Statement of Heritage Significance

Borden (Ceepee) Bridge
R.M. of Great Bend No. 405

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Cover Photo: Borden (Ceepee) Bridge over the North Saskatchewan River looking downstream. (R. Herrington; September 21, 2007).

Statement of Heritage Significance

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STATEMENT OF SIGNIFICANCE

Borden Bridge crosses the North Saskatchewan River immediately upstream of Highway 16 and 50km west of Saskatoon. The structure, which was completed in November 1936, is a reinforced concrete, triple-span, bowstring or rainbow arch bridge on concrete abutments and piers. Originally known as the Ceepee Bridge after the nearby former village of Ceepee ('Crossing Point') adjacent to the former Canadian Northern Railway line from Saskatoon to Edmonton, the structure is now known as the Borden Bridge.

HERITAGE VALUE

The heritage value of the bridge lies in its status as a distinctive feature and an important community landmark in west-central Saskatchewan. The Borden Bridge provided a long sought-after road connection across the North Saskatchewan River. It is also a symbol of pride for the families who, through hard work, produced a monument of enduring quality. The structure remains largely unchanged since its completion in 1936.

The heritage value of the structure also resides in its engineering technology. Reinforced concrete bowstring or rainbow tied arch structures became prevalent throughout southern Saskatchewan in the 1920s and 1930s, with more than eighty of these being constructed during this period. Construction of the Borden Bridge was an important Canadian engineering achievement through its association with one of Canada's prominent engineers, C.J. Mackenzie, and a pioneering Saskatchewan contractor, R.J. Arrand. The bridge has the longest arch span of any similar design in North America and may have been the last substantial reinforced concrete bowstring arch bridge designed and built in Canada.

The heritage value of the Borden Bridge lies in its association with federal and provincial unemployment relief programs of the 1930s. Plans for a steel segmental Warren truss bridge were drawn up in 1929 but these plans were quickly shelved by the government in favour of a more labour-intensive reinforced concrete structure. Many of the unskilled men hired for construction of the bridge were farmers from the Borden and Langham areas. Hiring was coordinated through municipalities. Those men who were employed on the bridge were able to pay their municipal taxes and to get some much needed cash to keep their farms operating and to provide food and other necessities for their families. Skilled labour came primarily from Saskatoon.

CHARACTER-DEFINING ELEMENTS

The heritage value of the Borden Bridge resides in the following character-defining elements:

- those elements which speak to its status as a landmark in the community, and its association with unemployment relief programs, including its form and massing and its location on its original site;
- those elements that reflect the property's engineering technology, such as the reinforced concrete tied arches, abutments, vertical hangers, and parapets.

ADDITIONAL INFORMATION

A. Historical Significance

Before the Borden Bridge was constructed, the ferry crossing and nearby downstream railway bridge of the Canadian Northern Railway had been known as the Crossing Point.[1] The word 'Ceepee' derives from this name. The traffic bridge was known initially as the Ceepee Bridge but even before its official opening in 1937, the Liberal government had changed this to the Borden Bridge, named after the nearest town.[2]

When the Canadian Northern Railway Company laid its tracks in 1905 west from Saskatoon to Edmonton, it chose to open up the agricultural land on the north side of the North Saskatchewan River rather than follow the old trail to Battleford along the south side of the river. This allowed the company to avoid the more expensive land in the established town of Battleford and to profit from the sale of lots in their own new town of North Battleford. Railway bridges were subsequently built at Ceepee and North Battleford and towns such as Borden and Radisson sprang up along the new line.

As settlement progressed, the demand for a traffic crossing of the river increased. A ferry was started in 1902 immediately upstream from the railway bridge at Ceepee, but the summer service was unpredictable. Natural difficulties at the site also created problems and occasionally necessitated changing crossing location.[3] Businessmen in the area and in Saskatoon soon complained that the ferry was a barrier to economic growth, and began to urge the provincial government to build a bridge at Ceepee. In late 1917, the Saskatoon Board of Trade forwarded a petition to the Department of Highways for a bridge but no action was forthcoming. Over the next several years the Board of Trade was supported by the Rural Municipalities, village councils, the Saskatchewan Motor Club, and local merchants through letters, petitions and resolutions. In October 1918, the province replied that this "large undertaking…owing to the present financial situation caused by the war is quite out of the question at the present time."[4] Rumours in early 1920 that the CPR was proposing to construct a new bridge north of Langham prompted the Langham Board of Trade to enquire about whether the bridge could be designed to carry road traffic.[5] Nothing was to come of this proposal since the charter for a new line was rejected by the federal government.

