Documentation of the Historic Bridge over White River (Lake Taneycomo) at Branson

Bridge No. J0705R
Taney County, U.S. Business Route 65/Missouri State Route 76
December 2009

MoDOT
U.S. Department of Transportation
Federal Highway Administration

Bridge over White River
(Lake Taneycomo)
at Branson

MoDOT Bridge No. J0705R

Taney County
U.S. Business Route 65/ Missouri State Route 76
MoDOT Job No. J8P0764

Historical and Photographic Documentation

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Introduction

The Missouri Department of Transportation intends to improve the safety and efficiency of Route 76 over White River (Lake Taneycomo) at Branson by constructing a four-legged roundabout and new bridge adjacent to the existing historic bridge. This project will be done in combination with Project No. J8P0764, which will rehabilitate the historic bridge by removing the concrete deck, roadway, curbs, balustrades and end posts, and replacing them with a wider deck and similar new balustrades and end posts. The existing concrete footings, piers, arches and arch columns will be retained. This work will have an adverse effect on the existing Branson Bridge, a property eligible for listing on the National Register of Historic Places.

In consultation with the Missouri State Historic Preservation Office and the Federal Highway Administration, a Memorandum of Agreement (MOA) for mitigation of the adverse effect was developed and executed on July 22, 2009. The MOA calls for documentation of the historic bridge with archival photographs, historic narrative, and original bridge plans. This documentation is submitted to fulfill those requirements.

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Historical Narrative

The bridge over the White River (Lake Taneycomo) between Branson and Hollister in Taney County carries traffic for both U.S. Business Route 65 and Missouri State Route 76. It is commonly known either as the Branson Bridge or the Lake Taneycomo Bridge. Designed by the Missouri State Highway Department and constructed in 1931-1932 by Fred Luttjohann, the bridge consists of five 195', reinforced concrete, open spandrel arch spans approached by one 56' reinforced concrete deck girder span at each end, and carried on reinforced concrete bents and piers set in bedrock. The White River Bridge is historically significant for its engineering as it features multiple, unsurpassed span lengths of 195', making it the longest of its type in the state. Its design departed from earlier open spandrel arch bridges built by the Missouri State Highway Department. The piers and arch ribs are elastic while the spandrel bents and floor slab are monolithic, with expansion joints occurring only above the piers. Furthermore, two of the arch spans are asymmetrical, and each of the five spans has a different rise. To advance the understanding of the mechanics of reinforced concrete arch structures, the department's bridge engineers fitted the bridge with a number of instruments to measure stresses and movements in various components of the substructure and superstructure both during and after construction. The White River Bridge is an outstanding example of the historic use of reinforced concrete technology in large-scale bridge construction.[1]

Originally the White River Bridge carried traffic for U.S. Route 65, a federal interstate highway connecting Missouri with Iowa and Arkansas. The highway's initial alignment followed a meandering course through the Ozark mountains of western Taney County. Highway Department engineers routed the highway through the small sister towns of Branson and Hollister to avoid high vertical cliffs that otherwise bordered most of the White River both up and downstream. Years before, in 1913, the completion of Powersite Dam near Forsyth partially harnessed the river for hydroelectrical power, creating Lake Taneycomo. At the Branson-Hollister crossing, Lake Taneycomo formed a channel approximately 600' wide. Lake elevations there could vary from 703' at low water to as high as 733.5', as seen during a major flood in 1927. The White River

[1] Clayton B. Fraser, HAER Inventory data sheet, Branson Bridge, J-705R (TANE02), Missouri Historic Bridge Inventory, 5 Vols., Missouri Department of Transportation, Project No. NBIH(6) (Loveland, Colorado: Fraserdesign, Inc., 1996).

required a substantial structure to carry Route 65 across the wide channel and safely above the high water mark.[2]

Some preliminary soundings on both banks of the river made in July 1930 showed stratigraphies of sandy clay, clay and gravel, and hard clay about 20' thick over bedrock. In early January 1931, a crew led by S. M. Hunter of the Highway Department's Bureau of Bridges took additional soundings along 1,200' of the proposed bridge alignment across the White River, driving a steel rod through the clays and gravels to determine the depths to bedrock. They found it to be fairly level all the way across. Hunter returned in April to make core drillings into the limestone rock.[3]

