NORRIDGEWOCK BRIDGE
Spanning Kennebec River on State Route 201A/State Route 8
Norridgewock
Somerset County
Maine

HAER ME-70
HAER ME-70

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

NORRIDGEWOCK BRIDGE
(Norridgewock Covered Bridge) HAER No. ME-70

Location: Spanning Kennebec River on
State Route 201A/State Road 8
Norridgewock
Somerset County, Maine

UTM: 19.436854E.4951814N

Date of Construction: 1928-29

Engineer: Llewellyn N. Edwards
Maine State Highways Commission Bridge Division

Present Owner: State of Maine
Department of Transportation
Augusta, ME 04333

Present Use: Vehicular Bridge

Significance: This bridge is the only extant multi-span reinforced concrete through-arch bridge of two built in Maine. The gracefully proportioned bridge was designed by nationally significant bridge engineer Llewellyn Edwards, Maine's first State Bridge Engineer.

Project Information: An October 2002 study determined that the bridge required replacement. To mitigate the adverse effects, the Maine Historic Preservation Commission stipulated documentation. The documentation presented in this report was undertaken to fulfill this stipulation.

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For:

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Summary of significance

The Norridgewock Bridge is significant due to its unique technical and aesthetic design and its association with nationally significant engineer Llewellyn Edwards. The bridge is one of only three extant reinforced concrete tied through-arch bridges built in Maine, and is the only example with more than a single span. Often referred to as the "Covered Bridge" in reference to an earlier bridge spanning the river, the present bridge was designed by nationally prominent bridge engineer Llewellyn N. Edwards. Edwards served as State Senior Bridge Engineer with the Maine State Highway Department's Division of Bridges during the 1920s, a decade referred to by a survey of Maine's historic bridges, as a "golden age" of bridge building in the state.[1] Edwards also influenced the field of bridge engineering on the national level, serving as a Senior Bridge Engineer with the U.S. Bureau of Public Roads and contributing to the field through research and experimentation. Edwards also led the development of the first set of national bridge design and construction standards and classifications during his career with the U.S. Bureau of Public Roads.

Description of bridge and setting

The Norridgewock Bridge is best described as a reinforced concrete tied through-arch bridge. Other terms for this bridge type include bowstring arch and "ribbed arch".[2] The bridge arches are tied to the deck with vertical supports, as opposed to other fixed through-arch bridges that have no horizontal supports. The Norridgewock Bridge connects the north and south sections of the Town of Norridgewock, and crosses the Kennebec River between two steeply sloping banks. The 8-span, 589'-0" bridge has four reinforced concrete through-arch spans of 102'-0" and four T-beam approach spans of 31'-0". The roadway width is 20'-0", and the total width of the deck is 21'-0". The arch spans consist of two parallel arch ribs that are tied to the deck by six evenly spaced vertical reinforced concrete girders, which resist the thrust of the arch. The bridge has a clearance of 40'-0" over the average depth of the Kennebec River. The structural action is similar to an archer's bow, and the bridge type is sometimes also called a

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[1] MaineDOT Historic Bridge Survey, Phase II Final Report and Historic Context, Prepared by Lichtenstein Consulting Engineers, August 2004, p. III-14.
[2] Cridlebaugh, Bruce S. "Bridge Basics." *Bridges and Tunnels of Allegheny County and Pittsburgh, Pennsylvania.* [November 2, 2001] [Online] Available: "http://pghbridges.com", August 3, 2006.

