St Kilda Street Bridge over the Elwood Canal

Location

St Kilda Street,, ELWOOD VIC 3184 - Property No B7260

Municipality

PORT PHILLIP CITY

Level of significance

National

Victorian Heritage Register (VHR) Number

H2080

Heritage Listing

National Trust

Statement of Significance

Last updated on - September 14, 2005

What is significant? The St Kilda Street bridge is a reinforced concrete T-girder bridge over the Elwood Canal. The bridge was designed and constructed in 1905 by John Monash of the Reinforced Concrete & Monier Pipe Construction Company.
How is it significant? The St Kilda Street bridge is significant for scientific (technical) and historical reasons at the National and State levels.
Why is it significant? The St Kilda Street Bridge is of technical significance as the earliest example of a reinforced concrete girder bridge known to survive in Victoria and probably in Australia. It demonstrates the technical innovation achieved by John Monash in the early years of the twentieth century and as such demonstrates the earliest stage in the development of reinforced concrete technology for bridge building. This innovation eventually led to the adoption of reinforced concrete as a standard bridge building material by road construction authorities in Australia. The survival of the sequence of theory, calculations and fabric relating to an innovative bridge design is rare.
The bridge is of historic significance because of its association with John Monash. The career of John Monash had been struggling until the design and construction of this bridge. The success of this innovative project was the foundation for the status and wealth that Monash achieved prior to his departure for service in World War I. The bridge is also historically significant for its association with the drainage works that led to the development of the suburb of Elwood.
Classified: 17/05/2004

Hermes Number 70282

Property Number

Physical Description 1

The St Kilda Street bridge is a reinforced concrete T- girder bridge of 5 spans. The bridge is set low over the Elwood Canal. The three interior spans measure 20 feet (6.10 m) from centre to centre of the piers while the outer spans are approximately 20 feet from the centre of the pier to the face of the angled columns incorporated in the abutment. The bridge has a total width of 40 feet (12.2 m) and is on a 29 degree skew. The support of the wide footpath is treated as a separate issue from the support of the roadway. The roadway has seven lines of girders spaced 4 feet 8 inches (1.42 m) apart, with a line of columns (parallel to the centreline of the road) for each line of girders. To span between the lines of girders, the deck slab is 61/2 inches (165 mm) thick. The girder supporting the outer edge of the footpath is spaced 8 feet (2.44 m) from the nearest roadway girder, with its own line of columns and the footpath deck slab is only 31/2 inches (89 mm) thick. This bridge was built before the problem of shear strength of bridge girders became prominent and the middle 5 feet (1.5 m) of the span have no shear reinforcement. It is not known whether any extra reinforcing has been added later. The piers consist of a line of individual columns with individual spread footings in the form of a truncated pyramid. The column heads incorporate small corbels in the direction of the span. The abutments consist of a row of columns, each supporting the end of one girder, backed by precast Monier plates to retain the earth of the embankment. The original iron pipe handrailing remains on the downstream side.

Intactness

The bridge is in its original form and has not been widened. The original railing remains on the downstream side. The upstream railing has been replaced with a high mesh fence. The road surfacing has been altered from gravel to bitumen. The Elwood Canal has had minor landscaping changes, but the context of the bridge in the Canal is essentially unaltered. The surrounding streetscape has changed dramatically.

Historical Australian Themes

REINFORCED CONCRETE TECHNOLOGY
In 1867 a French manufacturer of garden furniture named Joseph Monier, took out a patent for making planters and other containers from mortar reinforced with a grid of iron wire or rods. From 1884 onwards, Gustav Adolf Wayss and his company acquired control of the rights throughout Germany and Austria. Together with M. Koenen and E. Mörsch, he set out to develop the system and place the design of reinforced concrete structures on a scientific basis [2].

The Monier system was firmly planted in New South Wales in November 1892 when a trio comprising W. J. Baltzer, a German immigrant, James Carter, a Sydney contractor, and D. G. Snodgrass obtained a patent under licence to Wayss. Baltzer was then working with the New South Wales Public Works Department in Sydney. He prepared a Monier design for an experimental culvert, which was built, and a Monier alternative for an arched sewer aqueduct which was not built. In March 1895, working in his spare time for the contracting firm of Carter Gummow & Co, he prepared a similar proposal for a large aqueduct in Annandale. This time the PWD accepted the Monier alternative under guarantee from the contractor and Baltzer joined the company [3].

