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United States Department of the Interior
National Park Service

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JUN 22 2005

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in How to Complete the National Register of Historic Places Registration Form (National Register Bulletin 16A). Complete each item by marking "x" in the appropriate box or by entering the information requested. If any item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions. Place additional entries and narrative items on continuation sheets (NPS Form 10-900a). Use a typewriter, word processor, or computer, to complete all items.

1. Name of Property

historic name Rogue River Bridge No. 01172

other names/site number Rogue River (Gold Beach) Bridge No. 01172, Isaac Lee Patterson Bridge

2. Location

street & number Oregon Coast Highway No. 9 (US 101), MP 327.70 not for publication ___

city or town Gold Beach vicinity ___

state Oregon code OR county Curry code 015

zip code 97444

3. State/Federal/Tribal Agency Certification

As the designated authority under the National Historic Preservation Act of 1986, as amended, I hereby certify that this ☒ nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ☒ meets ☐ does not meet the National Register Criteria. I recommend that this property be considered significant ☒ nationally ☐ statewide ☐ locally. (☐ See continuation sheet for additional comments.)

James Hamrick 6/14/05
Signature of certifying official / Deputy SHPO Date

Oregon State Historic Preservation Office
State or Federal agency and bureau

In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. (☐ See continuation sheet for additional comments.)

Signature of commenting or other official Date

State or Federal agency and bureau

4. National Park Service Certification

I, hereby certify that this property is:

☒ entered in the National Register Edson Beall 8/5/05
☐ See continuation sheet.
☐ determined eligible for the National Register
☐ See continuation sheet.
☐ determined not eligible for the National Register

☐ removed from the National Register

☐ other (explain):

Signature of Keeper Date of Action

5. Classification

Ownership of Property
(Check as many boxes as apply)

- ☐ private
- ☐ public-local
- ☒ public-State
- ☐ public-Federal

Category of Property
(Check only one box)

- ☐ building(s)
- ☐ district
- ☐ site
- ☒ structure
- ☐ object

Number of Resources within Property
(Do not include previously listed resources in the count)

Contributing	Noncontributing	
___	___	buildings
___	___	sites
1	___	structures
___	___	objects
___	___	Total

Number of contributing resources previously listed in the National Register 0

Name of related multiple property listing
(Enter "N/A" if property is not part of a multiple property listing.)

C. B. McCullough Major Oregon Coast Highway Bridges, 1927-36.

6. Function or Use

Historic Functions
(Enter categories from instructions)

Transportation

Historic Subfunctions
(Enter subcategories from instructions)

Road-related

Current Functions
(Enter categories from instructions)

Transportation

Current Subfunctions
(Enter subcategories from instructions)

Road-related

7. Description

Architectural Classification
(Enter categories from instructions)

Late 19th and 20th Century Revivals
  Classic Revival
Modern Movement
  Art Deco
  Moderne

Materials
(Enter categories from instructions)

Foundation	Concrete
Other	Steel
	Concrete

Narrative Description
(Describe the historic and current condition of the property on one or more continuation sheets)

See continuation sheets.

8. Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing)

☒ A Property is associated with events that have made a significant contribution to the broad patterns of our history.

☐ B Property is associated with the lives of persons significant in our past.

☒ C Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.

☐ D Property has yielded, or is likely to yield information important in prehistory or history.

Criteria Considerations
(Mark "X" in all the boxes that apply.)

☐ A owned by a religious institution or used for religious purposes.

☐ B removed from its original location.

☐ C a birthplace or a grave.

☐ D a cemetery.

☐ E a reconstructed building, object, or structure.

☐ F a commemorative property.

☐ G less than 50 years of age or achieved significance within the past 50 years.

Areas of Significance
(Enter categories from instructions)

Engineering
Transportation

Period of Significance

1929-32

Significant Dates

Completed in 1932.

Significant Person
(Complete if Criterion B is marked above)

Cultural Affiliation

Architect/Builder

Conde B. McCullough, designer
Mercer-Fraser Company, Eureka, California, contractor

Narrative Statement of Significance
(Explain the significance of the property on one or more continuation sheets.)

See continuation sheets.

9. Major Bibliographical References

(Cite the books, articles, and other sources used in preparing this form on one or more continuation sheets.)

Previous documentation on file (NPS)
☐ preliminary determination of individual listing (36 CFR 67) has been requested.
☐ previously listed in the National Register

☒ previously determined eligible by the National Register
☐ designated a National Historic Landmark
☐ recorded by Historic American Buildings Survey # ________
☒ recorded by Historic American Engineering Record # OR-38

Primary Location of Additional Data
☐ State Historic Preservation Office
☐ Other State agency
☒ Federal agency
☐ Local government
☐ University
☐ Other
Name of repository: Prints and Photographs Division, US Library of Congress.

10. Geographical Data

Acreage of Property 2.61 acres

UTM References
(Place additional UTM references on a continuation sheet)

	Zone	Easting	Northing		Zone	Easting	Northing
1	10	383836	4697983	3			
2				4			

Verbal Boundary Description
(Describe the boundaries of the property on a continuation sheet.)

Boundary Justification
(Explain why the boundaries were selected on a continuation sheet.)

11. Form Prepared By

name/title Robert W. Hadlow, Ph.D., Senior Historian

organization Oregon Department of Transportation date June 30, 2004

street & number 123 NW Flanders Street telephone (503) 731-8239

city or town Portland state OR zip code 97209-4037

Additional Documentation

Submit the following items with the completed form:

Continuation Sheets

Maps
USGS map (7.5 or 15 minute series) indicating the property's location.
sketch map for historic districts and properties having large acreage or numerous resources.

Photographs
Representative **black and white photographs** of the property.

Additional items (Check with the SHPO or FPO for any additional items)

Property Owner

(Complete this item at the request of the SHPO or FPO.)

name Oregon Department of Transportation

street & number 355 Capitol Street NE telephone ________ city or town Salem state OR zip code 97301

Narrative Description

The Rogue River Bridge No. 01172 is a reinforced-concrete structure that spans the mouth of the Rogue River between the cities of Gold Beach and Wedderburn at milepost 327.70 on the Oregon Coast Highway No. 9 (US 101). The structure is also known as the "Isaac Lee Patterson Bridge," after the Oregon governor who promoted its construction The 1,898-foot multi-arched span consists of a set of nine 16-foot reinforced-concrete deck girder sections with semicircular arched curtain walls on either end of a series of seven 230-foot reinforced-concrete ribbed deck arches. The roadway measured 27 feet, with a total structural width of 34 feet.

The approach viaducts rest on bents anchored to solid rock, as do the abutments, piers 1 and 8, at the north and south ends of the main structure. Piers 2 through 7 are solid pedestals resting on piling. Footings for piers 2, 4, 5, and 7 consist of 180 timber piles driven vertically. Bases measure 29 by 38 feet. Concrete seals, 8 to 10 feet thick, cap the pile heads and serve as foundations for the piers. McCullough designed pedestals 3 and 6 as abutment piers to resist heavy thrust from adjacent arches. They rest on grids of 260 batter piles, driven half each direction along the longitudinal centerline of the span, at angles 20 degrees off the vertical centers of the piers.

McCullough's application of the Freyssinet method of arch precompression permitted the use of slender, even delicate, arch ribs that combined his passion for a mixture of classical designs with embellishments in the emerging popular "Art Deco" style. Forms for the arch ribs and Roman-arched curtain walls and railing panels were constructed to leave impressions in the concrete resembling mortar joints around *voussoirs*, or wedge-shaped pieces of masonry. Similar scoring of flat concrete surfaces also gave an illusion of cut stone construction. Twin battered spandrel columns fill the space between the tops of the arch ribs and the road deck. They take on a stylized Tuscan form, with simple pedestals and capitals, but also include Art Deco vertical scoring and horizontal banding. Elaborate elbow-like brackets support the sidewalks and railings. Entry pylons grew out of the batter piers at each end of the main structure (nos. 1 and 8). For their pedestrian passageways he designed simple Palladian windows in east and west walls and semicircular arched doorways with imitation *voussoirs*, set off with stylized Egyptian sunbursts. He capped them with small two-tiered obelisks. All concrete surfaces were rubbed smooth with carborundum abrasives to obscure any imperfections caused by the wooden forms.[1]

Inspections of the Rogue River Bridge in the 1990s noted that ocean salt had infiltrated the structure and caused extensive deterioration in the surface concrete and nearby reinforcing steel. In 2001, the Oregon Department of Transportation embarked on a three-year $20 million project to rehabilitate the bridge. It included removing deteriorated concrete and reinforcing bar, make the reinforcing bar continuous with splices, apply shotcrete or pressure-grouted concrete at repair locations, and apply arc-sprayed zinc anode to the entire surface of the bridge, except for the deck. In addition, the project called for milling the deck and inlaying it with micro silica concrete. The sidewalk rails were replaced with precast replicas that incorporated structural steel so that it would better prevent vehicle penetration. Finally, a city-owned waterline was relocated to a less conspicuous alignment under the deck.

