Cape Creek Bridge
Spanning Cape Creek on the Oregon Coast Highway
Florence
Lane County
Oregon

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PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
U.S. Department of the Interior
Washington, DC 20013-7127

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CREEK BRIDGE
HAER OR-41

Location: Spanning Cape Creek on the Oregon Coast Highway, near Heceta Head Lighthouse at Devil's Elbow State Park, eleven miles north of Florence, Lane County, Oregon
UTM: Heceta Head, Oregon Quad. 10/409375/4887150

Date of Construction: 1931-32

Structural Type: Reinforced-concrete open-spandrel deck arch

Engineer: Conde B. McCullough, Oregon State Highway Department

Builder: Main arch--John K. Holt, Salem, Oregon
North viaduct--Clackamas Construction Co., Oregon City, Oregon

Owner: Oregon Department of Transportation

Use: Vehicular and pedestrian bridge

Significance: The Cape Creek Bridge is an example of an ancient bridge design combined with early twentieth-century use of reinforced concrete construction techniques. While reminiscent of Roman stone aqueducts because of its two tiers of numerous arches and columns, the 619-foot bridge incorporates in its design a 220-foot open-spandrel rib-type reinforced-concrete deck arch. At the time of the bridge's construction, the U.S. Bureau of Public Roads was completing a 700-foot tunnel through nearby Heceta Head, at the south approach to Cape Creek Bridge. Both undertakings were part of long-range plans to complete a highway along the length of the Pacific Coast. This section of highway presented engineers with major construction problems. It became known to many as the "million-dollar mile" because of its high cost.

Project Information: Documentation of the Cape Creek Bridge is part of the Oregon Historic Bridge Recording Project, conducted during the summer of 1990 under the co-sponsorship of HABS/HAER and the Oregon Department of Transportation. Researched and written by Robert Hadlow, HAER Historian, 1990. Edited and transmitted by Lola Bennett, HAER Historian, 1992.

Related Documentation: For more information on Conde B. McCullough, see HAER OR-54.

HISTORY

The Cape Creek Bridge is one of many that Oregon's premier bridge engineer, Conde B. McCullough, designed in the 1920s and early 1930s to help complete the state's network of roads. Through his talents, McCullough made an indelible mark on the design and appearance of the Oregon Coast Highway (U.S. 101), which affords striking views as it closely parallels the state's rocky Pacific shoreline. Before the completion of U.S. Highway 101 in 1932, coastal villages were often isolated hamlets, with the sea as their only link with each other.[1]

The state of Oregon created its highway department in 1913 to inaugurate a new era of public road and bridge building. The United States government, through its 1916 Federal Aid Road Act, would finance part of the costs of construction. Its goal was to coordinate state road building activities on a national basis. At the end of the First World War, state legislators rallied around the call for a "motor road" along the state's coastline as part of a stronger national defense system, directed at warding off potential ocean-borne foreign invaders.[2]

Oregon voters approved the sale of $2.5 million in bond obligations, in 1919, that would be combined with matching federal military highway funds to finance a shoreline route. Nevertheless, federal monies failed to materialize and state government authority to sell construction bonds eventually lapsed. By the early 1920s, however, a mobile pleasure-seeking public clamored for improved travelling conditions between Portland and the ocean beaches and for construction of a coastal highway. In 1921, work began on the new road that had been classified as part of the state highway system and funded with more traditional state and federal construction funds. The Roosevelt Coast Military Highway neared completion in the early 1930s and was renamed the Oregon Coast Highway to avoid confusion with other similarly named roads in the nation and because the original intent for it had never been met.[3]

Cape Creek Bridge was constructed eleven miles north of Florence, over a stream that empties into the Pacific Ocean near Heceta Head, a point named after the eighteenth century Spanish mariner and explorer Bruno de Hezeta who sailed near these shores in 1775. The bridge is located in Devil's Elbow State Park. The region experienced little settlement by people of European descent until 1894, when a lighthouse and tender's residence were constructed on Heceta Head.[4]