bowstring arch. An uncommon detail of the bridge design is the configuration of the shoes or skewbacks that tie the arch ribs to the girders. The shoes consist of concrete encased steel casings and a built-up member into which the reinforcing bars of the ribs and girder are tied and where the stresses are greatest. The shoes are set on top of the deck and at every intersection with an arch. Vertical suspenders support the floor beams and a concrete slab deck; arched lateral ties brace the arch ribs at the top of the arch. The faces of these lateral ties feature a scored hexagonal design with a circle in the center at the apex and the ends of the arch. The arch ribs are decorated with ball finials at the two end lateral ties, which bear inscription panels dated "1928." The interior and exterior faces of the arch ribs have panel scoring. The bridge has 2'-5" wide, cantilevered sidewalks with concrete balustrades that flare over the north approach. The balustrade creates a pointed arch pattern that echoes the arched blind arcade pattern in the concrete cutwater piers. The T-beam approach spans have haunched beams joining the abutments.[3]

Major repairs to the bridge include the in-kind replacement of sections of the balustrade, some of the concrete panels, and the north "1928" date panel. Two of the pier caps have also been replaced due to the loss of material at the bearings. The bridge also originally featured globe street lamps at the ends of the north sidewalk approaches and at all connections between the arch ribs and the deck. The lampposts were removed sometime after 1963. Major repair work has occurred on the bridge in 1957 and 1963 in order to repair spalling and erosion of its concrete exterior due to vehicle impacts and environmental damage.[4]

Context for reinforced concrete tied through-arch bridges

While construction of concrete tied through-arch bridges was rare in Maine, the bridges are the product of a national trend in early 20th century American bridge building. James Barney Marsh (1856-1936) is credited as the preeminent concrete arch bridge designer in early 20th century America. Early in his engineering career, Marsh worked with steel bowstring truss bridges while working for the King Bridge Company of Cleveland, Ohio. After forming the Marsh Bridge Company in 1896, Marsh began integrating

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[3] Maine Department of Transportation Historic Bridge Management Plan, Maine Department of Transportation, 2003 MaineDOT Historic Bridge Survey, August 2004, Bridge # 2157 (Norridgewock Covered Bridge), section I-B.
[4] Historic Photographs, Bridge #2187 (Norridgewock Bridge), MaineDOT Bridge Maintenance Archives, Augusta, ME, 1957, 1953.

concrete into his bridge designs. While concrete arch bridges had been built in Europe as far back as 1904, Marsh's patent 1912 patent for the "rainbow" arch bridge introduced a new design to the United States.

The "Marsh" Arch as it became to be called, soon became the preferred bridge design in local communities across the country, due to their relatively low construction costs, minimal maintenance, durability, fire resistance and aesthetic qualities. Because the support arches are above the road surface, the bridge design reduces any impediment to the flow of water and minimizes the need for massive piers and abutments. Reinforced concrete bridges gained popularity in the United States and Europe for their aesthetic qualities as well. Progressive-Era initiatives such as the City Beautiful and Good Roads movement and the lasting influence of the 1893 Columbian Exposition in Chicago emphasized the need for beauty in the design of utilitarian structures and systems. The reinforced concrete bridge design deemphasizes the structure itself and, using simple and clean lines and finishes, becomes a sculptural landscape feature. One of the earliest known examples of a tied arch reinforced concrete bridge was built in Portland, Indiana in 1913.[5] Although concrete arch bridges were built in every part of the country through the 1910s and 1920s, few had been built in Maine, and no tied through-arch bridges existed by the middle years of the 1920s.

Llewellyn N. Edwards

At the beginning of the 20th Century, Maine's rural landscape experienced dramatic changes, due in part to the expansion of commerce, the introduction of Rural Free Delivery mail service, and the increasingly popularity of the automobile. These shifts demanded an expansion of the transportation infrastructure, which in turn required greater state-wide consistency in road and bridge construction and maintenance. The State of Maine began to allocate funds for bridge construction starting as early as 1901, and both the funding and oversight over bridge construction at the state level increased over the next twenty years and included the creation of the office of Highway Commissioner (1910) and later the State Highway Commission (1913). Bridge construction in Maine slowed during the First World War, but following the war's end, with more state and federal money available for transportation improvements, the 1920s became known as a "Golden Age" of bridge building in the state.[6] One of the principal

[5] Cooper, James L., *Artistry and Ingenuity in Artificial Stone: Indiana's Concrete Bridges*, 1900-1942, J.L. Cooper, 1997, p.31.
[6] MaineDOT Historic Bridge Survey, p. III-12.

figures during this period was bridge engineer and Maine native Llewellyn Edwards.