Meanwhile, the Bureau of Bridges under Bridge Engineer Norman R. Sack had drawn up a preliminary sketch of a five-span arch bridge with approaches spanning the White River, together with a sketch showing its proposed location at Branson-Hollister. In March 1931, the Highway Department submitted the sketches along with a formal application for the bridge's construction, in quadruplicate, to the Memphis, Tennessee, office of the Corps of Engineers of the U.S. War Department. The application included a resolution approved by the Missouri State Highway Commission in February authorizing Chief Engineer T. H. Cutler to secure the War Department's permission to construct the bridge. In addition, the Highway Department had obtained an Act of Congress approved on March 3 authorizing the bridge. The Corps of Engineers responded to the application with a long list of additional information they required, such as clarifications of various elevations and bridge clearances. Following a prompt follow-up response from the Highway Department, the Corps of Engineers held a public hearing in Memphis on April 23 and, presumably hearing no objections to the proposed bridge, forwarded a record of the hearing to the War Department. The Acting Chief of Engineers and the Assistant Secretary of War signed the instrument of approval on May 5.[4]

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[2] State-wide Highway Planning Survey, Missouri State Highway Department, "General Highway Map, Taney County, Missouri," 1940; Department of Natural Resources, Division of Geology and Land Survey, State of Missouri, and Geological Survey, U.S. Department of the Interior, "Branson Quadrangle," 7.5 Minute Series Topographic Map, Scale 1:24000, 1989; Elmo Ingenthron, *The Land of Taney: A History of an Ozark Commonwealth* (Branson: The Ozarks Mountaineer, 1983), 281-290; Missouri State Highway Department, "Bridge Over White River, State Road From Branson to Hollister, About 0.75 Mile South of Branson, Project No. U.S. 65-S116A, Taney County," Bridge J-705, July 20, 1931 [bridge plans, 20 sheets], Sheet No. 1. Microfiche. Bridge Division, Missouri Department of Transportation, Jefferson City.

[3] "Log of Soundings," 1930-1931, Bridge No. J-705R Correspondence File. Microfiche. Bridge Division, Missouri Department of Transportation, Jefferson City. Hereafter cited as Correspondence File; *White River Leader* (Branson), January 8, 1931, April 2, 1931, and *Taney County Republican* (Forsyth), January 15, 1931. Microfilm. Newspaper Room, State Historical Society of Missouri, Columbia.

[4] Chief Engineer to Major F. B. Wilby, "Application for Construction," March 17, 1931; Major Brehon Somervell to T. H. Cutler, Chief Enginner, "Highway Bridge; White River at Branson, Mo.," March 21, 1931; Chief Engineer to Lt. Col. F. B. Wilby, "Application for Construction," March 23, 1931; Chief Engineer to District Engineer, U.S. Engineers Office, March 31, 1931; War Department, U.S. Engineers Office, Memphis, Tenn., "Notice of Public Hearing," April 6, 1931; Brehon Somervell, Major, Corps of Engineers, to T. H. Cutler, "Approved plans; bridge over White River at Branson, Mo.," May 12, 1931, in Correspondence File; "Approval of Resolution Authorizing the Chief Engineer to Negotiate with the War Department for Approval of Plans for Constructing Bridge Across White River on Route 65, Taney

Branson heard of the imminent bridge construction on March 16, 1931, from Division Engineer H. P. Mobberly of Division No. 8 in Springfield. In addition to the "giant concrete bridge" over the White River, Mobberly informed the *White River Leader* that the Highway Department planned to construct about a mile of Route 65 through Branson, routing it across Roark Creek and down Walnut Street, cutting across some city blocks to Commercial Street, and following that street south to the bridge site. Arrangements had been made with the Branson Special Road District to secure the right of way. Altogether the road and bridge work would cost an estimated $300,000, one of the most expensive improvements ever made by the Highway Department for such a short distance.[5]

During April, while S. M. Hunter and his crew obtained core samples, Mobberly and the city officials of Branson and Hollister discussed placing electric lights on the bridge. It was agreed that the two cities would each pay one-half the costs for electric conduits and wiring; bridge design plans would accommodate the installation of the lights on the balustrade posts. The Branson Board of Aldermen passed a corresponding ordinance on May 4 to provide its share of funding for lighting the White River Bridge, as well as funds for lighting the Roark Creek Bridge. Hollister may have reneged on its promise, however, as electric light posts apparently were never installed. The local telephone company also approached Mobberly, asking to provide the bridge with conduits for telephone cables. After consulting with the bridge office, Mobberly informed them that several conduits for telephone and power lines would be installed along two sidewalks already planned to run the length of the bridge on either side. Mobberly also continued his coordination with the Branson Special Road District and secured the right of way deeds for the bridge site by the end of April.[6]

In the meantime, bridge designers at the Bureau of Bridges began their initial design of the White River Bridge, basing it on mathematical analysis. However, they realized that mathematical analysis alone could not accurately predict the various movements and stresses in the bridge components. In fact, the analysis required the simultaneous solution of some 270 equations, and the engineers considered the structural design to be "highly indeterminate." They believed it probable that a very marked difference would exist between the computed stresses and the actual stresses. The bridge piers would be of relatively small mass, insufficient to prevent movements from the thrust of the arch ribs. Loads and movements of one span would effect movements and stresses in neighboring spans, while the rigidity of the spandrel bents and floor slab would also affect rib stresses. To aid them in their design, the bridge designers