McCullough's job, in 1930, was to construct a bridge to span Cape Creek gorge with some type of bridge design that would traverse the offset streambed. He eventually designed the present 619-foot viaduct and open-spandrel reinforced-concrete deck-arch bridge that connects with a 700-foot tunnel through Devil's Elbow. It appears that there never had been a previous public-use bridge over Cape Creek in this location. While construction photographs of the 1932 bridge show a small timber structure to the east, it probably provided temporary service for construction workers or was part of an access road to the Heceta Head lighthouse.[5] Cape Creek Bridge helped to provide a continuous stretch of roadway from ferry docks on Alsea Bay at Waldport to ferry docks on the Siuslaw River at Florence.[6] Bids for Cape Creek Bridge were let in early 1931, with John K. Holt of Salem awarded the contract for the main arch of the span. Design changes prompted a delay in advertising for the north viaduct section. Clackamas Construction Company, of Oregon City received its contract. Final costs for the entire structure, which was begun on April 2, 1931 and completed on April 30, 1932, totaled $187,434.33. The main arch cost $135,664.89, while the north viaduct cost $51,769,44.[7]

DESCRIPTION

State Bridge Engineer Conde B. McCullough designed the span at Cape Creek to enhance its rugged setting. While the structure's total length is 619', its main arch is far less than that, measuring 220'.[8] The method of construction for this bridge is similar to that of others that McCullough created. Nevertheless, it is unique in the sense that it is the only reinforced-concrete bridge in Oregon that mimics the style of the Roman stone aqueducts of Europe, particularly that of the Pont du Gard near Nimes, France.[9]

McCullough had perfected the use of concrete, reinforced with steel bars, in Oregon bridge construction since the 1920s. He is credited with the design of thirty-two arched bridges using these materials. At Cape Creek he chose not to simply use rubble fill as approaches to an arched span over the creek. Concerns appeared in early 1931 about the logistics of hauling "a considerable amount of excavated material" through the Devil's Elbow tunnel, and across the bridge "to be wasted as embankment at the north approach." In a subsequent plan state engineers decided to instead use creosote-soaked timber construction as an approach to the bridge. The U.S. Bureau of Public Roads--a co-sponsor of the project--objected, preferring the use of hollow concrete towers and fill. McCullough argued that these could suffer destructive lateral movement from an unstable substrata.[10]

Eventually, McCullough chose a two-tiered structure, consisting of thirty arched panels on the upper level, spanning the canyon, over a lower level that included a 300-foot long seven-panel north viaduct and a three-panel south viaduct flanking a 220-foot open-spandrel reinforced-concrete rib-deck arch that rises 104' over the creek channel. The roadway is twenty-seven feet curb-to-curb, flanked by a pair of 3'-6" walkways. Deck width, out-to-out, is thirty-six feet. Its grade is a continuous 3½ percent, rising from north to south.[11] It is believed that McCullough hoped to solve the problems of anchoring a span through unstable fill by dispersing its load on to a series of piers.

The structure of Cape Creek Bridge, read from north to south, consists of the following spans:

one 30-foot reinforced-concrete on concrete columns
one 20-foot reinforced-concrete on concrete columns
six 40-foot reinforced-concrete on 4-foot concrete columns
one 220-foot reinforced-concrete open-spandrel rib-deck arch
one 40-foot reinforced-concrete on 4-foot concrete columns
one 41-foot reinforced-concrete on one 4-foot and one 3-foot concrete column
one 28-foot reinforced-concrete on concrete columns

Above this, between the 30-foot span to the north and the 28-foot span to the south, are twenty-eight 20-foot arched panels, reinforced-concrete on three-foot concrete columns.[12]

The viaducts and deck arch rest on thirteen piers, each a pair of concrete pedestals. The first four, beginning at the north end, are attached to bedrock, below a shallow layer of loose gravel. Pilings for the next five piers were made from spruce or hemlock. Those for the first four consist of sixteen, spaced in a thirteen-foot grid. The fifth, also the anchor of the deck arch includes ninety, positioned in a 24'-6" by 24' grid. The timbers were driven to a maximum depth of forty feet to a subsurface layer of hard gravel and boulders. The south pier of the deck arch and the three to its south rest on bedrock, below layers of loam and loose gravel.[13] For the balustrades, McCullough chose to use the following combination of concrete ornamentation: 3'-2¾" rectangular posts 2'-3" wide by 12" thick, with centered 3-inch flutes. Between these are spaced 6½"-wide pilasters with decorative precast 2'-5" wide by 2-foot rectangular panels. The pilasters and panels are capped with beveled 10-inch banisters or railings.[14]

