structural and conservation data.

Differences between the Chapters description and current condition

Current dimensions are highly similar to those specified in the Chapters, excepting the differences reported by Ferrari at the end of his works: the widened side arches (current dimensions 14.28-21.55-14.26 m) and the lowered columns (current dimension 3.91 m). This changes the ratio raise/span, increasing the acuteness of the arches with a current ratio of 1/2.48 for the central arch and 1/2.63 for the lateral arches.

One must ask why this geometric difference from the Chapters came about (especially thinking that the final project was in compliance with the state of art as proved by the comparison with Palladio's book). Ferrari declared the changes, narrowing the central arch, were necessary to increase stability and reduce crossing difficulty, even though the original project specifications foresaw the central arch at least three arms wider than the previous structure. It can be noted that using these dimensions, the bridge could be built on the same foundations as before, possibly even using part of the previous structure. Current structural calculations show the 1/3 ratio, as defined in the "Chapters", as the most efficient; the stability of 1/2.48 arch requires the structural contribution of pile infilling material, thus still reproducing the original project.

A further difference can be seen in the arch and piers width that is 12 arms rather than 10 as requested by the "Chapters" (*6.19m vs 5.05 m*), probably with the goal of widening the bridge deck. Finally the thickness of the voussoirs is lower as the blocks are slimmer than those specified in the "Chapters".

Stone lythology and signs carved by stonecutters

The type of stone used is uniform, 90% magmatic, typical of the Val Masino area. There is also a small quantity of brown metamorphic stone, gneiss and even some grey and lighter colour stone, changing in grain and texture.

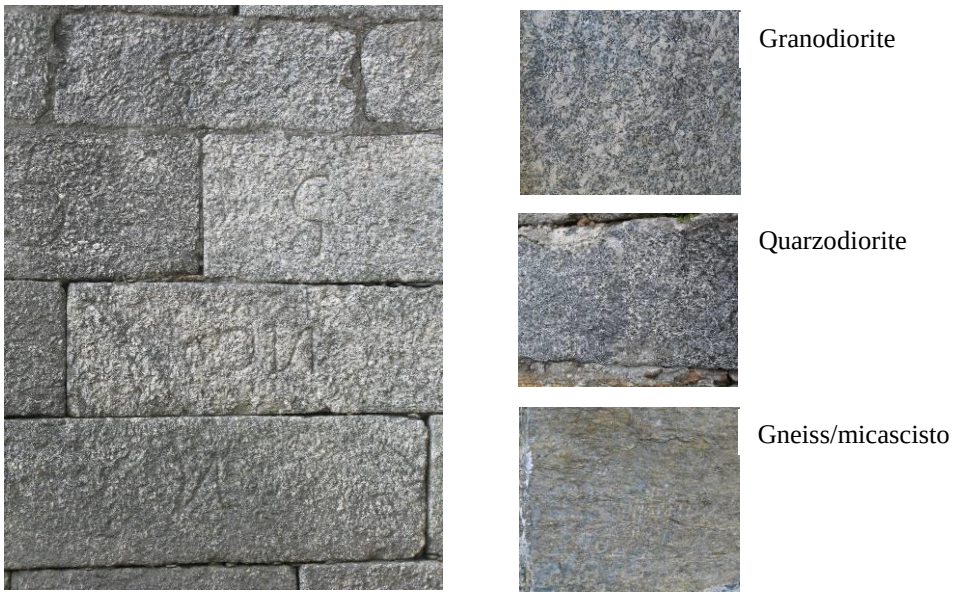

Fig. 6 signs left by the stonecutters during construction

From close up, many signs left by the stonecutters during construction can be seen (Fig. 6). The symbols, probably marks made by stonecutters, are grouped together principally in 3 groups, Z, Ç and NO. There is no order to the symbols suggesting no particular

assembly hierarchy. Stones were laid with great care while external mortar, due to the limited thickness of the joints, is eroded or absent, while the erosion not reach serious depth inside the structure.

General structural conservation

Rope inspection of both sides of the bridge gives a detailed analysis of cracks and deformations as well as the general state of bridge conservation. Voussoirs and external parameters maintain a good standard of masonry. The arch and buttresses show continuity with original planning; higher sections, however, are showing signals of sliding.

The archway intrados show significant signs of discontinuity between voussoirs and the vault. On the right arch this has led to a lowering of the vault compared to the front arch. Concretions are present in the intrados showing the gradual washing away of mortar in the masonry. The water breaks are positioned above lateral masonry and made of pyramid shaped blocks; they are not connected to the masonry behind and are now significantly detached from their original position. The apex and the blocks below show the absence of mortar in the joints; vegetation can be seen on the left side of the bridge between the joints.

Pile masonry appears solid; however at the base of the right pier, where heavy water flows occur, mortar has been eroded and washed away. In this area one block is so badly connected that it is now held in place only by iron bars. Joints at the base of the left column are in a bad shape, grouted with cementitious mortar. Furthermore on the upstream masonry of the left arch there is a visible crack developing along the mortar joint line (it is however the only relevant crack for the whole bridge).

Diagnostic analysis

Operative methodology

Fig. 7 inspection and ultrasonic measurements performed with positioning techniques by ropes

Structural stratigraphic analysis was carried out through continuous coring; to further improve data collection, video endoscopy was used in bore holes to identify internal cavities or discontinuity. Using ultrasound tomography (Fig. 7); the data was then improved through the analysis of elastic waves, allowing the finding of eventual cracks, cavities and other deformations (pulse echo technology). Wave frequency varies between 25 and 85kHz; shorter waves increase tomographic detail with better adaptation to material variety and thickness as well as identifying cracks filled with water.

Wave intensity will vary according to material acoustic impedance (acoustic impedance Z = density x elastic wave velocity). Air is an empty space and presents sound impedance at almost zero, that means that pulses will be entirely returned.

Foundation structures as identified by the analysis

The actual foundation asset differs greatly from that prescribed in the "Chapters". It is not clear how the right column was constructed following the declaration that it was built on a "sounding rock" and depending how big or solid this was. Three possibilities emerged: "light basis" made with the chisel or "laid down a strong foundation masonry" or "broken and hollowed out".

On the contrary, from the documents, the rebuilding of the left column foundation followed the guidelines. To confirm this, corings were carried out (fig 3). In agreement with the diagnostic results, masonry is haphazard and not following guidelines: mortar of bad quality with stones and lumps of brick was used. Abundant water leaks from the bore hole showing the great amount of holes that allow water filtration inside the structure. While reaching the maximum depth possible (as indicated in the "Chapters") through coring, it wasn't possible to recover cores from the foundation stones; conversely wooden fragments from the poles were recovered proving their use in foundation reinforcement.

Elevation structures as identified by the analysis

Arch masonry is made of stone blocks that, for the voussoirs, have a uniform thickness of 55/60 cm, while the "Chapters" indication was for 63 cm. Analysis shows that the two symmetric springs of the right arch have stone thickness of 80 and 63 cm, as the stones were cut on five faces but not on the back side, creating such variation in thickness. In this part of the structure, the infilling of the masonry is compact with good adhesion between mortar and blocks and stones of differing origin (including metamorphic) and smaller size, 20-30 cm. This rings true with Chapters descriptions that state that "in the infilling of arches irregular and river stone may be used, as long as they are of sufficient size".

The right pile, under investigation, shows the use of irregular stones but of 63 cm thickness, good mortar condition and infilling made with stones of varying lithology and size 20-40 cm. Coring allowed for direct inspection the half thickness of a pile, as the other side would be symmetrical. Results confirm the "Chapters" prescription of uniform layer construction. The abutment on the left side shows irregular blocks from 45 to 60 cm used on the external face, compact mortar and yet stones sized 20-40 cm used for the infilling.

Seismic Hazard

Italian codes for assessment and reduction of seismic hazard of cultural heritage define the knowledge of a historical construction as the fundamental pre-requisite to obtain a reliable assessment of the seismic hazard and accordingly they define a specific "path of knowledge" aimed at the individuation of relevant geometric and structural information.

In the case of Ganda bridge, the path of knowledge allowed the obtaining of the interpretation of the historical evolution of the construction and the crack and deformation pattern; the diagnostic activities allowed furthermore to obtain the structural identification of the construction and of its details and the evaluation of the correlation between soil and foundations. Tests for the evaluation of the mechanical properties of the materials were not performed (these properties were obtained from the tables of the codes) neither were tests for the geotechnical characterisation of the soil performed (for Ganda bridge this is not a relevant aspect).

On the basis of the surveyed geometry, it was thus possible to implement a structural model suitable to perform the analysis necessary to classify Ganda bridge according to the bridge categories defined by the Italian codes. As a result, the bridge is suitable for the 3rd category loads (that means it is a pedestrian walkway); so under these conditions it was verified both for static and seismic aspects.

Verifications were satisfied with reference to the stability (a fundamental aspect) and to the friction. With regard to compressive strength, the values of masonry resistance provided by the codes do not allow to express a positive judgement. However, the tabular values are probably overly cautious with regard to the compactness and regularity of the masonry of the Ganda bridge: to assess its actual strength it shall be necessary to deepen the analysis through specific test aimed at determining the effective compressive strength.

Conclusions

The historical analysis of the 18th century documentation in the Chapters confirms an excellent relationship between the design planning and final construction. There is, however, substantial difference between the detailed foundation design in the Chapters and the current state. Coring has shown stratified mortar in a highly weakened state due to its permanence under water. Water seeping is also present in the blocks constituting the foundation. These factors preclude a positive judgement on foundations until further analysis is carried out.

Detailed analysis also showed significant discontinuity at the intrados of the arches at the line between external voussoirs and the vault; this shows up the inadequate transversal strengthening in arch masonry and the evident difference in deformability between the external voussoirs and the vault, thus underlining a problem in global structural behaviour.

Overall, the survey and analysis, correlated with historical knowledge has provided a powerful tool in full expertise concerning an historical monument leading to the structural assessment of the present status and the best possible conservation in the future.

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Thanks also go to the Inter-departmental PoliNDT laboratory at the Politecnico di Milano (prof. Roberto Felicetti) and the structural and material testing laboratory – diagnostics for cultural heritage (Marco Cucchi) with whom tomographic analysis was carried out.

Notes

1. Johanne Antonio Amadeo, born in Pavia in 1447, worked from 1470 as the architect on the Colleoni chapel in Bergamo, the duomo in Milan and Cremona cathedral, the facade of S. Satiro church, Pavia cathedral (with Bramante) and the maggiore hospital in Milan, some of the most important Renaissance monuments in Lombardy.
2. 1 Como arm length is equal to 0,505 m and 1 ounce is equal to 1/12 arm = 0,042 m; in the paper metric conversions are shown in brackets.
3. 21 1/2 arms = 20 arms and 18 ounces, meaning 1 ounce = 1/12 arms
4. the unit used by Palladio was the Vicenza foot equal to 35.5 cm

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Wuhan Yangtze Great Bridge and the Cultural Change of Wuhan：from Dock Culture of Dock City to Great Wuhan of Bridge City

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A night scene photo of Wuhan Yangtze Great Bridge taken by the author's father Mr. Shoulong Cao

Abstract

The significance of a bridge can also be evaluated socially and culturally. On the basis of analyzing the importance of Yangtze River and depicting the process of building a bridge across the Yangtze River in Wuhan, this thesis researches how the Wuhan Yangtze Great Bridge has influenced the cultural change in the city of Wuhan from dock culture of dock city to great Wuhan of bridge city in different aspects. Also probes into the national iconographies forged by the bridge and the daily changes of common people.

Key words

Wuhan Yangtze Great Bridge; cultural change;

Introduction

The academician of Chinese Academy of Sciences and the honorary foreign academician of United States National Academy of Sciences, as well as the leader for building the Wuhan Yangtze Great Bridge, Dr. Mao Yisheng (Fig 1) has argued that "The history of human beings building bridges is a milestone of social development. The magnificent achievements of building bridges are the cultural exhibition of one country."①Therefore, the significance and meaning of a bridge can also be interpreted socially and culturally, not only technologically.

Fig 1. Dr. Mao Yisheng's image②

Coincidently, the year of 2017 witnesses and celebrates the 60th anniversary of the Wuhan Yangtze Great Bridge, meanwhile, also observes the 50th anniversary of the Ironbridge Gorge Museums Trust (IGMT). And this thesis will research on the relationship between the Wuhan Yangtze Great Bridge and the cultural change in the city of Wuhan.

Great importance of Yangtze River

Just as the meaning of the Severn River to the Ironbridge, the Yangtze River also have played a really important role to the Wuhan Yangtze Great Bridge.

Geographically

When it comes to the length, the Yangtze River is the longest river in Asia and the third-longest one in the world. And to the most importantly, the Yangtze River is the longest river flows entirely within one country(China) worldwide, by which, to some extent, the unified national cultural system has been developed in China. And also, the strong identical cultural identification has been attached amongst the people whose lives rely on the river. More specifically, the Yangtze River (Fig 2) is as long as 6,380 km, and flows from Qinghai Province then empties itself into the East China Sea. Its river basin totals to 1,800,000 km^2, and it is so large that the main stream goes through 11 provinces, meanwhile even the tributaries flow across 8 provinces. And Fig2 also demonstrates that not only the main stream of Yangtze River flows through the city of Wuhan, but also its tributaries do, which as a whole entitles the extremely outperformance on transportation of Wuhan.

Fig 2. Yangtze River Basin (source: Huilongguan Internet Community)③

Culturally

Yangtze River is the very cradle of Hemudu Culture（“河姆渡文化”in Chinese）. Meanwhile, another crucial Chinese river, Yellow River, plays as the birthland of Banpo Culture（“半坡文化” in Chinese）, and they jointly breed the Chinese Civilization (also known as “Huaxia Civilization” , “华夏文明” in Chinese) . Namely that is to say, the Yangtze River nearly have nurtured half of the traditions, customs, beliefs and family systems of the whole country. From Fig3 the site of Hemudu Culture, the traditional cultural elements in the Neolithic age of China can be felt.

Fig 3. Hemudu Culture Site (source: Baidu)④

Economically

Last September, the central government of PRC has released the Yangtze River Economic Belt Layout Plan to not only propel the economic development but also to protect the ecological environment throughout the cities and lands adjacent to the Yangtze River. More

specifically speaking, the plan integrates 9 provinces and 2 direct-controlled municipalities of China, and involves more than 40% of Chinese population and economic aggregate. Additionally, the influenced area by the plan is as large as roughly 2.05 million square kilometers, which nearly equals to 21% of Chinese territory. Above all these, it can be safely concluded that the Yangtze River Economic Belt is the largest economic belt in China, and Fig 4 just demonstrates the central and core position and responsibilities have been assumed by the city of Wuhan.

Fig 4. Sketch of Yangtze River Economic Belt (source: China Government Website)⑤

Flip side, the cardinal principal of the plan can be shortly concluded as “One Axle, Two Wings, Three Poles, Multiple Spots”. And in detail, “One Axle” means to take the main stream of Yangtze River as the golden waterway to bring the cities of Wuhan, Chongqing and Shanghai into play; “Two Wings” means to lay two expressways as the important transportation foundation for the demographic and industrial agglomeration for the key node cities; “Three Poles” means to witness three urban circles as major growth poles and “Multiple Spots” means to enhance the economic connections and interactions between the cities belong to and beyond the three urban circles. Therefore, by virtue of all mentioned above, the great significance of the Yangtze River, as well as the city of Wuhan, can be well proved.

Wuhan-- the Bridge City

With the debut of Wuhan Yangtze Great Bridge in 1957, up to now, there are totally 10 modern bridges across Yangtze River in Wuhan (two of them still in construction). Considering not only the totality of bridges has singled Wuhan out from other cities in China, but also roughly each of the 10 bridges have broken at least one world record, Wuhan has entitled to be ranked as “Bridge City”.

Hardships & Dreams (Failures)

Fig 5. Distribution map of the three towns of Wuhan (source: Wuhan Map)

Just as the Fig5 illustrates, the city of Wuhan is consisted of three different towns Wuchang, Hankou and Hanyang. Moreover, it is unfortunately that the three towns have been separated with each other by the Yangtze River and one of its tributaries- Han River, which had impeded the economic and cultural connections amongst the people and industries based in the towns. Therefore, the dreams of having a bridge built across the Yangtze River in Wuhan have been well founded for more than one century.

Before the very Wuhan Yangtze River Great Bridge, different parts of the governments at different times and experts have surveyed and dreamed of building a bridge across the Yangtze River in Wuhan for not only connecting the tree towns altogether, but also booming up the economic and social developments of the whole city. Nevertheless, all of them had met to nothing but failures.

Just name a few significant instances here. In 1911, the Qing Dynasty planned to build a Yangtze River Bridge in Wuhan, and designated Mr. Zhan Tianyou (also known as “Jeme Tien Yow”) to make preparations for building a bridge across Yangtze River in Wuhan. And two years later, he did it again and even had drawn a sketch for the Bridge in his mind (Fig 6).

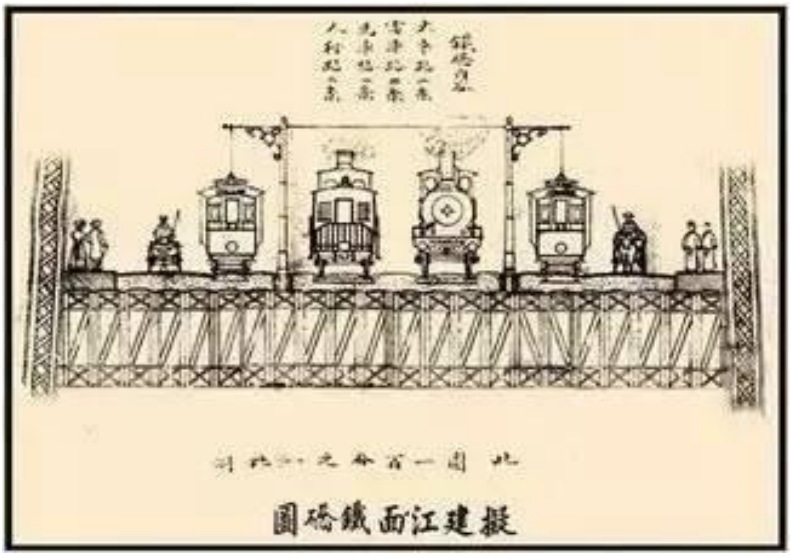

Fig 6. Mr. Zhan Tianyou's Sketch of bridge (source: Wuhan History)

In 1917, Mr. Sun Yat-sen argued to build a bridge or tunnel for connecting three towns of Wuhan in his famous The International Development of China. Then in 1929, the Government of the time invited Dr. Wardell to survey in Wuhan for the same reason, and five years later, Dr. Mao Yisheng also investigated in Wuhan also for the very bridge. And the nearest attempt was in1946, and the Government of the time even had set up a preparatory committee for the building the Bridge. So there were roughly 6 significant attempts(Fig 7), but all of them had come to nothing but failures.

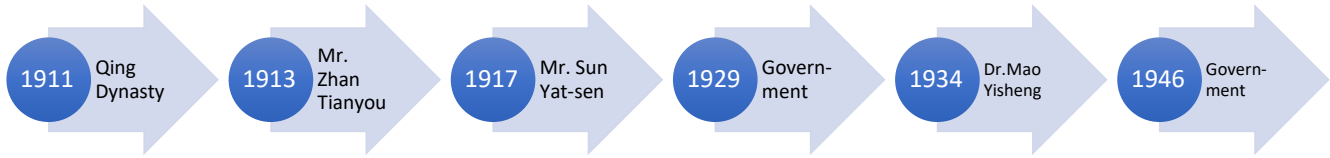

Fig 7. Planned bridges

With another angle, the three stages of the Bridge will be analyzed. Generally speaking, for human beings to build bridges across the Yangtze River in Wuhan can be understood in three stages:

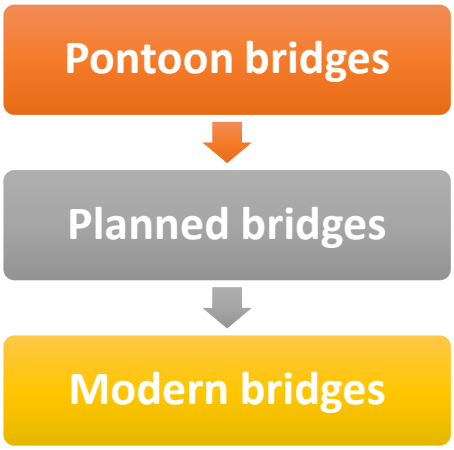

Fig 8. Three stages of the Bridge's construction

From AD 35 to 1853, many pontoon bridges have been built. And the earliest recorded one was the Jiangguan Pontoon Bridge in AD 35, but it was built in modern Hubei province. After that, the pontoon bridges were mainly built for military reasons, such as in the dynasties of Han, Tang and Song. Most importantly, on Dec.1852, the Taiping Heavenly Kingdom Army built three pontoon bridges to firstly connect three towns of Wuhan (Fig 9).

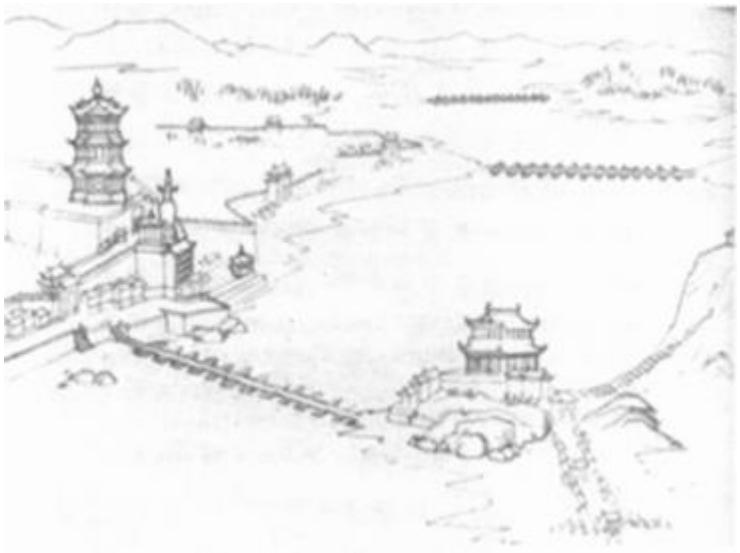

Fig 9. Sketch Map of Taiping Heavenly Kingdom Army's pontoon bridges⑥

From 1911 to 1946, just as mentioned before, during this long period, only planned bridges had been dreamed of.

From 1950 up to now, finally modern bridges have firstly been successfully built with the very debut of Wuhan Yangtze River Great Bridge which had been built from Sep 1955~ Oct 1957. After that brilliant success, till now, there are another 7 bridges have been built and another 2 bridges are still in construction. What is more, roughly each of them have broken more than one world record in terms of its technology and so on so forth.

Tab 1. The 10 modern bridges in Wuhan

Time	Names of the Bridge
Sep 1991~ June 1995	Wuhan Second Yangtze Bridge
Mar 1997~ Sep 2000	Wuhan Baishazhou Yangtze River Bridge
Dec 1998~ Dec 2001	Junshan Yangtze Bridge
Nov 2003~ Dec 2007	Yangluo Yangtze Bridge
Sep 2004~ Dec 2009	Wuhan Tianxingzhou Sandbar Yangtze Bridge(Fig10)
Jul 2008~ Dec 2011	Wuhan Two-Seven Yangtze River Bridge(Fig11)
Aug 2010~ Dec2014	Wuhan Yingwuzhou Sandbar Yangtze River Bridge(Fig12)
Dec 2014 ~ (e)2017	Wuhan Huangjiahu Lake Yangtze River Bridge
Dec 2007 ~ (e)2019	Wuhan Yangsigang Harbor Yangtze River Bridge

The Tab 1. clearly demonstrates that the Wuhan has become the “Bridge City”. And after the debut, the whole cultural pattern of the city has been gradually changed.

Fig10. 6th : Wuhan Tianxingzhou Sandbar Yangtze Bridge

Fig11. 7th: Wuhan Two-Seven Yangtze River Bridge

Fig12. 8th: Wuhan Yingwuzhou Sandbar Yangtze River Bridge(“Red Bridge”)

Wuhan Yangtze River Great Bridge

Up to now, different parts of the PRC’s government have granted many praises and gratitude to the Wuhan Yangtze River Great Bridge. Such as listed it as “Chinese Major Historical and Cultural Site Protected at the National Level” on May 3rd 2013 and initially listed as “Chinese Architectural Heritage in Twentieth Century” on Sep 2016.Except that, as the major accomplishment of PRC’s first “Five-Year Plan”, the Bridge’s image even had been chosen

as one of the third RMB notes(Fig13), which has symbolized the Bridge as a significant emblem of new China's national construction and development.

Fig13 The Wuhan Yangtze River Great Bridge's image on one of the third RMB notes with currency value as 0.2 ¥

Flip side, at the present time, 158 leaders and heads of different foreign countries have paid their visits to the Bridge, to some extent, which has made great contributions to entitle it as a world-renowned bridge. And when it comes to the construction period, the Bridge has experienced three different stages:

Fig14. Three stages of the Bridge's construction

It is worth mentioning that the Bridge was suspended for more than three months on account of improving the engineering standards (mainly for the rivets). And the ceremony was really solemn and unforgettable for celebrating the Bridge's openness to the traffic (Fig 15&16).

Fig 15 & 16. The grand ceremony of the Bridge

Additionally, there were more than9,000 postcards of the Bridge issued on the day o witness the happiness from different walks of life and the harmony relationship between the minority and majority (Fig 17).

Fig 17. The postcard shows the harmony relationship between the minority and majority of China on the ceremony of the Bridge's openness to the traffic (source: Chineseposters.net)⑦

Cultural Change of Wuhan
National Iconographies

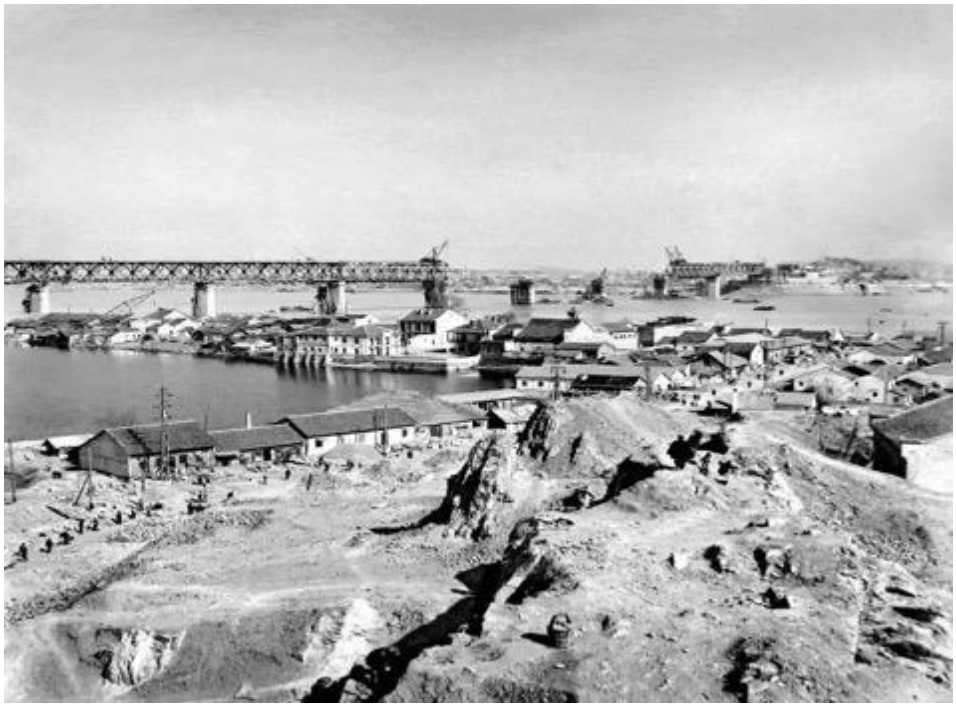

Fig 18. The construction site of the Bridge

The Fig 18 reflects that the surroundings around the Bridge were really not well-developed even in the mid-term of the Bridge's construction, therefore, it was really difficult for the new founded PRC and its people to successfully build a bridge across the very Yangtze River

considering its rather high and considerable floods annually. Nevertheless, the Bridge today successfully connects the town of Hanyang and Wuchang and is constructed with 7 layers inside. And it's actually a railway and highway combined bridge with the length of 1670 km and the width of 18 m. With this extraordinary accomplishment at that difficult time, this bridge definitely demonstrates the shift of spirts of the period and the common people.

As the epitome of Mao Zedong Era's spirits

Firstly, in terms of its engineering technology, the Bridge symbolizes the spirits of innovation. For example, its "large-scale colonnade foundation process" was a pioneering successful attempt worldwide at that time. And the sustainable ideology has already been attached well both on the design and technology of the Bridge considering its whole steel structure technology and far more beyond that.

Secondly, the process of the Bridge's construction vividly has shown the people working really hard for the new lives of theirs and the city, also the whole country. Basing on the remarks from Qiang Gong, a Yangzi River Daily journalist who had lived with the workers during the Bridge's construction, the couples and colleagues frequently quarried with each other for getting the opportunities of working longer time. And the workers who were hurt and gotten illness from the jobs related to the Bridge always come back to work regardless of the doctors telling them not. When the Soviet experts left a, peoples had to work extremely hard.

Thirdly, the great honor of the Bridge's success also should give the credits to the dedication for new life from the common people. Just as the volunteers have made invaluable contributions to the heritage movement in UK and beyond, there were more than 100,000 cadres and the masses as voluntary labors on the commencement day of the Bridge's construction, meanwhile, more than 100,000 people as volunteers for the clearance and plant works of the Bridge before the ceremony. And this number equaled to one twentieth of Wuhan's population at that time.

As the token of people's doughtiness

There are always stories between bridges and floods in different contexts. Bracegirdle (1974) has argued that "people were impressed by the survival of the Iron Bridge in the floods of that (1795) February"⑧. Similarly, the Wuhan Yangtze Bridge's solidness has been proved soundly by the floods. Up to now, based on the accident records, the Bridge has endured 7 floods and 77 ferry crushes. The most serious one was on 6th June 2011, a 10,000-ton class cargo ship badly damaged from its crash to the Bridge, but the Bridge kept in perfect condition and only showed white and black mark (Fig 19) .

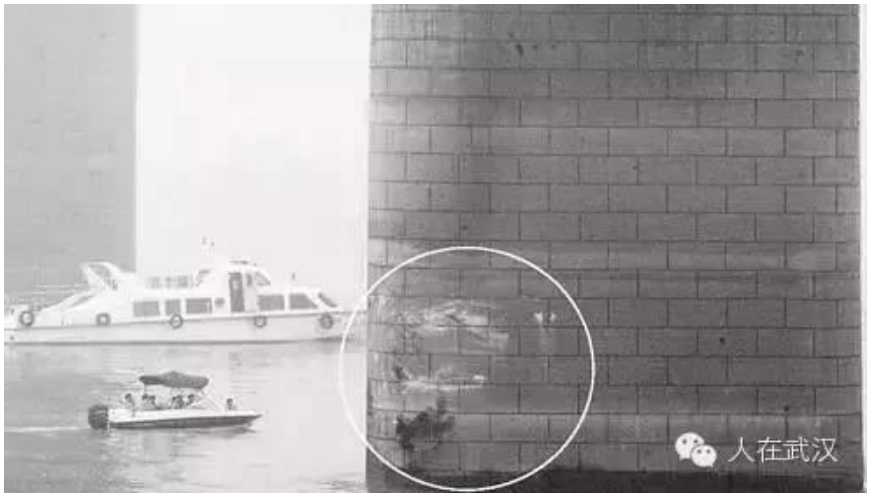

Fig 19. The mark of the Bridge after crush

And the latest crush was on 17th Sep 2015, a crane ship crashed suddenly to the Bridge but only left some marks (Fig 20).

Fig 20. The mark of the Bridge after crush

Remarks

Three of the important remarks to the Bridge have been attached here.

162 bridges have been built over the Yangtze River since the Bridge's debut.

-- China Daily

Without any deflection or sinking, the Bridge can still withstand pressures up to 60,000 tons, water flow up to 10 million cubic meters, floods with a flow rate up to five meters and earthquakes up to eight magnitudes.

Physical Examination Report issued by Wuhan Railway Bureau on April 17 2017

The Wuhan Yangtze River Bridge was expected to last 100 years. Although 60 years have passed, the Bridge is still in its 'strong years'.-- CGTN

Catalyst of city's cultural change

With the Bridge's completion, not only the three towns of Wuhan have been connected and integrated, the Beijing-Guangzhou railway line also was joined up for the first time. And after this, the urban belt in the central part of China has gradually forged, and also the central city circle has progressively been formed. Therefore, the Bridge can be regarded as a cardinal stakeholder in terms of the urbans' developments. On the other hand, the urban's cultural change of Wuhan also has happened mostly thanks to the Bridge.

Before the Bridge, due to the "natural chasm" (Yangtze river) is too long and wide, besides the floods issue, it had been really difficult for the economic and cultural communication between the three towns of Wuhan. And due to this separated situation, as well as the status of the transportation technology and the urban's economic level at that time, Wuhan's main economic formation, also the urban's cultural pattern, had been dock economy and dock culture for quite a long time. Fig 21 shows before the completion of the Bridge, the primary means of transportation had relied on the humble "ships".

Fig 21. Before the Bridge

After the Bridge's construction, there were much more people from outside choosing to travel to or live in Wuhan. Simultaneously, more Wuhan locals could go out. Tab 2 and Fig 22 jointly demonstrate that from1955-2015, a great deal of people had come to Wuhan and chosen to live there. With this process, the cultural elements from outside have been abundantly integrated into Wuhan's local context, and concurrently Wuhan's culture have spread to the surrounding cities and beyond.

Tab 2. The households of Wuhan from 1955-2015 (Source: Statistics Bureau of Wuhan Municipality)

Year	Households(million)
1955	39.6
1965	50.6
1975	59.9
1985	89.9
1995	196.34
2005	249.95
2015	297.09

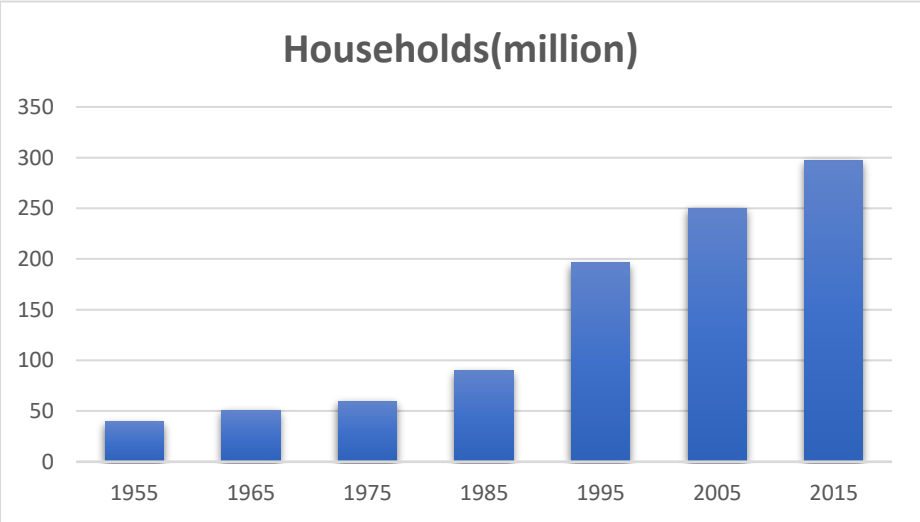

Fig 22. The households of Wuhan from 1955-2015 (Source: Statistics Bureau of Wuhan Municipality)

In short, the original dock culture has gradually shifted to the new culture form of the so called “Big Wuhan” or modern great Wuhan. And the Bridge has played the role of catalyst of Wuhan’s cultural pattern shift, especially considering the forge itself forging Wuhan as the central city of China. Fig 23 represents one common daytime when vehicles come across the Yangtze river via the Bridge. Specifically, roughly 100,000 vehicles and 300 trains come across the Bridge daily.

Fig 23. The daily transportation on the Bridge (source: CGTN)⑨

It is worth mentioning that the spirit of Wuhan was determined as “Dare to be the first and pursuit excellence” (Fig24) after around 200 thousand citizens’ election on December 2011. And the image slogan of Wuhan was concluded as “Wuhan, different every day” (Fig25) after roughly 800 thousand citizens’ votes on September 2014.

Fig 24. Slogan of Wuhan: Dare to be the first and pursuit excellence.

WUHAN
CHINA

Fig 25. The image slogan of Wuhan

With the debut of the modern bridge across Yangtze river in China, the Wuhan’s spirt has been forged and changed.

Values and Influence of the Bridge

Combination

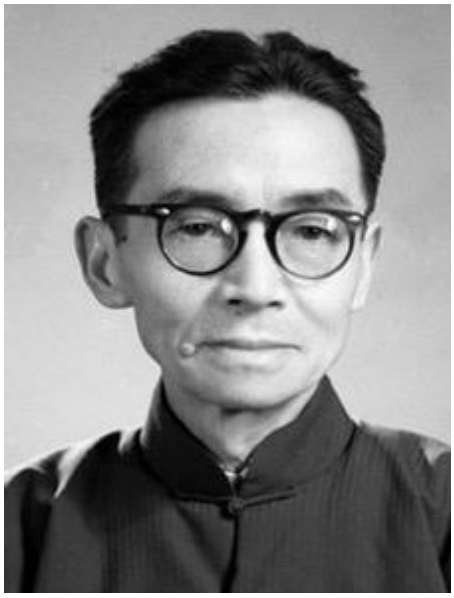

Fig 26. Liang Sicheng's image

Liang sicheng, as one of the committee members of Chinese Academy of Science, also the famous Chinese architectural historian and architect, has once left his commentary on the Bridge: The Bridge is first-rate on its design and structure, as well as aesthetically.⑩Namely that is to say, the Bridge is one of the stainless case of combining functions and architectural aesthetics. To be more specifically, all the ornaments attached on the bridge are teemed with essence of Chinese traditional culture, and Fig 27 selects the traditional "auspicious clouds" design which conveys the meaning of propitious and good luck. Additionally, the distinguished Yellow Crane Tower (left side of Fig 24) is close to the Bridge (Fig 28), therefore, they jointly have become the cultural landmark of Wuhan. Also, the Chinese traditional cultural symbol and the modern innovation spirit have concurrently merged into the whole city, which have arisen the cultural change of Wuhan.

Fig 27. The traditional "auspicious clouds" design

Fig 28. The Bridge is close the Yellow Crane Tower

The Bridge Industries

The completion of the Bridge has directly given birth to the bridge industries of Wuhan, and also shown great influences to the local economy of Wuhan and beyond. Specifically speaking, dozens of commercial brands were named after the Bridge: ping-pong balls, sewing machine, cotton candy etc. Fig 29 represents the products of chicken essence named after "Great Bridge". And when these daily necessities have come to innumerable families in urban and their common daily lives, the Bridge culture has gradually and strongly been connected with Wuhan's urban culture.

Fig 29. the products of chicken essence named after "Great Bridge" (source: products' official website)11

On the other side, the Bridge also has attracted countless tourists from other parts of China and foreign countries. Fig 30 shows one of the most fashionable and common photo of the tourists who traveled to Wuhan. To some extent, the Bridge is the proof and pride to the tourists, and the strong cultural identity and emotional connectivity of the locals.

Fig 30. Tourists to Wuhan always will take a photo under the Bridge

Beyond all those mentioned above, the Bridge has also shown great values on booming the economic development and urbanization both for the north and south part of Yangtze River.

Enormous changes on patterns of people's daily life

Besides the daily necessities and tourism, the Bridge have brought enormous changes on patterns of people's daily lives. And has played a key role in forming and strengthening the locals' sense of belonging.

Most importantly, the dialects of three towns of Wuhan have tended to be unified when the turnover and logistics quantity have increased largely. And thanks to this, the unified cultural identity has strongly been forged since the people from three towns firstly communicating with an identical rhyme. What is more, this significant change has laid crucial foundation of the ideology of "Big Wuhan" or "Great Wuhan".

Then, after the Bridge's completion, many newborn infants were named after the "汉桥"(means "Han bridge") or "大桥" (means "Great bridge") and others related to the Bridge. And since the quantity was so large that even the officials advised the parents to change the names.

Thirdly, innumerable people's leisure and lifestyles have been absolutely changed because of the Bridge, especially considering people from all walks of life choose to enjoy the leisure time adjacent the Bridge. It is quite common to see that the elders sit down under the Bridge and listen to the Chu opera with drinking tea, and the young start romances and friendships around the Bridge, either the families will walk and talk together beside the Bridge (Fig 31).

Fig 31. People relax themselves under the Bridge

Additionally, with the increased mobile population to Wuhan, people's choices of marriage have been broadened greatly. Just as what the Fig 32 has shown, many romance and relationships have been witnessed and proved under the Bridge. Furthermore, annually a large number of mountain biking fans will ride their bikes through the dark and cold night on each New Year's Eve to the Bridge for embracing the first sunshine of the new year(Fig 33).

Fig 32. A new couple take wedding pictures under the Bridge

Fig 33. The author rode mountain bike to the Bridge for embracing the first sunshine of the new year

Relationship with Chairman Mao & Literature

There was profound and long relationship between the Bridge and Chairman Mao who personally has paid his visit to the Bridge three times.

·On 31th May1956, Chairman Mao inspected the Bridge and firstly swam across the Yangtze River.

·On Sep 1957, Chairman Mao inspected the Bridge again, and read the album of painting of the Bridge.

·On Sep 1958, Chairman Mao visited the Bridge again, and inspected some schools.

Fig 34. Chairman Mao inspected the Bridge with Wuhan Secretary and other officials on Sep. 6th ,1957

And just after Chairman Mao firstly swam across the Yangtze River on June 1956, he wrote down the famous ci (a type of classical Chinese poetry, Fig 35) with the name of Swimming (to the tune of Shui Diao Ge Tou). And in this nationally well-known ci there is one famous sentence depicting the greatness of the Bridge:

A bridge will fly to span the north and south,
Turning a deep chasm into a thoroughfare;

And in Chinese it is:

“一桥飞架南北，
天堑变通途。”

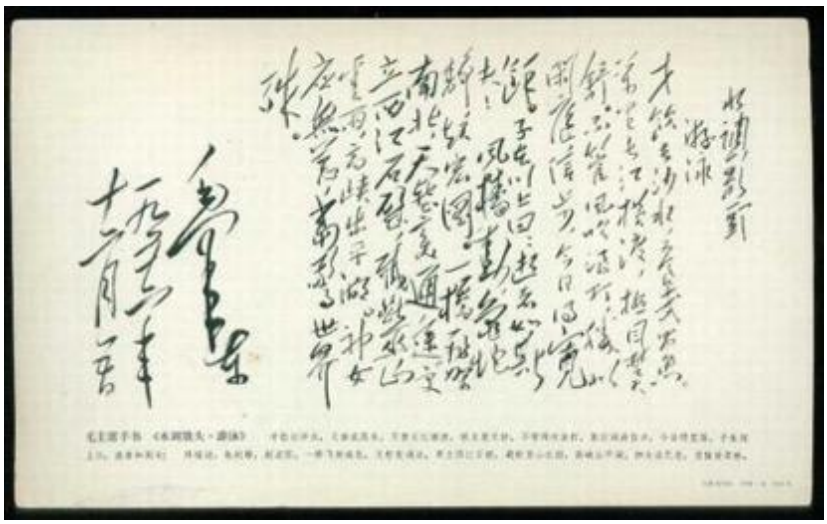

Fig 35 Scan copy of Chairman Mao’s Handwriting of the CI (source: China Government Website)

Conclusion

Basing on all things mentioned above, it can be safely concluded that the bridge has played a crucial role in the cultural change of Wuhan. What’s more, other points are as following:

1. China is the Bridge country. Wuhan is the Bridge city.
2. The Bridge has played a crucial role in the transformation of Wuhan’s cultural form: from Dock Culture to Modern Great Wuhan.
3. The Bridge have connected people’s hearts and people’s lives.
4. The Bridge have changed the people’s national iconographies.

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①Translated by the author.

②Image from the website(http://qclz.youth.cn/gw/tslz/201205/t20120528_2198580.htm), Retrieved on May 4th,2017.

③Image from the website(http://bbs.hlgnet.com/info/u1_20084716), Retrieved on May 6th,2017.

④Image from the website(https://baike.baidu.com/item/河姆渡文化/30234?fr=aladdin), Retrieved on May 8th,2017.

⑤Image from the website(http://www.gov.cn/zhengce/2014-09/25/content_2755974.htm), Retrieved on May 8th,2017.

⑥Image from: Changhai Yu(2007).The Historical Reviews of Yangtze River Bridges and Tunnels in Wuhan. Wuhan Historical Accounts.No.5,2007(30).

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⑨Photo and statistics from CGTN's website (https://news.cgtn.com/news/3d416a4d31557a4d/share_p.html), Retrieved on July 17th,2017.

⑩Translated by the author.

⑪Image from the official website of the brand(http://www.daqiao-food.com/index.aspx), Retrieved on July 18th,2017.

Shifted Meanings & Cultural Adaptions of Migrated Nubian Settlements

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Introduction

The Nubians are an ethnic group who has been residing since ancient times along the Nile in southern Egypt in the area historically known by their name: Nubia. This paper discusses the circumstances surrounding the migration of the Nubians due to the construction of the ambitious hydro-electric generation project known as the High Dam in the 1960's. They have been forced to be displaced from their traditional lands due to the flooding that occurred with the creation of a large manmade lake (Lake Nasser) behind the dam. Tens of thousands were dispersed in several places mostly towards the north, where they rebuilt their communities and attempted to adapt. Until today, Nubians regard the move as temporary and are still looking forward to a day when they will return to their so-called ancestral land in the south. The objectives of the paper are to discern the architectural, social and cultural consequences of such migration, and the adaptation techniques and strategies that the Nubians incurred on their life and buildings. The paper briefly traces this forced migration and sheds light on the meanings gained or lost in their new settlements and on their methods of adaptation. Architecture of the Nubian settlements, particularly homes, are in focus. The structure, form and morphology of Nubian villages and homes were created because of their social and cultural factors particular to their group including strong expressions of meanings associated with the family, the rituals, social associations, living habits, and tribal sense of place. In their new settlements, the formative factors disappeared with the new architecture and planning, so the Nubians attempted to recreate their architecture while responding to a shifting sense of meaning. Severe changes occurred in their society and heritage, resulting in a loss of their traditional way of life, and forcing new changes and adaptations. Those adaptations are best seen in their new architecture and the relationship with tourism which shows in the building of a selected number of new hotels to emulate the Nubian experience allowing for tourism to act as a vehicle to produce meaning. Findings support that the attractiveness of the Nubian region is attributed to cultural factors including elements of authenticity and diversity. Additionally, the setting within the natural landscape adds to the meanings of the place.

Nubia, Nubians, Nubian Architecture, Settlements and Dwellings

The name Nubia is believed to have originated from the ancient Egyptian word "nbu", which means gold, about the rich deposits of the gold mines that were in the area (Sakr, 2010). The land of Nubia consists of part of the Nile Valley south of Aswan. The area includes the non-navigable waterfalls in the Nile known as "cataracts," bordered by the First Cataract to the North, and the Fourth Cataract in the South. The area is characterized by pockets of agricultural land, separated by large areas of desert with sandstone hills, some areas with the sand dunes reaching right up to the edge of the Nile (Serag, 2013). The Egyptian – Sudanese border divides historical Nubia into two. Evidence of life and culture in that area can be dated back to pre-history (25,000-35,500 B.C.) with several distinct stages and developments and interaction with Egyptians, even with some pharaohs of Nubian origin ruling Egypt. Probable complete assimilation into Egyptian society was during the New Kingdom Era (1570-1070 B.C.), then we have Nubians ruling as pharaohs in the Kushite Period of the 25th Dynasty (760-656 BC), who were then repelled by the Assyrians. Christianity was adopted (543-1315AD) with three small kingdoms, however, with the gradual influx of Arabs and the advent of the Islamic Era (1315-1850 AD) the area gradually took and formed its "modern"

(1850-1960 AD) culture, markedly different from Egyptian culture to the north. The economic activities of the area were based on agriculture and some fishing (Al-Soghayer, 2010). The Nubians have their own languages that express their background and distinctive culture, with each tribe having its own distinctive features, language, architecture and lifestyle. Severe changes occurred after the construction of the High Dam and the forced relocation (1960 AD), those changes are still being recorded to date, as we will see from this paper.

Due to the location of Nubia, the Nubians existed in isolation from the Egyptian public eye and society as well as disengaged from the relatable Egyptian way of life. Nubians in their native land were not part of the changes that occurred in Egypt starting with the late 19th and early 20th centuries, except the ones who sought work in urban centers such as Cairo. Most Nubians didn't benefit from the educational, medical and health services and other common civil services. Very limited services were offered to the inhabitants (Kamel & Abdel-Hadi, 2012). To alleviate the economic pressures, men of the tribes were forced to leave Nubia and seek work and migrate temporality to the urban areas and become exposed to a new lifestyle. The migrant bodies of the Nubian households were becoming increasingly aware of the deprivations the Nubian settlements were facing and living in (Serageldin, 1982).

Nubia consisted of 40 sparsely populated settlements that stretched along the Nile over 320 kilometers, always depending on the Nile and living on its banks. Each settlement (called nahiya) consisted of clusters of houses (called naq') with a considerable distance between each house, lying on one or both sides of the Nile. A village could be made up to of 30 clusters and stretch over 30 kilometers (Serageldin, 1982).

The Nubian people consist of three clans whose mingling produce the rich diversity and originality of the Nubian heritage. The clans are: The Kanzi (Kenuz) in the north, the Arabs (Mahas) in the middle and the Nubi (Kushaf) to the south. They intermingled by marriage, in-spite of the different languages they speak. Being in direct link with the Nile over time, most of the daily and social habits were related to the river, which also added up to the distinctiveness of the different tribes. The community functions on a cooperative society mindset; associations or (gama'iyyas) were and still are an integral part of how the society functions. In these associations they help one another as a close knit community by giving mutual support in issues such as marriage, death and in the construction of homes. There is a motto they live by: "one man cannot build a house, but ten men can easily build twenty houses" (Kamel & Abdel-Hadi, 2012).

Depending on the terrain, the Nubian settlements had different grids. The Southern region on the flat lands had a grid pattern with the dwellings in rows parallel to the Nile, stretching the village and its extensions up to a few kilometers. The Northern region is characterized with a free pattern, where the dwellings are located on the hills and the flat lands are dedicated to the agriculture (Merdan, 1999). The settlements were built either near the river bank or a few hundred meters away from it (Serag, 2013).

The Old Nubia dwellings were characterized with their large area, floor plan and number of rooms. The houses consisted of five to six covered rooms, and an average of two open courts with guest amenities. The dwellings were built from local materials: mud, stone and sand and the flat roofs from the palm branches (jareed) and grain stalks and the arched domes were of clay bricks (Kamel & Abdel-Hadi, 2012). The façades had narrow openings, plastered with mud and decorated with traditional vegetal designs, geometric patterns, flags, flowers, birds and animals (Werner, 2006). Nubian women had a significant role in the painting and

decoration of the dwelling interiors and exteriors (Kamel & Abdel-Hadi, 2012). Foremost importance was given to the entrance door, whose size and decoration attested to the status of the owner. The facades were an indicator of status and wealth. The striking architecture melded features and motifs of pharaonic inspiration with an organization of space reflecting rural and Islamic cultural traditions (Werner, 2006).

The Migration Problem, its Causes and Need for Resettlement

Several times during the 20th century, the Nubians were forced to migrate and were evicted from their dwellings to different regions in the Nubian desert due to the annual Nile flooding and constant rise of the Nile's water levels submerging their dwellings and settlements. The series of migrations occurred several times from the early 1900s till 1940s. Despite the early 20th century construction of the Aswan Dam ("Aswan Reservoir"), the flooding of the Nile still affected the villages and the inhabitants causing submerging of multiple Nubian villages, agricultural seasonal disasters, even losses in lives (Serag, 2013). The Aswan Dam was raised twice to counter the effects of the flood. Each time the Nubians would relocate and construct new dwellings in nearby regions or on higher lands to escape the increasing water levels (Merdan, 1990). This eviction process continued into the 1960s, with the construction of the newer and larger "High Dam" resulting in the most critical eviction ever to occur (table 1).

1899 - 1902	The British construct of the Aswan Dam 32m
1902	First migration moves
1907 1912	The Height of the Aswan Dam was raised – Phase One 36m
1912	Second migration moves
1929 – 1934	The Height of the Aswan Dam was raised – Phase Two 42m
1933	Third migration moves
1960	Egypt constructs a new "High Dam", 196m
1963	Final and largest migration moves.
1970	Completion of the High Dam.

Table (1): Timeline of the causes of migration for the Nubians

For Egypt and Nubia, the Nile River has always been vital force in defining the region, giving it life sustenance and identity. The Nubian region is only habitable because of the river's flow and annual flood, giving the area its life and identity.

The annual flood is a result of the summer rains in the plateau region in Ethiopia which, overflows to form the "Blue Nile", the second main tributary of the Nile together with the "White Nile" in the Sudan, increasing the Nile water level in Egypt. This annual event, known as the "Fulfillment of the Nile" (wafaa' elnil) and historically has been anticipated by Egyptians since their settlement on the Nile banks from pre-historic times, promising prosperity and a plentiful harvest with the rising levels of the Nile. Lack of a flood for several years, if managed poorly by the central government, usually resulted in famine and eventual chaos. The rains on the Ethiopian plateau increased the average flow of the Nile in peak times to sixteen times the average volume. This was always accompanied with striking increase in

the water levels with the expected flooding of the banks and general increase in the water level throughout the smaller Nile tributaries and canals. Nilometers (a building with a graded column to measure the rise in the Nile level) were known throughout Ancient Egyptian history, with the ceremonial reading of Nile level to anticipate the "Fulfillment of the Nile" (wafaa' elnil) surviving and continuing to be a major event in medieval Islamic eras continuing up till the 19th century.

Due to the population growth in Egypt in the second half of the 19th century, continuous urbanization and urban sprawl led to an eradication of agricultural land. This led to an increase in agricultural projects and land reclamation projects with increase in the need for water for irrigation and electricity for urban and agricultural uses. A solution was also needed to utilize the waste resulting from the natural flow of a sizable portion of the Nile waters into the Mediterranean. There was also the need for better control the devastating effects of the flood which eroded the Nile banks and sometimes destroyed whole villages in high floods. Better management of the Nile water and the annual flood became a necessity. Eventually, this was realized in two projects: The Aswan Dam and the High Dam.

By 1882 the British Empire, the leading global colonial force at the time, invaded and occupied Egypt. Water management to ensure a plentiful harvest from Egypt's rich agricultural land was a necessity. By 1899 a decision was taken to start construction of the "Aswan Reservoir", or the Aswan Dam, which would help control the Nile water and generate hydroelectric power using the rapid flow of water and difference in levels after its construction. By 1899, under British administration, the "Aswan Reservoir", or the Aswan Dam, was envisioned to help control the Nile water and generate hydroelectric power. The dam was built at the first cataract of the Nile, south of Aswan. The dam was completed by 1902, and 10 Nubian villages were resettled to higher ground because of the inevitable flooding due to increase in the water level. However, the structure was soon found inadequate. Continuous flooding of the Nubian villages and temples like the Temple of Philae became a normal occurrence. To remedy the problem, the dam was raised 36 meters in a second phase that lasted from 1907 till 1912, resulting in the relocation of 8 more villages. Then a third phase was needed and the dam was raised 42 meters in a phase that lasted from 1929 till 1933, forcing 11 villages to be relocated. Electricity generation was added to get better use of this mega project (Shetawy & El-Shafie, 2013).

After the 1952 Revolution, the Egyptian Government considered building a new dam to provide a solution to the annual flood disasters and losses, as well as provide water for the agricultural lands reclamation. The need for electric power was also a target, as a major catalyst for the industrialization of Egypt under the 1952 Revolution regime. The designs for what soon to become the "High Dam" were drawn, since it was proven that the Aswan Dam (old Aswan Reservoir) alone was insufficient. With the signing of the Nile Water Agreement by Egypt and the Sudan in November of 1959, work began on the second Aswan dam, or "The High Dam" (alsaddal`aly).

The technical reasons given for the construction of the "High Dam" were numerous: to gain control of the Nile water flow from Aswan upwards, to regulate the volume of the water stream to match the actual needs without causing disasters, to protect the regions in danger during the flood and draught season, to generate hydroelectric power to suffice and meet the needs of the fast-growing population and industrialization projects initiated by the Revolutionary regime for development. Other reasons were: to use the additional water stored for reclaiming new lands, to expand the rice and sugar cane production to sustain the needs of the fast growing population thus opening up new employment opportunities, to increase the

agricultural production to sustain the food consumption and decrease food imports, to develop the navigation through the Nile and canals and finally the impact of the control of the Nile on better transportation economics and promote ease of river transport. However, the non-contestable direct negative impact of the High Dam was on Nubia: the destruction of the area and its heritage, the displacement of its inhabitants estimated at 100,000, the loss of the archaeological heritage of the area and the loss of assets, palm trees, vegetation and agricultural land.

The High Dam was constructed 7 kilometers south of Aswan. It is 3600 meters in length and 111 meters above the River bed. The construction started in 1959 and was completed by 1970; the dam did result in the protection of Egypt from drought and annual floods with the creation Lake Nassir, one of the largest man-made lakes as its reservoir, with an area of 350 Km2. The agriculture industry witnessed an increase in production and employment. Development was observed in the improved river navigation that benefited tourism and an increase in electricity generation which was necessary for the industry (Biswas, 2002).

Lake Nasser, created because of the construction of the High Dam, with an area of 350 Km2, is considered one of the largest man-made lakes, and one of the most destructive. Most of Lower Nubia was submerged under the lake. Villages, monuments and archeological sites from the First to the Third Cataracts of the Nile were submerged under water. The lake led to the displacement of 100,000 Nubians (48,000 to Egypt & 53,000 to Sudan) from their ancestral homes, which was forever lost under the rising waters. The list of losses also includes: 60,000 acres of rich cultivated land, one million palm trees, 1,000 water wheels. 42 Nubian villages were eventually submerged under water, thus leading to an immediate need of resettlement (Al Soghayer, 2010). In the 1960s, multiple rescue operations took place in hope of saving what could be salvaged from the monuments. One of the most publicized and largest salvage project was sponsored by the UNESCO (United Nations Educational, Scientific, and Cultural Organization), in response to an appeal by the Egyptian government to that world organization. Numerous monuments were saved, the most famous of which were the temples of Abu Simbil and Philae.

Guidelines for a successful resettlement were needed. The first step was to fulfill the wishes of the Nubian people and provide adequate compensation for their losses, because of the flood. The Nubians were to be integrated into the society with community facilities and services with sound infrastructure, provide a stable economic base and new industrial development programs and provide a smooth adaptation process into the unfamiliar environment.

The social requirements of the Nubians were: relocation was to be away from and existing and established region, but with transportation links to neighboring urban centers. Traditional values and attempt to preserve the traditional Nubian identity was in contradiction to the demands of some for modernity: access to education, elevated levels of communication, increased exposures to the neighboring regions and the exposure of the inhabitants to the mindsets portrayed by the mass media of the 20th century. Numerous Nubians were exposed to the urban lifestyle acquiring habits and urban lifestyles that deeply permeated Nubian values, and consequently had desires opposed to those who were isolated to the traditional Nubian rural lifestyle (Serageldin, 1982).

The site selected for the relocation is a region sitting on the edge of the Nile, 10 kilometers away, 50 kilometers away from Aswan and near the town of Komombo with variations in the site topography like the clan's locations (figure 1). Forty-Two Nubian villages in total were

evicted. The Nubians were asked to take their valuables only, and furniture, and were taken to the new location (Salah, 2013). They had sold anything of value that could not be transported, including wooden elements from their houses (lintels, frames, and doors), trees, and some livestock (Serageldin, 1982).

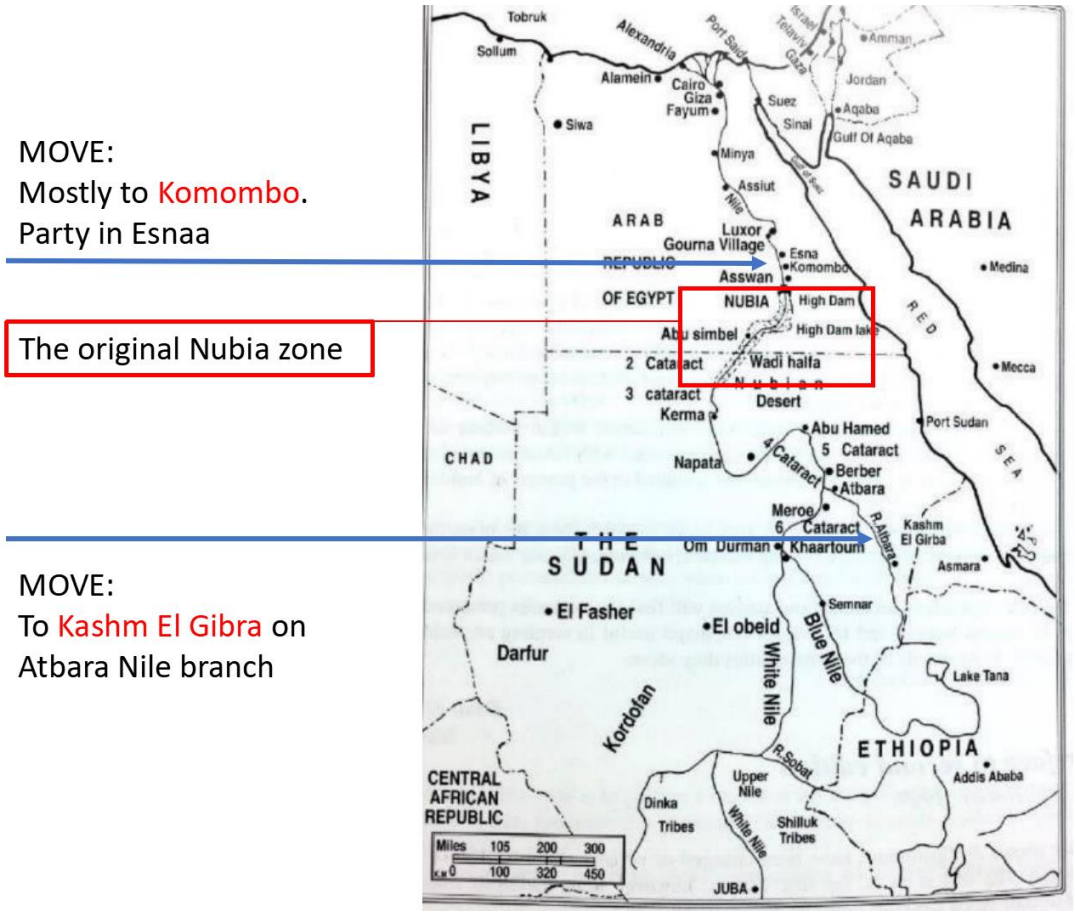

Figure 1 Nubia region and settlement site of Komombo

The Adaptation: Problems & Prospects

The Egyptian Government established a committee in 1961, The Joint Committee for Nubian Resettlement by the Social Affairs Ministry to make resettlement a reality (Serageldin, 1982). The committee included members from the ministries of Education, Urban Affairs, Health and Public Works, to study and cover all the parameters of the project. Each member of the committee was assigned with a task that fell within his jurisdiction. The Central Committee for the Relocation of the Nubian Population (CCRNP) had numerous tasks to meet the deadline for the relocation with the imminent flooding was a major time constraint.

When the time came for the implementation of the resettlement, the budget of the operation was more than the expected, resulting in cut backs to minimize the cost. The construction of the settlements was not even begun although it was less than 18 months to the deadline. Accordingly, pressure was imposed on the government to disregard the drawbacks (Shetawy & El-Shafie, 2013). With the budget constraints, the studies, the recommendations and the Nubians' desires and initial vision were neglected. Not all the villages were ready as promised, some were partially constructed, even some were not constructed at all. The

eviction process was rushed, without finishing the construction of the new villages. The families that were evicted from their homes did not find what was promised upon arrival to New Nubia. (Salah, 2013).

The layout for New Nubia was decided to be a replica of Old Nubia as much as possible, it terms of the organization of the old settlements. The clans were assigned the same configuration and organization as Old Nubia; the Kenuz to be in the northern region, the Arabs in the center and the Kushaf in the Sothern region. To cut back costs, the government neglected all the design guidelines, studies, surveys and the Nubian culture, and that was evident in the design of the layout (Shetawy & El-Shafie, 2013). The villages were linked by the ring road that connects New Nubia with Upper Egypt Highway and the railway for ease of connection with the urban regions. On the other hand, the villages were located on the borders of the reclaimed agricultural land. The villages were close to each other and the assigned agricultural lands were far away from the houses. Traditionally, the Nubians were used to having their lands right next to their houses, where they left their animals and tools in their lands and left for the day to start work again the following day. One of the main drawbacks of the rigid design was grouping the dwelling together based on size, a spatial organization decision that disrupted the social ties among the old villages. The allocation of the houses was according to the number of family members. This presented a critical issue, especially for the widows and the elders, who were located away from their relatives.

After conducting a study on the Old Nubian dwellings, a model house was built in Aswan in 1961 and the Nubian leaders were invited to inspect it. The housing model was approved, despite displayed uncertainty of its tolerance of a desert climate. Four prototypes were designed and offered in New Nubia: one, two, three, and four-room dwelling units with guest reception area, courtyard, animal pen, and kitchen. Number of rooms were related to family size. (Serageldin, 1982). To avoid waste of land and utilize the infrastructure, the government made restrictions for horizontal expansion, which was conflicting with the organic and customary expansion of the Old Nubian patterns. Limited allowance was provided for only one more floor, with space assigned for a staircase.

The houses had various drawback and design problems, and due to the quality of materials the prototypes were not environmentally suitable. Design defects were apparent. The guest and courtyard spaces did not offer the privacy and shade required for the function of the given space, needing the addition of partitions and shading to combat the harsh desert climate. The main defect was the layout of the dwellings, which was altered immediately by the residents. The space between the houses was too narrow to allow outdoor sitting spaces and provide privacy and security without encroaching on the adjacent household. The traditional construction methods and materials were replaced with modern ones. Limestone and concrete were brought into use in the new Nubian settlements. The construction materials and method chosen resulted in the temperature inside the houses being too high for the inhabitants to endure and way out of the comfort zone. The concrete and load bearing walls were not suitable for the desert climate, storing heat during the day and releasing it at night. An account of the adaptation of the people to this design and construction in the village of Abu Simbel in 1987 was as follows: “Because the rooms inside the houses are extremely hot and the courtyards are small and lacking appropriate cross ventilation, the houses are deserted and the inhabitants go outside and sleep in the streets. Men, women, and children sleep on plastic mats spread in the middle of the streets until early morning. Others sleep on the large mastabas they built in front of their houses. The streets look like a large sleeping space.” (Mahgoub 1990, p. 59)

Adjustment to Life in an Unfamiliar Environment & Transitional Hardships

After the resettlement journey, the Nubians were faced with emotional stress, anxiety, fatigue and disorientation. However, that did not stop the positive feeling about the move, especially from the younger generation. The youth faction of the Nubians was excited about the concept of access to education, employment opportunities and being near to urban settlements. The women were hopeful for a better married life, easier life for their husbands in terms of transportation to and from the urban cities and better future for their children with the promised services offered.

Used to the large dwellings, organic in configuration, with land and wide spaces surrounding the dwellings, the new urban settlements evoked mixed feelings. The concept of moving into small, restricted spaces did not sit well with the inhabitants, but the promise of the offered services, infrastructure and utilities made the resettlement bearable.

At first, the Nubians were excited for the move, and were open and flexible for the resettlement operation willing to accept modifications to their daily life and habits. And then the reality of the situation set in: the new settlements were not complete, there was a severe lack of services, many families were forced to share shelters until their dwellings were ready, the community centers were used as shelter for some families in non-sanitary conditions for months. Because of the bad memories associated with those centers, many of the children who had to stay in those centers, hate it and avoid it due to the adverse impact it left on them upon their arrival (Serag, 2013).

Health issue arose in New Nubia, due to the lack of clean water, the change in their surroundings and being exposed to the valley diseases after being isolated for so long. The first generation after the resettlement had a high rate of child mortality due to epidemics.

The settlements all looked identical, which called for a need for markings to differentiate the streets, along with the lack of privacy due to neighbors sharing common walls between the adjacent row houses. As mentioned before, the houses were assigned according to the number of family members, with no consideration to the social ties. Architectural modifications to the houses were made to achieve a form of the dwelling like what used to be in Old Nubia.

The location of the agricultural lands caused some social shifts. The women's role in agricultural decreased due to the location of the agricultural land away from their houses. Consequently, the women stopped working with the men and stayed at home looking after their young and elderly. However, the men lacked the agricultural background and knowledge their women possessed, since traditionally they migrated to the urban regions for employment opportunities. Due to their lack of knowledge about farming, they started selling or renting their lands to farmers to cultivate it on their behalf. The post-relocation Nubians lost their traditional connection with agriculture and farming (Shetawy & El-Shafie, 2013). There was a shift in the jobs the men took on, leaning towards the service sector or to other sectors and migrated to other cities in Egypt to find adequate opportunities.

Families, who could not accept their newly assigned homes, abandoned their houses and moved to the outskirts of their village to build a larger house using the old traditional ways. Although they were trying to escape the defects caused by the new dwellings in the

unfamiliar environment, they created a separate set of problems since they isolated themselves from their own community.

After the resettlement, a conflicts and mistrust was growing between the government and the Nubians. This was rooted in the drastic shifts they were forced to go through for was only for survival and not for the development of their community.

With the environmental and contextual resettlement, the resettled Nubians were faced with changes in food types, lack of clean water, lack of services and defects seen in the new social structure. Those changes did not assist the Nubians in protecting their culture or identity. The Nubians felt that resettlement has failed them and did not provide for a future where they can preserve their heritage and distinctive culture.

The transition impacted the Nubians in a way greater than expected and exposed them to grave hardships causing social shifts that were deeper than expected. The original distinctive environment that was Nubia was lost. With the locations of the villages far away from the river, all the social characteristics and habits peculiar to that relationship were eroded. With the loss of the river and accompanying vegetation and green areas in their daily lives, the social habits that revolved around such focus were lost.

The new and developed education system was taught in Arabic, with no consideration to the Nubian heritage. The Nubian language, traditionally unwritten but only spoken, started to give way to the Arabic language in many families and tribes with the increase in the level of education and literacy. Before the resettlement the Nubians used to marry from the same tribe, thus preserving the clan heritage, language and customs. After the resettlement, there was fear that the Nubian identity and unique heritage was being lost to the modern world. Consequently, the Nubians resorted to intermarriages with their neighbors to preserve the purity and continuity of their race and culture. The displacements altered the social and economic values and traditions of the Nubians severely, to the extent of endangering the existence of the Nubian culture.

Adaptation and Socio-Cultural Change

The daily lives, perceptions and values of the Nubians after the resettlement were dramatically changed and altered, to adapt with the unfamiliar environment, the Nubians were forced to survive in. During a fieldwork interview conducted in 2012 by the second author the following was quoted: “Strangers taught us to steal, to lock our doors and closets and to trust no one [...] we lost the community spirit our core identity and culture [...] we dress like the strangers, watch Satellite channels, abandoned many of our traditional dishes, women are no more helping men in land, we are rapidly losing our language, our songs and our ceremonies […] we are no more traditional”

The women were no longer helping the men with the agriculture, so they resumed their house maintenance activities, including remodeling and decorating the dwellings. Because the houses in the new resettlements were identical, with little features identifying each house form the other, the Nubians started to make modifications on their new houses in forms of paintings, decorating and/or constructing Mastabato restore similarity to the traditional forms of their houses (Shetawy & El-Shafie, 2013). Despite the excessive cost involved, it was the most popular activity among the settlements. Most of the modification were towards

increasing the areas of the dwellings and making it unique, just as they used to be in Old Nubia.

Modifications were applied to the design of the dwellings, rearrangement of the spaces to provide larger courtyards, better guest accommodations and providing spaces for small businesses in the service sector, mostly shops and cafes.

With the new villages' layout and house allocations, social relationships were no longer only family kin. The amenities and conveniences of life in New Nubia gave women more free time which they use for visiting and participation in programs at the handicrafts and social centers. Ties were formed between the neighbors irrespective of lineage, due to the social obligations between the neighbors and the continuous daily interaction. The urban concept that was super imposed on the inhabitants made the social relationships based on residential location and personal affinity. This social shift over ruled the deeply rooted loyalties and morals taught by the clan leaders and elders. Social customs reflected the introduced flexibility in social relations.

Due to the ease of transportation to the urban regions, many Nubians found attractive opportunities in Aswan to which they emigrated. Those urban migrants sought service and civil occupations in Aswan, consequently incorporating them into the local politics of the region. With the increased modifications in the customs, the cultural expressions of the interior and exterior of the Nubian dwellings, new traces and patterns of continuation of the Nubian architecture and traditions are observed, but in a new light.

Conclusions & Current Circumstances

The dwellings designed by the government for the Nubians for the resettlement were not satisfactory for the inhabitants; and their dissatisfaction was revealed and observed by the interior and exterior alterations within their home environment. The spaces in the house are smaller, have different configuration than what the Nubians are used to and desire. Moreover, there are spaces that were excluded from the design, spaces that are of importance in the traditional Nubian house. The residents redesigned and added elements to show their heritage and nostalgia for the old Nubian experience and lifestyle, to achieve some level of comfort and to showcase their individuality, which is an intrinsic part of Nubian culture with which they identify themselves with others. The elements added evolved over time with patterns of continuity that are observed through different elements.

The decoration and ornament of the exterior of the house is a statement of social standing and wealth, consequently foremost importance and effort was invested in the façade. The decoration of the exterior doorways is very distinctive and eye catching to the viewer. It is a mix of vivid vibrant colors and textures of plaster, adobe, ceramics, mirrors and dried animals. The entrances after the renovations were highlighted with pillars, with the doorway into the dwelling a vital and dominant element of the façade. Even though the changes executed on the facades reflect old Nubian architecture, but lesser decorations over time. Variations can be observed depending on the location of the dwelling. The desire to draw attention to one's home continued, especially when applied using the doorway as a symbol to the family (El-Hakim, 1993).

In the interior spaces of the Old Nubian houses, the traditional wall decoration was by using handmade straw dishes of assorted sizes and covering the walls with them. The bigger the size of the straw dish, the more important the space the dishes were installed in. The order of the decorations on the walls was decreasing in size from top to bottom (Kamel & Abdel-Hadi, 2012).

In the Old Nubian architectural culture, they played with the contrast of colors. The color scheme of the dwellings was an earthy scheme, varying between yellow, shades of brown and shades of white. (Kamel & Abdel-Hadi, 2012). After the resettlement, the color scheme consisted mostly of yellow, blue and green, and small percentages of grey and white.

All the elements of the traditional color scheme participate in creating the impression of cheerfulness, from the interior features to the walls to the openings. The spaces mostly inhabited by the women express more details in their decoration; "one finds painted and plastered ships, fish, scorpions, birds, camels, date palms, and flowers; suns, moons, and stars; crocodiles and lions, mosques and prayer carpets'' (Gerster, 1963). Today, the color scheme inside the new Nubian houses is dominated by the blue color, with soft and light blue variations.

In the Nubian culture, color shows and interprets the mood of the clan, whether an individual or a group. That explains why the most commonly used color is yellow in the exterior façade, which gives the impression of cheerfulness and delight. On the other hand, a sizable percentage use light blue in the interior façades of the houses symbolizing peace and serenity, and helps repel insects (Kamel & Abdel-Hadi, 2012).

The interiors used to be left in the original color of mud from which the walls were constructed and plastered, then decorated with patterns and wall hangings in bright colors. Currently wall interiors are being replaced by a single light color, mostly light blue, with plain walls.

In the old houses, the façades are divided horizontally into bands and accordingly the decorative bands in each region were different. The top band had a decorative motif design of "tree-and-grass" pattern that is repeated, while the bottom band is defined with a motif of "chicken-and-shrub". Both decorative motifs are repeated around the house, so the division can be seen from all sides. With the use of a single color as the base of the exterior walls, doors and windows were colored with contrasting colors to attract the eyes. The doorway or the main gate into the dwelling is the principal element in the façade that was to be decorated, since it was an indicator to the inhabitants' status.

As observed from multiple villages after the resettlement, the most common renovation activities were: adding a wall fence, adding a "mastaba" , or a built-in seating bench on the exterior façade for seating, reducing the size or completely removing the animal pen that was part of the initial design, and either converting it to space for storage or adding its area to enlarge the open courtyard, creating new, smaller clerestory windows, adding decorative motifs on the houses, changing the color schemes of the facades, interior and exterior.

Currently, Nubians have moved into the tourist industry by exploiting their heritage and architecture. Commercializing the Nubian culture became a way to earn living for Nubians. The architecture and pure expressions of the Nubian culture became a popular trend, with increased interest in all that is Nubian. Selling the Nubian culture to the tourists has been turned to be part of the tourist industry. The houses of the Nubians are now open houses that you rent to stay in a room or pay to have tour inside to get a glimpse of what used to be. The

natives' lifestyle and architecture are sold by merchants who are born in the resettlement villages (Shetawy & El-Shafie, 2013). Exploiting Nubian Heritage is now a "business", and following basic capitalist laws and market rules, with profit as the prime generator and the highest number in the bottom line is the aim. A "new" type of Nubian vernacular architecture is emerging, slowly.

Traditional Nubian culture has been heavily compromised. Attempts to adapt the existing settlements to recreate traditional Nubia is only cosmetic since the social structure, meanings and relationships can't be recreated. Currently, the best we can hope for is a repackaging of Nubian architecture, art and culture to preserve it as an interesting and attractive magnet for the tourist industry. This is not as bad as it sounds, since this is the only way that this culture will survive after the actual loss of the land, the architectural layout, the social cohesion, the social structure, the economic agricultural base and interactions that created the culture in the first place. Modern re-interpretations can serve as a starting point for development of art and architecture with a truly Egyptian Nubian identity based on the rich heritage of Nubia.

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DAVID LENNOX: SUPERINTENDENT OF BRIDGES

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DAVID LENNOX: SUPERINTENDENT OF BRIDGES

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INTRODUCTION

David Lennox (1788-1873) was a Scottish mason who emigrated to the penal colony of New South Wales at the age of 44, seeking better prospects. During the next 20 years he designed and supervised the construction of dozens of bridges in timber and masonry, including some of mainland Australia's first masonry bridges of any magnitude. Many of these were built by convict labour and several are still carrying traffic 180 years later. His greatest work was one of the longest and flattest arch bridges in the world at the time, yet he is virtually unknown outside Australia today. The occasion of an international bridge conference on all aspects of heritage is an appropriate time to review Lennox's life and work.

NOTE: This is an extended version of a paper presented on 7 July 2017 at the international conference 'BRIDGE: The Heritage of Connecting Places and Cultures', held at Ironbridge Gorge. The authors acknowledge that, unless referenced otherwise, the entire textual content comprises extracts and summaries of material originally published by Henry Selkirk (Selkirk, 1920) and Peter Alsop (Alsop, 2010, 2014a).

The paper is dedicated to the memory of the engineer and historian Peter F.B. Alsop (1935-2014). Peter published the first volume of a projected limited-circulation three-volume biography of Lennox in 2010. Volume 1 covered Lennox's life and times from his birth up to 1833. Volume 2, dealing with the period 1833-1844, was published in 2014. Sadly, Peter died shortly after its publication; his research collection (Alsop, 2014b), which includes material intended for Volume 3, is now in Deakin University, Geelong, Victoria, Aus.

Fig.1 Portrait of Lennox taken at the time of his appointment as Surveyor to the Parramatta District Council in 1843 (then aged 55) (courtesy of Parramatta Visitors Centre).

LENNOX'S CAREER IN BRITAIN

David Lennox was born into a farming family at Ochiltree, Ayrshire, on 9 February 1788. By the age of 18 he was working as a 'stone cutter' - cutting and carving stone for buildings and bridges. It is likely that he was employed on the vast Highland Roads and Bridges construction programme that was overseen by Thomas Telford. Lennox was living in Ireland by May 1818 when he married Jane Rome in Dublin. He moved on to work as a mason on several Telford projects, the first being the pioneering suspension bridge over the Menai Straits in North Wales. Two daughters were born while David and Jane were living at Bangor Ferry near the bridge works; Mary was born in November 1819 and Jane junior in May 1823 by which time Lennox had achieved the status of Master Mason.

He spent a couple of years working on swing-bridges on the Gloucester & Sharpness Canal, followed by three years as foreman mason for the contractor John Cargill building Telford's iconic masonry arch bridge on the Severn at Over near Gloucester which was completed in 1829. Jane died during this time and the two young daughters were sent away to relatives. Lennox then worked for a short time on the Birmingham & Liverpool Junction Canal before moving on in 1831 to St. Katherine Dock, London, where he arrived at the start of a severe financial recession. A brief entry in I.K. Brunel's diary hints that Lennox called on him in London on 16 September 1831, perhaps looking for work: 'Lenox [sic] formerly Master Mason at Menai and Glos'ter - an honest man'. When Brunel visited Over Bridge the previous month he noted that the arch had cracked and settled 'most awfully' after the centring was removed; no doubt he valued Lennox's 'insider' account of the project (Brunel, 1831). Telford himself expressed in his autobiography his regret about the settlement, 'as I have never had occasion to state anything of the sort in any other of the numerous bridges described in this volume' (Rickman, 1838).

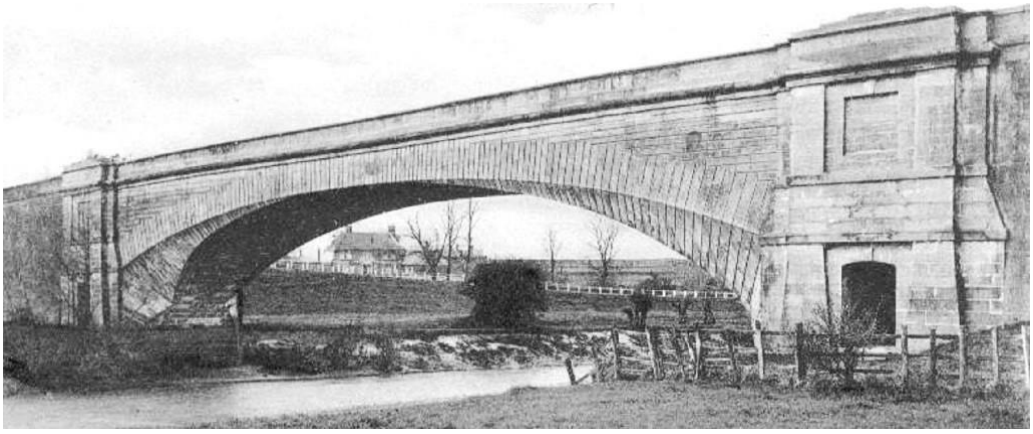

Fig.2 Telford's Bridge over the Severn at Over (image courtesy of Gloucester City Council).

The loss of his family, compounded by the ruinous combination of the recession and a cholera outbreak, induced Lennox to make the decision to emigrate. Like countless other distraught and disillusioned British engineers, craftsmen and artisans during the nineteenth century, he sought a new, more rewarding life in the Colonies. In April 1832, aged 44, he sailed from London to Australia aboard the merchant ship 'Florentia'. The First Fleet of 11 ships carrying convicts and free emigrants had founded the penal Colony of New South Wales in the same year that Lennox was born - a coincidence that he would hark back to with

pride in his later life. He landed at Sydney on 11 August 1832, carrying with him drawings of the bridges he had worked on, together with testimonials and letters of introduction which included one from Telford himself. In April 1834 Lennox wrote a candid, self-confident letter to Telford from Australia, thanking him for the 'great kindness in recommending me to this distant part of the Globe' (Lennox, 1834). Telford was not alone in taking interest in his welfare; when John Cargill advised Lennox that 'trying one of the Colonies is not a bad plan', he also hinted that they had built close personal relationships: 'I will be happy at all times to hear from you. Mrs. Cargill and my daughters send their kindest remembrances and best wishes for your welfare'. It is possible that Brunel had also advised him to consider emigrating if he wanted to improve his prospects.

LENNOX IN NEW SOUTH WALES

After two months working as a day labourer, one of Lennox's letters of introduction led to a meeting with the Surveyor-General of New South Wales, Thomas Mitchell (1792-1855) who later reported, 'A very well qualified person latterly arrived in the Colony has been strongly recommended to me and I have examined his working plans of arches of the greatest magnitude on which he has been employed'.

Mitchell had gained his experience mapping rugged parts of Spain during the Peninsular War against Napoleon’s armies. On half-pay and with a family to support, in 1827 he accepted the post of Assistant Surveyor-General of New South Wales before becoming Surveyor-General the following year. After Governor Darling announced that the Roads and Bridges Department was to become a branch of the Surveyor-General's Department in January 1830, Mitchell took on responsibility not only for exploring and surveying the Colony but also for setting-out and building the roads and bridges that were essential to its development. On 24 July 1833 he was able to report that he had completed setting-out the three 'Great Roads' leading from Sydney to its outposts but, he added, 'when they will be made, God knows'.

The availability of convict labour enabled Mitchell to undertake an extensive roads and bridges construction programme using newly formed 'ironed gangs' of twice-convicted felons wearing leg-irons, who constructed their own accommodation (huts or 'stockades') and could be sent to distant places. The system allowed progression from Road gangs to Bridge gangs as individual skills were gained. Those with the highest skills were assigned to Bridge gangs and did more specialized work, but even so the Bridge gangs consisted mostly of unskilled men. Mitchell later wrote, 'We had among the prisoners some tolerable stonecutters and setters but, until I had the good fortune to find among the emigrants a person practically acquainted with the construction of arches, their labours had never been productive of much benefit to the public'. The flimsy timber bridges the convicts were building were all too often unable to withstand the ubiquitous floods and bush fires. Mitchell quickly realised that Lennox had not only the technical expertise required to revolutionise travel within the colony by building substantial masonry and timber bridges but also the experience and strength of character to manage and train such a daunting work force. The Governor at that time, Richard Bourke, endorsed Mitchell's proposal that Lennox should be engaged as 'Sub-Inspector of Bridges ... to furnish the designs, construct the centring, direct the application of convict labour to stone cutting and setting, and to the branches of carpentry and masonry necessary for the construction of bridges'. All that, for an annual salary of £120 - half the salary of Mitchell's lowly Assistant Surveyors.

Lennox's bundle of 'working plans of arches' soon provided him with inspiration in his new post. In his letter to Telford, he summarised his progress since arriving in Sydney. He was now responsible for some large bridges: 'I completed the first stone bridge in the Colony (at least that deserves the name of such) about six months ago, it is upon the Western Road to Bathurst ... I gave them a design for another Stone Bridge on the Great South Road over Prospect Creek ... I have given the design for a Stone Bridge at Parramatta [and] one at Berrima 80 miles from Sydney'. In addition he was designing and building timber bridges. Funding was then, and always would be, a problem: 'Economy has reached such a height that I expect little practice unless I can build bridges for nothing'.

He went on to describe the workforce he had to train and supervise: 'I have only Prisoners of the Crown to do all kind of work and most of them working in irons ... It takes very close attention to make them do anything as it should be done'. The difficulties he regularly experienced provide some insight into the convict system and level of skills available in the Colony. Although some of the sentences were for 'heavy crimes', Lennox blamed the penal system itself rather than 'any particular depravity of the prisoners themselves'. He convinced Mitchell that good behaviour should be rewarded by remission of sentence and that better performance could be achieved by unshackling the 'iron gangs'. Arrangements were also made to confer on valued masons and carpenters the same status as convicts on 'private assignment', which translated as improved ration allowances.

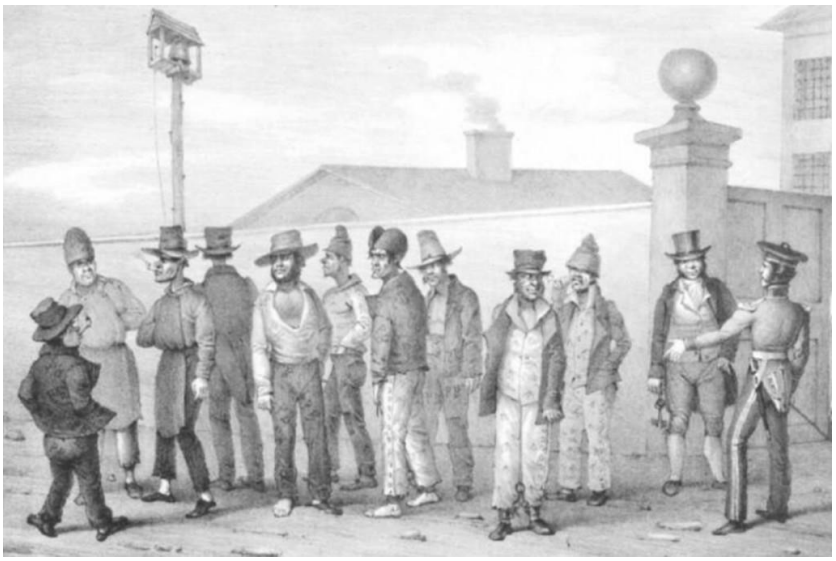

Fig.3 Earle, Augustus & Hullmandel, Charles Joseph & Earle, Augustus. (1830). A government jail gang, Sydney, N.S. Wales. The sketch depicts a convict gang and its military supervisors emerging from Hyde Park Barracks, to labour on public works in and around the town. Three of the convicts are in irons.

Lennox's 'first stone bridge in the Colony' was built to carry a realigned stretch of the Great Western Road, known as 'Mitchell's Pass', high above a creek where the road made a sharp U-turn on Lapstone Hill near the present Glenbrook, 45 miles from Sydney. In late 1832 he selected 20 convicts from a road gang to train in masonry and carpentry work at Lapstone Hill; they were accompanied by a constable and an armed sentry. By May 1833 the skills and

dependability of the work-force had progressed to the stage where he could occasionally leave the site under the supervision of a 22 year old convict, George Nielson, in order to begin preparatory work on a bridge over Prospect Creek on the Great South Road near Liverpool. Mitchell, supportive as ever, remarked at this time that Lennox's insightful management of convict labour was not only good for public works; it was also a reward for the men and it would do 'justice to Mr Lennox who has made them useful workmen'. Lennox petitioned the Governor to remit the remainder of the iron gang sentences of the eight convicts he wished to take with him to Prospect Creek, one being James Randall who had set most of the Lapstone Bridge masonry.

Fig.4 Lapstone Bridge. https://en.wikipedia.org/wiki/Lennox_Bridge,_Blaxland#/media/File:Lennox_Bridge,_Glenbrook.jpg, Craig Siczak CC BY-SA 4.0, accessed 6 November 2017.

Lapstone Bridge was formally opened on 28 July 1833. Its semi-circular span of 20ft might be considered unremarkable today, but it was indeed one of mainland Australia's first masonry bridges of any magnitude and is now its oldest extant bridge. Lennox skilfully curved the masonry to match the alignment of the road, hence its nickname 'Horse Shoe Bridge'. The Western Road was re-routed in the 1920s and the bridge now carries a local road. Extensive strengthening work was carried out in the 1970s.

Lennox was, by necessity, much less hands-on with the skills development and supervision of his Bridge gangs after Lapstone Bridge. One of the means by which he achieved his engineering feats with mostly unskilled convicts was to appoint capable men as overseers. The fact that such overseers were convicts selected from the gangs, or held tickets-of-leave, had no bearing on the fact that they were invaluable and essential to his projects. In what must have been a major setback, his trusted overseer George Nielson was dismissed for misconduct in July 1833. George Tasker, a new arrival said to be 'practically acquainted with masonry construction', was appointed in lieu but he turned out to be useless. Having sufficiently proven himself in the eyes of the Governor, Lennox's post was officially re-titled 'Superintendent of Bridges' four months after Lapstone Bridge was opened; even so, his salary remained unchanged. His paltry salary and the difficulty of retaining trained Bridge gangs would continue to cause tension between him and his superiors for the rest of his time in the Colony.

Governor Bourke named the bridge over Prospect Creek 'Lansdowne Bridge' at a foundation ceremony on 1 January 1834. While Lennox was based there he was tasked with several other projects by the Roads and Bridges Department which had the effect of redirecting him and his workforce from the site. Not only did this prolong the construction period of Lansdowne Bridge but it also brought Lennox into conflict with Percy Simpson, the Assistant Surveyor for Parramatta, over the matter of who had the more urgent need for trained convicts - in the event, Simpson usually took primacy.

Six months after the Lansdowne Bridge foundation ceremony Lennox threatened to resign unless his salary was raised. He pointed out that its 110ft span would be 'larger than any of the stone arches in London (Waterloo and the new London Bridge excepted) ... I have not now so much [salary] as when I was foreman to a contractor in England at similar undertakings, where there was a head engineer, a resident engineer, a contractor, a clerk, and three foremen besides myself ... Here everything is to be done by the man on the spot and four mechanics'. Following the successful completion of the bridge in January 1836 Governor Bourke rewarded him with a bonus of £200 and an increase of salary to £250 plus a forage allowance for a horse. James Backhouse, a Quaker missionary, visited the site nine months later while convict gangs were carrying out additional masonry work and road repairs around the bridge. He described their grim living conditions: 'At the quarries the men are lodged in 'boxes' or caravans, a little more than seven feet wide; four tiers of men, of five each, occupy one box. At Lansdowne Bridge, fifty men are lodged in two boxes, each ten feet wide'. (Backhouse, 1838).

Fig.5 Sketch of a mobile box to accommodate a convict road gang, Andrew Garran (ed.), Picturesque Atlas of Australasia, Volume 1, Melbourne, 1888.

Lennox wrote in his letter to Telford that Lansdowne Bridge would be built 'with Groins formed upon it similar to Over Bridge'. He was referring to Telford's use of 'hollow spandrels' whereby the roadway was carried by stone slabs supported on masonry walls over the arch barrel, forming voids which reduced the weight of backfill. It is not clear whether or not Lansdowne Bridge was actually built with hollow spandrels, but Lennox did use other Over Bridge features in addressing the problem of Prospect Creek's frequent heavy flooding: he kept the springings of the arch as high as possible through the use of a complex five-centred arch, and he chamfered the edges of the arch to streamline river flow.

Fig.6 Lansdowne Bridge in 2013.

He later described how he dealt with two 'indolent' young convicts at this time: 'I set them to hard work to break them in a little, and now they turn out very good boys. I intend to make carpenters of them as soon as we begin to make the centring for the bridge'. Lansdowne Bridge has the longest span of Lennox's surviving bridges and it still carries heavy traffic. A major refurbishment was carried out in the 1960s which included cutting-back badly weathered stone and inserting new facing stones.

In 1833 Lennox prepared plans for improving the Queen's Wharf at Parramatta which was subsequently completed by a road gang with William Barrett as overseer in January 1835. This masonry quay served as the terminal for all river traffic and was the vital link with the Port of Sydney until the arrival of the railway into Parramatta in 1855. The wharf is still in situ though parts of the structure have been relaid with concrete and modern stone additions.

By now Lennox was frequently attending to works on the Great South Road which Mitchell was especially keen to develop. He was instructed to build a bridge over the Wingecarribee River at Berrima; after a delayed start it was completed in June 1836 by overseer Henry Wise. It was in effect a scaled down version of Lansdowne Bridge but without chamfered edges to the arch.

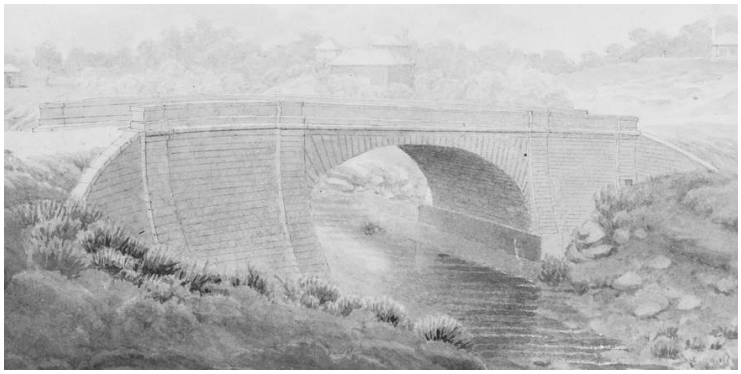

Fig.7 Berrima Bridge, water-colour by Thomas Mitchell, 3 April 1855 (State Library of NSW). This is the only surviving image of the bridge.

Berrima Bridge was destroyed by a flood in 1860, but the remains of two of Lennox's timber bridges are still extant further along the Great South Road. Early in 1834 he began building a three-span timber bridge on masonry piers twenty feet apart, over the Medway Rivulet three miles south of Berrima. It was completed early in 1835 but the deck was washed away by flood in 1860 and was later replaced. Known as Three Legs o' Man Bridge, it remained in service until 1950 and the piers are still present, though bypassed. The second bridge was at Crawford's or Black Bob's Creek, 8 miles south of Berrima, which was opened to traffic in April 1836. Mitchell reported that the walls were of excellent stone resting on a solid mass of rock, and that the bridge was constructed of strong timber beams spanning 30ft, supported by angled timber braces. The timber deck was removed in 1896 and a mass concrete arch bridge was built within the abutments, which are still extant.

Initially designed by Lennox as a timber structure on stone piers, Duck Creek Bridge on the Parramatta Road thirteen miles from Sydney was actually completed in 1837 as a semi-circular brick arch bridge of 30ft span - probably to a Lennox design. The road was widened around this bridge in 1930 which involved extending each end of the brick arch with concrete; the original facing has been obscured as a result. There is another small bridge with a masonry arch span around 15ft at Towrang on the original Great South Road between Berrima and Goulburn. The date 1839 was originally visible on the keystone; despite stylistic differences from his previous bridges, it is possible that Lennox was involved in the design and/or construction of this bridge also.

Never short of responsibilities, Lennox designed the Liverpool Dam in 1836, one of the first engineered weirs built in New South Wales. It was constructed under the supervision of Captain Christie of the 80th Regiment, Assistant Engineer and Superintendent of iron gangs in the Town of Liverpool. In addition to supplying water to the town, it served as a causeway across Georges River.

The last major bridge that Lennox designed and built in NSW was over the Parramatta River in Church Street, Parramatta. In September 1835 Bourke's rejection of his design for the bridge triggered a dispute between Lennox and his superiors about the size and appearance of the bridge which delayed its construction by a year, causing Lennox to complain, 'I am tired of it before the work is commenced'. Eventually Bourke accepted his design for a 76ft span arch. Lennox later wrote that Westgate Bridge at Gloucester was 'nearly the same in all respects as that at Parramatta'. Robert Smirke's Westgate Bridge had been completed in 1816 on a site less than a mile from Over Bridge, so Lennox would have had many opportunities to inspect it. It was demolished in the 1970s; photographs suggest the two bridges were only superficially similar. Lennox's plan was 'to build one half of the arch at one time and make the road passable over that part, until the other is completed'. He certainly did incorporate here a form of 'hollow spandrel' system of the type he told Telford he intended to use at Lansdowne Bridge.

Construction began in November 1836, re-using the Lansdowne Bridge arch centring which was transported to Parramatta by bullock cart and adjusted on site to suit. A month after work started, the Colonial Secretary informed Mitchell that supervision of Lennox and the Road and Bridge gangs was to be transferred to Captain Barney of the Royal Engineers on 1 January 1837. Mitchell was granted 18 months leave of absence to return to England; evidence relating to Lennox's activities becomes sketchy after Mitchell's departure.

Labour issues slowed down work on the Parramatta Bridge as the Royal Engineers regularly requisitioned the Bridge gang. Two overseers were prominent in its construction: Henry Wise who had been responsible for the completion of the Berrima Bridge, and John Weston, a stone-cutter by trade. It was not until October 1839 that the final configuration of the bridge was achieved and it was opened to two-way traffic. Earlier in the year Lennox designed and erected ten boundary stones to demarcate the Parramatta town limits; Weston carved the inscriptions. Lennox's daughters had arrived in Sydney by this time and they now joined him at Parramatta; both girls married Parramattans.

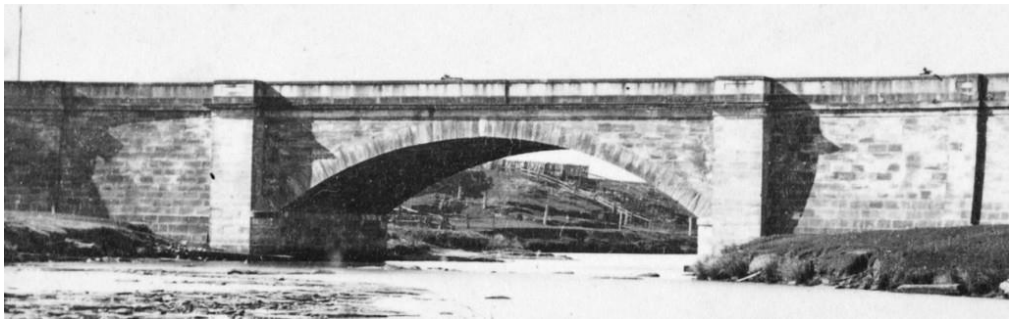

Fig.8 Western face of Parramatta Bridge in 1870 (Historic Houses Trust, Caroline Simpson Collection, Record No. 37824).

The Parramatta Bridge was officially re-named Lennox Bridge in 1867. It remained unaltered until 1902 when a 10ft width of the arch was strengthened internally to carry the Parramatta-Castle Hill tramway. In 1912 the parapet on the western side was removed and a cantilevered footway was added; in 1934-35 the bridge was again widened on the western side by the construction of a stone-faced reinforced concrete arch alongside the original masonry span, and the eastern stone parapet was replaced with concrete.

Major development works on the bridge in 2014 made it the focus of an archaeological excavation which gleaned valuable insights into the internal structure and the method of two-part construction. Excavation revealed, amongst other things, an un-mortared wall which appears to have been built to retain the fill supporting the road when the first half of the original bridge was being built. The publication of the archaeological report is eagerly awaited as it will doubtless reveal new material about the nature of the internal structure.

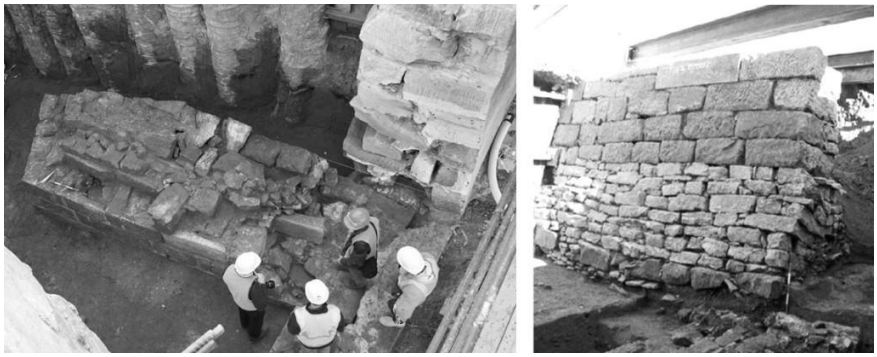

Fig.9 Parramatta Bridge archaeological excavation. Left, remains of a pier of the former timber beam bridge at the crossing; right, an un-mortared retaining wall (Images courtesy of Parramatta City Council).

An economic recession in the early 1840s thwarted Lennox's efforts to build a dozen or more sizeable timber and masonry bridges for which he had already prepared designs; it also raised the probability of his salary being drastically cut. With his livelihood under threat, he resigned as the Colony's Superintendent of Bridges in October 1843 to take up the newly created municipal post of Surveyor to the Parramatta District Council on a salary of £200. His appointment was perhaps a matter of formality, bearing in mind that his high reputation locally was augmented by the Deputy Surveyor-General's fulsome testimonial referring to his 'well known ability in bridge building (of the best construction) and the formation of roads, the construction of canals, construction of dams, and of most other descriptions of useful and public works'. (Newspapers, 1843)

Lennox's municipal duties now comprised little more than highway maintenance - a situation that no doubt frustrated him, especially after August 1844 when a Council motion was passed that would reduce his salary to £150 the following January. Fortuitously, he was enabled to resign as District Surveyor in October 1844 when Governor Bourke offered him a post on a salary of £250, based at Melbourne which was then in the Port Phillip District of NSW. On 18 November Lennox's Parramattan friends gave him a public dinner and a silver snuffbox 'as a testimonial of the esteem in which he was held by his fellow-townsmen'. He left Parramatta none too soon as the Council immediately advertised his vacated post at £100 a year, having belatedly decided 'it was not so much a Surveyor that the Council required, as an attentive man who would act as a master of the men'. (Newspapers, 1844)

LENNOX IN PORT PHILLIP AND VICTORIA

Lennox's new post was nominally Superintendent of Bridges for the Port Phillip District but, in his own words, 'circumstances rendered it necessary for me to take the charge of the whole of the Roads, Bridges, Wharves and Jetties'. His appointment proved to be controversial. The Town Council of Melbourne had recently organised a design competition for a new bridge over the Yarra river and Bourke appointed Lennox to report on the proposals, prompting an anonymous writer in the Port Phillip Gazette to grumble, 'Here is a manifest discouragement of our local labour, and an open censure passed upon local ability ... Because a Sydney practical bridge builder has superintended the erection of bridges in that district, [does that] give him superior qualifications over those in our own town who have performed similar works in England?' (Newspapers, 1844)

All Lennox's public works were now constructed by contract. The Yarra Bridge at Melbourne was by far his foremost bridge project. Having demonstrated the structural and economic inadequacies of all the competition entries, he designed several options. In October 1845 the most expensive at £10,000 was adopted - a single 150ft span masonry arch which he claimed would have 'the finest appearance of any in the British Dominions' (Newspapers, 1845). The bridge was named Prince's Bridge at the foundation ceremony in March 1846 in honour of Albert Edward, Prince of Wales (later King Edward VII). As at Parramatta, Lennox built the arch in two halves and used the 'hollow spandrel' technique. Unforeseen political and technical difficulties had pushed the final construction cost up to £19,900 when it was formally opened in November 1850. At that time it was among the longest and flattest arch bridges in the world, yet the bridge and Lennox himself were then, and still are, virtually unknown outside Australia. Part of the reason for this may lie in the destruction by fire of virtually all his personal and business records in 1850. (Newspapers, 1846-1850).

Fig.10 Prince's Bridge c.1875, photographer Charles Nettleton. State Library of Victoria, online item, http://handle.slv.vic.gov.au/10381/69265, accessed 8 November 2017.

When Port Phillip District separated from NSW to become the new Colony of Victoria in 1851 Lennox claimed to have built about 70 timber bridges in the District, some of them of great overall length and with long embankments on each approach, plus many miles of new roads. His salary was raised to £300 in 1852 and to £600 in 1853, reflecting his increased duties as advisor to various Government departments following the discovery of gold in Victoria in 1851. His masterwork, Prince's Bridge, was demolished and replaced in the 1880s when it became inadequate to cope with the massive increase in road and river traffic generated by Melbourne's population explosion resulting from the gold boom.

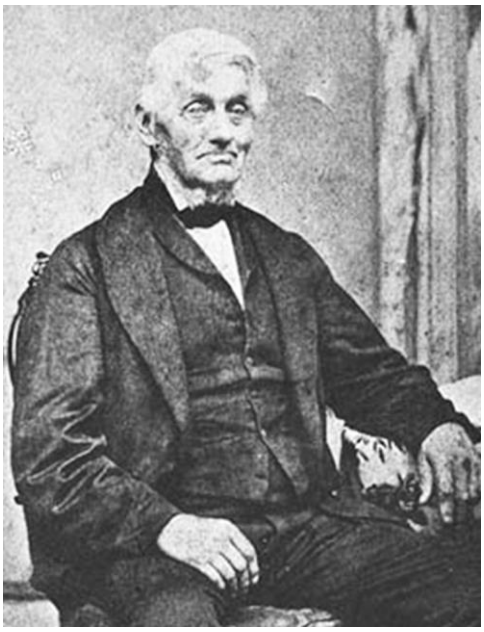

Fig.11 David Lennox in later life (State Library of NSW, photographer unknown).

After his retirement in November 1853 with a Government gratuity of £3,000, Lennox returned to Parramatta where he built himself a house at 39 Campbell Street which is still extant. He died on 12 November 1873, aged 85, and was buried in an unmarked grave in St John's Cemetery.

CONCLUSIONS

David Lennox was among the multitude of British engineers, craftsmen and artisans who emigrated during the nineteenth century, carrying their technical ability and experience to the farthest corners of the world. Despite the unforgiving natural environment, a relentless shortage of funding and an inexperienced and stubborn workforce, Lennox was uncompromising in his pursuit of high standards of design and construction. His mastery of masonry work, combined with strength of character and a firm yet compassionate approach to the management of labour, enabled him to transform the infrastructure of a developing nation. Recalling his first meeting with Lennox, Thomas Mitchell declared in 1855, 'thus originated all the bridges this Colony possesses worthy of the name'.

Lennox's legacy, in the form of a few extant bridges, can still be seen - displaying clear evidence of knowledge transfer from Old World to New World.

ACKNOWLEDGEMENTS

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Lennox, D. (1834): *Letter from David Lennox to Thomas Telford*, 5 April 1834, in the Mitchell Library, State Library of NSW, Aus, reference MLDOC 2669.

Newspapers

The authors made extensive use of the following newspapers in piecing together Lennox's activities between 1843 and 1850:

Sydney Morning Herald 1843-1846

The Australian 1843-1844

Parramatta Chronicle 1844

Port Phillip Gazette 1846-1850

Melbourne Argus 1846-1850

“The Bridge to Scotland: Matthew Paris and the Politics of Mapping Imagined Bridges in the Thirteenth Century”

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The Bridge to Scotland: Matthew Paris and the Politics of Mapping Imagined Bridges in the Thirteenth Century

Figure 1 "Map of Great Britain by Matthew Paris, about A.D. 1250 in the British Museum" from Alexander Lamb, *Dundee: Its Quaint and Historic Buildings* (Dundee: Georgie Petrie, 1895), no page number, in the possession of the author.

Sometime in the last 10 years of his life, between 1250 and 1259, the St. Alban's chronicler and historian, Matthew Paris drew four maps of Britain that he attached to the beginning of various editions of his histories. In both style and function these maps departed significantly from the prevailing cartographic traditions of medieval Europe. No English artist or monk had ever drawn a map like them, and the Continent knew no equivalent. Paris ignored long-standing cartographic traditions, narrowing the scope of his gaze to Britain, an area usually marginalized on medieval maps. In these, the first regional maps of the island, Paris allowed his audience to see, and presume to know, the whole of Britain for the first time. Of Paris's four Britain maps, the Claudius map (fig. 1) presents the most thorough and finished cartographic vision for the island. This is his most famous map, and it is the subject for this study.1

Because of the Claudius map's complexity and its inclusion in one of Paris's final manuscripts, historians have generally accepted it as the monk's best attempt at achieving a precise geographical representation for the island – his last, best effort at mapping Britain.

The cartographic historian P.D.A. Harvey has made the emblematic case for this argument (Harvey, 1992, pp. 109–122). Scholars have looked at the map as an important, but generally unsuccessful, effort at moving away from the more symbolic and cosmographic styles common to medieval mapmaking (see, for example: Lester, 2009, pp. 25–44; Vaughan, 1984, pp. 243–244; Woodward, 1987, pp. 276–341). The conventional thinking here goes that Paris was on the right track – the map's north-facing orientation, its nod to scale, and its effort at accurate geography are all encouraging signs of cartographic progress. But, at the end of the day, he didn't quite get it right. The geography of the island bends to follow the backbone of a straight pilgrim itinerary route from Newcastle to Dover, resulting in an island badly distorted from the one we know from modern maps. Scotland is deformed, the area around Carlisle has been pushed into Wales, and, Cornwall runs off the side of the map's neatline before getting cut off. The itinerary route has long been considered the map's most salient feature, in part because it connects seamlessly to Paris's other itinerary maps, which run from London to Rome. Harvey, expressing an idea that has become essentially canonical, wrote categorically that the map "should be seen as an itinerary." (Harvey, 1987, p. 496; Vaughan, 1984, p. 244). In consequence, studies of the map have tended to consider its

geographic oddities only in terms of faith. The broad scholarly consensus, then, is that Paris tried to make an accurate map, but his efforts were thwarted by his faith.
But this approach to the Claudius map that – one that insists on reading the document only for the truth-value of its geography – ignores the possibility that that Matthew Paris, like many other cartographers, also made choices about geography for political reasons. In our map-literate culture, we tend to think of maps as neutral documents presenting facts. But they are not. As the cartographic historian J. B. Harley demonstrated, mapmaking frequently reflects political power structures and ambitions; and maps themselves are often partisan tools posing cartographic arguments (For a representative sampling of Harley's work on the nexus between maps and power, see: John B. Harley, 1988; J. B. Harley, 2001). Historians of the modern and early modern world have utilized Harley's methodologies to examine the role of cartography in constructing frameworks for both centralizing an authoritative image of state spaces at home, and for supporting colonial project abroad (For the role of maps in fixing images of the state, see, for example: R. Craib, 2002; R. B. Craib, 2004). There has been some recent extension of these ideas to medieval mapmaking, but in the main, this conversation has not yet tuned to consider Matthew Paris's work (For examples of work on medieval maps as making political arguments, see: Birkholz, 2004, pp. 108–153; Millea, 2008).

However, the monk's maps deserve to be included in the discussion; Paris's cartography shares many of the qualities and conventions found in later, more accepted, instances of imperial mapmaking. The Claudius map makes a concerted argument for English rights to the whole of Britain, by limiting the territorial claims of the Welsh and the Scots, and by overwriting the land with a distinctly English history.2 Paris understood that, as Doreen Massey noted, "the identity of places is very much bound up with the histories which are told of them, how those histories are told, and which history turns out to be dominant" (Massey, 1995, p. 186).3 The Claudius map, and the chronicle it came attached to, gives its audience a history of England that the monk borrowed wholesale from Geoffrey of Monmouth. Geoffrey's fanciful and influential 12th-century pseudohistory, the Historia Regnum Britaniae – the History of the Kings of Britain – gives a past to the island and its people that stretched back to a mythical founding by Aeneas's great-grandson Brutus, and which drew a direct connection from the legitimating histories of Brutus and the Romans through to the Norman conquerors. In the chronicle that accompanied the Claudius map, Paris explicitly extended that line through the Plantagenets, all the way up to his own king, Henry III.

The Claudius map displays this constructed political world, and through its textual, geographic, and iconographic components, the map provides a visual gloss, arguing in shorthand the case that Paris's writings make at length: that the Plantagenet kings held rightful claim to rule all of Britain. This was a view that the monarchy held, as well. Throughout his reign, Henry III fought repeatedly with the Welsh, and made multiple efforts to gain lordships over the kings of Scotland. Henry's son, Edward I, famously, would go on to conquer both Wales and Scotland. In his histories, his illustrations, and his maps, Matthew Paris supported those ambitions.

Examining the ways that the Paris depicted Scotland (fig. 2) argues for this interpretation of the monk's cartography. The territory is oddly deformed, but its deformations, like others on the map, have not been rigorously considered. Scotland on the Claudius map not only twists oddly to the east – likely a result of the monk running out of room at the top of the page – but it is actually cut in two by a meeting of the firths of Clyde and Forth. Paris rendered the Highlands as an island labeled Scotia Utramarina – Scotland over the Sea – and he connected

it to the rest of Britain with a bridge at Stirling. This curious depiction of Scotland, and of the bridge, bear consideration, because they are keys to thinking about the map as a political and narrative tool.

The first thing to examine is the separation of Scotland into two parts. This is one of the map's curiosities, and one of the key points that has made scholars discount Paris's work. We know, after all, that the arms of the sea do not come together at Stirling, and we know that the Highlands do not form their own physical island.

Moreover, Matthew should have known this. In depicting Scotland in this light, he flew in the face Bede's authoritative description of Scotland – the venerable historian wrote that the kingdom of the northern Scots was divided from that of the southern Scots by "steep and rugged mountains," and that though the north was also separated by two long arms of the sea, those arms did not actually meet (Bede, 1999, pp. 22, 114). And, in fact, Paris' earlier maps of the Britain reflected Bede's description. The Royal map (BL Royal 14 C vii, fol. 5v), which most scholars believe to be his earliest effort follows Bede's geography, as does the Corpus Christi map (Parker MS 16, fol. 4v). On the Corpus Christi map, Paris adopted the term ultramarina, which was a soft crib from Bede, but he had not yet drawn the seas together as he did in his final map. So why did Paris make that change in the Claudius map? Why did he ignore the father of English history, and contradict his own past work?

Figure 2 Scotland on Lamb's copy of the Claudius map.

Paris's maps grew increasingly political, with the Claudius map standing as the most politically charged of the four. I suggest that Paris became gradually more invested in mapping the territory of Scotland's king as severely limited, constrained wholly to the part of Britain that lay beneath the firths in north and the Roman walls to the south. Those walls mark the tradition boundary between Scotland and England, and Paris noted that the space north of the Antonine Wall is "the region of the Scottish borders." The sea where the firths meet provides a tangible and natural boundary to the north. Paris, then, leads his reader to understand that two great forces acted to delineate Scotland's southern section: God and the Romans. And it is into this tightly bound space that the map sets the territory of the King of Scotland.

Almost all of the holdings of the Scottish throne that Paris drew fall into the southern region, with the royal castles of Edinburgh, Berwick, and Roxburgh sitting below Stirling Bridge. The land above the bridge, in Scocia Ultramarina, shows little royal footprint. Though the map includes a number of royal towns, which boasted a royal charter, Paris chose to include few of Alexander III's important personal holdings in the north. Of particular note, Paris excluded the towns of Perth, and Scone.

Paris's decision to leave these two towns off of the map created political distortions in Scotland as dramatic as the geographical distortions seen at the firths. Both Perth and Scone stood as positions of tremendous importance in Scotland's historical and political geography.

Perth, the home of one of Scotland's first royal mints, was the kingdom's traditional capital city (Carpenter, 2003, p. 183; Cowan, 1904, pp. xii–ix). And the small nearby village of Scone, with its abbey, held a unique and central place in the symbolic rituals of Scottish kingship. The abbey housed the famed Stone of Scone, on which every Scottish king had been either crowned or recognized. Scottish kings drew their authority explicitly from these rituals at Scone. If Perth acted as the realm's chief administrative center, then Scone stood as Scotland's ceremonial heart.

The absence of both Perth and Scone suggests Paris wanted to undercut Alexander's claim to independent reign in Scotland. Alexander's traditional capital and the literal touchstone of his right to rule disappeared from the face of the Claudius map, and, insomuch as the map makes a claim for verisimilitude, from the face of existence. But Paris did not content himself with merely omitting Alexander's centers of governance and ritual authority. Instead, the monk overwrote them. Scotland's label, Scocia Ultramarina, stretches through the region where Scone and Perth sit, and beneath that title Paris wrote, as a subscript, "Here (this land) was also called Albania" (hec et albania dicta est). In so doing, Paris tied this northern part of Scotland to the English, rather than to the Scots, in two ways that both connect back to Geoffrey of Monmouth's pseudohistory.

Geoffrey's text noted that the original name for Britain – prior to Brutus arriving and naming it after himself – was Albion (Geoffrey of Monmouth, 1985, p. 16). Medieval English writers seized on that idea with gusto, and increasingly elided their names for the island. Variants of the phrase "Britain, once called Albion, now called England" were commonplace (MacColl, 2006, p. 249). The map's repetition of this phrase, then, suggests that we should read it as setting Scotia Ultramarina in England.

Furthermore, the reference to Albania laid an English claim to the north through the genealogy of Brutus's sons. When Brutus, who settled the empty island, eventually died, he divided his kingdom up between his three sons: Locrinus, Kamber, and Albanactus. Albanactus received the north, and named it "Albania" after himself. However, he was soon killed by an invading army of Huns, and his people fled to England for safety, begging Locrinus for protection. Locrinus obliged them and beat back the Huns, after which possession of the north fell to him on three counts: inheritance, as the eldest brother; force of arms, as the leader who vanquished the barbarian invaders; and popular acclaim, as the king recognized by the Albanian people (for the full accounting of the story, see: Geoffrey of Monmouth, 1985, pp. 15–17). In reminding his audience that Scotia Ultramarina belonged, by rights, to the house of Brutus, Paris also reminded them that it belonged, by rights, to the Plantagenets.

Scotia Ultramarina, despite its name, is not wholly cut off from the rest of Britain. Paris connected the two halves of Scotland at Stirling, which he labeled Estruelin Pons – Stirling Bridge (fig. 3). His wording here should be provocative, as the actual name of

Figure 3 Stirling Bridge on Lamb's copy of the Claudius map.

the town and castle was Stirling, not Stirling Bridge. That Paris would have made a mistake out of confusion – by virtue of using second-hand information, for example – does not stand to reason. His other maps are far more ambiguous about the connection. Furthermore, the town had long been called Stirling; the earliest extant royal charter identified it as such, with no mention of the bridge, and later charters did the same. (Stirling, Scotland, 1884, pp. 2, 7) Additionally, none of the earlier writers from whom Paris drew appear to have used the name Stirling Bridge either. Roger of Wendover, Gerald of Wales, and Geoffrey of Monmouth seem not to have mentioned the burgh at all. Gervase of Canterbury made note of an abbey at Stirling (Abbatia de Struelin), while Roger of Hoveden referred to the castle of Stirling (castelum de Striveline). (Gervase of Canterbury, 1880, p. 442; Roger of Hovedon, 1868, p. 81).

In fact, the actual bridge at Stirling seems to have been mentioned in documents only sparingly before Paris's time. A law passed during the late 12th century made the center of the bridge at Stirling the point of restitution for cattle thievery that occurred between residents on opposite sides of the River Forth. Continuing somewhat in this tradition, King Alexander II decreed the "Brig of Stirling" to be an approved location for trial by combat for knights and freeholders (Cook, 1908, p. 131). Beyond these two laws, the bridge itself goes unmentioned.

One possible explanation for Paris's nomenclature here is that, by drawing the map in this way, he eliminated one more of the Scottish king's holdings in the north. Stirling was a site of particular strategic importance, and it was one of King Alexander III's favorite personal holdings. By naming the bridge for the town, Paris could remove the royal element from the map, effectively noting the importance of Sterling's physical location while denying Alexander's possession. Furthermore, the town's name, in combination with the image of the bridge, may have been a deliberate attempt to reaffirm the monk's graphical argument that the sea wholly sundered the lands of the Scots.

The bridge on the Claudius map is important for Paris's argument for more than just the work that its name does, however. The bridge itself is one of the few pieces of extra-urban built architecture on that Paris drew on his map, and it acts to connect Scotia Ultramarina to the English south by appearing to be a part of the map's pilgrim itinerary. The pilgrim road from Newcastle to Dover, which I mentioned at the top of this essay, has long been understood to provide the map's guiding rationale. Historians have almost universally read the road as going from north to south, carrying traffic from pilgrims and other travelers towards London. This approach understands the map as presenting an inward-looking cartography. However, thinking about the history that undergirds the map's itinerary route suggests a different directionality and purpose.

The pilgrim highway enjoyed a layered historical authority. It followed the Old North Road, which itself overlaid the ancient Roman Ermine Street – a throughway designed to carry Roman law and power to the north (Conybears, 2007, pp. 88–89). And the story mortared into the road's history goes deeper still, for Ermine Street itself followed the legendary track of Belinus's road. Geoffrey of Monmouth and Matthew Paris both recounted the story of King Belinus, a descendant of Brutus and a noted law-giver. Belinus conquered all of Britain, and then built a paved road from the south coast of England to the northern shores of Scotland in order to define the limits of the realm and carry his law to the whole island (Geoffrey of Monmouth, 1966, p. 46; Paris, 1874, p. 59). Belinus's road and the Roman street both carried power, authority, and culture from the island's core to its distant margins.

Reading the road on the Claudius map in this direction shows it to be an artery of civilization, supporting abbeys, castles, and towns with the heart's-blood of order and authority. The highway springs from England's center and runs northward, terminating at Hadrian's wall. Paris likely meant the road to be read with this directionality. The routes of his other itinerary maps run from the bottom of the page to the top, always heading away from the reader. It stands to reason that we should understand this road in the same way. If we do that, we see that thought the road proper ends in Newcastle, the visual line that its pathway creates continues, pulled northwards by the unique iconography of the bridge. The road seems to go on, following the ghostly path of Belinus's ancient road, through Stirling Bridge and on into the north. The bridge provides a vital visual connection between the south and the north, and its placement would have helped to encouraged the idea that Henry III, like Belinus and the Romans before him, should carry law and civilization to the farthest northern reaches of Britain.

This essay is a part of body of work concerning bridges, and so I'd like to conclude with a final thought about the work that this bridge is doing. Many commentators about bridges at the 2017 BRIDGE Conference tended to focus on the positive, connective nature of bridges. This is fair; bridges can tie distant lands and people, and the uniting elements of real bridges give rise to a range of bridge-related metaphors that connote joining, working together, and the creation of shared communities of space. And Matthew Paris's bridge does its share of connecting, as well. But this bridge to Scotland should also remind us that bridges can also serve as points of disjuncture and exclusion. For all that Stirling Bridge links England and her Plantagenet kings to the north, it also acts as a formidable piece of built geography that hems in the Scots to the north just as effectively as the Roman walls bound them to the south. This bridge, like many others, is a piece of imperial architecture, and it does its work all the more effectively if we don't pay attention to that fact. Certainly, not all bridges fit this mold. But we should note the ones that do, and realize that, when they appear on maps such as this, the connectivity that they champion is simultaneously making claims about space, and rights, and territorial possession.

[1] For purposes of image clarity, rather than using images of Paris's original work, which is held at the British Library, I am using William Gibbs's reproduction from Alexander Lamb's 1895 work, *Dundee: Its Quaint and Historic Buildings* (Lamb, 1895).

[2] There has been some work done examining Matthew Paris's maps as carrying political content. For the most relevant work, see: (Birkholz, 2004; Breen, 2005; Connolly, 2009) For a critique of each writer's approach to Paris's maps, see: (Greenlee, 2013, pp. 17–19)

[3] The italics are included in the original article.

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Medieval stone bridges: their rise, fall, survival and future

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Rise: 750-1350

One of the greatest achievements of English medieval civil engineering was the construction and upkeep of an extensive network of bridges and causeways. It was impressive in a number of ways. First, was its scale: by the 13th century, at all but a few sites where there was a bridge in 1750 there had been a bridge 500 years earlier and at many of these locations there had been a bridge by the 12th century. Secondly, the construction of these bridges was a remarkable feat of engineering. Laying foundations where river flows are substantial all the year round was not easy, but by 1500 medieval masons had built arched bridges over every river in the south and midlands. In the north, to cope with threat of flash floods in the turbulent rivers flowing from the Pennines, arches were constructed of prodigious spans of up to 30 metres.

The network of medieval bridges owed little to the Romans. Although the stone piers of some bridges, such as Rochester bridge, may have lasted for centuries, Roman timber bridges disappeared at an early date. We can trace their collapse where a Roman road diverted to a nearby ford, as at Wansford, after the Roman bridge at Water Newton on Ermine Street fell. Later a bridge was built on the site of the ford. As a result of the loss of Roman bridges, the England of Bede (writing in the 730s) was a land of fords. A story he tells about St Aidan, provides an insight into travel in the north of England: the saint 'had been given an excellent horse, and although he usually walked, he would ride it when he had to cross a river'.

Over the following centuries the situation began to change as the lack of bridges was a serious impediment to travel. Much of the pre-industrial bridge network was built in the 500 years after 750. We cannot trace its development in detail but here and there we can catch a glimpse of the process. There is some evidence that in the 8th century, about the time Offa' Dyke was constructed, the Mercian kings made improvements to crossing places such as Cambridge and Oxford to control movement into and out of Mercia. At this time we first hear of the obligation to work on bridges which is mentioned thereafter in many charters and later in law codes.

The system of burhs – the fortifications and fortified towns - built by Alfred and his successors was a spur to bridge construction. By late Anglo-Saxon England large structures had been built at Chester, Rochester, York and London, where timbers from a 10th century bridge have been found. These remained the lowest bridges on the rivers until the 19th century. Occasionally we can see the importance contemporaries attached to their construction – the Anglo-Saxon Chronicle entry for 923 records the building of the great bridge across the Trent at Nottingham as one of the major events of the year. In the 12th century a more detailed picture emerges. Where the evidence is available, for example for the bridges over the Great Ouse, it is clear that at this date the pre-industrial bridge network was largely complete: the isle of Ely had been joined to the surrounding areas by the three causeways of Aldreth, Earith and Soham and many bridges up river, including two at the minor settlements of Turvey and Harrold, had been built.

Anglo-Saxon bridges were constructed with timber roadways resting on timber or stone piers. From the 11th century through much of Europe bridges began to be built with stone vaults, like the choirs and naves of major churches. The remains of the earliest documented and surviving arched stone bridge in England survive under the Abingdon Road in Oxford, part of the structure built by Robert d'Oilly, sheriff of Oxfordshire, in the late 11th century. A few years later, as Ranulf Flambard, bishop of Durham, completed the revolutionary vaults of the

cathedral nave, he also constructed an arched bridge. To Simeon of Durham, this was something special: the Bishop 'joined the two banks of the River Wear with a stone bridge, a major construction supported on arches'. The bridge was rebuilt in the late middle ages, but a watercolour by Thomas Girtin shows a smaller, rounded arch, possibly part of the original structure. Flambard's contemporary, Matilda, wife of Henry I constructed a long causeway with several bridges over the River Lea. One of these bridges aptly became known as Bow Bridge because of its arch.

The next few centuries saw a transformation of the network. Vaulted bridges were built in every situation. By the sixteenth century a few timber bridges survived, for example on the lower Swale and lower Wye, but they were uncommon except around the middle Thames (from Reading to Kingston all the bridges were timber until the late 18th century) and possibly in East Anglia. The majority of major bridges were stone and were multi-arched. Among the finest was Great Bridge at Burton-on-Trent which was constructed with a continuous arcade of thirty-six arches. 500 m. long, It curved across the flood plain, looking rather like a railway viaduct.

Earth causeways interspersed with arches, like the one at Gloucester, were also common. The major Anglo-Saxon settlement in the Hull valley was at Beverley just to the west of the flood plain. Later, the town of Hull was established at the mouth of the river. Roads had to be constructed across the very broad valley. John Leland, the Henrician antiquary, noted: 'From Cotingham to Kingeston [Kingston-upon-Hull] about 4. miles by low ground, wherof 2. miles be causey way, dikid on booth sides'

Arched bridges were even constructed across wide, deep, tidal rivers. Old London Bridge was begun in 1176 and completed in 1209. Project overruns are not a modern phenomenon. Other bridges followed. Eventually the ancient timber-decked bridge at Rochester was replaced in the 1390s. The master mason, Henry Yevele, who had been warden of London Bridge and had designed many important buildings including the naves of Westminster Abbey and Canterbury cathedral, was involved in its construction. In the next century Bideford Bridge in Devon was rebuilt in stone. Together with its neighbours at Barnstaple and Wadebridge it survives to this day - a reminder of what has disappeared elsewhere.

The key to the construction of these large bridges was the need to find an alternative to coffer dams (these are water tight enclosures, erected around the area where a pier was to be built, from which the water was emptied by bucket so that the pier foundations could be laid in dry conditions) where the river was deep and tidal and the river bed leaky. At London the solution involved driving piles into the riverbed to form a pen. Into the pen rubble was thrown. On top of it the piers were constructed. Because this structure was unstable it was surrounded by another pen of piles also full of rubble known as a starling. Although the starlings significantly reduced the waterway, making it rush through the openings, these great estuarine structures were seen as marvels of their time.

In the north of England, masons confronted a different challenge: the 5 metre arch spans of most southern bridges were inadequate to cope with the flash floods experienced in the north. Much larger arches were required. Elvet Bridge Durham, probably a reconstruction of the 1230s, has tall arches with individual spans of almost 10 metres. Similar bridges were built throughout the north, for example across the Tees at Croft and Yarm, and as far south as Cromford and Matlock in Derbyshire.

Soon even larger arches were being built. An illustration of the ruins of Old Tyne Bridge, Newcastle, made after the spectacular flood of 1771, shows the large, solitary, surviving, semi-circular central arch, which may date from the 13th century. In the next century even larger, segmental arches were constructed, which were both stronger and produced a gentler gradient than semi-circular arches. Flat arches were employed in the Pontevecchio in Florence in 1345 and were being constructed by the second half of the century in England, notably at Dee Bridge, Chester. Thereafter bridges with giant arches replaced bridges of the Elvet type. The climax of late medieval design can be seen in two bridges built around 1500. One is Piercebridge over the Tees with its three sublime segmental arches constructed of precisely-cut ashlar voussoirs and its huge abutments to resist the powerful lateral thrusts. The other is Twizel Bridge in Northumberland. Leland described it as 'of stone one bow but greate and stronge'. With its single span of 90 ft, it looks very like the famous bridge at Mostar which was built later in the century. By way of comparison King's College chapel, Cambridge, the widest 15th century English church, has a span of just 40 ft..

Stability 1350-1760

While the bridge network was reconstructed in the later middle ages, in other respects the period 1350 to 1750 was one of remarkable stability. A new post-Roman road system had grown up which differed to a surprising extent from its Roman predecessor. The roads can be seen in full on the 14th century Gough Map and they continued in use for centuries. Even in the 20th century many roads followed the same broad alignment.

Moreover, few new bridges were built at hitherto unbridged sites between 1350 and 1550. There were a few exceptions, including the bridges began in and near Abingdon in 1415, but they were a small addition to a very large pre-existing stock of bridges. Even fewer new bridges were constructed between 1550 and 1700 or even 1750. The situation in Bedfordshire was typical. After the construction of Barford Bridge c. 1430 no new bridge was built over the Great Ouse in the county for 300 years. On the eve of the Industrial Revolution the network of bridges was essentially medieval and at many of the sites there had been an Anglo-Saxon bridge. In contrast, after 1760 there was dramatic change: many new bridges were built and older ones widened.

The implications of these findings are of great interest. Not only are they powerful testimony to the importance of road transport in the middle ages, but they also provide insights into many aspects of medieval society. Consider the capacity to provide huge resources for the construction and, of equal importance, maintenance of bridges. In view of the difficulties involved this was an immense task. We do not have precise figures for the full costs of any medieval bridge but we know enough to get a feel for the orders of magnitude involved. Just one of the donors, Geoffrey Barbour spent 1000 marks (£666) on the bridges and causeways at Abingdon and Culham. In the first summer, 1416, 300 men were at work on the project.

Most major medieval bridges survived until the late 18th century, although some were rebuilt before this period, for two main reasons. First, the remaining timber bridges continued to be replaced, including three bridges over the lower Swale, at Morton, Skipton and Topcliffe and the long estuarine bridge at Berwick, which were reconstructed in stone in the early seventeenth century. The process continued over the following century: timber Yorkshire Bridge in Derbyshire was rebuilt in the 1690s, Buntingford in Hertfordshire in 1719.

Secondly, some bridges were swept away. Such disasters occurred in the south, for instance ‘great water floods’ destroyed Bungay Bridge in 1696, but were more frequent in the upland north. Ilkley Bridge suffered frequently: in 1638 ‘a violent flood swept away both arches of the newly built bridge and it was again ‘overturned’ in 1673.

However, before 1760, when stone bridges were damaged they were usually patched up, not reconstructed. In 1674 the central arches of Sowerby Bridge in Yorkshire were rebuilt, but not the outer arches. Sometimes a lost arch was patched up with planks: an arch of Harrold Bridge collapsed in 1532; it was not rebuilt in stone until the 1840s. Many arches were destroyed in the civil war for defensive purposes, but afterwards the arches were replaced, not the entire bridge. The two arches on the southern side of St Ives Bridge were demolished and a drawbridge installed in 1645. The drawbridge remained until 1716 when the demolished arches were rebuilt, but the surviving medieval pointed ones retained.

Between the early sixteenth and eighteenth centuries, changes in the design, construction and width of bridges were negligible. Arch spans showed the same regional distinctions. In the south and midlands bridges with small arches remained the norm: Eckington Bridge, 1728, has six arches spanning only 43 yards in total. In 1736 Hawksmoor noted that the only bridge in the south with a large arch was the 100 foot span at Blenheim Palace. In the north, while new large arched bridges were built, no public road bridges constructed between 1600 and 1750 surpassed the massive spans of the previous two centuries; indeed, masons seem to have been less adventurous.

Fall: 1760 to 1860

After 1760 the situation began to change rapidly. Over the River Severn at this time there were 10 bridges as they had been two centuries earlier and with one exception were essentially the same structures. No new sites were bridged until the 1770s, but then new bridges were built in rapid succession: at Stourport in 1775, followed shortly by Coalport Bridge and Ironbridge.

In the same decade the ancient bridges began to be demolished. 50 years later all but two had gone: English Bridge, Shrewsbury, and Atcham Bridge in the 1770s, Worcester in the 1780s, and Bewdley, Montford, Buildwas and Welsh Bridge, Shrewsbury, in the 1790s. At Gloucester, the Severn divided into three main channels. The three bridges over them were demolished between 1800 and 1830. The 1000m causeway which were linked them was improved from the 1770s. The late 16th century bridge at Upton lasted until 1852 when it was washed away in a flood. Only Bridgnorth Bridge retains some medieval traces; Telford built several new arches, but merely refaced the western arches and the large pier.

How typical was the River Severn? On all rivers the main period of demolition was the 50 years after 1770, although a few bridges, especially very large ones, continued to be destroyed into the 1870s. However, demolition was not as total throughout the country as over the. The extent of demolition varied from river to river and major bridges survived in most locations, both in town and country. The old bridges over the River Trent met a similar fate to those on the Severn; only parts of one ancient bridge at Swarkestone survives: the bridge over the main river channel was replaced in 1795-97, but the mile long, narrow causeway remarkably remains much as it was centuries ago. In contrast, across the Thames

three out of 17 medieval structures survive largely unchanged and substantial parts of two others remain. Even more of the 17 medieval bridges of the Great Ouse are extant: three are essentially medieval and more have significant medieval remains.

In the north too there was the same variation. Over the Wear a remarkable six out of nine medieval bridges are extant. This collection of impressive bridges at Stanhope, Newton Cap near Bishop Auckland, Sunderland Bridge on the road to Durham, Elvet and Framwellgate (figure 7) bridges in Durham and Chester New Bridge near Lumley Castle, are testimony to the quality of medieval engineering. The situation is quite different for the River Aire. A single medieval bridge remains at Kildwick.

Just as the pattern of demolition varied from river to river, so bridges were demolished and survived in every location. Urban authorities often had substantial funds and urban bridges carried high level of traffic, but some historic bridges survived even here. Of 38 historic county towns of England, 5 retain their medieval bridges, namely Chester, Durham (with two bridges over the Wear), Lincoln, Hereford and Huntingdon. In addition, Guilford Bridge lasted until 1900 when it was washed away. Most of these bridges were also demolished. Just two bridges were demolished later in the century: Maidstone and Nottingham as late as the 1870s. Since then the only to have been rebuilt is the one at Guildford, which was swept away in a flood in 1900.

There has been no general study of the causes of demolition. There are, however, contemporary accounts of the reasons for demolishing more typical bridges. It is evident that just about every aspect of ancient bridges in the south and midlands was criticised, including their width, quality of construction and state of repair and quality of design.

Medieval bridges over major rivers were for carts. Most surviving bridges were originally approximately 3-4 metres wide and written sources indicate similar dimensions. A few bridges, particularly in towns, were up to 5 metres wide. Nevertheless, even in 1750 less than 10% of major West Riding bridges exceeded 16 feet in width. This was sufficient for two medieval carts to pass. However, by the 1760s such widths were no longer acceptable for the increasing volumes and width of traffic.

One option was to build a new bridge to by-pass the old, as happened at Dorchester in 1748 with the construction of a new road and Grey's Bridge. John Carter proposed this solution to save Ouse Bridge, York, but it was rejected and by-pass bridges did not become common until later.

The first step in making bridges more convenient for traffic was often to remove impediments to traffic. In 1765 Bedford Borough removed both gatehouses on the town bridge because they had hindered coach traffic as it entered the town. In the following year, 1766, the demolition of the Stone Gate on English Bridge, Shrewsbury, began. The next step was to widen bridges. For example, between 1758 and 1768 the busy Yorkshire town bridges of Wakefield, Sheffield, Leeds and Rotherham were widened to widths of 23 to 27 feet. The prolific architect, John Carr, who was also Bridge Surveyor to the North and West Riding, replaced some bridges, but widened many others.

Although most bridges could be widened, this option was often rejected. As we have seen, in the 1760s the corporation at Shrewsbury planned to widen English Bridge, but these plans soon changed after Robert Mylne pronounced that the structure was in 'ruinous' condition and ought to be rebuilt. By the early 19th century Bedford Bridge was described as "very

ancient, narrow, inconvenient and dangerous", and in 1810 the corporation accepted an estimate for a 30 foot wide new bridge.

A number of bridges in the country, even those on 'A' roads, for instance Newbridge and Radcot Bridge on the upper Thames, retain their medieval widths, but by the 19th century many bridges were wider. The surveys of West Riding bridges, made in 1752, and of the North Riding, c. 1805, show considerable change; in the former the median width of bridges was 12 foot, in the latter 16 foot.

Those who sought to demolish medieval bridges often argued that they were badly constructed and/or in poor repair, sometimes that they were beyond repair. In 1808 it was decided to widen Ouse Bridge, York (figure 10), and a competition was held to find a suitable design. The assessor, Thomas Harrison, who had recently rebuilt Skerton Bridge, Lancaster, however, concluded that Ouse Bridge was in such disrepair that complete rebuilding was necessary. He argued (wrongly) that building a new bridge would cost no more ... than repairing the old; this convinced the city council and the old bridge was demolished.

Criticism was not restricted to poor construction, but extended to basic design. Renaissance architectural treatises stressed the need for an adequate waterway and prescribed ratios for pier to arch span: Alberti, 1 to 3; Palladio, 1 to 4 or 6. These ideals became increasingly influential and English medieval bridges outside the north of England failed to meet them.

The problems caused by restricted waterways were particularly striking in a few great ancient estuarine structures, notably London and Rochester bridges. At these sites it was impossible to establish firm foundations on leaky gravel riverbeds in deep, tidal water. As a result, piers were founded on broad, unstable starlings, much wider than the piers, which took up most of the waterway at Rochester and at London. This created a huge 'fall' between the piers, leading to constant scouring of the foundations. The scouring meant that maintenance had to be carried out continuously and expensively, involving annual piling to shore up the starlings.

Yet the old bridges at London and Rochester survived well into the 19th century, probably because until then coffer dams could not be economically employed to establish firm foundations in the leaky riverbeds at these sites. Perronet had to employ a whole regiment of soldiers to empty the water from a cofferdam on the Loire. Finally, the problem was overcome by sheet piling and steam pumps which were used to construct and empty the coffer dams for Waterloo Bridge, 1811-17.

However, long, estuarine bridges did not have to be demolished just because they were founded on starlings, as the survival of Barnstaple, Berwick-on-Tweed and Bideford bridges demonstrates. At Bideford the riverbed was sand and therefore less of a problem. The piers were protected by starlings of loose stones held in place by 'windlasses', woven baskets of holly or hazel staked to the riverbed.

While there were powerful, practical, engineering reasons for replacing London Bridge and a number of other large ancient bridges, it is doubtful whether most bridges which were demolished needed to be. Many medieval bridges were too narrow for the traffic volumes and demands of the late 18th and 19th centuries, but in most cases they could be widened rather than demolished. Bridges were often in a serious state of disrepair, sometimes as a result of poor construction, but it is doubtful whether many were beyond repair. Wing, who designed the new bridge in the town, claimed that old Bedford Bridge was in a 'ruinous state', but the authors of an authoritative study of Bedfordshire bridges note that Wing's criticisms could have been made of any of the surviving medieval bridges across Ouse. They surmise 'that

given proper maintenance it could have survived to present day' The key point is that many medieval bridges have survived and that these were built to the same design as neighbouring bridges which were demolished. Many demolished bridges would be extant had there been the will to keep them.

Possibly the most important reason for the great demolition in the century after 1760 was a shift in attitudes. To medieval contemporaries such as Thomas of Walsingham, who described Rochester Bridge as 'sumptuosissimus', the construction of great stone bridges was a most impressive achievement. As late as the 18th century Defoe saw them as impressive structures, but this was soon to change.

Urban authorities wanted more fashionable as well as wider structures. Old bridges like many other buildings became the victim of civic improvements. The design of bridges, like that of other building types, was influenced by what has been described as 'classically informed notions of taste'. Important new bridges were decorated with Palladian-style forms of ornament. Skerton Bridge, Lancaster, completed in 1788, had low rounded cutwaters surmounted by small aedicules, following Palladio's drawing of the Roman bridge at Rimini. Gwynn's bridges were decorated with sculpted keystones.

Pressure for reconstruction came from architects and engineers as at Bedford, Shrewsbury and York where Wing, Mylne and Harrison respectively persuaded the corporations to abandon the original intention to widen the bridge and build a new one instead. Those responsible for bridges tended to opt for demolition between 1760 and 1860, and especially between 1760 and 1820) far more readily than they did before or after. Another important element was the availability of finance to realise new ideals. The provision of significant funds, from among others, the enormously wealthy Lord Clive, meant that English Bridge at Shrewsbury could be rebuilt rather than widened. Elsewhere increasing volumes of traffic led to increasing revenues from tolls which could fund new bridges.

In practice, replacement bridges of the second half of the 18th century often had more in common with their predecessors than their successors. In the 1770s John Gwynn considered piles unnecessary for his major bridges. An inspection of 1925-6 discovered that the piers of English Bridge were founded without any piles on oak platforms some only `just below the gravel bed of the river'. Towards the end of century there was more radical change. Jean Rodolphe Perronet of the Corps des Ingenieurs, sometimes described as the father of modern bridge building, was a major influence. He designed bridges such as the Pont de Neuilly (1768-1774) and the Pont de la Concorde (1786-1791), near and in Paris, with deep foundations, thin piers and flat arches of large span to achieve shallow gradients and maximise the waterway. Bridges with larger, flatter arches became common in the south of England, an excellent example being Cowley Bridge, Devon, 1813, with three spans each over 50 feet (George, 1997). Further north huge spans were built, culminating in Grosvenor Bridge, Chester (1827-33) with a huge single span of 200 ft.

After 1860: preservation and survival

However, over the 19th century the mood changed again. One reason was that new bridges were not always an improvement. The Burton Weekly News of 1876 observed that old

Burton-on-Trent Bridge (demolished 1864) had been curved so that 'each buttress [was] placed at right angles with the flow of the stream, and to this fact [was] due the long life of the Old Bridge.' The arches of the new bridge had the advantage in height and span and the buttresses were of less bulk, but because they stood diagonally to the natural flow of the stream, they formed an obstacle to its course of greater area than that of the old bridge, and consequently the freedom of the actual river passage was reduced to less than half the diameter of the arches. Over 20 years later, it was noted that most arches of the old bridge at its demolition were medieval and concluded:

had the ancient Bridge been widened throughout its length, as so many of our bridges have been treated, it would have been with us to this day, and I doubt not would, with proper repair, have outlasted the new Bridge.

More important was the increasing emphasis on preservation. One of the leading proponents of the incipient conservation movement, John Carter, led a campaign to save old Ouse Bridge, York. He was unsuccessful and the bridge was demolished c. 1810; however, 50 years later attitudes had changed. The last great bridge to be demolished, Trent Bridge, Nottingham, went in 1871; thereafter few bridges disappeared, except as a result of collapse.

In 1926 concern about the spread of motor vehicles led the Society for the Protection of Ancient Buildings (SPAB) to commission Edwin Jervoise to survey the bridges of England and Wales with a view to ensuring their protection. Some bridges were replaced at this time such as the 16th century Whitefriars Bridge, Norwich, which went in 1924 despite strong protests from the Norwich Society. One of the medieval bridges at Abingdon was reconstructed in the 1927, but the original stones were kept and used for refacing. Despite a few other losses, such as the attractive 17th century bridge at St Neots, in general SPAB's fears were not realised.

Over one hundred bridges survive substantially intact. Among the survivals are those at Huntingdon which carried the old North Road across the Great Ouse, the long bridge at Bideford and the large spans of northern bridges such as Framwellgate and Twizel, which exceed the spans of the greatest churches. Parts of many more bridges also remain, for example the flood arches of Old Exe Bridge, revealed in the 1960s. They are impressive remains of the medieval transport system and also a reminder of how many more survived until the century of demolition after 1760.

The future

Relatively few ancient bridges have been demolished in the last 150 years, but much is unsatisfactory. When bridges are repaired or strengthened, little opportunity is taken to study them. The changing organisation of repair and maintenance means that anonymous contractors have often taken the place of County Bridge Surveyors who were in post for many years and lovingly tended to their bridges as A.J. Wallis' pamphlet on Dorset Bridges so clearly demonstrates. Flood arches have been allowed to silt up and vegetation has blocked them, making bridges more susceptible to damage during floods.

In places ever-rising traffic volumes have been accommodated by building by-pass bridges. These have often ruined their setting. Highway Departments seem to have been increasingly staffed by philistines. Whereas the by-pass of Culham Bridge, Oxfordshire, constructed in the 1920s is a reasonable distance from the old bridge, more recent structures have been built far too close to the end of the medieval bridge as at Wakefield and Warkworth. Moreover, medieval bridges in England are too often still open to traffic. Compare the situation on the

Continent where bridges are commonly closed to motor traffic. The iconic medieval Charles Bridge in Prague is for pedestrians alone, and enjoyed by millions every year. In contrast, this is rarely the case in England. A rare exception is the old bridge at St Ives where banning traffic and re-routing it to the by-pass bridge has much improved the town; in nearby Huntingdon, despite similar circumstances, high volumes of traffic continue to be driven over the finest medieval bridge in eastern England to the great loss of the residents of the town and visitors to it. There is great potential for using ancient bridges as access to towns for pedestrians and cyclists while motorists use by-pass bridges. If the opportunity is taken our magnificent ancient structures could have a splendid new lease of life.

Crossing the Thames at Walton

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Abstract

Walton-on-Thames, 20 miles upstream of London, has been a crossing point of the River Thames for some thousands of years. The first bridge opened in 1750, and was painted by a

well renowned artist by the name of Giovanni Antonio Canal commonly known as Canaletto. The crossing was a speculative venture as it replaced ferries and contributed immensely to the highway network development, however the crossing did experience its fair share of problems over the years.

The following paper covers a history of the Walton bridge, it shows how a series of unfortunate events, such as rotting of the first bridge (1782) and the bombing (1941), forced the bridge to be rebuilt six times, over the course of over 250 years. This is presented both as a formal narrative and by appending a quartet of poems, that Thames-based poet Joseph Butler produced as a way of having a different perspective about the history of bridges. Additionally, a discussion is included on how Costain and Surrey City council exercised innovative and imaginative routes to community engagement throughout the construction of the sixth bridge.

Introduction

The construction of bridges has long been part of human and technological development. For many centuries, bridges have exceedingly contributed to the world's infrastructure and economy. Over the years most bridge projects have experienced successful completion and have continued to have successful operating lives after completion. However, that cannot be said for all bridge projects as some have sustained tragic failures after completion, due to various unfortunate circumstances. The Walton bridge for example, has experienced this phenomenon several times.
Due to the failure of the previous five bridges, Surrey City Council where forced to look for yet another solution. Before any work on the project began in 2011, the council presented options for a new permanent bridge design to the public, this approach was used as a way to get the community involved early on, in the project. This is further explained in section 3.0, building the sixth bridge.
The purpose of the new Walton bridge was to link Walton-on-Thames, on the Surrey bank, to the town of Shepperton. This project would be a new permanent solution that would greatly benefit the communities of Walton and Shepperton.

As previously alluded to in the abstract, the purpose of this report it to presents readers with the overall history of the Walton bridge. The paper further includes informative sections of the different strategies that were utilised in community engagement schemes, between the client, contractor and members of the local community, from the beginning to the completion of the project.

The History of the Crossing – bridging the centuries

Before the bridge

For many centuries before anybody had the idea of building a bridge between Walton and Shepperton, people had found a way across. We can imagine that early dugout canoes, such as that discovered at nearby Beasley's Ait (Chaplin, 1982), were useful both for navigating and crossing the river.

At times when the river was low, it would have been possible to ford the Thames at this point. The antiquarian William Camden, writing in 1586 Britannia (Camden, 1772), mentioned wooden stakes which had been found in the bed of the river here He interpreted them as defences put up by the Britons to resist the crossing of the Thames by Caesar in 50BC, but it is far more likely that they were the remains of a protected ford, fenced to prevent animals straying into deeper water.

Ferries were probably in existence by medieval times, and in 1676 Sir William Boreman applied to King Charles II for a patent to run a public ferry at Walton to carry 'horse, cart or coach' (Stonebanks, J. A. 1980)

The First Bridge 1750-1781

The first bridge was built at the expense of Samuel Dicker, a wealthy businessman and MP who lived nearby in Walton. He obtained a private Act of Parliament in 1746 'for the better ease and commerce of the inhabitants of the said counties' (Pollard, 2013). To repay the cost of construction, the bridge was made to be a toll bridge, this meant that anyone using the bridge had to pay a fee, therefore tolls ranged from a halfpenny for pedestrians, up to two shillings and sixpence for a coach and six horses.

The bridge was notable for its 'mathematical' method of construction, designed by William Etheridge (Pollard, 2013), in which the main timbers struck a tangent to the arches, and for the great size of its central span, necessary to placate barge owners who complained of an obstruction to their passage. At 132 feet wide, it was said to be 'much the largest arch in Europe' (The daily advertiser,1747). The size of the arch and novel construction soon made the bridge a landmark, and it was painted by several well-known artists, including Canaletto, who painted two versions in 1754 (Figure 1) and 1755

Figure 1: The first Walton Bridge, Canaletto, 1754 *(Dulwich Picture Gallery)*

The Second Bridge 1783-1859

The first wooden bridge lasted for at least 3 decades before it began to decay. Samuel Dicker had died in 1760 and left the bridge, and the expense of maintaining and then replacing it, to his nephew Michael Dicker Sanders. The replacement bridge (Figure 2) was of brick with stone footings and was designed by James Paine (Pollard, 2013). However, a significant amount of time passed between demolishing the old bridge and the opening of the new one in 1783. When it was finished, the new bridge had an extra pier in the middle of the river and two central arches instead of the previous single large arch.

Figure 2: The second Walton Bridge, J.M.W. Turner, 1806 *(Tate Gallery)*

The expense of the Bridge forced Sanders into bankruptcy, as a result the bridge was sold at auction in 1816. The second bridge lasted rather longer than the first, however, the central arches dramatically collapsed in 1859, because the new central pier was inadequate.

Thomas Allen owned the bridge around this time, however he took no immediate steps to replace it. This caused a lot of disruption for locals including W.S Lindsay M.P, Lord of the Manor of Shepperton. Lindsay complained that this would affect means of communication between two of the wealthiest counties i.e. between Chertsey and Hampton Court, (Pollard, 2013) He promoted an Act of Parliament to rebuild both Walton Bridge and the ruinous wooden bridge at Hampton Court, also owned by Allen. This aroused Allen to action and he proceeded to rebuild both his bridges. The ferry briefly resumed service until the completion of the third bridge

The Third Bridge 1864-1985

The third bridge (Figure 3), built in 1863-64, was designed by E.T. Murray. It was somewhat unkindly referred to as 'the ugliest bridge on the Thames'. The collapsed central arches of the old bridge were replaced by iron lattice work girders, supported on four new brick piers. To

save money, the original abutments on either side were reused.

Figure 3: The third Walton Bridge, photo by *(Henry Taunt, c1870)*

Like its predecessors, this was a toll bridge, but this was to change in 1870 when the Kew and other Bridges Act came into force. The Act stated that, the proceeds of the London Coal and Wine tax, levied on those commodities when they entered the Metropolitan Police Area, to be applied to purchasing toll bridges within the area from their owners, and making them public bridges free from toll. For the first time in 120 years, local inhabitants were able to pass freely over the bridge, and a grand celebration was held at which the gates were ceremonially removed.

The bridge lasted longer than either of the previous ones, but was damaged during a bombing raid in World War Two. This, and the post-war increase in motor vehicles, eventually led to its being declared unsafe for traffic. Middlesex County Council, short of money in the period of austerity after the war, built a 'temporary' replacement bridge alongside, retaining the old third bridge for pedestrians and cyclists.

The Fourth Bridge 1953-2013

The fourth bridge (figure 12), was intended to be a temporary measure, built alongside the third bridge, to relieve it from traffic. It was a Callender-Hamilton bridge (Pollard, 2013), named after the inventor, Archibald Hamilton, and the maker, the British Insulated Callender

Company. Like the later Bailey bridge, it was designed as a set of prefabricated components which could be bolted together to make whatever size of bridge was required.

The functional-looking ‘temporary’ bridge at Walton lasted for 60 years, far longer than intended, due to a series of deferred decisions about a permanent replacement. Inevitably, it began to deteriorate, and a series of decreasing weight limits was placed on the bridge, from 24 tons in 1985, decreasing to 17 tons in 1993, and eventually 7.5 tons in 1998. The third and fourth bridges lasted alongside each other for 31 years, until a pedestrian walkway was added alongside the fourth bridge, and the older bridge was finally demolished in 1985.

Figure 4: The fourth Walton Bridge *(Pollard, 2013)*

Planning for a replacement bridge continued through the 1980s and 1990s. Initial plans were for a concrete shallow arched, wider dual carriageway bridge design. However, the proposals were met with huge local opposition, particularly on the Walton side, where a campaign was formed to prevent a dual carriageway being directed into the centre of the town. The protests eventually led to the plans being withdrawn, so the temporary bridge soldiered on for a few more years, until its deterioration made a replacement imperative.

The Fifth Bridge 1999-2013

Figure 5: The fifth Walton Bridge, *(Pollard,2013)*

The temporary fifth bridge (Figure 5) was built on the site of the now-demolished fourth bridge, thus avoiding the need for a public enquiry as it occupied the same footprint. Planning permission was granted for a maximum of 15 years, perhaps with a view to how long the previous bridge had been in place.

It was of straightforward plate girder construction, easily matching the fourth bridge for the functionality of its design. Due to the narrowness of the site, it was built without footpaths, the old fourth bridge now assuming that role. The crossing now reverted to its original route, the road way crossing the original abutment of the third bridge on the Shepperton side, as well as the Victorian viaduct on the Walton side. It opened for traffic in December 1999.

Building the Sixth Bridge

In March 2003, Surrey County Council held a public exhibition on Cowey Sale beside the bridge to present options for the design of a new permanent bridge, and visitors to the display were invited to vote on their favourite. A tied arch design was selected. After nearly 60 years and two ugly temporary bridges, Walton Bridge was once again going to be a permanent structure, as innovative and imposing as the first.

Surrey County Council awarded the Design and Build contract for the new Walton Bridge to Costain and their designer Atkins in 2005. Government Funding Approval was given in December 2010 and construction began in January 2012.

Construction

The bridge carries the busy A244 road, which at the time of construction in 2012, trafficked 34,000 vehicles, 200 pedestrians and 400 cyclists each day (Richards and Bryans, 2009). This

new bridge design was chosen for many reasons, for example, unlike its predecessors the new Walton bridge considered to be a beautiful modern type bridge that would fill the local communities with pride. Furthermore, the new design was of sophisticated engineering as shown on figures 6 & 7, which had benefits such as that the new bridge wouldn't pose a threat to river traffic.

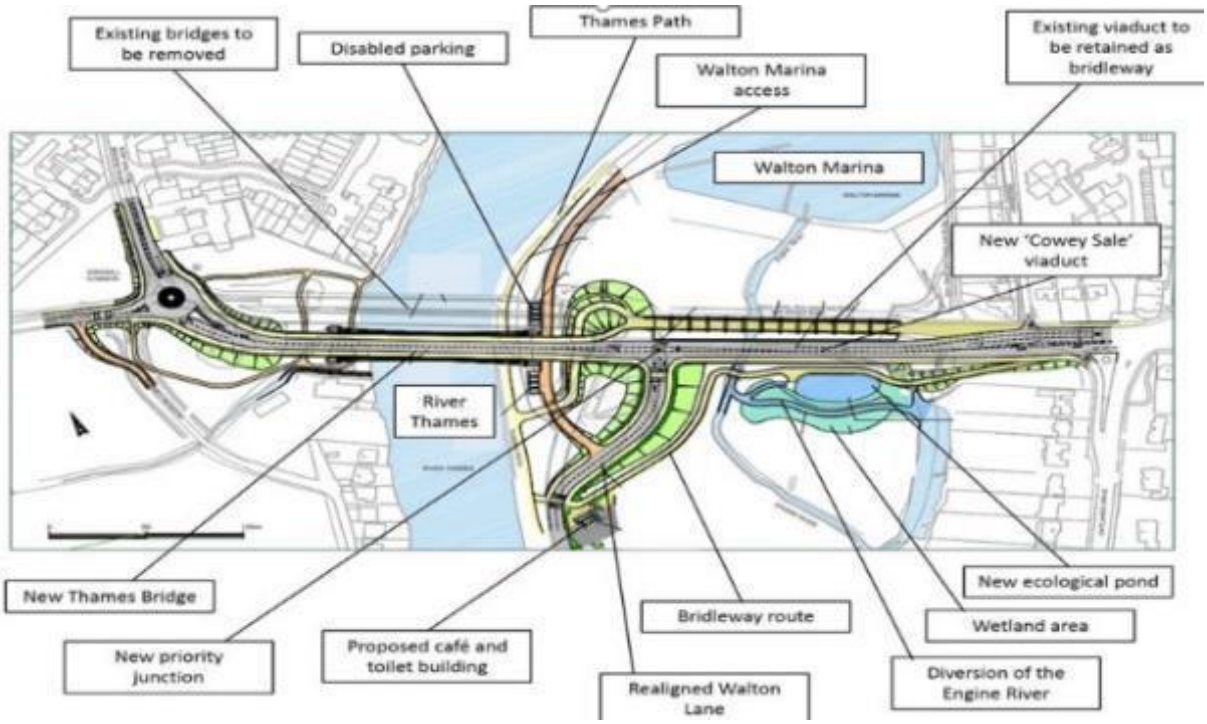


Figure 6: Birds eye view, highlighting the overall scope of project

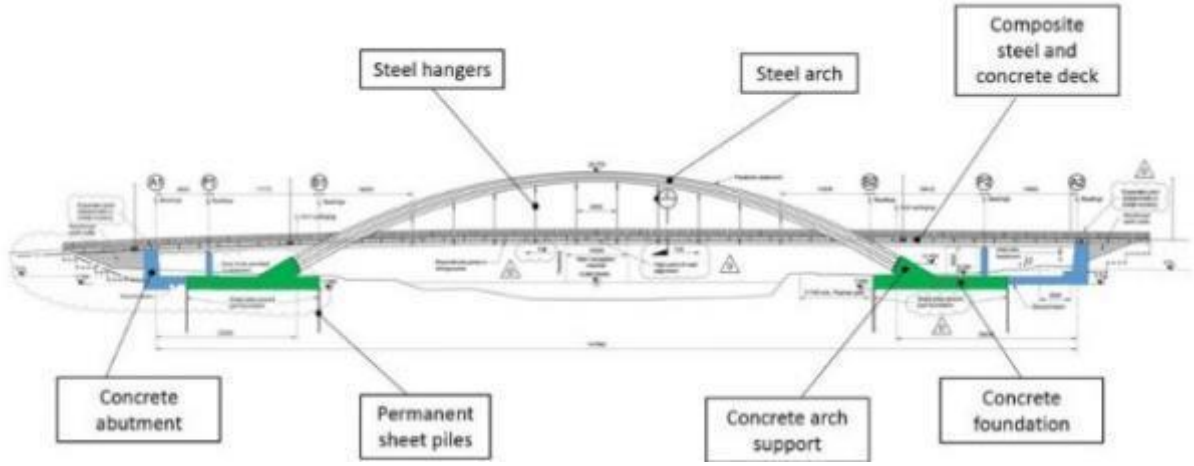


Figure 7: Side elevation of the bridge, illustrating principal engineering components

Building the bridge to the local community

Various industries and professions have different definitions as to what constitutes community engagement. According to the Scottish community development centre (SCDC), community engagement is developing and sustaining a working relationship between a public body and an organisation, to help them both understand and act on the needs of the community (Scdc.org.uk, 2017)

At a basic level, community obstruction to schemes should be avoided: because they add to increased project costs, create unwanted delays and generally divert management's attention. However, positive engagement is a benefit as occasional departures from constraints can be negotiated. Construction is a human activity, therefore it's important, that conflicts aren't created between people involved, however, it's imperative that to take full advantage of opportunities that will improve the quality of life. Construction works contribute to local economies, they provide new insights and interest to local people who may never have seen the like before. Furthermore, an influx of trained professionals can help communities in areas such as education and diversifying career choice.

The project team had a clear vision at the outset of the project that they wanted to involve the community throughout the design and construction of the project. The team wanted to end up having built a bridge that the community would be proud of and feel a part of. Early on in the project team engaged with the Café Gino.

> *Café Gino had been serving hot drinks and snacks on the banks of the River Thames for many years. Throughout the bridge construction works the café was run from a trailer in the riverside carpark next to the site. Every day workers and members of the public would mingle and chat about the project's progress while enjoying their food on the picnic benches by the site boundary. At the owner's request, diagrams illustrating the project were put up next to the café so that customers could visualise what was being constructed.*

The public enquiry process led to a wide range of measures being undertaken to minimise impact. Key was to allow local activities, traffic and trade to continue uninterrupted, so far as was reasonably practicable. Provided the measures can be seen as a win-win for both those charged with delivery of the work (client and construction team) and the community, it is normal to be able to achieve a great deal at relatively little cost.

For the project delivery team, what matters most is to agree measures early, so their effect can be allowed for in the design and costing: late change is the enemy.

For the public what mattered most was that they could see that they were being listened to and taken seriously, and that there was a strong integrity on the part of the delivery team: what it was said would be done, was done.

Various measures that were used to minimise disruption are illustrated in tables 1 – 3. To these may be added that:

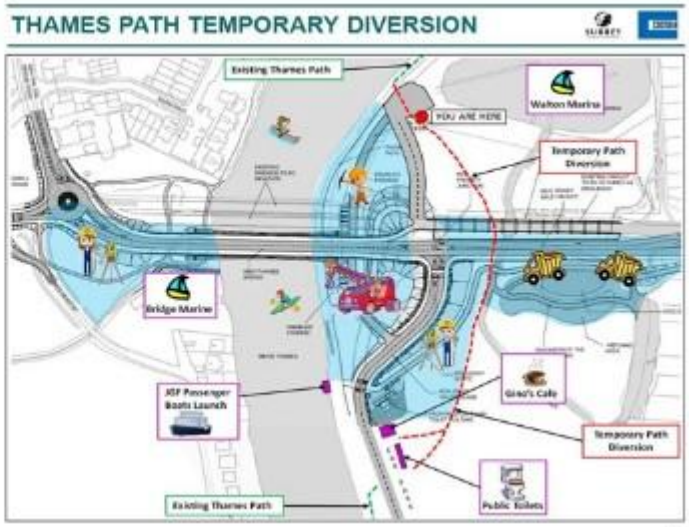
- Sheet piles were driven in by vibration rather than being impact driven; this greatly reduced the noise generated.
- The welding of the ten deck sections was sequenced to keep the river traffic moving at all times.

- Any works in the existing highway were done at night to minimise disruption to local residents and businesses.

The project team received the following email from a local resident:

> *"As frequent users of both the existing bridge and the river underneath it, we would like to compliment everyone involved in this project for the excellence in planning, management and execution. Every time we go under or over the existing bridge, the landscape changes. We find the whole thing a very exciting project and look forward to the next bits."*

Table 1: Minimising disruption – Thames Path diversion



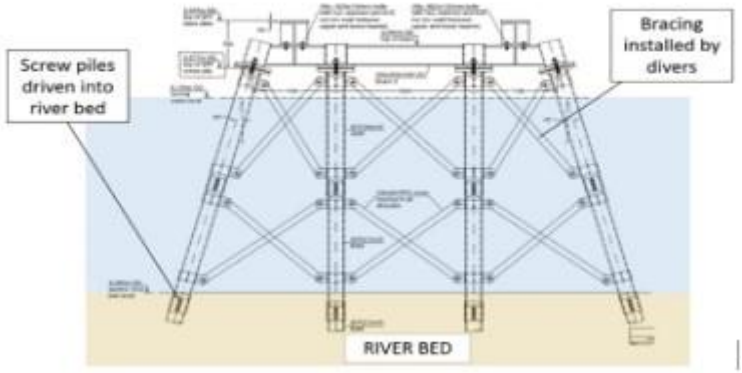
The Thames Path, which starts in Gloucester and ends at the Thames Barrier in Greenwich, runs along the Surrey (eastern) river bank at Walton-on-Thames. This footpath is very popular with walkers, runners and cyclists. In order to construct the new bridge, it was necessary to divert the Thames Path through the middle of the construction site (with fencing to protect the public from the works) for the duration of the project. A user-friendly map was produced to direct members of the public along the new footpath. Local businesses were marked on the map as a goodwill gesture for any inconvenience caused by the works.

Table 2: Minimising disruption – soil stabilisation rather than soil replacement, see also Fig 13

The river banks were formed of soft ground which wasn't suitable for withstanding the loads from the large equipment needed to assemble the bridge. Traditionally a stronger working platform would have been formed by removing a large volume of the existing soft ground and replacing it with stones to form a solid working platform. An innovative technique was explored instead whereby the existing ground was strengthened by 'rotavating' it with cement. This had a number of benefits, the principal benefit being the avoidance of the 12,000 vehicle movements that would have been associated with replacing the soft ground. The process is reversible – as soon as the bridge was assembled and the crane had left site the ground was 'rotavated' again, this time to break it up, allowing the landscaping to take place.

Table 3: Minimising disruption in the river channel

Another innovative solution that was employed was the use of screw piles to support a temporary trestle in the centre of the river channel. This trestle structure provided a temporary support to the bridge arches before the half-arch sections were welded together at the centre of the bridge span. The conventional way of erecting a trestle foundation would have been to drive sheet piles into the river bed forming a cofferdam in which a concrete base could be formed to support the trestle structure. By using screw piles the impact on the environment was greatly reduced. Once the bridge arches were fully in place the support structure could be taken down and the piles 'unscrewed' out of the river bed.



Working with Schools

The project team set up links with local primary and secondary schools to engage their pupils in bridge construction. To enhance work with local schools, the team set up construction site visits for the local primary and secondary schools. The Foreman and Engineers took a lead role in these visits, by explaining the different professions working on the project as well as the equipment and tools that used for different stages.

Figure 8: Pupils from Danesfield Manor School visiting the bridge *(Costain archives)*

There were a number of other ways that the project team supported local schools. The project staff gave presentations at school careers events as well as themed science events at primary and secondary schools. They led interactive workshops such as Spaghetti Bridge Building and judged science competitions. Well over 1000 children were involved in project activities.

The following was received form the Headmaster of a secondary school:

> *"Just a brief note to thank you and your team for such a fabulous afternoon and evening. All those involved in both the bridge building with spaghetti and the creative writing had a most enjoyable as well as rewarding afternoon.*

Working with the Local Community

Costain and Surrey County Council held regular community liaison evenings. These evenings provided an opportunity for the senior managers to update the public on the construction progress. They also offered an opportunity for local people to raise any concerns and give feedback on the works to date. A member of the public asked at one of the Community Liaison meetings whether it would be possible for local residents to tour the construction site. This idea was warmly received by the project team and a safe walking route was soon set up through the construction site that would allow participants to walk over the new structures. The site tour was very popular and to respond to the demand Costain led multiple tours showing a total of over 100 local residents the works.

Figure 9: Members of the public on a site tour *(Costain archives)*

Outreach

The work didn't end at showing local residents and school children around the work site. The project team also went out into the community and put their building skills to use. The team spent three days volunteering at The Swan Sanctuary, a local charity in Shepperton that is dedicated to the care and treatment of swans (Figure 10). 16 team members from Costain and the client, Surrey County Council, carried out general labouring tasks such as painting fence panels, weeding and cleaning up public areas in addition to installing a soak away.

After the work was completed the team received the following from the Swan Sanctuary:

> "*We're very grateful for the effort put in by the team. They did a lovely job. We are absolutely thrilled, especially about the well as this will save us a lot of money. Tasks such as this make such a difference to charities such as ours."*

Figure 10: Volunteering at the Swan Sanctuary *(Costain archives)*

The team also supported the local unit of the Sea Cadets by raising over £3,500 through a presentation for the Shepperton Aurora Rotary Club at the club's Prestige Lecture of 2013. It also raised more than £100 through a Hazard/Observation incentive scheme and provided work experience for one of the cadets.

Possibly the most valuable service provided to the cadets, however, was technical advice that saved the unit around £35,000 that it had been quoted for repairs to its jetty. The Senior Foreman at Walton Bridge visited the unit and realised they didn't need to spend all that money as he could see that much easier repairs were possible.