The provincial government continued to be reminded of the need for a traffic bridge through the 1920s. For example, in October 1926 the Honourable J.G. Gardiner responded to the North Battleford Board of Trade that "until our province is much more thickly populated than it is at present it is our opinion that we should advance slowly in the manner of constructing bridges across the river." Gardiner also stated that it was government policy to "enter into an arrangement with the railway company to provide traffic attachments to such bridges as either of the companies may undertake to construct across either the North or South Saskatchewan rivers."[6] The old Canadian Northern Railway Bridge at Ceepee had not been designed to carry traffic attachments.

By late 1928, and after more than a decade of agitation for a bridge to replace the ferry service, the Department of Highways finally agreed to build a structure near the Ceepee site which would provide a relatively cheap traffic crossing of the river. Plans were drawn up in 1929 for a steel segmental Warren truss which would include four spans each 200 feet long and 18 feet wide[7] but these plans were quickly shelved due to other government priorities in response to the onset of the Depression.

Since preliminary site surveys had already been completed, the University of Saskatchewan's Dean of Engineering, C.J. Mackenzie, suggested to one of his graduate students, Beverley A. Evans, that he design a suitable bridge for this crossing as a requirement of his Master's thesis.[8] Evans had been the chief draftsman for Saskatoon's Broadway Bridge project, which was opened officially in November, 1932. Evans's design was based on the popular reinforced concrete "bowstring" arch.

Chalmers Jack Mackenzie was the supervising engineer for the design and construction of the Borden Bridge. After graduating in Civil Engineering from Dalhousie University in 1909, Mackenzie set up a consulting practice in Saskatoon the following year. He was hired as a lecturer at the new University of Saskatchewan and became their first professor of Civil Engineering in 1913. He obtained a Master's degree from Harvard and then saw military service in the First World War. He returned to the U of S in 1919 and became their first Dean of Engineering. Mackenzie undertook the design of the Broadway Bridge in Saskatoon as a relief project during the Depression. In 1936 he was appointed a member of the National Research Council and became its President in 1944. He later became the first President of Atomic Energy of Canada Limited and was instrumental in shaping a National Science Policy. When Mackenzie died in 1984, he left a legacy of dedication to engineering and science, both in Saskatchewan and at a national level.

The province offered their two designs[9] as a possible public works creation project under the Public Works Construction Act of 1934. C.J. Mackenzie used his connections to the Federal Department of Public Works through the recently-completed Broadway Bridge relief project and his standing within the engineering profession to promote the bowstring design of his student. Although it was the most expensive, the bowstring design was selected because it was the most labour-intensive.[10] B.A. Evans was hired to act as site engineer.

Tenders for construction were called in the summer of 1935. The successful contractor, the R.J. Arrand Construction Company Ltd. of Saskatoon, was awarded the contract in October, 1935. R.J. Arrand was born in 1881 in Parkhill, Ontario and came to Saskatoon in 1907. He quickly established himself as an expert in the new construction medium of concrete. Many of his projects, such as the Broadway Bridge, are now regarded as Saskatoon landmarks. Arrand contributed significantly to the development of the city. He died of blood poisoning on January 2, 1938.[11]

Many of the men hired for construction were farmers from the Borden and Langham area. Hiring was coordinated through municipalities and those men who were employed on the bridge were able to pay their municipal taxes and to get some much needed cash to

keep their farms operating and provide food and other necessities for their families. Skilled labour came primarily from Saskatoon.

Construction of the Borden Bridge was completed by November of 1936. The official opening of the bridge took place on May 24, 1937 with about 7000 people in attendance. The old bowstring bridge was abandoned when the present highway bridge was completed in September, 1985.

Construction of the Borden Bridge had a significant impact on the road transportation network in west-central Saskatchewan and on the local economy. The bridge became a very visible symbol of the support that governments provided to many of the local residents during those very difficult Depression years. Without the need to provide a major labour-intensive project in Saskatchewan during those years it is likely that a cheaper and less innovative bridge design would have been selected for this crossing.