REPAIR AND MAINTENANCE

Cape Creek Bridge opened for traffic on 30 April 1932. One Bridge Section employee, in his May 1932 "Bridge Inspection Report," worried about driftwood diverting water flow on Cape Creek and causing scouring of one of the deck arch piers. In addition he noted that earth thrust had caused the north viaduct to shift to the south 3½". The inspector also found settlement under some of its expansion plates. Interestingly, John K. Holt, the principal contractor, did not build this section of the structure. Instead, Clackamas Construction Company, of Oregon City assembled it. Faulty workmanship alone does not account for the settling and lateral shift problems that plagued Cape Creek Bridge. McCullough, in 1931, wrote of his worries about the unstable nature of substrata under various proposed north approaches to the main deck arch.[15] A bridge inspector also noticed tension cracks in the top of the second full arch on the lower level north of the deck arch. By 1933 unequal pressure acting on the insides of the east and west curtain walls of the viaduct was causing them to fail. Another inspector, in October 1934, reported that the north end of the viaduct "moved noticeably west due to settlement and movement of fill ... approximately [five inches]." Yet, he forecasted that it would cease in two to three years and recommended that the highway department repair it and some badly damaged concrete on the south face of the main arch. The department jacked the curtain walls back into place, only to have them crack again two years later. Then, the Bridge Department placed timbers against the fill in an attempt to relieve the pressure it bore against the walls.[16]

Cape Creek Bridge received little more than minimal attention until the late 1960s, when inspectors noted that the structure was "mostly okay," except that many columns on the upper level of panels had exposed reinforcing bars. They recommended thorough cleaning, covering, and sealing as soon as possible. Problems mounted, though, for in the next decade more rebar became exposed to the elements because of chloride ion permeation of the concrete. In the late 1970s, Highway Division employees saw to what extent the Cape Creek Bridge had deteriorated, but they also recognized the cost to stabilize it would be well over $150,000. While they began comprehensive testing of Cape Creek Bridge, their priority at the time was to stabilize similar chloride ion damage on two other, much larger McCullough structures on the Oregon Coast Highway, the Yaquina Bay Bridge at Newport and the Alsea Bay Bridge at Waldport.[17]

The state accepted a bid, in the summer of 1984, from the Stauch Construction Company of Grants Pass, Oregon to repair rocker joints on the bridge that had frozen from salt corrosion and had limited its ability to expand and contract with climatic changes.[18] But the chloride ion was still causing extensive deterioration to the bridge's reinforced-concrete. The Highway Division of ODOT decided that cathodic protection was the only means available for stopping extensive rebar corrosion and concrete spalling on Cape Creek Bridge. In early 1989, it estimated that contracts for the proposed project would amount to nearly $2 million.[19] The Eugene, Oregon Register-Guard ran the following headline in its 4 August 1989 issue, "Electric charge to preserve historic Cape Creek Bridge." The story went on to say that, "It's not going to glow in the dark," but will have a permanent electrical charge of 900 watts flowing through it.

State bridge engineers at the time stated that electricity would keep corrosive chloride ions from developing around the rebar, thereby preventing the concrete from spalling. Michael R. Tighe, Vice President for ELGARD Corporation, explained the process in a July 1990 issue of Public Works. He wrote that "it arrests corrosion in reinforced concrete by lowering the active corrosion potentials of the reinforcing steel to immunity or passivity potentials." The complete system of cathodic protection also included coating the entire structure with paint containing zinc. This thin layer would act like a sheet of galvanized steel, forming a thin metal shield dispersing the electrical charge so that it could attract the chloride ions away from the rebar. As long as the electrical current is maintained, the corrosion process is halted.[20] In 1990 contractors are repairing damaged sections of the span and are putting in place the components of cathodic protection.

ENDNOTES

1. Federal Writers' Program, Oregon: End of the Trail, American Guide Series (Portland: Binfords and Mort, 1940), p.363.

2. Oregon State Highway Commission, First Annual Report, 1914, pp.5-8; Historic American Highways (Washington, DC: American Association of State Highway Officials, 1953), p.111.

3. Federal Writers' Program, Oregon: End of the Trail, p.363; Oregon State Highway Commission, Ninth Biennial Report, 1929-1930, p.39.

4. Lewis A. McArthur, Oregon Geographic Names, Fifth edition (Portland: Western Imprints, Oregon Historical Society Press, 1982), p.355; Federal Writers' Program, p.377.