Creating a legacy – time capsule, a bridge to future centuries

In advance of the bridge being opened a time capsule was prepared. The time capsule contained children's drawings from site visits, design drawings and photos of the construction, biographies of some of the people on the construction team, coins, stamps, newspapers, shopping receipts and a story from a long-term local resident. As a part of the opening ceremony, the capsule was lowered into the ground on one of the river banks by pupils who attended primary schools on both sides of the bridge

Figure 11: Opening the bridge – the time capsule being lowered *(Costain archives)*

Opening ceremony – a local celebration

The opening ceremony for the bridge took place on 11th July 2013. The bridge was opened by Patrick Mcloughlin who was Secretary of State for Transport at the time. McLoughlin cut the ribbon with the assistance of local school pupils (Figure 11). Inspired by the flotilla that had taken place on the River Thames in the previous year to mark the Diamond Jubilee of Queen Elizabeth II, it was decided to have a flotilla especially for the project to mark the

opening of the bridge. Local stakeholders were invited, along with the school children and Sea Cadets.

Figure 12: Opening the bridge – the ribbon being cut by Patrick McLoughlin, the Secretary of State for Transport at the time *(Costain archives)*

Recognition for community engagement

The project was recognised in the industry for its efforts and successes. Of particular note was a 10/10 in the 'Respecting the Community' category of the Considerate Constructors Scheme (Costain.com.2014). The 10th mark (for innovation) was awarded for the use of poetry as a medium for community engagement. The assessor noted: "Community activities are so numerous that they cannot all be recorded in the main body of this report. Suffice to say that best practice abounds"

Table 4: Awards won by the Walton Bridge project

- British Construction Industry Awards (BCIA) 2014 – Winner of Best Practice Award
- Institution of Civil Engineers (ICE) London 2014 – Community Award – Winner
- ICE Thames Valley 2014 – Best Overall Project – Winner
- New Engineering Contract (NEC3) Contractor of the Year Award 2014 - Winner
- Highways Excellence 2013 – Major Project – Winner
- Chartered Institute of Highways & Transportation (CIHT) 2014 – Major Projects - Highly Commended
- Royal Society for the Protection of Accidents (RoSPA) – Silver
- Considerate Constructors Award Gold 2014
- Construction News 2015 Project of the Year (between £10m - £50m)

Building a personal bridge

Civil engineering construction is an uncompromising activity involving skill and hard work, professionalism and tough targets. Attention to detail is paramount, minute by minute, an effort that must be sustained over years. There is the constant concern that an error will lead to a devastating collapse. The project's site engineer added a memoir of the project below.

Table 5: A memoire of the project by site engineer, Ruth Fuller

Walton Bridge project is the kind of project that always stays with you. The project team had enjoyed boat trips down the River Thames (courtesy of the Senior Foreman who moored his motorboat nearby), they had BBQs by the river and had taken part in local pub quizzes. Most of the project team lived on site during construction work which contributed to the team feeling part of the community.

After the project finished I'd find myself planning bike rides so that I could ride over the bridge. I even celebrated my 30th birthday back at the bridge with a pub lunch with my family followed by a personal tour where I walked them through how the bridge had been constructed! Whenever I return to the bridge I always have a good catch up with the friendly owner of Café Gino who is now based in the new permanent café that was built by the project team.

Project Photos from pages *14 - 16*

This sections shows some of the significant photos taken during the overall construction phase of the new Walton bridge. Not every construction photo was included in this project.

Figure 13: Soil stabilisation *(Costain archives)*

Figure 14: Arch support installation *(Costain archives)*

Soil stabilisation was followed by the installation of sheet piles, then proceeded to the arch support installation process as showed on (figure 14)

Figure 15: Completed support structures *(Costain archives)*

Figure 16: Arch sections being welded together on the river bank *(Costain archives)*

Concrete pouring of the eastern foundation bridge took place before the completion of the support structures (figure 15). A temporary support structure was completed on the river, this can also be seen on the (figure 17), then the bridge arches arrived on site prior to being welded together on riverbank as showed on (figure 16)

Figure 17: Lifting the arch section into place *(Costain archives)*

Figure 18: Deck installation over the river *(Costain archives)*

After lifting the arch sections into place, the bridge deck was then assembled and installed on the river bank before it was installed over the river as shown on (figure 18)

Figure 19: Completion of the concrete deck *(Costain archives)*

Figure 20: Laying surfacing *(Costain archives)*

The completion of the concrete deck was followed by the kerb laying process before the final procedure of surface laying process on (figure 20)

Poetry Section

In June 2012, Costain commissioned Joseph Butler to write four poems to mark the construction of the new bridge at Walton-on-Thames. A role was seen for a poet to celebrate the new construction. The four poems are reproduced as an appendix to this paper.

The process of engagement into the project involved site visits and other meetings, and also a poetry project in a local school. One site visit was to witness the arch-crown welding in progress. A meeting Costain was able to arrange was with Chris Wise, designer of the Millennium Footbridge by St Pauls in London; this was a far-reaching discussion on the creativity of designers, and how symbolism and art is a part of their work.

Table 6: Reflections on his brief, Joseph Butler
The brief was to re-imagine and see afresh: in the centuries since Smeaton, Telford, Brunel and their contemporaries gifted Georgian and Victorian Britain its extraordinary infrastructure, we have grown used to the sight of roads and railways and canals. They, and the bridges which carry them, have become a commonplace, ubiquitous to the point of invisibility: we lose sight of the graft and the craft, the invention and imagination, the pooling of human wit and problem-solving capability, the co-operation, co-ordination and teamwork which go into their making. We forget – because their designs are often self-effacing, because their construction is infinitely safer and better-managed than of old, because they do their job so well – what wonderful creations today's engineers deliver.

Poems as bridges

The four finished poems formed part of the Shepperton Aurora Rotary 10th Annual Charity Lecture on 27th March 2013, a fundraising lecture which Costain gave to raise money for local charities. It played a part in one of the more formal processes of community engagement which the company regularly undertakes. The poems were used as a bridge between the engineer's understanding of a structure (in terms of its materials, form, cost, purpose to carry traffic) to a different less technical appreciation from the perspective of a member of the community: the bridge's role in social change, in uplifting the spirit, in day-to-day effects in normal life.

The poetry project at Halliford School illustrated other ways of thinking about 'poems as bridges', however. First, any creative act, be it the building of a bridge or the writing of a poem, involves a consideration of content and form, of function and design. In deciding what to place in the gaps between us we can – all of us – give care and attention to the objects we craft. Civil engineers and poets are brought together by this understanding of craftsmanship. Second, we live in a world which values 'connectivity' but which provides fewer and fewer opportunities for nuanced and time-rich interaction. By encouraging creative self-expression in communities affected by large-scale construction, there can be opportunities for genuine dialogue, for a range of voices – dissenting, conciliatory, impassioned, objective – to be heard in an environment or setting which is safe – far rather express anger in a poem and generate empathy, for instance, than in the antics of physical obstruction or sabotage. Part of the writer's role – in facilitating the creation of writing by others – is simply to facilitate that exchange of views, to help that bridge to be built.

Words as bridges

If we imagine someone with something to communicate, and a person they wish to communicate to, there is a gap their words must cross. Words must form, like the arch taking strength from its foundation on one bank, then fly, like the arch across the river, and then land again, like the arch once again finding foundation in the ground on the further bank.

It is hoped that the personal words by Joseph Butler give meaning to this idea, helping those who are inspired by poetry to see into the creative process. Below is a reflection of words as bridges by, Joseph Butler.

In the space that exists between my desire to communicate and your grasp of what I have to say I place this – this assemblage of vowels and consonants, this single syllable – this word. Language is a bridge. It spans the gaps in our mutual understanding in ways that parallel the bridging of physical barriers by structures made from steel and concrete, wood and stone. Both word and bridge form a connection: they bring individuals and communities closer together. They mediate human interaction and exchange.

The parallels are not exact. Words are gossamer: ambivalent, insubstantial. They hang precariously in mid-air in ways that bridges cannot afford to. I don't want to strain the metaphor, but I do – as someone who works with both words and resistant materials – experience delight in it.

I treasure two memories from the writing process. The first is of climbing a gantry from river-level to the joining-point of the bridge's two halves, high above the waters of the Thames. There, beneath the cover of a tarpaulin, a crew of welders was working, with the intense heat of an electric-arc, to fuse the bridge's arch into a seamless whole. Where once there would have been the laying of a keystone, now there was this: 'a bridge not bound with stone but stitched with light'.

The second memory comes from my conversations with engineers. We were talking about the deliberate destruction in the Bosnian War of the bridge at Mostar – the re-creation of a chasm between the city's Christian and Muslim communities. I caught a glimpse, in that moment, not just of the engineer's sorrow at the passing of a structure, but of something more: the mourning of the bridge's symbolic function, its linkage across a sectarian divide – and the bloody consequences arising from the severance of those ties. That image of negative space – of an unbridged gap – informs the first of the four poems I wrote about Walton.

Conclusion

This paper, has shown how a disruptive civil engineering project can, if handled well, be a bridge at many levels: there is the physical bridge itself and Pollard shows from his historical account how communities are linked and shaped. Fuller explains first how, during the project design and construction period, links were built between the contractor and the community, and also how, for her, it evoked a deep and positive reaction from the exercise of skill and

craft, an inner bridge as it were. Butler, in his poems, not only explores these and other forms of ‘bridging’ but shows how the project at Walton was also a bridge between creative media – the art of the designer, the craft of the builder and his own art, of poet.

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The Daily Advertiser, 3rd March 1747

Walton Bridge Act 1746 George II

BRIDGING

A stone's throw, maybe, or perhaps
to be more accurate, a bowshot's length away.
And, if you cared to bend your back to oars,
just minutes in a crabbing rowboat,
course set counter to the current's force,
the river's slap insistent on your leaky boards.
But always that sense, as you stared across,
that what you gazed on was another country.

True, the smoke that rose above the thatch
that huddled on the farther bank
came, in all likelihood, from hearths
no different to your own. The old man by the water
mending nets could be your grandfather.
And you might hail him, gesture, wave;
but, just as likely, turn away – dismiss him
as you would a dream, a figment of your night-time mind
the river's intervention running like a liquid borderline
between the states of sleep and wakefulness.

It's soil that binds us to a kinship, common ground
that makes us fellows: friend or foe.
A territory's that span of earth it takes a day to cross on foot.
And Thames runs like a gash between the Saxon lands
of Mercia on the northern bank and Wessex to the south.
When William, the conqueror king, left blinded Harold
dying on the beach at Hastings the Roman bridge
at London had long fallen to decay.
He had to march to Wallingford in Oxfordshire
to make his crossing to the north.

Fast forward through centuries: a man who's made a life
designing bridges sits in a West End studio. The walls
are lined with photographs of structures he's conceived.
A drawing pad lies open on his knees. He flicks his pen:
a bow of steel appears. Again - the outline of a piling.
His bridges span the Thames, the Tees. The spars
of their suspension fan like sails, concrete blockwork gleams.
The line the decking cuts from bank to bank is irresistible.
"I count it a success," he says, "when the longing
that the lines express reflect a yearning in the land
to join at just that point."
As though he'd reinstated something that was lost.

"And if I get it right,"
(the bridge commissioned, laboured over, raised)
"I'll go and sit and, in my mind, dismantle
every nut and bolt, each welded section till at last
I'm left with just the walkway running out on emptiness.
I watch the men and women tread out on the void:
the city gent, his briefcase swinging to each stride
whose leather heels strike soundlessly on air.
A Mum and Dad lift children to a non-existent parapet
to stare down at the water's churn below.
And at the mid-point, high above the stream, a pair of lovers
catch the other's eye: run unsupported
through the firmament to clasp in an embrace.
I watch," he says, "then drop my gaze. I look away -
they're braided in a kiss so fierce it sets the air ablaze."

Poem 1: Bridging by Joseph Butler

PAST

Once they were raised, as cathedrals were raised,
to the greater glory of God.
Nothing slipshod in their stonework
when to mount those arches to their zenith
was to be raised heavenward.
And what those bridges overshot
were all the pagan deities embodied
in the river's course: the dank, desirous forces
prone to flood and swift to waterlog the soul.
Their memory lingers in the tales from Grimm:
of bogeymen beneath the bridge,
of trolls who slumber on their bed of bones
and wait to snare unwary passers-by.

Time's waters flow. Old orders change.
The toll exacted of the traveller's no longer paid
in prayer but coin. Another rank
of bridge-builder appears:
a moneyed venturer, a gentleman of means,
whose road across the river represents
an act of speculation, a fortune sunk
in wood and brick against the hope of capital return.
And be you drover, shepherd,
blacksmith, carter there's a fee
to get your goods across the water on a market day.

And so the wheels of commerce turn
and London sprawls, its suburbs merge,
the green fields of the villages give way to brick.
The footfall on the bridge - the wagon's creak,
the click of horses' hooves – becomes a slew,
a snarl, a stew of bawling draymen
driving iron-rimmed carriage-wheels.
A clamour rises: *Free the Bridge from Tolls.*
The private passes into public ownership.

And as those thoroughfares across the Thames
become a stream of steel, as livings gather pace
something happens to our sense of self.
It starts with the Victorian reformers:
the abolitionists, the suffragettes,
is carried by the fallen of the two world wars.
Unthinkable that Walton Bridge be held in anything
but public trust. Whose bridge is it? You ask.
It's ours. Our rates and taxes, yes, our debts, our deficit,
our wealth, our work arranged across the Thames.
So come, let's walk, let's cross from one bank to another.
The company we keep is ancient. The bridge laid down
on all those lives that passed before.

Poem 2: Past by Joseph Butler

Arc

Once there would have been the laying of a keystone,
that wedge of masonry that slotted home
to make the arch's throw complete
its two halves married up,
inclined towards
the other's mass
and bearing it
the lines of force
transformed - from imminent
collapse to something more compressive:
stresses shifting downwards through the mortar
and the blockwork to the structure's base - the pilings
and the bedrock - to Earth herself who takes the weight with grace.

The physics hasn't altered, just the scale. These days it's steel
that spans the gap. Two tapered metal tusks, hexagonal
in section, are craned out from the bank -
their flared ends butted up against
a pair of monumental stops,
the tapers held aloft
atop a scaffold gantry rising
sixty feet above the water-line.
The point of intersection's shrouded
in a cubicle of plastic sheet that's lit with bursts
of lurid ultra violet light: that livid, incandescent
flickering that comes each time the welder strikes an arc.

We lift the flap and pass inside, don masks and watch as, through the visor,
metal liquefies, surrenders its solidity before that needlepoint of brilliance,
becomes a molten pool to which the welding wire adds its bulk.
The welder moves his hand by slow degrees, impels the bead
of liquid steel forward along the seam. Behind the arc
the metal fuses, cools, congeals - in runs
of overlapping crescents, patterned
like the shapes left in the sand by a receding tide.
Even through the filter of the mask the glare is dazzling.
There's something potent here that stupefies, a force controlled
and focussed - visceral as lightning-strike. We stumble from the tent
regain the air, stare out on London from the gantry's height. To either side
the arch's curve declines, a bridge not bound with stone but stitched with light.

Poem 3: Arc by Joseph Butler

BRIDGE TO THE FUTURE

My daughter's six years-old. Last Saturday
we went to Cowey Sale to feed the birds.
We stood there with our bags of bread.
A swan approached, a full-grown cob,
ungainly, lordly, every inch as tall as her.
He stretched, and spread his wings. I felt their waft.
She never flinched, she held her ground.
She fed him titbits from the bag. I felt so proud.
We stood there on the Surrey bank
and stared along the Thames to Walton Bridge.
"What do you see?" I asked her. And she said:
"A bow, a metal rainbow with its feet touching the earth."
I smiled, she said: "when we get home tonight
I want to stay up late and watch the stars on ice."

One day, perhaps this year, we'll walk across that bridge.
We'll cross, as so many have crossed before:
our span of wood and stone and brick
remade in steel – the girders braced and tensioned,
tempered to withstand the shock
of centuries to come.
I'll lean against the parapet, ask her what the future holds.
She gestures to the bridge's end. "I want to dance,"
she says. I tell her: "Sweetheart, you already do."
She thinks I'm teasing her. I'm not.
With every step she takes she makes the world anew.

Poem 4: Bridge To The Future by Joseph Butler

A Magnet for Troubled Souls

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In ‘Bridge for the Living’, a work commissioned for the opening of the Humber Bridge, Philip Larkin wrote:

> Reaching for the world, as our lives do …
> Always it is by bridges that we live.

Bridges, as Larkin suggests, may be beautiful in design and possess the power to connect people and places. But, for some, they have a more sinister connotation.

> bridge
>
> you stretch across the Humber,
> bright magnet for keen tourists,
> seductive in your elegance
> and panoramic vistas;
>
> a vicious snare for fragile souls
> unseen on saucer-souvenirs,
> bodies dredged from lonely shores,
> drowned beneath your piers.

In 2003, after many years' struggling with schizophrenia, my son Peter took his own life by jumping from the Humber Bridge. In 2017, ‘Belongings’, a sequence of poems I wrote about Peter and our life together, was published. In this paper, I will draw on the snapshots of life contained in these poems to consider how an illness may develop – a tenderness of mutual concern too – through the irresistible pull of the bridge.

The personal moments contained in the poems are intended to resonate with those who are mentally ill and their carers. Perhaps they also shed a little light on why one young man was drawn to a bridge as a means of release from a world of torment.

The journey begins in a hospital ward. Any parent will recognise the apprehension, sense of wonder and deep responsibility present in such a moment as the birth of a first child.

> birth
>
> a long drowsy night
> waiting
> yet nothing happens
>
> falling asleep
> despite myself
> unable to keep watch
>
> anticipating
> the shrieks
> that do not come
>
> you will appear
> in a theatre

wrenched out with forceps

I will hold you first
embrace your lightness
bear your weight

My early memories of Peter include his innocent delight in physical being – 'glad animal movements', as Wordsworth would have put it. He was athletic, loved to swim and run. In particular, he loved to race towards me on his way home from school, ready to be swung round from my arms. There was no hint of what was to follow in the act itself, though there is in the altered perspective of the poem.

whirligig

drifting down the street
on auto-pilot
you look up

burst into a grin
sprint towards me
ready to be hurled

legs flying outwards
you swoop and spin
clinging to my grip

fearless, unrestrained
gliding to a halt
against a cloudless sky

how soon I will become
a satellite of you
hurtling towards oblivion

It seemed like the blink of an eye before he was studying for examinations at school – and reacting badly to the stress. Now there was an anxiety in his demeanour and the first troubling signs of mental illness, though I didn't realise the gravity of the situation at the time and put some of his behaviour down to him being a teenager.

writing on the wall

notes for your exams
start to appear line by line
above your desk

geometric diagrams

mathematical formulae
fragments you have shored

indecipherable scrawl
spiral out of control
you say they help you to revise

I don't read the signs at first
think it peculiar for sure
another teenage aberration

a kind of modern hieroglyphics
maybe a touch of genius
as the first cracks open

The construction of the Humber Bridge, which would form the backdrop to our lives, was started in 1972. I watched it being built. When it was eventually completed in 1981, it was the longest single-span suspension bridge in the world. For many people in Hull, it was a source of fascination, even if some saw it as a white elephant, leading nowhere at great expense.

For Peter, increasingly agitated by disturbed thoughts and voices, it would take on an entirely different significance...

landmark

we watched it rise out of the sea
vast concrete towers
cables stretching across the void

crowds gathered on the shore
to gawp and speculate
routine sunday pilgrimage

food wrappers
accompanied the usual flotsam
along the water’s edge

stone by stone it grew
until the first cars came
hovering in space

you biked there at night
gazed into the murky depths
for your private view

There were still positive aspects for him. Peter was an accomplished chess player and Humberside had a thriving chess association, the north and south banks of the river united in competition with other counties. These were happy occasions with a sense of camaraderie, involving a lot of travel and culminating in the Under-16 team winning a national tournament in 1991. It was a year of triumph for Peter personally, as he won the British Under-16 Chess Championship at Eastbourne.

chess

crossing the bridge into Lincolnshire
you are relaxed,
immersed in another world;

the team coach buzzes
easy banter flows
as miles race by

heading for the tournament,
where clocks tick, pawns advance
and pieces are exchanged;

your knee shakes,
you disappear offstage
between moves

but here there are solutions to problems
strategies for success
astute tactical manoeuvres

gambits,
a knight sacrifice
to lay bare the king;

you leave the board
fist raised
glow in victory

At the same time his behaviour was becoming increasingly troubled. He was more withdrawn and preoccupied with his appearance and the effect he assumed he was having on those around him. While I was extremely exasperated by this state of affairs, I tried to reassure him continually – to no avail. I took him to see our local GP, who might perhaps have realised the early signs of mental illness.

smell

you hide away

a hermit
in your shrinking room

sure you ooze
an odour
from your pores

there is no smell
I tell you
it's in your mind

you look aside
retreat upstairs
wash endlessly

The pressure of A levels led to a first breakdown in July 1993 and, after a second overdose in September, his eventual admission for assessment at De la Pole Hospital in Cottingham, near Hull. Here he was given his first anti-psychotic drug, Stelazine, with rare but disastrous consequences for him. The medication turned his body rigid which terrified him. After much delay, he was given an antidote, Procyclidine, which countered these alarming side-effects. But the damage had been done and his trust in medication and doctors fatally undermined. To make matters worse, this experience was repeated several times, including during the following visit I made to see him early one evening:

Going to see my son in ward six

Writhing sideways on the floor,
bulging neck twisted round,
he lurches forward with a groan,
hurls himself against the door,

while nurses huddle to one side,
cast nervous glances straight at me-
it seems that I'm the one to blame,
he was alright until I came.

The pills they gave him with his meal
had no effect on him at all;
his mind was calm, his body still
until I came.

He hugs me in the driving rain,
holds me close against the pain,
while nurses chant their set refrain:
he was alright until you came.

I'd like to try and give some idea of the pain he'd been experiencing as his illness progressed. Initially, I had no real idea of what was going on in his head – he was extremely good at keeping his thoughts to himself and disguising his state of mind. Looking back, I was completely ignorant of the voices that were tormenting him. I was trying to support him in any way I could and couldn't believe it when he said he just wanted to die. He had so many qualities – extremely intelligent and witty with a fierce sense of independence. Strong physically too. Maybe the only way to fully understand what he was going through would be to wear headphones with the voices continually present. It is a cruel paradox that he could be so bright yet suffer from a serious mental illness.

imagine

a fierce black bird
grips your shoulder
lunges at you in your cage

you try to block its jabbing beak
tearing at your head
while you twist and writhe

its claws dig in
as it blames you
for those secret sins

it clings to you
when you go out
mocking what you say and do

you hide all this
so no-one sees the shame
behind your averted gaze

this bird is here to stay

Everything changed when he decided to leave the home he shared with me and find an apartment of his own. He chose not to go to university, unable to face the prospect, but at the same time began to read voraciously, mostly at the Hull Central Library. He also joined a creative writing class and began his own novel, the aptly named "Closing Time". He would often seek out remote places to write, preferring solitude, and scribble in his almost illegible handwriting.

Holderness

you stride into the wilderness
on a mission
to find a hermit's space

scuttle through the undergrowth
past barren trees
head down against the driving wind

pitch your tent in open land
scouring for intruders
and prying eyes

scribble feverishly
give shape to life
record your slant

stripped to the bone
on scraps of torn-off paper
your parting testament

This gave him a purpose and a kind of mission. He threw himself into it and began to type it all up, eventually sending it to various publishers. Of course, he received rejections in return but he didn't lose faith in what he was doing. He moved into the countryside and settled into a caravan in a farmyard. This was fine in the summer but not so inviting in winter. I would visit him there once a week and we'd go out for a meal.

On one occasion, he said he hoped that I enjoyed my trips out to see him and that he was worried about how my life was going. Moments such as this really touched me. I realised that he was concerned about my well-being. It was not all one-way.

caravan in winter

in a farmyard
exposed
you take refuge

at night the wind
screams
through tin walls

I grip the icy handle
knock
peer inside

coffee stains
form seals
on scattered papers

rotting scraps of bread
accumulate
on mildewed surfaces

like a taut spring
uncoiled
you stride across

grasp my hand
abstracted
pointing to a pile of letters

you show me
rejections
from publishers and agents

yet smile
offer me a drink
enquire about my journey

All this living in a remote place eventually took its toll and fed his paranoia. I could see he was heading for another breakdown. The voices were assaulting him again. He needed a refuge and professional help.

We often used to go to a pitch-and-put golf course in Hornsea on a Sunday for a breath of fresh air and some exercise. Above all, it was a chance to relax in each other's company. The normally strong competitive instincts we both possessed were replaced by a simple shared pleasure. On this occasion, however, we both recognised what was happening to him again.

Mini-golf at Hornsea on Sunday afternoon

Breaking out through littered streets,
past factories, billboards, shopping malls,
barbed wire round the jail,

we head off for the coast down country lanes,
park before the ice-cream van.
No customers.

A sharp breeze smacks as we tee off;
your ball soars,
thuds to earth before the bunkers.

Afterwards the comforting routine:
greasy chips along the front,
gulls screeching overhead.

Strolling past the vacant fairground,
we both know the time has come
to stop the voices,

face the next incarceration,
the drugs, the twisted body-shapes:
surrender to a cylinder of pills.

He agreed to go to a centre for acute assessment and therapy back in Hull. Surprisingly, he was really good in this environment. He related well to other patients and was respected. He again showed his caring side when surrounded by those with delusions.

There were some humorous moments. One one occasion we listened to a young man who was convinced that George Harrison was his father. He was sure he was being followed by him everywhere he went. When Pete mentioned that I'd been at school with George Harrison, he clearly thought this was an absurd delusion, not to be taken seriously.

Sometimes a secure retreat is the only answer for those who are in crisis, even if it does give rise to concerns with medication again. It is necessary to have somewhere safe to recover. In this environment Pete appeared like any normal young man – at ease with himself and others.

Margaret Street

I'd like to introduce you to Phil.
He works undercover for the CIA.
This is his badge.

He's trained abroad,
knows how to spot the enemy.
Would you like a cup of tea?

I've never seen you so relaxed,
the perfect host in company -
at home with fellow-refugees

whose special powers give
access to presidents and deities
through television screens.

I drop into the vast couch,
sense a great weight lifted,
but know that you will lose this prop,

discover cardboard cutouts
have no currency
in the outside world.

The staff will disabuse you,
as they must,
and look to me for confirmation.

After some weeks here in Margaret Street, Pete moved out to live in a sheltered house run by the mental health charity MIND. For a while he seemed to stabilise and started attending classes in various activities but he was soon in another downward spiral, not helped by the diagnosis he was finally, and somewhat brutally, given of schizophrenia. At this point he was sure the people in the adjacent building were conspiring to kill him. One Saturday morning he ran barefoot in the rain to Humberside Police Station to denounce these same neighbours. He was outraged that he wasn't believed and that his complaint wasn't fully investigated, as he saw it.

next door

saw them through the bedroom window
going in and out-
know they're watching me again
ready to pounce

heard them plotting through the wall
how they're gonna do it-
as I left I saw them smirk:
their lips were mouthing murder

have to call the cops again
though they don't believe me-
for all I know they're in on it
part of the conspiracy

only need to watch the News
to see the writing on the wall:
suicide bombers in the street
terrorists in village halls

going to head outside tonight-
get some hash to calm me down-
wait till no-one's bugging me
come up with a final plan

I'll wipe the smiles from off their faces
next time that I meet the scum
they think I'm weak and have no friends:
the fools don't know I have a gun-

if that fails there's one sure way
to drown the whispers' nagging roar-
head out for the bridge again-
leap into the sea below.

Despite all this, he did manage to finish his novel and I helped him publish it online. For him this was a supreme achievement and I was delighted. Looking back, I can see that he was in the process of completing his affairs before taking his leave.

Our final meeting, one lunchtime later that week, had an air of heaviness about it – he seemed distant and withdrawn. I contacted his support worker to express my concern. They had a weekly appointment the following afternoon.

Linnet and Lark

we meet up for a drink
you knowing this will be the last time
we have the lunchtime special

eaten without relish
your eyes are elsewhere
words fall over a cliff

as forks scrape on empty plates
you take your leave in the street
accept a last embrace

against your rigid body
extract a promise from me
to see your novel published

if you get too tired

He didn't keep that appointment. Instead he set off for the Humber Bridge at lunchtime. I went round to his flat after work but he wasn't there. When I arrived home, there was a police car outside the house. I knew immediately what had happened.

My own sense of loss was overwhelming. For several years he had lived on a knife-edge and me with him. The longer he survived, the more I hoped he would learn to recognise his own symptoms, when he was ill, and cope with them. He did have a support network in place but there were still times when he felt despondent.

Ironically, there was a letter on his doormat the following day, confirming his novel would appear on the Internet site. This would have been a massive boost for him and his self-esteem. It may have been the one thing that could have changed his mind.

I've heard people say that to take your own life is a selfish act, disregarding those you leave behind and their feelings of loss and guilt. I can't agree. Firstly, I think that anyone who commits suicide is suffering to such an extent that life becomes unbearable for them. In some cases, they may genuinely believe they are releasing those they leave behind, doing them a favour. I feel that the things Pete and I went through together drew us ever closer and his death in no way diminishes my love for him. It did not seem like a betrayal when he leapt from the bridge into the water below.

police car

dark
was the night
it parked outside the front

i knew at once
plunged into the house
screamed before they spoke

black
the hole
which sucked me in

i walked for hours
while brazen streetlights glared
beneath the stars

heavy
the heart
bursting to leave this earth

His death was unreported in the media. He might not have existed. Just another statistic.

On the day of his funeral, the crematorium was packed out with those who knew and loved him. I felt nothing but admiration for the the person he was and the things he achieved in his life, despite the difficulties he faced. Nevertheless, there was a kind of unreality about it for me.

cortege

guided to the hearse
by black gloves
with ostentatious courtesy

i float behind your box
shrouded in leather upholstery
under the motor's steady purr

turn left at the lights
past the Haworth Arms
the usual journey

never to be repeated
crawl forward
as in a fog

am beached inside cemetery gates
by marble and chrysanthemums
stumble through the crowd

in the sun's glare
glimpse suits and hats
outlines of familiar faces

you crept away
chose your own departure
free from any spotlight

One of the hardest things for me afterwards was going to the police station to sign for his belongings. Nothing can ever prepare you for something like this.

collecting your belongings

at his desk
the officer is wary
as he goes to fetch the tray;

your wallet is still intact,
everything in its place,
travel card, student id, gym pass,

no cash to spare,
you never did have much of that,
but no debts either.

I sign for it
together with the bike
abandoned by the railings:

so much a part of you,
a battered frame
strained beyond endurance.

In conclusion, there are some brief general points I wish to highlight from my own experiences.

Firstly, when you sense that a loved one is struggling with mental health issues, you need to try and get them to talk about what is bothering them. You may well need to try and persuade them to seek professional help – be prepared to fight for this, as it is not always readily forthcoming.

Secondly, as resources are stretched in our NHS, I am aware of the shortcomings of support and treatment, despite the claims that mental health is now a priority. I felt that my son was

quite well supported by staff at the basic care level but he received virtually no attention from more senior healthcare professionals, such as a psychiatrist, who might have gained his confidence and engaged with him, especially in view of his high level of intelligence.

Thirdly, there will always be a time when a refuge is essential. Care in the community has its merits but is not enough sometimes. There were times when I could not help Peter and he needed professional care around the clock. But these places are continually being closed and the land redeveloped. The Friern psychiatric hospital described by Barbara Taylor in her excellent memoir, 'The Last Asylum: A Memoir of Madness in our Times', was converted into luxury flats. The De la Pole Hospital near Hull, where Peter was briefly a patient, closed in 1997.

Ultimately, the most important thing we can all offer is compassion and understanding. It is of no use telling someone who is struggling with serious mental illness to 'pull themselves together'. What matters is the ability to listen and give support. For, as Larkin also observed in ‘An Arundel Tomb’:

what will survive of us is love….

Bridges & Curves: Women, Infrastructure and Urban Space

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Bridges & Curves: Women, Infrastructure and Urban Space

As a public historian, as a museum curator, and a lecturer in history and urban studies, I am interested in the idea of public narrative and how historical experience is imagined and thus interpreted in museums. In particular I am interested in the ways in which women are imagined within cities. On a secondary level, my work also considers the interplay of historical narrative and visual culture within museums. Art museums increasingly use historical, and not just artistic, eras in order to frame exhibitions. For example, the National Gallery of Victoria in Melbourne used the 1930s as the premise for an exhibition in its 2017 winter season. Less prevalent is the use of art in history museums as an interpretive device that moves beyond the simply illustrative. This too, however, is beginning to change. Having worked in both types of institution, I am interested in models that explore ways to use art to consider broader historical ideas. It is within these concepts that this paper had its origins.

With this paper I suggest that in the British, Australian, American traditions, women have often been conceptualised in very limited ways with regards to cities. If however, one considers the women artists who use infrastructure as a subject, their work can provide points of access into alternative readings, alternative imaginings, of women and their relationship to urban space. This paper will focus on artists that were active between in the 1920s and 1930s, and will predominantly, though not exclusively, draw on Australian artists.

How are women imagined in cities?

To say that men and women experience cities differently is to be at once self-evident and revolutionary. Spatial designations and divides within a city consciously and recognizably follow the lines of economic variability, ethnic or racial identity, and land usage. Because the interactions between space and gender, while equally present, are less apparent in buildings, signage, and other physical markers, they can remain invisible or overlooked, be subject to partial recognition only, or manipulated to fit prior expectations (Stevenson 2003: 37-38; Sewell 2011: 596-598; Bondi 2005:4-5). Men's interaction with urban space takes on myriad forms, but women are commonly positioned in three ways: as victims or potential victims of violent crime; as sexual objects, particularly sex workers; as consumers and participants in leisure.

The possibility of attack, and the subsequent evaluation and designation of safe and unsafe space are central to women's negotiation of cities (Stevenson 2003: 38; Duggan 2001:96). Historically, within the Australian cultural tradition, while the city was on some level effeminate (when compared to the natural masculinity of the Bush), it was also thought to be dangerous and hostile to women (E. Wilson 1992:110,124; Carter 2006: 144-147). Despite crime figures indicating that young men are at greatest risk in public space, while women are at greatest risk of violent attack in private, the imaginings of the city as a place of danger often focus on women (Bondi 2005:5). The city as malevolent to women and girls is a recurring motif in the work of Australian artist, Charles Blackman. His Schoolgirls series (c1952-1956) was reportedly inspired, at least in part, by the death of Alma Tirtschke, a 12-year old who was raped and murdered in Melbourne in 1921. Another painting, entitled Running Home (1954), presents lone female figure running through a near-empty commercial urban landscape. The corner shop that she dashes past is at once familiar and ominous. The scene is capped by a darkening sky and a sense that this is a space that must be negotiated at speed.

The unspoken threat within these images and imaginings is often sexual and thus works hand in hand with the characterisation of urban women as predominantly sexual beings. As much

as cities were, are, presumed dangerous to women, equally women have historically been understood as dangerous to the city (Seal 2011:492). The female prostitute becomes the embodiment of the threats to both morality and health (D'Cruze & Jackson 2009:71). These 'fallen' women of the world's cities have been the subject of art for time immemorial. There are few depictions, though, that have been as honest in their mix of desire and misogyny as the monstrous women in Albert Tucker's wartime works such as Victory Girls (1943), Courtship (1943), Pick Up (1941) as well as works in the Image of Modern Evil series. Tucker's urban women with their exaggerated lips, exposed breasts, and eyes on the viewer rather than the men alongside them are a siren song; simultaneously alluring and repulsive. The relationships in Tucker's paintings are transactional, but even in those paintings in which women are not themselves for sale, their interactions with the city are often commercial in nature.

American artist, Edward Hopper, for example, paints a more sympathetic view of women in urban spaces. In his works, neither the city, nor the women are inherently dangerous. Chop Suey (1929), Automat (1927) and Hopper's most famous work, Nighthawks (1942) all depict women in cafes, while Two on the Aisle (1927) presents them as theatre-goers. All are shown as consumers rather than commodities. Indeed, Hopper further extends his rendition of urban women, and is one of the few artists who consistently paints women at work in professions other than actress, dancer or prostitute. Apartment Houses (1923), Table for Ladies (1930), New York Movie (1939), Office at Night (1940) and a later work, New York Office (1962), all show women in places of employment, contributing to the economy of the city. Yet, Hopper's women are still imbued with a sense of isolation and discomfort. To be fair, the same could be said of most of Hopper's men, and most of his American cities as a whole. While his women are somewhat more sexualized than his men, they are never treated with the blatant disdain of Tucker, nor the well-meaning pity of Blackman. Nevertheless, if one is seeking a positive counter-narrative of women's interaction with urban space, the limitations presented by Hopper women's become apparent, as they remain bound down by melancholy.
Persistent, even in the most sympathetic of depictions, is a relationship to urban spaces in which women are rarely shown in positions of ownership, of power, or as drivers of creative process. The visual constructions of their interaction with the city are constrained, both in role and space. The broader effect of this constraint is erasure. We lose a range of women's narratives and women's histories throughout the city. If this loss becomes apparent in the art of the city, it is certainly not limited to art museums, and is problematic across numerous interpretive genres and institutions.

An extreme example of interpretive erasure is to be found in the case of a new museum that was approved in October 2014 for a site in Cable Street, in London's East End. The application presented to the Tower Hamlets Council declared:
The museum will recognise and celebrate the women of the East End who have shaped history, telling the story of how they have been instrumental in changing society. It will analyse the social, political and domestic experience from the Victorian period to the present day. (Warnock 2015).

However instead of the promised stories of East End women, at 12 Cable Street one finds a museum of Jack the Ripper, complete with autopsy reports and photographs of murdered women. The owners protested that the museum was not intended to celebrate the well-known serial killer but was still focused on the women and "how they got in that situation in the first place."(Warnock 2015). Writing, in The Independent at the time of the museum's opening in August 2015, Becky Warnock retorted:

[P]resumably by being sex workers and/or human females on urban streets at night. And because they got themselves into it, I suppose it's fine that we gawp at the gory details of their deaths in a specially developed museum: after all, they're just prostitutes.
The autopsy pictures are particularly cogent to ideas of erasure and construction within the visual narrative of urban women. These images are the visualisation of both victim and sex object taken to the extreme. They have been put on display as part of a conscious, and it would appear contrived, exclusion of images of women in contexts where they have agency and control; images of them making contributions to the urban space and society. The space within city that this erasure takes place is equally significant. On the 4th of October, 1936, Cable Street was the site of a clash between the black-shirted British Union of Fascists and various Jewish, Communist and anti-fascist protestors, numerous young women amongst them. Given the original application for the Cable Street museum, one might well ask where are the pictures of those women?

Women artists and infrastructure.

Yet in spite of the erasures and the absences and the exclusions, counter-version of women's interaction with the urban space do exist. One such narrative begins with Australian artist, Grace Cossington Smith, and her work depicting the Sydney Harbour Bridge. The bridge, which spans a narrowing of Sydney Harbour between Dawes Point and Millsons Point, was built by Dorman Long and Co between 1923 and 1932 (Commonwealth of Australia). Cossington Smith was fascinated by its construction. She sketched it, drew it, and painted it in detail and expanse including Curve of the Bridge (1928-29), The North Pylon (1928-29), The Bridge arch from the Turret Theatre Hill (1930), Before the Arches met (c.1930), The Bridge in building (1929-30), The Bridge in-curve (1930).
Though Cossington Smith was prolific in her renditions of the Sydney Harbour Bridge, she was far from alone amongst artists who were drawn to it as a subject. Jessie Trail, Adelaide Perry, Dorrit Black, Gladys Owen, Gwen Barringer, Alisa Allan (aka Alisa Lee Brown), Sydney Ure Smith, Roland Wakelin, Henri Mallard, Frank Weitzel, Harold Cazneaux, and Margaret Preston all found a muse in the ironwork bridge now affectionately known as "the coathanger." That said, if one can draw even rudimentary, circumstantial conclusions from the offerings of gallery shops, the lasting artistic impression of the Sydney Harbour Bridge has been the work of the women. Cossington Smith's The Bridge in-curve became the catalogue cover and a publicity poster for the Art Gallery of New South Wales' exhibition Sydney Moderns in 2013. In 2017, this same work was one of the signature pieces within the National Gallery of Victoria's Brave New World exhibition of Australia in the 1930s. It was one of the few works in the exhibition reproduced for sale, available both as a post card and an inexpensive print. Margaret Preston's Sydney Bridge (1932) has meanwhile in available on notebook covers, as tea-towels and on other souvenirs. Preston and Cossington Smith's renditions of the bridge, along with those of Cazneaux, are the recognizable historical imagery of the landmark, which, until the Opera House's completion in 1973, was the iconic calling card of Australia's first city. Given their recognizable associations with this key piece of 20th century Australian infrastructure, Cossington Smith and Preston can be positioned as an anchorage, to borrow from a bridge analogy. By drawing spans outward from them, they connection to a number of other women artists become apparent.

Much of Preston's work at this time was in woodcut prints and it is her medium even more than her subject matter that leads to Eveline Syme and Ethel Spowers. Syme and Spowers also produced prints, though they tended to work with linocut rather than woodcut. Based initially in Melbourne, their work depicts the infrastructure of that city and its surrounds, and

cranes as well as bridges feature in their prints. Notably Syme's The city skyline (c.1926-28) shows a silhouetted urban skyline with construction cranes atop a rising skyscraper. Spowers' Princes Bridge (c.1925-1927) depicts Melbourne's major river crossing and thoroughfare, while her Timber Crane (1926) echoes her friend Syme's subject matter though places it even more clearly within the context of heavy industry. Syme and Spowers, in turn, draw the spans further outward to London, and the Grosvenor School of Art (Hylton 2000:51-52,56).

Claude Flight taught linocut printing at Grosvenor School. He and his students were by fascinated by motion and machines. They were influenced by the Futurists but were less nihilist in their views (Ackley 2008:23; Rippner & Rassieur 2008:77). Their prints featured stylised views of sport, transport and city architecture almost always with a sense of motion (Ackley 2008:22-28). Men and machine in tandem are evidenced by Flight's cityscape Speed (1922), and Cyril Power's Whence & Whither (1930), depicting crowds on an escalator, and The Tube Station (1932). A number of women, including Syme and Spowers, studied with Flight at the Grosvenor, and two of the schools stand-out artists were women: Lill Tschudi (see for example Tour de Suisse (1935) or Fixing the Wires (1932)), and Sybil Andrews.

There are no bridges in Sybil Andrews' work and in that she takes a further step away from Cossington Smith and Sydney. However, she does create powerful, noisy, depictions of infrastructure and city life such as in The Winch (1930), The Giant Cable/The New Cable (1931) and Sledgehammers (1933). In particular, Andrews provides a vision of crowds as interpreted through the feminine eye. The view is celebratory, often affectionate, speaking to the vitality of an urban population, such as those in Rush Hour (1930), Hyde Park (1931) and Market Day (1936), as well later work from her time in Canada such as Coffee Bar (1952). Notably Andrews' crowds often place the viewer in a position of participant rather than outsider. It is as though, one has glanced to the left and caught the eye of fellow spectators in Wet Race Meeting (1930). Straphangers (1929) capture the perspective of a commuter staring at the backs of fellow riders as the tube train hurtles under London; bodies swinging slightly askew around a bend. These views establish a sense of belonging within the urban space, perhaps even of ownership. Australian artists, particularly Ethel Spowers convey similar levels of comfort and shared activity amongst urban crowds in her prints Wet Afternoon (c.1929-1930), The Joke (1932), and Special Edition (1936).

The New Woman

The relationship between these women artists, the spaces and the populations they depicted, must be understood, at least in part, within the larger constructs of the modernist traditions and concept of the "New Woman" of the interwar period. Catriona Moore (2013:86) argues that "between the wars Australian women artists were more attuned to modernity then their male counterparts". She positions their relationship both to urban space and subsequent narratives in direct counterpoint to earlier Australian mythologies built around the Bush. Laurie Duggan (2001:81) makes a similar case, suggesting that the exclusion of women within the pastoralist tradition in Australian art forced them toward the relatively untapped imaginings of the city. Thea Proctor exemplifies the idea of the female artist simultaneously embracing the city and the new ideas of feminine expression (Duggan 2001:81). This self-positioning is particularly evident in Proctor's watercolour The bay (1927) later reconceived as woodblock print in Women with fans (1930). The works depict two women sitting on a chaise lounge, each holding a splayed fan. In the background apartment buildings rise along the shore of Sydney's Rushcutters Bay. Denise Mimmochi (2013: 67) describes the pair thus:

…they assert a self-assured modern attitude in their stylised elegance. They view the world from an elevated vantage pointe implying the new outlook that apartment living had brought to domestic life.

Mimmochi expands her argument by noting the transformative effect on the city of the building of these flats, which were subsequently inhabited by women engaged in creative cultural practice. The end result, she proposes, was a blending of the public and the private and, ultimately, a creation of urban space that was both feminine and "cosmopolitan" (2013: 67). Notably, in the on-line information for Women with fans, the Art Gallery of New South Wales suggests the women featured are Eveline Syme and Ethel Spowers, further cementing the associative relationship between these artists and understandings of feminised urban space in the interwar period.

If the New Woman was at one with the city, modernism, particularly when teamed with the destruction of male bodies in the First World War, rendered masculinity in urban space less clear and less defined (Mimmocchi 2013: 79; Duggan 2001:88, 95). However, it is worth exercising caution against a reliance on a 'see-saw' effect in which women are up because men are down. Though at various times, urban space was critiqued as effeminate or emasculating (Dugan 2001: 88,95; Carter 2006: 144-147) with all the coding about sexuality that such terms imply, at no time is the city fully ceded. Men continued to be a presence in the city during this period, they worked there, they create there, they filled the space. It remains a masculine place.

However from an urban history and urban studies perspective, the works of these women artists allow parallels to be drawn, bridges created between urban space as viewed through a masculine or a feminine eye. Thus the London of Syme's Bridges at Chelsea (1929) has echoes in both line and shade with the city in Whistler's Nocturne: Blue and Gold–Old Battersea Bridge (c.1872-5). Cossington Smith's, Centre of a city (c.1925) has the same canyons, crowds and commerce as Childe Hassam's Lower Manhattan [View down Broad Street] (1907). Sydney may not be New York, but in each painting a similar relationship between the city and its citizens is conveyed. Thus the narrative of women in the city becomes integrated with that of men in the city. Urban space need not always be designated masculine or feminine, public or private; the visual boundaries of urban space are revealed as more porous than they is often presumed.

Conclusions

In considering this case study, and its implications, its limitations must also be acknowledged. The women here discussed are all white, and of at least middle-class origins. Their relationships with their cities are, therefore, shaped by privileges in both race and class. Similarly in the first half of the 20th century, gender relationships were defined in light of the combination of casualties in the First World War, changes to suffrage and enfranchisement, and increasing, if imperfect, access to fertility control.

That all said, even if these women are products of a specific set of circumstances, nevertheless, their work lends itself to a reconsideration of women's relationship to urban space. It is true that Cossington Smith, Syme, Spowers and Andrews all produce images of leisure and consumerism. To some degree, Cossington Smith's crowds in Rushing (1922) and Crowd (1922), lack the comfort and inclusiveness of Andrews' or Spowers' work. Additionally Syme and Spowers each have at least one work of nudes, Not Titled [Reclining Female Nude] (1934) and Resting Models (1934), respectively. However, even if all those works are taken into consideration, the overall canon of these artists presents a feminine view of urbanism that does not fit easily into previous models. Their urban landscapes do not have the malevolence of Blackman's, their female subjects are not easily understood as victims,

and there is none of the hyper-sexuality and condemnation that laces through Tucker's work. Their women, either as subjects or viewers, traverse similar streets and establishments as those of Edward Hopper but with little of the loneliness or disenfranchisement of their American counterparts. Their city is familiar, growing, owned, and occupied. Significantly within these works is a sense of usual rather than unusual presence in a space. Beyond anything else, it is this characteristic that opens up the potential for additional narrative and additional discourse. If women are a routine visual presence during this era, then the absence of their presence in other cultural constructs, and at other times is brought into sharp focus. One must ask if they suddenly departed, and if so where did they go? If they did not leave, why then are they omitted? Thus even a limited model can pave the way for a more all-encompassing set of questions, even if, much like a Cossington Smith painting, it is an unfinished bridge.

APPENDIX
Works of art mentioned within the text and (where possible) links to images.

Sybil Andrews
Coffee Bar (1952), The British Museum.
http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=706487&partId=1&searchText=Andrews,+Sybil&page=1
Hyde Park (1931), The British Museum
http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=706510&partId=1&searchText=Andrews,+Sybil&page=1
Market Day (1936), The British Museum.
http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=706497&partId=1&searchText=Andrews,+Sybil&page=1
Rush Hour (1930), The British Museum.
http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=706515&partId=1&searchText=Andrews,+Sybil&page=1
Straphangers (1929) The British Museum.
http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=706517&partId=1&searchText=Andrews,+Sybil&page=1
Sledgehammers (1933), Museum of Fine Art.
http://www.mfa.org/collections/object/sledgehammers-479529
The Giant Cable/The New Cable (1931), The Museum of Modern Art
https://www.moma.org/collection/works/105741?locale=en
The Winch (1930), The Metropolitan Museum of Art.
https://www.metmuseum.org/art/collection/search/377662
Wet Race Meeting (1930), Limited print run, No identifiable original found.

Charles Blackman
Running Home (1954), National Gallery of Australia
https://nga.gov.au/federation/Detail.cfm?WorkID=99473&ZoomID=2
Schoolgirls series (c1952-1956). For example, Schoolgirls in a landscape (c.1955-1956), National Gallery of Victoria.
https://www.ngv.vic.gov.au/explore/collection/work/26879/

Claude Flight
Speed (1922), The V&A
http://collections.vam.ac.uk/item/O76702/speed-linocut-flight-claude/

Frederick Childe Hassam
Lower Manhattan [View down Broad Street] (1907), Cornell University.

Edward Hopper
Apartment Houses (1923), Pennsylvania Academy of the Fine Arts
https://www.pafa.org/collection/apartment-houses
Automat (1927), Des Moines Art Center
http://emuseum.desmoinesartcenter.org/objects/41752/automat
Chop Suey (1929), Collection of Barney A. Ebsworth
New York Movie (1939), The Museum of Modern Art
https://www.moma.org/collection/works/79616

New York Office (1962) The Montgomery Museum of Fine Arts
http://collection.mmfa.org/Obj3691?sid=3285&x=1834662
Nighthawks (1942), The Art Institute of Chicago
http://www.artic.edu/aic/collections/artwork/111628
Office at Night (1940), Walker Art Center
https://walkerart.org/collections/artworks/office-at-night
Table for Ladies (1930) The Metropolitan Museum of Art
https://www.metmuseum.org/toah/works-of-art/31.62/
Two on the Aisle (1927), Toledo Museum of Art
http://emuseum.toledomuseum.org:8080/emuseum/objects/54825/two-on-the-aisle

Cyril Power
Whence & Whither [The Cascade](1930) Joanna & Leslie Garfield Collection
The Tube Station (1932), The Metropolitan Museum of Art
https://www.metmuseum.org/art/collection/search/377664

Margaret Preston
Sydney Bridge (1932), Art Gallery of New South Wales.
https://www.artgallery.nsw.gov.au/collection/works/DA30.1964/

Thea Proctor
The bay (1927), Art Gallery of New South Wales.
https://www.artgallery.nsw.gov.au/collection/works/4382/
Women with fans (1930), Art Gallery of New South Wales.
https://www.artgallery.nsw.gov.au/collection/works/207.1975/

Grace Cossington Smith
Before the Arches met (c.1930), Queensland Art Gallery/Gallery of Modern Art
http://collection.qagoma.qld.gov.au/qag/imu.php?request=display&port=45001&id=db3f&flag=ecatalogue&offset=0&count=default&view=details
Centre of a city (1925), Art Gallery of New South Wales.
https://www.artgallery.nsw.gov.au/collection/works/299.2002/
Curve of the Bridge (1928-29), Art Gallery of New South Wales.
https://www.artgallery.nsw.gov.au/collection/works/1.1991/
Crowd (1922), National Gallery of Victoria.
https://www.ngv.vic.gov.au/explore/collection/work/3008/
Rushing (1922), Art Gallery of New South Wales
https://www.artgallery.nsw.gov.au/collection/works/OA8.1967/
The Bridge arch from the Turret Theatre Hill (c.1930), National Gallery of Australia
https://artsearch.nga.gov.au/detail.cfm?irn=71547
The Bridge in building (1929-30), National Gallery of Australia
https://artsearch.nga.gov.au/detail.cfm?irn=131114
The Bridge in-curve (1930), National Gallery of Victoria
https://www.ngv.vic.gov.au/explore/collection/work/3007/
The North Pylon (1928-29), Private Collection
https://nga.gov.au/Exhibition/cossingtonsmith/Detail.cfm?IRN=133911

Ethel Spowers
Princes Bridge (c.1925-1927), National Gallery of Australia.
https://artsearch.nga.gov.au/detail.cfm?irn=116028

Resting Models (1934), Art Gallery of New South Wales.
https://www.artgallery.nsw.gov.au/collection/works/255.1975/
Special Edition (1936), Art Gallery of New South Wales.
https://www.artgallery.nsw.gov.au/collection/works/416.1977/
The Joke (1932), National Gallery of Australia
https://artsearch.nga.gov.au/detail.cfm?irn=116040
Timber Crane (1926), National Gallery of Australia.
https://artsearch.nga.gov.au/detail.cfm?irn=116032
Wet Afternoon (c.1929-1930), Art Gallery of New South Wales.
https://www.artgallery.nsw.gov.au/collection/works/DA33.1968/

Eveline Syme
Bridges at Chelsea, National Gallery of Australia
https://artsearch.nga.gov.au/detail.cfm?irn=168988
Not Titled [Reclining Female Nude] (1934), National Gallery of Australia
https://artsearch.nga.gov.au/detail.cfm?irn=81349
The city skyline (1928), National Gallery of Australia
https://artsearch.nga.gov.au/detail.cfm?irn=168990

Lill Tschudi
Fixing the Wires (1932), Museum of Modern Art.
https://www.moma.org/collection/works/69406?locale=en
Tour de Suisse (1935), Museum of Fine Arts.
http://www.mfa.org/collections/object/tour-de-suisse-479543

Albert Tucker
Courtship (1943), National Gallery of Australia
https://artsearch.nga.gov.au/detail.cfm?irn=57531
Image of Modern Evil series, for example Image of Modern Evil: Female Figure (1943), National Gallery of Australia.
https://artsearch.nga.gov.au/detail.cfm?irn=99927
Pick Up (1941), National Gallery of Australia
https://artsearch.nga.gov.au/detail.cfm?irn=110449
Victory Girls (1943), National Gallery of Australia.
https://artsearch.nga.gov.au/detail.cfm?irn=82187

James Abbott McNeil Whistler
Nocturne: Blue and Gold–Old Battersea Bridge (c.1872-5), The Tate
http://www.tate.org.uk/art/artworks/whistler-nocturne-blue-and-gold-old-battersea-bridge-n01959

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Title: **Bridges are landscape infrastructure elements**
A method for connecting a bridge with landscape and infrastructure

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Abstract:

Bridges are landscape infrastructure elements. Looking through the eyes of a landscape architect, bridges become a continuation of the landscape; a manmade action that heals the misconnections of the landscape. The problematique of infrastructure as a type of landscape and connecting element is a crucial topic which influences the landscape. Connecting infrastructures such as bridges provoke urban, economic and cultural development. The theoretical and methodological analysis of the infrastructure as landscape element is important, in order to shape conditions for design. By analyzing examples such as the Golden Gate Bridge and Oresund Bridge, through landscape lenses, the notion of connection and its role in the formation of the landscape will be exposed. The challenge for landscape architects is to conceptualize and illustrate a design approach that involves the landscape-urban connection and influence the society, economic growth and natural processes. The design of a bridge is a multidisciplinary design which requires deep understanding of the landscape, natural processes and engineering. The framing of the landscape through the infrastructure, sense of orientation, symbolism, imageability and adaptability of the design constitute the method which a landscape architect should follow in order to design a landscape infrastructure.

Keywords:

bridge; landscape infrastructure; connection; symbol; natural processes

Introduction

Nature is appropriated in humanities not as a reality but as a human idea of the reality (Martin Drenthen, 2009) and that is because all landscapes are the product of human cultures, even those thought of as natural or wild (Raymond, 1980). Culture and nature overlap spatially and impact each other functionally (Sijmons, March 2013). Most of the processes around us are a hybrid of nature and human power. What has become clear through the years is that culture and nature are inextricably linked. Bridges belong to the cultural landscape which is defined as a "geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity or person or exhibiting other cultural or aesthetic values." (Charles A. Birnbaum, 1994) Bridges are made by people for people, they are closely related to them and to the imageability of the landscape where they are implemented.

Bridges can change the mental image of a city. A legible city is one whose parts, landmarks and pathways are easily identifiable and grouped in an overall pattern by people. The imageability of a city reflects in the mental image of its observers. The shape, color and arrangement are elements that can describe the image of a city (Lynch, 1960). Bridges are related to the notions of movement and cessation. They facilitate the orientation and legibility of space. By implementing a bridge, not only a potential landmark is created but also a point of orientation, an intense movement and place of observation. When a bridge is merged smoothly with the existing landscape, it can be part of the image and understanding of the city and through this, can be embraced by the beholders. Bridges are meeting points, places where everyone can refer to. The Golden Gate Bridge is a good example of a symbolic landscape bridge implemented in a strong seascape.

Figure 1: The Golden Gate Bridge is a symbolic landscape bridge with both geometric and timeless forms.
Source: google images. Author's editing

Chapter I

Bridge connections

Connectivity is important for the dispersal of organisms that inhabit the landscape. It can be operated either through natural connecting elements such as fallen trees and rocks or through manmade infrastructures such as bridges and paths. In order to avoid altering the ecology and biodiversity of the landscape elements due to the new introduced forms, the merging of landscape and infrastructure should be operated carefully.

Bridges have always been symbols of connection and communication. For example the Erasmus Bridge in Rotterdam, Netherlands, was built firstly to connect the part of the city and secondly to remind the city of its industrial character.

The Golden Gate Bridge was also built to connect two different landscapes and to celebrate the entrance in each one. Ecological bridges are manmade structures as well, but they can be adapted completely by nature. Humans create the conditions for nature to come and settle. Bridges are symbols of strength. They represent barriers, paths, crossings and they are implemented in everyday activities. They are symbols of hope, destination, progress and connectivity.

Figure 2: A bridge reacts as a symbol when it enhances stimuli of its observers. The function of the Erasmus Bridge is to formalize the crossing between the Northern and Southern areas of Rotterdam.
Source: google images. Author's editing.

Important elements of a bridge

The framing of the landscape through a bridge is also an important aspect of its design. Bridge structures can be harmonious and integrated within the landscape when they are in the adapted scale, alignment, color and material. The design should inspire rhythm and harmony. For example, a smooth deck that is aligned with the horizon gives a harmonious view to the driver that drives through the bridge. Another example is the perception under the bridge, where the pillars meet the water and give a rhythm by creating a pattern to the horizon. The framing of the horizon that the Oresund Bridge creates is an important characteristic of the area.

Figure 3: The bridge structure is harmoniously integrated with the landscape. It inspires rhythm and it creates a new horizon. A new perception of the seascape.
Source: google images. Author's editing

The strong shape of the bridge and the taller pillars in the middle, accompany the driver through different landscapes and mark the biggest span of the river for the boats while creating a climax at the crest. By framing the landscape through the bridge structure, the bridge reacts as a measuring system for the landscape which each beholder can use.

In addition, altering the surrounding landscape of the bridge is an important design assignment. In the example of Oresund Bridge, the landscape architects reclaimed a piece of land in order to make the exit of the tunnel on the western side and avoid undesired interferences in other locations. This new piece of land created conditions for the nature to adapt and take over. Another important alternation in the landscape was the creation of a new island in order to make the junction between the tunnel and the bridge. Instead of using the existing island, a new one was created nearby with the excavated material of the construction; this allowed to preserve the first's biodiversity. As it was proved recently, this new island merged with the larger seascape; small mammals and birds can be found on the island making the place part of nature. A manmade structure can be adapted completely from nature as long as there are the right conditions for it. Bridges are manmade structures that have the possibility to become under proper circumstances a new type of nature.

Moreover, a bridge design refers to all possible scales. It is ostensibly a small connection but its influence extends to the wider urban tissue and social, economic and landscape layer. For example, the Oresund Bridge was designed not only to connect Copenhagen and Malmo, but also to achieve an international connection between Central and Western Europe to Scandinavia. The connection is physical as it is political and economic. It is a motor for touristic and economic growth. The bridge became a motive for further investigation in a new urban plan of the city to handle the population growth and further ecological improvement of the Oresund bay.

Figure 4: The pepper island is a form of new nature that was a side creation of the Oresund Bridge. It is manmade but completely integrated in the natural environment of the area.
Source: google images. Author's editing.

The role of a landscape architect

In conclusion, bridge design should not only engage with its structure but also with the design of the landscape around. All the elements (structure, landscape, function and people) should function as a whole in order to recite a story for the places they connect. The approach of infrastructure as landscape can be considered as object oriented; the infrastructure is treated as an object in an integrated design which emphasizes the shape and form. On the other hand, conceiving landscape as infrastructure can be a goal oriented approach, which focuses on the urban development and ecological/economic processes (Steffen Nijhuis, 2015). When a design obtains both qualities at the same time, it becomes an integrated design which deals simultaneously with spatial, ecological and socio-cultural qualities. A good bridge design can transform and enhance the landscape itself, it celebrates the landscape and influences all possible scales. Designing and building a bridge is a multidisciplinary design which should

involve many areas of expertise. In order for the design to be landscape oriented, it should offer a strong connection appropriated in all scales, it should frame the landscape through the infrastructure, treat each landing of the bridge and provide a rhythm in the landscape, taking into account ecological alternations and finally involving beholders' perception. Designing a landscape bridge requires a better understanding of the infrastructure and its impact on the landscape. Natural processes are a strong element of the landscape design and should be introduced.

Chapter II

Concrete Dynamics

Concrete Dynamics is a multidisciplinary bridge design created within my academic years in TU Delft University, in the Netherlands. Since then, it became a personal ongoing research in the frame of landscape bridges and their qualities. The following lines contain a compact introduction and explanation of the project and its principles. It is a research design that applies all the above values and theories (further documentation of the project at the link: uuid:2e1c777b-ad6a-4e68-80b1-bccb6b9c620c).

The project "Concrete Dynamics" is situated along the borderline between Romania and Bulgaria. Its focus is to create a highway and pedestrian bridge connection among the two countries over the Danube River. As a result, a landscape bridge is designed halfway on the river borderline between them. The bridge connects the two landscapes, gives room to the Danube River and provides space for interaction among the countries. The bridge becomes the reference point which reflects ideas and values from both countries. It provides a common place to which both Romanians and Bulgarians can refer to.

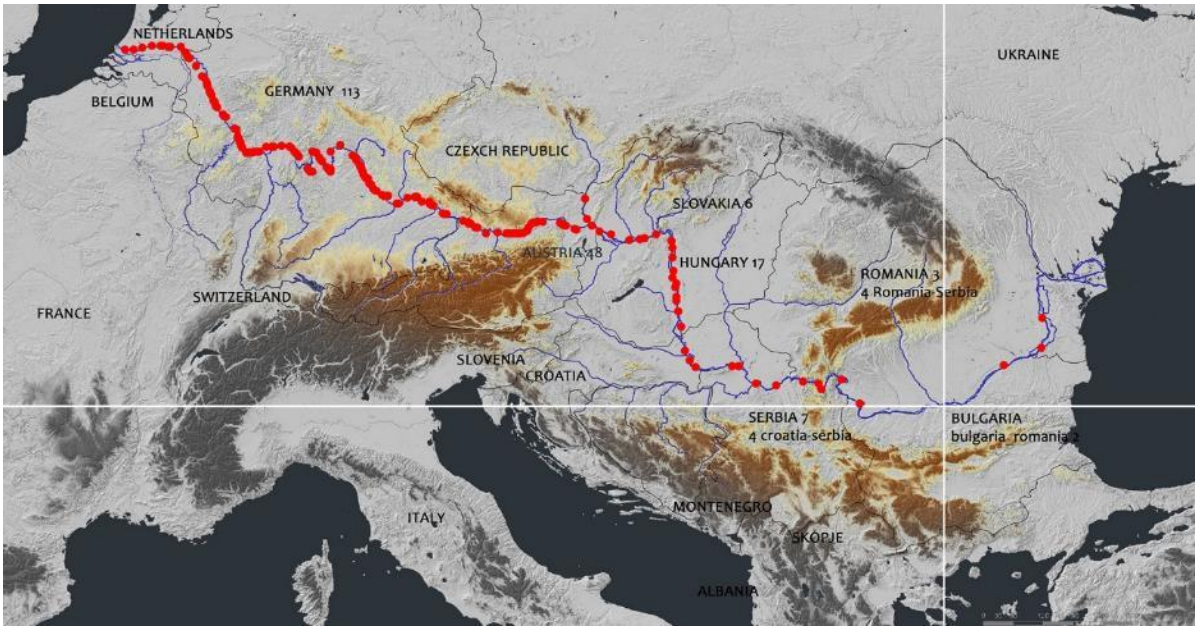

Figure 5: Location of the project.
Source: Drawing produced by the Author.

The River Danube follows the borderline among the two countries for more than 600km. Having in mind that there are only two bridges connecting the two countries (Calafat-Vidin and Giurgiu-Ruse), the communication and movement between Romania and Bulgaria is reduced and difficult. There are other types of transportation from one side to the other, for example small boats, but these are much less efficient. This difficulty in movement but also the fact that both countries speak a different language and have almost no exchange in regular basis, bring several political, economic and cultural issues. These facts lead to the problematique of the project. How can a bridge become the symbol among different countries,

offer a recreated common public space, heal the misconnection and adapt to the landscape on both sides?

The possibility of connecting by a bridge Romania and Bulgaria almost in the middle of their borderline, brings a strong improvement in communication among the two capitals. A big international highway will be achieved and act as a European spine for transportation of people, services and goods. The landscape bridge connects the two sides of the river and provides an easy access for both vehicles and pedestrians.

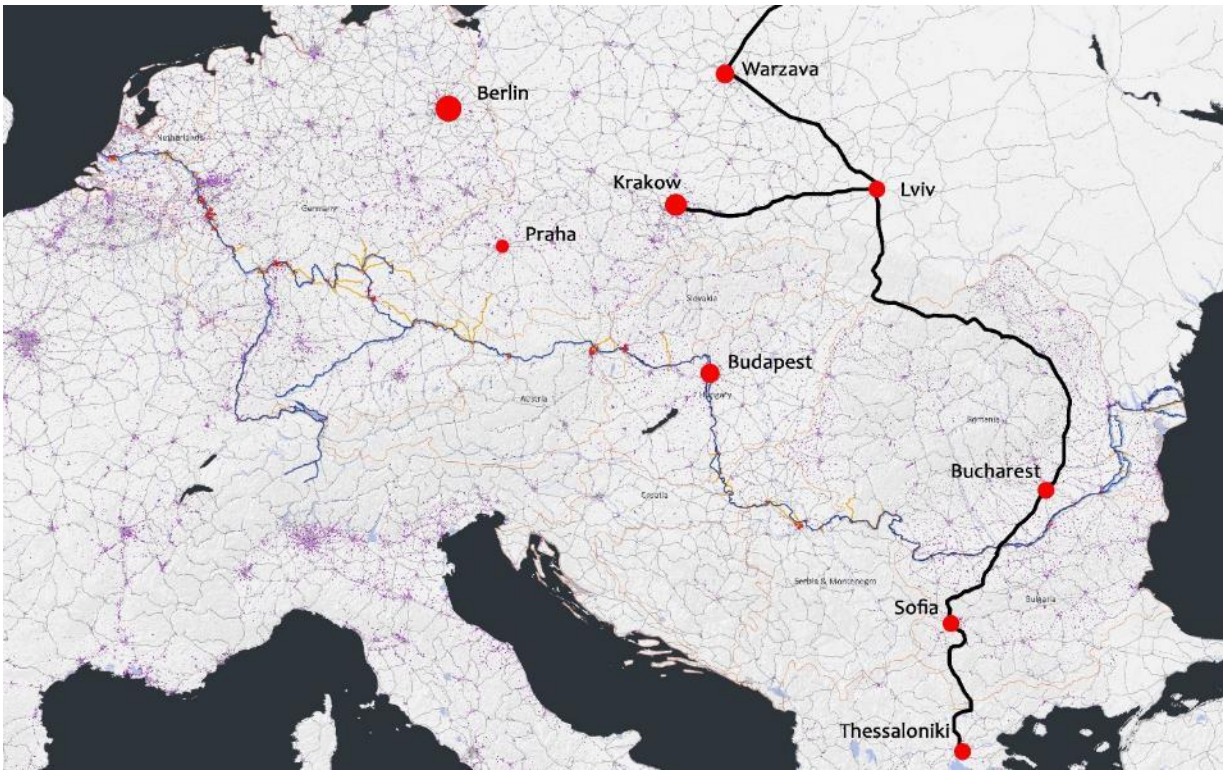

Figure 6: European spine highway
Source: Drawing produced by the Author.

Zooming in the area of implementation, the bridge is situated in a natural reserve called Persina. This area often suffers from floods due to sudden rain falls and changing water level but also from air pollution due to several power plan industries situated in the area. One aspect of the project is to enhance the shores of the River Danube in order to control extreme flooding events and to introduce new forms of industry and land occupation. These aims can be achieved through the implementation of the bridge. Through the infrastructure of the bridge, the ecology of the river will change for the better. The treatment of the shores around the bridge helps the breeding of fishes and the sedimentation process. Moreover, the landing points of the bridge are combined with ecological dikes that protects the mainland from flooding. In addition, a bypass canal is created on the Romanian side to give more space to the Danube River, improve the biodiversity of the area and introduce a common place on the "border line" where people from both countries can meet. As a result of the bypass canal, an island is created which will slowly change the identity of the border and introduce alternative forms of agriculture and industry.

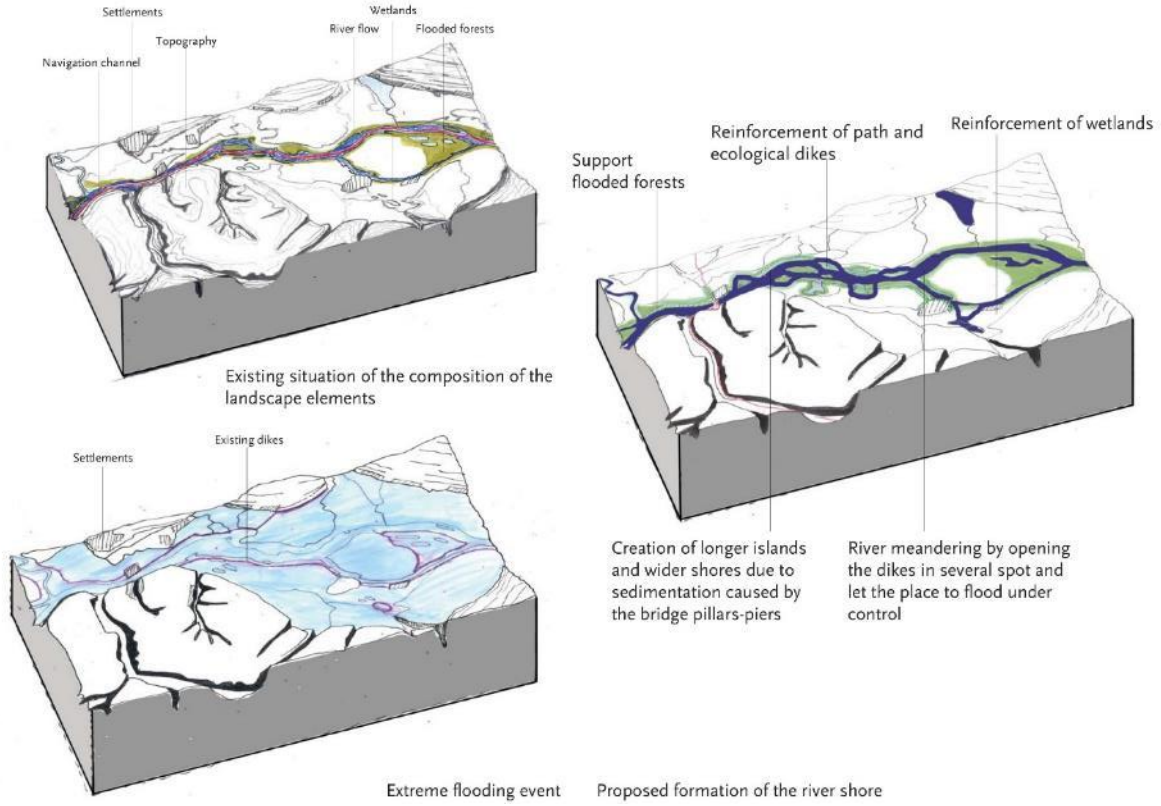

Figure 7: Diagram of flooding events and proposal
Source: Drawings produced by the Author.

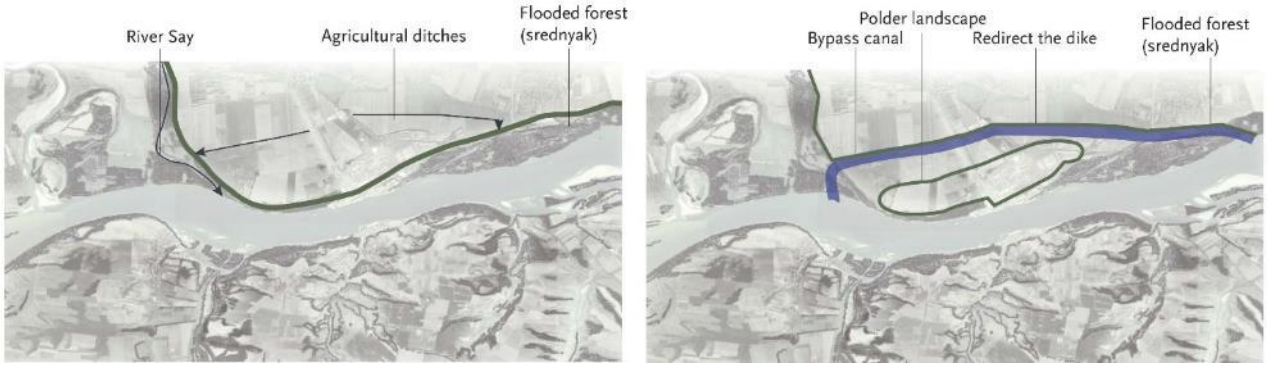

Figure 8: New dike and Bypass canal
Source: Drawings produced by the Author.

Figure 9: Master Plan of the proposal
Source: Drawing produced by the Author

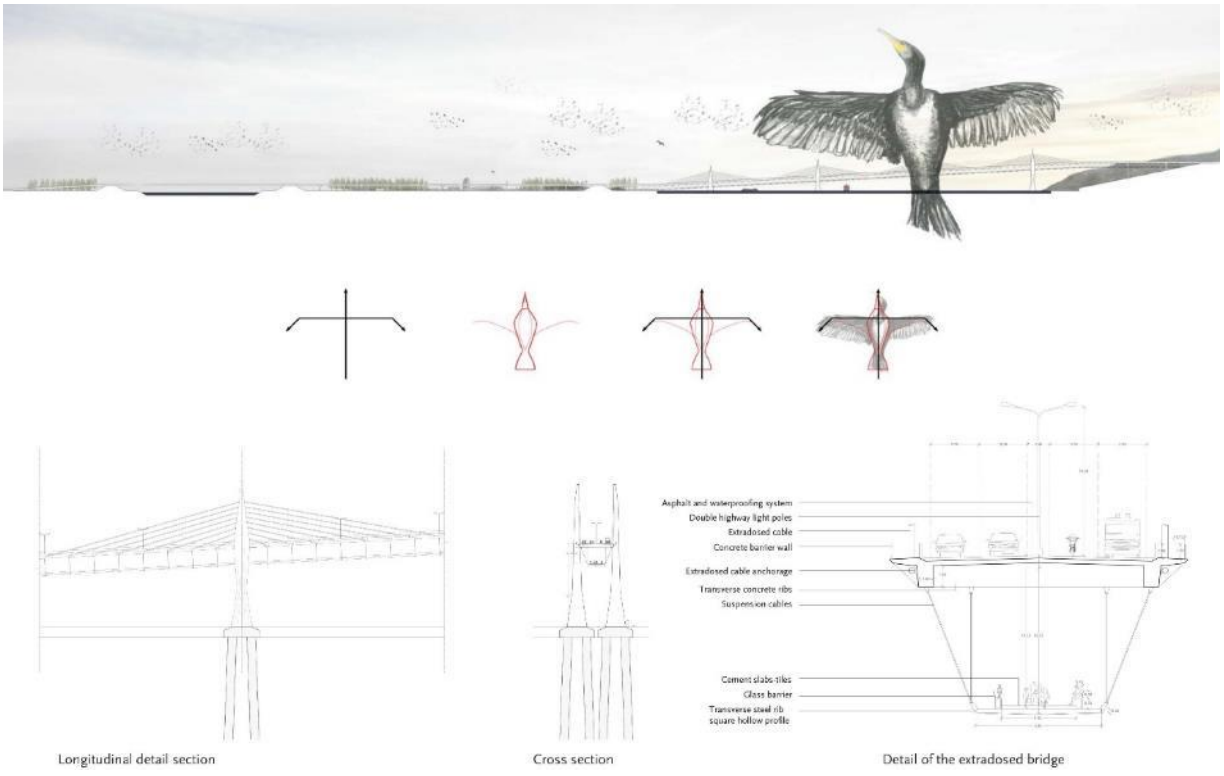

Figure 10: Sections of the extradosed bridge
Source: Drawing produced by the Author

The shape of the columns and the form of the bridge itself are other important aspects that need to be carefully considered. These elements are the ones which are going to form a symbol for both countries. The structure and form of the bridge derive from the interpretation of the existing landscape on both sides. The Bulgarian side is mountainous whereas the Romanian side forms a floodplain. This extreme height difference shaped the design of the bridge into an extradosed bridge built on an inclination from the floodplain up to the mountain. Due to this form, there is enough space under the bridge for the boats to cross (since the River Danube is 99% navigable throughout the year) and the landing of the bridge takes place smoothly on the top of the new dike in Romania and the mountain in Bulgaria without interfering with the ecology of the Persina nature reserve. Finally the form of the pillars derives from a protected bird of the Persina nature reserve, the Phalacrocorax (cormorant). As the bird spreads its wings wide open to fly from one country to the other, the bridge will fly over the river "obstacle" and connect the two landscapes naturally. The bridge becomes the symbol of connection.

Figure 11: Perspective view of the proposal
Source: Drawing produced by the Author

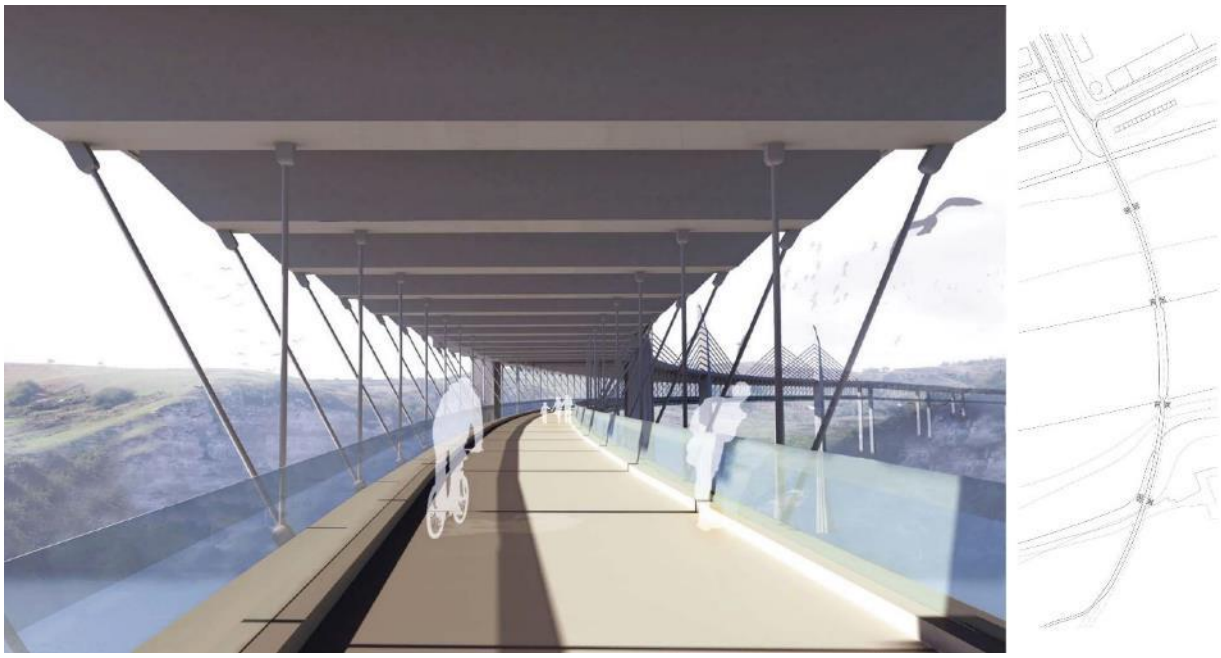

Figure 12: Perspective from the suspended pedestrian bridge
Source: Drawing and 3D representation created by the Author

Nowadays, the character of Romania at this borderline is industrial and the one of Bulgaria is more picturesque and historical. By implementing the highway connection a lot of changes will occur. The tourism and its economic impact on the place will improve as well as the exchange of services and goods facilitated by the harbor and highway. Currently, the area where the island will be created, is occupied by a power plant industry and fields. In the future vision of the design, the area will offer multiple functions such as industry, university of linguistic and economic studies, agriculture and residential areas. The design idea for the island is to change its function into a more sustainable one. The industry may turn into producing ecological pesticides and agro-touristic products. The University of Linguistic Studies will help to solve the problem of poor communication due to different languages. Moreover, the economic studies will provide better knowledge and management of the borderline area. People will settle in the new housing area and altogether the place will become lively. All the new functions are protected from flooding inside a new polder landscape (created from the bypass canal and the new dike). Outside the dikes of the polder, agricultural fields, flooded forests and marshlands occupy the space and increase the biodiversity of the area.

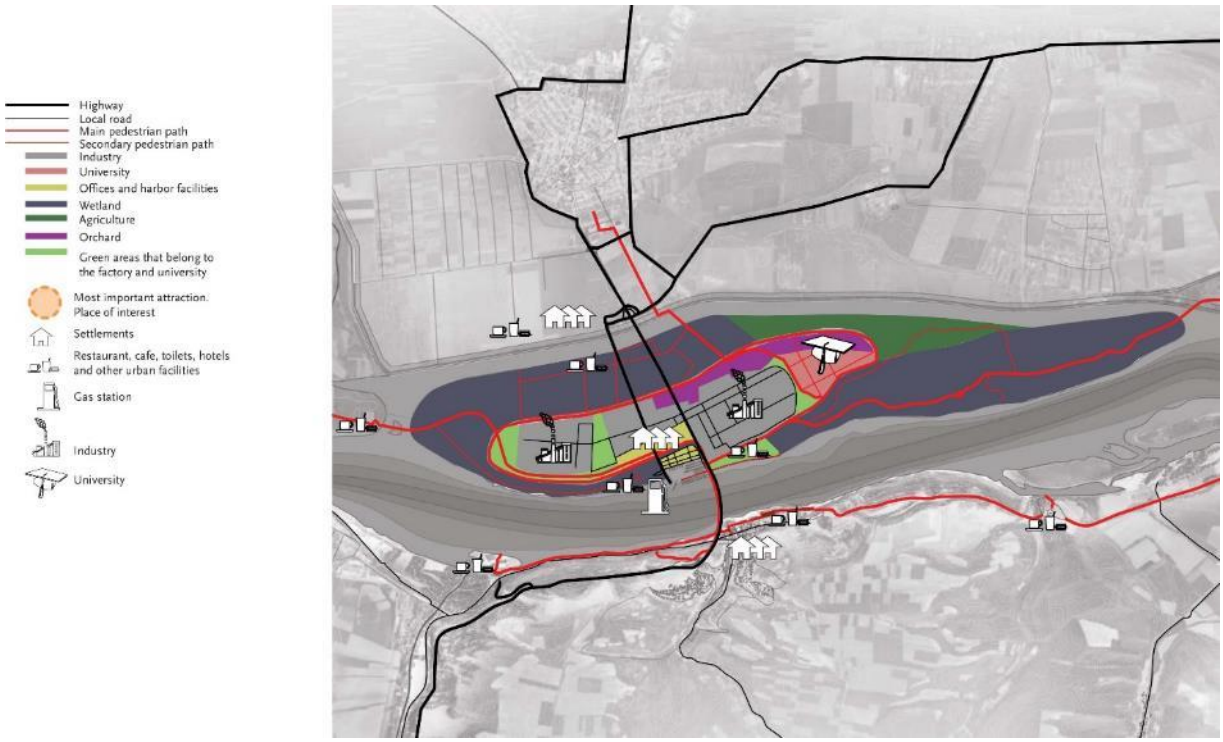

Figure 13: New facilities and services are introduced on the island formed by the bypass canal in the north and the dike.
Source: Diagram created by the Author

On the side of Bulgaria, the highway and pedestrian bridges land on top of the Bulgarian mountain where a highway stop is implemented. The bridge avoids the immediate interaction with the picturesque village in order to preserve its identity but also to provoke further urbanization towards the direction of the bridge. The pedestrian bridge is connected with small paths that lead to areas of importance.

Figure 14: Perspective of the bridge landing on the Bulgarian side
Source: Drawing created by the Author

My primary motive for the project is to intertwine architecture and landscape into one design where both are equally appreciated. In “Concrete Dynamics” the emphasis is given to the interaction of humans, infrastructure and nature. Flows refer to movements and scapes to territories. In the examined location, flows and scapes are either blended or absolutely separated from the borderline. My approach is to preserve the uniqueness of each country but to connect the green and water infrastructure in order to reinforce it.

In conclusion, “Concrete Dynamics” is a multidisciplinary project that focuses on the metamorphosis of the landscape, the economic growth and enriched social interactions. The goal of the project is to improve the connection between Romania and Bulgaria and through the infrastructure, to benefit the landscape. Biodiversity, natural processes and people flows are strong aspects of the project. The bridge succeeds to give the identity to the connection and form a new landscape for both countries to interact. A dynamic movement of people, services and goods is created through this the change of infrastructure and landscape.

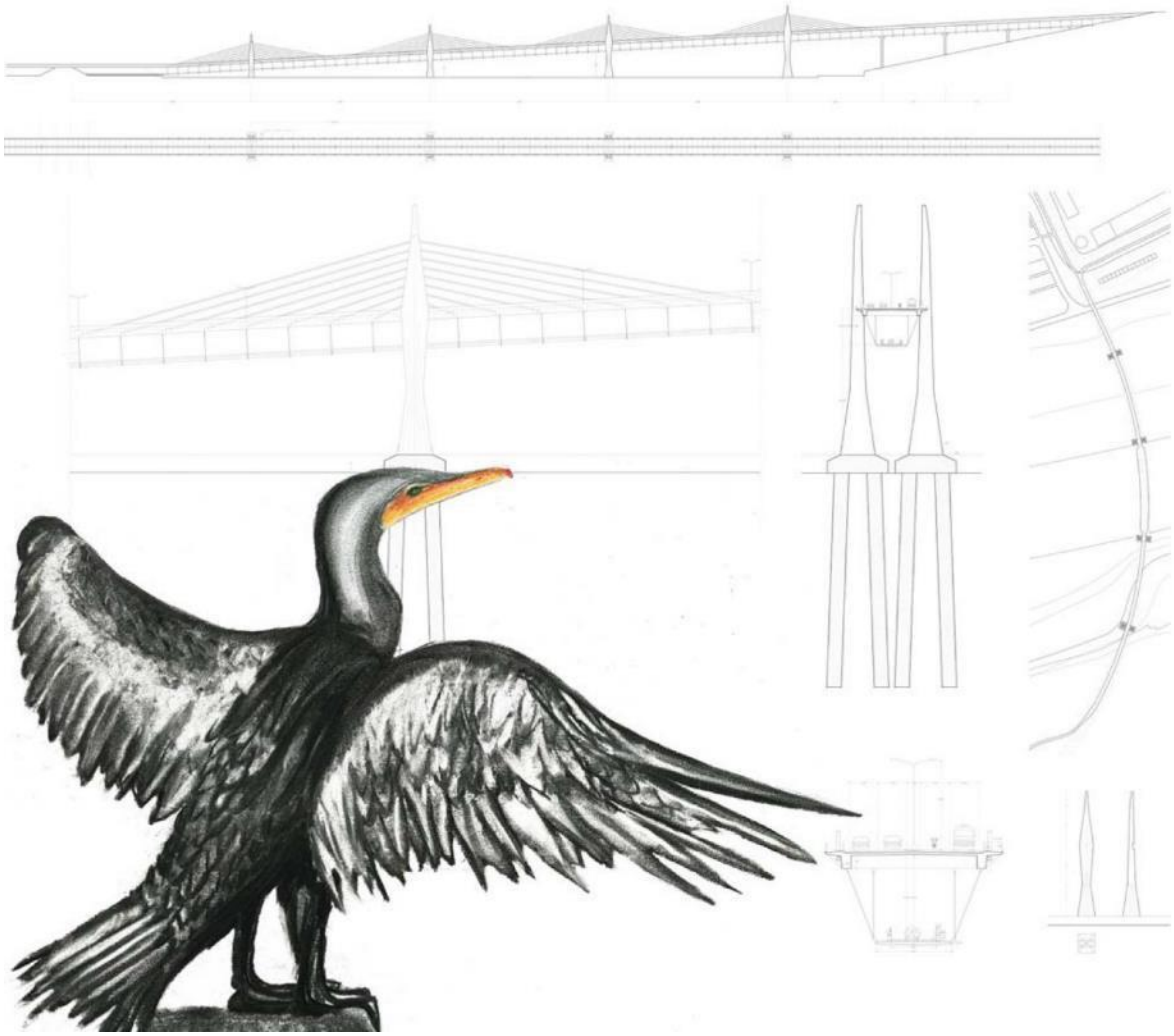

Figure 15: Juxtaposition of infrastructure and nature
Source: Drawing created by the Author

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Appendix

Golden Gate Bridge, San Francisco, California, 1933-1937:

In 1930 there were discussions on building a bridge that could connect the city to the Marin Headlands. It was a hard assignment due to a lot of restrictions such as changing tides, earthquakes, strong currents and harsh weather conditions. It was a cooperative design involving a lot of architects and engineers such as Joseph Strauss, Irving Morrow and Charles Alton Ellis. The architects and engineers designed a balanced form that becomes both natural and aesthetic. The famous orange color derived from the Art Deco ideas of Irving Morrow, but it was also a way to connect the structure of the bridge with the soil type color of the landscape around. The exaggerated height of the columns competes with the hilly landscape around but on the moment of sunset, the golden reflection of the structure, the warm colors of the rocks and the orange sun create a unique view towards the end of a day. The bridge functions as a gate to a new world by celebrating the cities it connects. It is linked with the landscape and the narrative of the area.

Oresund Bridge, Scandinavia, 1994-2000:

Oresund Bridge is a fixed road and rail connection between Central/Western Europe and Scandinavia. After its construction, it provoked touristic movement, economic investments and population growth. What is remarkable about the bridge is that it is divided into 3 moments. The first one is the bridge itself that starts from the agricultural fields of Swedish ground, it moves up on the crest of the bridge where the taller pillars are, it lands on a manmade island and then it follows a tunnel under the sea that exits on the reclaimed Danish land. The whole landscape design is described through the movement of the infrastructure. It is a good example of a landscape bridge that takes into account in the design the framing of the landscape, the nature preservation and the large economic and infrastructure connection.

Bridges: on the money

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Abstract

Coins are an important tool for influencing public thought. They were minted for centuries before the Guttenberg Bible and before widespread literacy, using imagery that was carefully crafted to deliver a message to the people using them.
The earliest coins were produced in Lydia around 640 BC. Within a century almost 1,000 Greek city states were producing coins, each using an emblem that symbolized the place. Many pictured mythological figures. As Rome grew in influence, it too produced coins, mostly with mythological or religious motifs. Julius Caesar broke with tradition and pictured himself on the coinage.
Coins not only underscore who is in charge: they also deliver messages about the nation's aspirations or accomplishments. At times this iconography features bridges: throughout history about 1,000 different coins picturing bridges have been minted, as have roughly 10,000 different bridge numismatic objects such as jetons, conders, notgeld, souvenir pieces, military orders, illustrated fare tokens, and commemorative pieces. Yet bridge coins comprise only a miniscule proportion of the total coinage. They are issued sparingly, purposefully, and for wide-ranging objectives: to celebrate military conquest, to stress political integration or national unity, to symbolize friendly relations with abutting countries, to celebrate historic events, to illustrate technological advance, to demonstrate economic development, or to honor cultural landmarks.

This paper discusses the nuanced imagery behind eleven illustrative bridge coins:

Bridge	Country	Theme
Burnside	United States	Historic commemoration
Anji (Zhaozhuo)	China	Engineering innovation
Stari Most	Bosnia Herzogovina	National unity
Ironbridge	England	Engineering innovation
Victoria Falls	Zimbabwe	Economic development
Jamuna	Bangladesh	Economic development
Regensburg Stone Bridge	Germany	Economic power
Shahara	Yemen	National unity
25th of April	Portugal	Modernization/Revolution
Sydney Harbour	Australia	National landmark
Roman Antioch ad Meandrum	Turkey	Military might?

Bridges: On the Money

Bridges are a mark of a civilized society. Primitive peoples do not require them, lack the technical skill to build them, and have not developed the social organization to finance them.
Throughout history bridges have been a source of awe. As if by miracle, bridges open an easy passage between places that had seemed permanently separated. The engineering that makes these miracles work has always pushed the limits of structural and materials know-how.
An established coinage also reflects a high degree of civilization, economic interaction, and governmental stability. In the ancient world the images on coins often stressed the legitimacy of the government through religious imagery, or divine support for its rulers.

The earliest coins were produced in Lydia, part of modern Turkey, around 640 BC. Within one hundred years more than 1,000 Greek city states were each producing their own coins. As Rome grew in influence, its coins often carried mythological or religious motifs. Julius Caesar broke with tradition and had pictured himself on the coinage, and this practice has often been copied.
About 1,000 different bridge coins have been produced since coins were used. The first one is a coin produced in the Roman Republican period by Aemilius Lepidus, around 114 BC. It shows an equestrian statue atop three arches, which is interpreted variously to represent the aqueduct Aqua Marcia -- the third aqueduct of Rome, the Pons Aemilia, or simply a triumphal monument.

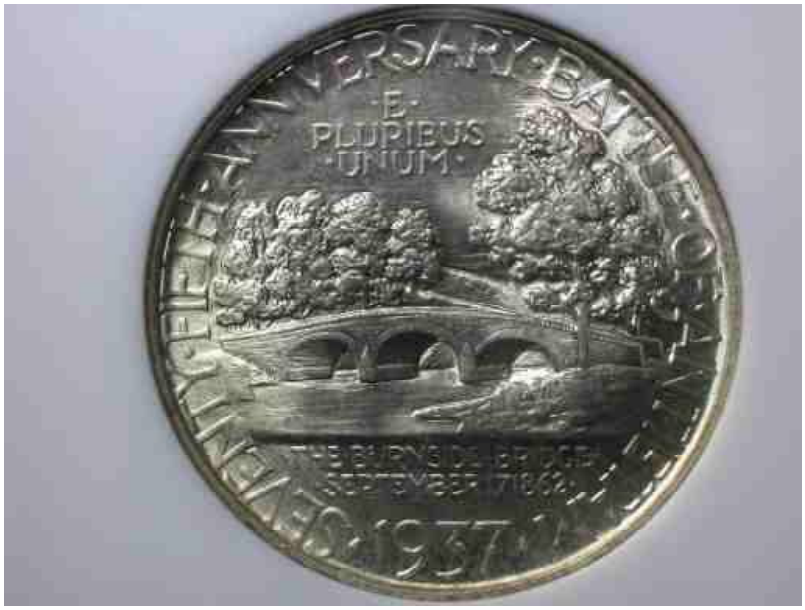
Bridges are shown only infrequently on national coinage. Prague's Charles Bridge in the Czech Republic and the Sydney Harbor Bridge in Australia are national symbols pictured on many of their coins, but these are exceptions.

Typically, bridges are more apt to be featured on coins when minted by local authorities. Thus, there are many bridge coins associated with the city states during the seventeenth and eighteenth centuries. In Germany, Regensburg and Frankfurt stand out; in Switzerland, Basel and Zurich produced large numbers of coins with bridge designs.

The images on coins are chosen to deliver a carefully crafted message, or propaganda. They are like "sound bites" carefully chosen to stress key themes. Whenever bridges are pictured on coins the message has always been positive: technological achievement, international friendship, historic heritage, military success, economic advance, or national unity. Here are a few examples.

Burnside Bridge, Antietam, Maryland, United States

A particularly beautiful bridge coin was issued by the United States to celebrate the 75th anniversary of the Battle of Antietam, the bloodiest battle of the US Civil War. The reverse of this coin shows the Burnside Bridge, which lay at the center of the battle, and gives the date – September 17, 1862.
The scene shown on this coin is tranquil and beautiful. The Antietam River flows gently beneath a graceful bridge of three stone arches, surrounded by water-willows, sycamores, and rolling hills. There are no soldiers, guns, trenches, craters, destruction, or bodies shown in the picture.
The bloodiest battle of the US Civil War took place here. In twelve hours of fighting it left more than 3,600 dead and 20,000 injured. It followed a decision by Robert E. Lee to lead a Confederate invasion into Union territory. The bridge was a key focus in the battle.
The battle itself was not decisive, but it changed the course of the war and of history. It halted Lee's invasion of the north, and it prompted President Lincoln to issue the Emancipation Proclamation five days later. This document profoundly changed the face of the nation forever by making a clear statement of national policy. Its issuance also blocked France and Great Britain from recognizing and supporting the South as a separate nation. Such support would have been damaging to the Union. It led to the issuance of the Emancipation Proclamation.



The US Civil War killed and wounded more Americans than have Korea, Vietnam, Iraq, and all US military actions since the end of World War II. Perhaps the message of the coin is that the pastoral peacefulness pictured on the coin was secured by terrible expenditures like those made at Antietam.

Anji Bridge, Hebei, China

Li Chun built a bridge 1,400 years ago that still stands as a testament to Chinese engineering skill and daring. Chun's bridge has many innovative features that were not discovered in the West until many centuries later. The Anji Bridge (also known as the Zhaozhou or Chaochow Bridge) in Hubei Province is an extraordinary structure, innovative in its engineering and beautiful in appearance. China featured the bridge and its builder on a 5 - Yuan commemorative coin in 1987.

Li Chun's greatest achievement was to introduce the "segmental arch" to bridge-building. Bridges with semi-circular arches had been built in many parts of the world for centuries

prior to Li Chun's birth. A semi-circular arch transmits the full force of the span's weight vertically down through the two ends of the arch to the foundation beneath. But Li Chun's segmental arch pushed not only down, but also sideways against the enclosing banks or foundations. The arch itself was a small segment -- less than half -- of a larger circle than the one that would be necessary for a circular arch spanning the same length. This results in a bridge that it is flatter than one using semicircular arches. This design allows long spans to be constructed with a relatively small rise, avoiding piers that interfere with the current or river traffic below the bridge, and which require less climbing from the traffic crossing above the bridge.

Segmental arches were a sensation in the West when they were used in the Ponte Vecchio in Florence and the Rialto Bridge in Venice. This western innovation came half a millennium after Li Chun used the technique in the Anji Bridge.

The Anji bridge has two smaller arched openings built into each spandrel. This design is attractive and reduces the area of the side profile of the bridge when flooding occurs. It also reduces the amount of material in the bridge – and the weight of the bridge – allowing construction of slender, graceful spans.

China's prowess in bridge building continue today. Mountainous Guizhou Province, in particular, is a hotbed of bridge building. Guizhou has more high bridges (100 meters or more from deck to water) than every other country on earth combined. By 2020 it will have more than 250 of them. The country with the second highest number of high bridges is Italy which has the 40 spans exceeding 100 meters in height. Of the world's 20 super-high spans that exceed 300 meters from deck to water, all but three are in China.

The Stari Most, Mostar, Bosnia Herzogovina

In Bosnia Herzogovina a beautiful stone arch stands high above the sparkling waters of the Neretva River as it flows through the village of Mostar. Mimar Hajrudin built the bridge in 1566 AD during the reign of Suleyman the Magnificent. It was a replacement for an earlier Roman bridge at this site. A previous effort to replace it collapsed during construction. Infuriated by this failure, the Sultan told Hajrudin that the new bridge must stand, or it would cost him his head. But the Sultan did not specify a deadline, so Hajrudin prolonged the project to postpone the day of reckoning. According to legend, when the time came to remove the falsework supporting the arches, Hajrudin was afraid that the great arch would

fall, and he fled in terror and hid. The townspeople found him in tears digging his own grave. They brought him back to the Sultan, where he was congratulated and honored.

Hajrudin's bridge stood for centuries in the center of Mostar, even as fighting between Muslims, Serbs, and Croats erupted in Bosnia during the 1990s. This war killed 200,000 people, and thousands more were left homeless or separated from families. The human suffering was immeasurable. The bridge at Mostar was destroyed in the fighting on Tuesday, November 9, 1993. Its pretense of immortality was shattered.

"Why do we feel more pain looking at the image of the destroyed bridge than the image of the massacred people?" wrote Croatian journalist Slavenka Drakulic. "Perhaps because we see our own mortality in the collapse of the bridge…We expect to die; we count on our own lives to end. The destruction of a monument to civilization is something else. The bridge, in all its beauty and grace, was built to outlive us. It was an attempt to grasp eternity. It transcended our individual destiny."

The World Bank, UNESCO, the European Union, and others joined with the City of Mostar to rebuild the old bridge as "a symbol of peace and reconciliation between the peoples of Bosnia and Herzegovina." All of Mostar's cultures and religions joined together to rebuild it. It combines old and new: hundreds of the original stones were recovered from under the water of the Neretva. Others were cut anew. The bridge once again connects the parts of Mostar on opposite banks of the river; it stands as a tangible symbol of unity among diverse cultures and their determination to achieve a peaceful, lasting society.

Ironbrige, Coalbrookdale, England

The Iron Bridge at Coalbrookdale is often cited as the first of its kind. Other iron bridges had been previously designed in parts of France, but these were never built. Earlier iron bridges may have been built in Great Britain, but these were probably much smaller structures of wrought iron. There is, however, strong evidence that there were cast-iron bridges in China in the fifteenth century.

There is no doubt that the Ironbridge was a daring and unprecedented venture, both in its design and in its scale. Both stone and cast-iron designs had been considered by the small number of shareholders, and they were deeply divided on which one to build, some fearing that the iron alternative could prove too costly. To allay their concerns, Abraham Darby III indemnified the reluctant shareholders, agreeing to turn to other sources of financing if the amounts agreed to in the initial subscription fell short. This proved to be a costly

commitment. The costs did end up being much higher than estimated, and contributed to Darby's financial ruin. Nevertheless within a decade the bridge was a prosperous enterprise.

The Iron Bridge has become a symbol of the Industrial Revolution, which transformed the landscape of Great Britain and indeed the world. It symbolized two key features of the Industrial Revolution -- the potential of iron, and the economic importance of transportation.

The Iron Bridge is pictured on a 1792 halfpenny token commemorating its construction 1779. Tokens like this were privately because small-denomination copper coins – farthing, half pennies, and pennies – were in scarce supply in late eighteenth century Britain. The government was reluctant to dignify copper coinage with official distinction, yet there was a need for low-denomination coins for general circulation in the growing cash economy.

Victoria Falls (Mosi-oa-Tunya) Bridge, Zimbabwe

In 1996 Zimbabwe authorized the Perth Mint to produce a ten-dollar coin commemorating the Victoria Falls Bridge. This steel-arch bridge is shown above the gorge in the foreground, and the horizontal crest of the falls rises above deck level in the background.
Victoria Falls in Zimbabwe is arguably the world's largest waterfall. It has long been one of Africa's top tourist attractions. It has won recognition as a UNESCO World Heritage site, under it original name, Mosi-oa-Tunya, or "smoke that thunders."
Cecil Rhodes, the diamond magnate who founded DeBeers, had the bridge built in 1905, as a key link in his Cape to Cairo railway. It is a steel arch that carries a road, a railway, and a walkway. It is one of three highway connections between Zimbabwe and its neighbor Zambia, and is the only rail link between them.

Today Zimbabwe is impoverished, battle-torn, and disease-ridden under the continuing dictatorship of Robert Mugabe. In 1980 Mugabe came in as a conquering hero who had thrown out the white majority leader Ian Smith. Mugabe began as a populist but he soon turned into a cruel tyrant. The West did not interfere with Mugabe's cruel use of force, a reluctance to get involved that Mugabe has consistently exploited to his advantage. The people of Zimbabwe have suffered a sharp economic decline, food shortages, and

hyperinflation. Although the Victoria Falls Bridge stands as majestic as ever, few visit the country today. Roads, water supplies, food, and medical services are inadequate.

The image on the Victoria Falls coin is like a Rorschach ink-blot test on colonialism, environment, and transportation. The American Society of Civil Engineers includes the bridge on their list of Historic Civil Engineering Landmarks, citing the bridge for its elegance of design and its responsiveness to a natural setting as well as its practical application, noting that it "embodies the best abilities of the engineer to enhance the beauty of nature rather than detract from it." Others see in the bridge a symbol of colonial subjugation and environmental degradation. According to one critic it "imposed itself at precisely the most visually dramatic point. A dubious environmental and aesthetic intrusion by today's standards, the bridge asserted British and European power and encapsulated a heady mix of imperialism and greed."

Jamuna Bridge, Bangladesh

The Jamuna Bridge in central Bangladesh is a vital link, both road and rail, between the eastern and western parts of the county. Economic development of Bangladesh had been hampered by the width and heavy current or the Jamuna River. Rail and road traffic relied on ferry crossings, which were expensive and time-consuming. The Jamuna River has the fifth largest flow of any river on earth, and its variable currents made ferry passage unpredictable.
The bridge was first proposed in 1949 by the popular political leader Maulana Bhashani, whose leadership began when the area was a part of British India; it later became Pakistan, and eventually Bangladesh. It would be nearly half a century before the bridge was actually built and opened, however. At three miles (4.8 km) long, it was the 11th longest in the world when it was completed in 1998. It is designed to withstand earthquakes and massive currents; to carry cars and trucks, two types of railroad, a gas pipeline, and other electrical and telecommunications links. The traffic-carrying parts of the bridge were built between 1994 and 1998 at a cost of $696 million. It was a stunning accomplishment, technically, politically, and economically. It is celebrated on three Bangladesh coins, the most common of which is a

small stainless-steel 5-Taka coin produced between 1994 and 1996 introduced into the circulating coinage while the bridge was being built.

Living individuals can surprise us and do embarrassing things; that is why some nations keep them off of coins. New bridges can do this, too: at around age 10 the Jamuna bridge developed cracks that led to a lawsuit between Bangladesh and the contractor. And in 2011 it was found that part of the toll being collected on the bridge ended up being siphoned off by corrupt contractors.

Stone Bridge, Regensburg, Germany

Few cities can trace their fortunes to transportation as directly as Regensburg, which features its stone bridge on nearly a hundred different coins minted during five hundred years.
As commerce grew in the late Middle Ages, Regensburg capitalized on its geographic location by constructing a massive stone bridge across the Danube. Goods from Europe, the Balkans, and the Far East all converged to cross the Danube here. The town prospered as all this economic activity came under its sway. The bridge itself, an impressive structure of sixteen arches, about a thousand feet long, continues to carry traffic today.

Regensburg is modest-size (about 150,000 people), pleasant, and colorful. Its medieval center is designated as a UNESCO World Heritage Site. Cruise boats dock there as they ply the Danube. The Thorn and Taxis Castle is there, as are a Roman gate, several museums, numerous churches, a university, and a thousand historic buildings, many built before 1500.

Most of what you see in Regensburg dates from when it was a part of the Holy Roman Empire, which began when it was conquered by Charlemagne back in 788. During much of this era the Bishops of Regensburg held tremendous power. The Stone Bridge was begun in 1135 and completed eleven years later. It was the first stone structure to cross the whole length of the Danube. Soon after it was built – in 1158 -- the Judith Bridge in Prague was built, and competed for routings and Danube crossings. But the Judith Bridge was washed away in a flood in 1172 and it would be another two centuries before Prague's Charles Bridge was built to replace it. During this time, Regensburg alone provided unbroken access across the Danube. Regensburg has been justifiably proud of its bridge. It was first pictured on coins when the town was under the control of the Bishop, who issued silver pennies showing his head above several arches of the bridge. It is not clear exactly when or why they were issued. Whatever they commemorate –perhaps completion of the bridge, perhaps the elevation of Regensburg to the status of a Free Imperial City -- these humble, crude pennies coincide with the emergence of Regensburg as an international trading power, which it remained for about two hundred more years. By 1500, however, Regensburg was loosing out in international trade as competition from other routes and other cities cut into Regensburg's business.

Most of the hundred or coins picturing the Stone Bridge are bird's-eye city views, looking down on the bridge and skyline of Regensburg from a vantage point across the river, in Lappersdorf. The view is the one you would get from a balloon across the Danube, making the bridge slant from the left in the foreground to the right in the background, with the tower of the Dom Saint Peter dominating the skyline. From the ground, it is difficult to see the entire bridge at once because the bridge crosses a couple of islands. The medalists who produced the images of Regensburg on its seventeenth and eighteenth century coins either climbed towers that are no longer there, rode up in hot-air balloons, or used their graphic skills to create virtual aerial scenes from architectural surveys at ground level.

Bridge Thaler of Charles VI, reigned 1711-1740.

The great number, variety, and time span of the Regensburg bridge coins have no rival among other states. One could spend a lifetime, and a king's ransom, trying to collect them all.

Shahara Bridge, Yemen

The Shahara Bridge is an exceptionally scenic structure perched high in the Jabal Shahara Mountains in southern Yemen. It drew a few curious, but necessarily hardy tourists before Yemen became the war zone that it is today. Jack Jackson, who ran tours to Yemen, commented that the trip to the bridge involved flying to one of the southern cities, Aden or Seiyan, and then taking four-wheel drive vehicles for hours over rough tracks to "to Al Garbey, where you pass into the hands of the local Mafia for the trip up to Shahara bridge. En route the Sunday Market at Souk Al Awad has guns, hand grenades and rocket launchers on sale." Or, you could walk from Al Garbey up to the Shahara Bridge if you didn't mind hiking for five hours up in the hot sun and another five hours down, and did not mind being pelted by stones, which schoolchildren toss down on tourists to amuse themselves.
The various regions of Yemen freed themselves from foreign control by mid twentieth century. Parts of the country then operated separately but political rivalries and tribal conflicts led to a civil war, which ended with the creation of a single country, the Republic of Yemen, in 1974.

The next year the Republic of Yemen minted its first coins – three different denominations. What to feature on these coins must have taken a lot of winnowing down: it is strange, but appropriate, that the Shahara Bridge make the final cut on one of them, the 1995 five-Rial coin. Bridges are not common symbols in the middle east, where arid climates are common and water courses needing bridges are less common than in many other parts of the globe. Neither the Koran nor the Bible makes any mention of bridges.

The choice of this symbol appears to show a national spirit of strength and security. The bridge is built in torturous terrain and for defensive purposes. It reflects hard-won national unity. North and South Yemen had been united into a single country only five years before the coins were minted, its civil war ended only one year earlier.

25 of April Bridge (Salazar Bridge), Lisbon, Portugal

Portugal minted a 20 Escudos silver coin celebrating the completion of the Salazar Bridge across the Tagus in Lisbon in 1966. It had been a long, long time coming. The first proposal for a bridge across the Tagus near Lisbon dates back to 1876, but it was not built until 1966.

It is a little longer than either the Golden Gate Bridge or the Verrazano-Narrows Bridge, although both of these have longer central spans. The initial stage, opened in 1966, had a single deck, located on top of the stiffening truss that runs the length of the bridge. The second stage added a second deck at the bottom of the truss.

António de Oliveira Salazar, for whom the bridge was initially named, became Prime Minister of Portugal in 1932 and he ruled until he died in 1968. Bridges are symbols of permanence. Leaders who are honored by having bridges named for them may feel immortalized. Salazar does not seem to have been smitten by this particular vanity, however. He had not wanted the bridge built in the first place, fearing it would create too big a strain on the public purse. Also, he was on record as being opposed to naming monuments after people until they were dead at least 200 years. Salazar was nonetheless in prominent view when the bridge was dedicated and named for him on August 6, 1966.

Salazar's authoritarian dictatorship stood in marked contrast to the democratic governments of western Europe during that period. Portugal continued to be a dictatorship for a few years after Salazar's death. It became a democratic government following the Carnation Revolution of 1974, during which a mob marched onto the bridge and took down a brass plate with the name "Salazar" on it and substituted the painted name "25th of April" The new name stuck.

Harbor Bridge, Sydney, Australia

By the early 1900s Sydney had become a bustling city and Australia's largest port. Sydney itself, and across the harbor, North Sydney had grown rapidly A bridge at this location had been first proposed in the early nineteenth century, and many more times thereafter. In 1920 more than a million people lived in Sydney; a third of these lived north of the harbor. The ferries that linked the two parts of the area were often disrupted by fog, storms, or strikes. A more reliable connection was desperately needed, and the 1922 Harbor Bridge Act provided for either a cantilever bridge or an arch bridge. A later design competition resulted in a hinged steel arch with suspended deck and pylons.
It was intended to be the longest steel-arch span in the world when it was completed in 1932, more than one and a half times as long as New York City's Hell Gate Bridge, completed in 1917. At 1635 feet, it would have indeed have set this record except in the decade that it was being planned and built, New Jersey's Bayonne Bridge, literally inched it out by about two feet the year before the Harbor Bridge was finished

Although the Sydney Harbor Bridge is located entirely within New South Wales, it is an icon not just of Sydney or New South Wales, but of Australia. It stands as a proud reminder of that nation's engineering savvy and as a tribute to the common man. It was opened during the worst year of the Great Depression. Thousands of people lined up to walk across it the day it opened. It has been called a symbol of the lack of class-consciousness among the working class in Depression Sydney. The bridge appears on 14 different Australian coins. The one pictured here was released to celebrate the bridge's 75th birthday in 2007.

Bridge at Antioch ad Maeandrum, Turkey

Among many different coin types issued by the Roman Emporer Gallienus, only one has a bridge. It was issued at the provincial mint in Antioch ad Maeandrum in Asia Minor, in Turkey about 100 miles east of Ephesus. It is one of twenty or so bridge commemoratives to come out of Rome or its provinces. It pictures a bridge of six arches across the Maeander River at Antioch, with a river god reclining on top.

Before newspapers and TV, when illiteracy was widespread, coins were a ready way to get a message out. Emperors were well aware of this, and carefully steered the content. Gallienus' various coins stress his support of the army, his links to the gods, and his creation of a reign of peace. Gallienus became co-emperor of Rome when his father Valerian raised him to this post as co-emperor in 253 a.d. They served together until his father was captured by the Persian leader, Sapor. Although Latin historians paint a bleak picture of Gallienus, he had a strangely modern flavor. He was a ready orator, elegant poet, skilful gardener, and excellent cook. He was a flamboyant dresser, possibly a transvestite. He was tolerant of Christians. He built professional military leadership and banned Senators from military positions to get rid of amateur generals.

Gallienus made noteworthy changes in how coins were minted. He set up local mints behind his lines of battle, allowing him to pay the soldiers regularly, and also paying them in full: the coins he minted for the army were full weight, while he sought to make ends meet by reducing the weight of coins at other mints. This devaluation did not go unnoticed. Indeed, it caused such disruption that merchants in Egypt stopped accepting his coins. History has faulted this monetary policy as Gallienus' worst failure.

The bridge coin shown here is itself the strongest evidence that there was a Roman bridge at Antioch ad Maeandrum. There are no physical remains and no other record of such a bridge, but there is little left of Antioch in any case. What was the coin's message? That Antioch enjoyed the patronage of Rome? That the region owed its trade and economic prosperity to Rome? That Rome's military might was nearby? Or, is the message a local one, like our river god is a mighty one, or our bridge is awesome?

Conclusion: Lasting Messages?

Gallienus' bridge coin shows that the iconography on a coin can live on, like the grin on Lewis Carrol's Cheshire cat, long after the thing itself is gone.

Bridges are durable structures made to last, as evidenced by many Roman and medieval stone arch bridges that still exist today, often having survived centuries of neglect. Today's magnificent suspension and cable-stayed bridges are incredibly durable. Whatever may happen in the centuries to come, their existence will be evident; possibly standing, possibly in ruins. Coins, too, are destined to last. Millions of coins from ancient times are still around today. These small metal objects are durable, portable, and easily protected from the elements. Today's coins will still be found hundreds and thousands of years from now.

The lives of these semi-permanent objects, bridges and coins, exceeds human life spans, and during their lives civilization advances, human values change, nations come and go, the earth reshapes itself. Centuries from now, a few of today's bridges and might stand as lasting testaments to the civilizations that produced them. Many of the coins picturing bridges will still be around. These surviving bridges and coins may conjure an aura of immortality. But their original purposes, once clear and forceful, will be blurred and indistinct; the values that they embodied may seem eerily misguided or outdated; their claims to greatness belied by subsequent history.

New Bridges in a Canadian World Heritage Site – An Architect's Perspective

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Introduction

The Rideau Canal World Heritage Site is one of the most important historic settings in Canada, and a key landmark in Ottawa, the Nation's Capital. It is the sole remaining canal system from the great North American canal-building era of the early 1800s that remains operational along its original alignment with the majority of its watercourses, dams, bridges, fortifications and lock stations still intact.

The over-riding design challenge for all of these crossings is how to achieve an appropriate aesthetic expression for a new bridge in a World Heritage Site context. It is imperative that the new structure respect and not overwhelm the character of the heritage place, yet it is also important that it be an expression of its own time. The concept of minimal intervention is critical – the heritage character-defining elements must retain visual dominance within the setting, with new interventions presenting a secondary, understated visual expression that does not diminish the original character, and ideally over time, should actually enhance it. It is also important that the new work has a strong visual and material quality that will stand the test of time, functionally and aesthetically.

The author has led the architectural and aesthetic design components of five bridge projects on the Rideau Canal (both vehicular and pedestrian/cyclist) over the past fifteen years. Three have been successfully implemented and won multiple design awards, with the other two currently in advanced design stages. All have required intensive, collaborative design & stakeholder engagement processes. This paper presents visual images from these projects to illustrate the delicate design balancing act required to successfully integrate a new structure in an important historic setting.

Rideau Canal

The Rideau Canal, a monumental early 19th-century construction covering 202 km of the Rideau and Cataraqui rivers from Ottawa south to Kingston Harbour on Lake Ontario, was built primarily for strategic military purposes at a time when Great Britain and the United States vied for control of the region.

It is recognized for the following values as outlined in UNESCO's 2007 "Statement of Outstanding Universal Value":

The Rideau Canal remains the best preserved example of a slackwater canal in North America demonstrating the use of European slackwater technology in North America on a large scale. It is the only canal dating from the great North American canal-building era of the early 19th century that remains operational along its original line with most of its original structures intact.

The Rideau Canal is an extensive, well preserved and significant example of a canal which was used for a military purpose linked to a significant stage in human history - that of the fight to control the north of the American continent.

The canal includes all the main elements of the original canal together with relevant later changes in the shape of watercourses, dams, bridges, fortifications, lock stations and related archaeological resources. The original plan of the canal, as well as the form of the channels, has remained intact. The Rideau Canal has fulfilled its original dynamic function as an operating waterway without interruption since its construction. Most of its lock gates and sluice valves are still operated by hand-powered winches.

The Rideau Canal system presents a distinctive visual character, typified by strong, solid utilitarian structures designed and built to last. At the same time attention has been paid to aesthetics so that the structures fit in and enhance their canal setting. High quality, durable materials including steel, concrete, local stone and wood are evident throughout the canal. A simple colour palette is utilized, predominantly featuring natural finishes that age well; if a paint finish is used, it is typically white or black. The key defining aesthetic characteristic throughout the system is the many variations on the arch form used for structural spans across water, providing pleasing reflections by day and night.

New Interventions in a World Heritage Site

To help guide the design of new built interventions in historic settings, there are some important reference documents that we always keep top of mind as designers, including the Standards and Guidelines for Conservation of Historic Places in Canada and the Vienna Memorandum 2005.
Some key guiding principles include:
Make the new work physically and visually compatible with, and distinguishable from the historic place
Incorporate minimal intervention (make the new work subtle and understated, don't make it "showy" or "gimmicky")
Avoid all forms of pseudo-historic design as laid out in the Vienna Memorandum
New work should be clearly expressed as NEW, utilizing the technology of our time

Five Projects crossing the Rideau

This paper discusses five projects that we have been involved with as designers over the past fifteen years, presented in chronological order. The first three are complete, in or close to Ottawa. The fourth is about to commence construction in Ottawa, and the last is in Detailed Design, close to the south end of the system in Kingston where the river widens out.
Laurier Bridge
Corktown Footbridge
Vimy Memorial Bridge
Rideau Fifth & Clegg Footbridge
Kingston Third Crossing

Laurier Bridge

The Laurier Bridge project involved widening of an existing historic bridge in downtown Ottawa, adding a new pair of arches on the south side, as well as new railings, lighting and landscaping. The original historic arches over the Canal had become an icon in the Capital, with a pleasing arch shape, and finished in a distinctive green colour that evoked the oxidized copper material of the roofline of Ottawa's Parliament Buildings. An early design decision was that the new pair of arches should utilize the same geometry and colour as the old, but be expressed with contemporary detailing, reflecting current structural technology. For instance, where the historic arches and cross braces utilized rivetted connections throughout, the new arches are connected with welded and bolted connections, clearly expressing the technology of today.

The completed bridge, when viewed from the new side with the Chateau Laurier beyond, evokes the iconic historic arch expression over the canal at a distance, but is clearly new when viewed up close.

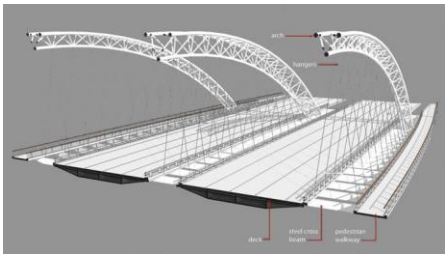
Corktown Footbridge

Just 400m downstream from Laurier Bridge is Corktown Footbridge, a new 46m span crossing connecting University of Ottawa over the canal to an important downtown main street. Ottawa is renowned for its extensive recreational pathway system – the bridge extends this in a universally accessible way, with a switchback ramp on the east side enabling a maximum 5% slope throughout the crossing experience.

The bridge is in a very important urban location, viewed in front of Laurier Bridge and Ottawa's iconic historic buildings on the skyline beyond. Finding an appropriate aesthetic was critical. A range of approaches were investigated as part of an intensive design review process – above-deck and below-deck structural options were accurately modelled to test and compare visual impact within the viewscape.

The final design, featuring a pair of below-deck shallow arches relating to Laurier Bridge beyond, presents a clearly contemporary expression that is subtle and respectful at the same time – the new structure touches the heritage setting lightly.

On pedestrian bridges it is important to enhance the pedestrian crossing experience up close and provide a visual quality that will last, and stand the test of time. At Corktown high-quality materials with natural finishes were specified – sandblasted concrete, bead-blasted stainless steel posts, linear brushed stainless steel railings and a bent bronze plate handrail that responds to Ottawa's legacy of copper and bronze usage on its built structures.



Vimy Memorial Bridge

Vimy Memorial Bridge is located in a beautiful natural setting adjoining a conservation area on the south outskirts of Ottawa where the canal becomes a much wider river. The challenge here was how to integrate a big vehicular traffic bridge without visually overwhelming the World Heritage Site. The overall objective was to maximize the visual effect of lightness and transparency. The 40 metre wide bridge needed to carry a lot of vehicular traffic, but still be inviting and comfortable for pedestrians. The main design strategy was to break down the scale by introducing three linear slots to separate the deck components. These slots provide space for three impressive open truss arches that span 125m, and suspend a large-scale grid of below-deck girders.

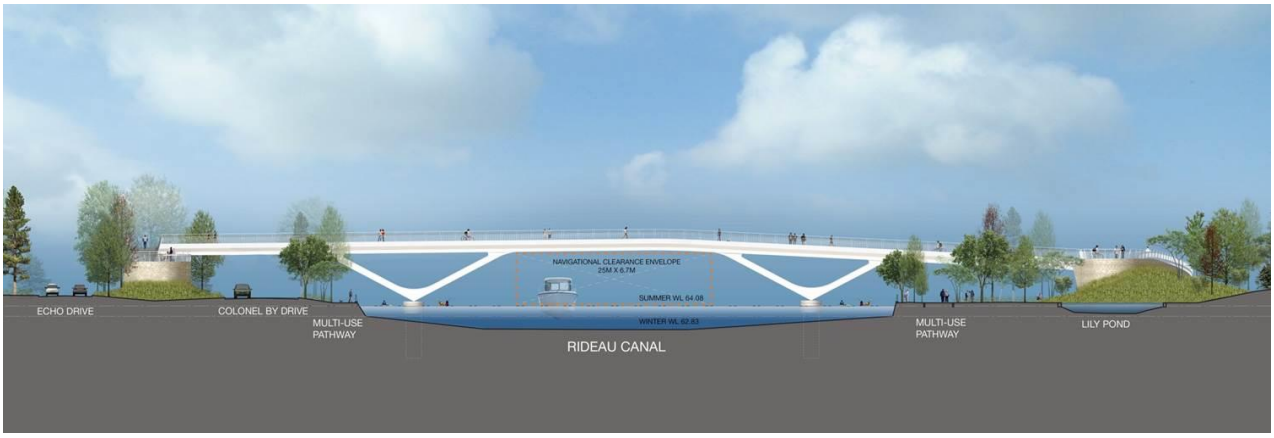
One of the most successful aspects of the design is the separated pedestrian pathways that pass by the outside arches in a gradual sweeping curve.

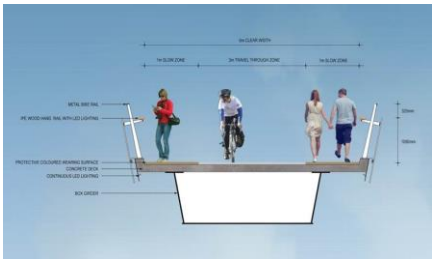
Pedestrians have great views of the setting and the bridge, and can look down to the water on both sides. Stainless steel cable railings terminate in solid end elements that contain special text recognizing the site's status.

The three slots introduce interesting light effects due to light penetration reflecting off the water below, reinforcing the impression of visual lightness, like the bridge is floating above the setting.

Rideau Fifth & Clegg Pedestrian & Cycle Bridge

This new pedestrian and cycle bridge will connect two established residential neighbourhoods in the heart of Ottawa. It breaks down into three components: a west side approach pathway that curves up to a lookout/landing; a 125m main span and a switchback ramp/stair descending on the east side. The design was inspired by the shallow tapering lines and angles of locks along the canal, and proposes two shallow V-piers in the canal framing the 25m wide navigation channel. This configuration enables a series of shorter girder spans to minimize girder depth and at the same time maximize the effect of openness and transparency within the setting. The cross section features a 5m wide shared use deck, cycle height railings angled out each side with durable pipe wood handrail and an outer veil of clear anodized aluminium pickets.





The lighting concept proposes a subtle and understated overall effect in the mainly residential context. Continuous LED lighting of the outside girder faces and the V-piers, with the deck surface lit from concealed fixtures in the handrail providing an attractive pattern of alternating pools of light.

Kingston Third Crossing

This project is of a very different scale – a 1.2 km long river crossing at the south end of the Rideau Canal system, close to Lake Ontario. The bridge plan is configured in a gradual sweeping S-curve with a focal 115m arch span over the navigation channel towards the east side, framed by a pair of above-deck tied arches tilted out at ten degrees supported on V-piers. The relatively narrow bridge deck carries one lane of traffic each way, as well as a 4m wide shared use recreational pathway which widens out under the arch into a curved lookout area, a place for pedestrians to get out of the through traffic, spend some time and appreciate the views. The seating bench elements serve double duty, also providing a hard, durable edge for snow plowing the pathway through the winter months.

Given the environmentally sensitive setting, it is proposed to utilize accent lighting only on the arch and V-pier components, with a single line of roadway poles providing points of light that subtly mark out the S-curve configuration across the full length of the bridge.

Conclusion

In conclusion the following approach is recommended for designing new interventions in historic settings:

First and foremost, a new structure must respect the character of the heritage place, and not overwhelm it

At the same time, it's important that it also be an expression of its own time – new elements should be expressed as new

New work needs a strong visual and material quality that will stand the test of time, functionally and aesthetically

New work should fit well and age well within the setting, and over time, if designed and implemented very well, the new work can actually enhance the heritage setting

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Withstanding Time, Connecting Cultures:
The Elgin Bridge in Singapore

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Withstanding Time, Connecting Cultures: The Elgin Bridge in Singapore

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INTRODUCTION

Spanning the Singapore River, the Elgin Bridge is named after Lord James Bruce Elgin. Inheriting his father's title, Lord James Bruce Elgin became the eighth Earl in November 1841.[i] The first visit of Lord Elgin to Singapore occurred in 1857. In the same year, Lord Elgin visited Singapore thrice in between his travels between China and India.[ii] Upon his arrival at Singapore on 3 June 1857, after discussing with the Governor-General of Singapore, Mr. E. A. Blundell, Lord Elgin made the decision to redirect the troops headed towards China to India with the purpose of preventing the India Mutiny from spreading.[iii] This decision eventually resulted in the quelling of the Mutiny, accrediting Lord Elgin with the honour of being hailed as one of the heroes of the 1857 Indian Mutiny.[iv]

The present Elgin Bridge is the result of four major reconstructions over two centuries. Initially, the significance of the bridge lies in its role as the main connection between the culturally disparate worlds of the Indian trader and the Chinese in the 19th century *entrepôt* port-city. Over time, as Singapore developed from an *entrepôt* port-city into a modern nation-state, the bridge also underwent alterations that paralleled the social and economic developments Singapore underwent since the 19th century. Today, the Elgin Bridge also stands as a metaphorical bridge between Singapore's past and present, providing a physical reminder of Singapore's history as a British colony, and yet at the same time embellished with symbols of Singapore's identity as the Lion City. Therefore, this paper examines the history and significance of Elgin Bridge from three perspectives: as a connector between the Chinese and Indian migrants in colonial Singapore; as a link in the development of Singapore from a colonial *entrepôt* port-city to a modern nation-state; and as a metaphorical bridge between Singapore's past and present.

WITHSTANDING TIME

When examining the history and the significance of the present-day Elgin Bridge, it is crucial to note that the Elgin Bridge was preceded by three other bridges, namely, the Presentment Bridge, the Thomson's Bridge and the (First) Elgin Bridge. In fact, prior to the Presentment Bridge, when Sir Stamford Raffles first arrived in Singapore to meet Temenggong Abdul Rahman in 1819, it was noted that there was a wooden foot bridge built by the natives to link both ends of the river.[v] However, as there remains little evidence of the native-built foot bridge, this essay will focus on the phases of Singapore's history marked by the construction and the demolition of the bridges starting with the Presentment Bridge. In so doing, this paper will examine the history and the significance of the present-day Elgin Bridge as the first bridge that spanned the Singapore River.

1822-1842: Presentment Bridge

Prior to the arrival of Sir Stamford Raffles in 1819, the population residing in Singapore numbered to no more than 120 indigenous Malays – *orang lauts* – in addition to a handful of Chinese. Although most of them were located along the Singapore River, the native-built foot bridge was sufficient as the only means of crossing the river for the small population on a "practically uninhabited island".[vi] However, over the next few years, the increase in economic prominence Singapore enjoyed as a trading port also directly resulted in an increase in the population living alongside the river, necessitating a replacement of the native-built wooden foot bridge. Thus, in its place, the Presentment Bridge – also known as the Jackson Bridge and the Monkey Bridge – was constructed in 1822 by Lieutenant Philip Jackson using "twelve closely spaced timber tiles".[vii]

The surge in Singapore's population can be accounted for by the influx of immigrants during the 19th century. Shortly after Sir Stamford Raffles' arrival in Singapore, the East India Company successfully attained the rights to establish a trading post in Singapore. News of the new establishment of a free trading port under the British flag disseminated rapidly, resulting in a surge of migration that saw traders and settlers from the Malay Peninsula, China and India relocating to Singapore as they considered Singapore a safer and more cost-effective option than their existing arrangements in Malacca, Brunei and Manila.[viii] According to Thomas Bradell, within three years of the establishment of Singapore as a free trading port – by 1821 – the total population of Singapore increased to 5874.[ix] Later in 1824, as recorded in the first population census, the population of Singapore doubled to 10 683 residents.[x]

To organize the influx of immigrants, Raffles appointed Lieutenant Philip Jackson, the assistant engineer attached to the detachment of Bengal artillery, to draft the "Plan of the Town of Singapore".[xi] By December 1822, through the drafting of the map, Lieutenant Jackson presented a detailed spatial organization for Singapore where the Europeans, the Chinese, the Indians and the Malays were allocated a distinct area along the Singapore River.[xii] Alongside with the conceptualization of the Plan of the Town of Singapore, Lieutenant Philip Jackson was also tasked to design a bridge to replace the native-built wooden foot bridge. This eventually gave rise to the construction of the Presentment Bridge in 1822.

After its construction, the Presentment Bridge served as the sole connector spanning the Singapore River until 1840.[xiii] As a wooden drawbridge, the Presentment Bridge was effective as the first structure spanning the Singapore River in the early days as a trading port as it could be lifted for boats to pass under it. This feature unique to drawbridges was essential for the newly established trading port as the relatively calm harbor at the Singapore River invited sailing crafts to pass under it.[xiv] However, the Presentment Bridge soon outlived its purpose as its narrowness could no longer accommodate the needs of the crowds living on both ends of the river. Initially, to mitigate this lack, ferry services on *dhonies* were employed to ease the traffic flow across the river.[xv] Unfortunately, by 1842, despite multiple repairs, the Presentment Bridge had to be demolished.

1844-1862: Thomson's Bridge

After the demolition of the Presentment Bridge, in 1844, John Turnbull Thomson, as a pioneering architect and a Chief Surveyor for the Straits Settlements from 1841 to 1853, constructed a wooden foot bridge which was later named Thomson's Bridge.[xvi] Although the

sophistication and the design of the bridge pales in comparison with Thomson's more prominent works such as the Horsburgh Lighthouse on Pedra Branca, the significance of the Thomson's Bridge in the history of Singapore should still warrant our attention.

The erection of Thomson's Bridge in 1844 permanently removed all traces of the indigenous community – the *orang laut* – from the river banks. Prior to the arrival of Raffles in 1819, the *orang laut* resided along the river as it was a convenient means for them to attack passing boats.[xvii] As a result, as Phyllis Chew asserts, a discussion about the indigenous community is often part of the "larger piracy discourse".[xviii] As an establishment heavily dependent on maritime trade, the presence of the *orang laut* community along the Singapore River would then be undesirable. Thus, as river traffic increased, the threat arising from the presence of the *orang laut* community along the river banks then became increasingly intolerable, compelling the British to eventually eradicate them from the shores along the Singapore River.[xix]

The elimination of the indigenous community living on *sampan* – house-boats – from the river banks effectively reduced the disturbance threatening the trade activities at the Singapore River, spurring the import and export of goods, eventually resulting in the full maximization of berthing facilities by mid 1800s.[xx] With the arrival of more vessels, the cargo loads increased. As a result, horse carriages were employed to transport cargoes across the river. Unlike Presentment Bridge that stood as the sole structure spanning the River, Thomson's Bridge was surrounded by other bridges such as Coleman Bridge erected in 1840. Despite the emergence of other means of crossing the Singapore River, the usefulness of Thomson's Bridge was not undermined as it continued to serve as the only bridge providing a direct link between North Bridge Road and South Bridge Road. Furthermore, as a carriage bridge, Thomson's Bridge was still in use, necessitating the need for it to be widened by six inches even in its early phases.[xxi]

However, despite this alteration, the Thomson's Bridge was still insufficient at meeting the needs of the ever-growing population, resulting in its demolition later in 1862.[xxii]

1862-1927: (First) Elgin Bridge

After the demolition of Thomson's Bridge, the first Elgin Bridge was erected by a Singapore Engineer, George Lyons. The first Elgin Bridge stood as a 10 feet wide iron bridge imported from Calcutta, and was later widened and strengthened in 1870 and 1886 respectively before two underpasses were built under the bridge in 1922. As a bridge serving the communities in the late 19th century, the significance of the first Elgin Bridge was embedded in the broader developments occurring in the rest of the world.

By the erection of the first Elgin Bridge in 1862, more than 75 percent of Singapore's shipping businesses was held at Boat Quay. As a result, the Singapore River was constantly choked with vessels, necessitating the need for a new harbor (i.e. Keppel Harbour) to ease the traffic at the Singapore River. [xxiii] However, despite the opening of an alternative option, many of the merchants were still hesitant to move their businesses away from Boat Quay after having established their support networks in that area. [xxiv]

To exacerbate the overcrowding situation at the Singapore River, it is notable that the first Elgin Bridge also witnessed the opening of the Suez Canal in 17 November 1869 and the

adoption of steamships for trade in that same decade.[xxv] While steamships are not new to the Southeast Asia region, its widespread adoption as a vessel for trade only came about after the opening of the Suez Canal as the existing mode of transporting goods on wind-driven clipper ships was no longer sustainable.[xxvi] Unlike the wind-driven clipper ships that had to succumb to the winds and the tides, steamships were sturdier, allowing it to withstand the monsoon season and allow trade to happen all year round.[xxvii] Furthermore, as steamships are powered by coal and are able to go through deep water, it was deemed to be more suitable as a vehicle to go through the Suez Canal.[xxviii]

By 1920, the number of vessels at the Singapore River numbered to 17 167 – four times the unmber in 1880.[xxix] As the river continues its identity as the heart of the commercial centre in Singapore, it was then necessary for the harbor of the Singapore River to be linked to the new harbor – the Keppel Harbour. Steam trams were adopted to connect these harbours, allowing for easier transportation of heavyweight cargoes across the island.[xxx] As trade extended upstream along the river, it was then necessary for the first Elgin Bridge to allow for tramway rails, resulting in it being strengthened to allow for greater tram traffic flow in 1886.

However, as a result of the constant increase of traffic flow, by 1927, the first Elgin Bridge was dismantled to make way for the present-day Elgin Bridge.

1927-Present: Elgin Bridge

The present-day Elgin Bridge was designed by municipal bridge engineer, T. C. Hood.[xxxi] Unlike its predecessors, the Elgin Bridge took a longer duration before it was erected. Although constructions began in 1927, the bridge was only opened in 1929 as the construction of the bridge was “a very arduous undertaking” that encountered many engineering challenges exacerbated by rough weather conditions.[xxxii]

The construction of the Elgin Bridge faced engineering challenges as the bridge could not be erected using conventional methods. By the 1900s, despite the introduction of the Keppel Harbour, the water traffic at the Singapore River was still immensely congested. Thus, the construction of the Bridge had to be done in a manner where the river traffic would not be disrupted, resulting in the need for the 140 feet wide steel framework to be “hauled across on barges” from the “northern bank” of the river.[xxxiii]

Unfortunately, shortly after the erection of the Elgin Bridge, the world economy experienced the 1929 Great Depression, causing the volume of goods traded at the Singapore River harbour to plummet.[xxxiv] Fortunately, Singapore’s economy managed to pick up during the postwar years, allowing both the Singapore River and Keppel harbour to regain its liveliness as a trading post.[xxxv] In fact, the busyness of the port eventually resulted in frequent reports raised in hope of mitigating the problems arising from the pollution of the river.[xxxvi]

Unlike its predecessors, the Elgin Bridge of today proved to be a sustainable superstructure that effectively catered to the needs of the ever-changing society. Although the bridge is drawing closer to its hundredth year since erection, a study on the significance of the bridge should not be being only from its erection in 1927. Instead, as Elgin Bridge takes the place of the first native-built foot bridge that greeted Raffles in 1819, the history and significance of the bridge would then be intricately connected to its predecessors spanning the

Singapore River. Thus, notably, the significance of the Elgin Bridge today would be its ability to withstand time as it serves as a physical reminder of the first footbridge erected in Singapore.

CONNECTING CULTURES

The second part of this paper examines the history and significance of Elgin Bridge from three perspectives: as a connector between the Chinese and Indian migrants in colonial Singapore; as a link in the development of Singapore from a colonial entrepôt port-city to a modern nation-state; and as a metaphorical bridge between Singapore's past and present. While the bridge's function as a physical link between the two disparate communities may be most obvious in a study of its significance in connecting cultures, one should also note the significance of Elgin Bridge in redefining the Singapore's identity into a developed society. Furthermore, on top of connecting the two physical communities, the design and embellishments on the bridge also serves as subtle reminder of Singapore's identity as a British colony. Therefore, it is necessary for this paper, in examining the history and the significance of the present-day Elgin Bridge, to study the cultures the bridge connects since its erection in 1929.

Migrant Communities

As the only link between the two roads, the significance of Elgin Bridge in connecting cultures would then be specific to the Indian and Chinese community living on North Bridge Road and South Bridge Road respectively.

The North Bridge Road was allocated to the Indian immigrants arriving from South India. From early 19th century, Singapore experienced an influx of Indian immigrants who were actively involved in the maritime industry back in India.[xxxvii] Reputed as strong labourers, careful handlers and skilled boatmen, the Indians were then thrust into the frontline of developing Singapore into an economic maritime hub.[xxxviii] The Indians dominated the trade industry by taking on roles as lighter-men. Over time, as the economic prospects available at the port increased, more Indians were lured to migrate over. Therefore, although in 1827, of the 1121 Indians living in Singapore, only slightly more than 25% of them were employed as boatmen, by the turn of the decade, there were more than 1750 Indian lightermen and more than 500 crafts – *tongkangs* – tightly packed from the Elgin Bridge, along the South Boat Quay, to the mouth of the Singapore River.[xxxix]

On the other hand, the South Bridge Road consisted of Chinese immigrants — mainly Teochews and Hokkien — who arrived only in the later half of the 19th century. Taking over the roles from the Indians who have left Singapore, the Chinese quick in building up their credibility as cargo handlers, promptly establishing themselves as the "new masters of the waterway".[xl] The boats operated by the Chinese were known as *Twakows*. The Hokkiens and Teochews differentiated their boats by the the colour of the painting of an eye on the bows of the boat in different colour. Hokkien *twakows* painted the eye in red, green and yellow paint whereas the Teochews painted the eye on the bow of their *twakow* only in red.[xli]

Beyond their racial differences, the Indian and the Chinese lightermen communities had much in common. As one of the few industries located along the river, both the Indian and

the Chinese lightermen shared common pastimes. Specifically, among the two categories or leisure activities raised by Stephen Dobbs – routine or festive – this paper argues that the bridge connected the two communities specifically in their routine leisure activities.[xlii] While festive activities are often dependent on one's cultural affiliations, routine activities are often based on their circumstances. Therefore, given that both communities were involved in the same industry and surrounded by the same groups of co-workers, both the Indians and the Chinese communities would then be connected by common social activities such as eating cheap hawker food and gambling by the river.[xliii]

Therefore, in light of this, it would be arguable that the Elgin Bridge served as physical connection for the two culturally disparate communities, allowing them to bridge their differences through both physical closeness and shared experiences unique to the lighterage industry located by the Elgin bridge.

Singapore's Development

However, as the immigrant communities grew along the bridge, the areas around the Singapore river's Elgin Bridge also became increasingly polluted and congested. Following shortly after Singapore's independence in 1965, Prime Minister Lee Kuan Yew casted a vision for the creation of a clean-and-green Singapore. However, the heavily polluted and congested river hindered this vision, necessitating the allocation of $170 million for a decade-long clean up.[xliv]

To begin, the harbour at Singapore River was relocated to Kallang River, and subsequently to the Pasir Panjang harbour. The Paisr Panjang harbour was deeper and more accessible, allowing for larger ships to sail right up to the docks and unload their goods. As a result, the lighterage industry came under increasing threat of obsolesce. As part of the urban redevelopment plans as well, the squatters on both banks of the Singapore river were demolished as the communities were moved into public housing.[xlv] The clean-up of the river and the two banks also affected the itinerant hawkers who had to go elsewhere to ply their trades. Most notably, the last *twakow* from along Elgin Bridge was removed in 1983.[xlvi]

Evidently, the function of the Elgin bridge was changing. The role of Elgin Bridge in connecting the Indian and Chinese communities on both banks of the river ceased to exist. Instead, one could argue that its function today is almost similar to the two other bridges nearby — the Cavenagh Bridge and the Anderson Bridge — that is, to facilitate vehicular traffic within the city.

However, despite its change in function, the Elgin Bridge is not obsolete today; it continues to serve its purpose as a vehicular bridge between the North Bridge Road and the South Bridge Road. Arguably more importantly, the significance of the bridge retaining its geographical location till date also highlights the importance of retaining a physical reminder of Singapore's past as an *entrepôt* port-city despite its status as a modern nation today.

Metaphorical Bridge between Singapore's Past and Present

Rather than to continue its role in connecting two local communities, the Elgin Bridge now has an elevated function, within the context of the new nation-state. As part of the sprucing up of the bridge, an Italian sculptor, Cavalori Rudolfo Nolli, was commissioned to design and

craft a plaque that was installed on the ends of the bridge.[xlvii] Nolli designed the plaque to feature a lion in front of a palm tree, highlighting Singapore's identity as the Lion City in the tropical Southeast Asia region.[xlviii] In so doing, Nolli's sculptor adopted the Elgin Bridge as a means of embedding Singapore's past into the structures found in modern day Singapore society.

CONCLUSION

Although this paper asserts that the history of Elgin Bridge should not be studied in isolation from the three earlier bridges, it is evident that the historical significance of the Elgin Bridge as the first bridge spanning the Singapore River, as well as the history behind its name, has been largely ignored. Today, as the Elgin Bridge stands alongside six other bridges along the Singapore River, its significance has been undermined by the bridges constructed in more recent times. Furthermore, as these newer bridges – Helix Bridge and Jubilee Bridge – are footbridges, the vehicular bridge will receive less public attention.

Fortunately, the Elgin Bridge was given the conservation status by the Urban Redevelopment Authority of Singapore, in 2009.[xlix] With the conservation status, it is then be one's earnest desire to see more locals and tourists ponder about the significance of Elgin Bridge as a historically significant superstructure that has withstood time and connected cultures since the founding of Singapore.

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[i] *General Register of the Colonial Dependencies of Great Britain* (London: Edward Stanford, 1862), 128. James Bruch, son of the 7th earl – Educated at Christ Church, Oxford, where he was 1st class in classics, 1832; became a fellow of Merton, and graduated with M. A. 1835, hon. D.C.L. 1856; was elected to represent Southampton in parliament in August 1841, and succeeded his father in the earl-dom in Nov. 1841; was governor-general of Jamaica from March, 1942 to August, 1946; governor-general of Canada, from Sept. 1846 to Sept 1854; appointed lord-lieut. of Fifeshire, 1854; sent to China as a plenipotentiary, March 1857, and negotiated there the important treaties of 1858; appointed postmaster-general, 1859; again sent on a mission to China, 1860, which ended in the capture of Pekin and the establishment of peace.

[ii] Charles B. Buckley, *An Anecdotal History of Old Times in Singapore Volume 2* (Singapore: Fraser & Neave, 1902), 655. Lord Elgin was three times in Singapore in 1857; once on his way to China, then on his return to Calcutta, and again on his return to China from India. He died in November, 1864, on his way to Lahore, while Governor-General of India, in which he had succeeded Lord Canning.

[iii] "Elgin Bridge", *Malaya Tribune*, November 1, 1928, 4; Donald Davis, "Sleepless Night for Lord Elgin" *The Straits Times*, April 24, 1955, 12.

[iv] "Elgin Bridge", 4.

[v] Victor R. Savage, & Brenda Yeoh, *Singapore Street Names: A Study of Toponymics* (Singapore: Marshall Cavendish Editions, 2013), 110-111; "History at Four More Places", *The Straits Times*, June 29, 1985, 13.

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[ix] *Ibid.*

[x] Buckley, *An Anecdotal History*, 154; Saw, *The Population of Singapore*, 9.

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[xiii] Savage, & Yeoh, *Singapore Street Names*, 110-111; "History at Four More Places", 229.

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[xv] M. Jayapal, *Old Singapore*. (Singapore: Oxford, 1992), 31.

[xvi] Savage, & Yeoh, *Singapore Street Names*, 110-111; "History at Four More Places", 229.

[xvii] Phyllis Ghim-Lian Chew, *A Socialinguistic History of Early Identities in Singapore: From Colonialism to Nationalism* (UK: Palgrave Macmillan, 2013), 39.

[xviii] *Ibid.*

[xix] Abdullah Abdul Kadir, *The Hikayat Abdullah*, trans. A. H. Hill (Kuala Lumpur: The Malaysian Branch of the Royal Asiatic Society, 2009), 164.

[xx] Buckley, *An Anecdotal History*, 30.

[xxi] Cheong, *Framework and foundation*, 51.

[xxii] Savage, & Yeoh, *Singapore Street Names*, 110-111; "History at Four More Places", 229.

[xxiii] Singapore Urban Redevelopment Authority, *Singapore River planning area: Planning report*, (Singapore: The Authority, 1994), 7.
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[xxv] *Ibid.*
[xxvi] Jean Abshire, *The history of Singapore* (California: Greenwood, 2011), 60.
[xxvii] *Ibid.*
[xxviii] *Ibid.*
[xxix] Stephen Dobbs, *The Singapore River: A Social History 1819-2002* (Singapore: NUS Publishing, 2003), 11.
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[xxxii] "Elgin Bridge Reconstruction: A Difficult Job. Sinking a Caisson," *The Singapore Free Press and Mercantile Advertiser*, 25 August, 1927, 9.
[xxxiii] "The New Elgin Bridge," 36; "Elgin Bridge Across," *The Straits Times,* 30 October, 1928, 11.
[xxxiv] Dobbs, *The Singapore River*, 11.
[xxxv] *Ibid.*
[xxxvi] *Ibid.*, 12.
[xxxvii] *Ibid.*, 7.
[xxxviii] *Ibid.*, 38-40.
[xxxix] *Ibid.*, 40-41.
[xl] *Ibid.*, 42.
[xli] *Ibid.*, 134.
[xlii] *Ibid.*, 92.
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[xliv] Felicia Choo, "5 Interesting Facts About the Singapore River Clean-Up," *The Straits Times*, 5 July, 2014, http://www.straitstimes.com/singapore/5-interesting-facts-about-the-singapore-river-clean-up
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The Bridges of Puyuan: A Look at Bridge-Building and Local Networks in the Town of Puyuan, Zhejiang, China[1]

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In a landscape criss-crossed by networks of rivers and streams, bridges are ubiquitous to the Lower Yangzi Delta as part of the landscape and community life. In the market town or *shizhen* of Puyuan, Zhejiang, bridges functioned as conduits facilitating the movement of people and goods within, into and out of the town. Yet they were also markers and representations of how local networks and social relations have changed and developed within the town over time. As a market town specializing in silk production in Late Imperial China, the construction of bridges to facilitate and ease the flow of human and goods traffic was a mark of both philanthropy and local standing. Gazetteer records tell of how bridges were constructed and reconstructed, holding them forth as exemplary contributions of local worthies to the community. Bridges also became more than mere conduits of traffic flows. They served not only as physical reminders of family prestige, and also as sites or gathering places for the local community where jobs were found, goods were exchanged and religious obligations fulfilled. This paper proposes to examine the practical and symbolic functions of bridges in Puyuan and how they could be seen as markers of urban growth and socio-economic change within the town in Late Imperial China.

INTRODUCTION

Bridges are ubiquitous in China where they not only join the separated and increased communication but also facilitated circulations of goods and human traffic. In China, as in everywhere else, bridges are "social and cultural constructions" that are anchored not only to the "stream-beds they traverse" but also to "the communities that built them" (Knapp, 2008). Bridges can be as simple as a couple of stone slabs across a narrow body of water or a massive, architectural monument across wide rivers and even seas. In whatever form bridges may take, they symbolise not only men's triumph over nature by overcoming natural barriers to communication and community building, but they also are insights into the history and cultural of the local societies they join as sites of communication and circulation. In line with this view of bridges, this paper focuses on the bridges built in and around the market town of Puyuan in the province of Zhejiang, China, in the late imperial period of Chinese history.[2] Many of the bridges still extant in Puyuan today are not the massive architectural monuments that one may have come to expect in relation to bridge-building today in China and elsewhere.[3] Rather, they are mostly simple creations designed to facilitate foot-traffic within the market town and to accommodate the expansion of the town over the centuries (see Figure 1).

Figure 1. Qifeng Bridge, built in the 12th century, is one of the oldest bridges in Puyuan. (Authors' own photograph).

This paper draws upon the idea of John Kieschnick (2002) that bridges in China were generally "symbols of charity, compassion and good governance" and explore how the bridges of Puyuan were similarly symbols of philanthropy and family prestige within the community as well as markers and representations of urban growth and social change within the local society over time. Kieschnick frames his discussion of bridges in China within the realm of Buddhism where bridges were manifestations of charity and merit making and where the construction of bridges usually involved a tripartite partnership between monks, local magistrates and local elites. In the case of Puyuan, questions may be raised as to whether members of the local society were inspired by Buddhist notions of merit-making or by other more worldly concerns of facilitating commercial traffic into and out of the town. In many places, as observed by Kieschnick, monks acted as technical specialists and solicitors

of funds in the process of bridge construction, yet such a process was apparently missing or either undocumented in the case of Puyuan. In this situation, the role of the local society in Puyuan, specific to bridge building, requires a closer look.

THE TOWN OF PUYUAN

Puyuan, as a centre of silk weaving production located on the Hangzhou-Jiaxing-Huzhou delta plains in the northern part of Zhejiang province, has a long history that dates to the mid-sixteenth century. The town and settlement, however, claims a much longer history, with the town histories or local town gazetteers harkening to its past as the marketplace of an ancient city known as Zuili or as the "grass market" of Yu'er in the pre-Southern Song dynasty period (before 1127).[4] The development from what seems to have been a rural marketplace into a more established settlement apparently took place in the early 12th century when a man by the name of Pu Feng settled down in the area. The foundation legend repeated in a number of the town's gazetteers recorded the beginning of the town's history when Pu Feng "escorted the emperor southwards" and settled in the area. The phrase "escorted the emperor southwards" was a common euphemism for the great southward migration of the Song court and population of North China into South China resulting from Jurchen incursions from the North.[5] Whether or not Pu Feng really escorted the emperor southwards is not of import, since this was a common motif found in local gazetteers and lineage genealogies in South China, but what should be noted was the ascription of the development of Puyuan to Pu Feng and his sons. All six of Pu's progeny and their lines of descent prospered in their new homestead under the Southern Song regime and the town was, so the legend goes, imperially bestowed with the name of Puyuan (*lit.* Pu's Courtyard) during the reign of Emperor Lizong (r. 1225 - 1265) on account of services rendered to the court by one Pu Dounan.[6]

Much of the information on Puyuan comes from an extant collection of seven local histories or town gazetteers that were compiled by various individuals over a period spanning the late seventeenth to the early twentieth centuries. The compilers of each of these local histories have different aims and purposes in mind, ranging from a conflation of family history with town history in the 1675 edition, nostalgic reminiscences of home in the 1808 edition, and factual recount of local society and development in the 1927 edition. A common thread, however, that ran through the different editions of the gazetteers, is that of detailed recording of local society and infrastructure. Prominent local personalities and their contributions to the local society and environment as well as the establishment, renovation and oftentimes decline and sometimes revival of local institutions and infrastructure such as government offices, religious institutions, manors, homesteads, waterways and bridges were all faithfully recorded in the local histories. These records, often paradoxically informative and ambiguous at the same time, provide not only snapshots of the town at various points in its history, but also an account of changing socio-power relations as manifested through patronage of religious institutions and sponsorship of infrastructure within the town.

The terrain surrounding Puyuan is generally flat and criss-crossed by many rivers and waterways leading to the description in the 1760 gazetteer of the town as a place "surrounded by fertile and flat fields which are in turn surrounded by tributary harbours and streams". This suggests that Puyuan was largely dependent on riverine transport that brought merchants into and goods out of the town.[7] The 1814 gazetteer further noted that the town was encircled by two major waterways and their many tributaries "flowing from the northeast and the

northwest[8]" facilitated the gathering of "merchants [and their capital] from all directions"[9] to purchase the silks produced in the town. The prosperity of the town was thus linked to its waterways.

This influx of human traffic, intent on purchase of silk products, into the town meant that communications and transport became of vital importance to the development of the town. From the gazetteers, hand-drawn maps of the town suggest that from the late seventeenth to the early nineteenth centuries, Puyuan's hydraulic landscape was transformed. From a largely natural environment where homesteads, religious institutions, and other community buildings were constructed *around* the waterways as depicted in a map dated 1675 (see Fig. 2), Puyuan appeared to have undergone widespread urbanization by the nineteenth century. A second map found in the 1814 gazetteer (see Fig. 3) depicts the town with the waterways largely unchanged though represented by straighter lines, paralleled by roads and lanes, thus suggesting that growing town demographics, combined with land scarcity and high prices, had increasingly encroached upon the natural landscape. This is perhaps best borne out by the observation recorded in the 1787 gazetteer that as the silk weaving industry developed in the Wanli reign (1572 - 1620), the town's streets and marketplaces expanded and the number of houses multiplied so many times that even lands in neighbouring towns valued at two to three taels of silver per *mu* were often snatched up and developed into residences at many times the price.[10]

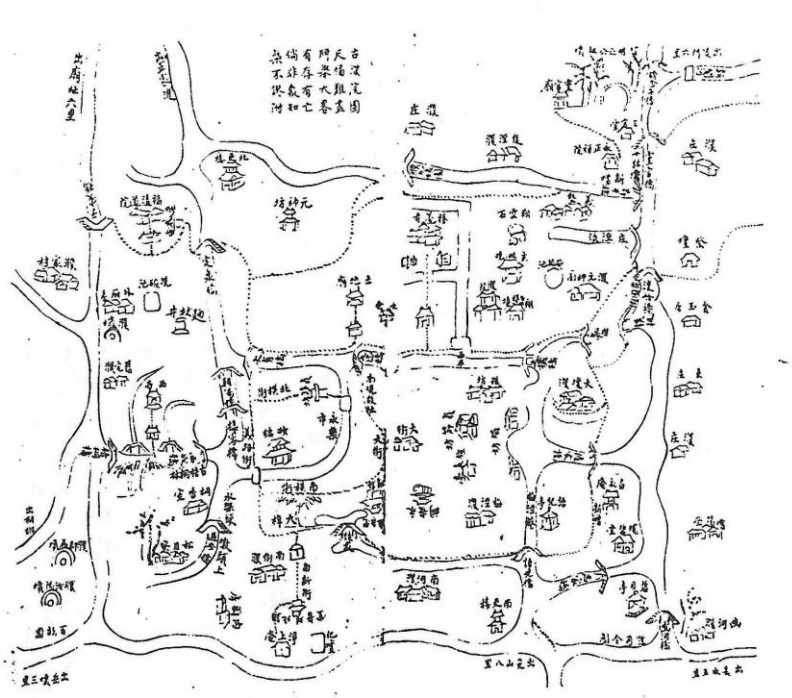

Fig 2. Map of Puyuan *circa*. 1670s. Taken from *Puchuan zhilue* (1675).

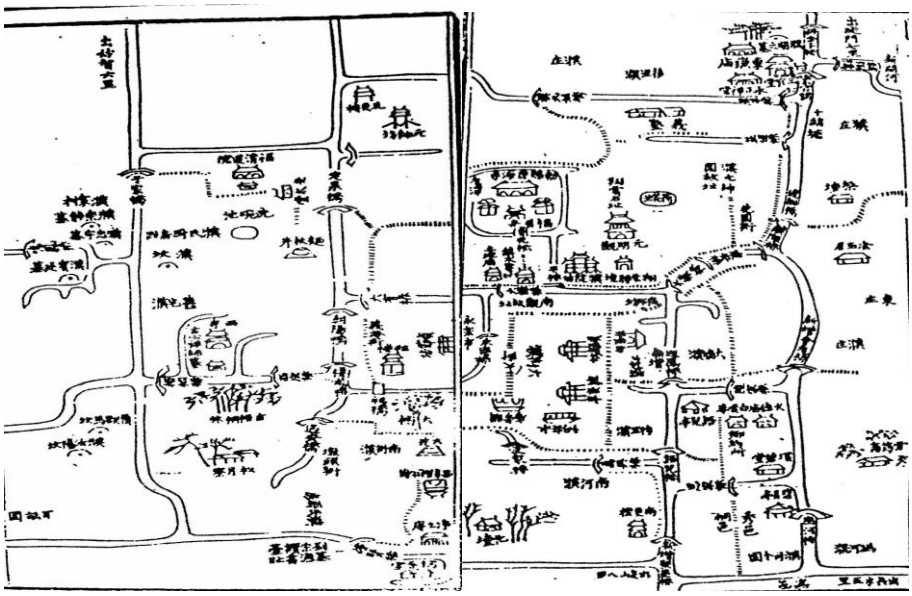

Fig 3. Map of Puyuan *circa* 1800s. Taken from *Puchuan suowenji* (1814).

THE BRIDGES OF PUYUAN

This paper is part of an ongoing project that aims to geo-locate the bridges and other landmarks of Puyuan spatially. Preliminary work was carried out through close-reading of the gazetteers and followed by *in-situ* fieldwork. A number of the bridges in Puyuan have been successfully geo-located (see Fig. 4) though it should be noted that in many other instances, the information provided by the gazetteers is so sparse and ambiguous that geo-locating the bridges, some of which have disappeared under the combined onslaught of time and modernisation, proved impossible. The gazetteers of Puyuan, in their different iterations, specifically listed some 109 bridges located within the town. Most of the entries included information such as the location of the bridges, the dates, usually approximate, of construction and on rare occasions, the people involved in the construction. The locations of the bridges are usually described in relation to geographical landmarks (such as the Yanshou Bridge or Bridge of Extended Longevity[11]); religious institutions (such as the Ping Bridge or Even Bridge)[12], or even relative to another bridge (such as the Chaoyang Bridge which was variously described to be west of Dayou Bridge and north of Qifeng Bridge[13]). Where more information appeared to be available to the compilers of the gazetteers, these would be included. Such information mostly referred to the history of the bridges - who built it, when it was built, repaired, and/or reconstructed.

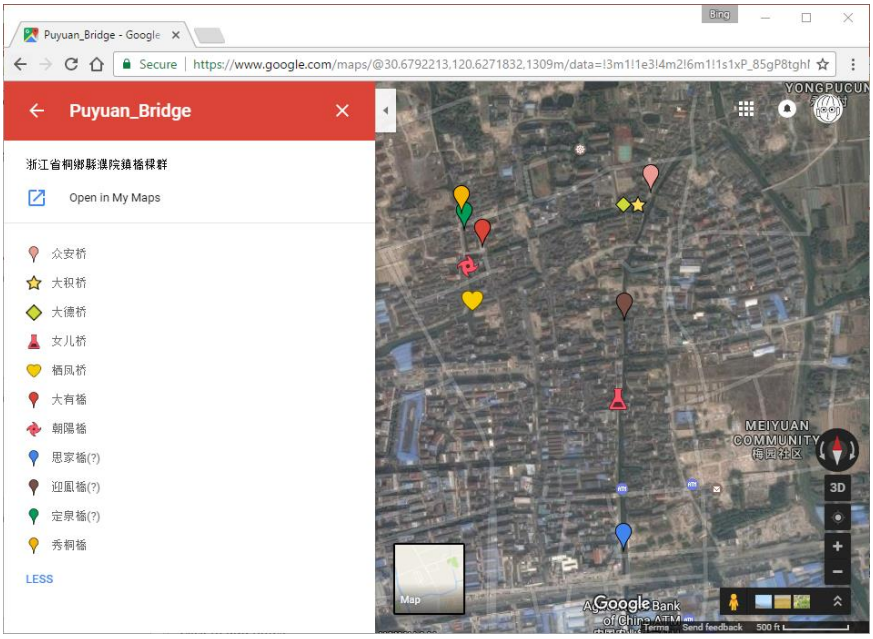

Fig 4. Geo-location of extant bridges in Puyuan.

Sieving through all the information related to the bridges in the gazetteers reveals a composite picture of the local society, of who the local worthies were, and major events that impact the town and its physical and human make-up as well. Where information is available, the development of particular bridges such as their links to local society, changes in construction materials, changes in the names of the bridges and so forth could be elucidated. Take for instance, the following passage that prefaced the individual entries on the bridges in the 1808 gazetteer:

> "Of the bridges whose construction and repairs could be traced, they are as follows. Wutong Bridge which stands at the entrance of the West Gate was built by Pu Feng when he first settled in the town. It was reconstructed by Mdm Pu, the mother of Zhong Jun in 1801. Guo'an Bridge (*lit.* Bridge of Tranquil Crossing) was constructed by Pu Jian simply because Qifeng Bridge (*lit.* Bridge of Phoenix Opening) has the same character as his ancestor's name and it was taboo for him to cross the bridge. Hence he constructed this bridge to facilitate comings and goings. Today the bridge is known as Gu'an (*lit.* Solid Tranquility) and the lane nearby took its name from the bridge. Pu Jian also constructed Dade Bridge (*lit.* Bridge of Great Virtue, now known as Temple Bridge), Dayou Bridge (*lit.* Bridge of Great Abundance) and Daji Bridge (*lit.* Bridge of Great Accumulation, commonly called the New Bridge, reconstructed by Chen Yuanxia in 1779). The Duchuan Bridge (*lit.* Ferry Bridge) was formerly a simple wooden bridge but it was reconstructed as a stone bridge in the Zhizheng reign of the Yuan dynasty (1341 - 71) and the name was changed to Daquan Bridge (*lit.* Bridge of Great Completeness) though people still continued to use the former name. Sijia Bridge (*lit.* Bridge of Homesickness) was constructed when the Pu surname were allowed to return to their hometown by imperial decree and they constructed this bridge to commemorate their origins. Pu Jiuniang Bridge was constructed by chaste woman Pu Jiuniang."[14]

In this singular passage, the origins of some of the bridges of Puyuan as well as the prominence and decline of Pu Feng's descendants, the Pu surname group, can be elicited.

The Pu Surname as Bridge Builders

If we are to take Pu Feng's settlement in the town as the starting point of the town's development, then Wutong Bridge, said to be built by Pu Feng himself, could be considered as one of the oldest bridges in the town, though no longer extant. Described in the 1675 gazetteer to be located to the west of the town and southwest of Fushou Buddhist Temple, it was also known in local parlance as Gu'tong Bridge. The entire area north of the bridge and surrounding the temple was occupied or owned by the Pu surname group.[15] By 1760, the bridge also became known as Duo'fu Bridge (*lit.* Bridge of Manifold Blessings)[16] and was, by 1801, during the Jiaqing reign of the Qing dynasty (1796 - 1820), reconstructed on instructions from Madam Pu by Zhong Jun, assisted by Dai Wencheng and Chen Erjia.[17] This reconstruction was followed by repairs to the bridge in 1896 though it was not known who oversaw that project.[18]

What these pieces of information suggest are several things. For one, Wutong Bridge and its surrounding area was likely to be the original settlement of Pu Feng and hence likely to be the site of the town before it developed into a much larger entity. The urban sprawl that occurred in the centuries after Pu Feng's settlement was thus one that occurred in all directions, with residents of the town presumably building and locating themselves where land was available. The bridge, originally built by the progenitor of the Pu surname in the town, was, somewhat ironically, given the patriarchal nature of Chinese society and kinship norms, reconstructed at the behest and sponsorship of a female descendant. Granted that it was her son, Zhong Jun, who helmed the project, albeit with the help of two other local men, the fact that Madam Pu identified sufficiently with her natal family and was apparently of sufficient independence and means to sponsor the reconstruction, suggests perhaps further examination of kinship and gender relations in market towns may be in order for a fuller explication of what we now know.[19] Given the numerous choices open to her in the form of the many bridges in the town, the choice of Wutong Bridge is perhaps also indicative of the extent of identification between the Pu surname group and the history of the town.

In many of the extant local histories of Puyuan, one name stands out in relation to the early development of the town. Pu Jian (1261 - 1312), otherwise known as Master Mingzhi, was the tenth generation descendant of Pu Feng and was described in the 1675 gazetteer as having a generous nature and being one who was willing to spend large sums on construction of "monasteries, temples and bridges".[20] Bridges constructed by him included the Dayou Bridge, Daji Bridge, Dade Bridge, the Guo'an Bridge and the Suijinzi Bridge (*lit.* Bridge of Gold Fragments).[21] However, it may be too simplistic to read into his construction of these bridges as altruistic acts in themselves. His biography in the 1820 gazetteer notes that he "established four great brokerages in the market of the town which collected and accumulated local silk products in anticipation for sales in all directions".[22] Thus, despite being lauded for "alleviating blockages by building bridges"[23], the fact that the bridges all led to the marketplace in Puyuan that was developed by him suggests more pragmatic considerations of facilitating trade and commerce lie behind the construction of the bridges.[24]

In mapping out the bridges built by the Pu surname group, however, it is possible to see how Puyuan developed as a town. The location of many of the bridges, as well as religious and charitable institutions, built by Pu Feng, Pu Jian and other members of the Pu lineage in the Southern Song and Yuan dynasties indicate that the original town and marketplace, which was known as Yongle (*lit.* Everlasting Happiness) market, grew up along the banks of a major waterway that ran through the town. The sprawling town depicted in the 1675 and

1820 gazetteers resulted largely from urban spread as the town grew more prosperous. It should be noted as well, that while the market town grew in prosperity, the Pu surname group apparently experienced a rapid decline in the early Ming dynasty (1368 - 1644) from which they did not seem to have recovered thereafter.

This much is alluded to in the quote above that notes that Sijia Bridge was constructed by the Pu to commemorate their origins after they were allowed to return to Puyuan by an imperial amnesty decree in 1404. While details are sparse on this episode, the local histories attest to the fact that in the first years of the Ming dynasty, the Pu surname group was ordered by Ming founder, Zhu Yuanzhang (*r*. 1368 - 98) to be dispersed from Puyuan in all directions. Their crime? Being too wealthy and putting on too ostentatious a display of that wealth while celebrating the marriage of a daughter, a celebration that was supposedly witnessed by the new emperor who was traveling *incognito*. The more likely reason was the support that the Pu lent to Zhu Yuanzhang's erstwhile rival, Zhang Shicheng, in the form of grain donations during the contest for power in the Yuan-Ming interregnum.[25] While this act of donating grains was praised in the local histories to have preserved the town while other nearby towns were ravaged by fighting and looting of the various rebel armies, it brought disaster upon the Pu surname group. The punitive expulsion from Puyuan ordered by Zhu Yuanzhang not only broke the group's wealth and power within the local society but also paved the way for other surname groups to rise to prominence. This is aptly bore out in the local histories where from the Ming dynasty onwards, individuals from various surname groups such as the Yue, the Feng, the Xia and so on were more prominently featured. The fact that reconstruction of bridges originally constructed by the Pu had to be sponsored by a married-out daughter and people from other surname groups such as Chen Yuanxia suggests that by the late Ming and into the Qing, the Pu were no longer the socio-economic force to be reckoned with within the town.

This sharing of social space and prominence, willingly or otherwise, could be seen in the case of the Duchuan Bridge (*lit*. Ferry Bridge), also known as the Daquan Bridge. The entry on Duchuan Bridge in the 1820 gazetteer reads:

> Duchuan Bridge obtained its name because this was [the point in the river] where the ferries gathered. During the Zhiyuan reign of the Yuan dynasty (*r.* 1264 - 94), the Pu surname constructed a farmstead to the east of the waters and reconstructed the wooden bridge in stone. Later on, the local people repaired the bridge and renamed it Daquan Bridge (*lit.* Great Completeness Bridge), though it was still colloquially referred to as Duchuan bridge. This is where the Duchuan fish market is located.[26]

One could surmise that the stone Duchuan Bridge, while not originally constructed by the Pu, was an improvement on its wooden predecessor and used, most likely, to facilitate transportation to and communication with the Pu farmstead nearby. It is further telling that it was the "local people" who later repaired the bridge, indicative not only of the Pu's reduced prominence in the town but also of the way Puyuan's local society viewed infrastructure such as bridges as community projects to be undertaken as a shared burden. Likewise, in the case of the Sijia Bridge. Originally constructed as a commemorative structure to celebrate the homecoming of the Pu to Puyuan after the general amnesty granted to them in the Yongle reign (*r.* 1402 - 20), it was rebuilt in 1917 with funds raised by one Zhu Xiangyuan.[27] What was family memory and property had, by the Republican period, transformed into public property and shared memories.

