NORTH HAMMA HAMMA RIVER BRIDGE **HAER No. WA-97**
U.S. Route 101 spanning the North Hamma Hamma River
Eldon vicinity
Mason County
Washington

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL PARK SERVICE
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HISTORIC AMERICAN ENGINEERING RECORD

NORTH HAMMA HAMMA RIVER BRIDGE

HAER No. WA-97

Location:	U.S. Route 101 spanning the North Hamma Hamma River, Eldon Vicinity, Mason County, Washington, beginning at mile point 319.70. UTM: 10/496800/5264920 Quad: Eldon, Wash.
Date of Construction:	1923
Engineer:	Washington Department of Highways
Fabricator:	Colonial Building Company of Spokane
Owner:	Washington Department of Highways Since 1977, the Washington State Department of Transportation, Olympia, Washington
Present Use:	Vehicular traffic
Significance:	The North Hamma Hamma River Bridge is one of two identical bridges spanning the north and south branches of the Hamma Hamma River (the other is the South Hamma Hamma River Bridge, HAER No. WA-96). They are part of the main highway along the east side of the Olympic Peninsula. Each is a three-hinged reinforced-concrete through arch. In many of their details, they are similar to other early reinforced-concrete through arches built by the Washington State Highway Department. Both Hamma Hamma River bridges are on the National Register of Historic Places.
Historian:	Wm. Michael Lawrence, August 1993

History of the Bridge:

The North and South Hamma Hamma River bridges are identical structures built as part of the Olympic highway, now designated U.S. 101. This road provides the only access to the east side of the Olympic Peninsula where it borders the Hood Canal, one of the branches of the Puget Sound.

The Hamma Hamma River, which feeds into the canal, splits into two channels at its mouth. These flow through a marsh which is partially immersed during high tides. Locational maps for the bridge construction project indicate that the road previously went around this marsh, crossing the river upstream from the point where it splits.[1] The Washington Department of Highways in the early 1920s chose to cross the marsh and the two forks, shortening the alignment.

According to the department's *Biennial Report,* the bridges were among at least twenty-one, built during the biennium from 1 October 1922 to 30 September 1924, and designated as "special structures," as opposed to smaller "standard" designs for use by the department and the counties. All but two of the special designs were of steel or concrete construction. Seven, including the Hamma Hamma bridges, were concrete arches. More specifically, these two structures were three-hinged reinforced concrete arches on U-abutments. They were the longest hinged through-arches built in the state up to that time. The long span was required to pass drift. The highway department chose reinforced-concrete construction rather than steel because of the close proximity of the site to salt water. The foundations were supported by battered piles driven in rather firm gravel.[2]

The engineers designed the bridges by the spring of 1923. A set of drawings received the approval and signature of State Highway Engineer James Allen in March 1923. The state applied for federal funding on 24 March, as provided for by the Federal Aid Road Act of 1916. Federal Project No. 108 received formal United States Bureau of Public Roads approval on 8 May.[3]

The state highway department called for bids shortly thereafter. A copy of the announcement appeared in the *Pacific Builder and Engineer*, the major contractors' journal published in the Northwest, on 15 June 1923.[4] The state opened the bids on 10 July and awarded the contract to Colonial Construction Company of Spokane, Washington.[5] The parties signed the contract on 14 July with a contract price of $ 77,838.00. The contractor began work on 30 July. On 15 November 1923 the state started building the approaches and the gravel roadway up to the bridges, using "state day labor" (convicts), and by 30 September 1924 this work was 80 percent done.[6]

Design and Description:

The North and South Hamma Hamma River bridges, are examples of a reinforced-concrete through ribbed arch bridge, a type that was built in the United States mainly during the 1920s and 1930s. They are similar to other reinforced-concrete through ribbed arches built and classified as special structures by the Washington State Highway Department.

Drawings survive for the Hamma Hamma River bridges, making it possible to describe and analyze them. Each consists of 150′ arch ribs using hinges at the skewbacks and crowns, with the deck supported by hangers inside the arch and by spandrel columns outside it. In such an arch the hinges eliminate moment forces at their locations and allow the arch to adjust itself when loaded. The 23′ long approaches consist of concrete slabs supported by pilings and walls that are U-shaped in plan, with the bottom of the U fitting around the arch abutments.

All members of the bridge are of reinforced-concrete. The 22′ wide deck consists of a slab on four rows of stringers framing into 24" x 16" wide floor beams. The beams are spaced 7′-1-5/8" on center. At their ends they are suspended from arch by means of 12" x 16" hangers, with two exceptions. The floor beam at each end of the span, to either side of the arches, is supported differently, by a spandrel column bearing on the arches, directly above the abutment hinges.[7]

The deck or floor is not continuous. Below the crown hinge, at the center of the span, it consists of a slab whose ends bear on shelves cantilevering from the nearest floor beams. Tar paper bond breakers separate the slab from the shelves. A 3/4" expansion joint separates it from the rest of the deck. Another expansion joint, at each end of the span, separates the floor from the approaches.[8] These details permit the free movement of the two halves of the arch ribs, under loading and due to expansion and contraction, at the hinges.