B. Engineering Significance

James Barney Marsh was the chief engineer and owner of the Marsh Bridge Company (later the Marsh Engineering Company) which was founded in 1904 in Des Moines, Iowa. Marsh's engineering career focused on reinforced concrete structures. By 1910 he had developed two types of reinforced concrete through arches which reflected his philosophy that structures should be economical and aesthetically-pleasing.[12] The first of the "Marsh Arches", as they became known, consisted of arch ribs that were connected to the concrete abutment (often referred to as a 'thrust arch'). The floor or road deck was suspended from each arch ring by vertical hangers. The second design became known as a 'bowstring' or 'tied arch' bridge with the arch ring and deck functioning as a continuous, integrated unit.[13] The road deck "contained the ring's horizontal thrust action, eliminating the need for heavily reinforced piers. Instead, the tied arch rested on lightly constructed piers that did not require solid rock foundations."[14]

The first reinforced concrete parabolic bowstring truss bridge constructed in Canada was the 80-foot Middle Road Bridge, constructed over Etobicoke Creek near Long Branch, Ontario in 1909.[15] The bridge included a concrete compression arch above the roadway that was tied to the road bed. Vertical tension members from the arches supported the deck. Unlike a true bowstring arch, diagonals members were used to stiffen the arch against distortion, and the bridge functioned like a steel truss. After this success, reinforced concrete bridges, especially those on municipal roads, became widely used throughout Canada.

The "first pure bowstring…tied arch, constructed of concrete in Canada was that at Riverview, Manitoba." Built in 1917, at 86.5 feet it was the longest of any tied arch in America at the time. [16]

In spite of this early success, however, it was several years before this design appeared in Saskatchewan, when a bowstring truss bridge was completed in 1920 over Wascana Creek at the historic McKell's Crossing.[17] This bridge is still actively used.[18] This design

was superceded by the reinforced concrete bowstring tied arch. In Saskatchewan, this type of structure is sometimes referred to as a "suspended floor" arch bridge.

The first reinforced concrete bowstring tied arch bridge erected in the province was constructed in 1921 over Bone Creek south of Tompkins in the R.M. of Carmichael No. 109. It was a 60-foot span and replaced an older pile bent structure[19] but has since been replaced by two large culverts. This type of structure became popular for smaller crossings until the late 1930s. Multiple-arch bowstring bridges were erected at several wider crossings throughout the province. These bridges were designed as a viable alternative to the standard steel truss on concrete abutments commonly in use in Saskatchewan at the time. The arch bridge was well-adapted to crossings where low banks existed, such as in many prairie streams. The cost was comparable and the design had the added advantages of low maintenance costs and a more aesthetically-pleasing structure.

Reinforced concrete bowstring tied arch structures became prevalent throughout southern Saskatchewan in the 1920s and 1930s, with more than 80 of these being constructed (almost half of these in the 1930s). Several of these distinctive bridges still exist in Saskatchewan although they have often been abandoned by new highway alignments. The triple-span bowstring bridge across the North Saskatchewan River near Borden is a visible representative example of Saskatchewan's early experiments with reinforced concrete bridge designs.

Aesthetic considerations likely shaped the final design of the Borden Bridge.[20] The designer, B.A. Evans achieved this by making the central arch about nine feet longer (213.5 feet) than the two outside arches (205 feet) and by elevating the roadway by five inches at the centre. While this may be a standard engineering approach, the result was that the lengthened central arch exceeded the previous longest concrete tied bowstring arch, the Alsea Bay Bridge at Waldport, Oregon (demolished in 1991) which was also constructed in 1936.[21] Although it is not known if Evans and Mackenzie intentionally sought the record, they certainly would have been aware of Conde McCullough's contemporaneous design for the Alsea Bay Bridge.[22] Nevertheless, the Borden Bridge can claim to have the longest arch of any similar design in North America.