BRIDGE BUILDING AS COMMUNITY PROJECTS

The decline of the Pu from the apex of local society and economy in Puyuan paved the way for other surname groups to come to the forefront. This can be seen the following passage in the *Puyuan suozhi* which reads:

> One may enter the market via Wutong Bridge and the bridges [of the market] are generally well-known. They are: Xicheng Bridge (rebuilt in the 8th year of the Jiaqing reign, 1803); Yifeng Bridge (reconstructed in Qianlong 10 or 1745); Chaoyang Bridge (rebuilt in the Qianlong reign). It was passed down that there was an extremely tall and large Parasol (Wutong) tree which often had phoenixes gathering atop of it during the later Zhou period. This is why the settlement was named Wutong and the names of the bridges are all linked to this. There were also the Dingquan bridge (rebuilt in Qianlong 60 or 1795); the Xiutong bridge located to the south of Guo'an Bridge; the Dong Bridge which stood about a *li* south of Daji Bridge; and Yingfeng Bridge (rebuilt by local worthy Dai Mingshang). To the east of Yingfeng Bridge stands the Lu Family Bridge and further south stands the Yu'er Bridge (rebuilt in the 2nd year of the Jiaqing reign or 1797). There were also the Juxing Bridge, Meijing Bridge, Shuangxian Bridge, … the You'hu Bridge, the Changmu Bridge (rebuilt as a stone bridge by Li Hanbai and repaired by his grandson, now known as Huilong [Bridge]). In the southwest, upstream from the river stands the Hengban Bridge, … the Zhong'an Bridge and to the north, the Daquan Bridge [the Ferry Bridge]. … … For all these bridges, only the recent repairs and renovations are known. As to when they were constructed and whether they were rebuilt or not, it can no longer be known.[28]

In itself, the passage may seem to be a rambling attempt at enumerating the bridges of note in Puyuan. However, when this is cross-referenced to the individual entries on the bridges so named, it is possible to get a sense of social change that occurred in the late imperial period within the town. For instance, Chaoyang Bridge was recorded to be built in the Yuan era by the Pu surname group and rebuilt twice, though by persons unknown, in the Qianlong and Jiaqing reigns of the Qing dynasty. Likewise, Yingfeng Bridge was reported to be constructed by Dai Mingshang and again repaired in the 10th year of the Daoguang reign (1830) by persons unknown. The Lu Family Bridge, in contradiction to its moniker, was constructed by a local man by the surname of Zhang while the Yu'er Bridge, originally a Pu construction, was rebuilt in the Jiaqing reign by again persons not identified in the records.

This general lack of information on the bridge-builders, especially in the late imperial period, is telling. For one, it points to the ubiquity of bridges within the town of Puyuan. It was entirely possible that because bridges were so common a sight in the town and because repairs and rebuilding were perhaps undertaken as mundane tasks and part of the general upkeep of the town, that the compilers of the local histories did not see it necessary to record *who* rebuilt or repaired the bridges but rather just *when* the bridges were renewed, possibly as a record indicative of when the next repairs or reconstructions might be due. In addition, the almost total absence of Buddhist intervention, such as monastic technicians or fund-raisers or project managers, in the bridge construction projects in Puyuan suggests that the lower one reaches into Chinese local society, the picture that emerges - be it social organization or construction or local leadership - is probably going to be very different from that gleaned from county and prefectural sources of information.[29] In Kieschnick's (2002)

conceptualisation of bridge construction projects, he sees a tripartite partnership at work - the technical expertise and fund-raising abilities of the monks combined with the financial support from the local elites and with the political and administrative support provided by local magistrates. This however was not the case at all in Puyuan. Not only were many of the local bridges constructed without the technical expertise afforded by Buddhist monastic advisors, the long hand of local administration in the form of the county magistrates did not materialise as well, thus suggestive that market towns such as Puyuan, while prosperous and economically crucial as nodes in the local and regional economies, were either beyond the administrative oversight of the local magistrates or may have, due to size, population and importance, fallen through the cracks given the many other administrative duties clamouring for the attention of the magistrates. From the county magistrate's point of view, the bridges of Puyuan would have been too small and unimportant in the whole fabric of territorial administration to devote attention to, even though they may loom large at the local level. Where bridge builders were mentioned, they would therefore have been the important local figures - such as members of the Pu surname group in the late Song and throughout the Yuan periods, or such as Li Maohua, identified in the passage above as the Li Hanbai who rebuilt the wooden Changmu Bridge in stone, in addition to constructing the Dengying Bridge which facilitated traffic into and out of the town.[30]

WHY BUILD BRIDGES?

This raises the question then of why would local histories continue to be fixated on bridges and what did building bridges achieve for the individuals involved? For the researcher, what would studying bridge construction in towns such as Puyuan yield? In a riverine landscape where bridges are ubiquitous and where bridge constructions, re-constructions, and repairs may have been looked upon as run-of-the-mill maintenance projects insignificant to be of note, unless prominent local men were involved, that the local histories of Puyuan (and of many other places as well) considered bridges sufficiently important to create separate categories and individual entries in the texts suggest that despite not being the majestic, soaring architectural masterpieces elsewhere, the bridges of Puyuan remained important fixtures within the local mental map of the compilers and the townsfolk. Part of this may be related to the administrative situation of Puyuan for most of late imperial China.

From the local histories, one may be forgiven for thinking of Puyuan as an autonomous entity, focused solely on production of and trade in silk products. Throughout most of the town's recorded history, the people of Puyuan were fortunate in that no major disturbances or calamities occurred in the region, apart from one or two instances of natural disasters such as famine toward the end of the Ming dynasty, isolated instances of banditry. While the local histories noted periods of disruption, these occurred largely during the Yuan-Ming interregnum and in the later half of the 19th century beginning with the devastation wrought by the Taiping Rebellion, repeatedly observed in the histories as the "bandits from Yue region" or "the disaster of *gengsheng* year (1860)". The lack of a centralized authority within the town or a focused centre of power for much of its history is tellingly evident from the observation that from the Southern Song dynasty onwards right until the late Ming, that is from the thirteenth to the late seventeenth centuries, there was no official representation of the government established within the town. The earliest indication of defences provided by the state for the town was in the early years of the Qing dynasty when the Commander's office for defence was established in Puyuan, and even then this was achieved at the request of a local man by the name of Zhang Douzhan rather than at state initiative.[31] It was

apparently not an important nor well-endowed office for we are told that Zhang had to pledge a donation of barracks for the sixty odd foot soldiers and horsemen stationed there in order for the office to materialise. Even so, it was only during the Yongzheng reign (*r.* 1723 - 1735) when the office shifted to the southern bank of the Duchuan Bridge that it finally obtained a permanent address. The premises of the office were later renovated and repaired by another local man Wang Guodong, yet another indication of the lack of administrative significance of the town.[32]

This lack of concerted attention by the authorities on the town was likely to have resulted from the fact that Puyuan was administratively divided between the three counties of Jiaxing, Tongxiang and Xiushui for much of the Ming and Qing. By the late Qing, the town was apparently managed, since the Guangxu reign, by an institution known as the Baoyuan Tang or the Hall of Preserving the Essence. In all matters requiring administrative oversight, the Hall would present detailed reports to the magistrates of the three counties for discussion so that all the villages and hamlets in the area could come to consensus on issues relating to education and defense. All matters within the town, especially those concerning local welfare, were managed collaboratively by the respective territories of the three counties.[33] Yet, the picture found in the local histories suggest a town populace more concerned with matters of trade as the number of trade guilds listed under official organizations outnumbered defensive offices established by the state.[34]

With such a political milieu therefore, the heavyweights of the town came to play an important role within local society and it was a role supported by wealth, examination success and literary cultivation. The Pu, having established themselves early in the Southern Song, played a major role as bridge builders and temple constructors throughout the Southern Song and the Yuan dynasties. The loss of their prestige within the town as well as their wealth (which was confiscated by the Ming state) thus meant that despite having blazed the pioneering trail of bridge building within Puyuan, they were unable to maintain and hold on to that role after their return to the town in the early Ming. Yet their contributions were not lost as the local histories continued to acknowledge the existence of bridges built by the Pu surname group though with each successive compilation, the emphasis incrementally decreased.

For anyone or any single surname group seeking therefore to make a mark within the local society, after having obtained wealth and/or success in examinations, addressing public needs would thus be key. This would include the provision of charitable schools for cultivation of the young; of public burial grounds; and the sponsorship of religious institutions to ensure spiritual cultivation for fellow townsfolk. In some cases, it even extended to the solving problems of transportation and communication; and the facilitation of trade within the town often in the form of construction of new bridges or the repair or reconstruction of existing bridges. Such philanthropic endeavors were often recognized with tangible rewards such as in the case of Pu Wengui, a Ming-dynasty scion of the Pu surname group, who was honored by the provincial authorities with the sash and cap and his name carved into a stele for posterity in the provincial city for his donation towards the construction of Datong Bridge.[35] As quickly as the Pu lost everything in their forced dispersal from the town, their place within local society was just as rapidly filled by other groups who sought to replicate the existing formula for social success.

Despite what Kieschnick (2002) observed in his survey of bridge-building as a Buddhist work of merit throughout China that depended on the technical and fund-raising

abilities of monks, the presence of monks in bridge construction in Puyuan is not obvious from the records. It is entirely possible that monks in fact were spearheading the bridge construction projects, given that Puyuan was home to several monasteries and temples of prominence within the locality, but the emphasis placed on contributions and leadership of local personalities by the compilers of the town histories, all local men themselves, points to a desire on the part of the compilers to enhance the image of the town. With the local magistrates of the three counties of Jiaxing, Tongxiang and Xiushui almost non-existent in the local histories and this desire to play up local worthies and their impact on the town, the lack of acknowledgement of Buddhist monastic intervention and support in bridge construction is perhaps understandable.

The story that emerges from the local histories of Puyuan in relation to the bridges therein is a two-fold one. On one hand, mapping and geo-locating the bridges allows us a glimpse of how urbanization within the town took place over a long period. Despite the sparseness of the information, the construction and location of the bridges within Puyuan do suggest facilitation of commerce as well as growing prosperity as a primary motivation. On the other hand, the nuggets of information contained in the local histories, while not totally illuminating, also provide windows into how local society evolved from one dominated by the single surname group (the Pu) to one where local influence and social prominence was shared among several surname groups. Much of this social change came about by external circumstances - the forced migration of the Pu surname group in the early Ming created a vacuum in local society as well as the rise of the literati class within the town through examination successes that entailed different criteria of social importance. In trying to understand the changes occurring in Puyuan throughout late imperial China, the study of bridges and their builders represent only the tip of the ice-berg. The social and economic changes in Puyuan should be understood in totality - bridges were part of the same landscape as Buddhist temples, Daoist monasteries, charitable organizations and trade guilds, to name a few. In and by themselves, bridges provide some evidence of social change, standing as artefacts and silent testimony to the influence of particular groups and individuals within the town and local society.

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[1] This paper is part of a research project "A Geo-Spatial Approach to Town and Village Gazetteers: The Case of Puyuan in Late Imperial China", funded by the Singapore Ministry of Education Academic Research Fund Tier 1.

[2] Puyuan today is better known as an industrial center producing woollen goods. At the time when research was carried out through *in-situ* fieldwork in Puyuan, the old town was largely abandoned due to the plans by the local government to redevelop the ancient quarter of the town into a model Jiangnan river town, presumably to tap into the tourist market.

[3] A cluster of nine ancient bridges in Puyuan has been listed by the government of Jiaxing under its Provincial Level Historical Relics Protection Unit in 2011. See Jiaxing County Government, "Puyuan guqiaoqun" [The ancient bridges of Puyuan], accessed from http://www.jiaxing.gov.cn/mljx/jxwh_36090/lswh/wzwhyc/sjwwbhdw/201401/t20140114_308698.html.

[4] See *Puchuan zhilue* (1675) (hereafter *PCZL*), 1.4a - 1.4b; *Puzhen jiwen* (1787) (hereafter *PZJW*), juanshou.1a; and *Puchuan suowenji* (1814) (hereafter *PCSWJ*), 1.1a.

[5] *PCZL*, 1.4b.

[6] *PCZL*, 1.4b, *Puyuan suozhi* (1808) (hereafter *PYSZ*), p. 429; *PCSWJ*, 1.1b.

[7] *PZJW, juanshou*.2a.
[8] *PCSWJ*, 1.4a.
[9] *Tongxiang xianzhi* (Guangxi edition), 1.8b.
[10] *PZJW, juanshou*.4a.
[11] Yanshou Bridge was also known as Ma Family Bridge and was located at the Pan Family Harbour. See *Puyuan zhi* (1927) (hereafter *PUZ*), 10.8a.
[12] There were two bridges of the same name, distinguished only by their cardinal point in relation to a religious institution. The Ping Bridge located to the east of Xianghai Monastery was known as the West Ping Bridge while the one located to the east of Xiangyun Daoist Temple was known as East Ping Bridge. See *PCSWJ*, 2.27a - 27b.
[13] *See PCSWJ*, 2.27a and *PYZ*, 10.4a.
[14] *PYSZ*, 431.
[15] *PCZL*, 2.10a.
[16] *PZJW*, 1.23b.
[17] *PCSWJ*, 2.26a. Zhong Jun was a National University student who was renowned for his filial piety and support for his kinsmen. Dai Wencheng was apparently responsible for raising funds and managing the artisans and materials in the reconstruction on the bridges, but unfortunately, no further information on him, apart from being a septuagenarian, is available from the local histories. See *PCSWJ*, 3.66a.
[18] *PYZ*, 10.4a.
[19] Madam Pu was described in the local histories as the wife of Zhong Wenyao who was widowed at a young age. She was renowned for being able to bring up her sons well and for her charitable works. In 1794, at the age of sixty, she made a pledge and sponsored the reconstruction of Ying'long Bridge, followed by the reconstruction of Wutong and Jufeng Bridges in 1801. These bridges were described as the gateway in the west of the town and travelers to the town were greeted by the arched bows of the three bridges, a sight widely praised by everyone. See *PYSZ*, 470.
[20] *PCZL*, 3.10b.
[21] *PCSWJ*, 2.26a - 2.26b.
[22] *PCSWJ*, 3.6a.
[23] *PYZ*, 13.7b.
[24] *PCSWJ*, 2.26b.
[25] *PCSWJ*, 1.2b.
[26] *PCSWJ*, 2.26b - 2.27a.
[27] *PYZ*, 10.1b.
[28] *PYSZ*, 431.
[29] In all the extant gazetteers of Puyuan, there was only one instance of monastic involvement in bridge construction which is that of a monk Jiru who raised funds for the reconstruction of the Yingchun Bridge in 1792. It should however be noted that the said bridge was not located within the town but was included in the local history because it was built with donations from the townsfolk. See *Puchuan suowenji xubian* (1818) (hereafter *PCSWJXB*), 1.16a.
[30] *PCSWJ*, 3.54a.
[31] *Puzhen jiwen*, 1.1a.
[32] *Puchuan suowenji*, 2.1a - 2.1b.
[33] *Puyuan zhi*, 1.5a.
[34] Many of the guilds are classified under the "official organisations" category in the local histories and most made their appearance in the late Qing period, dealing with interests ranging from silk looms, silk cloth, silk thread, rice, grains etc. See *PYZ*, 7.5a - 7.6a.
[35] *PCSWJ*, 2.32a.

The Pleasure and Pain of Poetry

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The Pleasure and Pain of Poetry

In his poem, Introduction to Poetry, Billy Collins uses imagery to present a philosophy on how to experience poetry. Collins compares reading a poem to finding the light switch in a dark room. Or walk inside the poem's room and feel the walls for a light switch. When you walk into a dark room, your first reaction is to find a light switch and turn it on to see the room and decide its purpose. It's the same with poetry, you need to find the light switch in the dark poem to understand its true meaning and feel the emotion inside the poem. Another image that Collins uses involves a mouse. I say drop a mouse into a poem and watch him probe his way out. Poems are like mazes and the readers are the mice, trying to understand the poem and find a way out of the maze. Collins started his poem of with imagery involving a color slide. I ask them to take a poem and hold it up to the light like a color slide. When you hold a color slide up to the light more details are revealed, similar to holding up a poem to the light where the real meaning is revealed. I think the speaker's philosophy of experiencing poetry is that it might not be easy, but you need to think deeper to understand the real meaning of the poem.

In her poem, How to Eat a Poem, Eve Merriam uses metaphor to present a philosophy on how to experience poetry. In Merriam's first stanza, she talks about how to eat the poem. It is ready and ripe now, whenever you are. When you eat fruit, it has to be ripe, and when you read a poem, you have to be ready to eat it. And when you eat the poem, you have to do it all by yourself. You do not need a knife or fork or spoon or plate or napkin or tablecloth. Reading poetry is meant for someone to discover its meaning on their own, not by using tools. To fully understand a poem, you need to eat the whole thing. For there is no core or stem or rind or pit or seed or skin to throw away. Experiencing poetry includes digesting the whole poem and then figuring out if you need to read it more or if you are full. I think that the speaker's philosophy of experiencing poetry is that you need to read the poem by yourself in order to understand the whole meaning of it.

I believe my philosophy about experiencing poetry is that it is fun but many people choose not to experience it because they are afraid of it not being fun. Whenever the poetry unit is introduced as our next topic, lots of people tend to groan. They do this because they are reluctant to experience poetry the right way. I do believe you need to understand everything about a poem to appreciate it. Adding onto my philosophy, experiencing poetry involves "eating the whole poem". People are afraid to eat the whole poem and rather take a few bites. That's why people don't appreciate poetry that much, because they are unwilling to eat the whole thing. I think the hidden things in the poem make poetry pleasurable to me. The adventure of finding what the poet really wants you to learn is the best part of poetry because you have to find it out yourself. My favorite poet is Shel Silverstein. Shel's poems have always made me laugh even if I don't really understand the real meaning of the poem. I do get what the poets are saying about poetry most of the time. For instance, I understand what Shel is saying about poetry; poetry is fun and should make you laugh.

Life is like a poem, you're going to have to figure some things out on your own.

The Historical Stone Bridge of Plaka In Greece. Historical, Architectural and Constructional Documentation after Its Collapse in 2015

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INTRODUCTION

This paper addresses the event of the 2015 collapse of Plaka bridge of river Arachthos, in Greece, as well as the actions that followed afterwards from the School of Architecture, concerning research and preliminary studies for the restoration of the monument.

General description

The historic stone bridge of Plaka (Figure 1) was built in 1866, in the southern part of Epirus in Greece. It connected the banks of the mythical Arachthos river, which originates from Pindos and flows into Amvrakikos bay. It was closely related to the history and the evolution of the region, since it was an impressive monument of historical, cultural, architectural, social and symbolic value, not only for the local community but for the whole nation.
The main arch span was about 40 m and its height reached 21 m. It was considered as the largest single-arched stone bridge of the Balkans. Next to the main arch there were two smaller relief arches. The width of the bridge in the middle of the main arch was about 3,20 m and the piers were getting gradually wider until the maximum width of 4,50 m at the ends of the bridge.

Figure 1: Plaka bridge before the collapse.

The collapse

The 1st day of February 2015, after prolonged heavy rainfall and floods of Arachthos river and many years of lack of proper maintenance and conservation, the biggest part of the main arch and the east pier of the bridge collapsed (almost 50% of the bridge). Despite the first impression of total collapse, 50% of the bridge remains in place and 17-20% of the total bridge are the accessible fallen parts (Figure 2).

Figure 2: Plaka bridge after the collapse.

Following actions

Immediately after the tragic event, the National Technical University of Athens created an interdisciplinary working group, with experts from different Departments (Schools of Architecture, Civil Engineering, Rural-Surveying Engineering, Mining-Metallurgical Engineering, Chemical Engineering and Electrical-Computer Engineering). This group prepared an in depth preliminary study and research, which served as the base for the final restoration project that will be conducted by private engineers and contractors, under the supervision of the Ministry of Culture and NTUA with the help and collaboration of the local authorities.

This study and research project included historical, topographical, architectural and structural documentation and analysis. It also included the examination and assessment of the existing condition of the remaining parts and the ruins in situ, the formation of specifications, and finally principles and proposals for the challenging project of the reconstruction of the stone bridge.

All the above were based on research works such as topographical-photogrammetric documentation and preliminary static and dynamic assessment of the bridge, analysis of the mechanical, physical-chemical and oryctological properties of the historic materials used, hydrological and hydraulic research of the river, geological - geotechnical studies including geotechnical drillings and seismic vulnerability study, conducted from the above mentioned Schools of NTUA.

The project of the working group of the School of Architecture started with a preliminary in situ survey on 22, 23 of May 2015 of the visible and accessible parts of the bridge, such as the still standing piers and the fallen fragments, in order to obtain information concerning the structural system and its construction details, sampling of all construction materials and elements (mortars and stones), as well as sampling of timber components and nails hidden in the mass of the stone bridge.

The results deriving from the analysis of the documentation collected on site and of all the other relevant data (historical information, previous studies, etc.) will be presented briefly in the following paragraphs. It must be also noted that the first action after the in situ visit was the proposal of immediate safety measures.

CONSTRUCTION PHASES

Historical background.

Before the bridge construction in 1866 (Lambridis, I., 1880, p.71), two other bridges (predecessors of this one) had also collapsed. The first one, situated in a near location, collapsed in 1860 (Papakostas, N., 1967, p.429) after foundation displacement. The second one collapsed in 1863, situated in exactly the same spot as the 1866 bridge, during the removal of the scaffolds at the opening ceremony. After the 1863 collapse, it is possible, but not yet proven, that the bridge of 1866 was built using a part of the anterior bridge that had not failed. According to this scenario, the construction was completed within the period of one summer (Mammopoulos, A., 1973, p.27).

Within the 150 year life span of the monument, there were several changes and alterations. The most significant construction and intervention phases are:

Phase 1 (1866-1927).

The new bridge was a one arch bridge having a significant curvature, designed and constructed by the leading craftsman Kosta Beka (Mammopoulos, A., 1973, p.27). Bekas worked also with the leading craftsman G. Frontzo, who was responsible for the erection of the previous failed bridge. The bridge was delivered partly incomplete because of shortage of funds. The upper part at the area of the deck was not completed and there were no protective parapets thus, making the bridge dangerous and difficult to use. From 1881 to 1913 the bridge wasn't in use because Arachthos river was at that time the natural border between Greece and Turkey. In 1913 after the liberation of Epirus region, the bridge started to be used again.

Phase 2 (1928-1945).

The Greek state funded the completion of the bridge. The masonry, deck and the typical, not solid parapets of the stone bridges of the Epirus area were completed making the passage safer and easier (Papakostas, N., 1967, p.432).

Phase 3 (1946-1947).

In 1946 a large hole was created in the east side, passing through the whole bridge at this area, by explosives (sabotage). The hole and damages were repaired in a very casual way with reinforced concrete (Figure 15, right).

Phase 4 (1947-2008).

In 1972, Plaka bridge was declared a "listed monument", protected by the Ministry of Culture. From 1995 till 2004 several reports for the need of maintenance and restoration works were made but just local repairs at the deck and the parapets were conducted. In 2005 a restoration study was made by the A. and G. Papageorgiou.

Phase 5 (2008-2014).

Minor maintenance and restoration works begun, but were never completed Eventhough the architectural-structural study of A. and G. Papageorgiou proposed underpinning of the foundation of the piers, no such action was made.

Phase 6, 01 February 2015, bridge collapse.

The bridge collapsed on Sunday February 1st 2015 due to foundation failure of the east pier. Parts of the east pier fell in the river bed, almost under their original position and parts of the main arch were broken into smaller fragments and were carried away by the river. Many of these fragments were located and collected during the works for the shaping of the river bed, as preliminary procedures for the geotechnical research in August 2015 and 2016.

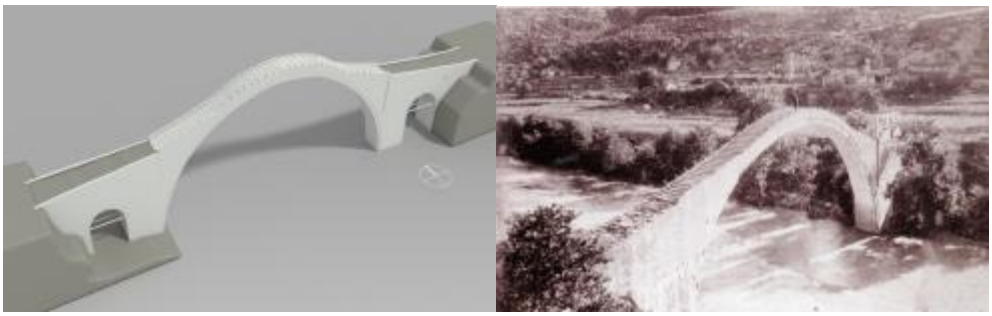

Figure 3: Construction phase 1 (1866-1927)

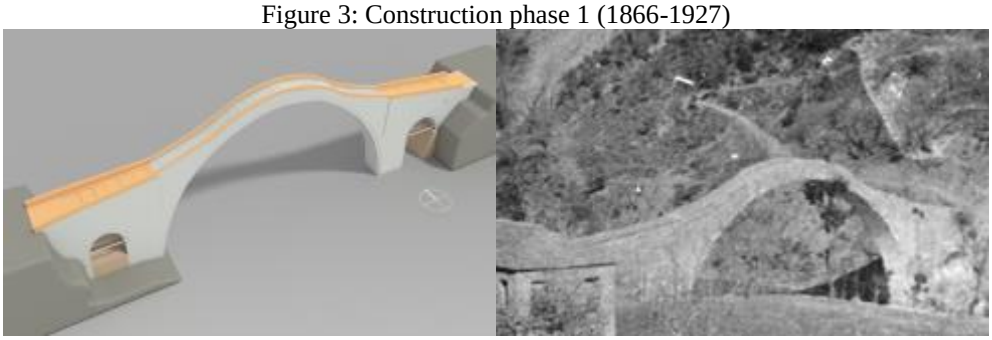

Figure 4: Construction phase 2 (1928-1945)

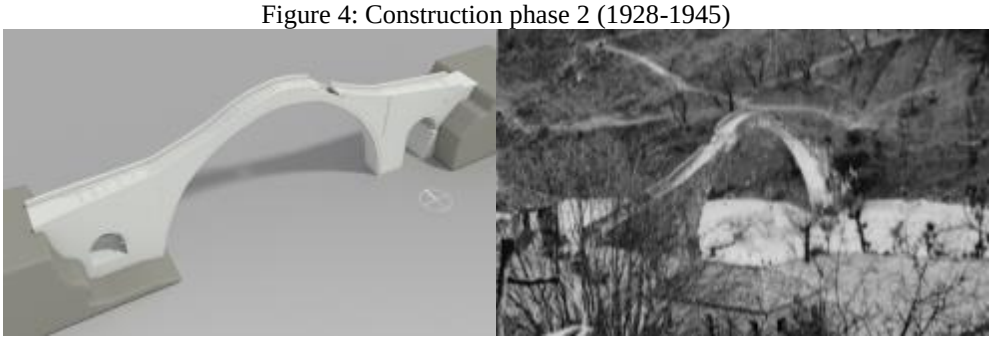

Figure 5: Construction phase 3 (1946-1947)

Figure 6: Construction phase 4 (1947-2008)

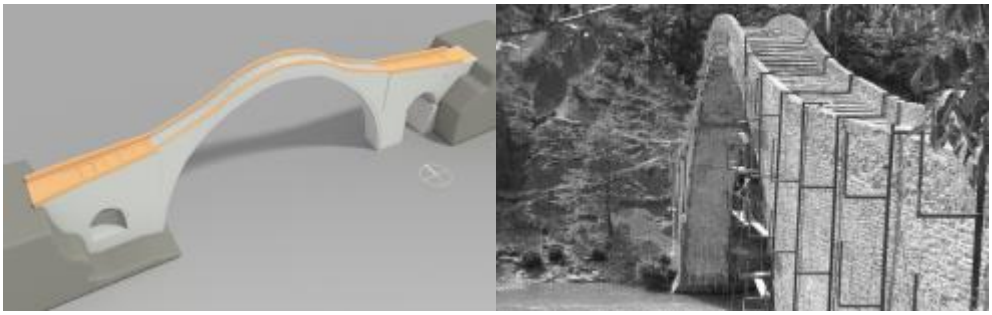

Figure 7: Construction phase 5 (2008-2014)

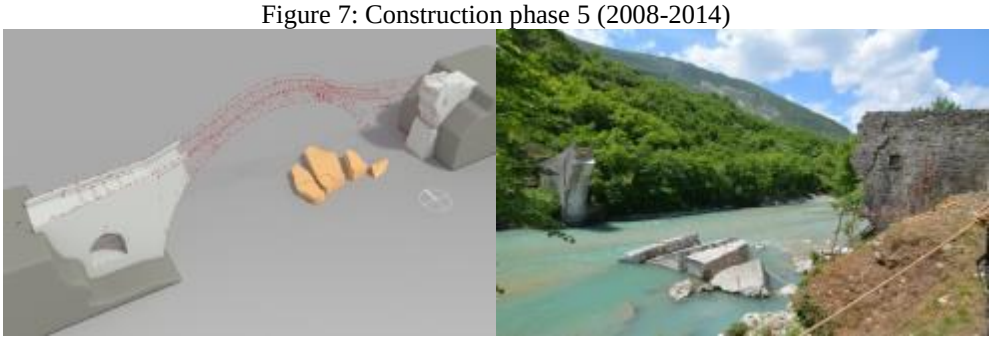

Figure 8: Bridge Collapse (01 Feb. 2015)

STRUCTURAL SYSTEM – CONSTRUCTIONAL ANALYSIS

Because of the large dimensions of the bridge's span and the characteristics of the construction, it is considered as a work of significant technology. It is important to note that due to the collapse, it was possible to detect the whole of the structural system and observe for the first time construction details that were not known until now.

The main arch

The main arch of the bridge was constructed by two individual arches placed one over the other. The inner arch was built with a small recess in relation to the upper arch. The construction of the arches was very good, with stones well shaped along the whole width of the bridge, thus providing a minimum width of joints ranging from 3 mm to 7 mm (Figure 9).
The main arch of the bridge is not defined as usually by one curvature but by double (Figure 1, Figure 23). The radius of the arches at the top part was different (smaller) from the radius at the lower part of the bridge and with a different center, causing a ~50 cm increase of the total height of the bridge. This was a design intention of the leading craftsman, it is also used in another bridge in Epirus (Konitsa) and is related to the construction methodology of the initial bridge. The height of the inner arch was about 60 cm and the height of the upper one about 50 cm, measured at the collapsed fragments that belonged to the lower part of the bridge. It is worth to mention that these dimensions increased at the upper part of the arches. This alteration of the dimension of the height of the main arch is depicted in the drawings of the survey of A. and G. Papageorgiou in 2005, and it is important to be noted that the change is distinguished more intensely in the area of the change of the curvature of the main arch. The main inner arch had a height ranging from ~62 to 74 cm, while the upper arch had a height of ~62 – 69 cm.

Figure 9: Inner and upper (secondary) arch of the bridge, general view (left) and detail (right).

Construction and Materials

The chemical and oryctological analysis has proven that local materials were used for the construction. The mortar was hydraulic. The outer shell of the bridge piers, as the arches, was constructed by a hard and dense limestone (flysch). The same material was used for the filling of the piers at their biggest part, only in the areas that transfer the loads directly to the ground (Figure 10). On the contrary, a lower density porous stone was used for the filling of the bridge at the arched part. The use of different materials as filling was a wise and intentional decision for the reduction of the loads at the free span part of the bridge and for the increase of the loads at the piers for stability reasons. Studying the fallen parts of the bridge it was noticed that the change of the filling material from limestone to porous stone was occurring at a specific point which coincided with a vertical recess constructed at the outer shell of the bridge (Figure 1, Figure 10 right). This is an architectural feature built intentionally by the masons, that also marks a hidden structural one.


Figure 10: West pier (left). The construction of the outer shell and the inner part of the pier can be clearly seen (the filling with porous stone, the holes of the timber reinforcements in the filling and the construction of the arches). Fallen fragments of the East pier (right). The change of the filling material from limestone to porous stone (yellow line) was occurring at a specific point which coincided with a vertical recess constructed at the outer shell of the bridge.

Timber reinforcements

Timber hidden systems were discovered unexpectedly in the interior of the stone structure. A unique system of timber grids was revealed when the stone parts of the bridge fell into the river and broke at the surfaces of the grids, since in most of these areas the timber does not exist anymore with one exception (Figure 12, left, center). Two types of timber grids were revealed. The 1st type was placed in specific distances, in between the well cut stones of the double arch of the bridge. At the same positions a 2nd type of grid existed, placed almost horizontally with a very small area of contact with the 1st type (Figure 11).
It is interesting to note, that the 4 longitudinal timbers of the 2nd type timber grid continued outside the inner mass of the bridge in order to become the tie - rods of the two relief arches at the piers (Figure 11, blue areas).
As mentioned before, only in one position, (fragment number 3) all the timbers were found in situ. Concerning the 1st type timber grid, longitudinal and transversal timbers of oak and of rectangular section approximately 5x12cm, were placed one on top of the other, connected with only one nail (Figure 11, Figure 12). On the contrary, the section of the timbers of the 2nd type grid was round with a diameter of about 12cm, placed one over the other with a small cutting of ~2-3cm, connected with one nail too. All timber parts were treated with lime probably for protection against decay.

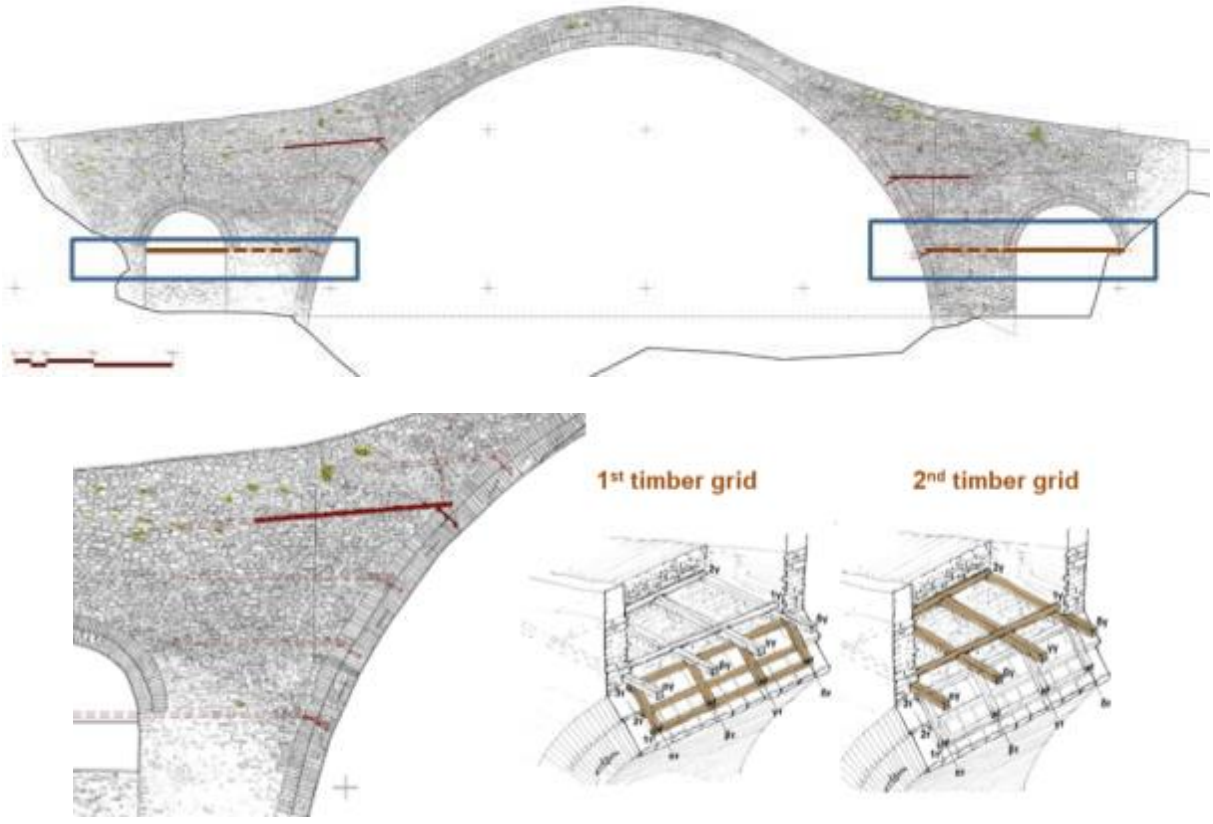

Figure 11: Position of timber reinforcement systems (red color) and graphic reconstruction of the two types of timber grid systems.

Figure 12: 1st type grid. Area of missing and decayed timber elements (left) and the only position that timbers have been found in place (center). 2nd type timber grid. Area of missing and decayed timber elements (right).

Metal reinforcements

Two systems of metal reinforcements were also found: The main metal reinforcement system is well-known and visible. It is a common method used in most bridges consisted of transverse, through, from side to side metal straps, placed only in the inner (lower) arch. These metal straps were anchored by metal "keys", at the face of the arch tying it transversally (Figure 13). The second system of metal reinforcements consists of metal straps incorporated within the mass of the stone material at the lower part of the piers. This system was hidden and unknown until the collapse of the bridge, because it was placed behind the stones of the face of the piers in horizontal levels, longitudinally and transversally, connecting the stones near the foundation of the bridge (Figure 13, right).

Figure 13: Metal reinforcements: Transversal reinforcement (left), horizontal metal straps in the lower parts of the piers (right).

Bridge deck

The deck of the bridge was made of stone (Figure 14). The deck had a different shape in the areas with higher inclination, towards the center of the bridge, in order to facilitate the passage. Both at the high and low inclined areas, the steps were formed vertical to the passage direction, with long stones, called "ougies". However, the steps are denser in the middle part of the bridge and as the inclination diminishes, the steps become sparser.
The deck has been locally repaired numerous times, not always succefully (Figure 14, left), in order to mend the problematic areas, so as to prevent water to enter through the deck and affect

the structural elements of the bridge. The central area of the deck remains mostly intact (Figure 14, right).

Figure 14: Bridge deck: Recently restored parts (left), original deck (right).

PATHOLOGY BEFORE THE COLLAPSE

The pathology documentation of the bridge before the collapse is based on the work of civil engineer D. Bakalis, Bakalis (1995), made during his thesis project in the School of Civil Engineering of NTUA. This documentation was updated with data originating from photographic documentation (crowd sourcing material), Stathopoulou et al (2015), and the archives of the Ministry of Culture, with information from different studies and reports conducted for maintenance or restoration works before the collapse of the bridge.

Figure 15: General view of the bridge before the collapse (left) and the area damaged by the explosives (1946) and repaired by reinforced concrete (1947) (right).

As mentioned before, severe damage at about one third of the width of the arch from the east was caused due to a demolition attempt with explosives during WW2 (Figure 15, right). In a symmetrical position to the previous damage, a horizontal crack existed for several decades as seen in old photographs, along the whole width of the main arch (Figure 16). It must be pointed out that the crack coincides with the point that the curvature of the bridge changes (Figure 16, left) and the central area of the bridge is becoming slender since only the 2 arches exist at this part. The topographic measurements showed that the bridge at this central area presents a quite high deformation at the horizontal level too.

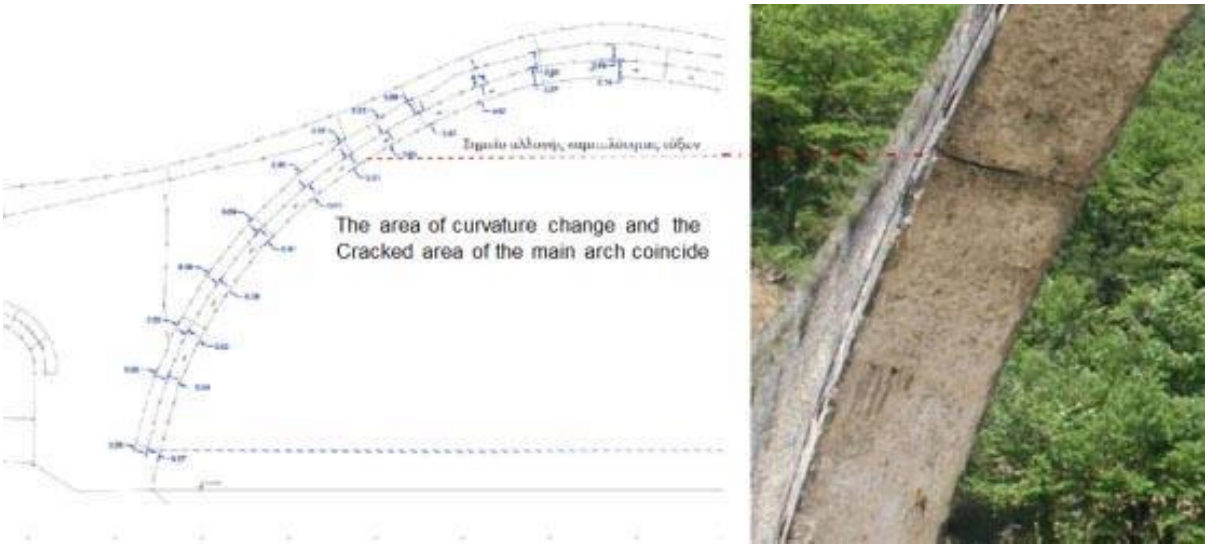

Figure 16: Area of curvature change (left, dotted line). Crack through the whole width of the arch (right).

Cracks were observed in the relief arches of the piers near the key along the whole width of the bridge.

Rain water passing mainly through the deck was responsible for a continuous corrosive action on the parapets, the masonry, the mortar and the timber elements at the inner parts of the bridge. The strenuous action of the moisture was worsened by the growth of vegetation, through its rooting system on the side faces of the bridge (Figure 15).

Also, a severe phenomenon of undermining was documented on the foundation of the east mid pier. It was first recorded in 1995 and it worsened since then a lot. It is considered to be the main reason for the bridge's collapse (Figure 17).

Figure 17: East pier before the collapse (left). Undermining on the foundation of the east mid pier before the collapse (right).

PATHOLOGY AFTER THE COLLAPSE – EXISTING CONDITION

East pier

Along with the main arch, a significant part of the east pier has collapsed. A part of the bridge drum and the small concrete slab of the deck has been severed from the pier and remained in an unbalanced condition (Figure 18). Both elements after the immediate measures have been secured from detachment and fall.

Figure 18: Existing condition of the bridge. The west pier at the left, the fallen fragments and the east pier at the right.

West pier

The west pier has been sustained in an angle of about 40 degrees from the theoretical center of the arch. The failure occurred once again in an area where timber elements were located (Figure 10). The parapets are dislocated and in danger of collapse. As mentioned before, in the past, cracks were found in the drums and in the area of the key of the relief arch, in the whole width of the pier. Cracks found there now, are not certain to be new. They might have been generated during the collapse or they could be cracks that had been repaired in the past and reopened. According to the new topographical survey, there are indications that the base of the west pillar does not present a change of position or rotation, in relation to the topographical survey of 1980. However the top part of the pier presents small shifts.

Fragments

The main fragments of the bridge found on the river bed after the collapse are four (Figure 18, Figure 19). Apart from these, there are also smaller fragments dispersed either next to the main fragments either towards the south of the river. Most of them are collected and moved next to the river for further study. According to the new topographical survey, the four large fragments have fallen in a position towards the north, which indicates the movement of the bridge towards that direction during the incident of the collapse.

Figure 19: The four main fragments situated inside the river (left). Collection of the smaller fragments dispersed in the river (right).

ARCHITECTURAL DOCUMENTATION

The architectural documentation was based on a combination of information, gathered from on-site visits, 2d surveying plans, image based generated 3d models with photogrammetric techniques, historical research and past restoration and surveying studies. Data from previous studies and surveys, Karakosta et al (1984), Bakalis (1995), A. and G. Papageorgiou (2005), had to be combined and enriched with recent measurements, new information and conclusions after the collapse. As a result, 2d architectural drawings were produced as part of the technical documentation, that describe all the main qualitative and quantitative characteristics of the monument, accompanied with 3d models and 3d sections, depicting a) the state before the collapse, b) the state after the collapse, and c) restoration proposals and guidelines (Figure 20 - Figure 22). By collecting data through crowd sourcing procedures, surveying engineers were able to produce an orthorectified image of the south facade of the monument before the collapse, Stathopoulou et al (2015). This orthorectified image was combined with the field surveying data of the campaigns of 1984, 2005 and 2015 in CAD environment.

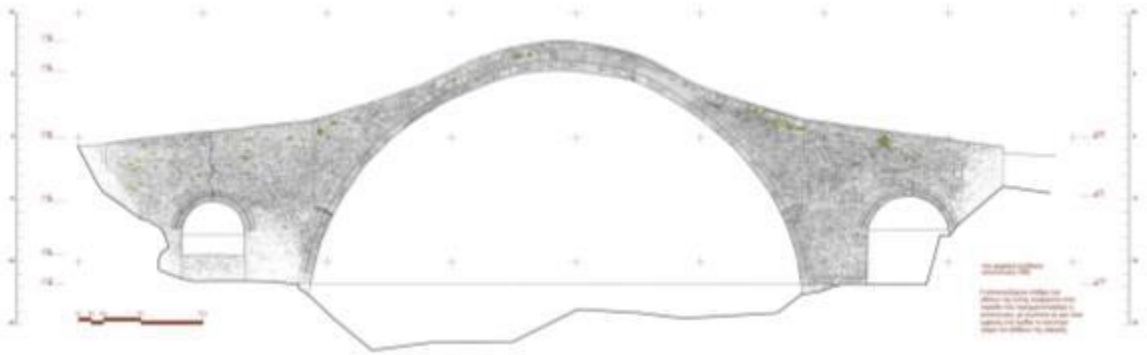
Figure 20: South façade plan.

Accurate elevation plans of the north and south facades were created, depicting the outline of the monument, the past and current pathology - cracks, fissures, detachments, deformations, biological degradation, etc.- and the sizes and types of the construction elements and building blocks.

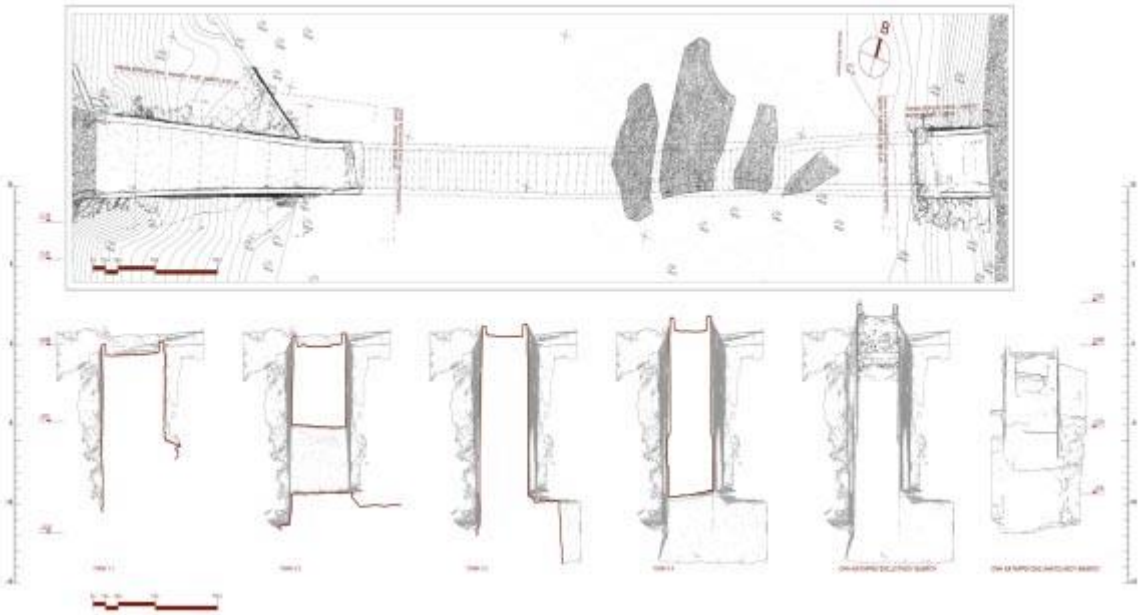

Figure 21: Plan and sections of the remains of the bridge.

For the current state of the monument, after the collapse, data was provided again by the team of surveying engineers of NTUA which was used to produce architectural drawings. Accurate sections (Figure 21) of the remaining parts of the bridge were produced in the areas of interest automatically from the 3D mesh (Figure 22), Kouimtzoglou et al (2017). Façade detail elements were also vectorized directly from the 3D model and were combined with the aforementioned plan sections and other conventionally drawn elements. New hybrid drawings were created, incorporating the accuracy of the reconstruction and at the same time trying to express the unique architectural and structural character of the monument since it is proposed to be restored to its original form.

Figure 22: Image based generated 3d models of the ruins: West pier (left) and East pier (right).

GEOMETRIC DEFINITION OF THE MAIN ARCH

An exact definition of the geometry and the outline tracing of the double curvature of the arches had to be rediscovered and documented by using the available research tools and digital assets, in order to produce the necessary data that will be used for the reconstruction of the missing parts of the bridge. The digital research procedure for the curvature definition involved an algorithm of consecutive division of the main arch into smaller arches. The centers of these arches were estimated and an overall average was calculated that revealed the existence of two centers and thus two curvatures. The calculated geometry of the original arch coincided perfectly with the topographic survey of the bridge in 2005, A. and G. Papageorgiou (2015) (Figure 23).

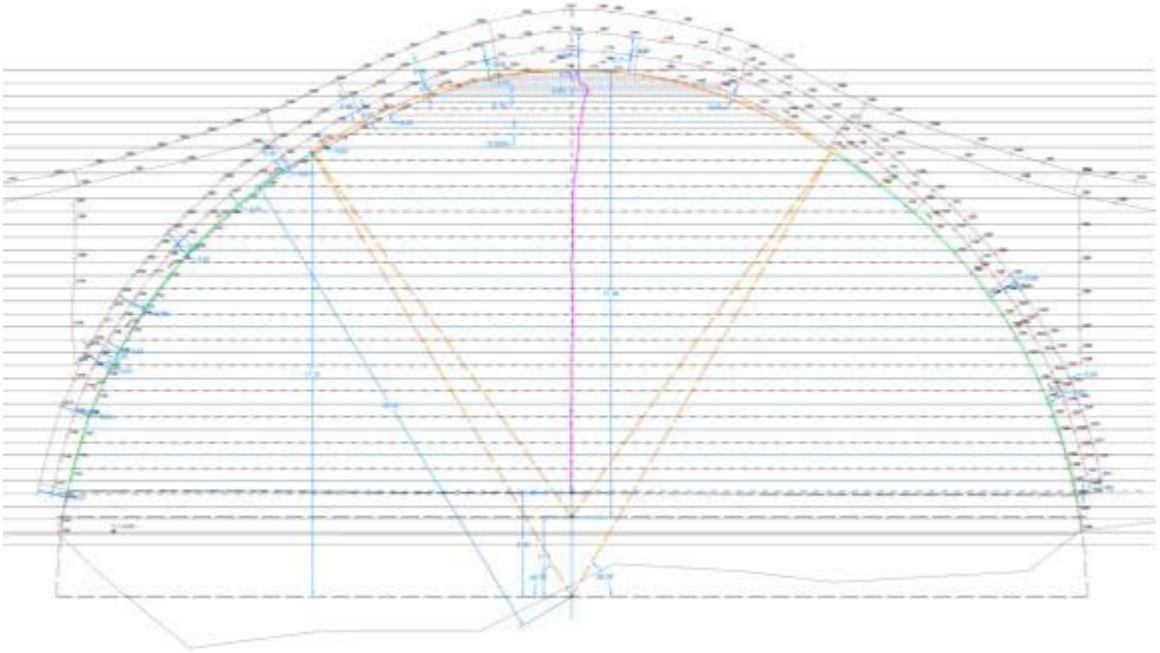

Figure 23: Structural displacements - deformations and double curvature definition drawing of the main arch.

CONCLUSIONS

As Plaka Bridge is a declared monument, it is imperative to reconstruct its form exactly as it was. As the use of the monument is not going to change, the structural requirements remain the same as the ones of the original bridge. The monument has a particular historical value and for this reason the local community has formulated too the request for the bridge to be rebuilt as it was. The research of the multidisciplinary NTUA team revealed important and until recently unknown details of the structural system. This data will be a valuable tool for the restoration process. National Technical University researchers believe that the anastylosis of the bridge must be realized as quickly as possible and with the above principles in mind. The preliminary architectural study for the restoration of Plaka Bridge presented in this paper, along with the rest of NTUA's studies, is a serious step towards the final restoration of the monument and a symbolic act that proves that there is a strong will and the adequate scientific knowledge for the protection of cultural heritage.

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BRIDGES AS SYMBOLS OF CULTURAL IDENTITY IN BOSNIA-HERZEGOVINA

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Summary

Bosnia-Herzegovina as the most western province of the Ottoman Empire for 500 years of occupation developed strong visual identity, strongly marked by Islamic elements. One of the highest achievements of Ottoman architecture aesthetically in Bosnia-Herzegovina are bridges. During history these had a vital role in the exchange of goods between cities, and became symbols of co-existence of the three main ethno-national groups (Bosnian Croats, Serbs and Bosniacs), during both the Ottoman occupation and the communist regime.

However, after the dissolution of Yugoslavia, when the war took place in Bosnia-Herzegovina (1992-1995), Ottoman monuments turned into symbols of division and reminders of oppression of the Islamic regime for the Bosnian Christians (Croats and Serbs), while for the Bosnian Muslims (Bosniacs) they became essential part of cultural identity.

The aim of this work is to analyze current narratives in Bosnia-Herzegovina on the example of two Bosnian-Herzegovinian bridges from the Ottoman period which are on the UNESCO Heritage List- Mehmed Pasa Sokolovic Bridge in Visegrad, and the Old Bridge in Mostar, to show how "emotional intensities" behind local narratives motivate social actions in struggles over identity and space.

This work also examines peace-building processes and the role of international institutions in the post-war Bosnia-Herzegovina, often criticized for their inability to understand the complexity of Bosnian conflict, for example, when imposing narrative of reconciliation only few years after the war, while memories of the conflict were still too vivid in the cities torn apart by suffering.

Key words: *dissonant heritage, cultural identity, place attachment, peace-building processes*

Introduction

This article discusses (re)construction of collective identities in the postwar society of Bosnia-Herzegovina, through the meaning-making processes (Kraus, 2007) revolving around the cultural heritage from the Ottoman period, namely bridges, in the cities of Mostar and Visegrad. Both of these cities were heavily affected by the last war (1992-1995) and divided by mutually exclusive historical narratives and performances of dominant ethno-national groups (Croats, Serbs, Bosniacs) in the power struggles over the ownership of "truth" and history, and therefore "authenticity" of national identities.

The overall historical context of this discussion is a dialectical interpretation of the Ottoman period in Bosnia-Herzegovina, most typically polarized between (Bosnian) Christian and (Bosnian) Muslim perspective (Lovrenovic, 2010) and reawaken by the need for identity affirmation after the last war, which coincides with the "postmodern cultural condition" of disappearance of "grand narratives" (Lyotard, 1984) of communism and a birth of new identity and memory politics in the entire Eastern Europe.

Following methodological design has been adopted: interpretative paradigm and qualitative analysis of social forces discovered by narratives to provide a coherent explanatory framework of a complex phenomenon that is relationship between place, heritage and social agency. Main source of evidence, official documents, on the one side,

and newspaper and websites articles, and brochures, on the other, have been chosen to convey information about the range of identity narratives, from official to grassroots level.

In accordance with the bottom-up perspective, this work adopts critical approach towards heritage management, that emphasizes the importance of "local" (Smith, 2004) in "developing post-western understandings" (Winter, 2013) of culture, history and heritage and the socio-political complexities of processes that "make" heritage (Byrne, 1991) in order to ensure its preservation (Smith & Akagawa, 2009).

The overall aim is to contribute to the general discussion on heritage definitions and concepts, openly criticized to be traditionally based on the Western understanding of heritage (Byrne 1991; Smith, 2004) which "implicitly relies on the nation-state as the developer of collective identities, overlooking settings where the primary mode of group identification and legitimization occurs at different (lower) levels" (Musi, 2014:54), as in Bosnia-Herzegovina.

This work also critically reflects on peace-building processes and the role of international institutions in the post-war Bosnia-Herzegovina, to examine "how policies pursued by international agencies to achieve an end to violence and rebuild institutions have had the unintended consequence of reinforcing ethnic identities and cementing ethnic divisions" (Aitken, 2007:247), for example, when imposing narrative of reconciliation only few years after the war, while memories of the conflict were still to vivid in the cities torn apart by suffering.

To understand *local* in *heritage*, this paper will address emotional attachment of the local community to the heritage site, as a fundamental element in the development of effective indicators for heritage management, through the concepts of "place attachment" and "intangible" and "dissonant" heritage. In which ways "geopolitics of bordering - as the processes of establishing psychological boundaries between 'us' and 'them', are materialized in heritage "through different affective intensities" (Laketa, 2016a:3), is the main question of this article. Such "visceral experiences of embodying a particular geopolitical identity are central for understanding the geopolitical conflicts over space and identity" (Laketa, 2016a:3).

Place attachment and heritage

Concept of place attachment is focused on the affects and emotions that people develop towards places where they are born and they live, in such a way that these places have a fundamental function in the lives of the people (Hernández et al. 2007). Emotional bond place-person can be positive (Hidalgo & Hernandez, 2001) or negative (Brodsky, 1996), so much so that a traumatic experience can generate negative feelings and even aversion to the place.

As a construct from environmental psychology, beside its emotional aspect (Hummon, 1992; Low & Altman, 1992), this concept can additionally be deconstructed on its cognitive and behavioral component (Hufford, 1992; Low & Altman, 1992). In cognitive terms, it implies the linking of meanings with the place through the processes of memory and distinctiveness while the third component can be operationalized through action which endows the space with individual and social meaning, through interaction processes (Vidal & Pol, 2005). At the individual level, experience and personal memory are the two most influential factors in the construction of spatial meanings. At the group

level, the attachment is composed of symbolic meanings that are shared with others (Low & Altman, 1992) with the aim of preserving culture and identity.

Smith & Akagawa (2008) implicitly acknowledge the relevance of the emotional factor in people's lives when they point out that heritage protection does not depend alone on top down interventions, but also on involvement of the local communities which, side by side with governments and heritage experts have a key role in preservation of heritage, values, traditions and customs for future generations.

However, UNESCO's conceptualization of heritage that traditionally comes from the Western European architectural and archaeological milieu (Smith & Akagawa, 2008) has neglected for a long time local agency in heritage studies. Western Authorized Heritage Discourse (AHD) has predominantly used terms as: "tangible, monumental, grand, 'good', aesthetic, and of universal value" (Smith & Akagawa, 2008:3) to imply that cultural heritage contributes "to sense of place as a source of pride, and by supporting feelings of distinctiveness and senses of continuity across time" (Hawke, 2010: para. 1). Nonetheless, grassroots narratives that are often shaped by dissonant voices, have been disregarded.

To correct such misleading and one-sided understanding of heritage, UNESCO's term of "intangible" heritage puts forward "the inherent dissonant nature" into debates on the global scale. This conceptualization acknowledges that heritage is a multidimensional concept that is constantly re-negotiated within cultural and identity politics in a series of conflicting practices (Tunbridge and Ashworth 1996; Graham et al. 2000; Smith 2006). It admits that "not only what is interpreted, but how it is interpreted and by whom, will create quite specific messages about the value and the meaning of specific heritage places and the past they represent" (Tunbridge and Ashworth 1996:27). Dissonant heritage, thus, permits to understand "a constitutive social process that on the one hand is about regulating and legitimizing, and on the other hand is about working out, contesting and challenging a range of cultural and social identities, sense of place, collective memories, values and meanings that prevail in the present and can be passed to the future" (Smith, 2006:82).

Ottoman period in Bosnia-Herzegovina

Historical evaluation of the Ottoman period has been a controversial issue ever since the rule of the Ottoman Empire has been changed for the Austro-Hungarian monarchy. Not even the appearance of the first institutionalized forms of critical science in Bosnia-Herzegovina at the end of 19th century brought any results over the course of the entire last century. As Lovrenovic (2010) states, this was not even the case in the developed period of the last Yugoslavia (1970-1990), when Bosnia-Herzegovina already had scientific research institutions and educated experts. In scientific circles it was clear then already that the "interpretation of the Ottoman period was the subject of dispute between two irreconcilable approaches, basically national-ideological, which made it impossible for this project to continue" (Lovrenovic (2010: para.13). Thus, the cultural history of the Ottoman period was never completed.

The rise of nationalisms at the end of 20th century which led to the violent conflict gave additional strength to the polarizing interpretation of Ottoman period which could be described, in the roughest lines, as "anti-Turkish" and "pro-Turkish" or, in Croatian, "turkofobija" and "turkofilija" (Lovrenovic, 2010: para.10). First discourse emphasizes

the repressive character of the Ottoman rule and Islamic religion, the neglect and the social misery of the non-Muslim population, conservatism, the general civilizational backwardness and the cultural vacuum of the epoch. This interpretation can be characterized as a Christian-Orthodox/Catholic, Serbian-Croat vision of the Ottoman Empire, while a historical cliché of Bosnia-Herzegovina as an idyllic Ottoman province, with good neighborly relations, tolerance, multiculturalism, economic and cultural prosperity "which were only 'threatened' by the malevolent nationalisms of the 19th century 'imported' from Europe," is one of the fundamental motifs of the new Bosniac national ideology, based on the uncritical idealization of Islam and Ottoman conquest of Bosnia-Herzegovina (Lovrenovic, 2010:para.10). This interpretation completely lacks the critical approach towards the occupation and destruction of the medieval Bosnian state and civilization, and it systematically avoids or minimizes the neglect of the non-Muslim population, as well as the emergence of religious fanaticism and exclusivity.

Lovrenovic (2001) discusses these issues widely in his work on cultural history of Bosnia-Herzegovina and proposes evaluation of the Ottoman period, based not on black-and-white totality of life reality and on arbitrary selection of materials that match two conflicting stereotypes, but rather on a comprehension of the complexity of historical circumstances, physiognomy of Bosnia-Herzegovina and, organic cultural processes in which simultaneously cohabit acting forces of divergence and strength of convergence.

Ottoman heritage – bridges

Physical structures are one of the visually strongest representations of historical and political epochs. Remaining in time, they help to create a strong link between the past and the present and to interpret cultural processes of change and continuity.

Bosnia and Herzegovina, as the most western province of the Ottoman Empire, during 500 years of occupation has developed a visual identity strongly marked by Islamic symbols and architecture. For its social and cultural physiognomy, decisive factor has always been its position between the Mediterranean and Central Europe and between the East and the West on the one hand, and on the other - the character of the closed, inner country bounded with Dinaric mountains and two major border rivers of Sava and Drina (Lovrenovic, 2010: para.1). Besides these two, Bosnia's biggest rivers are Neretva and Bosna. First one flows towards the Adriatic Sea, and the second one belongs to the Black sea basin, and together they represent a main transversal from Adriatic to Podunavlje (an area on the southern edge of Danube basin, located partially in Croatia and Serbia). From the prehistoric time, the development of this whole area is concentrated around this transversal (Benac, 1982). In total, Bosnia-Herzegovina counts 262 bigger and smaller rivers.

Thus, it is no surprise that one of the most prominent monuments from Ottoman period are arch bridges, which were highly relevant for the exchange of goods and people between cities. Construction of bridges was most prolific in the 16th century with 34 objects, 17thwith only 10 and in 18th century 15 bridges (Celic & Mujezinovic, 1969: 29). Due to their utilitarian purpose and non-religious character, "in the Ottoman theocratic state," where "religious community was the only organized and institutionalized form of expression of various ethnic, historical, cultural, political and other interests" (Lovrenovic, 2010: para.33), these structures symbolically belonged to everyone. Accordingly, the politics of "non-politicization" of Ottoman bridges, also continued in the time of Yugoslavia (Armakolas, 2015) given it was ruled by communist ideology that

"denied nationalistic particularisms, claiming these were historically overcome and politically neutralized" (Lovrenovic, 2010: para.13).

However, the last war (1992-1995) disrupted significantly relationship between cultural landscapes and sense of belonging in Bosnia-Herzegovina.

Old Bridge in Mostar and Mehmed Pasa Sokolovic Bridge in Visegrad

Old Bridge or Stari Most in Mostar, and Mehmed Pasa Sokolovic Bridge in Visegrad, have a lot in common. Firstly, both were built in the 16th century by the Ottoman Turkish architect Mimar Sinan and his disciple Hayruddin (Jezernik, 1995) and had a strategic importance in connecting Ottoman Empire with its West at the time. Secondly, both bridges have been included on UNESCO Heritage List, Old Bridge in Mostar in 2005 (UNESCO, 2005), and the Visegrad Bridge in 2007 (UNESCO, 2007), as a part of an international intervention, which tried to deploy them as symbols of reconciliation within peace-building processes after the war.

Nevertheless, such simplistic international narrative (Björkdahl & Mannergren Selimovic, 2016) has shown to have a counter effect on reconciliatory dialog and it was never incorporated into local narratives (Makas, 2012; Sahovic, 2007). The "local turn" and the critical approach, which have also been adopted just recently in the studies on peace and conflict, recognize and identify this problem as a result of an usual international practice of imposing "normative power" of the main actors (UN and EU, among others) in peace agreements all around the world; often negotiated according to Western rationality which disregards needs and wants of the local constituencies (Mac Ginty & Richmond, 2013). This has been the case, among many others, in Cyprus (1974 and 2004), Israel/Palestine (1992), Kosovo (1998), Afghanistan (2001) and finally, in Bosnia-Herzegovina in 1995 (Kappler, 2014).

To put the focus back on local community within the peace-building processes Mac Ginty & Richmond, (2013) set forth the role of culture, history and identity in international interventions.

Here we come back to the Ottoman period in Bosnia-Herzegovina, which we have put forward in this work as a historical setting for the birth of emotions and affects that formulate attitudes of the conflicted groups towards Mostar and Visegrad Bridge today and which, in the first place, relate to the polarized interpretation of the Ottoman period. As Lovrenovic explains (2010: para.5), Ottoman period in Bosnia-Herzegovina:

> "has determined cultural and political structure and appearance of this country in the new age, and the events and processes of the early nineties of the last century show that the historical and mental heritage of this period is very lively and active today. The nature of socio-historical and cultural identity of Bosnia and Herzegovina cannot therefore be understood without understanding the interactive and dynamic structure of the relation of the confessional-ethnic elements as established by the Ottoman conquest and the introduction of Ottoman-Islamic civilization into Bosnia and Herzegovina."

Polarized discourse on Ottoman period stems from the historical fact that Serbs and Croats during 500 years of the Ottoman Empire were second class citizens, where Croats–Catholics were in the worst position, given that Catholicism, with the religious center in Rome and political in Vienna, was the strongest ideological enemy of the Ottoman

Empire (Lovrenovic, 2010). Serbian Orthodox Church did not represent a significant threat given its patriarchy was under the Ottoman territory and therefore, easier to control (Lovrenovic, 2010). Such position of Bosnian Christians has shaped permanently their perception towards the Ottoman rule as an enemy force and an intruder. Bosnian Croats and Serbs never actually developed a significant sense of belonging, on a collective level, towards Ottoman identity or heritage (IPSOS, 2011:111).

Consequently, in the last war when the Ottoman (Muslim) Empire was mobilized as an image of the archenemy that forever changed the course of history of Bosnia-Herzegovina (as many other segments form history that were manipulated by all three sides), this "lack" of attachment easily progressed towards a strong negative affect (Traynor, 2004). Unlike Croats and Serbs, Bosnian Christians who converted to Islam with the arrival of Turks, have come to identify themselves with the Ottoman state identity significantly over the course of time, and therefore, "feel" Ottoman heritage as their own (Custo, 2013; IPSOS, 2011:111).

Secondly, the emergence of new identity and memory politics in the entire Eastern Europe after the fall of communism has caused a great shift in dealing with the "unwanted past." The war additionally complicated this task in Bosnia-Herzegovina. After the war, politics of non-politicization of "ethnic particularisms" typical for ex-Yugoslavia (Lovrenovic, 2010) were changed for a symbolic competition of identity affirmations among all three main ethno-national groups (Armakolas, 2015), through demarcation of territory with symbolic elements, where cultural heritage came to play a crucial role. In this way, both bridges in Mostar and in Visegrad turned into contested *lieu of memoire* (Nora, 1989) in the post-war period.

In the case of Visegrad, today in Republika Srpska (Serbian entity of Bosnia-Herzegovina), every year in May hundreds and thousands of Bosniacs gather in Višegrad to commemorate the death and the suffering of Muslim victims that were raped (Dzidic, 2014), tortured and killed on the bridge and other areas of the city by Serb paramilitary groups, like for example in the hotel complex Vilina Vlas, which today functions normally and without any visual reminder of the committed crimes (Vulliamy, 1998). The commemoration consists of throwing 3000 roses into Drina, one for each victim of atrocities committed in Višegrad (TeVe Novine, 2015). This act is an attempt of appropriation of physical space that would materialize the pain and the memory and reaffirm the community's identity through visual representation of the "truth." It is a powerful performance that completely turns the bridge into a symbol of Muslim suffering (Visegrade Genocide Memories), in the city where ethnic population after the war is almost entirely Serbian and where there have been various attempts of obstruction of erection of Bosniac memorials (Dzidic, 2014, Hooper, 2012).

As a response to such an "emotionally charged" territorial appropriation of Bosniac community, Serbian community has built its own *lieu of memoire* – Andricgrad (Andric city), a commemorative complex to Serbian history and identity (Tanjug, 2014), placed in the close proximity of the Visegrad bridge (Nikolaidis, 2014). It is a joint project of a famous film director Emir Kusturica and Milorad Dodik, president of the government of Republika Srpska. It is no coincidence that this "city" (grad) within the city – is called Andricgrad, as a homage to a Nobel winning author (1961) Ivo Andric (Jankovic, 2012) whose national identity is also a matter of controversy, given that he is considered to have Croatian origins (*Ft comment:Ivo Andrić 'not Serbian…but child of Croat parents*", 2014), so this too could be interpreted as an attempt of appropriation of cultural heritage. Furthermore, the awarded novel is entitled "Na Drini cuprija" (The Bridge on the Drina

river, 1945) and describes the city's life around the bridge in the multicultural Visegrad in the 19th century. However, it also speaks of Ottoman injustice towards Serbian habitants, thus offering a historical justification for an indifference or a negative affect towards all that it Ottoman and Muslim (Dzidic, 2106; Toe, 2013), and an excuse for a collective state of amnesia regarding the last war, for the great part of Serbian population (Dzidic, 2014, 2016; Singh, 2014). The Bosniac side holds the erection of this monument site provocative and defines it as "Disneyland of Serbian nationalism" (Nikolaidis, 2014).

Similar to Visegrad, on November 9, Bosniacs gather on the Old Bridge in Mostar to commemorate its destruction by throwing lilies into the river Neretva (Brin BiH, 2010). However, as opposed to commemoration in Visegrad, where they gather to commemorate human victims, here they commemorate the "death" of a physical structure. By doing so, they give to the bridge a human dimension (*Stari Most: A living memory of the Bosnian War*, 2014) and symbolically demarcate the territory by appropriating it from the "Other", in this case, Croats, making clear to whose cultural memory and identity it belongs.

Nonetheless, such practice only re-strengthens the lack of attachment to the bridge that traditionally exists in the overall Croat cultural memory since Ottoman times, given that this practice is perceived as a part of victimization discourse of Muslim politics (Merdjanova & Brodeur, 2010), that tries to impose collective guilt on Mostar Croats for the bridge destruction, while lacking to admit its own errors during the war (Lovrenovic, 2010) by mobilizing tragic events for the Bosniac nationalist political agenda. In Mostar's case, the final outcome of these practices is that younger generations of Croat community do not feel comfortable visiting the bridge nor do they "feel" the bridge as part of their own identity (Laketa, 2016b).

Conclusions

In this paper we have examined processes of establishing psychological boundaries towards the "Other", as materialized in heritage through different "affective intensities," arguing that place attachment of the local community is one of the crucial components in the development of effective indicators for heritage management, on the example of Ottoman arch bridges in Bosnia-Herzegovina.

Ottoman heritage has been chosen for its relevance in understanding historical context of the country, as introduced by the Ottoman conquest 500 years ago, and for its role both as an instrument and an aim of politics of embodiment of geopolitical identity in contemporary Bosnia-Herzegovinian society.

Particularly, on the example of Old Bridge in Mostar and Mehmed Pasa Sokolovic bridge in Visegrad, as seemingly neutral and non-religious Ottoman structures, we have shown how meanings of historical heritage are re-negotiated depending on the emotional attachment of the local community towards the heritage site. Emotional aspect is widely disregarded in top down interventions on heritage preservation while it is highly relevant for understanding local constituencies and motivations in everyday context, which is why it should have a central place in discussions on: narrative and performative power of heritage, its intangible value and its dissonant nature.

Additionally, to discuss the dichotomy between bottom-up and top-down approach towards heritage management and to prove our point, we have also critically reflected on inclusion of both bridges on the UNESCO Heritage List as part of the top-down intervention of the international community in peace-building processes in Bosnia-

Herzegovina after the last war (1992-1995) which tried to deploy both bridges as symbols of reconciliation without taking into consideration that the cultural trauma permanently disrupted sense of belonging to these historical places and developed mutually exclusive grassroots narratives which do not acknowledge reconciliatory "international" narrative as authentic until present.

To resume, both cases have shown that emotions and affects are indeed central for understanding political and social restructuring in postmodern world, as Laketa (2016a) argues in her work, and that the sense of belonging to the heritage site reaffirms or challenges "authenticity" of one's culture and it is therefore a (de)legitimizing force behind the local narratives and agency in struggles over identity and space.

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Bridge of Ojuela, industrial heritage of northern Mexico

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Bridge of Ojuela, industrial heritage of northern Mexico

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The present work is the result of a research in direct documentary sources about the Bridge of Ojuela, constructed for industrial purposes in a mining camp of the north of Mexico at the end of century XIX. The investigation starts from a historiographic and hemerographic revision and concludes with the exposition of evidences found in direct sources of the historical archive of Peñoles Mining Company, that ordered to construct the Bridge and until today it conserves it. The paper aims to add to what has been written on the subject, reporting the findings in the review of documents and records.

In this review, valuable data were located in records produced between 1899 and 1905. The documents, administrative assistants and accounting books of the Fund studied are of different years since there is no consecutive or complete series.

Between November and December 1899, the construction of the Bridge of Ojuela was completed, but there is reason to believe that it was projected since 1897 as part of a plan for the growth of mining operations, which required good communication channels. The Bridge was built in five months and this work gives us certainty of who was its builder.

Another objective of the study was to review the short-term impact of the use of this infrastructure, and whether the increase in the delivery of ore from Campo Sur and Ojuela and Anexas was notable. Ore is the mineral (rock or gravel) wich contains gold and other elements at an economic concentration grade and therefore susceptible to being extracted and processed.

Location

The Ojuela Bridge was built in 1899 in the Mineral of Ojuela owned by the Peñoles Mining Company - hereafter Peñoles - in the municipality of Mapimí, Durango. Ojuela is located 4 miles southeast of the city of Mapimí, Durango and 40 miles from Torreon, Coahuila. The distance to Mexico City is 654 miles and 430 miles from Eagle Pass, one of the border cities of the United States with Mexico.

Background

Mapimí, Durango was founded in 1598 and the Mining Company of Peñoles came to settle there in 1891.

In 1777 the rights of exploitation of the mine of Ojuela and other neighboring ones had the landowner José Valentín Vázquez Borrego. It was described as a mine worked with intelligence, with cannons, cruises, wells and all that was necessary, which promised many fruits, but was very destroyed (Morfi, 1980).

Mapimí was a Real of Mines of regular importance. A topographical description of 1791, ordered by King Carlos IV of Spain to Viceroy Revillagigedo in New Spain, includes a description of the mining situation in that region. The number of mines that were then worked is not specified, only three are mentioned who were considered the largest “Talpa”, “San Pedro” and “San Ignacio”. The main production was greta of lead. The silver was recovered and 9 foundry estates were installed in Mapimí, of which only 7 were active.

The report mentions that its methods of casting were not efficient, that by the thinness of the silver “the fire flies” and for that reason a lot of law was lost. (Vallebueno & Arreola, 1998: 28).

Even after the independence of Mexico the mining in Ojuela continued in charge of Spaniards until 1829. The new Mexican miners were holders of shares of the city of Durango but they lacked experience and accumulated technique that had the Spaniards, reason why the production was declining.

Among other situations the war with the United States between 1846 and 1848 (Arreola & Vallebueno, 1998:58) was also an obstacle to the growth of mining. The mines were owned by different owners during the following decades until the Mapimi mines passed into the hands of A. B. Sawyer who sold them to the Durango -Mapimí Company of Council Bluffs, Iowa, while he remained in charge of operations. Durango -Mapimí gathered the main mines and managed to benefit 20 tons of ore per day (Bernstein, 1964).

In the last third of the nineteenth century a new industrialist impulse arose in the country, with considerable importance being given to mining. Railway communications were established throughout the country and legal privileges were given to industries (Industrias Peñoles, 1988:11). They were years in which capitalized Mexicans and foreign investors went to the mining. Electrical energy was introduced to the mines of Mexico, the use of powerful explosives, modern machinery and the advances of metallurgy that made possible to benefit of low-grade ore.

According to the newspaper El Minero Mexicano, in 1893 it was reestablished in Mapimí Mineral, after the Mexican Independence War and the expulsion of Spaniards. In that seven-year period, 504 mines had been reported to the branch office with an area of 7,077 hectares (El Minero Mexicano, 1900:161).

Profile of the Peñoles Mining Company

The Peñoles Mining Company was founded in 1887 by Mexican partners from the denunciation of three mines located in the Sierra de Peñoles in San Pedro del Gallo, Durango. In 1890, the Company sought to acquire the Hacienda de Agua, in Mapimí, Durango, an old smelter, with the purpose of processing the product of the exploitation of its mines, Jesús María, Nuestra Señora del Refugio and San Rafael, which had long

been abandoned, in addition to establishing a large-scale purchase of metals (El Minero Mexicano, 1890:307).

On the other hand, in 1890 the Minerals and Metals Company was established with Jacob Langeloth of Frankfurt, Barthold Hochschild of New York, Metallgessellschaft of Frankfurt, Henry R. Merton and Company of London, which was a subsidiary of the American Metal Company. The Company Minerals and Metals was buying shares of Peñoles and in documents of 1909 specifies that the original plan contemplated that the total shares of Peñoles be divided into parts: 25% for Compañía Minerales y Metales, SA, 30% for Frankfurt and Cie. Des Minerals, 22.5% for American Metal Company and 22.5% for The Metallurgical Company of America (Industrias Peñoles, 1988:35), but the business plan for this Company was changed.

In 1891 the Mining Company of Peñoles purchased the rights of Ojuela in the Sierra de la Bufa and other annexed mines and the Hacienda de Agua in Mapimí in the state of Durango. It was in 1893 that its new shareholders decided to invest in the development of infrastructure that would allow the efficient extraction, transportation and smelting of ore for export as unrefined metal bars.

Peñoles then worked with 32 mines in the area (Industrias Peñoles, 1988:32) and had hired engineer Charles Riedt as General Manager of Peñoles. He was born in the United States and studied Freiburg, Germany (Casper, 1897). He made geological studies of the area and promoted the incorporation of foreign capital. With an investment of half a million pesos, began the installation of the most advanced equipment that Mapimí knew; invested in a plant of extraction and transport of ore, (Industrias Peñoles, 1988:17) among other things. Charles Riedt directed the first important development of Peñoles during its management that concluded in 1905.

Five smelting furnaces installed until 1896 had the capacity to process 200 tons of ore per day, to which five more furnaces would be added at the end of the year of 1897. In the smelting, lead and silver ingots (unrefined metal) were produced. The speiss of gold and silver were also separated in the process. All metal was sold in Hamburg, Antwerp and New York (Casper, 1897).

As for transportation infrastructure, by 1897 Peñoles had already built about 34 kilometers of railway line and two stations communicated to each other via a telephone line. (Semana Mercantil, 1897:409). The Company's Railroad brought the raw materials to the smelting's at Mapimí. It also moved passengers and various goods. In this way also came the metal bars of the smelter whose final destination were international markets. One station was within walking distance of the "Hacienda del Agua" at Mapimí, where was the smelting, and the other station was known as "La Sierrita", which was linked to the Central Mexican Railway of the then named Mapimí Station. The distance between both was of 24 kilometers of routes of adhesion. The Company built another 5.5 kilometers of rail line from the smelter to "El Cambio", where the line of adhesion ended and the 3.2 kilometers of rack train to Ojuela began at an inclination of 1000 feet.

In the newspaper *Semana Mercantil* it is mentioned that the railroad lines were built in ten months and that up to that time it had invested $ 500,000. It is also stated that by this route two hundred tons of metal (sic) were transferred daily to the Hacienda for its benefit (Semana Mercantil, 1897:409). The technology used in the rack was the Abt system, also known as "Cog". The railways of Peñoles served 2000 passengers per month. Freight and business passengers made it a profitable investment. (Casper, 1897). At the beginning it had 2 locomotives, 5 passenger cars and 65 cars to load fuel and mineral. By 1899 there were already 8 locomotives, including the Adhesion and Abt system (El Minero Mexicano, 1900:93).

Ojuela and annexes already had works of underground communication in the mines of "El Socavón", "San Ignacio" and "San Judas". Comfortable houses had also been built for the rooms of the operators and their families, and the casing of the water from the point of "El Cambio" had been carried out by means of a pipe that raises the water by a motor with a force of two hundred horses (Semana Mercantil, 1897:409).

In the mines, 700 workers were employed, paid between $ 1.00 and $ 3.00 dollars per day, and 200 houses for workers in Ojuela (Casper, 1897) had been built.

In 1898 the Mapimí Station of the Mexican Central Railway changed its name to Bermejillo Station (La Patria, 1898). It is noteworthy that José María Bermejillo, a Mexican businessman of Spanish descent who attended a variety of businesses, was a shareholder of Peñoles. The partners of the Mexican Central Railway renamed the station in his honor.

First results

The improvements implemented in the mines, the smelter and the transport system showed good results in the short term. On July 8, 1898, the Board of Directors of Peñoles agreed on the 30th ordinary dividend of $ 30.00 pesos per share, which would be paid in the office of the Bankers Señores Bermejillo y Cía. (El Tiempo, 1898).

Months before that official publication, the newspaper reports referred to a dividend of $ 30.00 pesos, as a result of the increase in profits from the recent installation of new kilns (La Voz de México, 1898) (El Nacional, 1898), which suggests that there were two installments of dividends during 1898.

There is evidence in the administrative books of Peñoles about the investment that continued to be made in the smelter, in the mines of Ojuela and annexas, and in Campo Sur and in the railroad during the following years. It also recorded the purchase of other mines and investment in exploration. All this the Company realized through reserves that created under the concept of "Immovable profit for improvements" and in some cases resorting to bank loans. (Compañía Minera de Peñoles, 1899-1918).

After many requests in 1899 the International Railway concluded the construction of a branch to the Bermejillo Station to connect with the Central Railway, thus facilitating

the transfer to the United States of Peñoles products and other regional goods and reducing costs in loading and unloading (The Two Republics, 1899:5).

Bridge of Ojuela, infrastructure to increase production

The Company did not give up investing in the set of mines that were on the other side of the Ojuela canyon and to obtain a good result it was necessary to improve the transportation system of the ore and to reduce the cost of that operation. An abyss of more than 100 meters separated the operation of Campo Sur where was located the Shaft 4 of Ojuela, where they concentrated the ore extracted by 3 shaft to where the rack train arrived. The project was also to load in Ojuela the ore extracted by the Shaft 4, to transfer them to the Hacienda in Mapimí. The solution was to build a suspended wooden bridge with steel cables and with a track to the center for freight wagons. The technological challenge was huge. The length of the bridge that was constructed is of 1,030 feet, 6 feet of width and the cables that support it are of three strings of braided steel of 2 inches. The total weight of the bridge was 150 tons. The maximum load was four six-ton ore carts, ranging from mines to gravity containers and pulled back through the bridge by a ½ inch cable operated by an electric motor (The Engineering Record, 1900).

The Bridge is a complement to the set of communication and transportation works that the company implemented and to which reference has been made. Presumably it was projected at the same time as the railroad tracks, but executed with a difference of almost two years.

North Towers of the Bridge of Ojuela, c. 1900. Copyright De Golyer Library, Southern Methodist University.

In November 1899 the new Suspended Bridge of Ojuela (The Mexican Herald, 1899:8) to the Ojuela mine through the latter.

This reduced labor costs and the purchase and maintenance of beasts of burden, or payment of rent of the same. Another important factor was the decrease of the time for the delivery of the ore. Previously the ore was lowered by the slope in the beasts of burden that were to surround a hill until leaving to “El Cambio” where was discharged in deposits and from there passed to the railroad cars, which required many workers and work hours. Also the bridge was beneficial for the workers since those who lived in Ojuela and worked in South Field no longer had to go down and climb the steep road twice a day. (Furman, 1900:265).

Bridge of Ojuela was considered “the only one of its kind in the Republic” (El Minero Mexicano, 1900:93). In the same edition an account is made of the works carried out by Peñoles in recent years.

Transport technology made it possible to accelerate the placement of water pumping technology, one of the main challenges of the mines in that area and mainly opened the possibility of installing more elevators powered by electric motors. The number of machines, tools, electricity generators and equipment for loading and transport that is acquired and installed in the mines during the following years is remarkable, which can be observed in the accounting records and more quickly between 1900 and 1909. This was in accordance with the advance and the ore reserves that had calculated, since the payment of rights of exploitation of more mining funds that could be interconnected from Ojuela or from Campo Sur was increasing. As a result of the investment in technology, the production of the mines rose and the ore reached the smelter in less time.

The direct expenditure for the transfer of ore from Ojuela to the smelting treasury, from 1901 was calculated at 1 peso per ton, that is to say 41 dollar cents of that time (Compañía Minera de Peñoles, 1901). case of the Dolores mine, which until that moment did not have the same connectivity and its ore transfer cost was very high.

It was essential that the growth of the business was in parallel, so the smelter grew its installed capacity with the construction of what they called Foundry 2 in 1902 which consisted of the installation of 8 kilns of calcination where sulphites were processed and the process was maintained of the oxides as was being done. The data is relevant because it shows the technological challenge that the Company was facing, implementing a new process given the quality of ore that were being mined in the area.

South side of the Bridge of Ojuela, c.1900. Copyright De Glolyer Library, Southern Methodist University.

To increase production, more energy was required, then a change in the way of producing it, introducing diesel “oil” engines and turbines that use coal. Among other things, in 1900, electric locomotives were purchased for the foundry (Compañía Minera de Peñoles, 1899, 1900, 1903), even though steam engines were not abandoned.

In summary, the investment began to pay off almost immediately, since ore extraction increased and metal production also increased since 1897, but even more so from 1901 onwards.

In 1896 production capacity of metal was 200 tons per day. By 1901 the foundry was of 460 tons per day. In 1902 were processed 556 tons and the second foundry was built.

In 1905 the form of reportability of the mines and of the smelting is modified. That year there is no report of growth in production. Perhaps it was the preamble of a change of direction and with it the implementation of new technologies and processes that impelled from 1906 Kuno Heberlein, when it was contracted to direct the company. Heberlein, of German origin, a metallurgist doctor, a family of metallurgists and who would later become a shareholder of Peñoles, created and implemented processes in the Mapimí smelter. The changes were not beneficial immediately, the growth was gradual and this can be noted in the Annual Report of 1912 (Compañía Minera de Peñoles, 1912) when 673 tons were produced per day. It was the time that Peñoles began to explore and develop new mines in other sites of the country.

The Mining Camp of Ojuela

The relevance of the Ojuela and Anexas mines can be measured by seeing the constant investment they were made. In May 1902 work was done for the installation of a 2000-horsepower dynamo for a new electric slide rail of Ojuela and to run the mine drainage pumps. As for transportation of ore, the transfer of Ojuela to Mapimí would be faster and the cost would be reduced by replacing the use of the stone coal to generate steam. (Escudero, 1902)

Much of the increase in both productive and social investment in Ojuela was later given to the installation of the rack train and the suspension bridge. In the first place a third constructive stage was detonated in the town increasing the works spaces and the number of houses for workers, becoming more than 300 only in Ojuela.

The production area had as its central axis the road that reached the foot of the North Shaft and the work yard where the wagons with ore were unloaded on the railroad cars that were transferred to the foundry Hacienda in Mapimí. On both sides of the courtyard were various facilities and workshops and along the center ran the steel track to the bridge. This one continued on the Bridge to cross towards the south, arriving until the opening of the Shaft 4 in the Campo Sur.

Ojuela maneuvering yard, c.1900, Copyright De Goylyer Library, Southern Methodist University c.1900.

The mining complex of Ojuela, its operations and daily life are worthy of studies apart.

Findings about its builders

1.- Starting from the data captured in the book *Primer Siglo de Peñoles, historia de un éxito* published in 1988 by the company itself, it was tried to verify if there are data of Santiago Minguín, who is mentioned as the builder of the Bridge of Ojuela. The first questions arise Who is he? What is the source of that statement?

Among the findings found in the few administrative and accounting books that are part of the Ojuela-Mapimí Fund and covering the period from 1899 to 1918 is an employee named Santiago Menghini, but there is no record of someone named Santiago Minguín.

Due to the technical complexity of the Bridge of Ojuela it is evident that the builder must have been someone with a high level of training and vast experience, who probably belonged to the circle of professionals in a specialized environment. It does not seem possible that the builder of Bridge of Ojuela was a stranger.

Returning to the documentary source of Peñoles, the oldest record we find of Santiago Menghini is in 1904 and his last record is in1911. Peñoles was an employee of trust and

was assigned in Ojuela. There is no data on any of your payroll records that speaks of your role in the Company.

As a conclusion to this point, there was no proof of the participation of Santiago Menghini or "Santiago Minguín" in the construction of the Puente de Ojuela, nor is there any certainty that he worked in Peñoles in 1899. However, some local people linked him with the Bridge and his name transcended as the bridge builder. The reference came to the eighties and from that "oral tradition" was taken the data for the book edited by Peñoles.

2.- Claude T. Rice in his article Mines of Penoles Company, Mapimi, Mex. (Rice, 1908) says that the Bridge was built by John A. Roebling's Sons Company, a statement echoed by David Mc Cullough (Mc Cullough, 1992). However, in the accounting records of Peñoles in 1899 is located a single payment for that company and is for the concept of "Cables". The 679 check was made on August 4, 1899 for the amount of $9066.38 Mexican pesos, equivalent to 4,350 dollars, charged to Ojuela, which coincides with the moment when the Bridge was being built. (Compañía Minera de Peñoles, 1899).

With these findings in the Historical Archives of Peñoles, it is clear that the degree of involvement of the company John A. Roebling's Sons Co in the construction of the Bridge was limited to being supplier of steel cables.

3.- William Panczner (Panczner, 2012-2013) mentions Wilhelm Hildenbrand as the builder of Ojuela Bridge and David McCullough (Mc Cullough, 1992) states that Hildenbrand was the bridge designer.

What was done in this work was to look for in other sources some trace of Wilhelm Hildenbrand in relation to the bridge of Ojuela and to look in the own file of the Mining Company of Peñoles, in order to verify if the construction of the Bridge of Ojuela was to charge of it. The following were found:

a) The testimony of Wilhelm Hildenbrand at the conference titled The Hanging Bridges from the earliest times to the most modern, dictated to the Union of Technicians in New York on April 6, 1905. His entire article was published in two parts in El Technologist, Communications of the German-American Union of Technicians (Hildenbrand, 1905).

In the context of the great works of Roebling: bridges of Brooklyn, Ohio and Niagara, Hildenbrand talks about some of his own works. First he mentions a bridge he built in Ecuador in 1888 for pedestrians and beasts of burden and then writes about the Bridge of Ojuela, which I quote from the text:

> *Bridge of metallic cables over the Ojuela canyon in Mapimí, Mexico, built by me in 1897 (sic). It has a length of 1030 feet and each cable is made of three steel wires of two inches, which holds the rail bridge seven feet wide. This bridge is owned by the Silver Mining Company of Peñoles and aims to transport the silver*

minerals extracted from the right bank to the rack rail on the left bank and thus mitigate the slow and expensive transportation of the mineral on the backs of mules for very dangerous trails of many miles. Part of the mining company's gain from the construction of this bridge has been used to justify allowing small wastage to beautify it with domes and solid silver ornaments. (Hildenbrand, 1905:105-106).

The article is accompanied by two photographs of the Bridge of Ojuela and a panoramic view of the Cerro de la Bufa. It should be noted the mention that Hildenbrand made of the year of the construction of the Bridge in 1897. It could be a confusion, but most likely, the track and suspension bridge were from the beginning in the same project that Peñoles contracted with Hildenbrand in 1897. There is still no record of Hildenbrand's stays in Mapimí and Ojuela prior to 1899, so it can not be assured that he was there during the construction of the tracks for the rack train.

b) The Index Voucher of the Mining Company of Peñoles where two payments made to W. Hildenbrand appear for their services for a total amount of $ 6,565 pesos - approximately 2735 dollars - from August and December of 1899. (Compañía Minera de Peñoles, 1899) .

c) In October 1903 Wilhelm Hildenbrand would return to Ojuela to make arrangements for the Suspended Bridge, so the Company paid him $ 3326.56 pesos with check number 2450 dated December 28 for services and travel expenses from New York. The pencil note in the book reveals that the payment was for fixing the Bridge of Ojuela and that his stay was two and a half months (Compañía Minera de Peñoles, 1903).

This reveals that Wilhelm Hildenbrand was indeed the builder of the Bridge in 1899 and took charge of the subsequent settlement in 1903.

4. On the other side, who assumes himself as the original designer of the Ojuela bridge is Henry G. Tyrrell in his book "Bridge engineering: a brief history of this constructive art from the earliest times to the present day". In the Peñoles Archive there have been no documents that relate Tyrrell with the bridge.

Major bridge restoration and repairs

Peñoles has restored and repaired the bridge between 1990 and 2008. In addition, different actions have been carried out to meet the needs of regular maintenance.

In 1990 a general repair of the structure of the Bridge was made with an investment of 125,000 dollars. In 1992 the change of the north and south towers was made, replacing the wooden ones by steel towers with an investment of 375,000 dollars. In 1996 the iron towers were covered with wood to preserve their original appearance with an investment of 175,000 dollars and in 2008 repairs were carried out by porters, architraves, bracing, hardware, painting and other works investing 125,000 dollars.

South side of the Bridge of Ojuela c. 2007. Copyright Metalúrgica Met.Mex Peñoles.

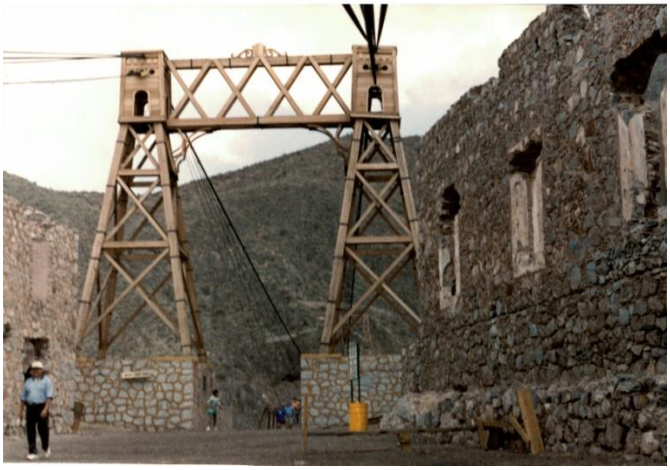
Undoubtedly the most relevant action to ensure the conservation of the bridge was made in 1992 by Peñoles and the Government of the State of Durango. To its more than 90 years of life began to be notorious the danger in which it was. Its wooden towers were beginning to give way. After several meetings, agreements were reached on the course of action. A work team was formed and the plan was implemented to replace the wooden towers with steel towers.

Replacement of towers

For the replacement of the towers was formed a team headed by Agustín Maqueo Cario and by Peñoles Carlos Villarreal Máynez. Also participated in the Project by the Government of the State of Durango Alfredo Alarcón and Joseph Buttler and by Peñoles Gabriel Chávez.

Agustín Maqueo Cario made an extensive report that gives an idea of the difficulties that had to be solved to replace the towers, whose replacement work was carried out on January 31 and February 12, 1992 in the towers on the north side and months later replaced the towers on the south side (Maqueo Cario, 1995).

Other works were carried out in 1995 by Peñoles in an emergent way, when the contraventeo cables of the south side were released. These cables were secured and carpentry, blacksmithing and civil works were carried out to avoid the deterioration of the bases of the towers.



North Towers of the Bridge of Ojuela, c. 1996. Copyright Metalúrgica Met.Mex Peñoles.

Ojuela today

In 1984 eleven of the buildings of Ojuela, including the Bridge were designated as Historical Monuments of Mexico by the National Institute of Anthropology and History (INAH).

Since 2007, there is a fixed-term loan between Peñoles and the State Government of Durango for the use of Ojuela as an ecotourism space, but it is a civil association that administers the site. It receives between 6000 and 10000 visitors annually.

In 2010, UNESCO granted the denomination of Cultural Heritage of Humanity to the State of Durango with 19 sites including Ojuela, as part of the Camino Real de Tierra Adentro.

Bridge of Ojuela, 2015. Copyright Manuel Medina Pegram

Ojuela is a reference for the inhabitants at the Laguna Region of México. It is a site that represents the industrialization of the late nineteenth and early twentieth century in Mexico. Undoubtedly Ojuela and its Bridge should have a master project to achieve a better management of the site, increase the number of visitors and project the relevance of its history, its buildings and one of the suspended bridges, made for the industry, most emblematic of his time.

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Playing the Bridge: exploring the sonic potential of Hull's swing bridge as a giant musical instrument

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Introduction

The paper presents the intentions and outcomes of 'Playing the Bridge', a commission carried out as part of Hull 2017 UK City of Culture, which allowed members of the public to explore a unique sonic experience of the city's new Scale Lane Bridge. The event, in early 2017, consisted of a series of workshops, performances and an audio-visual installation that took place primarily on or inside the bridge. These allowed members of the public direct access to explore the bridge's physicality and hidden engineering, and to actually play the massive steel structure as a giant musical instrument.

The multi-disciplinary project was organised by Nye Parry (composer), Jonathan McDowell (architect lead for Scale Lane Bridge) and Madi Boyd (artist), with Hull Music Service, Hull Community Gamelan, York University Music Department and Hull University Creative Music Technology programme. It was commissioned and supported by City of Culture's Creative Communities Programme in partnership with the Big Lottery Fund.

In line with the Creative Communities Programme's mission to "champion ideas large and small, that are adventurous and unique and (most importantly) connect communities to create incredible experiences and iconic memories" (https://www.hull2017.co.uk/guides/creative-communities-programme/) the project aimed to transform people's experience of a major piece of civic architecture and reinforce its cultural presence for the public.

By drawing on a tradition of music, Indonesian *gamelan*, which is innately communal and one in which communities are strengthened by the shared experience of coming together at a specific place to create music by hitting metal percussion, we were able to foster a new relationship between participants and their bridge through the workshops and performances.

Following on from this act of 'playing the bridge', an audio-visual installation extended the re-contextualisation of the architecture to encompass both the history of the bridge's construction and the hidden mechanics of its operation. Using sounds from the workshop, the installation revealed the materiality of the construction in a direct and physical experience while imagery that drew on construction photos and computer emulations of the mechanical parts encouraged visitors to place themselves into the process of bridge building and yielded an understanding of the scale of the engineering project.

The project consisted of 4 phases, which were attended by over 5000 people:

1. Weekly workshops introducing people to playing Javanese *gamelan*
2. A weekend of workshops in the bridge itself, focussing on
    a) creation of a new piece of music using the bridge steelwork as a giant musical instrument
    b) investigating the acoustics of the space and recording sounds to be used in the installation
3. An afternoon of performance presenting the results of the workshops, featuring live traditional *gamelan* music played on top of the bridge and the new Playing The Bridge composition played inside the structure.
4. An audio-visual installation inside the bridge using sounds recorded in the bridge, oral history interviews with people who built the bridge, construction photos and computer generated video realisations.

The setting: Scale Lane Bridge, Hull

Scale Lane Bridge (photo copyright Tim Soar)

Scale Lane Bridge is a new pedestrian swing bridge over the River Hull in the centre of the city that was completed in 2013. As well as improving connection between the city centre and the under-developed east bank, the new bridge acts as a focus for riverside regeneration and creates a memorable new civic landmark for people to enjoy the river. Uniquely the design allows people to ride on the bridge while it actually rotates, and is believed to be the first bridge in the world to do so. Scale Lane Bridge has already become a cultural destination and visitor attraction in the city.

The commission to design and construct the bridge was won through an open international competition by a team including architects McDowell+Benedetti (project lead: Jonathan McDowell), Alan Baxter Associates (structural engineers) and Qualter Hall (design/build contractor and mechanical/electrical designer). The project, for Hull City Council, was funded by Yorkshire Forward and the Homes and Communities Agency (HCA).

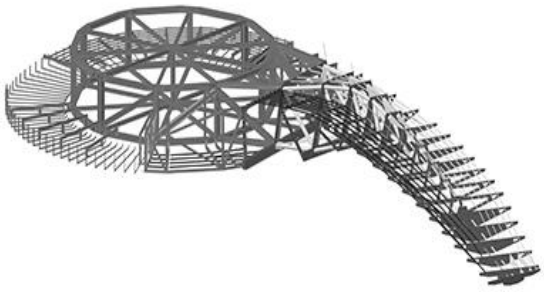
The bridge provides more than just a bridge connection across the river: the design creates a memorable new public place at this previously neglected but key point in the city. The distinctive curving form of the 60m long structure recalls Hull's maritime heritage. It creates a series of opportunities for people to enjoy being on the river, providing a choice of generous stepped and sloping routes, varied vantage points and places to sit, as well as a large circular space inside the bridge hub that is designed to house a café. The Playing the Bridge events took place on the upper level terrace and within the interior space.

As well as opening to allow larger boats to navigate the river, the bridge is opened at scheduled times by the city council to allow visitors to enjoy the experience of the ‘ride’ over the river.

Scale Lane Bridge opening sequence (photos copyright Tim Soar)

The bridge project also included new landscaped public spaces at each bank, connecting back into the city’s urban fabric. A public art installation, developed with artist Nayan Kulkarni, spreads across both bridge and public spaces to add further layers to people’s experience. This installation consists of text embedded in the ground and a subtle soundscape of birdsong emanating from concealed speakers around the space. The programmed sound and light systems are also utilised to signal and dramatize the opening movement of the bridge.

The 350t steel structure consists of a 40m curved spine cantilevering from a 16m diameter 3-dimensional braced hub. The spine is a hybrid structure, part diagrid and part shell. Steel plates clad the surface of the walkways whilst horizontal bracing provides additional longitudinal stiffness. The hub acts as a counterbalance to the cantilever span, with braced columns connected to horizontal steel ‘wheel’ structures at both levels and 650t of reinforced concrete ‘kentledge’ built into the floor and roof slabs. The electrically driven bridge rotates on a circular track concealed between hub and pintle below.



Structural model (Alan Baxter Associates)

Inside hub space (copyright Matter Architecture)

Since it opened Scale Lane Bridge has been widely published in the UK and abroad and has won numerous prestigious awards. It has become an important civic space in the city and has been the setting for a variety of public events and art installations. These include Spencer Tunick’s ‘Sea of Hull’ (2016), the city’s annual Freedom Festival, and the Rugby League Challenge Cup fifth round draw (2015).

At the time of the Playing the Bridge event the café space inside the bridge was not fitted-out or occupied so the empty the 250 sq.metre circular space was available to give the public access into the bridge and to its exposed steel structure for this event.

The *gamelan* tradition and Scale Lane Bridge

The notion that there might be opportunity to explore using the bridge as a musical instrument was informed by Scale Lane Bridge architect Jonathan McDowell's knowledge as a long-time player of the music of the Indonesian islands of Java and Bali. Central to the rich and varied music of these islands is the *gamelan*, a form of percussion ensemble consisting of tuned gongs and metallophones which are struck with wooden beaters to produce rich and complex music. The bridge's complex structure, with its metal components of different size and weight, has similarities to the varying sized metal keys and pots of the *gamelan*, albeit accidentally and at a more massive scale.

In this section we describe features of the *gamelan* tradition that have a direct bearing on how we approached the Playing the Bridge project. For a more general introduction to the music of Java and Bali see e.g. (Gold 2005) (Sorrell 1990) (Tenzer 1991).

Music and the community

The music of Java and (particularly) Bali is inherently based in local communities and is central to their sense of belonging. In line with the Creative Communities Programme's mission to "work with and engage people in Hull to celebrate the city and challenge perceptions" (CPP Guidance Notes), we set out to use the opportunity presented by Hull's 2017 UK City of Culture celebrations to work in the community to transform people's perception of this major civic landmark and to help them take ownership of their environment through sound and music.

Indonesian music is particularly pertinent to this as it is inherently social in a way that emphasizes collaboration and group activity. This could of course be said of most group music making, however the very nature of the *gamelan* as an instrument singles it out from other musics. Neil Sorrell writes:

> An important distinction is often made between the gamelan and the Western symphony orchestra. The *gamelan* is a set, housed in a special place. The players come to it empty-handed and depart likewise. They will probably remain anonymous, whereas the set of instruments will usually bear a name - a personality which is special to it and serves to identify the whole musical event. (Sorrell 1990, 19)

In other words the *gamelan* is not defined by the players, in the way that a band or string quartet may be, but by the instruments themselves, whoever happens to be playing them at the time. Each *gamelan* is built as a unit, with intricate carvings that relate all the instruments together. Each also has unique timbral characteristics and importantly a unique tuning, which is not standardised but varies from set to set. The tuning is therefore a characteristic of each individual *gamelan*, so a particular set may be particularly prized for the sweetness of its own tuning.

It is therefore useful to conceive of the *gamelan* not so much as a collection of instruments but rather as a single multi-player instrument. This is also reflected in the attitudes to performance, where players are usually uniformed and often choreographed with military precision. These conventions serve to lessen the individuality of the players, making them subservient to the common goal of the musical performance. They are not so much playing their individual instruments as collectively playing the *gamelan*. A personal experience also underlines this view. A leading Balinese musician (Pak Nengeh Susila) commented to Playing the Bridge composer Nye Parry that he preferred one of his *gamelan* pieces to another because the players in the latter did not play as one body but were acting individually.

In the Playing the Bridge project we have taken a similar view of the Bridge as a single sound-producing structure performed on by a large group of performers – the bridge as a giant instrument! Even further in the case of this particular bridge, the 'instrument' surrounds and contains the audience. This promotes a strong sense of collaboration and community among the musicians, furthering our aim to produce a unique relationship between the community and the architecture.

In Bali the idea that *gamelan* music serves the community is fundamental to the civic structures of the island. Michael Tenzer describes the role of the *gamelan* in the local 'Banjar':

> Being a musician is primarily a voluntary public activity, centred around a communal space: the *balai banjar*, or community meeting hall. Here is where the instruments are kept, where the group meets and rehearses, and in many instances where it performs too. People gather at the *balai banjar* to play *gamelan* for the pleasure of working hard together with their co-villagers to make something artistically satisfying and then enjoying the pride and sense of accomplishment of having done so. Making music without the challenges and rewards of group effort would be considered a pointless and unfulfilling chore to a Balinese. (Tenzer 1991, 104)

Obtaining a new *gamelan* is a matter of civic pride (and considerable expense) for the community. It is not too far-fetched to make an analogy with a civic monument such as a bridge. Playing the Bridge sought to use music inspired by the *gamelan* tradition to create a more personal relationship between the community and its architecture by re-casting (!) the bridge as a gamelan-style instrument allowing the community to create and experience a collaborative musical work centred on the structure.

In playing the bridge the community spirit of Indonesian music served as a model. A group of musicians from the community came together to perform on a single instrument, the bridge itself. The music was created on and for the instrument and each player served as a cog in the machine rather than taking solo roles or asserting undue individuality.

Parallels between Gamelan tradition and Playing the Bridge

Everything in Indonesian music, the musical structures themselves, the way they are taught, the way they are presented in performance, reflect this community spirit and many techniques and practices in gamelan music were taken over into the various

phases of the playing the bridge project. The following table summarises some of the parallels between our approach and the music of Java and Bali:

Indonesian *gamelan*	**'Playing the Bridge'**
Based in local communities (*banjar*)	Based in local community
Many people play a single *gamelan* (conceived as a whole individual instrument)	The bridge is considered as a multi-player instrument with audience and players inside the resonant chamber
Music is memorized and taught by rote	Music is memorized and taught by rote
Music is focused on and structured by percussion extended by other forms of instrument (*suling* (wind), *rebab* (string))	Music is focused on and structured by percussion extended by other forms of instrument (The Assembled ensemble's wind and string instruments)
Musical techniques include cycles and interlocking parts	Musical techniques include cycles and interlocking parts
Sounds created by striking metal (mainly bronze), with beaters	Sounds created by striking metal (mainly steel), with beaters
Different frequency ranges represented: Low frequency gongs played with soft beaters, higher frequency metallophones played with hard beaters	Different frequency ranges represented: Low frequency steel plate panels played with soft beaters, higher frequency columns and beams played with hard beaters
Gongs produce definite pitches with complex enharmonic overtone series	Steel panels produce definite pitches with complex enharmonic overtone series
Pitches of the *Slendro* scale appear to be based on the enharmonic overtones of the gong-chimes	Pitches used in the performance and installation derived from analysis of the overtones of the played structure

Table 1: Parallels between *gamelan* tradition and the use of Scale Lane Bridge in 'Playing the Bridge'

These parallels are manifested in different phases of the project to differing degrees and will be discussed below in relation to the workshops, performances and installation. The most obvious link with Indonesian music is of course the actual use of a *gamelan* in the workshops and the performances at the bridge.

The Workshops:



Participants at the Playing the Bridge workshops (photos copyright Richard Duffy-Howard)

Weekly Gamelan workshops

One of the starting points for the project was that it should allow wide community engagement on a range of scales and in a range of activities. The programme was devised to allow people to give different degrees of commitment to the project: from audience member, to weekend workshop participant, or regular commitment to the *gamelan* workshop group.

The latter was set up and mentored by local musician Laurence Rugg, who has a wealth of experience running workshops with people of all ages, backgrounds and abilities. He has worked in the community as a conductor, facilitator and teacher, working with choirs, orchestras and making a specialism of work with Javanese *gamelan* which he has taught in schools, prisons and community centres. The *gamelan* used for workshops, Hull Community Gamelan, is a set of instruments that belongs to Hull Music Service and is permanently housed at the Albermarle Music Centre in the city.

The *gamelan* workshops ran for 10 consecutive weeks in the run up to the performance event. The music covered included traditional *gamelan* pieces (*Kotek* and *Kendang Bubra*), as well as a new composition by Rugg and some structured improvisation. This marks a departure from traditional practices where improvisation is unusual, and reflects the fact that most of the group were entirely new to *gamelan* and able to use improvisation to master some of the playing techniques, such as damping and getting a good tone with confidence, as well as allowing them to bring previous musical experience with other forms of music making to bear on their communal experience.

Workshop participants were drawn from Hull University and local music groups, covering a range of ages from teens to 60's.

Hull City of Culture Volunteers attended these workshops (as well as the subsequent workshops, performance and installation) to act as stewards but were also specifically encouraged to be active participants in all three in order to help ensure a wider embedding of the experiences within the community.

Weekend Workshops on Scale Lane Bridge

The first events at the bridge itself were the weekend workshops on 25th and 26th February 2017. These were open both to members of the public who wished to

participate in the performance event (scheduled for the following month) as well as to anyone who just wanted to see what was going on and maybe join in briefly. Due to extensive media coverage in the run up to the event a considerable number of drop-in participants turned up, particularly on the second day.

Day 1: the Composition

The first workshop was devoted to exploring the sounds that the bridge could make and to the composition of a devised piece intended for the subsequent performance.

In addition to members of the public we were joined by York-based performance group The Assembled who, in order to complement the metallic percussion sounds of the bridge steelwork, brought western or at least non-Indonesian instruments (cellos, clarinet, flute, Indian Harmonium, violin and laptop). Unlike in a western classical ensemble, where percussion serves mostly as decoration and punctuation of a structure based on the melodic instruments, we took the lead from *gamelan* where percussion provides the foundation and other instruments (*Rebab*, *Suling*) provide supplementary decoration.

The piece grew out of the sounds of the bridge's structure being struck with *gamelan* beaters. Participants first freely explored the bridge interior, trying out the sounds that could be produced from different parts of the steel structure. Large padded beaters were used to strike the larger steel panels in the manner of the large Javanese gongs. Harder beaters, normally used for metallophones were used (with added cloth padding) on beams, columns and struts to bring out higher harmonics.

Under the direction of Nye Parry and through group discussion a loose structure and sequence of semi-improvised assemblies of sounds were agreed for the subsequent performance.

The overtone structure of the metal plates and members gave rise to the pitches used by the instrumentalists from The Assembled, who tuned their pitches to the most prominent audible harmonics to complement the resonance of the space. Even this has a strong parallel in the music of Java and Bali. It has been suggested that the unusual intervallic structure of the Javanese *slendro* scale arises in part from the enharmonic overtones of the gongs and (particularly) gong chimes (Sethares 1998).

Some Indonesian techniques were used to structure the music, including rhythmic cycles and melodies formed by interlocking parts split between different musicians These allowed the music to be more easily memorised as was learnt aurally and without any form of notation (again as in Indonesia).

Day 2: Recording

The second day of workshops was attended by sound recordists from the Hull University Media School's HEARO research group. Using members of the public to create sounds on the bridge structure we were able to gather material that would be processed to form part of the subsequent installation. Of particular interest was the ability to record impulse responses of the highly resonant circular hub space, which serve as a fingerprint of the acoustic and resonant frequencies of the bridge.

The Performances

Gamelan performance on Scale Lane Bridge (photo copyright Richard Duffy-Howard)

The performances took place on the (luckily warm and sunny) afternoon of Sunday 26th March 2017, and consisted of two halves: a performance of Javanese *gamelan* which took place on the bridge's upper terrace, followed by a performance of the 'Playing the Bridge' piece which had been devised in the earlier workshop and which took place inside the bridge's circular hub space.

A diverse audience of around 200 people attended the informal performance, from babies to pensioners and including people from the local community, visitors who had travelled from as far away as London for the event and some who happened to be walking by and joined in.

Javanese gamelan performance

The first part was performed on York University's *Gamelan Sekar Petak* which was set up under a marquee on the bridge's upper deck roof terrace. The Hull Community Gamelan group, consisting mainly of beginners who had participated in the weekly *gamelan* workshops, first played some simple traditional Javanese pieces as well as an improvised piece devised by Lawrence Rugg to illustrate different tones of the *gamelan*. That was followed by a group of more experienced York University music students, under the direction of Neil Sorrell, playing a variety of more complex Javanese *gamelan* pieces.

At the end of the performance the audience were invited to ‘have a go’ and a wide range of people, from children to community police officers, enjoyed the opportunity to play on the *gamelan*, getting hands-on experience of creating music through percussive striking of metal instruments.

These introductory experiences of *gamelan* provided a clear ‘bridge’ between an established refined musical tradition and the more experimental act of Playing the Bridge that followed.

The audience had the chance to play on the *gamelan* (photo copyright Matter Architecture)

Performance of ‘Playing the Bridge’

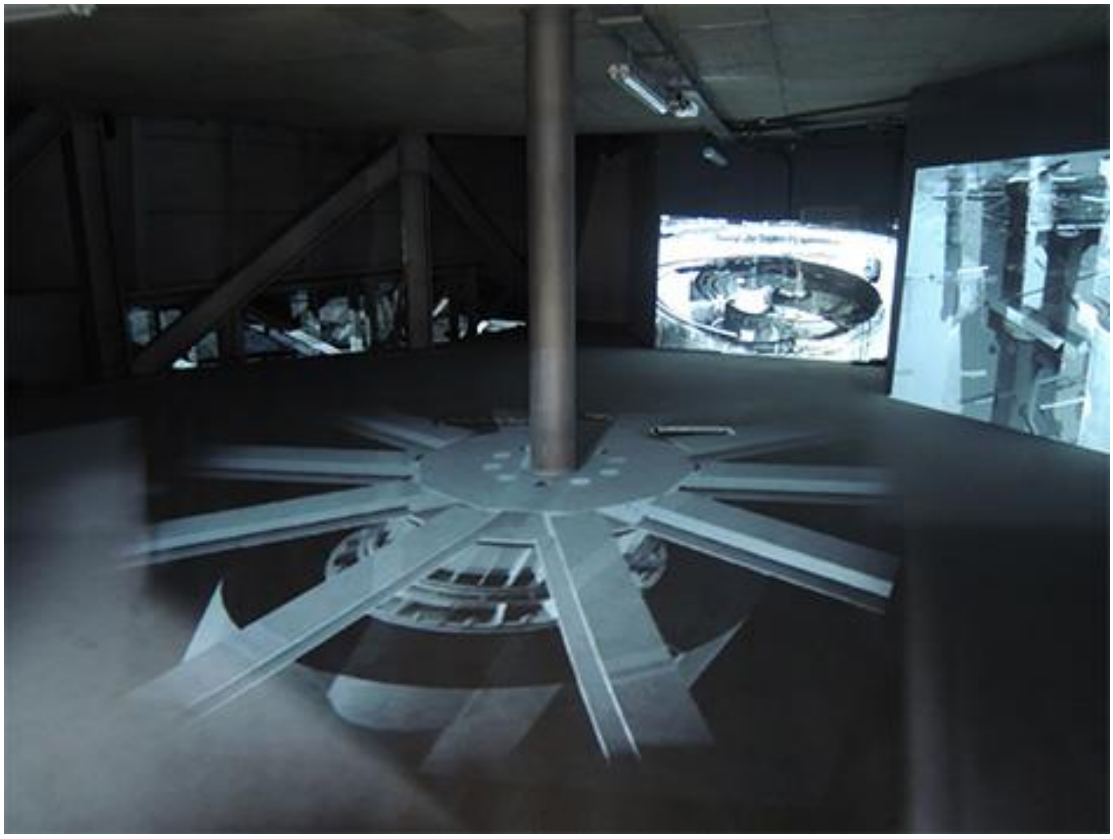
Performers ‘playing the bridge’ (photos copyright Richard Duffy-Howard)

After a short break, the Playing the Bridge piece, which had been devised in the earlier workshop was played inside the bridge hub. The circular 250 square metre space allowed an audience of about 100 as well as the 30 or so performers.

The 10-minute piece was played by performers striking the bridge’s structural members that enclose the space. In this way the audience were literally standing *inside* the massive instrument to experience its sounds and physical presence. Meanwhile members of The Assembled mingled with the audience wandering around the space, supplementing and enhancing the resonances of bridge sounds on their non-gamelan instruments.

The performance was concluded by both performers and audience processing up onto the bridge terrace above where the large Javanese gong was struck to end the piece, bringing the worlds of *gamelan* and the bridge together in a single gesture.

The Installation



Overview of installation inside bridge hub space (copyright Matter Architecture)

The project culminated in a month-long installation by artists Madi Boyd and Nye Parry inside the bridge's hub space. The installation was intended to add another layer to the public's engagement with the bridge by revealing some of the hidden aspects of its engineering and exploring the processes of construction through sound and image. The exposed bridge structure that encloses the hub space also provided the primary material for the sound of the installation, which combined audio from the workshops with sounds related to the building and mechanism of the bridge.

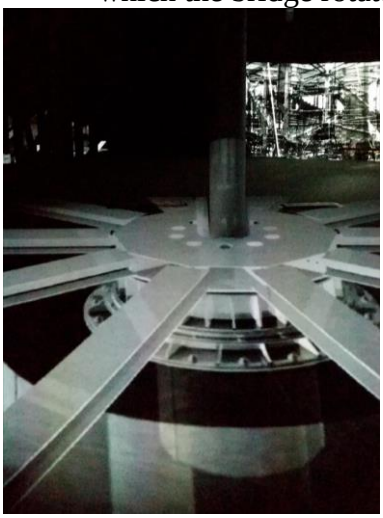
Visual content of the installation:

The installation visuals consisted of four areas with projected images. The room was blacked out and the projections provided the only illumination. The images were projected directly onto the surfaces of the structure: onto the floor around the central column, onto screen walls and onto exposed steelwork. The imagery fell into three basic categories:

1. Collage images of the bridge's construction:
   Photos of the construction of the bridge, provided by the architect and by Qualter Hall (the main contractors for its construction), were used by Madi Boyd as the basis for four sequences of slowly changing collages. These were projected in randomized orders on two walls. The imagery was mostly black and white with some striking regions of bright colour.

Bridge construction image (copyright Madi Boyd)

2. 'X-ray' images of the bridge workings:
   Images of the hidden mechanical and structural installations that support the bridge were projected onto the surfaces that conceal them, acting somewhat like X-ray views to allow people to 'see through' the skin. These computer-generated images were derived from the bridge's 3D fabrication model by Matter Architecture and Madi Boyd. The main image, constantly rotating around the central column, showed the actual central bearing directly below around which the bridge rotates.



Rotating projection on hub floor
(photo copyright Matter Architecture)

3. The river:
   An area of exposed complex supports was illuminated with moving projections of water, which appeared as reflections of the river beneath the bridge.

Moving water imagery projection on structure
(photo copyright Madi Boyd)

Audio content of the installation

Sound for the installation echoed the visual themes of construction and mechanism using a number of sound sources:

1. Recordings of the mechanism:
   The sounds of the bridge opening mechanism were captured in the sound recording workshop and used in the soundscape.
2. Reminiscences of bridge construction workers:
   Fragments of oral history from some of the people who had built the bridge were recorded at Qualter Hall's works. While the acoustic of the space made intelligibility a problem at any significant distance from a loudspeaker, it was felt that the presence of the voices of the men who had worked on site complemented the construction imagery. Material included lists of names and brief descriptions of the challenges of construction.
3. Sounds of bridge construction process:
   These were captured at the Qualter Hall works and were used to evoke the building of the bridge.
4. Sounds from the workshops:
   Pitched sounds created through the workshop process of members of the public striking surfaces with *gamelan* mallets were used both in raw form and using a process in which individual overtones were isolated and looped to create a bed of pitched drones.

Another sonic dimension was provided by the public who were encouraged to play the bridge themselves when visiting the installation, using the padded wooden mallets provided or whatever other means they chose to add their own sounds. This could get somewhat overwhelming and discretion was required from invigilators but some visitor feedback (see below) confirms both the popularity of this and the way it allowed members of the public to explore a new relationship with the space.

Public response to Playing the Bridge

Attendance records show that 5435 people visited the installation event, with hundreds more attending the workshops and performances. Comments by word of mouth, on

social media, and noted in the visitors' comments book were varied but almost universally positive. A selection of remarks below, noted in the comments book, indicates five key areas of interest for the general public.

1. the use of sound and projection:

"Lost myself for a bit. Wonderful"
"This is such a Powerful moving experience, to be able to see the movements with projection"
"Very different! Innovative and thought provoking"
"An atmospheric experience, wonderful to experience this piece about the Scale Lane bridge in the structure itself"
"Surreal experience, very interesting and informative. Great piece of history captured"

2. the opportunity for hands-on interaction with the civic structure:

"Really cool. Loved making sounds!"
"Enjoyed use of space and sound enabled you to play with your own sounds."
"Love it- total playfulness and a delightful place to make noises – the interplay that (sic) the film and music ranged from majestic to ethereal – adding my own voice and noise with drumming things was ace"
"Great innovative idea, got the boys participating in a piece of artwork, great stuff!"

3. insight into the construction and engineering of the bridge:

"Enjoyed hearing the construction of bridge. More than a bridge 'A Work of Art'."
"So easy to just see this without thinking about the complexity of its design and building. What a wonderful experience."
"Very interesting from an engineering meets art perspective!"
"Brilliant installation. Industrial heritage as art. Thank you"

4. the wider culture of the city, and of City of Culture:

"It's wonderful that people visiting Hull are able to gain a taste of its history, people and its very unique and wonderful culture! Well done!"
"Fascinating translation of experiences of residents and the city into a poetic exploration and new vision of a construction that defines the city!"
"Really interesting and intriguing- sense of place!"
"Visiting City of Culture and blown away by "Playing the Bridge"- a real city of culture experience, thank you. Hull is lovely too"

5. the possibilities of further cultural events related to the bridge:

"Interesting installation and space- hope it becomes a widely used community space".

"Great space for further installations"
"There should be more of this sort of thing"

Conclusion

The Playing the Bridge project was designed to broaden people's experience of the landmark structure through different levels of engagement and commitment. Workshop participants were able to share an experience of the space through musical participation and for visitors to the installation the space was opened up through projection and sound. For all those who will return to the site it will, we hope, remain much more than just a crossing.

Encouraging people to enjoy physical hands-on engagement with a civic structure was a key factor in forging a new relationship with the architecture, allowing participants to explore the bridge's physicality, its sound, weight and materiality directly. Visitors could see inside to experience its structure and engineering; experiencing stories and images of how the bridge was made while simultaneously exploring the boundaries of music, sound and noise; enjoying a memorable opportunity to play a giant musical instrument that you can stand inside; while reinforcing the bridge as a public place for people to enjoy and deepening its cultural presence in the city.

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TURNER'S BRITISH BRIDGES

David McFetrich

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Joseph Mallord William Turner (1775-1851)

Self Portrait c*1798*

INTRODUCTION

Turner began his artistic career as an architectural draughtsman. His 1794 painting of the old Welsh Bridge in Shrewsbury, made when he was nineteen, is a magnificent record of a fascinating structure that was to be demolished only a year later. However, as Turner became progressively more interested in the effect of light on colouring – effectively launching the approach that became known as Impressionism in 1874 – his paintings are perhaps less accurate as depictions of actual scenes. Indeed, some are really composite scenes, integrating views from more than one location. He was immensely prolific, producing over 500 oil paintings, 2000 watercolours and 30,000 sketches, drawings etc.

This paper covers a selection of Turner's finished bridge paintings, both oil and watercolour, but not his pencil sketches. (His 'Old London Bridge' Sketchbook of about 1823 contains 44 leaves of pencil sketches.) He also made paintings of several dozen bridges in continental Europe, but these have not been included. Apart from a few well-known bridges, such as Old London Bridge, there is often little information available about many of the bridges depicted by Turner. Some small bridges, such as towpath bridges and footbridges, which only make a minor appearance in a corner of a picture and about which almost nothing is known, have therefore also been excluded. Altogether, the paper has 83 separate bridge entries with 102 bridge paintings.

The two appendixes give full details of the pictures (title, date, medium, size and location) and link the pictures to the geographic locations of the bridges. Thus it is possible to start with a picture title and find the corresponding bridge, or start with a geographic location and find the relevant Turner picture(s).

It is perhaps worth pointing out that nearly all Turner's pictures can be found though the internet. Go to www.tate.org.uk > Art and artists > Find art and artists.

Old London Bridge, c1795

THE BRIDGES AND PICTURES

Abergavenny Bridge, Abergavenny, Monmouthshire

In 1809 this 15th century bridge over the River Usk was recorded as having 13 arches and being only about 12ft wide. However, a few years after Turner painted it, the bridge arches were extended further upstream to carry an early tramway. This was removed and the road deck widened to 27ft in 1868. By the 1930s the downstream face showed just four pointed and seven segmental arches spanning between piers with pointed cutwaters, but the later upstream face showed segmental arches only.

Turner's view against the evening sunlight pictures seven main arches and two more on the northern approach, one of which he has shown as pointed. The arches at the southern end of the bridge leading into the village of Llanfoist cannot be seen behind the rocky outcrop and trees. The hill immediately behind here is Blorenge while, on the right, can be seen the steep side of the "Sugarloaf".

Abergavenny Bridge, Monmouthshire, clearing up after a showery day, 1799

Abingdon Bridge, Abingdon, Oxfordshire

When Abingdon Bridge was first built, by the Fraternity of the Holy Cross in 1416, it crossed a minor channel of the Thames. The bridge initially had 11 narrow ribbed and pointed arches but three extra flood arches, known as the Maud Hales Bridge, were built in 1437 at its south eastern end and, in 1546, Leland recorded the whole bridge as having 14 spans. In 1790 the main river channel was diverted to run under the bridge, one arch being rebuilt to give headroom for navigation, and the whole roadway was widened at different times between 1800 and 1830 with segmental arch extensions on the upstream side. In 1927 the earlier navigation and three other arches were rebuilt to form a single 60ft-span new navigation arch.

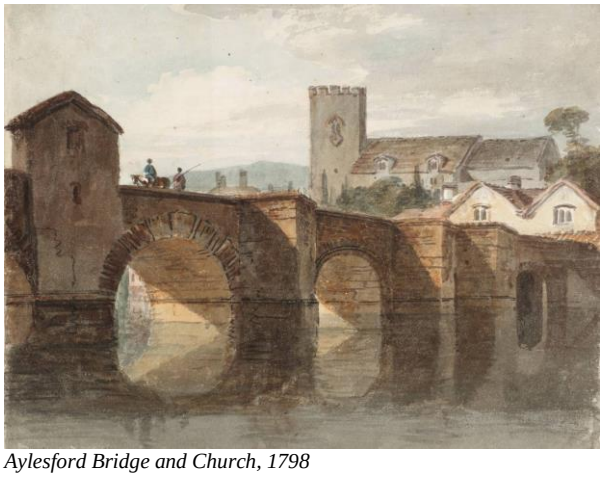
Turner has used much artistic licence in this evening picture but, in essence, his viewpoint is on the north side of the Abbey Meadow Island and he is looking down the Abbey Stream channel towards the south west. In the distance are two of the arches of the bridge and the spire of St Helen's Church can just be seen faintly above the pier between them.

Dorchester Mead, Oxfordshire, 1806

Aylesford Bridge, Aylesford, Kent

There was an earlier timber bridge over the Medway at Aylesford but the present structure probably dates from the late 14th century. This has long been a favourite with artists. The delightful Grade I 13ft-wide stone bridge was originally built with seven pointed arches each spanning about 13ft. In 1824 the two central arches were rebuilt as a single 60ft-span segmental arch to allow navigation for larger vessels.

Turner painted this view looking north to St Peter and St Paul's church, the river flowing from right to left, and his picture shows the bridge before its distinctive main arch was built.



Aylesford Bridge and Church, 1798

Barnard Castle Bridge, Barnard Castle, Durham

In 1112 Bernard Baliol built the eponymous castle overlooking the River Tees to defend this ancient crossing point. A bridge was built here in the 13th century and Leland recorded the bridge as having three arches when he saw it in about 1540. The present 15ft-wide Grade I stone bridge dates from 1596 and has two arches spanning between the abutments and a massive river pier, which is protected by triangular cutwaters continued up to parapet level. The upstream cutwater originally extended upward to form a tower (as shown by Turner), but this has long been demolished. The arches themselves are ribbed, slightly pointed and have triple arch rings.

In this view we are looking downstream, the castle silhouetted against the morning sun, with a lone fisherman in the centre of the picture.

Barnard Castle, Durham, c*1825*

Barnstaple Bridge, Barnstaple, Devon

The medieval long bridge at Barnstaple over the River Taw was first built in around 1280 with 16 pointed stone arches each spanning between 18ft and 26ft. It has been partly destroyed on several occasions, including in 1437 and 1646, and some of the arches were also completely rebuilt in 1589 and 1782. It has been widened three times, first in 1796 by the construction against the original spandrels of segmental arches that spring from the cutwaters at the outer ends of the original piers. In 1834 it was further extended by the addition of 4ft-wide cantilevered footways but these were removed in 1963 when a new upstream extension was built. The bridge is listed Grade I.

Turner's distant view of the bridge is looking downstream, with the town just visible on the right.

Barnstaple Bridge at Sunset, c*1813*

Battersea Bridge, Battersea, Greater London

The original timber bridge over the Thames at Battersea was designed by Henry Holland and built by John Phillips, being completed in 1772. It was about 24ft wide and consisted of 19 short spans ranging from 15ft to 32ft long. This was the bridge shown in several of Whistler's paintings that featured in his famous court action against Ruskin. In 1875 four of the timber spans were replaced by two larger navigation spans supported by N-braced wrought iron girders. In 1883 the structure's condition was such that vehicular traffic had to be prohibited and a new crossing, designed by Sir Joseph Bazalgette, was opened in 1890. This has five cast iron segmental arches, the central one spanning 163ft.

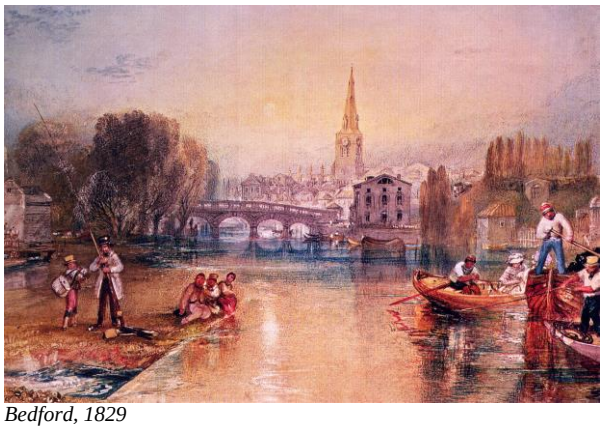
In this view we are looking downstream, in a roughly north-easterly direction, at the 1772 bridge, with the spire of St Mary's to the right. Between the bridge and the spire is Old Battersea or Fowler's Mill, built in 1788. This was an unusual windmill, in which 96 sails rotated in a horizontal plane around a vertical axis enclosed in a tall 50ft-diameter 12-sided tower. The tower had eight vertical shutters like Venetian blinds in each side, and these could be opened or closed to direct the wind onto the internal sails. The mill was dismantled in 1825.

Battersea Church and Bridge with Chelsea Beyond, ?1797

Bedford Town Bridge, Bedford, Bedfordshire

The medieval stone bridge to replace the ford over the Great Ouse here probably dated from the 13th century and, according to tradition, was built using stone taken from Bedford Castle demolished in 1224. A bridge chapel was built in 1331 and rebuilt in the 15th century, later becoming the north gatehouse and town gaol. In 1673 John Bunyan was imprisoned in it for six months and wrote the first part of *Pilgrim's Progress*. The present bridge, built by John Wing and opened in 1813, has five semi-elliptical stone arches. In 1938 concrete arches were built on the upstream side to widen the bridge from 30ft to 54ft.

Turner's picture looks upstream at the new bridge, its arches and balustraded parapet being bookended to the north by the Bedford Swan Hotel with the spire of St Paul's Church rising behind.

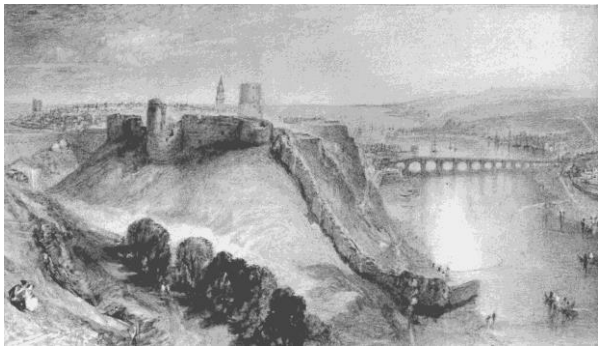


Bedford, 1829

Berwick Bridge, Berwick-upon-Tweed, Northumberland

An early timber bridge at Berwick was swept away by floods in 1199 and floods destroyed replacement bridges in 1211, 1294 and 1607. The Scots under King David broke down another bridge in 1345 during an attack on the north of England and a later one collapsed in 1542 when Henry VIII, in fear of a pro-French Scotland allied to continental Catholic powers, launched a pre-emptive invasion. The present low bridge, built between 1611 and 1624, has 15 segmental stone arches in two orders with spans varying from 75ft to 24ft and its width varies between 17ft and 19ft. These spans form a group of nine at the south end and six at the north, divided by a larger pier with bigger pedestrian refuges and a higher parapet that formerly marked the administrative border between the Borough of Berwick and the rest of England. Starlings surround all the piers, the ends of which are protected by triangular cutwaters that are cut back with pointed caps into buttresses that rise to form stretched semi-octagonal refuges at road level. To the north of the big pier, these pier end buttresses are also decorated with attached circular columns. The apex of the bridge is at the centre of the second span from the north end. The bridge is listed Grade I.

Here, we are looking south-eastward at the bridge in the middle distance, with the walls of Berwick Castle before us to the left.



Berwick upon Tweed, c1832

Big Bridge, Tonbridge, Kent

The Medway at Tonbridge was first crossed by a five-arched stone bridge in 1526. This was rebuilt in 1776 with three stone arches and in 1888 it was replaced by an iron beam bridge. This last structure was then widened with cantilevered walkways in 1928.

In this view Turner is looking north-westward at the 1776 arched bridge, with the towers of the castle showing slightly indistinctly in the upper centre part of his picture.

Tonbridge Castle, Kent, c1794

Bird Street Bridge, Lichfield, Staffordshire

The original Minster Pool in front of Lichfield Cathedral was formed in 1310 when Bishop Langton built a causeway across a much larger pool in order to extend Bird Street. This then formed part of a new route for the main London to Chester Road avoiding the cathedral close. The causeway included a narrow single-arch bridge over Leamonsley Brook which linked the new pools. In 1816 this bridge was rebuilt, to a design by Joseph Potter, with three semi-elliptical stone arches between pointed piers, although the outer two spans are blind.

Turner's view shows the west front of the cathedral with the Sandford or Upper Pool in the foreground. The western face of the bridge shown by Turner can not now be seen as the stream here was covered over to build the Museum Gardens in the 1850s. The building to the immediate left of the bridge is probably an old malthouse, near where the library was later built.

Lichfield, 1830-5

Blackfriars Bridge, City, Greater London

Blackfriars was the third bridge to be built across the Thames in the capital after London and Westminster Bridges. The bridge was designed by Robert Mylne, one of the last of the architect-engineers, and consisted of nine semi-elliptical stone arches – the first such arches to be built in Britain on a public bridge. In fact, the arches were three-centred, the middle and largest arch having a span of 100ft made up of a central circular segment of 56 ft radius and two equal flanking segments of 35ft radius. The completed structure was very handsome. The ends of the intermediate piers were decorated with double Ionic columns supporting entablatures that were possibly intended to house ornamental sculptures. However, these were never occupied and served merely as elegant pedestrian refuges. There was a stone balustrade and the whole classical triumphal style was described at the time as Venetian Gothic. Construction began in 1760 and the bridge was opened on 19 November 1769. The so-called Nancy's Steps, on the upstream, Surrey-bank corner of Old London Bridge, were where, in Charles Dickens's *Oliver Twist*, Nancy had her secret meeting with Mr Brownlow that led to her murder by Bill Sikes.

Turner's view of the bridge gives an excellent view of the decorative pier ends with, in the distance, one of the curving stairways linking the river bank to the new road level.

Old Blackfriars Bridge, c1795

Blenheim Palace Grand Bridge, Woodstock, Oxfordshire

The Grand Bridge, crossing the Glyme stream on the main axial approach to Blenheim, was built as part of Sir John Vanbrugh's overall design for the palace, the nation's gift to the conquering first Duke of Marlborough. Originally it was to be a triumphal bridge in the Palladian style, complete with a superstructure nearly 200ft long. The 36ft-wide roadway is carried on a segmental main arch spanning 101ft and smaller side arches. Construction of these arches was completed in 1711 but work was then suspended and not finally finished in its present reduced but still massive form until 1716. In 1774 'Capability' Brown completed his landscaping of the park that involved damming the marshy stream to create a lake. This raised the water level about 15ft submerging the lower parts of the arches but greatly improving the bridge's appearance in the landscape.

Turner's view is from the east, next to the main gate into the park from the town. The huge palace buildings appear on the horizon to the left of the bridge.

Blenheim House and Park, Oxfordshire, 1832

Bodiam Bridge, Bodiam, East Sussex

Although a Roman road crossed the River Rother here, the first record of a bridge near the romantic late-14th century Bodiam Castle is from 1313. A later record notes a bequest in 1408 for the repair of the bridge. The present 12ft-wide brick structure was built in 1796 and has three segmental arches with stone keystones, the central arch spanning about 20ft. The cutwaters rise right through the spandrels and are capped off just below the top of the parapet wall, this being supported on an attractive dentilled string course.

In Turner's watercolour, the main hump-backed bridge is in the left centre, two smaller flood arches to the right, with the castle in the distance. The early morning haze between us and the castle heralds a hot day – and women are putting out their washing to take advantage of this.

Bodiham Castle,,Sussex, c1816

Boston Bridge, Boston, Lincolnshire

There was a bridge over the River Witham at Boston in the 13th century and, typically for timber bridges, it needed much maintenance. In 1602 a new bridge was built which was protected by a stone gateway and in 1742 another bridge, with two timber truss spans, was opened that was itself replaced by a cast iron arch bridge in 1807. Designed by John Rennie and Thomas Wilson, this six-ribbed structure had a single segmental span of 86ft, a rise of 6ft and an overall width of 39ft, the deck being supported on vertical spandrel posts standing on the arch ribs. In 1913 a three-pinned steel arch bridge was erected between the existing abutments.

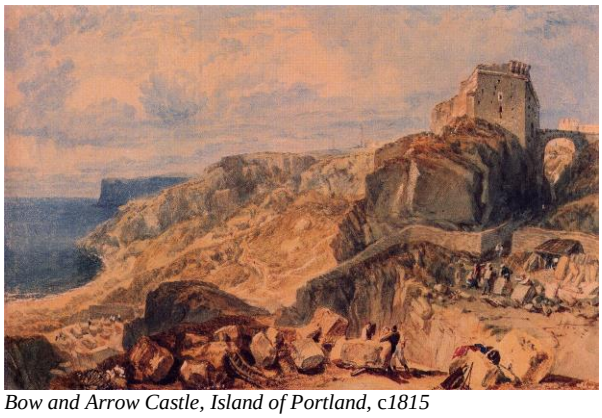
In this picture we are looking roughly northward, with the famous Boston Stump rearing up behind the bridge. The bridge itself, however, is based on a earlier sketch Turner had made of the 1742 timber structure.

Boston, Lincolnshire, c1823

Bow and Arrow Castle Bridge, Easton, Dorset

The existing castle buildings here date from the late fifteenth century and are on the site of the oldest of Portland's three castles which, it is claimed, had been built by William Rufus. The bridge has a 12ft-span semicircular arch that crosses the pathway leading down to Church Ope Cove and provides a 10ft-wide access way into the castle.

In this picture we are looking southwest, the cliffs near Portland Bill in the distance, with the bridge over the pathway to the cove in the top right corner. Quarrymen are working on the famous Portland stone in the foreground and lower down to the left.



Bow and Arrow Castle, Island of Portland, c1815

Brighton Chain Pier, Brighton, Brighton and Hove

Seaside piers are effectively one-ended bridges. Captain (later Sir Samuel) Brown RN completed his Brighton pier in 1823 to service cross-Channel and coastal shipping. The pier had four 255ft-long suspension spans supported by cast iron Egyptian-style towers that rose 25ft above deck level and stood on clusters of piled columns. There were four wrought iron chains on each side of the bridge made up of 20-ft long links, with a one-inch diameter vertical wrought iron rod hanging from each link connection to support the deck. The pier was destroyed by a storm in 1896.

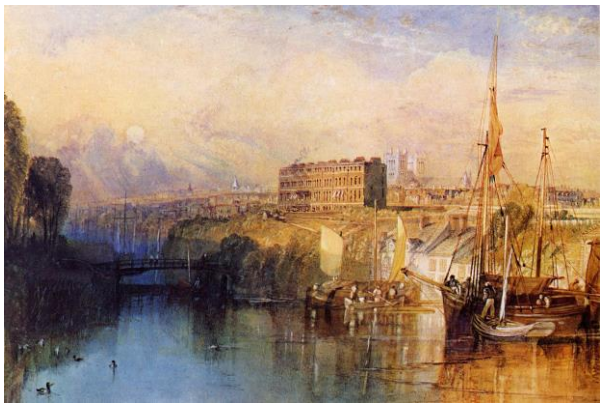
Turner's view shows the sun setting behind the pier whilst a boat approaches to unload passengers.

The Chain Pier, Brighton, c1828

Canal Bridge, Exeter, Devon

Before Exeter's new canal basin was completed by James Green in 1830, a small bridge crossed the canal from the west bank to the peninsular that lies between the canal and the River Exe.

Turner is looking south east at this bridge on the left and along the Exeter Canal towards the King's Sluice where the canal joins the river that runs behind the trees in the centre of the picture. Above and beyond these trees looms the mass of Colleton Crescent, a Georgian terrace on which work began in 1802. On the horizon to the right of this the towers of Exeter Cathedral can be seen.



Exeter, c*1827*

Cardiff Bridge, Cardiff

There were only timber bridges over the River Taff at Cardiff until the late 18th century when a builder called Perry built his first stone bridge. This was swept away, as was his next attempt – a bridge with five semicircular arches and steep approaches. His third bridge, completed in 1796, had three main stone arches, a central one spanning 60ft with flanking spans of 50ft. However this was narrow and in 1859 a new 32ft-wide bridge of four stone arches, each with a skew span of about 47ft, was built a little downstream. This, too, soon proved to be inadequate and was widened in 1880 by cantilevering out footways on each side. In 1930 the bridge was completely rebuilt.

In his picture Turner shows Perry's newly built third bridge. We are looking north east, with Cardiff castle behind the bridge.

Cardiff Bridge and Castle, 1795-6

Carew Castle Bridge, Carew, Pembrokeshire

Carew Castle is on an ancient fortified site and defended the crossing of the Cleddau River just to the north-east. An early stone bridge, possibly for packhorses, was built in the fifteenth century, but the present structure and causeway over the upstream end of the 23-acre millpond, dates from the eighteenth century. It has three segmental arches, the central one being wider and higher than its flankers, and the cutwaters to its piers extend up to form pedestrian refuges. In 1938 the bridge was renovated and the causeway raised to provide a level crossing and the bridge now carries the A4075.

This picture, from the north, shows the three arches of the bridge in the distance to the left while, in the foreground, some women get on with their washing.

Carew Castle, Pembrokeshire, c*1832*

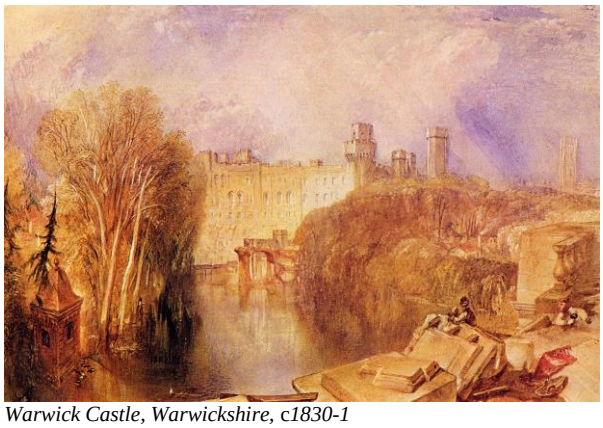
Castle and Old Bridges, Warwick, Warwickshire

The old stone bridge over the Avon at Warwick, with 12 or 13 arches, was reported as 'broken down' in 1374 and was partly swept away in the 1780s. An Act of Parliament for a replacement structure was passed in 1788, the new Castle Bridge being opened in 1791. This has a single stone arch spanning 105ft.

Turner's first view shows the new bridge, shortly after it was completed, framing the view of the castle with part of the old bridge just visible to the left below the castle.

Warwick Castle and Bridge, 1794

In his later view, with the Castle Bridge perhaps undergoing some maintenance work in the immediate foreground, a broken arch of the Old Bridge can be more easily seen in the distance.



Warwick Castle, Warwickshire, c*1830-1*

Caversham Bridge, Caversham, Reading

The first Caversham Bridge over the Thames, built around 1200, was a handsome timber structure that was later admired by Leland and had a stone-built chapel on an island near its north end. In 1643 a Parliamentary force besieging Reading successfully defended the crossing against a Royalist attack. At some stage the wooden bridge was replaced by one consisting of brick arches with a higher timber navigation span at the Berkshire end. This structure was replaced in 1869 by a five-span, wrought iron, lattice girder bridge that was in turn replaced by the existing reinforced concrete structure in 1926.

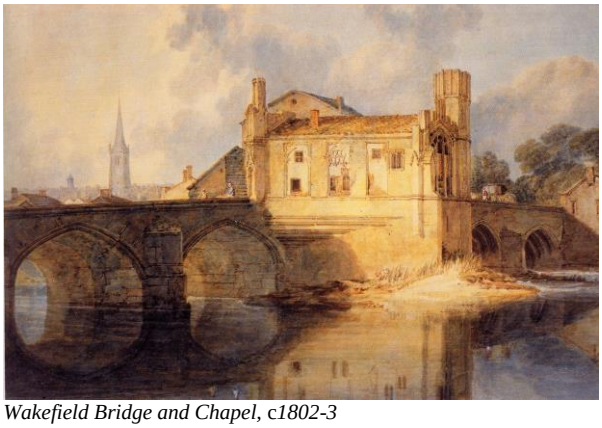
Turner's picture, looking downstream, shows some of the brick arch spans while, in the foreground, cattle stand knee-deep in the river to enjoy an evening drink.

Caversham Bridge with cattle in the water, c*1806-7*

Chantry Bridge, Wakefield

There were early timber bridges over the River Calder at Wakefield, one being mentioned in 1316, and the stone bridge was built in 1342. The bridge has nine pointed and ribbed arches and was at first about 16ft wide, although the bridge's upstream side has twice been extended with rounded arches taking its present width to about 30ft. St Mary's Chantry Chapel, which measures 45ft by 20ft, is located on a small island near the middle of the bridge on the downstream side and was probably built at the same time as the bridge. It was rebuilt by Sir Gilbert Scott in 1847 and further restored in 1890 and 1939.

In this view Turner shows the bridge chapel in strong afternoon sunlight, with the ribs to the bridge arches at the north end clearly visible.



Wakefield Bridge and Chapel, c*1802-3*

Chepstow Bridge, Chepstow, Monmouthshire

There is a 13th century record of a timber bridge, called the Bridge of Strogle, over the River Wye at this site but this was replaced in 1546 by another timber structure. By 1801 the bridge here had a small house on a mid-river stone pier and there were stone piers on the Monmouthshire side, although the rest of the bridge was still in timber. This bridge was replaced in 1816 by the present cast iron structure standing on stone piers with rounded cutwaters.

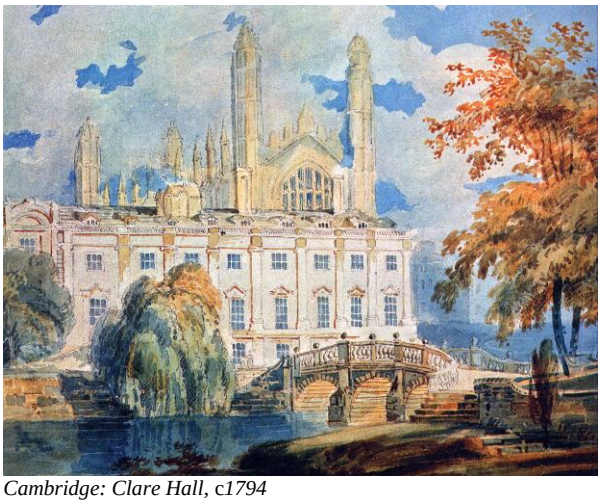
We are looking south-east across the river to the timber bridge, with the Great Tower of Chepstow Castle standing high on its rock behind. In the right foreground is the little building atop its pier.

Chepstow Castle, c1794

Clare College Bridge, Cambridge, Cambridgeshire

This stone structure, the oldest bridge across the Cam in Cambridge, was designed by Thomas Grumbold (for which he was paid three shillings) and completed in 1640. It is about 14ft wide between its classical balustrades, which are decorated with large stone balls. There are three arches, each spanning about 21ft, that were originally nearly semicircular. However, as a result of settlement, the western arch is distorted and the parapet over the central arch sags. Despite this, the bridge is still considered one of the most attractive 17th century bridges in England, and is listed Grade I.

In Turner's afternoon view the sun shines brightly on the west range of Clare College's Old Court, the soaring towers of King's College Chapel behind.



Cambridge: Clare Hall, c1794

Cliffe Bridge, Lewes, East Sussex

The first record of a bridge over the River Ouse at Lewes dates back to 1264. Cliffe Bridge, the hump-backed stone structure painted by Turner, was built in about 1727. It had a single span of about 55ft, with steep approaches on either side. The bridge was widened in the early 1930s and the approaches flattened.

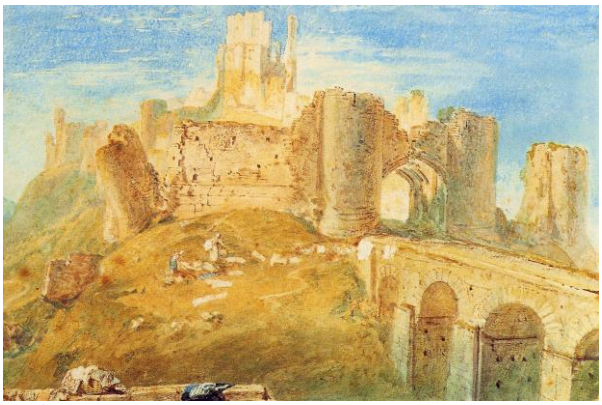
In this picture we are looking north-westward, with Lewes High Street leading away to the left.

A Bridge at Lewes, Sussex, ?1796

Corfe Castle Outer Bridge, Corfe Castle, Dorset

The ravine that the Outer Bridge crosses was cut by miners in 1207 to provide an additional defence for the castle and would originally have been spanned by a timber structure with a drawbridge section. Although its north abutment probably dates back a further three hundred years, the current bridge was built in the late 17th century. It consists of four unequal semicircular double ring stone arches standing on tall, buttressed, rectangular piers. The castle and bridge are owned by the National Trust.

Here, Turner is looking northward, the bright afternoon sun shining brightly on the bridge and the entrance gateway, King John's Gloriette high up behind. The tower on the left, which was mined as part of the slighting process after the castle had been captured by the Parliamentarians in the Civil War, leans over seeming to defy gravity.



Corfe Castle, c1812

Corwen Bridge, Corwen, Denbighshire

An earlier six-arch stone bridge over the Dee here was recorded in 1577. However the present structure of seven segmental stone arches dates from 1704, although there has been much rebuilding since then. The bridge, which slopes down from the town of Corwen at the east end, now has four main arches, all of about 40ft span, and two smaller arches at the higher end. At the lower west end there is a large masonry buttress on the south face, after which there is a smaller flood arch set higher up. All five piers have pointed cutwaters at both ends. The roadway was originally about 12ft wide, but the bridge was later widened to nearly 22ft between parapets and now carries the A5.

Turner's view is looking upstream to the south towards Cynwyd with, on the left, the partly-clouded slopes of Bwlch y Gaseg.

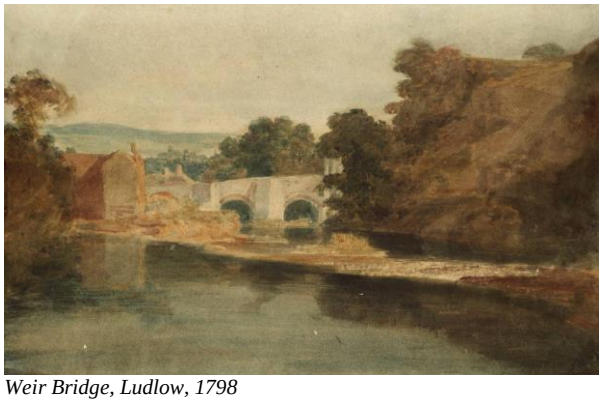
Trout Fishing on the Dee, Corwen Bridge and Cottage, 1809

Dinham Bridge, Ludlow, Shropshire

A little to the west of Ludlow's ancient Ludford Bridge (which has three 15th century arches each spanning 30ft) and just below the weir across the River Teme is Dinham Bridge. It is likely that an early medieval bridge here provided access into the rear of the castle but, by the 17th century, the structure, now called New Bridge, was a narrow stone packhorse bridge with about seven arches. In 1794 the roadway over this bridge was widened by cantilevering out timber beams on both sides and a new arch, designed by Thomas Telford, was built at the north end over the millrace. In 1823 the whole bridge except the arch of 1794 was rebuilt on a new alignment to a design by the Shrewsbury architect John Straphen. This handsome structure has three segmental stone arches with half-round columns above the two pointed river piers.

In the first picture we are looking westward with Dinham Bridge immediately beneath the castle, Telford's new arch of 1794 clearly visible to the right. The other two pictures are from the opposite side of the bridge, with the weir in the foreground of the second and the bridge only just visible in the more distant view of the third picture.

Ludlow Castle, 1800



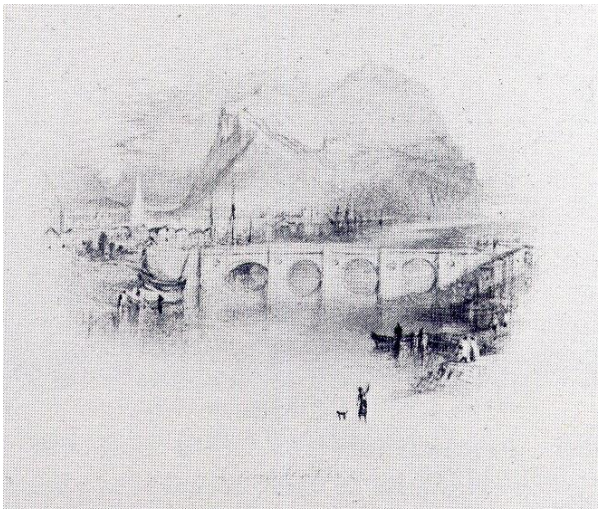
Weir Bridge, Ludlow, 1798

Ludlow Castle, Shropshire, c1829

Dumbarton Bridge, Dumbarton, West Dunbartonshire

The River Leven was bridged here in 1765 by a five-arch stone structure with three 62ft spans flanked at each end by a single span of 42ft, but two arches soon had to be rebuilt after being brought down by the fast-flowing river. In 1884 the bridge was widened from its original 20ft by the addition of 8ft-wide cantilevered footways.

Turner's view from Dennystown is looking in a south-easterly direction at the bridge, behind which is the huge rock on which Dumbarton Castle perches to guard the entrance to the river from the Firth of Clyde.



Dumbarton Castle and River Leven, c1833

Eden Bridges, Carlisle, Cumbria

When the River Eden was first bridged at Carlisle it had two channels separated by an island known as the Sands. Timber bridges were recorded in the early years of the 12th century, with repairs being needed later to rectify damage caused during Scottish raids into England and by floods. A stone bridge was built during the 16th century. In 1815 the present Eden Bridges were built, with the southern section being more of a raised causeway over small flood arches, but the southern arm of the river gradually silted up during the 19th century. The bridge was designed by the architect Sir Robert Smirke and has five high arch spans, all segmental stone arches 65ft long, with small rounded cutwaters protecting the intermediate piers. In 1933 the bridge was widened from 34ft to 70ft between parapets, the new work being built in concrete and refaced with the original stonework.

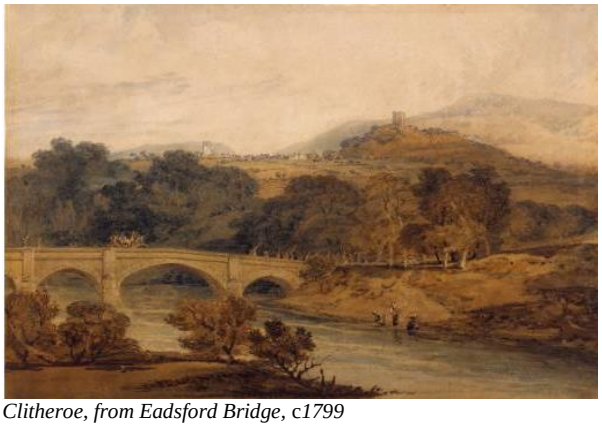
In this view Turner is looking in a roughly south-westerly direction with the main Eden Bridge on the right and the causeway structure to the left. In the centre background is Carlisle Castle.

Carlisle, c1832

Edisford Bridge, Clitheroe, Lancashire

It is likely that an earlier timber structure crossed the Ribble here, but this was replaced by an 8ft-wide five-arched stone structure that is thought to have dated from 1339. This bridge was later widened by 12ft on its downstream face and new arches were built over the flood plain to the west. The largest arch, probably rebuilt in the eighteenth century to replace two medieval arches, is segmental and spans about 60ft. There are three other river arches, each with three ribs and spanning about 25ft. The remaining five segmental spans to the west are generally smaller and are now over dry land. The upstream ends of the piers are protected by tall pointed cutwaters that change to rectangular pilasters at about the height of the arch crowns.

Turner's picture is looking north-east, with the largest arch being the second one in from the eastern bank on the right. On the hilltop in the middle distance is the tower of Clitheroe Castle.

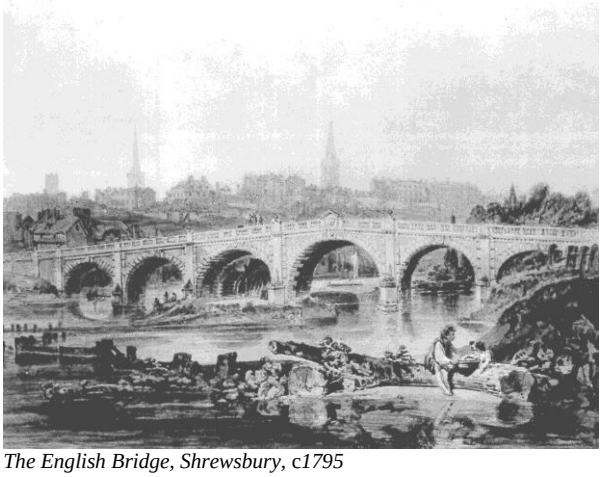


Clitheroe, from Eadsford Bridge, c1799

English Bridge, Shrewsbury, Shropshire

The first bridge across the Severn to the east of Shrewsbury, known as Stone Bridge, was probably built in Norman times and had five stone arches and a drawbridge. The old bridge was only 12ft wide and in 1768 work started on a new bridge designed by the architect John Gwynn. Completed in 1774 this had seven semicircular stone arches supporting a hump-backed roadway 24ft wide. Decorative embellishments included a pedimented alcove at mid-span and carved dolphins on the cutwaters. Between 1925 and 1927 the bridge was completely rebuilt to provide a 50ft-wide crossing with easier gradients. This new structure has seven arches as on the earlier bridge, but with the central five semicircular arches flattened to segmental spans. Apart from later concrete strengthening saddles over the arches, the bridge is in stone and it is claimed to be one of the last major stone bridges to have been built.

In this picture we are looking from the south-east across the river to the river-girt peninsula of Shrewsbury, within which the two church spires stand.



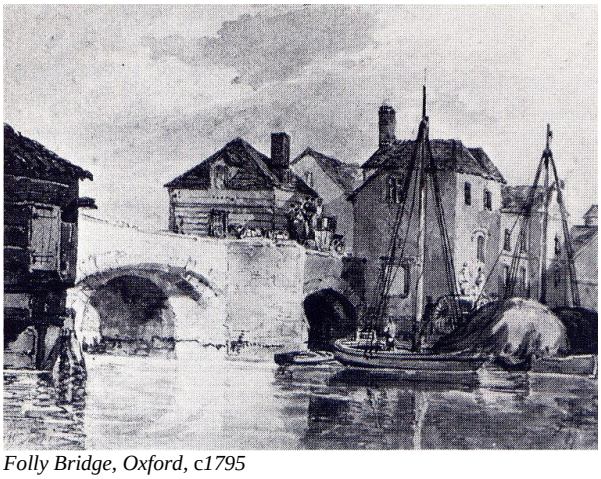
The English Bridge, Shrewsbury, c1795

Folly Bridge, Oxford, Oxfordshire

The Benedictine monks of Abingdon had built a timber bridge across the Thames at this site in Saxon times and the first stone bridge here, known as Grandpont and – despite its name – probably no more than a packhorse bridge, was built in about 1085. However, the bridge was certainly long, with eighteen main river spans up to about 14ft long and a further causeway of over 40 small arches. It is sometimes considered to be the first stone arch bridge to have been built in England. In order to protect the crossing, King Stephen built a gatehouse tower with a drawbridge in 1142. In the 1250s Roger Bacon used the tower for astronomical observations, leading it to be named Friar Bacon's Study. Following the Civil War, the bridge was widened and the then owner of the tower, a man called Welcome, built an extra storey on it that made it look unbalanced and it was thereafter called Welcome's Folly and the bridge Folly Bridge. Although the tower was demolished in 1779, the medieval bridge that it had guarded stood until 1825, when work began on the present four-arched stone structure.

In the first picture, made when Turner was a boy, he shows the view westward from Christ Church Meadow. His second, later, picture was painted from the other side of the river and is looking in a more northerly direction at the houses clustered round the city end of the bridge.

Folly Bridge and Bacon's Tower, 1787

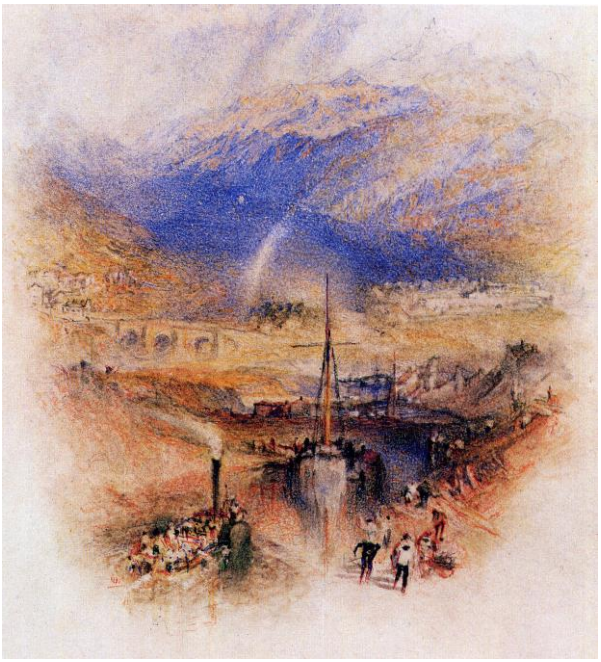


Folly Bridge, Oxford, c1795

Fort Augustus Bridge, Fort Augustus, Highland

Fort Augustus Bridge, also known as Old Oich Bridge, was built shortly after the second Jacobite Rebellion of 1745 as part of a new programme of roads and bridges following up those built by General Wade in the aftermath of the 1715 Rebellion. Two of the bridge's three stone arches were brought down by floods in 1849 and these were replaced by a four-span timber trestle structure. The road was eventually realigned onto a new bridge a short distance to the west, opened in 1934.

In this view we are looking eastward down the lock staircase of the Caledonian Canal, with the stone arched bridge left of centre and the blue of Loch Ness stretching away in the distance.



Fort Augustus, Loch Ness, 1833

Fountains Abbey Guest House Bridge, Aldfield, North Yorkshire

The Guest House Bridge, the older of the two abbey bridges, was built to serve the eastern guest house. It is about 6ft wide and has three semicircular three-ribbed arches, each spanning about 11ft between intermediate piers which are about 4ft thick and have pointed cutwaters at each end. It was probably completed by the third of three consecutive abbots named John – the builder-abbot John de Cancia (Kentish John) who ruled 1220-1247, although an earlier date of 1170 to 1180, when the buildings on either side of it were built, is not impossible.

Turner is looking directly upstream at the guest house and its supporting bridge, with the evening sunlight shining through the ruined window openings.

The Dormitory and Transept of Fountains Abbey – Evening, 1798

Framwellgate Bridge, Durham

Ranulf Flambard, Bishop of Durham from 1099 to 1128, built the first bridge that linked Durham's rocky promontory to the west bank of the River Wear in about 1112, some fifty years before Hugh Pudsey, one of Flambard's successors, built Elvet Bridge to the east. After floods had destroyed Flambard's bridge in 1400, Bishop Skirlaw built the existing Grade I structure. This has two flat, segmental, five-ribbed arches of 87ft and 83ft span, although buildings now hide a third smaller semicircular arch at the city end that is a possible survivor from the original bridge. The gateway and tower from the original bridge were removed in 1760 and in 1856 two additional arch ribs were built to widen the bridge from 20ft to 28ft.

In his first picture Turner is looking upstream at Framwellgate Bridge, the west end of the cathedral standing high over the central pier.

Durham Cathedral, from the River, c*1799*

In the corner of his 1835 picture, Turner has shown a mother and child looking downstream at Framwellgate Bridge from Prebends Bridge, opened in 1775.

Durham Cathedral, c1835

Goring Towpath Bridge, Goring, Oxfordshire

The old towpath bridge over a side channel of the river was a rough and ready timber structure with beams spanning between simple trestles constructed in the stream.

This view is looking to the southeast, possibly from the old road bridge.

Goring Mill and Church, 1805

Gunnislake New Bridge, Gunnislake, Cornwall

This bridge, completed around 1520, has four main very slightly pointed 21ft-span arches in white granite, together with two rather smaller spans. The pier cutwaters continue to parapet level to provide pedestrian refuges, the normal width between parapets being only 12ft. In July 1644, during the Civil War, Parliamentary forces under the Earl of Essex captured the bridge from Sir Richard Grenville, killing or capturing about 200 Royalists with the loss of about 40 of their own men. A few weeks later Charles I defeated Essex at nearby Lostwithiel, the king then marching his troops over the bridge on their way to the inconclusive Second Battle of Newbury. The bridge is listed Grade I.

The location of this well-known painting by Turner has only been identified in the last few years as Gunnislake on the Tamar. We are looking south with the bridge in the middle distance and the town on the right.

Crossing the Brook, c1815

Hornby Bridge, Hornby, Lancashire

The stone bridge at Hornby crosses the River Wenning just upstream from its junction with the Lune. It was built originally in the early seventeenth century, repaired in about 1651 (shortly after two children had been drowned at the bridge), and again in about 1699 and 1772. This is the bridge painted by Turner. In 1844, when the river was diverted, the old structure was demolished and rebuilt with three segmental stone arches. It was widened on its west face in about 1942.

In his picture Turner shows the high arch of the bridge just behind the big tree, with the sixteenth century tower of Hornby Castle beyond and slightly to the right.

Hornby Castle from Tatham Church, 1816-8

Ivybridge Bridge, Ivybridge, Devon

The bridge over the River Erme at Ivybridge carried the Exeter to Plymouth road. It was a small 13th-century hump-backed bridge with a single semicircular arch. A few years after Turner painted the crossing, a new bridge was built a short distance down river.

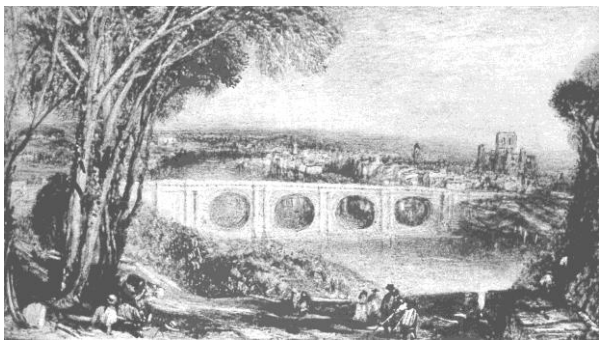
In this picture looking at the bridge from the south, we see the coach for Plymouth loading up while, on the right, a latecomer runs to catch it.

Ivy Bridge, c*1813*

Kelso Bridge, Kelso, Borders

The first bridge at Kelso was not built until work started in 1754 on a six arch stone bridge but this was partially washed away in 1797 following scour damage to its foundations. The present bridge, completed in 1803 by John Rennie, is not only extremely handsome in its own right, but also gives a good idea of how Rennie's larger 1817 Waterloo Bridge in London, "the noblest bridge in the world", would have looked. The bridge's 24ft-wide level deck crosses the Tweed on five stone arches that are semi-elliptical in shape and span 72ft with a rise of 10ft. The intermediate 12ft-wide piers have half-round cutwaters at each end on which stand twin engaged Doric columns and a wide projecting dentilled cornice supports the solid parapet with shallow rectangular refuges above the piers. Two of the lamp standards from the original Waterloo Bridge have been erected at the west end of the parapet and, at the town end of the bridge, is a tollhouse with a pyramidal roof. The bridge is listed Grade A.

In this picture we are looking north at the bridge with the remains of Kelso Abbey beyond it on the right.



Kelso, c*1832*

Kew Bridge, Kew, Greater London

The first bridge at Kew, replacing an earlier ferry, was a timber structure completed in 1759. It was a substantial 30ft wide and crossed the river in eleven spans with a central 50ft navigation opening. Following continuing scour damage to the piers, the timber bridge was replaced by a structure designed by James Paine on similar lines to his earlier bridge at Richmond and, like that one, financed through an insurance tontine. Work started in 1783 and the bridge, a short distance downstream of the existing timber structure, was opened in 1789. Compared with its unsatisfactory predecessor, this was a substantial Portland stone bridge of seven segmental river arches with a central span of 66ft and was crowned by an ornamental stone balustrade.