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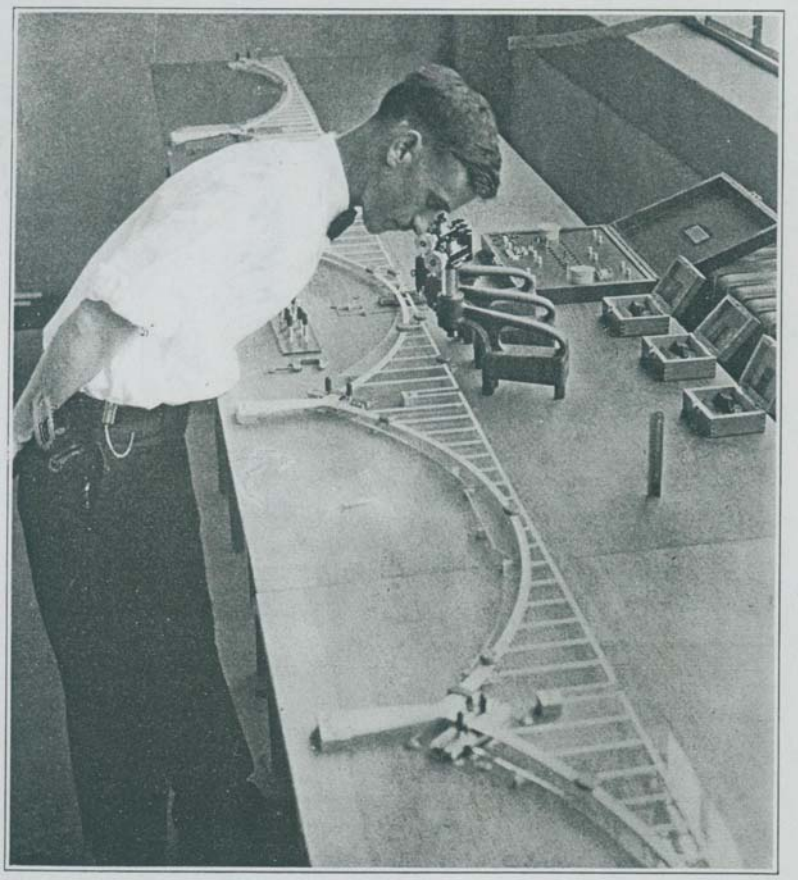
County, near Branson," February 10, 1931, in Minutes of Proceedings of Missouri State Highway Commission. Secretary's Office, Missouri State Highway Commission, Jefferson City.

[5] *White River Leader*, March 19, 1931.

[6] *Ibid*., April 2, 16, 30, May 7, 1931; P. T. Wise, Division Superintendent, Missouri Standard Telephone Company, to H. P. Mobberly, May 2, 1931; T. H. Cutler to P. T. Wise, May 11, 1931; "Ordinace No. 122," Board of Aldermen, City of Branson, May 4, 1931, in Correspondence File.

constructed a 14'-long celluloid scale model of the bridge and used a device called a Beggs Deformeter to help determine the stresses at various critical sections. Simulations of loads and other stress factors, observed by an optical micrometer and measured by gauges, provided graphic influence lines that, as expected, varied radically from those obtained from the mathematical analysis. A complete analysis of all the structure's vital points using the Beggs Deformeter required thousands of readings. While it is unknown how many actual readings the designers made, a final tabulation and analysis of those readings, when checked against the mathematical analysis, allowed final modifications to the bridge design.[7]



Checking arch stresses with Beggs Deformeter

This scale model of the White River Bridge underwent mechanical stress analysis to help determine the final design for the actual structure.[8]

[7] E. E. Dittbrenner for N. R. Sack to Hon. W. E. Freeland, Missouri House of Representatives, February 13, 1933; H. H. Mullins for N. R. Sack to C. B. McCullough, Assistant State Highway Engineer, Oregon State Highway Commission, July 19, 1939, in Correspondence File. For a thorough explanation of the Beggs Deformeter, see Conde B. McCullough and Edward S. Thayer, *Elastic Arch Bridges* (New York: J. Wiley and Sons, Inc., 1931), 282-300.

[8] Missouri State Highway Commission, *Eighth Biennial Report of the State Highway Commission of Missouri, for the Period Ending December 1, 1932*, 237.

