

BRIDGE 101 - Peter Mould

Background

Bridges have been part of human settlement for thousands of years, probably starting with a log across a stream. They have served the need for humans to connect; to span rivers and valleys, to promote trade, military endeavour, access and escape.

Some like Xerxes' Pontoon Bridges constructed in 480 BC to cross the Hellespont were simply boats strapped together with a deck laid over for the advancing army. The Chinese developed arch bridges well before the Romans and the Incas used ropes as simple suspension bridges. The Romans made viaducts and aqueducts of massive scale with masonry arches, and the industrial revolution was full of engineering innovation. The use of new industrially produced materials developed bridge designs of remarkable invention.

The first iron bridge was built at Coalbrookdale in England in 1779. Others followed; box girder bridges, steel cable suspension bridges, brick vaulted bridges.

All these historic bridges stand as evidence of the power and influence of past societies.

They vary greatly in style and reflect the culture and engineering innovations of their time.

They show the daring, engineering skill and craftsmanship of their builders.

Bridges even enter the lexicon. Bridge Street in Sydney is so named after the first bridge across the tank stream. The famous bridge in Mostar, built by the Ottomans and destroyed by the Croation Army in the 1993 Bosnian war, and subsequently rebuilt, gave the town its name - Most meaning bridge in Serbo-Croatian. Even in the Catholic Church the Pontiff (from pont - bridge and fex, from facere -to make) means bridge-maker in the social sense or in an even more metaphorical interpretation the bridge between the earthly world and god.

Identity

Bridges are a strong part of the identity of many cities. Paris has the Pont Neuf, London the Tower Bridge, in Florence it's the Ponte Vecchio, the Brooklyn Bridge in New York, the Rialto in Venice, the list is endless.

Some cities are defined by their bridges. The Golden Gate in San Francisco and the Sydney Harbour Bridge have become such famous landmarks that the city is clearly identified by them.

The scale of some of the World's great bridges inspires and allows us to contemplate the audacity and courage of their making, often with stories of remarkable innovation, extraordinary technology, massive workforces and great leaps of faith.

As primary pieces of infrastructure bridges defy local topography to connect communities and so increase access to work, move goods and services, support transport networks and stimulate civic and commercial activity.

So how are they designed?

Each bridge is unique; it must respond to the particularities of its site. The span, the height, the foundation conditions, the available technology, the load, wind conditions, the uses that may pass under it and so forth.

They are also determined by their function. Do they carry pedestrians, cyclists, cars, trains or in the example of the Harbor Bridge all of these?

Is the best response in steel or concrete, should it be an arch or a suspension structure.

With an arch bridge the arch is built and the road deck either hung below it or sat on top of it. A suspension or cable stay bridge builds towers at either end and suspends the deck from cables. A truss bridge constructs large trusses to span like beams between supports.

Sydney Bridges

And Sydney, well, Sydney has examples of all of these. The Harbour Bridge is the most massive spanning over 500 metres, made of 53,000 tons of steel and six million rivets it is impressive at all levels. It is an arch construction with a suspended deck. But many alternatives were proposed before this design was finally chosen. The alternative designs included truss, cantilever and suspension bridges, and even combinations of these, and some multiple arch bridges. Even tunnels were proposed 80 years before the Harbour Tunnel was finally built.

At the other end of the scale there is a delightful timber and steel pedestrian suspension bridge at Parsley Bay in Sydney's east. The cable stay structure of the Anzac bridge at Pymont across Johnston's Bay challenges the Harbour Bridge as one of the big three across the harbor. The old Iron Cove truss bridge is constructed of wrought iron lattice girders and the concrete arch bridge at Gladesville spanning an impressive 300 metres with sloping road decks rising to its peak is the third major harbor bridge crossing.

The nearby Tarban Creek Bridge is also a concrete arch bridge but it supports a flat road deck. Silverwater Bridge is a cantilever arch bridge of precast

concrete and Fig Tree Bridge is a steel girder bridge that spans the Lane Cove River.

Ryde Bridge has a section that lifts, originally to allow shipping to pass through, the Spit Bridge is a steel girder bridge with an opening section also to allow boats to pass, and the Glebe Island Bridge was an electrically operated steel swing bridge opened in 1903 to allow vessels through when open and traffic across when closed.

Lennox Bridge is our oldest, a stone [arch bridge](#) across the river in [Parramatta](#). It was designed by [David Lennox](#) and is the only bridge to bear the name of its designer. It was constructed with convict labour in the 1830s making it one of the oldest bridges in Australia.

Consequences

But there are also urban and social consequences of bridge building. The Harbour Bridge required the clearing of large areas either side of the crossing to accommodate the approaches leading to the span and the connections to road systems to collect and distribute the traffic it carried. It required resumption of residential and commercial properties and the displacement of their tenants, and it also impacted dramatically on the environment. The huge road decks above The Rocks and Milsons Point irrevocably changed the physical and visual landscape forever. Major tracts of land were given over to transport uses. The expressway on the northern approaches to The Bridge covers many hectares of land with concrete on what was originally residential or park uses.

These impacts are true of most bridges and the higher the bridge the further the reaches of its approaches must go. The Gladesville and Anzac Bridges because of the height of their span have pushed far into the banks on each side, overshadowing the residential neighbourhoods and creating vast undercrofts. These are the unavoidable consequences of bridge building but are not always well considered in the design process, and good design should attempt to balance these impacts against the primary problem of span.

Conclusion

At their least bridges provide links between communities, at their best they become symbols of those communities, demonstrating engineering and construction excellence, instilling excitement and creating awe by their scale. Great bridges can be audacious or beautiful enough to evoke wonder so that their primary function of linkage soon becomes symbolic.

And when they are truly wonderful and become the focus of attention, as say a tourist attraction, they move from the function of creating passage for a journey to become the end focus of a journey - a destination.

Bibliography

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