However, the bridge suffered from having a roadway only 18ft wide, from steep approaches with an awkward central hump, and from inadequate foundations. Rather than widen the bridge it was decided to build a completely new third Kew Bridge. This was designed by Sir John Wolfe Barry and has three semi-elliptical masonry arches with a central span of 133ft and two side spans of 116ft. Work on the bridge began in 1899 and it was opened in 1903.

Turner's first picture of Kew shows Paine's bridge a few years after its completion lit up brightly by the sun, although one end is in the shadow of a cloud. The second, more distant, view is from the north bank of the river looking eastward, with the new Kew Palace between the trees at the right.

Kew Bridge, 1805

Kew Palace, 1805

Kirkstall Canal Bridge, Kirkstall, Leeds

The Leeds & Liverpool Canal was built in 1816 and the bridge across it at Kirkstall was probably built in 1824 to carry the Leeds to Bradford turnpike road (now B6157). Its main arch spans about 10ft and a smaller accommodation arch provides access under the embanked roadway between the canal and the fields beyond.

Turner's picture shows the canal (not the River Aire) passing through the centre of the picture with a turning pool for canal traffic in the right foreground. On the opposite side of the canal, building work is in progress on the local brewery. The medieval Cistercian Kirkstall Abbey is in the middle distance to the right and in the centre, beyond the white Georgian house, the gates of the canal's Kirkstall Lock can just be seen.

Kirkstall Lock, on the River Aire, 1825

Lady Bridge, Tamworth, Staffordshire

An early timber bridge across the Tame on this site (also known as St Mary Bridge) was recorded in 1294 and there once was a statue of the Virgin Mary in the middle of a later structure. In *The Itinerary* published by John Leland in 1546 he describes the bridge as "havinge 12 great Arches". Two of these arches were swept away by floods in 1795. By 1839 the whole ancient structure had been replaced by a wider bridge containing six semicircular stone arches, and this was further widened in about 1939.

In Turner's view he is looking north-west and morning light illuminates the east face of the old bridge. The tower of St Editha's Church is just to the right of the castle and the Ladymills mill buildings are at the end of the weir just below.

Tamworth Castle, Staffordshire, c*1830*

Leatherhead Bridge, Leatherhead, Surrey

The attribution to Turner of this picture is still uncertain and, although the subject is usually given as Maidenhead Bridge, it is in fact Leatherhead Bridge. An earlier bridge over the River Mole at Leatherhead was largely rebuilt and widened on its downstream face in 1783. The bridge now has fourteen segmental brick arches all spanning about 13ft. Four semicircular pedestrian refuges on each side, originally supported on trumpet-shaped brick corbelling, now rest on cantilevered concrete slabs.

We are looking downstream at the bridge from the south, with ten arches and three of the distinctive refuges in view.

Maidenhead Bridge, c*1793-6*

Lindley Bridge, Lindley Green, North Yorkshire

Lindley Bridge over the River Washburn was built shortly after an earlier structure there had been destroyed by floods in 1767. Originally, it had two stone arches – a tall semicircular arch and a smaller flood arch – although a third arch was added in about 1866 as part of the project to build Lindley Wood Reservoir a short distance upstream. Cutwaters either side of the main arch are topped by shallow pilasters rising up to parapet level.

Turner has painted this picture looking at the bridge from the south, the buildings of Lindley Hall and its farm just visible on the horizon above the flood arch.

Lindley Hall, with Lindley Bridge, c*1818*

Lion Bridge, Alnwick, Northumberland

Bridges have crossed the River Aln here just north of Alnwick since Norman times, the present bridge's predecessor being badly damaged by the 1771 floods. The present Grade I stone bridge overlooking the Duke of Northumberland's castle and park was built by John Adam in 1773. There is a central segmental arch spanning 50ft with a 40ft-span segmental arch on each side. The bridge is now called Lion Bridge because of the statue of the lion above the battlemented bridge parapet. The original outstretched tail was copied from the arms of the Duke's Percy family.

In his picture, Turner is looking east, with the bridge in silhouette beneath the castle. The lion and its tail, on the far side of the bridge, can just be seen almost directly beneath the sun.

Alnwick Castle, Northumberland, c*1829*

Llandeilo Bridge, Llandeilo, Carmarthenshire

There had been an earlier bridge over the River Towy at Llandeilo in 1577 and this, or a successor, was described in the early 1700s as a handsome structure. In 1795 a pier and two arches of the then seven-span bridge were washed away by floods. A third arch was destroyed the following year and, although three replacement arches were completed within a year or two, the bridge remained unsatisfactorily narrow. The present fine stone bridge was built in 1848 and has a 145ft-span main arch – the longest stone arch in Wales – and a small flood span supporting a 26ft-wide deck.

Turner painted his watercolour a year after the 1795 collapse. He is looking west and shows a ramshackle timber footbridge spanning the gap with a rickety midspan prop standing on the remains of the old pier. The steep slopes of Pen Lan-fawr rise up behind.

Llandeilo Bridge and Dinevor Castle, 1796

Llangollen Bridge, Llangollen, Denbighshire

Llangollen Bridge was once described as one of the Three Jewels of Wales. This present stone bridge, replacing an earlier structure dating from before 1282 (possibly from 1131), was built over the Dee in about 1500 and has four arches – three pointed and one segmental. These are from 21ft to 28ft in length and span between massive piers with pointed cutwaters that extend up to parapet wall level. The original narrow bridge was widened in 1873 and again in 1969 and is now 36ft wide. It is listed Grade I.

In Turner's distant view, looking upstream to the west, it is possible to see six arches of the bridge, with the church tower just visible behind.

Llangollen, North Wales, c*1836*

Llanvihangel Crucorney Bridge, Llanvihangel Crucorney, Monmouthshire

The first stone bridge over the River Honddu here was a late medieval structure, with a large pointed cutwater and two main relatively flat segmental arches – although these could have been rebuilds of earlier semicircular arches. In 1826 this bridge was taken down and replaced by a single segmental stone arch spanning 45ft, completed the following year, which in turn had to be rebuilt after a great flood in 1853 brought down all the bridges over the Honddu.

In his painting of the first structure, Turner is looking upstream at the east face of the bridge, with the cottage on the right being on or near the site of the present Lower Cottage.

Llanvihangel, Crucorney, Monmouthshire, c1793 [B&W > Colour]

London Bridge, City, Greater London

In 1176 Peter of Colechurch began to build a new bridge in stone just to the west of an earlier wooden structure he had built. Old London Bridge was finished in 1209 and it served the city for 622 years. For the first five centuries of its existence, until Fulham Bridge was opened in 1729, it was the only crossing of the Thames below Kingston, about 20 miles upriver. Old London Bridge consisted of 19 pointed arches of Kentish ragstone and a wooden drawbridge span, with each pier protected by a massive starling. The lengths of the arch spans varied between about 12ft and 33ft and the thicknesses of the piers between about 17ft and 36ft, the overall length being about 900ft with a deck about 20ft wide supporting a roadway about 12ft wide. The original bridge piers were founded on three rows of timber piles, mainly of elm, within which loose stones were placed supporting massive oak sleepers on which the stone superstructure was then constructed, progressing across the river at the rate of roughly one completed arch span every eighteen months. The protective starlings outside the piers also consisted of rows of timber piles enclosing loosely dumped stonework, each subsequent repair increasing the size of starling. The reduced width of waterway caused by the starlings resulted in a considerable difference in water level between each side of the bridge, the maximum recorded being over 4½ft in 1736. In order to take advantage of this source of energy, mill wheels were built under the two southern arches in 1559 and in 1580 waterwheels were installed at the north end to pump water into the City. By 1767 there were seven wheels and these remained until removed by Act of Parliament in 1822. There were also buildings on the bridge, including at first a chapel (where Peter was buried) and two gateway towers and, later, many houses. Between 1758 and 1766, under George Dance the Elder, all the buildings were demolished, one of the central piers was removed and the Great Arch spanning about 50ft was built. The bridge roadway was also widened to a standard width throughout by extending it out over the starlings.

Old London Bridge, c1795

Old London Bridge, c*1794*

The bridge remained in this state for another 65 years until 1831, when it was completely demolished after the Rennies' replacement structure had been opened.

One of Turner's early pictures is a rare view of the waterwheels at Old London Bridge that were powered by the river, which in this case is flowing upstream with the incoming tide. Immediately behind the bridge is the tower of St Magnus Church church that before the mid-18th century rebuilding had straddled the roadway onto the bridge, with the Monument standing slightly farther back.

The picture from about 1794 showing four arches is a view looking upstream at low tide, with the first Blackfriars Bridge (opened 1769) visible in the distance. The arch to the right is part of the new Great Arch, the high arch just left of centre being another new arch constructed at the same time. This spanned what had originally been the drawbridge opening immediately to the south of the stone gatehouse that was begun in 1426 and replaced by Nonesuch House between 1577 and 1579. The picture clearly shows how the large starlings restricted the flow of the river.

In Turner's view of the port, which also looks upstream at the bridge, a boat with its mast lowered (in the centre of the picture) has just shot the Great Arch of the bridge on the ebb tide. Behind the bustle of the busy port the tower of Southwark Cathedral can just be seen to the right of the two large masts on the left side.

The Port of London, 1824

Longthwaite Bridge, Rosthwaite, Cumbria

This bridge over the River Derwent has a single semicircular stone arch spanning 40ft supporting a 9ft-wide carriageway. The arch ring is of dressed stone but the spandrels and parapet walls are of rubble.

In his painting, looking downstream to the north, Turner shows the bridge in the middle distance, but the small size of the structure is indicated by the two people crossing over it. Nearer to us, cattle are drinking from the river.

Borrowdale, Longthwaite Bridge and Castle Crag, c1798-9

Looe Bridge, Looe, Cornwall

The original bridge at Looe was one of the country's great medieval long bridges and dated from about 1418. It had 15 arches and was just over 6ft wide. It had originally included the chapel of St Anne in the centre of the bridge but this was probably destroyed during the Reformation. Major repairs to the structure were recorded in 1521 and 1689. The current bridge, built higher upriver as a replacement in 1853, has nine somewhat misshapen stone arches.

In this picture we look south across to West Looe with the old bridge in the foreground, its sharply pointed cutwaters plainly visible.

East and West Looe, Cornwall, c1816

Magdalen Bridge, Oxford, Oxfordshire

Earlier bridges over the River Cherwell here, then known as East Bridge, date back to pre-Conquest times and repairs were mentioned in records dated 1459. There is also a record of 'Maudlin Bridge', spelt as it is normally pronounced, being destroyed by floods in 1571. After part of a later bridge collapsed in 1772, John Gwynn was commissioned to design the present bridge, which was opened in 1782. This classically styled structure consists of two sets of three semicircular stone arches with banded barrels. These span between piers with ends that are decorated with pilasters consisting of alternate deep and shallow horizontal bands of stone. The bridge was widened by 20ft in 1882.

Turner's view is from the south, showing the west face of the bridge.

Magdalen Tower and Bridge, Oxford, c1794

Maidenhead Bridges, Maidenhead, Windsor & Maidenhead

There was a narrow and rickety timber bridge to carry the Great West Road over the Thames at Maidenhead from around 1280 until the present 30ft-wide structure was completed in 1777. This handsome Grade I bridge has seven main stone arches over the river, varying from 28ft to 35ft span in the centre, with a further three smaller land arches at each end that, though faced in stone, have brick barrels.

Brunel's magnificent bridge was opened in 1839 to carry his broad gauge Great Western Railway over the River Thames. The two main semi-elliptical brick arches span 128ft and, with their rise of only 24ft (a span:rise ratio of 5.3:1), were the flattest long-span arches then built. There are ten rings of brickwork in the arch barrels. Four smaller semicircular arches flank the main spans at each end. In 1893 the bridge was widened to 60ft by extending the arches on both sides, thus allowing quadruple standard gauge tracks to be laid.

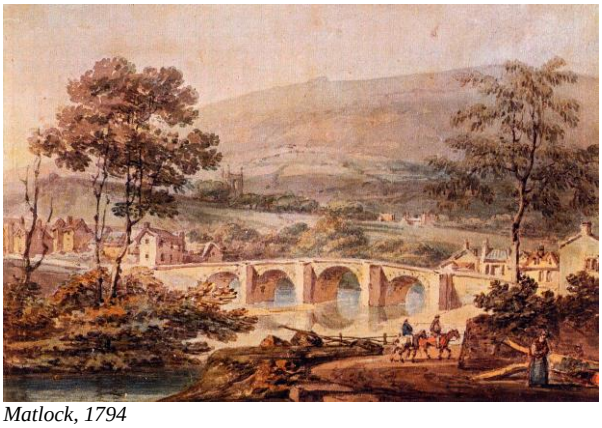
In this picture we are looking east as a train thunders over the railway bridge towards us and, on the left, we can just discern some of the arches of the old road bridge.

Rain, Steam and Speed – the Great Western Railway, 1844

Matlock Bridge, Matlock, Derbyshire

This fifteenth century bridge over the Derwent, built to replace a ford, was originally very narrow but its width was increased to about 28ft when the upstream side was rebuilt in 1904 and the roadway levelled. There are three main tall pointed arches each spanning about 28ft, with massive triangular cutwaters on the intermediate piers. At the west end is a slightly higher flood arch with a span of about 25ft.

We are looking roughly southeast, with the tower of St Giles Church just visible above the arch at the left end of the bridge



Matlock, 1794

Ness Bridge, Inverness, Highland

Early timber bridges over the River Ness at this point were built to carry the main road from Inverness over the River Ness and north via Beauly, the first of these by King Alexander II before 1249. In 1411, Donald of the Isles, marching to the Battle of Harlaw near Inverurie, burned the town of Inverness and its oak bridge, considered to be one of the finest in Scotland. Later wooden bridges were destroyed by floods in 1620 and 1664. In 1685 a seven-arch stone bridge was built, this containing a prison vault within the second pier from the east bank. The second pier from the west bank supported two corbelled towers enclosing a defensive gatehouse, later used for the collection of tolls. This bridge was swept away by floods in 1849. It was replaced in 1855 by an asymmetric suspension bridge, designed by J M Rendel, with a single tall battlemented gateway-style tower on the east bank and two small anchorage towers on the west. It had a single 225ft-long span and a 30ft-wide deck. A temporary Bailey bridge was built alongside it during the war and, in 1959, the suspension bridge was removed and a prestressed concrete structure with a 44ft-wide roadway and two 9ft-wide footways was built in its place. This is a double cantilever with a central suspended section, the spans over the river being 63ft, 120ft and 63ft. In 1982 the A9 route through Inverness over the bridge was bypassed with the opening of the new Kessock Bridge.

In Turner's picture, we are looking north-east at the 1664 bridge, the left hand steeple being that of Old High Kirk and with the Tolbooth Steeple to the right. In the centre is the tower on the south side of the gatehouse.

Inverness from the River Ness, c*1833*

North Bridge, Edinburgh, City of Edinburgh

The first bridge on this site, where the old Nor' Loch had been until it was drained in 1760, linked Edinburgh Old Town to where the new Georgian squares were being built to the north and was completed to a design by William Mylne in about 1768. This bridge had three main semicircular stone arches spanning 72ft standing on tall piers. In 1769 the bridge partially collapsed when the pressure of fill within the abutment forced the side wall to collapse, burying four people. It was rebuilt by 1772 to include weight-reducing cylindrical voids in the spandrels and was then replaced in 1897 as part of a plan to extend Waverley station.

Turner's first view looks westward over the buildings of Calton Jail (where St Andrew's House now stands) to the castle, with North Bridge in the centre. The second picture is in the opposite direction with the castle esplanade in the foreground and Calton Hill on the distant horizon.

Edinburgh from Calton Hill, c*1819*

Edinburgh Castle: March of the Highlanders, c1835

Pensarn Bridge, Conwy

Originally, the road leading due south to Llanrwst from Conwy left the walled town by the Porth y Felin gateway before crossing the River Gyffin on Gyffin Bridge. In 1779 a new stone bridge, now called Pensarn (or Penysarn) Bridge, was built at a cost of £39. This was 15ft wide between parapets and had a central segmental arch spanning 15ft flanked on each side by a semicircular arch spanning 6ft. In 1828 the bridge was again rebuilt but in a slightly different location, this time incorporating a new passageway through the town walls. The structure itself is 18ft wide and has a single arch spanning 12ft. Just nearby, Telford's suspension bridge over Afon Conwy was built in 1826 to carry his new Holyhead road.

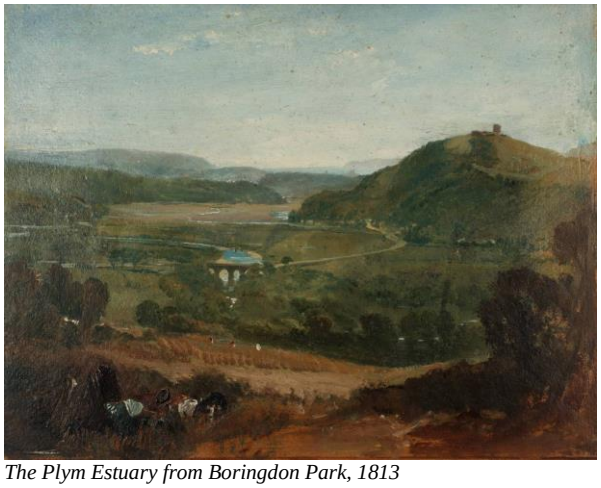
Turner view from the south-west shows the 1779 bridge, with the towers and walls of Conwy Castle looming up behind.

Conway Castle, c1800

Plym Bridge, Plympton, City of Plymouth

It is probable that the medieval bridge here, on which an old bridge chapel had stood, had pointed arches, the remains of which can be seen on the existing piers, particularly on the arch abutting the left bank. The present bridge has five semicircular arches spanning between piers ending in sharply pointed cutwaters and it may date from the eighteenth century.

In Turner's picture, looking south towards the sea, there is only a glimpse of the bridge in the middle distance.



The Plym Estuary from Boringdon Park, 1813

Pont Aberglaslyn, Beddgelert, Gwynedd

Records show the bridge here over the Afon Glaslyn was repaired in 1776, that it was recorded in 1796 as being one of Carnarvonshire's five bridges, and that it was further repaired and widened in 1804. It was also known as the Devil's Bridge following a tradition that it had been built by the Devil who, having contracted for a life in exchange, was duly outwitted by the cunning locals arranging for a dog to cross first. The single stone arch spans 30ft between rocks on either side of the steeply rushing river.

Turner is looking upstream towards Snowdonia in the north.

Aber Glaslyn: Welsh Mountains and a River, c1799

Pontypridd Bridge, Pontypridd, Rhondda

The sequence of bridges that the self-taught local mason (and non-conformist minister) William Edwards (1719-1789) built over the Taff at Pontypridd is one of the most celebrated sagas of British bridge building. Although there had been many earlier timber structures here, Edwards started the first stone bridge on the site in 1746. Completed in 1750, this was a three-arch structure that was swept away by floods within three years. Edwards' second bridge, designed to avoid flood damage by leaping the river in a single 140ft-long segmental arch span, was also destroyed by floods during its construction while it was still supported by its centering across the river. In November 1754 during its rebuilding, the bridge again collapsed, this time as a result of an unstable design that caused the heavy weight of the structure at the abutments to force the crown upwards. In his successful fourth attempt, completed in 1756, Edwards rebuilt the arch with the same 140ft span and rise of 35ft but with three large cylindrical tunnels through each of the spandrels to lighten the bridge haunches. These are 9ft, 6ft and 3ft in diameter. The roadway is 11ft wide and the structural arch ring is only 2½ft deep. However, the steepness of the approaches caused great problems to traffic and, although the slopes were reduced slightly in about 1826, a new level-decked three-span arched bridge was built by public subscription in 1857, unfortunately very close to Edwards' masterpiece. In 1892 the old bridge was resurfaced with steps and restricted to pedestrians. The bridge remained the longest span bridge in Britain until the cast iron Wearmouth Bridge opened in 1796, and the longest masonry span until 1831 when Rennie's New London Bridge was completed. The bridge is listed Grade I.

Turner shows the bridge looking downstream to the south. The large building in the middle distance, seen beneath the right hand side of the arch, was the Brown Lenox chainworks, opened in about 1826.

The Bridge at Pontypridd, c1826

Pulteney Bridge, Bath, Bath & NE Somerset

Bridges supporting buildings (inhabited bridges) were an interesting feature of medieval life. A few, such as Bristol, Lincoln and London Bridges, contained complete streets allowing the residents to take advantage of the better air and simple way for disposing of waste. Many had guard towers or their own chapels where travellers could give thanks for a safe crossing. Pulteney Bridge, completed in 1773, was designed by Robert Adam as a modern version of a bridge lined with buildings. It was built as a link between a new residential development and the town, and included two rows of small houses (now shops) with attics above.

Turner produced this painting to illustrate his professorial lectures on perspective at the Royal Academy. In this view we cannot see the three segmental stone arches, each spanning 33ft, which form the 58ft-wide bridge structure itself, but are instead looking between the buildings that line the bridge.

Pulteney Bridge, Bath, in Perspective, c1810

Rhayader Gwy Bridge, Rhayader, Powys

Rhayader Bridge over the River Wye had a single semicircular arch. which was built in 1780, destroying the waterfall after which the town is named. The structure was rebuilt in 1929.

We are looking upstream at the bridge, the low viewpoint of the picture emphasising the bridge's extreme narrowness, perhaps no more than 6ft. Through the arch we can see a small cottage surrounded by windswept trees with, below it, women doing the washing.

Rhayader Gwy Bridge, c1795

Richmond Bridge, Richmond, Greater London

Richmond Bridge was designed by the prolific architect James Paine, who also designed the bridge at Walton, now replaced, which Turner painted as well. Richmond Bridge was built between 1774 and 1777 and replaced an ancient ferry service that dated back to the early 15th century. Funds for construction of the bridge were raised through the tontine principle of gradually fewer surviving investors in the original project sharing the interest earned from the capital put up by their deceased partners.

The bridge has five main segmental stone arches with the roadway rising fairly sharply as the spans increase towards the central 60ft span. The piers are extended out slightly over the pointed cutwaters to rise as curved pilasters through to the top of the classical balustrade, giving the bridge a lively elevation. The bridge was widened by 12ft on its upstream side between 1937 and 1939, the original Portland stone facing being taken down and rebuilt to the new line. The Grade I Richmond Bridge is now the oldest bridge over the Thames in Greater London and has attracted many artists over the years.

In these two paintings Turner is looking east, with Richmond Hill behind the bridge.

View of Richmond Hill and Bridge, 1808

Richmond Hill and Bridge, c1828

Richmond Bridge, Richmond, North Yorkshire

The first stone bridge over the River Swale on this site had four arches and probably dated back to the 15th century. However it was badly damaged by floods in 1771 and the present bridge was built in 1789. This is 26ft wide and has three 48ft-long segmental arch stone spans. Semicircular columns stand on the rounded cutwaters and rise up to provide refuges at road level.

In the first picture Turner shows the bridge from the west, with the ancient castle looming up behind it.

Richmond, Sunrise, c1798

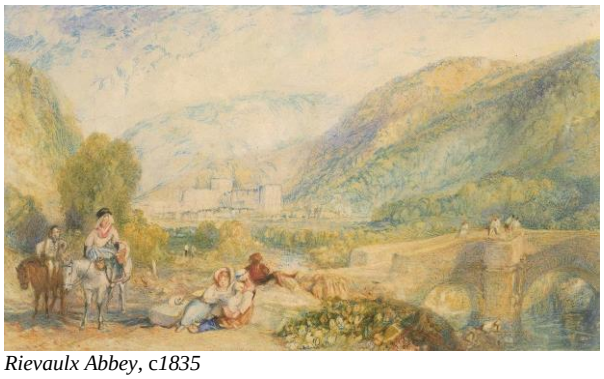
The second picture, looking west, shows only a glimpse of the bridge to the left of the castle on its easily defended rocky promontory.

Richmond Castle and Town, Yorkshire, c1825

Rieuvaulx Bridge, Rievaulx, North Yorkshire

An early medieval bridge over the River Rye here, just downstream from Rievaulx Abbey, was swept away by floods in 1754. The present stone bridge, built to replace it, has a main nearly semicircular arch flanked by two lower and smaller segmental arches. The two intermediate piers have pointed cutwaters rising to parapet level to provide pedestrian refuges.

Turner is looking north, with the remains of the Cistercian Abbey in the distance.



Rievaulx Abbey, c1835

Rochester Bridge, Rochester, Kent

The Romans probably built a timber bridge over the River Medway between Rochester (Durobrivae) and Strood to carry Watling Street, the Roman highway that ran from London to Dover and Richborough – the Romans' Channel ports – but no record or relic has survived. There was probably another bridge there by around 900. In 1215 the bridge was captured during King John's siege of the castle. Later, further timber bridges were built on the site, all of which suffered damage by fire and floods, and there are records of commissions appointed to organise repairs in many years including 1381, which may have been following damage when Wat Tyler led his Kentish men over the bridge in June 1381 during the Peasants' Revolt. In 1387 work started on a stone bridge, possibly under the supervision of Henry Yevele who also built the western bays of the nave at Westminster Abbey, and Chaucer would have seen the work in progress during his *Canterbury Tales* pilgrimage in 1388. This bridge, which was completed around 1392, was 14ft wide and had ten arches founded on massive piers and abutments, these being supported on more than 10,000 elm piles. Each arch spanned about 30ft, and there was a further drawbridge opening. In 1820 John Rennie largely rebuilt the whole structure, widening it throughout and replacing the two small central arches with a single span. Rennie's bridge was, in turn, replaced by a 40ft-wide cast iron bridge, designed by Sir William Cubitt, which had a 50ft-long swinging section to allow passage for river traffic. In 1914 yet another rebuilding was completed in which steel trusses replaced the cast iron arches and the bridge was widened to 46ft. Finally, in 1970, the crossing was widened again when a second bridge was built alongside to take the eastbound traffic on the A2. This has two continuous steel box girders spanning 154ft, 186ft and 154ft between piers of the disused East Kent Railway Bridge that Joseph Cubitt had built in 1858.

This engraving, made from a painting by Turner that was later destroyed by fire, shows Rennie's bridge, with its enlarged central arch, and Rochester Castle at its eastern end.

Rochester, Stroud and Chatham, Medway, c1836-7

St Mawes Castle Bridge, St Mawes, Cornwall

St Mawes Castle was built as a Henrician coastal artillery fort, and it was completed in 1543. The access into the fort, over a deep dry moat, may originally have been by a drawbridge but there is now a stone bridge with two semicircular arches.

Here, Turner shows St Mawes Castle roughly from the north west with the bridge over the moat prominent in the foreground. However, this picture is something of a composite view as he has included Pendennis Castle on the hill behind St Mawes Castle.

Falmouth, c1825

Skerton Bridge, Lancaster, Lancashire

There was a timber bridge over the River Lune at Lancaster in 1216 when King John ordered that timber should be made available for its repair. The architect Thomas Harrison designed the present bridge in 1788 and it was one of the first road bridges to have a level rather than hump-backed deck. It has five main segmental arches, each spanning 60ft, and has pedimented niches over each pier. An elegant balustrade finishes off the structure. The Lune Aqueduct, built by Rennie in 1796, has five semicircular 70ft-span stone arches.

Turner's view is looking south down the River Lune to Skerton Bridge although he shows this as having six arches. His picture contrasts those involved in agricultural activities beyond the canal with those taking their ease beside it. On the right hand side he shows a corner of the Lune Aqueduct.

Lancaster from the Aqueduct Bridge, c1825

Trent Bridge, Newark-on-Trent, Nottinghamshire

The bridge at Newark beneath the castle walls crosses the river just below the junction of the southern arm of the Trent and the River Devon. An early timber bridge here was recorded in 1169 but floods destroyed its successor in the 15th century. It was rebuilt as a 12-span timber trestle structure between stone abutments around 1486 and again following the Civil War. In 1775 Stephen Wright built the present stone-faced structure, which has seven segmental arches, and in 1848 cantilevered footways were added to extend the overall width to 38ft.

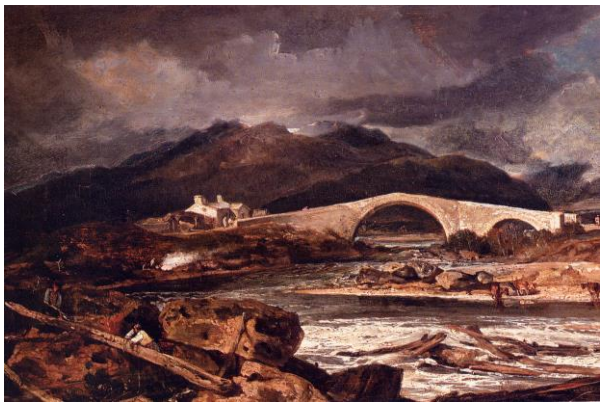
In this view Turner is looking north-east along the walls of the castle, with the bridge in the distance.

Newark upon Trent Castle, c1796

Tummel Bridge, Tummel Bridge, Perth & Kinross

Tummel Bridge stands beside the famous Road to the Isles between Loch Tummel and Loch Rannoch. Where the road crosses the River Tummel, John Stewart designed and built this Wade bridge, completing it in 1733. There is a semicircular main arch spanning 55ft and a smaller segmental flood arch where the 11ft-wide road cranks off to the northwest. The Grade A bridge was renovated in 1973 and traffic now uses a modern girder structure.

Turner's picture shows the bridge standing brightly lit in evening sunshine against the background of mountains and beneath a threatening sky.



Tummel Bridge, Perthshire, c1802-3

Tyne Bridge, Newcastle upon Tyne

The first stone bridge over the Tyne at Newcastle was built to replace a timber structure reportedly burnt down in 1248. Following damage by floods as well as general wear and tear, the bridge was extensively repaired or even partially rebuilt many times, resulting eventually in the number of open arches being reduced to nine. In the final flood of 1771 four of these collapsed. A temporary bridge was opened less than a year later.

Robert Mylne's 1781 replacement Tyne Bridge of nine segmental stone arch spans was an elegant structure but, at only 24ft wide, was inconveniently narrow and the height under its arches was suitable for small boats only. The spans of these arches varied from 27ft to 58ft. Twenty years after its completion the bridge was widened by about 5ft on each side by David Stephenson. However, the inconveniences of the bridge for increasing river traffic ultimately led to it being replaced by the Newcastle Swing Bridge and, in 1866, demolition of the old bridge began. The new Tyne Bridge, which was opened in 1928, is a two-pinned steel crescent arch and was Britain's longest steel arch for more than 30 years. It is located a short distance downstream from the site of the earlier Tyne Bridges.

Turner shows Mylne's bridge from downstream, the keep of the Norman castle just above the northern abutment and the lantern of Newcastle Cathedral higher up to its right.

Newcastle on Tyne, c1823

Usk Bridge, Brecon, Powys

Floods destroyed an earlier bridge over the River Usk at Brecon in 1535. The present Grade I bridge was completed eight years later and was widened to 22ft on its upstream face in 1794. The structure originally had seven segmental stone arches, with spans of from 16 to 24ft between piers with massive cutwaters that extend up to parapet level, but two extra arches were added in 1794. Later work includes the addition of cantilevered external walkways.

Turner's view from south of the river shows two of the bridge arches and Brecon castle beyond, with Honddu Bridge being glimpsed through the left arch. This was a three-arched stone bridge which was destroyed by floods in 1853, and another flood destroyed the replacement bridge in 1873.

Brecon Bridge, c1798-9

Usk Bridge, Usk, Monmouthshire

The bridge here carries the road from Monmouth to Newport over the River Usk. There was a series of earlier timber bridges, one of which was repaired in about 1387, but the first stone bridge was not built until William Edwards (of Pontypridd Bridge fame) completed the present five-arch stone structure in 1756. This had five segmental stone arches spanning between piers with triangular cutwaters extending up to parapet level to form pedestrian refuges. In 1836 the bridge was extended on both sides to give a width between parapets of 27ft, although the refuges were not reconstructed, and the gradients over the bridge were eased. Two arches fell during floods in 1877.

Turner's first view of the bridge is looking upstream to the north, the tower of Usk Castle clearly visible above the right hand end of the bridge.

Usk, Monmouthshire, Seen from across the River: Five-Arched Bridge in Foreground, 1798

The second view also looks to the north but from further downstream.

Usk, Monmouthshire, from the South, 1798-9

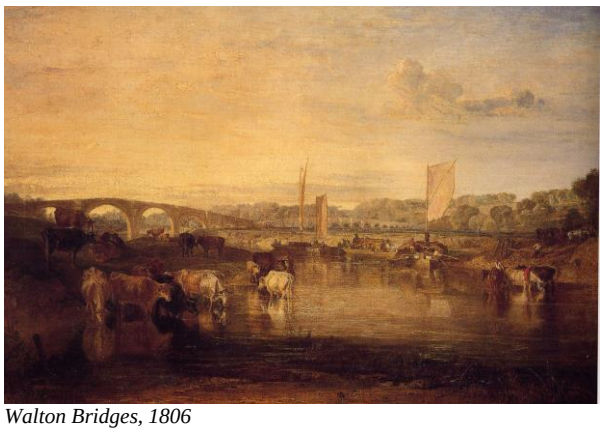
Walton Bridge, Walton-on-Thames, Surrey

The first bridge over the main river channel of the Thames on this site was the timber structure built by William Etheridge in 1750 as a larger version of the Mathematical Bridge at Cambridge and immortalised in two charming paintings by Canaletto. For three years it was the country's longest span bridge. The approaches on each side of the bridge were initially earthen ramps but these were later replaced by smaller brick arches, which still stand. The main wooden structure, however, quickly decayed and in 1786 James Paine built a replacement bridge, consisting of four spans of brick and stone, the previous large central span being now divided into two. This is the larger of the two structures shown in Turner's paintings of Walton Bridge. The two middle arches were destroyed when the new central pier collapsed in 1859 and, by 1863, a third bridge, described as the "ugliest bridge on the Thames", had been completed. This was a continuous lattice girder structure with the same spans as its predecessor. Following bomb damage during the Second World War, loading restrictions were imposed on this structure and in 1953 a temporary Warren girder bridge was erected alongside while a new bridge was planned and built. In 2000, this bridge was replaced by a new seven-span plate girder temporary bridge spanning between cross-head joists above A-frame bents with tubular columns. In 2014 a new permanent structure was completed 20m upstream. This is a 90m-span steel tied-arch.

A short distance to the east of the main crossing described above a separate structure crosses a flood channel. This bridge, which dates from about 1755, consists of 13 segmental brick arches, each spanning about 25ft between piers with rounded stone cutwaters. It now has a steel and concrete plank footbridge cantilevered from its north face. In association with the new main bridge a new viaduct has been built alongside the existing viaduct, with the existing viaduct remaining in use for pedestrians, cyclists and horse riders.

Turner's first painting of Walton Bridge, from 1805, shows the multi-arch brick structure from downstream and, in his 1806 view from the south, both bridges can be seen. The 1807 picture is from the north, James Paine's four-arch bridge now being on the right.

The Thames near Walton Bridges, 1805



Walton Bridges, 1806

Walton Bridges, 1807

In his 1828 painting, also from the north, Turner shows a team of draught animals pulling an unseen boat into the picture from the left while another boat, its mast in centre of the composition, is towed downstream. In the foreground a flock of sheep have been driven down to the river for a drink.

Turner's last picture of the bridges is a more distant view looking south showing both the old structures.

Walton Bridge on Thames, c1828

Landscape with Walton Bridges, 1835-40

Waterloo Bridge, Westminster, Greater London

Initially called the Strand Bridge, the structure was renamed Waterloo Bridge for its opening on the second anniversary of the battle. It was the first London bridge to have a level rather than a hump-backed deck. Designed by John Rennie, it was 42 ft wide and had nine semi-elliptical arches, each of 120 ft span and rise of 35ft. At 1240ft between abutments it was London's longest bridge. It was much admired for its lightness, grace and symmetry, and was described by the Italian sculptor Antonio Canova as 'the noblest bridge in the world ... alone worth coming to London to see'. As a result of scour damage to the foundations, following demolition of Old London Bridge, it was replaced by the present structure, completed in 1944.

This unfinished painting, possibly intended as a response to John Constable's 1832 painting of the bridge's opening, prefigures Monet's many depictions of the bridge seen through London's smoke and fog.

The Thames above Waterloo Bridge, c1830-5

Welsh Bridge, Shrewsbury, Shropshire

The first timber bridge over the River Severn to the west of Shrewsbury, known as St George's Bridge, was built in the early 12th century just above an ancient ford. This was replaced in about 1262 by a bridge with six stone arches. There was a protective tower at the west end, built about 1539, and a gatehouse leading into the town at the eastern end – both built on the bridge piers. There were also houses above the narrow roadway on the bridge itself. The bridge was damaged by floods in 1672 and the Welsh Gate was removed in 1773. The bridge itself was finally demolished after the present Welsh Bridge was built in 1795. This is 30ft wide and has five segmental stone arches with a central span of 46ft and side spans of 43ft. Pilasters separate the arch spandrels above small pointed cutwaters, and there is an elegant stone balustrade.

Turner's very evocative picture of the eastern face of the Old Welsh Bridge shortly before its demolition shows the ribbed arches and the

Old Welsh Bridge, Shrewsbury, 1794

tottering superstructure of houses. In the background the new bridge can be seen under construction about 200ft downstream. This superb picture makes one regret that, during his early days as an architectural draughtsman, Turner did not make similar records of many of Britain's other medieval bridges before so many of them were demolished in the nineteenth century.

Westgate Bridge, Canterbury, Kent

The existing medieval gatehouse, which was built in about 1379 on the site of an earlier gateway, had a drawbridge over the western arm of the River Stour. This was later converted to a fixed crossing of two pointed arches, the roadway sloping up to the gateway. In about 1829 a new road crossing over the Stour was built.

Turner's picture, looking from the north, shows the bridge with its roadway sloping upward to pass between the twin towers at the front of the gatehouse.

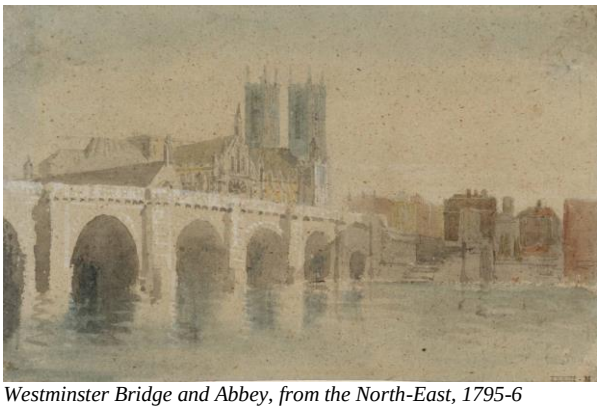
The West Gate, Canterbury, c1794

Westminster Bridge, Westminster, Greater London

By the beginning of the 18th century the growth of London westward from the original city was restricted by the lack of a second crossing over the Thames. Eventually, Charles Labelye, a naturalised Swiss, was appointed to build a stone bridge of 15 semicircular arches. The foundations for the river piers were laid within caissons, 80ft-long flat-bottomed boats that could be sunk accurately onto a previously dredged site and the sides subsequently floated off for re-use, the first use of this technique in Britain. Labelye's bridge had a central arch of 76ft span, flanked either side by successively smaller spans. The 6ft-high balustrade was broken by domed pedestrian shelters over the piers on either side of the centre span and of the second span in from each end. The bridge was opened in 1750. Before the bridge had been completed problems began with settlement of one of the piers, which eventually sank nearly 3ft requiring the adjacent arches to be rebuilt. Foundation problems continued, exacerbated by the removal of Old London Bridge in 1831, and a replacement bridge, to be built slightly upstream of the old structure, was approved following agreement to rebuild the Houses of Parliament and construct the Embankment.

The two paintings by Turner of the destruction of the old Palace of Westminster must be among the most dramatic pictures ever made of a bridge. The first viewpoint is just upriver from the bridge on the Surrey bank.

Westminster Bridge, with the Abbey seen across the River, 1795-6



Westminster Bridge and Abbey, from the North-East, 1795-6

Turner's second picture of the fire, also from the Surrey bank, looks back from somewhere between Westminster Bridge and Waterloo Bridge (opened 1817).

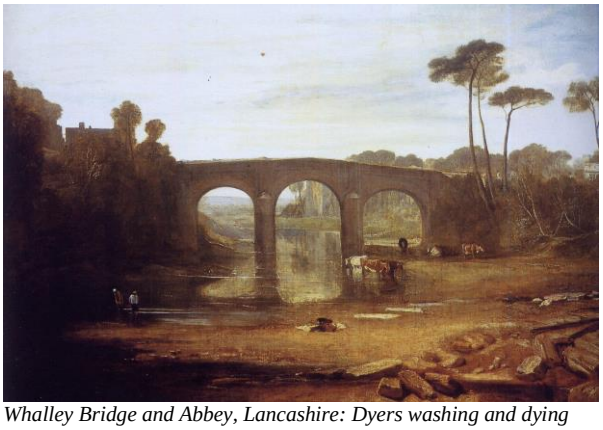
Burning of the Houses of Parliament, 1835

The Burning of the Houses of Lords and Commons, 16th of October, 1834, 1835

Whalley Bridge, Whalley, Lancashire

The supporting ribs of the 8ft-wide original medieval bridge over the River Calder at Whalley can still be seen under two of the arches of the existing structure. That first bridge has been widened twice – once on its downstream side and twice on the upstream. During these widenings the earlier hump-backed profile has been flattened to provide a level roadway. The bridge has three semicircular arches with semicircular cutwaters on the intermediate piers that now rise to provide semicircular pedestrian refuges at parapet level.

In this picture we are looking west, the remains of the old abbey buildings being visible beyond the bridge.



Whalley Bridge and Abbey, Lancashire: Dyers washing and dying cloth, 1811

Windsor Bridge, Windsor, Windsor & Maidenhead

There have probably been bridges over the Thames at Windsor ever since early man built fortresses on the castle mound, and records of them date back to 1172. The last of many timber bridges was replaced by the present Town Bridge, completed in 1824. It is 25ft wide and has three segmental, seven-ribbed, cast iron arches, the central one spanning 56ft between the 8ft-thick granite piers and the flanking arches spanning 43ft. The bridge now carries foot traffic only.

In the top picture we are looking east towards Town Bridge with Windsor Castle on the horizon.

Thames near Windsor, Evening: Men Dragging Nets on Shore, 1807

Wynch Bridge, Newbiggin, Durham

The original suspension bridge on this site, opened in 1741, was the first suspension bridge built in Europe. It spanned about 70ft across the Tees with a 2ft-wide footway, a handrail on only one side, and restraining chains beneath the deck to limit movement. The bridge collapsed in 1802 and was replaced by a similar though stronger suspension bridge and this, in turn, was replaced in the 1960s.

In Turner's picture looking upstream we see the suspension bridge hanging over the gorge in the distance.

Chain Bridge over the River Tees, c*1836*

APPENDIX 1: PICTURE DETAILS

Picture Title	Date	Medium	Size (mm)	Location	Ref [1]	Bridge Name	Page
Abergavenny Bridge, Monmouthshire, clearing up after a showery day	1799	Watercolour	413 x 760	Victoria and Albert Museum	W252	Abergavenny Bridge	9
Aber Glaslyn: Welsh Mountains and a River	c1799	Watercolour	330 x 228	Tate Gallery	D01920	Pont Aberglaslyn	29
Alnwick Castle, Northumberland	c1829	Watercolour	283 x 483	Art Gallery of South Australia	W818	Lion Bridge	24
Aylesford Bridge and Church	?1798	Watercolour	224 x 284	Tate Gallery	D00864	Aylesford Bridge	9
Barnard Castle, Durham	c1825	Watercolour	292 x 419	Yale Center for British Art, New Haven, USA	W793	Barnard Castle Bridge	10
Barnstaple Bridge at Sunset	c1813	Watercolour	216 339	Tate Gallery	D25443	Barnstaple Bridge	10
Battersea Church and Bridge with Chelsea beyond	?1797	Watercolour	200 x 326	Tate Gallery	D00857	Battersea Bridge	10
Bedford	c1829	Watercolour	349 x 489	Private Collection	W831	Bedford Town Bridge	11
Berwick upon Tweed	c1832	Watercolour	87 x 152	Private Collection	W1092	Berwick Bridge	11
Blenheim House and Park, Oxfordshire	1832	Watercolour	296 x 468	Birmingham Art Gallery	W846	Blenheim Palace Grand Bridge	12
Bodiam Castle, Sussex	c1816	Watercolour	381 x 559	Private Collection	W428	Bodiam Bridge	13
Borrowdale, Longthwaite Bridge and Castle Crag	c1798-9	Watercolour	521 x 800	Minneapolis Institute of Arts	†	Longthwaite Bridge	26
Boston, Lincolnshire	c1823	Watercolour	280 x 419	Private Collection	W859	Boston Bridge	13
Bow and Arrow Castle, Isle of Portland	c1815	Watercolour	152 x 230	University of Liverpool	W459	Bow and Arrow Castle Bridge	13
Brecon Bridge	c 1798-9	Watercolour	230 x 340	Manchester Art Gallery	†	Brecon Bridge	34
Bridge at Lewes, Sussex, A	?1796	Watercolour	152 x 217	Tate Gallery	D00858	Cliffe Bridge	16
Bridge at Pontypridd	?1798	Watercolour	272 x 382	Tate Gallery	D00843	Pontypridd Bridge	30
Burning of the Houses of Lords and Commons, 16th October 1834	1835	Oil	921 x 1232	Philadelphia Museum of Art	BJ359	Westminster Bridge	38
Burning of the Houses of Parliament	1835	Oil	925 x 1230	Cleveland Museum of Art	BJ364	Westminster Bridge	37
Cambridge: Clare Hall	c1794	Watercolour	210 x 267	Yale Center for British Art, New Haven, USA	W75	Clare College Bridge	16
Cardiff Bridge and Castle	1795-6	Watercolour	226 x 350	Tate Gallery	D00702	Cardiff Bridge	14
Carew Castle, Pembrokeshire	c1832	Watercolour	305 x 457	Manchester Art Gallery	W851	Carew Castle Bridge	14
Carlisle	c1832	Watercolour	83 x 142	Yale Center for British Art, New Haven, USA	W1070	Eden Bridges	18
Caversham Bridge with cattle in the water	c1806-7	Oil	855 x 1160	Tate Gallery	BJ162	Caversham Bridge	15
Chain Bridge over the River Tees	c1836	Watercolour	278 x 426	Private Collection	W878	Wynch Bridge	39
Chain Pier, Brighton	c1828	Oil	710 x 1365	Tate Gallery	BJ286	Brighton Chain Pier	13
Chepstow Castle	c 1794	Watercolour	203 x 297	Courtauld Institute of Art	W88	Chepstow Bridge	15
Clitheroe, from Eadsford Bridge	c1799	Watercolour	213 x 313	Art Gallery of Ontario	W290	Edisford Bridge	18
Conway Castle	c1800	Watercolour	419 x 619	Whitworth Art Gallery	W271	Pensarn Bridge	29
Corfe Castle	c1812	Watercolour	138 x 223	Fogg Art Museum, Cambridge, Mass, USA	W450	Corfe Castle Outer Bridge	16
Crossing the Brook	c1815	Oil	760 x 650	Tate Gallery	BJ130	Gunnislake New Bridge	21
Dorchester Mead, Oxfordshire	1806	Oil	102 x 130	Tate Gallery	BJ107	Abingdon Bridge	9
Dormitory and Transept of Fountains Abbey – Evening	1798	Watercolour	456 x 610	York Art Gallery	W238	Fountains Abbey Guest House Bridge	20
Dumbarton Castle and River Leven	c1833	Watercolour	181 x 184	Private Collection	W1095	Dumbarton Bridge	18
Durham Cathedral	c1835	Watercolour	295 x 442	National Galleries of Scotland, Edinburgh	W873	Framwellgate Bridge	21
Durham Cathedral, from the river	c1799	Watercolour	305 x 407	Royal Academy of Arts	W249	Framwellgate Bridge	21
East and West Looe, Cornwall	c1815	Watercolour	159 x 241	Manchester Art Gallery	W461	Looe Bridge	26
Edinburgh Castle: March of the Highlanders	c1835	Watercolour	86 x 140	Tate Gallery	W1134	North Bridge	28
Edinburgh from Calton Hill	c1819	Watercolour	162 x 254	National Galleries of Scotland	W1062	North Bridge	28
English Bridge, Shrewsbury	c1795	Watercolour	247 x 295	Shrewsbury Museum Service	W136	English Bridge	19
Exeter	c1827	Watercolour	300 x 428	Manchester Art Gallery	W807	Canal Bridge, Exeter	14
Falmouth	c1825	Watercolour	145 x 220	Private Collection	W762	St Mawes Castle Bridge	33
Folly Bridge and Bacon's Tower	1787	Watercolour	308 x 432	British Museum	W5	Folly Bridge, Oxford	19
Folly Bridge, Oxford	c1795	Watercolour	203 x 267	Aberystwyth University	W132	Folly Bridge, Oxford	19
Fort Augustus, Loch Ness	1833	Watercolour	130 x 100	Private Collection	W1129	Fort Augustus (Old Oich) Bridge	20
Goring Mill and Church	1805	Oil	855 x 1160	Tate Gallery	BJ161	Goring Towpath Bridge	21
Hornby Castle from Tatham Church	1816-8	Watercolour	292 x 419	Victoria and Albert Museum	W577	Hornby Bridge	22
Inverness from the River Ness	c1833	Watercolour	92 x 159	Inverness Museum & Art Gallery	W1128	Ness Bridge	28
Ivy Bridge	c1813	Watercolour	280 x 409	Tate Gallery	W442	Ivybridge Bridge	22
Kelso	c1832	Watercolour	81 x 143	Private Collection	W1074	Kelso Bridge	22

Picture Title	Date	Medium	Size (mm)	Location	Ref [1]	Bridge Name	Page
Kew Bridge	1805	Watercolour	257 x 365	Tate Gallery	D05946	Kew Bridge	23
Kew Palace	1805	Watercolour	247 x 342	Whitworth Art Gallery	W413	Kew Bridge	23
Kirkstall Lock, on the River Aire	1825	Watercolour	160 x 235	Tate Gallery	W745	Kirkstall Canal Bridge	23
Lancaster, from the Aqueduct Bridge	c1825	Watercolour	280 x 394	Lady Lever Art Gallery	W786	Skerton Bridge	33
Landscape with Walton Bridges	c1835-40	Oil	863 x 1175	Private Collection	BJ511	Walton Bridge	35
Lichfield	1830-5	Watercolour	286 x 438	Private Collection	W882	Bird Street Bridge, Lichfield	12
Lindley Hall, with Lindley Bridge	c1818	Watercolour	398 x 445	Private Collection	W623	Lindley Bridge	24
Llandeilo Bridge and Dinevor Castle	1796	Watercolour	356 x 502	National Museum of Wales	W140	Llandeilo Bridge	24
Llangollen, North Wales	c1828-34	Watercolour	267 x 419	Private Collection	W872	Llangollen Bridge	25
Llanvihangel, Crucorney, Monmouthshire	c1793	Watercolour	156 x 219	Private Collection	W43	Llanvihangel Bridge	25
Ludlow Castle	1800	Watercolour	356 x 671	Barber Institute of Fine Arts	W265	Dinham Bridge	17
Ludlow Castle, Shropshire	c1829	Watercolour	305 x 457	Private Collection	W825	Dinham Bridge	17
Magdalen Tower and Bridge, Oxford	c1794	Watercolour	286 x 222	Whitworth Art Gallery	W69	Magdalen Bridge, Oxford	27
Maidenhead Bridge	c1793-6			Private Collection	†	Leatherhead Bridge	24
Matlock	1794	Watercolour	105 x 164	Indianapolis Museum of Art	W91	Matlock Bridge	27
Newark upon Trent Castle	c1796	Watercolour	303 x 421	British Museum	W168	Trent Bridge, Newark-on-Trent	33
Newcastle on Tyne	c1823	Watercolour	152 x 215	Tate Gallery	W733	Tyne Bridge	34
Old Blackfriars Bridge	c1795	Watercolour	260 x 172	Whitworth Art Gallery	W146	Blackfriars Bridge, London	12
Old London Bridge [4 arches]	c1794	Watercolour	260 x 362	Tate Gallery	D00892	London Bridge	25
Old London Bridge [waterwheels]	c1795	Watercolour	346 x 219	Tate Gallery	D00696	London Bridge	25
Old Welsh Bridge, Shrewsbury	1794	Watercolour	218 x 279	Whitworth Art Gallery	W82	Welsh Bridge	36
Plym Estuary from Boringdon Park	1813	Oil	245 x 305	Tate Gallery	BJ217	Plym Bridge	29
Port of London	1824	Watercolour	292 x 445	Victoria and Albert Museum	W514	London Bridge	25
Pulteney Bridge, Bath, in Perspective	c1810	Watercolour	672 x 999	Tate Gallery	D17084	Pulteney Bridge	30
Rain, Steam and Speed – the Great Western Railway	1844	Oil	910 x 1220	National Gallery	BJ409	Maidenhead Bridges	27
Rhayader Gwy Bridge over the River Wye	c1795	Watercolour	331 x 443	National Museum of Wales	W81	Rhayader Bridge	31
Richmond Castle and Town, Yorkshire	c1826	Watercolour	275 x 397	British Museum	W791	Richmond Bridge, North Yorkshire	32
Richmond Hill and Bridge, Surrey	c1828	Watercolour	291 x 435	British Museum	W833	Richmond Bridge, Greater London	31
Richmond, Sunrise	c1798	Watercolour	423 x 549	Tate Gallery	D01116	Richmond Bridge, North Yorkshire	31
Rievaulx Abbey	c1835	Watercolour	122 x 207	Tate Gallery	W1151	Rievaulx Bridge	32
Rochester, Stroud and Chatham, Medway	c1836-7			picture destroyed by fire	W877	Rochester Bridge	32
Tamworth Castle, Staffordshire	c1830	Watercolour	292 x 445	Private Collection	W844	Lady Bridge	23
Thames above Waterloo Bridge	C1830-5	Oil	905 x 1210	Tate Gallery	D1992	Waterloo Bridge	
Thames near Walton Bridges, 1805	1805	Oil	370 x 735	Tate Gallery	BJ184	Walton Bridge	35
Thames near Windsor, Evening: Men Dragging Nets on Shore	1807	Oil	890 x 1190	Petworth House (Tate Gallery collection)	BJ64	Windsor Town Bridge	39
Tonbridge Castle, Kent	c 1794	Watercolour	198 x 277	Fitzwilliam Museum	†	Big Bridge, Tonbridge	11
Trout Fishing on the Dee, Corwen Bridge and Cottage	1809	Oil	915 x 1220	Taft Museum, Cincinatti, USA	BJ92	Corwen Bridge	17
Tummel Bridge, Perthshire	c1802-3	Oil	280 x 465	Paul Mellon Collection	BJ41	Tummel Bridge	33
Usk, Monmouthshire, from the South	1798-9	Watercolour	326 x 476	Tate Gallery	D01906	Usk Bridge, Monmouthshire	35
Usk, Monmouthshire, Seen from across the River: Five-Arched Bridge	1798	Watercolour	280 x 457	Tate Gallery	D01668	Usk Bridge, Monmouthshire	34
View of Richmond Hill and Bridge	1808	Oil	914 x 1219	Tate Gallery	BJ73	Richmond Bridge, Greater London	31
Wakefield Bridge and Chapel	c1798	Watercolour	260 x 434	British Museum	W241	Chantry Bridge	15
Walton Bridge on Thames, Surrey	c1828	Watercolour	289 x 457	Private Collection	W824	Walton Bridge	36
Walton Bridges	1806	Oil	927 x 1238	Loyd Collection (on loan to Ashmolean Mus)	BJ60	Walton Bridge	35
Walton Bridges	1807	Oil	922 x 1224	National Gallery of Victoria, Australia	BJ63	Walton Bridge	35
Warwick Castle and Bridge	1794	Watercolour	425 x 527	Whitworth Art Gallery	W79	Warwick Castle and Old Bridges	14
Warwick Castle, Warwickshire	c1829	Watercolour	297 x 451	Whitworth Art Gallery	W841	Warwick Old Bridge	14
Weir Bridge, Ludlow	1798	Graphite	332 x 225	Tate Gallery	D01343	Dinham Bridge	17
West Gate, Canterbury	c 1794	Watercolour	280 x 203	National Gallery of Ireland	W56	Westgate Bridge	37
Westminster Bridge and Abbey, from the North-East	1795-6	Watercolour	132 x 205	Tate Gallery	D00884	Westminster Bridge	37
Westminster Bridge, with the Abbey seen across the River	1795-6	Watercolour	114 x 176	Tate Gallery	D00894	Westminster Bridge	37
Whalley Bridge and Abbey, Lancashire: Dyers washing and dying cloth	1811	Oil	612 x 920	Loyd Collection (on loan to Ashmolean Mus)	BJ117	Whalley Bridge	38

APPENDIX 2: GEOGRAPHIC INDEX

County or Unitary Authority	City, Town or Village	Bridge Name	Grid Ref [2]	Picture Title	Page
Bath & NE Somerset	Bath	Pulteney Bridge	ST 751 649	Pulteney Bridge, Bath, in Perspective	30
Bedfordshire	Bedford	Bedford Town Bridge	TL 050 495	Bedford	11
Borders	Kelso	Kelso Bridge	NT 728 336	Kelso	22
Brighton and Hove	Brighton	Brighton Chain Pier	*	The Chain Pier, Brighton	13
Cambridgeshire	Cambridge	Clare College Bridge	TL 446 584	Cambridge: Clare Hall	16
Cardiff	Cardiff	Cardiff Bridge	ST 177 764	Cardiff Bridge and Castle	14
Carmarthenshire	Llandeilo	Llandeilo Bridge	SN 627 220	Llandeilo Bridge and Dinevor Castle	24
Conwy	Conwy	Pensarn Bridge	SH 782 774	Conway Castle	29
Cornwall	Gunnislake	Gunnislake New Bridge	SX 433 722	Crossing the Brook	21
Cornwall	Looe	Looe Bridge	SX 254 536	East and West Looe, Cornwall	26
Cornwall	St Mawes	St Mawes Castle Bridge	SW 840 328	Falmouth	33
Cumbria	Carlisle	Eden Bridges	NY 400 565	Carlisle	18
Cumbria	Rosthwaite	Longthwaite Bridge	NY 255 143	Borrowdale, Longthwaite Bridge and Castle Crag	26
Denbighshire	Corwen	Corwen Bridge	SJ 069 434	Trout Fishing on the Dee, Corwen Bridge and Cottage	17
Denbighshire	Llangollen	Langollen Bridge	SJ 215 422	Llangollen, North Wales	25
Derbyshire	Matlock	Matlock Bridge	SK 298 602	Matlock	27
Devon	Barnstaple	Barnstaple Bridge	SS 557 329	Barnstaple Bridge at Sunset	10
Devon	Exeter	Canal Bridge	SX 922 917	Exeter	14
Devon	Ivybridge	Ivybridge Bridge	SX 636 564	Ivy Bridge	22
Dorset	Corfe Castle	Corfe Castle Outer Bridge	SY 960 821	Corfe Castle	16
Dorset	Easton	Bow and Arrow Castle	SY 697 712	Bow and Arrow Castle, Island of Portland	13
Durham	Barnard Castle	Barnard Castle Bridge	NZ 048 163	Barnard Castle, Durham	10
Durham	Durham	Framwellgate Bridge	NZ 272 424	Durham Cathedral from the River	20
Durham	Durham	Framwellgate Bridge	NZ 272 424	Durham Cathedral	21
Durham	Newbiggin	Wynch Bridge	NY 903 278	Chain Bridge over the River Tees	39
East Sussex	Bodiam	Bodiam Bridge	TQ 783 253	Bodiam Castle, Sussex	13
East Sussex	Lewes	Cliffe Bridge	TQ 419 102	A Bridge at Lewes, Sussex	16
Edinburgh, City of	Edinburgh	North Bridge	NT 258 739	Edinburgh from Calton Hill	28
Edinburgh, City of	Edinburgh	North Bridge	NT 258 739	Edinburgh Castle: March of the Highlanders	28
Greater London	Battersea	Battersea Bridge	TQ 269 773	Battersea Church and Bridge with Chelsea Beyond	10
Greater London	City	Blackfriars Bridge	TQ 316 806	Old Blackfriars Bridge	12
Greater London	City	London Bridge	TQ 328 805	Old London Bridge [waterwheels]	25
Greater London	City	London Bridge	TQ 328 805	Old London Bridge [4 arches]	25
Greater London	City	London Bridge	TQ 328 805	The Port of London	26
Greater London	Kew	Kew Bridge	TQ 190 778	Kew Bridge	23
Greater London	Kew	Kew Bridge	TQ 190 778	Kew Palace	23
Greater London	Richmond	Richmond Bridge	TQ 177 745	View of Richmond Hill and Bridge	31
Greater London	Richmond	Richmond Bridge	TQ 177 745	Richmond Hill and Bridge	31
Greater London	Westminster	Waterloo Bridge	TQ 307 805	The Thames above Waterloo Bridge	37
Greater London	Westminster	Westminster Bridge	TQ 304 796	Westminster Bridge, with the Abbey seen across the river	37
Greater London	Westminster	Westminster Bridge	TQ 304 796	Westminster Bridge and Abbey, from the North-East	37
Greater London	Westminster	Westminster Bridge	TQ 304 796	Burning of the Houses of Parliament	37
Greater London	Westminster	Westminster Bridge	TQ 304 796	The Burning of the Houses of Lords and Commons, 16th of October, 1834	38
Gwynedd	Beddgelert	Pont Aberglaslyn	SH 590 481	Aber Glaslyn: Welsh Mountains and a River	29
Highland	Inverness	Fort Augustus (Old Oich) Bridge	NH 378 092	Fort Augustus, Loch Ness	20
Highland	Inverness	Ness Bridge	NH 665 451	Inverness from the River Ness	28
Kent	Aylesford	Aylesford Bridge	TQ 729 589	Aylesford Bridge and Church	9
Kent	Canterbury	Westgate Bridge	TR 144 578	The West Gate, Canterbury	37
Kent	Rochester	Rochester Bridge	TQ 740 689	Rochester, Stroud and Chatham, Medway	32
Kent	Tonbridge	Big Bridge	TV 590 465	Tonbridge Castle, Kent	11

County or Unitary Authority	City, Town or Village	Bridge Name	Grid Ref [2]	Picture Title	Page
Lancashire	Clitheroe	Edisford Bridge	SD 726 414	Clitheroe, from Eadsford Bridge	18
Lancashire	Hornby	Hornby Bridge	SD 585 684	Hornby Castle from Tatham Church	22
Lancashire	Lancaster	Skerton Bridge	SD 479 623	Lancaster from the Aqueduct Bridge	33
Lancashire	Whalley	Whalley Bridge	SD 733 359	Whalley Bridge and Abbey, Lancashire: Dyers washing and dying cloth	38
Leeds	Kirkstall	Kirkstall Canal Bridge	SE 257 357	Kirkstall Lock, on the River Aire	23
Lincolnshire	Boston	Boston Bridge	TF 327 437	Boston, Lincolnshire	13
Monmouthshire	Abergavenny	Abergavenny Bridge	SO 292 140	Abergavenny Bridge, Monmouthshire, clearing up after a showery day	9
Monmouthshire	Chepstow	Chepstow Bridge	ST 536 943	Chepstow Castle	15
Monmouthshire	Llanvihangel Crucorney	Llanvihangel Bridge	SO 324 209	Llanvihangel, Comcorney, Monmouthshire	25
Monmouthshire	Usk	Usk Bridge	SO 374 007	Usk, Monmouthshire, from the South	35
Monmouthshire	Usk	Usk Bridge	SO 374 007	Usk, Monmouthshire, Seen from across the river: Five-Arched Bridge in Foreground	34
Newcastle upon Tyne	Newcastle upon Tyne	Tyne Bridge (now Swing Bridge)	NZ 252 637	Newcastle on Tyne	34
North Yorkshire	Aldfield	Fountains Abbey Guest House Bridge	SE 275 684	The Dormitory and Transept of Fountains Abbey – Evening	20
North Yorkshire	Lindley Green	Lindley Bridge	SE 224 483	Lindley Hall, with Lindley Bridge	24
North Yorkshire	Richmond	Richmond Bridge	NZ 169 005	Richmond Castle and Town, Yorkshire	32
North Yorkshire	Richmond	Richmond Bridge	NZ 169 005	Richmond, Sunrise	31
North Yorkshire	Rievaulx	Rievaulx Bridge	SE 574 843	Rievaulx Abbey	32
Northumberland	Alnwick	Lion Bridge	NU 186 138	Alnwick Castle, Nortumberland	24
Northumberland	Berwick-upon-Tweed	Berwick Bridge	NT 996 527	Berwick upon Tweed	11
Nottinghamshire	Newark-on-Trent	Trent Bridge	SK 796 541	Newark upon Trent Castle	33
Oxfordshire	Abingdon	Abingdon Bridge	SU 499 969	Dorchester Mead, Oxfordshire	9
Oxfordshire	Goring	Goring Towpath Bridge	SU 596 808	Goring Mill and Church	21
Oxfordshire	Oxford	Folly Bridge	SP 514 055	Folly Bridge and Bacon's Tower	19
Oxfordshire	Oxford	Folly Bridge	SP 514 055	Folly Bridge, Oxford	19
Oxfordshire	Oxford	Magdalen Bridge	SP 521 061	Magdalen Tower and Bridge	27
Oxfordshire	Woodstock	Blenheim Palace Grand Bridge	SP 439 158	Blenheim House and Park, Oxfordshire	12
Pembrokeshire	Carew	Carew Castle Bridge	SN 047 038	Carew Castle, Pembrokeshire	14
Perth & Kinross	Tummel Bridge	Tummel Bridge	NN 762 591	Tummel Bridge, Perthshire	33
Plymouth, City of	Plympton	Plym Bridge	SX 524 587	The Plym Estuary from Boringdon Park	29
Powys	Brecon	Usk Bridge	SO 042 285	Brecon Bridge	34
Powys	Rhayader	Rhayader Bridge	SN 967 678	Rhaiado Gwy Bridge over the River Wye	31
Reading	Caversham	Caversham Bridge	SU 711 746	Caversham Bridge with cattle in the water	15
Rhondda	Pontypridd	Pontypridd Bridge	ST 074 904	The Bridge at Pontypridd	30
Shropshire	Ludlow	Dinham Bridge	SO 507 744	Ludlow Castle	17
Shropshire	Ludlow	Dinham Bridge	SO 507 744	Weir Bridge, Ludlow	17
Shropshire	Ludlow	Dinham Bridge	SO 507 744	Ludlow Castle, Shropshire	17
Shropshire	Shrewsbury	English Bridge	SJ 495 123	The English Bridge	19
Shropshire	Shrewsbury	Welsh Bridge	SJ 488 127	Old Welsh Bridge, Shrewsbury	36
Staffordshire	Lichfield	Bird Street Bridge	SK 115 096	Lichfield	12
Staffordshire	Tamworth	Lady Bridge	SK 205 038	Tamworth Castle, Staffordshire	23
Surrey	Leatherhead	Leatherhead Bridge	TQ 161 563	Maidenhead Bridge	24
Surrey	Walton-on-Thames	Walton Bridge	TQ 092 665	The Thames near Walton Bridges	35
Surrey	Walton-on-Thames	Walton Bridge	TQ 092 665	Walton Bridges	35
Surrey	Walton-on-Thames	Walton Bridge	TQ 092 665	Walton Bridge	35
Surrey	Walton-on-Thames	Walton Bridge	TQ 092 665	Walton Bridges	36
Surrey	Walton-on-Thames	Walton Bridge	TQ 092 665	Landscape with Walton Bridges	36
Wakefield	Wakefield	Chantry Bridge	SE 338 201	Wakefield Bridge and Chapel	15
Warwickshire	Warwick	Castle and Old Bridges	SP 287 646	Warwick Castle and Bridge	14
Warwickshire	Warwick	Castle and Old Bridges	SP 287 646	Warwick Castle, Warwickshire	15
West Dumbartonshire	Dumbarton	Dumbarton Bridge	NS 392 753	Dumbarton Castle and River Leven	18
Windsor & Maidenhead	Maidenhead	Maidenhead Bridges	SU 901 810	Rain, Steam and Speed – the Great Western Railway	27
Windsor & Maidenhead	Windsor	Windsor Town Bridge	SU 967 772	Thames near Windsor, Evening: Men Dragging Nets on Shore	39

NOTES

1. In Appendix 1 the 'Ref No' column relates to entries in the following catalogues of Turner paintings:
   BJ for Butlin & Joll, 1977 (oil paintings)
   D for Turner Bequest holdings at the Tate Gallery
   W for Wilton, 1979 (watercolours).
   † indicates that the picture is not in these catalogues.

2. In Appendix 2 the 'Grid Ref' column gives the Ordnance Survey grid reference for each bridge (* indicates there is no longer any bridge at the site where Turner had painted one).

3. Unfortunately, for copyright reasons, available images for the following three pictures are in black-and-white not colour: Berwick upon Tweed; English Bridge, Shrewsbury and Kelso.

ACKNOWLEDGEMENTS

Regarding Turner

Eric Shanes who, despite being very busy with his definitive biography of Turner, took the trouble to locate for me a copy of Andrew Wilton's out-of-print book.
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Tate Gallery: Amy Concannon who confirmed that Turner had visited Leatherhead at about the time the picture previously wrongly identified as being of Maidenhead Bridge was probably painted.
Agnew's Gallery: Christopher Kingzett who confirmed that Agnew's had previously sold the painting then identified as being by Turner and of Maidenhead Bridge but that the gallery had no further information available.

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Vicky Cooper, Information Centre, Lichfield District Council (Bird Street Bridge, Lichfield)
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Garry Miller, Architectural Historian (Hornby and Whalley Bridges)
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Paul Roberts, Inspection Team Manager, North Wales Trunk Road Agency (Corwen Bridge)
Tom Robson, Senior Archivist, Cumbria Archive Service (Eden Bridges)
Jackie Smith, Honorary Archivist, Abingdon-on-Thames Town Council (Abingdon Bridge)
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Frances Younson, Gwent Archives (Llanvihangel Crucorney Bridge)

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AUTHOR

David McFetrich first became interested in bridges while he was at Oundle School and, when he left in 1956, he went on to study civil engineering at King's College in the University of Durham (now Newcastle University). He then worked in a structural engineering design office, where one of his projects was the design of a footbridge in Scotland. He followed this by moving into contracting and progressed to being site agent on several prestigious projects, one of which involved the construction of two major road bridges. He left the civil engineering industry in 1970 and spent the rest of his working life in management consultancy, while continuing to collect books and information about bridges as a hobby. He is the author of the definitive book *An Encyclopaedia of Britain's Bridges* (see www.britainsbridges.co.uk).

A Review of the evidence for English bridge chapels

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Abstract

Once common place, today only a small number of intact bridge chapels survive in England, most notably those situated on bridges. However, chapels were also frequently attached to the end of bridges. However, the situation was more complicated as some chapels were situated along the bridge approach road. Other bridges possessed churches, hermitages or hospitals situated nearby, which served the same function. The vast majority of these chapels no longer exist due to impact of the Reformation and post-medieval bridge rebuilding. Ongoing research has identified over 200 locations across England where chapels and related structures (hermitages and hospitals), once existed on or by a bridge although in some cases, this may be purely coincidental. This paper presents some of that evidence and considers the English bridge chapel, and its related structures, in their wider context including continental parallels from the France, Germany, Ireland, Italy, Portugal, Russia, Spain and Switzerland.

Introduction

Celebrated for their rarity today, bridge chapels were a common feature of medieval bridges. Today chapels, built onto bridge piers, are considered for their architectural merit rather than their context and original function (Watson this volume). Any consideration of bridge chapels is compromised by the lack of a national gazetteer and even the exact number of surviving bridge chapels, though in single figures, has not been firmly established. According to Morriss (2003, 201-3) research had identified nearly fifty bridge chapels in medieval England of which six (often restored or rebuilt) examples survive. As well as the surviving chapels at St Mary's Bridge, Derby (Derbyshire), Rochester (Kent), St Ives (Cambridgeshire) (figure 1) Bradford-on Avon (Wiltshire), and Rotherham (South Yorkshire) (figure 2) and Wakefield (West Yorkshire) (figure 3), he acknowledges that the fragmentary remains of others survive – most notably at the end of St Mary's Bridge, Cromford (Derbyshire).

Medieval bridges form an important, but neglected aspect of communications and economic development across England (Harrison 2004; Harrison this volume). Medieval bridges were generally built by secular or religious landowners or by urban communities, who normally assumed responsibility for their maintenance. Funding was also raised through pontage, a temporary toll granted by the king for the building or repair of bridges or by the selling of Indulgences by the Catholic Church. Bridges also benefited from bequests and other acts of piety. Chantry chapels were constructed on or by bridges for the personal salvation of rich benefactors and as symbols of piety. These chapels also met the spiritual needs of travellers and provided convenient venues to collect tolls and donations to fund bridge maintenance (Watson this volume).

Harrison's estimate of over a hundred bridge chapels (2004, 199) provided the impetus for the present survey currently being undertaken by the author, Bruce Watson and David Harrison under the auspices of the Medieval Bridge Chapel Research Company Ltd. The project results will be published in 2020 and the project archive lodged with the Archaeology Data Service. The online archive will include a detailed site gazetteer. Full details concerning the various unreferenced examples of bridge chapels cited below will all be included this gazetteer.

Figure 1 Chapel of St Ledger and St Ives bridge

By Hongking at the English language Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=5990187

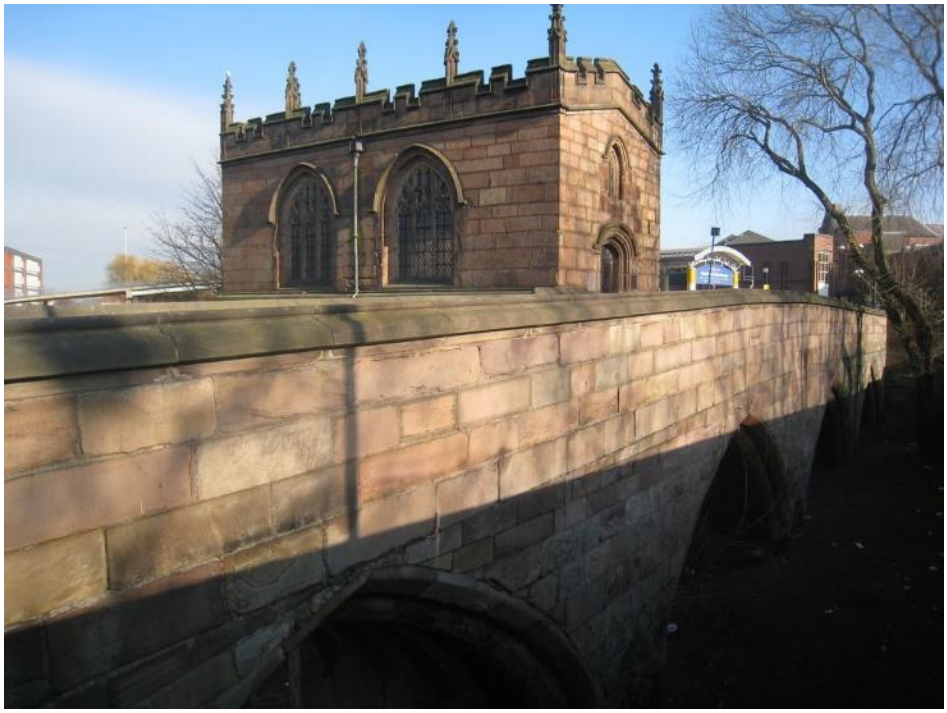

Figure 2: Chantry Chapel of Our Lady and Rotherham Bridge, 29 January 2011

By Jonathan Thacker, CC BY-SA 2.0,
https://commons.wikimedia.org/w/index.php?curid=36366848

Figure 3 Wakefield Chantry chapel and bridge

By Robhamhar - Own work, CC BY-SA 3.0,
https://commons.wikimedia.org/w/index.php?curid=28063598

Scope of study

So how many bridge chapels were there in medieval England and how many survive today? What may appear simple, straightforward questions cannot be answered so easily. Lack of a comprehensive gazetteer also hampers any wider consideration of these monuments and their role in medieval society.

Bridge chapels can be defined as 'a chapel built onto the structure of a bridge' (heritagedata.org n.d.) http://purl.org/heritagedata/schemes/eh_tmt2/concepts/69968 accessed 16th September 2017); a definition informed by the location of most of the surviving chapels. As will be seen, chapels were as likely to be built at or near the bridge end as on the bridge itself. Bridge chapels cannot be considered in isolation and a range of religious monuments and buildings, ranging from simple crosses through to hospitals and even parish churches, which were situated either on, or in the proximity of bridges. Some of these foundations happened to be built on or by bridges so the concept of a 'bridge chapel' could be considered

as a modern construct accentuating both the rarity and unusualness of the surviving chapels that happened to be built on bridges.

Both documentary and structural evidence highlight the importance of endowing a bridge with a chapel as an act of piety as well as the more prosaic need for revenue generation. Many bridge chapels are only known through documentary sources where they may be described as 'on' (supra), 'at' (ad), 'by' (juxta) or 'near' (prope) a bridge. In some cases, these references might be no more than descriptive labels distinguishing chapels of similar names in the same parish or act as locational aids but there are usually stronger associations. Occasionally bequests explicitly funded the construction of chapels on bridges, notably at Rotherham in 1483 and 1485.

Structurally, a bridge chapel could be conceived as part of the original design of the bridge through the enlargement of a pier as at St Ives, (Morriss 2005, 202), or added subsequently through alteration of the superstructure. Either way there was a conscious decision to place the chapel on the bridge though it was more convenient to build a chapel at the bridge-end, unencumbered by the challenges of altering an existing structure. For the medieval traveller journeys were difficult and dangerous, but as pinch points in a road network, travellers converged on bridges. Fording rivers was hazardous. For instance, in 1427 Pope Martin V offered an Indulgence to all those who gave alms towards the building and of a stone bridge over the River Tweed by the town of Melrose (Scottish Borders). The wording of this exhortation pointed out that people had been drowned crossing the river when it was in flood due to the absence of a bridge (Lateran Regesta 1906). The danger of crossing rivers ensued that bridges were ideal locations for siting chapels and hospitals to attract alms and offerings from those either starting or completing hazardous journeys.

Antiquarian interest and history of research

Bridge chapels started to attract antiquarian interest during the 19th century. The earliest work grandiosely titled. 'A Dissertation on Ancient Bridges and Bridge Chapels: And Especially that Remarkable Edifice on Wakefield Bridge, Commonly, But Erroneously, Called the Chapel of Edward the Fourth' by Norrison Scatcherd was published in 1828. This study was followed in 1881 by Kershaw's (1881) article on 'Ancient Bridge Chapels', which listed some surviving and destroyed examples. He noted that many bridge chapels continued in use in Europe, notably the Santa Maria della Spina in Pisa (Italy) built in about 1230 (Kershaw 1881, 204). Subsequent research stressed the role of hermits in maintaining bridge chapels (Kerry 1892; Clay 1914).

The only national survey of English and Welsh medieval bridges was undertaken during the late 1920s and early 1930s by Edwin Jervoise under the auspices of The Society for the Protection of Ancient Buildings in response to pressures to modernise the road network (Jervoise 1930, 1931, 1932, 1936). These volumes complemented by separate publications on the bridges of Devon and Cornwall (Henderson and Coates 1928; Henderson and Jervoise 1938), documented both the extant and some destroyed bridge chapels. With references to bridge chapels spread over six volumes, it is difficult to obtain an overall impression of the number and distribution of bridge chapels.

Compiling the gazetteer

Subsequent studies inevitably tended to focus on individual surviving bridge chapels often in the form of guidebooks (e.g. Innes-Smith 1987; Taylor 2011). Wilson and Mee (2002) produced an in-depth study of Ouse Bridge (York), including its demolished bridge chapel.

The surveys by Jervoise, Henderson and Coates highlighted the wealth of documentary evidence available. Bridge chapels feature sporadically in a range of documentary sources particularly through pontage grants and chantry endowment grants, plus the granting of Indulgences. Contemporary descriptions are rare. William of Worcester, writing in in 1478-80, produced a detailed account of the chapel of St Mary the Virgin on Avon Bridge in Bristol, including paced dimensions (Harvey 1969, 129, 131). Some urban bridges are well documented through Bridge Masters or Wardens accounts, as at Rochester (Becker 1930) and York (Stell 2003). Other bridges, particularly those in the smaller towns and in rural locations, may be known from a solitary reference – a bias in the documentary record partly redressed by 16th-century surveys connected with the Reformation. John Leland the king's antiquary (appointed 1533) travelled around England and Wales visiting cathedral and monastic libraries to collect manuscripts of historical interest. In his Itinerary (compiled circa 1540 and 1545), many details concerning bridge chapels, which were about to close were recorded (Chandler 1993). A few years later, in 1546 and 1548 Chantry Certificates were issued providing accounts of the contents of many English bridge chapels, prior to their appropriation by the Crown (Duffy 1992, 517). At least ten bridge chapel inventories have been published.

Monuments associated with bridges

Although the focus of the study is the bridge chapel, many medieval bridges without chapels were furnished with crosses and statues as symbols of piety. Although once a common feature in the landscape, both the physical and documentary evidence for such monuments is slight.

Bridge furniture: crosses

Maisemore Bridge approach (Gloucestershire) formerly possessed a medieval cross bearing an inscription commemorating its founder (illustrated in Watson this volume). In 1312 it is documented that Crowthorpe Bridge (Northamptonshire) possessed two crosses. A rare survival is the socket stone preserved on a cutwater on the eastern side of Tun Bridge at Chew Magna (Somerset). A will of 1518 made by John Cowper, a York butcher requested that either his wife Margaret or others to undertake three regional pilgrimages on his behalf, if he had been unable to make these journeys during his life. One of these pilgrimages was to 'the Roode' of Doncaster (South Yorkshire) at the bridge end.

Bridge furniture: statues

There is some evidence for the presence of religious statues erected on medieval bridges. Richard Langfellay (died 1537) left funds for the erection of a substantial cross with an image of 'our lady' (St Mary the Virgin) on Otley Bridge (West Yorkshire). In 1492, the rector of the parish church of St Magnus the Martyr situated at the northern end of London Bridge (Middlesex) complained to the papacy that two members of the 'Bridge House' had recently erected a statue of St Mary the Virgin on London Bridge (within his parish) without his permission and were using it to collect alms for their own benefit.

Prominent statues on bridges would have been particularly vulnerable to iconoclasm during the Reformation. The Royal Visitations of 1547 banned sacred images from English churches and the 1550 Act subsequently ordered their destruction (Duffy 1992, 457-69). A few images did survive, such as the figure of Christ being crucified and two other statues adorning the gatehouse on Holt Bridge (Cheshire and Denbighshire), until its demolition during the 18th century. During the later 17th and 18th centuries, Protestant England would not see the revival in furnishing bridges with statues in contrast to central Europe where the statues, often dedicated to the to St John of Nepomuk were erected on many bridges. Thrown to his death from the King Charles Bridge in Prague (Czech Republic) into the Vlatava in 1393, a statue commemorating his martyrdom was erected on the bridge in 1683. Following his canonisation in 1729 statues dedicated to him were erected on many bridge parapets, a practice that continues to the present day.

Chapels on bridges

The surviving structures, documentary sources and antiquarian illustrations combine to highlight the diversity in the both siting and size of bridge chapels and related structures. The evidence points to a range of designs and locations for individual chapels.

The surviving chapels of Rotherham, St Ives and Wakefield are all two-storey structures built on an enlarged midstream pier perpendicular to the roadway. In each case the upper storey contained an ornate chapel above an undercroft or crypt. Both the destroyed chapels of St Thomas the Martyr at Tyne Bridge, Newcastle and at London Bridge processed undercrofts below the level of the roadway. These chapels are very similar in form to the famous example on at the Pont Saint-Bénézet, Avignon (France) (illustrated in Watson this volume).

Figure 4 Bradford on Avon bridge chapel

By Sally Muir - Flickr: Bradford on Avon, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=24708544

In contrast to these large two storey chapels, the small, chapel at Bradford-on-Avon, (figure 4) is corbelled out from a pier of the bridge. During the 18th century it was rebuilt as a lock-up. A very similar chapel formerly stood on one of the piers of St Lawrence's Bridge, Bath, (Somerset), whilst the name, location and usage of the 'The Nook' as a lock-up on Tone Bridge, Taunton (Somerset) is also suggestive of the post-medieval reuse of a bridge chapel.

Not all bridge chapels were founded on enlarged piers or at right-angles to the roadway. These chapels were usually built over enlarged arches adjacent to the river bank. St Anthony's chapel, one of two chapels on Elvet Bridge, Durham, is built over an enlarged arch at the east end of the bridge. Much altered and enlarged, traces of late Norman ashlar masonry suggest that the building was contemporary with the foundation of the bridge by Bishop Puiset (died 1195) during the late 12th century, but it apparently was not completed until the 1220s (McAuley 2009). At Derby, although the medieval bridge was replaced by a late 18th-century bridge on a slightly different alignment, the medieval St Mary's chapel survived. The bridge chapel is built on an enlarged pier, punctured by a small, flat-topped flood arch underneath the east end.

Figure 5. St Edmunds church tower was constructed over an arch of Exe bridge (Copyright Eve Boyle)

At the north end of Exe Bridge, Exeter, (Devon), a chantry chapel, dedicated to the St Mary the Virgin was built over one arch. On the opposite side of the roadway the remains of St Edmunds (parish) Church spans two arches (figure 5). A second church, dedicated to St Thomas, stood at the south-west end of Exe Bridge until 1411.

Figure 6. St William's chapel and bridge, by Thomas Girtin, 1800. Yale Centre for British Art

By Thomas Girtin - gQFMYpHevO_Rkw at Google Cultural Institute maximum zoom level, Public Domain, https://commons.wikimedia.org/w/index.php?curid=22156243

Similar, now vanished, bridge chapels are known from 18th-century illustrations. St William's Chapel on the Ouse Bridge, was founded on two arches built on extended cutwaters along the northern side of the western end of the bridge (Wilson and Mee 2002, 39-47) (figure 6). The same arrangement could be found at the Old West Bridge, Leicester. Some bridge chapels are known only from documentary or pictorial evidence. Turner's painting of circa 1798, offers a tantalising glimpse of a possible, otherwise undocumented, chapel situated on a central pier of Aylesford Bridge (Kent) shortly before this pier and the arches on either side of it were in 1824 replaced by a single larger arch to improve the passage of river traffic.

There were also more unusual arrangements to accommodate a chapel on the bridge. The Tudor antiquarian John Leland, observed a fine new timber chapel at the 'nearer' end of the bridge at Droitwich (Worcestershire) (Chandler 1993, 515). As a parochial chapel of St Peter's, Droitwich this chapel remained in use after the closure of the chantries. Apparently, the public road with horses and carts passed through the chapel, the congregation sitting on one side of the road, the priest on the other, until in 1763 when it was demolished. Morriss (2003, 202) offers an alternative explanation suggesting that the chapel was built above rather than on either side of the roadway. One chapel that was built above the roadway was on Avon Bridge, Bristol. This was evidently a substantial, upper level structure with a bell tower with the appearance of a gatehouse. This arrangement has a parallel in Germany. The Krämerbrücke, Erfurt was bracketed by bridgehead churches at each end of the bridge with the roadway still passing under the Ägidienkirche at the east end of the bridge. More problematic is the relationship between churches built on the approaches and the bridge. Adjoining the south west end of Monnow Bridge (Monmouthshire), famous for its gatehouse

built soon after 1297 (Rowlands 1994, 4), is the chapel of St Thomas the Martyr. This chapel also backs onto the river. First documented in 1163 as a dependency of St Mary's Priory (founded 1075), it subsequently served as a chapel of ease. Bridgeheads were lucrative locations to locate a foundation which may or may not have had a responsibility for maintaining the adjacent bridge.

Chapels by bridges

Less visible in the literature and more of an unknown quantity are chapels built at, or near the end of bridges. Often these structures were removed as a traffic obstacle or as part of urban renewal replacing ramshackle and narrow medieval bridges with classically inspired structures (see Harrison this volume). Where the bridge chapel survives too often the context has been lost. At Rochester, although the medieval bridge has long since been replaced, its chapel survives as part of the headquarters of the Rochester Bridge Trust, which continues to maintain the present bridge. The chantry chapel at Morpeth (Northumberland) originally stood at the northern end of the medieval bridge. Following the construction of a new bridge nearby in 1831 and the removal of most of the medieval bridge three years later the spatial relationship of Morpeth chapel with its bridge was destroyed.

Occasionally the chapel may be situated some distance from the bridge introducing doubt into the association. The chantry of St. Mary Magdalene, Taddiport (Devon) is first mentioned on 2 February 1311-12 as 'juxta pontem de Chepyngetoriton' (Henderson and Jervoise 1938, 5, 91). It is also associated with a leper house dedicated to the same saint by 1344. Although situated some 60m from the end of the bridge, the present chapel of St Mary Magdalene, may be the chapel referred to in the medieval documents.

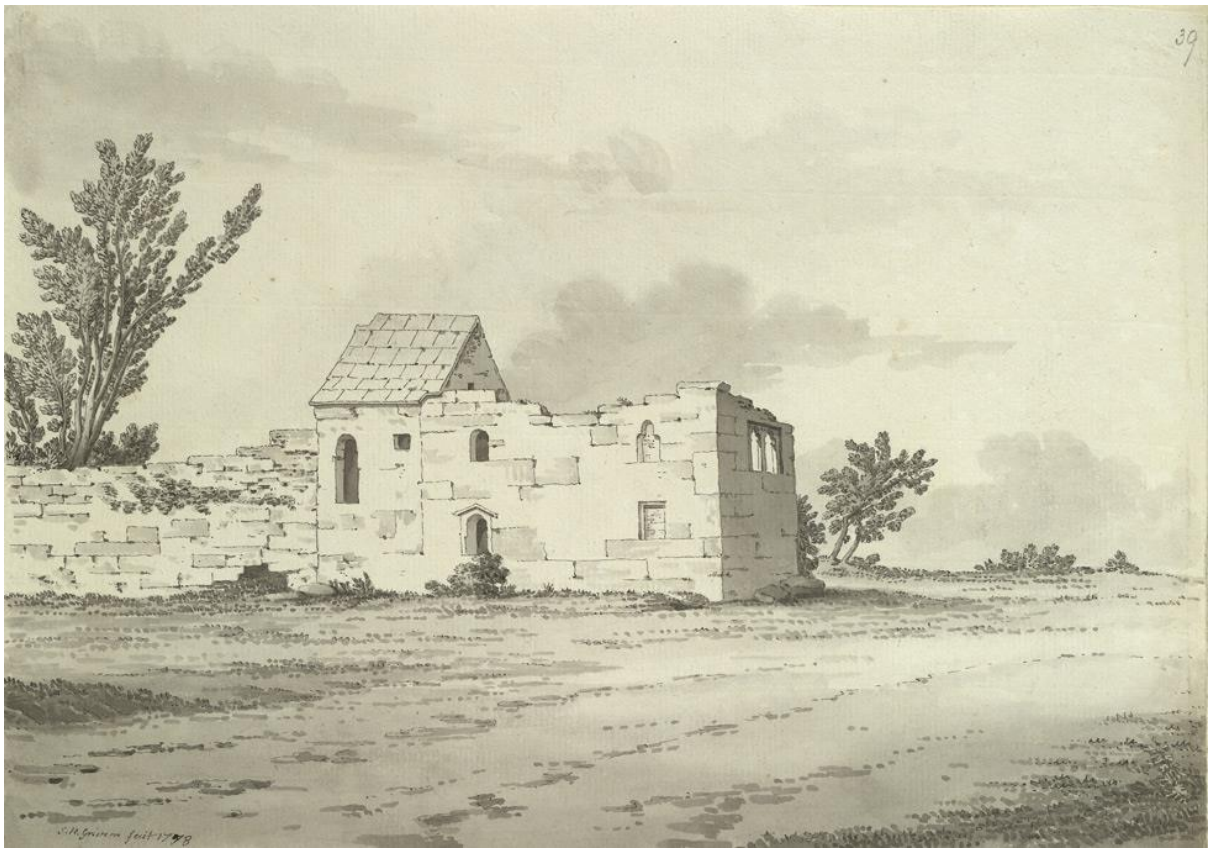

Figure 7. The ruins of St Anne's chapel at Catterick bridge by Samuel Hieronymus Grimm, 1788. Reproduced by kind permission of The British Library. (c) British Library Board (Shelfmark: Additional MS 15548).

Some of the chapels built at the bridge end were evidently substantial two storey structures similar to those on the bridges at Rotherham and elsewhere. As the floor level of the chapel at St Mary's Bridge Cromford lies below road level, its remains apparently represent an undercroft below a demolished upper level chapel, level with the roadway. Late 18th century illustrations provide evidence for similar two storey chapels at Chester New Bridge, Lambton (County Durham) and Catterick Bridge (North Yorkshire) (figure 7).

Hermits and hermitages

Medieval hermits (male recluses with a religious vocation) often served as bridge wardens and ran bridge chapels (Clay 1914, 57-65). At southern end of Clopton Bridge, Stratford-upon-Avon, (Warkwickshire) there was apparently both a chapel and a hermitage by 1357. In 1571 the former chapel and hermitage at Earith Bridge (Cambridgeshire) was converted into a farmhouse. The 15th-century hermit at St Mary's Bridge chapel, Derby. collected the tolls and looked after the chapel. He probably lived in part of the priest's house, which adjoined the chapel. The will of Simon Cotes (dated 1527), the hermit of Hermitage Bridge, Westbourne (West Sussex) explains that he had built a chapel dedicated to St Antony (the Holy Confessor) and lived in an adjoining house. The substantial nature of the buildings at Catterick Bridge and Chester New Bridge (Co. Durham) may well have provided dwellings for a chaplain or hermit.

Hospitals and Bridges

Apart from caring for the sick or elderly, medieval hospitals fulfilled other functions. As Poorhouses and Almshouses they provided care for the poor but as reflected in the etymology of the term hospitalia, they also provided guest accommodation for travellers including pilgrims. The proximity of English medieval hospitals and leprosaria to bridges (see Watson this volume) forms a recurring pattern.

Founded by Bishop Bingham of Salisbury by 1244, Harnham hospital, St John's chapel and bridge, Salisbury (Wiltshire) forms an architectural complex beside the River Avon. The hospital, on the north bank of the river, was founded sometime before 1227 but the chapel, incorporated into a later house, and bridge are not recorded until about 1244. The bishop originally intended that the chaplains of St John's would conduct Masses for the benefit of travellers in the chapel with offerings collected paying for the bridge maintenance (Edwards 1956). The complex at Harnham has a well-documented, but not unique association between hospital, chapel and bridge. In the 1220s Peter Undergod founded a hospital on the north bank of the River Teme at Ludlow (Shropshire), dedicated to the Holy Trinity, St Mary the Virgin and St John the Baptist for the poor, aged and infirm (Angold et al 1973). It was a large foundation, spread over two and a half acres (1.01 hectares) including St John's House immediately beyond the north-east corner of Ludford Bridge. Given its location, St John's House was probably a chapel associated with both the hospital and Ludford Bridge.

Figure 8 Duxford Chapel is situated beside the low causeway leading from Whittlesford Bridge

By Tony Lewis, CC BY-SA 2.0,
https://commons.wikimedia.org/w/index.php?curid=7138686

Around 1200, William De Coleville (died 1230) founded a hospital of St John at Whittlesford Bridge (Cambridge). Originally under Augustinian rule, by 1337 the chapel had ceased to function and was converted into a free chapel. The hospital was dissolved by 1548 with the chapel building used as a barn for the adjacent Red Lion Inn. Now known as Duxford Chapel (figure 8), the single storey building lies alongside the low raised causeway leading from the bridge.

A number of hospitals recorded by bridges were Leper houses. The chantry of St. Mary Magdalene, 'juxta pontem de Chepyngetoritone' (Henerson and Jervoise, 1938, 91: see above) at Taddiport is associated with the nearby Leper hospital of the same name. However, the connection between the bridge, chapel and leper house is circumstantial. Other monastic associations with bridges are provided through documentary evidence. Holland Bridge and causeway near Spalding (Lincolnshire), was latterly maintained by St Saviour's Priory, who received numerous pontage grants between 1353 and 1399.

Bridge chapels elsewhere in the British Isles and Ireland

Bridge chapels in Wales, Scotland and Ireland are understudied and are mainly known from documentary evidence. Welsh examples are known from documentary sources at Haverford West (Jervoise 1936, 70) and Cardiff. In Ireland there is documentary evidence for chapels at Dublin Old Bridge and Baal's Bridge, Limerick where there was also a hospital, dedicated to SS. Mary and Edward the Martyr by the foot (juxta pedem) of the bridge (Lateran Regesta, 397: 1443). In 1384 a chapel was recorded at Bennettsbridge (Co. Kilkenny), when the status of its 'parson' was ratified. (O'Keeffe and Simington 1991, 172-74).

Several chapels and hospitals associated with bridges are known from documentary sources in Scotland. In 1232 King Alexander II granted 'four marks yearly to maintain a chaplain and a clerk' at the chapel of St Nicholas by the Bridge of Spey at Brig O' Boat, Borham (Moray) A hospital is mentioned at the bridge three years later, in 1235. A number of chapels are late foundations and the remains of two of these buildings possibly still survive within the greater Edinburgh area. At Leith, a writ dated 18 July 1493, records that Robert Ballantyne [Bellenden], Abbot of Holyrood, made an endowment for two chaplains at the recently built chapel, dedicated to St Ninian, at the north end of the bridge. Research by the Greater Liberton Heritage Project (2016), has tentatively identified a ruined outbuilding at Bridge End farm as the chapel founded at 'the end of the bridge of Craigmiller' by Sir Simon Preston in 1518.

Bridge chapels in Europe

The bridge chapel was a European phenomenon which would have been a familiar sight to pilgrims and travellers. Arrangements of chapels built, perpendicular to or parallel with the bridge roadway can be observed throughout Europe. The Pont Saint-Bénézet, Avignon (France) and St Nicholas's Chapel on the Inner Bridge, Esslingen (Germany) (Figure 7) are examples of the former, whilst the Chapel of Our Lady of Grace-and-All-Joy on the Pont des Cieutats, Villeneuve-sur-Lot (France) is an example of a chapel aligned along the roadway (Mesqui and Repérant 2010, 41).

Figure 9. The Nikolauskapelle (far left)and bridge houses, Innere Brücke, Esslingen, Germany (copyright author)

Figure 10. The Kapellbrücke, Lucerne, Switzerland, originally led directly into the church of St Peter through the door visible below the church tower.

Of the more unusual arrangements, the north end of the Kapellbrücke, Lucerne, Switzerland, originally led directly into the church of St Peter (figure 10). The bridgehead churches at the Krämerbrücke, Erfurt, have already been discussed. There are also examples of chapels built over the roadway in Spain at Puente de la Virgen (Caliph Bridge), Pinos Puente, Granada (Navarro and Balboa 1994, 118-119) and at Portomarín on the French way Camino De Santiago pilgrimage route to Santiago de Compostela, Galicia. Bridge chapels and hospitals are routinely associated with the Camino. With 78 arches, perhaps the greatest medieval bridge (built 1380-1386 probably on site of an earlier bridge) crossed the estuary of the River Eume at Pontedeume and would have been a familiar sight to those on the English Way. Supporting towers at each end, the bridge carried a chapel and hospital, dedicated to the Holy Spirit, between arches 21 and 22. On the site of a 12th-century foundation, the 16th-century convent of San Marcos by the bridge over the Bernesga in León (Spain) was a particularly spectacular example of hospital adjacent to a bridge. Though as one of at least seventeen hospitals in the medieval city providing care for pilgrims (Martin 2008, 176) San Marcos serves as a reminder that chapels and other buildings associated with bridges are not an exclusive group of monuments but need to be considered as part of a wider landscape. The spectacular Roman and medieval Ponte de Lima (Portugal), possessing two chapels and two 19th century Alminhas (shrines), lies on the Portuguese Way of the Camino. Further afield, the chapel of the 'Miraculous Cross' stood at the western end of the medieval Great Bridge of Novgorod (Russia). Until the 1930s the site of this church was marked by a wooden cross bearing an inscription stating it had been placed there in 1548 'by the will of servant of God Peter Nevezhin on the bridge' (Troianovskii 2009, 72-79).

The spatial association of hospitals and bridges is also seen in Bavaria at the Katharinenspital in Regensburg (Germany), the Heilig-Geist-Spital, Nuremberg at the Bridge over the Pegnitz and the "Spitäle" at Würzburg (Faber 2011). In Toulouse (France), the Benedictines had responsibility for the Pont de la Daurade which connected the Saint-Jacques Hospital to the Daurade church on either side of the Garonne, both properties of the Benedictines. Other hospitals and indeed chaplaincies (Aumôneries) were established by bridges without any liability for the upkeep of the crossing (Mesqui 1986, 113-114).

The Judith Bridge in Prague, Czech Republic, the predecessor of the Charles Bridge (see above) was washed away by floods in 1342. It was located directly north of its successor. At the eastern end of the Judith Bridge the redundant Baroque church known as St Peter na Poříčí occupies the site of a medieval hospital. A convent of the Franciscan nuns here which was refounded and re-endowed in 1235 by St Agnes of Bohemia as a hospital.

Conclusions

Despite the small number of surviving bridge chapels in England, documentary evidence suggests that there were once over two hundred chapels, hermitages, hospitals and even churches on or beside medieval bridges. Bridge chapels provided comfort and solace to travellers and increasingly personal salvation to rich benefactors who endowed chantry chapels. Yet proximity of a chapel or a hospital to a bridge alone does not prove a direct association or responsibility for the adjacent structure. Each case needs to be considered on its merits. Documentary evidence and repeated observations do suggest that there was often a relationship between the two elements and this topic will be explored further during ongoing research.

Research is not confined to the English bridge chapel but places these buildings in the wider European context of travel and pilgrimage. Whilst impossible to produce an exhaustive list of European bridge chapels, the study will provide sufficient context for the English examples. Existing studies have focused on architectural merits of individual chapels. In undertaking a systematic review of the evidence, the value of these buildings can be better understood and the significance of other structures recognised.

Acknowledgements

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The First Permanent Iron Bridge Over Vistula River in Warsaw and its Construction Seen Through the Eyes of Photographers in Pictures from the Collection of the National Museum in Warsaw, Poland

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Pictures made by the first Warsaw photographers, precursors of Polish professional photography create an important part of the Iconographic and Photographic Collection of the National Museum in Warsaw (NMW). Apart from immortalizing the city's inhabitants, photographers documented various historical events, the city's development and its material culture.

Daguerreotype was introduced worldwide in 1839. Yet five years later Karol (Charles) Adolf Beyer (1818-1877), son of Wilhelm Beyer and Henriette neé Minter, born in Warsaw, got interested in this new invention and in 1845 opened the first permanent photographic atelier in the capital city of then Kingdom of Poland (Jackiewicz, 2012). Soon other photographers followed him, among them Konrad Brandel (1838-1920) and Maksymilian Fajans (1825-1890). The construction of the first permanent steel bridge over Vistula river was one of the many subjects took up by the first photographers.

For military reasons the Russians who occupied this part of Poland were not interested in constructing permanent bridges over a river that was difficult to cross and was located close to the then western border of the Russian Empire. Nevertheless in the 19th century the expansion of Warsaw made it increasingly necessary to build a permanent crossing over the Vistula. Construction of the Warsaw-Vienna and Saint Petersburg-Warsaw railway lines became an important factor of development. Kierbedź Bridge (first named Alexander Bridge) that via the first Warsaw tramway line connected the two terminus railway stations was of great economic significance. It provided a new transport link and improved the quality of life of its residents, being a driver of the city growth.

The bridge was built between 1859 and 1864. It was designed and constructed by Stanisław Kierbedź, a brilliant Polish engineer, who graduated from the Institute of Transport Engineers Corps in Saint Petersburg. The bridge was built as the extension of Nowy Zjazd Street, running from the Castle Square, through a viaduct constructed in 1844–1846 according to the design of Feliks Pancer (Pancer Viaduct), towards the Vistula river.

Karol Beyer and people from his atelier systematically registered the progress of this investment from 1860 to 1864. Partly unknown photographs from this particular photo-reportage served for preparing commemorative albums for people who took part in it. Some of them survived though all of them differ between each other in the choice and number of photographs.

An album with twenty two photographs from Beyer’s atelier but also containing one that was made in 1866 by Maksymilian Fajans is stored at the Warsaw Public Library (Chylińska-Stańczak, 2006). It once belonged to engineer Tadeusz Chrzanowski (1822-1892) who was the site manager and the main structural engineer from 1861 to the bridge construction completion. He handed down his private library to the Warsaw Section of the Society for Supporting Industry and Trade. Between 1912 and 1914 the Society passed it on to the Library, together with the Alexander bridge album. The album has been digitized in Mazovian Digital Library [1].

Another album with twenty two photographs was sent in 1865 by unknown “Russian engineer” to École des Ponts et Chaussées in Paris - it has also been made accessible on-line [2]. Eighteen photographs are included in an album in a cloth-leather binding, stored at the Warsaw Museum (former Historical Museum in Warsaw; Mossakowska, 1994: 81, 111, figs. 77-78). Documents and some articles cut out of newspapers attached to the album indicate Edward Klopmann as its former owner. Edward Klopmann (1801-1878) was a water and building engineer (civil engineer), the member of the Bridge Construction Committee. Among others in the eighteen forties he held the office of Warsaw city architect.

Other known photographs of this series are kept as separated copies. Eleven photographs have recently been located by the author of this article in the Russian State Historical Archive in Sankt Petersburg [3]. Their provenance is unknown. Separate prints are

also stored in the collections of the National Museum in Warsaw (around twenty two pictures) and in the Polish Academy of Sciences Archive in Warsaw, where five pictures from the archive of Julian Adam Majewski (1826-1920) are kept. Julian Adam Majewski was a senior engineer, supervisor of works on site. Three prints have also been made accessible at polona.pl - website of the National Library in Warsaw [4].

All photographs presented in this article come from the collection of the National Museum in Warsaw and derive from three different sources. Majority of them belonged to Leopold Méyet (1850-1912) - Polish philanthropist, layer, writer and collector, whose collection was inherited by the Museum. Single photographs were given by the family of a collector Seweryn Smolikowski (1850-1920), whose father, also Seweryn (1809-1897) was the main structural engineer of the bridge until 1861 (later he was replaced by Tadeusz Chrzanowski). Single photographs come from the collection of Tomasz Chełmiński, who might have bought each of them separately, on different occasions.

Apart from the mentioned photographs the NMW's collection also features an album containing different prints - images of Warsaw (DI 96203 NMW). There are also some interesting pictures incorporated into it, that were made by Beyer's atelier and show the bridge construction site and its surroundings. Five of them present elements of the temporary auxiliary bridge and piers scaffolding. The album was most probably artificially made by the collector Leopold Méyet, however its origin is still not cleared. At the moment it is impossible to say how many diverse photo representations of the Alexander bridge construction process were actually made. Most probably their number exceeds thirty.

1 

Fig. 1 Temporary timber bridge from the Warsaw Old City side, photo by Karol Beyer, 9 October 1860 (DI 41815, copyright by Ligier Piotr/National Museum in Warsaw)

Works on the Alexander bridge construction began with the erection of a temporary, auxiliary bridge. It was a 12-span Town lattice truss timber bridge. It was designed by engineer Julian Adam Majewski. Its spans were made of three girders. All spans had the deck placed on girders, with the exception of the first span, counting from the Warsaw Old Town side - this one was a through span that allowed for river boats traffic during high tide (Fig. 1). There were two railway tracks on the bridge deck (Fig. 2, 3).

2 

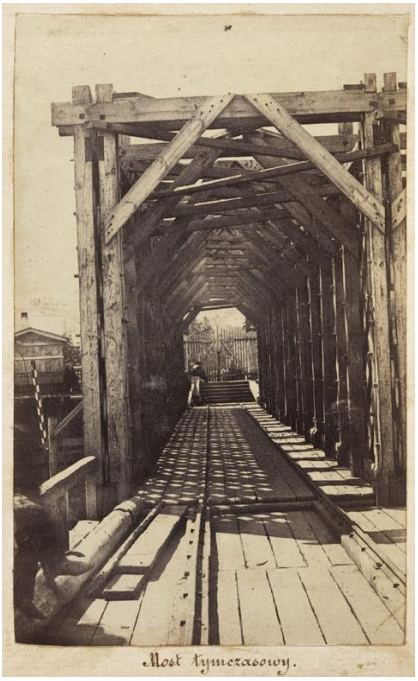
3 

Fig. 2 Deck of the temporary auxiliary bridge, photo by Karol Beyer, date unknown (DI 96203/138, copyright by Ligier Piotr/National Museum in Warsaw)
Fig. 3 Deck of the temporary auxiliary bridge, first through-truss span, photo by Karol Beyer, date unknown (DI 96203/136, copyright by Ligier Piotr/National Museum in Warsaw)

The bridge piers were built with the use of an innovative technological solution of those times - the caisson method for laying foundations. Each pier of Kierbedź Bridge was based on four iron cylinders (Fig. 4). The lower part of cylinders, after being sunk to the required depth, was filled with concrete. Their upper parts, as well as the interiors of the piers and abutment bodies were filled with red sandstone. Support sidings were made of granite with hydraulic lime mortar (Fig. 5).

4 

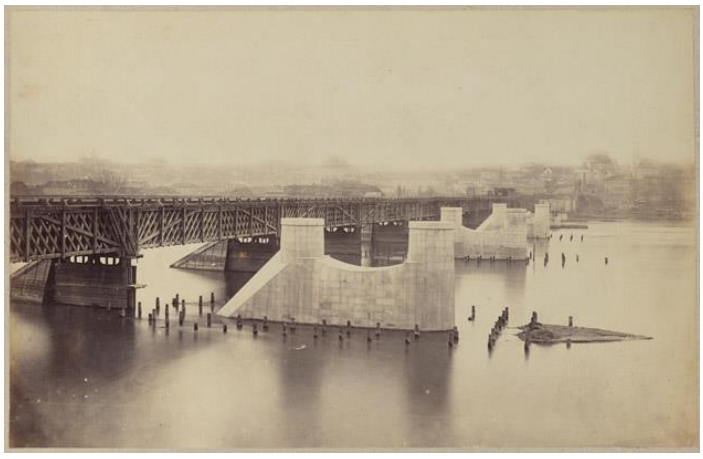
5 

Fig. 4 Construction of the bridge pier, top view of cylinders filled with concrete, photo by Karol Beyer, 6 May 1862 (DI 37191, copyright by Ligier Piotr/National Museum in Warsaw)
Fig. 5 Temporary bridge and piers of Kierbedź bridge, photo by Karol Beyer, 3 February 1863 (DI 37199, copyright by Ligier Piotr/National Museum in Warsaw)

The bridge was 475-metre-long. It had six spans, riveted, truss structure of the American type and the deck between the girders. It was based on five piers and two

abutments. The bridge superstructure resembled an open-sided cage (Fig. 6). It was constructed of three two-span continuous beams, each composed of two girders with parallel chords. The structure-assembly site and workshops were situated on the Praga side of Vistula (Fig. 7). Beams already assembled on land, were longitudinally launched from Praga side and laid on the bridge piers. A special scaffold was erected for this purpose to provide an additional support for the launched beams (Cézanne, 1864: 258; Majewski 1861; Mistewicz & Tucholski, 2014; Fig. 8, 9, 10).

6 

Fig. 6 The first beam of the bridge, view from the Old Town side, photo by Karol Beyer, 5 February 1864 (DI 37194, copyright by Ligier Piotr/National Museum in Warsaw)

Konrad Brandel (1838-1920) who was at first Beyer's employee and later set up his own photographic atelier is the author of the picture, showing bridge builders in January 1864. What is most fascinating about it is the fact that it was made "by electric sunlight" and provides evidence of the first ever experiments with electric lightning in Warsaw that were conducted just on Kierbedź Bridge construction site. Newspapers from those days informed about this incident (Gazeta 1864; Jackiewicz, 2015: 8-9).

7 

8 

Fig. 7 "Iron bridge workshops", photo by Karol Beyer, date unknown (DI 96203/139, copyright by Ligier Piotr/National Museum in Warsaw)

Fig. 8 View of the two bridges connected by platforms and wooden scaffolding between the piers to support beams during their launching. The first beam already launched is visible on Warsaw side, Karol Beyer, 1 October 1863 (DI 37196, copyright by Ligier Piotr/National Museum in Warsaw)

Apart from Poles and Polish companies that worked on the construction, there were also Italian masonry masters and French companies – Société Ernest Goüin et Cie dealt with foundation works and the assembly and installation of spans (Park-Barjot, 2005: 107), whereas Schneider et Cie factories produced iron structural elements. Engineers Ernest Cézanne (1830-1876), Charles Cotard (1835-1902) and a Pole Stanisław Janicki (1836-1888) supervised foundation works and installation of spans on behalf of Ernest Goüin et Cie.

9 

10 

Fig. 9 “Iron bridge scaffolding”, photo by Karol Beyer, 3 February (?) 1863 (DI 96203/140, copyright by Ligier Piotr/National Museum in Warsaw)
Fig. 10 Scaffolding used to support beams during launching, photo by Karol Beyer, 1863 (DI 36551, copyright by Ligier Piotr/National Museum in Warsaw)

The history of the bridge reflected the fortunes of the city. The period of the bridge construction coincided with the January Uprising (1863-1864), an act of resistance to the Russians occupying this part of Poland. It fell on difficult times of increased repression after the collapse of the Uprising. The bridge was opened on 22 November 1864 – the ceremony had an official character, without the participation of the city residents who boycotted the occasion. The bridge was formally named Alexander Bridge (in honour of Emperor of Russia Alexander I) but was popularly called Kierbedź Bridge (from the name of its designer) or the First Bridge by Warsaw inhabitants. A picturesque photograph of the bridge was made by Konrad Brandel (1838-1920) in August 1873 from the Royal Castle tower (Fig. 11).

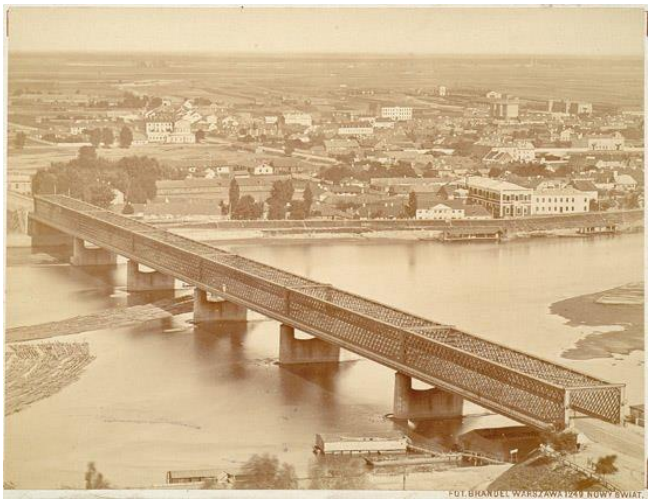


Fig. 11 View of the Alexander (Kierbedź) Bridge from the Royal Castle tower, photo by Konrad Brandel, 26 August 1873 (DI 17751/1, copyright by Ligier Piotr/National Museum in Warsaw)

During World War I, on 5 August 1915, two middle spans of the bridge were blown up by the withdrawing Russian troops. Below the damaged bridge German sappers erected within a month a beam bridge on timber pile supports. It was named Beseler Bridge, in honour of Hans Hartwig von Beseler (1850-1921), governor-general of the General Government of Warsaw created between 1915-1918 as part of the German Empire. The reconstruction of the Kierbedź bridge started in September 1915 and on 27 January 1916 the bridge was reopened (Bernhard, 1916). New spans were rebuilt in a changed form - the scheme of continuous two-span beam was replaced with two beams simply supported. In its cross-section the new structure was composed of three truss girders with the upper chord curved in the shape of a circular sector. The third girder was located in the bridge longitudinal axis. In 1918 Poland regained its independence and the bridge was officially christened as Kierbedź Bridge.

After the reconstruction, the bridge served Warsaw almost to the end of World War II. During the Warsaw Uprising (1 August-2 October 1944), which was an act of Polish resistance undertaken in order to liberate Warsaw from German occupation, on 13 September 1944 Kierbedź Bridge was blown up. The damage was much more serious than in 1915 and the bridge superstructure was almost totally destroyed. Only its abutments, utmost piers and utmost spans survived. After the war, the bridge debris was dismantled and removed from the river. The preserved supports of Kierbedź Bridge were used to build Śląsko-Dąbrowski Bridge, which is still one of the most important Vistula river crossing in Warsaw.

In order to record the history of the oldest Warsaw bridges and the history of Polish bridge engineering, the project has been undertaken since 2008 with the objective to discover and save the remnants of bridge structures lying at the bottom of Vistula river. Kierbedź Bridge fragments were found and excavated in 2011. Cleaned and coated bridge elements have been displayed on the premises of the Road and Bridge Research Institute in Warsaw. They create part of so called Pontiseum – an outdoor exhibition of fragments of bridge structures.

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The Poetic Bridge in the Nineteenth Century

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Since time immemorial, bridges have played a role in the popular imagination. From trolls lurking beneath bridges in the fairy tales of our childhood, to iconic cinematic images of San Francisco's Golden Gate Bridge or Venice's famed Rialto, bridges have infiltrated our culture and rooted themselves in our art and literature. It is not only the practical function of these imposing architectural landmarks – to allow access between separated spaces through an elevated crossing – which captures the imagination of artists, novelists and poets: but perhaps more importantly their symbolic value, as places of cultural connection, imaginative exchange and purposeful movement. Istanbul's famous Galata Bridge, for example, exemplifies the cultural exchange between East and West through its position straddling the Bosphorus Strait, thereby connecting the Asian and European sides of the city (Mak, 2007: 1). In a similar manner, Berlin's Glienicke Bridge became known as the 'Bridge of Spies' in recognition of its unique role as the point of exchange of spies from East and West Germany during the Cold War: a role which continues to inspire writers of political thrillers and espionage dramas (Donovan, 2015: xvi).

It is with these impressions of movement, connection and symbolism that we approach the topic of bridges in nineteenth century poetry. The Victorian poetic bridge was more than simply a device for linking separate spaces, providing a crossing-point from place to place: the bridge motif moreover provided poets with a viewpoint, a place for romantic observation and reflection, and a connection to the historical or legendary past through the action of crossing, remembering and imagining. The icon of the bridge carried a great depth of meaning to which nineteenth century poets responded, reshaping famous landmarks as sites of quasi-spiritual encounters. However, juxtaposed with these pleasant images lurks the murky underside of the nineteenth century bridge: the arches beneath which ladies of the night ply their trade; robbers and villains stalk for victims, and the railings which form the central focus of Victorian suicide narratives. The bridge in nineteenth century poetry is thus a complex image, and this paper seeks to unpick some of these diverse and fascinating aspects.

No study of bridges in Victorian poetry would be complete without first turning to Wordsworth's famous sonnet, 'Composed upon Westminster Bridge.' Dorothy Wordsworth, the poet's sister, recounts their journey through London in her *Grasmere Journals*:

> The City, St Paul's, with the River & a multitude of little Boats, made a most beautiful sight as we crossed Westminster Bridge. The houses were not overhung by their cloud of smoke & they were spread out endlessly, yet the sun shone so brightly, with such a pure light, that there was even something like the purity of one of nature's own grand Spectacles.
>
> (Greenblatt, 2006: 400)

In Dorothy's words we can see the images which so inspired William Wordsworth. Both William and Dorothy Wordsworth, in their poetry and prose, capture the stillness of the morning observed from Westminster Bridge: the 'calm river,' the 'silent streets' and the 'still' cityscape surrounding them (2006: 317). London, the centre of commerce and trade, is described in terms of natural beauty: as William Wordsworth comments, 'Never did sun more beautifully steep / In his first splendour, valley, rock or hill' (2006: 317). When we consider the importance of wild natural landscapes to the Romantics, and particularly to Wordsworth himself, who enthused about the craggy waterfalls and 'wild nature' of Yorkshire and the Lake District, this comparison of the built urban environment to nature neatly captures the

monumental quality which the poet found in his view from Westminster Bridge (Sanders, 2004: 363). Even the poem's sonnet form is traditionally reserved for love poetry; and we can read 'Composed upon Westminster Bridge' as a love sonnet to the City of London (Greenblatt, 2006: A81).

The Westminster Bridge which Wordsworth crossed was opened in 1750, providing a crossing-point over the Thames from the rapidly-growing Westminster (Roberts and Godfrey, 1951: 66-68). Yet, the primary importance of the bridge for both Dorothy and William Wordsworth is not the action of crossing of the bridge, or the journey from one bank of the Thames to the other; rather, it is its usefulness as a space for observation. Viewing the vast stretches of London, the 'ships, towers, domes, theatres and temples,' gives Wordsworth an almost spiritual experience: as he comments, 'Ne'er saw I, never felt a calm so deep!' (2006: 317). Westminster Bridge is no longer primarily a space for crossing and movement; rather, it becomes for Wordsworth a site for exercising the Romantic imagination. In the poet's seminal Preface to *Lyrical Ballads* Wordsworth notes that 'All good poetry is the spontaneous overflow of powerful feelings,' and in this case it is pausing at Westminster Bridge which provides the catalyst for this 'overflow' of emotions (2006: 264). The poet Coleridge encapsulates this importance of pausing a journey and enjoying the view:

> The reader should be carried forward, not merely or chiefly by the mechanical impulse of curiosity, or by a restless desire to arrive at the final solution, but by the pleasurable activity of mind excited by the attractions of the journey itself.
>
> (2006: 481)

For the Romantic poets, and for Wordsworth in particular, the traditional primary function of bridges as sites of crossing and movement is pushed aside in favour of an interpretation of the bridge as a site of reflective observation.

The bridge as a place of observation is also explored by Alfred, Lord Tennyson, in his poem of 1840 entitled 'Godiva.' In the poem's prologue, Tennyson describes a visit to the Midlands city of Coventry, where he waits for a train on the railway bridge at Coventry Station:

> I waited for the train at Coventry;
>
> I hung with grooms and porters on the bridge,
>
> To watch the three tall spires; and there I shaped
>
> The city's ancient legend into this: […]
>
> (1976: 281)

In much the same way that Wordsworth saw the vast expanse of London stretching before him, so too Tennyson watched the city from the bridge, taking poetic inspiration from the view set before him. However, whereas Wordsworth's sonnet describes a contemporary, if idealised, account of the scene, Tennyson's view is across the realms of history and legend. The narrator then proceeds to tell the story of 'the woman of a thousand summers back,' who 'rode forth, clothed on with chastity' in a famous act of defiance against her husband's taxes (1976: 282). The mundane railway bridge in Tennyson's 'Godiva,' the 'haunt of grooms and porters,' becomes instead a temporal bridge, spanning the gap between present and past, and between history and mythology (1976: 282).

Tennyson's fascination with the legends of the British Isles greatly influenced his poetic career: from his early poems, such as 'The Lady of Shalott' to Tennyson's later verse epic *The Idylls of the King,* mythology has infused his oeuvre (Lambdin and Lambdin, 2000: 13). Yet these mythological and historical imaginings are often contrasted with a framing device, which roots them in the Victorian present (Pearsall, 2003: 121). By framing his 'Godiva' within a nineteenth-century setting, Tennyson illustrates the link between past and present: in 'Godiva' Tennyson stresses that it is

> Not only we, the latest seed of Time, […] that prate
>
> Of rights and wrongs, have loved the people well
>
> And loathed to see them overtax'd […]

(1976: 281-282)

Godiva's actions mirror nineteenth century concerns about urban poverty, and through framing the poem in Victorian Coventry Tennyson highlights this link between present and past social problems. Coventry's railway bridge can be read as an illustration of this blurring of the boundaries between the two realms of factual present and mythical past.

Although reimagining past societies and reinterpreting legends were popular Victorian literary tropes, it was not universally respected (Brooks, 1998: 2). Elizabeth Barrett Browning comments in *Aurora Leigh* that

> I do distrust the poet who discerns
>
> No character or glory in his times
>
> And trundles back his soul five hundred years,
>
> Past moat and drawbridge, into castle court […]
>
> Nay, if there's room for poets in this world
>
> A little overgrown (I think there is),
>
> There sole work is to represent the age,
>
> Their age, not Charlemagne's […]

(2006: 1105)

Browning, like Tennyson, employs the bridge as a metaphor for the temporal crossing between present and past: for Browning, a musty medieval drawbridge represents the crossing, whereas Tennyson envisions our link to the past as a modern railway bridge, a symbol of innovation. In this lexical choice, we can perhaps read Tennyson and Browning's respective views on the reuse of ancient literary settings and stories. For Browning, the retreat into a mythical past is restrictive and uninspiring, yet for Tennyson the stories of the past, both factual and mythological, provide vivid and innovative source material – and the image of the bridge the means of accessing it.

The action of observing the view from the bridge at Coventry railway station opens for Tennyson a world of medieval history and stories. The American poet Henry Longfellow, in his poem 'The Bridge' published in 1845, similarly sees the bridge as a means of connecting present and past. Yet for Longfellow, the visions conjured by standing on the bridge are of the more recent past, and the memories conjured are personal rather than imaginative. For the

narrator, the action of crossing the bridge opens a gateway to the narrator's most tragic memories:

> Whenever I cross the river
>
> On its bridge with wooden piers,
>
> Like the odor of brine from the ocean
>
> Comes the thought of other years.

(2000: 45)

The narrator sees a 'bright reflection' in the river beneath him, reminding him of his late wife (2000: 45). From personal memories, the narrator turns to a broader recollection of the multitude of people, the 'thousands / Of care-encumbered men' who have crossed the bridge like him (2000: 45). The bridge acts as a site of both personal and collective memory, creating a link between present and past, and connecting the narrator to the scores of others who have used the bridge. As with Wordsworth and Tennyson, we can read the bridge as the gateway to these spiritual or emotional experiences: physical bridges allow the poet to transport himself back in time, to access both personal and collective memories, and to observe the beauty of the world around. Interestingly, the bridge over which Longfellow crossed, shown on the screen in its nineteenth century form and which spans the Charles river in Massachusetts, was renamed the Longfellow Bridge in the twentieth century in honour of the poet who had been so inspired by it (Haglund, 2002: 454).

We have so far touched upon many of the pleasant ways in which nineteenth-century poets have been inspired by real bridges. Yet the bridge also had a far more disturbing side: once we stray away from the top of the bridge, we may find ourselves in rather more unpleasant, even dangerous, locations. The railings of the bridge and under the arches: these were the sites of tragedy which haunted the Victorian imagination. The unwary traveller who strays into these peripheries may find themselves in the dark underworld of Victorian society. Bridges thus held a dual function for nineteenth century poets – both as sites of memory, connectivity and romantic observation; yet their peripheries representing sites of tragedy and moral corruption.

The bridge as a site of female sexual transgression captured the imagination of Victorians (Nicoletti, 2004: 1). The Pre-Raphaelite artist Dante Gabriel Rossetti was particularly inspired by the image of the fallen woman reduced to selling herself beside the bridges of the Thames, a concept around which he based his painting and poetry pair, 'Found.' In a letter to William Holman Hunt, whose famous painting *The Awakening Conscience* also depicts a scene of urban prostitution, Rossetti describes his idea for 'Found':

> The picture represents a London street at dawn, with the lamps still lighted along a bridge which forms the distant background. A drover has left his cart standing in the middle of the road […] and has run a little way after a girl who has passed him, wandering in the streets […] sunk under her shame upon her knees.

(1914: 2)

The accompanying poem emphasises the narrative of prostitution. Wandering the streets near the bridges of the river, and ashamed to meet her former lover, the reader is led to assume that the girl has become a fallen woman, selling her body by the banks of the Thames. Rossetti couches his poem in the language of moral transgression: the 'Love deflowered,' the 'darkness' which threatens to chase away the dawn, and the 'locked heart' of the fallen

woman (2003: 192). By positioning her close to London's bridges, Rossetti adds to the vivid Victorian notion that female sexual transgression ultimately results in urban prostitution, and contributes to the growing body of works positioning fallen women close to the river. One other such artist, Augustus Egg, mirrors this theme in his narrative triptych, *Past and Present* (Broad, 2011: 39). The trio of paintings narrates the downfall of an adulteress, from the moment of her husband's discovery of her affair to the final scene, in which she shelters destitute beneath the arches of a London bridge, shielding an illegitimate child.

For many of the so-called 'fallen women' who captured the Victorian imagination, the bridge was not only an image which represented the location of their trade, but also became an icon of their death, an image which has fuelled portrayals of nineteenth century 'fallen women' into the modern era. It is no coincidence, for example, that, although Dickens sets Nancy's death by the hands of Bill Sikes in a domestic location, in the 1968 film *Oliver!* her cinema death is transposed to London Bridge at midnight. The Victorian popular press, artists and poets were inspired particularly by the attempted suicide of Mary Furley in 1844, who threw herself into Regent's Canal, and they shaped the bridges of London into symbols of female sexual transgression and suicide (Nicoletti, 2004: 11; Broad, 2011: 39).

Thomas Hood's poem 'The Bridge of Sighs' was published shortly after Furley's attempted suicide (Broad, 2011: 39). Relocating the scene to Waterloo Bridge and the Thames, Hood presents an 'unfortunate / weary of breath' who casts herself into the Thames, and is found on the bank. Both sympathetic and moralistic, the narrator urges the reader to treat her 'not scornfully,' yet simultaneously condemns her behaviour as transgressive, weak and 'evil' (Broad, 2011: 44; Nead, 1988: 168-169). The title 'The Bridge of Sighs' juxtaposes the famous Venetian landmark, and its connotations with romance, tourism and beauty, with the 'rough river' and poverty surrounding Waterloo Bridge (Hood, 1939: 662). Over the following decades, artists reimagined this scene, each displaying the woman at a different stage in the narrative (Nicoletti, 2004: 14). In John Millais' 1858 illustration of the poem, the fallen woman gazes over the cityscape of London, with Victoria Bridge and St Paul's eerily looming in the background. Gustav Doré chooses to depict the moment before the act in his *Glad to Death's Mystery* (1871), as the woman prepares to hurl herself from the railings of the bridge into the torrents below. The woman is lit by a ray of light shining from the firmament, and, again, St Paul's Cathedral features prominently in the background, suggesting a moralistic overtone (Nicoletti, 2004: 1). Frederick Watts, however, chooses to present the post-mortem scene in his *Found Drowned* (c. 1850), with the woman laid upon the bank beside the bridge (Broad, 2011: 53). The popularity of these suicide narratives, from the reports of the popular press to Hood's poem and the following paintings and etchings, firmly fixed the tragic peripheries of London's bridges as places of transgression and, ultimately death, in the Victorian imagination.

In conclusion, we can read the bridge as a microcosm of Victorian life. At daybreak the bridge is calm, but later in the day the bridge became a hive of activity: we can imagine the hustle and bustle of traffic and people, the sounds of the horses and carts, the cries of street vendors along the road. We can see Wordsworth, Tennyson or Longfellow gazing out, and can imagine their excitement as a poem begins to form in their minds. However, as the sun begins to set, the less savoury aspects of the bridge begin to reveal themselves. We hear the shouts of drunks from the alehouses nearby, and see ladies of the night beside the bridge searching for customers. We recognise the shadowy figures of Bill Sykes and Fagin plotting beneath the arches. And as night falls, we catch a glimpse of someone climbing up to the railings, and we turn away quickly for fear of their desperate intentions.

This multi-faceted image of the bridge inspired Victorian poets as it captured so many aspects of human life. The bridge caught both the light and shade of the Victorian imagination, and for this reason proved to be a useful and versatile poetic image. The iconography of the bridge and its hidden meanings fascinated nineteenth century poets, writers and artists – and as this conference has made clear, continues to fascinate us today.

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Luristan Cultural Landscape: a Glance at the Capital of Historical Bridges in Iran (Sasanian and Early Islamic Periods)

(By The materials and technologies of bridges the heritage of form and function consideration)

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Abstract
Communities, constantly, are in social, cultural, economic and political exchange with each other. The geographical situation can be as a connector element. Exchanging can be under the influence of this factor. Bridges are the connector between two different geographical points; by any kind of materials, structures, shapes and sizes they could be the cause of progress and development. The existence of a bridge in an area can be denoted by the economic and strategic importance of that area. Luristan is situated in the Zagros Mountains, between Iran Plateau and Mesopotamia. This area according to archaeological remains and due to geographical and strategic situation always had a main role in communication in the area, during different periods. The most of Sasanian and Early Islamic Periods' bridges are in Luristan. The existence of more than 90 historical bridges in Luristan can show the principal role of this area during the history. The location of bridges on maps shows they have been built in important routes led to the capitals of different empires which were in north, south, east and west of Luristan. Each one of these bridges, by the geographical situation, has a different technique, material, shape and size and represents specific architectural style.
This paper is an attempt to introduce briefly the area in archaeological view and its numerous bridges, with a different character; and then it will follow by the study on structures, functions, technique and materials of bridges.
Keywords: Luristan, Sasanian, Early Islamic Period, historical bridge, architecture.

Introduction

Obviously the first bridges were built, a part from of time and place, to pass from one side to another one, to have quick access for communication, relationship and connection. Certainly, the area, the bridge was built in, had an important role and constructing a bridge at that area could keep the role and facilities in connection, too.
There are a lot of Historical Bridges in all around of Iran, but nowhere like Luristan has such great number and different bridges from various periods; due to a large number of Historical Bridges in Luristan, the province was named "the Capital of Iranian Historic Bridges" in Iran. However, this province is mountainous with deep valleys, clamorous rivers and just a few limited plains, but it is considered as a central point for transformation and during each Historical Period different bridges were built or previous bridges were restored and reused. Nodaway there are about 90 bridges from the different era in different parts of this province. By considering the architectural knowledge of each period, various materials and techniques were used as a subsequent a wide range of bridges with different characters were built. Studying of each bridge separately and comparing them as a whole together can give a whole portrait of the material and techniques were applied for these bridges.

Luristan geographical situation :

Luristan province is one of the western provinces of Iran. It's mountainous and except a few limited plains, all of the province covered by the Zagros Mountains. Luristan despite the clamorous rivers, such as Seimareh, Gamasiab, Kashkan, Sezar, etc., as well as springs, is one of the richest networks of the flowing waters.

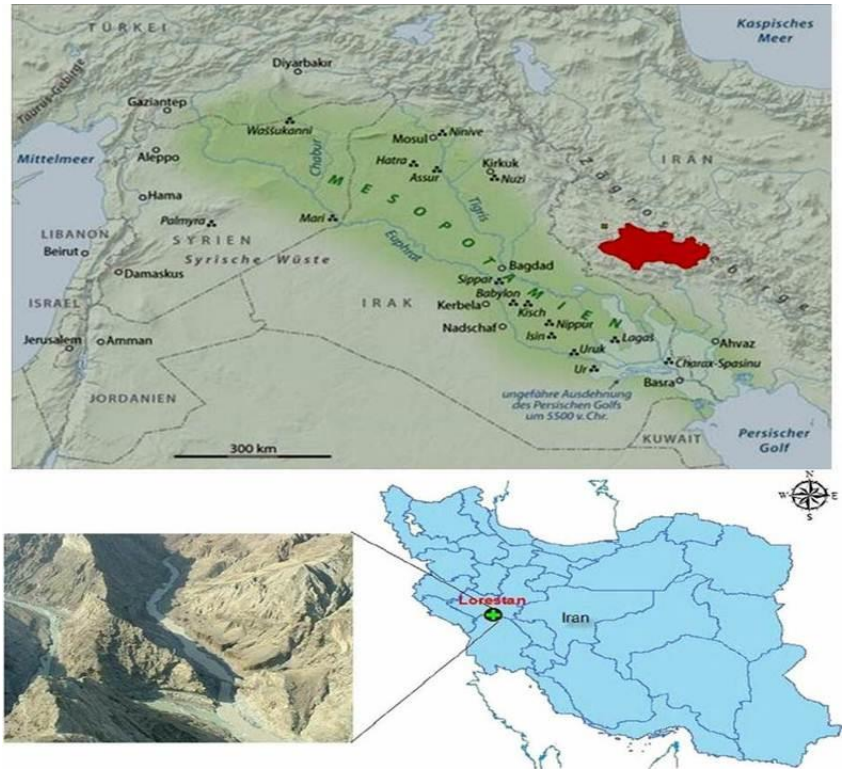

Fig. 1 Luristan on geographical map

Although the main part of Zagros chains, that are drawn to the North West to the south, (Figure 1) is situated in this region; but due to its particular situation, was the main route and the intersection of which connecting major hub for Iran and the Iranian plateau to the South and West, in addition, it seems here was the connection between the Iranian plateau and Mesopotamia, too. In fact, even nowadays this area in the most strategic area in Iran, linking the north to the south and the west to the east.

Luristan, historical situation

As a whole, in all entire history of Luristan, except some scatter historical notes such as hinting to the inhabitant of Zagros, by the name of Kissaioi, were mentioned first in Aeschylus the Persians and Herodotus, latest in post-Alexandrian time as a contingent of the army of Antiochus III at the battle of Raphia in 217 B.C.E. (Polybius, 5.79 (for the succinct overview of the debate, cf. Potts, 1999, pp. 337-40, 373-78) or passing Persian kings from Zagros to Mesopotamia (see Olmstead, 1948), there are no appropriate information or document.

But according to archaeological studies, Luristan since the late Pleistocene had suitable climatic conditions. The Ice Age in this area has ended about 150 thousand years before Europe. Perhaps the existence plenty of water with enough food and fuel were the most important factors of human settlements in the territory outline. The presence at least 17 caves from Mousterian, Baradoustian and Zarzian periods in Khorramabad valley, the center of the Luristan province, could confirm it (see Hole & Flannery, 1968).
Most of our historical knowledge of this province back to excavation results. According to recent results, Luristan was famous by its Paleolithic, Bronze Age and Iron Age remains. Late Bronze Age and Iron Age sanctuary in Sorkh Dum-i- Luri in Kuhdasht

Valley, the material of first millennium B.C and later from Kaftarlan I and Chigha Sabz, and Mir Vali (Potts, 1993). The rock shelters and" Painted Caves from Kuhdasht town in Luristan (Bewley, 1984). Prehistory, Iron Age, Achaemenian, Parthian and Sasanian sites in the valley of Hulailan in Luristan discovered by Professor Mortensen (Haerinck, 1977). Historical, Achaemenid, Seleucid and Parthian settlements from Surkh Dum- i- Laki, (Shishehgar, 1384/ 2005); several Parthian and Sasanian sites in Seimareh valley in Luristan (Hasanpour, 1389 & 1391) and a lot of other research showed this area was an important point during the history.
It should be noted, too, Luristan situated between Iran plateau and western neighbors so often that it was a strategic route between west and east (see, Olmstead, 1948). The existence of about 90 bridges, from different periods, near or in the direction some of the most important archaeological sites in this province stressed the importance of the area.

Ancient routes in Luristan

Although, it couldn't be utter where and when the first bridge was built; but, certainly, building the bridge began for passing on a river and arriving at another side of a river. The need for shortening the distance can be one of the causes for building the bridges, it happens for the raging rivers, deep canyons and valleys.
Achaemenid Empire was the first dynasty seriously paid attention to the roads in Iran. Their "King Road" identified as the first and longest road, it started from Babylonia by passing from Zagros Mountain Chains it continued to Kermanshah and Ecbatana it by passing from Ragha ended in Bacteria. There are reliable documents shows that the "King Road" continued until Gavmishan Bridge, in Pole Dokhtar city, in Luristan (See Farhangi & Ahmadi 2009). In this period two one of important capitals, Susa and Ecbatana, were in the south and north of Luristan. We don’t know anything about the routes during Seleucid and Parthian routes in this area. However, today, we really do not know any bridge belongs to Parthian period, but maybe in Sassanid bridges could find the effect of the Parthian architecture (see Mokhlesi, 2000) During Sasanian Dynasty the architecture had reached the highest level of development. They built numerous bridges in this area. The ancient roads in Luristan almost always were important paths before and after Islamic period. Some of Sasanian bridges reconstructed during the Early Islamic period, by local governments, but for pilgrims in this period. Even nowadays these routes are utilized as the highway in this area.
According to Ancient geographical books, the North-South route passed from Luristan was from Hamedan (Ecbatana) to Khouzestan (Susa). In this road there are several historical bridges. The East- West route was another essential route passed from Luristan. It seems this way had an especial role for Sasanian Empire. Although this way was mountainous with a lot of valleys and long and vast rivers, but there are the remains of a lot of Sasanian bridges upon two great and vast Kashkan and Seimareh rivers (see Izadpanah 1350).

Luristan Bridges

During Sasanian period the architecture was the pick of development. Generally, a significant percentage of the massive bridges built in ancient Persia back to the Sasanian period or at least their basic cores belong to this period. In many experts opinion the golden age of bridge building is the Sassanid period, most of Sasanian Bridge remains are in Luristan province. In Luristan the bridges are upon wide and clamorous rivers.

Obviously, by the passing time most of them collapsed and just some bases of them remain. The technique, materials and enormity of bridges indicate their essential roles in transferring and connecting. On every river, in a special place, at least more than two bridges can be seen. It seems by passing the time the previous bridge was substituted by the new one; it can show the usage of the bridge in one hand and the importance of the area as vital route, in another hand (figure 2).

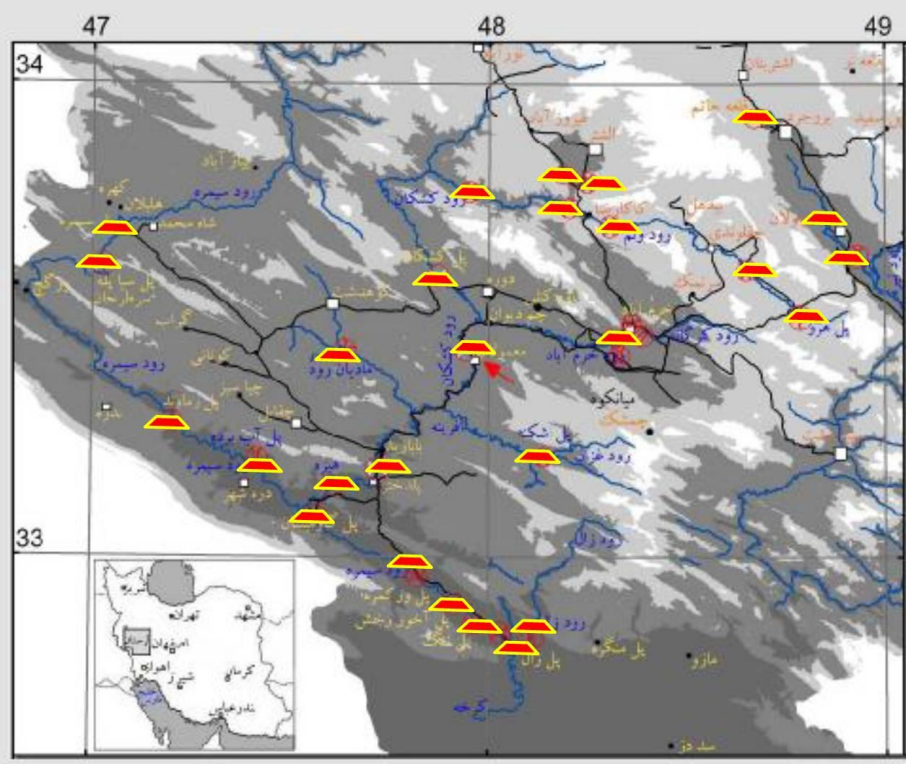

Fig. 2 some bridges in Luristan Province

As it passed before, most of the bridges collapsed; except some bases at the bank of rivers these bridges haven't other remains and it made difficult to give any idea regarding their structures and forms.
Since the number of bridges is numerous, mentioning and describing one by one will be out of time. So, at first, we introduce briefly several bridges with special characters, and then the materials and techniques will be discussed.

Some bridges with special characteristic

Gavmishan Bridge (Sasanian- early Islamic)

Besides the length of this bridge (230 m length), and 15 in high, the arch of the main lock of this bridge is about 33 meters. The lock of Gavmishan Bridge has the widest arch among all historical bridge in Iran. In addition, in the bridge's body in the horizontal direction, there are some pathways with high arches for commuting (figure 3). The presence of stairs, corridors and rooms in the upper sections of bases shows that this bridge was not the only a way to connect, but also it's used at least as a Caravanserai or another usage (see Record File of Gavmishan Bridge, 1998).

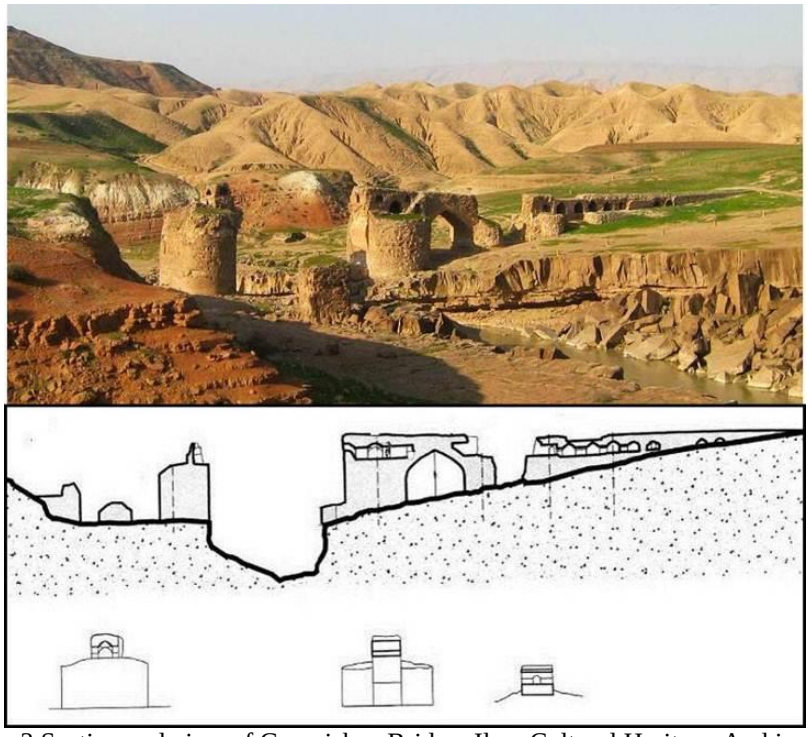

Fig. 3 Section and view of Gavmishan Bridge, Ilam Cultural Heritage Archive

Kashkan Bridge (Sasanian- early Islamic)

This bridge with 325 m length and 26 m high, at the highest point and 4.75 m in the lowest point, is one of the longest historical bridges. The bridge has 14 bases; the area of each base is 170 m^2. The wider arch lock is about 27.5 meters (figure 4). The deck of the bridge was completely flat; it can show the usage of this bridge. (See Sajjadi, 2003)

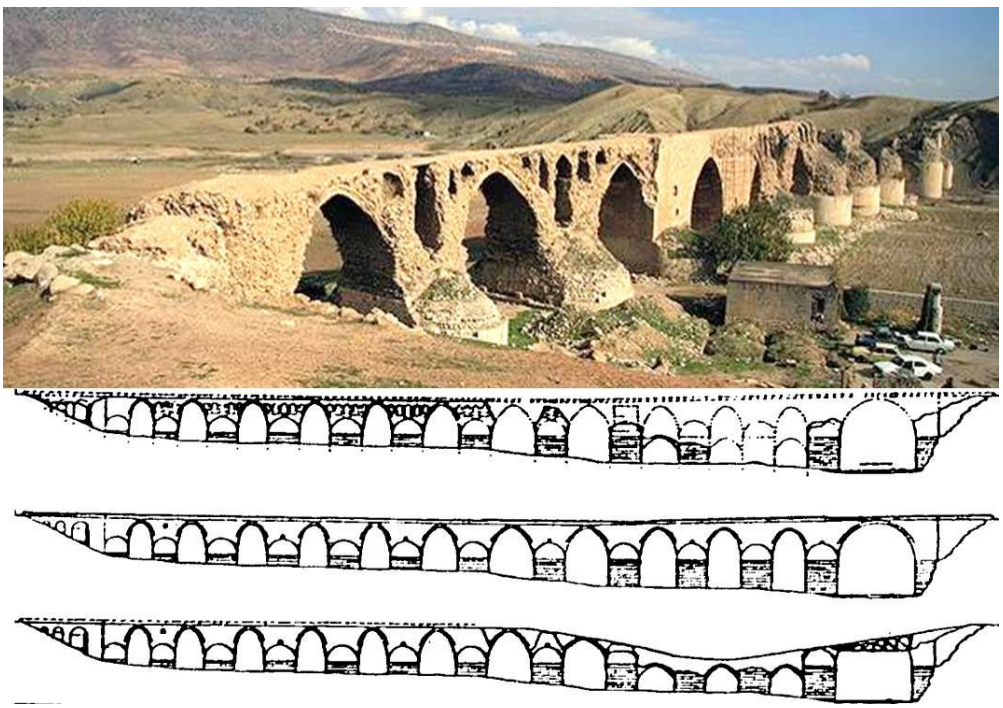

Fig. 4 Kashkan Bridge with the reconstruction of recent periods, southern view, Kiani 1987

Kalhort Bridge (Sasanian- early Islamic)

This Bridge has 91 m length, 26 m high, a wide deck with 7.6 m and 4 bases. It considered as one of the highest historical bridge in Iran (figure 5). The arch lock of this bridge is about 26. 10 m. The most significant feature of this Bridge is the way to access of it, because of the creating graved route on the rocky surface of mountain (see Parvis 2001).

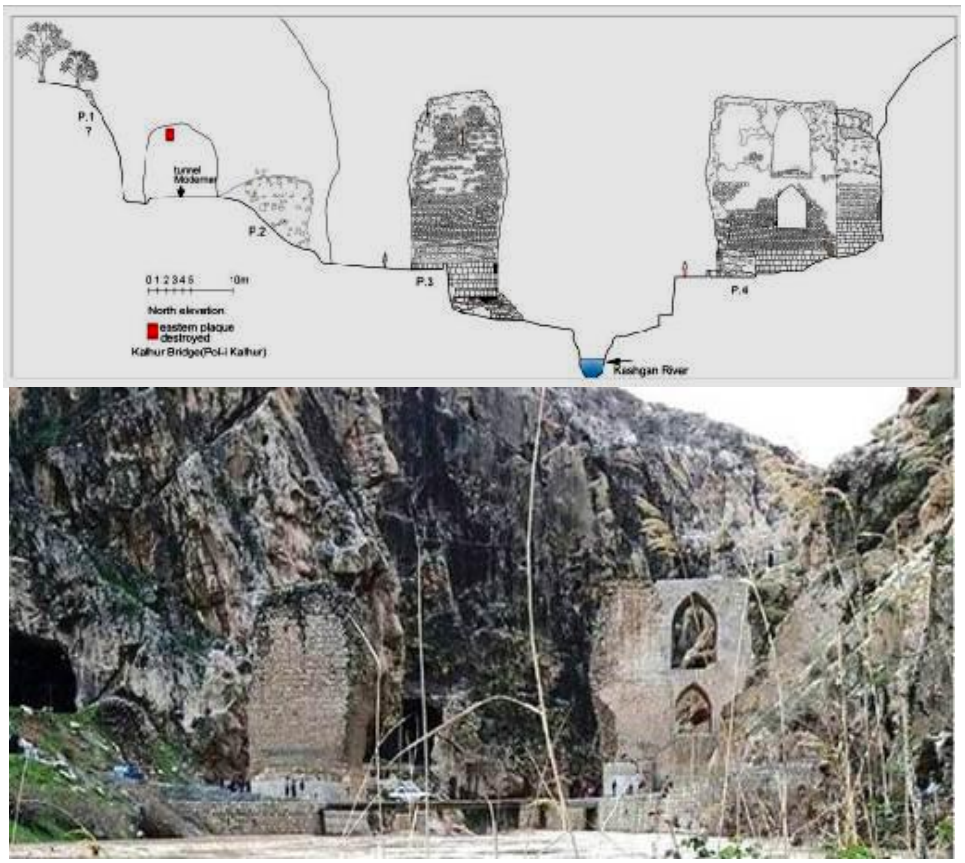

Fig. 5 Southern view of the Kalhort Bridge, Parvis, 2001

Pole Dokhtar (Sasanian- early Islamic)

The length of the bridge is about 270 meters. It had 12 bases; each base had an area about 117 m^2. The smallest arch lock has 22.5 m high (figure 6). The bridge had gates, in the surroundings of it there are the remains of buildings, settlements and facilities for passengers. It seems that the bridge has a maximum height in the middle of its center, in the form of a double-sided slope (see Record File of Pole Dokhtar Bridge, 1985).

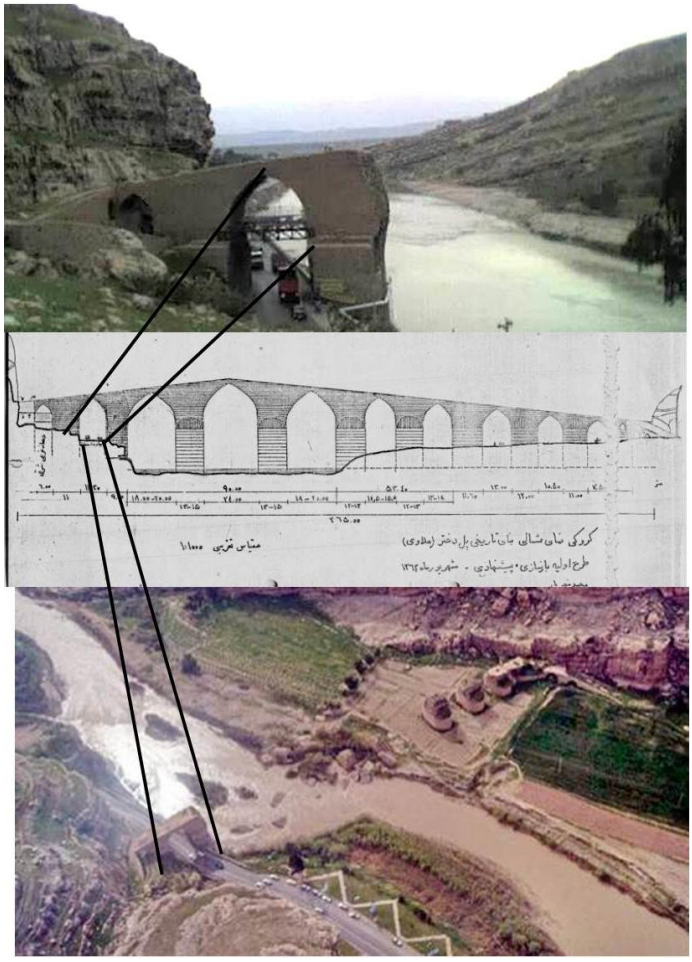

Fig. 6 Pole Dokhtar Bridge, northern view of, above; Aerial view, down.
Luristan Cultural Heritage organization's Archive.

Luristan Bridges' Materials

It seems by architecture development, considering the size, the place and the usage of a bridge, different materials were used; but the bridge builders considered the aesthetic factor, too. The common point among all of the bridges is the source of materials. In all the periods, the bridges were built by local materials. They came from nearby mountains, mines and sometimes the riverbeds. The materials consist of ballast, rubble, well- cut stone, brick; and mortar and Lime and plaster as cement.

During Sasanian and Pre- Sasanian Periods they usually used of rubble for rubble trench foundation of bridge bases. For façade, carved and well- cut stones, irregular- cut stones for arches, toward foundation, if the riverbed was enough rocky and stable, they used of its riverbed, otherwise the foundation bridge by using lime mortar and rubble was constructed.

At some cases, a bridge was made with high precision in appearance. For example the deck of the bridge was made with well- cut colored stones or the façade of base columns were built by well- cut black stone with precise mortar between them; almost always such bridges were close to historical sites; perhaps such bridges were urban bridge or during a

special period such technique was used and aesthetic factor was an important element, as Shapuri, pole Horou, Shapuri KakaReza and Talkhab Bridges (Sasanian bridges).

During Early Islamic Period Independent local rulers in Luristan built several bridges; in addition, they restored most of Sasanian bridges in Luristan. They follow the construction of Sasanian bridges; however they used of some new materials and new styles, too. In this way they could create huge and resistant bridges. In this time the column bases were built by large stones, and arches with brick were made. The use of bricks made it possible to create wide, high and new style arches for the bridges. Beside mortar the plaster was used for arches as new cement. Sometimes the bases of bridges were huge and inside of the basements were filled with mortar and rubble and outside of bases were covered by well- cut big stones (Gavmishan Bridge).

According to the materials, bridges can be classified into four groups.
Stone- bridges with mortar.
Stone- bridge bridges with lime and plaster.
Stone- brick bridges with mortar.
Stone- brick bridges with lime and plaster.

Stone- bridges with mortar
These bridges have been built in different periods. Some of these bridges remain from the Pre-Sassanid period. Based on these remains, the bridges were made of ballast, rubble, and well- cut stone with mortar. Among these bridges can be referred to Pole Dokhtar 1, Kashkan 1 and Ahar Rakhsh bridges.
There are some bridges, in the Sassanid period, constructed by reusing Pre-Sassanid bridge materials. Latter parts constructed with a slightly different in dimensions and pointing than previous bridges. New precise pointing minimized water penetration in the bridges. Among these bridges Pole Dokhtar 2, Gavmishan, Shapuri, Horou bridges and some other bridges can be mentioned.

Stone- bridge bridges with lime and plaster
These bridges were built in the late Sassanid and Early Islamic Periods, which can be referred to Kalhort Bridge.

Stone- brick bridges with mortar
These bridges were built in the Early Islamic Period, as Pole Dokhtar 2.

Stone- brick bridges with lime and plaster
These bridges were built in the early Islamic period to the Safavid, such as Gavmishan and Pole Gap Bridges.

There are another group of bridges constructed of stone with and well- cut stone on façade. These bridges were built in the Pahlavi period, the bridges constructed with modern materials. From this set of bridges can be referred to as Kashkan 3, Kaka Reza, Haji, Do Aab, Talkhab 2 Bridges.

Luristan Bridges' techniques

In the construction of Luristan bridges, based on the location of a bridge, at each period the variety of technique and different knowledge had been used, which leads to creating various architectures elements, such as:

Classification of bridges by geographical condition
According to the geographical condition of the area, in one hand, and the bridges' location in relation to the direction of the river, on the other hand; Luristan bridges can be divided into two categories:

Straight Bridges

These kind of bridges were constructed directly and perpendicular to the stream of the river, and extended the width of the river with the least length. Two Pre- Sasanian bridges Kashkan 1 and Pole Dokhtar 2 bridges have such characteristic.

Diagonal bridges
These bridges toward the flow of the river were built obliquely. As a result, the bridges had the length longer than the width of the river. A lot of Bridges were constructed with this technique; such as Shapuri, Khorramabad, Sarpoltagh bridges and several other one.

The deck shape of the bridges is divided into two flat deck and non-flat (diagonal or arched shape) decks.

Flat deck bridges
These bridges have a flat deck that made for easy and comfortable passing. Shapuri, Khorram Abad (Sassanid), Cham (Sassanid), Kashkan (Sasanian-Islamic) and Kalhort bridges (early Islamic period) could be mention.

Non-flat (diagonal or arched shape) deck bridge.
Such bridges have the highest elevation at their top and have an arched deck. Regarding the remains of the bridges, of the Sassanid-Islamic Bridges has such character. In some others, the largest span is located on one side of the bridge, so the bridge have the highest height on one side and the other side has the lower one, it creates a deck with slope, Sartagh Bridge is a Sasanian Bridge with the recent characteristic.

In some of other bridges, because of destruction and lack of deck remains, the explanation for the types of the deck cannot be definitely. Most of these bridge back to Pre_ Sasanian period.
In some others, due to the distance between the bases and the remains of the foundations, it is possible to comment somewhat on the type of deck, including Shapuri and Si Pele bridges. It seems these bridges had a flat deck.
Another set of Luristan bridges built during Safavid and Pahlavi periods. These bridges have the flat decks, using now a day, too. These bridges include the Gap (Safavi), Pahlavi of Kashkan-2, Haji, Do Aab and Talkhab bridges.

Classification of bridges by breakwater system and buttress

Bridges with circular (semicircular) and sharp triangular breakers.
Bridges with circular, semicircular, sharp triangular and rectangular buttresses.
For controlling the pressure of water on the bases the breakwater system was used. Generally, the heights of breakwaters were about one- third or one- fourth of the total height of a bridge
In some bridges, buttresses and breakwaters have the same shape (semicircular) that with the bridge base together created an ellipse form. Si pele, Sartagh Ban, Pole Dokhtar 1, Kashkan 2, Kalhort and Gavmishan 1 bridges have such feature.
Some bridges have sharp triangle buttresses and breakwaters as Shapuri Bridge.
There are some bridges with sharp triangle breakers and semicircle buttresses, such as Horou, Talkhab 1 and 2, Kashkan 3 and Do Aab.
Sharp triangle breaker and rectangular buttress is another method was used for some bridges like some bridges during Safavid and Pahlavi periods.
In some bridges due to the severity of destruction, it is not possible to detect the form of breakers and buttresses. It requires more study and use of modern science and technology. Pre-Sasanian Bridges are among this group of bridges.

Luristan bridges can be divided into two categories in terms of foundation (running on the riverbed)

The Bridges constructed directly on rocky riverbeds
Apart from the two bridges Sassanid Kaka Reza and Pahlavi Kaka Reza Bridges, all bridges of the Pre-Sasanian, Sasanian, and Islamic periods of Luristan have this feature. But the Sasanian Talkhab Bridge is a bridge without foundation, because the soil is being washed down and the foundation has been damaged.

The Bridges with foundation
There are some bridges for their constructions, at first a foundation were built on riverbed, which can be referred to the Sassanid Kaka Reza Bridge. For this bridge, at first, a 15-meter-wide bedding stretch across the river that has a gentle slope in the direction of the river, and then the bridge was built.

Classification of Luristan Bridges by the arch

The identifying the kind of arches is the most vague part of study for the ancient bridges in Luristan, since due to the destruction of the deck and bases there are no arches, and the recognition of the arch type is not possible, such situation can be seen at the Kashkan 1, Pole Dokhtar 2, Si Pele 2 and Kalhort bridges.
Acute Arch attributed to the Islamic period; there are some bridges in Luristan with such arch but it can be seen in the Achaemenid Bridge, too, in the Doruod Zan Bridge, which has a rocky acute arch. Definitely, this matter needs to more study in future.

Some bridges have a Circular Arch, such as the bridges during Pahlavi Period. Kashkan-3, Haji, Kaka Reza, Do Aab, and Talkhab Bridges .

Classification of Bridges according to base and lock

Luristan bridges can be divided in terms of distance between bases, too, but some bridges have been so damaged over time their bases are not properly recognizable; so often that it cannot be calculated even the exact number of bases. Kashkan 1, Pole Dokhtar 2, Si Pele and Talkhab bridges are among such category.

At most of the bridges, according to the situation of the place bridge was built, the lock hadn't equal dimension. In some bridges sometimes the first lock was built on rocks and the rock held the weight so they consider this lock as the largest and carries the weight of the bridge and had the maximum width. It was the main tributary of the river's passage. As far as the other side of the bridge moves, some bases have an equal width and ultimately reduce the width of the locks. Sar Tagh, Si Pele, and Kashkan 2 bridges have such feature.

Some bridges because of the same distance between the bases have the approximately equal width of locks, which can be found on the bridges of Cham Nemesht, Shapuri, Haji, Gap, Do Aab and Kalhort bridges.

In some bridges, the larger lock was located approximately in the middle and the adjacent locks had a lower width, most of Sassanid- Islamic Bridges have such character.

General consideration

Some features of Luristan bridges have dimensional characteristics which briefly can be mention:

Generally, In terms of the height, the bridges have a domain between 4- 30 meters. According to the length, they have a range between 63- 375meters. Considering the lock the bridges have a range between 2- 28 meters. In terms of the width of the deck has a range of 5 to 11 meters.

Most of time beside to every vault manhole cover system were used, In this method, not only the pressure of weight on arches was minimized, but also the surface of bridge was ready to provide a flat bridge deck, made it possible to cross the equipment and chariots, in addition the existence of manhole cover made a quick drain of water behind the bridge during a rainy day. In the other hand, by this technique, the usage of materials and the weight of bridge were reduced, as Kashkan Bridge.

Some of the bridge, depending on the situation of the area, the depth and speed of rivers, were built in the widest or narrowest; lowest or highest parts of the river.

A bridge had gates and in the bridge's body there were some pathways with high arches for communication. The presence of stairs, corridors and rooms in the upper sections of bases shows that this bridge was not the only a way to connect, but also is used at least as a Caravanserai or another usage. In the others hand around of some bridges, some archaeological remains were found which may indicate some facilities for passengers.

Some of bridges were built flat as Shapuri or Kashkan; but some others as pole Dokhtar or Kalhort bridges because of a deep valley and mountainous situation it seems the bridge had a maximum height in the middle of its center and double-sided slope down.

Conclusion

Luristan is situated in the Zagros Mountains, between Iran Plateau and Mesopotamia. This area according to archaeological remains and due to geographical and strategic situation always had a main role in communication and it was an important connector point not only between west and east, but also north and south of Iran.
Sasanian period was the golden age of bridge building, in addition, most of Sasanian and Early Islamic bridges are in Luristan. The existence of more than 90 historical bridges in Luristan can show the principal role of this area during the history.
Each one of these bridges, by the geographical situation, has a different technique, material, shape and size and represents specific architectural style and creativity. The highest, the longest Bridges and the widest arch of Historical Bridges of Iran are in Luristan, we should added the great accuracy, Sustainability, by using different materials and techniques, and aesthetic factors for building each one of these bridges, too.
It seems according to the location of bridges on maps they have been built on important routes led to the capitals of different empires which were in north, south, east and west of Luristan.

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THE SHORT SPAN
SYMBOL AND CONSTRUCTION NATURE OF STEEL FOOTBRIDGES IN ITALY

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INTRODUCTION

After the Second World War the issue of the bridge assumes distinct paths in Italy, each one pursuing different objectives. The professional acclaim of Italian Engineering involve the most important national technicians who are mainly interested in large infrastructure projects, mostly addressed to the process of the post-war Reconstruction and later, the completion of national motorway network. On the other hand certain architects are involved in the development of short length footbridges design, connections marked by a different architectural scale and often realised with a steel construction. In the paper we will explore the main works of Italian architects about this line of research and the multiple meanings related to footbridges, not only considered as technical tools, but also expressing the own features of the context as valuable architectural realisations. Indeed footbridges aren't only instruments to overcome a short span, but finite objects whose construction proceeds, in contrast to processes of industrialization and prefabrication, with a gradual recovery of craftsmanship which claims the centrality of the project and contrasts the mechanic automatisms of industrial standardisation. The relationship between new architectures and urban contexts is a critical issue, which can't be solved with generic solutions proposed by industrial technologies; the paper evidences how some Italian experiences offer original solutions to this critical aspect defining different relations between the city and the landscape. The pedestrian bridge projects of Scarpa, De Carlo and other Italian architects, are not just the solution to overcome endless lights, but finite objects, whose size has to deal with the scale of the city or the landscape. A size that is always human, because the context is a human landscape and because the human knowledge is the technological support for the construction of footbridges. This technological aspect of the footbridge is something else that we will also investigate during the paper. In the boom years of industrialization and precast construction, the technological apparatus that went with this alternative approach led to a gradual recovery of traditional techniques, supported by innovative technologies and materials. The development of the entire design process is brought back under control and verification of its wonderful creators: the designer and the master craftsman. The former is able to produce highly detailed designs which focus on individual material parts and their connections. The later can translate those ideas, through his skill and mastery, in built.

THE ITALIAN SCHOOL OF ENGINEERING AND LONG SPAN BRIDGES

Second post-war history of engineering represents the most fervent period for infrastructure development in Italy. During the fascist period there was an intense theoretical research but a limited advancement in the construction of infrastructural works.

In the country hit by a deep technological backwardness, the reconstruction of 2600 bridges, destroyed during the war, gives the

possibility to show great stages of innovation and structural experimentations.
The academic and professional research initially concerns reinforced concrete technologies with the use of traditional bridge types, inserting also innovation coming from abroad, as the studies of Maillart arch bridges. But the greatest innovation in structural bridge engineering arrives thanks to pre-stressed concrete, used for several connections involving the most important engineers according to three main directions (Poretti, 2005).
Firstly large length bridges claim the nature of "the subject of building science" and try to introduce new formal codes. According to this principle, it is possible to regard the prestressed concrete as a reinterpretation of reinforced masonry, respect to which the theme of its light weight properties is necessary for the formal study of molded surfaces, as in the Olympic Overpass in Rome designed by Riccardo Morandi. On the other hand the experimental technique of prestressed concrete defines the bridge in its essential elements and through the transformation of these elements into design components, as in Pinzano Bridge designed by Silvano Zorzi. Lastly, the structural innovation could be also expressed in formal experiments generated by original mathematical procedures which resulted in the plastic surfaces being used to great effect and also led to a reduction in the use of construction materials, as in Basento Bridge designed by Sergio Musmeci.

THE FOOTBRIDGE ARCHITECTURE IN ITALY

The topic of large length bridges built with reinforced concrete technologies occupies the biggest part of academic and professional research, starting from the decades of the fascist regime, but other experiences in Italy explore the theme of the bridge from other points of view: the bridge as an architectural connection, capable to overcome the specific domain of 'infrastructure' and expressing functional, dimensional and temporal features of the place, also through small interventions. This characters are particularly shown by footbridges, connections with a multifaceted essence that, solving the existing fragmentation often located in urban areas, go beyond the strictly technical aspects becoming complex objects which establishes new relationships with the surrounding area.
Although Bruno Zevi didn’t believe the footbridge was “truly” architectural, because of the lack of interior space, it produces a constantly changing spatial dynamic creating direct and indirect relationships with people; those qualities are reached through the ability and technological expertise of designers, able to express meaningful values also through short span steel connections.
In the talk we will also show how the footbridges case studies pursue the goal of not only physical representation of the object but also the desire to reach the symbolic reconstruction of tangible and intangible aspects, as an alternative to muscular architecture which exists to exhibit its technological soul. The Italian pedestrian bridge projects are not the

instrument to overcome endless lights, but finite objects, whose size has to deal with the scale of the city or the landscape that is always human, because the context is a human landscape and because the human knowledge is the technological support for the construction of footbridges. The smaller scale and the need of a low impact on historical settings, favour the use of steel, the opposing technology to engineering research mainstream, worked in order to reflect and represent a deepening morphological and historical relationship between the city and the landscape. Therefore in these aspects it's possible to see the singular character of our case studies. If the project comes from the understanding and analysis of the context, the solutions cannot be general and not subject to repeatable patterns in each location, but must respond to the specific "genius" of the place itself. This desire is expressed in some examples of projects and footbridges, which exhibit a poetic and a shared ideology.

"BRIDGE-WALKWAYS" AND THE MASTERY OF CARLO SCARPA

The works of the Carlo Scarpa could be selected as a manifesto of 20th century footbridge in Italy because the Venetian "Master" transferred in the dimension of this "object" the complexity of his approach to the architectural design.