The twenty bridge design sheets for Bridge J-705 indicate it was designed in May 1931 by Designers Herman Dal for the piers and abutments and H. H. Mullins for the arches, spandrel bents, floor slab and balustrades. Dal, Mullins, and others in the Bridge Bureau then drew, traced and checked the plan sheets during May, June and July. Bridge Engineer Sack and Chief Engineer Cutler signed the bridge plans on July 20.[9] That post-dates the first anticipated contract letting date of June 26, 1931. The June letting had to be postponed, however, after the Highway Department's Chief Counsel informed the Highway Commission at its June 9 meeting that it may not have the legal authority to construct bridges over navigable streams. The counsel's opinion arose from a proposed bridge over the Osage River at Tuscumbia, Miller County. At its next meeting on July 14, the Commission heard from Chief Engineer Cutler on the matter. According to Cutler, the Chief Counsel's office had determined after all, based on previous court decisions, that a stream was only considered navigable by specific statute; all other streams were considered non-navigable unless they were navigable "in fact" and so held by the courts or designated by law. The department could assume that most streams, including the White River at Branson, were non-navigable.[10]

With that legal hurdle out of the way, the Highway Department advertised for bids for construction of the White River Bridge under Project No. 65-116A, as well as for the construction of 1.23 miles of Route 65 through Branson under Project No. 65-115A. When the bids were opened on July 31, H. H. Carrothers of Kansas City, Missouri, received the bridge contract for the low bid of $158,031.81. C. F. Johnson and Sons out of Buffalo, Missouri, received the roadway contract that included the bridge over Roark Creek for its bid of $63,166.03. The Highway Commission approved the bids on August 11, 1931. Based on drawings of the White River Bridge, Branson's *White River Leader* predicted it would be "one of the most beautiful structures of the state's highway system."[11]

Later in August, H. H. Carrothers declined the bridge contract for unknown reasons. Fred Luttjohann of Topeka, Kansas, who did not bid on the project, took over the construction contract under the same terms of Carrothers's bid. W. A. Sailer arrived in Branson in late August as Luttjohann's superintendent of construction. F. C. Larsen would serve as the project engineer for the Highway Department, aided by Fred Hunt as assistant project engineer and W. B. Hart as the concrete technician. Construction of the White River Bridge began on September 1, 1931.[12]

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[9] Missouri State Highway Department, "Bridge Over White River," Sheet Nos. 1-20; Missouri State Highway Commission, *Eighth Biennial Report*, 112.

[10] "Discussion of Bridge on Route 17, Miller County, at Tuscumbia," June 9, 1931; "Discussion of Matter of Building Bridges Over Navigable Streams," July 14, 1931, Minutes of Proceedings; *Taney County Republican*, July 23, 1931; *White River Leader*, June 11, 18, July 16, 1931.

[11] *Ibid*., July 23, 30, 1931; "Approval of Awards for Bids on State Road Work Received July 31, 1931," Minutes of Proceedings.

[12] *White River Leader*, August 27, 1931, October 20, 1932.

Bridge Engineer Sack and his team of engineers soon decided that the project afforded an opportunity to investigate many different engineering and construction aspects of reinforced concrete, open spandrel arch bridges. The Bureau evidently had a continuing interest in such investigations. Over a year earlier, in February 1930, Bridge Construction Engineer D. C. Wolfe had designed an instrument called a level bar, also called a clinometer, fitted with a 10-second air bubble and an Ames Dial graduated to .0001 of an inch. The American Instrument Company of Washington, D.C., built the instrument based on Wolfe's sketch. Under his direction, it was used during and after the construction of the Meramec River Bridge at Route 30 in Franklin County, a bridge of five 100' open spandrel arch spans and deck girder approaches. There, the project engineer J. G. Lester used Wolfe's level bar to measure the rotation of the bridge piers and the deflections of the arch ribs in conjunction with fluctuations in air temperatures. Lester found the average rise and fall of the ribs to be .0115 inches per temperature degree, close to the calculated movement of .0110 inches per degree. As for the pier rotations, Lester became perplexed by their contradictory movements, calling the problem "a pain, also a headache." Lester eventually compiled the data into a report that the department would issue in 1932.[13]

In late September 1931, with the construction of the White River Bridge underway, D. C. Wolfe made inquiries regarding methods to measure the pier foundation pressures; determine stresses in the reinforcing steel and concrete along the arch ribs; check the stresses in the spandrel bents and floor slab, given the lack of expansion joints between the piers; and measure the temperatures of the concrete. The Baldwin-Southwark Corporation of Philadelphia, Pennsylvania, forwarded information on the carbon pile resister telemeter, or telemeter cartridge. The American Society of Civil Engineers had reported on the experimental use of 140 telemeter cartridges at the Stevenson Creek Arch Dam in California, and as a result of that investigation the telemeter cartridges had been much improved in recent years. A report issued by the Bureau of Public Roads and an article published in the *Engineering News Record* described the use of telemeters in concrete arch bridges. They could be placed in pier footings to measure loads, and the telemeter cartridges could also be used with the Leeds and Northrup Type S testing set to measure temperatures in concrete. The Baldwin-Southwark Corporation recommended the Whittemore Strain Gauge to measure strains in steel reinforcement. In October, Wolfe inquired further about using the telemeter cartridges in the pier footings. Wolfe and his colleagues planned to cast the cartridges vertically within the concrete only a few inches from bedrock to measure the pressure of the footings against the rock. Baldwin-Southwark advised that Wolfe's plan might be feasible if the pressures were on the order of 200 to 300 pounds per square inch, but satisfactory readings would depend upon the magnitude of the loads.[14]

