

Shark Creek Bridge

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Item

Name of Item	Shark Creek Bridge
Item Number	4309568
Type of Item	Built
Item Sub-Type	Pre-1948 Concrete Slab and Arch Bridges
Roadloc	
Address	**** Pacific Highway, former alignment near Grafton 2463
Local Government Area	****
Owner	Roads and Traffic Authority
Current Use	Not in use
Former Use	Road bridge

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Statement of significance

Statement of significance	<p>As one of only two reinforced concrete bowstring arch road bridges built in NSW, the Shark Creek Bridge has rarity value at a State level. The unusual design of the bridge makes it aesthetically distinctive, and is of technical interest. It demonstrates a high level of creativity in using the engineering developments of the 1930s to satisfy the new demands of motor vehicle transport, at the same time creating a graceful and attractive structure. The bridge has generated interest and appreciation within both the professional engineering community and the local community since its construction. Locally, the bridge has significance, with other remnants of the cane industry's river transport infrastructure, being designed to allow cane barges to pass underneath.</p> <p>This bridge has been assessed as being of State significance.</p>
Date Significance Updated	27 January 2004

Description

Designer	Karmalsky & Britton
Builder	State Monier Pipe and Reinforced Concrete Works
Construction years	1935 - 1936
Physical description	<p>This reinforced concrete bowstring arch bridge crosses Shark Creek, a tributary of the Clarence River. It carried two lanes of traffic, but has now been bypassed by a replacement structure on an improved alignment with increased shoulder widths. The main span is 34.4 m, with the deck structure and kerb members providing the stabilising tie for the two arches. The arches are rectangular in form with 12 hangers each framing to underdeck transverse members which in turn support the deck slab. The single approach spans at each end of the arch are of three longitudinal support beam type. The abutments are of packed earth, with stone pitching surrounds. The railing system consists of concrete end posts with two rectangular rails on the approaches, with a similar system on the main span but with a corbel along the road face giving a continuous line of protection past the hangers. Between the approach and mainspans, the arch terminates in a relatively massive endpost thickened by an upcurved upper surface.</p> <p>The bridge is sited just downstream of the current crossing and is accessible from the western end along the remains of the old highway. Mounted on the bridge is a plaque commemorating the historical significance of the bridge as the first reinforced concrete bowstring arch to be built in New South Wales.</p>
Physical Condition and/or Archaeological Potential	<p>Original condition assessment: 'The bridge is in excellent physical condition for its age. There is only minor evidence of microcracking, and no evidence of spalling or other distress. The vertical hangers appear to have been painted at some stage and this may disguise some earlier repairs. The approach roadway, despite the absence of traffic, has dropped by perhaps 100mm at each end of the bridge, giving an indication of the soft local surface soils, and by default, confirming the effectiveness of the original piling.' (Last updated: 15/12/2003.) 2007-08 condition update: 'Good.' (Last updated: 17/4/09.)</p>

Modifications and dates	The bridge was superseded in 1987 by a replacement bridge on a new alignment.
Date condition updated	17 April 2009