The parabolic arch ribs, the main compressive members, rise 30′ from the abutments to the crown. Each rib is 2′-6" wide through its entire length. The dimension from its extrados to its intrados varies, however, from 2′-6" at the crown to 4′-0" at the spring lines.[9] The variation is necessary to accommodate compression forces as they accumulate from the crown to the abutments. It is small when compared to fixed arches, however, in which the rib must be thickened greatly at the skewbacks to accommodate moment forces.[10] Six overhead cross braces, of which four survive today, span the distance between the arches and help prevent sidesway.

According to the drawings, each hinge consists of a pair of steel castings joined by a pin. Each casting is solidly embedded within the concrete on either side of a 1-1/8" expansion joint. A copper joint collar surrounds the pin and is imbedded in the concrete to either side of the expansion joint. These collars were covered by asphaltic joint filler to protect them.[11] The filler at the springlines has fallen away, however, due to the fact that at high tide the these joints are immersed in water.

Each abutment, which is trapezoidal in elevation, is 2'-8" across, the same width as the arch. It rests on a 10' wide footing that varies in depth from 5' at the channel side to 3' at its back end. It slopes down towards the channel.[12] Each footing bears on battered piles, driven through the sandy soil, to gravel below.[13] The footings are thickest under the skewback hinges, where the downward thrust of the arches is greatest. The slope enables the footings to counteract the outward thrust of the arches. Most of the piles slant inward towards the bridge and are perpendicular to the sloping footings, to counteract the outward thrust of the arch.

According to the drawings, steel reinforcing in each floor beam is located in the lower part of the beam, all bars having hooks at their ends.[14] They resist the tension forces in that area. The reinforcing bars in the arch ribs are concentrated near the extrados and intrados. Hoops surround these bars.[15] They hold them in position before the concrete pours and together they resist shear stresses.

The engineers included several features to make the bridge more attractive. The railing is in the form of a balustrade, with arched openings in those parts built over the spans. The overhead sideway bracing and the railing flanking the approaches are scored to simulate inset panels; and the sides of the arch ribs were bush hammered to reveal the aggregate, giving contrasting textures and hues.

Many of the details and techniques used in the design and construction of this bridge are similar to those at other bridges built by the Washington Department of Highways at the same time. The Indian Timothy Memorial and Goldsborough Creek bridges, like the Hamma Hamma River bridges, are also reinforced-concrete through arches, but were constructed without hinges. The four bridges are similar in the forms and even in the dimensions of some of their members.[16]

Repair and Maintenance

The two Hamma Hamma river bridges appears to have survived with only minor deterioration such as leaching, spalls, nicks from

vehicles, and an occasional exposed reinforcement bar. Sometime during the last few decades, the highway department added steel guard rails at the approaches, to prevent vehicles from colliding into the structure.

The one major alteration of these bridges was the removal of the overhead lateral braces closest to the ends of the bridges in 1977. The clearance below these was 13'-6", too low for traffic. Their removal increased vertical clearance to 16' -3".[17]

Data limitations

A search through professional journals such as the *Engineering News Record* failed to uncover any articles specific to the bridge, which probably is due to the fact that engineers and highway departments were building many concrete arch bridges at the time, and the journals would concentrate on large structures. The *Tenth Biennial Report of the Washington State Highway Engineer* and *Pacific Builder and Engineer* provided contractual information and dates. Drawings surviving at the Washington Department of Transportation made it possible to describe and analyze the structure. Searches of newspaper clipping files discovered no articles concerning the bridge.

Project Information

This project is part of the Historic American Engineering Record (HAER), National Park Service. It is a long-range program to document historically significant engineering and industrial works in the United States. The Washington State Historic Bridges Recording Project was co-sponsored in 1993 by HAER, the Washington State Department of Transportation (WSDOT), and the Washington State Office of Archeology & Historic Preservation. Fieldwork, measured drawings, historical reports, and photographs were prepared under the general direction of Robert J. Kapsch, Ph.D., Chief, HABS/HAER; Eric N. DeLony, Chief and Principal Architect, HAER; and Dean Herrin, Ph.D., HAER Staff Historian.