Llewellyn Nathaniel Edwards was born in Otisfield, Maine in 1873. He attended the University of Maine in Orono and earned his Bachelor's Degree in Civil Engineering in 1898 and his Master's Degree in 1901. Edwards' first professional engineering experience came as a draftsman for the Boston Bridge Works. His first bridge design work was with the Boston & Maine Railroad, after which he went on to work for the Chicago & Northwestern Railroad, Canada's Grand Trunk Railroad. In 1913, he was hired as the supervising bridge engineer for the City of Toronto. In 1919 Edwards became a Senior Bridge Engineer with the United States Bureau of Public Roads.[7] Edwards was an innovator in the field of structural materials analysis, and published papers and reports on a number of subjects, including metal bridge inspections, steel-concrete bonds, and concrete surface area strength. His work in this area received a great deal of interest from engineering departments and laboratories in the United States and Canada.[8] In addition to his contributions to technical theory, Edwards also published *A Record of History and Evolution of Early American Bridges*, a comprehensive history of American bridge technology.

In 1921 Edwards became the first State Senior Bridge Engineer of the Maine State Highway Commission. In addition to his implementation of new construction designs and materials, Edwards applied Progressive-Era management practices to help improve both the operation of the department and the quality of the built products. He emphasized the importance of individualized bridge construction at a time when local governments, in an effort to cut costs, purchased pre-fabricated bridges and materials that were often ill-fitted to their particular surroundings and load requirements. Despite the higher initial costs, Edwards stressed that a thorough analysis of each bridge's unique setting would "result in ultimate economies which more than offset the costs involved."[9]

In addition to advancing the technical competence of the State Highway Department's Division of Bridges, Edwards also emphasized the importance of a bridge's aesthetic value. In an article entitled "Concrete Making for Highways and Bridges," Edwards

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[7] Edwards, Llewellyn N. *A Record of History & Evolution of Early American Bridges.* Orono, ME: University of Maine Press, 1959.
[8] Llewellyn N. Edwards Papers, Special Collections, Raymond H. Fogler Library, the University of Maine at Orono, Folder 12.
[9] Edwards, Llewellyn N. "Present Tendencies of Highway Bridge Design and Construction"; *The Canadian Engineer,* December 12, 1922.

expressed his opinion on the importance of artistically-inspired bridge design.

> "Let us place a little more care upon the design and the construction of our bridges. Let us make them worthy of our day and of our civilization."[10]

During his tenure as State Senior Bridge Engineer, Edwards designed the Norridgewock Bridge, as well as other notable bridges in the state, including the New Portland Bridge (1924) and the National Register listed Bailey Island Cobwork Bridge (1928, listed April 1975).[11] The Bailey Island Bridge may have been Edward's greatest technical achievement. The 1,100'-0" long bridge is supported by a permeable granite crib which allows for the ebb and flow of the tides, and is the only bridge of its kind in the country.

While the concrete tied through-arch was popular in the Midwest, few such bridges were built in the East. The unique tied through-arch design of the Norridgewock Bridge is only one of three remaining in the state, and the only multi-span example. The other two one-span versions are located in Lewiston and Blue Hill Falls; a fourth bridge built at Farmington was destroyed by a flood in March of 1987. Both of these structures are built with the same consideration of setting, proportion, and balance as the Norridgewock Bridge. These Edwards-designed bridges differ from most Marsh bridges and other concrete tied through-arch bridges in that the vertical reinforced concrete ties are connected to the arch ribs by concrete-encased steel shoes or skewbacks. None of the other tied through-arch bridges in New England or the Mid-Atlantic feature this innovation.