History

Historical notes	<p>Grafton began to develop as a centre for timbergetting activities and a ship-building centre in the late 1830s and 1840s. The Clarence River was reached by an escaping convict, Richard Craig, in 1834/5, but not explored officially by settlers until 1839 when Thomas Small, a Sydney merchant, organised an expedition to the Clarence Valley and began running cattle in the area. In the same year Captain S.A. Perry, deputy Surveyor General, entered the river in a steamer and named the Clarence. Further interest in grazing land in the Clarence Valley followed shortly, prompted by the affects of drought to the south. Early aspirations to corner the NSW wheat market were ruined by rust, and the area was given over to maize and then sugar production and dairying. Timbergetting has continued until the present on the fringes of the valley. The Aboriginal owners of the Clarence Valley underwent a sharp decline in population towards the end of the nineteenth century in the face of armed conflict and disease. By 1891 the Aboriginal people of the area were mostly peaceably settled in reserves and working on cane farms, as stockmen or in the fishing industry. (Regional Histories, 1996, pp. 56-69)</p> <p>The subject bridge is situated on an old alignment of the Pacific Highway between Grafton and Maclean, crossing Shark Creek, a tributary of the 'South Arm' of the Clarence River. North-south routes developed through the nineteenth century to connect settlements around the Richmond and Clarence Rivers, Port Macquarie, which began as a penal settlement in 1823, and Coffs Harbour, an important shipping outlet for the region's agricultural produce particularly in the period prior to the northern railway (built by 1915). In 1928 the Pacific Highway or North Coast Road between Maitland and the Queensland border, was declared a Main Road under the Main Roads Act, and its development and improvement was subsequently given priority, with the other Main Roads cum State Highways by the recently constituted Main Roads Board. Work was undertaken to seal and widen the Highway and provide bridges over major waterways to replace vehicular ferries. To the north of Grafton, the road took a form largely unsuitable for motor traffic until the completion of major works undertaken between 1925 and the late 1930s, with many sections realigned and paved. Several river crossings were improved with the construction of new bridges, including the subject bridge over Shark Creek, constructed in 1935, a bridge over the North Arm of the Clarence River between 1934 and 1936 and several bridges over crossings of the Tweed River, to the north, and its tributaries. By mid 1939, 50 per cent of the Pacific Highway had been surfaced with bitumen. (DMR, 1976, pp. 138-155, map opp. p. 64, map opp. p. 80, map opp. p. 112, 161, 169-70)</p> <p>The first known bridge at the site was constructed in 1883, a timber bridge with two end spans 35 feet in length and a central timber arch span of 80 feet. It was replaced with a reinforced concrete bridge in 1916, a relatively early date for reinforced concrete bridge construction. The bridge was to be the first of its type on the north coast. The pros and cons of building a concrete bridge, as against a wooden bridge, were extensively discussed at local government level and within the community - it was held that a concrete bridge would be more expensive, but have a much longer life-expectancy and lower expected cost of maintenance than a timber one. The bridge was a girder or beam bridge 153 ft long, consisting of two outer spans of 46ft with curved soffits, and a central span of 60ft. It stood on reinforced bases on ironbark piles. The designs were prepared by Mr T.L. Thompson, Harwood Shire Engineer, and construction was carried out by Country Constructions Ltd., of Sydney. The reinforcing steel bars were imported from England. The opening of the bridge, on 29th November 1916 was well attended despite rain on the day. Speeches were made by several Shire Councillors and the ribbon was cut by Mrs D. McIntyre, wife of the Shire President. The local ladies provided refreshments. (The Argos, 1 December 1916, p. 8) Another local paper, The Examiner, reported that this bridge demonstrated the 'progressiveness and enterprise' Harwood Shire Council and that its construction signalled 'a new era in local government works'. (The Examiner, 1December 1916, p. 1)</p> <p>Most ironically, given the optimistic projections for the life expectancy of the 1916 bridge - 150 years - on the day of opening (The Argos, 1 December 1916 p. 8), after a mere sixteen years, the bridge was in such poor condition that the planning of a new bridge was set in train. A December 1932 inspection revealed extensive cracking in important structural members, many exposed stirrups succumbing to rust and a generally poor quality of concrete. (RTA General File 10/274.1200 pt 1). This bridge was also of limited longer term utility as its deck was only 12 feet (3.65m) between kerbs.