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[13] David C. Austin, "Meramec River Bridge, Bridge No. H-996R1, Franklin County, Route 30/47, MoDOT Job No. J6P0709," January 2000, Cultural Resources Section, Design Division, Missouri Department of Transportation; Bridge No. H-996R1 Correspondence File, *passim*. Microfiche. Bridge Division, Missouri Department of Transportation, Jefferson City.

[14] D. C. Wolfe for N. R. Sack to Emery-Tatnall Company, Philadelphia, September 22, 1931; C. H. Gibbons, Baldwin-Southwark Corp., Philadelphia, to N. R. Sack, Bridge Engineer, September 25, 1931; C.

As part of his duties as Bridge Construction Engineer, Wolfe inspected the White River Bridge construction on October 15-16, 1931. The contractor Fred Luttjohann had about twenty workmen and three foremen on the job. Their equipment included two gas-powered crawler cranes, a McKiernan-Terry pile hammer, a 1,800-pound drop hammer, a two-barrel Rex concrete mixer, a Winslow wheelbarrow platform scale, and a 6" centrifugal pump. A problem had arisen at Abutment No. 1 on the north bank where the approach span would cross over railroad tracks running parallel to the river. Blasting out the railroad cut years before had considerably loosened the bedrock there, and the bridge abutment footings had to be taken down 5' deeper than expected. That forced a redesign of the abutment. Its right wing was turned back on a 30° angle, and extra rock had to be excavated at the face of the abutment. At the time of Wolfe's visit, workers were pouring the abutment footings. Elsewhere, the footings for Abutment No. 2 had been placed and the workers were excavating for Pier No. 3. They had driven falsework pilings for Spans 2 and 3. Hammered down to bedrock, the pilings would support the wood falsework, or centering, for the arch spans. Luttjohann planned to build a trestle out across the river to Pier No. 6, driving the pilings with a stiff-leg rig, and to use the pilings in the trestle to support the centering. He was shipping one of the crawler cranes to the south bank for Abutment No. 7. All told, Luttjohann had gotten off to a slow start. He had difficulties producing the coarse aggregate for the concrete and borrowed about 100 cubic yards from Johnson and Sons working on the neighboring Route 65 job. Luttjohann also had trouble finding timbers for the cofferdams for the pier excavations. Wolfe believed the contractor needed a larger crew, yet he thought that the work would speed up, as it appeared Luttjohann had become better organized.[15]

In mid-November, however, Division Engineer Mobberly wrote to Luttjohann, pointing out that he was behind schedule. Mobberly reminded him of the contract completion date of October 6, 1932. He requested that Luttjohann take whatever steps were necessary to expedite the work, and to spell out what those steps would be. Luttjohann replied he had fallen behind because of delays in receiving materials, and that he would add more men and equipment on the south river bank in mid-December, which would put him back on schedule during January 1932. Chief Engineer Cutler found Luttjohann's explanation satisfactory, but suggested he make every effort possible to improve his progress.[16]

Wolfe made another inspection on December 2-3, 1931, accompanied by project engineers Larsen and Hunt, and noted a slight improvement in progress during the previous few weeks. Luttjohann had found a sub-contractor to supply the coarse aggregate. Workmen had nearly completed the north deck girder span over the railroad

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H. Gibbons, Baldwin-Southwark Corp., Philadelphia, to N. R. Sack, October 1, 1931; D. C. Wolfe for N. R. Sack to C. H. Gibbons, Baldwin-Southwark Corp., Philadelphia, October 13, 1931; C. H. Gibbons to N. R. Sack, October 19, 1931, in Correspondence File.

[15] "Inspection Report," October 15-16, 1931, in Correspondence File.