There are several differences of figurative and construction features in the footbridges, called "bridge-walkways" by the "architect", that he designs. In the renovation of Castelvecchio Old Castle, (Verona – 1962), in the refurbishment of Querini Stampalia Building (Venice – 1963), or the project of outdoor design of Feltre main square (Feltre – 1975), the Venetian master shows that the footbridge is an interval between one side and another, between internal and external, emphasizing diversity and separation of margins through asymmetric configurations and connections where these margins are carefully assessed and resolved. The art of joining, typical Scarpa's approach and one of its best expression of quality, recovers the void between the two margins, between the two thresholds, between two limits. The bridge and stairs that are often part of it, are a typical place where cuts and layers are multiplied; through the project Scarpa evidences the separation and the light weight properties as its own formal and construction qualities. Furthermore Scarpa follows a process of multiplication of parts obtained by cutting and overlaying materials, defining details as the edge of a marble slab, the lines between the planks of wood or the void between the steps. In order to define each aspects of the project into a built architecture, Scarpa's method provides as an essential aspect his choice of materials for different components and the definition of workmanship which reliable craftsmen have to follow to express the aesthetic and architectural quality of the materials. Scarpa doesn't reject the industrial techniques which he has used together with traditional techniques in order to obtain formal expressions that are always original. He doesn't

search a merger of crafts and industrial production, but attempts to a possible integration that produces new solutions.
The bridge-walkway that connects the Campiello Querini, along the canal, with the Querini Stampalia Building, reaches its final structural design, through several steps and best represents the exercise of the "curious faculties" of Scarpa.
This faculty, according to the architect, allows us to consider that a dimensional aspect, a thickness, for example, is an important quality of the physical value of things.
The Querini Stampalia bridge is mounted in a single day with the help of a boat, using procedures similar to those designed by Scarpa for positioning the bridge deck of the Accademia in Venice.
The bridge-walkway is asymmetric, both for functional reasons, given by different levels of the two areas of support and for conceptual reasons due to the different nature of the two fronts: one open to the Campiello and the other closed to mark the entrance to the building (Fig. 1).
The new entrance is opened in an eccentric position on the façade through the transformation of a window. The bridge is hinged to the Campiello and to the base of the building: the two beds are in Istrian stone, molded to accept the steel structure of the deck, which exhibits a low arch profile, with an asymmetrical configuration due to the different levels of starting and ending. The main structure consists of iron semi-arch, made of two curved plates, separated by wedges taken from iron square section. This profile supports the metal plates of wooden steps and tables which form the inflected surface that joins the two sides. The back deck is slightly bent. The parapet is composed by the assembly of iron elements that are always duplicated; the vertical rods, profiles consisting of iron, are supported at the bottom by double metal elements thicker than the rods which are joined at the top by metal tube supporting the teak wooden handrail. It has a profile consisting of three straight segments, differently inclined, connected by four brass elements. The footbridge is an echo of the old Venetian bridges, with the intrados curved and the parapet which has a polygonal path. The bridge Querini Stampalia shows his constructive nature through an overlay of elements that mark the separation and transparency of the architecture achieved. Each component of the bridge is shaped according to the internal rules of the structure of the material (Dal Co and Polano,2006).
During the restoration of the Old Castle of Castelvecchio in Verona, part of the fourteenth-century fortress, the rampart La Scala is discovered. So faithful to the principle of highlighting different layers of the castle, Scarpa decides to continue the excavation and he demolishes part of Napoleonic barracks under which the rampart runs. Because of the excavation of the site, it is necessary to build a footbridge at the southern tip to ensure maintenance access at the south entrance. Scarpa designs an asymmetrical bridge which overcomes the difference between the two opposite sides of the bridge. The architect manages the problem of height difference with small flights of concrete steps leading to the footbridge. The location of the walkway is in contrast to the regular geometry of

Fig. 1 The Querini Stampalia footbridge, designed by Carlo Scarpa, Venice, 1963 (photo by Renato Morganti)

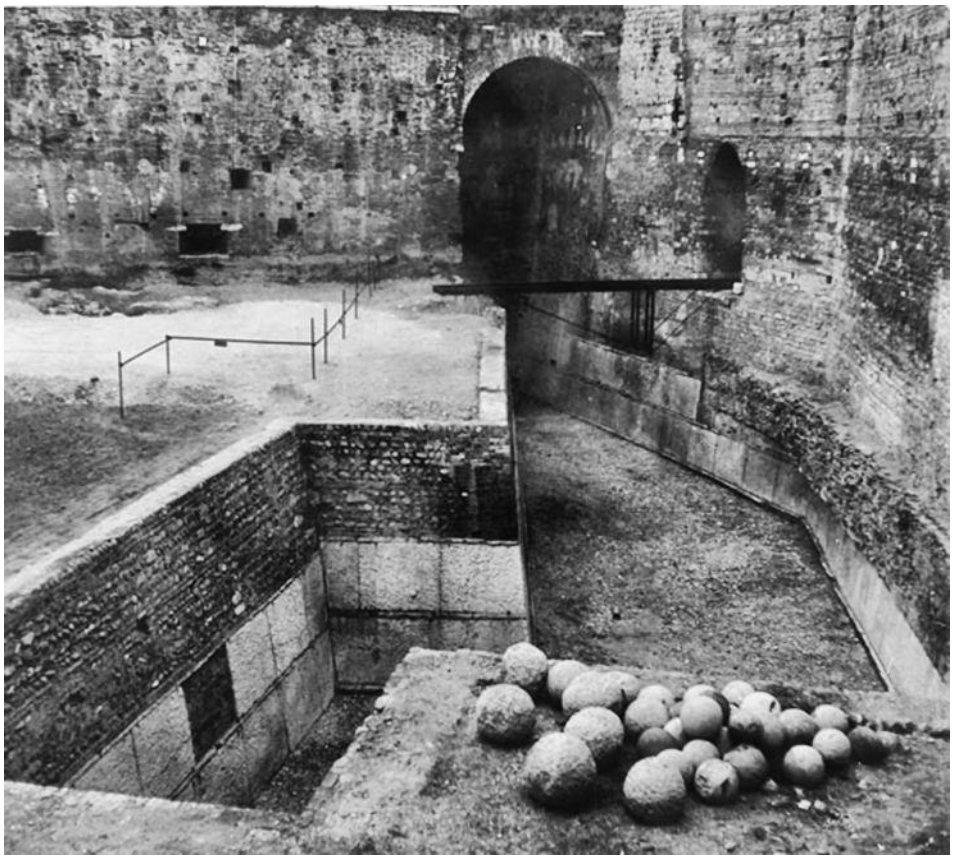

Fig. 2 A picture of the footbridge over the "vallo" in Castelvecchio, by Carlo Scarpa, Verona, 1962 (Courtesy of Archivio Carlo Scarpa Museo di Castelvecchio di Verona, inventory number: CS007146 / amc/001/133)

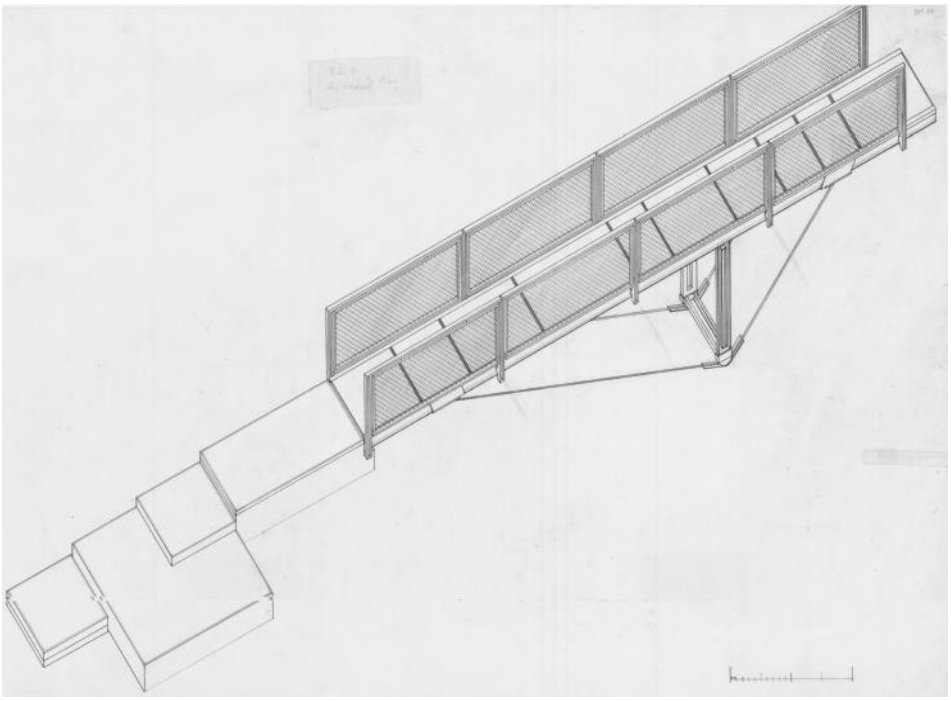

Fig. 3 Castelvecchio, Verona: an axonometric drawing of the walkway on the inner "vallo" and steps in stone leading to the courtyard, by Richard Murphy (Courtesy of Archivio Carlo Scarpa Museo di Castelvecchio di Verona, inventory number: 36222 recto)

courtyard design and it remains linked to the course of the rampart and to the museum complex (Fig. 2). The sophisticated light weight property and energy of the structure contrast with the weight and tectonics of the rampart, as well as the walls and the verticality of the tower behind it. The bridge-walkway proposed a structural scheme of two supports formed by beams with asymmetrical tensions and separated by the deck making of irregular shaped concrete slabs. Scarpa works on this project with engineer Tamannini of Verona; they decide the structural scheme together, while the large production of sketches and drawings shows a detailed case study of different parapets, struts, one of which, the drawing for the double supports, is chosen for the final design (Fig. 3). Due to the position of the struts, it is necessary that the length and tension of the cables must be different; this aspect is related to the differences in two sides united by the footbridge. In order to achieve an assonance with the interior space, they include also steel cylinders, similar to those used in the museum (Murphy, 1991).

In order to facilitate movement after the removal of a part of the first floor of the castle, while still in the design stage, Scarpa includes another bridge; he angles the walkway at 45 degrees and this choice is due to emphasize the vertical space, that is useful to look the statue of Cangrande della Scala. Two horizontal beams support irregular concrete slabs, which contrast the regular pattern of the floor in the other rooms. However more research have been required in order to solve the problem

of the parapet: the individual profile of the uprights has a same width as the wing of the beam, and connect the twin elements of the handrail. The vertical supports are connected to steel frames which take the weight of pitch-pine planks, a various widths and which are irregularly spaced.

ITALIAN STEEL FOOTBRIDGES OF THE LATE TWENTIES CENTURY

Scarpa's mastery is a fertile heritage for different generations of designers of the late twenty century, Italians or not, who often are be inspired by masterpieces of the Venetian "architect". While the Scarpa's approach becomes in fact a reference point for many, some architects explore different ways to design, finding and defining autonomous and singular experimental projects that are only partially or entirely detached from Scarpa. These different approaches try to include in the design the logic of industrial production establishing a new and extensive relationship with building industry, without the loss of the architectural quality.

As an example in 1964 Aldo Rossi designs the footbridge in the park for the entrance of exhibition "Triennale of Milan". It is a triangular section bridge which is composed of two parts, with tubular frame structure and covered with wire mesh. It is supported by columns and cylinders. The bridge, later removed, reached directly the first floor in the Triennale building. The walkway passes over an exhibition area, designed by Rossi himself and conceived as an archaeological site with parallel walls and an internal path. In this case the relationship with the city and the landscape isn't in the original site, but the architect arranged to introduce this aspect through the transfer of different landscapes sceneries in the Triennale park. Rossi uses the architectural components to build a new landscape, different from the original: the bridge, having an industrial aspect, its supports, columns and cylinders which appeared such as archaeological retains and the exhibition area, echo of the archaeological area in Pompei. In contrast of the different natures of the parts, the resulting space is a complex synthesis which returns a symbolical representation of the reality (Fig. 4).

Always in the north of Italy, Costantino Dardi designs in 1982 the Pavilion on the water at the Venice Biennale. The architect connects the opposite sides with a walkway composed by industrial steel frames. Given the different nature of the site, Dardi decides to adopt a different approach than Rossi. The steel planar trusses, constituting the bridge, aren't just a celebration of industrial technology, but the architect uses the potential of this structure to ensure a solution which overcomes the technological aspect; planar trusses become the generator of an architecture which measures the context and is related with the finite dimensions of the place through a modular system, establishing a dialogical relationship with the context (Fig. 5).

In 1995 Giancarlo De Carlo is employed to study seven new gates for the city of San Marino republic and one of the entrances to the city is a footbridge. The architect reinterprets the towers of Mount Titano in a steel tower structure which forms the supports to hold the bridge and gives the impression of being a drawbridge built on the street below.

A spiral staircase snakes its way around the outside of the tower, a clear echo of the past. This light-hearted dimension to the structure expresses the peaceful nature of the city, which is kept itself out of centuries of bloody wars. To emphasize this aspect the sign "Welcome to the ancient land of liberty" is inscribed on the bridge. The difference in altitude between the two sides is filled with the asymmetry of the bridge, which has a curved profile and a steel frame with a floor and a handrail both made of wood. One side of the bridge can be reached via the spiral staircase, while the other side of the bridge is reached from the opposite hill (Mckean, 2004). The supporting ties start at a single section from the tip of the tower, which is topped by the flagpole, duplicating, as they approach the bridge, such as branches of an upside down tree (Fig. 6).

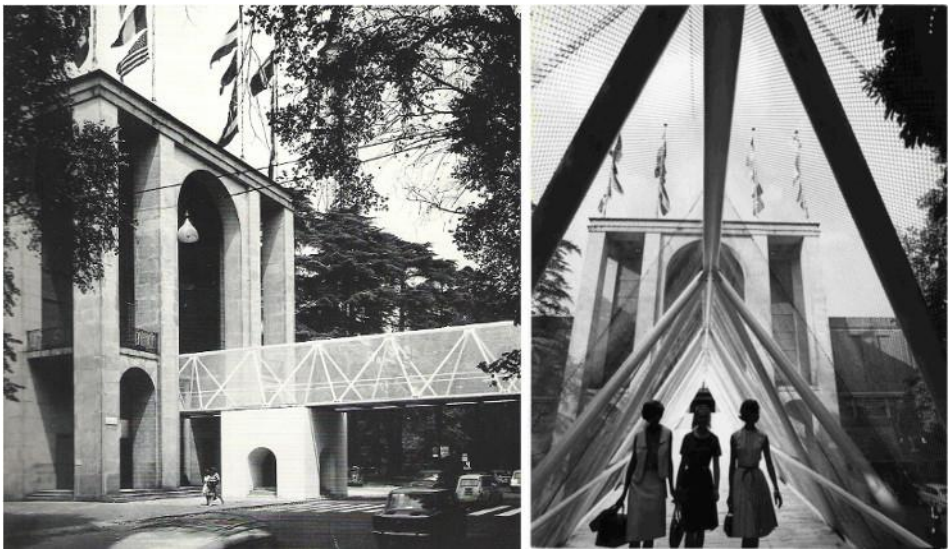

Fig. 4 The footbridge at the XIII Triennale, by Aldo Rossi, Milan, 1964 (Braghieri, 1963)

Fig. 5 Footbridges at “the Padiglioni sull’acqua” at the Venice Biennale, designed by Costantino Dardi, Venice, 1982 (Dardi, 1987)

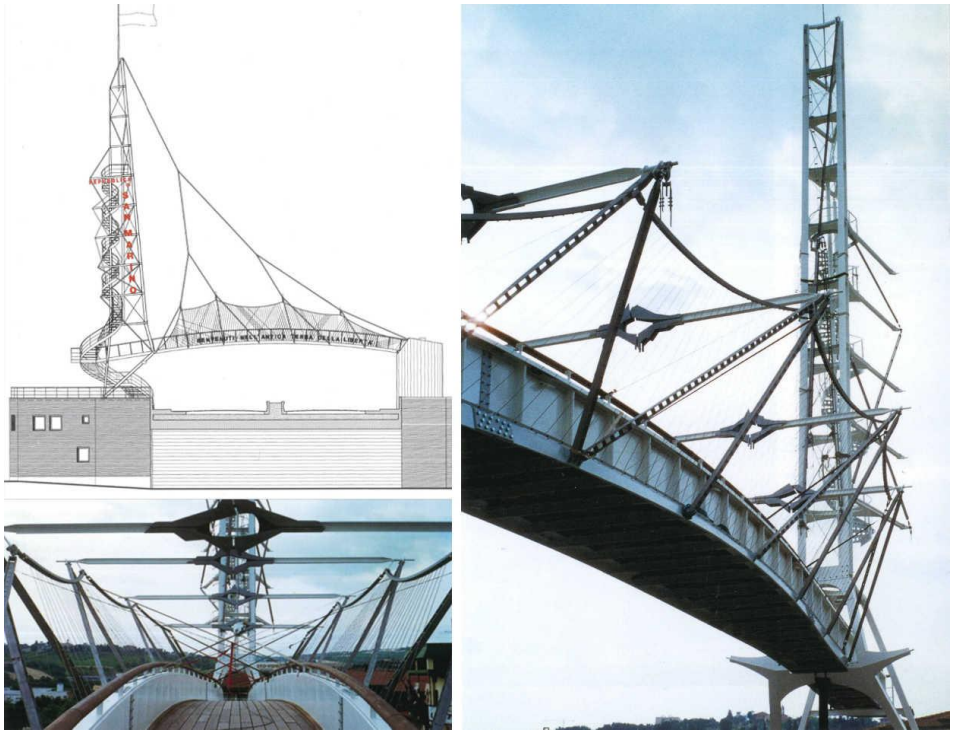

Fig. 6 The Porta di Dogana footbridge, designed by Giancarlo De Carlo, San Marino,1995: (Courtesy of the "Serenissima Repubblica di San Marino - Segreteria di Stato Territorio Ambiente e Turismo")

The first two rows of stays are connected by horizontal cross-sections of steel, on which in the middle are placed polychrome decorations. With a contemporary language and technology, De Carlo creates a new architecture which symbolizes the nature of the place, through his use of references to the past.

In 1999, in occasion of the Catholic Jubilee, Francesco Cellini, Insula architects and Fabio Brancaleoni won a competition for the design of the footbridge in Annibaldi Street in Rome. An initial proposals didn't include the area next to the Coliseum as a possible site for the bridge; therefore designers have adapted in a second time their original proposal for that location. The winning design conceives a bridge which is not perpendicular to the Annibaldi street due to the decision of restoring the lost historical path of Polveriera street. In addition the central part has a slight curvature, assuring the minimum height of 5 meters so as not to interfere with bottom street traffic. The curved profile of the walkway has a steel structure, with the top surface clad in stainless steel and a central beam, a hollow rectangular section, that constitutes the backbone and emerging from the extrados of the catwalk, to form a bench. Cantilevered steel beams that support the planking level, are fixed to the high central beam. Seats of the bench and the floor are in lava stone, while the handrail is metal. There is a concrete basement, clad with basalt, only on one side while on the other, the curved section finishes directly at the pavement level. The steel structure has been pre-assembled and put in place in the work site just in one night (Fig. 7).

Fig. 7 The Annibaldi footbridge, by Francesco Cellini, Insula architects and Fabio Brancaleoni, Rome, 1999 (photos by Remo Di Felice)

THE THIRD MILLENNIUM

Talking about 2000s, in Rome it is possible to select several short span steel footbridges, particularly designed for archaeological areas. For example, the reorganization of the archaeological areas in the Trajan's Market is an opportunity to build new pedestrian walkways: the urban transformations which over time have interested the archaeological site have changed its internal relationships and in particular have reduced, as a marginal path, the ancient Biberatica Street which connects all the area. The aim of the project is to reconnect the open spaces and buildings into a single museum. Two significant realizations are provided: the first one, built between 1999 and 2002, has interested the upper part of the complex and has reconnected with each other the Biberatica Street, the Hemicycle building, the Torre street, the Belvedere terrace and the Milizie Garden; while the second one, completed in 2004, has interested the recover of the Tabernae along the Biberatica Street and the construction of a footbridge over the Campo Carleo (Ciucci et al. 2006).

The first intervention is designed by Luigi Franciosini, Francesco D'Aquino and Mauro Olevano; the general plan includes the construction of a series of short footbridges and walkways that integrate with the route system in order to accommodate persons with reduced mobility. These objects are made of wood and iron: parapets consist of a repetition of horizontal iron profiles while the wooden slabs pavement allow us to see the archaeological remains under the bridge (Fig. 8).

The new footbridge in the Milizie Garden is a single span slab while the others are placed on few steel supports, bearing Glued laminated timber beams which are bottom hold by a longitudinal system of struts and ties, instead of a forecast transversal system composed by the asymmetrical arrangement of struts, made by cut I beams, and a cable as tie. On one side, the steel structure of parapets assures the support of walkways through adjustable uprights functional to overcome differences in height. A secondary steel structure supports the floor in teak strips, reinforced

with two steel round bars (D'Aquino and Franciosini, 2006). In the original design an articulated seating system was integrated with walkway sections. The steel rods and the technical solutions pursue a technological minimalism which doesn't attempt to alter the perception of the area and its precious historical value.

Fig. 8 The Trajan's Forum footbridges, designed by Luigi Franciosini and Riccardo D'Aquino, with arch. Mauro Olevano, Rome, 2003 (Courtesy of Prof. Arch. Luigi Franciosini)

The second realization is the pedestrian bridge over the Campo Carleo Street, designed by Nemesi Studio and Labics, which is a weathering steel bridge, with slim parapets to obtain the minimum visual impact on the massive monument that is preserved in its material and visual consistency. The weathering steel in particular provides an assonance colour with red brick. The bridge deck has a thin section; on one side the walkway bends and becomes a bench; this asymmetrical aspect is evidenced by the different metal handrails from one side and the other; on the bench side the handrail has a single profile, while on the other hand it has two profiles section starting parallel and overlaying along the path at different levels. The parapets are steel cables (Fig. 9).

The footbridge from the archaeological area is perceived as a layering of slabs of weathering steel, which are supported by beams starting from the ancient walls. These slabs, forming the floor pavement on the upper, have different patterns separated by thin cuts on the material. The footbridge ends with an inclined cut, highlighted by the various offsets of the slabs and the handrail. The dialectic between old and new is defined in the Labics and Nemesi studio's design on a thin and well conceived equilibrium; the choice of an innovative material, aged for a process of artificial oxidation, the desire to avoid any anachronistic mimesis, the clever use of thin sections are significant tools which establish a learned dialogue between the monument and the contemporary intervention.

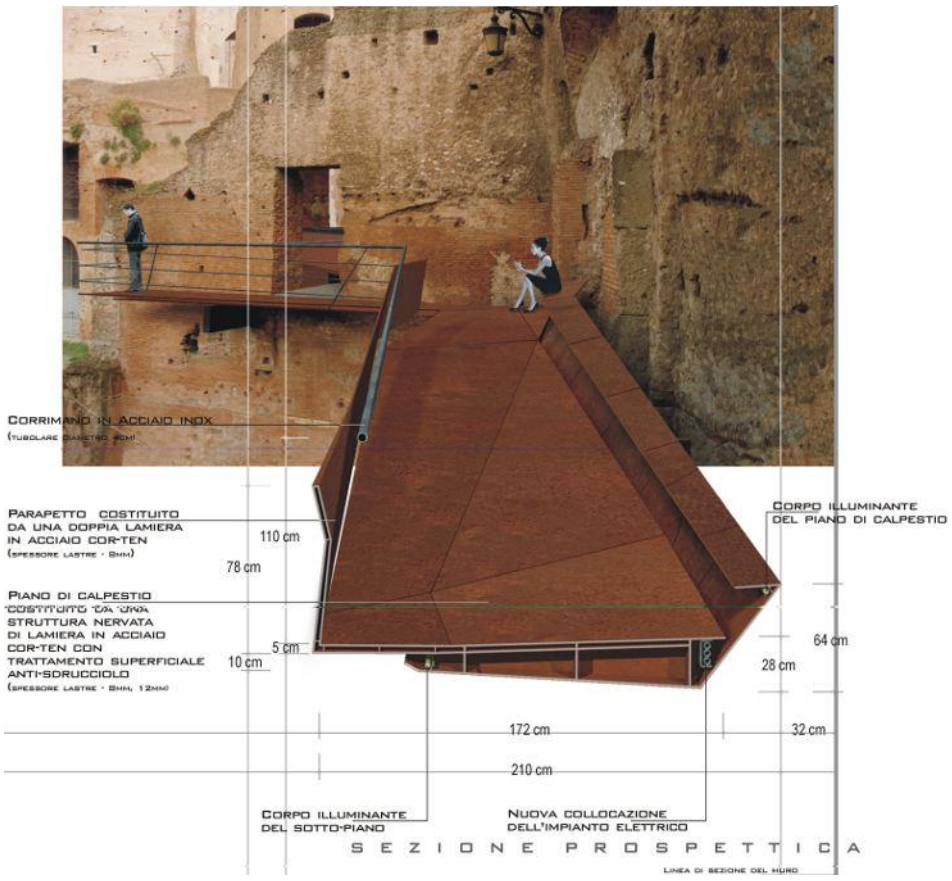

Fig. 9 The Campo Carleo footbridges in Trajan's Forum, by Labics and Nemesi, Rome, 2004 (Courtesy of Labics)

In 2009 the act_Romegialli studio designs a steel footbridge in Mandello, a small village located on the eastern shore of the Lake of Lecco. The new connection, which links a new square with Via Dante Alighieri, overcomes the small riverbed of a torrent with a dynamic shape, characterised by two curved steel beams which are placed with an asymmetrical arrangement and support a metallic deck. The decision to use the painted steel structure is inspired by both historical and technical reasons: the use of metallic construction is a direct link with the industrial past of the area, famous for the presence of many fabrication

shops and engineering companies that work whit metals, instead the beams shape and section are studied in order to use them in alternative positions without compromising their structural integrity.
The production of the beams follows the contemporary procedure of steel laser cutting, an industrial technique that is able both to overcome the character of mechanical standardisation which often affected past industrial products, and saving time and building cost.
The main steel structure is composed of two high channels, used also as railings, connected at the bottom by metal profiles that represent the support for the deck, which is made of corrugated sheets, finished with concrete cast and asphalt pavement (Fig. 10).

Fig. 10 The footbridge in Mandello, designed by act Romegialli, Lecco, 2009 (Courtesy of act Romegialli)

The last catwalk has been built on the Canal Grande, in the historic center of Trieste, and has been designed by the architects of the Municipality, Marina Cassin, Moreno Suzzi, Laura Visintin, while the engineer Luigi Rebonato has been in charge of structural aspects. The 26 meters long walkway fits elegantly and lightly into the city. It is made of painted weathering steel; the use of the steel construction has allowed to pre-assemble several parts in a single trunk outside the work site and placed in situ on a single day, in order to provide an adequate response to the complex logistical constraints (Fig. 11).
The single span walkway has a central box girder, which is composed by plates of different thickness. In order to assure the slenderness of the side profile, double and tapered plates have been welded on the two sides of the box girder; in their shape, clad by steel sheets, there is the echo of naval details such as ribbings of boats. These cantilevered couples of steel plates complete the structure of the bridge deck and support both

glass parapets and lateral strips of the floor in modular perforated sheet metal panels, while the central pavement is in stone. The final painting, which proposes again the colour of weathering steel, is functional to ensure the durability of the structure even in a salty environment.

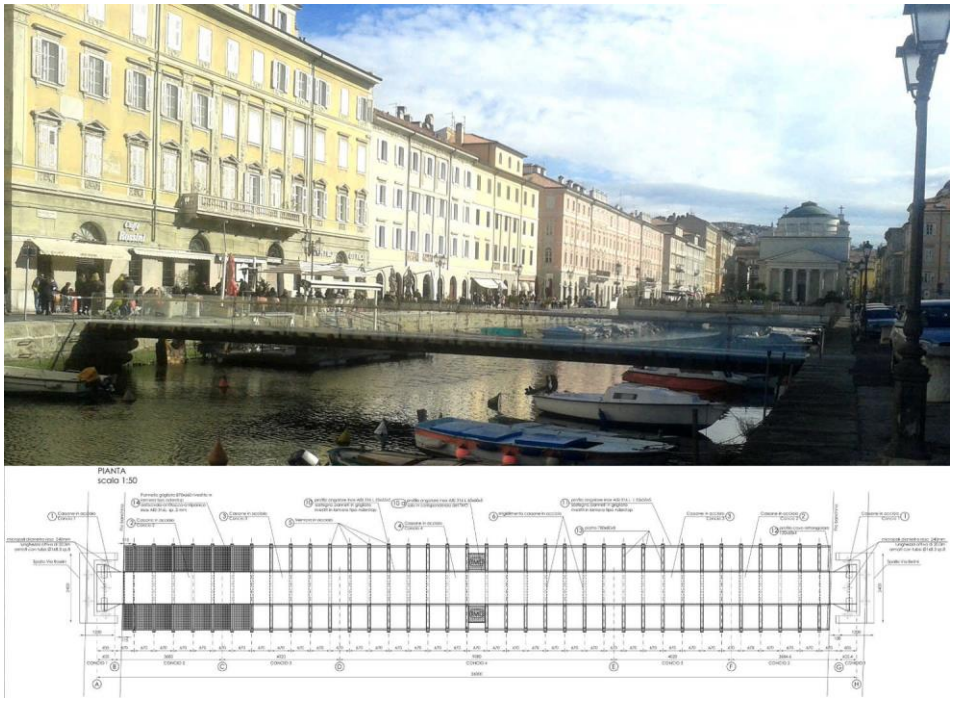

Fig. 11 The pedestrian bridge in Trieste, by the architects Marina Cassin, Moreno Suzzi, Laura Visintin and the engineer Luigi Rebonato, 2012

Even in contemporary realisations we find the same values described before: singular shapes properly designed for each context, technical solutions that allow easiest construction processes and that are highly connected to historic roots of places, and lastly, meaningful architectural appearances, that definitely enrich urban landscapes.

CONCLUSION

Although arriving at different results, the common denominator between the chosen case studies is determined by the conception of the project which encompasses the variables that define it, such as the material and phenomenological aspects of the reality and the characters which identify the intangible nature of life space; as in the famous quote of Italo Calvino about the city of Zaira, "city consists of its relationship between the dimension of its space and the events of its past". In Italy cultural heritage and craft traditions that have characterized the construction of the bridges are a common path which have connected two different parts of the technical design of the bridge. The first part which is related to large infrastructure employed the craftsmanship to overcome the backwardness of the construction industry but at the same time being aware of theoretical advances in Italian engineering. In the case of short

span steel footbridges, craftsmanship has allowed the creation of architectures which are unique from the aesthetic and technical point of view. Furthermore the bridge does not arise as a single solution to the system of morphological constraints that define the context or the solutions proposed in the construction industry, but is the result of a process of critical understanding of reality. The project comes from the understanding and analysis of the context, the solutions aren't general or repeatable for every location, instead they reply to specific features of the place itself. Italian short span steel footbridges deal with the complexity of historical, morphological and social urban contexts, giving every time a meaningful and specific answer.

ACKNOWLEDGEMENTS

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Pedestrian Bridges, Walking Routes and Placemaking: Historical and Contemporary Examples from New Zealand

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Pedestrian bridges, walking routes and placemaking: historical and contemporary examples from New Zealand

Introduction

This paper discusses the relationship between the design of the pedestrian bridge, and its engagement with the walking body and the site as way of experiencing and coming to know places. I discuss how the design of the pedestrian bridge operates at multiple levels including the experience of crossing, the expansion of pedestrian networks and its role in urban place-making processes. In this exploratory discussion these issues are addressed through a preliminary analysis of examples of pedestrian bridges in New Zealand, positioning contemporary practices within a historical continuum.

How does the pedestrian bridge direct and connect with the energies and senses of the walking body as it moves through time and space? How does the materiality, structure and walking experience of pedestrian bridges engage with, articulate and co-produce site specific experiences? To address these questions I begin by positioning the experience of the pedestrian bridge as a spatial, material, and social encounter as well as a durational event. Secondly, I consider how the pedestrian bridge experience has contributed historically to the specific character of recreational walking experiences in New Zealand and their appeal as leisure/tourist attractions. Thirdly, I discuss the place-making contribution of examples of urban pedestrian bridges focusing on material elements and site responses alongside the recuperation and development of pedestrian networks. Finally, I consider how the experiential, everyday and iconic dimensions of the pedestrian bridge can come together as structures that signify place identities.

1. Bridge and the design of pedestrian experience

The role of the pedestrian bridge in enhancing urban walkability and pedestrian networks has been well documented (see for example (Ceccon & Zampieri, 2016; Keil & McKenna, 2013; Siviero & Martini, 2015). In addition to these functional benefits the experience of the pedestrian has also been carefully considered in the development of design criteria for walking routes (see Ceccon & Zampieri, 2016) and pedestrian bridges (see Keil & McKenna, 2013).

In this paper, the design of the bridge and the temporal experience it affords is positioned as a structural and designed direction of a walking experience. To better understand the relationship between embodiment, physical movement, material structure, and site, the paper draws on phenomenological approaches to walking, and the built environment. This includes scholarship that has addressed the rhythm of walking (Edensor, 2010; Lefebvre, 2004; Wunderlich, 2007), as well as atmosphere and the built environment (Böhme, 1993; Grant, 2013; Holl, Pallasmaa, & Pérez-Gómez, 2006; Zumthor, 2006.).

Pedestrian bridges structure a walking experience of place in very specific kinds of ways. In particular, as has been recognized, it is the slowness of the pedestrian pace that facilitates the depth of experience of the structure and site (see for example Siviero and Martini, 2015, p. 399, and Stephen, 2004, p. 247). The pedestrian bridge structure is usually designed to facilitate flows of movement: pedestrian mobility at an elevated level above, and unimpeded flow beneath. As site responsive structure the bridge facilitates not only connection but vantage, aspect and, where afforded, repose. As Bishop has emphasized, the bridge, exists within the tension of the in-between space. This moment of suspension between the two sides that it connects is underscored by the act of crossing (Bishop, 2008, p. 55-56). In this context the site, the bridge structure, and the pedestrian become existentially bound together to produce a particular way of understanding and experiencing place.

To consider how the design of the bridge directs the movement of the pedestrian through space and time sets of inter-related factors need to be considered. Firstly, the qualities of the site itself, the architectural engineering and design of the bridge[1] and its visual and physical relationship to the site, and the prevailing climate and weather conditions at the site.[2] Of particular interest to this preliminary study was to consider how the bridge afforded the pedestrian an unfolding sequence of sensory/perceptual engagement. Located within a spatio/ temporal framework and the event of crossing, Gibson's categories of substance, surface and medium provided reference points (Gibson, 1986). Close attention was given to the materials of construction, their densities, surfaces and textures, and the sound of the structure and its

1 The design elements and strategies attended to within the bridge structure include considerations of scale, rhythm, sequence, gradient, focalization; material qualities including density, surface and colour; and narrative and metaphor. New Zealand Transport Agency (NZTA, 2009, p. 2) advance a set of principles for pedestrian bridge design. These are: location; accessibility; integration; landmark design; experience: form; approaches; safety; lighting; landscaping; maintenance; colour. This paper focuses on qualities related to the principle of experience.

2 The physical conditions of site considered included aspect/orientation, local and micro climatic factors such as wind, temperature and sun /light, internal and local sound, surrounding structures, vegetation and natural elements, including water.

capacity to absorb or reflect external sound. These qualities were considered together with site histories and the symbolic narratives embedded in any iconographic elements present. Together these provided a framework for the site analysis and fieldwork undertaken in this preliminary study.

2. Bridge structures, energetic connection and walking as recreation

Walking has an early history as recreational activity in New Zealand, closely related to the nation's early development of tourism. As early as the 1880s tourism was identified as a key strategy to draw visitors and potential colonists to New Zealand and iconic sites were identified. The Milford Track, a recreational walking route in southern New Zealand was developed as local and international tourist attraction at this time, sought out by tourists seeking out an experience of the sublime in landscape. The track promoted a particular kind of walking linked to the aesthetic pleasure of landscape (see Wevers, 2004). This aesthetic experience was grounded in the physical process of walking the track which produced, as described by Wevers, "an intense awareness of the terrain through the medium of the body and the senses" (2004, p. 45).

Given the significance of rivers in the region, for the track to be viable as an accessible walking route, bridges were an essential element in the track development. The pedestrian suspension bridge structure, locally known as a swing bridge,[3] enabled a very different kind of engagement (as seen in Figure 1) to that of the more robust river crossing. While the walker is elevated and dry, the body's negotiation of the bridge involves a radical departure from the walking rhythm of the track and connection of feet to ground. This demarcates the bridge crossing as specific event in the track experience.

3 See (Thornton, 2001) for further discussion of early bridge structures and types in New Zealand.

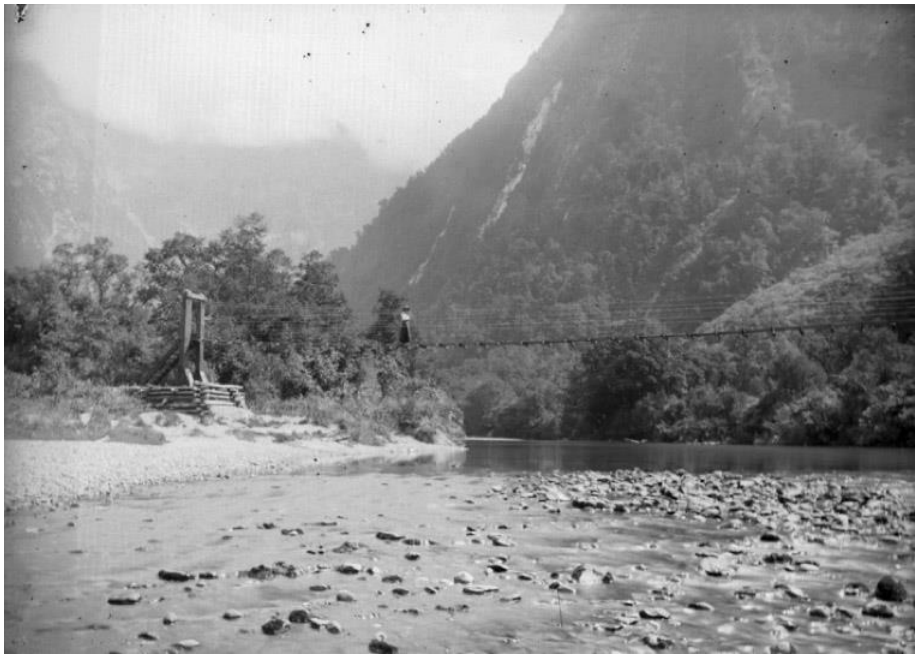

Figure 1. Dore, John Benjamin Charles: The suspension bridge over the Clinton River at Glade House, Lake Te Anau. 1900-1910. Ref: 1/2-180516-G. Alexander Turnbull Library, Wellington, New Zealand. Item link:http://natlib.govt.nz/records/22482220. Reproduced with permission of the Alexander Turnbull Library.

The suspension bridge has continued to play an essential role not only in the formation of the walking tracks but as attraction selected to feature in contemporary track publicity.[4] The appeal of the suspension bridge lies not only in its elevation and the views afforded but also in the experience of the specific energetic connection between the physics of the structure and the body. The structure affords a safe challenge to an everyday grounded experience of space, and hence its global appeal and popularity as attraction and destination.[5] Importantly it augments the body's capacity to negotiate terrain and experience an aerial perspective of the space between the two connection points. Where the location allows standardized beam bridges now also feature in many New Zealand walking tracks, easily helicoptered in to remote locations (see Figure 2). Significantly, the sonic resonance of these steel structures contributes a very different set of sounds to the soundscape of the New Zealand bush to that of the suspension or timber beam bridge.

4 See for example (http://www.doc.govt.nz/parks-and-recreation/places-to-go/southland/places/stewart-island-rakiura/rakiura-national-park)
5 The recently opened Charles Kuonen Suspension Bridge in the Swiss Alps suspension bridge offers a dramatic example of suspension bridge as attraction and destination. See https://www.theguardian.com/travel/2017/aug/02/worlds-longest-pedestrian-suspension-bridge-swiss-alps-charles-kuonen.

Figure 2: Beam bridge, Tongariro National Park, New Zealand. Photography: J Naismith

Footbridges: local connections and contemporary walking attractions

The early recreational walks laid down a tradition of recreational walking in New Zealand for both locals and tourists alike. The now vast network of walking tracks includes those developed and maintained by the Department of Conservation, (many of which are in National Parks), and those that are part of the Te Araroa Trail.[6] Opened in 2011, this series of connected routes enables the walker to traverse the length of the country on foot. These routes and tracks incorporate numerous heritage bridges and repurposed former railway structures. New Zealand's convoluted coastline has meant that simple post and beam pedestrian bridges have frequently been built to connect the north and south sides of estuary settlements. The Whananaki footbridge[7] is a significant example.[8] As Giligren has noted it provides a critical social connection to schooling and shops for communities on both sides of the estuary. (Giligren, 2013, pp 10). The bridge is not only a community asset and local place signifier, but heritage tourist and holiday attraction, offering a specific durational experience of the tidal estuary.

3. Urban pedestrian bridges: bridge, site and place-making

The urban pedestrian bridge has in recent years become a structure closely associated with roading infrastructure and amenity access. Earlier motorway developments in New Zealand' major cities. driven by infrastructure imperatives were often less concerned with their impact of separating urban centres or communities from access to waterfront or other amenities. The subsequent repair and reconnection of these separations has a notable focus of urban

6 see www.teararoa.org.nz
7 for image see https://commons.wikimedia.org/wiki/File:Whananaki_Bridge.jpg
8 At 395 metres long the bridge is the longest of its type in the southern hemisphere (Giligren, p.11).

development in the last two decades. (Wells, 2011, p. 448). This has included both the design and construction of bridge structures as well as public recreational space and development.

The first kind of pedestrian connection discussed here is that of the connection of civic space or community to its waterfront. Over the last 25 years the importance of access to the urban waterfront has been recognized as central to a city's livability and attractiveness. This has been addressed by civic authorities in many New Zealand towns and cities through significant urban development projects (See NZ Ministry for the Environment, New Zealand Urban Design Protocol 2015). Discussion of the following examples considers how pedestrian bridges have recuperated pedestrian connection to a local waterfront. It also considers how the bridge, through structure, materials and narrative interprets the site and its histories to become a significant element in the making, understanding and iconic signification of specific places.

Crossing an urban motorway the *City to Sea Bridge* in Wellington was built as part of a larger project to re-develop connections between the Wellington Waterfront (Whairepo Lagoon area) and Civic Centre initiated in the 1980s (see Waterfront Leadership Group 2001). Completed in 1994 and designed by architects Rewi Thompson and John Gray and artist Paratene Matchitt the bridge was a response to a brief from the Wellington City Council that, as summarized by Gray, "should address the cultural significance of public space and the water's edge" (1994, p. 29). Stories that relate to the creation of Wellington Harbour, Te Whanganui a Tara[9], alongside the significance of the coastal edge site for both Maori and Pakeha[10], underscore the narratives embedded in the bridge materials and iconography (Gray, 1994).

Key symbolism is embedded in the sculptures by Paratene Matchitt that form the balustrades on the north and south side of the bridge.[11] Harper and Lister noted that in 1994 the bridge was a clear assertion of the place of Maori art and culture and its visibility in public place

[9] For further discussion of narratives and iconography related to the creation stories of Wellington Harbour see Gray 1994, Harper and Lister 2007, Stocker 2014, and New Zealand Ministry of Education http://eng.mataurangamaori.tki.org.nz/Support-materials/Te-Reo-Maori/Maori-Myths-Legends-and-Contemporary-Stories/Ngake-and-Whataitai-the-taniwha-of-Wellington-harbour.

[10] non Maori

[11] Whales and birds respectively form the north and south side balustrades. Following Maori legend, the whales (taniwha) were instrumental in the formation of Wellington Harbour. The birds (manu), with open wings, are welcoming elements. (Stocker, M., 'Sculpture and installation art - Māori sculptors', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/photograph/41983/city-to-sea-bridge-sculptures)

making contexts (Harper & Lister, 2007, pp. 16-18). Sitting at threshold between city and sea, between the formality of civic structures and the aging and eroding timbers of coast and port, the bridge draws powerful connections between the site's geography, and its Maori and Pakeha/settler histories of site and place.

Figure 3a: City to Sea Bridge (Thompson, Gray and Matchitt) balustrade north side bridge platform, sculpture by Para Matchitt. (Photography P.Thomass)
Figure 3b: City to Sea Bridge (Thompson, Gray and Matchitt) balustrade south side bridge platform, sculpture by Para Matchitt. (Photography P.Thomass)

When traversing the bridge from west to east the pedestrian moves from the formal architectural spaces of the civic square to the organic forms of the bridge with the harbour at the horizon edge. The walking surfaces of the bridge follow this movement through a material shift from hard paving to soft timber planks, changing the sound and resonance of the walker's foot-fall. On the wide platform that forms the bridge, the heavy sculptural balustrades provide shelter, sound insulation and north facing seating options. As the pedestrian progresses through and across the space a complex array of different elements come into and move out of focus. The bridge, therefore works as an elevated urban park, its design directing a flow of experience and offering multiple vantage points, both within and beyond the structure.

Figure 4a: City to Sea Bridge (Thompson, Gray and Matchitt) North east aspect, bridge platform, sculpture by Para Matchitt. (Photography P.Thomass)
Figure 4b: City to Sea Bridge (Thompson, Gray and Matchitt) West aspect bridge platform, sculpture by Para Matchitt. (Photography P.Thomass)

Twenty three years since it was opened the bridge has become a weathered core element in its local urban environment and an iconic attraction. When I sat on the bridge, taking field notes over a number of days in a relentlessly windy January in 2017, the site was sheltered and warm - quietly inhabited by visitors and locals - rhythmically moving through and pausing within the elevated space of the bridge platform. As Edensor (2010) notes "the collective choreographies of congregation, interaction, rest and relaxation produces situated rhythms through which time and space are stitched together . . ." (p.70). In turn, these rhythms are embedded into the bridge structure through the eddies and flows of unfolding narratives and material encounters that direct and structure the pedestrian experience. The sun bleached, weathered timbers of the bridge absorb and release warmth- offering welcoming spaces and surfaces for pedestrian encounter and rest. At the same time their aged, salt soaked fibres emit the substance of coastal edge and following Ingold (2012) persist within an "ecology of materials" (p. 438) in a continuous process of emergence.

The *Taumanu Reserve Bridge*, designed by Isthmus Ltd,[12] located in Taumanu Reserve in Onehunga, Auckland, is another example of a pedestrian (and cycle) bridge which recuperates the connection between community and harbour foreshore. A major motorway development in the 1970s separated the suburb of Onehunga from the harbor foreshore. Opened in 2015 the bridge is a key element in a significant foreshore reclamation project,[13]

12 see isthmus.co.nz/project/taumanu-reserve/
13 This involved a partnership between Auckland Council, Mana Whenua, New Zealand Transport Agency.

which included a recreational lagoon and landscape design of the foreshore area. The name Taumanu means reclamation, and was gifted to the project by local Maori groups (Auckland Council, n.d.).

The concept of reclamation works metaphorically at a number of levels within both the bridge structure and the reserve – this includes the new reserve's reclaiming/ reconstruction of the coastal edge, the bridge's reclaiming of connection to the waterfront and the recreational space – as well the materials used in the bridge structure. These materials are used as dominant design elements to produce a quiet, sound insulated space that crosses the busy traffic of the airport motorway. Like the *City to Sea Bridge* the meaning of the *Taumanu Reserve Bridge* is deeply layered. The Council state the community's desire for a bridge that was both a "physical and symbolic connection to the sea and the maritime history of the bay" (Auckland Council, n.d.). Isthmus, the designers of the bridge describe it as "…a low elegant pedestrian bridge designed to be of the land" (Isthmus Ltd., n.d.). The site response and design was developed with advice from Maori groups linked to the area, and this indigenous knowledge informs the reclamation project across multiple levels (Isthmus Ltd., n.d.).

The bridge structure materially and physically coheres the reserve, assertively drawing the two sides together. On encountering the bridge from the lagoon side the bridge expands the visual and physical reach of the park space and draws the walker towards the harbour. It is a heavy, substantial structure and its structures and surfaces engage the walker in a sequence of material rhythms and textures drawn from the visual language of site and coast.

Figure 5a: Taumanu Reserve Bridge, approach from Eastern side. (Photography J. Naismith)
Figure 5b: Taumanu Reserve Bridge, looking East. (Photography J. Naismith)

Work by Maori artist Bernard Makaore is designed into the interior face of the windward balustrade structure and this, as stated by Auckland Council "was inspired by the Manukau tides, the ancient unaunahi (fish scale) motif, and patterns seen in spiral shells and mudflats" (Auckland Council, n.d.). Carved into aged, heavy hardwood these finely executed ripple forms connect built environment to natural, activating the material energy of the timber and offering visual continuity in the crossing experience. The visual and material weight of this balustrade structure creates a space for the pedestrian that is sheltered and acoustically quiet. The feeling of containment is augmented by the effect of the upper protective barrier structure. Thus, the crossing experience occurs within a slow and separated space in which the material weight of the immediate foreground overrides the constant flow of fast moving traffic beneath. Here it can be seen how the temporal quality of slowness embedded in the pedestrian bridge experience is co-produced between designer and pedestrian. As Pallasmaa has pointed out "we prefer to have time that has been slowed down so that we can experience it more fully" (Pallasmaa, 2016). Here, the design of the bridge allows time for the walker to respond to the site, connecting present to past through material and sculptural form.

Form, colour and pedestrian bridge as iconic signature

The previous examples draw on a language of connection to harbour edge and a longevity of cultural traditions and histories related to the site. While their contexts and sites are quite different they share some similarities in terms of materials and their concern for the co-production of a sheltered and quiet amenity space.

The *Westgate Footbridge* (Aurecon, Jasmax, NZTA, 2013) assumes a very different approach (see Figures 6a and 6b). Recent development of motorway infrastructure in the rapidly growing Auckland region over the last decade has precipitated an accompanying need for pedestrian bridge re-connections. This situation, as Wells has noted, has created opportunities for innovative architecturally engineered structures. Examples of these he emphasizes, have gone "beyond the simple function of connecting or reconnecting . . . and reflect an aspect or theme into the context in which they are placed or try to enhance the experience of those travelling across them." (Wells, 2011, p. 448). The *Westgate Footbridge* on the Auckland Western Ring Route, was designed as a pedestrian and cycle motorway

crossing to reconnect residential and shopping/amenity areas.[14] The site's topography as Wells outlines, suggested an extended route, elevated on the north side above the Manutewhau reserve (2011, p. 453).

Figure 6a: Westgate Footbridge approach from Mangatewhau Reserve. (Photography J. Naismith)
Figure 6b: Westgate Footbridge approach from Westgate Centre, showing motorway crossing (Photography J. Naismith)

Composed of a series of fluid curves and steel trusses, the structure offers an extended walking experience across the reserve and motorway. The linear structure has a playful tone, linking it to a language of playgrounds and parks and in this way to its youthful users. Painted bright yellow[15] it assertively uses colour to extend an emotional connection towards its users, and at the same time assert its identity as local signifier.[16] In this way the structure co-produces an atmosphere between materials and walker. This draws attention to Bennett's observation that "*All* forces and flows (materialities) are or can become lively, affective and signaling" (2010, p. 117).

As the walker crosses the motorway, the openness of structure and form means that the pedestrian is inevitably immersed in the noise and movement of the traffic beneath. The section of the journey elevated above the reserve, however, provides a strong counterpoint to this, affording birds-eye perspectives into the regenerated native planting in the reserve below. The length of the ramp maintains an even gradient across bridge providing a consistent experience of elevation and descent for both walkers (and cyclists). This means the bridge is learnt and understood by the body as a sequence of smooth curves, speeds and

14 The NZTA bridge construction responded to community safety concerns related to motorway crossing at risk and a fatality in 2004 (New Zealand Transport Authority, 2013).
15 A strategy to link the local identity of nearby bridges (also painted yellow) on the Western Ring Route (Wells 2011, p. 454)
16 The use of colour has been an important strategy in the design of the recently completed award winning *LightPath, Te Ara Whiti / Canada Street Bridge,* Auckland, by Monk MacKenzie Architecture, GHD, Landlab and Novare Design. (http://www.monkmackenzie.com/index#/nelson-st-cycleway-1/). It features a pink/magenta coloured resin surface and is lit by an LED light pole structure at night (Monk McKenzie n.d.) Opened in 2016, this award-winning project has been heavily used and has received considerable media exposure.

rhythms- an experience and event that, for regular users, becomes a part of everyday life. As Lefebvre (as cited in Edensor 2010, p. 69), has noted "every rhythm implies the relation of a time with space, a localized time, or if one wishes a temporalized place" (1996 p. 230). Here, the bridge becomes a key agent in producing these specific local place qualities. As distinctive form in the environment the bridge inscribes a new relationship between structure, place and people that is progressively embedded by its use.

4. Conclusion

This exploratory study has contextualized a small selection of New Zealand pedestrian bridges within their respective historical or contemporary frameworks and considered their contribution to place experiences and identities. [17] The experience of the bridge, it has been argued, plays an important role in how the bridge makes connections between the walking body, site and place. The specific nature of this experience is characterized by the bridge's structure –its physics, materials, surface and sonic qualities, entrance, and direction of the walker's movement across the space to arrival on the other side. As a human scaled structures pedestrian bridges engage in a direct relationship with the perceiving human body. In this way, the bridge defines the body's experience of it while at the same time this experience defines the essence of the bridge.

Pedestrian bridges claim the importance of pedestrian space. In an environment in which the independence of walking (and cycling) challenges the dominance of motor vehicles in urban spaces, they are asserting a new position in the hierarchy of public infrastructure. They also tell historical stories about places and are an important element in recreational walking experiences. As site-specific responses they have the expressive capacity to engage with and articulate a depth of cultural understanding of place and can represent an evolving and contemporary place identity. Pedestrian bridges offer, therefore, an increasingly important contribution to the understanding and making of public places. Their experience as flow and rhythm, material, and social encounter, and the enclosure or openness of their spatial connections, all become known and embodied through their use, through the rhythms of walking.

17 The contemporary examples discussed are a small component of a rapidly expanding set of iconic pedestrian bridge structures asserting an important role as place signifiers, attractions and destinations, across both urban and regional settings in New Zealand.

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‘Compleating the Union’ and the Building of Bridges in the Post-Culloden Highlands

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Introduction

This article explores the practical and symbolic significance of bridges in the Highlands during the period after the 1745-6 Jacobite rising, and highlights how bridges were understood by contemporaries as vital to the control and transformation of the region. The paper begins by placing the construction of bridges within the wider context of the Highlands in this period, and then, with reference to Stirling and Perth, explores the particular significance of bridges in this context. These bridges were on the boundary of the area legally defined as the Highlands and, as such, were seen as critical in the relationship between the region and the rest of the United Kingdom. By considering these examples it is possible to see a change in emphasis in the way bridges were understood, reflecting the negotiated nature of the relationship between the Highlands and the state.

Background and Context

The Jacobite rising of 1745-6 was a failed attempt by the House of Stuart to overthrow the Hanoverian monarchy. While Jacobites were not exclusively Highlanders, the rising began and attracted support in the region. After the Jacobites were defeated at the battle of Culloden in April 1746, the Hanoverian Government identified the need to deal with what it regarded as a rebellious and uncivilised Highlands. This part of the Kingdom was considered the source of the rising and, more generally, 'a problem region' that posed a threat to the stability of the union (Devine 1994: 84-5). While there was a range of views about what precisely the problem was, the Highlands were generally represented as a distinct region that, while geographically within the United Kingdom that had been established in 1707, was culturally and politically an outlier. Edmund Burt an English rent collector and Justice of the Peace, stationed in the Highlands, expressed a typical contemporary view of the region:

> The Highlanders differ from the People of the Low Country in almost every circumstance of Life. Their language, customs, manners, Dress etc are unlike, and neither of them would be contented to be taken for the other. (Burt 1818: 1-2)

Burt's thoughts on the Highlands were written before the rising but they reflected a long-established view of the region held by many within the Government, the army and more widely. The Jacobite rising was seen as a vindication of this view and as a justification for government action to address the perceived problems of the Highlands. However, there were differing views on the precise nature of the problem and, therefore, what the Government's response should be.

Broadly, two different approaches were taken; the first aimed at subjecting the Highlands to military control; the second was concerned with the economic improvement of the region. The first approach was advanced by those who perceived the Highlands as a threat that needed to be contained. They advocated punitive policies, such as prohibitions on the wearing of Highland dress and the carrying of weapons within the Highlands. These measures were introduced as an initial response to the rising and their effective enforcement required a statutory definition of the region. The following definition from earlier proscriptive legislation was revived:

> The shires of Dumbarton on the North-side of the water of Leven, Sterling (sic) on the North-side of the river of Forth, Perth, Kincairdin, Aberdeen,

> Inverness, Nairn, Cromarty, Argylle, Forfar, Banff, Sutherland, Caithness, Elgin and Ross. (19 George II C.39)

Disarming measures were aimed at containing the Highlands and allowing the assertion of military control. However, the Government was also influenced by proponents of long-term reform and introduced legislation that was intended to integrate the region into the rest of the United Kingdom. In constitutional terms, this was referred to by contemporary lawyers as 'compleating (sic) the Union' (Mitchison 1970: 27) a desire which resulted in the abolition of private legal jurisdictions of landowning nobility – an aspect of Highland distinctiveness, which had been retained by the Acts of Union between Scotland and England in 1707. More broadly, the policy of 'improvement', which was intended to achieve economic and cultural reforms in the Highlands, was promoted by those who sought to assimilate the Highlands into the UK economy and society, rather than isolate it.

The Construction of Bridges

In the context of attempts first to control, then to integrate the Highlands, the construction of bridges was significant. In the statutory definition of the Highlands, adopted in the disarming legislation, rivers were identified as boundaries. This is not unusual, of course, but the significance here is the role that bridges played both as practical measures for the economic and cultural integration that was desired, and as symbols for these aims.

Bridges had been destroyed during the rising in order to prevent the movement of Jacobite troops. In the climate of suspicion that led to the punitive post-45 legislation, bridges were seen as critical to military control of the region. This is articulated in the following example of the many documents that were produced at this time proposing solutions to the perceived problems of the Highlands:

> A number of small Redoubts Garrisoned by 30 or 40 men erected at the principal Bridges and Passes, would protect magazines, preserve the communication, and prevent any provisions going into these countries without the Government's permission. The Principal Bridges are, Stirling, Taybridge, Kinnachan bridge, over the Tummel, Spey Bridge near the Garrisons, High Bridge and the Bridge at the Head of Loch Tyne.
>
> (*Memorandum concerning the Highlands* (1747) 12 December. Box/76/B Jac B.II.1-2; from the collection at Blair Castle, Perthshire.)

However, the deliberations about the rebuilding of an arch on Stirling Bridge, demonstrate that different views on the role of bridges existed. During the 1745-6 rising, the British General in charge of Stirling castle, General Blakeney, ordered the southernmost arch to be destroyed to prevent Jacobite troops from being able to cross the river Forth. After the rising, as the army sought to consolidate its control over the Highlands, the rebuilding of the bridge became necessary. Correspondence about this indicates the different ways in which the benefits of the bridge were understood.

Lieutenant-Colonel Humphrey Bland, wrote to the Secretary of State, the Duke of Newcastle, emphasising the strategic importance of Stirling Bridge because of its location and the need to replace the temporary wooden structure that had been used to repair it:

> The wooden reparation then made in Haste, is now very Rotten, Dangerous for wheel carriages to go over, and lyablle to be carried away by every flood; and as it is the only communication we have by land to the north, Renders absolutely necessary that the said arch should be immediately rebuilt with stone as it was be before, otherwise His Majesty's Troops….will have no passage to or from the North.'
> (Humphrey Bland (1747) 2 February. State Papers 38/11A; The National Archives, Kew [hereafter TNA]).

Similar sentiments were expressed by the Earl of Albemarle, who had just finished his post as the Commander-in-Chief in the Highlands, also in a letter to Newcastle:

> It may be greatly detrimental to his Majesty's service, in case his Troops have not a free Passage over the Forth and as the rebuilding this arch will be of infinite use to the Town and County of Sterling (sic), whose Magistrates and Inhabitants have signalized themselves in their zeal and attachment to His Majesty and His Royall (sic) Family;
>
> (Albemarle, (1747) 19 February. State Papers 54/35/36A; TNA).

It is notable that he seeks to emphasise the loyalty of the people of Stirling to the Crown, indicating that a certain anxiety existed about the Highlands in general and, in particular, whether it was safe to rebuild this bridge. While Bland makes reference to the general benefits of building the bridge, the specific advantage that he mentions is that it would facilitate the passage of troops. This differed from the arguments set out in the representations originally sent by the Magistrates of Stirling:

> So that by reason of the great use the Bridge is not only for the conveniency of your majesty's Troops infrequently passing thereat, but for carrying on the ordinary commerce in this country, the repairing of the said arch with stones appears to be absolutely necessary.
>
> (*Petition from the Magistrates of Sterling* (1747) 19 February. State Papers 54/35/ 36C; The National Archives, Kew.)

Here the focus is on commerce and the military benefits are downplayed. This difference in approach can partly be explained by the identities of the authors – civil magistrates rather than military commanders – but it also reflects a tension between the central government and local agents which existed more generally as both sought to exert authority over the Highlands. In the years immediately after the rising the state's approach to the Highlands was primarily militaristic and this is reflected in the way Bland and Albemarle articulated their rationale for rebuilding Stirling Bridge and chose to represent the benefits of doing so to the Duke of Newcastle.

However, a number of influential figures within Scotland envisaged a need to move beyond military control and consolidate long-term fundamental reform. The policy of improvement, which comprised economic as well as cultural initiatives, had been promoted before the rising. But the proponents of 'improvement' intensified their arguments in favour of economic reform of the Highlands, citing the Jacobite attempt

as evidence for the need to integrate the Highlands into the rest of the United Kingdom, economically and culturally.

Improvement, reached its post-Culloden zenith in the creation of the Commission for Annexed Estates. This was established by the Government to manage 13 Highland estates, which had been annexed from landowners deemed as traitors for taking part in the rising. In this role the Commission was responsible for introducing reforms with the aim of:

> Civilizing the inhabitants upon the said estates, and other parts of the Highlands and Islands of Scotland, the promoting amongst them the Protestant Religion, Good Government, Industry and Manufactures, and the principals of Duty and Loyalty to his Majesty.
> (25 George II C.41)

An important aspect of this aim was that, while the Commission focused much of its endeavour on the 13 estates, its vision was broader. It hoped to have a 'civilising' effect on 'the other parts of the Highlands and Islands,' too. Bridges were a central aspect of the Commission's and it funded 45 during the period of its existence between 1755 and 1784 (Smith 1982: 182). In this context the construction of bridges was understood in terms that were less about control and more about civilising the Highlands. Furthermore, bridges were represented not simply as one practical benefit but a fundamental aspect of the Commission's wider mission, reflecting the way that economic and cultural reforms were perceived to be linked. This is clear from the Commission's report to the Treasury in 1760:

> In the Highlands which are mountainous, they abound with rivers and rivulets which in the winter and by torrents swell so excessively and descend with such rapidity that where there are no Bridges no passengers can go from one side to the other; no horses can ford them and no person can get thro' on foot; And for that reason the Inhabitants cannot go to Church or Mercat or Carry on any dealings with their Neighbours, tho' at no great distance; And as free and frequent Intercourse with the Low Country [is limited] and the Inhabitants among themselves and Bartering the severall produce of their Industry must for a great part of the year be entirely as an Island, the Building of Bridges would greatly Tend to soften their Manners and Quicken their Industry and be means to prevail with them to shake off their Sloth and Idleness and Improper means of supporting themselves.
> (Reports to the Treasury, (1760) 7 January. Forfeited Estates Papers E723/1; National Records of Scotland, Edinburgh [hereafter NRS].)

This makes quite explicit the broader advantages that the construction of bridges was perceived to bring, and placed such construction firmly in a narrative about improvement and civilisation, stimulated by social intercourse and trade between the Lowlands and Highlands. Such arguments proved useful for those in the Highlands who sought funds for bridge building. A petition from Perth magistrates to the Commission for Annexed Estates, from 1764, for a contribution to the construction of a bridge over the Tay, adopted a similar approach to that of the Stirling magistrates some years earlier but with greater emphasis on 'improvement.'

> If the Trustees cast their eyes upon the Maps, and examine the situation of Perth, and all the several countrys Lying on the Northside of the Tay, the extensive benefites (sic) of this Bridge will readily occur to there (sic) well informed judgement. Whether they direct their attention to the Political or Commercial Intercourse of the Kingdom, To the Civil or Military police of the Highlands, In every view the Communication will appear necessary to compleat (sic) those which have been already so judiciously made by hand and Bridges in different parts, and to give full effect to all the salutary schemes for the Improvement of the Highlands which have been so wisely devised, and are now happily coming into execution.
>
> (*Memorial submitted by the Noblemen and Gentleman of the County and Town of Perth to the Trustees on the annexed forfeited estates*, (1764), 8 June. Box 50.1.39, from the collection at Blair Castle, Perthshire)

While, the Memorial mentions policing of the Highlands, the benefits emphasised are largely civil. However, the Magistrates highlighted advantages to the country as a whole, reflecting the fact that bridges had now become part of an improvement narrative. The Commissioners agreed to fund the bridge noting that providing funding 'quite conformed to the spirit and intention of the Annexation,' thereby referring to the Commission's bold aims (quoted in Smith 1982: 193).

It is clear, then, that bridges were becoming part of a narrative about improving the Highlands and thereby rendering the union more complete, in both practical and symbolic terms. Rivers formed the boundaries of the imagined separation, and bridges, therefore, represented the erasure of such boundaries. The success of the improvement narrative in this regard is marked by the legislation, which established the Highland Roads and Bridges Commission in 1803 and provided funding for bridges that were 'necessary for opening extensive Communications through that part of the United Kingdom, whereby its Fisheries may be encouraged, and the Industry of its Inhabitants greatly promoted' (43 George III C.80). This was certainly a development from the emphasis of 1747 on controlling provisions and, under these auspices, the Roads and Bridges Commission funded much of the work of Thomas Telford in the Highlands.

Conclusion

The building of bridges was an important activity that formed part of the state's engagement with the Highlands after the '45. However, bridge construction was more than just a large proportion of the work carried out. Given the significance of the way in which the Highlands were imagined and conceptualised as a distinct region, bridges were symbolic. Militarisation and improvement were not mutually exclusive but a study of how the construction of bridges was understood demonstrates that a narrative about the civilisation of the Highlands through assimilation or 'intercourse' with the Lowlands became prominent as a way of representing the erection of bridges in the Highlands.

One problem with this narrative is the extent to which it consolidated a binary understanding of the Highlands on one side and the rest of the United Kingdom on the other. Ironically, representing the bridge as the medium for boundaries helped sustain an idea of an 'uncivilised region' being opened up. However, by closer analysis of the correspondence around the building of bridges, it is clear that Highlanders – certain Highlanders at least - helped develop

this narrative and used the idea of ‘civilisation’ as a way of securing funds to promote economic transformation, an alternative to the Highlands being subject to military control. Therefore, this study demonstrates that Highlanders were active in ‘compleating the Union’ and that bridges were a critical element of this process.

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The incorporation of accessibility in gentrification issues: A bridge crossing the IJ in Amsterdam – perceptions of residents.

BRIDGE: The Heritage of Connecting Places and Cultures | Ironbridge Gorge World Heritage Site | 6 – 10 July 2017

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Introduction

A bridge is a connection between two sides. It could bring an improved interaction between both sides as a result of improved accessibility. However, to what extent do both sides actually desire an improved accessibility?

This paper is investigating this issue in the context of gentrification processes in Amsterdam North, The Netherlands. Although Amsterdam is a global city, its northern district (North) is cut off from the rest of the city by the IJ-river[1]. Since the development of North about 100 years ago, ferries are the most important mode of transportation for cyclists and pedestrians to cross the IJ, as a central crossing is missing due to the busy waterway.

Although the popularity of Amsterdam under the new urban middle class is rapidly increasing for years and gentrification is spreading across the city, changing more and more formally characteristic neighbourhoods, North has been spared for decades. Until recently, though. At the riverside new high rise developments have popped up like tulips. Also in the nearby social economic lower class garden-city style neighbourhoods, the new urban middle class is settling and gentrification-like facilities are popping up.

"A real resident of North is glad that the urban mess stays on this other side [of the IJ]" (Het Parool, 16 January 2017). The social tensions are rising between the new social, cultural and economic stronger and dominant new residents and the old social economic lower class residents.

The city responses systematically and has the capacity to generate 'speech', as Sassen (2013) suggests. In line with Sassen's speech approach, I wonder: What is the perception of the old residents on the effects of improved accessibility? By interpreting their perception I intent to discover more about the function of accessibility in resisting the unwanted effects of gentrification that might change the social-cultural characteristics of North.

Policies and urban planning are perhaps biased towards accommodating newcomers (Baum, 1998; Gent, Boterman & Hoekstra, 2016). The social and cultural capital of newcomers in gentrifying areas, but also their ability to connect with legislature and public leaders in the City Hall, allow the higher educated new residents to (re)direct policies towards their personal and collective desirability.

As Gent, Boterman and Hoekstra (2016) found in one neighbourhood in North, the municipality of Amsterdam and social housing association have continued to engage in middle class quarter making. Gent, Boterman and Hoekstra (2016) interpret this as a form of state-sponsored gentrification, or symbolic politics. Or as Slater (2014) puts it: false choice urbanism, in which the residents are, to an extent, fooled into leaving the neighbourhood to make space for more affluent residents.

I would like to give the residents a voice, before they draw the shortest straw. If they will eventually leave, so will their social-cultural characteristics fade away, as is already visibly happening in Amsterdam. What will then be left? A Social homogenic city for in particular the elite, a nostalgic reference to local identities, a boring city that lacks stimulus and a city that lacks diversity and therefore innovation.

To capture the perception of the residents of North, I performed a online survey via Facebook groups that was answered by 388 respondents of both new and old inhabitants. This survey contained four open questions in which the respondents were encouraged to explain their answers with arguments. Through a content analysis of the responses, I obtained their perceptions in percentages and frequencies, by which I used chi-square to test if the socio-economic profile affects the responses.

On a local level, I expect the results of this research will put the perceptions of the unexplored current residents of North into a new light, instead of a policy attention for future residents that should generate economic growth. Academically, Amsterdam North is a very interesting case. It is a rare situation that in a global, economically striving city, the accessibility of a large urban area is lacking. In this context, the case of Amsterdam North is an interesting case to investigate the influence on a lacking, improving and improved accessibility on gentrification processes in a social economic lower class area.

This paper is structured as follows: first I will explain the DNA of Amsterdam North, from an historical perspective, and the situation concerning the plans for a bridge connection crossing the IJ. Then I will discuss a conceptual context. The discussion of the results from the survey will explain the perceptions of the residents of North on an improved accessibility.

DNA of Amsterdam North: an historical explanation

The IJ is like a buffer zone between the busy and hectic city centre of Amsterdam and quiet Amsterdam North. The most common option to cross the IJ for bikers and pedestrians, is by ferry. The ferry is a "peaceful moment between work and home" (respondent 203). You are forced to stand still and to enjoy the view on the water. The motion of the water, the fresh sea air coming from the IJsselmeer, the wind blowing through your hair. "It takes away a bit of stress […]" (respondent 202). The ferries have become part of the charm of North (respondent 110, 129, 202, 387). The ferries, but mostly the deplorable accessibility of North, appear to have been a decisive part in the historic development of North.

The IJ is indeed quite a busy water road, which limits a permanent, centrally located bridge construction. North has unique characteristics that are more rural than urban. Chart 1 shows the most important characteristics of North, as perceived by residents. Undeniably these are more rural than urban characteristics, despite the geographically proximity of the highly urban city centre at the other side of the IJ.

The different urban districts of the city of Amsterdam have similar features, as table 1 demonstrates. With 92.917 inhabitants, the urban district of North has a reasonable amount of citizens on a city level. Remarkable, however, is the low population density. This number is mainly caused by the spatial urban planning of North, with a remarkable amount of green space for parks and nature. The residents of North live a relative long period of time on one address, North has the highest percentage of household with children and a relatively low percentage of single households on a city level. This mirrors the traditional setting of this social-economic lower class district. Amsterdam has a high number of social housing dwellings spread across the city, 57% of the total number of dwellings is a social housing dwelling (OIS, 2016), meaning: in rich and poor, expensive and affordable areas. This explains why North does not have a relative high percentage of low income households compared to the city level and that the number of owner-occupied housing units is more or less even across the city.

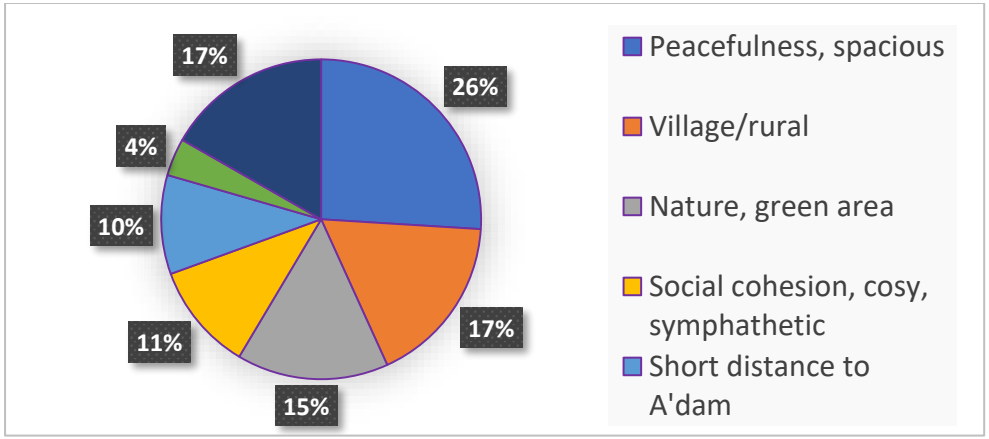

Chart 1: Character North as perceived by residents

Note: Respondents could name multiple categories in one answer. The categories are displayed that mirror the perception of the majority of answers and respondents.

Table 1: DNA of Amsterdam North – data of 2015

Urban District	Number of inhabitants	Population density per km2	Average length of residence on 1 address in years	% of household are families with children	% of household is single household	% of household is low income (2013)	% owner-occupied housing
Centre	86499	13758	8,4	14,5	62,6	32,1	29,6
Westpoort	200	10	6,6	11,1	77,8	x	6,4
West	143964	15301	8,0	20,1	57,4	32,7	28,8
New-West	149397	4401	8,5	33,3	45,2	26,8	30,4
South	143258	9269	9,0	20,0	56,0	26,9	30,7
East	132421	7440	7,7	26,6	52,0	27,4	29,6
North	**92917**	**2224**	**10,3**	**33,6**	**44,8**	**28,5**	**29,2**
South-East	86057	4302	8,8	32,2	50,9	33,8	27,8
Amsterdam	834713	5065	8,6	25,1	53,1	29,6	29,6

Source: IOS, 2016.

Historical development
The historical development of North has been determined by a bad connection over the IJ. Until the late 19th century, dike villages such as Nieuwendam, Schellingwoude and Buiksloot, among others, determined the landscape structures of the northern lands of the IJ. These villages were depending on Amsterdam for their (economic) development. As the city of Amsterdam grew on the south-side of the IJ into the world riches city during the 17th century, the Golden Age of Amsterdam, the northern part seemed to lack the ability to profit from its proximity. This is perhaps caused by its geographical location, being at the other side of the river, or by the political control of Amsterdam over its surroundings.

However, as Amsterdam grew into a dense, dirty city with smelling canals, inner city industries, overpopulation, diseases and epidemics, the other side of the IJ emerged as a place to escape the limitations and negative effects of urban development. Already from 1409 onwards, gallows were positioned near the river side on the northern part of the river for the visibility from the city side of hanging corpses of death criminals. Later, inhabitants of Amsterdam escaped the city to stroll through the parks on the north side of the river.

Because space was getting scarce in Amsterdam, from 1900 onwards industries were starting to be interested in the wide-open lands on the north side of the IJ for the development of heavy industries, as for instance shipbuilding and petrochemical industries. The municipality of Amsterdam annexed the north side of the IJ in 1921[2].

Garden-villages
At the same time, the 'garden-city' idea from England set foot on Dutch soil. Factory owners assumed that a good living situation of workers led to higher productivity. The idyllic areas with short streets, squares and green space was thought to have a positive physical and mental effect. The first 'garden-villages', as they were called in Amsterdam, were built between the 10s and 20s of the 20th century near factories and the IJ. They were social housing developments, with low-rise housing, a lot of green space, squares and only a few facilities.

The initial idea was that people worked and lived in North. The reality, however, was that with the development of North, the pressure on the connection with the rest of the city across the IJ solely by ferry, actually increased. Partly as a result of the limited accessibility, the department of urban development of the city of Amsterdam called North in 1926 an "urban planning error" (Stichting Historisch Centrum Amsterdam Noord, 2011: 92).

Better connection
A solution was proposed by an industrial from North, called T.C. Groot. In his plan from 1939 he suggested an "efficient and rapid connection between the two banks of the river, which divides Amsterdam in two." (free translation from Dutch from his open letter to the city council, in: Stichting Historisch Centrum Amsterdam Noord, 2011: 94) Partly due to his commitment, the accessibility of North improved, although decades later, by the Schellingwouder bridge (1957), Coentunnel (1966) and IJ-tunnel (1968). North will be even better accessible after the opening of the new North/South metro line in 2018.

In the last decades or so, the popularity of Amsterdam has put a great pressure on the local housing market. As a response, the municipality of Amsterdam and the metropolitan area are planning to build tens of thousands of new housing units (a number that has been adjusted a few times already). A great number of new units are planned in North. The urban planning

and empty former industrial areas allow spatial possibilities for the construction of new housing units. As a result of new constructions and the stimulation of new pull factors in North, but no investments in improving its accessibility, the pressure on the ferries. traditionally the main (centrally located) mode of crossing the IJ for cyclist and pedestrian, has intensified greatly and has eventually exploded around the year 2016/2017. Naturally, this resulted in a collective call in favour of a bridge. Answering this public outcry, in mid-2017 the municipality of Amsterdam has expressed a preference for the development of a bridge crossing the IJ (Koops, 2017). The municipality of Amsterdam has allowed this to happen, as they were keen on new development but reluctant to improve the modes of transportation. I will discuss this in more detail later in the paragraph on symbolic politics.

Conceptual context: Speech, DNA, gentrification and symbolic politics

A city is extremely complex. Giving a useful definition of the city is then quite a difficult task. Sassen (2013; 2015) gives not only an inspiring, but also a more comprehendible definition of the complexity and incompleteness of the city, in which she allows to include the role of social and economic diversity in the contemporary (global) city:

> "Cities are the spaces where those without power get to make a history and a culture, thereby making their powerlessness complex. […] In this mix of complexity and incompleteness lies the possibility for those without power to assert 'we are here' and 'this is also our city'. […] The powerless leave their social, cultural and economic footprint in the city. This diversity gives cities its cosmopolitanism." (Sassen, 2015)
> "Cities are one of the key sites where new norms and identities are made." (Sassen, 2013: 211)
>
> "Cities are complex systems. But they are incomplete systems. In this incompleteness lies the possibility of making – making the urban, the political, the civic. The city is not alone in having these characteristics, but these characteristics are a necessary part of the DNA of the urban – cityness." (Sassen, 2013: 209).

The key features that Sassen gives to the "study of the urban", are incompleteness, complexity and the possibility of making. We should not perceive the city from a certain perspective, either with a personal of professional perception. A city is not a row of similar houses, or a build area, or a place for the happy few. Instead, and because, a city is incomplete, complex and gives possibilities for making.

Urban speech
The city responses systematically. The city speaks. The city has a capacity to generate speech. 'Speech' captures "the social and material physics of the city" (Sassen, 2013: 210). The city is then characterised as "an elusive mix of space, people, and particular activities, especially commerce and the civic" (Sassen: 2013: 210).

> Sassen (2013: 210) rests her notion on two matters. One is "the fact that the city is still a key space for the material practices of freedom […] and a space where the powerless can make speech, presence, a politics. The other is that these features of cities are under threat by a range of acute processes that deurbanize cities […]; these threats include extreme forms of inequality and privatization, new types of urban violence, asymmetric war, and massive surveillance systems".

We should, again, learn to listen to the city. To understand the features of speech in the urban realm. In processes of density, materiality and interaction, the city talks back. This speech is "a capability to alter, to shape, to provoke, to invite, all following a logic that aims at enhancing or protecting the city's complexity and its incompleteness." (Sassen, 2013: 214).

It is indeed power that can override the speech of the city, for example in megabuildings, highways running through the city or extreme high-income gentrification (Sassen, 2013). Sassen (2013) calls this 'deurbanizing trends'. Speech matters, because it secures cityness. The capability to talk, respond or of speech are constituted as hybrids, a mix of the material and social physics of a city. "It is about understanding a systematic dynamic that has the capacity to contest what is destructive to its DNA". A DNA that "is conductive to cityness and its diversities" (: 221). Deurbanizing forces "silence the speech of the city and destroy urban capabilities" (:221). Speech then is the key method to stop deurbanizing forces that threaten the local or neighbourhood DNA.

Gentrification

Slater (2014) talks about residents having a false choice between gentrification (reinvestment) and 'concentration of poverty' (disinvestment). "These processes have left residents of low-income neighbourhoods in a situation where, since they exert little control over either investment capital or their homes, they are facing the 'choices' of either continued disinvestment and decline in the quality of the homes they live in, or reinvestment that results in their displacement" (Slater, 2014). I would like to add that many residents tend to not have the social capital to realise the options they might have, but are rather (actively) seduced into thinking improvements are good while being unaware of the consequences.

In many European cities, including Amsterdam, there is no question of replacement of old residents by new, more affluent residents (Lees *et al.*, 2015). Gentrification these days, as Gent, Boterman and Hoekstra (2016) show, is more a process of symbolic politics, an empathy for the new urban middle class by civil leaders from similarity, and a clear preference for the new urban middle class. Gentrification is about money, not necessarily individual money or investments, but rather a financial game in which the financially strong players win their spot in the urban realm. It is a game in which the losers will have a sense of loss of place (Gent, Boterman & Hoekstra, 2016). The problem is that the DNA of the city and cityness are not being treasured, but are fading away. The consequences could include a serious effect on the competiveness of the city and local innovation. But even more important: the liveable city with identity that primarily focuses on its citizens, is lost.

A common misconception in gentrification is that it can be controlled or stopped, while, in fact, it is a dominant process that will not stop until the area is completely gentrified and changed. This is the nature of gentrification based on the increasing popularity of a neighbourhood and, simultaneously, continuous investments in order to increase profits.

Symbolic politics

Gent, Boterman and Hoekstra (2016), in a paper on gentrification in the area Van der Pek in Amsterdam North, clearly recognize the existence of symbolic politics in policies in the area Van der Pek in Amsterdam North, one of the first garden-village style areas in North. They state that this area is "neither a natural occurrence nor accidental, but the outcome of political 'choices' made at various levels of government at different points in time."

Gent, Boterman and Hoekstra explain how this symbolic politics occurs: “By introducing and facilitating cultural entrepreneurs and artists in the area – as part of regeneration and gentrification strategies -, the representation of what the neighbourhood is, and ought to be, gravitates towards the planners’ future vision.” (Gent, Boterman & Hoekstra, 2016: 2) In this process, the legitimacy of long-term residents is undermined as urban planners and city leaders accommodate for new residents by adjusting the area according to the consumption lifestyle of the new urban middle class (Gent, Boterman & Hoekstra, 2016).

As Gent, Boterman and Hoekstra (2016) demonstrate for one neighbourhood in North, symbolic politics seems to be a threat to the character of all garden-village neighbourhoods in North due to their similar social-cultural characteristics and their geographical location close to the IJ. Actually, municipal policy literally states gentrification as a positive process (Gent, 2013). Also, politicians and senior policy makers publicly advocate in favour of the social transformation of social-economic lower class areas (Gent, Boterman & Hoekstra, 2016). In this way, politics is actively, directly and indirectly, striving for replacing (a part of) the old inhabitants for new inhabitants, either voluntarily or through a ‘false choice urbanism’-mechanism. What is striking is that the social-cultural characteristics are replaced by (the urban planners’ and urban leaders’) perceived ‘better’ characteristics.

Why? To house the new urban middle class and find a solution for the shortage of affordable housing for this urban population group. Although new housing units could be developed to solve this issue, available housing units in existing social-economic lower class areas fits the preferences for this economically strong population group.

Bridge?
A bridge could unite social groups. In the case of the IJ in Amsterdam, the bridge seems to be used as a political tool to further accelerate gentrification in North, in particular in the garden-village areas. In fact, the bridge seems to be part of the symbolic politics of the municipality of Amsterdam and urban planners.

In North, the mix of complexity and incompleteness is still present. The DNA of North is being threatened because of deurbanizing trends, which are gentrification forces. On a city level, these forces destroy urban capabilities, affecting the city’s diversity and capability to innovate. The residents (of North in this case) should speak up, share their Speech-capacity, in order to preserve their cityness and make clear ‘we are here!’. The symbolic politics with which the municipality tries to change the garden-village areas in North, are indeed allowing false choice urbanism.

It seems that a metaphorical bridge is needed between policies from the City Hall and Amsterdam North, in which the DNA of the garden-village areas in Amsterdam North is respected.

In the current situation, a bad accessibility might be a better solution than a bridge connection. No bridge could preserve the social-cultural characteristics while the existence of a bridge could eliminate any ‘natural protection’ (by the IJ) and could further accelerate the dominant urban forces to cross the river.

Hypotheses: How to catch the perception of the residents of North?

This research mainly focused on the areas in North under threat of gentrification processes (Gent, Boterman & Hoekstra, 2016), which are the garden-village areas. In the garden-village areas reside in particular long-term residence: (descendants of) working class families with their own distinct social cultural characteristics. This is the urban culture that is generally under threat of gentrification. New residents in particular have different social-economic and (therefore) different social-cultural characteristics.

In this research, it appeared that the influx of other social classes is causing tensions between these different social groups in the garden-village areas. Additionally, higher educated new residents apparently have better social capital and a better network and as a result they will make their voice heard in the City Hall (see Gent, Boterman & Hoekstra, 2016) concerning improving the bad connection with the rest of the city, although this issue plays since the development of North in the 1920s and 1920s and has had only limited policy attention since. For this argument, I would like to assess the following proposition:

H1: *Higher educated, new residents prefer a better accessibility while lower educated, old residents prefer keeping their characteristics.*

A better accessibility can improve professional possibilities and decrease the distance to facilities. I expected especially the younger generations to confirm the preference for a better accessibility. According to this guideline, I assume:

H2: *Younger respondents prefer a better accessibility while older respondents prefer keeping characteristics.*

Methodology: Focus on the perception of inhabitants

Based on Sassen's Speech notion, in this research I intended to discover the perception of the inhabitants of North on the positive and negative effects of an improved accessibility.

In order to do this, I spread an online questionnaire with four open questions that intended to catch the perception of the respondents. The questionnaire was spread via a variety of Facebook groups, with in particular a variety in social-economic and social-cultural background of the members of the Facebook groups. The questionnaire had 388 respondents[3]. The respondents were stimulated to explain their answer with arguments in their own words.

At the time the questionnaire was spread, the public discussion on a bridge connection was quite intense: everyone seemed to have a clear opinion about the bridge plans. As a consequence, the questions had to turn away from this emotionally heated public discussion on a bridge, towards the perception of the respondents on accessibility, in which the respondents were given the opportunity to express their opinion in arguments.

I wanted to catch their speech. I captured the perception of the respondents by interpreting the arguments they gave in conceptual categories. Then I created an original database in which I counted every response per category as "1" when positive, otherwise "0" when negative. Subsequently, I tested my hypotheses through a chi-square test by which I could analyse the results in relation to the social profile of the respondents (mainly, education (high/low, age and years of residence (long/short).

Table 2: Perception of respondents on the effects of improved accessibility, analysed by social profile.

Answer category				Age category			Duration of residence in North		Education		
Optimistic answers:		N	%	<40	40-49	>50	< 10 years	> 10 years	Low	Middle	High
New focus on liveability/facilities/development	Yes	43	11.10	23	11	9	25	18	0	6	37
	No	345	88.90	142	74	139	105	240	16	125	204
Characteristics will not go away	Yes	36	9.30	19	4	13	20	16	4	7	25
	No	352	90.70	136	81	135	110	242	12	124	216
It is going to be better/change is good	Yes	31	8.00	17	9	5	19	12	0	3	28
	No	357	92.00	138	76	143	111	246	16	128	213
Improves social diversity	Yes	29	7.50	16	7	6	16	13	1	2	26
	No	359	92.50	139	78	142	114	245	15	129	215
Changes are already happening despite a good connection	Yes	30	7.70	15	5	10	12	18	0	9	21
	No	358	92.30	140	80	138	118	240	16	122	220
Better accessibility (geographical)	Yes	22	5.70	9	5	8	9	13	0	4	18
	No	366	94.30	146	80	140	121	245	16	127	223
North becomes part of the city (positive-emotional)	Yes	18	4.60	9	2	7	10	8	0	5	13
	No	370	95.40	146	83	141	120	250	16	126	228
Pessimistic answers:											
Social-cultural characteristics fade away	Yes	116	29.90	38	26	52	25	91	3	46	67
	No	272	70.10	117	59	96	105	167	13	85	174
Higher influx new inhabitants (negative)	Yes	60	15.50	20	12	28	10	50	2	29	29

	No	328	84.50	135	73	120	120	208	14	102	212
More tourists/crowdedness	Yes	57	14.70	26	8	23	17	40	3	20	34
	No	331	85.30	129	77	125	113	218	13	111	207
Dominance new inhabitants	Yes	29	7.50	9	7	13	6	23	1	16	12
	No	359	92.50	146	78	135	124	235	15	115	229
Negative effect on affordability and housing availability	Yes	24	6.20	9	4	11	7	17	0	9	15
	No	364	93.80	146	81	137	123	241	16	122	226

Note: The age categories are based on ‘new urban middle class’ (Ley, 1996) (<40), middle aged and older. The categorization of ‘Duration of residence in North’ is based on the type of answers given. Education is based on the Dutch educational system: low = no education, primary school or secondary school’ middle = MBO or equivalent; high = bachelor (HBO/university), master or PhD.

Table 3: Do respondents prefer a better connection or to preserve characteristics?

				Age category			Duration of residence in North		Education		
		N	%	<40	40-49	>50	< 10 years	> 10 years	Low	Middle	High
Better connection	Yes	155	39.90	69	31	55	80	75	3	34	118
	No	233	60.10	86	54	93	178	55	13	97	123
Preserve characteristics	Yes	167	43.00	51	36	80	142	25	11	79	77
	No	221	57.00	104	49	68	116	105	5	62	164
Both	Yes	51	13.10	25	16	10	25	26	1	13	37
	No	337	86.90	130	79	138	233	104	15	118	204

Table 4: Respondents perception on the effects of a better accessibility, analysed by social profile.

				Age category			Duration of residence in North		Education		
		N	%	<40	40-49	>50	< 10 years	> 10 years	Low	Middle	High
Effects are good	Yes	96	24.70	48	22	26	52	44	0	19	77
	No	292	75.30	107	63	122	78	214	16	112	164
Effects are bad	Yes	180	46.40	60	36	84	37	143	8	82	90
	No	208	53.60	95	49	64	93	115	8	49	151

Results: Perception on accessibility and, additionally, gentrification

This paragraph will display and discuss the result. I incorporated several quotes from respondents to illustrate certain findings.

Worries in relation to accessibility
Table 2 mirrors the main issues that residents of North worry about in relation to improved accessibility, both positive as negative. The table clearly underlines hypothesis one: higher educated recent (< 10 years) residents of North have another perception on the effects of an improved accessibility than lower educated long-term (> 10 years) residents of North. As the long-term residence are accustomed to the 'bad' accessibility, they understand that this bad accessibility nurtures their exceptional living environment. Newer residents, however, have a stronger relation with the other side of the IJ and therefor demand a better accessibility and connection.

Remarkable is the effect of an improved focus on liveability, facilities and development, because both long-term as recent residents value this effect and predominantly young respondents named this possible positive effect of an improved accessibility. North is a low-income, former working class area and the residents long for an improved policy attention after decades of more-or-less lacking policy attention for the residents of North by the municipality. This might relate to Slater's (2014) 'false choice urbanism'.

Better accessibility or preserving characteristics?
Table 3 also clearly underlines hypothesis one as well: higher educated relatively new residents have a preference for a better connection over preserving the characteristics of North, while lower educated long-term residence prefer to protect their characteristic living environment. Several respondents claimed both are important, however their social profile does not show remarkable data.

Bad or good effects of accessibility
Table 4 also shows that the perception of bad effects of a better accessibility is mainly shared by long-term residents, while the perception of good effects of a better accessibility is basically shared by both long-term as short-term residents. Age does not give an explanation or differentiation. However, in particular lower educated residents, and also higher educated residents, perceive the effects of an improved accessibility as bad, while in particular higher educated residents perceive the effects of improved accessibility as good.

Optimistic quotes
Many see the effects of an improved connection (for example a bridge) as positive. "A better connection(s) means to be a full part of the city of Amsterdam instead of a kind of unreachable attachment. So let's go with the bridge" (respondent 140; 192). Others point out the economic and cultural opportunities that come with a better accessibility (respondent 145). Others are drawn to the effect of a bridge on North becoming more attractive (respondent 166).

Several respondents are more sceptical about preserving characteristics and mainly support (and cannot wait for) a better accessibility, preferably a bridge connection. "Robinson Crusoe also wanted to leave his island" (respondent 169). "Time does not stand still. The city is growing and North has to deal with that" (respondent 273).

Pessimistic quotes
In particular long-term residents appear to have a strong opinion about newcomers[4]. "Nothing but trouble, and new inhabitants are going to decide how things should work over here" (respondent 37). "First no-one wanted to live in North and now it's hot. Better just stay away (respondent 37). However, they appear to understand quite well the underlying process of gentrification. Respondent number 366 relates the developments in North with North becoming a "normal" part of the city, including "increasing gentrification, increasing housing costs, more tourism and more interference by the municipality". "Be proud of this part [of the city]" (respondent 23).

Effect on segregation
Others point out an interesting feature: the current social balance that is under threat, and additionally increasing social segregation between old and new residents (respondent 43). Respondent 311 also emphasizes increasing social segregation. "In the last couple of years, North is more far than ever from an inclusive society", as she puts it. "[The characteristics] are already fading away with the arrival of new Amsterdammers: cargo bike-children on rubber boots with messy hair. They don't how to properly clean their windows… a real inhabitant of North keeps their street clean!" (respondent 22).

Chi-square test and significance
Table 5 indicates that the socio-economic profile is related to the perceived effects of an improved accessibility. I do not know yet if the correspondences are positive or negative, endogenous or exogenous, but the chi-square coefficients are all statistically significant. In this sense, the independent variables (age, years of residence and education) influence the perceptions of respondents who consider the effects of an improved accessibility is either bad or good. In other words, the hypothesis null is rejected by an alternative hypothesis of an independent relation in all cases, thus the perceptions of both young and old people, new and old residents as well as higher or lower educated people produce fragmented opinions on an improved accessibility.

Table 5: Social economic profile versus the perception on the effects of improved accessibility.

	Effects are good			Effects are bad		
Independent variables (X)	X^2 Test	*(K-1)*	Hypothesis test	X^2 Test	*(K-1)*	Hypothesis test
Age (ranges)	7.377*	2	X > Y	10.629**	2	X > Y
Years of residence	24.442***	1	X > Y	25.273***	1	X > Y
Education (ranges)	19.359***	2	X > Y	21.846***	2	X > Y

*Significant level at: * <0.05; ** <0.01; *** <0.001.

Table 6, in turn, points out clearer correspondence between age and the predominant perceptions of the residents of North. Age seems to be more correlated with 'preserve characteristics', while education and years of residence support the ambivalence of public opinion –the latter two correspondences are both highly and statistically significant-. More precisely, this chi-square test supports the idea that older people are more likely to preserve characteristics. However, both highly and lower educated people as well as new and old

residents present divided or contested perceptions where they are more likely to prefer both ‘better connection’ and ‘preserve characteristics.

Table 6: Social economic profile versus better connection/preserve characteristics.

	Better connection			Preserve characteristics		
Independent variables (X)	X^2 Test	*(K-1)*	Hypothesis test	X^2 Test	*(K-1)*	Hypothesis test
Age (ranges)	2.256	2	X = Y	13.836**	2	X > Y
Years of residence	25.658***	1	X > Y	45.211***	1	X > Y
Education (ranges)	21.854***	2	X > Y	32.332***	2	X > Y

*Significant level at: * <0.05; ** <0.01; *** <0.001.

Conclusion

The analysis of the results of the questionnaire demonstrate to some extent the taboo that lays upon public policy in favour of social-cultural lower class urban citizens. The new highly educated residents of North who, in some ways, invaded inhabited territory, try to influence public policy by using their human capital and, somewhat, dominative power instead of adapting to the new living environment that they recently moved into. This should be perceived as socially undesirable, as it is increasing social segregation, but is instead backed up by public policies.

Moreover, the public discussion on a bridge seems to be part of the symbolic politics by the municipality to cause a public outcry in favour of a bridge. Even though social diversity is essential in the urban economy and the city (Sassen, 2013), social homogeneity is preferred for no clear reason other than catering for ‘your own social class’. However, the consequences are quite clear and upon us like a real threat: increasing social homogeneity, rapidly increasing and high housing prices and a city for purely the elite; a homogenic sausage, in which the new urban middle class is poured into a sausage maker and a homogenic city flows out. Is this really what Amsterdam wants to become?

The solution to the dominant and destructive characteristic of gentrification and the new urban middle class lies in a (complete) focus on the current inhabitants and thereby not stimulating nor actively preventing gentrification and, subsequently, keeping the current social housing stock and catering for (current) inhabitants.

It is difficult to make a causal relation between accessibility and gentrification in North. Gentrification is already appearing in North in the Van der Pek area and the NDSM wharf. However, it is remarkable that gentrification did not appear in North for many decades, despite the short geographical distance from Central Station. I suggest this is the results of the lacking accessibility caused by the IJ as a metaphorical wall.

A bridge, and the plans for building a centrally located bridge, will most definitely further push gentrification into the garden-village areas in North. As long as there is a shared preference for gentrification processes in the municipality of Amsterdam, the urban district of Amsterdam North and in the social housing corporations, the social-cultural characteristics in

North and in Amsterdam are under threat of slowly disappearing. This is a result of the clear dominant nature of gentrification. Undeniably, this process and its effects can therefore not be stopped.

The social-cultural characteristics in North have emerged because of isolation. By erasing this isolated character, (complete) integration is being pursued. However, in a dominate process as gentrification, the vulnerable social groups and their social-cultural characteristics should be protected or else they will be erased in the process.

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[1] The IJ looks like a river, but is in fact a former estuary of the South Sea. Currently it interconnects the IJsselmeer (formerly known as South Sea), the Amsterdam-Rhine Channel, Port of Amsterdam, North-Holland Channel (opened 1824) and the North-Sea Channel (opened in 1867). Therefore, it can be perceived as a (quite busy) river.

[2] By annexing the municipalities of Buiksloot, Nieuwendam (with the village Zunderdorp) and Ransdorp (with the villages of Schellingwoude, Durgerdam and Holysloot).

[3] The sample is representative to a population of 92917, with 95% confidence levels, 5% sampling error and a 50% occurrence rate.

[4] Note: Amsterdam people, and also Dutch people, are known for their directness and strong opinion. One could say it is part of their cultural characteristics.

The Bridge as a Barrier – the Ibar Bridge in Mitrovica

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Introduction

The area nowadays known as Southeastern Europe or, in vaguer terms, "the Balkans" is a region of bridges, in a double sense. For centuries, this seemingly impenetrable and mountainous peninsula has connected the center of Europe and its Eastern outskirts on the way to Asia Minor. It brought different cultures from West and East to meet, assimilate or fight each other (cp. Todorova, 2009, 15f. on the ubiquitous notion of the Balkans as a transitional region). Furthermore, it is a land of bridges in a literal sense, hosting hundreds of ancient and modern pathways that traverse the mountainous terrain.

The bridge metaphor has been explored in additional ways, first and foremost as a metaphor for reconciliation, usually condensed in the description of "bridging divisions" (e.g. Björkdahl & Mannergren Selimovic, 2015). Where bridges were being rebuilt, so was society. But the wars of the 1990s have revealed that a bridge – both physical or metaphorical – can fulfill the oppositional function: to pose as places of contention, of conflict and destruction (cp. title "The bridge betrayed" by Sells, 1996). While the deliberate destruction of bridge structures as icons of cultural heritage has been researched extensively, little has been written about places of conflict where physical destruction didn't occur. Such is the case with the Ibar Bridge in Kosovo's northern city of Mitrovica, where tensions have lingered in the shadow of the Kosovo War for the last two decades. This paper aims to lay out the historical preconditions for the conflict and the youngest developments around Ibar bridge. An examination of the role of the bridge itself in the conflict concludes the paper.

A portrait of Mitrovica

Mitrovica (Serbian: Mitrovica, Albanian: Mitrovicë), commonly also known as Kosovska Mitrovica to differentiate it from Mitrovica in the region of Syrmia in Serbia, is a city and community in the north of Kosovo.iii The cityscape is shaped by the confluence of river Ibar und river Sitnica.

While the Sitnica river surrounds today's city center in a loop to the east, river Ibar cuts through the center of the municipality, creating two separate population centers on its northern and southern shore. The hinterland of northern Mitrovica is populated mostly by Serbs, Roma and Bosniaksiii, with some Albanian enclaves. In practice, northern Mitrovica is an enclave of Serbian population: bounded by the mostly Albanian parts of the city in the south, the loop of river Ibar to the east, and a chain of Albanian settlements upstream to the west, with the next Serbian settlement being the westward village of Zupče some 7 kilometers away (Luković, 2007: 83–85).

The oldest remaining structures in the area are the remnants of Zvečan/ Zveçan Fortress north of contemporary Mitrovica's city center. After the area was taken by the Ottomans in 1459, the population constituted itself of Turks. Albanians arrived after the area had been abandoned by Serbs in the so-called Great Migration, following the retreat of the Austrian Army after the recapture of Serbia by the Ottomans in 1690 (Luković, 2007: 100). Mitrovica saw the opening of a railway in 1873 and grew to regional importance as a trading center, by accounts from that time being economically on par with major settlements like present-day Priština/ Prishtina (Luković, 2007: 93). This function was increased furthermore by two events: Firstly, by the arrival of so-called muhajirs in the late 19th and early 20th century, traders from Bosnia that founded the old mahala quarter. The neighborhood is nowadays known as Bošnjačka mahala (Luković, 2007: 96) and was described earlier as Saraj Mahala (Stern, 1916: 86).

The second economic boost was caused by the opening of a mine in Trepča ca. 1930 for the extraction of noble metals. With the economy, the population grew and diversified (Luković, 2007: 99). In the phase of economic prosperity and opening of the city for international trade a lot of new population groups arrived, among them Muslims from Mojstir (today in Montenegro), Albanians from today's Đakovica/ Gjakova and Serbs from all corners of the Kosovo plains (e.g. contemporary Priština, Vučitrn, Peć and Prizren), as well as Slavs from Macedonia and a community of Roma (Luković, 2007: 101).

After a lot of Muslims left the area after it had been taken by Serbia in the First Balkan War, the 1920s saw a new influx of Albanian population. While censuses were held quite regularly in Yugoslavia, changing ethnic labels used to collect the data hinders comparability.[iv] (Musaj, 2015: 87) Still, it remains evident that Mitrovica retained a mixed, multi-ethnic character throughout the 20th century, at least until the 1990s (for numbers cp. Luković, 2007, 102f.). Meanwhile, Kosovo as a whole become majority Albanian, because the high fertility made up for effects of emigration from the area (Rathfelder, 2012: 42). The advent of the Kosovo War changed the ethnic makeup of the city permanently. To examine the conflict in a meaningful way, a short primer on its history is needed.

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[i] For parsimony, the name of the city will be given as "Mitrovica". General disclaimer: Any other names that denote contemporary places in Kosovo will be given in both Serbian (Latin alphabet) and Albanian. When talking about Yugoslav times, place names will be given in Serbian.

[ii] The status of Kosovo is disputed. The province declared independence from Serbia in 2008 as "Republic of Kosovo". Serbia does not recognize the declaration and deems Kosovo part of its territory.

[iii] The term "Bosniaks" denotes an ethnic group of Slavic origin and predominantly Islamic faith, originating in Bosnia and Herzegovina.

[iv] Since 1961, people could identify as "Yugoslav", which blurred the results. The category of "Muslim" was then meant to apply to people of "Yugoslav" origin, but not to the Albanian population (Musaj, 2015: 87). Still, the differentiation between "ethnic" Muslims and Muslims "just by faith" (which potentially included Slavic Muslims, Turks, Albanians etc.) followed only later, by creating the categories of "Muslimani" (capital M) or "muslimani", respectively (Sundhaussen, 2014: 29–31). 1961 saw a change in the denomination intended for the Albanian population, from "Šiptari" to "Albanians" (Luković, 2007: 102). The influence of Islam on Albanian ethnic identity is limited (Grulich, 1999: 242).

The Kosovo conflict – a short overview

Kosovo was in Yugoslav times an autonomous province within the Socialist Republic of Serbia, which itself constituted one of six republics that constituted up the Socialist Federal Republic of Yugoslavia. Kosovo was and still is home to ethnic Serbs and ethnic Albanians, plus a share of different small minorities.

Albanians have been in the area since ancient times. Despite a degree of later assimilation with the Slavic and Roman population the Albanians preserved their old traditions and the Albanian language, which does not bear strong resemblance to any other European language. The exact time frame and modalities of ethnogenesis are unknown (Maliqi, 1999, 120f.; on the Albanian language Fortson, 2010, 446f.). Serbs came to the area in the 7th century, as part of a greater Slavic migration. The term "Serbs" itself was just one name of a few dozen recorded names to denote the mix of older tribes and new arrivals that was the Slavic population back then (Ćirković, 1999: 16).

After ethnic tensions between Albanians and Serbs in the province of Kosovo had been growing throughout the 1990s amid discrimination of the Albanian population, the province saw the formation of the so-called Kosovo Liberation Army (Ushtria Çlirimtare e Kosovës, short UÇK). The UÇK engaged in violent attacks against Serbian authorities and was initially deemed a terroristic organization in the international community Albanians sought the establishment of their own underground parallel institutions, such as institutions for education and a provisional assembly. In 1999, a NATO coalition intervened on the side of the Kosovo Liberation Army (UÇK). The UÇK had been engaging in armed conflict with the federal Yugoslav Army, which was under Serbian control (recommended overview in Judah, 2008, 64ff.; Rathfelder, 2012).

In the ensuing war NATO troops took the province of Kosovo and forced the Yugoslav army into retreat behind the river Ibar. There it came to a halt, resulting in a ceasefire line along the river that left the northern parts of the province of Kosovo under Serb control. Why NATO didn't push the offensive further north remains unclear to this day (also observed by Rathfelder, 2012, 216f.) and is the source of speculation and conspiracy theories – the most prominent theory being that the northern parts were left as a later price for negotiation (account given to author on site).

Mitrovica 1999: displacement and segregation

Kosovo Serbs now concentrated in the northern parts of the country, in the municipalities of - Leposavić, Zubin Potok and Mitrovica, which were not taken by the NATO forces. Serbian enclaves in the heart of the country mostly vanished, with exception for example in the area around Štrpce and Gračanica. The Albanians remained in the south of the municipality and fled from the northern parts (For illustrative purposes compare the map given in Organization for Security and Co-operation in Europe, 2008: 32). The imaginary border between the new population centers ran and still runs through the city of Mitrovica, aligning with river Ibar. Therefore, the city of Mitrovica exemplifies the ethnic distribution of the whole territory of Kosovo like a „microcosm" (Knaus, 2005: 73).

Population figures in Mitrovica are contentious since after the 1991 census. The latest census with international recognition took place in 2011 under guidelines given by EUROSTAT and the United Nations, but still remained flawed (cp. Musaj, 2015, 89ff. and the warning note by the European Center for Minority Issues (ECMI) in Peterson, 2013). The population in

Mitrovica North could not be assessed due to boycott of the 2011 census by Serbs living there. The September 2015 estimate by the OSCE counts 22530 Serbs living in Mitrovica North and surrounding villages, outnumbering a local population of approx. 4900 Albanians. While the latter are participating by a small share in providing local services like the police, most Albanians choose to obtain their healthcare from Mitrovica South (Organization for Security and Co-operation in Europe, 2015a). The findings for Mitrovica South indicate virtually non-existent Serbian presence (Organization for Security and Co-operation in Europe, 2015b). Accordingly, for the purposes of this paper the shores of the river can be accurately referred to as the Serbian or the Albanian side.

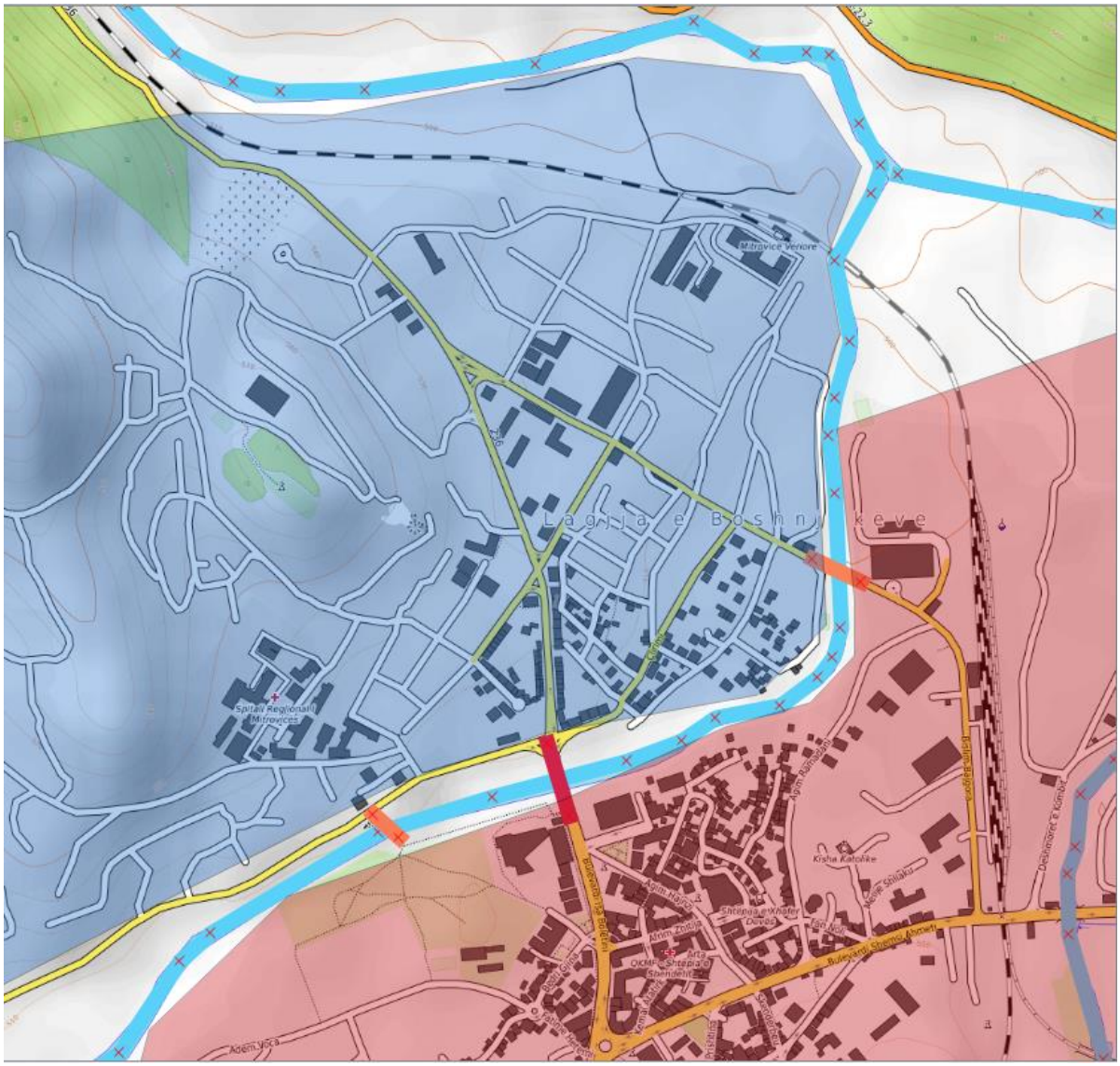

Illustration 1: Schematic ethnic distribution of Mitrovica. Serbian parts in blue, Albanian parts in red. Ibar bridge marked red in the center, note adjacent bridges. Source: Screenshot of OpenTopoMap at scale 1:12.000, own colorization; Attribution as requested by creator: OpenStreetMap-Mitwirkende, SRTM; Kartendarstellung: © OpenTopoMap (CC-BY-SA); basemap taken from opentopomap.org.

Post-war: opposing claims

After the war ended, all of Kosovo was placed under international administration, the United Nations Interim Administration Mission in Kosovo (UNMIK). The administration was authorized by the Security Council (United Nations Security Council: S/RES/1244, 1999). After the end of the fighting, passage across the bridge was controlled by NATO troops. Meanwhile, the legal status of the territory was left in limbo, since resolution 1244 as the basis of the international presence affirmed the integrity of Yugoslavia (United Nations Security Council: S/RES/1244, 1999, preamble (p. 2)). De facto, Kosovo soon became partitioned along river Ibar.

UNMIK worked towards the prospect of a united Kosovo. Yet it refused to enforce an opening of the town, fearing a bloodbath. Special Representative Kouchner emphasized that the Serbs viewed the northern shore as their safe haven. The KFOR presence on the bridge angered Albanians from the south, as it restricted their freedom of movement throughout "their" country. Furthermore, war criminals were given the ability to hide in northern Mitrovica (Erlanger, 1999).

The post-war period was characterized by two opposing claims: Both the Serb and the Albanian side consider(ed) Kosovo, i.e. all of Kosovo, legally theirs. Kosovo-Albanian authorities and politicians demand(ed) free passage across the bridge to the north of the territory, a claim that was further substantiated by the declaration of a Republic of Kosovo that also encompasses Mitrovica North in 2008. The demand for “reunification” of the northern shore with the rest of municipality within the declared Kosovo Republic has been featured in recent election campaigns (e.g. KosovaPress, 2017). Serbian representatives (from Mitrovica North and Belgrade) sought and still seek to redevelop the bridge and its surroundings. Since the south of the allegedly Serbian land of Kosovo has already been „conquered“, the bridge in Mitrovica North for them symbolizes the last stronghold against Albanian invasion from the South and the most prominent remnant of Serbian life in Kosovo. Accordingly, they show in interest in fortifying the bridge, in a move to protect their own safety and defend Mitrovica North against the feared Albanian takeover. Free passage may be a long-term goal, although de facto, a return of all of the territory into Serbian control seems unlikely.

2001: a “new bridge” between communities?

In an effort to bridge the divide the French Government funded the renovation of the Ibar bridge in 2001. Contractor of the new steel-truss structure was the French construction company Freyssinet (No Author, 2001; Russell, 2005). The bridge was built by a multi-ethnic team of 61 workers, the project was deemed a success (contemporary acclaim by Beardsley, 2001). The worker’s names are engraved in the bridge’s internals until this day (Aliu, 2017).

The new bridge so far failed to meet its objective of connecting the two communities alongside the river. Growing tensions within Kosovo escalated into major unrest across the territory in 2004. Mitrovica proved to be a hotbed of conflict. Albanians stormed the bridge and laid gunfire onto the north, a move resulting in several casualties on both sides (cp. contemporary UN report: United Nations Security Council: S/2004/348, 2004).

The escalation proved that alienation had grown since the official end of the Kosovo War. The two populations subsequently had become more and more alienated in the post-war period. In the north, a Serbian de-facto micro-state had evolved, with backing from Belgrade. On the surface, it emulated numerous characteristics of statehood, among them own public institutions for healthcare and judiciary, registration of cars with the state of Serbia and salaries for the administration from Belgrade. Furthermore, the Serbian state initially transferred payments to so-called Bridge Watchers, a privately organized security force "guarding" the bridge, largely undisturbed by KFOR or UNMIK Police (Organization for Security and Co-operation in Europe, 2003). The bridge came to resemble an international border, which it never was.

Symbolic construction

Both sides tried to emphasize their claim to the territory through construction work. The Serbian side tried to use the bridge as a barrier against the Albanian side. Roadblocks were set up all across the northern municipalities and the bridge access was blocked numerous times, most notably in 2011 and 2014, the latter resulting in clashes on the bridge (Lowen, 2011; No Author, 2014). The year 2014 saw the creation of a „Peace Park" by Serbs in Mitrovica, de facto a barrier that was removed two years later (Hopkins & Peci, 2014; Morina, 2016a). Last year, a wall facing the bridge was built on the Serbian side, allegedly for protection of the promenade against landslides, but was teared down after an agreement was reached (Morina, 2016b).

Through symbolism, both sides tried to reclaim the bridge's surroundings, that now guarded by an array of memorials. The northern side saw the erection of a "Monument of Truth" from 2007 that commemorates Serb victims of the NATO bombings and actions by the Albanian Kosovo Liberation Army (UÇK) (No Author, 2007). On the Southern shore, the end of the pedestrian area is guarded by a statue of Isa Boletini from 2012, an Albanian national hero known for fighting against Serbian troops in the First Balkan War (KosovaPress, 2012). Both monuments provide opportunity for displaying national emblems close to the river as provocation.

Why this bridge?

The previous part of the paper has established that the central bridge in Mitrovica has over years developed into a conflict hotspot in the area. What contributed to the central role of the bridge in Mitrovica for political conflict? This second part will examine the push factors that led to this particular bridge becoming the central stage for unrest.

Location on front line?

Bridges connect and separate at the same time. They traverse physical obstacles, may it be a river, a valley, or a railway. By overcoming these obstacles, they also emphasize their presence. What implications does this have for ethnic distribution? Are bridges naturally prone to becoming barriers of ethnic segregation when there is a conflict present? The example of Vukovar makes a claim for the opposite case.

The Croatian town of Vukovar is located on the rivers Danube and Vuk. In recent years, tensions have worsened between the local Croatian and Serbian population. Vukovar is

famous for suffering almost total destruction when it was captured and besieged by the federal Yugoslav Army in late 1991. During the capture in November 1991, Serb forces carried out atrocities against Croatian soldiers and civilians. The city remained under Serb control until 1995, when a transitional administration was established by the United Nations. It was then transferred back to Croatia peacefully in 1998 and nowadays lies on Croatian soil (Weinstein & Stover, 2004, 7f.; from a military standpoint Central Intelligence Agency, 2002, 93, 99f.). The shared contentious past proves difficult for coexistence of Serbs and Croats in the city, with both sides often seeking dissociation from each other – for example by supporting a segregated school system (Čorkalo et al., 2004: 156).

Despite these contentions, the current ethnic geography in Vukovar presents itself as colorful, although the development of the predominantly Serbian settlement of Luzac marks a tendency towards urban segregation (cp. map in Baillie, 2015: 42). Accordingly, so far the bridges over the narrow stream Vuk aren't signifiers of communal division and the division between the communities is just a "psychological wall" (Čorkalo et al., 2004: 143). Only the Danube riverside can be considered a spatial reference axis. The international border between Croatia and Serbia follows the course of the river, with the Vukovar promenade facing Serbia to the east. Both Croats and Serbs are determined to redevelop the promenade in their interest – to either fortify it as the Croatian border or connect to it to the Serbian mainland – and have erected a number of monuments (Baillie, 2015: 41).

This can be explained by tracing the frontline at the end of the war. The city was captured quickly, fell in November 1991 and subsequently remained under Serbian control long after the end of hostilities in the Yugoslav wars of succession. The city as a whole changed hands without further being divided in two by a ceasefire line cutting through it. Instead, the political conflict could be traced alongside a ceasefire line to the west of the city (cp. map in Baillie, 2015: 42 and illustration in this paper). Peaceful reintegration of the city into Croatia was completed in 1998. This shifted the focus to the newly established international border to the east, which is clearly and effectively marked by the Danube river. By negation we can infer that the presence of a central bridge does not create the conditions for a conflict hotspot, but that local geography and conflict geography have to match.

Local geography?

This fits exactly the case of the central Ibar bridge in Mitrovica. The bridge became the center of the conflict as a result of local geography. As the northbound movement of KFOR troops came to a halt at river Ibar, the bridge became a point on the frontline and later ceasefire line. The subsidiary bridges are located off-center and therefore didn't draw that much attention. Still, an argument can be made that Mitrovica demonstrates the proneness of bridges to becoming conflict hotspots: Since rivers segregate space, frontlines tend to follow their course. In settlements that are developed around rivers, bridges become the center of attention. Control of the bottleneck that is a central bridge is of highest military importance.

Heritage?

Much has been written about deliberate destruction of heritage in warfare – may it be Ferhadija mosque in Banja Luka, the city library in Sarajevo or, most famously, the case of Stari Most in Mostar. The latter was deliberately shelled in an act of ethnic warfare by Croatian militia in 1993. Mostar's Old Bridge stood as testament to both peaceful coexistence

and historic Ottoman presence in the area and was thus perceived as a threat to Croatian life in the area. The cultural heritage was identified as a symbol of identity and history, which they then tried to eradicate (cp. Coward, 2009, 1ff. for an introduction).

When one compares Mitrovica to different cities in Kosovo or throughout the Western Balkans, Mitrovica is not especially laden with cultural heritage (cp. Schwartze, 2012: 222). Nevertheless, the crossing of river Ibar has been a staple of life in the city for centuries, at least since Ottoman times. But curiously, the bridge itself is not a positive projection surface for either side – the author's search for heritage narratives surrounding the origins or the recent fate bridge turned up no results. In older accounts of the townscape of Mitrovica, there is no emphasis on the bridge itself. For example, the Ottoman-era description given by Georg Stern, which is based on an account from 1892, just casually mentions the bridge by the name of "Ibar bridge", stating: "Stretching straight from the Ibar Bridge to the aforementioned hilly terrain at the southern exit of the city, a wide road, around which left and right the separate quarters are grouped, is traversing the settlement. At this main road lies the Čaršija [central square and heart of urban life in Ottoman cities, the author], the Bazar, then the main mosque. Here one notices a few prettier and bigger houses, which indicate a certain wealth of their owners" (Stern, 1916: 87, author's own translation from German). Predecessors of today's "New Bridge" in Mitrovica served as mere traffic hubs that didn't derive fame or recognition from their presence.

With no historic precedence to build on, the bridge has been free from affiliation with either faction since the wake of the Kosovo war. If it is connected to any force at all, the new steel bridge is associated with a broad imagination of "the West" as an influence in the area: built with foreign money under the foreign provisional government of the United Nations, both Serbs and Albanians perceive the bridge as a symbol for the failed internationally administered transition to a stable democracy in the first post-war decade (Schwartze, 2012: 226).

As it was not affiliated with either of the conflicting factions, the crossing of river Ibar in its material form never attracted violence onto itself – neither during, nor after the war. Instead, the bridge simply acts as a stage for political protest, provocation and clashes between the opposing parties.

Mitrovica today

The analysis showed that the Ibar Bridge in Mitrovica became a central stage of post-war conflict through the combination of two factors. Local geography and ceasefire line at the end of the war matched, so that the population segregated along the river, making the bridge a bottleneck in between. As opposed to other famous bridges, cultural heritage is not a contribution factor to the recognition.

Today, the distribution of residency in the area of Mitrovica proves to be nearly ethnically homogenous (see above). The area around the bridged remains affected by the conflict. During the author's last visit in March 2017, the bridge was guarded by KFOR and Kosovo Police. The presence of the latter marks a progress in fostering a dialogue between Belgrade and Prishtina. Life in Mitrovica North revolves around a central street that is an extension of the bridge way. The street is currently undergoing construction that develops it as the urban center of Mitrovica North (A similar impression is shared by (Luković, 2007: 86). The cityscape on the opposing side is gravitating toward a major roundabout two kilometers South of the river. At the roundabout, a new mosque (Xhamia e Zallit) of impressive

dimensions has been built. Major roads lead to a newly built university, shopping malls and a hospital. As a result, the bridge drifts away from the gravitational center of urban life in the (joint) area of Mitrovica, while continuing to serve as a stage for political conflict.

However, despite the overwhelmingly Serbian populace, public signs of Albanian live could be spotted in the adjacent borough of Bošnjačka mahala. The name indicates that this has historically been the neighborhood of, among others, a Bosniak minority population (see above). Traces of the historic multi-ethnic character of this quarter remain. A number of shops put up their offerings in both Serbian and Albanian language. Women wearing headscarves could be seen sorting through the sales displays. Traffic for delivery between the shores continues to flow over the adjacent bridges. While the Serbian Dinar has become the de-facto currency of Mitrovica North, some stores also accepted Euro, which is used as currency in the Republic of Kosovo.

The EU supports the goal of free passage by funding restoration efforts. In 2015, four landmark agreements between Belgrade and Prishtina/ Pristina were brokered through the efforts of EU High Representative for Foreign Appairs and Security Policy Federica Mogherini (Jovanović 2015), one of which also foresaw the soon reopening of the bridge (European External Action Service 2015). The reopening was delayed to May 2017 (Isufi, 2017), but this date also passed without results. As of today (October 2017), road traffic across the bridge is still blocked and demonstrates effectively the notion proposed in the beginning – that pathways can also serve as barriers.

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The Main Directions taken by Road Bridges in the 20th Century

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Abstract

By the end of the 20th century, road vehicles were transporting people and goods on an unprecedented scale. The success of individual motorised transport is closely linked with stages in the development of road bridges for German motorways. Prior to the Second World War, three types of bridge indicated their capabilities by way of initial pilot projects. After 1950...prestressed concrete– the “overcompression” of cracked tension zones in reinforced concrete beams by means of pretensioning with high-strength steel tension members cast into the concrete to form an efficient overall cross-section –steel-concrete composite– the structural jointing of rigid reinforced concrete and structural steel parts to form a complete cross-section –steelwith directly trafficked orthotropic steel deck and their consummation in cable-stayed bridges with prestressed cables developed their standard rules for construction within just 10 years, connected their individual loadbearing elements to form integrated structural systems and started to optimise their construction within the following five years. Continuum cross-sections developed for their superstructures, thus allowing the forms of construction to be interchanged.

The innovation phase for joining the parts of the cross-section (1900–1945)

As the 19th century drew to a close, engineers were able to use iron and steel to build bridges to cross large valleys and rivers. Using elastic beams and arches, but also suspension bridges in tension, they had developed the primary forms of loadbearing structure that enabled transport routes to be planned without constraints.

However, what all the successful forms of trussed framework had in common was that they were assemblies of inhomogeneous, planar structural systems in which the individual loadbearing elements functioned strictly separately and were added together to create the total load-carrying configuration. The loadbearing elements functioned independently of each other and in each case transferred their loads to the next loadbearing element without considering the overall loadbearing behaviour of the structure (Weitz; 1975).

1.1 Steel-concrete composite bridges prior to 1945

Monier’s reinforced concrete slabs, which Mathias Koenen had brought to the attention of engineers in 1886, gave the building industry an unruly competitor to the theoretically advanced yet still additive arrangement of iron or steel members shortly before the start of the 20th century. François Hennebique (1842–1921) employed the brilliant idea of exploiting the properties of reinforced concrete to form a complete structure made up of slabs and plates for the superstructure of the Pont sur Vienne in Chatellerault (1899).

The predecessors of reinforced concrete were “bonded beams” – suspended slab or smaller bridge structures with rolled or riveted beam sections encased in concrete. A bridge with rolled beams encased in concrete was built in Ravensburg, Germany, as early as 1876.

It was in 1926 that the Swiss railway engineer Jim Adolph Bühler (1882–1951) verified the high transverse distribution capacity and hence joint load-carrying behaviour of the beam sections and the surrounding concrete of these bridges. Encasing the economic rolled beams in concrete became the standard method of construction for the Deutsche Reichsbahn (German State Railways) in 1911. This form of construction was also used successfully for road bridges (Pelke & Kurrer, 2015).

Beginning in the USA, the form of construction named after its inventor Joseph Melan (1853–1941) branched off from this around 1894. Cast-in trussed frameworks support the

total cross-section by sharing the load through additive tension and compression members (Eggemann & Kurrer, 2009).

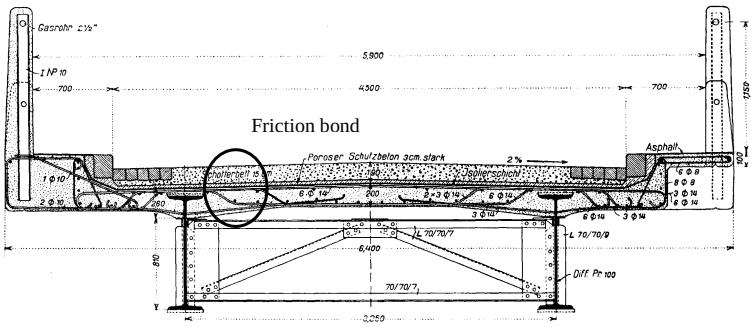

Fig. 1: Cross section Achergg Bridge Switzerland, 1914 Source: T.K.V.S.B. (1944)

The beam sections were gradually separated from the superfluous concrete. Starting with arch-like recesses between the beams, the bonding decreased until, in the end, only the top flange was encased.

At Acheregg Bridge on Lake Lucerne (1914), the Swiss engineer Arthur Rohn (1878–1956) was one of the first engineers to link longitudinal and transverse systems to form a common beam. The modern look of this cross-section is remarkable even today (Fig. 1).

In Switzerland in 1925, angles were retrofitted with rivets to attach new reinforced concrete slabs to existing iron longitudinal deck beams in order to increase the load-carrying capacity of existing bridges (T.K.V.S.B., 1944).

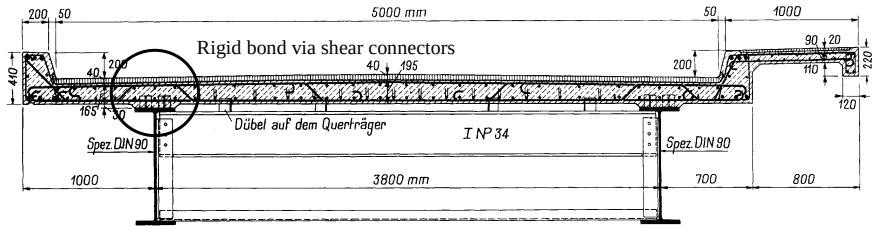

Fig. 2: Cross section Willerzell Viaduct Switzerland, 1936 Source: T.K.V.S.B. (1944)

The bridge projects in New York City between 1928 (Goethals Bridge) and 1936 (Triborough Bridge) provided ideas on the path to the steel-concrete composite cross-section. Their long spans called for weight-saving, efficient decks and led to the concept of using mechanical shear connectors to join the reinforced concrete deck to the longitudinal beams underneath (Bowden, 1938). That led to the development of the first successful steel-concrete composite bridges, which were known as “slab and stringer bridges” and had a quasi-rigid bond between the materials (Paxson, 1934). The same period saw the construction of Leven Bridge in Tasmania, Australia, which was a very early steel-concrete composite bridge with safe transmission of bond forces for reinforcing bars (Knight, 1934).

The Swiss engineers Adolph Bühler Fritz Bühler (1891–1959) designed the first European steel-concrete composite bridge with rigid bond in 1936. A rigid shear connection joins the two deep beam sections to the directly trafficked reinforced concrete deck (Fig. 2). The forerunners of the open continuum cross-section for the steel-concrete composite form of construction had thus been shaped.

1.2 Steel bridges prior to 1945

On the other hand, the lightweight construction requirement in compliance with the doctrines of the National Socialist government remained a specifically German approach. It had its origins in the government's "four-year plan of 18 October 1936" and served, in preparation for war, to direct large quantities of steel to the armaments industry.
"Braced curved plates", an optimised form of the well-known pressed plates, were the only contribution to steel-concrete composite forms of construction by German engineers in this period. This development can be attributed to the deck of the first road bridge over the Rhine at Worms (1900) (Fr. E., 1900). The engineers of the Bridges Department of Maschinen-Actiengesellschaft Nürnberg (MAN A.G.) in Mainz-Gustavsburg built it from 8 mm thick iron plate, which is supported by longitudinal beams every 1.25 m and has a 10 cm thick concrete topping connected to the plate by riveted iron Z-sections. Wooden block paving bedded in asphalt served as the wearing course. The – at the time – very lightweight deck to the bridge over the Rhine at Worms and the braced curved plates mark the fork in the road leading to steel-concrete composite solutions on the one hand, orthotropic decks on the other.

Fig 3: Cellular steel deck Flyover near Juningen Germany, 1936
Source: SAAI Karlsruhe

Although it could not achieve the same weight-savings as steel-concrete composite construction, German engineers put all their efforts into state-supported lightweight steelwork construction (Schaechterle & Leonhardt, 1938). Here again, American bridge projects provided the inspiration. On the one hand, very lightweight decks, such as the "T-Tri-Lok-bridge construction", and, on the other, the "battle-deck-floors", closely spaced rolled beam sections supporting flat plate spanning one-way with 2.5 cm thick asphalt blocks. The flat plates and the beam sections were welded together (Seegers, 1950). A particular attention would be paid to the deck replacing of the Smithfield road bridge in Pittsburgh, Pennsylvania USA, in 1933, by stiffening aluminium plate (Reppert, 1933).
The robust American deck structures were initially developed further by the company engineers of MAN A.G. to create lightweight steel decks. Their "bridge deck assembled from rolled sections" was granted a patent on 10 July 1934. Curiously, the granting of this patent was not made known until about nine years later, a fact probably due to internal differences with the two other advocates of lightweight steel decks on the side of the authorities: Karl Schaechterle (1879–1971) and Fritz Leonhardt (1909–1999). This patent, which was never put into practice, describes separate welded deck elements made from groups of beams and a deck plate that transfers its loads to a system of secondary beams.
It was left to Schaechterle and Leonhardt to weld the deck plate directly to the longitudinal and transverse beams to form a cellular steel deck. After their "lightweight" deck on a works road in Hamburg had successfully passed the series of tests of the Materials-Testing Institute in Stuttgart in June 1934 did the Gesellschaft Reichsautobahnen (State Motorways Corporation) decide to adopt the cellular

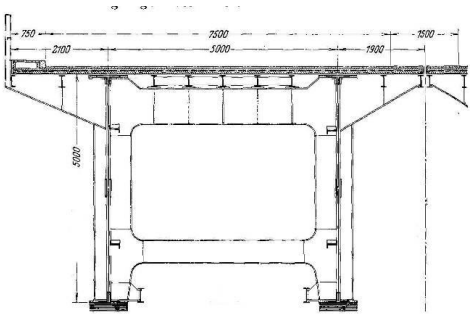

Fig 4: Steel upper flange of main beams with stiffened steel flate deck plate - proposal by W. Winkel, 1936

steel deck for a structure on the motorway at Kirchheim/Teck and for accommodation crossings at Jungingen (1934) (Fig. 3) and near Hamburg in 1936.
It might be attributed to the onset of development that by assuming a pure membrane, overoptimistic deck plate thicknesses (7 mm at Jungingen 10 mm at Kirchheim-Teck) and support spacings were chosen. The cellular steel decks of Schaechterle and Leonhardt are technical milestones on the road to the steel continuum cross-section (Seegers, 1950).
A final, yet crucial, step prior to the Second World War was taken in 1936 by the engineer W. Winckel from the Seibert company in Saarbrücken (Fig. 4). He designed a steel beam bridge in which the upper flange of the main beam was replaced by a stiffened flat deck plate (Winckel, 1939). Otto Eiselin (1896–1962) provided the first theoretical principles behind Winkel's design proposal (Eiselin, 1938; Weitz, 1975: 6).

1.3 Prestressed concrete bridges prior to 1945

The idea of pretensioning concrete developed between 1886 and 1930 and a number of patents were granted (Pelke, 2011: 99). Whereas the German building authorities exerted a great influence on the history of steel-concrete composite and steel bridges, they made virtually no contributions to the development of prestressed concrete.
That development is closely linked with the Dyckerhoff & Widmann A.G. and Neue Baugesellschaft (NBG) Wayss & Freytag A.G. companies. All the more amazing as prestressed concrete bridges are very closely linked with the ideological concept of saving steel.
In 1935 NBG Wayss & Freytag A.G. board member Karl W. Mautner (1881–1949) helped to acquire the patent of Eugène Marie Leon Freyssinet (1879–1962) (Grote & Marrey, 2000). Dyckerhoff & Widmann A.G. relied on the ingenuity of its senior engineers Ulrich Finsterwalder (1897–1988) and Franz Dischinger (1887–1953).
Of the pre-1945 pilot projects, it was only those bridges based on Freyssinet's patent that determined future developments: "Bauer Hesseler" and the Pont d'Elbeuf (Grote & Marrey, 2000).
The small crossing at Oelde, Westphalia, dating from 1938 (Fig. 5) has four longitudinally and vertically prestressed precast concrete beams, cast in a heated prestressing bed, which were completed on site with an in situ concrete deck. The so-called Frankfurt and Dresden tests carried out on the occasion of constructing the crossing meant that this small structure had a significant influence on the first German code of practice for prestressed concrete – DIN 4227, 1953 ed. (Mörsch, 1943). Even in the late 1950s, assuming 1500 kg/cm² as a global creep and shrinkage loss, a figure from the Frankfurt tests, was still part of everyday engineering in Germany.

Fig 5: Bridge „Farmer Hesseler" at Oelde Germany, 1938
Source: HWA Darmstadt

With its curved longitudinal tendons, the transversely and longitudinally post-tensioned slab (lspan = 10.50 m) of the Pont d'Elbeuf built in the Alsace in occupied France in 1942 provided the blueprint for most post-war prestressed concrete designs.
Freyssinet's full three-dimensional prestressing solution was an improvement on Hennebique's pure reinforced concrete cross-section. Freyssinet determined the first generation of prestressed concrete bridges up to about 1967 and thus created the future prestressed concrete continuum cross-sections.

The establishment phase of continuum cross-sections irrespective of material (1945–1965)

After the Second World War it took only 10 years of development work to create superstructure cross-sections for beam bridges in all three types of construction in which all the components contribute to carrying the loads and whose design language was not limited to any particular material.

Prestressed concrete bridges after 1950

Whereas the contribution of Dyckerhoff & Widmann A.G. to prestressed concrete prior to the Second World War involved Franz Dischinger concentrating on formulating the theoretical principles behind creep and shrinkage, the "inventor engineer" Ulrich Finsterwalder, thanks to his easily constructed single bar tendons, achieved the breakthrough for the use of prestressed concrete for large bridges with the Nibelungen Bridge (Pelke, 2011: 106–107). Two box girders – with virtually three-dimensional prestressing and connected via a transversely prestressed deck slab function as one unit – grew over the Rhine at Worms between 1951 and 1953 using the balanced cantilever method (lspan = 114.20 m).
Fritz Leonhardt and his team gave countless German road bridges an identity with the continuous, parallel-chord box-girder Neckargartach Bridge over the Neckar (1951) (Fig. 6) and the T-beam Untermarchtal Bridge over the Danube (1953). The further developments can be followed in Pelke (2011).

Fig 6: Neckar Bridge Neckargartach Germany, 1951 Source: Municipal Archive Heilbronn

Citing the individual plates and prestressed slabs of Le Corbusier, the new generation of prestressed concrete engineers gave the flexible designs of prestressed concrete a continuum cross-section. Together with its low steel content and the moderate spans usually adequate in Germany, success during the building of the German motorway network was readily forthcoming.
Prestressed concrete had a permanent effect on the use of steel, up until then the favourite material for bridges. In order to keep pace with the economic successes of concrete bridges, steelwork engineers threw their great theoretical knowledge of analysis and design into the fray and called on every component to help carry the load.

Steel-concrete composite bridges after 1950

The coalescence of the cross-sectional components in steel-concrete composite and steel bridges required traditionalist steelwork engineers to question their thinking in terms of bar-type members and discontinuities. Their forms of construction are not generous. They demand considerable endeavours and development steps.

It was on 27 April 1948 that the Deutsche Ausschuss für Stahlbau (DASt, German Committee for Structural Steel) was re-established after the war. Chaired by Wilhelm Klingenberg (1899–1981), whose first experience of composite construction was under Hugo Junkers (1859–1935) in 1929 and who was now responsible for bridge-building in the newly founded Federal Transport Ministry, the subcommittee "composite beams" was set up in May 1949. Two conferences were organised for December 1949 and April 1950 so that the subcommittee could first establish the international status of composite construction (Schleicher & Mehmel, 1950). Klingenberg initiated comprehensive test series to examine still elusive solutions.

In order to be able to quantify the loadbearing contributions of steel and reinforced concrete and the shear force at the joint between the two materials, findings regarding the creep and shrinkage of prestressed concrete had to be transferred to composite construction. The forms of connection had to be configured, the influence of non-static loads defined and plastic theory tests broadened (Klingenberg, 1952).

The solutions available in 1950 for structural connections to close the joint between steel and concrete were categorised by Klingenberg (Schleicher & Mehmel, 1950) as "bonding bars" and "anchors". According to Klingenberg, the former (short round reinforcing bars welded and bent up at 45°) were only suitable for haunched concrete decks. For him, the future belonged to anchors, which, quoting US engineer C. P. Siess (1948), could be divided into "soft" and "hard" types. Despite their lower load-carrying capacity, non-rigid, i.e. soft, anchors, usually cropped and welded U- or L-shaped pieces, would in future be preferred by engineers in the USA because of their ease of assembly. Rigid anchors would mainly be used in Europe, had structural advantages and therefore permitted a reliable and large shear force transfer as long as they were not embedded too deep in the concrete slab. The rigid "block" anchors were supplemented by reinforcement stirrups to secure the reinforced concrete deck against uplift.

The range of forms was extensive at first and was not consolidated. A long discussion about connections rigid or not rigid in shear, encompassing a multitude of shear connectors, resulted in the use of headed studs as standard following the introduction of stud welding into construction from about 1960 onwards (Sattler, 1962).

Therefore, the practical, non-rigid U-connector of the Oregon State Highway Department dating at the start of mechanical connector development in 1934 turned out to be visionary. Siess (1948) submitted the theoretical basis for this 14 years later.

In addition to the connectors, the road to the continuum cross-section also required the development of efficient methods of erection that exploited the elasto-plastic redistribution of forces.

The Nidda Bridge at Rödelheim (1947) in the course of the A648 motorway (formerly the A80) crosses the River Nidda with a span of almost 30 m and a structural depth of 2.19 m in the form of a 50°skew, four-beam grid with horizontal bracing to resist torsion. Vertical stirrups and inclined bonding bars connect steel beams to haunched reinforced concrete deck. It was probably one of the first steel-concrete composite bridges in which the elasto-plastic behaviour of the concrete was considered quantitatively.

The Untermain Bridge in Frankfurt am Main was opened for traffic in 1949. External post-tensioning during erection helped to compensate better for the internal forces within this early steel-concrete composite bridge. Its beam grid is composed of 10 closely spaced main beams and crosses the River Main in five spans. The 18 cm deep reinforced concrete deck has considerable haunches at the main and transverse beams. Shallow angles combined with tall, inclined bonding bars were chosen as the connectors in the longitudinal direction. To avoid restraint stresses, a 3 m wide shrinkage gap was left over the piers. With beam grids simply supported during construction with continuity introduced successively, there is a trussing arrangement underneath which prestresses the composite superstructure for permanent loads via intermediate jacks. After establishing the continuity of the individual beam grids, the shrinkage gaps were closed and could thus allocate the traffic loads to the continuous beam grid.

Fig 7: Shear connectors with reinforcing bar anchors of the New Herdecke Bridge Germany, 1951 Source: BMVI

Fritz Leonhardt's external post-tensioning composite concept for the Untermain Bridge was surpassed by Hellmut Homberg (1909–1990) through his use of tendons for the new three-span bridge over the Ruhr at Herdecke (1951) with its maximum span of 64.21 m (Fig. 8).

Hellmut Homberg anchored a continuous grillage of plates to a jointless, prestressed 22 cm deep deck (Fig. 7). The steel grillage is made up of four main beams at a vertical spacing of 3.00 m, seven load-spreading beams and four transverse support beams at a spacing of about 16 m and therefore forms a space frame supporting the prestressed concrete deck. Owing to the interaction between the post-tensioning and the settlement of the central supports after concreting the deck, Homberg achieved his aim of a totally "crack-free" deck.

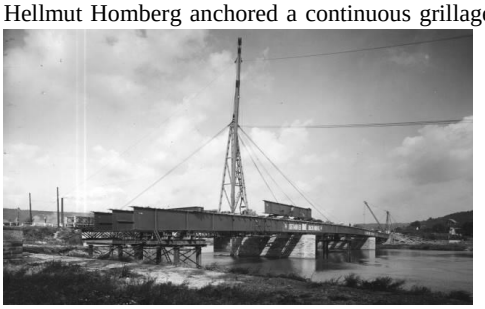

Fig 8: New Herdecke Bridge under construction Germany, 1951 Source: BMVI

The composite action was finally optimised by prestressing measures in conjunction with keeping cracks small by using the leapfrog method of construction. In this method the spans are concreted first before moving the formwork traveller back to the supports to close the concrete bridge deck.

The five-span Lautertal Viaduct at Kaiserslautern (1956) in the course of the A6 Mannheim–Saarbrücken motorway is an early steel-concrete composite road bridge. The leapfrog method was used here for concreting in an attempt to keep cracks small over the supports, indeed, in the words of its design engineer Otto Eiselin (1896–1962), "to rule them out". The double-T beams with transverse beams at a lower level reach spans of up to 64 m.

The Nidda Bridge at Rödelheim, the Untermain Bridge in Frankfurt and the new bridge over the Ruhr at Herdecke laid the foundations for modern composite bridges in Germany. The Lautertal Viaduct demonstrates the use of those principles.

The transition from additive construction to connections rigid in shear scored successes at first. However, prestressed concrete with its much more careful use of steel brought about the rapid need to optimise the weight extensively. Secondary longitudinal and transverse plates, which quickly led to delicate trussed frameworks, were needed to reduce the weight of the deck. As webs and bottom flanges became thinner, so the risk of buckling and torsional

buckling increased. At the start of the 1960s the only competitors for German motorway bridges were one-part superstructures with severely segmented secondary support systems. This constraint conflicted with the maintenance stipulation of the Federal Transport Ministry of providing one superstructure per carriageway.
It was only the changeover to plastic design according to Karlheinz Roik (1924–2009) and the grants available to owners and developers in the years following the unification of East and West Germany that brought about a revival in steel-concrete composite construction (Pelke & Kurrer, 2015).

Steel bridges after 1950

The new technology of providing a connection rigid in shear between the rigid concrete and steel elements constrained traditional structural steelwork yet further. The lightweight form of construction had to compensate for the extra steel needed to support the concrete deck above.
By emphasising the use of fewer but deeper main beams, extra weight was avoided in the cellular steel decks of Leonhardt so they could focus on slab-type deck and main beam top flange. With bending in the steel deck and axial tension or compression from the main beam top flange, this was the first time a combined loading had been considered in a steel superstructure.
This form of construction was first used for a movable bridge, where weight is critical. The Haase Lift Bridge at Meppen (1946/1947) has a 14 mm thick plate supported every 430 mm on longitudinal plate girders that transfer their loads via transverse beams to two deep main beams 3.80 m apart. Further movable bridges with steel decks followed.

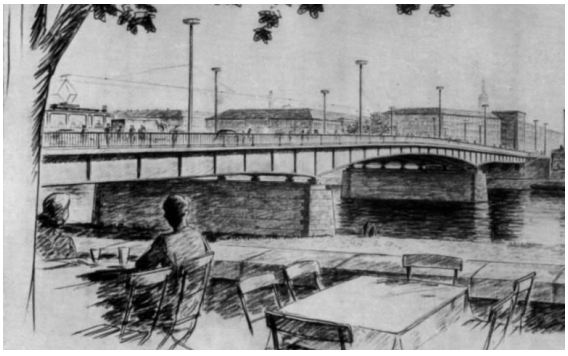

Fig. 9: Kurpfalz Bridge Mannheim Germany, 1950
Source Städtisches Tiefbauamt Mannheim (1950)

The first fixed bridge was the Kurpfalz Bridge in Mannheim (1950), which replaced the Friedrich Bridge (1891) and has a central span of 74.8 m (Fig. 9). Its beam grid consists of eight main beams whose top flange forms a steel deck fitted with closely spaced L-shaped longitudinal beams.
The first large bridge followed as early as 1951 – over the Rhine at Cologne-Mühlheim, which has a central span of 315 m (Fig. 10). This true suspension bridge has a stiffening girder open underneath and made up of two widely spaced main beams with integral steel deck made from closely spaced bulb flats and 12 mm deck plate. The continuous beam of Cologne-Mühlheim enabled the amount of steel to be reduced from the 12 896 t of the first bridge (1929) to just 5810 t. After completion of this bridge, all large steel bridges in Germany were built as a continuum cross-section with a steel deck, now called an orthotropic deck (Seeger, 1950; Pelikan, 1957) (Fig. 11).

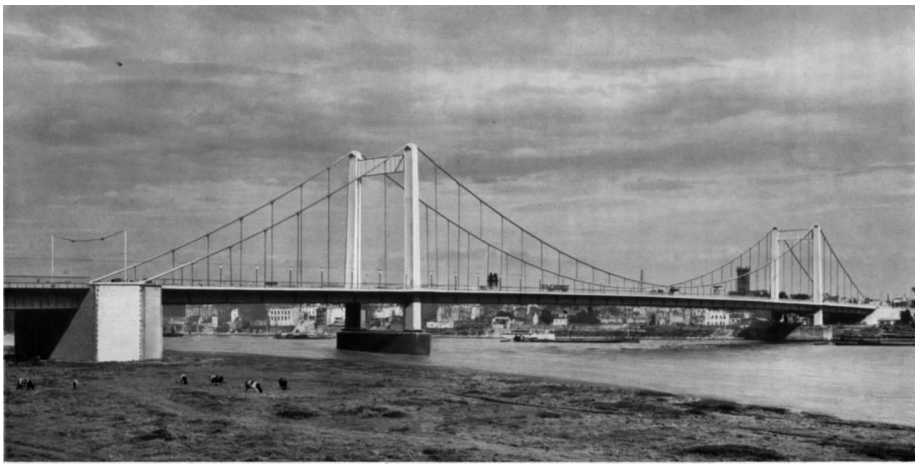

Fig. 10: Rhine Bridge Cologne-Mühlheim Germany, 1951 Source: Stadt Köln (1951)

The theoretical basis for this was provided by the designer of the aforementioned bridges, Wilhelm Cornelius, who used Huber's orthotropic plate theory, and Hellmut Homberg (Homberg, 1949), whose grillage provides an exact solution for the discontinuous orthotropic plate. Pelikan and Eßlinger would extend this to the finite structure of the orthotropic plate and the torsional stiffness of the longitudinal beam in 1957. This theoretical work provided the yardstick for a long time, even though the form-finding process for the orthotropic deck is still in use today (Fiedler, 2009), and finally resulted in constructional rules for safeguarding against fatigue.

The MAN A.G. engineers Cornelius, Pelikan und Eßlinger and the early bridges in Meppen, Mannheim and Cologne-Mühlheim provided the crucial ideas for the open steel continuum cross-section that characterises the 20th century.

Other engineers were responsible for the early torsionally rigid box girders. Fritz Leonhardt (1949) designed a three-span continuous beam with a central span of 184.45 m for the bridge over the Rhine at Cologne-Deutz, which was opened for traffic in 1948. Its three-cell box girder has intermediate double-T beam sections to carry the deck plate. On top of the deck plate, Leonhardt called for a directly trafficked concrete wearing course connected via rigid shear connectors.

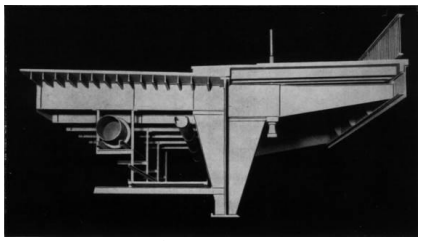

Fig. 11: Segment of the steel superstructure with orthotropic deck of the Rhine Bridge Cologne-Mühlheim Germany, 1951 Source: Stadt Köln (1951)

This was followed by the 206 m bridge spanning the Rhine between Düsseldorf and Neuss (Schaechterle & Wintergerst, 1952). The primary structure consists of a three-cell box girder. Web plates, bottom flange and orthotropic deck fully enclose the girder and are connected via massive steel diaphragms. Steelwork fabricator Hein, Lehmann & Co. A.G. and design engineer Louis Wintergerst (1913–1977) were thus able to create an extremely elegant beam bridge whose slenderness ratio related to the central span varies between 26.4 and 62.4.

By using open and closed continuum cross-sections plus welding as a jointing method for large bridges, it was possible for the traditionalists among the steel contractors to survive initially through considerable material-savings in the market segment for long spans.

It was around 1960 that the material-labour costs structure started to shift. Steelwork engineers turned to the production chain of supply, fabrication shop and erection. The art in the flow of forces took a backseat (Weitz, 1975).
The bridge over the Rhine at Wiesbaden-Schierstein (1962) was one of the first bridges to have a continuum cross-section optimised for fabrication. Structurally conceived systems were no longer in the foreground. Instead, from now on the crucial aspects were a favourable geometric cross-sectional form and the simplification of the form in order to save on construction elements and reduce the joints (Weitz, 1975: 219). The two all-steel river spans and the steel-concrete composite approach spans of the Wiesbaden-Schierstein bridge merge to form a continuous open cross-section with interfaces optimised for fabrication and construction.

Prestressed concrete fights back

The young generation of prestressed concrete engineers readily took up the challenge of achieving the best possible rationalisation. Revealing Le Corbusier's variety of forms, they successively broke down the construction sequence and mechanised it. Following the early successes of balanced cantilever construction for prestressed concrete, travelling centres evolved from which fully mechanised launching gantries developed from 1960 onwards. The first prestressed concrete bridges built with launching gantry were the bridges at Kettiger Hang (1960) and Krahnenberg (1964) and already exhibited the severely restricted design language of the twin-web prestressed concrete T-beams with identical spans as a variation on the open concrete continuum cross-section. It was 10 years later that the incremental launching of prestressed concrete box girders appeared on the scene – a method that is still successful today (Pelke, 2011: 217).
Mechanisation enabled prestressed concrete engineers to counter successfully the fabrication optimisation of structural steelwork and finally push aside its competitors, steel and composite construction, leaving them only niche markets in Germany.
And with the integral form of construction, the monolithic connection of substructure and superstructure through a highly skilful stiffness interaction, prestressed concrete was able to expand the idea of the continuum to the substructure and reach another zenith.

The continuum cross-section for long spans

With a central span over the Rhine of 259 m, the road bridge at Cologne-Zoo was reaching the limits of closed steel continuum cross-sections. If the span was to increase further, the haunches on the beams at the piers would have to be resolved and the continuum cross-section below them continued through as stiffening girders.
Prestressing – and not the suspension of ropes employed with moderate success in the 19th century – and hence the knowledge gained from the building of prestressed concrete bridges is the prerequisite for the construction of modern cable-stayed bridges.
The foundation was created by Franz Dischinger (1949) in his theoretical treatise on suspension bridges for the heaviest traffic loads, which Hans Wenk put into practice for the first time for Strömsund Bridge (1955–1957). The reinforced concrete deck plate was still not functioning as part of the total system. The triumph of the cable-stayed bridge with orthotropic deck began in 1958 in the shape of the Theodor Heuss Bridge in Düsseldorf (Roik, Albrecht & Weyer, 1986).

The arrangement of the cables determines the nature of the continuum cross-section. Central cables require a torsionally rigid, closed continuum cross-section. Outer cables enable the use of an open continuum cross-section with edge beams and intermediate orthotropic deck. Overcompressed continuum cross-section and prestressed cables join together to become the total superstructure cross-section of the cable-stayed bridge.

Imagining it as a symmetrical structure, the true span of the asymmetric Severin Bridge in Cologne (1959) would be about 600 m. Its directly founded A-frame pylon encompasses the deck, groups the cables centrally at the top and achieves, through the angles of the cables, the high overall stability of the bridge. The engineers of the Gutehoffnungshütte heavy industry works at Oberhausen-Sterkrade around Wilhelm Stoltenberg (1899–1977), working with Fritz Leonhardt as adviser, no longer distinguished between main beams and deck, instead, like Wenk in Sweden, used the entire superstructure to carry the loads (Roik, Albrecht & Weyer, 1986).

Commented [PT1]: Tippfehler im Deutschen: Gut**e**hoffnungshütte, nicht Gut**en**hoffnungshütte!

Still conceived as pier substitutes, the large spacings of the cables of the first cable-stayed bridges resulted in excessively large deck beams. It was difficult to distribute the large tension forces in the cables over the deck beams. Hellmut Homberg (1909–1990) was the first to use closely spaced cables. That keeps the bending moments in the beams small and simplifies load transfer and erection. Homberg's multi-cable patent for open and closed continuum cross-sections carried the success of the cable-stayed bridge beyond Germany (Pelke & Kurrer, 2012).

First basic multi-cable system with closed continuum cross-section – the bridge over the Rhine in Bonn (Friedrich Ebert Bridge)

In 1962 Hellmut Homberg was appointed by the then North Rhine-Westphalia Highways Authority, the Landschaftsverband Rheinland (Rhineland Countryside Association), to produce the draft design and tender documents for a bridge over the Rhine in the north of Bonn. After submitting his patent No. 1 235 973, the bridge was put out to open tender in 1963 and the contract awarded based on a design hardly altered from that of the authority.

The cable-stayed central-girder bridge crosses the Rhine with a main span of 280 m and side spans of 120.1 m (Fig. 12). There are 20 stays in harp formation per group of cables; individual cable diameters range between 91 and 123 mm. The distributed transfer of the cable forces simplifies the design of the torsionally rigid deck and pylons decisively and allows the flow of the forces in the central girder to switch from a discretely supported to a continuously supported beam.

The pylons are totally separated from the central girder and connected directly and rigidly to the piers in the river. Pendulum bearings accommodate the uplift forces at the ends of the side spans.

Built cantilevering out from both banks in line with the requirements of the engineers of Hein, Lehmann & Co. A.G., the main span of the Friedrich Ebert Bridge quickly grew in 27 m long stages. Resolving the multi-strand cable into single cables helped here. As work progressed, so the cables were laid out on the deck, lifted up to be fixed to the pylon first, subsequently attached to the cable anchorage girder and then prestressed (Pelke, Kurrer, 2012).

Fig. 12: Friedrich Ebert Bridge in Bonn Germany, 1967 Source: BMVI

Second basic multi-cable system with open continuum cross-section – Rees-Kalkar bridge over the Rhine

The Rees-Kalkar Bridge is part of an almost 1 km long crossing over the Lower Rhine. The bridge is at 90° to the river and has a main span of 255.0 m arranged harmoniously between two side spans of 104.0 m. Hellmut Homberg won the competitive tender for his business partner, Düsseldorf-based DEMAG AG, in 1964 with an open continuum cross-section. Four outer pylons made it possible to use a lightweight grillage for the deck. The groups of cables are divided into eight harps of 10 individual cables positioned beyond the parapets – calling for special cable anchorages on the outside of the torsionless stiffening girder, which is connected rigidly to the pylons. The DEMAG AG engineers, like Hein, Lehmann with the bridge in Bonn, built the bridge using the cantilever method. As in Bonn, the cables could be immediately tensioned to their calculated final figures.
The pairs of pylons are carried on neoprene pot bearings on top of the U-shaped piers in the river. The pier on the east side serves as a fixed point. Tension- and compression-resistant pendulum bearings anchor the ends of the stiffening girders. Independent bearing units fix the continuum cross-section in the transverse direction via its bottom chords at the expansion joint piers.

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Urban Transformation and Bridge's Metaphor in City

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Abstract.

Primitively, the bridge spanned river or valley in natural materials with vernacular style. Gradually, the creation of bridge is influenced by the innovation of technology. In Chinese, "Bridge" (qiao,橋) is as a boat on the water (水梁也), meaning an architectural structure. On the canal/river, the bridges reconcile the views of landscape and offering a place to admire the scene, as a plateau on the water. The bridge offer physical passing, also can be a "philosophical" passing, as the poem "Fragment": On the bridge you're enjoying the scenery, The people watching at scenery is looking at you. The moonlight adorns your window, you ornament the other's dream. (Bian Zhilin, 1910-2000).

Today, in city, the design of bridge can be considered into with urban transformation because of its characters: passage (linar), connection (node), exchange (place), separation, etc,. in order to enriching and integrating into morphology, typology of project (footbridge Passerelle Simone-de-Beauvoir, London Millennium). The bridge does be a place/a point of exchange/change (perception, mind, thought, and time), as " …through shifts in perspective, that is, changes in the angle of intellectual vision on the relationship between time and consciousness" (The Poetics of Passage, Heike Pollster). To build a bridge can not only modify the distance and the time to destination, but also produced new culture and activities in place (Passerelle des Arts in Paris, Bridge of Sighs in Italy). These may become be the history of future.

In Building Dwelling Thinking, Matin Heideggere talk about 'the ancient art of dwelling' and "building". That will be the point to make rethink of the questions following, as: What's the revelation from the ancient bridge? The difference between the modern bridge and the ancient in city except of high technology? How about the influence of bridge in urban transformation and the metaphor of bridge?

Keywords pedestrian bridge, traditional garden, urban transformation, skyline, metaphor

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I.INTRODUCTION

Primitively, the bridge is spanned river or valley in natural materials with vernacular style. Gradually, the construction for bridge shows the progress of technology in human civilization

and it is not needed any more only constructed by local materials and nor limited by its geographic situation absolutely. On the other hand, the word "bridge" is used as the way of "connection" or/and of "passage(path)", the sense and the expression of "crossing" for bridge is employed not only a physical and psychical transmission.

Nowadays, the complex construction and multiple uses of bridge could be applied on more than "design process" [1] to think different objectives. That's because the design of bridge could be to resolve more problems about man and environment, but not only a creation of high technology and a sophistic form, for example: the "connection" is one of the ways to pass and to join two separated spaces, brought a big step of progress, in human community, in city and also for human civilization and technology. Besides, the sense of correspondence by bridge is not only between places or basic elements (as accessibility, comfort and security), we take attention to where's the site? What's the landscape? How to see? Nowadays, the bridge presents also a symbol for different objectives.

II. CHINESE SPECIFICATIONS LITTERATURE

The word "Qiao"(Bridge) in Chinese garden and lifestyle

In Chinese, we could understand the word of "bridge" from its form and signification of writing. As the bridge, the language is one of communication way and it's the expression of culture and thinking. We could read its original creation (qiao,橋)…

The chinese word "Bridge" show us, primitively, how the bridge is to build, the material used, structure and construction, also the use and the definition. The Chinese character of "Bridge" (橋, pronounce "Qiao") is created and written by combined by the Chinese character "木" (Wood, Tree). "木" is the pictograph from the form of TREE, means Wood or Tree both, pronounce «mou», signifies the original construction of bridge. That shows how man set that with the local material (easy to get, take and set correctly). The part of Chinese character "喬" (prononce « Qiao») means Great/Big TREE, but also it means the action "arrangement", as the bridge is a structure to build upon and to cross in height above somewhere. That means we can manage to crossing or linking a spatial interruption. That means also the bridge is a structure suspend on the water, as the function of "Beam" in building. "Beam" in construction which charges the extra weight or transform the charge from the structure and the passengers. In Chinese character "Bridge" means as a boat on the water (水梁也), similar an architectural structure. Besides, "Bridge" (橋) is adjacent to the word "Lian"(梁) , as QiaLian (橋梁), that means cutting wood for a beam upon the river for a crossing.

Since the Dong-Han dynasty (25-220 AD), the progress of diversion channel, In Chinese traditional Garden, there are elements combined the architectural creation and

[1] *The bridge is a complex structure that introduces into the surrounding landscape relevant variations, dealing with a number of specialist fields.* (Innovative bridge design handbook: construction, rehabilitation and maintenance, Butterworth-Heinemann is an imprint of Elsevier,2015)

structures, as terrace, Pond and Kiosk etc. Bridge is one of important connection, which make sure the continuity of promenade or movement in the Park, that's a spirit 'Harmony" between The Nature and Men. On the canal/river, the bridges reconcile the views of landscape and offering a place to admire the scene, as a floating "platform" on the water. Therefore, the bridge plays an intermediated role in building by form or structure. There are miscellaneous heights or view to create, as simple bridge(平橋), kiosk bridge (亭橋), arch bridge(拱橋) (raise the platform in height on center) for different intentions and actions, as passing, staying and looking or admiring the landscape.

A long temp ago, the Chinese garden was only built for the emperor or the imperial family. The Garden became a private and social place to show the master's favorite, collection and wealth. From the emperor, the imperial family to private and public, the action 'crossing' of bridge offer more possibility to connect, to stay, to thought, to discover etc. The bridge plays an indispensable role in Chinese traditional garden and integrated in the landscape by creation of form & structure. It's not only just a pass path, also that's integrated the Chinese philosophy and thought. On the other hand, the Chinese traditional garden is like an miniature of the world. We use it to access to the Nature and it's an intermediary "passage" and "place" to combine culture and art. It connects people and space by reducing the distance of feeling and thought.

Bridge and City: connection real and metaphysis

Nowadays, the creation of bridge is more free thankful for the innovation of technology and it could be used to resolve divers needs in human life. There are sophistic and great masterworks in bridges, not only just for correcting geographical interruption, but also for beautiful meeting on space. Sometimes, that plays an important iconic role in city, as Venice, London, Prague, Paris, etc.

If the bridge could be an spiritual imagination or an metaphor thought, that means the sense of "connection" or "crossing" have a symbol over a visual space. The bridge offers a passenger, also a philosophical" path, as the poem "Fragment": *On the bridge you're enjoying the scenery, the people watching at scenery is looking at you. The moonlight adorns your window; you ornament the other's dream* (Bian Zhilin, 1910-2000). This poem is often interpreted into the bridge in the Chinese traditional garden since longtime ago. In Western, we can compare as the word "landscape" (scene). "Bridge" plays a pass and a stay physically and psychically, it can be a Passage, Decorating and Interpreting Landscape. That's a reciprocal link between men and place.

That could be identifiably to apply into urban transformation, the design of bridge could be considered into, as its spatial characters, with urban space: as "passage" (linar), "connection" (node), "exchange "(place) and "separation"... That might be used in order to enriching and integrating into morphology, typology of project (footbridge Passerelle Simone-de-Beauvoir, London Millennium) (the image of city). We see the bridge does be a place/a point of exchange/change (perception, mind, thought, and time), as " …through shifts in perspective, that is, changes in the angle of intellectual vision on the relationship between time and

consciousness" (The Poetics of Passage, Heike Pollster). To build a bridge can not only modify the distance and the time to destination, but also produced new culture and activities in place (Passerelle des Arts in Paris, Bridge of Sighs in Italy). These may become be the history of future.

III. BRIDGE IN TAIPEI, TAIWAN

Taiwan is located off the southeast coast of the Asian Continent at the western edge of the Pacific Ocean. Island of TAIWAN is called Formosa since 16th century by the Portuguese for its verdant beauty of island. The surface is approximately 36,000 square kilometers and it's measured about 394 kilometers in length from North to South, and around 144 kilometers in width from East to West. Two-third of the total area is covered by forested mountains (the four major mountains) include more than 200 peaks arising than 3,000 meters in height above sea level. The remaining area consists of hilly country, platforms and highlands, coastal plains and basins (Geography & Demographics, Executive Yuan, Republic of China (Taiwan)). Moreover, there are rivers (about 119, mostly E-W), lakes fed by runoff from the island's centrally located mountains and hills.

Geographically, the development of Island of Taiwan depended on the creation of train for N-S and E-W. That needs to construct many bridges to penetrate, to connect, to across from mountains to rivers and to valleys. Taiwan's geo-climate is "complicated': rainstorm, earth flowing, typhoon, artificial problem of construction. There are many rivers, small and rapid, from the central mountain towards to the sea, they could not support sudden amount of precipitation and be caused serious catastrophe.

Primitively, the bridges in Taiwan were built in bamboo, wood, rattan for valley and in stone on flat ground. The history of bridge can be presented not only progress construction, but also human society: urban development, geo-climate record etc. The construction of bridge in Taiwan is a record to memory the development of Taiwan and the modernity of Cities.

Identity – Connection between time and space

At the end of the 19th century, Taiwan was built the first train between Taipei – Keelung City on the North island (1887-91), then it's the part of Taipei-Xinzhu City during the Prefet Ming-Chuang Lui. That's the emergence of modernity for Taipei City. In 1893, there are already about more 70 bridges (in wood or in steel) were built, most for passagers or transport of merchandising (Taiwan Revue Manuel, 2005.06台灣月刊).

The construction of bridge in Taiwan did be limited by local geographic, material produced, not only according to development needs (communication, transportation and leisure-tourism). At beginning, the construction was simple and could not support important charge nor big span, because of technological construction and material, as bamboo, wood, rattan or stone etc. (In plat ground, mostly in wood or in stone. In valley, mostly (in rattan chain, bamboo chain, then in iron chain or steel chain) for suspend bridges. Some bridges were rebuilt thankful of the progress of materials and technology to satisfy the important project.

From 1895 to 1945, Taiwan was the colony by Japanese. During that, there were many modern western constructions were built, because of the western movement in Japan at the same period. The old Railway Bridge (高屏溪舊鐵橋)was built across Gaoping River. The engineer overcame the challenge of swift and treacherous by river current and that was completed in 1913, 1526m in length with 24 piers in concrete. That had been the first long bridge in Asia-East at that moment, presented the progress in technology. The Bridge was renovated in 1964 and ended its function in 1987 and inscrit in the national cultural heritage in 1997. In conclusion, since 1895, The Japanese introduced and applied the technique of concrete in Taiwanese bridge construction. There are plus 2300 bridges in the end of the Second War World. In 1940s, the quality of concrete was improved and in 1950s, there are the pre-stressed concrete bridges (Changhong Bridge in Cantilever method construction, 1967). Taiwan is returned to the Republic of China in 1945.

In 1949, The Republic of China officially installed in Taiwan and Taipei became its capital. The project of construction N-S highway was developed in 1960s, completed in 1968, about 373.3km length, among 35 km (about 10%) built pre-stressed bridge, the longest span was 150m. It had been the largest spanned in East-Asia at the moment. Until in 1970s, Taiwan was into an economic prosperity period, several projects of development were run to connect between Metropolitans, as the Ten Major Construction Projects, the transportation of highway and train, etc. All that needs to build bridges geographically and used pre-stressed concrete reinforced the charge of span and there were more various constructions realized, as the continued arc bridge in steel 20 m in width (The Guandu Bridge, 1983) and the cable-stayed bridge in steel (Chuang-Yang Bridge, 1989) with 200m of span crossing in the River Danshuei Taipei. After in 1980s, many projects in transport needed connection by bridges, particularly for the high speed train N-S, of long 345km, Among 157 km in length above the valley.

After 1970's the bridge was planned and applied into urban strategy for the urban development of city in Taiwan. The construction of bridge is a historical testimony of Taiwan Cities in Technology, industrial, lifestyle, social change, politic movement, geology and environment etd. So it's a resource of souvenir, a trace of development for citizens.

Urbanization and Modernization of Taipei

Taipei city, Capital of Taiwan (ROC) since 1949, located in the center Basin of Taipei, on the north island of Formosa, about 20km in W-E and 27 km in N-S. The city was developed by Chinese continent immigrant in the early 18e century. The superficies of city is about 271, 8 km², among 243 Km² under 20m the sea level. The surrounding mountains are about 300 m in length, ranged on the East side of basin. There are plain lands along to the sea side on the West.

Taipei city was modernized since the end of 19e century when the construction of train was carried out (Lui MingShang, Taipei-Jiluang). In 1900, the plan for Taipei city was

established under colony Japanese (1895-1920 for Taiwanese cities), called correction of Tapei city (inter walls of Taipei). The walls of Taipei were destructed and the Rd. ZhondHua was built as three Refuge island (sam-suànn-lōo). The urban planning was proceeding in 1932 and the plan was established in 1933.

According to the definition of "urbanization" and "modernization", Taipei city ass modernized from the end of Dynasty Ching and the Urbanization was at the colonial period by Japanese. The transformation of modern city and of metropolitan was after the second world war.

In 1950s, lots of immigrants resided in Taipei, they came from different provinces of the continent china cause of domestic war and the separation of government. Taipei had found the first urban plan in 1954. In 1967, Taipei became a special Municipality - independent and mutual administration in Politic. In demography, Taipei city had more 20, 000 inhabitants in 1935 (274, 157 inhabitants) and attaint to 710, 000 inhabitants in 1958. There were more than 2 million inhabitant in 1980 already.

Today, Taipei city is consisted on 12 administrative districts, 2620 million of inhabits (2008), about 9650 inhabtants/Km² (2e density city). Historically, the development of city is begun from West to East. The modernity is concentrated on the East. There are four main rivers (Jiluan (基隆)、Danshuei(淡水)、Xindian(新店)、Jingmei(景美) Rivers) in Taipei which are built various bridges to connect.

Bridge in urban transformation

In 20e century, that's not only the progress of technology and construction, but also the open mind and thought in art and in architecture. 'Modern' means something different from the tradition, or something is new. ("modern" definition: Late Middle English: from late Latin modernus, from Latin modo 'just now'). In 1922, Le Corbusier proposed three types of « idea city » (ville idéale) in plan: the contemporary city for three million inhabitant, the glowing city and the shelf-linear city (la "ville contemporaine de trois millions d'habitants", la "ville radieuse", une ville linéaire) in Salon d'automn (la nouvelle esprit). The ideas are to leaving free space for circulation and for the Nature, also to leave free the communication between Men and the Nature. That's proposal a rational city realized with the structure of "Pilotis" in order to living easier and to concentrating human needs (*living*, *transport*, and *Walking*, CIAM categories). Although, Le Corbusier's "the contemporary city" did not be realized, but in 1970s, the world was influenced and we constructed more and more toward the sky.

The modern development of Taipei city was the context of all type of construction in City. That's important to understand the city's history. Between 50s and 60s, Taipei city was developing roads, schools and housing. Roads of Taipei were constructed for vehicles and many Taiwanese went to Taipei City for Job and Study. That's why in 80s, the demography of Taipei city was attaint to more 2 millions. That' also the reason in 70s, there were lot of high buildings were built and Traffics were in jam. In 80s, that's a globalization time and

that's taken on place for the projects of metro and of underground railway. In 90s, that's the project of rapid urban road and specific way for bus etc.