</p> <p>The new bridge was a reinforced concrete bowstring arch bridge, completed in 1936, one of more than 1,000 bridges built by the Main Roads Board cum Department of Main Roads (DMR) between 1925 and 1940, a period in which the Department's engineers were adapting existing standards of road and bridge design to meet the requirements of improved motor vehicle performance - bridges were generally wider than previously with an improved load capacity, and durable reinforced concrete became a favoured construction material. The principal types of bridges constructed in this period were: concrete slab; reinforced concrete beam; steel truss on concrete piers; and timber beam bridges. The few reinforced concrete arch bridges built in NSW in this period were significant due to the variety of designs employed. (DMR, 1976, p. 169, 170) The bowstring arch design had been employed in timber and steel bridges, at a number of sites in New South Wales such as the laminated timber arch across South Creek at Windsor, built in the 1870s and the composite timber and steel bridge over the Lachlan River at Cowra built 1893, which uses several bowstring trusses (Roadmakers illustrations after p. 232) This type of arch differs from the traditional arch in that the outward thrusts of the arch, instead of being resisted by the ground of the abutments, are carried within the structure by the tie members along each side of the deck which tie the two ends of the arch together. In the 1930s, Department of Main Roads engineers, Vladimir Karmalsky and Alexander Britton pioneered the use of the bowstring principle in reinforced concrete. In a 1935 article, 'Bowstring Arch With Temporary Hinge', the pair expounded the dynamics of the design, explaining the behaviour of the tied arch, and in particular describing a new method which they developed to limit bending stresses in the reinforced concrete arch members themselves. Whereas other bowstring arch builders had balanced the bending effect of adding the weight of the deck by using horizontal jacking of the tie members, the new concept incorporated an extra hinge in the arches at their crown which allowed the deck load to cause movement without generating bending stresses in the arch. After completion of the deck concreting, the hinges (formed by a star pattern of reinforcing bars) were infilled with concrete to give a final form with full bending strength across the crown. (Transactions of the Institution of Engineers Australia, Vol., 16, 1935, pp. 193-197, also 'Calculation of 112 ft Span Bowstring Arch with Temporary Eccentric Hinge', Institute of Engineers Australia Journal, Vol., 4, 1932, p. 333).</p> <p>Their theories had been actualised in the Shark Creek Bridge. The choice of a bowstring arch at that site was in part driven by the deep soft soils at the site which were unsuitable to resist the thrusts which would have been generated by a traditional (untied) arch.</p> <p>In 1938 a similar bridge was constructed over Hillas Creek on the Hume Highway near Tarcutta. Both bridges excited continued interest in professional circles, with the Hillas Creek Bridge pictured under construction in the Department of Main Roads Annual Report of 1938-9, and both bridges featuring in a 1940 article by F C Cook and H W Cover, 'Reinforced Concrete Highway Bridges in New South Wales', in the Institute of Engineers Australia Journal. Despite this enthusiasm, the overall cost of this bridge form meant that it did not compete with more modest structural types and no more were built on New South Wales main roads.</p> <p>The new bridge was cast-in-place by the State Monier Pipe and Reinforced Concrete Works for over 5,333 pounds (plaque affixed to bridge). A 1948 document reports that the arches were poured first, on 16th and 19th December 1935, the central section of the deck poured on 22nd January 1936, the hangers on 7th February and the temporary hinges concreted up on 6th March 1936. By way of comparison, the deck of the Hillas Creek Bridge was constructed first, with the upstream arch and hangers poured together, then the downstream arch and hangers, and the central section of the deck completed last. (RTA General File 10/274.1200 Part 2)</p> <p>Like the previous two bridges on the site, the subject bridge was designed to allow the unimpeded movement of river traffic along Shark Creek, essential for the movement of barges transporting cane down the South Arm of the Clarence River for processing and export. (The Examiner, 1 December 1916, p.1) The bowstring arch design allowed the cane barges to pass underneath readily, having no mid span piers and a shallow deck thickness. The construction of the bridge was co-ordinated with CSR Company's early harvesting and transport of nearby sugarcane so that the bridge falsework and construction process would not interfere with the barges and vice versa (plaque fixed to bridge).</p> <p>Some deck cracking caused concern in the late 1940s, and designer Vladimir Karmalsky was consulted. He allayed concerns by pointing out that it was most likely accounted for by elastic extension of the steel ties, that this possibly should have been allowed for in construction, but was of minor importance. (RTA General File</p>
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10/274.1200 Part 2) Harwood Shire Council and State Government authorities have carried out regular and minor repairs on the bridge over the decades.