In performing an underwater examination of the bridge for potential scour mitigation, the agency discovered that the river has cut a new bottom level at the south edge of the main channel, at pier 2. A scour mitigation project in 1976 provided an enlarged and deepened concrete seal with stay-in-place steel sheet pile forms. Subsequently, the river eroded the sheet pile and began to undermine the repair. A stability analysis of pier 2 confirmed this was a serious problem that required prompt attention. The agency installed a system of drilled shafts with reinforced concrete tied into a reinforced-

[1] "Isaac Lee Patterson Bridge," *House Concurrent Resolution No. 1*, 24 February 1931, Legislature, 36th Assembly, Oregon; and Oregon State Highway Commission to Mrs. H. J. Edwards, Coos Bay Chapter of the Daughters of the American Revolution, January 18, 1932, File 8-4, 76A-90/3, Highway Division Records, Oregon State Archives. Crews used hoists and derricks operating clamshell buckets to excavate piers. They drove the piling with a Vulcan steam hammer, using a five-ton weight, which delivered 60 blows per minute. By 1 December 1930, they had poured concrete for all of the piers. See also "Bridge Plans," Bridge at Mouth of the Rogue River (No. 1172), Bridge Section, ODOT, Drawings 3875, 3878, 3879, 3888, and 3889. See W. A. Scott, "Rogue River Bridge at Gold Beach, Oregon," *Western Construction News and Highways Builder*, 25 May 1932, 281.

concrete shell, which that was then post-tensioned through the existing foundation to transfer all loads on the pier to the new foundation.

Narrative Statement of Significance

The Rogue River Bridge No. 01172 is being nominated under the C. B. McCullough Major Oregon Coast Highway Bridges Multiple Property Submission. It is significant under National Register criterion C because it embodies the distinctive characteristics of a type, period, and method of construction for mid-twentieth-century reinforced-concrete arch bridge technology. Just as important, it significant under criterion C as the work of a master, Conde B. McCullough, Oregon state bridge engineer from 1919 to 1936. The bridge is also significant under criterion A for its association with construction of the Oregon Coast Highway, which eventually ran the length of Oregon and connected with adjacent segments in California and Washington. The road would not have been complete without eleven major bridges, including the Rogue River Bridge, and many other spans.

The Rogue River Bridge possesses national significance as one of the six major bridges that McCullough constructed on the Oregon Coast Highway between 1931 and 1936 and spanned the remaining barriers to efficient travel along the route—three bays and three river estuaries that relied on an outmoded ferry service. (The others were the Alsea Bay Bridge at Waldport, the Yaquina Bay Bridge at Newport, the Siuslaw River Bridge at Florence, the Umpqua River Bridge at Reedsport, and the Coos Bay (McCullough) Bridge at Coos Bay.) Completion of these bridges (one in 1932 and five in 1936) is considered the dividing line between the period of relative isolation and dependence on sea transportation for many of Oregon's coastal communities and their newfound association with each other along this ribbon of asphalt, known as US 101. The Rogue River Bridge was the first reinforced-concrete arch bridge built in the United States using the Freyssinet method of arch decentering.

The Rogue River Bridge is also significant under criterion C as the work of a master, Oregon State Bridge Engineer Conde B. McCullough, and due to its thematic association with several other major steel and reinforced-concrete bridges designed by McCullough and erected along the Oregon Coast Highway in the 1920s and 1930s. During his years as State Bridge Engineer, and later as Assistant State Highway Engineer, McCullough authored several books and many technical articles on bridge design and construction. He is significant for his use of innovative bridge technology, and for his visually appealing designs. He attained international recognition for the large-scale structures he designed to span the major rivers and estuaries, and several other thematically-similar concrete arch, beam, and girder structures, along the Oregon Coast Highway.

The Rogue River Bridge is significant under criterion A because of its association with the construction of the Oregon Coast Highway in the 1930s. Completion of the Oregon Coast Highway was a major public works effort in the early and mid-1930s to establish an uninterrupted transportation route from California to Washington. The effort was aided by the US Bureau of Public Roads and the Reconstruction Finance Corporation for the Rogue River Bridge and the Public Works Administration through the Oregon Coast Bridges Project, to construct six modern bridges to replace the existing slow, cumbersome ferries that crossed the larger bays, rivers and estuaries. An immediate accomplishment of the route's completion was the construction jobs that it provided to many unemployed workers. In more long-lasting terms, the highway's completion was a major factor in the development of commerce and tourism in Oregon's coastal regions, and it has since become one of the most notable scenic routes in the United States. The Oregon Coast Highway is worthy of its recent designation as a National Scenic Byway.

Completed in 1932, the Rogue River Bridge continues to serve motorists journeying along the dramatic coastline of Oregon. To construct the bridge, McCullough employed a technique perfected by French engineer Eugène Freyssinet. In it, arch ribs are pre-stressed by hydraulic jacks placed at their crowns to compensate for deformations due to shrinkage of concrete, differential temperature changes, movement of supports, and elastic and plastic shortening. The result is that, in theory, the ribs shorten to a point equal to, but not beyond, their original position.

The Oregon State Highway Commission and the U.S. Bureau of Public Roads (BPR) built this bridge to provide a modern crossing over the Rogue River and to conduct a sophisticated experiment in which they tested Freyssinet's hypothesis.

The two government agencies provided much insight into this technique for the engineering community through their sophisticated collection of data and reporting of their findings. In 1982, the bridge received the American Society of Civil Engineers' designation as a National Historic Civil Engineering Landmark because of its contribution toward the development of the civil engineering profession in the United States.

Ferries traveled between Gold Beach and Wedderbum almost since the founding of the villages in the nineteenth century. During initial construction of the Oregon Coast Highway in the 1920s, private citizens and chambers of commerce all along the route complained bitterly about the slow unreliable ferry service at Gold Beach, Reedsport, Coos Bay, Florence, Alsea Bay and Yaquina Bay. One critic labeled the crossing at the mouth of the Rogue River an abomination. He lamented that the coast highway would "never amount to anything until there is a bridge built [at Gold Beach]." California vacationers, he believed, were by-passing the Oregon Coast to take advantage of more complete routes to the east, including the Pacific Highway. As a result, the region's communities were deprived of tourist dollars that they deserved.[2]

In June 1929, the Oregon State Highway Commission began studying eight proposals that McCullough and his designers had prepared for a Rogue River crossing. The commission favored a $628,000 structure that was designed to serve traffic needs for many decades. The multiple-span reinforced-concrete deck arch bridge included a wide road deck and ample sidewalks and required minimal realignment of existing approaches. That fall, the War Department's Army Corps of Engineers, which oversaw construction of structures over navigable waters, granted the OSHD a permit to build the bridge.[3]

In early 1930, Congress uncharacteristically pushed for construction as soon as possible. The nation faced crippling economic problems in the wake of the stock market crash. Congressmen saw this and other projects as an integral part of President Herbert Hoover's policy of limited public works aimed at curbing nationwide unemployment. Contributions through Federal-Aid Road Act funds amounted to two-thirds of the bridge's cost.[4]

Characteristically, McCullough mixed aesthetic and practical considerations in the design of the 1,898-foot bridge. He created a multi-arched structure that harmonized with the rolling hills of the coastal mountains and resembled his other large arch bridges. McCullough hoped to economize by employing a relatively obscure decentering technique perfected by renowned French bridge engineer Eugène Freyssinet for reinforced-concrete deck arches—one never previously used in the United States. Freyssinet's technique for shortening ribbed arches had the potential to lower costs by 10 percent over traditional construction methods. In the early twentieth century, Freyssinet, who was born in 1879 and studied at the École des Ponts et Chaussées (College of Bridges and Roads) at the turn of the century, developed a method for decentering reinforced-concrete bridge arches that seemed quite unorthodox at the time. He sought to subject concrete to an initial compression to neutralize tensile stresses and applied the method as early as 1907 on a 100-foot arch over the Bresle River.[5]

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[2]Robert L Withrow, Editor, *Gold Beach Curry County Reporter*, to H. B. Van Duzer, Highway Commissioner, 15 December 1928, File 8-4; and J. G. Eckman to Oregon State Highway Commission, 13 August 1929, and attached undated newspaper article in File 8-4, 76A-90/3, Highway Division Records, Oregon State Archives.