[16] H. P. Mobberly to Fred Luttjohann, November 14, 1931; T. H. Cutler to Fred Luttjohann, November 24, 1931, in Correspondence File.

tracks, and were building the forms for the span's sidewalks. Pier No. 3 was built up to the arch springing line, and the centering was nearly complete for the northernmost arch span, Span 2. Excavation was nearly done for Pier No. 4, and pouring would begin there within the following week. Another crew drove falsework piling out to Pier No. 5. Luttjohann expected to place more men at the Pier No. 7 excavations on December 10, and to begin pouring the arch ribs for Span 2 on December 12. Wolfe noted that the forms were made of good-quality lumber, and were well constructed to provide a good surface finish for the concrete. A special crew worked on rubbing the finished concrete for a uniform appearance; the same men would remain at that task throughout the construction.[17]

Wolfe discussed the matter of camber at the crown of the arch at Span 2. The contractor had provided for ¾" camber, but Wolfe believed that to be too little, and predicted the span would end up 1-½" below grade after the concrete cooled and the centering was removed. Although it was Luttjohann's ultimate responsibility, Wolfe suggested providing for at least 2" camber at Span 3. He also gave instructions to closely monitor the amount of deflection at Span 2, and to use the information to determine the proper amount of camber for the last three spans. Luttjohann indicated he would follow the sequence of pouring the voussoirs, or blocks, in the arches as outlined in the contract's Special Provisions. He would take measurements after pouring each set of blocks in Span 2 to determine if a change in the pouring sequence would be warranted for the remaining spans. He would use a rich-mix concrete in the final key sections of the ribs to give the keys an early, high strength.[18]

In early January 1932, Wolfe made a final inquiry about using the telemeter cartridges in the pier footings. Writing to O. S. Peters of Baldwin-Southwark's laboratory in Washington, D.C., Wolfe explained that the Highway Department had purchased six of the cartridges and planned to use two of them to measure the foundation pressures. However, Wolfe still had doubts if the cartridges could accurately measure small pressures under seventy pounds per square inch, as they had calculated the pressures would be, or if strains could be measured closer than .00006 of an inch using calibration charts. Peters replied that he was "very doubtful" if readings of pressures of only seventy pounds per square inch would be more than qualitative. Even if accurately corrected for temperature and moisture, the pressure readings would be nullified by other "unavoidable errors."[19]

It was probably soon after receiving Peters' response that the Bureau of Bridges issued a set of instructions under the heading, "Procedure of Arch Investigations." Amounting to over five typewritten pages, the detailed instructions were unsigned and undated but may well have been written by D. C. Wolfe in early 1932. They were

[17] "Inspection Report," December 2-3, 1931, in Correspondence File.

[18] *Ibid*.

[19] D. C. Wolfe for N. R. Sack to O. S. Peters, January 9, 1932; O. S. Peters to N. R. Sack, January 12, 1932, in Correspondence File.

obviously intended for project engineer Larsen and his assistants Hunt and Hart. An accompanying sketch (Sheet 21 of the set of bridge plans), also unsigned and undated, showed where various test instruments would be placed in and on the bridge. The pending investigations were meant to obtain data for use on future designs of open spandrel arch bridges. The information would complement the theoretical basis of the bridge design derived from the mathematical analysis and the use of the Beggs Deformeter device. The investigations had nine specific objectives, some of which overlapped:

1. To measure the pier foundation pressures;
2. To determine the rotation of the piers;
3. To determine the correct order of placing the voussoirs by measuring the deflection of the intrados forms;
4. To determine the temperature of the concrete in the keys when the arch rib began to show stress;
5. To determine the actual stresses in the arch ribs;
6. To determine the movement at the expansion joints;
7. To determine the actual stresses in the spandrel bents and columns;
8. To determine the actual stresses in the floor; and
9. To determine the shrinkage and temperature stress in concrete through the use of a test beam.[20]

Despite the previous doubts about their effectiveness, two McCullom-Peters telemeter cartridges, or electric strain gauges, would be placed vertically within the footing of Pier No. 4 about 2" from bedrock in order to measure the pier foundation pressures. Theoretically, the pressures would increase from the thrust of one arch prior to the placement of the adjacent arch. Lead wires would extend from the cartridges to the base of the bent columns near the springing line where an outlet box would be cast in the concrete. As explained in the instructions:

> The cartridge telemeter is a single-resister type electric strain gage, which measures changes in length between gage points by changes in resistance of a carbon stack, the length of which is varied by the strain in the material. These instruments will be accompanied by a calibration data, and certain corrections will be necessary. The telemeter is read by means of a Leeds and Northrup Type S testing set. Since the changes in temperature of the telemeter cause changes in the resistance, it is necessary to obtain the temperature at each reading. The temperatures are found by measuring the change of resistance in resistance coils, contained in the cartridges. The resistance of these coils at 70 degrees F. is predetermined and from any change in resistance can be determined by the change in temperature [*sic*]. Data regarding the coils and their use will accompany them. The Test Set is a Wheatsone Bridge, and was designed to locate "breaks" or "shorts" in long circuits. The galvanometer is very sensitive and extreme care should be exercised in its use. Balance the two circuits as close

[20] "Procedure of Arch Investigations," in Correspondence File; Missouri State Highway Department, "Bridge Over White River," Sheet No. 21.