From the late 1970s concerns surfaced regarding the approaches to the bridge, which were sharply curved. Several accidents had occurred on the bridge approaches, and the Department considered that oversize curve warning signs with advisory speeds were necessary and possibly the widening of road shoulders on the bridge approaches. (RTA General File 10/274.1200 Part 2) A new bridge was planned upstream from the arch bridge on an improved alignment, which eliminated the two dangerous curves (completed in 1987). (RTA Construction File 10/274.1187 part 2)

Although the bowstring arch bridge was no longer to be in use by traffic, it was recognised by those within the Department of Main Roads, the Heritage Council and the community that the structure held a unique place within the region and the State and should be retained. In correspondence of 1985, the Chief Engineer (Bridges), on the advice of a consultant architect, requested minor modifications to the design of the new bridge, which was to be built very nearby, as the piers were heavy in appearance and would not harmonise aesthetically with the graceful arch bridge. (RTA General File 10/274.1200 Part 2). A plaque was placed on the bridge in 1988, one of about 50 plaques intended to 'provide NSW residents and visitors with interesting details about the State's historic bridges' others included the bridge over the Hawkesbury River at Richmond and the sister bowstring arch over Hillas Creek near Tarcutta. (RTA General File No. 178.147) For its rarity as a bowstring arch, the bridge has been listed under Schedule 2 of the North Coast Regional Environment Plan, and is on the National Trust Register, also check Historic Bridges Register.

Maintenance work was carried out after 1996 to bring the bridge to a good and stable condition where it might be retained successfully and require little work in the foreseeable future. Repairs to cracking and spalling in various locations was planned and general cleaning of the structure, and clearing of vegetation. The Roads and Traffic Authority also intended to apply a protective coating to the bridge (It is unclear if this has been implemented) (RTA General File 10/274.1200 Part 2). Discussions continue within the Roads and Traffic Authority about the best way to provide a safe and amenable area for public access to the bridge in the form of a picnic area.

Listings

Heritage Listing	Reference Number	Gazette Number	Gazette Page
Heritage Act - s.170 NSW State agency heritage register			

Assessment of Significance

Historical Significance	The bridge is part of an interesting history of crossings on the site, successor of a timber arch bridge and an early concrete beam bridge and succeeded itself by a concrete bridge composed of precast components. The bridge is also associated with the cane industry, its design partly chosen to facilitate the traffic of cane barges, when the river was as important a highway as the road. Several cane loading crane supports remain along South Arm and Shark Creek, and a cane barge rests in the carpark of the local tourist cafe.
Historical Association	The bridge has a strong association with Vladimir Karmalsky and Alexander Britton, Department of Main Roads engineers, who designed it.
Aesthetic/Technical Significance	The bridge is aesthetically distinctive, having a visually striking superstructure. The bridge has a high level of technical significance, being probably the world first (and in New South Wales, first of only two) examples of the reinforced bowstring arch with temporary eccentric hinge. It thus has importance also at an international level.
Social Significance	The bridge's design generated interest in the professional engineering community at its time of design and construction and for some years afterwards. When the bridge was superseded in the 1980s, its significance was widely appreciated within the Department of Main Roads and wider community and provision was made for its retention.
Research Significance	****
Rarity	The bridge is rare both on a local and a State level, being one of only two reinforced concrete bowstring arch bridges to be built in New South Wales. As the first bowstring arch to use the temporary concrete hinge during construction, it is unique.
Representativeness	****
Integrity/Intactness	****
Assessed Significance	State

References

Type	Author	Year	Title
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Study details

Title	Year	Author	Inspected by	Guidelines used
Pre-1948 RTA Controlled Concrete Slab and Concrete Arch Bridges in NSW	2004	Burns and Roe Worley and Heritage Assessment And History (HAAH)		Yes

Custom fields

RTA Region	Northern
Bridge Number	2146
CARMS File Number	****
Property Number	Bridge
Conservation Management Plan	****

Images



View of arch from upstream, with Clarence River in background



The State's first reinforced concrete bowstring arch bridge, built over Shark Creek on the Pacific Highway near South Grafton in 1935-36.

Shark Creek Bridge. Early photograph. Source "The Roadmakers"



Plaque on bridge with historical background



View of bridge on old Pacific Highway centreline



Oblique view of downstream face showing suspended watermain



View of bridgesite from south showing access off new highway alignment

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