[3]The OSHC chose from among eight designs proposing structures at different points along the river. The bridge selected, costing an estimated $628,000 was the most costly of the group but required no expensive realignment of the coast highway at its approaches. The commission called for bids for the seven-span reinforced-concrete deck-arch structure at its December 1929 meeting. Its action attracted attention from many large construction firms. On 16 January 1930, the Mercer-Fraser Company of Eureka, California, received the contract for $568,181. "Preliminary Estimate [1927]," File 8-4, 76A-90/3, Highway Division Records, Oregon State Archives. See Betty Van Leer, "Spanning the Mighty Rogue—How the Bridge was Built," Rogue Coast Supplement to the *Gold Beach Curry County Reporter*, 26 May 1982, 7-9.

[4]Van Leer, "Spanning the Mighty Rogue," 8.

[5]Albin L. Gemeny and C. B. McCullough, *Application of Freyssinet Method of Concrete Arch Construction to the Rogue River Bridge in Oregon, A Cooperative Research Project by the U.S. Bureau of Public Roads and the Oregon State Highway Commission* (Salem: Oregon State Highway Commission, 1933), 2. See H. P. Hopkins, *A Span of Bridges: An Illustrated History* (New York: Praeger, 1970), 261-262, and J. T. Thompson,

Freyssinet had discovered in the early 1900s that a traditional reinforced-concrete structure with a relatively flat deck arch experienced elastic shortening after its falsework was removed. The span assumed a shorter curve under its own dead load because of axial thrust. Temperature decreases and gradual material shrinkage only accentuated this condition, causing the arch to sag to a lower position. The change in the arch rib's curvature set up tensile, compressive, and deformation stresses, which weakened the structure at its skewbacks. It was prohibitively costly to strengthen arches and piers with additional concrete and reinforcing steel.[6]

As an alternative, Freyssinet introduced a system of hydraulic jacks into the open crowns of the ribs. This technique lengthened the axis of each arch rib by an amount calculated to equal the deformation. Once jacked into position, ribs were keyed with high-strength concrete, and reinforcing bars were spliced at the crowns. Freyssinet theorized that his technique could shorten arch rings to their initial axis without bending. The ribs then carried their own dead load without extraordinary stresses induced at the skewbacks. The method, Freyssinet argued, made possible construction of large-scale arches using slender ribs. Nevertheless, it did not gain use in the United States for over two decades. .[7]

McCullough employed the Freyssinet method at Gold Beach as part of an experiment in bridge design jointly sponsored by the BPR and the OSHC, and it upheld the agencies' research mandate to determine the advantages and disadvantages of Freyssinet's technique. Moreover, McCullough an his federal colleagues sought to better understand arch rib behavior after decentering, when falsework and forms were removed, and how the weight of the road deck and spandrel columns on the arch rings affected the distribution of rib stress. Finally, they hoped to learn to what degree formwork prevented the ribs from moving after decentering. They monitored how temperature changes and shrinkage affected rib concrete from the time when it was first poured until it was fully cured. From his perspective, McCullough saw the technique as a way to reduce construction costs and to save public funds [8]

McCullough had taken on the project with BPR Chief Thomas MacDonald's encouragement. Members of MacDonald's staff in Washington, D.C., especially senior structural engineer, Albin L. Gemeny, worked closely with McCullough and his bridge designers. Gemeny had already completed a great deal of research on hingeless reinforced-concrete arches for the Bureau's division of tests. He and McCullough had previously collaborated on BPR technical bulletins. As a team, one complemented the other.[9]

McCullough secured sixteen 250-metric-ton jacks from the Paris firm Freyssinet had contracted for his three-arch bridge over the Elorn River at Plougastel, France. McCullough required this quantity to simultaneously decenter two arch panels. He used four jacks on the ribs of each arch, two extrados and two intrados at the crown. The cost of acquiring additional jacks, combined with the logistics of pouring the entire structure with hand labor in one session, prevented him from employing the technique on all of the arches simultaneously. For each span, McCullough created an elaborate system of piping, hand-activated plunger pumps, and pressure meters to regulate the hydraulic pressure sent to the jacks during the

"Freyssinet Method of Arch Construction," *Baltimore Engineer* 5 (January 1931): 4-6. See also Robert W. Hadlow, "Oregon's Isaac Lee Patterson Bridge: The First Use of the Freyssinet Method of Concrete Arch Construction in the United States, 1932," *IA (The Journal of the Society for Industrial Archeology)* 16, No. 2 (1990): 3-14.

[6]Hopkins, 262-67. Freyssinet attempted to compensate for shrinkage of concrete, dead load, differential temperature changes, movement of supports, and elastic and plastic shortening. See Gemeny and McCullough, *Application of Freyssinet Method of Concrete Arch Construction*, 4-5; Conde B. McCullough and Albin L. Gemeny, "Designing the First Freyssinet Arch to Be Built in the United States," *Engineering News-Record* 107 (26 November 1931): 841; Conde B. McCullough and Edward S. Thayer, *Elastic Arch Bridges* (New York: John Wiley and Sons, 1931): 337-38. See also Eugène Freyssinet, "The Bridge at Villeneuve-sur-Lot, Department of Lot and Garonne, France: Advances in the Construction of Great Arches," trans. Lloyd G. Frost, TMs, [1925], 28-29, original appeared in *Le Génie Civil*, 79 [1921].

[7]Ibid.

[8]Another term for falsework is centering. When it and forms are removed during construction the process is called striking the centering or decentering. Gemeny and McCullough, *Application of Freyssinet Method of Concrete Arch Construction*, 7-8.

[9]Ibid. See Gemeny and McCullough in its entirety for a complete discussion of the Freyssinet method and its application at the bridge.

procedure. He designed structural steel emplacements extending ten feet into the ribs from the arch crowns, thereby transferring the thrust of the jacks into the ribs and preventing them from crushing the concrete.[10]

There were other considerations. McCullough feared that the lifting action created in the ribs might adversely affect the rest of the structure. Fixed spandrel columns and the traditionally constructed deck could restrain the ribs and prevent the upward movement, or articulation, he desired during the jacking procedure. But construction schedules necessitated compressing the arch rib sections with the structure, including the deck, in place. Accordingly, McCullough used a complex system of temporary hinges and joints that made the spandrel structure more flexible. This complicated arrangement was the best solution to the problem. Essentially, he had created a floating road deck with spandrel columns that gently rested on the arches and exerted only vertical load forces without creating any additional thrust action.[11]

McCullough's also introduced employed temporary hinges, or articulation points, near the skewbacks of the arch ribs. They resembled those perfected by French engineer Armand Considère, which consisted of bent reinforcing bar bundled with steel hoops to resemble an hour glass. The hinges helped eliminate stresses in the ribs during the jacking procedure.

The construction of the bridge was also a marvel in logistics. In 1930, Gold Beach, Oregon, was remote, some eighty miles from the nearest railway line. Cement and reinforcing bar, pre-cut to proper lengths, were shipped to Port Orford, thirty miles to the north, where trucks conveyed them south to the mouth of the Rogue. Lumber came from local mills, mostly from Bandon, a coastal village sixty miles to the north. Logs for piling came from local forests and concrete aggregates from the river itself. Carpenters built the formwork in an open-air shop adjacent to the construction site.[12]

Once falsework was in place and reinforcing bar arranged, crews poured the concrete for the arch ribs continuously, except for a section near each skewback for the Considère hinges and at the crowns for the jacks. Then the jacks were installed and the Freyssinet technique was applied, after which the hinges and the arch crowns were keyed with concrete.

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[10]McCullough wrote to the Paris Établissement Morane Jeune in June 1930 for plans for its 250 metric-ton hydraulic jacks, and necessary valves and pumps (250 metric tons = 275.6 English tons). The company replied in late July with drawings for a forged steel model that had been used on the arch crowns of the La Toumelle Bridge in Paris in 1928. A second model, differing from the first in that its piston was threaded, prevented the jack from accidentally compressing if it lost hydraulic pressure. McCullough chose the latter version. See R. H. Baldock to Ian Macallan, 9 September 1952, Bridge at Mouth of Rogue River (No. 1172), Maintenance Files, Bridge Section, ODOT. McCullough placed the order for the jacks in late September 1930. The shipment from the Morane Company arrived by steamer in Washington, D.C., in January 1931, but did not reach the Pacific Northwest for another month. The Bureau of Public Roads' Division of Tests held them for the interim to calibrate the pumps and gauges and then sent the equipment, by rail, to Salem. The invoice from Paris totaled $5,950. By adding charges for customs duties, brokers' fees, and freight, the shipment cost about $8,200. [Établissment Morane Jeune] to [McCullough], July 24, 1930; McCullough to Gemeny, 9 August 1930; Morane Hydro to McCullough, telegram, 26 September 1930; Consumption Entry, United States Customs Service, District No. 13, Invoice No. 32,176, 13 January 1931; Receipt, L. P. Seibold, Inc., Washington, D.C., 22 January 1931; Freight Bill No. 5,378, Baltimore & Ohio Railroad Co., 20 January 1931; McCullough to E. S. Thayer, OSHC, 29 August 1931, all from Bridge No. 1172, Microfilmed Records, Bridge Section, ODOT. For a description of construction of the arched bridge at Plougastel, see Eugène Freyssinet, "The 600-ft. Concrete Arch Bridge at Brest, France," trans. by S. C. Hollister, *Proceedings of the American Concrete Institute* 25 (1929): 83-97, and discussion, 98-99.