> as you can estimate before using the galvanometer. Be sure the clamp has lifted the needle before moving the set, and be sure to turn the switch. The set should be level for best results when in use. It will be necessary to provide new dry coils when the sensitivity of the needle becomes small. The ends of the wires must be clean and should be scraped before each reading.[21]

The readings would be taken at close intervals after the concrete had been poured to determine the effect of the heating and cooling of the concrete. Frequent readings would also be made when changes in the pressures would most likely occur. Larsen and his team had to give "considerable thought" to developing forms for recording and interpreting the readings.[22]

As with the previous investigations at the Meramec River Bridge in Franklin County, the pier rotations would be measured with the Level Bar. Any pier rotations would be caused by unequal thrusts of the arch ribs. The instructions described the Level Bar and gave directions for its use:

> The bar is made of a 1 inch square section of cold-rolled steel on which is fitted a 10 second level bubble. There are pins at each end of the bar and one is arranged so that it may be moved up or down until the bar is level. The movement is measured to .0001 of an inch by means of an Ames dial. Plugs of non-rusting material are set in the concrete parallel to the centerline of bridge and the legs of the Level Bar rest in especially drilled holes and grooves in these plugs. A small round hole is drilled in one plug while the other one is slotted parallel to the direction of the Level Bar so as to compensate for any change in length of the Level Bar due to temperature. A reading is first taken in one direction and then the other. The difference in the readings divided by two gives the difference in elevation between the two points. The difference in any two readings divided by 20", the distance between pins on the Level Bar, gives the rotation in radians. The plugs should be located over the piers as shown in the sketch and should be placed in all piers on both sides of the centerline. Readings should be taken only when there is likely to be thrust on the piers which might cause them to rotate. The Level Bar to be used has been found to have some peculiarities and the observer should practice considerably with it so that his readings will check. Some thought should be given to matter of recording these readings and a form drawn up. Attention is directed to the fact that the sun will affect the readings considerably with so sensitive a level bubble. The bar must be kept vertical and a cross bubble is provided. A support for steadying [*sic*] the bar is also provided.[23]

In conjunction with the pier rotations, their horizontal displacements would be measured with a transit placed on the piers' centerline. Movements from the vertical

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[21] "Procedure of Arch Investigations," in Correspondence File.

[22] *Ibid*.

[23] *Ibid*.

would be determined by "plumbing up" a point set at the springing line or ground line, and another point set at the tops of the piers. Readings would be taken at the same time as readings from the Level Bar and would be recorded on the same form.[24]

The third objective in the investigations was to determine the most effective sequence of pouring the voussoirs of the arch ribs. This would be done by measuring the displacement of the intrados forms as each block was poured. The set of instructions recommended using a constant tension wire strung along the length of an arch at the level of the crown. Measurements to 1/8" would be taken on as many as eleven points on each of the first two or three arch ribs poured, including one symmetrical arch and one asymmetrical arch. The recorded measurements would be displayed graphically.[25]

The investigations would also measure the temperature of the concrete within the key voussoirs as the arch rib began to show movement. The heat generated by concrete as it set normally forced movement of an arch rib at the crown. Coupled with a rise in air temperature, an arch rib could rise off the centering support altogether. Colder air temperatures, in contrast, could cause a deflection of the arch. The sequences of pouring the voussoirs in an arch were based on minimizing these temperature stresses. As the last blocks to be poured, the temperature of the keys would better inform bridge designers of the correlation between the temperature of the concrete and the stress and movement of an arch rib. The temperatures in the key voussoirs would be measured by temperature coils embedded in the concrete. Corresponding movements of the ribs would be measured against the constant tension wire. Readings would be taken at one-hour intervals until the concrete set and the ribs began taking stress, then readings would be taken twice daily. The air temperatures would be noted as well.[26]

The actual stresses of the concrete and reinforcing steel within the arch ribs would also be checked. The concrete stresses would be determined by both telemeter cartridges and by mechanical Whittemore strain gauges. Two telemeter cartridges would be placed in the arch of Span 3 near the springing line, and two more at the crown. The electric wires would lead from the cartridges through the sidewalk to metal outlet boxes cast in the concrete. The cartridges were considered "quite expensive" and would require considerable care as they were placed in the forms. Numerous Whittemore strain gauges would be placed on Spans 2, 3 and 4, connected to plugs cast in the concrete. Using them accurately was "quite a difficult task" and required some initial practice. Strains in the reinforcing steel would be measured with a strain gauge. One 14"-long section of a steel reinforcing bar would be placed within a form but outside the arch itself. Small holes drilled in the bar would allow it to be connected to a strain gauge.[27]

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[24] *Ibid*.

[25] *Ibid*.

[26] *Ibid*.

[27] Ibid.; Missouri State Highway Department, "Bridge Over White River," Sheet No. 21.