The principle component of the Monier arch bridge was a thin barrel vault (often referred to as "the rib" or "arch ring") spanning between abutments of masonry or mass concrete and reinforced with a mesh of iron rods. A dry mix of fine concrete, referred to as "compo", was thoroughly tamped into place around the mesh. The design of the arches was aimed at eliminating tension stresses which would have brought the iron rods into play, so although the rods did provide an added margin of safety, they were actually ignored in the calculations.

Obviously the next step was to investigate ways of applying the idea of reinforcing concrete with iron in flat beam or girder bridges in such a way that its strength would be fully utilised. This involved a separate body of engineering theory.

While it could be said the Monier arch technology was imported "fully formed" into Victoria in 1897, the technology for the reinforced concrete girder was in its infancy in Europe and America in the early years of the twentieth century, and therefore presented a greater design challenge. Monash had the courage to experiment with this innovative technology using real structures. In January 1903 Monash asked Baltzer to visit Melbourne and bring with him technical literature in French and German, detailing the latest theories of reinforced concrete. From the texts and journals provided, Monash learned of a further development: the concept of the T-girder bridge. At a time when the cost of materials, as delivered, was high in comparison to that of additional labour, the T-girder represented a very economical alternative to the arch.

From April 1903 Monash offered T-girder designs for bridges and floors, and for covers to stormwater drains, but his first actual use of the principle in bridges was at Stawell Street, Ballarat East with a single span of 20 feet (6.1 metres). Unfortunately, when the supporting timbers were removed in mid-March 1904 it was obvious that not all was well. The reinforced concrete T-girders cracked, and Monash found it necessary to "stitch" the girders at Stawell Street with clumsy iron trusses whose vertical members were threaded through holes drilled in the concrete. The bridge was never satisfactory and was demolished after several years' service [4].

Reinforced concrete theory was in its infancy, and Monash returned to the University of Melbourne to conduct tests in order to better understand the behaviour of reinforced concrete T-girder bridges. From the results of these tests, which he published in the Journal of the Victorian Institute of Engineers [5,6], Monash was able to revise the method for the design of T-girder bridges, such that Monash's next T-girder bridge, the St Kilda Street bridge of 1905, was successful. Monash's calculations for the design of the St Kilda Street bridge still exist [7], and, together with the bridge, these form an important link in our understanding of the development of reinforced concrete technology.

After the success of the St Kilda Street Bridge, Monash always advocated the adoption of the T-girder in preference to the arch, and this eventually came to be the standard form for most Victorian road bridges. Engineers around the world had been simultaneously arriving at the same result under the name of different patents. The T-girder bridges as designed and built by Monash, though still called "Monier" bridges at the time, were the forerunners of modern reinforced concrete bridges.

There is little doubt that Monash took the lead with T-girder design and construction in Victoria. Indeed it seems very likely that Monash led in reinforced girder bridge design and construction Australia wide. His Hindmarsh River bridge built at Victor Harbour, South Australia in 1907, was hailed as the first reinforced concrete railway bridge in Australia [8]. According to Fraser, the first reinforced concrete slab bridge in New South Wales was built in 1914, and that State's first T-girder bridge was built in 1916 [9]. In the same year the Reinforced Concrete & Monier Pipe Construction Co. tendered unsuccessfully for a bridge over Shark Creek at Maclean in northern NSW. It is interesting to note that the local shire engineer, Thomas Thompson, based the specifications for the bridge on those of "Colonel Monash" for the Shepparton Bridge [10], built in 1913 (now demolished). It appears from the work of Colin O'Connor, that the adoption of reinforced concrete girder construction was even later in the other states [11]. A possible exception is in Queensland, where the Lamington Bridge was built by Alfred Brady in 1896, reinforced according to the Wunsch system, however this has the appearance and properties of an arch bridge.