The recording team consisted of Karl W. Stumpf, Supervisory Architect (University of Illinois at Urbana-Champaign); Robert W. Hadlow, Ph.D., Supervisory Historian (Washington State University); Vivian Chi (University of Maryland); Erin M. Doherty (Miami University), Catherine I. Kudlik (The Catholic University of America), and Wolfgang G. Mayr (U.S./International Council on Monuments and Sites/Technical University of Vienna), Architectural Technicians; Jonathan Clarke (ICOMOS/Ironbridge Institute, England) and Wm. Michael Lawrence (University of Illinois at Urbana-Champaign), Historians; and Jet Lowe (Washington, D.C.), HAER Photographer.

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"Construction News," *Pacific Builder and Engineer* 29 (13 July 1923): 2.

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Washington. Department of Highways, "Piers and Approach Details Hamma Hamma River Bridge Olympic Highway Mason County" (approved 14 March 1923). 1 sheet of drawings.

Washington. Department of Highways, "Plans of Olympic Highway Federal Aid Project No. 108 Mason County Hamma Hamma River Bridges" (approved 8 June 1923). 1 sheet of drawings [cover sheet for working drawings ?].

Washington. Department of Highways, "Map and Profile of State Road No. 9, Mason County, Hamma Hamma Bridges" (approved 11 September 1923). 1 sheet of drawings.

Washington. Department of Highways, "Through Hinged Arch Over the Hamma Hamma River Olympic Highway Mason County" (approved 16 March 1923). 6 sheets of drawings (sheet 1 missing).

Washington. Department of Highways. *Tenth Biennial Report of the State Highway Engineer, 1922-1924.*

Washington. State Department of Transportation. Bridge Preservation Section. Bridge Files.

ENDNOTES

[1] "Plans of Olympic Highway, Federal Aid Project No. 108, Mason County, Hamma Hamma River Bridges," approved 8 June 1923. 1 sheet of drawings [cover sheet for working drawings ?]; and, "Map and Profile of State Road No. 9, Mason County, Hamma Hamma Bridges," approved 11 September 1923. 1 sheet of drawings, Division of Highways, Washington Department Public Works, held by Records Control, Washington State Department of Transportation, Olympia [WSDOT].

[2] Washington Department of Highways, *Tenth Biennial Report of the State Highway Engineer, 1922-1924*, 32-35, 76-77.

[3] "Piers and Approach Details Hamma Hamma River Bridge Olympic Highway Mason County," approved 14 March 1923, 1 sheet of drawings; and "Through Hinged Arch Over the Hamma Hamma River Olympic Highway Mason County," approved 16 March 1923, 6 sheets of drawings (sheet 1 missing), Division of Highways, Washington Department of Public Works; Washington Department of Highways, *Tenth Biennial Report*: 76.

[4] "Construction News," *Pacific Builder and Engineer* 29 (15 June 23): 8.

[5] "Construction News," *Pacific Builder and Engineer* 29 (13 July 1923): 2.

[6] Washington Department of Highways, *Tenth Biennial Report*, 76-77.

[7] "Through Hinged Arch Over the Hamma Hamma River Olympic Highway Mason County," sheet 4, Division of Highways, Washington Department of Public Works, held by Records Control, WSDOT.

[8] Ibid., sheets 3 (top plan) and 5 (Section G-G).

[9] Ibid., sheet 3.

[10] Department of the Interior, National Park Service, Historic American Engineering Record, "Indian Timothy Memorial Bridge, HAER No.WA-85," by Wm. Michael Lawrence, 1993.

[11] "Thru Hinged Arch over Hamma Hamma River," Division of Highways, Washington Department of Public Works, sheet 5.

[12] Ibid., sheet 4.

[13] Washington Department of Highways, *Tenth Biennial Report*, 77.

[14] "Thru Hinged Arch over Hamma Hamma River," sheet 4 section A-A.

[15] Ibid., sheet 4, half longitudinal section at centerline.

[16] Washington State Department of Highways, drawings for the Goldsborough Creek bridge (approved 1923); "Indian Memorial Timothy Bridge, HAER No. WA-85," by Lawrence. According to drawings for each of the three, a segment of the rib, between the abutments and the crown, was to be poured after the rest of the arch. The Hamma Hamma and Indian Timothy Memorial bridges both use shelves with tar paper bond breakers and expansion joints in their decks. The reinforcement of the floor beams and arches is similar, although the bars do not have to be seated on hinge casting in the fixed arches. The railings at all three bridges are almost identical. Rectilinear line patterns may be found on the arches of the Hamma Hamma River and Indian Memorial Bridges. The *Biennial Report* lists these structures as special designs, but the three are similar in many ways, suggesting that even in special situations, the engineers used a great deal of standardization.

[17] Inspection and Maintenance Records, Washington State Department of Transportation Bridge Preservation Section, Olympia, WA.