Unlike many other bowstring arch bridges in Saskatchewan, this bridge has been known for the fine of concrete workmanship and the care exercised during the bridge's construction. This is due in part to the research on concrete failures undertaken by C.J. Mackenzie and Dr. Thorbergur Thorvaldson of the Chemistry Department at the University of Saskatchewan. In 1920, Thorvaldson devised a method of increasing the durability of concrete when it is in contact with sulfate-rich, alkali soils, which has become the standard approach throughout North America and greatly expanded the use of concrete for bridge construction throughout Saskatchewan.[23] The Engineering Institute of Canada recognized Mackenzie's research in 1927 by awarding him the Plummer medal.[24]

Construction of the Borden Bridge was an important Canadian engineering achievement. The collaboration between one of Canada's prominent engineers, C.J. Mackenzie, and a

pioneering Saskatchewan contractor, R.J. Arrand, completed what may have been the last substantial reinforced concrete bowstring arch bridge designed and built in Canada. The bridge integrates the history of the region, including the interwar growth of the road transportation network in the prairies and the impact of the Great Depression. The Borden Bridge is truly a Saskatchewan and Canadian success story.

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[1] *Western People* magazine, August 2, 1984, p9.
[2] It has been suggested that Norman Smith, a Borden merchant and its mayor when the bridge was opened in 1937, used his strong federal Liberal Party connections to promote this name over Borden's nearby rival, Langham. [*The Saskatchewan Valley News*, September 20, 1984.]
[3] See, for example, the Annual Report of the Department of Public Works for 1910-1911, p.54.
[4] Letter dated October 17, 1918 on file 308-39-19, Saskatchewan Highways and Transportation, Bridge Services, Regina.
[5] Letter dated January 9, 1920 on file 308-39-19, Saskatchewan Highways and Transportation, Bridge Services, Regina.
[6] Letter dated October 8, 1926 on file 308-39-19, Saskatchewan Highways and Transportation, Bridge Services, Regina.
[7] Information dated September 5, 1929 on file 308-39-19, Saskatchewan Highways and Transportation, Bridge Services, Regina.
[8] *The Saskatchewan Valley News*, September 20, 1984.
[9] The Department of Highways proposed two bridges: an 800-foot steel truss bridge similar to the one that crosses the North Saskatchewan River; and a contemporary concrete design consisting of seven 126-foot bowstring arch spans.
[10] The design and construction of the Broadway Bridge in Saskatoon was another major employment relief project.
[11] "The Borden Bridge: An Assessment of Heritage Significance", unpublished report prepared for the Borden Library Board by David Neufeld, October 1984, p.9.
[12] Elegant Arches, Soaring Spans: C.B. McCullough, Oregon's Master Bridge Builder, Robert W. Hadlow, 2001, Oregon State University Press, p.18.
[13] This structure was similar to the iron Whipple bowstring arch bridges in use in the late 1800s.
[14] Elegant Arches, Soaring Spans: C.B. McCullough, Oregon's Master Bridge Builder, Robert W. Hadlow, 2001, Oregon State University Press, p.19.
[15] "Bridge Building", C.R. Young, *The Engineering Journal*, Vol. 20, June 1937, p.494.
[16] "Bridge Building", C.R. Young, *The Engineering Journal*, Vol. 20, June 1937, p.494.
[17] The Public Service Monthly, Vol. VIII, No.9, Regina, April 1920, p.1.
[18] It is believed by the author that this was the only reinforced concrete truss bridge constructed in Saskatchewan.
[19] Annual Report of the Department of Highways for 1921-22, p.28.
[20] The Borden Bridge: A Descriptive Essay, unpublished manuscript prepared by David Neufeld, c1984, p.14.
[21] Elegant Arches, Soaring Spans: C.B. McCullough, Oregon's Master Bridge Builder, Robert W. Hadlow, 2001, Oregon State University Press, p.103. Conde McCullogh is particularly remembered for his beautiful reinforced concrete bridges in Oregon. He gained much from his early work in Iowa with Barney Marsh, who conceived the bowstring arch.
[22] The Borden Bridge bears a striking similarity to McCullough's design. It also looks very similar to McCullough's Jacob Conser Bridge over the Santiam River in Oregon (three 200-foot reinforced concrete through-arches) which was completed in 1933.
[23] http://www.nrc-cnrc.gc.ca/eng/education/innovations/scientists/20_thorvaldson.html
[24] The excellent present condition of the concrete can be attributed partially to this research.