After the formation of the Country Roads Board in Victoria in 1913, reinforced concrete T-girder bridges became the preferred bridge type and standardised designs were developed. These designs, upon which much of Victoria's bridge construction was based up until the 1940's, directly evolved from the work of John Monash.

THE ELWOOD CANAL

Early attempts to solve the drainage problems in the low lying swampy land in the Elsternwick and Elwood districts were uncoordinated and of limited effect. A drain cut along the Elster Creek through Elsternwick park by the Brighton Borough Council in 1871 brought increased drainage problems to the St Kilda Council, which was obliged to continue the drain down to the sea. The drains had little effect on the Elwood Swamp, north of Glen Huntly Road, which had become a smelly receptacle for rubbish. In the late 1880s the Public Works Department tackled the problem, with a scheme to fill the swamp and construct a canal from the sea to Glen Huntly Road. This also proved inadequate, as the canal received the offensive wastes from the houses in the Elster Creek Catchment, as yet unsewered, and silt deposits reduced the canal's capacity [12].

In 1904 the Public Works Department commenced a new scheme of extensive improvements to the district's drainage, spending over £30,000. The scheme included reclaiming the swamp by raising the land level with earth filling, paving the existing canal with bricks and concrete, and extending the canal by the construction of the Elsternwick Main Drain from Glen Huntly Road to the new railway station at Elsternwick South [13]. These works, coupled with the development of transport facilities, contributed to the district's development, making more land available and accessible for urban settlement. The swamp drainage provided new land for subdivision at Elwood. Another suburb was taking shape around the new railway station, named Gardenvale following a naming competition conducted by the local press in 1906 [14]. The other important development for the district was the construction of the Brighton - St Kilda Electric Tramway, which opened in May 1906 [15].

The new Elsternwick Main Drain was 130 feet wide and three feet deep, with turfed slopes. A central pitched channel carried the water in ordinary times and the main channel was deemed sufficient for the heaviest flood [16]. By January 1906 the section through the Elsternwick Park to just beyond New Street was completed, and by the end of 1907 the canal was finished as far as Asling Street. The canal was bridged progressively as each section was finished. Upstream from Gardenvale Station the Elster Creek remained in its natural state [17] and remained the responsibility of local government.

The Elwood Canal provided John Monash with the opportunity to develop reinforced concrete girder technology for bridge building. The low-lying flat land required low bridges of short spans, where girder bridges were preferable to arches. Earlier bridges constructed over the canal had been "iron trough girder and concrete bridges" [18]. These were made by spanning the canal with iron troughing, then pouring concrete on top to fill the troughs and form a flat deck. Monash and his company were able to offer a cheaper alternative in reinforced concrete. From 1905 to 1907 the Reinforced Concrete & Monier Pipe Construction Co. built seven bridges in the Elwood district. Six of them were built across the Elwood Canal for the Public Works Department, all under separate contracts. The other bridge was built over the Elster Creek for the Towns of Brighton and Caulfield. The developing design and construction techniques can be seen over the three year span of the seven contracts, with a standard design emerging for the last three. Monash also offered to construct a bridge similar to the St Kilda Street bridge for the new tramway for £850, however his tender was unsuccessful [19]. The Public Works Department stuck with the iron trough girder and concrete construction for the tramway bridge across the canal.

The bridges were just a small part of the drainage scheme, amounting to about 10% of the overall cost. However technically advanced they may have been, they were unspectacular structures which attracted little attention from the press. Although Monash had ideas for an opening celebration for the first bridge at St Kilda Street, involving the Premier, Sir Thomas Bent, who was also a Brighton councillor, no such event appears to have taken place [20]. Perhaps the opening of a small bridge was insignificant compared with the coming of the tramway and the other signs of progress in the district.

Three of Monash's Elwood bridges remain in use, although one is altered. Three bridges of similar design to the one at Brickwood Street - at Marine Parade, Cochrane Street and Asling Street, have been replaced, and the Gardenvale Bridge was lost when the Elster Creek was put into a tunnel under the Nepean Highway.

This place/object may be included in the Victorian Heritage Register pursuant to the Heritage Act 2017. Check the Victorian Heritage Database, selecting 'Heritage Victoria' as the place source.

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