IV. Pedestrian bridge in Taipei City

The urban problem were never the same and more complex in the modern Age. During the urbanization of Taipei city, the objective of project for public transport was planned for vehicle, in priority. That's the reason we built the pedestrian bridge in order to flowing of car in city. Even after, the rapid road was built to cross above the city. The high bridge for rapid way was built and cut the urban skyline. The objective to raise car is in order to crossing easily urban spaces with full constructions during the modernity to resolve the problem growth of car.

Taiwanese society is more capitalism, the economy is all priority. The pedestrian bridge built in order to bringing the passant in security, however, that might not the only or the best way to do, althhough, that could resolve the conflict between the passengers and the urban vehicles. Taipei city did not consider the environment and the user gradually, but only the material and the point of view economy during 60s to 80s. City is complicated and there are different needs to complete, so that there were many social problem appeared after 70's.

In order to offering a security to passage, the pedestrian bridges were built. One types of Walkways called Skybridge (天橋/空橋) 、Pedestrian Bridge(陸橋) or Foot Bridge (陸橋), that's all for protection of pedestrians, especially nearby to school, public building or space, commercial zone or pedestrian zone in 1960's. In 2007, we talk about "passage with priority(人本交通)" (means *In the plan and the management of transportation system, the pedestrian should be ranged in priority, that 's security, friendly, crediable, confort and healthful soustainable environant transportation*(2007). That's the moment to rethink of what should be "the real priority" in city and how to do that.

The relative regulations

The development of the pedestrian bridge in Taipei does be a history of urban development. Also the creation (form and structure) of bridge is a historical testimony of material and culture for Taiwan, That's accompanied the development, the growth and the change of Taiwanese cities since long time age and will be continued for the future. In 1960's, it's a prosper period in the urban development for Taiwanese cities. The economic development was considered in priority. In 1976, there was the Urban Expressway (都市快速道路), 3.5m in width with 60~100km/h, crossing the urban spaces from the air, as Jianguo Viaduct. At the same times, the pedestrian path way was constructed and planned in some specific zone, called Sidewalk or Walkways (人行道), that's to response the needs of economic development and urban circulation.

The "Walkways" is a zone to reserve for passengers, needs at least 8m, and 10%-20% of the width of Road. For the road plus 15m in width, we reserve at least 20% of pedestrian zone. All that's according to the *Notes to the Design Standards of Urban Roads and Accessory*

Works (市區道路及附屬工程設計標準). The "Walkways" is defined to *road sections allocated for pedestrian passage, overpasses, and pedestrian underpasses*.(指專供行人通行之道路空間、人行天橋及人行地下道) " in *Notes to the Design Standards of Urban Roads and Accessory Works* (市區道路及附屬工程設計標準), article 17, "Design regulations for urban road overpasses and pedestrian underpasses". The relatives law and regulation following are : Notes to the Design Standards of Urban Roads and Accessory Works (市區道路及附屬工程設計標準)、Urban Road Act (市區道路條例)、Design Standard of Common Duct (共同管道工程設計標準)、Building Act (建築法)、 Design Specifications of Accessible and Usable Buildings and Facilities (建築物無障礙設施設計規範)、BRIDGE DESIGN (公路橋梁設計規範), etc.

Priority or Integrality

In Taipei, there are three types of pedestrian bridges during the modernity of Taipei city in 1970s, there are: the Zhonghua passage bridge in the Shopping Yard(中華商場)nearby Taipei Main Station (1961-1992) which was destructed in 1992, the footbridge YUNPIN (永樂太平人行天橋)in 1968 which is conserved today and the pedestrian bridge TeunYun (騰雲人行天橋) which is a pedestrian and landscape bridge (cross a river Xindian) built in 2006. They are link of different urban managements.

The Zhonghua pedestrian bridges

The Zhonghua bridges were created in the Shopping Yard(中華商場)near Taipei Main Station (1961-1992). The shopping yard composed 8 buildings of 3 floors built in 1961. Originally, the centre government made there to be a temporary place in order to installing immigrant came from different provinces of Chinese continent since 1949. However, there had more and more illegal buildings and that caused many social and urban problems, in public security and in environmental hygiene. In 1961, the project of 8 building mix functions – commerce and inhabitation, were realized on place. Those buildings were along on Rd. Zhonghua where was 78m in width since 1900 (urban correction by Japanese) and total project of 8 buildings in RC was occupied 1711 m in length.

In principle, the shopping yard was built along to the Zhonghua Rd and the buildings were located in according to the urban street-blocks and the disposition of streets and lane-roads. The buildings, from Nord to South, were 15m in depth and 135m, 91m, 79m, 75m, 187m, 140m, 127m, 134m in wedth. The distance between buildings, from nord to south, was 20m, 19m, 22.5m, 18m, 78m, 23m, 19m in distance.

Most of location of buildings were correspondent with the creation of pedestrian bridges, but also to link surroundings streets or roads. That's the most prosperity commercial zone in

1970's. In there, it was intercultural and that's like a shopping mall or a department where we find everything needs in life. Besides, we could taste a serious of Chinese gastronomy, because most of commerce consist of different immigrants came from different provinces of Chinese continent, that's never been (jamais vu) as situation in history. The pedestrian bridges were prosper and actives. The pedestrian bridges were constructed about one floor, about 3m in height (total buildings were 3 floors) and transported people from place to place, building to building, building to place, place to building. People could stay on there to admire urban landscape, but also, sometime, another illegal business on places too. The zone was degraded in security and in hygiene in 80s. Moreover, at the end of 80s there were the project of underground Taipei Main Station cause of the serious traffic jam. Finally, the destruction was taken on place in 1992.

That's a significant Rd. Zhonghua and it's spared different periods : Dynasty Ching, Colony Japanese, ROC modernity, etc. That's the most memory Rd of Taipei for citizens of Taipei who lived and past this period. The Zhonghua Rd. was managed to a grand boulevard with specific bus way today. The progress of modernity brings a comfort environment for people, but it's "individual", not "collective".

The footbridge YUNPIN

The footbridge YUNPIN (永樂太平人行天橋) was constructed in 1968. It's a typical urban pedestrian bridge. It's built between two elementary school (childrens' age 6-12 years old) YunLe and TaiPin (YUN & PIN) for bringing students to across the busy road YianPin. That's a usual urban installation to resolve the problem of conflict between the pedestrian and the vehicles in 70s.

The pedestrian bridge was built above the road YianPin North II with width 16.36 m and near the crossroads LianZou Street of 12.7m in width. The pedestrian bridge is about 3.5~4m in height and 4 m in width. Although, originally the bridge was made for children in security after their courses, but also that's a place to touché, that made children to meet and to separate together every days. When we promenade on this bridge, we get an extraordinary urban landscape view. On the other side, the bridge arise us on bridge, there is quit far from the urban noisy and nearby the natural vegetation, there are beautiful scenery view again. In 2014, the Taipei government decided to demolish it, but it's conserved finally, even if we are not sure how long time we can conserve it still?

The pedestrian bridge Teun-Yun

The pedestrian bridge TeunYun (騰雲人行天橋) was constructed in 2006. It's a typical urban landscape bridge. It's built between two districts separated by the rapid way of Rd. Shuiyuan(水源路) of 36m in width. The rapid way is consisted on two levels: one of part is on the arising bank Xindian nearby the River embankment park. Another one is on ground level adjacent to the urban park ChingNian(means Youth). The Youth park is the fourth largest park (about 24.44 hectare) in Taipei nearby a dense zone of habitation. There are many social buildings around surrounding. The pedestrian bridge Teun-Yun was built to connect

two parks for local inhabitants. It's a rare bridge in Taipei considering the accessibility and installing the elevator to access for aging population and handicap.

Bridge and urban metaphor

The bridge does be a place/a point of exchange/change (perception, mind, thought, and time), to build a bridge can not only modify the distance and the time to destination, but also produced new culture and activities in place (Pascrell des Arts in Paris, Bridge of Sighs in Italy). These may become be the history of future.

Primitively, the construction of pedestrian bridge was used to the needs. But that's also thankful by the progress of construction and experience of construction in bridge. When the project joined factors as politic, economy, modernity and developed space, the goal of pedestrian bridge become multiple and complex. That's the reason the bridge don't be only to offering walking, but it can be a urban history and story. However, it seems when the high technology is integrated, that doesn't bring always more public participation. Heidegger mentionned in "…Building Dwelling Thinking" talked "today's houses may ever be well planned easy to keep, attractively cheap, open to air, light and sun, but do the houses in themselves hold any guarantee that dwelling occurs in them? …". That lets us think of the urban transformation of Zhonghua Rd. today. The modern pedestrian bridge built on the modern boulevard, but it's difficult to recall or to gather cultural activities.

Secondly, the world moves and changes, the technology can be satisfied to response maximum of human use in security or in comfort. However, we consider and think less the liaison of factors, as user and environment. We care less what's happen it, because there were easily to resolve by technology. Then, Building is far from dwelling. The first point is consist of the relationship of the bridge itself. The second point is about bridge and space. The urban policy cannot think of one point but in all of integration. In fact, today people do use less for crossing roads by pedestrian bridges, why?

Taiwanese Cities are "youth", we do transfer spaces to adapt and to satisfied human function. In Taipei, some pedestrian bridges has destructed or will be demolished lately. There are 88 pedestrians bridges built in Taipei and that would be only conserved about 59 in the future. All that consider less use, old or dangerous will be demolished. That's cause of the point of "skyline". The pedestrian bridges were built in raising 2-3 floors height in urban spaces and influence the view of urban skyline. That's also when the pedestrian bridges were built, mostly located in an active urban zone, sometimes they were set in front of windows of building which are disturbed to habitants.

The bridge is not always just a connection (passive), but, sometimes, it's a place gathering (positive). Heidegger mentioned if it does be a bridge, it's can be a symbol. When the bridge plays a role positive, then that signifies that might set a story of place cause of gathering, ex: became to a relays or a village. It can be located on an important or special correspondence place and likes an organic place to grow gradually by following the necessary of development. Then the bridge brings also multiple social activities and form its cultural and style life, then that's consisted different urban morphology and typology. People might stay more longtime

in there. That will be found local culture and created more links on place. However, that might less in modernity, everything is perfect on function, as a programmed machine, non opportunity to develop "individual" story, the bridge stay on an annexed structure on place. Time is immovable.

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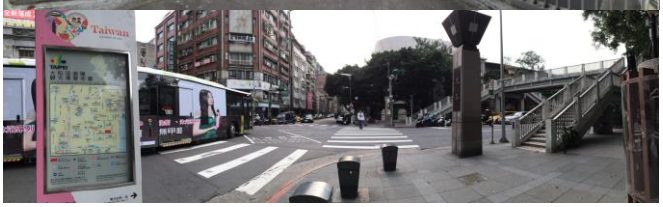
Name	Tyle&Place _ Name	Utilisation_function	year

The Zhonghua pedestrian bridge (中華人行路橋)	In the Shopping Yard(中華商場)District ZhongZhen, Taipei City	Crossing urban road and connecting Commercial Buildings. Nearby Taipei Main Station	(1961-1992)
The footbridge YUNPIN (永平人行路橋)	Typical urban pedestrian bridge. District DATUNG	Elementary schools: YunLe and TaiPin (YUN & PIN).	1968
The pedestrian bridge Teun-Yun (騰雲人行天橋)	typical urban and landscape bridge Taipei_district ZhongZhen_WangHua	between two parks (two districts) separated by the rapid way of Rd. Shuiyuan (水源路), 36m of large	2006





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From Älvsborg Bridge to Göta River Bridge, and Back

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From Älvsborg bridge to Göta river bridge, and back

Abstract

This story is about a constant transformation in a city and a cultural heritage with some identity issues. From eighteenth century East India Company to the twenty first century ship racing, it is a story of a city going through evolution. The, today existing, bridges have been monitoring only a fraction of that story, yet maybe it's most intense period – the twentieth century.

The three bridges that were monitoring the latest century of development are called Götaälvbron, Älvsborgsbron and Angeredsbron. But the three can tell a whole story of the city. They would not have been built if it wasn't for the previous development. As we all do not exist without a past story that had been creating the prerequisites of our existence and even our DNA. A DNA of a city lies in all its parts.

Gothenburg has been a strong industrial city and a centre of the industrialisation in western Sweden, including the maritime development. Now, the industry being gone, there is another new denomination: the post-industrial city. Adding to previous, the city has many identities. It has been pre-industrial and mega-industrial and trade and tourism and "events" city.

Shipyards, car industry, harbours and trade are the common denominators of the last century Gothenburg. The bridges of Älvsborg, Angered and Göta can tell that story.

Keywords: modernism, cultural heritage, industrial heritage, meme, Gothenburg, Älvsborg Bridge, Göta river Bridge, Angered Bridge, monument, icon, significant,.

Introduction and summary

Gothenburg has been one of the strongest industrial cities and a centre of the industrialization in western Sweden during the twentieth century, and more specifically its maritime development. Now, the industry mostly being gone, there is another denomination of Gothenburg: a post-industrial city of big events and technological advance. Yet, that progress grew out of the city's focus on developing a genius industry in the previous century.

The bridges Göta, Älvsborg and Angered are from 1939, 1966 and 1976. During that time the most extensive industrial and social history of Gothenburg was made. It was a time of industrial and social mega projects. By the end of year 1976 it was also a start of a decline in the economic development.

In the 1950s the Gothenburg shipyards have won for themselves a remarkable position in world shipbuilding, with an annual output which few other shipbuilding cities could match. The biggest of the three yards in the city ranked at some peak moment as the third largest in production quantity in the world.

This was also a time when architecture was not only an architectural development, but a social movement of change. It was an era of rational industry of building prospered from a number of political decisions, beginning in the 1930s. It was called The Swedish Model. Identity of the Modern Gothenburg is closely related to that Swedish model.

This paper introduces some of the products of these social ambitions, in combination with the post-war economical development and their impact on the specific landscape of Gothenburg. The main idea of the paper is that the modern society of Gothenburg is an important historical period which shaped the city and as such must be regarded as cultural heritage.

But there are problems with the concept of modern heritage and issues on its preservation. Modernity per se is a concept of a never ending process of development. There is a constant change and a self-destructive nature of modernization. It seems paradoxical to preserve a change.

And finally, the character of the city can be called its Gothenburgishness. That identity of Gothenburg is like language, characteristic and unique, but under constant change. Intangible yet rooted in material elements that create the physical world we exist in.

Industrialisation and before

A journey through Gothenburg's past identities

Gothenburg, receiving its Charter 1621, grew steadily, though the city now and then dropped the population due to epidemics or emigration. During the 20th century the population tripled in terms of the people, as well as of the surface. It happened mainly because of the industrialization, when the city gradually incorporated the margin parishes. At the turn of the 1800 Gothenburg had 12 000 inhabitants and in the year 1900 there were, according to the statistics, more than 130 000 citizens, while in the year 2000 nearly half a million (about 467 thousand) people lived in Gothenburg. Today, the figure is over half a million inhabitants.

Gothenburg was in the beginning a commercial and maritime town, with a strong military presence. The port's business, the export and import of goods, took place during the first 200 years via water channels (Grand Harbor channel and the Eastern and Western Harbor channels). East India Company, for example, played a major role. There were a lot of buildings outside the moat, simple housing in Haga and Majorna, manors for the rich, or settlements which had ties to agriculture. Haga is usually mentioned as the first suburb to Gothenburg. Majorna was incorporated in 1868.

Major changes in the context of industrialization made Gothenburg to change its character from trade to industrial, in the mid 1800's. The changes took place gradually in line with altered functions and needs. The city also changed its shape by freely spreading in branches on the geographical map, rather than spiraling around its inner core.

Gothenburg is like Luxemburg or Hamburg, a city by the water and other common past features; probably sharing similar future in a globalized development. The city has both one and many identities. It has been pre-industrial and mega-industrial and trade and tourism and recently an "event-city".

During the first decades of the nineteenth century Gothenburg had a population of around two thousand inhabitants. The French trade blockade against Great Britain in 1806 made Gothenburg the only open, big port in Northern Europe. These years meant an explosive increase in shipping, a considerable immigration of foreign merchants, import of foreign capital and increasing profits that could be invested in real estates and building of the city. Which lead to a great trade expansion in the area during this time, but also to a decline after 1815 when the blockade ceased.

The beginning of the nineteenth century constituted the end of a century-long economic development which was characterized by a mercantilist direction of the economy. This meant there were introduced measures for stimulation of commerce and selective production of goods. (Andersson 1977)

At this time, Swedish economy rose as the markets in Western Europe were buying raw materials like copper, iron and timber that Sweden exported through its port to the West: Gothenburg. Foreign trade, therefore, played a major role for the economic development of the city of Gothenburg. The city combined good contacts with producers in the surrounding areas and with foreign interests and capital.

This preindustrial development made grounds for Gothenburg as a city which followed its own route of industrialization. The Gothenburgishness of Gothenburg may be traced to this period, together with the start of the industrialism. Later the city's was shaped by the expanding industry which both gave a specific maritime character and left highly visible traces of its progress.

the Gothenburg paradox

Gothenburg was, paradoxically, an expansive city during the European phase of stagnation 1920-45. Sweden has gone against the tide during these years in terms of growth. During that time, the population grew in Gothenburg by 40 percent. The city was one of the most internationalized cities and the country's leading export sites, which accounted for a quarter of Swedish exports.

Gothenburg had in the mid twentieth century more than 8oo industries. Many of these were firms in special branch industries, their products being renowned for their quality throughout the world. Volvo was an industry with an international reputation and enormous capacity, breaking many records in sales and exports in the 1950s. Also in the 1950s Gothenburg's harbor and shipping industry was world leading. Gothenburg's Scandia harbor is even today the largest in Scandinavia.

Eriksbergs verkstad (The Eriksberg shipYard and mechanical workshop).

The history of Eriksberg shipyard goes back to 1871. Later, in the years between the two World Wars it specialized in repairs to an extent which no other big Swedish yard did. During the war and the post-war years, Eriksberg took a remarkable part in the rebuilding of the Norwegian Merchant Navy and, at the same time, striking technical developments took place. The shipyard was considerably extended and a number of constructions of advanced design were built. Large areas were acquired and laid out for pre-fabricated shipbuilding. Great cranes carried welded sections weighing up to 40 tons. Ships of up to 30,000 tons were built, and the biggest of the three floating docks accommodated ships up to about 24,000 tons. On an average, twelve ships were launched and as many delivered every year.

Lindholmens varv (The Lindholmen shipyard).

1845 saw the beginnings of this yard, and in the earlier part of the 20th century it was the biggest yard in Sweden. It was particularly distinguished by its naval record, a number of battle-ships and other fighting vessels having slid down the ways from its building berths into the waters of River Göta.

The shipyard was hard hit by the depression of the early 1930s. But, since being acquired by the international Johnson Concern, it was extensively modernized and re-planned. It specialized in medium-sized general cargo motor ships.

Götaverken (the götaverken shipYard)

Götaverken was Gothenburg's biggest shipyard - and the biggest in Sweden too in the 1950s. Among the best known ships built there were for example a transatlantic liner M.S. Stockholm, Saga - serving the Swedish Lloyd passenger line between Gothenburg and London, and the 20,000 tons whale-oil factory ship Kosmos III. During 1949, widespread national interest was focused on the so-called "Nimbus" series, a group of ultra fast cargo ships built by Götaverken for the Transatlantic Company of Gothenburg. Another Götaverken event which caused much world-wide interest was the evolution of a specially designed Götaverken Diesel engine, which, for several years, has been fitted in all vessels built by this yard.

Götaverken employed in the 1950s well over 5,000 people and some 800 officials.

Gothenburg, a view from the north.The old city core is in the left corner, the shipyards on the opposite side of the river where the cranes are by the water and the Kattegat sea is visible in the background. Only the Älvsborg Bridge is distinguishable on this photo, the Göta älv and Angered are further back in the north. Photographer Olof Ohlsson, from a newspaper Göteborgs Posten 21 june 2017

A spirit of industrious optimism in an austere post-war era or - The pain of growing

The Swedish model and the planning of the 1960s

The concept of the Swedish model emerged in the 1930s and put the Swedish Social community development policy on the international map. The policy was based on a compromise between market forces and social interests to create prosperity for all.

In Gothenburg, the basis for urbanization in the twentieth century was laid through the extensive expansion of the port, shipyard and engineering industry. The large workplaces were planned together with matching large residential areas. And in order to enable rapid urban development, the city's area increased. Current prevailing ideals of industrial development, large scale and mass production led to a social transformation process that has shaped most of the Gothenburg we see today.

The growth of welfare that started in the 1950s was based on a powerful economic boom. As part of redistribution policy of the surplus in state finances was invested in schools, hospitals, and eldercare. There was a widespread housing shortage parallel to the industrial growth. The Social Democratic congress in 1964 voted in favor of a huge effort to build Sweden out of the housing shortage. A bill was introduced in parliament the following year that affected the physical planning trough the million-housing programme. (Berg 1999)

In Gothenburg this gave strong echo in the 1950s and 60s, when future ideas about social care were combined with rational construction in the comprehensive building. Neighborhood units - such as Norra Guldheden from 1945 - became internationally recognized and well attended. Julianska and Gregorianska streets in Kortedala from 1957 were also examples of the welfare state-building and visited by international tours.

At this time the building of the city was not only an architectural development, it was a social movement of change. The rational industry of building created a style some choose to call structural and brutal architecture. Although it was a state decision, studies show the influence of the state authorities on the design of the built structures was negligible. Rather, the municipalities, developers and building companies, together with the architects, shaped the housing environments of the 1960s. (Söderquist 2008) This was a part of a big metamorphosis of the physical structure of the city and was based on a number of political decisions since the 1930s. This metamorphosis was a core result of the Swedish model.

The curve

Twentieth century’s development has also a specific reciprocating line. Where the biggest boom is at the beginning of 1950 and the decline is at 1975. The construction industry was increasing in scale and the housing was growing in numbers. The times were sparkling with a spirit of industrious optimism in an otherwise austere post-war era. The population grew with two hundred and thirty thousand residents.

The topographical conditions in Gothenburg steered the building to follow the river valley and other waterways in lower parts, or on the slopes and the flattened plateaus. During the record years of the 1950s and 60s, shipbuilding was one of the leading industries in Gothenburg. World trade and world production grew vigorously. During the record years, shipbuilding was one of the leading industries in Gothenburg. World trade and world production grew vigorously. The business community locally was aiming towards high-

productivity with specialized activities, the so called genius industry. And in the fifties, the construction industry developed new technologies for building larger houses and house groups.

The development of the city during 1945-74 meant also that the population grew with two hundred and thirty residents. Automobile roads tied together a new city to be accessible between living and working. Gothenburg became intersected and covered by the roads, high ways and tram lines. New town plans could be made according to new rational methods. This urban development was adapting the design and planning concept of self-contained housing estates and characterizes a period of intensive urban development between the 1950s and 80s.

“Comprehensive industrial city” can be used to characterize the interwar Gothenburg, a highly industrialized period in Sweden, the years of 1930-1980. The ideals of an industrial development, increasing scale and mass production directed a social transformation process that has shaped a major part of Gothenburg as we see it today. It took some pain of growing from the grid structures of the 1910s through the radial city of the 1930s and to the stretched out amoeba of the 1960s.

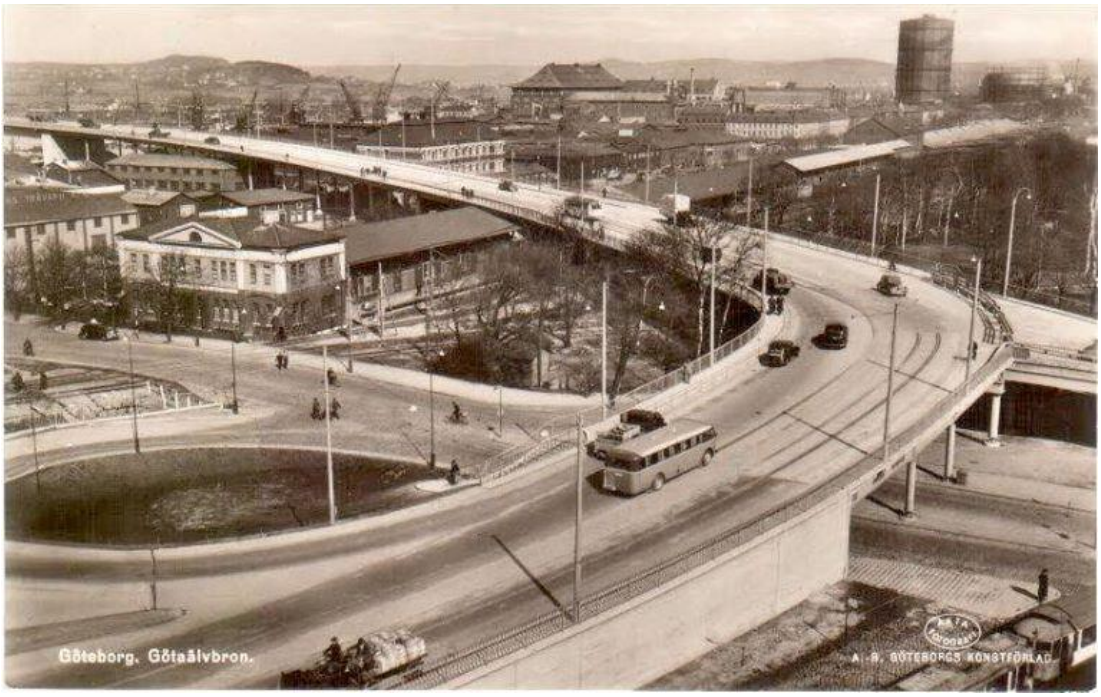
That sudden growth which caused some pain of growing also, a couple of decades later, created an urban layer characterized by dispersion and segregation. By the 1970s there were illustrations of Gothenburg as a segregated city. By tram travel from Örgryte residential neighborhood, through Lundby mix of industries and wooden houses, up to Biskopsgården compact high-rise buildings, you would be traveling through different social classes. This negative trend of development was also a part of the Gothenburg city history, a part of its evolution.

Bridge - a metaphor of modernity/ from steel to concrete

Specific identities of cities are generated through the course of their history and are based on the inherited cultural values. In that context buildings and other artifacts remaining from the past are interwoven with a quantity of intangible modes. Intangible cultural heritage, underlying their physical constructions, exist through the spatial structures. These spatial strucures assemble both new and old social structures, reflecting the continuity of human social life. The concept of cultural heritage, exists both in the monumental reminders of ambitions in previous societies and in some less visible elements.

Consquently, historical layers of the city have different intangible and dynamic aspects that follow the material structure of the city. These layers of history merged with traces of identity and belonging and the result of that overlay can be called a palimpsest. The physical structure is built, rebuilt and demolished (written, rewritten and erased) in an ongoing process of forming the city. Certain parts of the present merge and blend with parts and layers of those of the past.

The bridges of Göta, Älvsborg and Angered are from 1939, 1966 and 1976. During that time the most extensive industrial and social history of Gothenburg was made. They together show the story of rise and decline as the rise towards the peak in the 1950s, when the Gothenburg shipyards had a remarkable position in world shipbuilding, towards the down peak in the 1970s. Accordingly, bridges in Gothenburg could be used as a metaphor for a Gothenburg model of modernity with its start in the 1930s and some kind of anti-climax in the 1980s. Recent plans are to demolish the old Göta River Bridge. Metaphorically that would put an ultimate end mark on the record years of modernity in Gothenburg.



Göta River Bridge in the 1940s. A view from the mainland. Archives of Gothenburg City Museum

Göta River bridge - the dawn

During the early part of the 20th century, the car made its entry into the city. As the steel bridges are also associated with the spread of the railways in the early industrial period, so could the development of concrete bridges be associated with the emergence of car industry and the late industrial period. Iron as a building material for bridges was first used in Sweden in 1813.

Göta River Bridge was constructed by a German company (Dortmunder Union Brükenbau AG) and assembled at the local shipyard Götaverken. It was the first larger welded construction in the whole country in the 1939, the year of its inauguration. When the construction of the bridge began in 1937 it was a pioneering project from the technical point of view. It is a bascule-bridge (a girder bridge of steel) with a vertical clearance of 19.5 m above mean water level.

The Göta Bridge carried about 83,000 vehicles per average work-day before the Älvsborg Bridge was opened, which was just about its full capacity.

Älvsborg Bridge in the 1970s. On the north side of the river are all of the shipyards. Archives of Gothenburg City Museum

Älvsborg bridge - the peak

In the 1960s Gothenburg was able to open two new permanent traffic routes across the Göta River. The Älvsborg Bridge in the west at the mouth of the river was commenced in 1963 and opened for traffic in 1966. It has six lanes, three in either direction. Before 1966, the Göta River Bridge was the only connection of any capacity across the river. In connection with the Älvsborg Bridge certain traffic flyovers and connecting roads were built. The bridge allowed an increase in travel across the river. For traffic on Hisingen the opening of the Älvsborg Bridge meant a leveling out of the existing intensity of traffic on the road network caused by the industries nearby. But, it was also significant for the location of new industrial plants.

The shape of the bridge is based on the modern building methods, where the steel's tensile firmness gave possibilities for a slender bridge despite its size. The honest plainness of design and material, unpainted concrete and the open steel truss, is typical of high modernism.

Until 1969 there was also the Hisingen Bridge, the town's first bridge across the river. Built in 1874, it was a low swing bridge.

Angered bridge – the decline

Angered bridge was begun in 1971 and finished in 1978. This three lane bridge is 47 meters high and it spans the Göta River valley including two motorways. It was a project that started late although born out of the early modern plans. The bridge was built in order to connect the Volvo factory in Torslanda on Hisingen and its four thousand hectares large industrial park.

This was the time when the industrial economy together with the housing suburbs already started feeling the pain of growing. The modern city was built but the progress of the Swedish model was on decline. But the bridge itself shows no traces of depression. It is a slender monument of the times of industrious optimism.

Angered Bridge. Wikimapia.org

Gothenburgishnes is a genuine construction - intangible yet material

Gothenburg's organized activities in the cultural heritage have since early twentieth century been searching for a peculiar character of the city; from preserving the traditional building locations in the city to our days searching for its modern identity. It is a search for the city's identity with an aim to identify the different elements of that peculiar identity, the DNA, of Gothenburg. The Gothenburgishness of Gothenburg is, thus, embedded in the specific evolution of this city.

DNA of a city that lies in its entire small parts which could be named memes, like Richard Dawkins did it in The Selfish Gene, in the 1970s. Examples of memes are melodies, fashion, and the technology of building arches. Icons too, can be memes. Material structures in the city that reflect memories and the intangible and tangible evolution of the city. (Dawkins (1989) p. 192)

Modern Gothenburg has an imposing cultural heritage. Its matter is very solid and tangible, but there is an ongoing process of change. That change makes literally the previously solid concept to become fluid. Almost as a language, a language may sound almost the same

during long times, but is evolving constantly. The identity of Gothenburg is like a language, specific and distinguishable but under constant change. It is intangible, yet rooted in its physical elements.

Industrial character

Göta River with its banks has been characterized by the activities that dominated in the city since the 17th century. During the fortification time, the defense was the major designer of the city shape. During the epoch of the trading city, it was the merchant's shipping and shipyard's space, and during the industrial boom the river became the elongated extension of the industrial areas along the two watersides.

The shipping production has had a special position among the industries, as they almost dominated the northern river for most of the 20th century. The three major shipyards Eriksberg, Lindholmen and Götaverken bordered more or less to each other and completely imprinted the river room with its cranes, industrial halls and huge boats lined along the quays.

In the course of the thesis of this paper, where constant change is a part of the city history, specifically during the modern industrial period of the middle twentieth century, how can we preserve a story of that evolution? When preserving the industrial heritage of the shipyard, what elements should be monitored and listed so that they preserve or retell the story of an evolution?

Some of the features that characterize major industrial areas on the northern river bank are therefore highlighted here. It is a list of characteristic elements in a typical industrial production area together with justifications for cultural historic treatment:

• The river shore was a living industrial area for hundreds of years. That story needs to be preserved, as a memory of living and working conditions in the industrial city.

• Industries on the northern river banks have been directed towards the water. They communicate across the river with the city core. By communication is meant: in which direction buildings were placed and where the signs were placed.

• The industries have been inverted with strong connections within the plant, but they have weak connections with the urban structure around. The buildings are built independently, not in composed environments.

• The buildings are mainly independent of each other and constructed one and one during longer periods of time. When drawn by the same architectural office they hold similar architectural style.

• The plants create a specific silhouette alongside the river, including quays and cranes

• Backyards and the rougher appearance with industrial traces are important for the image of the area.

Specifically about the cranes:• For over 100 years, lorry cranes have been classic silhouettes across the lane areas seen from the city on the other side of the river and have a great symbolic value for Gothenburg. They are part of the city's identity and an important part of the city's skyline.

• Today, only a handful of Gothenburg's countless port and lorry cranes remain. There is only one group of really big lorry cranes left in the port of Gothenburg.

• The cranes as symbols are both the city's brands and icons where they stand on the quay. In addition, they are attractive city sculptures that are located close to the city center. They are located in straight view-line from the former harbor channel.

• Many Gothenburgers have expressed a strong relationship with the cranes and the bridges.

Iconic status – an epilogue

The bridges are memes of a specific part of the city's history, in the 20th century. They tell the story of the past and transform in an inevitable chain of a city's evolution. They are parts of one and many identities of the Gothenburgishness and at the same time an evidence of the modernism that is not constant in its essence.

Bridges tend to be popular icons/landmarks. Early twentieth century Göta River Bridge and the mid twentieth century Älvsborg Bridge, but also Angered Bridge are historical landmarks, rooted in the consciousness. They are gradually creating the identity/ies of a city.

Älvsborg Bridge is significant as a part of the infrastructural apparatus created in the late 1960s. But it becomes even more significant when charged with meanings obtained from the viewer. Älvsborg Bridge is more popular than Göta River Bridge. Both have an interesting story to tell, are significant in the history of the city and its identity. Angered bridge is seldom mentioned, almost as if it is a painful reminder.

The Älvsborg Bridge is a landmark and a symbol of an affluent history. At entry to Gothenburg is Vinga, Älvsborg Bridge and Masthuggskyrkan three distinct landmarks which characterize the city. The Älvsborg Bridge is a monument of 1960s large-scale urban planning thoughts and of industrial society, where an efficient transport system was a necessity for a continued strong development. As a product of modernity, it is possible Älvsborg will have a fate similar to Göta Bridge lasting less than a hundred years.

Tourism seeks icons and popular culture reinforces and uses icons that denominate the characteristic features of the city. Älvsborg Bridge is such repeatedly highlighted icon. Not so much because of its own significance, but because it is located at a point where the city starts and "ends". This gives an impression and a promise of something large, unknown and waste, a point of both departure and homecoming. It is also a monument of a prosperous period, an icon not significant in its own, but in the stories that it contains. As an icon of the modernity in the city, it will carry the memes of modernity long enough for several generations to remember.

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VANITY IN MYKONOS

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"*Vanity in Mykonos*" is how a poster referred to the temporary exhibition, *Vanity: Stories of Jewelry in the Cyclades*, at the Mykonos Archaeological Museum, which ran from August 2016 to September 2017. "Vanity in Mykonos" refers to the reputation Mykonos has as an international tourist destination, noted especially for its beaches, bars, clubs and many jewelry stores that cater to high-end visitors.

Our story begins not today on Mykonos, however, but more than 2,500 years ago on nearby Delos.

FROM DELOS TO MYKONOS

Facing the waterfront between the ferry port and Chora, the main part of town, and up some steps from the rough-paved street, sits the Mykonos (Μύκονος) Archaeological Museum. "Neo-classical" in style, it is a modest, provincial museum, a sanctuary of sorts from the strong sun and people glitter outside.

Figure 1: Mykonos Archaeological Museum, 1902. Built by Dimitrios Stavropoulos, first Director of Antiquities of the Cyclades. Renovated in the 1930s and 1970s. Throughout the 20th century, it remained a provincial, even backwater, museum. www.inmykonos.com/history.html

It was built in 1902 to house the contents of a communal burial pit dug up 1898-1900 by Dimitrios Stavropoulos, the first Director of Antiquities of the Cyclades (Κυκλάδες) in Rhenea (Ρήνεια), six miles west of Mykonos, that consisted of bones and funerary offerings, primarily vases, less what had been already looted.

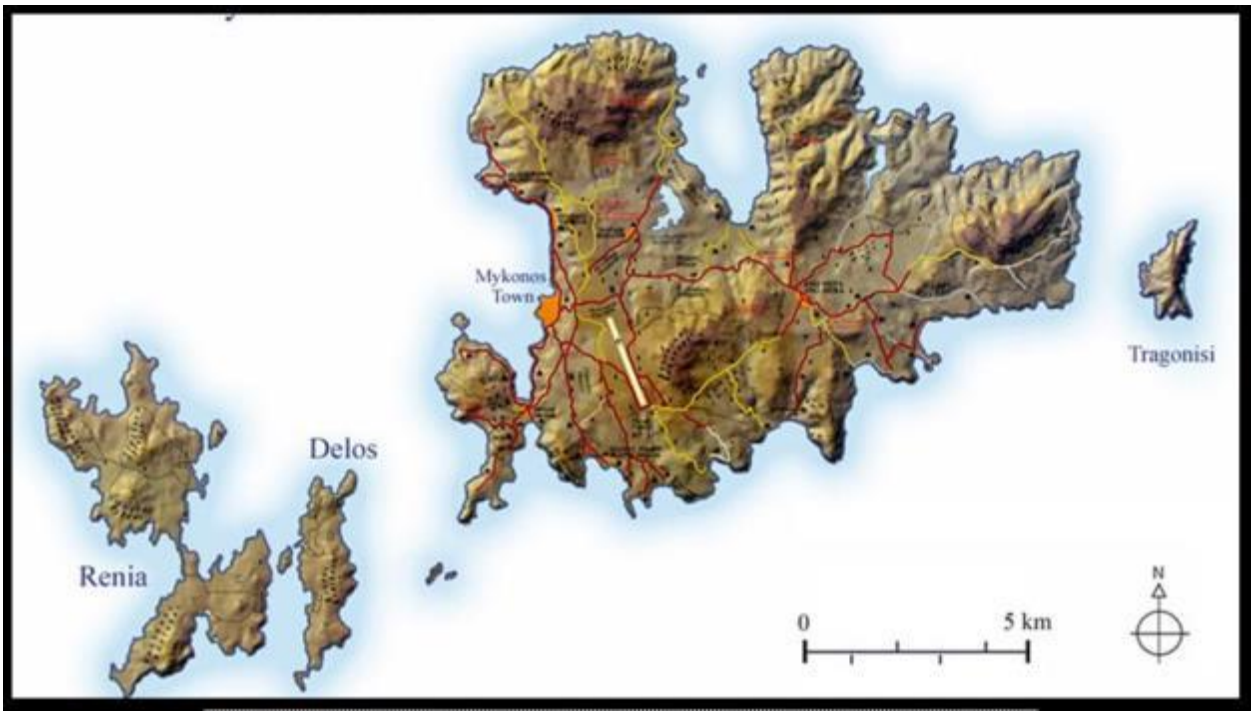

Figure 2: Mykonos town, or Chora (center, in red), Delos (lower left), and Rhenea (extreme lower left). Mykonos Accommodation Center. http://www.mykonos-accommodation.com/hotel-and-lodging-maps.htm

This was the so-called "purification pit" where burial remains from Delos (Δήλος), the island across the channel from Rhenea to the east, had been moved in a purification ceremony in 426-425 BCE. Writing during the Peloponnesian war (431-404 BCE), Thucydides explains.

> "The same winter [426/425 BCE] the Athenians purified Delos in compliance, it appears, with a certain oracle [Delphi]… All of it [graves on Delos] was, however, now purified in the following way. All the sepulchers of those that had died in Delos were taken up, and for the future it was commanded that no one should be allowed either to die or to give birth to a child on the island; but that they should be carried over to Rhenea" (Thucydides, 1972: II,104).

This was done to preserve and enhance Delos's sacred quality. Rhenea became the graveyard of the Delians, Delos became deserted.

Why would the Greeks purify the island to the point of eliminating the population? The short version of why the Delians were disappeared is that Delos was considered the birthplace of Apollo, god of light, and, secondarily, the birthplace also of Artemis, goddess of the night, of the moon. The name Cyclades refers to the islands encircling (κυκλάς) the sacred island of Delos, which, along with Corinth and Delphi, was the most important place in the Greek world.

Figure 3: Cyclades islands in the Mediterranean between Greek mainland (northwest), Turkey (northeast), and Crete (south). From Mykonos (in the northeast of the Cyclades), Delos is five miles southwest, Rhenea six miles southwest, Syros 25 miles west, Naxos 25 miles south, Paros 27 miles south, Santorini 75 miles south, and Milos 75 miles southwest. Eric Gaba, Wikimedia Commons.
https://commons.wikimedia.org/wiki/File:Cyclades_map-fr.svg

A place already purified and sanctified by the 5th century BCE to the point of purging and eliminating the indigenous Delians. Yet a place very much tied to and mixed up with other communities and other groups -- Egyptians from Alexandria, Lebanese from Beirut, Italians. And this occurred, even before Christians and Jews settled. Delos was always already much more than merely or only "Greek," whatever that may mean. But if it is not one of the cradles of "western civilization," of Judeo-Christian culture, then what is?

Today, there are no Delians, and there have not been any for over 2,000 years. Today, there are only ruins: houses, temples, statues, columns, mosaics, fountains, market squares, halls, porticos, colonnades. The failure of success. Decline and destruction at Delos was so striking precisely because at its apex it had been so spectacular, grand, opulent. Outsized grandeur made for colossal ruins. It is one of those places, so far away in time and world view, that conduce to Romantic meditation on the vicissitudes of fortune, the vanity of human endeavor. This ethos is expressed, for example, in a 19th century imagined reconstruction of Delos reproduced today on the map and guide every visitor receives with their admission ticket.

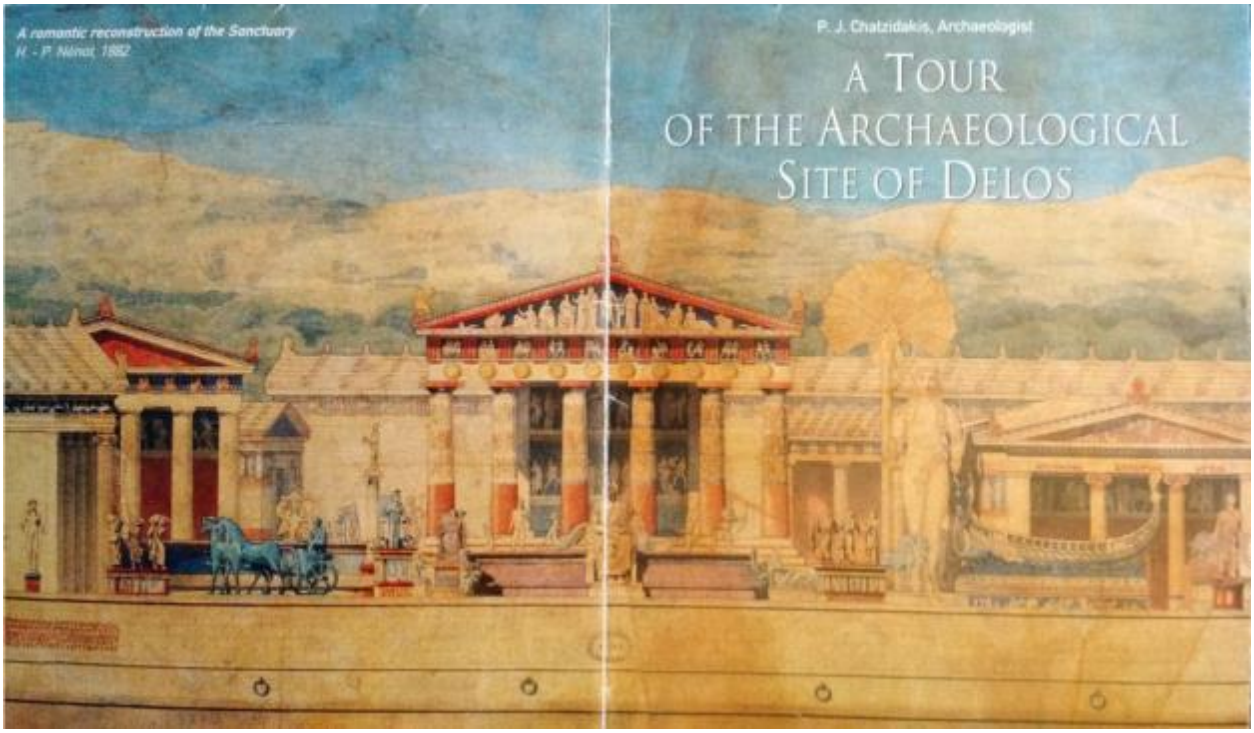

Figure 4: "A Tour of the Archeological Site of Delos," visitor guide with reproduction of H.-P. Nénot, *A Romantic Reconstruction of the Sanctuary* (1882). The sanctuary, established at least by the 9th century BCE, reached its peak during the archaic (7th-6th century BCE) and classical (5th-4th century BCE) periods. People from all over the Greek world gathered there to worship Apollo, the god of light, and Artemis, the moon goddess. Beside the Doric order temple dedicated to Apollo, once stood a colossal Kouros of Apollo, only parts of which remain extant. Parts of the upper torso and pelvis remain in situ, a hand is kept in the Delos Archaeological Museum, and a foot is in the British Museum. Collection of the author.

As a perspicacious British visitor in 1885 wrote, "There are a few huts scattered about and a wooden shanty, where two old men live to guard the ruins from the descent of European

pirates, who will go there in yachts and steal what they can find. All around stretches a vast sea of ruins, recalling Pompeii in extent and complete annihilation; you wander through houses with mosaic pavements, pillared halls with cisterns below, and the richness of marble wherever you turn is most striking, and in the brilliant sunlight almost dazzling" (Bent, 230).

Barely a decade earlier in 1872, archeological excavations had begun, and which continue today. During the last quarter of the 19th century, most pieces unearthed were sent to the National Archaeological Museum in Athens. Given the sheer quantity and size of the objects, this was deemed increasingly impractical, and the Delos Archaeological Museum was built in 1904.

MYKONOS ARCHAEOLOGICAL MUSEUM "FIRST FOUNDING"

At the Archaeological Museum in Mykonos, the permanent collection changes little. Not nearly as noteworthy as the Delos museum, what could be termed, without much exaggeration, the detritus of Delos is what ended up at Mykonos. Long-dead Delos continues to exert its spell, and maintains its connection with Mykonos.

The Mykonos museum reflects this history. Consider some of what was excavated from the purification pit and other digs on Rhenea.

--A small bronze sistrum, ceremonial rattle, from grave IV on Rhenea devoted to a priestess of Isis Filo (Thucydides, 1972: II, 104; Strabo, 1917: I, 486).

--Roman-era glass jewelry from grave IV on Rhenea devoted to a priestess of Isis Filo (Thucydides, 1972: II, 104; Strabo, 1917: I, 486).

--A grave stele, "Tertia Horaria," originally on top of a marble sarchophagus from a 2nd century BCE Hellenistic cemetery. The deceased woman on the left extends her hand in farewell to her husband on the right. A slave child at lower left holds her jewelry box.

--Statue of Heracles with a club and holding a lion skin. A copy of a classical Attic work of 450-425 BCE, made of marble from Paros. Parakastri on Rhenea, 2nd century BCE. Parakastri is the earliest gravesite of the early Early Iron age in the region.

Other finds from Mykonos and elsewhere have added to the museum's collection.

--Large burial *pithos*, or storage container, depicting the capture of Troy (ca. 1184-1180 BCE). Tinos, mid-7th century BCE. Excavated at Mykonos, 1961.

Figure 5: Detail, large burial *pithos*, storage container, depicting the capture of Troy (ca. 1184-1180 BCE). Tinos, mid-7th century BCE. Excavated Mykonos, 1961. In an early depiction of the Trojan horse on the neck of the container, the faces of hidden warriors are shown, while others descend from the horse. Travelling Runes, Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Mykonos_vase.jpg

--Grave stele of Glykon drowned at sea that represents him sitting on the rocks disconsolate, and with the bow of his ship at right. 2nd-1st century BCE.

--Clay Cycladic "frying-pan" decorated on the lower part with female genitalia. Early Cycladic II period, 2800-2300 BCE, Mykonos

--Amphora with woman in profile wearing earring. 625-600 BCE, Milos.

Figure 6: Detail, amphora with woman wearing earring. 625-600 BCE, Milos. Mykonos Archaeological Museum. Milos is located 75 miles southwest from Mykonos, and engaged in trade with it in such items as this. All photos by the author unless otherwise indicated.

VANITY IN THE MUSEUM

A stylized version from this same or a similar amphora could well be the model for a poster for the museum's first ever temporary exhibition, *Vanity: Stories of Jewelry in the Cyclades.*

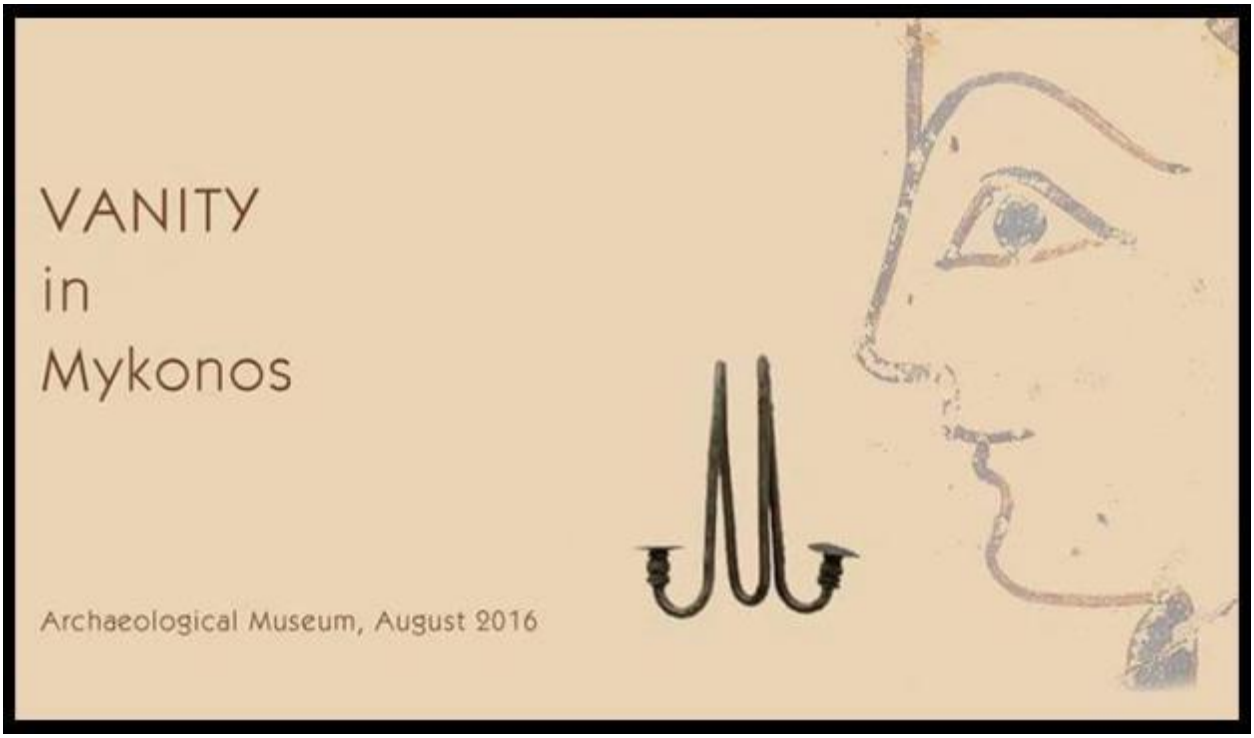

Figure 7: *Vanity in Mykonos* poster for *Vanity: Stories of Jewelry in the Cyclades* exhibition. Mykonos Archaeological Museum, August 2016-September 2017. Vanity Exhibition at Mykonos Archaeological Museum (2016).

The show consists of 230 pieces of jewelry from throughout the Cyclades (see figure 3 above). Spanning nearly 8,000 years from the Neolithic 6th century BCE to the 1970s, the highly eclectic exhibition includes diadems, hair rings, earrings, necklaces, pendants, fibulas, pins, finger rings and bracelets. Materials for the broaches include, for example, "shells, bones and ivory, common and semi-precious stones, glass, faience and coral as well as copper, silver and gold" (Koletas, 2016).

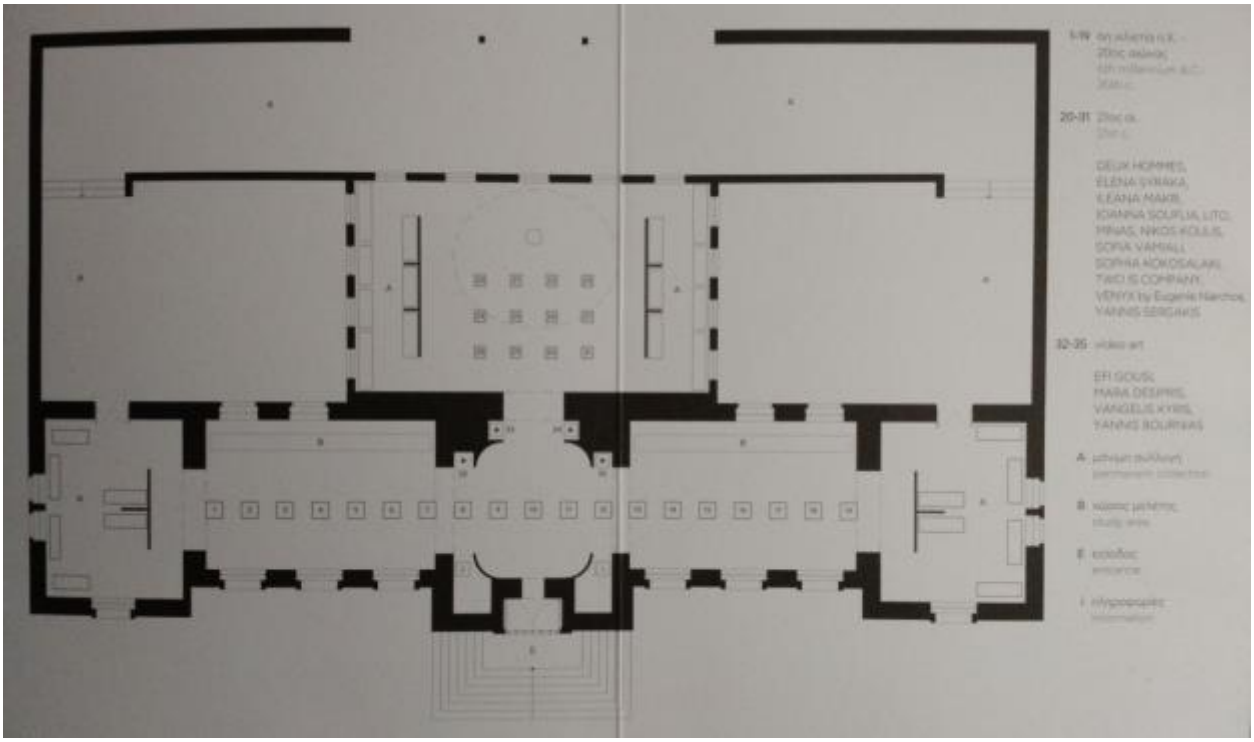

Figure 8: *Vanity: Stories of Jewelry in the Cyclades* exhibition layout. A: the permanent collection has been moved to the back and sides of the museum (top and upper sides). E: the visitor walks up the steps to the museum entrance (bottom middle), and directly into the center of a long hall stretching to the left and right with the 19 cases of historical jewelry in the exhibition ranging from the 6th millennium BCE to the 20th century (lower center). B: two long benches along either side provide a sitting and study area (lower center). Visitors cross the long hall into the center gallery where 12 cases of 21st century jewelry (cases 20-31) commissioned for the show are arrayed on pedestals in front of the museum's prized *pithos* depicting the capture of Troy, with a giant tilted mirror behind it (center middle). Exhibition flyer, Mykonos Archaeological Museum. Collection of the author.

To mount the exhibition, the museum has been turned inside out. The permanent collection has been moved to the back and sides of the museum, while the jewelry is displayed in the front and center galleries. To describe a few of the pieces suggests how eclectic they are in time, place and style.

--From Mykonos, a necklace with 33 gold beads in the form of a left-handed helix hammered in a stone mold. Tholos tomb at Angelika. Mid-14th-early 13th century BCE.

--From Paros, a silver belt-buckle. Ecclesiastical Collection of the Church of Panaghia Ekatontapyliani. 18th c CE.

--From Thera, the prehistoric city at Akrotiri on Santorini, a late Cycladic wall painting of a female "priestess" holding a censer. She wears a long, hieratic garment and jewelry not normally found among the many ornaments on Theran wall paintings. The ochre wheel-shaped earring, probably a symbol of the sun, is unique in Thera and the Cretan-Mycenaean region. West House, room 5, upper floor. 17th century BCE (late Cycladic I).

--From Sankri, Naxos, a wall painting of the Virgin and Infant Christ wearing an earring. A faintly visible Greek cross hangs from a silver hoop in his right ear. The depiction of the Christ Child wearing an earring is relatively rare. Church of St John in Avlonitsa. 1260-1280 CE.

--From Delos, a gold disk.

--A Byzantine icon of the Virgin wearing a fibula, or brooch.

The books in the exhibition study area are equally eclectic. One stack includes *The Glory of Byzantium at Sinai*, and a second book also published by the Benaki Museum in Athens, plus a book on Akropiti, and a second book on Byzantium.

The 12 contemporary pieces in cases on pedestals in the museum's central area were commissioned expressly to "expand the narrative to the present, opening the museum to the bustling marketplace of this cosmopolitan island," according to museum director Demetris Athanasoulis, writing in the exhibition flyer (Athanasoulis, 2016).

Organized in just two months, the exhibition ran August 2016 to September 2017. Next it will travel to museums on Santorini, Naxos and Milos. On Mykonos, Athanasoulis used state of the art museological display techniques so that "The exhibition content becomes jumbled with its container… to transform the Museum shell into an enormous jewelry box."

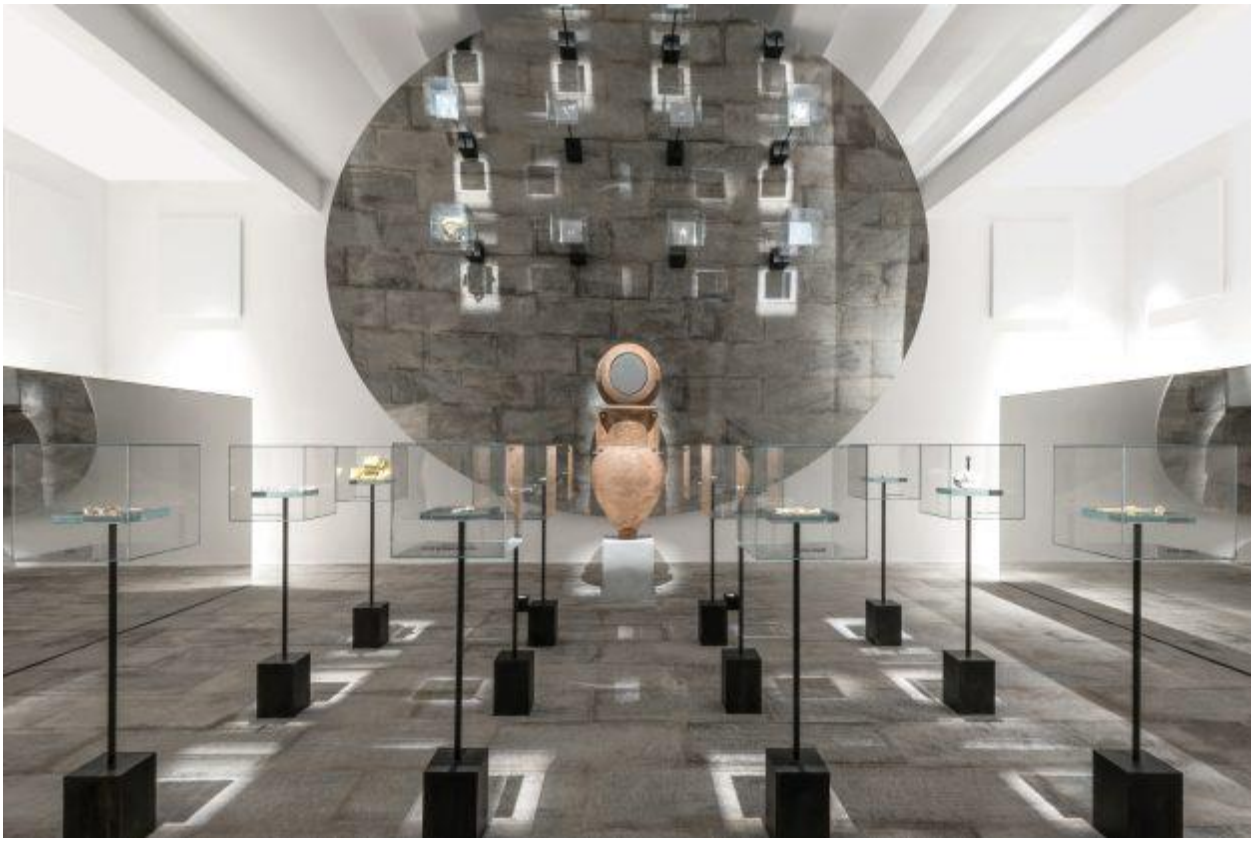

Figure 9: Central gallery area, *Vanity: Stories of Jewelry in the Cyclades* exhibition, Mykonos Archaeological Museum. Commissioned designer jewelry in glass boxes on pedestals

(foreground). Large *pithos* depicting Trojan War (see figure 5 above) excavated 1961 in Mykonos (center background). Giant tilted circular mirror (background). "The exhibition content becomes jumbled with its container… to transform the Museum shell into an enormous jewelry box." Exhibition flyer. Vladisavljevic, B. (2016)**.** Photo by Giorgios Sfakianakis.

This was done in several ways. The historical jewelry arranged in reflective glass cases employs ceiling spot lighting like that in a jewelry store. Rather than traditional museum wall labels, it is state-of-the-museum art pull-out drawers beneath the glass cases that identify and describe the objects, just as in a jewelry store. Pull out the drawer labeled "Rhenea Hellenistic (late 4th-1st c BCE) burials. Hellenistic. Late 4th-1st Century BCE. Jewelry from the necropolis of the Delians," for instance, and we learn that

> "The jewelry which accompanied the Hellenistic burials on Rhenea included primarily gold earrings, finger rings, and silver bracelets; fibulas and pins were rare. The jewelry from Rhenea, less valuable and impressive than that found on Delos itself, reveals among other things a preference for simpler jewelry types to accompany the deceased as grave goods" (*Vanity: Stories of Jewelry in the Cyclades*, Mykonos Archaeological Museum).

That the commissioned contemporary pieces in plexiglass boxes in the central exhibition area are placed on pedestals underscores that they are on display just as in commercial stores where their designers sell their work. Moreover, the official flyer for the exhibition mimics a high-end jewelry ad of the sort found in glossy magazines and jewelry display windows.

Figure 10: *Vanity: Stories of Jewelry in the Cyclades* exhibition flyer, Mykonos Archaeological Museum (left). Jewelry store display window, Mykonos (right). The official flyer for the

exhibition looks exactly like a high-end jewelry ad – rings and bracelets adorn a nude model -- of the sort found in glossy magazines and jewelry display windows.

The main museological technique is, however, the copious use that is made of glass and mirrors throughout. The very large circular mirror in the central area tilted slightly recalls nothing so much as a giant hand mirror (figure 9 above).

Figure 11: Central gallery area, *Vanity: Stories of Jewelry in the Cyclades* exhibition, Mykonos Archaeological Museum. Commissioned designer jewelry in glass boxes on pedestals (left and foreground). Large *pithos* depicting Trojan War (see figures 5 and 9 above) excavated 1961 in Mykonos (upper right). Giant tilted circular mirror (upper right background). Floor-to-ceiling mirrors on either side of the central gallery produce a maze of mirrors effect.

Floor-to-ceiling mirrors on both sides of the central gallery produce a maze of mirrors effect not unlike the climactic shootout in Orson Welles's *Lady from Shanghai* (1947). Mirrors at both ends of the long rectangular gallery produce infinitely receding, distorted reflections as in a carnival funhouse.

JEWELRY AS ART AND AS CRAFT

What exactly is “jewelry in the Cyclades”? What can jewelry ranging over nearly 8,000 years from successive societies and cultures in the Cyclades – Neolithic, Cycladic, classical Greek, Hellenistic, Roman, Byzantine, Venetian, Ottoman -- possibly share in common?

Historically, jewelry has been used for many reasons ranging from offerings at sanctuaries, as magical talismans, as well as bodily decoration. It has been used to attract, charm, stand out, and ward off evil, in addition to decorate. The idea of jewelry has changed, too, what it is, what it means, what value to ascribe to it. In short, its status as art and craft has varied over time. In the modern period since 1750, “art” is commonly understood to be skill used to produce an aesthetic result. More recently, “art” refers more narrowly to creative art or “fine art.” Skill is used to express the artist’s creativity, and to engage the audience’s aesthetic sensibilities. Key is the distinction between works with a practical function and those without. The latter are considered artworks, or fine art, while the former are regarded as decorative art, applied art, and crafts. But this distinction does not work well for earlier, typically preindustrial societies characterized by artisanal production. In such places at such times, the most highly regarded artistic media included metalwork, engraved gems, textiles and others considered today as "applied arts." Ritual and use value counted for at least as much, if not more, than exchange value, and was calculated according to the cost of materials, plus the time and labor spent fashioning the work as much as the creative “genius” of the artist, who was often considered a skilled craftsman.

In short, “jewelry in the Cyclades” as an organizing exhibition concept is a catchall, a hodgepodge, and a mish-mash. However, the story, or narrative point, of *Vanity: Stories of Jewelry in the Cyclades* is vanity, that which is considered empty, hollow, useless, and illusory. *Vanity*, moreover, plays on what it means to see and be seen, to mirror, and to be on display. The point is driven home in the exhibition’s use of mirrors: “The preeminent use of the **mirror** as implicit **symbol of vanity**” (Athanasoulis, 2016. Emphasis in original). As posters for the show coyly suggest, *Vanity in Mykonos* exists outside as well as inside the museum; it refers both to what can be seen in the museum and outside in the town.

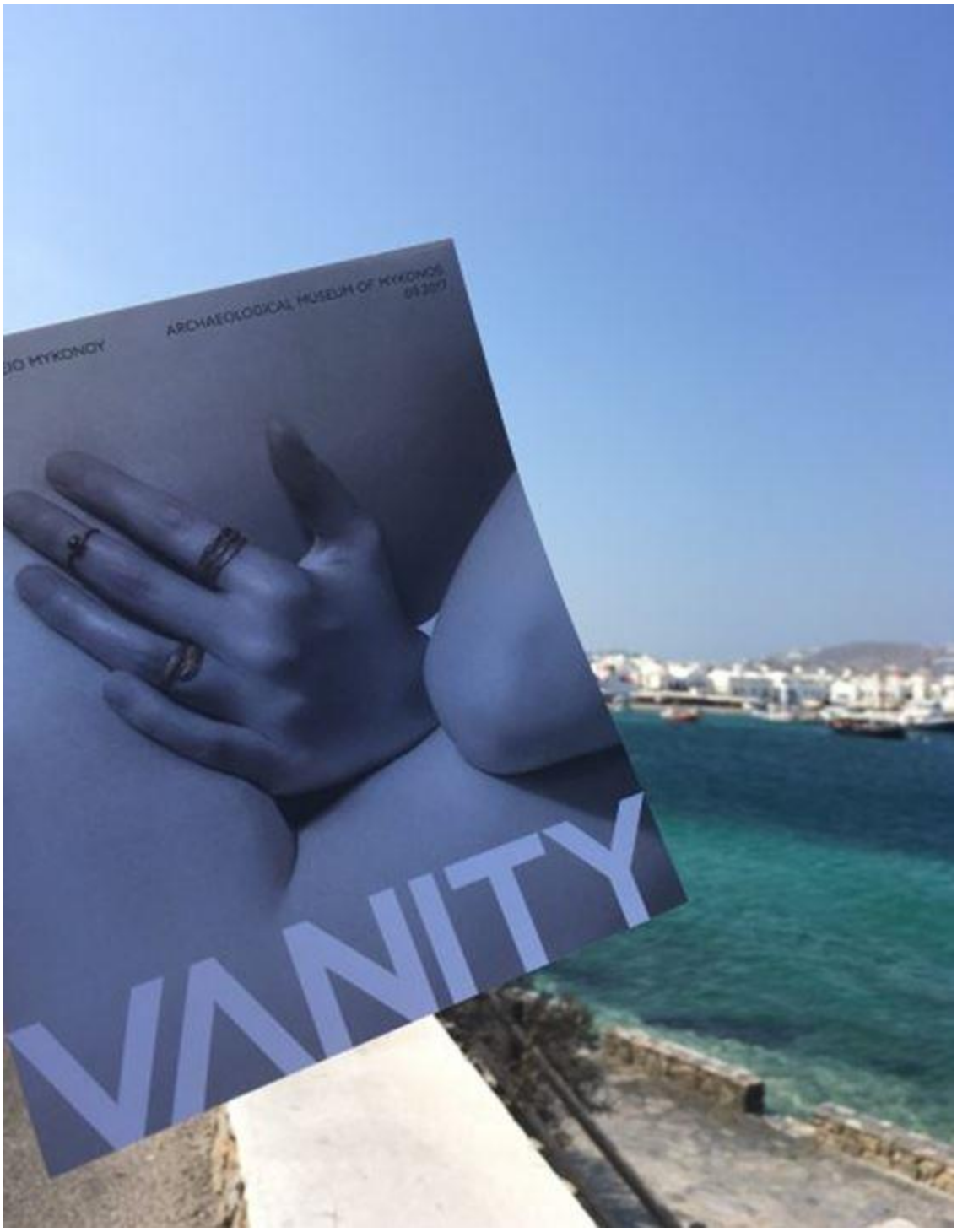

Figure 12: *Vanity in Mykonos* exhibition poster (left foreground), and Mykonos town (right background). "Vanity in Mykonos" refers both to what can be seen in the museum and outside in the town. Koletas, A. (2016)

VANITY IN MYKONOS

As a commercial website promoting Mykonos tourism puts it,

> "Vanity by definition is excessive pride in or admiration of one's own appearance. How appropriate that this exhibition of Cycladic jewelry from antiquity through to the modern era begins its journey in Mykonos, where the beautiful people adorn themselves with enhancements in the form of pricey baubles, expensive watches, designer shoes and high end clothing for the nightly summer street parade of seeing and being seen" (Vanity Exhibition at Mykonos Archaeological Museum, 2016).

Vanity "creates a bridging narrative… between the modern and historical pieces," one reviewer wrote (In Mykonos, all that glitters may be ancient jewelry, 2016)**.** In the process, it links public museum and private business. As director Athanasoulis put it, *Vanity* demonstrates how to "showcase the intangible surplus value of the archaeological heritage," that is, how to make money today off archaeological objects from the past (Athanasoulis, 2016)**.** No wonder that the gold bracelet on the exhibition flyer looks very like one in the show from Naxos made 850-760 BCE.

Figure 13: On the *Vanity: Stories of Jewelry in the Cyclades* exhibition flyer (left*)*, the nude model wears a gold bracelet that looks very like the one in the show from Naxos made 850-760 BCE (right*)*. Davis, A. (2016).

The museological look of the exhibition, achieved through glass, lighting, plexiglass cases, and mirrors, is indeed striking: chic, contemporary, cutting edge. Including contemporary jewelry is a smart marketing as well as museological move. Transforming the museum into a jewel box for the show, and opening it up to public underwriters and private donors for a glitterati opening night makes euros and sense.

But the best example of how public and private clasp in a capitalist embrace are the designers featured inside the show, and the shops where they sell their work outside. Some have jewelry stores or market in Mykonos. Most are young, many in their 30s; one is self-taught. Many of the others learned jewelry making in places like Athens, Paris, and Santa Monica, California. Few reside in Mykonos. The majority live in Athens, but nearly all emphasize a globetrotting lifestyle that takes them regularly to New York, Paris, London and elsewhere. These high-end jewelers command 5,000 Euros, 10,000 Euros and more for their work. Several sell in exclusive shops the world over -- New York, San Francisco, Beverly Hills, Paris, Doha, Beijing, Shanghai. They like to drop the names of people they sell to, such as Jennifer Lopez. Those who also exhibit in fine art galleries and museums consider that the art world's imprimatur for their work.

In many respects the jewelry of the 12 is as eclectic in style as the historical pieces in *Vanity*. Lito, Ileana Makri, and Syraka all make pieces that use the evil eye motif. Many group their pieces in disconcertingly varied collections. Makri's work ranges, for example, from her "bugs" and "Deco" collections, to her "punk" and "pistols and love grenades" pieces.

Figure 14: Left: Gold disk with relief bust of Aphrodite and Eros on her right shoulder. Delos, 2nd-1st century BCE. *Vanity: Stories of Jewelry in the Cyclades* exhibition, Mykonos Archaeological Museum. Right: Benedetta Dubini, Artemis medallion with an ancient silver coin. Royce-Greensill, S. (2016).

Some rework older, "traditional" motifs. Most obvious is Benedetta Dubini, an Italian living in London. Although not featured in *Vanity*, she markets in Mykonos. "Long fascinated by Greek and Roman mythology," she

> "creates one-of-a-kind jewels using ancient coins alongside precious stones and metals. 'Mykonos is one of the most elegant islands and it attracts people who are looking to shop for unique treasures. Each of the coins I select has its own myth or legend, which certainly makes them rare'" (Royce-Greensill, 2016).

Elena Syraka is more subtle, eclectic, and decidedly multicultural. Want ancient Greek gods? Check out her "Demi-Gods" collection. Want Cycladic? After visiting Athens' Cycladic Museum, she created her "Idols" collection. Middle Eastern? After visiting Athens' Benaki Museum of Islamic Art (separate from the Benaki Museum of Culture), she created her "Nour" collection.

Figure 15: Elena Syraka, *Nour* collection. Pendant, inspired by surgical scissors. Iran, 19th c. CE (left). Ring, inspired by gilded copper horse's nasal ring. Ottoman Turkey, 16th c. CE (right). http://www.elenasyraka.com/collections/nour/

She says, "Jewelry making has been practiced in Greece for thousands of years… "We currently have amazing craftsmen and extremely talented designers who… continue *the tradition*…" But which tradition exactly? "My creative goal is to translate powerful and iconic *images of Ancient Greece* to modern symbols… At the same time, I hope to present *the rich heritage of Greece*" (Davis, 2016. Emphasis added). Apparently for her, "*the rich heritage of Greece*" includes 19th century Iranian surgical scissors and 16th century Ottoman Turkish horses' nasal rings. Just as when Delos is unreflectively considered as quintessentially, homogeneously "Greek," there is a similar confusion about "Greek jewelry." "Greek jewelry," like "Greek art" and "Greek culture," confuses works *in* or *from* Greece with works *of* Greece. Such formulations essentialize as "Greek" what was always already cosmopolitan, multicultural, and transnational.

Figure 16: One contemporary jewelry designer featured in *Vanity: Stories of Jewelry in the Cyclades*, Niko Koulis, also owns his own store in Mykonos, which is described as "a blend of Cycladic architecture with art deco touches." Royce-Greensill, S. (2016).

Back in Mykonos, where *Vanity* designer Niko Koulis has a store, "a blend of Cycladic architecture with art deco touches," he competes with other high-end jewelry stores and chic tourist boutiques. One of them boasts that it "features unique high-end items from the world over, focusing on beachwear, sunglasses, sandals, swimwear and of course jewelry, often created by passionate Greek designers exclusively available at Dew." Another is Rousounelos "Luxury Watches and Jewelry," which features Cartier, among others.

Figure 17: Dew boutique and jewelry store draws on Cycladic design motifs for its exterior: whitewashed walls, inset bench (left), and pavement stones. Dilousmbaka, E. (2016). http://dewmykonos.com/index.php?option=com_content&view=article&id=94

There are many other jewelry stores to visit, 91 altogether, most of them less expensive than the high-end ones. Other businesses that cater to tourists also run the gamut in quality and price: 177 fashion stores, 38 souvenir stores. Accommodations: 170 hotels, 194 rooms and apartments, 18 villas, and two camping sites. Places to eat: 117 restaurants, including 11 beach restaurants, 19 fast food, 36 tavernas, 44 cafes, 18 ice cream and pastry shops, and five bakeries (Shopping in Mykonos, 2017).

TOURIST ECONOMY IN MYKONOS

For these and other stores, there is a rich – literally -- tourist market, both in numbers and high-end spenders. Greece, the Cyclades, and the island of Delos have been tourist destinations for a couple of centuries.

What has happened, as with so many other places to varying degrees, is that as the number of tourists increases, the infrastructure supporting and catering to tourism – hotels, restaurants, travel agencies, guides, guidebooks, and shops (laundry, clothing, jewelry, markets, liquor, souvenirs) – increases, thickens, and becomes more highly differentiated. The shift from upper class, especially aristocratic, 19th and early 20th century Europeans visiting Mykonos to early 21st century high volume tourism, especially from cruise ships, that caters to travelers at every point on the price spectrum occurred over 125 years, accelerating only after the Second World War.

Until a century ago, the main tourist attraction in the Cyclades was Delos, because many if not most visitors had a classical education, and knew about its historical and cultural significance. The only islands covered by the 1894 *Baedeker Guide*, for example, were Syros, Mykonos and Delos (Baedeker, 1894). And Mykonos was only included, because it was the obligatory stopover and jumping off spot for visiting uninhabited Delos. According to the most authoritative English 19th century guide to the Cyclades, published in 1885, "In itself it [Mykonos] is one of the least interesting islands of the archipelago. 'Lowly Mykonos,' as Pliny described it, is a fair description still" (Bent, 1885: 224). People came to Mykonos not to see it, but to visit Delos. Nearly "all the glory of Mykonos is reflected. Every possible piece of antiquity comes from Delos, even the pillars down by the harbor to which the sailors moor their boats are from a temple in Delos" (Bent, 1885: 224).

Figure 18: Constructed in the 16th century by Venetians on a small hill overlooking the harbor to mill wheat, Mykonos' now-iconic windmills were decidedly less so in this 1885 photograph taken in the same year that Bent published his *The Cyclades, or Life among the Insular Greeks* (Bent, 1885). Note individuals on left. Photographer unknown.
https://www.pinterest.com/pin/368028600775894620/

> Moreover, travel was difficult. In 1885,
>
> "How can people come to Mykonos? Unless you are armed with a letter of introduction, there is no possible means of obtaining a night's lodging. The steamer comes only once a week, when the weather is fine, so a traveler who visits Mykonos, and would not stay a week on this uninteresting island, must depend on the precarious passage by caïque" (Bent, 1885: 225).

Ten years later there was a single boarding house (Baedeker, 1894). In 1911 the *Guide Joanne* devoted 12 pages to Delos out of a total of 22 on the Cyclades. At that time, Mykonos had one hotel and two boarding houses. Twenty years later in 1933, slightly more than 2,000 tourists traveled to Mykonos, while 200 foreigners visited Delos and the Mykonos archeological museum (Kourtara, 1995: 26). Mass tourism to Greece only really took off in the 1950s, at the same time as the postwar Greek "economic miracle," which lasted into the 1980s. From 1957 on, tourism revenue grew 20 percent a year.

Figure 19: Group of well-dressed, wealthy European tourists in the 1930s in the Alefkantra quarter. In the background is Mikri Venetia, or Little Venice, a row of arcaded Venetian houses built right on the water. Today, much more than in the 1930s, it consists of bars, boutiques, clubs, plus a row of popular waterfront restaurants frequented by many more tourists, most of whom are less wealthy. Photographer unknown. MYKONOS… Old Photos of Mykonos by Dimitris Koutsoukos https://www.youtube.com/watch?v=_HMMFhH5Rs8

A distinguishing characteristic of Mykonos tourism today is the number of gays who visit. It is very likely an exaggeration to say that "Mykonos has been a gay friendly destination since ancient times." But certainly after Italian artist Piero Aversa opened his bar in the early 1970s, "the vibe exploded with thousands of gays flocking to the island." Tourist attractions run the gamut from gay beaches – Elia Beach and the left side of Super Paradise Beach -- to gay hotels – the Elysium Hotel and slightly inland the Geranium Hotel -- and to gay bars. On the west side of the harbor along the waterfront, a series of gay bars "cater especially to the gay crowd with nightly drag shows throughout the summer" (Mykonos Gay Tourism, n.d.).

Figure 20: A patron stands in from of Bar Pierro's, opened by Piero Aversa in the early 1970s, the earliest and single most famous gay bar in Mykonos. mykonos,80s Pierro's Bar the early days! by dimitris koutsoukos https://www.youtube.com/watch?v=EfOZGgCpWBU

The number of tourists to the Cyclades varies from island to island. Certain ones, such as Naxos and Syros, do not depend solely on tourism. In 2005, there were 909 hotels in the Cyclades. The main tourist destinations were Santorini with 240 hotels, and Mykonos with160 hotels. In 1997, there was an average of 0.75 beds per inhabitant in the Cyclades as a whole. The number of beds per capita was double that on both Mykonos and Santorini. In 2011, Santorini was voted best island in the world, and Mykonos ranked fifth best in Europe. Yet the Cyclades see only a tiny fraction of all tourists to Greece: in 2006, only 310,000 of a total 11.3 million

visitors, less than .003 percent. Carrying capacity is crucial. Mykonos town, Chora, is tiny, for example. Its population numbered for centuries in the low four digits. As recently as 2001, it was 3,000, and only reached 11,000 in 2011 (History of the Cyclades, 2017).

What about tourism and the still-continuing Greek economic crisis? A reviewer of *Vanity* noted that "While having an international customer has benefited many top Greek jewelers, worldwide fiscal insecurity since 2008 has left even international buyers conservative with their orders, according to designers, which makes their continued design innovation all the more singular." For the reviewer to go on and say, "the last few years in Greece have been economically unstable, at best," is a breathtaking understatement (Davis, 2016).

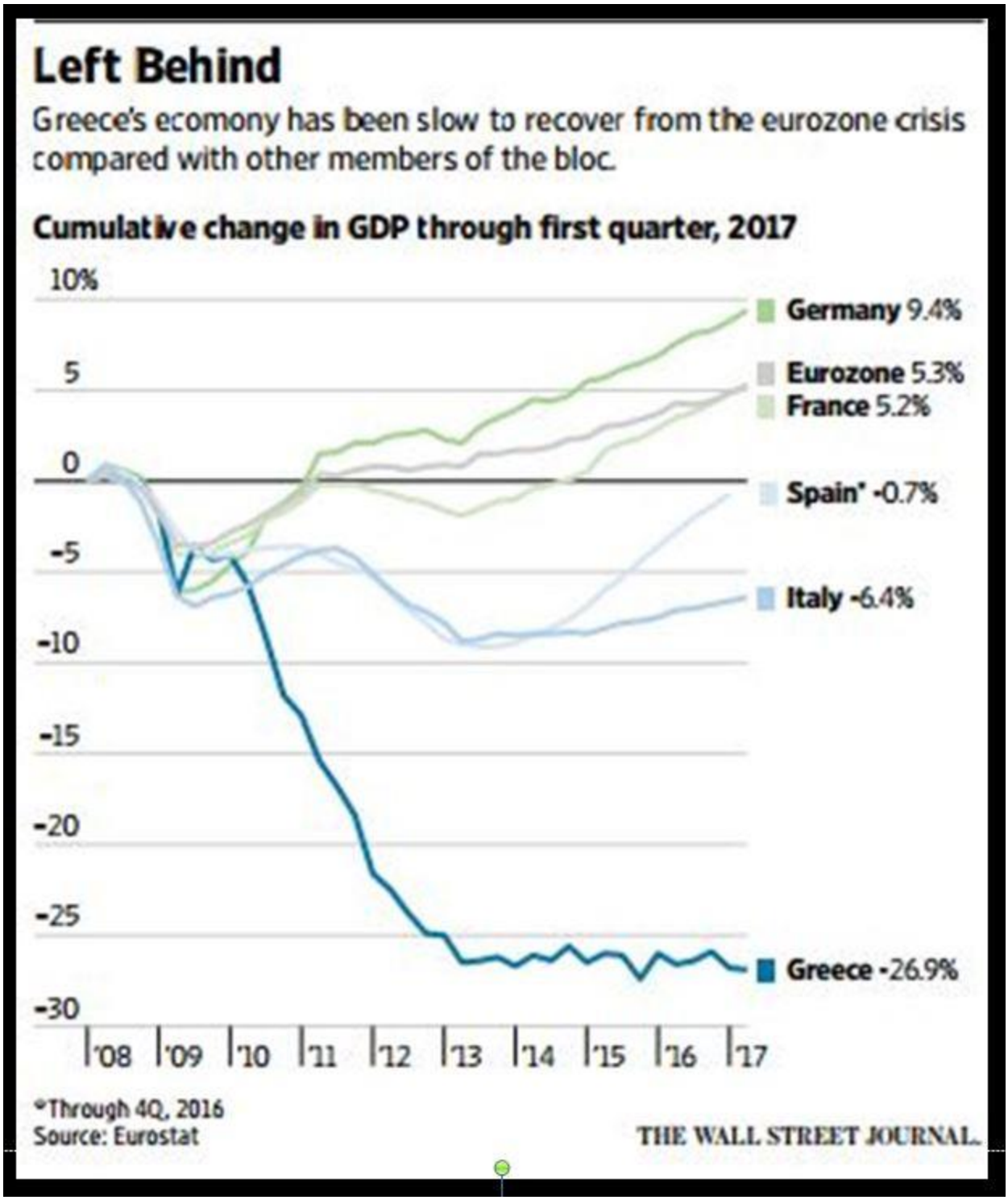

Figure 21: "Left Behind: Greece's economy has been slow to recover from the Eurozone crisis compared with other members of the bloc." *Wall Street Journal*, June 16, 2017.

Since the Great Recession of 2008, the Greek economy has plunged nearly 27 percent. Unemployment, 25 percent in 2015, stands at 23 percent in 2017. Greece has been the hardest hit

by the Eurozone crisis. A quarter of Greeks live under the poverty line. More than 400,000 residents, many highly qualified, have left the country since 2008 (Greek government-debt crisis, 2017). Exacerbating the economic crisis has been the more recent refugee crisis. In 2015, Greece became the main European point of arrival for Syrian and other Middle Eastern refugees. In 2016, Turkish refugees fleeing after the failed coup d'état added to the influx (European migrant crisis, 2017).

ARCHITECTURE *IN* THE CYCLADES AND *OF* THE CYCLADES

Yet in a very real sense, the Mykonos tourist economy is recession-proof. The Greek economy may tank, but Mykonos continues to attract visitors with so much disposable income, surplus wealth, that they will never not have enough for expensive baubles. For what continues to attract tourists, and not only high-end ones, is Mykonos' Mediterranean island setting, and in particular its "picturesque" so-called Cycladian architecture, "pretty as a postcard." To be sure, buildings and stores in the Chora have been prettified, spruced up. Old photos and films attest to very significant changes in the urban landscape since the beginning of the 20th century and earlier. Nearly all gone are the loaded-down donkeys in the alleyways, for example, as is the excrement they deposited.

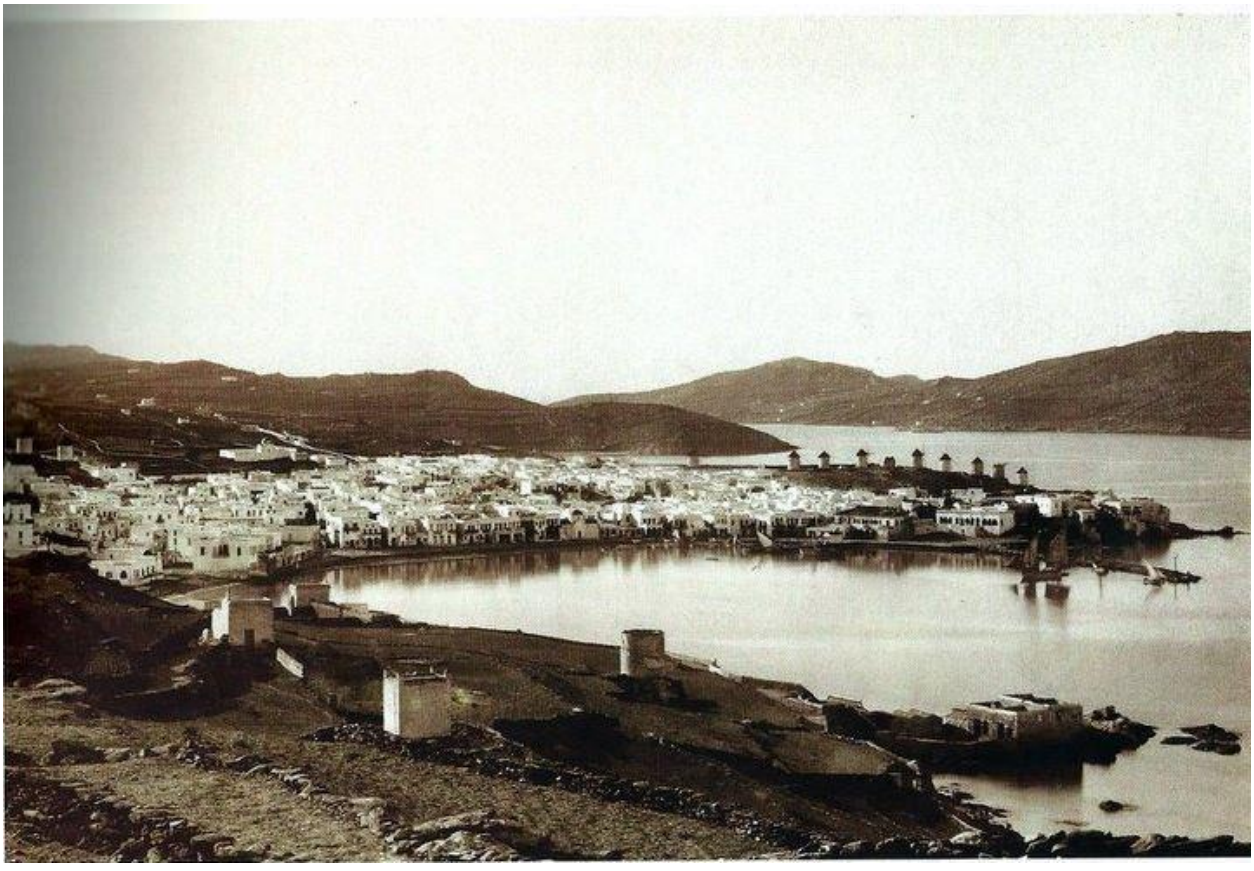

Figure 22: Dimitris Stavropoulos, *Mykonos*, 1901. View west towards the Chora and harbor with windmills behind (middle right). Left foreground is location of Mykonos Archaeological Museum built the following year in 1902 by Stavropoulos, first Director of Antiquities of the

Cyclades. https://i.pinimg.com/736x/fd/e7/a8/fde7a8fe37947018de6ba27e996c9c78--myconos-cyclades.jpg

As with what is considered "Greek" and "Greek jewelry," however, there is a similar confusion with "Cycladic." The problem is that the term refers both to a place, the Cycladic archipelago, and to a specific archaeological period, the Cycladic, which dates to 3200-2000 BCE. Again, however, there is a difference between "Cycladian architecture," that is "architecture *of* the Cyclades," and "architecture *in* the Cyclades." In Mykonos, we are talking about a specific and singular, not to say idealized, urban, especially residential, variant of "architecture *of* the Cyclades," which is commonly referred to as simply "Cycladian architecture." The following popular account is characteristic. Mykonos' "architecture is typical of Cyclades, all white-washed cubic houses with blue windows, charming narrow streets with pebble-stoned pavements and little white chapels with sky-blue cupolas" (Mykonos Sightseeing, 2017). In other words, there is a high degree of architectural abstraction, meaning simple lines and a distinctive manner of dealing with volume, cubes, and space. This results in an immediately recognizable architecture: white-washed buildings with little decoration, streets made of flat stones with bands of whitewash, and distinctive architectural structures such as dovecotes.

Yet this quintessentially "Cycladic architecture," that is, "architecture *of* the Cyclades," differs markedly from "architecture *in* the Cyclades," the former varying slightly but discernibly from island to island – from Oia on Santorini and Chora on Mykonos compared to neoclassical buildings in Ermoupolis on Syros. On the other hand, "architecture *in* the Cyclades" consists of a veritable catalogue of successive historical styles from Cycladic, ancient Greek, Hellenistic, and Roman, to Byzantine and Venetian. Even the single most iconic example of "Cycladian architecture," of "architecture *of* the Cyclades," the Panagia Paraportiani (the Church of Our Lady) on Mykonos, is not as "pure" as the guidebooks would have us believe. Arguably one of the most famous architectural structures in Greece, and one of the most photographed places in the world, the church constitutes in fact a jumbled heap of several churches piled on top and around one another through a series of decidedly impure accretions. Built over 200 years between the 15th and 17th centuries CE in five different stages, it actually consists of five different churches. Four of these comprise the base: the church of Agios Efstathios (Saint Eustathios) in the center, surrounded by those of Agios Anargyros (Saints Anargyroi), Agios Sozon (Saint Sozon), and Agia Anastasia (Saint Anastasia). The fifth one, the church of the Virgin Mary, sits on top like a dome.

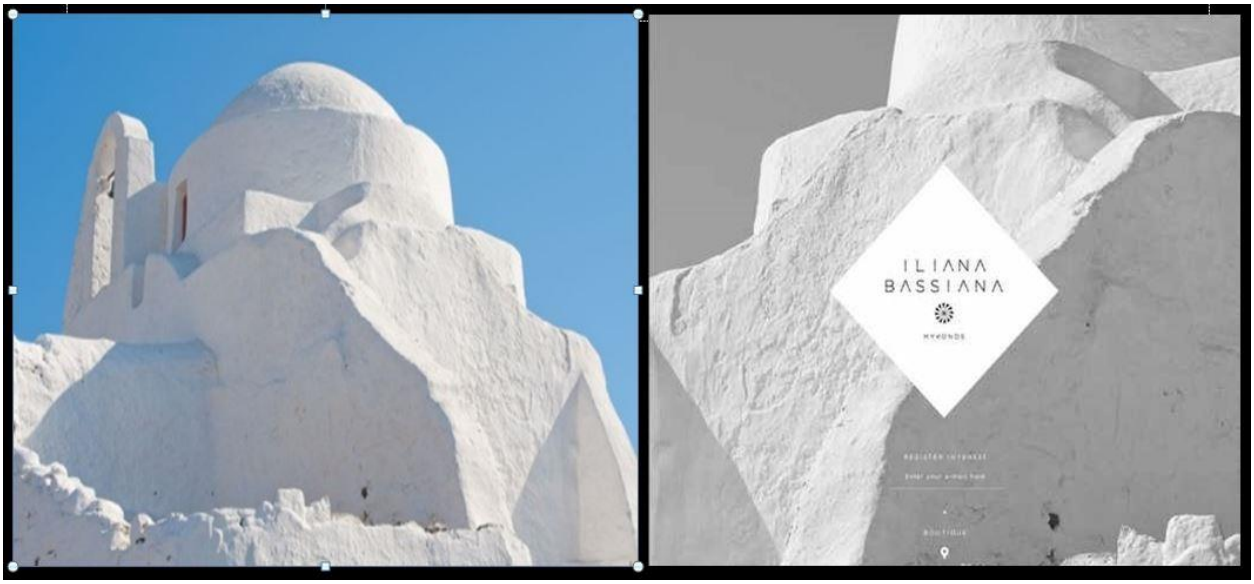

Figure 23: Church of Panagia Paraportiani (Εκκλησία της Παναγίας της Παραπορτιανής), 15th-17th centuries CE. Mykonos (left), and advertisement with the Church as backdrop (right). The Church's name literally means "Our Lady of the Side Gate," because it was located next to the entrance to the former *Kastro*, or tower, area. Constructed in 1207, the *kastro* was torn down in the 16th century and what was left was covered up in the 18th century when Chora began to expand. Iliana Bassiana, an architect and fashion designer, opened her eponymous "luxury resort wear" boutique in 2015. http://mygreecetravelblog.com/2015/05/08/mykonos-set-for-banner-year-of-tourism-with-new-places-to-eat-drink-shop-sleep-and-party/5/

"Cycladic architecture," that is, "architecture *of* the Cyclades," is often glossed as "minimalist," "modernist" or "organic." It can border on what is considered "primitive," or "other." In fact, its very "difference" has become its chief attraction. It is lauded for its "organic" connection to its natural surroundings. The maze-like streets and narrow alleyways, which originated as urban forms of defense against pirate attacks from the sea, are viewed today as "exotic," "romantic."

Key is the synergy created between this "Cycladian architecture" in Mykonos, and the contemporary international, upscale shops now located in what were mostly old houses that formed the urban skeleton. "Cycladic" architectural minimalism consists of, among other things, simple backdrops, neutral backgrounds -- whitewashed walls and cobblestones -- against which almost any shop can fit right in. The maze-like character of "Cycladian" urbanism constitutes, moreover, the body, or backbone, on which the stores adorn themselves. This is why you almost need a map to find your way to a particular store.

MYKONOS ARCHAEOLOGICAL MUSEUM "SECOND FOUNDING"

Figure 24: Mykonos Archaeological Museum. "First founding" permanent display (left), and "second founding" *Vanity* temporary exhibition (right). On left, "the glass and wood shelves, which are kin to the design of late 19th century museum cases, are filled with row after row of restored pottery." danieljlay (2017).

Located as it is right on the waterfront, you do not need a map to find the Mykonos Architectural Museum. Yet the neoclassical building, especially its interior, has changed over time just as buildings in the Chora. The "first founding" of the museum, as it may be termed, occurred when Stavrapoulos built in 1902 what was and remained throughout the 20th century a provincial, "long neglected" archaeological museum. What may be called the museum's "second founding" has occurred with Director of Antiquities of the Cyclades Athanapoulis's *Vanity* show. "For us this is very important," he says, "because it's the first exhibition in the island. In fact, it's the first temporary exhibition in the Cyclades" (Mandal, 2017). The makeover has repurposed the museum awkwardly but firmly between the public and private spheres. "Vanity is part of a campaign to enhance cultural tourism on an island renowned for its beaches and bars" (Vanity Exhibition at Mykonos Archaeological Museum, 2016). From older, traditional-style displays of archaeological artifacts, the museum with its *Vanity* show now makes money showcasing the holdings' "intangible surplus value" (Athanasoulis, 2016). Compared to an average 10,000 annual visitors, more than 4,000 museumgoers saw *Vanity* in its first six weeks alone. As for Athanasoulis, he "admitted that his grand plan does entail making Delos an archaeological hub just like Pompeii, which in turn could attract millions of euros in funding restorative actions" (Mandal, 2017).

He is not the first. Already in the 19th century, British traveler Bent had observed in 1885, that "All around stretches a vast sea of ruins, recalling Pompeii in extent and complete annihilation" (Bent, 1885: 230). In 2001, the population of Delos was 14. In 2008, 2.6 million tourists visited Pompeii.

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‘The ornament of Bristol and the wonder of the age’: Brunel’s Clifton Suspension Bridge and a regional design heritage

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‘The ornament of Bristol and the wonder of the age’: Brunel’s Clifton Suspension Bridge and a regional design heritage*

Introduction

There is perhaps no symbol of Bristol more recognisable than that of the Clifton Suspension Bridge, which spans the Avon Gorge and links Clifton in the city of Bristol to Leigh Woods in North Somerset. Originally proposed as a stone bridge in 1753 in the will of merchant William Vick, a wrought-iron suspension bridge finally opened over a century later in 1864. Designed by the engineer Isambard Kingdom Brunel (1806-1859) in 1830, the Clifton Suspension Bridge has become a key part of Bristol’s visual identity. The man responsible for its design and construction has become an equally important regional symbol – you cannot walk through Bristol without feeling the legacy of Brunel, nor can you visit Bath without recognising the impact of the Great Western Railway on the city’s built heritage. More than just a physical bridge between two bodies of water, Brunel’s bridge stands as a symbol, both of the Bristol region and all that it is capable of, and of the connection between the region’s historic engineering acumen and its continued aptitude for design in the present day.

History matters and analysis of Brunel and his bridge can provide a figurative bridge to understanding the region’s contemporary capacity for design. This capacity has contributed to a growing legacy of design across the South West, ranging from Bristol to Bath and further afield to places like Bradford-on-Avon, Trowbridge, Street, Malmesbury and Corsham. However, the region is home to far more than just an historic legacy of design. Design continues to add social, cultural and economic value across the region today, as acknowledged by the recent Arts and Humanities Research Council (AHRC) and Design Council funded project, ‘Bristol and Bath by Design’, which was undertaken jointly between University of the West of England (UWE), Bath Spa University and University of Bristol. More than just having an economic value, design and the creative industries are inextricably connected to the social and cultural landscapes of cities, regions and countries, meaning that a holistic approach is necessary if we are to truly understand value and impact. Historical change, as well as industrial development, urban regeneration and new approaches to policy can drive and be driven by design (Bristol and Bath by Design, 2016).

Design-driven industries like engineering and architecture are visibly embedded in the region’s visual identity, with the Royal Crescent and the Circus in Bath sitting beside the Clifton Suspension Bridge as noted examples. The former provide an essence of elegance and wealth in a city of leisure, while the latter serves as a bold, iron-willed structure for an industrial city. Those people responsible for their design and construction have become equally important symbols of the cities. Brunel’s works, from the Clifton Suspension Bridge, S.S. Great Britain and Temple Meads station in Bristol, to Bath Spa train station and Box Tunnel, are some of the region’s most recognisable landmarks, serving as symbolic bridge between past and present design, between design and city identity, and between design as artefact and process.

These historic landmarks provide a starting point for discussions around contemporary ideas of design within the region. This paper focuses upon the design and lasting visual legacy of the Clifton Suspension Bridge as a case study for the development of a diverse design heritage in Bristol and beyond. It is about a bridge and about design; about the problems, possibilities and

issues that emerge when we bring these two things together; and, above all, about how the journey to fully understand the Clifton Suspension Bridge and its significance to the South West region forces us to think about all of these issues together in new and, perhaps, unexpected ways. We often treat the significance of the bridge as a design 'noun' rather than a design 'verb', concerning ourselves with the finished article. The fact is, the artefact that is left to us in the end comes at the cost of understanding, and of appreciating, the significance of the design process itself, especially in regard to constructing a regional design legacy.

Designing a legacy

Design in Bristol, Bath and the surrounding area has advanced and prospered due to the region's geography, resources, people and heritage, however, it is often well-hidden within the region's wider history. To truly understand the value and impact of design and design-related activities here, an understanding of the historical design contexts within which the cities of Bristol and Bath have grown is essential. Combined with the effects of serendipity throughout history, design has played a role in each aspect of the region's development and exists in every part of its landscape, serving as a reflection of the region's identity, with the Clifton Suspension Bridge serving as a case-in-point for the power and potential of good design to bridge the gap between past and present and between design as artefact and design as verb.

Setting the Scene

Firstly, of course its design, its very existence, is inextricably tied to the life and career of Brunel. This is in spite of evidence that suggests Sarah Guppy, and not Brunel, was the real designer, following her suspension bridge patent application in 1911 and well-known acquaintance with Brunel (Dresser, 2016). Whatever the case, the Bristol and Bath region owes an enormous debt to Brunel and his legacy, for whether or not he was wholly responsible for the bridge's design, he was the driving force in establishing the Great Western Railway, Swindon Railway Village and Works, Box Tunnel, Sydney Gardens in Bath and the Royal Albert Bridge, as well as building two of his most famous steamships in Bristol, including the SS Great Britain (a major tourist attraction), repairing the Cumberland basin, and enhancing waterworks, among other achievements (Buchanan, 2006).

During the first half of the nineteenth century, Bristol had experienced a period of major change in design and industry, as the city moved away from the traditional trades and industries associated with its port and expanded its interests. By the end of the eighteenth century, the city was experiencing increased competition from the port of Liverpool, which was much better suited to receiving the larger ships being used for transatlantic trade. Though Bristol has been Britain's primary slaving port in 1736, by 1807 the abolition of the British slave trade by Parliament had greatly reduced the volume of goods and raw materials being exchanged in Bristol (Penny, 2005, 11).
Despite being overtaken by Liverpool as Britain's second port in 1750, the construction of the Floating Harbour between 1804 and 1809 allowed Bristol to maintain a strong, if not thriving trade until the 1960s (Morgan, 2006). The Official Illustrated Guide to the Great Western

Railway (1866) describes Bristol as a 'famous old city' that had 'been an emporium of commerce for a longer period than almost any seaport in the Kingdom' (Measom, 1860). The majority of Bristol's financiers were its merchants, who had accumulated their wealth through overseas trade in the seventeenth and early eighteenth centuries. In the guise of the Merchant Venturers, they financed a number of projects in and around Bristol, including the Kennet and Avon Canal, the Great Western Railway and several turnpike trusts, namely in Bristol, Bath, Somerton, Ilchester and Shepton Mallet (Minchinton, 1954, p. 85).

There were huge improvements in transportation in the nineteenth century, namely the opening of the Great Western Railway between Bristol and London in 1841 and the decision to build a spur to Bath on the Bristol-Birmingham section of the Midland Railway Line in the 1860s. These improvements increased industrial and building activity in both cities, while providing a faster and more affordable way of sourcing materials and selling products. The arrival of the Great Western Railway was a major moment in the industrial and manufacturing history of Bristol, Bath and the surrounding region. Though the residents of Bath were originally opposed to the plans for the Great Western Railway, with support and pressure from Bristol-based merchants and entrepreneurs, Brunel's plans were finally approved in 1835 (Harvey and Press, 1988).

Bristol, Brunel and the Clifton Suspension Bridge

Brunel arrived in Bristol to recuperate from injuries sustained while constructing the Thames Tunnel, having become chief engineer after his father, Marc Brunel, became unwell. While living in Clifton, he found out about a competition to design the bridge that would span the Avon Gorge, connecting Clifton to Leigh Woods. In 1753, a merchant called William Vick had left £1,000 in his will for the project, stipulating that a total of £10,000 had to be raised before the money could be touched. It was not until 1829 that the amount reached £8,000, enough that a subscription fund was launched to raise the remainder of the money and finally build the bridge – the first step of which was the competition (Buchanan, 2006).

Engineers from around the world entered designs into the competition. The judge, Thomas Telford, an elite engineer who had recently completed the suspension bridge over the Menai Straits between Anglesey and Wales, rejected all five finalists on the grounds of safety. There was public outcry when Telford then put forward his own costly scheme with two gothic piers, so a second contest was held. The Bridge Committee favoured Brunel's Egyptian design featuring sphinxes guarding the stone pillars on either side of the river and he won the competition, saying that he was:directed to make such drawings, lithographs etc., as I, in my supreme judgement, may deem fit; indeed, they were not only liberal with their money, but inclined to save themselves much trouble by placing very complete reliance on me (Buchanan, 2006, 48).

Both Brunel and the civic leaders of Bristol recognised the importance of the bridge to the city, seemingly aware of its imminent legacy from the start. An extravagant ceremony was held to mark the beginning of the bridge's construction, with Sir Abraham Elton saying presciently of Brunel that:

The time will come… [w]hen, as that gentleman walks along the streets or passes from city to city, the cry will be raised 'there goes that man who reared that stupendous work, the ornament of Bristol and the wonder of the age' (Gillings, 2006, 43).

However, the 1831 Bristol Riots put a stop to work and the investment dried up. Though the foundation stone was finally laid in 1836, the project was plagued by one false start after another. Work slowly begun again and the bridge piers were completed, but then in 1842 the money dried up entirely and the Clifton Suspension Bridge went bankrupt. The trustees thought a basket crossing attraction might raise vital funds for the project, but the £125 in receipts was nowhere near the £30,000 required. Brunel never gave up on the bridge, however, he died before the bridge was completed – for years the stone towers stood on either side of the gorge without a bridge to connect them (Goff, 1974, 303-304; Gillings, 2006, 44-45).

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Despite all of the troubles that came throughout its construction, the Clifton Suspension Bridge was finally opened at noon on December 8, 1864. Crowds gathered in Avon Gorge to watch the proceedings as guns fired their salute and the first dignitaries crossed the bridge from Clifton to Leigh Woods. Though Brunel died five years before the bridge was officially completed, winning the competition some 30 years previously served as the beginning of the legacy of Brunel that reaches to this day, for it brought him to the attention of the city's key investors – the Merchant Venturers Society (Buchanan, 2006; Brindle, 2013). According the Fox (2003), 'Brunel became a celebrity, an engineering superstar at a time when the public works of engineers were remaking everyday life in large, visible ways and sparking the popular imagination as never before'. Inspired by his rising star, the Merchant Venturers subsequently backed all of his projects across the region, from the Great Western Railway, train stations and steam ships to Box Tunnel and Sydney Gardens, thus establishing his legacy.

Bridging the gap: design as action

Brunel was not the first high-profile designer to work in Bristol, nor was the Clifton Suspension Bridge the first monumental design achievement in the South West. While the bridge itself as a designed artefact is a significant driver of regional design (as a noun), the design (verb) and construction of Brunel's bridge catalysed more than a century of innovative design action. Design has in turn played a role in each aspect of the region's development, existing in every part of its landscape and serving as a reflection of the South West region's identity, but its processes are often completely hidden within the region's wider history.

An understanding of design as process is important. It is important that our discipline, history of design, is so good at promoting the cult of the artefact, what you might almost call the 'Antiques Roadshow' cult, but so poor at understanding and articulating the complexities of processes behind the creation of that artefact. It is increasingly important to the organization responsible for design in this country, the Design Council, who can tell us that design and design-related activities are worth more than £70 billion annually to the British economy, yet do not provide a definition for the very activity that they oversee; so many, varied and complex are the implications that come to light when discussing 'design as verb' (Design Council, 2015). And the importance of design as process and the value it contributes to the wider economy is now becoming ever clearer to the UK government. Together, the Design Council and the Arts and

Humanities Research Council (AHRC) employed us as part of a team of academics from the universities of the West of England, Bath Spa and Bristol in a major project called 'Bristol and Bath by Design' to attempt to map, using twenty-first century parlance, the design ecology of the region in order to understand why it is so successful and whether this success can be transferred to other regions.

The government's interest naturally concerns the now and future of the British economy; so how, apart from noting that the Clifton Suspension Bridge continues to transport approximately four million people and their cars to and fro each year, does the bridge and its history help us to shed light on the issue of 'design as verb?'

Designer as communicator

The remainder of this paper considers just one aspect of the question, and that is what might be described as 'designer as communicator', by looking at the lessons provided by the communication processes that Brunel employed in the design and building of the bridge and at the methodology that the Bristol and Bath by Design project developed in order to better understand issues of communication and other aspects of the modern-day design ecology of the region.

Building a bridge is, as we know, a complex process, one that grows ever more complex. One of the great services that the historian can offer is to shine a light on the processes of a simpler past as a means of informing our understanding of the complexities of the present day. For this reason, studying the design history of the region quickly became a core aspect of the 'Bristol and Bath by Design' project. We rapidly found that whilst we were amply served with specialist histories of the region's various industries; from the rich histories of textiles, ceramics and glass to modern-day aerospace and electronics; histories of how these industries worked to support each other, of how other technological, cultural and economic aspects underpinned them and how the region's industries related to those in other parts of the country or indeed internationally were in desperately short supply. Just like Brunel and his bridge, we had to build our methodology from the ground up, learning the lessons of history.

The Clifton Suspension Bridge started with a design, a process and type of artefact (the drawn design) that had been known and understood within Western culture since at least Renaissance times. What made Brunel remarkable to his contemporaries were the ways in which, and the extent to which, he involved himself in the evolution from design on paper to finished artefact, an involvement that arguably makes him one of the first truly modern, truly professional designers.

By way of exposition, let's start with one of his customarily self-congratulatory diary entries, from the end of 1835:

The Great Western railway now is in progress. I am thus engineer to the finest work in England. A handsome salary, on excellent terms with my directors, and all going smoothly…And it is not this alone, but everything I have been engaged in has been successful. Clifton Bridge, my first

child, my darling, is actually going on: recommenced work last Monday-Glorious…This at the age of twenty-nine. I can hardly believe it (Acworth, 1897, 293).

If Brunel could hardly believe it, his contemporaries certainly could. This was a man who built his reputation on the sheer workload that he put himself under, as well as his abilities as a communicator. One eye-witness to his cross examination in parliament ahead of the Great Western Bill noted that Brunel was 'rapid in thought, clear in language and never said too much or lost his presence of mind. I do not remember ever having enjoyed so great an intellectual treat'. These abilities were compared favourably with fore-runners like George Stephenson who, with his 'unpolished manners, his slow hesitating utterance, and his harsh Northumbrian burr, was so roughly handled by the opponents of the Liverpool and Manchester Bill on its first introduction that the promoters, when they came forward a second time, did not venture to put him into the witness-box' (Acworth, 1897, 292).

The Clifton Suspension Bridge was, as Acworth (1897) put it looking back on Brunel's career in 1897, 'a small affair, at least from a pecuniary point of view, but it powerfully influenced the whole after course of Brunel's life'. (295) What it seems to have taught him was the power and significance of communication, of making links between individuals and groups in furtherance of the design process and of the ecosystem within which his designs were to exist. Here is Acworth again saying that, 'where [George] Stephenson was content to be bound by the hard, practical, commercial facts of the then existing conditions, Brunel's mind took a wider sweep, and built the Great Western, not for the traffic that was, but for the traffic that was to be' (Acworth, 1897, 293).

Looking at Brunel's own records quickly tells us that effective, agile communication with very different groups of stakeholders was key to the successful prosecution of the bridge project. This communication of course frequently involved travel, and transportation links are indeed another powerful theme underpinning the region's success as a creative hub. In pursuing the bridge's completion Brunel was also physically and intellectually engaged in an exploration of the region that hindsight tells us supported future successes such as the Great Western project. The links, collaborations and partnerships that he made along the way from quarry owners and engineers to millionaire financiers were critical to his success. Here in an extract from his diary he is meeting the fabulously wealthy William Beckford in September 1830 to garner support for his bridge design. Beckford, who is most famous perhaps for his fantastic gothic mansion at Fonthill in Wiltshire, received Brunel at his Bath Residence with enthusiasm:

Well received – an agreeable, gentlemanly well informed man… He entered warmly into the bridge affair… praising strongly the architecture I had adopted –approving of Egyptian but condemning in strong terms all the others (Buchanan, 2005).

One hundred and seventy seven years later, the 'Bristol and Bath by Design' team examined the contemporary role and significance of designers as communicators using a methodological tool called Enterprise Imaging, which is a visualisation method capable of capturing the intricate organisational arrangements of complex systems (Mills et al, 2013). The process involved conversations with designers that explored the enterprises in which they worked, eventually creating visualisations that enabled us to see how different types of resources interact in design-

related enterprises to create value in the form of a product, service or experience. These resources included skills, knowledge, people, tools and materials (Bristol and Bath by Design, 2016).

It is the ability to effectively co-ordinate these resources that give design and design-related businesses their competitive edge. Design value, we found, is created within the interactions between business participants and as a result of their relationships. It is the designer's role to understand the client's needs, and to communicate these to all the other design-related parties involved in the enterprise. The ability of design companies to manage relationships with clients, Third Parties and Indirect Third Parties is an essential factor in determining the success of design-led companies (Bristol and Bath by Design, 2016).

In essence, 'Bristol and Bath by Design' found that now, as in the 1830s, designers, when they are communicating as effectively as Brunel are more than just important figures in the process of design to production, whether of teacup or bridge. They are the key and crucial interlocutors between the different parties in the process and, as such, essential to the success of the project in more ways than simply as providers of the design.

Conclusion

Published nearly a decade ago, NESTA's History Matters: Path Dependency and Innovation in British City Regions sought to determine the extent to which 'history matters' in determining the strength of innovation and adaptability of English city-regions with and without strong industrial pasts (Simmie, et al., 2008). Though Bristol never reached the height of industrialisation that was experienced in the Midlands and the North of England, design and making in the city and surrounding region has remained consistent and steady over the last two hundred years, with old industries replaced by new industries as dictated by time and circumstance.

New and innovative design activity is continuously developing beside established industries and companies, adding richness to the time-honoured tradition of diversity and resilience in design as artefact and design as process that defines this region (Buchanan and Cossons, 1970). With many of the region's designed objects today being made outside of the United Kingdom, design and manufacturing are viewed as separate activities. However, from a historical perspective designing and making were inextricably linked, as seen in Brunel's design process for the Clifton Suspension Bridge.

Thus the history of design is tied to the history of industry, manufacturing and building, for to speak of one was to speak of the other. When taken alongside social and cultural history, Brunel's bridge serves as a bridge between past and present design, its visual legacy underscoring the context necessary to understand the region's cultural heritage and overall identity. According to the West of England Local Enterprise Partnership (2012),

Historically, the economic performance of the city region has outstripped that of any other city… Bristol and Bath are becoming a powerful force in high growth sectors such as microelectronics, creative industries, computing and environmental technologies (4).

Within this diverse background, there exists a seemingly unending series of perceptions, reputations, attitudes and assumptions about the region's design identity. Throughout its history, the link between the Clifton Suspension Bridge and the city of Bristol has been perpetuated through travel guides, newspaper accounts and personal correspondence. This short paper has hopefully helped to make the issue of design as verb slightly less unsettling. The importance of Brunel's masterly use of communication in the evolution of the Clifton Suspension Bridge helps to place it within the early ecology of what is now a thriving design sector in the South West. It is only but one of a series of achievements by the master engineer that help to lend the area its distinctive design identity.

However, we cannot claim to be the first to be concerned with revealing the significance of 'design as process'. Returning for a last time to our 1892 commentator, Acworth, his biggest regret was that the towers of the posthumously completed bridge 'lack the ornament which, with characteristic fertility of resource and lavishness of voluntarily incurred labour, Brunel had intended for them'. That ornament was to be 'a series of figure subjects illustrating the whole work of constructing the bridge, from the quarrying of the ore and the forging of the chain-links to the driving of the last rivet' (Acworth, 1897, 294).

Despite Acworth's concern, Brunel and the Clifton Suspension Bridge have become a symbol of Bristol and a bridge connecting the region's historic engineering acumen and its continued aptitude for design in the present day.

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Bridge over river Tagus: urban transformationand population displacement, 1966

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Abstract

In 1961, the Portuguese government signed a contract to the construction of a suspended bridge over the Tagus river that would connect the capital Lisbon to the south bank of the Tagus, opening up a whole new world of opportunities for people and businesses alike. The following year, the work was definitively allocated to the United States Steel Export Company, with a scheduled completion period of four years. About six months before the expected deadline, the bridge was opened on the 6th August 1966.

When the road infrastructures of access to the bridge were built, in the area of the Alcântara valley, on the river shore, the demographic tissue and the territorial property in this zone was characterized by a high diversity of housing, palaces, warehouses, and a dense population in majority of working class that had been providing the industries established for more than two centuries in the area.

It was on this urban landscape that deep urban transformations were imposed by expropriating land and the demolition of inhabited areas to erect the structures to support the construction of the bridge and its accesses.

Resorting the notions of territorial and symbolic frontier and the correlations between socioeconomic exclusion and spatial segregation, this paper seeks to articulate, from a historical and anthropological perspective, the displacement process with the impact of the measures applied, through the relocation of slums, the construction of temporary housing, as well as the eviction of populations to the city's outskirts.

A bridge over the river: a political background

The first quarter of the twentieth century in Portugal marked a period of successive and turbulent events and political transformations that dictated the collapse of the 1st Republic1 and established the ground for a military dictatorship, and the later transformation into the Estado Novo2, a nationalist and repressive regime of authoritarian, autocratic, fascist, and corporatist configuration.

Portugal would live the almost fifty years after the military coup of 1926 in dictatorship, the longest period in Europe. After 1933, and until 1974, the Estado Novo had António Salazar3 as President of the Council of Ministers, the de facto ruler until 1968, followed by Marcelo Caetano until 1974.

The 1960s were a period associated with the acceleration of economic growth and the occurrence of changes in the economic structure. The primary sector lost its position and the industrial sector gained a preponderance both in the contribution to GDP and in the share of the labour force. Although late, the integration of the Portuguese economy in the international economy was accentuated and there was an increase in the construction of large public infrastructures (Folgado, 2012: 57-120).

At the same time, friction with a colonial war without a military solution that has dragged on since 1961-62, on several African fronts, has isolated Portugal internationally, under

continuous pressure, and has produced growing internal opposition to the regime with political and military expression.4

In Lisbon, the growing rural migratory flow to the capital fuelled the expanding labour market, increased the population density of the city, and aggravated the shortage of housing. Despite the creation, during the Estado Novo, of special programs for the construction of social housing districts, there was a saturation of the urban center's neighbourhoods and the oldest and ruined areas of the city. Inevitably, it increased the construction of precarious and unhealthy housing, without sanitation, erected with the possible ingenuity using rests of building materials. Opportunities have emerged in non-urbanized land grants. Inevitably, the so-called "slums" multiplied (Baptista: 1999; Teixeira: 1992).

It was in this social, economic and political context that the State created a Study Commission to assess and produce a study of the financial and technical feasibility of the construction of a road and rail bridge over the Tagus River. The report, produced between 1953 and 1957, guaranteed technical and financial feasibility and, two years later, an international tender was launched for the construction of the bridge (Rodrigues, 2016: 70-89). In 1960, the construction of the bridge was provisionally awarded to a consortium of eighteen companies led by the United States Steel Export Company, in which were the Portuguese companies Sorefame, SOPOL and Sociedade Lisbonense de Metalização, among others.5 Two years later, in May 1962, and after the Portuguese state guaranteed the financing contracts with US and French banks, after the change of the first project, and of creating its own legislation for the necessary expropriation regime, the construction was definitively awarded, starting six months later the first construction works. The deadline was established in 4 years, and the bridge should be ready in February 1967.6

Alcântara: an industrial neighbourhood over time

Localized to the west of Lisbon, the zone of Alcântara was located in the term of the city next to the parish of Ajuda. From medieval times, the attractive lands of Alcântara were used by the crown for the attribution of rewards and favours to the nobility and religious orders (Freire, 1929; Paes, 1881).

Benefiting from a privileged location near the mouth of the river Tagus, and the existence of an important stream, despite a certain isolation, Alcântara was slowly growing over time. During the early modern period, to the reserved and bucolic character of the place, to the territorial division into noble estates and their palaces, and to the small house along the paths that crossed the cultivated lands, were added several buildings of royal initiative. By the middle of the eighteenth century Alcântara had, beyond the nobility's estates, a convent and church, a monastery, a hospital, the Royal Powder Factory and, more importantly, a royal chapel surrogate of a seventeenth-century hermitage, a royal palace and the Real Park of Alcântara. By this time, the population was about six hundred people (Consiglieri et al, 1996: 137-14; Vidal, 2006: 36-ss).

The very serious earthquake of 1755, which destroyed the city of Lisbon in a terrible and fatal sequence of earthquake and aftershocks, tsunamis and fires, consequently forced the progressive transformation of the landscape in Alcântara.

At the end of the earthquake, a number of factors contributed to population growth and to the gradual metamorphosis of economic activities, specifically: the reduced impact of destruction on Alcântara; the initiative of the crown minister Sebastião José de Carvalho e Melo in search of quick and effective solutions; the hydrographical resources of Alcântara; the need of materials for the capital's reconstruction effort; the deployment of various industries to support reconstruction through the production of vital goods and materials; and the proximity, in Ajuda, of the Royal Tent.7

It is in the overlapping of these aspects that Alcântara gradually became, and after the earthquake of 1755, a territory of implantation of an emerging and growing industrial activity.

Since then, Alcântara has hosted several industries, which have come to dominate the local landscape. Among the most significant and enduring, there were until the mid-twentieth century, the stamping and tanning, the dyeing of the Royal Silk Factory, the oil factories of Viúva Burnay & Sons, the soap, candles and oils factory of the viscount of Junqueira, the soap and oil factory Lisbon Oil Mills Limited, the Daupias & Cª textile and wool factory, the Lisbonense Wool and Textile Company, Companhia União Fabril, Companhia Industrial Portugal e Colónias, Companhia de Açúcar de Moçambique, the Sociedade Industrial Aliança, the Sidul or the Napolitana factory (Pistola, 2009: 38-82; Vidal, 2006: 64-81; Custódio: 1994).

In parallel, there was a demographic development characterized by the consolidation of a working class weakened in labour relations, illiterate, and with scarce financial resources (Ferreira, 1998: 74-159; Vidal, 2006: 49-64). The urban fabric, with no urbanization plan and adjusted by occasional official or illegal initiatives, grew and was marked by precarious nature, fragmented distribution, and high population density.

In the transition from the nineteenth to the twentieth century, the problem of housing (extensible throughout the city) was aggravated and never resolved effectively.8 At the beginning of last century, the valley of Alcântara was a shredded meshwork of working quarters – resulting from successive initiatives to meet the needs –, of precarious housing and of changes in the existing building, in a mix of clandestine residences, stalls and shanty-town quarters, dark courtyards and streets, with a strong identity character visible in the multiplicity of place names that denounced the various territorial divisions (neighbourhoods of Alvito, Casal Ventoso, Sete Moinhos, Monte Branco, Liberdade, Quinta do Capitão, Quinta do Jacinto, Calvário).9

From the center of Alcântara, where the valley ends, towards the banks of the river Tagus, the territory was dominated by the facilities of large companies, state companies and industries, with warehouses, parks and factories, to the east, and a bourgeois building of private and municipal buildings with some palaces and properties of noble families, to the west (Vidal, 2006: 83-126).

When the road infrastructures to get access to the bridge in the Alcântara valley in the early 1960s were designed, the demographic composition and the property built in Alcântara were highly interdependent. At present, the chaotic and fragmented existing urban design resulted from the inexistence of structural planning and an integrated vision for the long term and reproduced the high fragility of the living conditions of the populations that fed the industrial.

In the analysis of the municipality, it was an "area of the city not yet been planned and which presented with poor sanitation conditions, with houses, warehouses and industries installed in a careless way, that took in the valley of Alcântara" (CML, 1967a: 165).

[1] Further developments on the 1st Republic period (1910-1926) can be found in Catroga (2000), Pinto (2000), Telo (2010), Rosas and Rollo (2011), Pinto and Monteiro (2014). Additionally, about the military dictatorship (1926-1933), see Pinto and Monteiro (2014) and Mattoso (1994).

[2] About Estado Novo period, see Pinto and Monteiro (2015), Serrão and Marques (1992).

[3] About António Salazar, see Meneses (2010), Rosas (1996).

[4] Pinto (2001), Alexandre (2000), Macqueen (1997).

[5] For the complete list of the 18 companies of the consortium, and their respective competencies and tasks, see Rodrigues (2016: 116-117).

[6] To follow some aspects of the construction phases, see Rodrigues (2016: 125-171).

[7] On the conditions that fostered the development of Alcântara as an industrial centre, see Pistola (2009: 19-36). For a focus on geographical potential, see Justino (1986).

[8] Until the 1990s, the problem of informal, degraded, and clandestine housing was never objectively addressed and effectively resolved, despite being recurrently present in discourses, studies, and successive relocation plans. Mesquita (1967), CML (1967b), Baptista (1999).

[9] Ferreira (1998: 59-73).

Urban transformations: expropriations, demolitions and new constructions

The magnitude of the project involved large portions of territory in Alcântara, due to a set of interventions: first, the construction of the ramp and the "node" of Alcântara; then the construction of the concrete structures of the pillars to support the tray and the avenue of the bridge; third, the avenues, viaducts, and access roads in the Alcântara valley and along the slope of Campolide; and lastly, the deposits of materials, parks of machinery and equipment, deposits and offices from the construction companies and state agencies.

These interventions required the expropriation and demolition of several urban areas in Alcântara and on the nearby slope of Campolide. They led to the suppression of some industries, forced to leave Alcântara because the expropriation of land, and to abandon their facilities. On the other hand, some large estates and aristocratic landowners received carefully cautioned economic compensations.

But it was mainly in the fragile urban centre of the Alcântara valley that the greatest impact occurred, due to the construction of the last road access to the platform of the bridge: the road intersection known as “Alcântara node” – which is essentially a long ramp followed by a sharp turn, with traffic in both directions.

The infrastructure was implanted directly into the heart of a network of small neighbourhoods, destroyed existing social flows, and created an insurmountable physical barrier between the centre of the Alcântara square and the working-class neighbourhoods.

The legislation that has been approved, supported and framed the existing expropriation regime, declaring that “the expropriations necessary for the construction of the bridge are of urgent public use”, and provided instruments for application to the various territories through which the access network multiplied, that is to say, “viaducts and access roads on both shores”, as well as, the “urbanization of the areas on both ends of the bridge, in accordance with the general plans and the partial designs approved by the Ministry of Public Works”.1

In this way, other expropriations and demolitions were carried out in order to visually eradicate the social "wounds" in the territory adjacent to the accesses to the bridge, eliminating as much as possible the degraded urban lattice visible to those who circulated on the bridge.2 In the same direction, operations were carried out to hide the manifest degradation of other areas, such as Casal Ventoso, removing the immediate scenario from the necessary rehousing, by painting the exterior walls of the houses with white paint, creating the illusion of similarity to the typical, immaculate and ideal Portuguese village.

To the same effect, many families were evicted regardless of the type of bond they held on the housing – whether they were renters of municipal or private houses, legal tenants or owners of their own dwellings in buildings to rent, or illegal subtenants with no acquired rights, living in degraded or overcrowded dwellings without sanitation, on municipal or private land.3

The process was sensitive, complex and time-consuming, and sparked off some episodes of tension resulting from the conflict between public interests and private rights. With regard to the construction of the Calouste Gulbenkian Avenue, the Lisbon City Council (CML), in the publication of G.T.H. in 1967, regretted the delay in the following terms: “the work could never have the necessary development for its completion within the prescribed period, having the same ones to be subordinated to the existing occupations and to the free areas that were being made available to the contractor” (CML, 1967a: 184).

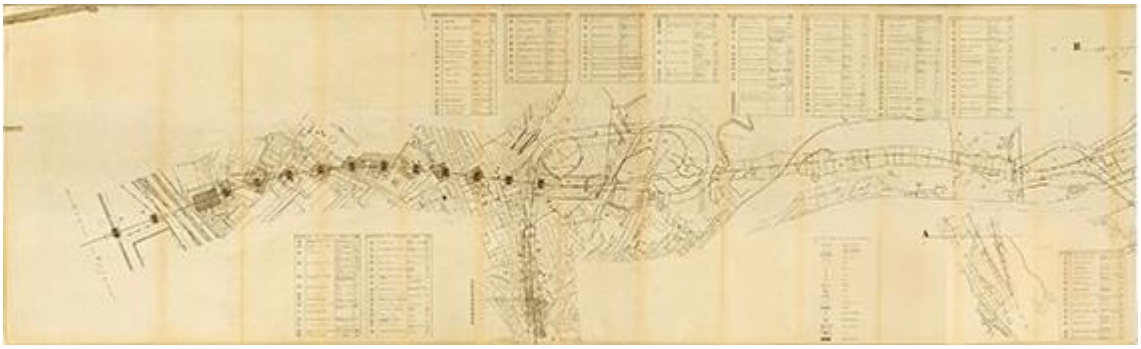

Figure 1 – Plan of the bridge avenue, pillars, access and exit of Alcântara with identification of the plots of land to expropriate, 1957-1962 (AML – Ref. PT/AMLSB/CMLSB/UROB/EV/1746, folha 1)

Figure 2 – Centre of Alcântara with the working-class neighbourhood of Quinta do Jacinto, 1965
(AML – Ref. PT/AMLSB/AIB/001120)

Figure 3 – Construction of the Alcântara ramp in the area of Quinta do Jacinto, 1965
(AML – Ref. PT/AMLSB/AIB/001236)

The impact of this set of urban changes dislodged some thousands of people, which had several sorts depending on the capacity of intervention of the authorities and according to the normative social State standards (Nunes, 2013).

[1] Artigo 4º from Decreto-Lei Nº 43514 of 23 February 1961. The scope of this legislation has been extended by the decretos-Lei Nº 45561 of 13 February 1964, and Nº 48856 of 22 January 1969.

[2] The rare echoes in the press: *Diário de Lisboa*, 29 July 1962; 15 November 1962; 23 May 1966. Pereira (2006: 16).

[3] Some press reported the apprehension of the Lisbonense Tenants' Association, whose associates had received letters announcing expropriations for short, *Diário de Lisboa*, 27 and 29 July 1962. Less than two weeks later,

the Ponte Sobre o Tejo Office, by the hand of the director himself, Canto Moniz, exercised the right to clarification and had published an extensive statement where he defended the method of expropriations and hoped that "thanks to the great spirit of cooperation", the necessary relocations were solved, and even for a certain number of families should be possible "to find housing in that area and with rent conditions compatible with those who currently have", *Diário de Lisboa*, 10 August 1962.

Displacements, relocations and a rehousing plan

Dealing with the need to relocate thousands of people has proved to be a monumental task. The great diversity of situations, political and administrative ineptitude and neglect, lack of anticipation, and socio-political prejudices have created obstacles and indecisions that have proved fatal for a large part of the population.

Indeed, as early as 1962, the first phase of demolition of houses was designed to enable the construction of access to the bridge, focusing on the poorest and most degraded districts in the Alcântara valley. In total, the press pointed to about 900 "stalls".1

For the next phases, it was inevitable to devise a large-scale relocation program. Articulated between the Ministry of Public Works and CML, a unique and complex relocation operation was created. The process was risky and demanding, and to make it functional and ensure its success, a special plan was designed whose budget would support the construction of 7,500 homes in the northeast of the city. However, the execution occurred late and was deficient, ignoring the social problem created by the fear of overcoming circumstances and prejudices.2

In 1966, it was estimated that the cost of a first phase of the relocation program, which had started in the meantime, would have been close to 100 million escudos.3 In a City Council meeting optimism was perceptible, since it was expected that the construction of houses of economic income would be enough to "rehouse all those who have to leave the zone of the Alcântara Valley, hit by the accesses to the bridge over the Tagus". And that money would enable the construction of 1750 houses (CML, 1966c: 448), "whose progress has been rapid and has already been allowing the relocation of numerous families". And it was added that "it was hoped that by the end of July all the families of the Alcântara Valley that they cannot stay there will be relocated".4 In fact, the CML assured the construction of only 1000 houses in the neighbourhood of Olivais-Norte.

The reality was more complex than the official initiative simulated. Indeed, the authorities did not accurately diagnose the problem, did not anticipate an effective population census due to informal housing and high clandestine sublease, did not effectively prevent a compatible timetable between demolitions and the construction of new housing and ignored the multiple social, family and labour networks, now in rupture, that supported everyday life of the populations.5

Although the CML ensures that "a large part of the Cabinet's activity is concentrated in order to fully respect the commitment (...) regarding the construction of large numbers of houses" (CML, 1967a: 480), the rehousing plan was not fulfilled, collapsing and failing completely.

To overcome the situation that was caused by the failure of the plan and to solve the problem of the displaced and homeless residents and the lack of housing, faced with the urgent need to relocate these same people, the CML came up with two solutions, in fact, a dysfunctional reconfiguration of last resort.

First, transferring compulsorily the most disadvantaged population living in informal and rundown clandestine housing to peripheral areas, mostly rural estate, where they then rebuilt their homes using the original materials. It was effectively the relocation of tents, cases of Quinta da Musgueira or Monte Coxo (Figueiredo, 2001: 26-29).6

Second, housing the population in prefabricated homes of a temporary nature, where they would wait to be transferred to permanent homes, which should have been concluded by then.

Until such time for the definitive rehousing of the residents, the CML constructed a neighbourhood consisting of 750 prefabricated metal homes, with a temporary life of 10 years, on a plot of land on the edge of Lisbon airport, with a total area of 13 hectares. This group, idealized like model, was baptized as the Neighbourhood of the Metallic Houses of the Chelas' Zone and known by "Bairro do Relógio". Out of the advertising spotlight were other places of recourse, already existing, such as Quinta da Calçada (Figueiredo, 1999: 9-17).

Figure 4 – Neighbourhood of Quinta do Monte Coxo, 1968.
(AML – Ref. PT/AMLSB/JHG/S02108)

Musgueira shanty town: relocation on periphery

Located in the north of Lisbon, Musgueira was part of the extensive rural area on the outskirts of the city, divided into large estates of private, aristocratic and municipal property. In 1964, the first displaced families from Alvito and Avenida de Ceuta areas were transferred to a portion of Quinta da Musgueira – obtained in an exchange of land with the family owned – by CML, which ensured the transportation by truck of the people and their assets. In the assigned lots, without any support and basic conditions, families rebuilt their homes using reused materials and waste (boards, tiles, plastics and metal sheets). As works continued in the Alcântara valley, hundreds of other households were later evicted, prompting the city hall to promote the total occupation of Quinta da Musgueira. By setting this population in a shanty, peripheral zone and without local job opportunities, poor integration and lack of basic social support accentuated precarious living conditions.

Strategically hidden behind a curtain of trees, CML built decades later small 2 floors' blocks in masonry, in a linear layout organized on a main street, which benefited generations after the first families despite maintaining the character of segregation (Figueiredo, 2000: 55-62).

Stigmatized and feared by associated crime, it was only in the late 1990s that the whole neighbourhood was demolished by CML, an operation integrated into an ambitious project to eradicate slums in Lisbon, and its residents were finally rehoused.

Bairro do Relógio: the reality of a transitory solution

Built by Sorefame through a public tender, between 1966 and 1967, it was a temporary housing neighbourhood with municipal ownership, consisting of houses distributed along winding roads, so as not to alter the topographic physiognomy of the land intended for future green reserve of Chelas (CML, 1967b: 65).

The houses were composed of prefabricated blocks, similar to containers, composed of a metal structure and sandwich-type panels, which slotted into one another, so as to "reconcile provisional character with dismountability" (CML, 1967b: 10). Not only did this model mean that they were easy to assemble, but it also meant that they could be transferred elsewhere at a later date.

These blocks had one or two storeys. There were 248 houses with three rooms (T2), and 502 houses with four rooms (T3), depending on the size of the family. Constructed of metal, without any thermal insulation, they were unbearable in summer, due to the greenhouse effect by heat, and in winter, by the rigor of the cold.

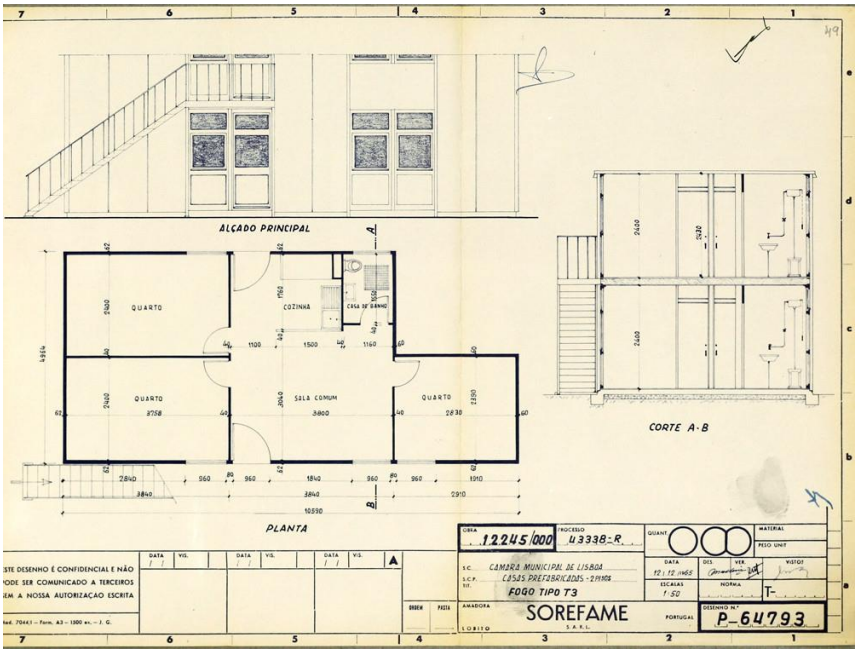

Figure 5 – Project with plan and elevation of a T3, 1965.
(AML – Ref. PT/AMLSB-CMLSB/AGER-N/02-08-01/00012, Folha 49)

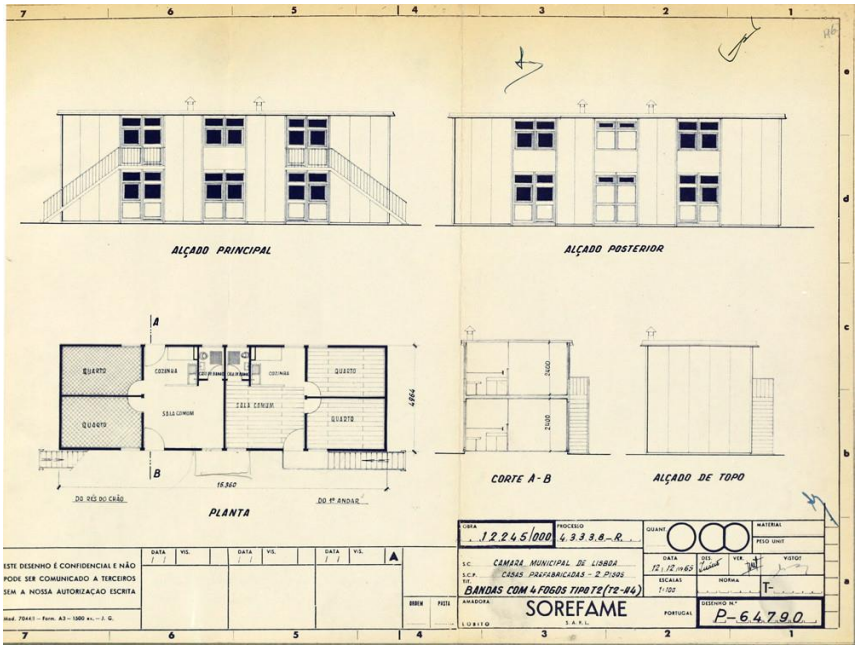

Figure 6 – Project with plan and elevation of a T2, 1965.
(AML – Ref. PT/AMLSB-CMLSB/AGER-N/02-08-01/00012, Folha 46)

Given the provisional character of the neighbourhood, the social equipment that was provided to the community obeyed the same precarious principle, and consisted of two primary schools, one chapel, one market and one community centre, comprising a kindergarten, a milk dispensary and a family care unit (CML, 1967b: 66).

Two years later, the neighbourhood would receive an increase of 400 new housing units intended to house populations from slums, in prefabricated wood units of inferior quality to the original ones.

As the years went by, the authorities proved incapable of fulfilling their plan, so that what was originally a temporary solution became a permanent one. The poor quality of the construction, the lack of any measures of conservation or maintenance and the overcrowding, vandalism and general neglect all meant that the physical conditions of many homes were so bad that the houses gradually turned into ruins (Figueiredo, 1999: 59-66).

[1] *Diário de Lisboa*, 15 November 1962.

[2] In addition to ideological and economic issues, another dimension has contributed to the fact that an extensive program for the eradication of informal and clandestine housing has never been implemented with the relocation of populations. In a 1967 CML publication, it was written in this connection that "the construction of large housing complexes, which are necessary, in addition to the technical and economic disadvantages mentioned above, would entail the even greater danger of stimulating new emigrations, that the ease found in the antecedents would not fail to tempt", CML (1967b: 11). Echoes in the press, see *Diário de Lisboa*, 30 November 1962.

[3] Over 38 millions euros at current prices.

[4] City Council reunion of 22 June 1966, CML (1966a).

[5] *Diário de Lisboa*, 29 July1962.

[6] Other families, on their own initiative, rebuilt the dwellings where they could, in vacant lots, or through negotiation with the owner, in an area circumscribed to Alcântara, in Algés and Ajuda. *Diário de Lisboa*, 15 November 1962.

Demographic and social impacts

In July 1966, the CML admitted that “it had to transfer from slums to other slums, approximately 300 families because some did not want or could not pay the low rent that they are asked for, others because they were not legally constituted families and, still others, because they had not reached a situation of life, of morals that allowed them to inhabit a house”.1

In addition to justifying the inevitability of the transfer of "shacks" for economic reasons, the other arguments used by the authorities expose the underlying social construction (Nunes, 2003: 107).

In a CML report published in 1965, with regard to the urbanization plan for eastern Lisbon, it was admitted that “the re-housing of the population living in slums poses serious problems of social and urban integration”, justifying it with the financial incapacity of these families. But, curiously enough, it was admitted that it was a problem “in reality extremely vast”. Although biased by ideological presuppositions, but recognizing the existence of various unresolved dimensions with rehousing (medical, sanitary, educational, labour, and economic), was acknowledged the inconsistency of “fragmented efforts that might even delay the true solution of the problem” (Machado, 1965: 446).

With the forced eviction of the residents, regardless the nature of the housing bond, there were significant demographic and social impacts. Notified and summoned by the police a few days in advance, about the inevitability of the eviction, and to carry out the demolition of their shacks themselves, these families were subject to a summary and coercive procedure without appeal. The aid provided by CML was scarce and timid and, at destination, they could only rely on the materials themselves, resulting from the demolition as indispensable, and sometimes unique, elements that they could use in the reconstruction of a housing with mutual aid and complicity between families (Pereira, 2011: 81-83).

Far from places and job opportunities, with the breakdown of support, affection and intra-community solidarity networks and workers’ support that were created, the situation was dramatic and distressing for many, whether they were valid men, old people, the sick, the disabled, young couples, children or single mothers.

In the places of destination, the lack of shelter and inadequacy suffered by the families generated many problems of social and psychological, economic, family and urban balance, which prolonged or aggravated the poor living conditions of their inhabitants. To the trauma of the process of displacement and coercive relocation in an unknown destination was associated the deficient or nonexistent primary urban infrastructure (sanitation, water, electricity), as well as the extreme difficulty in obtaining access to transportation, medical-sanitary support, and schools among others (Pereira, 2011: 15-18).

[1] City Council reunion of 20 July 1966, CML (1966b).

Conclusion

After exploring the various aspects of expropriation, demolition and rehousing involving the affected populations, we now summarize the key ideas in a final reflection.

Although aware of the operation's complexity, the authorities were slow to devise a plan in view of the urban and demographic diversity scenario in Alcântara. Likewise, the timing of the political and financial mechanisms that would guarantee the construction of permanent housing for displaced populations failed.

Given the responsibility and inevitability of finding a quick and possible solution, the bankruptcy of poor planning, pushed the CML into a set of decisions that ignored and subverted the aspirations and needs of the people, leading in three ways: first, partial compliance with the idealized construction program, with only 1000 definitive houses; secondly, an improvised solution with a temporary prefabricated neighborhood (which would become definitive); and finally, the transfer and relocation of families to new areas of informal, degraded and unhealthy housing.

All these three solutions, it should be stressed once more, were provided on the periphery of the city. And all these projects couldn't instigate an effective integration of this population and contributed to further extend their segregation.1

We then come to the notion of frontier as an epistemological category, to understand the creation of mechanisms of differentiation and social circumscription, applied to the displaced populations of Alcântara.

We are interested in resorting to the idea of dematerialization and persistence of the frontier (Cole and Wolf, 1974), a notion applied to the asymmetries between units of political, cultural, material and mental analysis (Donnan and Wilson, 1994, 1999). Going beyond the notion of frontier as a portion of territory, we articulate its analytical capacity to a contextualized and functionally delimited space. In this way, being this space the neighborhood, the subjective limits find a context in borders of social, cultural, political, economic, and administrative scope (Parkhurst, 2008).

The families' removal to the periphery of the city seriously restricted access to a range of work opportunities, solidarity, assistance, and transit networks. Thus, the fact that they are peripheral and circumscribed territories, involved a spatial exclusion, because they were built as a ghetto and administratively delimited. Between the neighborhoods and the surrounding spaces where they were inserted, spatial borders were born that segregated the space of the neighborhood.

But to this border another one was added. The socioeconomic exclusion of a group of population also had a way of social categorization of these populations, evaluated according to ideal parameters of morality, health and education praised in the ideology of the Estado Novo. Considered to be unworthy and outside the normal State standards (Nunes, 20013: 107) – "how to proceed, for example, to the rehousing of families in which there are socially pathological cases or serious and contagious diseases?" (Machado, 1965: 446) – the circumscription in a remote territory reinforced the stigmas and accentuated the social segregation, therefore, creating a symbolic frontier (Cachado and Baía, 2012: 49).

Thus, population transfers and relocations in temporary districts exposed the contradictions between the official discourse and the actions taken. The State's narrative in combating the

social "wounds" of clandestine, informal and degraded housing was defended publicly for aesthetic and urban development issues. But, in parallel, it was shaped by the desire to control a population considered, socially and politically, as inept and dangerous (Cachado and Baía, 2012: 49). The discourse of social progress (duly supervised) of these populations concealed an instrumentalization that was related to the need of the lands (Cachado and Baía, 2012: 52), and with a process of construction and the moral and social improvement of the populations (Nunes, 2003: 107).

It was known that it would not improve the living conditions of those families, so that it would not solve the problem of social "wounds". On the contrary. However, this problem was pushed to the periphery of the city, away from the modern, technological and cosmopolitan city, forgotten and hidden by political power.

[1] This stigmatizing sense still continued to undermine the rehousing programs in the following decade, as Nuno Teotónio Pereira on several occasions detected and pointed out, Pereira (2011: 23-24).

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Harrison Ave Bridge: The Life and Death of a Small-Town Icon

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Abstract

Fueled by a large immigrant labor population, Scranton in the 1920s was a thriving hub of the Iron and anthracite industry with a growing population, diverse in both economy and race. The Harrison Avenue Bridge connected the prosperous neighborhood of East Scranton and the labor class neighborhood of South Scranton during this period. Although other bridges and highways connected the two disparate parts of the city in roundabout ways, public pressure for a direct connection across the Roaring Brook gorge necessitated the construction of this bridge. At a time when social activism was making headlines in the United States, the idea that local citizens spearheaded the construction of this bridge in the early 20th century is noteworthy.

The events that lead to the rise and fall of the Harrison Avenue Bridge are more significant than the actual bridge itself, which connected the labor class to the benefits of a growing city. In comparison to other bridges designed by the chief engineer Abraham Burton Cohen, this bridge, a three-span reinforced concrete deck structure, was by no means extraordinary in its design and construction.

The crowning glory for this symbol of a progressive era was at the listing on the National Register of Historic places in 1988. Time and weather have not been kind to this local icon. Deterioration and wear, despite repairs and renovations, show through this structure. Decision to tear down and replace this historic bridge put the local community and the state of Pennsylvania on different sides of the “bridge”. This paper focuses on the history, the rise and fall, the glory, the local significance and the lack of vision in saving this bridge in the setting of a city that powered America’s Industrial Revolution.

Scranton, PA

Scranton, the 6th largest city in PA, is a small town of approximately 77 thousand residents, located in the northeast part of the state of Pennsylvania in Lackawanna County. It was noted to be the 3rd largest city in Pennsylvania in the height of its industrial era in the late 1800's to early 1900's.

The area along the banks of the Lackawanna River, rich in wildlife and densely forested, was home to the Leni-Lenape, a group of Native Americans occupying a small village in wigwam style dwellings. As the Europeans claimed settlements across the area, the Leni-Lenape were caught in the middle of skirmishes between the English and the French. For many decades, the natives deterred the settlers from venturing into the area and settling down. Eventually, by the early 1800's, colonists from Connecticut surveyed a five-square mile settlement including Providence Village, Tripps Flatts, Hyde Park and Slocum Hollow, which would eventually become the City of Scranton.

Called by different names like Unionville and Slocumville, the settlement was named "Harrison" in 1845, in honor of the President Benjamin Harrison and eventually changed to "Scranton" in 1851 because of the Scranton brothers who drove the steel and coal industry in the area.

Scranton was the center of the largest anthracite coal mining region in the US. The region became the center of mining, railroads, steel and the home to thousands of immigrant workers

from all over Europe. By 1900, Scranton had a population of 102,026, making it the 38th largest city in USA. By 1915, Scranton's population stood at 137,783, and it continued to swell through the decade as employment opportunities in the mines and factories, while often grueling and gritty, made the city an attractive destination.

Pennsylvania was a leading iron manufacturer, in large measure because of its natural resources and growing markets for iron products. The state had iron ore deposits, vast forests that provided charcoal, abundant coal beds that also supplied fuel, the limestone used as flux, and streams for water power. Early residents of the colony had noted these resources, particularly iron ore deposits and the potential for iron production. Before 1840 most iron manufacturing relied on technology adopted from Britain in the early eighteenth century. Although Europeans had been forging iron and making steel for nearly three centuries, the processes for creating blister steel and crucible steel were slow and extremely expensive. The discovery of anthracite coal in the Scranton area, a harder and cleaner burning coal, changed the landscape of iron manufacturing in Pennsylvania.

In the mid 1800's the Scranton brothers focused instead on manufacturing pig iron using a blast furnace and experimented using anthracite coal to make steel, rather than existing methods which used charcoal or bituminous coal. The success of this process spurred them to establish the Lackawanna Steel Company, once the 2nd largest steel company in the world.

Scranton gained additional reputation as "The Electric City", when electric lights were introduced in 1880 at the Dickson Locomotive works, and subsequently in 1886, the country's first electric street cars began to operate in the city. These street cars ran solely on electric power, and at its peak, operated on almost 100 miles of track. The advent of automobiles and cheap gas were a few reasons for the decline of the trolley system.

Industrial growth and Population in the 1900s

The city of Scranton was primarily established around the iron industry. Although the city would later be associated with the mining of anthracite coal as much as a railroad hub. The Scranton brothers settled in what was then known as Slocum Hollow in the 1840s and set up Scranton, Grant & Co., which would later be known as Lackawanna Iron and Coal and the Lackawanna Steel Company. By 1865, they had the largest production capacity of any iron producer in the country, and were primarily focused on building iron rails for the railroad industry. They introduced railroad to Scranton in 1851, to transport iron across the country. A few years later, they expanded their railroad to New York, creating the Delaware, Lackawanna and Western Railroad, which would be the largest employer in the area for the next century.

As the steel and mining industries rapidly grew in Scranton, immigrants as labor class from all over Europe settled in the city. By 1915, Scranton was had become an industrial powerhouse, manufacturing items like typewriters, glassware, furniture, pianos, textiles like lace, hosiery and silks, parts for automobiles, in addition to the railroad and mining industries. Of the more than 28,000 city residents, about one in every five, were immigrants. Many of those came from

Eastern Europe, mostly Russia, Lithuania and Poland, with thousands more from Italy, Ireland, Austria, Wales, Germany and England.

Access and Social Activism

The success of the industries in the area ensured the growth of the city and the building of communities at a rapid pace. The town of Scranton was incorporated as a borough in 1856 and subsequently, as the City of Scranton in 1866. As the city of Scranton grew in population and the settlements began to be determined by both economic and cultural definitions, the haves and have-nots lived in different parts of the city. Industrial workers, more often labor and working class, lived under poor working conditions and low wages closer to the mines in the south side (also known as Shanty Hill). Mine and industry owners lived in the Hill Section (east side) in larger homes and mansions, close to city center and easy access to administrative center of downtown.

The wealth of the industrial era was concentrated in the hands of the relatively few. An emerging and educated middleclass, determined to change the world around them, generated a swell of innovations in society. The Progressive Era thus began with a period of widespread social activism and political reform across the United States, from the 1890s to the 1920s. Commitment to public service and ensuring the welfare and interests of the people and country was the driving force of many grassroots reform movements. Citizen activism, that promoted the improvement of the lives of urban immigrants, factory workers and the poor, through construction of better sewers, building codes, street paving, etc. placed Scranton from a 3rd class to a 2nd class city.

The neighborhoods of the South-Side and East-Side were separated not just by an economic divide, but also by the Roaring Brook Gorge. The only access route and connection, was via a long detour through downtown. Residents of South and East Scranton, realizing a common problem in the detour, worked together for a direct connection between their neighborhoods. Attesting to the high level of citizen involvement, neighborhood interests formed a "South to East Scranton Bridge Association" to lobby the city for a bridge across Roaring Brook gorge. Citizens petitioned the city and city council for a bridge that provided easier access to neighborhoods. Community meetings, town-hall meetings, organized petitions, and letters, spearheaded the process. It was during the time of the Progressive Era, that the community came together to petition the construction of a bridge that connected the south side to the commercial and administrative section on the east side of the city.

Roaring Brook and the Bridge

The Historic Harrison Avenue Bridge spans the Roaring Brook Gorge, which is a tributary of the Lackawanna River. The gorge at the location of the bridge spans approximately 410’ and a depth of approximately 130’ from the streets above. Although community activism spurred the city of Scranton to acknowledge the necessity for a bridge, World War I and lack of funding pushed the conversation and the monies in different directions, until public pressure hastened the construction process. The completion of the bridge from inception and execution took over two decades.

Abraham Burton Cohen, an American civil engineer, was chosen by the city of Scranton, to design the new bridge, while he was a consulting engineer in New York City. He was notable for his role in designing innovative concrete bridges and often took inspiration from the Pont Du Gard, an ancient Roman Aqueduct built in 1st century AD. His reputation as an "Artistic Designer of Concrete Bridges" and the prestige of a New York engineer, spurred the Scranton City Council to hire him to design two bridges in the city. He had just completed the Delaware, Lackawanna and Western Railroad's Tunkhannock Viaduct (the world's largest concrete structure when completed) a few miles north of the city, and so his association with the Harrison Avenue bridge was certainly justified in its design and notoriety. In addition to Cohen as the Chief engineer, two local engineers, William Schunk and Charles Schroeder were more actively involved in the day-to-day supervision of the construction.

Construction

The Harrison Avenue Bridge is a reinforced concrete deck three arch bridge, with a central open spandrel ribbed arch, and two closed spandrel arches on either side. The central arch stretched over the Roaring Brook, while the southwestern closed arch stretched over the former Lackawanna and Wyoming Valley Railroad or the Laurel Line. The northeastern closed arch spanned the Delaware, Lackawanna & Western Railroad. The Laurel Line was converted to highway use in 1964, as the Central Scranton Expressway and the DL&W railroad is now a heritage line operated by the Steamtown National Historic Site.

The construction of the bridge began in 1921, when the city broke ground on July 21st. The total cost of construction was estimated to be around $197,000. The bridge was associated with a variety of names, including "Roaring Brook Viaduct," "Connecting Bridge," and "South-East Scranton Viaduct." According to the Department of Public Works' description, "provision was made in the design for a street car track" by depressing the middle of the 10"-thick roadway in the main arch span. However, no track was ever installed across the bridge. Four decorative pylons on the central piers stood as iconic anchors marking the presence of this bridge.

The Bridge

The bridge was dedicated on September 20th, 1922 amidst great pomp and celebration. The dedication exercise brought together thousands of people interested in a progressive united development of South and East Scranton. On September 21, 1922, the Scranton Times published that "other new construction projects are promised." The dedication was an elaborate three-hour ceremony reflecting its monumental function. As a symbol of the connection made by the new bridge: three men, representing South Scranton, East Scranton, and the entire city joined hands at mid-span. It was attended by the mayor, engineers, councilmen, community leaders and thousands of citizens from all the neighborhoods of Scranton. Amongst the many speeches, Colonel Watres (President of the Scranton Board of Trade and one of Scranton's foremost citizens) said that there was no longer an East, West, North and South Scranton and "It is all one Scranton and there is nothing sectional about it. We are a united people and this bridge will speed up our growth and mean a bigger and better Scranton".

More than 15,000 vehicles and a significant volume of pedestrian traffic use the Harrison Avenue Bridge each day. It is a vital link between neighborhoods, schools, businesses, hospitals, and other services on both sides of the Roaring Brook gorge. The bridge is also used extensively by ambulances and other emergency service providers to connect the southside to the hospitals across the bridge. A builder's plate was placed on the western portal of the bridge with the dates and names of parties involved in the design and construction of the bridge. This was removed when the city broke ground for the construction of the new bridge.

In 1988, the Harrison Avenue Bridge was surveyed and documented for a nomination on the National Register of Historic Places. The documentation is listed on the Historic American Engineering Survey (HABS) and is documented in the Library of Congress, with photographs and a narrative of the history of the bridge.

The Beginning of the End

The first signs of trouble were noticed in 1937, with reports of cracks on the bridge, but the issue was tabled for several years. The first repairs occurred in 1946, when the bridge roadway was taken down to its base structure, and re-finished to prevent water infiltration and corrosion. The depression for the streetcar track in the middle of the 10"-thick roadway in the main arch span appeared to be the source of water infiltration and the eventual cause of deterioration of the

bridge, according to some engineering surveys. It was during a routine inspection and repair job in October 1971, that construction workers uncovered hidden defects, such as internal voids and corroded reinforcement. Subsequently, major renovations of the Harrison Avenue Bridge occurred in 1972 and 1973. One contractor even suspected that "the bridge appears to have fewer reinforcing rods than it should." This led to a complete reconstruction, that included improving the drainage and replacing the deck, sidewalks, railings, and expansion joints. The bridge was under construction and extensive repairs, at an estimated cost of $418,909, during its fiftieth year of existence. It was during this process that the four decorative pylons atop its central piers were removed. As noted in the HAER documentation, removal of the piers left the structure looking unfinished. In 2007, temporary supports were added under the bridge deck to support columns and seal the deck joints and in 2011 the decision was made to replace the bridge.

The Process

Twenty years ago, the Pennsylvania Department of Transportation (PennDoT) received an application from PHMC (Pennsylvania Historic Museum Commission) for the need to restore the bridge. PennDoT inspected the bridge approx. 10-12 years ago and began a collaboration with the engineering firm of Dewberry-Goodkind, Inc. in 2007. As is typical of structures on the National register of Historic Places, Section 106 was invoked by PennDoT, which required a review by the Pennsylvania Historical and Museum Commission (PHMC), for structural alteration. Subsequent discussions between PennDoT and PHMC lead to a decision about demolition of the existing bridge and construction of a new bridge, based on structural report submitted by PennDoT. In the meanwhile, Dewberry engineers prepared a feasibility study which compared the possibility of repairing the bridge versus the construction of a new bridge, with drawings for the new construction. Although the feasibility study suggested restoring the bridge as an option, discussions appeared to skew towards the construction of a new bridge.

Engineers stated in the report that the bridge was structurally unsafe, beyond repair and there were serious stress cracks, and so the process to decommission the bridge began in 2012. Parties involved in active communication appear to be PennDoT, PHMC, SHPO (the State Historic Preservation Officer) and the City of Scranton. During this entire process, where were all the stakeholders? Where was the community? Where were the people? Why were the local papers not tuned in to the communication mechanism? And, why was the local historical society not part of the conversation?

PennDoT reached out to the City of Scranton on January 19, 2011 in a memo addressed to the "Consulting Party" to meet February 10th, 2011, at the Scranton City Hall. The memo said, "The meeting will focus on potential impacts to the bridge as a National Register-listed structure. The rehabilitation feasibility report and associated documents will serve as the basis for discussion." Twenty people attended the meeting and although discussions about saving the bridge were started, decisions regarding new construction appeared to dominate the conversations. Eventually, as word got out regarding the decision to replace the bridge, neighbors, local communities, historic bridge agencies from around the country, the Lackawanna Historical Society and the Scranton Architectural Heritage Association, sat on the side of the saving the bridge, but all in vain.

It is important to note that many historic concrete bridges, similar to the Harrison Avenue Bridge, have been restored across the United States. The state of Oregon, as far back as 1970, recognizing the value of saving their historic bridges, put in place policies towards preserving these structures. As a result, they have successfully restored more than twenty historic bridges across the state. The Rock Point Bridge in Oregon, was built in 1921 by Conde B. McCullough, Oregon's master bridge builder. This bridge was one his earliest designs and is coincidentally, very similar to the Harrison Avenue Bridge with its concrete arches and spandrels. It is 501 feet long and the main arch span touches down on each bank of the scenic Rogue River. Restoration was completed in 2011 and according to the Oregon Department of Transportation, fiber-reinforced polymer wrapping, epoxy injection, and concrete repair methods were used to help restore the bridge to its original condition. It was noted that while preserving a piece of important Oregon bridge history, quality and safety were not compromised.

Feasibility

Dewberry-Goodkind, Inc. prepared a feasibility study with a final design proposal and submitted it to PennDOT for approval of a $12-million bridge replacement. The study was accompanied by an in-depth field inspection of the bridge and drawings supporting the findings. A condition survey report was prepared, which included a comparative analysis of rehabilitation versus replacement. And in the spring of 2012, PennDoT chose to replace the historic Harrison Avenue Bridge with a new steel deck utilitarian bridge that serves the purpose of connectivity across the gorge, but devoid of the character that endeared the old bridge to the public.

	Bridge Rehabilitation	Bridge Replacement
Cost		
Total Cost – Construction Items	$10,599,000	$7,628,000
Total Construction Cost (including 25% contingencies, 3% inflation to let year 2012, 12% E&C)	$15,445,000	$11,699,000
Utility Impacts		
Underground	None/minimal	Relocate natural gas, sanitary sewer, water main
Overhead	Temp. relocation of electric, telephone	Permanent relocations – electric, telephone
Right-of-Way Impacts		
Residential Displacements	1	3
Duffy Park	Temporary closure during project	Permanent relocation
Method of Maintaining Traffic during Construction	Temporary run-around	Existing bridge
Impacts to National Register Listed or Eligible Historic Site	No adverse effect (bridge rehabilitation in line with Secretary of Interior's standards)	Adverse effect (removal of existing bridge, no anticipated impacts to historic properties/district)

Too Little Too Late

A little late in the game (2015), local activists and architects toyed with the idea of "What If" the old bridge could be saved and repurposed as a linear park or pedestrian bridge like a smaller version of the successful Highline in Manhattan. The relationship between south and east Scranton today, is very different from the setting of the Progressive Era. The importance of connections through walking trails, bike paths and public spaces has been documented to be beneficial to the growth of cities.

Just as engineering reports deemed the historic bridge unsafe for pedestrian use, local activists reached out to PennDoT in a final attempt to save the bridge, but without success. In a letter dated May 8th, 2015, PennDoT stated that the fiscal burden of ownership, maintenance and repairs would befall the city of Scranton and its taxpayers, and that PennDOT would not be responsible for maintaining the pedestrian bridge. Additionally, the ability to retain the historic bridge as a pedestrian walkway, was compromised by the design of the new bridge. Furthermore, the city of Scranton made it clear that it was in no position to take on the fiscal, ownership and maintenance responsibility for the "pedestrian bridge," and thus ended any possibility of saving this local icon.

The Replacement

The 2008 inspection and condition survey report quoted the replacement of the Harrison Avenue Bridge at an estimated cost of about $11.5 million. In comparison, the rehabilitation of the historic bridge was placed at approximately $15.5 million. As of October 13th, 2017, the overall cost of the new bridge stands at about $30.8 million, with the date of completion (including the removal of Harrison Avenue Bridge) projected to be September 2018. The design of the new bridge is expected to "at least mimic what the existing bridge connecting Scranton's Hill Section and south Scranton looked like when it opened in September 1922" as stated in the local newspaper. The new bridge in its design is not a re-envisioning for today's modern Scranton, but a facsimile of what was thought to be an economic solution to a deteriorating bridge. The design idea of mimicking the period details of 1922 are so far removed from the design intent and craftsmanship of that era, that this new bridge misses the mark. It's fair to say that the new design pales in comparison to the old bridge.

Rise and Fall

In conclusion, the Harrison Avenue Bridge was built at a time of strong industrialization and was built on hope, ideology and a grassroots activism that established stronger people-to-people connections within the community. The cause and its result empowered the people and communities that it connected. The fall of the bridge on the other hand, is based in a post-industrial city financially strapped by the demise of industries and a dwindling population. As

the city struggles to support its built history, lack of communication, top down decision making and lack of vision appears to have been the path leading to the “death” of this local icon.

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Political Representation and City Memory: Cultural Analysis on Nanjing Yangtze River Bridge

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This essay analyzes the value and function of Nanjing Yangtze River Bridge from the perspective of culture. The authors address the following issues: how Nanjing Yangtze river bridge represented the political and cultural psychology in contemporary China, how it becomes the cultural memory of Nanjing city, how it is protected and developed as a cultural heritage. According to the authors, Nanjing Yangtze River Bridge is a city's cultural symbol and dialectical image, witnessing the change of political culture in contemporary China. It contains elements such as history, technology and aesthetic culture regarded as the cultural memory image of Nanjing and even China. As cultural heritage, not only should the protection and development of bridges be combined with the construction of urban culture in Nanjing ,but the path of sustainable development be taken in order to have a strong vitality.

Nanjing Yangtze River Bridge, as an important city symbol and landmark of historical and cultural city, is a significant milestone in the history of Chinese bridges as well as a vital achievement in modern industrial construction in New China. For nearly half a century of the changing winds, the bridge has been translated into a rich cultural symbol, which not only embodies the political and cultural psychology, but witnesses the change of political culture in contemporary China.Meanwhile,it has gathered and stored a sequence of elements such as revolutionary history, technological development, literature arts, aesthetic culture and others, becoming a cultural memory image of a city even China. The cultural heritage value has been recognized and highlighted, and its cultural identity and self-confidence has been conveyed in contemporary China and Nanjing for the combination construction of urban culture with bridge protection and development.

Representation of political culture on Nanjing Yangtze River Bridge

Nanjing Yangtze River Bridge’s original intention of designing and constructing is that the Chinese want to build a bridge in an insurmountable natural moat in order to solve the traffic difficulties that the Shanghai-Nanjing and Tientsin-Pukou Railway cannot be penetrated. It not only terminates the history of the train ferrying to the Yangtze River, but realizes the Nanjing people’s dream of connecting north and south of the Yangtze River.

However, the bridge is not just a simple traffic bridge, seen as important representation of Chinese politics and culture characterization at that moment. In other words, its design plan is not a historical accident rather than the inevitable result of construction of politic culture and legalization expression in New China, which is the target selection of political development and the result of establishing “Evolutionism” in the way of thinking based on political culture in China.

From the perspective of the construction of political culture, the bridge is an important representation on the completeness and unitarity of The Communist Party of China constructing and maintaining the political value system after New China just being founded. Nanjing Yangtze River Bridge began to be constructed in 1960 and completed in December 1968. It is a special historical period in which the “Great Leap Forward” and the “Cultural Revolution” is carried out throughout the country. “Dare to think, speak and act”, “Go all out, strive for the construction of socialism” was a relatively clear political attitude of China at that moment. It was the political belief of The Communist Party of China to safeguard the

purity of the party, continue the proletarian revolution and realize the Communist Ideals. Therefore, the birth of the bridge coagulated the political culture psychology of Chinese society and the revolutionary feelings of the broad masses of the people at that moment. The "Three Red Banners" obviously standing on the bridgehead is the political consciousness symbol of "General Route", "People's Commune" and "Great Leap Forward". Four huge sculpture of worker-peasant-soldier-students merchants representing the people as masters of the country is the main symbol of socialism construction in that era, in which the people wearing badge of Chairman Mao, handling quotations and the sunflowers relief is regarded as a metaphor for worshiping him and devoting to his thought. The whole construction of bridge is "one of fruitful achievements of socialist revolution and socialist construction in our nation, especially for The Great Proletarian Cultural Revolution". As some scholars have said that "the birth of the bridge is a capital cultural symbol instead of a simple bridge in social life." As a capital signifier, it refers to the revolutionizing Chinese politics in the modern times instead of the bridge in the original sense of function, which is a political monument upon itself (Hu,2012). As a symbol, it is used for presenting worship leader at that moment: That Chinese workers are armed with Mao Zedong Thought can cope with any insurmountable difficulties and would not give in to peaks such as the sky can be held up when falling down, and the subsidence of surface can be filled up(Xinhua,1968).At the same time, it praised the victory of great Socialist Construction and The Great Proletarian Cultural revolution. The completion of the bridge make people believe that, with the leadership of Chairman Mao, fighting against nature, marching to science and battling with heaven and earth is not only the great historical mission entrusted to people by an era, but the great revolutionary task of socialist construction. Therefore, the bridge takes advantage of itself and the code meaning attached to itself in order to hoist aloft the great banner of Mao Zedong thought and construct the political system of a socialist modern country. Meanwhile, the system value as concept of building a complete and unified political community further endows the significance and legitimacy on the existence of Socialist Country of China.

The bridge concentrated on the political and aesthetic imagination of the country and the people at that time from the view of aesthetic. In terms of architectural form, the bridge was a world first-class railway and highway grand dual purpose bridge. The railway bridge length is 6772 meters with wide of 14 meters and highway bridge length is 4588 meters with wide of 19.5 meters. The main span length is 1577 meters. The bridge has a total of 262 holes, including 10 holes of main bridge and 252 holes of bridge approaches. The bridge, with huge building size, possesses 9 piers about height of seventy or eighty meters seating in river as steady as a rock. The whole bridge is in the form of neat, symmetrical, balanced, majestic and magnificent order, which would make people register profound respect. The design of formal beauty conforms to the political aesthetic ideal China pursued at that moment, that is, it is the ideal of achieving lofty Proletarian Revolutionary practice.