[11]Gemeny and McCullough, *Application of Freyssinet Method of Concrete Arch Construction*, 8-9; McCullough reasoned that as the deck and spandrel columns were placed above the arches, they might cause the falsework to settle and create cantilever action in the ribs, which would induce extraordinary stresses at their bases. He believed this a serious matter since the ribs were not as massive as those usually seen on deck arch structures on which the traditional decentering technique, with extra steel and concrete, was employed. McCullough and Gemeny, "Designing the First Freyssinet Arch to Be Built in the United States," 844-45. See also, Hadlow, "Oregon's Isaac Lee Patterson Bridge," 8-10.

[12]The concrete plant was on the north bank of the river. Workers there combined standard bags of cement with local aggregate and water in a "27-S Foote" non-tilting mixer. Then they elevated the mix by an 80-foot-high (later a 104-foot-high) wooden tower and distributed it through a wooden shoot to the forms. Concrete for piers, columns, and beams was designed for a 28-day compressive strength of 2,500 psi. For the deck slabs it was rated at 3,000 psi, and for the arch ribs, 5,000 psi. McCullough used the following ratios for the concrete of different compressive strengths: for 2,500 psi, 5 sacks of cement per cubic yard, with water-cement ratio of 0.80; for 3,000 psi concrete, 5.5 sacks of cement and a water-cement ratio of 0.75; and for 5,000 psi, 8.25 sacks of cement and a water-cement ratio of 0.60. Glenn S. Paxson and Marshall Dresser, "Concrete Arch Ribs of the Rogue River Bridge Decentered by Built-In Jacks," *Construction Methods* 15 (April 1933): 37-39.

McCullough recorded the distribution of jack-induced strain throughout the bridge with telemeters and other apparatus placed within the structure. Their measurements revealed how stress was transmitted from ribs to piers in reinforced-concrete deck arch bridges, something Freyssinet had not done.[13]

The French engineer claimed that it was nearly impossible to determine the exact distribution of rib stresses in traditional arches. His method for rib precompression, however, guaranteed a shortening of the arch axis that closely approximated mathematical calculations. Findings collected during the decentering at Gold Beach proved Freyssinet to be correct. His precompression technique caused the arch rings to shorten to their initial point without bending, with the ribs carrying their own dead load without extraordinary stresses induced at the skewbacks. The method eliminated the need for excessive amounts of reinforcing bar and concrete, but McCullough's belief that it reduced total construction costs remained uncertain. Critics contended that expenses for additional skilled laborers needed in the Freyssinet technique equaled or outweighed any savings in materials. In addition, McCullough could not have attempted the project without BPR cooperation.[14]

The bridge neared completion in late 1931. Contractors originally planned to open the span sometime in January 1932, but an extremely wet December had swollen the Rogue River and disabled the old ferry, the *Rogue.* This prompted an early opening for the bridge, on 24 December 1931. The ferry never ran again at Gold Beach. Crews finally towed the dilapidated vessel north to Waldport where it provided supplemental service transporting vehicles across Alsea Bay, where McCullough completed a multi-span reinforced-concrete through tied arch structure in 1936.[15]

Thousands drove to Gold Beach for the Memorial Day weekend celebration. Many came just to travel over the coast highway, where the ocean was in sight for nearly one-third of the four-hundred-mile route. Lengthy stretches of open slopes and coves resplendent in native flowers and a luxuriant growth of ferns," and "myriads of shady dells and vistas of ocean," the *Curry County Reporter* intoned, "greet the traveler." Some sought out Gold Beach merely to touch the sixty-three-million-pound bridge that was "a mammoth mass of concrete, artistic in design, which blends harmoniously with its rough and rugged background." The *Salem Oregon Statesman* reported the bridge to be "an interesting structure, a monolithic monument to the design of engineers and the skill of mechanics." Further, it hoped that "All of Oregon will take pride in this bridge. It is an Oregon product and will stand for centuries, we trust, in token of the vision and the courage of the people of this generation."[16]

Conde B. McCullough's experiment at Gold Beach was the first and only one of its type constructed in Oregon. No others bridges using hydraulic jacks in the same manner have been built in the United States before or since. McCullough came to see the Freyssinet arch rib precompression technique as more than an economizing measure, though economy remained a goal in all of his designs. More importantly, the experiment contributed significant engineering data regarding the vexing properties of elastic arch bridges. McCullough and Gemeny spoke on the experiment's results at numerous conferences and authored several professional articles and a major technical bulletin. McCullough's work at Gold Beach was a genuine contribution to world-class bridge design.[17]

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[13]Gemeny and McCullough, *Application of Freyssinet Method of Concrete Arch Construction*, 54-58.

[14]David Plowden, *Bridges: The Spans of North America* (New York, W. W. Norton and Company, 1974), 319. Interview, Robert W. Hadlow and Richard L. Koochagian with Ivan Merchant, Construction Inspector for OSHD at the Isaac Lee Patterson Bridge (1930-31), Gold Beach, Oregon, 16 August 1990, tapes held by Environmental Section, ODOT.

[15]Van Leer, "Spanning the Mighty Rogue," 18.

[16]"More than 1,000 Cars in Caravan for Celebration," *Marshfield Coos Bay Times*, 30 May 1932; Withrow, "Throngs See Coast Road Link Opened"; and Withrow, "Great Throng Joins in Big Celebration," *Gold Beach Curry County Reporter*, 2 June 1932 (quotes); "The Patterson Bridge," editorial, *Salem Oregon Statesman*, 27 May 1932 (quote), CF-OSA.

[17]Albin LeRoy Gemeny continued with the BPR as a senior structural engineer. He died after suffering a heart attack on 1 December 1939. Other than his association with the Patterson bridge project, he was most noted for his work in the 1930s to revise highway bridge specifications in the

A few years later, McCullough went on to design five other large bridges for the Oregon Coast Highway. This marked an end to ferry service along all of US 101 in Oregon. McCullough left the country briefly to design three short-span suspension bridges, in 1936, for the Inter-American Highway, in Panama, Honduras, and Guatemala. Upon his return to Oregon in 1937 he became Assistant State Highway Engineer. McCullough served in this administrative post until his death in 1946.

The Rogue River Bridge meets the property type and registration requirements for the C. B. McCullough Major Oregon Coast Highway Bridges Multiple Property Submission. It was completed during the period of significance (1927-36) on the then current alignment of the Oregon Coast Highway. It was designed by Oregon State Highway Department bridge engineers under the direction of Conde B. McCullough. Its primary or secondary main spans are reinforced-concrete arches. It possesses a high degree of original integrity of design and materials.

United States. See "A. L. Gemeny Dies; Prominent Bridge Engineer," *Engineering News-Record* 123 (7 December 1939): 738.

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--------. "Throngs See Coast Road Link Opened," *Gold Beach Curry County Reporter*, 2 June 1932.

Verbal Boundary Description

The property is described as beginning at the north end of the Rogue River Bridge, at mile post 327.70 on the Oregon Coast Highway No. 9, and running 1,898 feet to the south end of the bridge. It is 60 feet wide (30 feet either side of center line on the bridge).

Boundary Justification

The boundary includes property associated historically with the Rogue River Bridge.