After his eventful career with the Maine State Highway Commission ended in 1929, Edwards continued to wield an influence on the American bridge industry. He returned to the U.S. Bureau of Public Roads and helped create the first set of national bridge construction standards. At the National Conference of the American Association of State Highway Officials (AASHO) in 1931, Edwards worked with other highway officials to produce a set of standardized guidelines regarding variables such as live load allowances, materials classification and allowable stresses.

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[10] Llewellyn N. Edwards Papers, Special Collections, Raymond H. Fogler Library, the University of Maine at Orono, Folder 3.

[11] National Register Information System, National Park Service, http://www.nr.nps.gov/, accessed July 22, 2006.

Edwards' recommendations were guided by his predictions that traffic and truck weights would continue to increase faster than bridge technology. Many of these classification systems are still used in bridge design and construction today.[12]

Community context

The Norridgewock Bridge is often referred to as the Norridgewock Covered Bridge because the concrete bridge replaced an earlier wooden covered bridge built in 1870. The covered wooden bridge was an important part of the town's identity, and when the concrete bridge opened in 1930, it was lamented in local newspapers that its replacement was "regretted by many of the older residents of the town."[13] The 538-0"covered bridge featured an arched portal and a distinctive gambrel roof that extended to cover sidewalks.[14] The covered bridge was the sixth crossing to be built over the river, with the first built in 1810 to replace an overtaxed ferry system. In addition to connecting the two sections of the town, the crossing was a crucial transportation route between central Maine and Canada. Benedict Arnold crossed the Kennebec at Norridgewock en route to the doomed winter assault on Quebec during the American Revolution. An iron railroad trestle located directly west of the bridge was built in 1873, and reportedly has helped to extend the life of the Norridgewock Covered Bridge by breaking up ice and log jams. By the 1920s, however, increasing logging traffic and the constant battering by the often violent Kennebec River required the construction of a new bridge. Increased postwar bridge funding allowed Maine State Representative Blanche Emory Folsom from Norridgewock, to secure the $250,000 appropriation for the bridge.[15]

After a two-year construction period, a grand opening was held on September 20, 1930. The ceremony was attended by a group of dignitaries that included Representative Folsom and ex-Governor Ralph Brewster.[16,17] The covered bridge was disassembled soon

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[12] MaineDOT Historic Bridge Survey, p. III-11.
[13] *Maine Sunday Telegram*, September 21, 1930.
[14] Shettleworth, Earle G., Jr., "Some Background from the Maine Historic Preservation Commission", http://www.maine.gov/mdot-stage/ncb/history.php, accessed July 4, 2006.
[15] *Portland Press Herald*, July 30, 1928.
[16] *Maine Sunday Telegram*, September 21, 1930.
[17] Engineering Drawings, Maine State Highway Commission, Bridge Division, 1928: *Covered Bridge over the Kennebec River in the Town of Norridgewock*, Somerset County, located at MaineDOT archives, Augusta, ME.

after, although remnants of the piers remain, and stone from the banks was used to support the new bridge abutments. Today the Norridgewock Bridge is still a strong part of the town's identity, and is featured on community banners, signs, and the town seal. The Norridgewock Chamber of Commerce motto is "Bridging the Gap to the Future." In 2001, the Maine Historic Preservation Commission determined the bridge to be a contributing element to an eligible National Register Historic District. The district encompasses the town center on the south side of the Kennebec River and a group of older residential structures on the north side; the north side was the earliest settled area of the town. The district also includes six properties individually listed in the National Register of Historic Places. These properties include three houses, two educational institutions, and the public library. The Norridgewock Bridge is a contributing element to this district for its historical association with the town's development on both the north and south sides of the Kennebec River and for its commanding presence as the primary physical link between both sections of town. Presently the Norridgewock community and the Maine Historic Preservation Commission are working with the MaineDOT to ensure that the design of the proposed replacement bridge echoes the character of the current bridge design.

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