Since the founding of New China, the central government needs to realize the legitimacy of the political power through positive political action as well as the cultivation and establishment of the Communism lofty ideals. The lofty ideal of Communism is the political aesthetic imagination of modern Chinese society and the ideal of lofty Proletarian Revolutionary practice as well. There is no doubt that bridge is closely related with the

political interests on implementation of the proletarian revolutionary ideal, which makes itself perceptual form behave as realization form of political ideal and reflect the strong "purposeful political aesthetic"(Zhou and Zhao,2015).This political beauty expresses a sense of loftiness in the psychological structure, especially a sense of shock and oppression produced by the observation subjects of the bridge when feeling the huge form and spirit. Just stare blankly and meditate on observation subject facing to remarkable bridge with imposing such as rainbow. "In a daze, we gradually forget ourselves in a daze, attentively looking at, accepting, absorbing and imitating it. Then suddenly he is up with waist stretched more straightly, head held higher, the spirit being more serious and passionate than usually. We imperceptibly obliterate the boundary of persons and objects, in which the 'noble' of object is printed into my heart becoming my 'noble'"(Zhu,1987).Absorbed in such an aesthetic state of mind, the observing subject sets up political cognition, which is that the revolutionary ideal of proletarian, led by the Communist Party based on worker, farmer and soldier as the main body, will inevitably be come true. China has completed an important harmony between political value and political sensibility in the psychological experience of oppression and tension brought by the bridge. Therefore, the Nanjing Yangtze River Bridge aroused the people to political desire and imagination for realizing the great ideals of Socialism and Communism. Meanwhile, to understand the current political reality relies on the political cognitive ability and then let people feel great situation of revolution and construction, which also inspires the political enthusiasm and further promotes the development of socialist modernization to continue developing.

Nanjing Yangtze River Bridge witnesses the continuity and reconstruction of political culture in the current cultural context. Economic construction has taken the place of class struggle as the working focus of our party and government since the beginning of the opening up policy. Deng Xiaoping pointed out: "Economic work is the biggest political and economic issue currently and the economic problem is an overriding political issue. Not just at the moment, I'm afraid the long-term work should be focused on economic work"(Deng,1994).It means that Chinese political culture has entered a new period of development and ideology, based on the logic of market economy, will influence and shape the development its direction as well. Comrade Deng Xiaoping's Speech during the inspection tour in the South creates the specified direction for establishment of the market economic system, but especially strengthen and highlight the development. In face of market ideology, the pattern of bridge is confronted with new transformation and challenge. On the one hand, it needs to preserve and extend the original revolutionary cultural concept of the bridge. Whether it serves as a revolutionary history museum and a classic text of history and language textbook or as a patriotic education base, the original political and cultural function of bridge and sacred position in people's hearts still be saved; on the other hand, the political culture of bridge is not immutable. It is also in the process of continuous change in the evaluation of market economy logic and capital value. Its original traffic function and economic value have been reconsidered as well as original cultural value is impacted by the market forces. Many media published articles enthusiastically talking about the problem "Should Nanjing Yangtze River Bridge be demolished" facing to economic losses caused by the bridge traffic congestion and shipping restrictions since 2003. Some people think that the bridge built during the Great

Cultural Revolution is too old to meet the actual needs of the current economic, which is a “Dilemma” of modern economic development. Meanwhile, with the existence value of bridge suspected by economic facts, it needs to be dismantled and rebuilt. Others think value of bridge cultural heritage as a symbol of a period of history should not be underestimated instead of judging the value with the present visual angle. We can feel the bridge is being challenged and subverted on both sides of the debate as an original revolutionary cultural symbol and the symbolic significance of a political monument, in which useful value is also lowered. More importantly, the bridge is also endowed with new political cultural implications by the argument about reconstruction. It is the reform and transformation of market economy system that changes our understanding on bridge to a great extent, and meanwhile great changes have been made in the life expectancy and political expectation, which makes itself have a certain openness and inclusiveness.

Nanjing Yangtze River Bridge: Memory and Identity of a City

The bridge, belonging to the whole China, is a landmark achievement of China's Socialist Modernization Drive as well as a symbol on the spirit of modern industrial culture in China. But it, located in and belonging to Nanjing, is a veritable public image of Nanjing City, the visual landscape shared by most urban residents, and rooted in the hearts of the city dwellers of Nanjing as well.

Firstly, the bridge carries traumatic memory and national identity. The planning and construction of the bridge is not accidental from the birth of the bridge, behind which there is a solemn and noble historical inevitability. “Human traumatic memory is the same as human national concept’s in fact, which is regarded as an external condition for the purpose of internal stimulation and growth” (Zhang,1999).To some extent, the construction plan of bridge is not only the inspiration on a generation of traumatic memory, but the embodiment on self-reliance and making efforts of the Chinese nation spirit.

Recalling the history of bridge construction, in 1937, the National Government has heavily engaged American bridge expert Walter to conduct field investigation on the river surface from Nanjing to Pukow, drawing a conclusion that “the water is too deep and urgent to be suitable for building a bridge”. Then the domestic situation in trouble and the outbreak of Counter-Japanese War and Civil War in succession led to planning and construction of bridge being of sheer fiction. After the founding of New China, the construction of bridge was interrupted once again because of Sino-Soviet relation breaking down. Historical trauma that China lagging behind is beaten for two or three hundred years and traumatic experience that bridge is unable or impossible to be built, as long as scars branded in the memory of generations, becomes a fixed cultural and psychological facts to remind that generations don’t forget the intolerable past you’ve gone through. At the same time, the past pain has inspired the generation to prove and demonstrate the dignity of the Chinese nation. Trauma and treatment are consistent. After the founding of the New China, a modern bridge must be built at the site previously determined to be impossible as a dreaming symbol of the national modernization as well as a recipe curing for spirit and culture trauma. Bridge for the first

time used HSLA steels developed by ourselves, seamless line and the fly ash ceramsite lightweight concrete as well as high-strength bolts instead of rivets on the construction technology.The bridge creatively adopted heavy concrete caisson, steel sheet pile cofferdam, steel immersion with pipe column and floating steel reinforced concrete caisson leading to nine piers firmly anchored on the strata of river bottom. Among them, the heavy concrete caisson of No. 1 pier sinks to a depth of 54.87 meters with the deepest caisson in Chinese bridge project up to now. At the same time, under the support from all sides, we overcame the dangerous situation of the Yangtze River flood peak in the process of construction and carried forward the dauntless spirit of the building bridges army in China. They not only overcame difficulties but strived for excellence in each construction detail reflecting the meticulous and excelsior craftsman spirit of the four thousand construction workers.

Secondly, the bridge is the class memory of Proletarian Revolution as well as the group memory carrier of the Communist Party leading the people in building socialism.Bridge is the history of solidification and a memory form of the times as well. The construction of bridge, just in the special historical period of the “Cultural Revolution”, not only fully reflects the particularity of Chinese political culture, but is converted and engraved into class memory of the revolutionary. The sculpture theme based on “People’s War”, “Three Red Banners”,“Mao Zedong thought shining the people from all nationalities in the world” and “The Great Proletarian Cultural Revolution”, constitutes the class memory of the Proletarian Revolution in that particular era on the bridgehead. Petals, 100 pieces of sunflower carve, have 31 discs. Petals surrounded by four piece of leaves is combined with red sun so that intuitive symbols are used to expound the theme expressed by “East is red” and “Sailing the seas depends on the helmsman” two revolutionary songs: Cultural Revolution shifting giant waves, Red Political Power continuous years. There is no doubt that it constructs a common historical and cultural memory.

The sculpture and sunflower of bridgehead highlights the Proletariat Revolution memory of the bridge from one side. In addition, 22 pieces of carves, in bridge, show the new face of socialist construction under the leadership of the Communist Party with a panoramic perspective. The content of the sculpture shows the political, economic and cultural achievements of a multi-ethnic and multi-class Socialist New China, including Daqing Oilfield, Dazhai Production Brigade, Chengdu-Kunming Railway, Beijing Railway Station, Fushun Coal Mine, Anshan Iron and Steel Company, Xin’An River Hydropower Station, Island Female Soldier, Desert Camel, Shanghai Million Ton Steamboat, Inner Mongolia Prairie, The Great Wall, Hainan Island Coconut Scenery and so on, which covers industry, agriculture, city construction, inland and border, East and West, technology, national defense and other aspects. In this sense, the bridge tried to construct group memory of the Chinese nation with use of a centralized and public form in the process of sharing and spreading.

Obviously, the group memory constructed by bridge has a strong cohesiveness. At the level of time, it combines the poor and backward state history of Old China with the thriving New China. It will be Set and preserved in a visual communication way, including the past important events, the important achievements having been built and the memories on them. In addition, making itself continues to gain practical significance and even obtain profound spiritual and cultural value. On the social level, the bridge contains the common value

system and code of conduct of socialist construction. On the basis, the formation of a recognition force come into being a certain binding force on all members. If a person relies on memory making self-sensation become clear and defined in order to win the true identity, a group can only rely on the preservation and extraction of the common experience to form a strong subjective force and stronger cultural and psychological structure. This means that Bridge, as a form of memory, becomes the Chinese shared memory through the public exhibition and exchange. Historical subject consciousness of Chinese is gradually constructed through the expression of cohesion and preserved as a form of cultural identity as well.

Finally, the memory of Nanjing Yangtze River Bridge is reconstructed. Whether the bridge serves as a traumatic memory or revolutionary memory, it is a cultural memory in the final analysis belonging to the special memory and cultural image of Nanjing city.
Any kind of cultural memory is impossible preserve past in the integrity needing "reconstruction to act on. That is to say, it always links its knowledge to an actual or contemporary situation.……Sometimes it goes through misappropriation, sometimes criticism, sometimes preservation or transformation.……Every contemporary context puts the objective meaning into its own perspective and gives its own understanding"(Jan,2011). When the bridge meets the contemporary cultural context and the individual and collective memory, its memory becomes a choice and reconstruction that conforms to the cultural interpretation framework and is preserved and transformed in different forms. Literary art on reconstruction of the bridge cultural memory is the most prominent. Artistic form expressed aesthetic understanding of literary artists on the bridge, such as poet Shi Zhi's "Nanjing Yangtze River Bridge", Li Zhaorun's lyrics "We Came to Chairman Mao Through the Bridge", Wu Guanzhong's "Bridge's Beauty" and painting "Nanjing Yangtze River Bridge", Wei Zixi's Chinese painting "Natural Moat and Thoroughfare" and Qian Songyan's Chinese painting "Grand Plan of Country". On the one hand, they can be close to and embrace the new era as well as explain aesthetic cultural value of the bridge in the language and image way, showing and inheriting a cultural confidence. On the other hand, these memory forms, beyond the routinization existence, have completed the cultural characterization and aesthetic reproduction of the bridge.

In addition, the memory form, including stamps, food stamps, badges, sparks, candy wrappers, New Year paintings postcards, calendars, posters, exercise books cover, cards and so on, lead bridge culture to objectify and actualize constantly, and the bridge to be extended into a "retrospective memory space". Obviously, the presentation of the bridge on different carrier forms make itself constantly become a symbol of popular cultural, the original aura and holiness of which disappear gradually and be frozen and solidified in Nanjing or cultural products overflowing from Nanjing. In the reconstruction of the memory, there is always varying degrees of difference and falsification between the original image and cultural image of reconstruction. It is endowed with different meaning, which is the important manifestation on cultural memory flowing of the bridge.

Protection and Urban Cultural Construction of Nanjing Yangtze River Bridge

In the face of game between social development and local interests, the bridge has become a pronoun of obstruction in local economic development and Nanjing city traffic jams, and an overwhelming reality that it is in crisis and under great pressure. In this situation, the discussion about the bridge's survival, easing the traffic congestion, bridge and urban planning is also continuous. These problems have gradually become an important problem of urban governance in Nanjing. Therefore, standing at the intersection of history, reality, inheritance and development, how to protect and excavate economic and cultural value of the bridge as well as bring new vitality to itself, is the topic seriously considered and explored by Nanjing and her residents.

The bridge should be an important manifestation of urban cultural characteristics in terms of cultural value. In 1960, it was included into the "Guinness World Records" with the "longest Rail Transit Grand Dual Bridge in world". In July 2014, it was selected as an immovable cultural relic. In September 2016, it was selected as listing of the "First Batch of 20th Century Architectural Heritage in China". Therefore, with the bridge taken as a city cultural heritage, we have good reason to protect, explore and inherit the cultural value, which is an important path to revival.

As cultural heritage of city, the protection of the bridge should be closely integrated with urban cultural construction and take the route of sustainable development. "Today, the reason for the protecting cultural heritage not only depends on whether it has the use value and partially depends on how valuable it is in art and science, but depends on it having been an important component of city culture, deeply engraved in people's memory"(Shan,2013).For Nanjing Yangtze River Bridge, it is not only a historical witness of Nanjing development, but also a realistic carrier of urban civilization. It embodies the thoughts, wisdom and life of the contemporary Chinese, telling the history and culture of Nanjing. The public can learn a lot of the unforgettable city scenes through the bridge as well as clearly see the growth process of the city. It is worth pondering that the bridge is the historical truth that we may touch today and can make the people living in Nanjing feel the existence of history directly. It is an indispensable link in the course of Nanjing's urban life. It connects the past emotions, memories and glories as well as the future of Nanjing development. Therefore, the bridge bears the historical mission of continuing the urban culture and preserving the city's memory in Nanjing.

From another perspective, the construction and development of the city should be accompanied by the construction process of urban culture instead of lacking urban culture. Meanwhile, culture heritage should be needed to nourish the spirit so that the majority identifies their own urban culture, thereby creating a sense of pride and happiness. Only in the way does the city get the real sense of development. The experience of city cultural heritage protection in developed countries is worth learning. For example, with a total of 32 historic bridges in Thames River of London downtown, there are 8 bridges protected only in the tow. In Berlin, the government stipulates that all traditional buildings existing over

80-100 years must be kept without reservation. Japan safeguards historical heritage and protects the historical authenticity and the integrity of the environment to emphasize the spiritual value of cultural heritage through constant revision and implementation of legislation the protection of cultural heritage. Their successful experience tells us that in the process of modernization, only through strengthening the identification and protection of cultural heritage as well as discarding the false ideas of self-contempt and total repudiation to make it integrate into the development of urban culture, do the cultural heritage obtain sustainable development, which also provides a useful reference for Nanjing Yangtze River Bridge restoring vitality.

If the bridge is regarded as a spiritual wealth that conforms to the public interest and converted into cultural resources on enhancing comprehensive quality of the public, then the bridge will become a spiritual theme beyond history and time, which will be protected and honored forever. There is no doubt that the bridge has the conditions for such transformation just as scholars said. “If the stream of traffic on the bridge is replaced by an endless stream of people, bridge deck can be naturally conceived as open-air exhibition hall with 1576 meters long and 15 meters wide. The railings on both sides of the bridge are regarded as exhibit board of hall, and meanwhile the 202 reliefs are the exact contents of the giant exhibition”(Qian,2010).Therefore, the bridge is a living museum. As a result, the matter survival such as emboss on the bridge and related historical documents have become the exhibition contents, which are used as the form of cultural activities. Through the protection of bridge in culture, education, aesthetic and spiritual aspects of the cultural resources, we can derive urban culture with distinctive regional cultural characteristics to further enhance cultural identity and cultural self-confidence of Nanjing.

The protection of the bridge is an important part of urban governance in Nanjing. It needs Nanjing City decision-makers and administrative department of cultural relic protection undertaking a solemn mission, the general public actively supporting and cooperating as well as a highly conscious awareness of cultural heritage protection and participation. As a major project in Nanjing, the bridge was closed in October 2016 and integrally repaired for 27 months, investment of which achieves 1.1 billion. Its repair contents are that highway bridge deck is replaced, bridge deck of approach bridge and T beam bridge are reformed, double arch bridge is reinforced and reconstructed, etc. Nanjing has convened relevant experts to review the designing project of the cultural relic protection for the bridge maintenance. The project will ensure the authenticity and integrity of the cultural relic as much as possible with upholding the principle “Minimal Intervention”. On the day of bridge closed, people from all over the world expressed “a temporary departure” on the bridge including walk, photography and so on in the rain(Dai,2016).Nanjing protection measures, on the one hand, respond forcefully to others about the discussion of “dismantling the bridge” and bear cultural heritage protection duties with “duty-bound to defend one’s country”. Only by means of technology and engineer is environmental deterioration curb and the bridge traffic function is promoted. On the other hand, through a variety of media publicity and display, the bridge is transformed into public discourse walking into the daily lives of the public, which makes people understand the concept and significance of bridge repair. In the form of

communication and cultivation of emotion, we actively acquire the support and understanding of the masses, and influence and arouse the attention of the broad masses of the people and participate in the protection of the bridge.

Conclusions

As a public image of the city, Nanjing Yangtze River Bridge is an inevitable production during a particular era request as well as witnesses change of Chinese political culture. As a place of public memory, it not only symbolizes the individual memory of bridge planners, builders and participants, but also is a cultural memory on institutionalization organized directly by the Party and country's leaders, reflecting the organization, public organization and centrality. As time goes by, the bridge turns into cultural heritage of Nanjing, recalls the context and inheritance and shows profound experience of city. Only when joined up with Nanjing city cultural construction and transformed into the cultural resources for serving real life as well as understood, appreciated and shared by general public, can its due dignity be manifested, and can the past brilliance be reproduced.

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HRADECKY BRIDGE:
A STORY 150 YEARS OLD BRIDGE FROM FIVE PERSPECTIVES

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INTRODUCTION

This paper describes 150 years of the Hradecky Bridge (Hradeckega most), a three-hinged prefabricated cast-iron truss arch bridge that crosses the River Ljubljanica in Ljubljana, Slovenia. Five different perspectives are taken. The first focuses on three different plans for the new iron bridge, the second describes its construction and two subsequent relocations, the third describes its three-hinged structure, the fourth provides the details of its three non-structural elements, and the fifth explains the three names given to this bridge. A short biography of the relatively unknown engineer Johann Hermann who designed the bridge in 1865, is included as well.

The primary structure of the Bridge consists of three prefabricated three-hinged cast-iron truss arches with the total span of 30.4 metres and the height of 2.2 metres. The prefabricated elements comprising the truss arches were made at the iron foundry in Dvor pri Žužemberku (Hof in Krain). The Bridge, 5.7 metres wide, was opened in October 1867 and named after Janez Hradecky (Hradeczky), the mayor of Ljubljana.

At its original location, the Hradecky Bridge (Hradeckega most, 1867-1931) connected the Old Square (Stari trg) and the New Square (Novi trg) in the centre of Ljubljana. After 64 years in use at the original location, the prefabricated Bridge was dismantled during the river bank regulation in 1930s and reassembled some 2 km downstream the river. At its new location the Bridge was close to the town's mortuary and thus it became known under the nickname Mortuary Bridge (Mrtvaški most, 1932-2010). At the end of the 20th century it was first closed for vehicle traffic and finally dismantled. After undergoing a complete refurbishment, it was reinstalled in 2011 at its third location in Ljubljana, this time 450 metres upstream the river from its original location.

Built in 1867, the Bridge was the first three-hinged arch bridge ever built in the Habsburg Monarchy. In 2017, 150 years after its construction, it still serves as a pedestrian bridge in Ljubljana city centre and again bears its original name, namely the Hradecky Bridge (Hradeckega most, 2011). It remains the world’s oldest surviving three-hinged bridge and although little known the Hradecky Bridge is a pure treasure of the world’s heritage.

RIVER LJUBLJANICA, LJUBLJANA AND TWO BRIDGES

The River Ljubljanica has always played an important role in Ljubljana. To the south of Ljubljana there is a marshland called the Ljubljana Marshes. In the prehistoric times (5000–1500 BC), when the marsh was still a shallow lake, the natives lived in pile dwellings. In the first decade of the 1st century a Roman town called Emona was established on the left bank of Ljubljanica that became an important Roman transport trade route. During the Middle Ages Ljubljana was formed along the river banks beneath the Ljubljana Castle. The castle was first mentioned between 1112 and 1125 as Castrum Leibach while the medieval town was first mentioned as Luwigana in 1144 and later as Laybach in 1278 [Štih, 2010]. At that time Ljubljana was at the crossroads of the Latin, Germanic and Slavic cultures.

The earliest records documenting a bridge in Ljubljana date back to 1288 when the Old Bridge (Stari most) is mentioned [Dolinar et al. 2011]. During the next centuries, different timber bridges at this location got different names: the Lower Bridge (Spodnji most), the New Bridge (Novi most), the Špital Bridge (Špitalski most), and the Franz's Bridge (Frančev most). All these bridges were situated at the location where the Triple Bridge (Tromostovje), a group of three bridges built so close together that they form a single architectural unit, stands nowadays.

Another timber bridge, situated approximately 300 metres upstream the River Ljubljanica, was mentioned in 1323 [Dolinar et al. 2011]. It connected two medieval quarters of Ljubljana, namely the Old Square (Stari trg) and the New Square (Novi trg). At first the bridge was called the Upper Bridge (Zgornji most). In the 13th century it was renamed as the Butcher’s Bridge (Mesarski most) because the timber cottages for the butchers were built on the bridge. The fire destroyed the Butcher’s Bridge several times, but in 1614 Peter Peliorini designed a model of a new timber bridge [Vrhovec 1895, 371]. After model was publicly displayed for a short period of time, the new bridge was built according to the model but with certain modifications incorporating the wishes of the town's people. It

was made in timber with 24 timber cottages intended for shoemakers and other craftsmen (Fig. 1). The bridge was renamed again, this time to the Cobbler's Bridge (Šuštarski most) or Shoemaker's Bridge (Čevljarski most) [Stopar 1992, 56-8].

Fig. 1: The Cobbler's Bridge across Ljubljanica at the end of 18th century [Stopar, 1992].

The bridges at both locations were made entirely of timber, including the piers and small cottages for craftsmen's shops that were built on the bridges. As they were made of timber, the bridges needed sustained maintenance due to rot, recurring floods, occasional fire, and especially because old branches and other floating material brought by the river were damaging the supporting piers. These two bridges had been the only river crossings in Ljubljana for almost five centuries.

In those times it was considered self-evident that the town authorities collected bridge tolls for crossing both bridges. Constructing a bridge has always been both financially expensive and technically demanding, especially if the nature failed to provide ideal conditions at the chosen site. This was the case in Ljubljana for several reasons all until the second half of the nineteenth century. First, leaving the Ljubljana Marshes just before reaching Ljubljana, the River Ljubljanica flooded the town several times each year and eroded the river banks at the same time. Second, the soil along the river bed is made of clay and thus not well suited for laying the foundations of the stone piers supporting a bridge. And finally, Ljubljana, or Laibach as it was officially called in German at that time, had been just a modest provincial town of limited resources for most of its history.

To drain the Ljubljana Marshes and thus prevent the River Ljubljanica from flooding, Jesuit Gabriel Gruber, an expert in hydro technology and architecture, designed and built a water channel (1773-80) that surrounds Ljubljana from behind, i.e., to the south-east of the Castle Hill, while the Ljubljanica flows through Ljubljana, i.e., to the north-west of the Castle Hill. At the time the new channel was made it was called the Imperial Channel, but was later renamed as the Gruber Channel (Gruberjev prekop). Three new timber bridges across the River Ljubljanica and two bridges across the Imperial Channel were built at that time as well [Vrhovec 1895, 374]. The town authorities also wanted to rebuild both old timber bridges in the town centre in stone. The first attempt was in 1789 when the plans for the new masonry Cobbler's Bridge were already designed but due to the lack of money they were not carried out.

However, due to the new channel the level of the River Ljubljanica decreased significantly during the following years and thus the two old timber bridges became dangerous. As the exposed piers were rotted, both bridges were closed for heavy traffic with carriages by the Court Inspector in 1834. They were considered unsafe [Kladnik 2004, 46] and stayed open for passengers only. But as both old timber bridges were located along the busiest streets, the town authorities decided to replace them.

In 1841-42 a new masonry bridge was built according to the plans of Italian architect Giovanni Picco at the location of oldest bridge in Ljubljana, i.e., at the location of the present Triple Bridge (Tromostovje). It was made in stone, with one supporting stone pier standing in the middle of the river. This was the first masonry bridge in Ljubljana [Valenčič 1966, 147-8]. During this occasion it was renamed from Špital Bridge to Franz's Bridge, in the honour of Archduke Franz Karl of Austria. After

the bridge was built, there was no money left to replace the second oldest timber bridge, namely the Cobbler's Bridge, with a new masonry bridge.

THREE DIFFERENT PLANS FOR THE BRIDGE

A story of replacing the old timber Cobbler's Bridge with a new cast-iron bridge, later named Hradecky Bridge, starts with a suggestion made by Janez Hradecky, the Mayor of Ljubljana, that they could build a new bridge using either cast iron pipes or an iron-chain suspension.

The oldest preserved plan of an iron bridge at the location of the later Hradecky Bridge was made in 1837 by Franz Hutter, an ironworker from Vienna [Suhadolnik, 2003]. It was based on a system for constructing iron arch bridges with a minimal rise-to-span ratio that he himself invented in 1830. However, his plan has never been realised (Fig. 2).

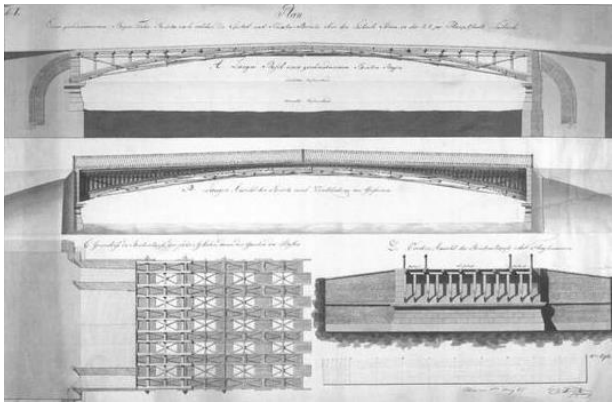

Fig. 2: Franz Hutter's 1837 plan of an iron arch bridge [ZAL, 1837].

In autumn 1860 the town authorities in Ljubljana announced a competition for a new bridge that was supposed to replace the old Cobbler's Bridge. One of the main requirements of the jury was that the new bridge should be made in iron instead of timber [Kladnik 2004: 46-7]. They received six plans and after taking a considerable amount of time to decide, the jury announced in 1865 two equivalent prizes [ZÖIAV 1866]. The prizes were won by two civil engineers from Vienna, August Köstlin (1825-1894) and Carl Hornbostel (1825-1913). The Köstlin's plan has been lost, but Hornbostel suggested a simple truss bridge without any piers (Fig. 3). At the end all proposed competition entries were considered too expensive.

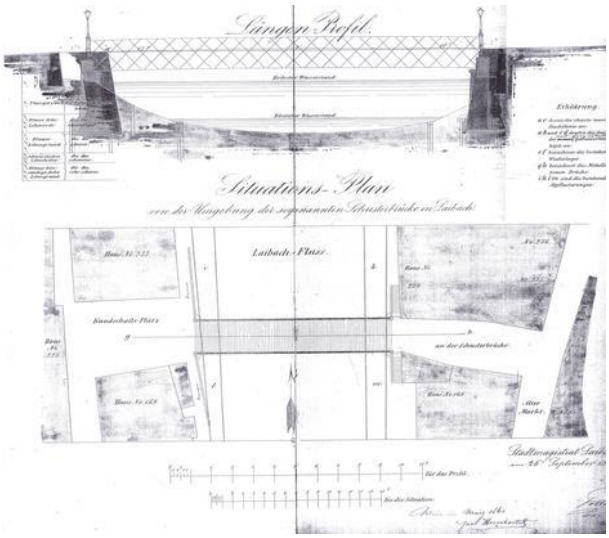

Fig. 3: Carl Hornbostel's 1860 competition plan of an iron beam truss bridge [ZAL, 1861].

The town authorities later decided to accept yet another project, put forward by nowadays almost unknown engineer Johann Hermann (also written as Herrmann or Herman) from Vienna. His first proposal, dated 1865, is a single arch truss bridge made with eight different triangle elements made of iron (Fig. 4). As the new bridge could be made solely by local industry and craftsmen the plan was very attractive to the town authorities.

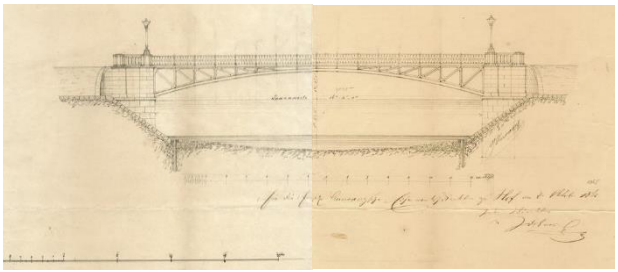

Fig. 4: Johann Hermann's first proposal (1865) of the new iron bridge [ZAL, 1865].

In his second design, dated 1866, Hermann changed the number of triangle elements and included hinges to the arch. He reduced the number of triangle elements in each cantilever from eight to seven. He also added three hinges to the arch so that the structure became a three-hinged arch bridge, with one hinge element in the crown of the arch, i.e., in the middle of the arch, and with one hinge element at each side of it, i.e., near the abutments.

Finally the financial plan was confirmed and the construction was about to start. The building firm Gustav Tönnies from Ljubljana started to consolidate both river banks near the bridge with concrete, and the stone foundations were constructed as early as March 1866 [Žargi 2000, 91]. For the construction of the foundations the concrete was used for the first time in Slovenia [Humar, 2013]. A prefabricated cast-iron structure, i.e., the bridge itself, was made by the Auersperg Ironworks and Foundry in Hof in Krain (Dvor pri Žužemberku), the most famous ironworks and foundry in Slovenia during the 19th century. The bridge prefabricated structure allowed the initial assembly in the foundry yard for inspection purposes. After the inspection the bridge was transported to Ljubljana piece by piece. It was assembled and put in place at its designated location in October 1867.

Before the bridge was open, the structure was tested regarding the temperature and load. Both tests were made on October 15th, 16th, and 17th 1867. A structural load of 90 tons had been put on the bridge for 24 hours and the deformations were measured. The load deformations were only 20 mm and thus still within the elastic area. The deformations caused by the temperature were more severe. If the difference of the temperature was 1°Ré (0.8 °C), the bridge was longer for 1.5 millimetres. Hence, if the difference between winter (-20°C) and summer (+30°C) temperature in Ljubljana are around 50°C, the Bridge is approximately 9.4 cm longer in the summer! After a few days of testing with temperature and load, the bridge was finally opened for the transport (Fig. 5).

Fig. 5: Johann Hermann's Hradecly Bridge at its original location [ZAL fototeka].

On December 28th 1867 Johann Hermann gave a lecture at the Austrian Society of Civil

Engineers and Architects (Osterreichischen Ingenieur- und Architekten-Vereines) in Vienna. In his lecture he explained the structure of the bridge, the aim of the two different hinge types, and the results of the temperature and load tests. His lecture was summarized in a paper entitled "Die Radetzky-Brücke in Laibach" ("Radetzky Bridge in Ljubljana") [ZÖIAV 1868] with the plan added in the appendix (Fig.15).

THREE DIFFERENT LOCATIONS FOR ONE BRIDGE STRUCTURE

Initially, the Hradecky Bridge stood at the location of the second oldest timber bridge, the Upper Bridge [Slivnik, 2012]. From its construction in 1867 until the regulation of the river banks in 1930, it connected the Old Square (Stari trg) and the New Square (Novi trg) (Fig.6). During the extensive regulation the river bed was consolidated and the banks were bolstered. Due to the works the Hradecky Bridge suddenly became too long. Therefore it was dismantled and moved nearly 2 km downstream the river (Fig. 7). It had been assembled again close to the Ljubljana Mortuary and put in use in 1932. Officially the bridge was still named the Hradecky Bridge but as it was so close to the Mortuary it became popular with its nickname the Mortuary Bridge (Mrtvaški most).

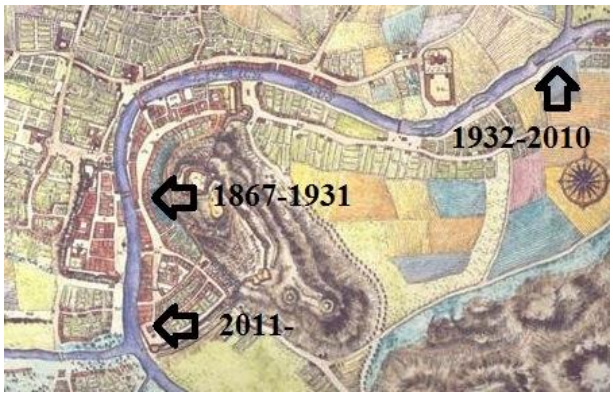

Fig. 6: The three different locations of the Hradecky Bridge.

Fig. 7: Dismantling the structure at the first location in 1931 (left)
and constructing it again on the second location a year later (right) [ZAL fototeka].

Very little is known why this iron structure was moved to the new location and used again. At the location near the Mortuary, there had been a bridge since the beginning of the 20th century. But it was a small wooden bridge for pedestrians only. Most likely the town authorities decided to reuse the old bridge in order to save some funds, a very likely measure during the economic hardships in 1930s.

At the new location the entire iron structure of the bridge remained the same (Fig.6). Only a few minor corrections were introduced, including improved foundations and reshaped concrete parapets (where the Mortuary Bridge was connected with the river banks). This new entrance to the bridge on the second location was designed by Jože Plečnik, the most famous Slovene architect and the head of

the River Ljubljanica 1930s regulation project.

The quiet and unimportant location behind the Mortuary actually saved the Bridge during the decades of socialism, the system so often at least ignorant if not even hostile to the cultural heritage. The only thing from that period worth to be mentioned is that in 1960s the hot water pipes were installed below the Mortuary Bridge markedly hiding its cast-iron structure (Fig. 8).

Fig. 8: Johann Hermann's Hradecky Bridge at its second location around 2008, with Jože Plečnik's conical parapets [photo Slivnik].

After more than 70 years in use at the second location, the modern traffic became far too heavy for the nineteenth century bridge structure. Hence, the town authorities closed the Mortuary Bridge for heavy traffic in 2004 and afterwards the Bridge remained open for pedestrians only. But in 2009 they decided to replace the Mortuary Bridge with the wider one and move the old bridge structure once again, this time to a more prominent location closer to the town centre approximately 450 metres upstream from its first, original location (Fig. 6) [Slivnik & Brate, 2014].

After taking the Mortuary Bridge carefully apart, it was established that even after more than 140 years all parts of the primary structure made of grey cast-iron were still in a very good condition [Gruden, 2011]. During the refurbishment, all parts were first sandblasted and then examined by visual and penetrant test. Only three parts of the original primary structure (out of 84) needed some repair. Finally, all parts were protected against the various weather conditions, especially against UV light and rust. The bearings were cleaned with acid and smeared with graphite to improve the corrosion resistance. At the renovation place, the six cantilever trusses were assembled from the original cast-iron pipes and triangles using new, pre-stressed screws. Afterwards, still at the renovation place, two groups of three cantilever trusses were connected with the original I beams. The two halves of the bridge, now renovated, were transported to the new location where the foundations strengthened with 20 metres deep piles on both river banks were prepared in advance. Finally, after both parts of the bridge were laid down into their final positions, the bridge was fixed by the hinges (Fig. 9).

Fig. 9: Dismantling the structure at the second location in 2010 and constructing it again on the third location in 2011 [photos Gruden; Brate].

After the Hradecky Bridge was carefully renovated and constructed again, it was opened on May 11th 2011. Today it is a pride of Slovene industrial heritage (Fig. 10).

Fig. 10: The Hradecky Bridge by Johann Hermann (1867), Jože Plečnik (1931) and Saša Dalla Valle (2011) at its third location in 2013 [photo Slivnik].

THREE-HINGED PREFABRICATED CAST IRON TRUSS ARCH STRUCTURE

The Hradecky Bridge is a relatively small bridge made of prefabricated cast-iron only. The three-hinged truss arch bridge is 18 Wiener Fuß (Vienna Feet) (5.7 metres) wide, 7 Wiener Fuß (2.2 metres) high and the total span is only 96 Vienna Feet (30.4 metres) [ZÖIAV, 1868]. The structure is very light: it weighs only 32.5 tons.

The entire prefabricated structure is made of 42 identical pipes and 42 triangles of seven different types. There are 6 identical cantilever trusses, each comprised of 7 pipes and 7 different triangles joined together with screws (Fig. 11). Two cantilever trusses form a single arch truss spanning across the river. As there are 6 cantilever trusses, the bridge consists of 3 arch trusses, transversely connected together with diagonal I beams.

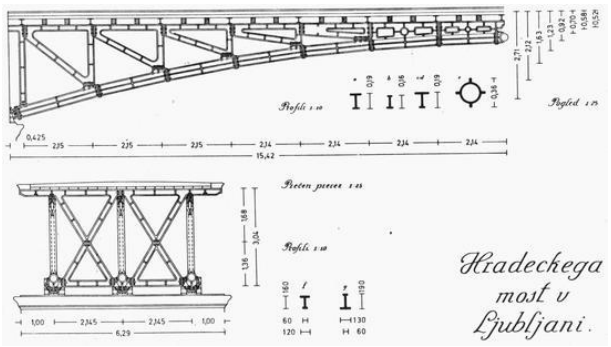

Fig. 11: The detailed plan of the new bridge:
the front elevation of one cantilever and the cross section [Kurent,1983].

From the structural perspective, the Hradecky Bridge is a three-hinged structure. On the one side, the cantilever truss is fixed on the supports (foundations) by a hinge, and on the other side, in the crown of the arch, it is connected to another identical cantilever truss, with another hinge. Thus two cantilever trusses form a three-hinged arch across the river. As the bridge is composed of three parallel arch trusses, each hinge point includes three hinges placed along a line orthogonal to the bridge.

A hinge (or a pin) is mechanical element that holds two structural elements together and permits reciprocal rotation with respect to a line or a point. In three-hinged arch structures, two hinges are used as hinge supports and the third hinge is at the crown of the arch. In the case of the Hradecky Bridge, two different types of hinges are used (Fig. 12) [ZÖIAV, 1868]. The two hinges used as hinge supports

are at the bridge abutments and are called “Kämpferscharnieren”: the end pipe element of the trusses simply lies on the special, slightly curved element fixed on the stone (or later concrete) foundation. The central hinge at the crown of the arch is described as a “Charnierbolzen”. It is made of two pipe elements which are connected with a pin which permits free rotation of one part of the arch with respect to the other [Slivnik, 2013a].

Fig. 12: The hinge at the bridge abutments
and the central hinge at the crown of the arch [photo Slivnik].

From the structural perspective, the three-hinged arch is entirely free to “breathe”. The flexible hinges compensate for the thermal deformations and settlement stresses of the structure. For instance, the three-hinged structure of the Hradecky Bridge was inadvertently yet critically tested during the Ljubljana earthquake in 1895. Although the bridge sustained the 8-9 degrees MCS earthquake, it was still perfectly stable and without any damages.

THREE NON-STRUCTURAL ELEMENTS

Not only was the cast-iron structure of the Hradecky Bridge a complete novelty, its non-structural elements were in the contemporary spirit as well. Three different non-structural elements are used at the Bridge: cast-iron fence, lightings, and pavement.

The only non-structural element that remains the same until today is the cast-iron bridge fence (Fig. 13). The bridge fence ornamentation with rose elements is Neo-Gothic. Bridge fence with a handle is made of 14 identical prefabricated elements at each side of the bridge and one shorter element at the each end of the parapet. The 28 longer elements are 2.34 metres long and 4 shorter ones are 1.6 metres long. The separate fence elements are connected with octagon pillars, 32 in total.

Fig. 13: A view of the fence [Kurent, 1983] and the fence before the last renovation [photo Slivnik].

Although the primary structure of the bridge remained the same during the 1931 replacement, a

few minor corrections were introduced. These corrections included improved foundations and thus the new parapets had to be added at both sides of the bridge. The concrete parapets, designed by Jože Plečnik, were added at the end of each side of the fence where the bridge structure meets the banks. These concrete parapets were moved together with the Bridge when it was moved to its third location.

The lamps at each side of the bridge changed in time with the advance of technology (Fig. 14). At the first location, prefabricated cast-iron gas lamps stood at all four ends of the fence. After the electrification of Ljubljana in 1898 all four gas lamps were replaced with just two electric lamps. Thus each new lamp was hanged from the newly designed iron arch forming the entrance to the Bridge. During the 1931 replacement, new electric lamps in a form of a cone, designed by Plečnik, were installed on the concrete bridge parapet ends at both entries to the bridge.

The hardest issue when the Bridge was moved to the third location in 2011 was to decide which parapet and lamps should be installed at the bridge. The Institute for the Protection of Cultural Heritage of Slovenia (Zavod za varstvo kulturne dediščine Slovenije) believed that the lamps should look like the original cast-iron gas lamps, but made as new electric lamps. However, architects and art historians, fascinated by the fame of Jože Plečnik, insisted that the new additions made by Plečnik are far more important and that the lamps and parapets should remain. Hence, the concrete parapet and concrete cones for the electric lamps were built again using the original Plečnik's drawings.

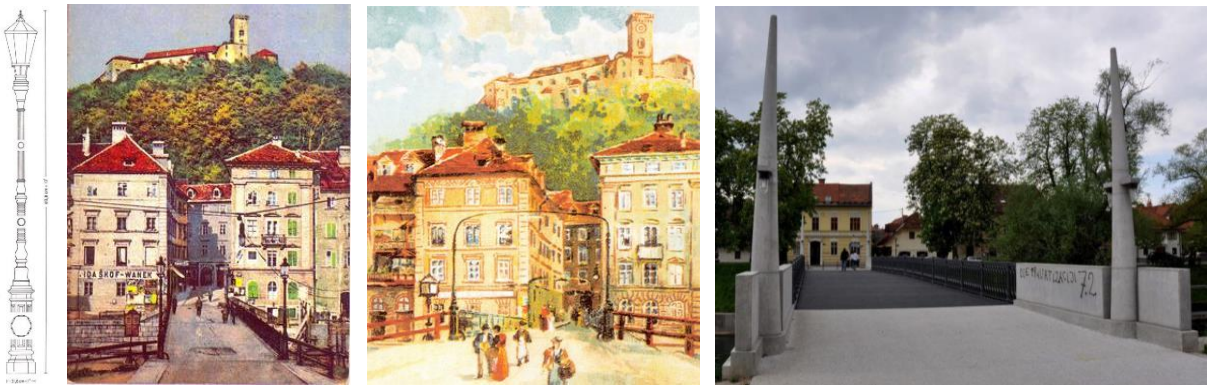

Fig. 14: The detailed plan of the gas lamp [Kurent, 1983],
the first bridge with gas lamps [Stopar, 1992], the first bridge with electric lamps [Humar, 2009],
and the third bridge with the concrete parapets and concrete cones for electric lamps [photo kraji.eu].

At its original location, back in the 19th century, the Hradecky Bridge was paved by oak bricks. After the bridge had been moved for the first time, behind the Ljubljana Mortuary, it was paved by asphalt as this suited the modern traffic better. Nowadays, the bridge is open for pedestrians and cyclists only, and thus it was decided to pave it using a tartan track.

THREE NAMES OF ONE BRIDGE

When constructed the Bridge was officially named the Hradecky Bridge (Hradeckega most) (Fig. 15) after Janez Hradecky (1775-1846), a pro-Slavic Mayor of Ljubljana from 1820 till his death in 1846. However, a Viennese Journal of the Austrian Engineers and Architects Association (Zeitschrift des Österreichischen Ingenieur- und Architekten-Vereins) [ZÖIAV, 1868] published a paper entitled "Die Radetzky-Brücke in Laibach" ("Radetzky Bridge in Ljubljana") (Fig. 15). This reveals that the German name was taken after Austrian general Joseph Radetzky (1766-1858), nowadays mostly famous after the well-known Radetzky March composed by Johann Strauss the Father. As the names were so similar no agreement was reached and thus in German literature the bridge is known also as Radetzky Bridge (Radetzkybrücke) [Lorenz 1990]. The story about the two names for one bridge, i.e., the Slovene name and the German one, clearly illustrates the national tensions in the Habsburg monarchy at that time.

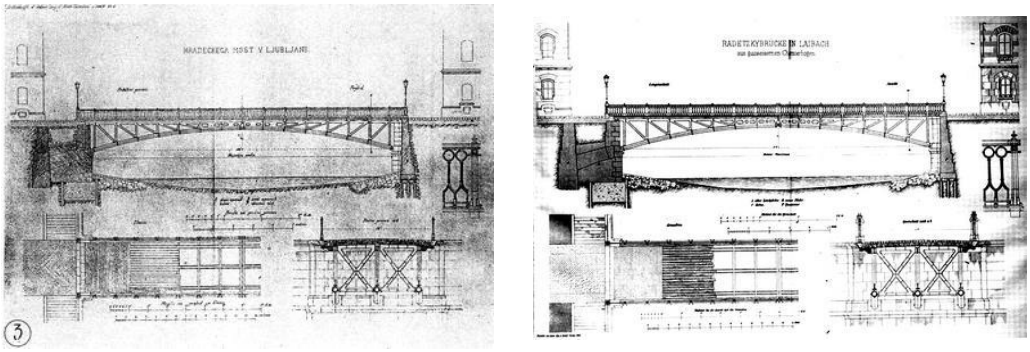

Fig. 15: Johann Hermann's original plans refer to Hradeckega most in Slovenian language (left) and to Radetzkybrücke in German language (right) [ZAL, 1867; ZÖIAV, 1868].

The confusion about the two names of the same bridge continued on the contemporary postcards. On the same postcard it was written in two languages as “Ljubljana - Hradeckija most” and “Laibach - Radetzky-Brücke”. Another example is the postcard where the text reads “Laibach – Hradetzky Brücke”. The confusion ended in 1918 with the disintegration of the Habsburg monarchy and the formation of the Kingdom of SHS (later renamed to Kingdom of Yugoslavia).

After the construction of the Bridge at the second location, its official name remained the Hradecky Bridge. But as it was close to the Ljubljana Mortuary, the Bridge became popular with its nickname the Mortuary Bridge (Mrtvaški most).

Nowadays, at its third location, the bridge remains to be called the Hradecky Bridge and thus bears the same name as it always did. The German name, namely the Radetzky Bridge, has been lost in the sands of time.

ENGINEER JOHANN HERMANN

Little is known about the life and work of Hradecky Bridge’s engineer Johann Hermann. His surname was also written as Herrmann, unfortunately also in [ZÖIAV, 1868]. As an engineer, Hermann was a member of Austrian Engineers and Architects Association from 1856. It is known that in 1873 he lived in Vienna, Margareten district, Rüdingergasse 9 [ZÖIAV, 1873]. He designed at least two bridges: Hradecky Bridge (Hradeckega most, Radetzkybrücke) in Ljubljana and Stieger Bridge (Stiegerbrücke, Meidlinger Brücke) in Meidling near Vienna [ZÖIAV, 1868].

Among Johann Hermann’s work the Hradecky Bridge is best known and most probably the only surviving structure. An article was written after he had a lecture at the monthly meeting of the Austrian Engineers and Architects Association (Österreichischen Ingenieur- und Architekten-Vereins) in Vienna on 28th December 1867 [ZÖIAV, 1868]. In this lecture Hermann presented the arch bridge bearings, the temperature and the load tests. The plan of the Bridge is also added. Hermann was introduced to the audience as a head-engineer (Ober-Ingenieur) from Vienna and the author of two recent bridge projects: the Meidling Bridge (Meidlinger Brücke) at the outskirts of Vienna and the Hradecky Bridge (Radetzkybrücke) in Ljubljana.

The Stieger Bridge (Stiegerbrücke) in Meidling near Vienna was finished in 1869 [Winkler, 1873]. Most likely this bridge was mentioned as Meidling Bridge in [ZÖIAV, 1868]. In Stieger Bridge Hermann used the same design principles as in the Hradecky Bridge. With almost the same span of 30.3 metres the 14.0 metres wide bridge was wider and thus using four arch trusses instead of three (as in the Hradecky Bridge) seemed reasonable. Unfortunately the Stieger Bridge was demolished during the regulation of the River Wienfluss in 1898.

Johann Hermann became an inspector at the Emperor Ferdinand Northern Railway (Kaiser Ferdinands-Nordbahn) around 1870. He was also a member of the Board of Directors of the Austrian Engineers and Architects Association (Österreichischen Ingenieur- und Architekten-Vereins) from 1872 [ZÖIAV, 1873]. Later, in 1884, 1885, and 1886 he served as the editorial board member of Journal of the Austrian Engineers and Architects Association (Zeitschrift des Österreichischen Ingenieur- und Architekten-Vereins).

CONCLUSION: ONE BRIDGE STRUCTURE AT THREE LOCATIONS

The Hradecky Bridge is an important treasure of the Habsburg Monarchy's history of civil engineering and structures. The bridge is the first three-hinged arch bridge built in the Habsburg Monarchy. As it may be the oldest three-hinged bridge still in use in the world, it is a pride of Slovene industrial heritage.

At the time when the Hradecky Bridge was constructed, the development of the three-hinged structures only just begun [Slivnik, 2013b]. The first three-hinged bridge ever constructed was a railroad bridge called the Unterspree Bridge (Unterspreebrücke) in Berlin, Germany, in 1865, designed by Johann Wilhelm Schwedler [Knippers, 2000; Lorenz, 1990] and dismantled in 1887. Only four years later, the Hradecky Bridge as the first three-hinged bridge built in the Habsburg Monarchy, was opened. The Bridge structure contains some of the first hinges ever made, thus the preservation of this quiet yet important monument have become an obligation.

Because the Hradecky Bridge is made of cast-iron prefabricated elements, it is possible that the same structure could be constructed at different locations. Thus the cast iron truss structure first spanned the River Ljubljanica in the centre of the city from 1867 until 1931. The Bridge was later dismantled and constructed again at the outskirts of Ljubljana where it stood from 1932 to 2010. After a year of a careful research, renovation of primary structure, and remanufacturing of some elements of the fence, the Hradecky Bridge was assembled again and put in place at its third location in 2011. Despite its age, the primary structure still serves its purpose very well. Maybe this is the only permanent bridge in the world that has so far stood at three different locations.

The Hradecky Bridge in Ljubljana was a great success at the time of construction. Encouraged by this success, Auersperg's Ironworks and Foundry produced a number of similar proposals for constructing prefabricated bridges in Vienna and Graz (Austria), or even some bridges at the Austrian Northern and Southern Railways [Žargi, 2000, 91]. But unfortunately the Auersperg's Ironworks and Foundry burnt down in 1869 together with all its archives that are now lost. After the fire, the Ironworks and Foundry never fully recovered and it was closed down in 1891.

In 150 years since its construction, the Hradecky Bridge sustained two relocations, several earthquakes including one 8 degrees MCS, countless temperature changes and permanent settlement stress. Despite all these, it continues to serve its purpose.

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The Bridge as a Witness to life, a Friend to people and an Essential piece of a city

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Books about the history of bridges start with suspension bridges made from ropes and end with suspension bridges made from steel cables. It may look like "no progress" other than the materials but indeed there is a considerable step up from 50 to 2000m.

These books are not complete without such stories as that of the Roebling family who inherited the construction of the Brooklyn bridge, a rescue attempt by a professor Farquharson of a dog called Tubby while Galloping Gertie was pulling apart and how the London bridge piers were so obstructive that the river boats should "shoot the bridge" to pass under. (Gies, 1963; Steinman and Watson, 1957).

This paper will mention similar stories and people's interactions with bridges together with engineering features focusing on bridges of so called Asia Minor.

The first to mention is an 850BC dated bridge in Smyrna. It is registered in the Guinness World Records (2017) as "the oldest datable bridge in the world still in use". Even though it is hard to find justification other than all the bridge history books agreeing on it! It is called Caravan Bridge, having carried the caravans over the river Meles. The current bridge is a single 8.5m span made of stone. (Tyrell, 1911)

The setting of this bridge is famous as the birthplace of Homer, the semi-legendary author of epic poems the Iliad and the Odyssey. History, or fable, tells us that his mother Critheis named him Melesigenes because she bore him on the banks of the Meles. (Griffin, 1990)

This spot was the custom's gate of Smyrna and travelers would stop here for rest and enjoy the pretty scenery of the Meles. A traveler's description gives a good impression: "…one-arched bridge, and two or three large weeping willows hang over its margin. Under the shade of these trees the Turks collect in parties to smoke; and the Meadow of Caravan Bridge, for so the place is called: Mall of Smyrna" by Broughton (1810).

Another crossing with a story is the ancient Hellespont, known today as the Dardanelles. The Persian Emperor Xerxes had to cross this spot to march his army from Anatolia to the European side. He bridged the strait two times in 480BC. 5th century historian Herodotus describes these bridges in detail. Each time, they constructed two bridges, probably to accommodate the long length of the army. The first time, one bridge made using flax and the other with papyrus. After their collapse, they constructed the bridges a second time using flax and papyrus together for each bridge. They laid ships and triremes alongside each other and let down great anchors. They then secured them with cables from land, placed logs of wood and laid it with earth. Fences were put on either side so the horses would not be frightened. (Godley, 1920)

When the first bridges swept away in a storm and Xerxes heard of this, he commanded that the Hellespont to be whipped with 300 lashes and pair of fetters to be thrown into the sea, which then becomes a tradition. Many movie scenes have shown people who lost their families in rivers similarly lashing the rivers to show their anger.

Herodotus narrates another story from the year 546BC. When Croesus, King of Lydia, had a reason to fight with the Persian Emperor Cyrus, he sent emissaries to oracles to inquire whether he should send an army against the Persians. The judgement given to Croesus by each of the oracles was the same: if he should send an army against the Persians he would destroy a great empire.

Blinded with pride, he misinterpreted the message and started a war against the Persians but was then unexpectedly defeated by Cyrus. As a result Croesus lost his Empire.

When he questioned the oracles with blame, they responded to him by saying "…he ought, if he had wanted to plan well, to have sent and asked whether the god spoke of Croesus or of Cyrus' empire".

Herodotus describes the army's river crossing: "…when he came to the river Halys (Kızılırmak), he transported his army across it by the bridges…" He also mentions the common belief that Thales of Miletus, mathematician of the day, divided the river into two channels to cross. Thales supposedly started from a point upstream from the army camp, dug a deep semi-circular trench to the rear of the camp and passing it, thus the soldiers were transported over fordable streams. (Gilli, Yamaç, Tok 2014)

This spot is now home to one of the unique stone bridge of Anatolia, called Ceşnigir Bridge. It is not dated exactly but classified to be from the Seljuk period dated around 1100. The bridge was in very poor condition and was renovated during 2001. It has a very authentic appearance with many half circle openings randomly placed on the spandrel wall. Bedding itself onto rock, it follows a broken line for its route which is typical to bridges during this era. (Çulpan, 1975)

Figure 1 Ceşnigir Bridge over Halys River (Photo: Kantaratlas-2010)

The Romans and Seljuks left many remarkable structures to Anatolian lands. One of the significant Roman bridges is the Cendere bridge crossing over the Chabinas (Cendere) River in the south eastern region. This bridge was a gift from four cities for the honor of the Empire.

200 BC dated Cendere Bridge, has a span of 34m with 7.5m width but interestingly only 4.5m in clear passage between the parapets. Its appearance is dominated by the stepped parapets leading to the crown of the bridge. The parapets are detailed well to keep a pattern and to comply with the gradient of the bridge. Toward the end they are stopped with pedestals, one

of which is used for inscriptions. The bridge had 4 columns of 9-10m height at either side of its entrances. Each column was dedicated to a family member of Emperor Septimus Severus and held a statue of that person. The ones on the south side dedicated to Septimus and his wife Julia Domma, and the other two dedicated to their sons, Caracalla and Geta. (Çulpan, 1975)

Cendere Bridge tells us a classic story of a battle for the crown. The two sons of the Emperor, Geta and Caracalla were always in strong opposition to each other. Caracalla ended these arguments by murdering his brother. “Mortally wounded, Geta died, drenching his mother's breast with his blood”. Consequently Geta’s column was removed from the bridge and his name chiseled from the inscription in order to delete his memories from history.

Nowadays this amazing bridge is still intact with its nice yellow stone color and 3 remaining columns.

Figure 2 Cendere Bridge over Chabinas River (Photo: İnvestadıyaman 2017)

The next bridge was a lucky present for me. I was on the way to a bridge hunt and stopped in a village to get directions. A person called Mustafa offered to show me a local bridge which was a special one for him. First we saw a roman bridge called Çakırca which served for the ancient roadway to İznik (Nicea) and is currently cut off from the road network. Then we went to İnikli Bridge. Mustafa told me the story of a big flood in the region which he escaped from by parking their car on the bridge. (Kantaratlas, 2015).

The bridge is nearly sunk in vineyard nowadays. It belongs to a unique group of bridges with its alternating brick and stone arches and this feature continues for the entire width of each arch. This type of construction is typical of the Byzantium period dated from 500-600, with similar examples in the vicinity.

When I first saw the bridge, I thought that old amphoras had been recycled this way, but soon realized that this was the design. Five similar bridges are recorded in the vicinity where tile is used in construction.

Figure 3 İnikli Bridge in İznik (Photo: Kantaratlas-2005)

More importantly the bridge arch is segmental and one of the earliest examples of this type. A Segmental arch is one with the rise smaller than the radius of the semi-circle arch. Thus providing more space underneath the bridge. The openings in between the main arches are to reduce the weight and the amount of material.

A bridge with a similar character is the Beşköprü crossing over a formidable river, called the Sangarius (Sakarya). Beşköprü Bridge is one of the achievements of Emperor Justinian, who was famous for the construction of the Haghia Sophia. The bridge was part of another ambitious canal project to utilize the Sangarius for sea transport and also regulate its flood. There are numerous theories on the design purposes of the bridge and the mystery of its use. The facts are that the arches are segmental and have two rows; both can be regarded as features to this group of bridges. (Whitby, 1985)

Even though it is now well hidden in grass land over the old (perhaps artificial) basin of the Sangarius, it does not lessen in its magnificence owing to its dimensions and original architecture. There was a triumphal arch with a spiral staircase leading to the top at one entrance and another arch with half dome roof on the other end of the bridge. An ‘epigraph” is mentioned to have been placed on the triumphal arch. This epigraph was written for the rivalry of Justinian with the river by construction of the bridge. (Şahin, 1999)

Byzantium bridges had another distinctive feature as they had symbols of Christianity especially on the keystones. Karamağara Bridge is one of them and it is an early pointed arch application. Its arch is ornamented with an anecdote from their holy book. Letters on each voussoir read “God protect your coming and going all the times’. When the bridge came in danger of being sunk under the dam lake of the Euphrates, the arch voussoirs of the bridge were dismantled and carried to a Museum. (İlter, 1967)

During the 10th century, Anatolia was home to the Seljuks and then the Anatolian Beyliqs who settled at various locations. The Beyliqs settled for short durations and were nomadic by nature. Their bridges also had similar characteristics. They did not follow certain rules and were also often constructed with cranked plan, variable widths and spans, regularly resting on the ruins of older bridges.

Some of the Beyliqs already had their own techniques and cultures. One of these groups was the Artquids, a Turkmen dynasty that ruled in Eastern Anatolia. They left significant monuments and one is the engineering feat of the magnificent Malabadi Bridge, with a clear span of 38.60m. It was constructed between 1145 and 1154 to cross the Batman River which leads to the river Tigris. (İlter, 1978)

Figure 4 Malabadi Bridge - Year 1918 (Karabekir 2017)

The chambers on either side were incorporated mainly to reduce weight on the arch. Stairs provide access to these rooms via an entry structure of a person's height on either end of the bridge. These rooms are 4.5 x 5.3m each; they have been home to travelers, fishermen, singers and also engineers who constructed the nearby bridge in 1956. (Köpriyet, 2014).

This bridge has been a stop for many travelers. A famous one from Ottoman times called Evliya Çelebi showed his amazement by saying: "When it comes to describing this bridge; language is poor and the pen is broken!". (Dağlı and Kahraman, 2001)

Another traveler, Albert Gabriel, who visited the bridge in 1932, provides a good visual description that "the Haghia Sophia's largest dome of 33mm can be inserted under the bridge". (Gabriel, 1940)

On plan view, the bridge is not straight and this is referred to as a common method to slow attacks on the city for defense purposes. At the same time, arch thrust is set directly

perpendicular on rock formations giving greater stability. Cranked plan also provides larger area to resist and spread the flood waters.

There are stretchers on the spandrel walls at regular intervals which enhance the seismic behavior of the masonry structures, a feature especially important for the Anatolia region being an active seismic zone.

Nowadays, it is not possible to visit the bridge without a group of kids accompanying you all the time and telling the story of the bridge followed by a famous folk song. (Alagöz, 1975)

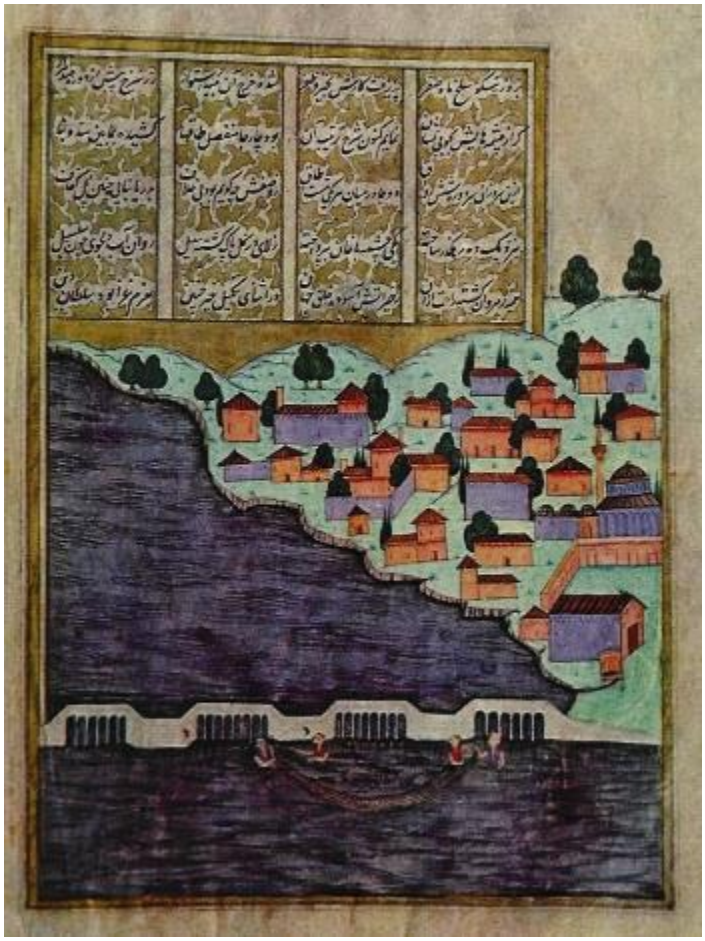
According to this song, the bridge has been connecting communities and especially two lovers. Malabadi has been the place where the story of a brave man started and ended. “He gave his heart to a girl from the opposite clan. They met on the bridge every day. Her father did not let them marry and killed them on the bridge. Guns boomed, the lovers went silent. Malabadi Bridge has been a grave to them ever since”.

There is a collection of bridges with unique characters and different features distributed all over Anatolia. This unification in bridge architecture can be observed during the time of the Ottoman Empire which was one of the Beyliq groups who ruled Anatolia for the next 500 years. Some remarkable achievements belong to Sinan, who was the Royal Chief Architect-Engineer during the reign of Sultan Suleiman. Two of these are Moglova Bridge and Büyükçekmece Bridge. (Bozkurt, 1952)

Figure 5 Moglova Aquaduct (Laurens 1847)

Eastern Culture does not traditionally credit individuals and accordingly one should stay humble and not in the picture. Sinan describes himself as “mûr-i nâtüvân” meaning “poor ant” and refuses to place his signature on mosques which he also believed belong to God.

Interestingly however he did place his signature on the inscription of Büyükçekmece Bridge. (Şenalp, 1988)



Büyükçekmece is a bridge in 4 parts each connecting on artificial islands which were also constructed as part of the bridge. This also provides leeway for excessive flood waters with least obstruction. It shows typical examples of Ottoman bridge architecture with inscription towers, balconies and bollards at the entrances. The spans are crossed with pointed arches and piers are surrounded by pointed or rounded cutwaters. (Kantaratlas, 2014)

Figure 6 Miniature with the Büyükçekmece Bridge from Sahnama Selim Han (1581) (İşmen 1972)

The Ottomans left outstanding monuments in the Balkans and a distinctive one is Drina Bridge also attributed to Sinan. Drina Bridge has been the starring character of a book called, "The Bridge on the Drina". This book narrates the stories and life around the bridge starting from the construction of the bridge in 1571 until its destruction in 1914. Ivo Andric won the Nobel Prize for literature for the epic force of his novel in 1961. (Edwards, 1959)

First published in 1945, the story of the whole nation and the region is explained through the life of the bridge and also the bridge itself is described as a character through its interaction with people's lives. An old tradition of human sacrifices to a River God, who was made angry by the construction of the bridge, starts the book. Water leakage from holes on spandrels is described as the milk of a mother whose baby has been sacrificed for the bridge. Then the bridge becomes a playground for kids who try to run away from the people hiding inside the bridge.

It also became a part of life as it welcomed settlers to have coffee and discuss the political and other issues of the day.

Then, Westerners conquer Sarajevo. The cultural and social differences of occident and orient are narrated in their treatment of the bridge. Oriental culture did not know how long the bridge was but they lived over the bridge, drinking coffee and discussing political issues. Occidents came and first they measured and surveyed the bridge, looked after it, assigned soldiers at the

entrances but never did they sit over the balconies. The book ends with the death of one of the main characters, Hafiz Pasha which correlates with the collapse of the Bridge.

The fall of the Ottoman Empire can also be marked with a bridge over the Maritsa (Meriç), in Edirne. Meriç bridge construction took over 10 years and the Sultan struggled to finance the project. (Çulpan, 1975)

Figure 7 Meriç Bridge over Maritsa (http://www.kulturportali.gov.tr/medya/fotograf/fotodetay/12684)

During its decline, the Ottoman Empire had many projects carried out by foreign companies with special contracts, called "imtiyaz" meaning 'privileges'. One famous one was the 1912 Galata Bridge. It was designed by the German Firm, MAN, manufactured in Nurnberg and transported to Constantinople. It was a pontoon bridge with the swing part opened by rotating around the pin point by the pull of a ship. This bridge survived 33 years with some parts gone missing, the rest sunken and departed to a resting place in the Golden Horn. (Özyüksel, 2014)

The history of the Golden Horn and its bridges is a book of its own with main character being the 1912 Galata Bridge. (Evren, 1994)

Besides being a home to locals, visitors and fishermen, it has been a stage for important scenes from movies, played vital roles in national events like being a host to the funeral of Ataturk. It was decorated with an arch during the visit of foreign politicians and used as a character in criticizing politics. This inhabited bridge caught fire in one of its shops in the year 1992 while the current Galata Bridge was under construction.

A famous poem about the 1912 Galata Bridge was written by Orhan Veli, who was a forerunner of modern Turkish poetry.

"Standing on the bridge, I enjoy watching you all. Some of you will get mussels from pontoons, some of you a boat, broke the sycamore to go under the bridge ... All of you are on duty for life. Is it only me having pleasure? Who knows one day, I will say a poem, perhaps about you; I will get some money and put some food in my tummy!"

Indeed, the most important bridge over the Golden Horn was a humble bridge which has survived countless misfortunate events. It is a still surviving pontoon bridge being a rare example of its type. Gaston Pigeaud was contracted for the design. When the design he sent from France did not arrive in Constantinople, this was in the news with a heading "wanted". This concerned the authorities who thought the design might be stolen by other firms. He had

to send the design again. Soon after the opening of the bridge, a storm moved the pavement tiles and the bridge had a "hump back in its very young age". (Cumhuriyet, 1930; 1937)

This new bridge was very important because its name given "Gazi" meaning 'veteran' in honor of the nation's leader, Ataturk. This lead the bridge design to face intense scrutiny and it led to endless debates about whether the bridge should have oriental features to reflect the nation origins or should have a modern appearance to emphasize the new republic. These debates nearly created a revolt between local Authorities during discussions in 1938. Having so much attention and emphasis, in the end a bridge with no pleasing looks and no dignity was the result. (Örmecioğlu, 2010)

Year 1923, the foundation of the republic has opened a new era for everything including bridge building and their meaning in people's lives. The independence struggle of Anatolia has been won against invaders and also ended the Sultanate. Nation and its people were the Ruler! Engineers have given full dedication and respect to their work. They were highly motivated, fresh and believed in. This also created a style for engineers; they were wearing fedoras and were proud of their work.

Their surnames, picked up by themselves after the "Surname law", and were an indication of their involvement with work. Some examples were: Bridgebuilder, Whitestone, Ironwork and Concretemason. Bridge names were also chosen with great care and opening ceremonies were like a public party or at least a very crowded formal ceremony.

I call bridges of this era as "Köpriyet", a name derived from Köprü (bridge) and Cumhuriyet (Republic).

The Turkish Republic inherited a diverse culture and knowledge from the Ottomans however the countryside had either been left to its own destiny for years or war had destroyed everything behind it. There was no road network, no material and not many engineers. Moreover with the adoption of a new latin alphabet, new engineers had to learn their profession with new letters.

The first bridge of this era, constructed in 1928 was a stone bridge most probably cladded with concrete for its appearance. Iron was not available, even then the road network did not exist to bring material to site. It was a single span bridge crossing over Garzan river in Siirt. (Haykır, 2011)

Many and varied bridges were designed and constructed. Most of them were "for the first time bridges of their type". Concrete arches, Tied-Arches (Bowstring), Bridges with hinges (Gerber) and a few steel bridges were among the types applied. (Nafia, 1933)

Kömürhan Bridge with a 108m span was a real achievement of its time, designed by a Swedish group Nydqvist & Holm AB (NOHAB) and constructed by local firms. Bridge name was determined by a parliament decision and the opening ceremony in 1932 made with a huge celebration. (Nohab, 1937)

Figure 8 Timber preparation for a Bridge near İzmir (Smyrna) Year 1937 (KGM 1970)

This bridge was considered to be a victory and gave hope to people, as it crossed over one of the most formidable rivers, the Euphrates (Fırat). Unfortunately today it is sunken in a Dam Lake.

Railway bridges had a similar history with an elapsed timeline. They needed more technology which was not available locally and also some lines were already given to foreign companies with inherited contracts from Ottoman times.

In fact, it was railway projects and experience established during the execution of them as foreign companies employed local subcontractor's work forces that improved the engineering practices in the republic. An important example is the Hejaz railway line project to connect the rail line from Constantinople to the Sacred Lands in the Arabian Peninsula. It was completed in 1908 and had many engineering challenges due to harsh climates, local conditions and geography. (Özyüksel, 2014)

One of these railway bridges, called Boraltan Bridge was used in a movie. The movie called "When the sun will rise?" is based on the real story of Caucasian immigrant refugees evacuated from Europe and destined be delivered to the Soviet authorities towards the end of the Second World War in 1945. Their pleas for permission to settle in Turkey were ignored even though they were definitely doomed to be executed by Stalin's regime on their return. They crossed the bridge for their execution. This event is known with the name "Boraltan Bridge". (Kılıç, 1977)

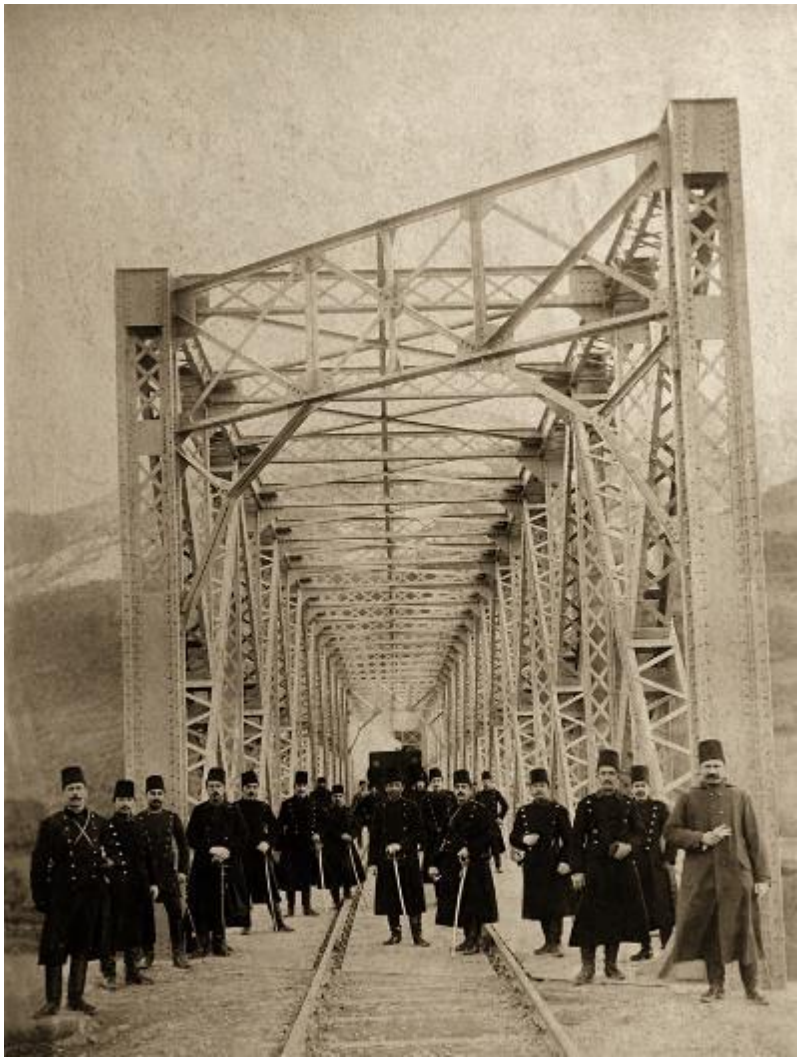


Figure 9 Military School students in front of Railway Bridge, 1891

(courtesy of Engin Özendes Collection)

The actual bridge is not known to me but probably dated to 1930's and exists in this poem:

"Boraltan is a bridge, passes over Aras – Even if you clean it with Aras water, can't get rid of the black color of your face.."

This movie was filmed in 1977 and was banned from screening in cinemas. Eventually permission was given but one of these showings was the ignition of the Maras Terror which led to the 1980 Military Occupation in Turkey.

Modern day stories about bridges are not as romantic as the old times. The famous River Euphrates had laments written for people who lost their lives in the river. Birecik Bridge with concrete arch spans crossed Euphrates River. Ground conditions were so poor, the main 57m span had 4 hinges, also called Gerber system. This bridge ended the ferry traffic and long delays. Consequently, during the construction of the bridge, an Engineer has been killed by ferry owner in 1953. Engineer Kadri Cile has been buried at the entrance of the bridge, so his grave said to be an eternal guard for the bridge. (Cumhuriyet, 1971; Lok 2004)

Another story of an engineer to cross the same river comes as a movie titled simply "Bridge". There is no information if film is based on a true story or not but the issues are definitely real.

This movie, dated 1975, narrates the life of a boy who lost his mother, who was carried to hospital by boat on the river. He dedicated his life to being an Engineer and building a bridge over Euphrates. After returning back to his village as an engineer, he started to construct a bridge. This was not welcomed by his stepbrother who earned his living with a ferry transfer over the river. The last scene was a critical argument and the bridge was about to be blown up since the ferry owner had placed dynamite. The ferry owner claimed the bridge as an enemy as it ruined his business and did not show respect for the traditional transportation which had worked fine for many years. Engineer replied saying: it will serve people better and even save their lives. Then he sat down in the middle of the bridge awaiting his death and all the people joined him. The ferry owner had to remove the dynamite from the bridge. (Gören, 1975)

This movie "Bridge" was to be entered in an international film festival in Karlovy Vary, Czech Republic in 1976. But instead, a movie with the title "Bride" was sent by mistake. *The Bride*, was the story of a family who migrate to Istanbul and their struggle for survival. Bride did not win a prize. The movie "Bridge "was sent to the Tehran film festival instead. (Akad, 1973: Cumhuriyet, 1975)

In Turkey brides have further connections with bridges, there is a tradition that a bride and her entourage should cross a bridge, stand in the middle and throw an apple into the water. This tradition still survives in many places and one famous one is the Cetinkaya Bridge, in Bafra. Cetinkaya Bridge crosses over the Halys River where it reaches to the Black Sea. It is now a Köpriyet bridge dated 1937, 300m long with 6 spans with a tied-arch over the carriageway.

A well known folk song, Köprüden Geçti Gelin, 1937, narrates the story of the bride who was crossing the original wooden bridge at this location. The horse was suddenly frightened by a flying eagle, who had snatched the hairband of the bride and got the other horses worked up as well, so they drove in the river and the bride and her entourage lost their lives.

This folk song has been used in many movies, including one filmed around a Seljuk bridge near Aspendos. It starts, "Bride crossed over the bridge, hairband has fallen; you have passed me bride, but I cannot give up on you "Serik Bridge is constructed over the remains of a Roman Bridge and also uses remnant materials from an aqueduct. (Kessener and Piras 1998; Onal, 1969)

The end of the Köpriyet era can be considered to be the Bosporus Bridge opened in 1973. It was also a project with a long history. Many proposals were made for example; Carl von Ruppert (1867) as an innovative new design for bridge, Ferdinand Arnodin as a transporter bridge (1900) and Ulrich Finsterwalder (1958) as a Catenary-cantilever Bridge. The suspension type was selected but it took a long time to secure the contract for the bridge. (İlter, 1988; The Engineer, 1876; Walther, 1968)

Figure 10 Serik Bridge over the Eurymedon River (Photo: Kantaratlas-2006)

The Bosporus Bridge used an innovation of new aerodynamic steel box section, which was a brave decision when steel truss was nearly becoming a universal typical application. Another new design feature was the inclined hangers, which at later life of the bridge were discovered to create issues. Testing of this bridge can be considered as a social experiment. Truck drivers were waiting for the long ferry que when the announcement came of the opening of the bridge on the night of 15.10.1973 and they were let on to use the bridge. The trucks were then kept on the bridge for 1.5hours for each loading condition. (Brown, W.C., Parsons, M.F. and Knox, H.S.G., 1975 ; Tezcan, 2004)

Bosporus Bridge faced many protests ranging from people living at the bridge approaches to university students. A Theater group was founded by students to start revolution against imperialism. They acted their play on the streets. The play about the bridge was narrating the story of a village boy who lost his life in a river and his story is connected to Bosporus Bridge. Decoration was simple a blue scarf was the river and a white sheet was used to resemble the sea. (Üzümkesici, 2016)

Another protest by a group of young people called “Devrimci”, meaning ‘revolutionist’, started a campaign to construct a bridge over Zap River at the eastern border of the country. Their statement was “Equal wealth and fair distribution of services across the nation”. This campaign was mainly driven by a movie called “Oksüz/Orphan” and poem called “Anayaso/Constitution”. The campaign was very successful and supported by private companies, universities and local people. The same theatre group set up a play to raise money and special rosettes were sold for funding of the bridge. (Belli, 1968; Olgaç, 1968)

Nearly all material for the subsequent Zap river bridge was provided from the private sector, cables were used from an old bridge carrying pipeline. Groups of volunteer students who travelled from Istanbul camped at the bridge site. The project was guided by a University Teacher and they constructed the bridge themselves. Memories of this are still alive among local people. The bridge is called “Revolution Bridge” and also named for Deniz Gezmis who

was the student leader of the revolutionist movement. He has actually never been to the bridge site and even opposed this naming finding is “populist”. However his name was a symbol of this movement and he was assassinated by the government together with 2 friends in 1970. (Kabadayı, 2007)

In 1999, this bridge was blown up and remained with its towers as opposing statues waiting to be connected again. The story of the bridge was filmed as a documentary with the name “A Bridge at the Edge of the World” in 2007. This Documentary led to another campaign for the bridge. A concert called “Bridge to Peace” raised enough money to reconstruct the bridge again. Finally the bridge was opened again in 2010 by 200 students who came from towns all over Turkey.

Bridge stories in Turkey will never end. “Deli Dumrul” is a mythical character from the epic stories of Oghuz Turks. He had a bridge built across a dry river bed. He collected 33 akchas from anyone who passed over it, he beat and charged 40 akchas anyway even people who didn’t use the bridge. He did this to challenge anyone who thought he was braver than Deli Dumrul. (Ergin, 1997).

This folk story was recalled by many when an explanation was made by officials: “Everybody, even those who do not cross the bridge, has to pay for the bridge as it is credited with a minimum use guarantee” during the opening ceremony of a 3rd Bosporus suspension bridge. (Oneido, 2017)
So as the stories will never end, so the bridges will always witness, serve and carry meaning.

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New Bridges for New Japan

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New Bridges for New Japan

Introduction

Two years ago, in 2015, some 23 sites in Japan were approved by UNESCO for world heritage status in connection with their contribution to the rapid industrialization of Japan. The sites included coal mines, reverberatory furnaces, shipbuilding docks, steel works, and even a giant crane, but no bridges. I do have a candidate for such status: the Rokugo Bridge. This is Japan's first major modern bridge. It was built across the Tama River that flows into Tokyo Bay between Tokyo and Yokohama; it was built as part of the construction of Japan's first modern highway linking these two great cities. (Steele, 2016a). All that is left of this history-making bridge is the Northern Entrance Gate preserved in a small park close to its original location. (Figure 1) The bridge, completed in 1926, was made possible by the introduction of new technology and new building materials into Japan in the early twentieth century. The paper also introduces the unsung hero of modern bridge-building in Japan, Masuda Jun (1883-1947). He oversaw the design and construction of the ferro-concrete Rokugō Bridge that allowed for the first time easy access for a growing volume of truck, automobile, bicycle, rickshaw, horse and pedestrian traffic into and out of one of the world's largest cities.

Figure 1: The Northern Entrance Gate to the Rokugo Bridge, with the replacement bridge, built in 1984, in the background.
(Author's photograph)

An Unbridgable River

One of the first Western language accounts of the Tama River is by Engelbert Kaemper who ferried across the "gentle, deep river" in 1691 on his way to Edo (Kaempfer, 1999: 348). If he had traveled a few years earlier, he could have walked across a bridge. The original Rokugo Bridge was built in 1600 soon after Tokugawa Ieyasu set up his headquarters in Edo. It was part of the Tokaidō Highway that linked Osaka and Kyoto with Edo, but the 218 meter wooden bridge suffered repeated damage by floodwaters. In 1688, the government declared the river unbridgeable, and for the next two hundred years ferries carried all traffic across the river; there were 27 crossings, but the Tokaidō

Crossing at Rokugō was the busiest.

Bridging the Tama

Even in 1868, when the young Meiji emperor proceeded to take up residence in the new "eastern capital" (Tokyo), a special platoon bridge was devised to allow him to be carried across the Tama. The river continued to hinder overland transport in and out of Tokyo, especially between the international port in Yokohama and the nation's politic and economy center. Indeed, one of the first industrial endeavors of the new government was to link the two cities by rail. A British engineer, Edmund Morel, oversaw the construction of a wooden railroad bridge across the Tama near the Rokugō Crossing as part of Japan's first railroad, 29 km of track between Shinbashi (in Tokyo) and Yokohama. Construction of the 624 meter bridge was completed at the end of 1871, well in time for the opening of the new railroad on 14 October 1872. The bridge used stone abutments and was constructed with native timber by Japanese carpenters under Morel's supervision. Tracks were laid across board planks.

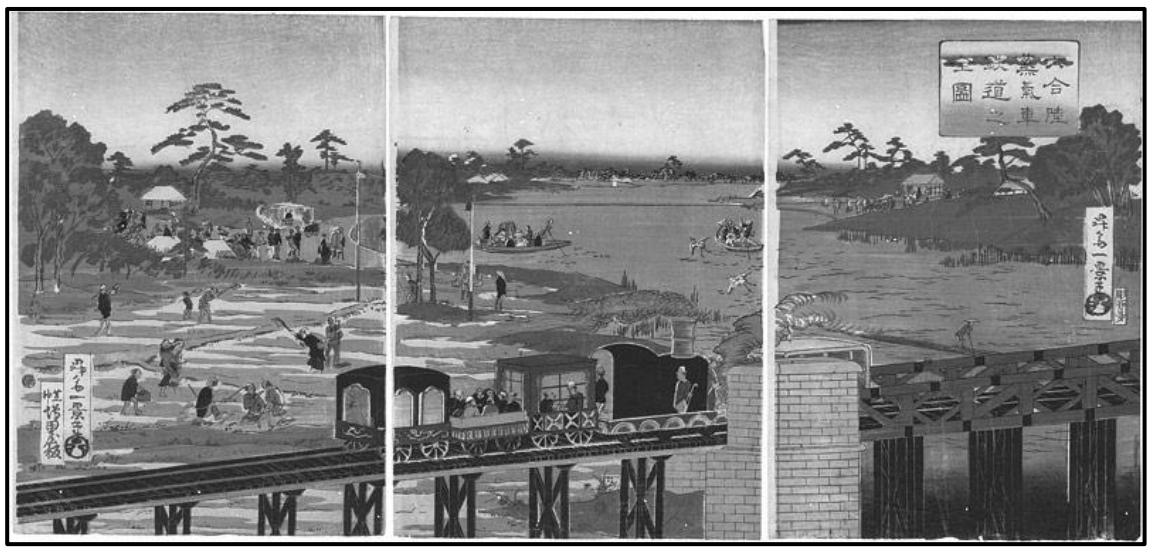

Figure 2: The Rokugō Railroad Bridge with the Rokugō Ferry Crossing upstream, ShōsaiIkei, Rokugō riku jōkisha tetsudō no zenzu, 1871. (Author's Collection)

The railroad bridge became an immediate showcase for Japan's modernity. (Figure 2) Nonetheless, the bridge was condemned in 1875, after only three years service. Richard Vicars Boyle, who succeeded Morel as Engineer-in-Chief of the Japanese Railways, ordered the renewal of all bridges and culverts with iron superstructures and permanent foundations and piers. (Boyle, 1882) Boyle's new Rokugō River Bridge went into service in November 1877. This time no compromises were made. All ironwork was imported from England and the alignment and brick and cement work connected with the piers was carefully done in order to strengthen the bridge against flooding. According to the October 6, 1877 issue of the Japan Weekly Mail: "When this new bridge is completed, it will be the longest in Japan, and in strength and general permanence of structure, may be almost termed everlasting, in which respect, it is unsurpassed by any bridge of its class in the world." (Japan Weekly Mail, 1877)

Nonetheless, pedestrian, rickshaw, and cart traffic continued to use regular ferry services across the Tama. A series of wooden bridges were attempted, but none survived the periodic floods—which had increased in frequency after the Meiji Restoration. The Great Flood of 1910, for example, killed 1231 persons nationwide and resulted in the loss of some 518,000 houses. Needless to say, the wooden bridge was destroyed, and the river remained un-bridged until 1926.

Bridges and Roads

The establishment of Japan's Road Improvement Association in March 1919 brought businessmen and politicians together in a "good roads movement" similar to the group that helped bring about the Federal Aid Road Act of 1916 in the United States. Road builder Samuel Hill, visiting Japan in January 1919, added his weight to the movement. In an essay published in March 1919, he professed himself shocked to learn that "There is not one mile of hard-surfaced road in the Empire." He went on to say that the poor condition of Japan's roads gave foreign visitors the impression of disorderliness and sordidness. "The roads are dirt, and the frequent rains make them continually muddy. So that this mud may not become too deep small stones are strewn over the surface, which make walking especially disagreeable. There are no sidewalks anywhere. It is impossible to motor any distance with comfort, for there is always the possibility that one's trip may not be continued by reason of the lack of bridges over the various streams and creeks. What bridges there are, are too narrow for the gauge of a modern motor car. There are no graded roads." He found it baffling that Japan, which has shown itself among the foremost in everything that pertains to progress, should nonetheless be "the most backward in highway building." A good roads movement, he maintained, would contribute greatly to Japan's prosperity. (Salomon, 1919)

As if in response to this message, on April 10, 1919, the national government enacted a much-needed Road Law. The new law gave the central government authority to build new roads and bridges and repair (or improve) existing ones. (Yamamoto, 1993) The Home Ministry, envisioning Japan in the year 1950, issued a 30 year plan involving the paving of prefectural and national roads, the construction of new highways designed specifically for automobile traffic, the construction of permanent bridges, river embankments, dykes, and dams. It floated a loan to raise 282.8 million yen to help pay for these massive public works projects. It is at this point that rivers, roads, and bridges combine in the making of modern Japan.

In 1920 there were only 7,912 cars and trucks in the entire country of which 2,695 were in Tokyo; in the United States the number was already 9.2 million. While numbers were small, the environmental and economic consequences of this emerging car culture were great, serving to initiate an "age of construction" in the years before the 1923 Great Kanto Earthquake. Gravel, asphalt and concrete were in sudden demand for a surge in civil engineering projects, including highways and bridges.

The construction of the 26.8 km Keihin Highway (National Highway 1; now National Highway 15) between Tokyo and Yokohama with the Rokugō Bridge across the Tama River as its centerpiece provided a model for Japan's future national road system.

In some sections, the new highway followed the old Tokaidō post road but for the most part entirely new roads were constructed. Equipment imported from the United States and England included a variety of 8, 10, 12, and 15 ton rollers, graders, rock crushers, asphalt plants, concrete plants, asphalt pavers, dump trucks, cranes, and pumps and gasoline-powered electric generators. (Tanaka, Y. 1927) The asphalt came from the Akita oil fields and gravel from Tama River pits. Cement was available from the giant Asano Cement Company and other domestic producers. The width of the two-lane road varied between 18 and 27 meters, allowing cars and larger trucks to pass safely; pull over areas were also created to improve safety. Careful attention was paid to gradient and camber, allowing rainwater to run off into covered culverts. Trees and other vegetation were planted on both sides of the road in the interests of beautification; attempts were even made to reduce the number of telegraph poles along the route. (Figure 3)

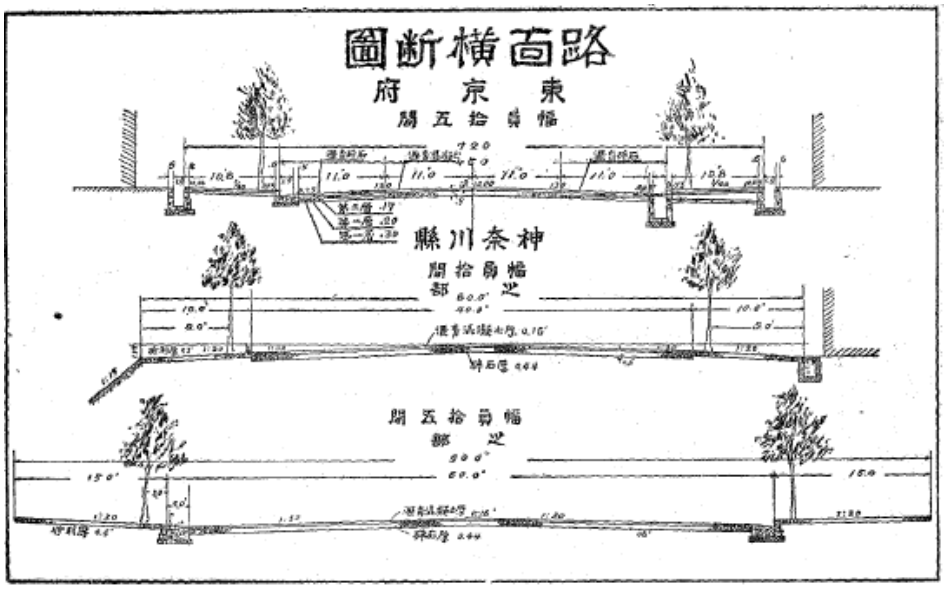

Figure 3: Cross-section of the new paved road; note calculations for grade and camber and trees on both sides. (Tanaka Y. 1927)

The Rokugō Bridge was literally central to the project, at mid-point between the Tokyo and Kanagawa sections of the 27 km highway. Design of the new bridge was entrusted to Masuda Jun, a civil engineer who became Japan's master bridge builder in the 1920s and 1930s. Born in 1883, he graduated from the Faculty of Engineering of Tokyo Imperial University in 1907. (Fukui, 2004) University connections with John Alexander Low Waddell, a American bridge architect with teaching experience at the University of Tokyo in the 1880s and later author of major textbooks on bridge engineering, allowed him to take up a position in Hendrick and Conchrame (Consulting Engineers) in Kansas City, Missouri. Masuda worked under Ira G. Hendrick for 15 years before returning to Japan in 1922 and setting up his own firm in Gotanda.

The Rokugō Bridge was one of Masuda's first Japan bridges; he drew up a meticulous

set of plans that were submitted in December 1922. (Masuda, 2002) The bridge design called for a 135.3 meter tied arch span bridge (each span 67.655 m) over the actual river channel on the Kanagawa side and a 310.9 m girder bridge supported by 17 piers over the floodplain on the Tokyo side. The roadbed was 16.4 m wide and consisted of reinforced concrete paved with asphalt, thus insuring ample space for motorized traffic, including large trucks. (Tanaka K. 1926) Work was interrupted by the Great Kantō Earthquake in 1923 and flooding from typhoons that hit the Kantō area weeks after the earthquake, but construction proceeded smoothly thereafter, reaching completion in June 1925. (Figure 4) The total cost was reported at 3.5 million yen.

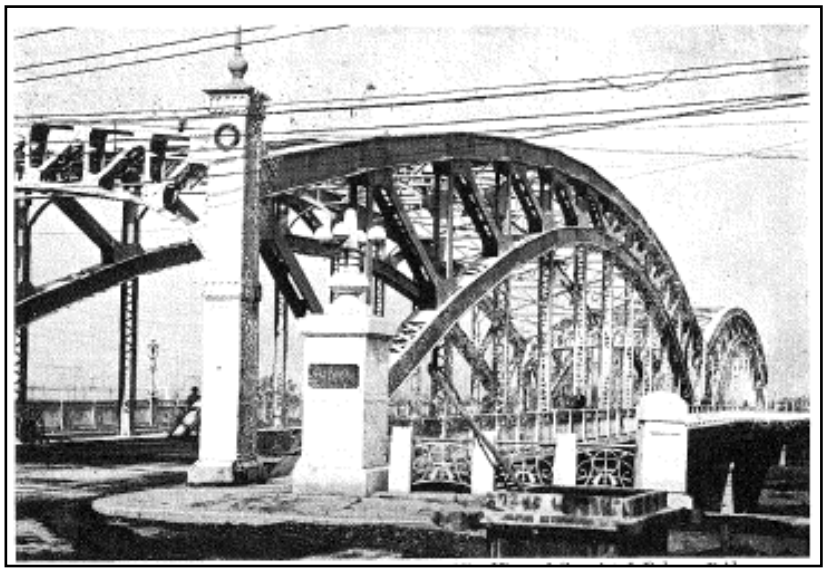

Figure 4: View of completed Rokugō Bridge.
(Courtesy Civil Engineering Library, Tokyo).

Great celebrations including religions ceremonies, speeches, and fireworks were held on the bridge to open it and the Kanagawa section of the new highway to traffic on August 3, 1925. Tokyo Governor Usami praised the new Rokugō Bridge: “now it has been given the status it deserves as the gateway to the metropolis and the most important bridge in the empire.” Kanagawa Governor Kiyono attributed even a greater future for the bridge. He began by recognizing the long history of the Rokugō Crossing, but recognized that the ferry and the wooden bridge were no longer suitable to the transportation needs of the new age. “Thanks to the beneficence of the government, we are blessed with a new bridge and a new highway without peer in Asia.” (Commemoration Ceremony, 1925)

Military Priorities

The Rokugo Bridge initiated a golden age in the construction of modern ferro-concrete bridges in Japan. Masuda Jun was responsible for over 50 such bridges during the ten years between 1922 and 1932, including iconic bridges still in use such as the Jūsō Bridge over the Yodo River, the Yoshino River Bridge in Tokushima, the Muko River Bridge in Hyōgo, the Ise Ōhashi Bridge over the Nagara River and the Shirahige Bridge over the Sumida River in downtown Tokyo. He also built bridges for the empire, in Taiwan, Korea and Manchuria.

The Rokugō Bridge was built to withstand the ravages of the Tama River. It remained in service until 1984 when it was replaced by a new bridge so seamless with other sections of that highway that drivers were hardly aware of crossing over a river once deemed unbridgeable. (Figure 5)

Figure 5: The Rokugō "Bridge" Today
(Author's photograph)

In the 1930s the number of automobiles continued to grow but road and bridge construction failed to keep pace. The next bridge-building boom in Japan proper had to wait until after the Second World War—from the 1950s. In the 1930s, Japanese bridge engineers found their talent employed instead in the task of "constructing East Asia" (Tō-A kensetsu). During the depression years of the 1930s, the United States devoted more than one-third of all work-for-relief jobs to road and highway and bridge projects. In Japan, however the government turned to massive military-related spending as means to stimulate the economy. (Steele, 2016b)

One such initiative undertaken involved the construction of new lines of super-express trains (shinkansen, known popularly as dangan ressha or bullet trains) that would link Tokyo with Shimonoseki, and from then by undersea tunnel to Korea and Manchuria and other parts of Asia and South-east Asia, and a parallel project to build a "bullet highway" (dangan dōro)—the Great East Asian Highway. (Kushner, 2006: 46) Both plans were conceived as monumental projects to commemorate the 2,600th year of imperial rule in 1940. (Tagawa, 1940)

The Great East Asian Highway, modeled on Hitler's autobahn, would serve to bring together the members of the Great East Asia Co-Prosperity Sphere; but it would also establish land links between Japan, Asia, and through Russia to Europe. (Takabe, 1992: 135-39) It was an early ancestor of China's recent "belt and road" imitative with designs to link East and West.

Needless to say, while these projects excited people's imagination, the worsening war situation meant that much remained on paper. Nonetheless, some work was begun on a new limited-access highway linking Tokyo with Kobe, laying the foundations of Japan's postwar highway network and bridge and tunnel links between the islands that make up Japan. For example, The Kanmon tunnel, a 3.5 km link between the islands of Honshu and Kyushu (between Shimonoseki and Kita Kiyushu), was completed in 1942; at that time the world's longest undersea tunnel. (Figure 6)

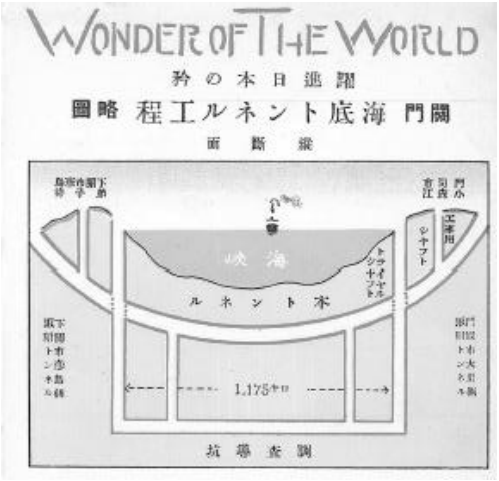

Figure 6: The Kanmon Tunnel, "Wonder of the Word"
(Postcard, author's collection)

Figure 7: The Iron Bridge Over the Yalu River
(Postcard, author's collection)

Another major wartime project was the Yalu River Bridge, on the border between China and Korea and known now as the Sino-Korean Friendship Bridge, but built originally for rail and automobile traffic as part of plans to erase barriers dividing the Great East Asian Co-prosperity Sphere. Construction was begun in 1937 and completed in 1943. (slide) A swing bridge, it combined rail, automobile, and pedestrian traffic across the Yalu. (Figure 7)

Conclusion

The 1926 Rokugo Bridge was just the beginning. Japan is now a country with extraordinary number of bridges; there are over 153,000 bridges (over 15m) as part of the national road network. All major islands are linked by bridges or undersea tunnels. Massive highway, rail and bridge building projects helped to kickstart the postwar Japanese economy. (slide) The technology and vision that fueled these projects had its origins in the 1920s and 1930s. The forlorn and forgotten Rokugo Bridge gate needs better press. Here is an important industrial heritage site that marks a new age of mobility and free flow of goods and people in and out of the world's largest city.

But, as with all historical markers, other stories can be told. I imagine that many of us here at Ironbridge are impressed with the recent Chinese "belt and road" initiative—a multi-billion dollar infrastructure project to build a twenty-first century "silk road," linking some 65 countries—a bridge stretching all the way from Asia across Europe and Africa to the Americas. According to Chinese President Xi Jinping, this mammoth project will presage a new era of globalization and prosperity. This sounds wonderful, but I am immediately reminded that the new technology involved in the construction of the Rokugo Bridge and Japan's first national highway in the 1920s, also allowed Japanese engineers in to pursue their own "belt and road initiative," the Great East Asian Highway, with similar visions of co-prosperity intertwined with the politics of hegemony. I also recall that just seven years ago Japanese and Korean researchers announced plans for the construction of a 209 km undersea rail and automobile highway tunnel between the two countries. Prime Minister Hatoyama supported the mammoth project hoping it would serve as infrastructure for the creation of an East Asian Community similar to the EU, but critics in Korea and China criticized the tunnel as a neo-colonial project seeking to expand Japanese economic and political influence on the Asian Continent. The project stalled and I rather suspect China's "belt and road" initiative will run into similar political and economic realities. Nonetheless, as bridge lovers, and as idealists, let's hope for the best: the as-yet unrealized quest for a world without borders—a bridge to a true co-prosperity sphere.

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Historical narration in the urban context.
Display of an ancient useless bridge as an open-air museum in Sicily.

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Abstract

Built during the first half of the 12th century, at the behest of the Norman king Roger II's grand admiral, George of Antiochia, the so-called Admiral's Bridge in Palermo (Sicily) testifies to the considerable professional skills of the Arab and Norman engineers, who could also draw on Byzantine experience in bridge-building. Moreover, Admiral's Bridge is a place of great historic interest because close to it took place an important battle between the men of Giuseppe Garibaldi and the Bourbon soldiers during the Italian Risorgimento war. The former won and succeeded in freeing Sicily and south Italy from Bourbon domain. That crucial moment of the Sicilian and Italian history is remembered by the name of the street where the Admiral's Bridge is, therefore called "Corso dei Mille" (Avenue of the Thousand) to honour Garibaldi's soldiers. In 1931 a frightening flood covered Palermo and river Oreto overflowed its banks, but Admiral's Bridge, almost 1000 years old, resisted without any damage and nowadays it represents an absolutely unusual structure, of great historic interest and symbol of a lost past. The bridge has still its original appearance but under it there is nothing to be crossed: in the past the reality was different because it two opposite sides of the river Oreto but later, the river of Palermo has changed its course, making the bridge useless. Admiral's Bridge is one of the oldest surviving post-Roman era arch bridges in Europe and now it is restored and surrounded by a new park, but also being surrounded by traffic-busy Sicilian roads, cut off from its original purpose, and outside the main tourist area. The Admiral's Bridge deserves more touristic interest as an unusual historical object placed into the urban context as an open-air artefact museum even if it is referred to an ancient and useless bridge.

Introduction

Located on the northern coast of the Italian island of Sicily, Arab-Norman Palermo and the Cathedral Churches of Cefalú and Monreale (De Seta et al. 2002) is a group of several buildings with a religious but also a civil purpose (Paolini 1974) referred to the Norman kingdom of Sicily - about 1130-1194 (Chalandon 1960; Mack Smith & Biocca Marghieri 2009; Renda 2003) as different palaces, churches and also a cathedral (Maurici 2016; Maurici et al. 2015). In this list, we can consider also a bridge, all in Palermo as the capital city of the Arab-Norman kingdom (Bajamonte & Campione 2015; Bellafiore 1990). Two more cathedrals are in Monreale and Cefalù towns (De Seta 2009) close to Palermo. This inhomogeneous architectural complex represents a historical attestation of the ethnic syncretism between ancient and medieval Western and Eastern worlds: Christian-Islamic religious interconnections, Norman-Arab cultural backgrounds, Byzantine-Moresque historical events (Causale 2012). This social, historical and cultural syncretism created a new artistic language which took place in all the Euro-Mediterranean area (De Simone 2000). The monuments included in this special list are the followings: the Royal Palace and Palatine Chapel (Tronzo 1997); Zisa Palace; Palermo Cathedral; Monreale Cathedral; Cefalù Cathedral; Church of San Giovanni Degli Eremiti; Church of Santa Maria dell'Ammiraglio; Church of San Cataldo; and Admiral's Bridge. Each of them shows the meaning of the Norman Kingdom of Sicily during the 12th century (Chirco 2015). The innovative re-elaboration of architectural forms, structures, and materials as well the artistic, decorative, and iconographic treatments – most conspicuously the rich and extensive tesserae mosaics (Cilento 2009), pavements in opus sectile, marquetry, sculptural elements, paintings, and fittings celebrate the fruitful coexistence of people having different ethnic origins.

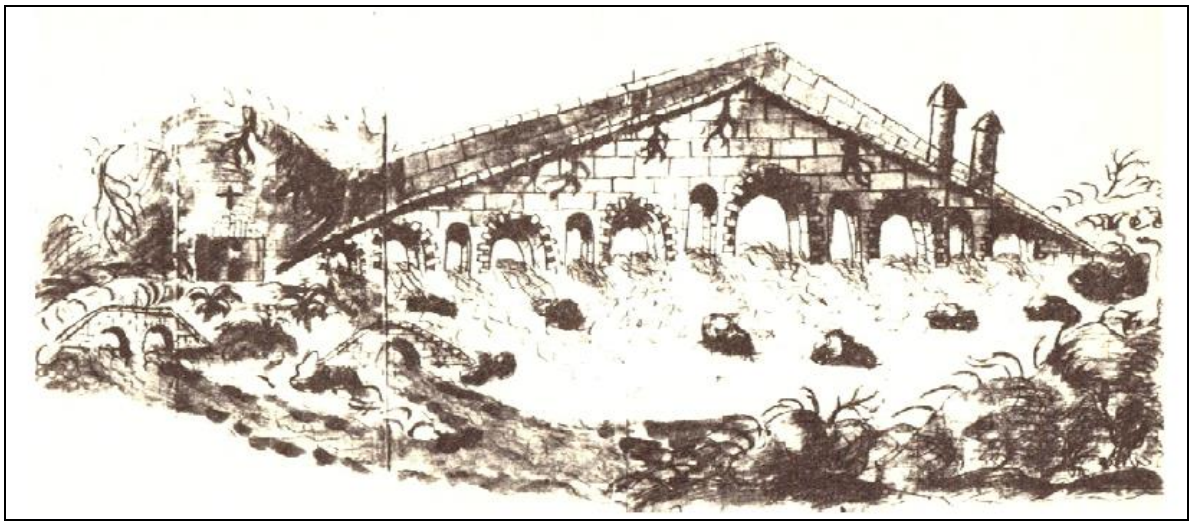
Palermo: now-a-day view of the Admiral's Bridge.

The Admiral's Bridge

The Admiral's Bridge is located in the Scaffa Square, near to the Oreto River. It is a bridge which is characterized by a simple and essential structure, with twelve six-pointed arches (seven double degrading ring halves, alternating with five minors embedded in the pylons, to lighten the water pressure), made using large limestone blocks well- carved. The use of the distinctive boulders allowed the bridge to withstand very high loads; it has minor arches between the shoulders of the large ones to lighten the structure. The bridge is donkey-back shaped, under its currently undercut arches they crossed the Oreto River and it was diverted in 1938. The bridge's deck has a cobblestone pavement that was built in the twentieth century, and it was built during 1131 by George of Antioch, Admiral of the Norman King Roger the Second of Altavilla, aiming to connect the city to the gardens beyond the river Oreto. It was the first monumental stone built to cross the Oreto River. According to a legend, the bridge rises to the place where Archangel Michael appeared to King Roger, helping him to conquer the Arab city. In that place was built the church of Saint Michael, then demolished, which was originally suffragan the Palatine Chapel built by King Roger in the Royal Palace. Very meaningful is the dedication to Saint Michael both in relation to the mentioned legend and relating to the role of the Holy Weighting of souls who must be kept in the Lamb.
In ancient time, the area was crossed by Via Valeria, the Roman military road built by the Consul Marco Valerio Levino in 202 BC; it led from Messina to Lilibeo (Marsala) and, to reach Palermo, it had to cross the Oreto River in a place we do not know. Access to urban walls, however, probably took place along the course of the "Corso dei Mille" Avenue, a region best suited for crossing the Oreto River because rather flat and intermediate between a

riverbed bordered by upstream (west) and a heavily swampy territory in the direction of the mouth. This is the place where the Admiral's Bridge was built (Fatta 2015: 2). While considering the need for a very long bridge, able to overcome a fenny bed from the variable course over the years, for monumental design and executive perfection, this artefact can hardly be qualified as a simple functional infrastructure. In fact, it emphasizes the entrance to the great and noble city through the ancient consular road. We must imagine that in the medieval times (Patera 1980) the territory where the river was flowing it was magnificent and from the Arab period to the Svevian (Tramontana 2000: 15-102, 137-170) there were "stupendous palms".

In the 16th century, in addition to agriculture, they developed the valley of the river for the sugar cane processing, paper mills and other productive activities that led to massive deforestation in the mountains of the Conca d'Oro coast for the supply of timber needed but also for the production of paper. This massive loss of trees was the cause of a series of rainwater flooding in the surrounding mountain slopes that were now deforested, determining serious damage to the Admiral's Bridge and to the city too. Since that time, the bridge had to be repaired several times. In 1775 the river was partially diverted but the operation did not have a great success.



Palermo: Admiral’s Bridge, drawing by the Marquis of Villabianca (1792)

The Marquis of Villabianca in his famous diaries back to 1788-1802 (Di Matteo 1986) wrote that the bridge still "honored the blessed city “and reports that in 1751 "at the Admiral's Bridge, besides the greater extension of his feet two rows of trees were added, such as elms, palms, poplars, etc. “, as can be seen from several nineteenth-century paintings.

Palermo: Admiral's Bridge, Engraving from the "Voyage pittoresque" by R. de Saint-Non (1785)

Among the Grand Tour travellers in Palermo we can see Jean-Claude-Richard de Saint-Not, known as Abbe of Saint-Not (Paris 1727-1791) whom collected his own impressions between 1781 and 1786 in the personal report titled "Voyage pittoresque ou Description of the Royaumes de Naples-Sicile" (Società Editrice Napoletana 1981), including a beautiful picturesque engraving with the Admiral's Bridge (probably the oldest known view).
An engraving artefact of 1827, dedicated to the Marquis of Favare, already shows the Admiral's Bridge with the deviation of the river waters. Only during 1938, after the great flood of 1931, the whole course of the river was totally diverted and isolated from the Admiral's Bridge as it is nowadays visible.

Palermo (now-a-day): The Admiral Bridge as an open-air museum.

The bridge now-a-days is placed in a small urban park, into a metaphysical isolation, and since 3rd of July 2015 is part of the World Heritage of Unesco within the Palermo Arab-Norman route and the cathedrals of Cefalù and Monreale1. The bridge, repeatedly photographed in the Nineteenth Century, was taken over in the 1860s stereoscopic Frenchman Eugene Sevraiste, a photographer who documented the Battle of Palermo between Garibaldi and Bourbon Reign (De Lorenzo 2013). His pictures show us the following situation at the deviation of the Oreto river course. The construction of the railroad bridge caused other changes, but the environmental disaster was full because of the flood during 1931, which led to the final insulation of the Admiral's Bridge, as it is visible now-a-day.
The Admiral's Bridge, as the best connector between the two banks of the Oreto River, had a remarkable historical role in the Battle on 27th of May 1860 when the General Garibaldi, having encamped with his troops on Gibilrossa Mountain, between Misilmeri and Belmonte Mezzagno towns, began to conquer Palermo, not before crossing the bridge, guarded by the military of the Army of the Bourbons (Fruda 2014). The clash ended with the victory of the so-called "the Thousands" of Garibaldi, entering the city through "Porta Termini". So Garibaldi conquered Palermo, helped by the populace that came up; the bloody battle entered the myth with the gesture of the "red shirts" of the thousands of Garibaldi's picciotti and this event made a remarkable contribution to the unity of Italy and the independence of the new Italian Kingdom (Banti 2004; Beales & Biagini 2005; Casalena 2010; Francia 2012; Lupo 2011).

The Admiral's Bridge, from the Risorgimental myth to the UNESCO open-air museum.

Just after the Battle of Garibaldi, the Admiral's Bridge became a symbol of a historical passionate narrative related to the Risorgimento's epopee (Betri 2010: 225-341; Sorba 2015) in the urban context (Baioni 2009), a famous monument that became subject to so many engravings, paintings, and sculptures by artists who played the famous clash in work of arts.

Palermo: M. Rutelli, relief at the base of the Monument for Garibaldi (1891)

In Palermo there are two important monuments referring this patriotic and fervent national devotion. The first one is the relief by Mario Rutelli in the base of the equestrian monument at G. Garibaldi by Vincenzo Ragusa, 1891, in Libertà Avenue. Rutelli respects the historical time dressing of the combatants with their specific uniforms.

Palermo: Antonio Ugo (1910), celebratory monument of fifty years of national unity.

The second monument is the relief of Antonio Ugo in the celebratory monument of fifty years of national unity created in 1910 by Ernesto Basile, at the end of Libertà Avenue. Both of the reliefs cover the theme of the armed clash with the Admiral's Bridge which is visible in the background of the portrayed scenes, but Ugo transcends the temporal figure by showing the naked figures as in a mythical struggle, following the artistic intent to put emphasis on the historical events from the epical point of a patriotic view.


Rome: Antonio Ugo (1910): commemorative medal
for the fiftieth anniversary of the Italian Reign, silver.

Also in 1910 Antonio Ugo coined a medal for the same fifty years where the Admiral's Bridge is visible, while in the foreground are two elegant long-dressed ladies, a symbol of Italy and Sicily that are reunited. In 1930 the futurist Giulio D'Anna then painted a delightful picture entitled “The Moon on the Admiral's Bridge”.
So, we arrive in 1951 when Renato Guttuso (1912-1987) returned to the topic with the painted dissertation "The Battle of the Admiral's Bridge", which gave him a sharp criticism, but also praise by those who understood that counter-current work: they had not been seen for many decades and alluded to the quest for the freedom of the peoples, through the realistic language to which the master was always faithful. Renato Guttuso presents to the general public "The Battle of the Admiral" at the Venice Biennale in 1952, during which the painting is considered as a manifestation of the historical "new realism".

Rome: Renato Guttuso: the two different versions of "The battle of the Admiral". The details of the paintings 1952 – green (Firenze, Uffizi Museum) and 1955 (Rome, Modern Art Gallery).

It is interesting to note that there are two versions of the painting. Even if they are similar the painting has some different features: the first one dated on 1952, preserved at the Uffizi Museum (Natali 2005) in Florence and the second one dated on 1955, exhibited at the Modern Art Gallery in Rome for the Frattocchie Institute of Togliatti (Molferini 1987), already owned by the Italian Communist Party. The Sicilian painter Guttuso shows in his painting "The Battle of the Admiral's Bridge" a particular sensibility to the Risorgimento history (Banti et al. 2011; Casalena 2010; Malandrino 2011: 9-41; Riall 1997), motivated by double reasons: autobiographical and ideological ones. His grandfather was one of the protagonists of that battle, while the ideological component was linked to the political situation of the years in which Renato Guttuso paints, particularly on the themes of civilian Resistance during the Nazi-German Occupation of Italy and the political struggle supported by the Italian left Party. If the artist feels the political need of a civic active participation at the contemporary events, then his human and artistic devotion is always indissoluble and it has the must to be manifested. The Garibaldi-Resistance reference is explicit (Isneghi 2010; Riall 2007; Tobia 1991). Within the Uffizi Painting, in addition to two self-portraits, many faces are contemporaneous to him. The face of Pajetta, partisan of the Italian Resistance, is recognized in the knight to the right of Garibaldi, in the role of F. Nullo, the faithful Colonel of General Garibaldi. In the 1955 painting, the faces of contemporaries no longer appear, but this contemporary connection to the present doesn't seem less vibrant and meaningful (detail d.).

Even today in the so-called Scaffa Square, the Admiral's Bridge represents a symbol of the connection between the city centre and the peripheral area of Palermo. Now-a-day, under the arches of the Norman Bridge, the river no longer flows after its course was diverted because

of its continuous overflows. The story of the battle is recalled by a marble plaque placed in the garden during the 1960s by the Sicilian Region.
The Admiral's Bridge from the point of view of the visitor, perhaps, is the most "simple" monument among all those of the Arab-Norman route, which on average are more daring, imposing and original. The Admiral's Bridge, however, has the charm of showing off in a surreal suspension in the mid of city traffic, though his soul seems to be interested in the essence, like that of an old acquaintance. Moreover, bridges have to be more useful than beautiful, although its history and antiquity gave him the acknowledgement of the UNESCO Organization. Admiring the Bridge almost it seems to be in front of a self-assured and stubborn war veteran who does not fear either the passing time or the weather. Passing the time the park where is located the bridge has more invigorated fatty plants, getting some visits from tourists but no more from the homeless of the town. Many citizens now "greet" and enjoy the bridge from the line 1 of the urban tramcar that passes by giving the site a breath of modernity while the bridge seems to continue to exist peacefully, sharing the scene with the new Oreto Bridge, which is a car traffic and urban tramcar artery.
The Bridge is located in a territory belonging to the historic centre of the city, but as it has happened to many ancient areas of Palermo, it has been abandoned for decades to the degradation of building and social marginality, becoming the context of discomfort rather than of pride of the city, of pride for its beauty and its multi-billionth history. In the overall recovery of the whole old town, we would like to have the political will of the restoration of those parts of the city which, from the centre of their location and history, have become unhealthy and disadvantaged suburbs.
The Admiral's Bridge is now inside a square, in a green area and it exalts its ancient beauty. A unique example of open-air museum of an ancient bridge that is completely preserved but no longer in use. The housing density is very high in the area surrounding the bridge that is rounded by city buildings that need restoration work. These interventions can give a greater decor of the whole area and the beauty of the bridge can give a better enjoyment to the resident people and travellers because this architectural cultural heritage still represents a symbol of the link between the city centre and the peripheral area of the Brancaccio district. The choice to talk about this artefact during the Birmingham conference is motivated by the strong historical-artistic significance of the bridge that, after decades of abandonment and consequent risk of serious deterioration, has been brought to the forefront of international recognition by the Unesco at the touristic Norman-Arab Route of Palermo as a world Heritage site, where the Bridge is inserted.
The knowledge of the Admiral’s Bridge can contributes significantly to improve the historical memory and the belonging sense of the local citizens, aiming to rediscover the values of peaceful coexistence between different cultures and religions, following the Norman-Arab example (Metcalfe 2003), which created an exemplary guide of civilization during the medieval era in Sicily and in the whole ancient Euro-Mediterranean world (Leone et al. 2005).

[1] UNESCO, Culture, World Heritage Centre, World Heritage List. Document: http://whc.unesco.org/en/list/1487 - accessed 14th October 2017.

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The Lost Heritage of Iron Bridges in the Eternal City

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Introduction

After waiting two centuries and an half, a few feet away from Capitoline Hill and the Forum, it is finally completed in 1853 the walkway restoration of "Pons Aemilius", achieved through an iron suspension bridge. It represents one of the first contributions to the knowledge of metal construction in the Eternal City, whose building tradition was historically related to the use of brick and travertine. This construction begins an exceptional collaboration between Italian engineers and foreign specialists, mainly French and Belgian engineers, who will build within forty years several bridges with iron and cast iron structures down the Tiber, promoting through an imported know-how the introduction of different technological solutions according time after time to the features of the urban context (Fig.1).
This condition is implemented through different support systems: from the suspension to the open sprandel arch bridge, or from the beam to the truss bridge, each one suitable for the reunification of separated parts of the city centre and the connection between areas where the future urban development will be directed.
With the river banks refurbishment of the Tiber and the exponential increase of vehicle traffic already in the first years of the 20th Century, most of the iron bridges of Rome are being gradually replaced by bridges that use other constructive technologies, irremediably losing an heritage which was strongly linked to the international scenario of the time. The contribution tells the lost story of this heritage, rediscovering the strong relationship between the iron construction and the City of "Pontifex".

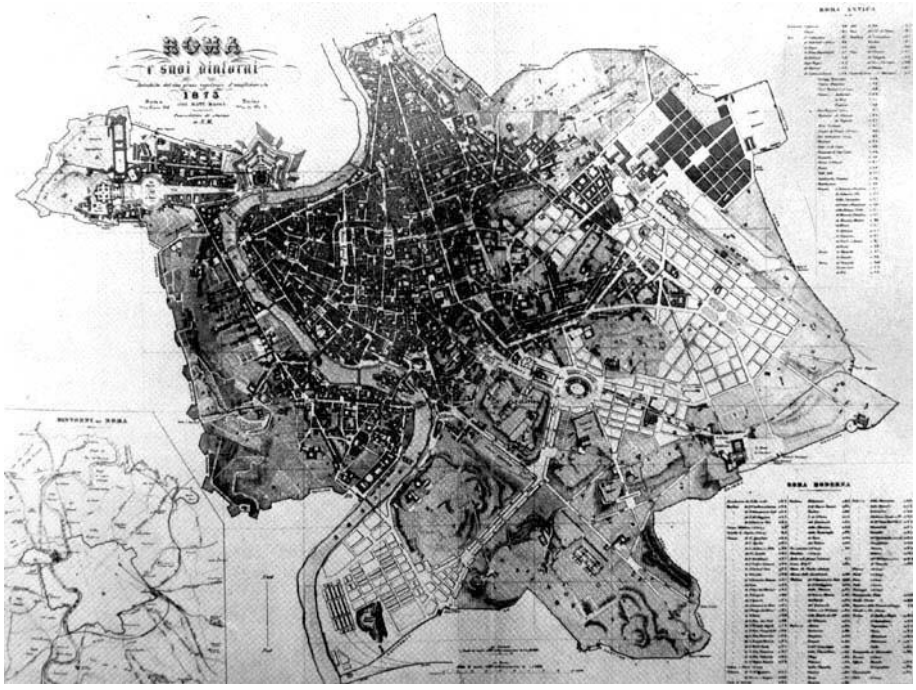


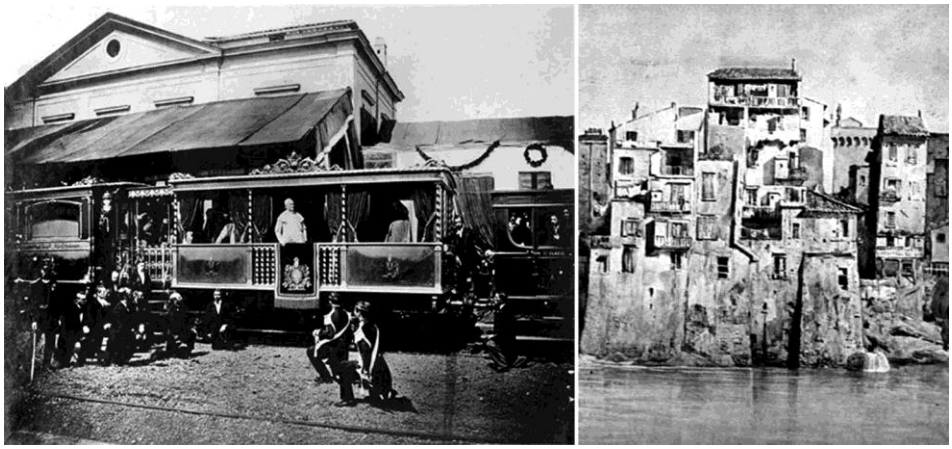
Fig. 1. Urban plan of Rome in 1873 (Comune di Roma, 1873)

Iron bridges of the papal states

In the middle of 1800s, Rome seems to be a city stopped in time, a capital characterised by a deep backwardness and indifferent to large economic and social transformations which have already interested the greatest European cities.
Pope Pio IX, descendant of the noble family of Mastai Ferretti originating from the centre of Italy, is elected on the papal throne in 1846, he is aware of this condition and he intervenes

with a long series of acts on administrative and urban plan, in order to overcome the ideological legacy of Roman Curia, supplying the city of necessary infrastructures for its functionality (Spagnesi, 1997).
The interventions launched by the Pope are part of an extraordinary plan that intends to refurbish Tiber banks, damaged by important collapses, and it works also for the realisation of the first rail network, trying to connect Rome with the main centres of Papal States and Italian peninsula. (Figg. 2-3). Metal construction plays a pivotal role in this affair: new bridges are built with ferrous materials, with projects and technology which are imported from France and Belgium due to the underdevelopment of iron industries and also relevant political issues linked to the defence of Papal States.
Indeed the French put an end to the short experience of Rome Republic of 1849, a temporary and revolutionary government guided by Giuseppe Mazzini that forces the Pope to escape from Rome for some months. French armies occupy the city until the end of 1860s, when the defeat in the Franco-Prussian war leads to the deposition and the exile in London of Napoleon III.

Urban development project, desired by Pope IX, promotes an exceptional collaboration between Italian and foreign engineers, condition that is marked by the construction of three bridges along the Tiber, each one made of cast-iron and iron; the last important realisations of Papal States before its definitive downfall in 1870.



Figg. 2-3. Pio IX on a train (Danesi, 1863) and rundown Tiber riverbanks in a painting of 1870s (Roesler Franz, 1870s)

Realisations of Supension Iron Bridges Company

In 1847 the Duke Pio Braschi Onesti founds the Suspension Iron Bridges Company, whose management is given to a French engineer, Camillo Montgolfier Boudin. The company is authorised to build four suspension bridges along the Tiber, whose cost would have been recovered by the payment of a toll, but bureaucratic and legal difficulties, as well as the end of Papal States, will permit the construction of only two bridges (ASR, 1860).
The first intervention concerns the refurbishment of “Pons Aemilius”, one of the oldest masonry bridges in Rome, known as “Broken Bridge”, due to three missing arches, and named also “Senate Bridge”, because of its proximity to Palatine Hill. The French engineer Dumont, who is responsible for the project, collaborates with the Italian engineer Pietro Lanciani, designing a suspension iron bridge that links existing masonry arches with Aventino embankment (Fig. 4).

The metal structure consists of a couple of tapered columns and on their head it is placed the suspension system, characterised by jointed chains and suspenders under tension, that support a metal deck, which is 6 meters wide and 63 metres long.
The intervention of Dumont and Lanciani, completed in 1853, contrasts with the pre-existing ruin and the ancient surroundings: without researching any mediation, the tapered columns are directly attached on the roman remains (Cacchiatelli and Cleter, 1865) and the bridge, celebrating the new technology, doesn't reach a figurative assonance with the context.
Broken Bridge and its suspension iron structure is demolished in 1887, because of refurbishment of Tiber banks and only one of the three ancient roman arches is saved, thanks to the conservation actions carried out by historians and Roman inhabitants.

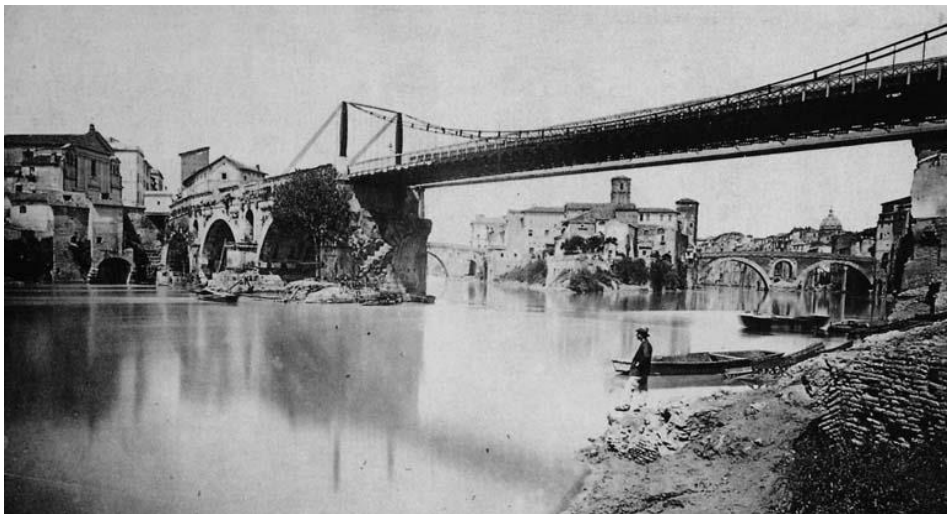


Fig. 4. Broken Bridge and the suspension iron structure (Fratelli D'Alessandri, 1875)

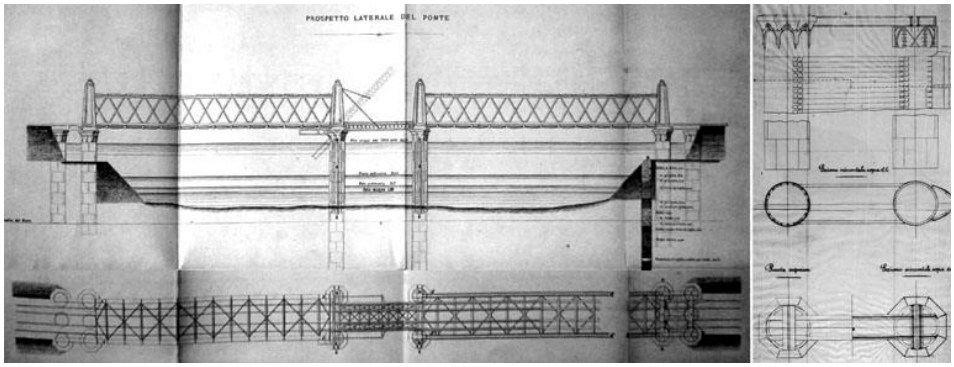
Ten years later Boudin's company realises another suspension bridge, in the river section facing San Giovanni dei Fiorentini Church, where earlier a little harbour guaranteed the river crossing. For its design is charged the French designer Alphonse Oudry and he collaborates with Paolo Cavi and Raffaele Canevari, two Papal States engineers. The suspension system is more complex than the previous one and it uses for the first time not only iron elements, but also steel components, carefully fabricated in English industries.

Fig. 5. Fiorentini Bridge and its complex suspension system in a postcard (Unknown, early 1900s)

The bridge shows two lateral bays, 10 metres long, and a central one, 93 metres long, which is suspended by a system of chains, anchored at the ends to a couple of portals, placed near the two riverbanks (Fig. 5). The portals are composed of two columns, athwart linked on the upper part by a slender iron lattice and fixed on the other side to a masonry basement. The suspension system consists of chains, separated by two metal struts with adjustable heights and slight diagonal strings, to which are linked inclined suspenders, that sustain high iron lattices, reinforced by trusses supporting wood deck panels. The geometrical complexity of suspension system and the greater stiffness of the deck, designed by Oudry "in order to achieve a firmer structure, less subject to oscillations", make Fiorentini Bridge one of the most meaningful examples of metal construction of Papal States (D'Onofrio, 1980).
Unfortunately nowadays there are no traces of both realisations of "Suspension Iron Bridges Company". Senate Bridge is demolished in 1887, because of Tiber banks refurbishment and Palatine Bridge construction, but thanks to archaeologists and city historians, one of the three roman arches is saved and even today it is possible to admire the ruin. Fiorentini Bridge is dismantled in 1941 in order to recover iron components that could be useful for wartime industries; in its place it will be built Principe Amedeo Savoia Aosta Bridge, with a structure composed of masonry arches and a traditional travertine finishing.

Roman Rail General Company and the Industry Bridge

Before 1846, railroads in Italy are placed outside Papal States borders, but with an ordinance of that year, Pio IX promotes the construction of a local rail network. The first lines, completed in 1850s by Roman Rail General Company, link Rome, Frascati and Civitavecchia and related stations are located beyond the Aurelian Walls, in order to avoid the onerous crossing of the river. This arrangement is modified a few years later: in the area of "Termini" is built a big railway station thanks to a breach in the ancient Aurelian Walls and the construction of a bridge between Ostiense and Papareschi riverbanks is required.
The bridge is designed by the English engineer Louis Hach, under the direction of three engineers, Leopoldo Brockmann, Francesco Barthelemy and Paolo Cavi and it is built with materials that are imported from Britain by a Belgian company (ASR, 1863).



Figg. 6-8. Train passing on Industry Bridge (Unknown, 1908) and construction details (Burri, 1864)

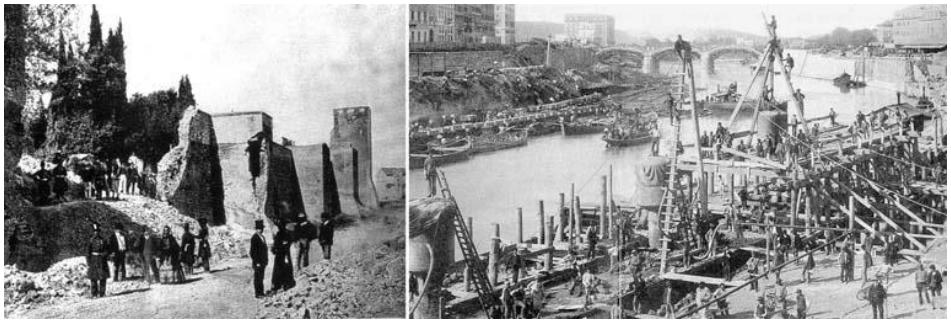
The bridge is composed of three spans, two of them are fixed on the sides with a couple of trusses 43 metres long, instead the central one is movable, thanks to a drawbridge 13 metres long, that allows the transit of ships to the near Ripa Grande harbour (Fig. 6).
About the columns, they are realised with the method of compressed-air caisson, invented in 1840s by the French engineer Jacques Triger, and an amount of sixteen metal tubes is used: six for each bridge abutment and four for the central bearings (Figg. 7-8). The columns are built through the assembly of several rings, obtained by six curved metal sheets, strengthened along the edges and the diagonals (Jorini, 1905). The metal tubes, which have a diameter of 3 metres, are assembled simultaneously with the digging out phase, they are filled with stones in order to enhance the stiffness and they are completed on the head by metal capitals, decorated with gothic mouldings that are similar to those of railway bridge over the Canal de Garonne designed by Gustave Eiffel. The lateral girders, influenced according to the critics of the time by the model of Robert Stephenson "tubular iron bridges", show lateral trusses composed of upper and lower chords with criss-crossed diagonal braces. Truss elements under compression consist of reinforced profiles, instead rods under tension are made of iron plate couples. Lateral trusses are athwart linked by upper and lower joists, stiffened with original curved braces, and they finish at the abutments on sturdy lattice columns, concealed by metal sheets and mouldings used for the lower columns (Jodice, 1985).

Figg. 9-10. Alari Bridge near Castel Sant'Angelo (Unknown, early 1900s) and transformation of Industry Bridge (Lalupa, 2014)

Completed in 1863, the execution of the bridge is carefully verified: Prof. Giorni manages load tests on each span, instead Romolo Burri, a Papal States engineer, together with Roman Rail General Company technicians, evaluates strains with the transit of the first train. On September of the same year, Pope Pio IX can finally inaugurate the structure thanks to the positive test results (Testa, 2007).
The new connection, known as Industry Bridge, because of its proximity with Ostiense productive district, is the only one between Papal States iron bridges which isn't removed, but it is affected by several transformations starting from the early years of 20th century: addressed for car and pedestrians flows, it will preserve only the lower columns, instead the upper part of the bridge will be replaced by two bowstring trusses, built with steel components of Alari Bridge (Figg. 9-10), a temporary connection used for the construction of Vittorio Emanuele II Bridge, near Castel Sant'Angelo (Spagnesi, 2000).

Iron bridges of the capital

After the breach of Porta Pia in 1870, Rome becomes the capital of Kingdom of Italy and the first municipal council nominates a special committee composed of eleven architects and engineers, addressed for the enlargement and improvement of the city (Fig. 11).
In the same year Rome is hit by an exceptional Tiber overflow. Because of the huge damages, the authorities decide to start refurbishing the riverbanks in order to prevent floodings in the future. Between the proposals, the engineer Raffaele Canevari promotes the realisation of high side walls, named "muraglioni", which irremediably modify the previous relationship between the city and the river (Fig. 12).
The municipal committee, headed by Alessandro Viviani, designs two urban plans for the city: the first one, completed in 1873, will be never adopted due to the stop of dispossession process; the second one, published ten years later, will partly accept the previous one modifying several previsions.
The explanatory report of 1883 Plan states: "The City is divided in two parts by the Tiber, so new connections for the river crossing will be required; and considering that the present bridges are insufficient to the need, (…), the Committee recognise useful the construction of new bridges not only in the places addressed for city enlargement, but also along the river banks of the city centre. Anyway the distance between the bridges shouldn't overcome 300 or 400 metres and they should be placed near main existing or new avenues, oriented perpendicularly to the riverbanks" (Insolera, 1962).



Figg. 11-12. Breach of Porta Pia (Unknown, 1870) and refurbishment of riverbanks (Unknown, 1890s)

According to these criteria the plan promotes the construction of six new bridges, the refurbishment of Broken Bridge and the enlargement of connections near the Tiber Island. In these years several projects of roman designers arrive to the municipality: among them, there is the project of "Three orders bridge made of cast-iron and iron, with a single span 100 metres long" (Fig. 13), designed by the architect Andrea Busiri Vici, one of the first designers in Rome experimenting cast-iron and iron construction (Busiri Vici, 1880).

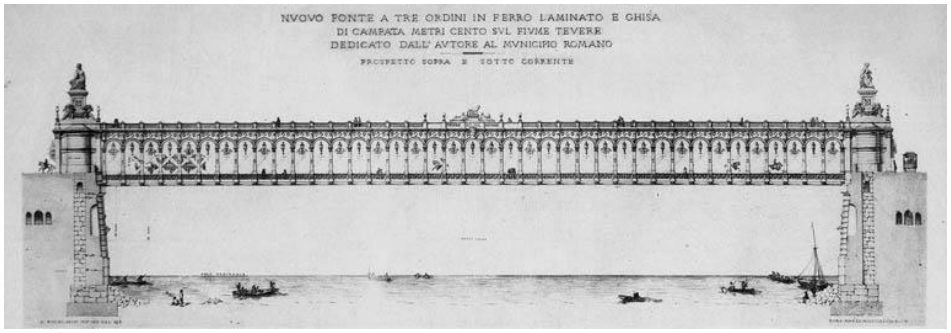


Fig. 13. Bridge design proposed by Andrea Busiri Vici
(Busiri Vici, 1880)

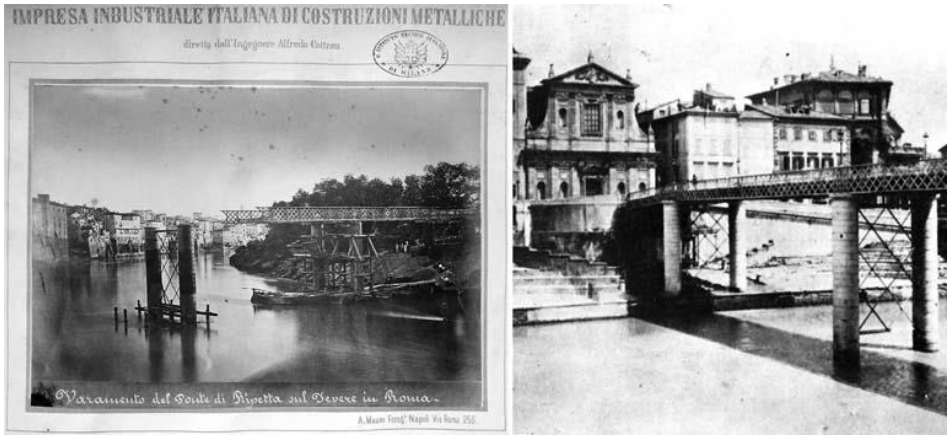
Bridges of Cottrau's Industrial Italian Company of Metal Constructions

In 1877, Cahen d'Anvers family, main promoter of Prati district urbanisation, suspicious of a rapid construction of the bridge planned by the municipal committee, starts building a temporary pedestrian crossing between the left bank of the Tiber and the new district, close to the area of Ripetta Harbour, a little seaport of the 17th century.
Cahen d'Anvers family charges of its design the Industrial Italian Company of Metal Construction (IIICM), directed by engineer Alfredo Cottrau, that is at the time involved in the enlargement of Sisto Bridge deck (Figg. 14-15), achieved through a cantilevered metal structure, composed by big shelves fixed into masonry walls (Cottrau, 1878).

Figg. 14-15. Enlargement of Sisto Bridge deck (Cottrau, 1878)

About Ripetta Bridge, Cottrau's company realises eight tubular columns filled with stones, using the same technique of compressed-air caisson, already experimented for the Industry Bridge, with some differences: the metal tubes, obtained joining short iron sheet rings, show on the top capitals without decorations and they are connected two by two with lattices made of iron diagonal braces (Fig. 16).
The columns support an horizontal deck, that is 100 metres long, composed of parapet lattice girders, connected by equidistant truss joists, employing one of Cottrau's traditional technical solutions (Carughi, 2003).
The bridge execution, reached with the collaboration of engineer Francesco Kossuth, are completed in 1878 and on November of the same year some load tests are carried out in order to check the structure. The bridge is inaugurated after a few months, in the presence of King Umberto I and Cahen d'Anvers family.
The bridge impression on the urban context, full of historical signs, is quite restrained and solved by the dialectic between the deck slenderness and the columns firmness (Fig. 17); however at a later time it will be abandoned.
In 1901, after the completion of near Cavour Bridge designed by Angelo Vescovali, the municipality decides to remove the metal structure of Ripetta Bridge moving it in the Magliana area.

This intervention involves a radical transformation of the existing structure: the bridge is "cut" in two segments separated by a central drawbridge which allows the transit of the ships.
Because of Tiber overflows of the following years, the municipality wants to replace it soon, but it will definitely be demolished after 1944, when it is seriously damaged with Second World War bombing. The construction of the new Magliana Bridge starts in 1938 and it will be completed after the war.
The applied building solution relegates the use of steel only for the central movable span, instead reinforced concrete is the main actor of the structural solution, in which the arch characterizes the shape of the other six spans.



Figg. 16-17. Ripetta Bridge: construction and completion (Cottrau, 1878)

3.2 Garibaldi and Palatine Bridges of Water Municipal Office

Between the six bridges planned by Alessandro Viviani, only two are involved in the executive regulation of municipal government: Garibaldi Bridge in Regola district and Palatine Bridge in Orsa quarter, both designed by the Water Municipal Office directed by the engineer Angelo Vescovali.

Garibaldi Bridge is considered "the greatest one built in Italy for the transit in ordinary way" (Vannelli, 1979) and Vescovali uses for it two metal arches with bearings at the ends. This solution is similar to that one of Jonelière Bridge in Nantes, designed by Dupuy in 1875, which uses a "mixed system: two pinned ends that flank the hinge and when they are softly under compression caused by static loads, with a medium temperature, they balance the strains caused by unequal loads" (Bonato, 1889).
In the first project the bridge is placed on the north end of Tiber Island, in order to make a watershed, composed of masonry abutments, a central masonry column, and two open sprandel metal arches that cover the distance of riverbanks, 141 metres long.

The final solution leaves unaltered the adopted scheme, but the bridge is isolated in the riverbed and it is oriented on an oblique direction that, according to the divergence of riverbank walls, is useful to guarantee a regular configuration to metal arches (Fig. 18).

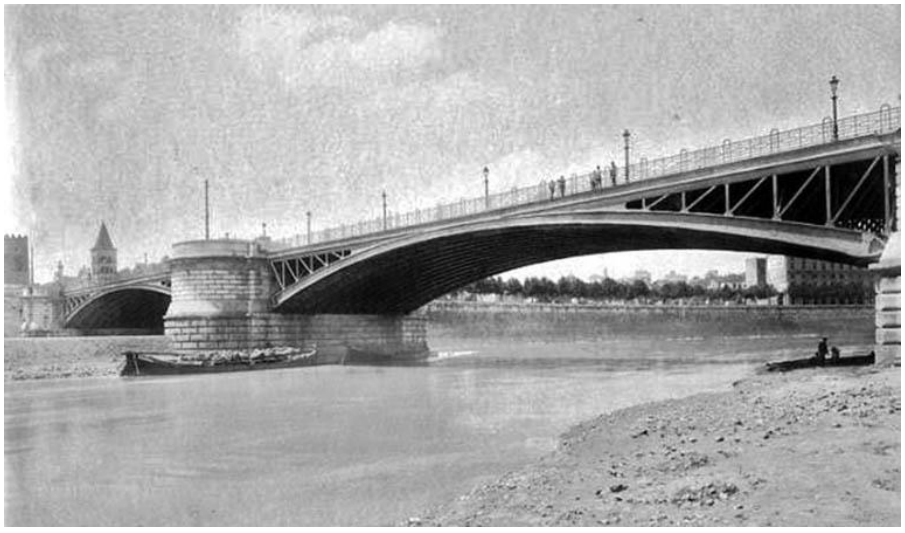
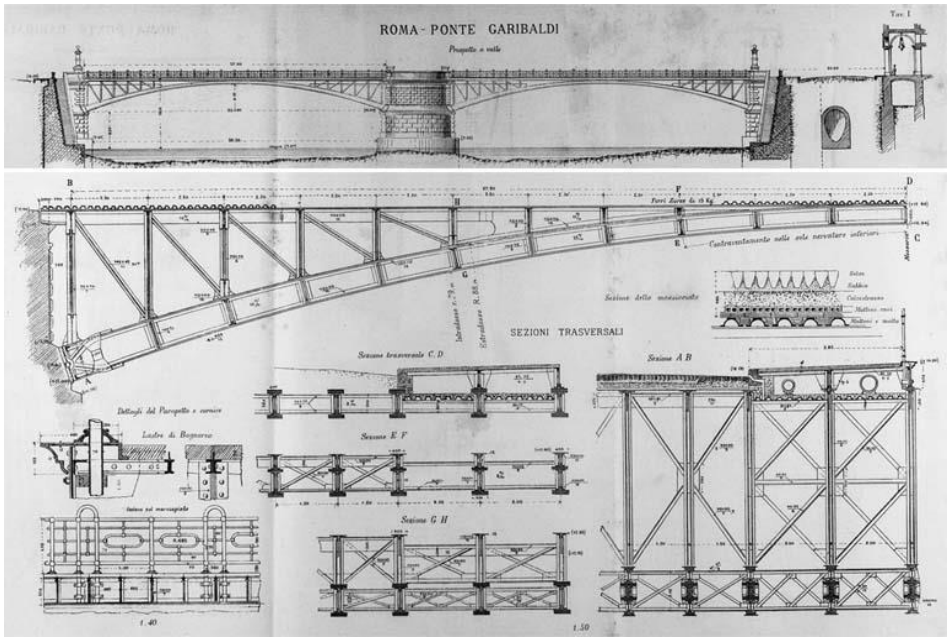


Fig. 18. Metal arches of Garibaldi Bridge in a postcard (Unknown, early 1900s)

On May 1884 the realisation of bridge foundations is given to C. Zschokke & P. Terrier Company, already active in the riverbank walls work, also charged one year later of the realisation of metal structure, because it is owner of a great iron fabrication shop, located in the area of Marmorata.
The supply of material for the construction of metal arches and deck elements, arrive from Trady & Benech Industries of Savona, that experiment for the first time in Italy an innovative process for the beam punching, using drills produced by Bouhey Company of Paris, and for the riveting, using hydraulic machines supplied by Fielding & Platt Company based in Gloucester.
About the foundation system of the columns and abutments, the compressed-air system permits the realisation of metal caissons, composed of metal sheets, reinforced by triangular shelves and a masonry boulder, built before the column sinking. The central core of abutments and column is made of tuff, up to the level of bearings, and of flint on the top; the exposed masonry façades are clad with travertine blocks, except on the imposts of arches where it is used red granite from Baveno.

Each side of Garibaldi Bridge consists of thirteen metal arches, of which the span is 55 metres long and the rise is 5 metres high; every arch is shaped by I section with adjustable height, obtained by assembly of different parts: an iron plate 15 millimetres thick, four angles and two flanges, made of four overlapped plates. The upper part of the arches is composed of vertical struts and diagonal braces with different sections as in a truss structure, regularly strengthened with couples of angles that permit also the connection between the braces. A tapered girder, 28 metres long, composed of reinforced profiles with a I shape section, works as the upper chord and the whole metal girder have six different bracing systems, arranged horizontally and vertically (Figg. 19-20).



Figg. 19-20. Construction details of Garibaldi Bridge (Bonato, 1889)

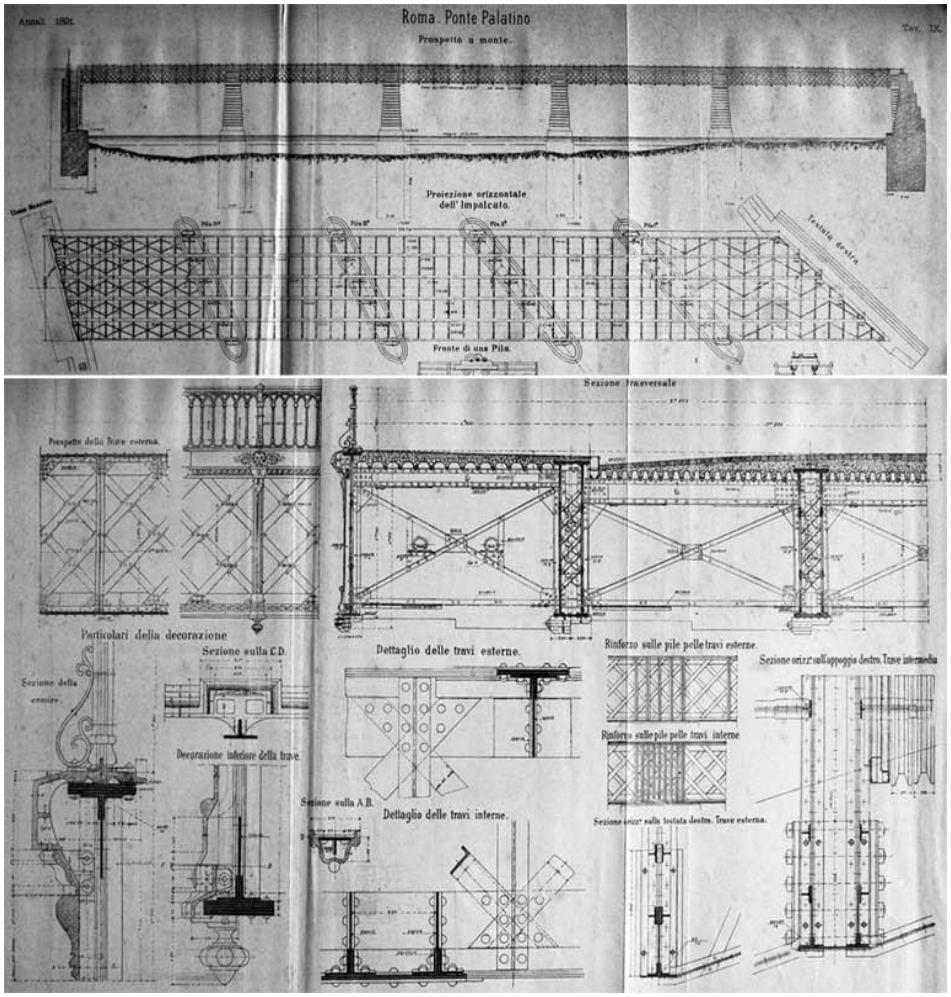
On the bearings the arch flanges bend to the cylindrical pivot axis, made of wrought steel, that represent the hinge system; on both sides of tapered profile, two pinned plates are added to recompose the profile height and they end into a thick steel plate. The hinge pivot is fixed into cast-iron slabs, built in Baveno granite blocks and stuck with steel wedges.

The bridge deck occupies 9 of 13 arches, it is composed of Zorés iron connections placed athwart and bolted on plates; instead footpaths have a double structure: the lower one, made of Zorés iron braces and concrete casting that is useful for the system tubes, while the upper one, made of stone tiles laid on granite blocks.
A simple parapet, composed of metal tubes, is connected to the external arch web and it is integrated to a cast-iron frame that, inserted between the struts, is finished with circular studs fixed through lead seal.
The metal arches are built following clear work stages that permit the assembly of each piece of the structure, from the external sides to the internal axis of the bridge, which is inaugurated in 1888.
Garibaldi Bridge has been used with its metal arches until 1950s, indeed after some load tests caused by the increase of car transit, a structural intervention, designed by Prof. Giulio Krall, radically modify its iron appearance (Iori and Poretti, 2014).
The second iron realisation of Water Municipal Office is the new bridge of Orsa quarter, the connection near to Palatine Hill that should replace Broken Bridge, for which Angelo Vescovali, choses a scheme of a continuous beam bridge with six supports: two abutments integrated with the riverbank walls and four columns placed in the riverbed (Bonato, 1891).

Figg. 21-22. Palatino Bridge and remains of Broken Bridge in two postcards (Unknown, early 1900s)

The whole span of the bridge is 154 metres long, due to the obliquity of bridge axis and indeed the columns are arranged like a span, according to the slanting line and the direction of water flow (Figg. 21-22). The bridge is built again by Zschokke & Terrier Company, that on this occasion charges IIICM for the realisation of metal girder.
About the foundations, the same pneumatic system of Garibaldi Bridge is used for the sink of metal caissons, the walls are made of brickwork up to one meter under the water level and they are composed of tuff and flint on the upper part, which ends with thick granite blocks. On the second column, longitudinal bearings are laid on cast-iron plates, instead on the others girders are laid on cast-iron rolls.

On the top of the supports there is a travertine cladding, with short masonry walls, useful to conceal the irregularity of the bearing system.
The six continuous beams that compose the whole metal girder have different length and also their span is not regular because of the slanting axis of the bridge and the column positioning. They are composed of reinforced profiles, characterised by two webs for the internal beams, and a single web for the others (Fig. 23-24).



Figg. 23-24. Construction details of Palatino Bridge (Bonato, 1891)

The internal beams are made up with two parallel channels, which are built riveting iron plates and angles, in order to reach wide flanges and a thick web. The main iron elements are connected with a square lattice, composed of two different braces: the first one is a reinforced profile, made of angles and plates, and the second one is obtained by a couple of riveted iron plates, connected with the angles of the lattice and gathered I shape struts near the bearings.
For the external beams, the exposed connecting lattice is still made of two layers, but it uses flat profiles. The bridge deck is completed by reinforced joists with adjustable height, in order to create the right space for Zorès iron braces and concrete.
Diagonal braces, placed both horizontally and vertically, connect the complex system of girders and joists, and they guarantee the positioning of system tubes.
The execution starts in 1886 and it is completed only in 1890, when load tests are carried out.
The external girders of Palatine Bridge are concealed and mitigated by a complex system of

cast-iron decorations: frames and mouldings clad upper and lower chords, short columns are put on vertical struts, consecutively with the parapet solution. Therefore technical dimension of metal construction experimentation is restrained, definitely rejecting the research of a different relationship between historical language and modern lexicon for a new modern capital.

Conclusions

When Rome becomes the capital of the Kingdom of Italy, the bridges seem to leave the character of experimentation which is distinctive of Papal States bridges, using building elements and figurative features that, in order to reach a prevalent assonance with the context and its appearance, lead to a definitive refusal of complex supporting systems.
The bridge goes back to be designed according to classical building principles and using historical tradition materials that define the shape of abutments and columns: huge masonry masses, clad with stone material, worked following complex and composite stereometric shapes.
Instead iron is used with a technical tone for the management of crossing span, for the bridge girders and deck design, according only to executive experimentations that remotely involve architecture, indeed cast-iron decorations and mouldings conceal material and tectonic truth balancing the industrial appearance of the structure.
Industry Bridge and Palatine Bridge are the only witnesses of a complex and meaningful story that tried to transform Rome into a modern European city.
The partial refusal of metal construction in the 20th century knows a trend reversal at the beginning of this millennium with realisations that try to show the structural system, also through the use of colour, looking at experiences that, once again, as in the past, have a clear international origin.

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The Sydney Harbour Bridge through the eyes of engineers, artist and writers

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Observatory Hill by Roland Shakespeare Wakelin (1887-1971), ML 1169

Introduction

This paper focuses on the passion attached to the Sydney Harbour Bridge as seen through the eyes of photographers, artists & engineers, and the words of politicians and writers. This is a selective tour through the chronology of development and debate across Sydney Harbour from first people to present day Sydney dwellers and admirers.

The arrival of the Sydney Harbour Bridge is described here only in relation to the State Library of New South Wales remarkable collection.

Since white settlement there have been debates about how to best cross the harbour - over or under? What would be the best bridge design and who would pay?

The Sydney Harbour Bridge has been affectionately known as ‘the iron lung’, ‘the arch’, ‘the coat hanger,’ and is now an iconic part of Sydney landscape enshrined in objects from coat hangers to tea towels and models made out of matchsticks and sea shells.

The Bridge has been recorded by photographers like Harold Cazneaux, painters like Roland Wakelin, print makers such as Jessie Trail and writers like Ruth Park.

> “It hangs there like the ghost of the wheel of fate, in a sky brindled with sunset, until darkness comes and vanishes away this remarkable shape, which above all things that sign of Sydney”. (Park, P, 1973.p75)

Eora Nation

Sydney from Bell Mount, 1813 painted by Stephen Taylor, call no DG 100

What is now called Sydney is built on the land of the Cadigal people of the Eora nation. Now a city of over 4 million people, it was a different country before settlement.

United by a common language, strong ties of kinship, and a rich saltwater economy, the Cadigal people survived as skilled hunter-fisher-gatherers in family groups or clans scattered along the coast.

Water transport across the Sydney Harbour

> "The ferries were much larger then and dangerously overloaded. Mum said nearly every trip somebody would fall into the harbour, trying to jump off the ferry as it came into the wharf on the Northern side of the harbour" (Egan, A. 2017)

During the growth of Sydney in the 1800s and early 1900s the water proved a divide between the northern and southern shores of Sydney harbour. Not surprisingly water craft and ferries became a major mode of transport and were in many cases dangerously overcrowded.

The 1900s was a busy time for ferries. At any time in peak hour there were 75 ferries docking or in the water. The five major ferry services linking the North Shore to the city carried 13 million passengers a year, the ferry companies not surprisingly were against the bridge. To many Sydneysiders and ferry passengers the idea of a huge arch connecting the two sides of the harbour seemed fanciful.

Mort family - Photographs of Sydney & N. S. Wales [ca. 1879-1889] PXD 956. 150 albumen prints.

Proposals for crossing Sydney Harbour

The first known recorded suggestion for some form of crossing over Sydney harbour was in 1815 from convict turned government architect Francis Greenway in letters to the Australian newspaper 14th & 28th April 1825.

> "In the event of a bridge being thrown across from Dawes point to the north shore, a town would be built apon that shore.. . and would have formed with these buildings a grand whole that would have indeed surprised anyone on entering the Harbour, reflected credit and glory on the colony.." (Greenway, F, 1825. p1)

Unfortunately he produced no plans.

The struggles to get a consensus for a harbour crossing (and agree to fund it) took over a 100 years. There were many plans for bridges. The first was in 1840 when a floating bridge was proposed, 45 feet wide, guided by fixed chains across the harbour and propelled by steam …apparently at incredible speed.

In 1857 another proposal was drawn by Peter Henderson, an engineer who had worked under the great bridge builders Robert Stephenson and Isambard Brunel in England. His spectacular construction would have been a flat span of cast iron, supported by towers at each end and lit by oil lamps all the way across. Drawings of this bridge are in the Library's collection and are about to be digitised. This grand proposal would have impeded shipping.

In 1878 Government bridge engineer Mr W. C. Bennett suggested a floating bridge to allow for the passage of water borne vessel.

Later Sir John Fowler planned a suspension bridge at an estimated cost of £400,000.

In 1879 T.S. Parrett proposed a seven truss bridge with a maximum truss of 500 foot. This scheme was for a medium level bridge that would have restricted shipping.

It was in the 1880s the crossing of the harbour became more of a political issue.There were various parties formed to support their particular version of a harbour crossing, there was: the bridge party, the tunnel party and the pontoon party.

Sir Henry Parkes (known as the Father of Federation and later Sir Henry Parkes) used the promise of building a bridge as part of his political campaign, In one of his electioneering speeches in the early 1880s he set the imagination and expectations of the St Leonards electorate on the North Shore of Sydney alight when he dramatically paraphrased the call of Horatio Coles to his fellow citizens in Rome. “O who will stand at my right Hand and build the bridge with me” (Spearritt, P, 1983. p 25)

After becoming Premier and no bridge eventuated, an observation was made “someone must have stood on his right hand”.

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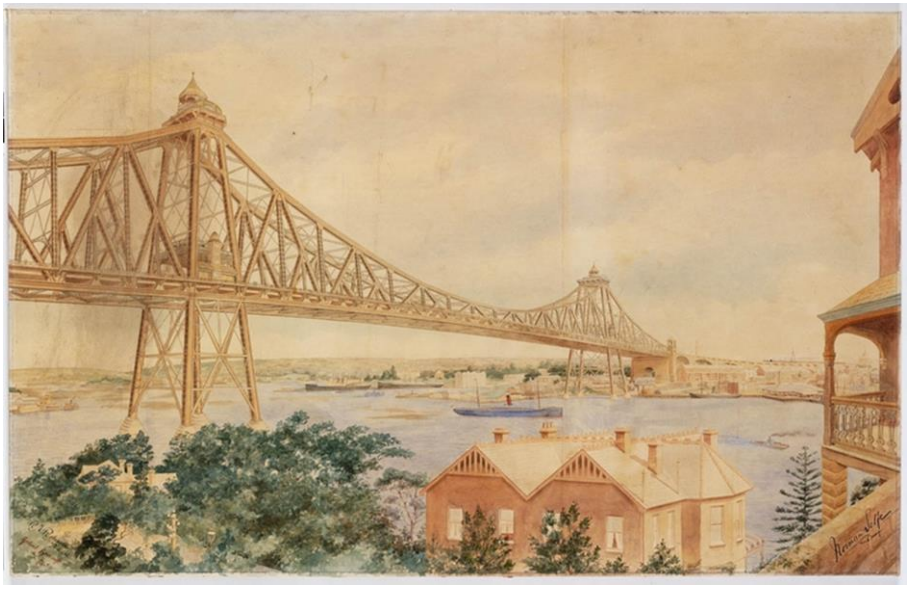
Design for a three span bridge with a central tower linking Sydney-North Shore-Balmain. Proposed by the architect, Ernest Stowe, 1922. Note: Goat Island (centre), Balls Head (foreground), Millers Point (top left), Balmain (right) architect Ernest Stowe, 1922 .

Photo Sir John Sulman personal and professional papers, including Sulman family papers, 1826-2000, MLMSS 1381 item 15

A number of bridge building schemes were suggested and four bills were presented to parliament including two for a tunnel. Tunnel connections to North Sydney were first proposed in 1885. There was to be one tunnel for railway traffic and one for vehicular traffic, supported by urban planner Sir John Sulman. There were also plans for a pontoon bridge and a seven-span bridge and even for the harbour to be filled in between Milsons Point and Dawes Point. None of these schemes reached fruition

Significant designers and engineers

Norman Selfe 1839-1911



Proposed Sydney Harbour Bridge, ca.1903] / Norman Selfe Design, R. M. Robinson Del., Herbert Beecroft Pinxt .1839-1911 ML 1401

Engineer, naval architect, inventor, urban visionary and advocate of technical education, Norman Selfe was one of Sydney's most energetic and civic-minded citizens. His vision for Sydney included a harbour crossing decades before the Harbour Bridge was built, and an independent system of technical education long before the advent of Technical And Further Education (TAFE). During his lifetime, his efforts were not successful, but many of his innovative ideas were later realised.

Approaches to bridge Sydney to North Sydney in combination with scheme for remodelling the "Rocks" district / arial view of remodelling proposal 1891. Circular Quay." SSV / 47 Q339.5/N Location Mitchell Library,

By the 1880s and 90s a harbour crossing and city railway extension were on the governments agenda . Norman Selfe proposed a number of bridge solutions and his urban visions were prominently featured in the 1909 Royal Commission [on the planning of Sydney]. By the late 1890s a harbour crossing and a city railway extension were again on the agenda. The New

South Wales Government, (the Lyne Government) had committed to building the new Central Railway Station, and organised a worldwide competition for the design and construction of a Harbour Bridge. Selfe submitted a design for a suspension bridge estimated to cost £1,128,000 and won the second prize of £500. The first prize went to C. E. W. Crutwell, of Westminster with a design estimated to cost more than twice as much. After the outcome of the competition had become mired in controversy, Selfe in 1902 won a second competition outright, with a design for a steel cantilever bridge stretching from Dawes Point to McMahons Point. The selection board were unanimous, commenting that

> "The structural lines are correct and in true proportion, and ... the outline is graceful".

(Ian, A, 2001.p 21) His 1903 design for a harbour bridge from Dawes Point to McMahons Point was accepted by the NSW Government but was never constructed.

Construction of Selfe's version of the Sydney Harbour Bridge never started due to an economic slowdown and a change of government at the 1904 state election. Much to Selfe's outrage, the Department of Public Works kept his calculations and drawings, and copied and printed them. Eventually in 1907, the department contacted Selfe and asked him to collect his drawings, but refused to return the calculations. Selfe was never given the £1,100 prize, nor was he paid for his subsequent work which he estimated to be worth more than £20,000

John Job Crew Bradfield 1867- 1943

John Job Crew (J. J.C.) Bradfield's name is synonymous with the Harbour Bridge and the design of Sydney's railways. In his approach he could combine the practical and the aesthetic.

In his thesis of Bradfield (1924. p.2.) said:

"Engineering encompasses.. The utility of material things with the beauty of spiritual things" .

In 1912 engineer, Bradfield had convinced the politicians that it would be possible to build a single arch bridge which would not block shipping. The bridge would be an important part of the residential decentralisation that social reformers favoured for Sydney.

Bradfield investigated bridges around the world and found that an arch bridge would be possible and £350,000 cheaper than a cantilever bridge

> "The history of this bridge is the history of our politics for the last forty years. This bridge has been the sport of politicians for the whole of that period(it will) open up those splendid areas of undulating land which are so admirably suited for the purposes of … the building of homes of citizens, the housing of the happy and healthy people on that side of the Harbour . Mr Bradfield has a mastery of it "

so said J. D Fitzgerald (Fitzgerald, J, 1918. p 4) a housing reformer and town planner who introduced the ill fated Sydney Harbour Bridge bill to the legislative council in 1918.

The benefits of a bridge across the harbour were promoted as a reduction in working expenses, cheaper fares, and quicker transport, thus enabling workers to reside further afield and enjoy fresh air and sunshine. It was believed that the bridge would open the residential land on the North Shore.

Designing and building the Bridge

Australians see Bradfield as the main architect and driver of the Bridge proposal and design, with some slight structural modifications by Dorman Long and Co, the British firm who won the tender to build the Bridge.

Dorman Long won the tender for its construction at a price of £4,217,720. Their engineer in charge was Laurence Ennis, he supervised the construction, they also employed another engineer, Sir Ralph Freeman to design the Bridge in detail calculating the size of all the pieces of steel and working out how to join them.

The details of the daily costs and payments of construction were carefully recorded by Bradfield and the Library holds the final report of the building of the Sydney Harbour Bridge and its approaches.

The embarking of such a massive engineering program at the beginning of the depression was fortuitous.

> 'Sydney was ringed by soup kitchens .. every night thousands slept in the parks, on railway stations and in odd shelters. Sydney became a city of beggars. . Many had good jobs in the past. But their spirits were broken. Hardier spirits took to the track. It was these shabby people haggard with hardship and hopelessness who stood in their thousands on that autumn day more than 80 years ago to see the bridge open ". Said J D Lang in (Park, R, 1973. p75)

The Bridge became known as the 'Iron lung' as it kept so many people breathing. It gave employment to 1,400 workers on the site. As well as many thousand more in the steel, cement, sand and stone trades. The development of the Bridge gave hope to a city amidst the depression. The NSW Government discriminated in favour of employing war veterans., unionists, and when the depression hit hardest, family men. There was variety of Australian born workers, English engineers, Scottish and Italian stonemasons, American, British and European riggers, Irish and English boilermakers and machinist joined. About 1500 people worked on the bridge annually and an estimated 2,500 + over the ten years.

Dorman & Long Co built a whole town at Moruya to house 25 quarry workers and their families. The cement was made with graded Moruya granite aggregate, Nepean sand and Kandos cement.

Over 500 houses were destroyed around Milsons Point and North Sydney to build the new bridge approaches and railway.

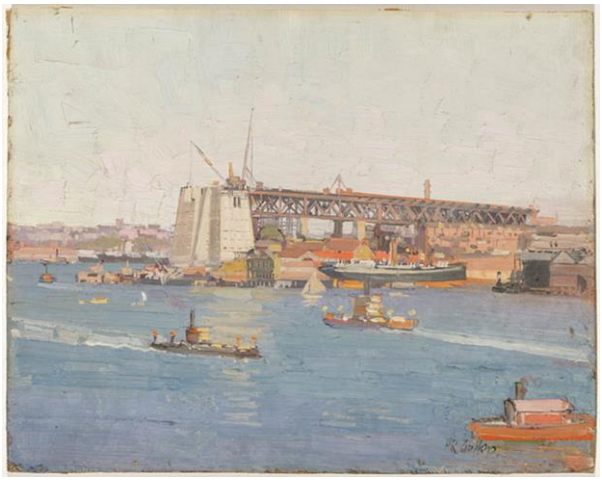
There was an enormous demolition on Dawes Point on the south side of the harbour. The building materials from the houses went for very low prices, one house's material was sold for 10 pound. The Scots church that JD Lang had built behind the rocks was a demolished and replaced with the larger structure. The Old Dawes Point battery was destroyed as well. Property owners were compensated; leaseholders and casual renters were not.

During the seven years of its construction there was a fair amount of cynical humour about whether the Bridge would be finished on time if at all.

> "My father who worked in his butchers shop in Neutral Bay (north shore), told me that many people were sarcastic about the Bridge, because they thought the cars had to go up and over the arch. There were not many cars on the North Shore at that time and none of them could have made the climb over the arch. They changed their tune when the Bridge opened ." 8 (Egan, A 2017).

It was in 1932 when the Bridge was finally finished with a 1600 foot span, dual road, for rail and train tracks and its ornamental pylons in the Egyptian manner. It was tested with a load of ninety six steam locomotives and forty eight coal tenders, (weighing 76000 tonnes) buffer to buffer and pronounced safe and ready.

Art and the bridge



Dawes Point, showing Sydney Harbour Bridge in the course of construction, ca.1927 / oil painting by Herbert R. Gallop 1890-1958). Call Number ML 437

As a feat of modern engineering, the nationalistic tenor of the project captured the imagination of the country with many artists documenting its progress. A themed exhibition celebrating the Bridge's completion was hosted by the Australian Painter-Etcher Society in April 1923.

The Bridges construction excited the artist's community from cartoonists and graphic designers to poets and painters.

Harold Cazneaux: photographs of Sydney city, PXD 806/1-39

Another artist in the Library's collection who drew the construction of the bridge was Jessie Traill, who was drawn to large industrial works like the building of the Sydney Harbour Bridge. The Library has a series of Traill's drawings and prints depicting the construction. From the beginnings of the project in 1927 to its completion in 1932, Traill regularly travelled to Sydney to record the emerging and ever-transforming structure.

Sydney Harbour Bridge under construction, 1927-1932 / prints by Jessie Traill, 8. The Red Light Harbour Bridge June 1931, 1932. Aquatint PXD 335 vol. 3

Traill's etchings of the bridge embrace the intrinsic patterns and contrasts of the structure's scaffolds and girders, beginning with the early, frenzied stages of construction. This animation gives way to a sense of stillness in 'The red light, Harbour Bridge,' July 1931, in

which the bridge is shown in totality; its steelwork arch sweeping across the Sydney Harbour skyline.

> "What we see is a solid mass of concrete and intricate lace work of iron made more intricate by the play of light and shade; something that giants might play with as a child would with his Meccano Set." (Traill, J)

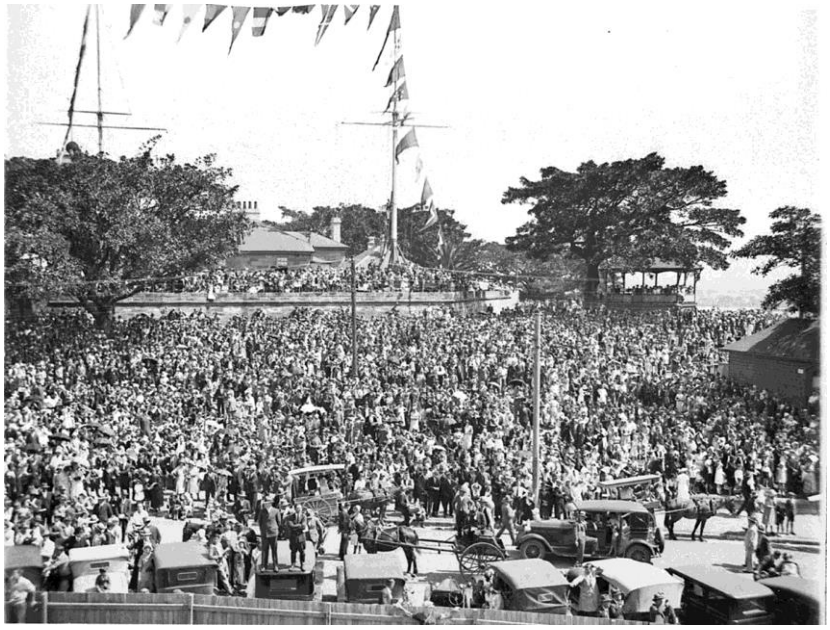
Bridge Opening

> "In tendering my thanks, I do not forget the workmen who so splendidly responded to the trusts we placed in them. Throughout, they worked magnificently and built the bridge a credit to industrial Australia. " (Bradfield, J. 1932)

Dr and Mrs JJ.C. Bradfield, Ted Hood collection Home and Away - 5302

JJC Bradfield's vision of Sydney captured the imagination of many including the NSW Premier J T Lang.