United States Department of the Interior
National Park Service

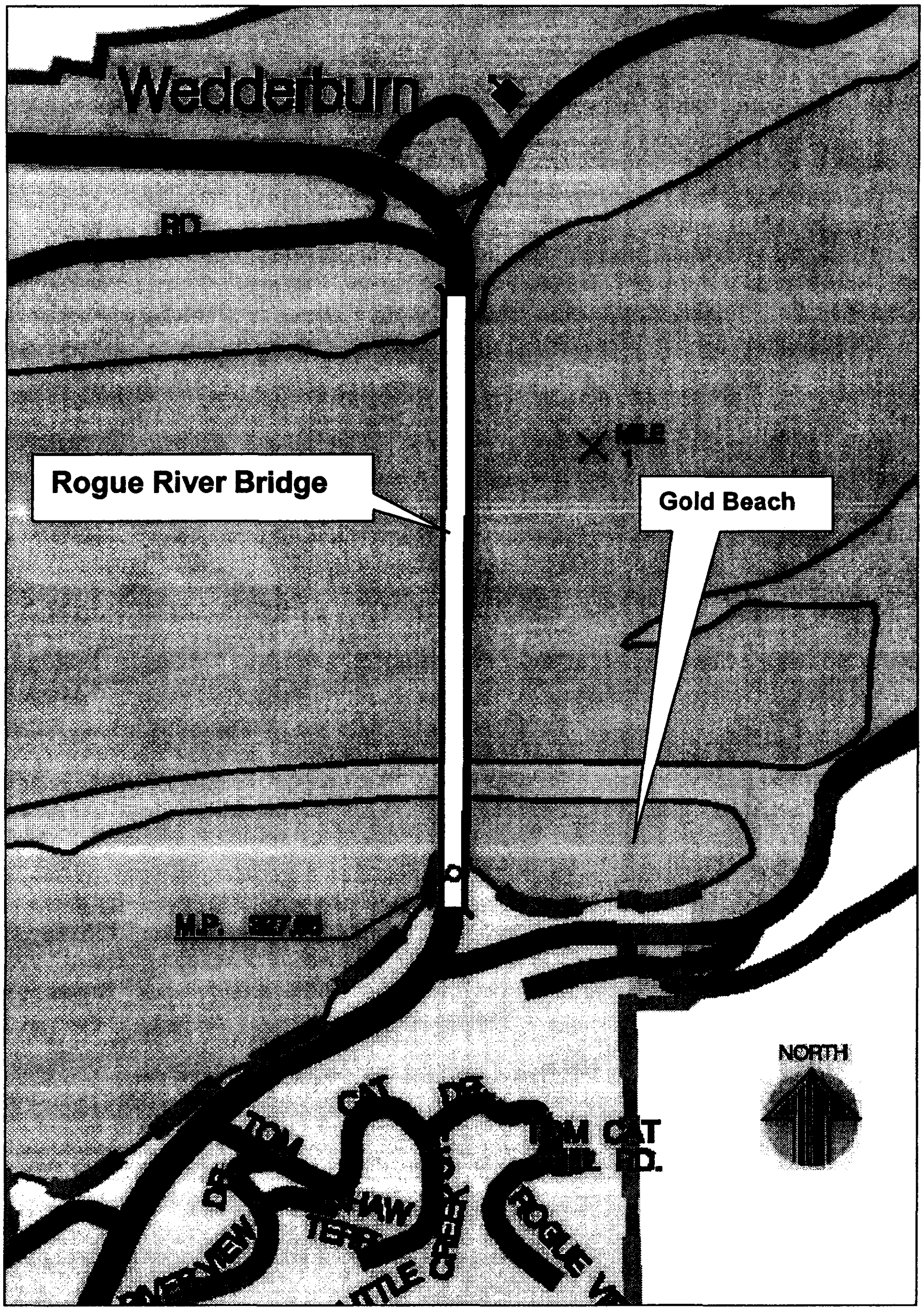
NATIONAL REGISTER OF HISTORIC PLACES
CONTINUATION SHEET

Photographs

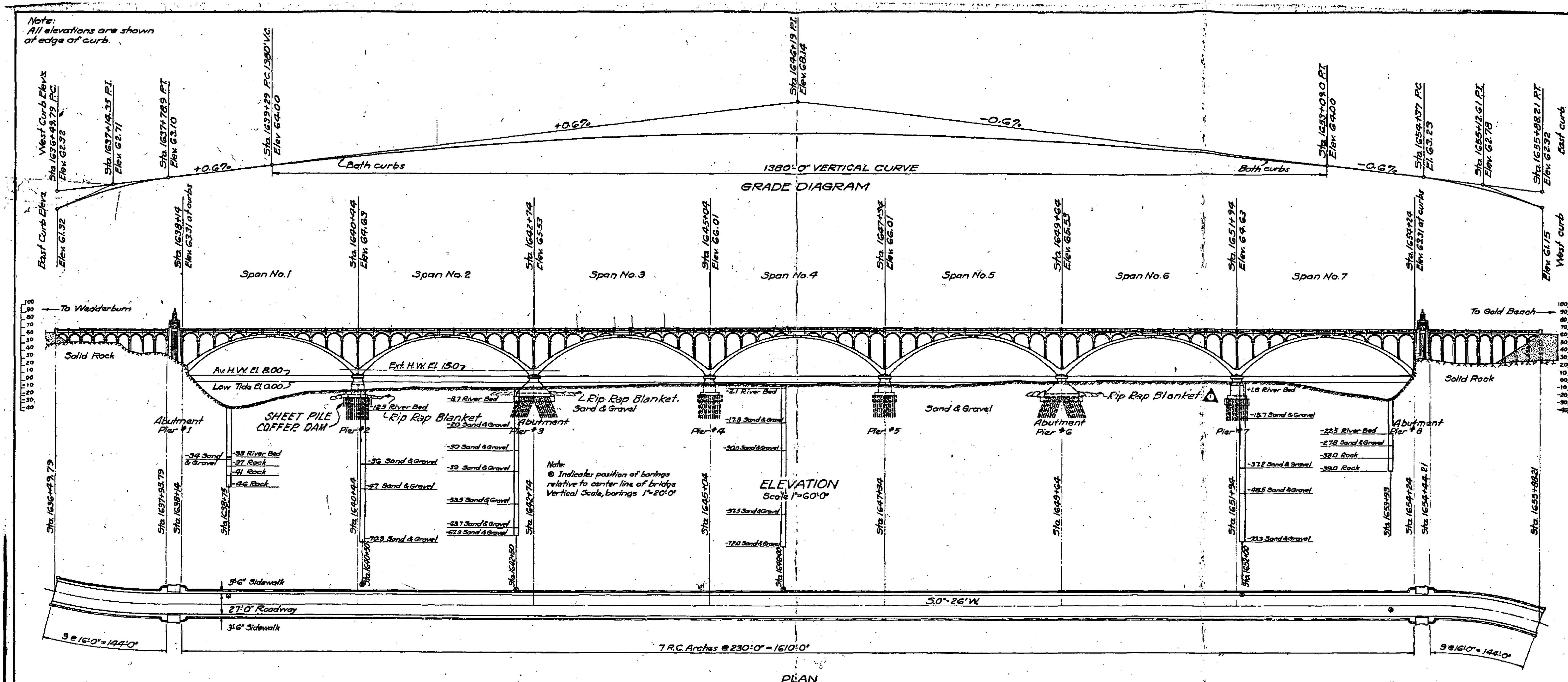
Leslie Schwab, Photographer, June 2003
(Original negatives housed at Oregon Department of Transportation, Salem, Oregon)

Photographic Description

View No.	Description
1	General perspective view of the Rogue River Bridge, view looking northeast.
2	General view of the bridge, view looking northwest.
3	Detail view of the bridge, view looking west up west at the key of the arch.
4	Detail view of the pedestrian pylon at the north end of the bridge, view looking east.
5	Detail view of the pedestrian pylon at the northwest corner of the bridge, view looking southwest.
6	Detail perspective view of the (reconstructed) decorative reinforced concrete bridge railing, view looking south.
7	Detail view of the railing view looking west.
8	Detail view of the spandrel columns and arch ribs (taken during current restoration project). View looking north.



Rogue River Bridge No. 01172
MP 327.70, Oregon Coast Highway No. 9
Gold Beach, Curry County, Oregon



GENERAL NOTES:

Roadway and sidewalk slabs shall be Class "D" concrete, arch ribs shall be as provided in the special provisions, pier seals shall be as specified for seal concrete, handrail shall be as shown on Dwg. 3890. All other concrete shall be class A.

All exposed corners shall have ¾" bevel unless noted otherwise.

Footings shall be carried below elevation shown if necessary to secure suitable foundations.

Copper water stops shall be provided at all construction joints in columns and arch rings.

All reinforcing metal shall be deformed bars placed 2" clear from the nearest face of concrete except where noted otherwise.

Sequence of construction shall conform to the typical pouring schedule shown on Dwg. 3881 and as defined in the special provisions.

All material and workmanship shall conform to the specifications for the Bridges of the Oregon State Highway Commission.

NOTE:
After these drawings were prepared this structure was officially designated as "THE ISSAC LEE PATTERSON BRIDGE."

△ AS CONSTRUCTED 6-10-75

NOTE: See "Bridge Maintenance Files" for additional as constructed details.