5. For copies of construction photographs see: Oregon Department of Transportation, Bridge Section Photograph Collection.

6. Oregon State Highway Commission, Ninth Biennial Report, 1929-1930, p.13.

7. ODOT Bridge Maintenance Files, Cape Creek Bridge (No. 1113), "Oregon State Highway Commission Bridge Maintenance, Repairs and Renewals [1934]."

8. "Suggested Wording--U.S.F.S. Sign Cluster at Devil's Elbow State Park," "Cape Creek Bridge File," Environmental Section, ODOT.

9. Dwight A. Smith, James B. Norman and Pieter T. Dykman, Historic Highway Bridges of Oregon, second ed. (Portland: Oregon Historical Society Press, 1989), p.108.

10. Conde B. McCullough, Bridge Engineer, Letter to Roy A. Klein, State Highway Engineer, 27 April 1931, in "Cape Creek Bridge File," ODOT Environmental Section. McCullough believed that a reinforced-concrete north viaduct was the best alternative because it would permit earlier use of the highway, present "a much more desirable appearance", eliminate the uncertainty as regards the placement of such a high fill on movable sub-strata, and eliminate the expense of continually adding more fill to one that would shrink over time.

11. Oregon Department of Transportation, "Engineering Antiquities Inventory for Cape Creek Bridge," [photocopy], 1982; Smith, Norman and Dykman, p.108; E.S. Hunter, Assistant State ODOT Highway Engineer, Letter to David Plowden, 14 June 1973, photocopy in "Cape Creek Bridge File," ODOT Environmental Section.

12. Oregon Department of Transportation, Bridge Section, "Bridge Log: Cape Creek Bridge."

13. ODOT, Bridge Section, "Bridge Plans: Cape Creek Bridge (No. 1113)," Drawing No. 4247, 27 April 1931; Lawrence Hulin (Seattle, Washington), Letter to Oregon Department of Transportation, Bridge Engineering, 20 August 1984, [photocopy], "Cape Creek Bridge File," Environmental Section, ODOT. Mr. Hulin was a laborer on the Cape Creek Bridge. His letter

gives some insight into the construction methods used on this structure.

14. ODOT, Bridge Section, "Bridge Plans," Cape Creek Bridge (No. 1113), Drawing No. 4219, 4 March 1931.

15. Oregon Motorist, May 1936; ODOT, Highway Division, Bridge Section, Maintenance Files, Cape Creek Bridge (No. 1113), "Bridge Inspection Report, May 1932"; McCullough to Klein, 27 April 1931.

16. A.G. Skelton, Letter to C.B. McCullough, 6 January 1934, in Cape Creek Bridge (No. 1113), ODOT Bridge Section Maintenance Files; ODOT, Bridge Section Maintenance Files, Cape Creek Bridge (No. 1113), "Bridge Inspection Report for 12 October 1934"; Skelton to McCullough, 6 January 1934; ODOT, Bridge Section Maintenance Files, Cape Creek Bridge (No. 1113), "Bridge Inspection Report for 19 August 1937."

17. ODOT, Bridge Section Maintenance Files, Cape Creek Bridge (No. 1113), "Bridge Inspection and Maintenance Report for 27 November 1968; "Bridge Inspection and Maintenance Report for 15 July 1969"; "Bridge Inspection and Maintenance Report for 5 May 1970"; "Bridge Inspection and Maintenance Report for 1 December 1970"; Duane Kirby, Region Bridge Inspector to J.X. Wilson, Region Maintenance Engineer, 13 February 1979, "Cape Creek Bridge (No. 1113)," ODOT Bridge Section Maintenance Files, ODOT; J.X. Wilson, Letter to John Wood, Bridge Maintenance Engineer, 14 February 1979.

18. Tony Hazarian, "State Fixing Flaw in Cape Creek Span," Florence (Oregon) Siuslaw News, 22 August 1984.

19. Kamal Kamadoli to Bob Pool, Region 2 Engineer, 23 February 1989, Cape Creek Bridge (No. 1113), ODOT Bridge Section Maintenance Files.

20. Larry Bacon, "Electric charge to preserve historic Cape Creek Bridge," Eugene Register Guard, 4 August 1989; Michael R. Tighe, "Cathodic Protection Leads Charge in Corrosion Battle," Public Works, July 1990.