> " Bradfield wanted to be the Napoleon III of Sydney, he wanted to pull down everything in his grandiose schemes always thinking of the future. He was the first person to plan for a city of 2 million" (Spearritt, P, 1979.)



Huge crowd waiting for the opening Sydney Harbour Bridge 19th March 1932 Sam Hood, Home and Away - 5279

A million people are said to have shared in the opening. It was broadcast live across Australia, Britain and the US. There were pageants, balls, a sailing regatta, a race meeting, a celebratory cricket match. There were many processions including some led by lady Life Savers and survivors of the Sudan War, 1885.

The opening of the Bridge shifted the function of Sydney. It also changed the perception Sydney had of itself, and its place in the world as it was the largest arch bridge at the time and the first world class structure built in Sydney (now of course we have the Opera House).

Labor Premier Lang, who officially opened the Bridge, was abhorred by the conservatives and those with loyalty to the King. The New Guard were such a group and one member Frances De Groot took on the role of disrupting the official opening on 19th March 1932.

The public were surprised and amused to see a man whip in and cut the ribbon before the premier could wave his scissors. A wild horseman in Army uniform, brandishing a sword burst from the crowd, brandishing a sword, he slashed the ribbon with his sword and shouted as he opened the Bridge , "in the name of the decent citizens of NSW" he was pulled from his horse by the police, the ribbon tied together and the ceremony proceeded.

De Groot, an antique dealer was taken to a psychiatric hospital for evaluation, found sane and fined five pound with 4 pound extra fine for offensive behaviour in a public place. He receive quite a lot of public support.

Impact of the bridge

> "The harbour bridge, like a humpback dominates almost every aspect of the city as inescapably as the blue water fills the end of every other view. Day and night as trams, omnibus, motor cars and human beings cross from north to south and back again, the bridge trembles like a living thing." (Slessor, K, 1940?. p.23)

As well as the visual impact on the city skyline the Bridge changed the nature of travel in Sydney, use of ferry's diminished and the number of people living on the North Shore increased.

In 1934 (Closed in 1971) the South East Pylon opened as a tourist venue, and during the 1950s to 1971 there was a pylon lookout with the "All Australian Exhibition" showing display's of Australia's achievements from agriculture to mining. The Pylon also housed a tearoom and souvenir shop and owned the famous Pylon White Cats. They had a 'cattery' on the Pylon roof and became a major tourist attraction.

A toll was originally placed on travel across the bridge, in both directions, to recoup the cost of its construction. This cost was recovered in the 1980s, but the toll has been kept (indeed increased) by the State Government's Roads and Traffic Authority to recoup the costs of the Sydney Harbour Tunnel.

In December 2006, Bridge Climb provided an alternative to climbing the upper arches of the bridge. The Discovery Climb allows climbers to ascend the lower chord of the bridge and view its internal structure. From the apex of the lower chord, climbers ascend a staircase to a platform at the summit.

Collection 08: Events, celebrities, celebrations and performances in Sydney, 2011-2013 / photographed by Robert Wallace New Years Eve fireworks from Barangaroo, 1 January 2012

The Harbour Bridge along with the Opera House have become immediately recognisable as symbols of Sydney and Australia.

The Harbour Bridge has become a focal point for celebration and protest. Decorated with fireworks for New Year's Eve and covered with hundreds of thousands of people in the 'Walk for Reconciliation' in 2000.

The Bridge also continues to be recorded and celebrated by photographers, artists and writers.

As JJC Bradfield said in his final report on the Sydney Harbour Bridge "that future generations would judge us by our works" (Bradfield, J, 1933. p6)

I think he would be judged a success.

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Bridges, Engineering, Architecture and Empire: Dorman, Long & Co in the 1920s and 30s

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Introduction

Dorman Long is a famous name in bridge building, being responsible for bridges world-wide, from the Sydney Harbour Bridge started in 1923 to the Humber Bridge completed in 1981. See Redpath Dorman Long (1982), and Russell (2002). However, the company started as a steel manufacturer, becoming a bridge builder at short notice and by accident. My interest in Dorman Long sprang from an architectural history study of the partnership, Sir John Burnet and Partners, in the 1920s. The work of the partnership in the 1920s is described by Edwards (1930). For most of this period the senior partner was the Scottish architect Thomas Tait, some of whose life and work has been described by Walker (1991). As described by Wardleworth (2016), Tait designed the pre-stressed concrete, stone-clad pylons of the Sydney Bridge, structures which act as gateways onto the bridge. In preparing this account I became intrigued by three questions:

Figure 1 Sydney Harbour Bridge

Why did Dorman Long take the precipitate decision to take on the Sydney Bridge project?

How, having moved into bridge building, did they manage to sustain a successful international operation through the difficult interwar period?

What influence, if any, did this bridge building adventure have on the development of the company?

This current paper seeks to answer those questions.

I start by describing the events which lead up to the signing of the contract for the Sydney Bridge between the New South Wales Government and Dorman Long in 1924. I then discuss Dorman Long's business strategy in the 1920s, the expansion of its bridge building and steel construction business, and the value of strategic business partnerships and of imperial connections. I consider the crisis faced by the company in the early 1930s, and how it was resolved, and the role of the bridge building department and the British Government in this. Finally, I explore the growing business confidence and success of the company in the run up to the Second World War.

The Sydney Harbour Bridge

Figure 2 The Hell Gate Bridge

Bradfield (1934) has described how in January 1921, the Parliament of New South Wales authorised him to arrange for a cantilever bridge over Sydney Harbour. As engineer in chief for the City Transit, John Jacob Crew Bradfield was given the task of obtaining bids from suitable companies. In anticipation of this in early 1914 he had already undertaken a global tour looking at the latest in bridge technology and meeting bridge builders. In September 1921, he issued a specification for a cantilever bridge and a call for bids. One of the companies to receive this call was the Cleveland Bridge & Engineering Company of Darlington, UK. The chairman of the company, Charles Dixon contacted Ralph Freeman of the engineering consultants Sir Douglas Fox & Partners, with whom he and his senior engineer Georges Imbault had worked on the Victoria Falls Bridge in 1905, see Freeman (1934: 433). Freeman did not believe that a cantilever bridge was appropriate, believing that a bow-string truss arch bridge such as the Hell Gate Bridge in New York designed by Gustav Lindenthal and completed in 1916, would be more suitable for the site. For a brief history of the bow-string truss, see Cruickshank (2010: 37). Freeman persuaded Dickson to allow him to develop this design also. Lindenthal's design had incorporated towers at each end of the bridge which were decorative only, serving no engineering purpose. Freeman did not want towers, preferring a pure arch, see Freeman (1934: 429). Dixon wanted towers to be provided as an option, and called in Sir John Burnet and Partners to design them.

Thomas Tait, recently returned from the Middle East where the practice was designing memorials for the First World War, provided towers based on Egyptian temple entrance pylons. As with the Hell Gate towers they serve no engineering function. At 87 meters high they are huge abstract sculptures providing symbolic entrances to the bridge at each end, and a sense of stability and balance. For the bid by Cleveland Bridge, Freeman and Tait provided some different options, including an arch without pylons and a cantilever version. The complete set of bids received from all companies are described by Bradfield (1924). The perspectivist Cyril A. Farey, at that time employed by Sir John Burnet and Partners, prepared drawings and water-colour paintings for some of the options, which were included in Dorman Long's bid. See Farey (1924).

Figure 3 Farey's painting of the Sydney Bridge

Bradfield (1922a) has described how on 16 March 1922, he embarked on another world tour visiting companies preparing bids. He went to New York and met Lindenthal who was

preparing a suspension bridge design for McClintic-Marshall. He saw the Hell Gate Bridge. He visited Dixon in Darlington, who put in a strong plea for the arch option to be included, and may have shown Bradfield the Farey perspectives. At the end of his tour Bradfield was very enthusiastic for the arch design. Before returning to Australia on the SS Diogenes, he sent a cable to Sydney asking for the deadline for tenders to be extended. On the voyage back he spent time calculating to convince himself that the arch design was practical, Bradfield (1922b). After he arrived back on 17 January 1923 he issued a revised call including the option of an arch bridge. In the new specification Bradfield wrote: 'Tenderers must distinctly understand that although cost will very largely be the determining factor … the aesthetic appearance of all details of the Bridge and Approaches will receive due consideration.' Bradfield (1923: 16). I think that this is a strong hint that Bradfield already wanted the arch with Tait's pylons.

Shortly before the deadline for submitting bids, on 25 September 1923 Charles Dixon unexpectedly died. Within days the board of Cleveland Bridge met and decided to withdraw from tendering for the Sydney Bridge. With Dixon gone there was no support for taking the risks involved. When he heard of this, Bradfield cabled Cleveland Bridge asking them to reconsider, pointing out that he had included the arch bridge option at Dixon's request, see Freeman (1934: 434). The board was unmoved. Freeman contacted Lawrence Ennis, general manager of the Redcar Steel Works owned by Dorman Long, possibly one contact among many. Ennis was an American engineer who had started his career as a bridge builder, and who, like Freeman, was a member of the Institution of Civil Engineers. Together they persuaded the two most influential board members, Sir Arthur Dorman and Sir Hugh Bell to take on the project. On 9 October, just two weeks after Dixon's death, Ennis was at a Dorman Long board meeting at which, according to the minutes, he showed 'the Architects' plans of the bridge' probably including Farey's paintings. The board backed the project (DMB, 9 October 1923). A Dorman Long team, including Ennis, was despatched to Sydney, and by March 1924 a contract for £4.2m, about £200m in today's money, had been signed (DMB, 11 March 1924). Ennis was promoted to the Dorman Long board, and put in charge of the construction project, living for the next 10 years in Sydney. Georges Imbault, who had been working with Freeman on the preparation of the bid, resigned from Cleveland Bridge and joined Ennis's team in Sydney, see Redpath Dorman Long (1982).

Why did the company take on the project?

To understand why Dorman Long took on the Sydney project so quickly we need to look at the history of Dorman Long and the key people involved. James (2013) provides the most detailed study. Dorman Long was formed in 1875 when Arthur Dorman, son of a Kent coal merchant, then 27 years old, formed a partnership with Albert de Lande Long, son of an Ipswich solicitor, 31 years old, to purchase the West Marsh Ironworks in Middlesbrough. From the start the company followed a policy of rapid expansion by acquisition and merger, and a switch of focus to steel-making by the open-hearth process. The acquisitions also brought in the ownership of large iron ore deposits and coal fields so that the Dorman Long company became able to supply most of its needs in raw materials. By 1914, the company was one of the largest steelmakers in the UK.

Arthur Dorman was Chairman and Managing Director and as such very much in charge. Long disappeared. By 1923 the members of the Board of Directors were all either of the Dorman family or of the families who owned companies that had been taken over. Of these

Hugh Bell, of Bell Brothers, taken over in 1901, was Vice-Chairman, and the only other Director of any influence. Once Ennis had persuaded Dorman and Bell, the Board rubber stamped the decision. It had been Ennis who had been in charge from 1914 of converting the Redcar Works into a war machine, producing about half the shells used by the British Army. It had been Ennis who oversaw the building of a large steel-making plant at Redcar from 1916 onwards using a cheap loan from the Government. In a speech reported in The London Times Dorman (1920) said that he trusted Ennis as 'a man not given to prophecy unless he has good grounds to go upon'. Dorman trusted Ennis as a man who could deliver the Sydney Bridge. Dorman also saw this move as furthering the strategy of vertical integration, by becoming a major user of its own steel. Manufacturing in the UK had entered a severe depression from which Dorman Long were suffering. Industries like shipbuilding, a major user of steel, were in rapid decline. A thriving bridge building business overseas could boost the steel making business. Dorman's dominance of the company and the entrepreneurial temperament that had produced its rapid expansion made it easy for him to make a quick decision.

How did bridge building thrive?

Dorman decided to move vigorously into bridge building and construction, setting up a department based in London. Building in London was expanding, with large new office blocks and shops, all using steel frame technology. This expanding department required strong leadership. The obvious candidate, Ennis, was needed to stay in Sydney to make sure that the flagship project, the Harbour Bridge, did not falter. Leading a project of this kind required leadership and engineering skills of a high order to overcome the inevitable unforeseen problems that could arise. To run the London office, Dorman Long recruited Charles Mitchell from outside the firm. Mitchell is a rather shadowy figure. It is not clear where he came from. Boswell (1983: 109) says his 'earlier career had been in constructional engineering and the supervision of large contracts at home and overseas'. There is no doubt he made a success of running the Bridge Department and developed strong contacts with important figures in the City and in the Bank of England. It may have been these contacts which enabled him to get early information about overseas projects on the fringes of Empire, in Egypt, in Sudan, in Rhodesia and in Thailand, enough to make the bridge business a profitable one.

One of the first bridges for the new department was in the UK, the Tyne Bridge, Newcastle to Sunderland. Design work on this started in late 1924. It was another bow-string truss arch like the Sydney Bridge, designed by Mott, Hay and Anderson, with Freeman retained as consultant, see Dorman Long (1930: 49-52). The bridge was opened before huge crowds, much ceremony and much publicity by King George V. He and Queen Mary drove across the bridge in their Ascot landau. Very soon pictures of the growing arch in Sydney started to appear in the British Press. Dorman Long's bridge building provided an important boost to its prestige at a time of acute business difficulty. The supervising engineer recruited for the Tyne Bridge, James Ruck, became a stalwart member of the Bridge Department through the interwar period.

Other projects started in the 1920s retained the partnership with Freeman and Tait. The first was Alfred Beit Bridge over the Limpopo in Rhodesia, see Dorman Long (1930: 49-52). Alfred Beit was a close colleague of the South African empire builder Cecil Rhodes and made a large fortune in gold and diamonds, see Albrecht (2012). When he died he left a will

of about £4 billion pounds in today's money, which set up a trust to create infrastructure in Rhodesia, including bridges. The first bridge across the Limpopo linking Rhodesia with South Africa, it was designed by Freeman and built by Dorman Long, being opened on 31 August 1929. Tait's contribution was the design of a concrete pillar at the centre of the bridge which bore a bronze plaque containing a low relief portrait bust of Alfred Beit by Henry Pegram RA.

Figure 4 The Memorial Bridge, Bangkok

The second was the Bangkok Memorial Bridge, or the Phra Phuttayotfa Bridge, crossing the Chao Phraya River and joining the two halves of the city. Designed by Freeman it has a central bascule style span. It has four obelisks, two on each end, acting as entrance markers, designed by Tait, see Anon. (1932: 248-9). The original design was much more decoratively elaborate, including an equestrian statue of the King of Thailand, but these plans were considerably cut back because of a shortage of funds, as described by Fusinpaiboon (2014: 409-413). Construction started in December 1929 and the bridge was opened on 6 April 1932 by King Rama VII. Ruck was the supervising engineer.

The problems with Dorman Longs steelmaking business

Through the 1920s the Bridge Department and the Sydney Bridge were operating almost as separate organizations. They still needed finance from Dorman Long to provide working capital, but each project appeared to produce profits. Ennis and Mitchell provided separate written reports every month to the Board. Ennis was a Board member but being in Australia he attended only one meeting, in 1927, where he presented a verbal report. In contrast, as described by Boswell (1983: 109) the core steelmaking business was performing very badly. Much of its plant was mothballed. It was making only small profits, even the occasional losses. No dividends were being paid. To raise capital, it had to resort to bank lending or the issue of debenture stocks which committed it to annual interest payments which were becoming increasingly burdensome. Arthur Dorman's statements to the Annual Meetings, as published in The Times every December, although acknowledging the difficulties always offered rays of hope for the future. He would have believed this. He had been with the company for 50 years, and seen many cycles of depression and recovery.

There was much concern about the state of British industry. It was increasingly recognised that compared with overseas competition, British industrial units were smaller and less efficient. There were calls for 'rationalisation', mergers of whole industries followed by ruthless efficiency drives and the closure of uneconomic assets. There were some successes. The whole of the heavy chemical industry had merged to form Imperial Chemical Industries in 1925 (Reader 1970-76). The steel industry, in spite of the many mergers which had taken place was seen as a particular problem area by people in the City and Government, with Dorman Long its heavy indebtedness and aging autocratic leadership the most difficult. The idea of a united and efficient North-East Coast steel company centred on Tees-side began to

be floated. In late 1927 merger talks started between the Middlesbrough rivals Dorman Long and Bolckov Vaughan. The two were combined under the name Dorman Long. Sir Arthur Dorman saw this not as 'rationalisation' but a continuation of his policy of expansion by merger. The next step was to be a merger with the South Durham company, the only remaining rival in the North-East.

The crisis in the 1930s

The first sign of a more radical change and of possible external pressure was the election of Charles Mitchell to the Board (DMB, 13 March 1929). Mitchell, based in London, was seen by people in the City and the Civil Service as one of the most successful and dynamic of the senior managers in Dorman Long. It was hoped that he could push the merger and the rationalisation of Dorman Long forward. But South Durham, half the size of Dorman Long and not laden with debts, were reluctant to join what they saw as a dinosaur wishing to swallow them up. Boswell (1983: 115-21) Talks did not start well. Sir Arthur Dorman's insistence on wanting to call the merged company Dorman Long seemed to confirm South Durham's view. The banking crisis of September 1929, following the Wall Street crash, exposed Dorman Long's weak financial position. The resulting weakness of the Australian pound also exposed the fact that the Sydney Bridge project had made a loss. In 1930 Dorman Long were unable to pay the interest owed to debenture holders.

In April 1930, the Labour Government formed a company called the Bankers' Industrial Development Company, the BID Co, with a nominal capital of £6m, provided by the City. Its Board, chaired by Montague Norman, the chairman of the Bank of England, was given the remit of reorganisation and rationalisation, and the steel industry was in its sights. Mitchell became a member of the BID Board, see Boswell (1983: 109). The talks between Dorman Long and South Durham dragged on but the BID Co could start to apply direct pressure by offering cheap loans under certain conditions. In February 1931 Sir Arthur Dorman died at the age of 83, but to the horror of the BID Co, Sir Hugh Bell, 3 years older than Dorman, was elected in his place. However, Sir Hugh died in June. Mitchell was elected Chairman and set about a reorganisation of Dorman Long's finances and a clearing out of senior management.

The reorganisation of the finances required a writing down of the capital value of the company The debenture holders took a significant financial hit. They formed an action committee, chaired by Sir Miles Mattinson, a significant figure in the investment trust world, and advised by a 42-year-old accountant from Peat, Marwick and Mitchell called Ellis Hunter who had previously audited Dorman Long's accounts. Mattinson criticised the company for 'bad trade in the past … unfortunate commitments … extravagance … excess of capitalisation on amalgamations which had not prospered … splendid bridges which did not pay;' an obvious reference to the recently discovered debt in the Sydney Bridge account (Boswell, 1983: 157). The committee decided to sue Dorman Long asking for the company to be put into the hands of Receivers. The court found in their favour suggesting the terms of a negotiation with the company to avoid receivership. The talks with South Durham collapsed. On 28 March 1934 (DMB) Mitchell resigned as Chairman and Managing Director. On the same day work started on the Birchenough Bridge in Rhodesia (BDCF 8).

The last bridges of the 1930s

Figure 5 The Birchenough Bridge

The Birchenough bridge was the second built by Dorman Long for the Alfred Breit Trust. It was another arch bridge designed by Freeman, without towers. To quote the press release (BDCF 8) for the opening ceremony on 26 December 1935: 'The bridge itself is something to stir the imagination the great single arch of 1080 ft. span, the third greatest arch span in the world, and nearly twice the span of the Tyne Bridge at Newcastle, rising 380 ft. above the river and towering above the Bush land of the wide valley of the Sabi, in an area inhabited only by Mashona and kindred tribes, an area with a few rough wagon tracks as its only means of communication, and the nearest small town 80 miles distant.' It is very beautiful. The spare curve without towers making it like a rainbow hovering over the rural landscape.

Ruck was now Manager of the Bridge Department, reporting to Ennis, now Managing Director. There were significant problems with the construction of the bridge which the resident engineer, Leishman, found difficult to deal with. Ruck decided to go out to Rhodesia himself, take over from Leishman and send him off on leave of absence. The problems Ruck faced and solved are set out in a series of letters he sent back to Ennis (BDCF 8). When he arrived on 17 March 1935 he wrote that he had found a variety of problems 'in particular with the derrick cranes' used in the erection process. He complained that 'the plant supplied and the general erection scheme for this job is pathetic and a positive disgrace to us.' He reassured Ennis: 'You must not let any of this worry you. I will straighten all this out … I am in my natural element now.'

On 1 April Ruck wrote that the set of complaints that Freeman had made in an earlier letter had 'no justification' and that Freeman had now 'practically apologised'. He had been badgering Freeman, 'that it was impossible to build this arch as designed … cross members should be fixed at certain panel points.' Freeman had denied this at first but later agreed that they were essential. On 10 May Ruck reported that Freeman was now on site and that they had sorted out concerns with the erection process. Leishman was also back and in very good health. 'His problem was that he was over-worried by certain conditions that should never have arisen on this job. They are, of course, now all straightened out.'

On 17 June Ennis wrote: 'Directors join me in congratulating yourself, your staff, your workmen and all those contributing to the successful completion and connection of an Arch that will be recorded in bridge history as an outstanding feat both from a design and construction point of view.' Ruck wrote back: 'Coming from you, I know that you are congratulating my staff and myself for bringing to a successful conclusion a piece of work fraught with numerous risks, problems, and difficulties, which only a man with your experience can ever visualise, or realise, existed.' He contrasted this with the usual congratulations received from directors who had no real understanding of what was involved.

The crisis resolved

At the Board meeting on 28 March 1934 (DMB), at which Mitchell's resignation was accepted, Ennis was present, having now moved back from Australia. Ellis Hunter was also 'in attendance', presumably on behalf of the debenture holders. RD Kitson, who had been chairman of Bolkov Vaughan when it was taken over by Dorman Long, was elected as Chairman, but he made it clear that this would be very temporary. On 17 April (DMB) Ennis was formally appointed as Managing Director. On 9 October (DMB) it was announced that Baron Greenwood had accepted the post of Chairman and that a Board of eight would be appointed, the Chairman, three nominated by the debenture holders, four by the present board. On 19 October (DMB) Kitson made way for Greenwood, and the new Board, including Ennis, met for the first time. The debenture holders were no longer looking for receivership and had effectively taken control.

Greenwood was undoubtedly seen as a calming influence. A short biography by Seedorf (2004) describes him. A Canadian who had emigrated to Britain as a young man, he became a Liberal MP for York and then for Sunderland, and a member of Lloyd George's Coalition Cabinet from 1919 to 1922. He was the last First Secretary for Ireland, pursuing a ruthless policy of suppression, using the infamous 'Black and Tans', and negotiation, leading to the creation of the Irish Free State and the UK Province of Northern Ireland. He was 64 when he became Chairman of Dorman Long.

From 1934, under the triumvirate of Greenwood the tough politician, Hunter the forensic accountant, and Ennis the experienced engineer, the steel business of Dorman Long began to improve. The Bridge Department was slimmed down considerably and started to concentrate on small bridges. Apart from the Birchenough bridge there were to be just two further large bridges, the Storstrom Bridge in Denmark, started before 1934, and the Zambesi Bridge. The Storstrom Bridge was at the time the longest bridge in Europe (BDCF 6), designed and supervised by the Danish Railways bridge department. Dorman Long supplied the steel and shared the construction with a Danish construction company. In 1937 a third contract was obtained from the Alfred Beit Trust, this time a suspension bridge over the Zambesi, designed by Freeman (BDCF 36).

In 1937 the Board undertook a review of the department (BDCF 1). The Accountant in a memo dated 7 April 1937, estimated that from 1924, when the Bridge Department was formed, to 30 September 1936, the department, not including the Sydney Bridge, made a net profit of £186,998.10.9d. The Sydney bridge may well have lost at least the whole of this profit just because of the depreciation of the Australian pound. On 15 October 1934, the Accounts Department noted that £552,000 were sitting in the Bank of New South Wales, presumably part of the receipts from the contract, when the Australian pound stood at £125 to £100 sterling. The memo noted that small bridge construction had in the early days lost money, but that since the slimming down of the Bridge Department, and the consequent reduction in overheads, such contracts now made a profit. It noted that policy was now 'standing down [bridge contracts] in favour of customers for plain material'. Large contracts were few, and with business booming 'we can work our Mills and Constructional Department to capacity without orders from the Bridge Department.' However, it noted that 'during the last depression … the orders for the Storstrom Bridge … were very helpful indeed' and that 'it would appear to be prudent to consider possible markets which might be available when trade is not as good as it is at present.' The Bridge Department might be kept in a low state of operation as a fall-back if times became hard again.

Ruck wrote a memo on 19 March 1937 on how to make greater use of the Bridge Department (BDCF 1). He had already pointed out that 'the present world shortage of steel is likely to have the effect of discouraging … the building of big bridges.' He noted that although the 'staff … had been cut down … the remaining staff forms a cadre of considerable technical organising and managing ability.' He suggested that the 'Department could have its usefulness considerably extended … [when] the British Government is carrying out its re-armament programme.' He suggested pursuing 'large Contracts for various classes of construction work'. 'If the services of Mr Ralph Freeman, who is retained as our Consulting Engineer, were also associated with us … we would be offering a collaboration of exceptional value, as Mr Freeman's position and standing ranks very high in the Engineering World.' He added that Freeman 'had very considerable experience during the Great War … That work, on which I acted as Agent under Mr Freeman's instructions … was regarded in Government circles … as a civil engineering achievement of great war value.' The Zambesi Bridge when completed was the last bridge, and from then the Bridge Department was fully engaged in re-armament work.

Hunter was appointed to the Board as Deputy Chairman in January 1938 (DMB). In May Ennis died (DMB 20 May 1938) of a heart attack in his office at the age of 77. Hunter became Managing Director and later Chairman when Greenwood retired, taking full control in the post Second World War period.

Conclusion

To return to the three questions I posed at the start.

Why did Dorman Long take the precipitate decision to take on the Sydney Bridge project?

Sir Arthur Dorman dominated his Board, who simply accepted his decisions. He was an adventurer, liking to expand into new areas without worrying about the detail. He saw the proposal as meeting his strategy of vertical integration to make Dorman Long as self-sufficient as possible. He admired and trusted Ennis.

How, having moved into bridge building, did they manage to sustain a successful international operation through the difficult interwar period?

The Sydney Bridge was a one off and treated as separate from the Bridge Department. Ennis and Imbault were isolated in Sydney and had no influence on the development of the department in London. The recruitment of Mitchell was the key. His entrepreneurship, his contacts within the City and the Civil Service allowed him to bid successfully for contracts in and on the fringes of the British Empire. The relationship with Freeman allowed them to win a string of successful contracts for large bridges. The company had recruited engineers of genuine ability in people like Ruck, who were able to provide the mastery of detail and improvisation required to make Freeman's designs work. However, the restructuring of the company included a significant reduction in the size of the Bridge Department.

What influence, if any, did this bridge building adventure have on the development of the company as a whole?

Probably negative. Mitchell was running the Bridge Department, which made him the obvious choice for Chairman and Managing Director when Dorman Long's crisis came. He did try to change the culture of the company to improve its performance, but his handling of the South Durham merger talks was a disaster which almost brought the company to ruin. It is also interesting to speculate what might have happened to Ennis and to Dorman Long if he had avoided banishment to Sydney. It is very likely that he would have become Managing Director earlier and the history of Dorman Long as a steelmaker in the late 1920s might have been quite different and more successful. However, the collaboration with Freeman and Tait produced some beautiful and inspirational bridges, which struck and still strike the popular imagination. Dorman Long, one of the largest steelmakers in the UK, is remembered mainly as a bridge builder. Failing to take up the Sydney Harbour Bridge contract might have made Dorman Long richer, but would have made the world a poorer place.

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Picture credits

Figure 1. The Sydney Harbour Bridge. Photograph by the author.

Figure 2. Hell Gate Bridge, New York. (CC-BY-SA-2.0): Rob Zand (2012): Wikimedia Commons File: Hell_Gate_Bridge_cricket.jpg.

Figure 3. Tender A2. Proposed Arch Bridge across Sydney Harbour. Cyril A. Farey, 1923. State Records New South Wales, Sydney. In series NRS 17045. Courtesy of SRNSW.

Figure 4. The Memorial Bridge, Bangkok. (CC-BY-SA-4.0): Cun Cun (2016): Wikimedia Commons File: The Memorial Bridge, Bangkok.jpg.

5. The Birchenough Bridge. (CC-BY-SA-4.0): Graph Geo (2014): Wikimedia Commons File: Birchenough Bridge.jpg.

Heavenly work on earth: medieval bridge building as an act of piety
BRIDGE: The Heritage of Connecting Places and Cultures at Ironbridge July 2017

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Introduction
Peter McKeague, David Harrison and myself are researching the topic of bridge chapels and our aim is to produce the first major publication devoted to the bridge chapels of medieval England and place these monuments in their European context. In 2020, we will publish a volume of synthesis concerning English bridge chapels and their European parallels, which will be supplemented by a comprehensive online site gazetteer. Full details concerning the various unreferenced examples of bridge chapels cited below will all be included this gazetteer. For interim statements concerning our ongoing research see Harrison (2015) and Harrison *et al* (2010).

From the 12th century onward there is increasing evidence that bridges across north-west Europe were built as acts of piety and as a result many of these bridges were furnished with chapels as emblems of Christian charity (Boyer 1976, 31-40; Duffy 1992, 367). The aim of this paper is to briefly explore why, how and when and this process of bridge chapel construction took place within England (until the Reformation) with reference to European examples.

Why
Until the Reformation the Roman Catholic church was the only branch of Christianity that was recognised within Western Europe. Therefore, the development of medieval bridge chapels must be seen within the contemporary ideological framework. Interestingly, the pope and every bishop was a *pontifex* (bridge-builder). This would have served as a reminder to 'theologically sophisticated, bridges were symbolic as well as practical structures, emblems of the Christian life and of the communication of charity within the community' (Duffy 1992, 367).

An important aspect of the teaching of the medieval Roman Catholic Church concerned sin and personal salvation. Only the exceptionally vitreous were expected to go straight to heaven and the evil or very sinful the church taught went straight to hell, while the vast majority of people expected to spend some time in purgatory as because of their sinful lives their souls would need 'cleansing' before they could go to heaven (Chidester 2000, 162-71). Indulgences were a certificate remitting some of this time or punishment in purgatory obtained in return for acts of charity including cash donations to the church or an approved organisation. Of course one advantage of giving money towards bridge construction or repair opposed to simply donating the equivalent sum to a local church was that there was the added bonus of community benefit. Rochester Bridge chapel (Kent) displayed a scroll listing its benefactors' names as a public reminder of their generosity (Becker 1930, 21). There are numerous examples of indulgences being granted by the pope, plus English archbishops and bishops for bridge construction and repair. One of the earliest English bridges to raise funds this way was Thrapstone, (Northamptonshire) in 1224, by 1313 this bridge possessed a chapel. In 1225 Archbishop Gray of York granted an indulgence to all those who contributed to the construction of Elvet Bridge Durham and he granted another one in 1228 for the construction of Otley Bridge (West Yorkshire). It was the corrupt and commercial sale of indulgences in 1517 that triggered Martin Luther's protest which begun the Reformation (Chidester 2000, 342).

In William Langland's *Piers the Ploughman* (B text *c*. 1377-79, Book vii, an allegorical theological text and social satire – the quest for faith/truth in a wicked world), we hear of Truth wanting merchants to use their profits to 'repair the hospitals and help folk in trouble –

to get the bad roads mended quicker and rebuild broken bridges' etc. in return for which Truth promises that St Michael the Archangel will lead their souls to Heaven (Langland 1978, 78).

How: Definition and spatial location and distribution

The best known bridge chapels are situated on or physically attached to the bridge structures. Widely known examples of chapels situated on bridge piers include Wakefield,(West Yorkshire) or St Ives (Cambridgeshire). But there are other spatial locations for bridge chapels including at one end of the structure. Examples include St Mary's Bridge, Cromford (Derbyshire). While some chapels were situated a short distance away from the bridge they served along the approach road. Examples of detached chapels include Rochester (Kent) and Morpeth (Northumberland) (figure 1) (see McKeague in this volume for a more in depth discussion).

Figure one, Morpeth bridge chapel, showing the 1738 eastern extension. Today the former chapel serves as a bagpipe museum, craft shop and tourist information centre(copyright author).

The vast majority of English bridges surveyed possessed only one chapel, but Exe Bridge (Exeter) had two chapels and a parish church (in 1411 one of its chapel's closed and relocated). Examples of bridges with two chapels include: Maidenhead (Berkshire); possibly Tyne (Newcastle-upon-Tyne); St Ives; Bideford (Devon); Elvet Bridge (Durham); Ludford (Ludlow) and Ilchester (Somerset). Some chapels like those on London Bridge (City of London) or Ouse Bridge in York were clearly integral features of construction. The construction of some chapels, such as Old Trent Bridge (Nottingham) and Rochester (Kent) and can be linked with rebuilding programmes. However, this was not always the case as Foss Bridge (York), which is first documented in 1145-48, did not acquire a chapel until 1424. Likewise Catterick Bridge (North Yorkshire) was rebuilt in 1422-25, but a chapel was not added until 1505. Some chapel sites were also adorned with crosses or shrines, while

other examples just possessed a cross or a statue and no chapel (discussed later). There are also instances where a monastic house or a hospital served as bridge chapel (discussed later). A number of English medieval bridges possessed other buildings such houses/shops (which generated revenue for maintenance) or served as part of urban defences (Harrison *et al* 2010, 47-49). Medieval London Bridge in addition to its chapel was lined with houses and shops. It also possessed a 'Drawbridge tower' and a 'Stonegate' (or barbican) to defend the southern approach to the city (Watson *et al* 2001, 105-108; figure 2).

Figure two, medieval London Bridge looking north-west showing the chapel of St Thomas the Martyr (1), the Drawbridge Tower (2), the Stonegate (3) and the church of St Magnus the Martyr (4).This view is based on a portion of Wyngaerde's panorama of circa 1544.

As medieval bridge chapels were non-parochial places of worship, the priests that staffed them were described as chaplains. The smaller English bridge chapels generally were staffed by one chaplain, but some poorly endowed examples could not afford a full-time chaplain. For example, in 1538 services at Bridgnorth Bridge chapel (Shropshire) were conducted by the local Franciscans on a paying basis. The larger, wealthy urban chapels, such as those at London Bridge or Ouse Bridge employed a number of chaplains and other staff.

When

It has been suggested that the concentration of Roman coins and other objects recovered during dredging interpreted as votive offerings imply the existence of one or more phases of shrine on Roman London Bridge (Watson *et al* 2001, 34-35). Dredging on the site of the Roman and medieval Tyne Bridges at Newcastle Upon Tyne has produced a Roman altar dedicated to Neptune and a figure interpreted as Fortune, implying the existence of a shrine on the bridge. The Roman bridge at Kâhta or Kiakhta in Turkey, often referred to as the Severus Bridge, originally carried four dedicatory columns, three of which survive. The Latin inscription on these columns state that the bridge was built by four local cities in honour of the emperor Septimius Severus (AD 193-211) and his family (O'Connor 1993, 129).

During 1031-37 Eudes II, Count of Blois announced he would construct a bridge across the Loire at Tours in France, for the benefit of his soul (Boyer 1976, 34). Blois Bridge, also located in France had been completed by 1078, when two of its water mills were given by Etienne, Count of Blois to the Benedictine Abbey of Pontlevoy (Boyer 1976, 38). Latterly this bridge also possessed a chapel dedicated to St Fiacre, plus fortifications (Porte Saint Fiacre), houses and shops. In 1185 at Lyons in France the abbot and monks of Ainay contended that the bridge chapel on the bank of the River Rhone was prejudicial the prosperity of St Michael's parish church and the brothers of the bridge fraternity (see below) agreed to remove it. However, in 1226 the abbey allowed the Lyons fraternity to build a new bridgehead chapel (Boyer 1976, 55). The three earliest examples of English bridge chapels are: London Bridge, completed by 1209 (Watson *et al* 2001, 83-90; figure 2); Ouse Bridge apparently was constructed in *circa* 1170-80; and in 1196 the post of 'chaplain to Exe Bridge', was documented. The construction of masonry bridges in England only became common during the 12th century (this topic is discussed by Harrison in this volume**).** At Avignon in France, St Bénézet (died *circa* 1184), during the 1170s is credited with organising the construction of a bridge across the River Rhone for which he was canonized. He was buried within the chapel erected on his bridge (Lefranc 2000) (figure 3).

Figure three, St Bénézet's chapel on the southern end of Avignon Bridge(only four arches of the medieval bridge remain) looking north. This two storey chapel was built onto an enlarged pier situated on the eastern side of the bridge. The lower storey or undercroft of the chapel is of 12th century date, but the upper storey (situated at road level) known as St Nicholas's chapel was rebuilt during the late 14th century and the bell-turret was added during the 16th century (copyright author).

Numbers of Bridge Chapels

Although very few English bridge chapels survive today they were one commonplace. For details, concerning their numbers and distribution (see McKeague this volume for further details). In addition to the bridge chapels there were also a small number of English examples of medieval chapels connected with other forms of communication. At Wade Bridge (Cornwall), two chapels originally served the ford and pre-date the 15th-century bridge. There were also some lighthouse chapels, today the only surviving English example is St Catherine's Oratory, on the Isle of Wight. There is a surviving example of a seamark chapel at Plymouth Hoe (Devon). There was a hermitage chapel at the Itchen ferry, near Southampton (Hampshire).

Chantry Chapels

The vast majority of English bridge chapels were endowed as chantries during the 14th or 15th century, this was a cult of Masses for the dead to speed the passage of the soul of the founders and their families through purgatory (see above). The establishment of these chantry chapels was linked with the development of a new concept of personal salvation which started during the early 13th century (Cook 1947, 6-7). The earliest example documented of the establishment of an English bridge chantry chapel is St Andrew's on the Elvet Bridge, Durham (figure 4). It was founded between 1212 and 1230. A second chantry chapel St James's was established at the opposite end of the Elvet Bridge before 1289. Other early examples of English bridge chantry chapels include St Mary's chantry which was established on Exe Bridge by *circa* 1258. It is probable that St Andrew's at Maidenhead Bridge (Berkshire) had been established by 1270. While at Morpeth Bridge (Northumberland) a chantry chapel was in existence before 1294. The motivation of these donors was eloquently summed up in 1303 by John le Palmer of Nottingham and his wife Alice, when they obtained a licence to establish a chantry in the chapel of St Mary at 'Hethebethebrigge' (Trent Bridge, Nottingham), it was 'for the souls of them, their ancestors, and all Christians who assign their goods or part of them to the maintenance of the said church' (*Calendar Patent Rolls Edward 1, vol 4, 1301-07*, 133), While a chantry chapel at Wakefield Bridge (West Yorkshire) was relicensed and endowed in 1397 by Edmund Langley Duke of York 'to pray for the soul of the founder and all other Christian souls' York (*Calendar Patent Rolls Richard II, vol 6, 1396-99,* 140). Personal chantry endowments were far too expensive for the vast majority of people, so instead they formed parochial guilds to organise chantry Masses and orbs for their members (see below).

Figure four, Elvet Bridge, showing the remains of St Andrew's chapel at the south-eastern end of the bridge. This chapel has been extensively rebuilt during the post-medieval period and now functions as a bar and restaurant (copyright author).

As chantry chapels the majority of English bridge chapels were closed by the Chantries Act of 1547, and their funds confiscated (Duffy 1992, 454, 517). During the Catholic revival of 1553-58, a few English bridge chapels did reopen including: Duxford (Cambridgeshire), Ouse Bridge (York) and Wakefield (West Yorkshire) and possibly Rotherham (South Yorkshire). A few bridge chapels escaped closure during the English Reformation (1533-53) because they were functioning either as parish churches or parochial chapels. For instance, St Edmund's church on Exe Bridge, only ceased to be a parish church during the 1950s.While at Morpeth (Northumberland), by the mid-16th century part of the bridge chapel was occupied by the town's grammar school and the rest of it as served a chapel of ease for the town, a role it retained until 1846 (figure 1). Some chapels passed into civic ownership during the Reformation and subsequently served a charitable function. At Bury St Edmunds (Suffolk) the former chapel became almshouses and the one at St Mary's, Derby served initially as a workshop to employ the poor. Other examples ended up as prisons. For instance, the chapel on Town Bridge, Bradford on Avon (Wiltshire) was apparently rebuilt as a lockup during the early 18th century.

Bridge crosses, plaques and statues

A number of medieval English bridges never possessed chapels, but instead as a sign of piety they were adorned with crosses, statues and plaques listing the names of donors. Richard Langfellay (died 1537) left funds for the erection of a substantial cross with an image of 'our lady' (St Mary the Virgin) on Otley Bridge (West Yorkshire). At Maisemore Bridge. (Gloucestershire), there was formerly a cross and a medieval inscription Latin/Norman French listing the name of the builder and recalling the fact he built the bridge 'in honour of

God'. The present cross and inscription was installed in 1956 (figure 5). The bridge at Stockbridge (Hampshire) formerly possessed a plaque asking that people pray for the souls of various donors. Holy Trinity Bridge, Crowland, (Lincolnshire), is a unique triangular footbridge with a single statue probably representing Christ in Majesty, but its name implies the presence of two other statues.

Figure five, Masiemore Bridge, the cross and replica inscription were installed along the eastern approach road to the bridge when it was rebuilt in 1956 (copyright author).

Hospitals and Monasteries

The earliest example of a medieval monastic house associated with a bridge is Clonmacnoise Abbey, County Offaly, Ireland. Here next to the abbey during early 9th century a timber bridge was constructed across the River Shannon (Boland *et al* 1996). It is assumed that this bridge was constructed by the abbey for the benefit of pilgrims, travellers and themselves as it was situated on a major route-way known as the 'Pilgrims' Road.' During 1036-48 the convents of Aniane and Saint-Guillem-le-Désert agreed that there should be no chapel built on their new bridge across the Hérault at Gouffre-Noir (Boyer 1976, 55). This decision was presumably intended to avoid a dispute with the local parish church, who may have resented the potential competition (see above Lyons). In 1397 the endowment of a chantry based in the new chapel at one end of Cross Bridge. Beverley (East Yorkshire) was also linked with

establishment of a nearby new hospital for 'twelve poor persons' (*Calendar Patent Rolls Richard II vol 6, 1396-99*, 162).

There is a reoccurring spatial link between medieval bridges and medieval hospitals, leprosaria and monastic houses. The majority of these religious institutions were suburban and they were often situated along approach roads to towns and cities. They sought access to busy thoroughfares as all but the very richest houses relied heavily on alms from pilgrims and travellers seeking divine protection or offering thanks for a safe journey. Alms could more easily be solicited at stopping places such as town bars or bridges where traffic was congested or tolls were collected (Rawcliffe 2005, 263). Some hospitals were situated on bridges. For instance, by 1252 at Romans in France on one side of the bridge pier nearest the town was the chapel of St Mary the Virgin and on the other side a lying-in hospital (Boyer 1976, 51).In some cases it can be established from documentary evidence that a particular bridge was maintained by an adjoining religious house. For instance, the Hospital of St John the Baptist, Lechlade, (Gloucestershire) was founded in or before 1246 by Isabella de Mortimer and given the responsibility to maintain the nearby bridge across the River Thames. This relationship between the hospital and the bridge was subsequently confirmed by grants of pontage in 1338, 1341 and 1388 (the right to collect tolls for a fixed period to provide funds for bridge maintenance). In this case the hospital chapel situated on the bridge approach road would have served as a bridge chapel to collect alms. However, in many cases no relationship can be established between a monastic house, parish church, chapel or hospital and an adjoining bridge due to the lack of documentary evidence. At the northern end of London Bridge in the City of London is the parish church of St Magnus the Martyr (established by 1128-33) and adjoining its southern end was formerly the Southwark parish church of St Olave's (established by 1096) (Watson *et al* 2001 94; figure 2). Most or probably all of the medieval bridge was within St Magnus's parish, but the two churches apparently had no other connection with the bridge that linked them. London Bridge possessed its own chapel, which held regular services and also served as a chantry (Watson *et al* 2001, 109-113), but it did not fulfil a parochial role for the residents of the bridge.

Hermits and Anchorites

Medieval hermits were male recluses with a religious vocation, but whose calling did not fit with any of the monastic orders or priesthood, which gave them considerable personal freedom to undertake social duties and the opportunity to support themselves by maintaining roads and bridges, the sort of philanthropic works now undertaken by public bodies (Davis 1985, 203; Flower 1923, 40). Various bridges possessed hermitage chapels and some hermits served as bridge-keepers (collecting alms, tolls, raising funds etc.). At the southern end of the Clopton Bridge, Stratford-upon-Avon (Warwickshire) there was both a chapel and a hermitage. The term hermit also described men who falsely claimed to be recluses, when they were really beggars. To address this problem in 1389 the anti-vagrancy statute made it mandatory for hermits to carry a testimonial letter from the person who had ordinated them. This statute increased the degree of episcopal supervision of hermits (Davis 1985, 206). In 1423 when a new hermit of Maidenhead Bridge (Berkshire), was appointed, the local bishop provided him with a comprehensive list of spiritual obligations and temporal duties concerning bridge repair (Cox 1907, 19). At St Mary's Bridge in Derby, the resident hermit collected alms and tolls and in 1467-68, when he was assaulted and his attackers were prosecuted and fined. Not all bridge hermits were godly men, in 1354 the hermit of Corbridge (Northumberland) was pardoned for the theft of a pig.

An anchorite (male) or anchoress (female) were a different category of Christian recluse to hermits as they were voluntarily immured within their cells (Warren 1985, 7-18). At least three English bridges possessed accommodation for anchorites or anchoresses. For instance, by 1300 there was an anchoress's house at St Edmund's chapel at Doncaster Bridge. Most anchorites and anchoresses relied on alms, bequests and endowments for their support. The donors would have expected their gifts and the resulting prayers to have reduced the time their souls spent in purgatory (see above).

Parochial Guilds and Fraternities

St Bénézet, the builder of Avignon Bridge (see above), established a 'society of brothers of the bridge' (*fratres donati*), all laymen who raised and managed funds for bridge construction and maintenance (Boyer 1976, 39). Attached to many medieval parish churches were fraternities or guilds, their primary function was normally to maintain either an altar or chapel dedicated to their patron saint and to celebrate Masses for their 'brethren, living and dead' (Cook 1947, 20). However, some guilds also undertook a wide range of charitable activities, which could include the maintenance of local roads and bridges. In 1451, when Maidenhead Bridge was in need of repair, Thomas Mettingham, the chaplain of the chantry based at the bridge chapel of St Andrew's and St Mary's Magdalene's obtained a licence from Henry VI to found a guild known as the Fraternity of St Andrew 'for the maintenance of his chantry as of the bridge over the Thames.' This grant allowed the guild to levy tolls 'for ever' including on traffic passing under the bridge and also control of the fisheries on and adjoining the bridge (*Calendar Patent Rolls Henry VI 1446-52, vol 5*, 576). A small maison dieu or almshouse was situated at the eastern end of Ouse Bridge opposite St William's chapel, it was apparently founded during the 13th century and refounded in 1302 by a guild of citizens and functioned until the mid-16th century (Wilson and Mee 2002, 54).

Destruction and Rediscovery

During the later 18th and 19th centuries economic expansion and growth of road traffic led to the replacement of many single lane roadway medieval bridges with new dual-roadway bridges (Harrison 2004, 147-49). During this rebuilding many chapels situated on bridges or at the end of bridges were demolished. Occasionally, the destruction of bridge chapels was opposed by antiquarians who were well aware of the historian importance of these structures. When. Old Ouse Bridge in York was demolished in 1810, its historic fabric was recorded by antiquarians and elements of its Romanesque masonry were retained (Wilson and Mee 2002, .41-47).

Antiquarian interest in English bridge chapels begun with Norrison Scatcherd, who in 1828 published a rambling treatise on ancient bridge chapels, which was largely devoted to Wakefield bridge chapel as an attempt to promote its restoration. By the 1840s there was growing public pressure for the restoration of Wakefield chapel, which was described as decayed and desecrated. As a result in 1847 it was rebuilt (rather than restored) by Sir George Gilbert Scott and it reopened in 1848 as an Anglican parish church. Subsequently other bridge chapels at, St Mary's, Derby and St Mary's Rotherham (South Yorkshire) have been restored as places of worship. While examples at Duxford , St Ives , Morpeth (figure 1) and Rochester have been restored as historic monuments rather than places of worship.

ACKNOWLEDGEMENTS
The ongoing research into English bridge chapels is sponsored by the Rochester Bridge Trust. Thanks to Peter McKeague for his input concerning aspects of the content of this article. Figure 2 is reproduced by kind permission of the Museum of London.

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Fragments, Frog-ments.
Ethnography of the pedestrian *Butchers' Bridge* in Ljubljana.

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Introduction

The inhabitants of Ljubljana may find themselves referred to or even addressed as *frogs*, not for being avid frog eaters - though there are some restaurants in Ljubljana with frogs on the menu - and not particularly because part of Ljubljana was built on marshes but mainly due to the colloquial Ljubljanian version of the word *kaj (what)* being *kva*. As children in Slovenia learn early, the *kva-kva* is the language of frogs. When students participating in *Sociology of mobile cultures* class, at the Faculty of Tourism studies, Turistica were offered to engage in an ethnographic research of the *Butcher's bridge* they proposed the working title: *Frog-ments*. Ostensibly the reason was play on words fragments/frog-ments that was additionally supported by frog-like sculptures on the bridge (fig.1.) yet the occasional twinkle in the eye told us it was also ever so subtle reference to the inhabitants of Ljubljana. Frog-ments was a work in progress throughout the semester, a collective student effort that resulted in one research note (Hrovatin, forthcoming) and performance on the bridge carried out on September 22nd 2017 as one of the events of the *European Heritage Days* with this year's lead topic: *Water from Myth to Architecture*.

Using ethnographic methods, participant observation, informal interviews and visual analysis, students were mainly focusing on tourists on the bridge, while my focus was public art and children though I touch upon tourist and tourism as well. As students will publish their own research elsewhere, this paper tackles the pedagogical process outline, ethnographic notes and a description of the videotaped performance on the bridge.

The paper is partly organized as a montage of ethnographic fragments inspired by Benjamin's method in *The Arcades project* without laying any claim to his epic scape in volume, knowledge, depth or impact but rather referring to his practice of juxtaposing fragments that may not be clearly related at a glance in order to potentially **unlock** a new insight. Throughout the text Benjamin's seven fragments from the 2002 edition of *The Arcades project* are used in color to point out that many of his notes were written on a colorful pieces of papers that were wrapped round the newspapers in Berlin. Whenever I come across the most reproduced black and white image of Benjamin, the one with a cigarette that Susan Sontag wrapped her essay around (Sontag, 1981), I tend to imagine the color ribbons in front of him. Though Benjamin was very fond of his numerous colorful notebooks (Rippin, 2013), the strips of paper are stuck in my mind, not without influence of the Hughes's 1992 film *One Way Street: Fragments for Walter Benjamin* in which color papers are scattered on that final fateful slope on the French-Spanish border where Benjamin ended his life in 1940, wind emptying the briefcase of his unfinished *The Arcades Project*.

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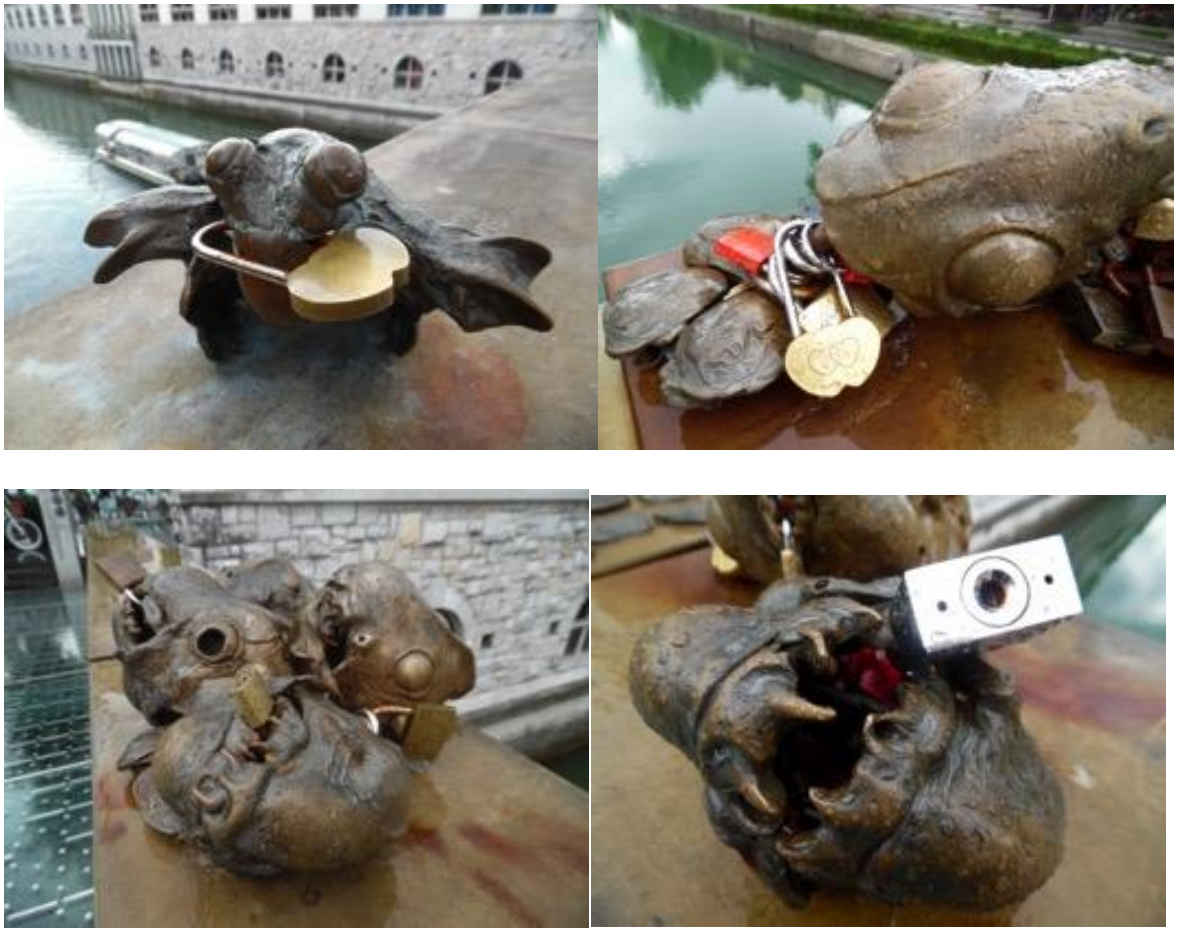

fig.1. The "Frogs". Some of the several smaller sculptures by Jakov Brdar, on which the increasing number of locks are being attached. Photo: Irena Weber.

Denkbild

After the introductory lecture on *Sociology of mobile cultures* at the Faculty, all consequent lectures were delivered *in situ*, i.e. in a caffé by the *Butcher's bridge.* The initial *Denkbild* (fig. 2). was organized around a vector of a bridge to include the flows, directions, authors, concepts that some students were already familiar with or were about to read. Benjamin, Bauman and Lefebvre were on the previous course reading list while Simmel, his text on Bridge and door (1994), was new and though a short one didn't take off among students.

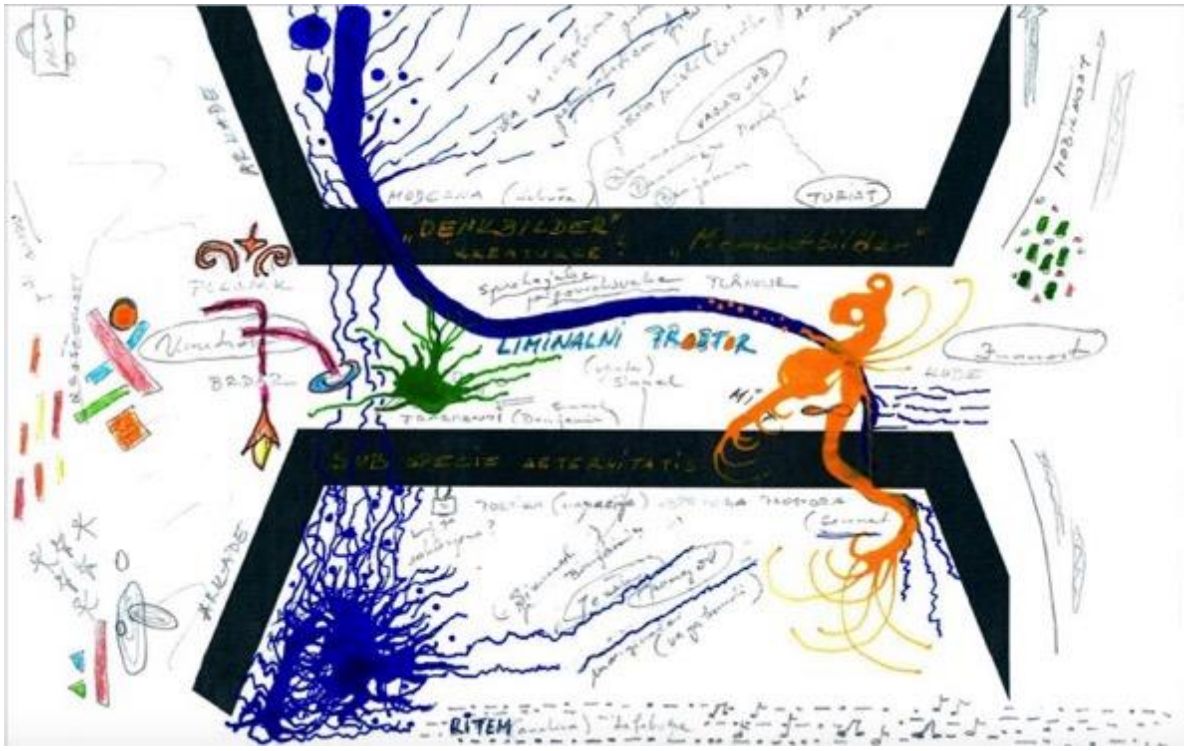

Fig. 2. *Denkbild.* Design: Irena Weber

Denkbild, usually translates as though-image and was meant to connect directly with Benjamin. Adorno (1997) described Benjamin's writings in the One Way Street, as a collection of *denkbilder*, though-images that can't be expressed in words. On the other hand the *denkbild* served as a prop for the brain storming with students to sift through some concepts and possibilities for the research and performance. Drawing on Benjamin's clusters of *objects* (bridge, colonnade, sculptures, statues), *topics* (art, tourism, heritage), *figures* (the stroller, the tourist, the lover), *authors* (Plečnik, Brdar, Kobe) it was a continuous process of selection and juxtaposition of urban fragments as they present themselves in material, narrative and imaginary.

Two architects based in Ljubljana were invited to give short lectures on their view of the bridge. With the first architect we took a three quarter of an hour trip by a tourist boat down and up the river (the tourist boats are conveniently moored bellow the Butcher's bridge). With the second architect we discussed the bridge and the life on it from our standard caffé.

After lectures students engaged in their fieldwork choosing their own schedules. Thus we have all in our own time and way went "botanizing on the asphalt" (Benjamin 2002, 372).

Towards the bridge

Approaching the Butcher's bridge from the right bank just off the Dragon's bridge on any Saturday, one encounters an increasingly concentrated mixture of noises, chatter, clatter, music, laughter, with each step the cacophony growing wider. Before the bridge had been nested between the two banks, the right one was quiet and rather empty. Only the residents of the right bank or some lonely stroller would opt to walk there, the rest of the residents and visitors would opt for the left bank on which the main city main Market resides and is busy everyday but most populated on Fridays and Saturdays.

The *Butchers' Bridge* has been first envisaged nearly a hundred years ago by the Slovenian master architect Jože Plečnik. However, his idea and model never saw the realization though it was supposed to round up his other iconic work on and around the river Ljubljanica, particularly the *Triple bridge* and the *Market.* The *Butchers' Bridge* finally materialized only in 2010 among heated discussion on Plečenik's heritage, new modern bridge architecture and the uses of art on the bridge. The pedestrian bridge connects Plečnik's colonnade with the embankment on the other side, yet many pedestrians choose not to cross it and walk only up to the monumental sculptures, representing Adam and Eve, Prometheus and the Satyr. The sculptures were created by an intriguing contemporary sculptor Jakov Brdar whose work often carry controversial public responses. Other pedestrians, following the contemporary fashion, place love padlocks on smaller sculptures, or on the railings, the practice that contributed to the unofficial designation of the bridge as a *Love bridge.*

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The city is only apparently homogeneous. Even its name takes on a different sound from one district to the next. Nowhere, unless perhaps in dreams, can the phenomenon of the boundary be experienced in a more originary way than in cities. To know them means to understand those lines that, running alongside railroad crossings and across privately owned lots, within the park and along the riverbank, function as limits; it means to know these confines, together with the enclaves of the various districts. As threshold, the boundary stretches across streets; a new precinct begins like a step into the void-as though one had unexpectedly cleared a low step on a flight of stairs. p.88

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Sitting at the bank of the river outside the perimeters of the caffé yet within the clear earshot of the people sitting at the tables, one must learn to tune out the conversations in order to observe the Bridge undisturbed, as it were.
The chosen vantage point renders the possibility of clear distinction of gazes bellow and over the handrails. Most children fit under the handrails along the string lines on which locks, teethers and other objects are placed. (fig.3, 4.)

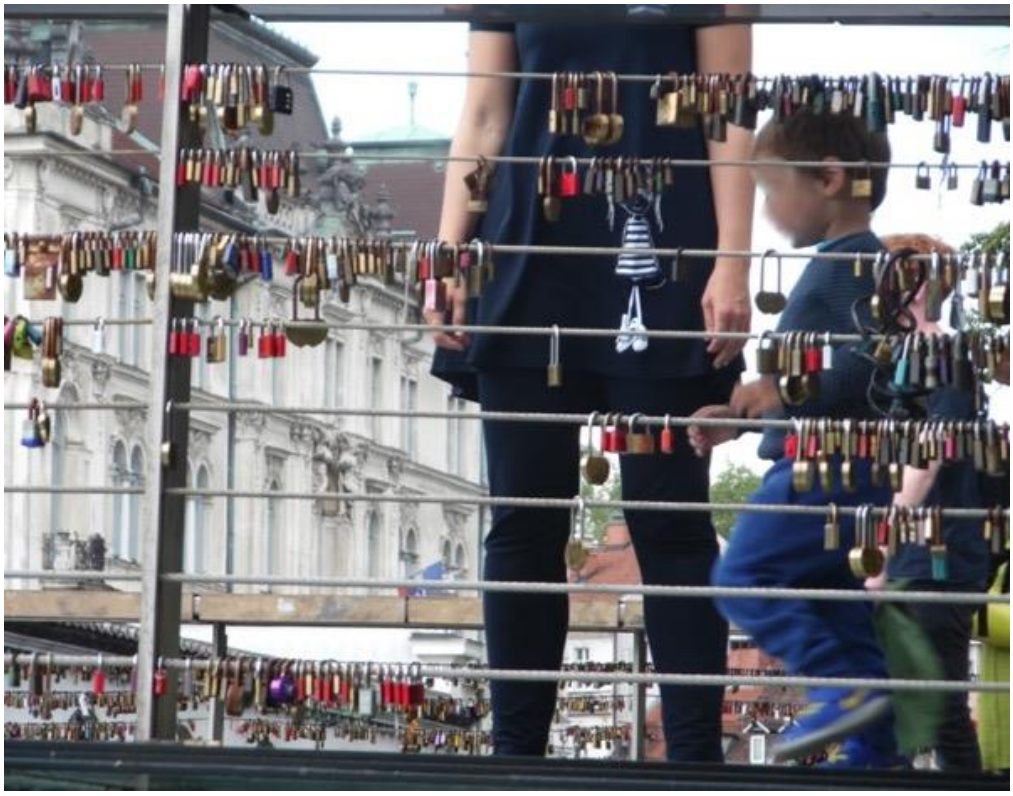

Fig.3. Bellow the handrail. Photo: Irena Weber

Fig.4. Teethers. Photo: Irena Weber

Art and children on the bridge

Running Prometheus

When the sculpture first arrived on the bridge it was nicknamed “The Butcher”.

***

Brdar’s Prometheus is not in chains, he is running. Is he to escape the wrath of Zeus? Is he to become whole again?

***

Mark Strand:
“When I walk
I part the air
and always
the air moves in
to fill the spaces
where my body’s been.

We all have reasons
for moving.
I move
to keep things whole.”

***

“That river which one crosses but once; that pitcher of the Danaides, always full and always empty; that liver of Tityus, always regenerated under the beak of the vulture that always devours it anew, ... - these are so many speaking hieroglyphs, about which it is impossible to be mistaken.” p.353

Fig.5. Gazing at Prometheus. Photo: Irena Weber

The classical myths as retold stories offer children the realm of exciting worlds of adventure removed from everyday life while transmitting the elements of cultural heritage constructed, appropriated and selected in accordance to Eurocentric standards of meta-narratives. Greek myths may be read globally but are by no means universal, rather culturally specific. The value of particular retold stories is measured by the narrative structure interlinking cultural heritage and moral judgments. Aside from transmittance of values and socially accepted norms, myths in a way provide children with a map, a pattern, an itinerary to follow so that they can position themselves in the surrounding world. The stories frame explanations of geographical place names directly i.e. Europe, Aegean sea, the pillars of Heracles, further they describe the strategy of finding one's way out of the labyrinth by using Ariadne's thread and not the least they provide a tangible location of Hope. In English most commonly referred to as a box or more accurately to a Greek original a jar, *pithos,* that Pandora opened, Hope has a definite place at the bottom of a jar. Since the jar is an object that can be moved, Hope may reside anywhere. (Weber 2014). So when the little boy is gazing at Prometheus he may be mapping a story through an image.

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Benjamin: "The fragment is an image not a story" (Hughes, 1992)

Kairos, Singularity

Children unlike adults hold the gaze. Stop. Are present. Are in present. (fig.7). Are singular as in Deleuzian singularity, "witnessed through the eyes of the other who has not lost sight of the singular" (Kennedy and Bahler, 2017, ix)

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Task of childhood: to bring the new world into symbolic space. The child, in fact, can do what the grownup absolutely cannot: recognize the new once again. (…)
Every childhood discovers new images in order to incorporate them into the image stock of humanity. p.390

Children open up the potential of kairic moments. *Child in time.*

In contrast to Chronos (χρονος), the ancient Greek god of time, depicted as an old man, winged, bearded and usually clothed, the image of Kairos (καιρος) is one of a youth, with a double set of wings, at the shoulder and at the heels. Kairos is naked, balancing a scale on a razor's blade. His head is shaved save for the single long lock of hair hanging from his forehead that needs to be grasped if one is to seize the right moment. While Chronos is a flow of time, a continuity and something that is measured, a quantified time, Kairos is an opportunity, a proper, or the right timing. Conversely with Chairos we are "in time" clothed in tradition and constant measure while with Kairos we are "on time" naked in the timeliness of opportunity as it were. That opportunity makes an opening for innovation.
The ancient Greeks didn't necessarily perceive the right timing as a short moment in time, as an instant opening for an instant decision. It was rather a variable time span within which the

right decisions had to be made, and the consequences of those decisions entailed some degree of personal responsibility. Thus Chronos is often associated with the objective and ontological and Kairos with subjective, qualitative, "anthropological". Chronos is a time of gods who possess an absolute measure of time. Kairos, on the other hand, while a divine entity, is also a time of humans, situational and interpretive. It is situated not in *any* time but in *the* time.

When kairic moment presents itself one does not decide on a proper action outside of the wider "objective" circumstances and by extention without the Kairos of others. Kairos may well represent personal choice, yet the opening of creative opportunity can't be seen as pure subjectivity if both principles, timeliness and measure are to be observed. (Weber 2015)

Fig. 7. Singularity. Photo: Irena Weber

Satyr

The rain just stopped. Group of tourist are still lingering bellow the bridge. The surface is shiny from the rain. Empty. Then the girl with the white umbrella appears. (fig.6.) She takes out her white phone to take a picture of the Satyr. Who does not want to be photographed. Doubling her down into the bridge. He is about to be punished by Apollo.

Fig.6. The Double. Photo: Irena Weber

A passage from L'Eternite par les astres- "The number of our doubles is infinite in time and space .... These doubles exist in flesh and bone-indeed, in trousers and jacket, in crinoline and chignon" … p.362

Moving objects

The locks and increasing number of teethers are movable on the wires. And children dedicatedly move them. Rotate them. Inspect them. Make noise with them. Sort them. They are Benjamin's collectors. Unpaking the bridge.

Fig.8. Moving objects. Photo: Irena Weber

Tourists

But the great reminiscences, the historical shudder-these are a trumpery which he (the *flâneur*) leaves to tourists, who think thereby to gain access to the genius loci with a military password. p.416

Many come on the bridge as a guided group in English or Italian mostly. Plečnik is the name one hears repeatedly. Never the name of the architect of the present bridge. After the guide's speech they disperse around. Look at the locks. Take pictures. Strike pose with a Satyr.

In his seminal work on photography *Camera Lucida* (2010) Barthes reflects on the social game of posing, of "making another body, transforming in advance into an image. " (Barthes 2010, p. 10). In contemporary practice of digital snapshots by tourists the image often appears to be constituted within the space of *extimacy*, where the exteriorizing of intimacy is both accepted and expected.

Solitary local figure sitting on the windowsill calmly smoking his cigarette while tourist are taking pictures (fig. 9). Being reduced to shadows.

Fig. 9. Tourist and the local. Photo: Irena Weber

The bridge acts as a square thus not necessarily inviting one to cross from one bank to another but rather to linger, criss-cross, return to the same bank.

In her analysis of walking and sensing urban space in everyday life, Wunderlich (2008, p.131) uses three types of walking practices, "Purposive walking, Discursive walking, and Conceptual walking". Those engaged in purposive walk straight across the bridge, many with bags from the market. They may walk in pairs, often engaged in conversation. The second group of purposive walkers are tourists who engage in ticking off the walk, or a snap and return to the bank they came from.

The second group of walkers, the discursive ones engage in pace and rhythm that varies according to their own inner rhythms and are the closest to the Benjamin's *flâneur*, an epitomised figure of modernity in search of the new imaginary is a person who walks in the rhythm of his own perceiving the space both as a landscape and a room at the same time. *Flâneur* may not walk on the bridge at the same pace, he stops, turns, continues according to inner and outer rhythms, the rhythms of place.

The third group of conceptual walkers represent those locals and tourists who think about their walk in advance, contemplate the entering, engage in "creative response to the place" (Wunderlich, ibid.), draw as it were a mental walking map.

Different groups of walkers intermingle during the day in cacophony of rhythms.

The street conducts the *flâneur* into a vanished time. For him, every street is precipitous. It leads downward-if not to the mythical Mothers, then into a past that can be all the more spellbinding because it is not his own, not private. Nevertheless, it always remains the time of a childhood. p 416

***Frog-ments*: performance (artistic action)**

On the day of the rehearsal it was raining so we sat in a caffé waiting for the rain to stop, reading through the ever changing script deciding on the lines and noises of the *artist*, *researcher*, *architect*, *her 1* and *her 2*. With enough time on our hands we watched the clip from the famous performance by Marina Abramović, *The artist is present* in MOMA. We decided that the question Are you present? should be included in the *Frog-ments* performance along with two pick-nick chairs. *So it goes.*
After the rain the bridge was empty, truly resembling a stage. It is the most difficult to perform on a stage that no one perceives as a stage, a public space. Not Agora anymore.

On the day of performance it was a clear sunny day after a long spell of rain. Two hours before noon we were preparing balloons, placing Benjamin's fragments, translated to Slovenian, inside the balloons so that the pedestrians will find them later when the balloons loose their breath. Lively discussion and laughter attracted the attention of tourists at the nearby tables so we explained the event (some of the tourists later joined the performance).
The bilingual poster "Are you present?" was tied to the railings along with colorful ribbons of paper with Benjamin's fragments. Two chairs were placed in the middle of the bridge at the railings. A few minutes before the start of the performance arrived a street musician as if hired by our group and started to play a guitar thus providing the musical background for the entire performance. Each of the participants decided which fragments of lines and sound to use based on the live situation on the bridge: the artist conversing with the sculptures, the architect looking for its bridge, the researchers writing notes, the characters uttering questions and sounds, bewildering pedestrians crossing and tourist watching.
All the balloons were handed out or placed on the Satyr (fig.10) and on the rails. After the group decided that they are out of sounds and lines the performance was over. After hugs students departed to another location to have a coffee where they met by chance the elusive artist Jakov Brdar. They told him that he has just been performed on the bridge offered him a balloon for good luck which he refused as he "doesn't want to be lucky", but accepted the scrip of the Frog-ments. According to students it was a perfect fragmented day.

Fig. 10. Performance. Photo: Irena Weber

Rather than pass the time, one must invite it in. To pass the time (to kill time, expel it): the gambler. Time spills from his every pore. -To store time as a battery stores energy: the flâneur. Finally, the third type: he who waits. He takes in the time and renders it up in altered form-that of expectation. p.107

For three days after the performance, at different time of day, I would come by the bridge to observe what happened with the object we left on the bridge: the "Are you present?" poster, balloons, paper fragments. The balloons were all gone in a day, the paper fragments were disappearing slowly one or two at the time while the poster was a bit more resilient. Some people were glancing at it, some frowning, some taking pictures, some apparently completely lost in thought in front of it. The wind would tear the first and then the second string, making the poster flap till on the forth day the poster was no longer on the bridge. Whether it was collected by the cleaning crew or slid down into the river floating towards the Three bridges, was not observed. For three days it was present.

Fig 11. After performance. Photo: Irena Weber

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Bringing History to Life: LiDAR and digital modeling for the spatial reconstruction of Selma's 'Bloody Sunday' on the Edmund Pettus Bridge

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Bringing History to Life: LiDAR and digital modeling for the spatial reconstruction of Selma's 'Bloody Sunday' on the Edmund Pettus Bridge

On March 7, 1965, at the south side of Edmund Pettus Bridge in Selma, AL, armed State Troopers attacked peaceful civil rights demonstrators attempting to march to the state capital of Montgomery in an incident that became known as Bloody Sunday. Selma, like much of the south, was an entirely segregated city and it was, as Craig Barton illustrates in *Sites of Memory: Perspectives on Architecture and Race*, "replete with redundant cultural systems and whose landscape was designed to create spatial, political hierarchies designated by race".(2001: 12). The bridge, however, was a singular construction that provided the connection between the City of Selma and the environs of Dallas County. As a structural and symbolic point of connection between the dual geographies of Selma, it became a focal point for the Civil Rights movement. Because of the design of the bridge, the 600 protestors were unable to see the police officers on the south side of the bridge until they reached the apex of the bridge's deck, 100 feet above the Alabama River. Despite the danger ahead, the protestors continued their marching without stopping but once they stepped across the threshold between the city limits and Dallas County, they were attacked with tear gas, beaten with billie clubs, and forced to retreat back to Selma. Televised footage of the brutal attack presented Americans and international audiences with horrifying images of marchers left bloodied and severely injured, and roused support for the Selma Voting Rights Movement.

Despite the vivid archival material, little interpretation addresses the physical context and experiential timeline of "Bloody Sunday". Visitors can cross the Edmund Pettus Bridge, problematically named for a former KKK leader, but large portions of the built and natural environment have changed dramatically since 1965, presenting visitors with an altered perception of the sites surrounding the conflict. In order to digitally record this significant Civil Rights site and to make the specific context of the event more experientially engaging to the general public, this project's multidisciplinary team of architectural historians, Civil Rights historians, cultural resource managers, and construction technology specialists paired collected 3D digital data of Selma's extant structures with digital reconstructions to recreate the site through virtual simulation. By melding the physical and virtual, this project will bring enhanced historic interpretation to several extant museums and National Park sites in Selma. Additionally, the dissemination of the digitally reconstructed bridge from 1965 will allow viewers in distant locations to virtually 'visit' the bridge and discover an enriched presentation of the bridge's place in history, addressing its construction, the representation of the bridge in media, and how the bridge continues to act, simultaneously, as a community unifier and divider.

An Introduction to Selma

Prior to its role in the modern civil rights era and the horror of the Bloody Sunday event, the city of Selma was an industrial city, closely tied to cotton production and trade in Alabama's black Belt region that has heavily reliant on an enslaved workforce. Founded in 1815, Selma later functioned as a site of military manufacturing for the Confederacy during the US Civil War. In April 1965, The city was defended by white supremacist and early Ku Klux Klan leader General Nathan Bedford Forest but Union forces prevailed, destroying much of the city's arsenal, foundry, and private residence. Slow to emerge from the ruin of the Civil War, the city became the seat of Dallas County in 1866 as the south struggled to recover from the war and adhere to Reconstruction Amendments: the 13th amendment mandating the

abolishment of slavery, the 14th amendment ensuring citizenship rights and equal protection for all, and the 15th amendment outlining the prohibition of voting discrimination based on race, color, or previous condition of servitude.

Nearly a century later, the naming of a piece of key, connective infrastructure proved that Selma had made little progress to separate itself from its racially segregated past. In May 1940, the Edmund Pettus Bridge was dedicated, replacing an earlier bridge that was essential for the transportation of cotton from plantations in the north to the state capital of Montgomery, along what is now known as route 80, and further south to the port of Mobile in the Gulf of Mexico. Designed by Selma-born engineer Henson Stephenson the bridge consists of eleven segments, ten in concrete and the largest main space in steel. The name boldly painted on a spanning beam between the steel arches is, however, the most notable feature of the bridge (FIGURE 1).

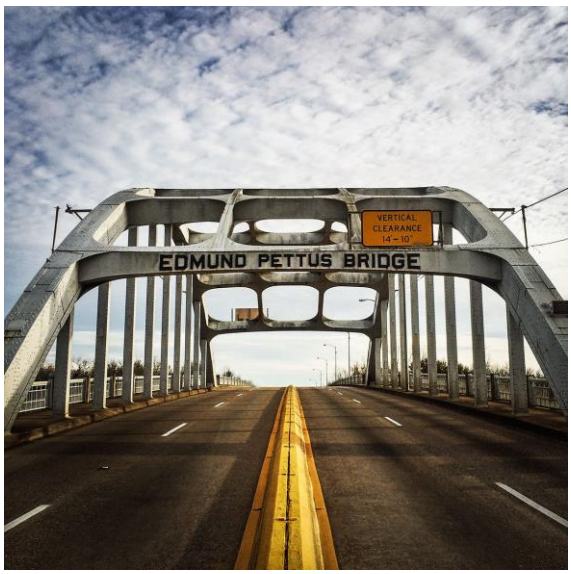

Figure 1. A view of the Edmund Pettus Bridge.

Edmund Pettus (1821-1907) was the son of a Revolutionary war veteran and he grew up on a cotton plantation, fueled by enslaved labor, and became a lawyer with fierce streaks of both racial supremacism and secessionism in the Antebellum period. Although captured three times and severely wounded in battle as a brigadier general with the Confederate Army, Pettus survived the Civil War and settled in Selma. Here, he served as a chairman of the state's Democratic National Convention and a Grand Dragon of the Alabama Klan. Elected US Senator in 1896, was reelected in 1903 and held the position until his death in 1907 at the age of eighty-six. So this was the name, and ever-present atmosphere of oppression and embraced history that celebrated racial hierarchy, that 600 peaceful and organized marchers passed beneath on March 7, 1965 as they planned to walk towards the capital of Montgomery, championing the Selma Voting Rights Movement.

Selma had been home to the Student Nonviolent Coordinating Committee (SNCC, 1960-1976) to since early 1963. Outraged by the February 26, 1965 murder of 26-year old Deacon Jimmie Lee Jackson by State Trooper James Bonard Fowler in Marion, AL during a peaceful civil rights protest against the arrest of a local Southern Christian Leadership Conference leader, the marchers assembled in Selma to raise the profile of Jackson's senseless death and the need for immediate access to Constitutionally-mandated civil rights. However, at the apex of the Edmund Pettus Bridge, 100 feet above the Alabama River, they were met with a daunting view on Route 80: a sea of Alabama State Troopers equipped with gas masks and a sheriff's posse mounted on horseback armed with clubs wrapped in chicken wire. Determined to march on, John Lewis and Hosea Williams led the demonstrators south but once they passed the invisible line separating the City of Selma from Dallas County, they were attacked with teargas and billy clubs. That night as national television audiences watched the premiere of *Judgement at Nuremberg*, a film about Nazi war crimes, news broadcasts interrupted the film and brought the gruesome images of this bloody encounter to American living rooms. Amelia Boynton (1911-2015), who both helped organize and participated in the

march, was beaten unconscious. A photograph of her lying on the road of the Edmund Pettus Bridge appeared on the front page of newspapers and magazines around the world. In all, seventeen marchers were hospitalized and fifty were treated for lesser injuries, providing the rationale for the event's memorialization as "Bloody Sunday".

Although a violent event, Bloody Sunday raised the profile of the Voting Rights Movement and prompted two, successive events. Calling on the support of clergy from around the nation, Martin Luther King, Jr traveled to Selma to lead another march from Selma to Montgomery, but without proper federal protection from state interference, the group only briefly crossed into the territory of Dallas County, earning the name of Turnaround Tuesday for the March 9, 1965 attempt. Despite this seemingly peaceful respite, tensions proved deadly that evening when Unitarian Universalist minister James Reeb of Boston was beaten to death in Selma. Rallying once more, March 21, 1965 marked the beginning of a successful, peaceful march from Selma to Montgomery, 54m (87 km). The marchers traveled approximately ten miles a day along what is now designated as a U.S. National Historic Trail, the Selma to Montgomery Voting Rights Trail, thereby replacing yet another problematically named route: the Jefferson Davis Highway. Although the marchers started with approximately 3,200 in Selma, the crowd grew to 25,000 once they reached Montgomery on March 24th and they were protected by nearly 1,900 Federal Marshalls en route. After several delays, President Lyndon B. Johnson signed the Voting Rights Act into law on August 6, 1965, ensuring the enforcement and protection the 15th Amendment from 1870.

Visualizing an Erased History

Today's visitors to the Edmund Pettus Bridge (1940) see, simultaneously, a National Historic Landmark, designated in 2013, that was integral to the Civil Rights Movement and a structure that is named after a Confederate General and Grand Dragon of the Alabama Ku Klux Klan. In 2015, a petition circulated to rename the bridge; yet, two United States House of Representatives members, Georgia delegate and Bloody Dunay survivor John Lewis (GA-05) and Teri Sewell of Alabama (AL-07), defended the bridge's name, "renaming the Bridge will never erase its history. Instead of hiding our history behind a new name we must embrace it — the good and the bad" (2015).

Photographs, movies, documents, personal notes, and artifacts now serve as the records of this conflict, some of which are presented to the general public through museum exhibits or online interfaces. However, despite the vivid archival material, there is little that addresses the physical context and experiential timeline of the Bloody Sunday conflict. In order to address these discrepancies and enhance the public access to interpretive materials on such a critical event in American and social history, a multidisciplinary team has been formed with five key researchers from Auburn University: the author, from the School of Architecture, Planning and Landscape Architecture, Junshan Liu and Dr. Richard Burt of the McWhorter School of Building Science from the College of Architecture, Design and Construction (CADC), and Dr. Keith Hebert and Dr. David Carter from the History Department of the College of Liberal Arts. This project, initially surveying and modeling a swath of compromised land adjacent to the bridge and measuring 250ft x 500ft, will form the proof of concept for a larger proposal to survey, research, and digitally reconstruct the entire route of marchers through Selma on March 7, 1965.

In hopes of bringing history to life, the team will, ultimately, create a digital interface where it will be possible to view the site as it was on Bloody Sunday, through the eyes of marchers,

troopers, and onlookers. Through the creation of digital and physical models, this project will enhance visitor experience to the site. Few people perceive the physical location of the conflict due to safety concerns, since the line of the conflict crosses the busy highway and museum studies prove that contemporary audiences are more receptive to immersive learning experiences. With the creation of a digital model that may be used for enhanced interpretation on-site, the team will not only enrich the experience of visitors to Selma, but those in diverse locations will have access to a public website, created by the project team, with interpretive content, digital models, and animations.

Data Collection Methods

In order to create a dynamic and interactive model, the team for this multi-year project is conducting on-site surveys, searching a number of archives for historic images, and testing the boundaries of digital modeling. In addition to traditional photography and field notes, the team is using modern building construction technology, such as 3D LiDAR, photogrammetry, and UAV (e.g. drone), in their survey of the site of the conflict, now largely degraded, and they have already identified several elements suitable for future historical preservation projects. In order to manage the thousands of audiovisual materials collected during the research phase of this project, the project team is, concurrently, developing a structured system to organize these materials, never before collated in a single database, so they can be retrieved at a later date as efficiently as possible.

Reconstructing the Bloody Sunday confrontation will require amassing hundreds of historic photographs, videos, maps, and illustrations that either depict the actual event as it happened or document the various buildings, structures, and sites at the time of the incident as well additional photographs captured on 'Turnaround Tuesday' and at the start of the later, successful march to Montgomery. The project team is currently in the process of gathering high-resolution photographs and videos that are archived in various public and private collections nationwide, ranging from the collections of famed photographer Spider Martin to those captured by various national news agencies, the Federal Bureau of Investigation, the United States' National Archives, the Alabama Department of Public Safety, the *Selma Times-Journal*, the *Montgomery Advertiser*, the Southern Christian Leadership Council, and many more. In the days that followed Bloody Sunday, newspaper photographers from across the nation descended upon Selma seeking to capture the scene of the violent confrontation. From these photographs as well as the collections of private individuals in Selma and the surrounding area, we will be able to digitally reconstruct the various buildings, structures, sites, and landscapes of the selected site during March 1965.

On-site Surveying in the 21st Century

The on-site survey of extant built and natural landscapes will be completed with LiDAR Technology. Terrestrial Laser Scanning (TLS) is also called LiDAR (Light Detection And Ranging) technology and although it was once considered a high-tech, experimental, and expensive technology, laser-scanning technology has seen a significant shift in applications across multiple disciplines in the last twenty years. The use of laser-scanning to model existing structures for renovations is being frequently used in urban areas in Europe and Asia with still limited use in the United States. There is existing research on using 3D laser scanning technology for documentation and conservation of historical architecture. It has been mentioned that 3D laser scanning can create point-in-time record for some of the most at-risk structures, and to create a foundation data set for future erosion monitoring within the site.

The Leica C10 is considered an all-in-one product and provides the laser range finder a 360º by 270º field of view with a reflectivity of 90% accuracy at 300 meters. It can capture 50,000 points per second at peak. The Leica C10 ScanStation comes with proprietary software, Cyclone. Cyclone is the version of Leica's solution to point cloud importing, exporting, registering, viewing and manipulating. Cyclone provides users with essential tools for gaining information from a given point cloud. There are several key functions that are being used with the Cyclone software once a project is imported from the Leica C10. The first is simple viewing and cropping a given point cloud. Next is combing several scans into a single point cloud. Third, users can acquire a large variety of information including measurements, angles, and elevations of selected points. Lastly, point clouds can be exported to multiple computer aided design (CAD) tools for the next step in building information modeling (BIM) (Leica Cyclone, 2012).

For the on-site survey, Junshan Liu led the team and located twenty-six stations along US-80 and used two laser scanners to capture a data set known as a 'point cloud'. With multiple scans combined into a single database, the georeferenced point cloud has more than 125 million points and its coordinate system is tied to the Alabama State Plan Coordinate System (**FIGURE 2**). This point cloud, in combination with photogrammetry generated by a UAV, serves as a highly accurate database that the team is using to build a 3D digital model of the existing site, complete with topography, buildings, signs, and vegetation. The point cloud generated by the laser scan will be analyzed to identify measured points that are identifiable on historic images and collated with scan station data.

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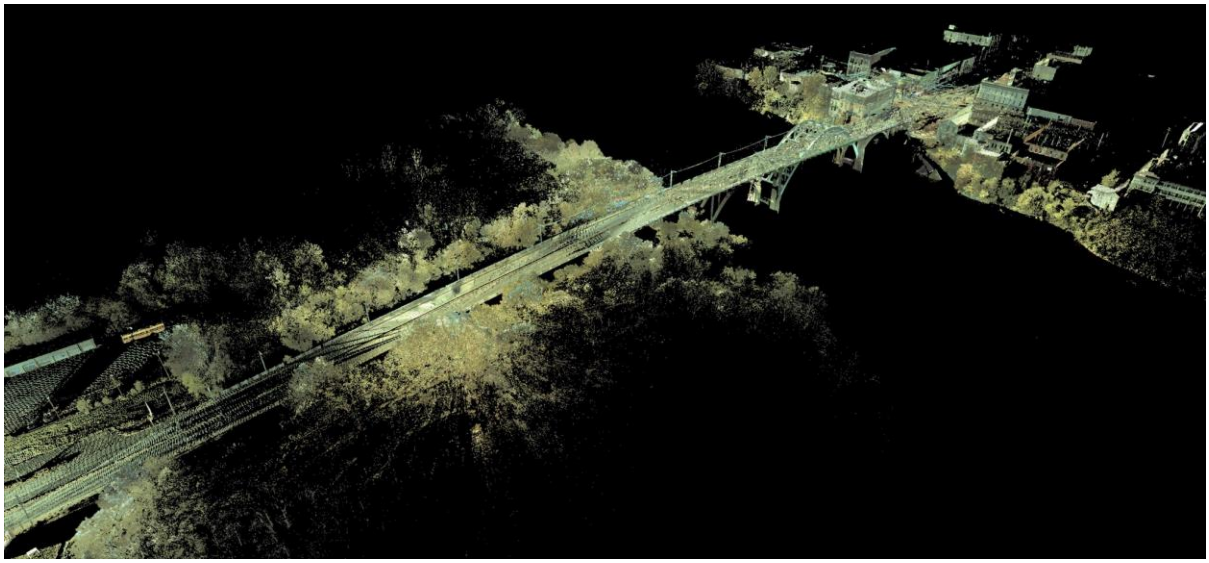

Figure 2. A screen capture of the full pilot site of the 3D scan, capturing the site of the conflict (bottom left), the Edmund Pettus Bridge, and downtown Selma (top right).

Geometric and Dimensional Analysis

Initial investigations have identified several sources of historic images taken during the three key events in March 1965. These can be simply categorized into photographs taken at ground level and those taken from the air. Initial investigations have shown that multiple images were taken of the scene by the same photographer and it assumed the camera and lens configuration have remained consistent through the taking of the photographs. Digital Photogrammetry software such as Photomodeler allows the team to obtain geometric and dimensional data from a single or multiple historic photographs (Kalisperakis et al., 2003),

(Grussenmeyer &. Jasmine, 2003). The nature of the digital photogrammetry software process requires the photos to be high resolution in order to identify details of remaining and lost features, "whole" not cropped or distorted in other ways, and need to include at least 5 distinct points on the historic photographs that the current X, Y, Z coordinates can be determined.

Three dimensional (X, Y, Z) coordinate data of the site will be obtained from the point cloud generated by the series of scans captured with the Leica C10 Laser Scanner and this data is undergoing analysis to select measured points that are identifiable on historic images. Individual or sets of images will be processed using Photomodeler Digital Photogrammetry software to obtain geometric and dimensional data of missing features. The process for obtaining geometric and dimensional data from historic images involves obtaining information about the camera that took the image, specifically focal length, format size, principal point, and lens distortion. In order to accomplish this task, at least five points of which the (X, Y, Z) coordinates are known will need to be identified on a single image. The position of these control points is marked on the historic photos and the Photomodeler software will calculate required information. This will provide the team with the coordinate information of the where the camera that took the photograph was and its orientation to the subject matter in the photograph. Once this process has been completed, points on missing structures can be marked and further processing will allow the team to obtain geometric and dimensional data of missing features.

State of the Art Integration of Archival Content, Measured Drawings and Digital Models for an Unprecedented, Immersive Visualization of a Historic Event

Despite the growing number of 3D scanning projects underway internationally, the primary commonality between the vast majority of these digital documentation and dissemination projects is that they record static objects and sites. This project will challenge the conventions of precedent: while the team will record the extent site of the Bloody Sunday conflict (with approximately 50% site integrity), the team will integrate the site survey with historic maps and measured drawings in CAD. Then, archived audiovisual material will be processed with innovative photomodeling technology to enliven historic images and populate a 3D digital model with accurate geometric and dimensional data of important elements from the Bloody Sunday conflict, such as state vehicles, the changing positions of key photographers (i.e. Spider Martin), the changing position key individuals (i.e. John Lewis), the location of key incidents (i.e. line of State Troopers and launched of tear gas), and the exact form and placement of buildings, structures, and signage that are no longer present on the site. Using the digital model as a reference file, the project team will create physical artifacts in the form of high-resolution 3D printed models to donate to various sites in Selma, including the National Voting Rights Museum and Institute and Selma Public Library; additional copies may be placed in other key sites in Selma, including the Old Depot Museum and the National Park Service Interpretive Centers in Selma or Lowndes County.

Dissemination and Future Goals

Although the project team is currently working with the sample site to secure a full proof of concept, it is clear that the established methodologies for on-site documentation using 3D LiDAR and UAS photogrammetry in concert with 3D data collection from archival photographs are proving fruitful (**FIGURE 3**). In the coming years, this project will result in a number of digital and physical products that will be broadly disseminated through a series of venues and media. Specifically, the team's innovative integration of archival content, measured drawings, photomodeling, and 3D laser scanning will result in a full 3D point cloud of the current condition of the site of the conflict, documented for historic record and important to future preservation efforts since the bridge was deemed functionally obsolete in 2011. Building upon this geo-located data, the team will generate a base plan and 3D digital model of the site as it was on March 7, 1965, using AutoCAD, and a series of interactive animations that allow viewers to have an immersive experience of a historical event, offering the perspectives of the marchers, State Troopers, and photographers. This final product will be especially useful for on-site exploration when integrated into an augmented reality app for use by National Park Service Rangers during their tours with visitors and for off-site exploration using a virtual reality app and immersive goggles.

Figure 3. A hybrid image showing portions of the 3D scan, digital recreated signage from Photomodeler analysis, and elements of photographic data captured on March 7, 1965.

One of the most promising and motivating aspects of this project is that it is entirely replicable. The project team's intent to demonstrate a proof of concept for digitally modeling conflict archeology as well the accurate reconstruction of a specific, historic landscape with built and natural features, may be applicable to a wide range of historic sites and corresponding events. The protect team plans to model the entire March 7, 1965 march path, capturing several structures and landmarks that are no longer standing, but there is strong potential to model other sites and associated conflicts related to the Civil Rights movement. This project also offers the potential for new research, visualization, and analysis projects for Alabama's designated landmarks and National Park Service sites, some of which are now on the World Monument's Fund Watch List as compromised sites, as well as historic sites farther afield from different historic era thereby translating the tenants of conflict archaeology from the battlefield and into the study of contemporary landscapes of inequity and empowerment.

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Bridges as corridors and filters: a biogeographic and ecological perspective

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Bridges as Corridors and Filters: A Biogeographic and Ecological Perspective

Abstract

The idea of the bridge has significantly contributed to the understanding of biotic dispersal, past and present. Specific cultural metaphors have often been cited in development of models used in biogeography, and recognition of the dynamic Earth enhanced the application of these models in paleontology. Hence the relevant literature is rich in discussions of "land bridges" that are now understood in terms of variable sea levels associated with glacial/interglacial cycles or, in longer-term examples, the actual movements of land masses. Scholars in the social sciences may not realize the extent to which modern bridges and metaphors derived from them have brought clarity to natural science discussions, or the similarity in terms of the questions being asked. Was a given dispersal event accidental ("sweepstakes dispersal") or part of an ongoing pattern of expansion? To what extent did a bridge serve as a selective barrier, filtering those who would attempt to cross ("filter bridge"), much as the use of stepping-stones is limited to those who can jump far enough? Biogeographic and ecological evidence reveals temporary natural bridges that are predictably repetitive; such as winter ice across river barriers, fords available at low water, or seasonal delivery of fallen trees by floodwaters. From a cultural perspective these could have been the conceptual origin for constructed bridges. Examples are provided to illustrate the application of "bridge" models by biogeographers, ecologists, and palaeontologists, and underscore the roles played by metaphors borrowed from modern cultural use of bridges. Given modern ecological concerns, bridges and tunnels are now being culturally constructed as wildlife corridors to allow animals (and plant propagules that they carry) to counter the impacts of cultural barriers such as roads, developed areas, or areas cleared of cover vegetation. In this way bridges promote interconnectedness within metapopulations and help to maintain or increase natural biodiversity.

Introduction

Much is said in this symposium about the role and character of bridges for people: but what can we say about their role for other members of the biota, especially other land mammals? Today, the role of bridges, both natural and artificial, is becoming ever more relevant in studies of biodiversity and conservation. Especially in recent years, bridges have been constructed, many in national parks or other conservation areas, to serve as corridors for the movement of vulnerable animal species across barriers such as major highways. The proliferation of these bridges comes not simply from a desire to reduce the number of highway accidents, but from a growing understanding about the importance of genetic diversity and the value of maintaining the interconnectedness of animal populations. These newly constructed bridges may be local in scale but programmes to enhance animal dispersal corridors are becoming increasingly regional, even international in scale. Among the latter is the "Y2Y" (Yellowstone to Yukon) Conservation Initiative, which seeks to enhance the connectedness of montane and intermontane lands and their biota over a distance of more than 3000 km between the state of Wyoming in the United States and northern Yukon Territory in Canada. Along this axis, federal, state, provincial, and territorial governments have already created a still-discontinuous band of national parks, state and provincial parks, and managed conservation areas that comprise 21% of its included lands; and improved

management practices have been implemented in an additional 30%, allowing wildlife species and especially larger mammals such as ungulates and carnivores to disperse or migrate more freely (Yellowstone to Yukon 2017).

Constructed wildlife bridges reflect deeper understandings from biogeography that had long ago led to the definition of zoogeographical "realms" or faunal "provinces," some of which (e.g., the Holarctic realm) encompass multiple continents (e.g., Sanmartín et al. 2011). For centuries people have known that animals and plants of strikingly similar character could be found with disjunct distributions, sometimes on widely separated landmasses; and that, conversely, natural barriers had affected species dispersal even over seemingly short distances. Inquiry into such issues grew dramatically in European-based science with the Age of Exploration. Observations made during travels led to questions about the underlying factors, ranging in scale from Samuel Johnson's musings about the local differences between island faunas in Scotland and the Hebrides, to the more global issues of biogeography raised by scholar-travellers Charles Darwin (1859) and Alfred Russell Wallace (1876; 1890 [1869]). Some disjunct occurrences might be explained by so-called "accidents" of dispersal: examples include founding populations of birds carried by storms, tortoises rafted on drift-debris, and even small human groups swept unexpectedly far on rafts or boats. But it is now also understood that some of these "accidents" may reflect underlying dispersal patterns as part of adaptation to unstable environments: the "supertramp strategy" (Diamond 1974; Wilson 1979). But others were too comprehensive to be explained away so easily, involving entire assemblages of terrestrial species separated by oceans. They seemed to indicate the former presence of direct linkages that had functioned as land bridges. Hence the idea of the bridge has played a central role in contributing to the understanding of biotic dispersal, past and present, and in turn to the rise of evolutionary theory. That role has evolved – one might say has mutated – as earth scientists have moved from a model of fixed continental locations to the recognition of continental drift and thence the modern view of plate tectonics. Despite these changed views, the bridge remains a key metaphor in modern biogeographic understanding.

Specific cultural metaphors have often been cited in development of models used in biogeography. But the biogeographic interpretations have also given rise to themes used in the arts, such as in written fiction. This two-way interplay of explanation and metaphor has at times led to confusion between science and fantasy, but has had many beneficial effects, as are noted below.

Moving continents and bridges at a global scale

Flemish cartographer Abraham Ortelius in his 16th-century Thesaurus Geographicus was perhaps first to suggest the former linkage of continental masses across the Atlantic, suggesting that the Americas had been torn away from Europe and Africa by earthquakes and floods (Kious and Tilling 2016 [1996]; in this he was attempting to relate Plato's story of the submergence of Atlantis to his own knowledge of the continents (Ortelius 1596: entry, "Gadiricus" [Cadiz]). Benjamin Franklin, in a 1782 letter to a colleague, described deformed sedimentary rocks with marine fossils in Derbyshire and posited a theory that the Earth's interior was a dense fluid and the surface was "a shell capable of being broken and disordered by the violent movements of the fluid on which it rested" (Franklin 1782).

It is beyond the scope of this paper to detail the many people who contributed to the rise of the modern plate tectonics theory (see Harland 1969; Kious and Tilling 2016 [1996]; and Hamilton 1988). Recognition of closely similar continental shapes grew as Atlantic exploration expanded, but exploration of the Pacific Ocean provided no direct parallels. This contrast, however, would ultimately be an important clue (in the form of the "Ring of Fire" and its subduction zones) in support of continental drift and the underlying, unifying theory of plate tectonics.

More than two centuries of geological inquiry were dominated by a debate between "mobilists" and "stabilists" as to the history of the continents and their variably similar biotas, the latter of central interest for the present paper (Hamilton 1988). No model in 18th and 19th-century science could fully explain the biotic linkages. If one were to assume that the continents were fixed in place, there must have been ancient land linkages – land bridges and lost continents – that would explain close biological affinities of disjunct animal and plant communities. This fertile field for speculation fed not only natural science but also fantasy and adventure writing. One could envision these land bridges and lost continents as gently and slowly rising above or subsiding into the oceans, or somehow driven by past cataclysms. The former was plausible in a long view of Earth history but the latter was especially needed if a literal Biblical model and Bishop Ussher's calculations for Earth time were given pre-eminence over not only scientific findings but also over other global religious views, allowing only 6000 years for all of Earth history.

Few such "lost lands" and lost land bridges have stood the test of time, and the surviving examples are understood not in their original context but in the light of a very different view of Earth dynamics: that of moving continents and variable sea-levels. The "giant" among these lost continents was Lemuria, proposed by Philip Sclater (1864) to have once linked South Africa and Madagascar with India and thereby to explain a number of close faunal similarities. Sclater had seemingly verged upon continental drift by suggesting that Lemuria had split up into islands, some of which merged with Africa and Asia, and others remaining as islands. Later, however, he and his son William suggested that Lemuria must have extended across the Indian Ocean "to the further side of the Bay of Bengal" as a more substantial entity (Sclater and Sclater 1899). While fading from scientific attention, Lemuria embarked upon a robust life in fantasy literature, allegedly supporting the cradle of humankind and "lost civilizations," a role it shared with a number of other fancied lands such as Atlantis and the lost continent of Mu (de Camp 1970).

The alternative was to posit that continents had been rifted apart from some sort of ancestral supercontinent, carrying their linked faunas with them. A leading proponent of this view was Alfred Wegener, a meteorologist interested in ancient as well as modern climates, whose theory of continental drift was especially supported by discoveries of similar terrestrial fossils on disparate southern land-masses: South America, Africa, the Indian subcontinent, and Australia. A strong argument could also be made that specific geological belts could be traced across from continent to continent. Alas, his efforts failed on at least three grounds. His 1915 book was in German, was rebuffed in the post-Great War sentiment, and was not translated into English until 1924. Eurocentric science was also slow to acknowledge the global significance of examples were largely from southern continents and in a considerable part described by Southern Hemisphere scholars. And Wegener's model for movement was untenable: he portrayed the continents as sliding around on a global surface rather like pucks on an ice hockey rink (or ploughing through its uppermost zone, in ship-like fashion), pulled by lunar tidal forces. The model seemingly defied understandings of physics, geological

processes, and the Earth's structure; yet vestiges of his ideas do survive in the sliding nature of subduction zones.

There were alternatives: Occam's razor was well tested. John Joly and Arthur Holmes, accepting the continental fit, had followed earlier authors to posit a "theory of thermal cycles" in which heat from radioactivity deep in the core caused the Earth to expand, stretching landmasses apart and allowing molten magma to fill the fractures (Holmes 1931, 1944). Intervening cooling phases allowed solidification and a degree of shrinkage that accounted for the "wrinkling" that built mountain ranges. Expansion and contraction did, in a sense, bring a sort of "drift" of continents, but only in the sense of diverging and converging dots on an expanding, then deflating balloon. Challenges to this viewpoint are discussed by Hamilton (1988). But Holmes' proposal did require the presence of thermal convection cells in the Earth's mantle, a key idea that outlived the expansion/contraction model; and as Hamilton argued, careful reading of Holmes' work reveals most of the major elements of the later plate-tectonic theory.

Setting aside arguments about mobile or fixed continents, Leon Croizat (1958) developed a theory of "panbiogeography" that was panned by critics as assuming fixed continents. He amassed evidence upon maps of the modern continents, from multiple species of plants and animals, for coincident linkage vectors ("tracks") that could have suggested former bridges and even lost continents, now submerged below the seas. However, Croizat's technique did not in fact require fixed continents to be useful: rather, he was looking for these coincident vectors on a tableau that was for simplicity fixed – a heuristic device that along with other evolutionary ideas of his that were prematurely dismissed by colleagues (Colacino 1997). Devotees of the Atlantis, Mu, Lemuria, and other "lost worlds" might have felt empowered; but Croizat's work was eclipsed by rapidly evolving findings, from the 1950s onward, in terms of the dynamics of Earth's plate motions.

The era of Cold-War ocean-floor exploration brought the realization that there were mid-oceanic ridges with double mountain chains and that ocean-floor rocks were progressively older away from these ridges. Sea-floor spreading was documented by Heezen and others (1959), albeit in an expanding-Earth model. Dietz (1961) and J. T. Wilson (1961, 1963) and Hess (1962) integrated this information with evidence for the presence of subduction zones consuming oceanic crust along certain continental margins or associated with oceanic island arcs, and the grand unifying theory of plate tectonics was born. The Earth's outer shell, or lithosphere, is divided into a number of relatively rigid plates that move in relation to one another. Moving continents were given an impetus and a process; and there have been multiple occurrences of supercontinents, separated in time by episodes of breakup. If all plates are in motion on a spherical surface, it is inescapable that landmasses will periodically rift apart or come into contact, either by direct collision or by sliding past one another, and that on a much longer timescale there will be repeated episodes of multiple assembly, each different from the next (Murphy 2013). Land bridges therefore found a new raison d'être, while some "lost continents" turned out, in a sense, not to have been lost at all.

There are existing plate-tectonically created natural land bridges today with ongoing interchange of biotas, as with the modern link from South to North America that brought "The Great American Biotic Interchange": a phenomenon of the past ~3 million years, but likely preceded by an earlier linkage. This and other examples benefit from the use of detailed morphological studies of micro- and macrofossil assemblages and, increasingly, genetic sequencing studies of modern (and now fossil) populations to test or refine geological estimates for event timing (Denk et al. 2010; Baker et al. 2014; Fritz and Baker 2017; and references therein).

Adding the Icing

Plate movements were, nonetheless, not the full story for land bridges. Deep-sea drilling also provided clear evidence for the regular timing of glacial-interglacial cycles of the past two million-plus years. The cyclic nature of continental glaciation had been recognized on land but because each glacial advance destroyed much of the record for previous advances and retreats, only four or five of the more than twenty such cycles now known had been discerned (e.g., Ehlers and Gibbard 2004). During advances, continental glaciers stored vast volumes of water that at warmer times would have returned to the oceans. Exploration of continental shelves also revealed that ocean levels had dropped by as much as 130 m during the Last Glacial, exposing wide areas and leaving dry land between northeast Asia and northwestern North America (the Bering Land Bridge), between the British Isles and mainland Europe, and in many other areas. The modern insularity of Britain resulted from flooding of shallow shelf areas during interglacial marine high stands (including the present "postglacial"), facilitated by entrenchment and breaching of bedrock barriers in these areas (e.g., at Dover Strait) by spill-over glacial meltwaters during marine low stands (Gupta et al. 2017).

With the synthesis of plate tectonic and glacial-nonglacial theories, biogeography had its explanation for disjunct biotas. Land bridges – in a new and more dynamic form – endured. Recognition of the dynamic Earth enhanced the application of these models in paleontology. Hence the relevant literature is rich in discussions of "land bridges" that are now understood in terms of variable sea levels associated with glacial/interglacial cycles or, in longer-term examples, with the actual movements of land masses and doming or depression of ocean floors.

Cultural metaphors in biogeography

Metaphors from cultural models have been applied to several biogeographic processes. One of the biogeographic findings from application of the plate tectonics model has been that landmasses can rift apart, carrying their biotas with them, isolating formerly continuous populations and allowing them to diverge morphologically over time. This is the basis of vicariance biogeography, as distinct from dispersal and differentiation of species (Wiley 1988). Likewise, other landmasses can collide ("dock"), bringing disparate biotas together, resulting in competition and possible extinctions. Such landmasses have been dubbed "Noah's Arks" because of their transportation of living biotas. But these moving landmasses were or are also carrying, in their geologic strata, the fossils of earlier biotas: hence, immediately juxtaposed rocks of docked landmasses may present fossil faunas and floras that never, in life, were in contact. The cultural metaphor of choice here is "beached Viking funeral ships": they bring the dead to new lands in which they had never lived (McKenna 1973, 1983; Jacobs et al. 2011). Lines of volcanic islands resulting from plate movement across a stable hotspot (e.g., the Hawaiian-Emperor Seamount Chain) provided opportunities for biotas from older, eroding and subsiding islands to colonize newly formed ones: a process named "Hopscotch on the Elevator" by McKenna (1983; Jacobs et al. 2011). These cultural metaphors not only served as useful heuristic devices; McKenna's gentle tongue-in-cheek humour may also have attracted a wider readership and more prompt attention than would otherwise have been the case.

Bridges and biotic dispersal on varied scales

Just as social-science scholars may not realize the extent to which cultural metaphors have brought clarity to natural science discussions, they may be pleasantly surprised also to note the similarity in terms of the questions being asked. The term "corridor" is typically used for direct linkages upon landmasses, allowing organisms to disperse or migrate with relative ease from one place to another. Some connections are, however, selective: "filter bridges" may allow certain species to disperse while others are prevented from doing so, much as the use of stepping-stones is limited to those who can jump far enough. These terms are typically applied to terrestrial examples, but as we learn more about the oceans it is increasingly evident that there are traditional migratory pathways linking populations while also defining them as distinct from others. An example would be the distinction between resident, offshore and transient (or Bigg's) orcas (Orcinus orca, "killer whales") along the west coast of North America: these three ecotypes are to a degree sympatric but differ in prey selection, seasonal distribution, social structure, and behaviour; with the transient forms appearing only seasonally at specific localities during their migrations (Ford et al. 1998; COSEWIC 2008). Hence the restriction of "corridors" to land examples may prove facile, and if there are "corridors" of favourable waters for dispersal or migration in the oceans, there should by extension be something analogous to bridges, allowing passage from one favourable water body to another. It seems paradoxical to argue for "bridges" within water but biogeography, including human geography, has emphasized land masses over water bodies when both have biotas clearly partitioned into communities and when some species have traditional migration routes. On a more global, long-term scale, the opening of seaways by movement of tectonic plates has provided "bridge" waterways or "gateways" of great importance, as at stages during the complex history of the Tethys Ocean. For a time in the Mesozoic Era, Tethyan linkages allowed circulation of water around the Earth near the Equator; closure of these gateways and north-south opening of the Atlantic Ocean brought major paleoclimatic and biogeographical changes (e.g., Hamon et al. 2013).

Was a given dispersal event accidental ("sweepstakes dispersal") or part of an ongoing pattern of expansion? Sweepstakes dispersal is typically applied to examples in which animals or plants somehow cross large water-bodies: for example, on rafts of vegetation or (for flying animals) by being carried on storm winds (Matthew 1918; Simpson 1965; McKenna 1973; Wilson 1979).

Biogeographic and ecological evidence of course reveals temporary natural bridges that are predictably repetitive; such as winter ice across river barriers, fords available at low water, or seasonal delivery of fallen trees by floodwaters. But analogous features have functioned at many scales.

The Bering Land Bridge between northeast Asia and northwestern North America emerged repeatedly during sequent glacial advances. During these times, the adjacent areas on both continents were ice-free (the continuous open region called "Beringia"), because of a "snow-shadow" effect from high mountains even though there were ice masses to the south. Megafaunal species travelled both ways, with Eurasian mammoths and bison colonizing North America, and American horses and camels colonizing Asia. Ancient DNA (aDNA) data clarify findings from modern phylogenetic studies and now show that movements were more complex for each group, involving movements back and forth (Sanmartín et al. 2001; Shapiro et al. 2004; Enk et al. 2016). In North America a pathway south from Beringia

awaited the early phases of glacial retreat, likely involving both coastal and mid-continental ("ice-free corridor") routes well after the time of first arrival in Alaska/Yukon; by the time the first colonizing populations could move southward the land bridge was already being submerged as meltwaters fed the rising ocean (Hetherington et al. 2004; Jackson and Wilson 2004).

Was there ever a Horatius at a natural bridge, stopping some species from crossing? Geist (1989) suggested that humans may have been prevented for several thousand years from entering North America via Beringia because of the presence in the New World (including eastern Beringia) of the giant short-faced bear, Arctodus. This was a cursorial predator considerably larger than the brown bear (Ursus arctos) and could have been a formidable competitor. Oddly, however, Arctodus also does not seem to have been able to move into Asia, suggesting either a stand-off or different set of limiting factors for both. Whether or not this specific example is valid, there must be other examples in which biotic factors such as competition, predation, or diseases have blocked potential immigrants from successfully using land bridges: hence the "Horatius effect" is here accepted as a potentially useful paradigm.

A western North American example of a filter bridge involves late Pleistocene, early post-glacial mammals from islands in and bordering the Salish Sea (Puget Sound and the Straits of Georgia and Juan de Fuca) in Washington State and British Columbia. During the Last Glacial, the presence of thick ice caused the lands in this region to be depressed, even as sea levels were also lower because of storage of water in the ice. With the retreat of ice, there ensued a "race" between rising global sea level and the rebound of these lands, such that one must talk of "relative sea level" at any given time to express the land-sea relationships. Between about 14,000 and 12,000 years ago [12,000 and 10,000 radiocarbon years ago], when relative sea levels were still lower than today, giant bison (Bison antiquus) and giant short-faced bears (Arctodus simus) were able to disperse from the adjacent mainland, across the San Juans Islands, to Vancouver Island. A giant ground sloth, Megalonyx jeffersonii, was able to reach the San Juans but evidently not Vancouver Island. Among the small mammals, of several vole species known on the mainland today, only one is found on Vancouver Island. These findings indicate the presence of a filter bridge, possibly in the form of a linked land mass including the San Juans but with a narrow water barrier (Haro Strait) between the San Juans and Vancouver Island. While the filter bridge was still available, island populations were linked as a larger metapopulation, a group of spatially separate local populations still able to exchange individuals (see Hanski 1998), able thereby to maintain genetic diversity. Rising sea levels in the wake of glacial melting and retreat brought increasing isolation of islands in the San Juans group and widening of Haro Strait, ultimately stranding the bison as small, isolated populations. By 12,000 years ago they were extirpated from the area, likely by a combination of isolation and predatory pressure from humans, bears, and probably wolves. The metapopulation had been fragmented into small populations with correspondingly less genetic diversity and little resiliency (Wilson et al. 2009; Kenady et al. 2011).

With ongoing global change there are many examples of the effects of habitat fragmentation in the absence of bridges. Mammals of the alpine zone, if limited in their dispersal ability, can become restricted to small mountain-top patches bordered by advancing forests. Further forest advance can simply "pinch out" local populations of these species, putting the entire metapopulation at risk. This is one of multiple factors limiting the distribution and resiliency of the critically endangered Vancouver Island marmot, Marmota vancouverensis (COSEWIC 2000).

The Role of Artificial Bridges and Managed Corridors in Conservation

Given modern ecological concerns, bridges (including underpasses) and tunnels are now being culturally constructed as parts of wildlife corridors to allow animals (and plant propagules that they carry) to counter the impacts of cultural barriers such as roads, developed areas, or areas cleared of cover vegetation. In this way bridges promote interconnectedness within metapopulations and help to maintain or increase natural biodiversity. They can also facilitate new dispersal, an issue of growing value as animal populations need to move in response to ongoing global change. Intentional construction of wildlife bridges follows upon a long, documented history of initiative shown by the animals themselves. The late Carl Gustafson told me an apocryphal story that when the centre span was put in place on the Snake River Bridge for Highway 261 at Lyon's Ferry, Washington, the first to cross the full span, even before the workers, was a jackrabbit. Certainly it is also documented that another species, Ord's kangaroo rat (Dipodomys ordii) did not occur north of the Snake River in the early 1950s; by 1956 their range extended several km beyond the US Highway 12 bridge near Pasco, Washington, and now they are found widely around the Pasco region, their range expanding by over 1.5 km per year (EIS Task Force 1975, p. IV-368).

All biotic species disperse by one means of another: some do so relatively passively, as by gradually filling available space through reproduction and establishment of new neighbouring territories, but many are highly mobile at some point in their life-cycle. Even one-way dispersal requires viable corridors, temporary or not. Some highly mobile animal species are also migratory; that is, they undertake seasonally patterned movements back and forth from one region to another for reasons such as to optimize food availability, cope with temperature extremes, or to seek cover habitat for birthing of young. Such a pattern requires a corridor for movement. Studies of migratory ungulate populations in Africa and elsewhere have shown that in a given species both migratory and resident ecotypes may be present; but if so, the migratory forms by far outnumber the resident ones. This may be because migratory ungulates, being non-territorial, benefit from spending time in the buffer zones between sequent predator territories in addition to being able to optimize grazing possibilities (Fryxell et al. 1988), in which case migration itself is an adaptation crucial to survival. Beringia was likely a corridor for both directional dispersal and cyclic migrations.

Discussion and debate has emerged around the idea of "assisted colonization," the moving of species outside their modern natural, restricted ranges to promote their survival. In some cases this has been necessary when the original habitat now offers no suitable places in which a species can survive, or within which introduced predators or competitors now preclude its survival. Nevertheless, a relocated species is of course intrusive to its new "refuge" habitat and this effort might only set in motion a cascade of further impacts; hence there has been considerable debate (e.g., IUCN/SSC 1998; Ricciardi and Simberloff 2009; Willis et al. 2009; CBD 2010; Stanley Price 2010; Fernández-Manjarrés and Tschanz 2010; Ruhl 2010; Stone 2010).

An alternative to the artificial transplantation of populations is to provide physical corridors for their own, more natural dispersal or migrations. In Qatar two camel bridges have been constructed in recent years. One is near Al Doosari Zoo and Game Reserve on a new rural arterial road from Al Shahaniya to Leatooriya and Lijmiliya, from central to northwest Qatar. These bridges are part of a larger strategy for wildlife, also involving underpasses and guard-

rails (Anonymous 2017). The bridges are relatively simple enclosed, ramp-type structures with protective guardrails, but could still appear visually as physical barriers to the animals.

A more elaborate type of wildlife bridge involves not only a physical structure but also placement of planted vegetation upon the bridges to provide a continuous habitat corridor. Banff National Park in Alberta, Canada, is traversed by a portion of the Trans-Canada highway, a major multilane divided route. There are now 44 wildlife crossing structures, including 38 underpasses and 6 overpasses or bridges, together with 82 km of fencing to keep animals off the highway and to conduct them to the preferred crossings (Beckmann et al. 2010; Highway Wilding 2013; Parks Canada 2017). These not only serve migratory ungulate populations but also provide important connectivity between carnivore territories and populations, and routes for dispersal to new territories (e.g., Clevenger and Wierzchowski 2006; Sawaya et al. 2013).

Such examples, together with the vast, regional Y2Y Conservation Initiative described in the introduction, illustrate the importance and potential of the growing field of connectivity conservation (Crooks and Sanjayan 2006). In this context and given the increasing urgency of issues relative to global change, bridges can and do play a central role, whether they be constructed features crossing barriers such as highways, or major swaths of interconnected, protected lands.

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"At the Very Moment the Accident Happened: " Adjustments to Change in Physical and Imagined Landscapes Along Railways Near the American Appalachians

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INTRODUCTION

In the mid- to late nineteenth century, the building of trans-Appalachian railroads through rugged terrain required engineering feats that, to many observers in the United States, were as impressive as the powerful locomotives those roads were designed to carry. Grading and laying of track in mountain areas required contractors to go to unusual lengths to not only build iron bridges and trestles across gaping divides but also blast cuts and tunnels in order to create usable roadbeds on steep terrain. The changes that the landscape underwent in rural upcountry areas and small towns required of residents and railroad workers a variety of mental, physical and legal adjustments. Overpasses, for example, led to visual obstructions that could be hazardous at intersections, particularly in areas where railways curved. Likewise, a cut or removal of a natural barrier could flood nearby farmland during heavy rains. People driving horse-drawn buggies and wagons from town to town had to learn to judge the speed of oncoming trains.

Leisure class Americans from larger, urban areas often held romanticized views of rural areas that differed from that of their more rural, upcountry counterparts. Consumers of travel brochures and "local color" fiction often saw the interaction between the manmade and natural landscape in romantic terms as new infrastructures and their perceived dominance over time and physical space became the stuff of wonders for tourists to observe on vacations. At the same time, their vacation destinations were often rural areas where they tried to recapture a perceived rural past that the United States had largely left behind. This paper marks an attempt to contrast the literary and promotional depictions of modern transportation as a means of reaching idyllic rural areas with accident reports and court cases involving injuries, fatalities and property damage that people in rural areas encountered toward the turn of the twentieth century, from loss of control of their physical spaces to fatal accidents during routine errands. In addition to pertinent secondary literature, I examine short stories set in New England and the South, along with promotional literature from railroads, and compare and contrast them with railroad accident reports and court decisions involving residents of and railroad workers in hill country and mountain areas of North Carolina and New Hampshire, the two states in which Appalachian peaks reach the highest elevation in the United States east of the Mississippi River.

THE MYTHOLOGY OF THE AMERICAN SOUTH AND NEW ENGLAND

At the turn of the twentieth century, the United States maintained an ambivalent relationship with its own understanding of progress. At the same time that many Americans dismissed as dead weight anyone or anything that stood in the way of industrialization's march, they tried to hold on to a remnant of a preindustrial pastoral identity they sensed they were leaving behind. Works in American Studies from Marx (1976 [1964]) to Hallock (2003) have long noted this tension between past and present in nineteenth century American literatures that embrace disappearing landscapes, that lament the loss of disappearing American Indian tribes, and that gaze nostalgically at rural and small-town America. This sense of loss started to manifest itself clearly in the mid-1870s, by which time the southeastern United States had been defeated in the American Civil War, rail service in the United States had spanned the continent, the Sioux had been defeated on the Great Plains and the nation was transitioning more and more toward an industrial economy. As white Americans in the eastern United States began to feel as if they were coming unmoored from their cultural roots, they began to turn to regionalism as a means of preserving -- in discrete

pockets -- endangered subcultures they began to fear losing altogether. In fiction and promotional literature, writers began to construct imagined versions of geographical regions of the United States, suggesting wistfully that these regions contained American subcultures that were unique, that were essential parts of the American fabric, and that were disappearing as industrialization homogenized culture.

Among the first regions within the United States to claim imagined traditional heritages were New England and the southeast. Comforti (2001c:204-205) notes that after the Civil War, an "Old New England" myth emerged that celebrated industrial New England's hardy, independent colonial past. At the same time, the southeastern states, their economy and infrastructure devastated, began to create an "Old South" myth claiming that prior to the Civil War, the southern slave states had been an idyllic, gracious place in which African American slaves were content, masters were benevolent and life was simpler without the complications that the emancipation of slaves brought to African American-white race relations. Urban readers who lived in growing cities east of the Mississippi River provided writers with a growing audience for stories based in the rural South and northern New England depicting isolated individuals living their lives in a preindustrial context, off the beaten path, forgotten by time and out of synch with the world around them. Within these stories, industrial infrastructures became the perfect means of joining imagined rural spaces to modernized urban areas. Railroads, with their massive cuts and trestles, could themselves serve as a sort of character forming connections between city and country, the present and the past.

One reason that railroads worked so well as fictional connectors between the present and the past is that the proliferation of the regional "local color" genre in the postbellum United States coincided with the growth of recreational travel and tourism. In promotional literature for real-life railways, railroad companies could present their lines as a means for middle and upper class Americans intrigued with stories of isolated regional pockets to visit for themselves regions romanticized in fiction. Purchase (1999c:55) observes that tourism is an industry that sells a "product" that is "imaginative," not "material." Combining landscape and local color, railroad companies used language similar to that of regional local color writers to describe pastoral travel destinations, convincing a growing number of vacationers that they could use the fruits of progress provided by railroads that had, supposedly, conquered space and time to reach into the past as they traveled to rural areas fictionalized in local color narratives.

Mountain areas in New England and the South were particularly suited toward achieving these ends for fiction writers as well as promotional writers. The Appalachian Mountain range fit into the creation of the Old New England and Old South myths in part because it spanned the entire eastern United States and provided themes of sublime vistas and quaint, isolated mountain folk applicable to North and South. The construction of railroads into the Appalachians between the 1840s and the 1890s involved blasting cuts in rights of way that exposed rock and earth, presenting visual maps of the layers and crevices formed over millennia. These cuts, easily visible to urban tourists, accentuated a sense of permanence and of chronological distance from their modern lives while suggesting at the same time the notion that technology had conquered time. Finally, mountain New England and the mountain South could be mythologized, as Comforti (2006 c:206, 271) hints, by the purging of African Americans from regional narratives for the benefit of whites who saw them as, at best, an unfortunate backdrop to American culture and legal institutions. The relatively low African American populations in mountain New England and the mountain southeast made it easy for white Americans to render African Americans invisible there and to downplay the fact that slavery had existed in or on the edge of both areas. As Farrow (2014c:75-81) notes, many white New Englanders even today are unaware of the strong presence of slaves in New England before the American Civil War. For this paper, then, I intend to focus primarily on

two ranges within the greater Appalachian chain, the White Mountains in New Hampshire and the Blue Ridge in North Carolina.

STEAM POWER, TIME AND CULTURE IN FICTION

One means that regional writers in New England and the South used to connect time and place was the creation of characters from supposedly backward cultures within the two regions, then writing steam-powered transportation into their narratives as a literary vehicle to carry these characters into modernity. One example is the "The Dulham Ladies," a short story published in 1890 by Maine native and local color writer Sarah Orne Jewett. Jewett's fiction dealt predominantly with characters based in rural coastal Maine, but she had access to a wide range of rural New England areas from the mountains to the coast, she had visited New Hampshire's White Mountains, and she is representative of a group of authors who helped establish the mythical, rural New England region that included upper New England's mountains as well as its coastal areas after New England had gone through its industrial transition. By the end of the nineteenth century, notes Sweeting (2003 c:91) "no region had more advanced factories and railroad networks" than New England.

"The Dulham Ladies" is a wistful portrait of Miss Dobin and Miss Lucinda, two aging small-town New England spinsters who, upon their parents' deaths, suddenly become cognizant of the fact that they are no longer youthful. The ladies are described in the narrative as walking anachronisms, quaintly clinging to manners long ago dismissed by their younger neighbors even as they try, hopelessly, to retain their youth and to stay up to date. Facing the realization that their hair has started to thin, the sisters decide one day to take a train from their fictitious hometown, Dulham, to a larger, nearby town to shop for hairpieces. Duped by an unscrupulous wigmaker into buying cheap, outdated false bangs from leftover stock, Miss Dobin and Miss Lucinda return home, cheerfully oblivious to how ridiculous they appear to their neighbors. Of their failure of the sisters to stay current, Jewett (1896 [1890]c:86) observed in her story that "time and space are but relative after all."

A twenty-first century reader who has watched any of the abundant number of popular documentaries about Albert Einstein might wonder at the casual nature with which Jewett observes as a truism the relativity of time and space in the early 1890s. Jewett's pairing of the temporal and the geographical, however, was reflected in the minds of everyone in the late nineteenth century who was amazed at the degree to which the power of steam engines -- manifested in railroads and ships -- sped up travel. Jewett was able to use as an effective plot device a train transporting Miss Dobin and Miss Lucinda from their lifelong home to a larger town to emphasize the chronological disconnect between the ladies and the culture that had left them behind. In making a geographical leap from their hometown to Dulham, the sisters could at least try to catch up with the time that they had let slip by.

Jewett's trope of "backward" or "out of touch" rural people thrust out of their time and place was preceded by some thirteen years in an early piece of fiction by Frances Hodgson Burnett, a native of England, where the industrial transition came far in advance of North America's. Burnett, best known for her classic children's book *The Secret Garden*, lived in the Appalachian South for a portion of her life and used a fictionalized version of mountain North Carolina culture as the basis for a short story titled *Esmeralda*. *Esmeralda*'s improbable plot heads toward its climax when a culturally anachronistic mountain farmer named Wash travels to Paris, France, and retrieves the title character, whose engagement her mother hoped to break up by taking her across the Atlantic. One of the Parisian characters in the story observes that Wash carried “the look . . . of a person who has lived a simple life, and who

knows absolutely nothing of the world." Wash's ardor for Esmeralda is described by the character as "the love of the lost Arcadia—serious and innocent." (Quotes in Burnett (2017 [1877] c:27, 30).

TRAVEL PROMOTED AS A MEANS OF CONQUERING TIME AND SPACE

Like Jewett, Burnett appealed to a lot of readers feeling a sense of loss in a rapidly industrializing nation amid bold claims by engineers, capitalists and promotional writers that time and space could be conquered by a steamship, a steam locomotive, iron rails and wooden crossties -- themes explored in Kraus (2013) and Storey (1979). The more ubiquitous railroad travel became, the more common were references to railroads conquering time and space. In an undated book titled *Who Were There and What They Said* commemorating an 1885 dinner for Baltimore & Ohio Railroad officials in Staten Island, New York, Erastus Wiman, a wealthy Canadian railroad investor, exulted that "The railroad, even in our own recollection, has done more to conquer time and space . . .than all other forces and influences combined."

In a similar spirit, promotional writers used modern transportation as a means of connecting time and place, with one difference: they reversed the roles of the rural characters presented in "Esmeralda" and "The Dulham Ladies." If rural and small-town denizens in regional fiction could reach "civilization" by steamer or rail and return home, urban tourists could move backward in time, by taking a trip to a rural location that held the simplicity that they craved in their increasingly busy lives -- then return to their modern lives at the end of their vacation. Steamships greatly reduced the time of ocean travel, and as Wilson (2016) notes, even continents separated by vast bodies of water seemed closer. But for middle class passengers who lacked the means to travel to Europe, riding the rails and seeking simplicity within their own nation seemed a good alternative. Among members of the burgeoning middle class, railroads could serve as leisurely linkages between the present and the past.

PROMOTION OF LANDSCAPE

Literary imagination and good advertising, then, joined to solidify white American civilization around both a pastoral myth and a celebration of progress. Rail service in the Appalachian chain served as a perfect conduit for people who wanted to escape either into the past or a (constructed) primeval Arcadia. Advertising copy for roads leading to the White Mountains and the Blue Ridge emphasized the two regions' perceived cultural pasts, their natural wonders and the engineering skill that it took to build the roads up steep grades, to bridge wide gaps, and to cut tunnels through earth and rock. In a promotional booklet titled *Portland and Ogdensburg Railroad Line: Eastern Division*, the P&O Railroad combined a sense of mystery and practicality as it sold the White Mountains to potential investors for its expansion from neighboring Vermont into New Hampshire: What the Yo Semite [sic] is to the West the White Mountains are to the East, the crown and consummation of majesty and beauty in the aspects of nature. . . . When . . . it is . . . recollected . . . that for all coming time there is to be but one White Mountain upland, it cannot be questioned that . . . an annually vaster host of devotees will year by year come.

Similarly, in the 1890s, promotional writers began to sell North Carolina's mountains to northern tourists on behalf of the trans-Appalachian Western North Carolina Railroad. Frank Presbrey, a New Yorker and an adman writing promotional literature for the Southern Railway, a large multistate network which controlled the WNCRR, exulted in a pamphlet

titled *The Land of the Sky and Beyond*, published not in the South but, ironically, in New England that "The spur of the Southern Railway running southwest from Asheville to Murphy, a distance of 120 miles, is famous as one of the most daring pieces of railroad engineering in this country. During almost the entire length of the road the scenery is romantically wild, and . . .offers to the sportsman a perfect paradise.

For the nineteenth century, the trans-Appalachian lines that ran through the White Mountains and the Blue Ridge were quite impressive feats of engineering. But claims like those of Erastus Wiman that humanity had triumphed over space and time were, obviously, overblown. For people who actually lived in the areas painted as representative of simpler times, and for workers for the railroads that wended their way into these area, the industrial transition was often just as jarring and stress-inducing as it was for many urban dwellers. There as in the rest of the nation, technology had progressed ahead of society's ability to cope with the changes it brought -- to daily life, to people's views of cause and effect, and the manner in which law and governance adjudicated the uneasy relationship among ancient landscapes, infrastructure and the people who lived their lives in the tension between the two. Welke (2001) discusses the stresses that railroads brought to Americans effectively in her book *Recasting American Liberty: Gender, Race, Law, and the Railroad Revolution, 1865-1920*.

The construction, operation and maintenance of rights of way required serious adjustments, and the descriptions of altered landscape and injured bodies in accident reports and court decisions of the late nineteenth century provide a stark contrast to the language of quaintness and the sublime in regional fiction and considerably tourist booklets. By 1907, as Aldrich (2006c:2-3, 118-119) notes there were some 12,000 railroad-related fatalities a year in the United States, even after fatalities involving passengers (as opposed to employees) dropped over the last decade of the nineteenth century. A large number of railroad accidents in or near mountain New Hampshire and North Carolina during the late 1800s involved bridges, cuts and intersections.

FATAL MISJUDGMENTS OF TIME AND SPACE

Some of those accidents reflected the sudden necessity for people to estimate velocity and time -- or to estimate heights -- when split-second reaction times meant the difference between life and death. On the night of May 8, 1899, at about 11:30 p.m., a conductor for the Boston & Maine Railroad, one of the New England roads that carried tourists through rural New Hampshire into the White Mountains, was filling in late one night for another employee. Herbert Wells was leading a Boston & Maine train on a portion of road between New Hampshire's state capital, Concord, and Woodsville, that was not on his regular route. Wells's destination, Woodsville, lay about 80 miles to the northwest of Concord, just east of the Vermont-New Hampshire border near the western edge of the White Mountains (See Map 1). When the train arrived at Woodsville, Wells was nowhere to be found. After finding blood near handholds on a freight car, some other Boston & Maine employees telegraphed a later train following the same route. Workers on the following train found Wells's body with a fatal wound visible on his forehead. The following day, railroad employees discovered the spot where Wells's head had struck the bottom of a bridge passing over the railway near the outskirts of Woodsville then known as Pike's Station. The bridge was most likely an overpass near an complex of buildings owned by a manufacturing company. As it turned out, the bridge that killed Wells was old, in disrepair and was being replaced by a newer bridge under construction some 250 feet to the south. The clearance of the older bridge was about four feet lower than the new bridge. According to the railroad's accident report to New

Hampshire's railroad commission, the fatal run was only Wells's second after he began substituting on the Concord to Woodsville route, and he was standing on a freight car running board when his head hit the bridge. After making it through the first bridge, he apparently either forgot about or failed to correctly estimate the clearance of the older bridge.

A year earlier, in the wee hours of a May morning sometime after 2 a.m. on the same route, a Boston & Maine brakeman disappeared from a train going over a bridge on its way toward Woodsville. According to the *Report of the Railroad Commissioners of the State of New Hampshire* for 1898, Daniel McPhee had climbed down onto the steps of the train engine as it was entering a curve and transitioning to a steeper grade. McPhee was trying to watch the rail cars behind the engine to make sure that none disengaged from the train. When another worker watching McPhee looked away from McPhee, looked back and saw that McPhee was not on the steps, he got the engineer to stop the train. They discovered McPhee lying on the bridge. McPhee, who never regained consciousness, died the next afternoon from a head injury. "As no one saw him at the very moment the accident happened, and as he never recovered consciousness, the cause can never be positively known," New Hampshire's railroad commissioner concluded as he exculpated the railroad. Apparently, McPhee lost his balance. Whether his fall came from the centrifugal force of the train going through the curve, the sudden shift of the engine to a steeper ascent, a jostle of the train or a combination of factors is, indeed, impossible to say. But the fact that McPhee's his attention was focused behind him -- as he was moving forward in the dark -- almost certainly played a factor.

Wells's and McPhee's deaths reflected a growing problem with people working long hours handling dangerous machinery. In a tort system that, by the mid-nineteenth century, was an awkward combination of common law tradition with an Enlightenment view of individual rights and social contracts, people were considered autonomous: able to make their own decisions, to assess risks, and to voluntarily assume those risks as a consequence of their employment. This legal approach may have worked well when both parties to injury suits were overwhelmingly individuals whose injurious encounters with each other did not involve mismatches of speed and weight. But as Thomas (1999:c72-73) queries, how much autonomy did a person in the industrial world hold compared with a corporation or a machine? Looking from the vantage point of the early 1920s, American jurist Roscoe Pound (1931 [1921]c:48) laid out the problem with applying preindustrial principles of negligence to industrial-based accidents: “Before the days of workmen's compensation it was said that statistics showed the great majority of industrial accidents happened in the last working hour of the day, when the faculties were numbed and the operative had ceased to be the free agent which our theory contemplated. But there was no escape from the legal theory. That very condition was a risk of the employment, and was assumed by the laborer.”

As was the case in larger urban areas, railroads also imposed themselves on the everyday lives and landscapes of rural and small-town residents of mountain North Carolina and New Hampshire. If experienced railroad workers slipped up and got hurt or killed on the job, ordinary townspeople could be expected even more to make misjudgments or become victims of high speed machinery that they encountered in the context of their daily lives. Many died trying to race trains to intersections. The growing familiarity with railroads, may itself have contributed to the alarming number of fatalities in rural areas. "The quickened pace of travel implanted the feeling that [people] could always go a little further and do a little more" observes Purchase (1999:c47). One example of a local driver whose misjudgment proved fatal involved Robert Libby, a farmer from Warren, New Hampshire, a town in the White Mountains southeast of Pike's Station. According to the *Report of the Railroad Commissioners of the State of New Hampshire* for 1899, Libby, 60, and his wife were heading south by wagon on a fall morning to Wentworth, a town that bordered Warren, for a family visit. The highway from Warren to Wentworth ran parallel to the railroad and crossed

the Boston & Maine track at a point called Clifford's Crossing, and the Libbys were ahead of a train that, apparently, had left the Warren station five minutes late. According to the engineer and other men working the route that morning, Libby was startled by the train and tried to make it through the crossing after hearing a warning signal. The train, despite braking, hit one of the wagon's rear wheels, and the couple was killed. "Accepting the evidence before us, which is uncontradicted, the conclusion follows that he [Libby] . . . miscalculated his distance from the train and acted upon the impression of the moment that if he hurried a little he could get over ahead of it in safety," New Hampshire's railroad commission concluded.

If individuals were injured or killed, railroad companies assumed that the accident victim was at fault unless there were clear structural problems with the railroad's rolling stock that led directly to the accident. Railroads acted on the premise that people operated at their own risk in public spaces, and judges hearing suits against railroads were repeatedly treated to debates, in language that seemed to anticipate the thought experiments of twentieth century physicists, the degree to which everyday people could judge the speeds of trains approaching them from a distance.

The Libbys, of course, could not give their version of events at the state railroad commission's investigation of the accident. However, by the early 1890s, New Hampshire's legal system was beginning to give citizens the benefit of the doubt when they challenged railroads in court. One of the people most responsible for the change was the state supreme court's innovative chief justice, Charles Cogswell Doe, who grew up in a small town in New Hampshire near Sarah Orne Jewett's hometown on the other side of the Maine/New Hampshire border. Doe's indefatigable approach to the law, described by Reid (1963), was similar to that of far more famous American jurists Roscoe Pound and Oliver Wendell Holmes. That approach is visible in a precedent-setting 1890 decision by the New Hampshire Supreme Court in favor of a man whose wife, a woman named Martha Huntress, was killed along with her mother when their carriage was hit by a Boston & Maine train while crossing a straightaway in Greenland, a tiny New Hampshire town that sits on Great Bay near the Atlantic Ocean. Responding to the railroad's argument that any healthy traveler would have been able to either see or hear the train approaching, Doe observed in his decision for *Huntress v. Boston & Maine Railroad* (1890): “Whether a train is going twenty miles an hour or forty, is a question on which the opinion of but few observers would be considered valuable by a railway expert. In estimating time, distance, and rapid motion, the mass of men are inexpert. . . .They are not ignorant of the probable consequences of a collision, but are likely to be misled by an erroneous view of the probability of a collision. Reasonable care often depends upon actual knowledge, or reasonable and rightful expectation.” Doe's decision reflected the fact noted by Aldrich (2006:c 2,3) that by the late nineteenth century, people were increasingly assessing risk in statistical terms as the nation became increasingly safety-conscious and prosecutors were trying to establish chains of causality that would allow courts to hold railroad companies liable for injuries and fatalities.

PROBLEMS ARISING FROM ALTERED PHYSICAL SPACES

Accidents on mountain roads brought to the fore an interesting question in the midst of this shift in jurisprudence: How could one determine a chain of causality attributable to a company or an individual if the landscape itself seemed to play a causal role in an accident? It was difficult to assess blame when physical spaces were altered due to technology. An example of such a problem faced the North Carolina Supreme Court after a railroad employee was the victim of a nighttime accident in Haywood County, North Carolina, west of

Asheville (see Map 2). L.J. Styles, a section worker for the Western North Carolina Railroad, slid onto a track and had his leg severed by the wheel of a WNCRR train coming through a cut an hour behind schedule. Styles slipped on loose dirt from the cut as he was trying to climb onto a bank in the cut in order to avoid the oncoming train. According to the report for *Styles v. Receivers for Richmond & Danville Railroad Company* (1896) the court was split in its interpretation of the chain of events that led to the accident. Justice Alphonso C. Avery, who wrote the majority decision reversing a lower court decision in favor of Styles, insisted that Styles should not have been in the cut in the first place, as his section boss testified that he had ordered him not to go into the cut until the train that injured him had passed. The majority held that "The leaving of the earth in the cut was a fact accomplished, and, if the plaintiff went into the cut contrary to the command of his superior, (the section boss) he was guilty of contributory and concurrent negligence."

Missing from the majority opinion, however, was the fact that it was the section worker's job to inspect the cut, make sure that it was clean for trains to pass through, and, if necessary, to signal the oncoming train not to go into the cut. Styles testified that he had gone into the cut when the train failed to arrive on time to make sure that it was still safe for passage, as the cut often had dirt come loose and slide onto the track. He estimated that the train was a good fifty yards away from him when he climbed onto the bank to avoid getting hit. In Justice Walter Clark's dissenting opinion, he attached causal significance to the presence of the dirt itself, as had the jury in the lower court which had sided with Styles. "The plaintiff stepped off the track in full time to avoid being hurt, and his being in the cut was not per se the cause of the injury, but it was the treacherous condition of the earth which the defendant had allowed to slide down and fill up the side ditches. . . . This negligence of the defendant was, therefore, the 'last act,' or in other words the 'proximate cause,' of the injury."

The presence of the altered landscape, then, became a factor in the case. According to Clark, the railroad's failure to deal with the problem of landslides was the key factor in the chain of causality that led to Styles's injury. The majority, however, saw the road's role in the chain of causality differently: "The leaving of the loose earth, which constituted the defendant's first negligent act, was also a fact accomplished before the plaintiff started back through the cut," Avery argued. "The defendant had no opportunity to prevent loose earth from following a natural law in giving way when a man threw his weight suddenly upon it." To Avery, the looseness of the dirt was beyond the railroad's control.

The Styles case revealed the sometimes drastic changes that came from making huge cuts through mountain earth and rock. These changes affected not only railroad employees but also people who owned land along railroad rights of way. The case *Aiken v. Boston, Concord & Montreal Railroad--Eaton v. the Same* (1872) dealt with two landholders who lived in Wentworth, New Hampshire, a town in the White Mountains about 20 miles southeast of Woodsville, Milo Aiken and Ezra B. Eaton claimed that a flood that hit the town in 1869 damaged their properties, which both sat adjacent to a river that went through the town. Aiken and Eaton alleged that overflow water from the river flowed down a cut that the Boston, Concord & Montreal Railroad (the precursor to the Boston & Maine) had made through a ridge on rights of way adjacent to their farmland and washed debris onto it. Before the road made the cut, the ridge had served as a natural barrier protecting Aiken's and Eaton's land. Both Aiken and Eaton had signed releases allowing the road to build across their farmland, and the railroad claimed that the releases protected the road from liability. The New Hampshire Supreme Court, however, disagreed, ruling that the releases did not cover problems caused by a portion of the cut that did not lie on either person's land. "The injury complained of in this case is not a mere personal inconvenience or annoyance to the occupant.. . . it is a physical injury to the land itself, a physical interference with the rights of property, an actual disturbance of the plaintiff's possession," the court ruled.

Unlike the Styles case, then, the Aiken and Eaton involved the property rights of landholders, which is probably the main reason that the case went in the farmers' favor. “Could the defendants say they were not liable because they did not cause the rain to fall,” which resulted in the freshet; or because the water “came there by the attraction of gravitation?” The court asked rhetorically as it ruled in favor of Aiken and Eaton. As with the Styles case, however, the Aiken and Eaton suits show the tricky nature of trying to decide how to combine moral responsibility with major alterations in terrain when industrial and preindustrial landscapes came face to face with each other.

CONCLUSION

Wells's and McPhee's fatalities, the fatal collision of the Libbys' buggy with the Boston & Maine, and Styles's disabling injury, are graphic reminders of the problems people in the nineteenth century faced in adjusting to the quickening pace of life and the tremendous changes to the landscape brought by the growth of rail traffic over the course of the nineteenth century. Though less grisly, Aiken's and Eaton's case also emphasizes the fact that railroads could be intrusions upon as well as reflections of progress. For urban Americans, the contradiction led to an unsolvable paradox, as stories and promotional literature that encouraged people to use modern technology to access idyllic scenery also promoted the growth of technology that compromised the idyll itself. American literature often marked attempts to deal with this paradox, lamenting the loss of supposedly pristine landscapes to progress. But if the sense of loss led to a sense of nostalgia among urban readers and vacationers, it was, perhaps, even more stark for people who actually watched the industrial transition come to their supposedly Arcadian rural areas. Real-life fatalities, maiming and the effects of erosion as revealed in court cases and accident reports reveal the losses people incurred in ways far more jarring than any piece of sentimental fiction or advertising copy. No one, whether they lived in rural or urban areas, could escape the effects of industrialization for good or ill. Local color writers and promotional writers extolling the landscapes and quaint cultures of the Appalachians might have captured the imagination of middle class readers and tourists who, as Gleick (2016) notes, were anxious to use literature as a vehicle to take them back to another time. But the legal and official prose describing those who lived there and whose lives were upset -- or taken -- revealed that while adjustment was possible, there was no returning to the past.

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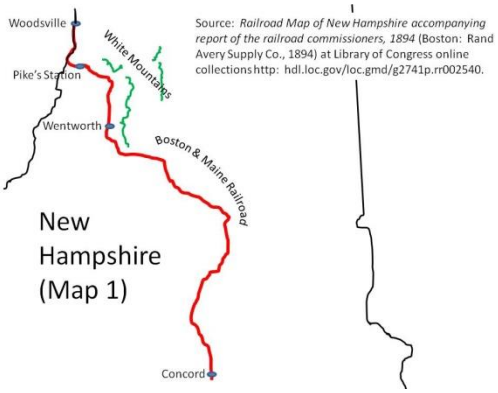
MAPS



Source: *Railroad Map of New Hampshire accompanying report of the railroad commissioners, 1894* (Boston: Rand Avery Supply Co., 1894) at Library of Congress online collections http: hdl.loc.gov/loc.gmd/g2741p.rr002540.

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The Rise of Environmental Consciousness in Sweden and Denmark: The Protests against the Oresund Bridge (1970s–1990s)

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Introduction

Uniting the Danish capital Copenhagen and the Swedish city of Malmö, the Oresund bridge (Øresundsbron) is the longest combined rail and road bridge in Europe. Developed on two levels, it comprises a 16 km long double-track railway and a four lane motorway running on a 7.8 km long three-section cable-stayed bridge from Malmö up to a height of 57 metres over the Flintrännan channel to the 4 km long artificial island of Peberholm, constructed from material dredged from the seabed. Peberholm connects the bridge to a 4 km immersed tunnel, the Drøgen Tunnel, ending in a 1 km long peninsula on the coast of Copenhagen (Øresundsbron, 2005). In 1993 after an international design competition, Øresundskonsortiet, a joint venture between the state companies Svedab (Sweden) and A/S Øresundsforbindelsen (Denmark), chose the two-level bridge designed by Danish architect Georg Rotne for ASO Group, a joint venture between private firms from Britain, France and Denmark, who would design the bridge concept and monitor the construction works. In 1995, the construction works bid was won by Sundlink Contractors HB, a joint venture consisting of two Danish, one Swedish and one German construction company (False-Hansen & Larsson, 1999). The costs for the link's construction, covered by a 4 billion euro loan from the Danish and Swedish states, will be completely repaid by 2040 thanks to the fees applied to the bridge's crossing by the owner company, the Øresundskonsortiet.

Inaugurated in July 2000, the bridge has since then been open to the passage of the hundreds of thousands of commuters who travel daily from Copenhagen to Malmö and back. It has freed the commuters from the "dictatorship of the timetables" of the ferry boats which cross the Sound between Malmö and Copenhagen. Since the end of 2015, the bridge has only been partially achieving its initial function: in 2000, the hour-long trip across the Sound became ten minutes long; after December 2015, the ten minutes became forty to fifty. In December 2015, the Swedish government aired the proposal of closing it down in the face of the Syrian refugee crisis. According to prime minister Stefan Löfven, the resources that Sweden could put into the refugee crisis were limited. The bridge, allowing the entrance of thousands of refugees, would have presumably put the stability of the country at risk. Border control and ID-checking were found to be the answer to this crisis situation, which has generated drastic proposals for homeland security: the chief of the Swedish police even made the unprecedented proposal of recruiting civilians for border control in the areas around the bridge. Nowadays, ID-controls are a reality for the thousands of commuters who move daily between Copenhagen and Malmö. This is the first crisis that Scandinavia has faced in the twenty-first century.
The political management of this crisis has seriously influenced the function of the bridge, even threatening its closure as a solution to the whole issue. This crisis has shown that the bridge closure may still happen. The bridge is the result of a Danish–Swedish cooperation which has strengthened the international mobility and economy of the two countries. Before being realised, it had been a vision since the eighteenth century. As such, its project has been shaped, modified and stopped several times in consequence of the political and cultural shifts happening in and between the two countries. Throughout contemporary history, there have been many hopes and fears connected to the realisation of the bridge. In present times, the fear of uncontrolled immigration and of infiltration of terrorists has succeeded in modifying the mode of use of the Oresund bridge. Since it is still possible to image a different bridge or a sound with no bridge, it is worth analysing what issues have threatened the existence of the fixed link from start, by which arguments and instruments, how those arguments succeeded in re-shaping its project according to

specific requests, and how those issues permeated the public discourse of the two countries.
This paper aims at presenting the fears and concerns of environmental destruction connected to the Oresund bridge project in the 1970s–1990s experienced by Danish and Swedish actors, and the bridge planners' responses to these societal, political and scientists' anxieties. It will show how various sets of environmentally conscious Swedish and Danish actors opposed environmentally careless politics which considered the modification of the natural environment and the exploitation of natural resources as economic and political decisions. By their protests, those actors succeeded in stopping the Oresund bridge in the 1970s and partially in re-drawing it in the late 1980s. It will also show that, despite the fact that the protests ultimately did not succeed in stopping the realisation of the Oresund bridge, the rise of environmental consciousness since the 1970s has provided an important societal control on a transnational megaproject by implanting principles of environmental responsibility in the two states' institutions, by redefining and establishing new academic discourses and, more importantly, by developing a widespread environmental sensibility.

Theory

Every architectural project comes from a human need to fulfil a set of functions. The bridge was originated as an imagined solution to surmount the Oresund strait. Since the mid-nineteenth century, a fixed link across Oresund was started to be imagined by literates and engineers on both sides of the strait in order to shorten the distance between Sweden and Denmark and in order to promote Danish and Swedish trade at international level. Imagining is the work of thinkers, who play in their minds with the status quo of the present, by defending it strenuously or aiming to change it. Therefore, imagination is a mental production strictly related to two different kinds of expectations: hopes and fears. Imagination is the first step towards innovation and desire for change, but it is also the first one towards rejection of change and anxiety of conservation. Desires and anxieties are pre-rational invitations to action on which the mind elaborate strategies of survival and improvement of daily conditions. According to Ulrick Bech (1992), modern politics are mediations of societal desires and fears supported by rational arguments. Modernity has introduced into European society a systematic way of dealing with hazards and insecurities. These hazards and insecurities are related to natural phenomena, but also to human intervention into the organisation and life of societies. Modern institutions manufacture uncertainties and try to control the unpredictability that they have created. The history of the several projects for a fixed link over the Oresund strait and of the several unsuccessful attempts to realise it through the nineteenth and twentieth centuries portray the impact that calculable and non-calculable risk had in Danish and Swedish twentieth-century history.

Previous research

Unfortunately, previous research has focused almost exclusively on the positive expectations connected to the Oresund bridge. For Markus Idvall (2000), the projects for the förbindelsen-making are tied to the hopes and expectations of more liberal politics and to the synchronisation of the northern region with the liberal plan for a more connected Europe; the bridge would have therefore interconnected different kinds of imagined and

physical landscapes (Idvall, 1997). Anders Linde-Laursen (1995, 2010) has instead focused on the region-building function which the idea of the förbindelsen had since 1658. Fredrik Nilsson (1999) wrote an interesting ethnological study of the expectations connected to the link: his conclusion is that the bridge would have shortened the distance created between Scania and Denmark three-hundred years ago, creating integration and bringing positive effects to the Öresund region.
Only Gustav Peebles (2011) has pointed out that, beside the positions in favour of the bridge, which were tied to the positive expectations of overcoming borders in order to create the Øresundsregion and to join the European Union, the förbindelsen was also identified as a negative symbol by those who opposed the Øresundsregion, the European Union, and the Euro currency. In the early 1990s, the imagination of Danish and Swedish people was divided between extremely positive and extremely negative consequences that the bridge would come with. Still, due to that work's time period focus on the early 1990s, it is difficult to understand how the fear of an environmental disaster was combined in those years with the fear of losing sovereignty in favour of transnational capitalist forces which favoured both the Oresund bridge and the Swedish accession to the European Union.
In a recent article (Zavatti, 2017), I have shown that the visions connected to the bridge have been, in the last three centuries, the reflection of Scandinavian, European and national phenomena and trends present on both sides of the Sound – the bridge, in good and in bad times for both Scandinavian countries, has reflected tendencies of Scandinavian and European integration: tendencies which were widespread in both societies but difficult to realise; and, because of this, the supporters of physical and political integration have faced many defeats across the last century and a half.

Sources

This study is based on the Swedish Government Official Reports (Statens offentliga utredningar) and the Swedish and Danish government and parliamentary acts. The archives considered for this research include the documents of the Swedish–Danish bilateral commission (Öresundsdelegation), which was instituted in 1952 and which re-started its work every time the two governments agreed on realising the förbindelsen (in 1968, 1973, 1975 and 1984); the archives of the commission are conserved at the Swedish Royal Archives (Marieberg and Arninge) and at Dragør local archive in Denmark. A particularly important set of sources comes from the Lund Regional Archives, which conserve the archives of the environmental association Aktion Skåne-Miljö, which also collected many sources coming from the other side of the Sound. Another set of sources is represented by Swedish and Danish press articles on the förbindelsen. In each of the archives mentioned, a consistent number of press clippings from Danish and Swedish local and national newspapers concerning the Øresundsförbindelsen for the period 1946–2000 are collected, together with many informational materials given out by private actors and public authorities; they well represent the political, social and cultural debate concerning the bridge. Press clippings on the idea of the Oresund bridge from the 1850s to the present day are available in the digital collections of the Swedish Royal Library.

The rise of environmental consciousness

Changing hopes: from industrialization to environmental consciousness

Since the beginning of the 1970s, a ghost has haunted the project of the Oresund bridge: the ghost of environmental disasters. According to many critical voices in Danish and Swedish societies, the megaproject supported by the two social-democrat governments would irremediably alter the natural environment of Scania and Sealand. This fear generated a huge debate against the bridge project and almost succeeded in stopping it from being realised. Strangely enough, just two decades earlier, the Swedish newspapers had praised the idea of Ruben Rausing, the founder of Tetra Pak, of draining the Oresund via a system of dams and by this creating a natural link between Sweden and Denmark; at that time, no one objected to this proposal, which was instead described as 'a fantastic idea!' (DN, 1953: 7).

Rausing's project was only one of the dozen projects presented to the Oresund Delegation, a bilateral commission instituted by Sweden and Denmark in order to assess the feasibility of the project, which had been supported in 1953 by the Nordic Council. Through the fifties, which were a decade of vertiginous economic and social growth for the two social democracies, the projects for the Oresund link and for a contiguous City of the Sound (Örestad/Ørestat) were perceived as an opportunity to create a region developed 'like the Flanders or the Ruhr, but much more beautiful' (HD, 1959: 5). In the end of the fifties and in the sixties, Malmö, Karlskrona and Helsingborg (the coastal cities of Scania) had each effectively started an intense propaganda campaign in order to be appointed as starting point for the bridge. Each city, under the aegis of the major and of the local major entrepreneurs, had their own team of engineers presenting different projects in order to include the bridge in their own cities. Industrialisation, expansion and concentration of resources were the keywords of the first post-war decades, and the demonstration that the social-democratic model developed in the 1940s could produce richness and prosperity, providing new services for all its inhabitants.

In the seventies, those hopes were not so shiny anymore. The spread of environmental consciousness had changed the perception of the bridge and its related projects. The local and regional entrepreneurs continued to dream of the building of Örestad, which would have projected the Sound into the centre of Europe, and imagined that an airport on the island of Saltholm would serve this purpose just as well. An imaginative landscape of railroads, motorways, airports, new urban districts, land reclaimed from forest and agriculture probably contributed to giving life to the several conservationist instances which railed against the planned regional development of Scania and Sealand. As historians of environmentalism have noted, 'the varieties of environmentalism are not sequential or evolutionary models, but parallel and sometimes competing ways to see, to experience and to care for the environment' (Armiero & Sedrez, 2014: 10). This is also true for the opposition to the Oresund bridge, which was carried out by a broad spectrum of actors with wide-ranging arguments, from conservationism to eco-efficiency.
Agreement between the two governments on the fixed link was reached in 1973, which had also been a year of unprecedented change for the political landscape of the two social democracies. The Nordic model started to be opposed both by the so-called 'red wave', a myriad of leftist movements which in the countries of social-democracy supported class struggle, and by the so-called 'green wave', a constellation of environmentalist associations concerned about nuclear power and the concentration of population (Agius, 2006; Dobson, 2007). Among the latter, the nation-wide associations Fältbiologerna and Naturskyddsförening, but also regional associations like, for example, Aktion Skåne-Miljö, The Scanian Ornithological Society, The Fishermen Society, and the Scanian

Hunters (Sydsvenskan, 1973b: 1). According to these groups, the bridge would have caused various environmental disasters. For example, Aktion Skåne-Miljö considered that the excavation for a tunnel could have caused serious hydrographic consequences for the groundwater of the whole of Scania; therefore, it requested scientific investigations to be done in order to verify whether the project would create a natural disaster or not (Öresundsdelegation, 1975).

These associations were extremely active and successful in propagandising their concerns. When the agreement on the fixed link was reached in 1973, the association Campaign against Orestad was established; in the column of the Campaign periodical Miljöfront, one could read that 'Orestad accelerates the development of the west coast to a Ruhr-like area […] Either you take part in it or you are forced to leave' (Miljöfront, 1975: 2). On Lucia Day (12th December) 1973, a series of demonstrations were held in all the major coastal cities against the agreement on the bridge. The protestors were wearing traditional white robes and brought panels which asked the government to 'stop the bridge' (stoppa bron) and invited people to sign against the project; they made the front pages of the national newspapers and succeeded in getting the sympathy of the audience.
In Sweden, the leader of the bourgeois and farmers' Centre Party (Centrepartiet),

Thorbjorn Fälldin, succeeded in capitalising on the success of the green wave by presenting himself as the champion of environmental defence and decentralisation, and by depicting the Social Democrats as grey, heartless, pro-industrialist, Stockholm-based decision makers (Andersson & Östberg, 2014: 223-228). Among the Swedish politicians, Fälldin had been the only one that could consistently undermine the Social Democrats' discourse. He chose to do so by embracing the environmental discourse. Fälldin (1973) stated during the parliamentary debate on the agreement:
The motorway over the Sound […] was not based on any investigation on the consequences for the environment. The Malmö and Lund areas are already heavily exploited. A bridge in this area will destroy a big part of the traffic that now passes through Helsingborg and Elsinore. It will stimulate the concentration of trade and industry and infrastructures to the Malmö-Lund area. Furthermore, it will generate environmental problems that we cannot accept.

He brought his party up to 25% in the 1973 parliamentary elections and promised to stop the bridge, presented as 'a monument of a past epoch', which is social democracy. Three years after, in a round of parliamentary elections fought majorly on the question of nuclear power (the 'Nuclear elections'), the bourgeois opposition lead by Fälldin won, and proposed to allot the bridge's financing in support of small firms and for maintenance of secondary roads (Lidén, 1981).

Nevertheless, not all of the environmentalist groups were satisfied with Fälldin's government. In 1978, his government collapsed specifically on the nuclear question. While for a short period of time, the most radical conservationist environmentalists and a bourgeois party had shared the same opposition to a social-democratic infrastructure which generated fears of pollution and concentration of population and industries, that alliance was over within five years. Environmentalist associations' members and political parties' leaders based their environmental concern on a series of beliefs, values, and attitudes linked to the sense of individual responsibility towards the environment (Sanchez & Lafuente, 2010). Those beliefs were confirmed by the critique of modern consumerism society, which was based on the re-reading of Swedish philosophers and writers, like Elin

Wägner (1882-1949), who promoted the restoration of the partnership between mankind and nature, and Sara Lindman, who injected the idea of a correlation between war and pesticides into the Swedish debate (Petersson & Merchant, 1986). But they also found confirmation of their scepticism towards the ruling class in the new discourse elaborated by the environmental movement which in those years was starting in the universities.

Environment as a new paradigm

In the seventies, part of the scientific community complained that the bilateral delegation was not considering experts' assessments on the impact that the bridge would cause to the environment. In those years, academia was experiencing a paradigm shift away from the traditional scientific and scholarly disciplines towards a reconsideration of the relationship between mankind and nature, rediscovering the environmental thought of nineteenth and early twentieth century philosophers (Isenberg, 2014: 3-4) and inspired by a number of unconventional works like Silent Spring (1962) by Rachel Carson and The Limits to Growth (1972) by Donella H. Meadows, Dennis L. Meadows, Jørgen Randers and William W. Behrens III, and by innovative environmental policies like the US's Environmental Impact Assessment (1969). Based on this new paradigm-in-the-making, Lund University established the Environmental Studies programme in 1975.

Several scientists had noted that a bridge would deeply impact the region through car traffic, noise and air pollution, waste problems and lack of growth for the rest of the region. In particular, Nils Lewan, associate professor at the Institution for Cultural Geography at Lund University considered that regional development, with the bridge, would be based on car traffic; he considered that a re-worked bridge proposal would have made the project feasible and sustainable for the whole region. Nils Malmer, professor of Ecology at Lund University, considered that the bridge would be a 'serious waste of natural resources'; in order to support his argument, he stressed both that the concentration of industries would cause serious environmental problems in the proximity of the bridge, and that the rest of the region would suffer from depopulation. For this reason, he appealed to the inhabitants of the region to engage against the bridge (Björk, 1973).

Not only scientists, but also scholars and professionals expressed their opposition to the bridge. Historian Sverker Oredsson and nurse Greta Kruse, both People's Party (Folkpartiet) representatives, considered that the state commission was basing its decision to proceed with the project on the 'out-of-date' conclusions contained in SOU 1967:54, which considered the concentration of population and industries in the Scania region as positive – while in the meantime the population had grown to one million inhabitants and with this project it would increase even more (Kruse, 1973). Bertil Hultén, architect and urbanist, considered the social-democratic government as 'short-sighted' for wanting a project which would have caused 'more car traffic, increased road charges, contamination of land and water, asphalting of the country's best arable land and the continuation of a so-called regional politics that nobody believes in' (Hultén, 1973).
The Oresund commission received reports and suggestions by Scania's scientists and scholars on the negative consequences that a bridge on the Sound would have caused (Broberg, 1973). For example, it received a request for contact by the newly established

Environmental Studies Program at Lund University, which contacted the State Department in order to offer a 'value-free mapping [värderingsfri kartläggning] (impact study) of the impact on the environment of a fixed link over the Sound' (RA, 1975). The Oresund

delegation had since the 1950s requested assessments on the feasibility of the bridge and of the tunnel. But it did so only in order to check the feasibility of the infrastructure and to avoid blocking the salt water inflow into the Oresund strait. For example, several geologists (RA, 1952) had suggested that the Elsinore–Helsingborg strait was unlikely to be able to host an underground tunnel; in the sixties, the delegation asked oceanographers for an assessment of the impact of the bridge on the inflow of salt water from the Northern Sea into the Baltic Sea; the oceanographers suggested that a tunnel/bridge connection could be designed that would not negatively affect the ecological balance in the Baltic Sea though compensatory dredging above the tunnel and under the bridge to replace the loss of through flow area (National Swedish Environmental Protection Board, 1968). Except for this assessment, it had requested nothing similar to a contemporary environmental impact assessment, which was not in use in Sweden and Denmark at that time.

In 1975, the Oresund Delegation appointed a research team composed of economic geographers based at Lund University to produce a report on the trade and industry consequences of the bridge (SOU 1978:20, 16-17), and financed a team of researchers led by Rune Frisén at the Agricultural University to produce a land management and environmental analysis of South-West Scania (RA, 1975a). A sub-commission edited an assessment of the project and considered it feasible and non-dangerous for the marine flow (DsK, 1978); therefore, the Swedish State Commission assessed the environmental impact of the bridge as minimal (SUO 1978:19, 288-289). From the archive of the commission, it emerges that at that time the environmental impact was still considered a political matter (RA, 1975b). In 1979, the project was put on hold due to the oil crisis, which made it impossible to formulate any traffic forecast.

From consciousness to holism

In the eighties, environmental concerns became part of a more general critique of liberalism, enshrined in the European Community and its leading financial and industrial groups. In 1982, the Roundtable of European Industrialists – a lobby group composed of Europe's biggest interest groups and led by Volvo's CEO Per Gyllenhammar – presented the Scandinavian Link's consortium, whose aim was to unite Scandinavia with Europe via a system of fixed infrastructures. The core of the project was the Oresund bridge. After years of intense lobbying in the European and Scandinavian institutions, in 1984 the Swedish parliament decided to create a new Oresund Delegation. In those years, the fear of environmental disaster became intertwined with the fear of losing national sovereignty. This would have happened by allowing the big European industries to take over the Sound with cargoes and trucks filled with imported products. Powerful and obscure 'men in black', according to the description given by Danish association 'Scanlink – Nej Tack!', had already planned to take over the continent by lobbying and corrupting. The bridge was represented as a Trojan horse filled with trains and trucks full of nuclear waste, cars, exhaust gases and imported products. This would have made of Denmark a transit-land, damaging irremediably its environment and draining all the resources for other local infrastructures. In Sweden, the bridge was defined by the newspaper Alternativ as 'the bridge of nightmares', while the journal Mot Länken depicted ERT's leaders in a comic as obscure, faceless, men-in-black members of a global society destined to be overcome by multinational corporate firms. According to Bertil Hultén, it was 'Volvo [which] needs the Oresund bridge' (Hultén, 1988: 1); 'otherwise', he continued, 'a tunnel would have been more respectful of the environment'.

Engineering the Oresund would also have consequences for the way in which human activities exploited the territory for work purposes. This also moved several segments of Swedish society against the bridge. These segments choose to use environmentalist arguments in order to defend their works. Since 1973, the Malmö Province Scanian Farmers' Association feared the disappearance of arable land (Sydsvenskan, 1973a: 1) in 'Europe's most fertile soil' (Andersson, 1973, 1). In the eighties, the Maritime Association (Svenska Sjöfolksförbundet) started an intense campaign in defence of the interests of its associates with the argument that shipping boats pollute less than trucks, are cheaper and more effective. In 1987, the truck-drivers' Swedish Transport Union also expressed obection to the bridge, since it would heighten market competition (Svenska Sjöfolksförbundet, 1987).

Since many entrepreneurs proposed different projects for the fixed link, some among them chose to use the fear of environmental disaster as an argument for favouring their own project and delegitimising the others. For example, Stockholm-based industrialist Jan Erik Jarlås advertised his project for an 'Oresund tunnel' by arguing that the bridge would have polluted the environment much more than his tunnel project (Jarlås, 1983).

The bridge as an ambivalent symbol

After the signing of the agreement between Sweden and Denmark in 1991, the bridge was linked in the Swedes' imagination to the decision to join the European Community, in a context of an unprecedentedly high unemployment rate and of the rise of the extreme right. In Denmark, the same unpopularity had hit the bridge between 1991 and 1994: 61% of the Danish population was strongly against it. While in previous years, only nuanced opinions on the Oresund bridge and on the European membership had been expressed, in 1993 these became polarised: an imagined landscape of very positive and very negative consequences were seen as linked to the European membership: peace or war, economic benefit vs. ruin, strengthening vs. undermining of environmental protection, gain vs. loss of international influence and weakening vs. strengthening of workers and women's rights, social welfare, sovereignty, democracy, neutrality, regional policies, animal care, control of migration, consumer protection, quality of the public services, and support of the third world (Twaddle, 1997). The bridge became partially a symbol of this polarisation: while in 1991 most Swedes were favourable to a combined railway and motorway bridge (Findhal, 1991), in 1993 almost the absolute majority of those against the bridge was also against European Union membership, despite the fact that in absolute terms the majority was still in favour of the bridge (Gilljam & Falkemark, 1994). This concern over the bridge was supported by the action of a new wave of environmentalist groups, which contested the Environmental Impact Assessment provided by the Øresundskonsortiet. In the face of these critics, the two governments appointed a panel of international experts in order to give an independent assessment on the impact on the water flow and on the marine biology. In the same month, the Commission for the Environment (Sweden) rejected the project by applying the precautionary principle, since the socio-economic benefits were not proven by the joint venture, and the traffic consequences were assessed as negative. In November 1993, the Swedish Water Rights Court (Vattendomstolen) tried the project and approved it upon request of modification. In June 1994, the Swedish parliament gave permission to begin the works (Jansson & Velner, 1995), provoking the resignation of Centreparti politician Olof Johansson from his chair as minister of the environment. In Denmark, after the ratification of the treaty, the parliament passed a public works act

which was subject to environmental hearings in 1992–3, which resulted in another modification of the project (Lundhus & Bræstrup, 1995).

Conclusion

The Öresund Institute's investigations prove that the Oresund bridge has created work possibilities and integration between the two sides of the Sound. Nevertheless, even nowadays, the bridge's impact on the region is disputed. In 2010, the Swedish Radio P1 interviewed the protagonists of the 1970s–1990s opposition to the bridge. Those who had opposed the bridge's realisation – for a variety of reasons, from environmental concerns to critique of the kind of society imagined around the bridge – continued to support their theses: 'It was a wrong idea' reiterated Olof Johansson (Lempert, 2010). Therefore, while at a cultural level the opposition to the bridge has remained in the public discourse, from a strict environmental perspective, the Sound has certainly been modified, but the feared reduction of salt water inflow has not taken place: an inflow took place in 2003, and the 2014 inflow has been the third largest major one recorded in history (Mohrholz, 2015). Nevertheless, the most important transport policy experts of northern Europe have assessed that the project has been conducted unsatisfactorily since, during its building, risks have been high and have been treated in a deficient manner in feasibility studies and project appraisals; on the other hand, they have also pointed out that it is always difficult to predict those kinds of megaprojects with certainty (Bruzelius & Flyvbjerg & Rothengatter, 2002).

Despite the bridge being finally realised, in the process, the Swedish and Danish states have been deeply affected by the environmental movement which for over twenty years has opposed the realisation of the Oresund bridge and other megaprojects on both sides of the Sound. The environmental consciousness instilled into both states' societies and institutions is a structural aid in preventing a repeat of old errors while imagining and planning the relationship between mankind and nature, including new fixed links across the Sound.

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