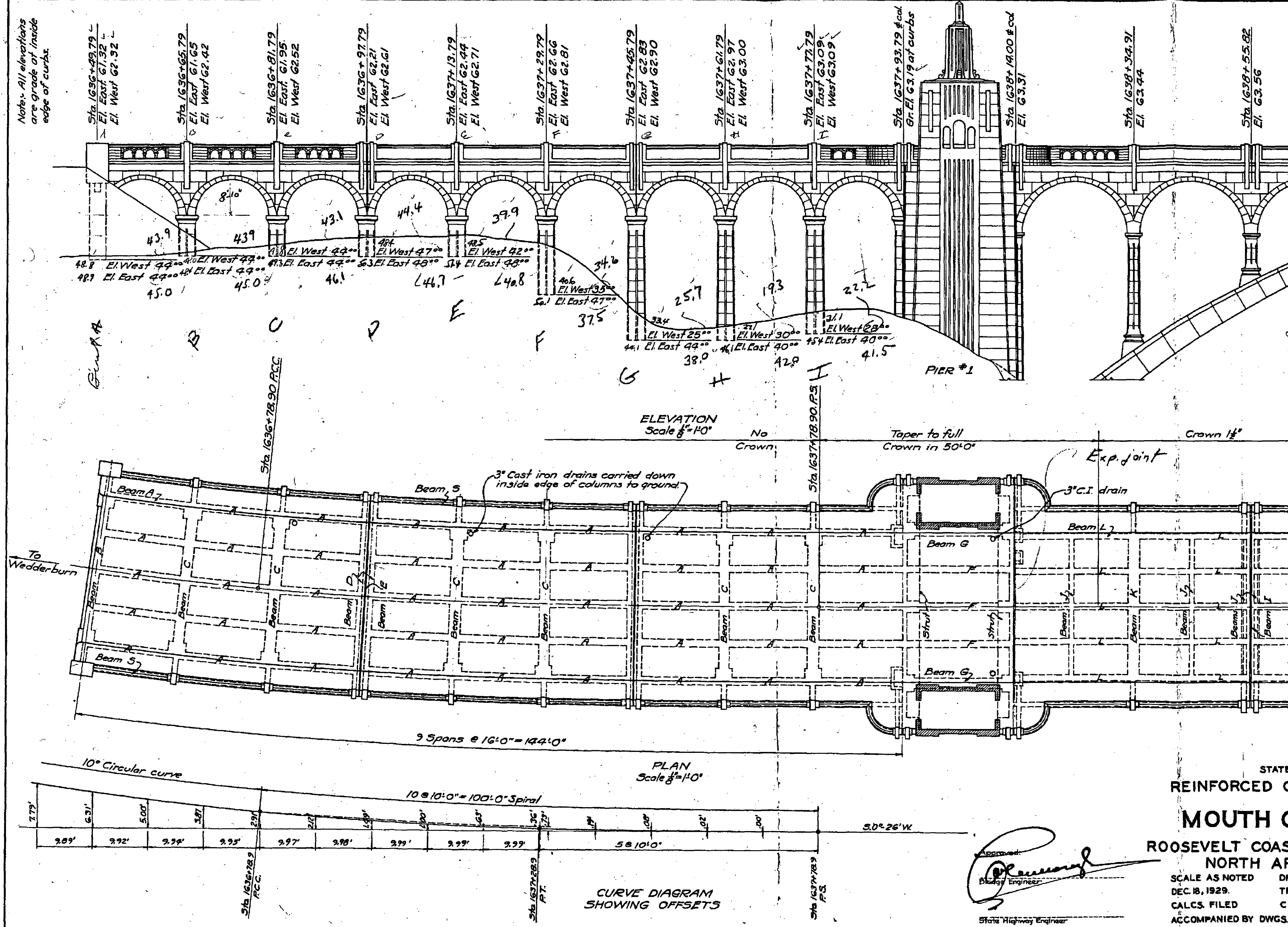
Approved
Bridge Engineer
State Highway Engineer

OREGON
STATE HIGHWAY COMMISSION

REINFORCED CONCRETE ARCH BRIDGE
AT
MOUTH OF ROGUE RIVER
ON
ROOSEVELT COAST HWY. — CURRY CO.
PLAN AND ELEVATION

SCALE AS NOTED	DRAWN BY L.S.S.	SHEET 1 OF 20
DEC. 18, 1929.	TRACED BY "	BRIDGE NO. 1172
CALCS FILED	CHECKED BY	DRAWING NO. 3874

ACCOMPANIED BY DWGS. 3875 TO 3890 INCL.
4069-4070-4073-4233



See accompanying sketch for length of vertical steel in piers #1 & #8.

Approved: Bridge Engineer

State Highway Engineer

OREGON
STATE HIGHWAY COMMISSION

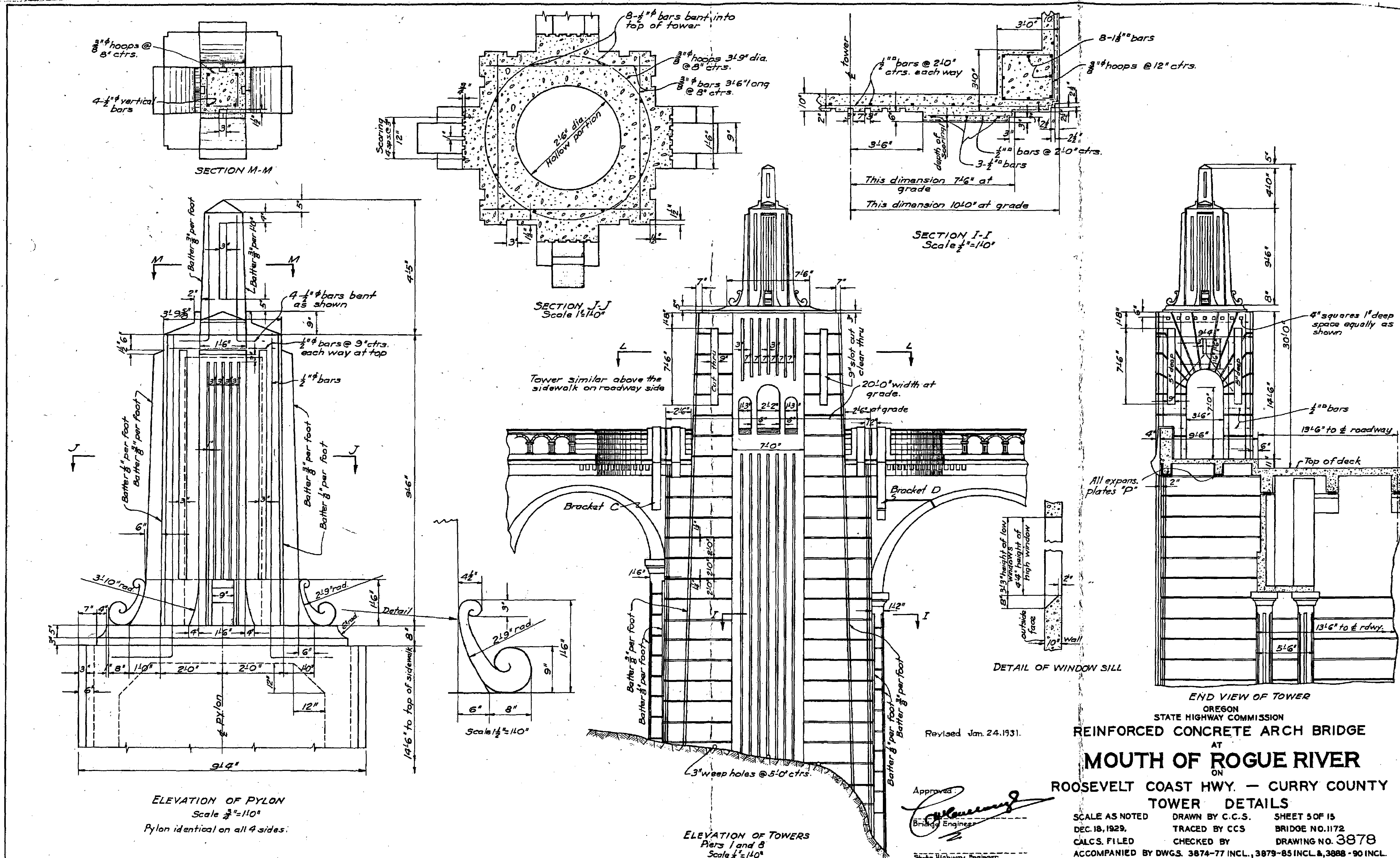
REINFORCED CONCRETE ARCH BRIDGE
AT

MOUTH OF ROGUE RIVER
ON

ROOSEVELT COAST HWY. — CURRY CO.
NORTH APPROACH DETAILS

SCALE AS NOTED	DRAWN BY L.S.S.	SHEET 2 OF 15
DEC. 18, 1929.	TRACED BY L.S.S.	BRIDGE NO. 1172
CALCS. FILED	CHECKED BY	DRAWING NO. 3875

ACCOMPANIED BY DWGS. 3874 - 3876 TO 3885 INCL. & 3888-9-90



OREGON
STATE HIGHWAY COMMISSION

REINFORCED CONCRETE ARCH BRIDGE

AT

MOUTH OF ROGUE RIVER

ON

ROOSEVELT COAST HWY. — CURRY COUNTY

TOWER DETAILS

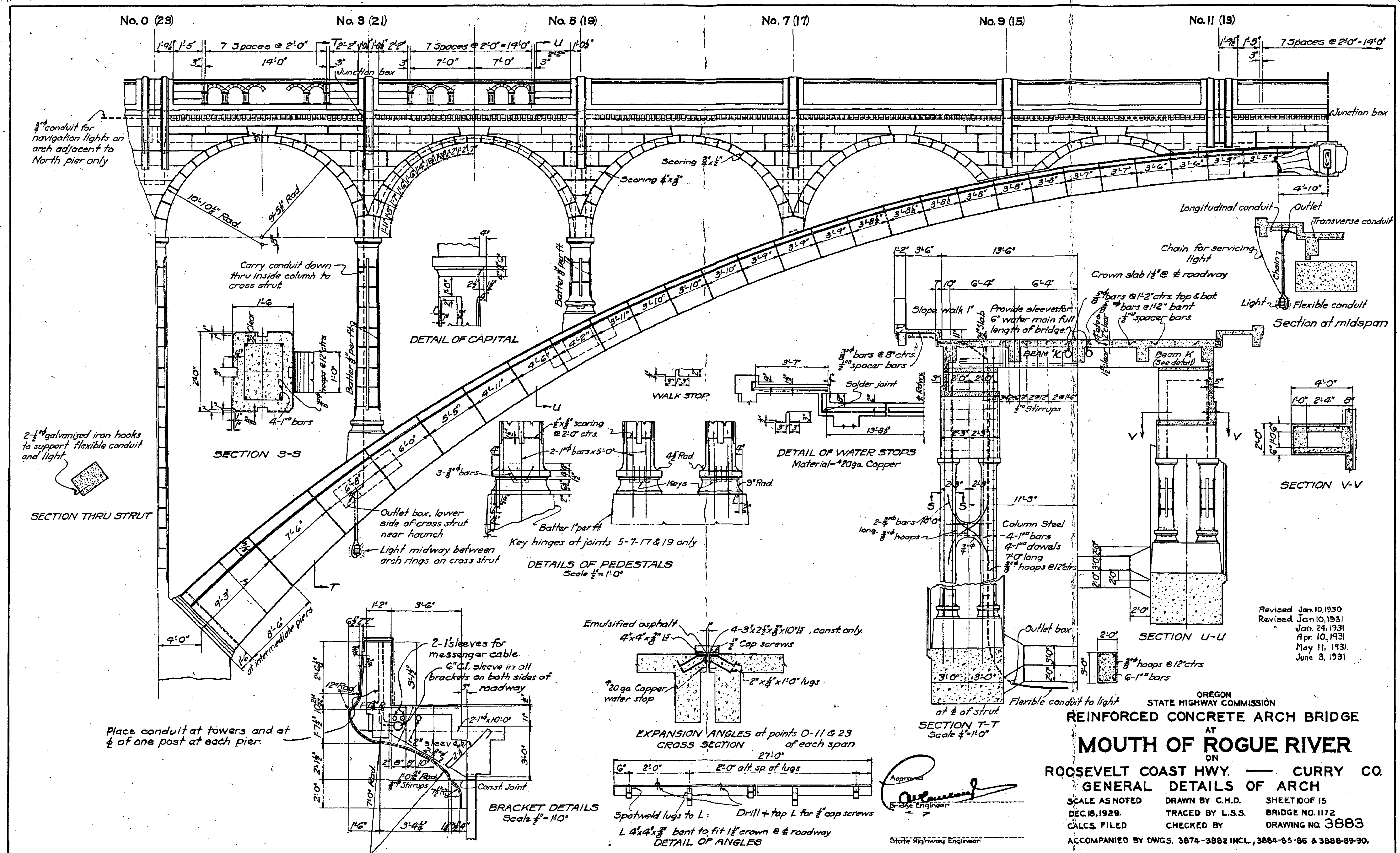
SCALE AS NOTED	DRAWN BY C.C.S.	SHEET 5 OF 15
DEC. 18, 1929.	TRACED BY CCS	BRIDGE NO. 1172
CALCS. FILED	CHECKED BY	DRAWING NO. 3878

ACCOMPANIED BY DWGS. 3874-77 INCL., 3879-85 INCL. & 3888-90 INCL.

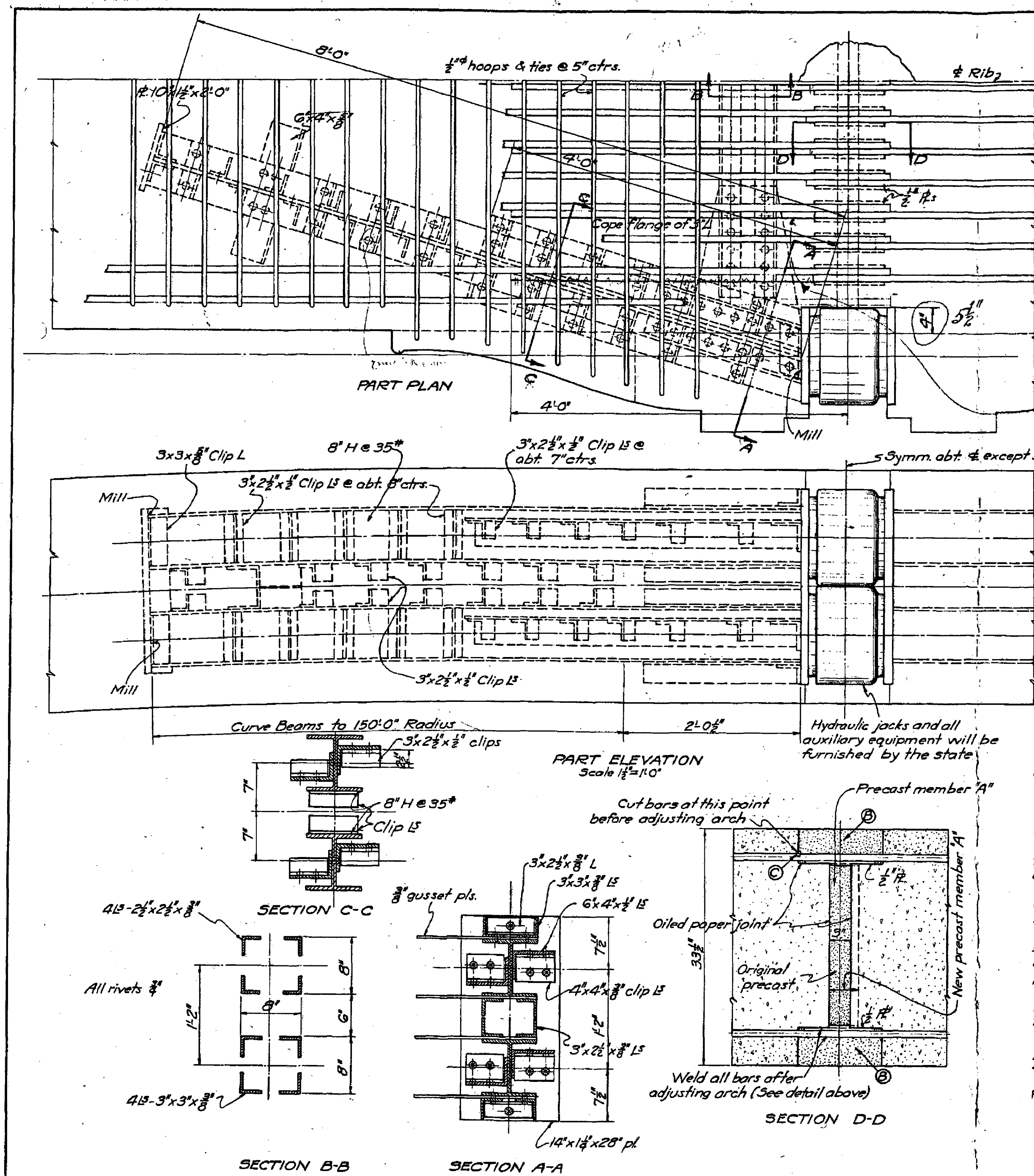
Approved:

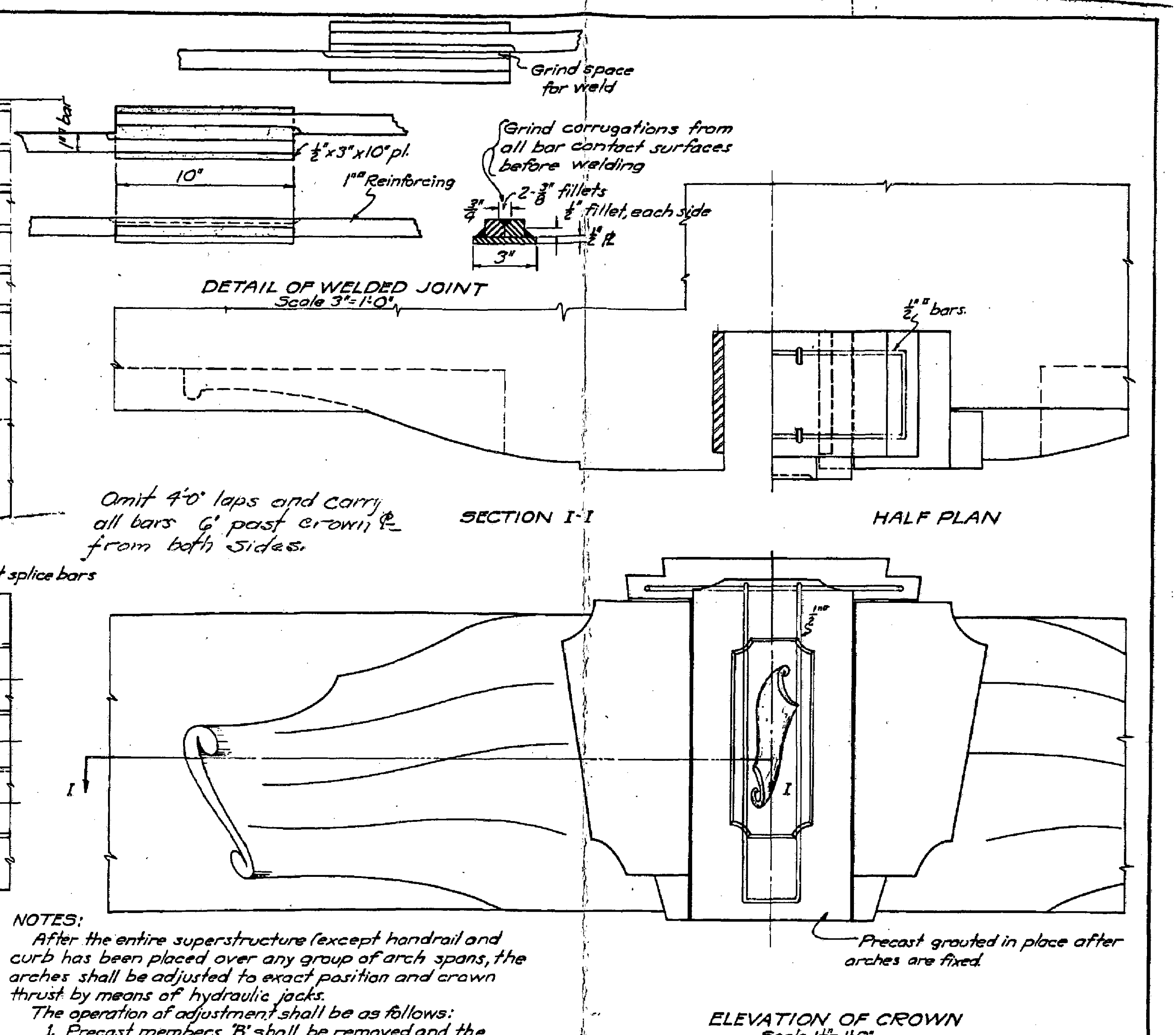
Bridge Engineer

State Highway Engineer



No. 0 (23)
No. 3 (21)
No. 5 (19)
No. 7 (17)
No. 9 (15)
No. 11 (13)
7 Spaces @ 2'-0"
14'-0"
7 Spaces @ 2'-0" = 14'-0"
Junction box
3/4" conduit for navigation lights on arch adjacent to North pier only
10'-10 1/2" Rad.
Scoring 3/4" x 3/8"
Longitudinal conduit
Outlet
Transverse conduit
Chain for servicing light
Light
Flexible conduit
Section at midspan
Crown slab 1 1/2" @ ¢ roadway
Carry conduit down thru inside column to cross strut.
DETAIL OF CAPITAL
Batter 1/8" per ft.
SECTION S-S
4-1" bars
2-1/2" galvanized iron hooks to support flexible conduit and light
SECTION THRU STRUT
Slope walk 1"
Provide sleeves for 6" water main full length of bridge
Beam K (See detail)
WALK STOP
Solder joint
DETAIL OF WATER STOPS
Material—#20 ga. Copper
SECTION V-V
Outlet box, lower side of cross strut near haunch
Light midway between arch rings on cross strut
Keys
Batter 1" per ft.
Key hinges at joints 5-7-17 & 19 only
DETAILS OF PEDESTALS
Scale 1/2" = 1'-0"
Column Steel
4-1" bars
4-1" dowels
7'-0" long
3/8" hoops @ 12" ctrs.
SECTION U-U
Outlet box
Flexible conduit to light
at ¢ of strut
SECTION T-T
Scale 1/4" = 1'-0"
3/8" hoops @ 12" ctrs.
6-1" bars
at intermediate piers
2-1 1/2" sleeves for messenger cable
6" C.I. sleeve in all brackets on both sides of roadway
Place conduit at towers and at ¢ of one post at each pier.
Const. Joint
BRACKET DETAILS
Scale 1/2" = 1'-0"
Emulsified asphalt
4"x4"x3/8" Ls
4-3"x2 1/2"x3/8"x10" Ls, const. only.
1/2" Cap screws
2"x1/4"x1'-0" lugs
#20 ga. Copper water stop
EXPANSION ANGLES at points 0-11 & 23 of each span
CROSS SECTION
27'-0"
2'-0" alt. sp. of lugs
Spotweld lugs to L.
Drill + tap L for 1/2" cap screws
L 4"x4"x3/8" bent to fit 1 1/2" crown @ ¢ roadway
DETAIL OF ANGLES
Approved
Bridge Engineer
State Highway Engineer
Revised Jan. 10, 1930
Revised Jan. 10, 1931
Jan. 24, 1931
Apr. 10, 1931
May 11, 1931
June 3, 1931
OREGON
STATE HIGHWAY COMMISSION
REINFORCED CONCRETE ARCH BRIDGE
AT
MOUTH OF ROGUE RIVER
ON
ROOSEVELT COAST HWY. — CURRY CO.
GENERAL DETAILS OF ARCH
SCALE AS NOTED
DEC. 18, 1929.
CALCS. FILED
DRAWN BY C.H.D.
TRACED BY L.S.S.
CHECKED BY
SHEET 10 OF 15
BRIDGE NO. 1172
DRAWING NO. 3883
ACCOMPANIED BY DWGS. 3874-3882 INCL., 3884-85-86 & 3888-89-90.





NOTES:

After the entire superstructure (except handrail and curb has been placed over any group of arch spans, the arches shall be adjusted to exact position and crown thrust by means of hydraulic jacks.

The operation of adjustment shall be as follows:

1. Precast members "B" shall be removed and the reinforcing bars cut at the point marked "C."
2. The span shall be jacked up sufficiently to slack off the pressure on precast member marked "A", and this precast shall then be removed.
3. The span shall then be jacked to exact position and crown thrust and measurements taken for a new precast member "A."
4. A new precast member "A" conforming to these dimensions shall then be cast utilizing a quick setting cement and a rich mix such as will develope a strength of 3000 lbs. per sq. inch in not less than three (3) days.
5. The new precast member "A" shall then be inserted and the spans slacked down to bearing upon the same.
6. The bars shall be welded as shown in detail and the spaces left by the removal of precast members "B" completely filled with a dry tamped mixture.

Revised Jan. 10, 1930

Approved

Bridge Engineer

State Highway Engineer

OREGON
STATE HIGHWAY COMMISSION

REINFORCED CONCRETE ARCH BRIDGE
AT
MOUTH OF ROGUE RIVER
ON
ROOSEVELT COAST HWY. — CURRY CO.
DETAILS OF JACKING BRACKET

SCALE AS NOTED	DRAWN BY W.D.S.	SHEET 12 OF 15
DEC. 18, 1929.	TRACED BY L.S.S.	BRIDGE NO. 1172
CALC. BK. NO.	CHECKED BY	DRAWING NO. 3885

ACCOMPANIED BY DWGS. 3874-3884 INCL. & 3888-89-90.