Movement at each expansion joint in the floor would be measured. Small holes would be drilled in the floor slab on either side of the expansion joints on both sides of the roadway, out of the way of traffic. The holes would be filled with hot babbitt metal, then small center punch holes made in the babbitt. Calipers would measure the distance between the holes to one hundredth of an inch. The readings would continue after the bridge opened to traffic.[28]

The lack of expansion joints between the piers would affect the stresses in the spandrel bents. To determine those stresses, several of the spandrel bents on Span 3 would be fitted with plugs for using the Whittemore strain gauges. Measurements would then be made in regard to temperature, and to live and dead loads. Additional plugs set in the floor slab along three of the spans would allow the use of the strain gauges to measure temperature and load stresses of the bridge deck.[29]

Finally, the investigations would involve the construction of a reinforced concrete test beam as a control. The test beam would be 6' long, 2' wide, and 1'-10" high, with 3/4"-diameter reinforcing steel. It would be fitted with plugs for a Whittemore strain gauge to measure the stresses in the steel and concrete while the concrete set. Air temperatures would also be recorded. The test beam had to be fully supported and not subjected to any loads.[30]

The set of instructions emphasized the serious importance of the investigations and the need for cooperation from the project engineer and his assistants:

> It is imperative that the observers understand thoroughly the purposes and methods to be followed in obtaining the data. The equipment used must be studied and understood as regards its peculiarities and the observations must be taken earnestly and sincerely or else the investigation will be a failure. It would be far better never to attempt an investigation of this kind than to obtain data which might lead to new theories and then find that the data are incomplete or in error. On the observer rests the success or failure of the investigation. You are earnestly requested to study the information desired and the methods outlined below to be followed in obtaining these data and to make such changes in the procedure as you see fit in the best interests of the investigation.
>
> The equipment should be cared for so that it will not fail to function properly at times when important readings should be made. Take the work seriously and impress on the contractor that the work is important and keep his cooperation in following through. Look ahead and follow such sequence in doing the work that

[28] "Procedure of Arch Investigations," in Correspondence File.

[29] Ibid.; Missouri State Highway Department, "Bridge Over White River," Sheet No. 21.

[30] "Procedure of Arch Investigations," in Correspondence File; Missouri State Highway Department, "Bridge Over White River," Sheet No. 21.

there will be a minimum of "hitches." Keep your records up to date and set down your conclusions as you go along.[31]

Luttjohann's progress on the bridge construction hit another snag when the excavations at Pier No. 7 on the south river bank, started in late December 1931, encountered different bedrock than what the soundings had indicated. It was decided to take core drillings down to the level of the footings, and accordingly the excavations there stopped on January 16, 1932. The core drilling outfit arrived a week later, but high water delayed the work, and the core drilling was not completed until mid-February.[32]

As work on the piers and arch spans continued, careful attention had to be paid to the proper proportional mixture of the concrete throughout the construction. Technicians William B. Hart and Roy M. Rucker supervised the concrete mixing for the highway department. The materials were proportioned by volume and measured by weight. They used Standard Portland cement produced in Ash Grove, Missouri. For the fine aggregate they used a fine, rounded quartz sand commercially produced from the Arkansas River, while the coarse aggregate came out of the White River a few miles upstream from the bridge site. In addition, two pounds of Celite, a commercial product of dichotomous earth, were added with each sack of cement to improve the concrete's workability. A batch of concrete using two bags of cement required approximately 3.5 cubic feet of fine aggregate and 6.8 cubic feet of coarse aggregate, with 2.8 percent of Celite by weight. Depending on the moisture content in the sand, a batch required about ten gallons of water, more or less. Generally, the mix ratio in the arch ribs came to 1:1.8:3.4 of cement, fine aggregate, and coarse aggregate, respectively, although proportions of the sand could vary slightly. Assuming dry weights of the fine and coarse aggregates, the theoretical factors in the mix ratio for the substructure were 1.432 barrels of cement, 0.598 tons of sand, and 0.938 tons of gravel per cubic yard of concrete. For the superstructure the theoretical ratio was 1.486 barrels of cement, 0.589 tons of sand, and 0.919 tons of gravel per cubic yard. The concrete was wrapped in wet burlap or covered with damp sand or sawdust while it cured. Periodically, samples from a batch were made into test beams and later broken in the field to test for compressive strengths. Other batch samples were formed into test cylinders and shipped to the Materials Laboratory in Jefferson City where they were tested as to strength after curing for at least three weeks.[33]

Luttjohann methodically constructed the arch spans from north to south. The key voussoirs for Span 2 were poured on December 23-24, 1931. The keys closing the arches of Span 3 were poured on February 6, 1932. Soon after that, Luttjohann's construction superintendent W. A. Sailer informed the *White River Leader* that they were not unduly rushing the construction because of the uncertain fluctuations of the river, yet they remained on schedule with about twenty men on the job. One worker had been injured

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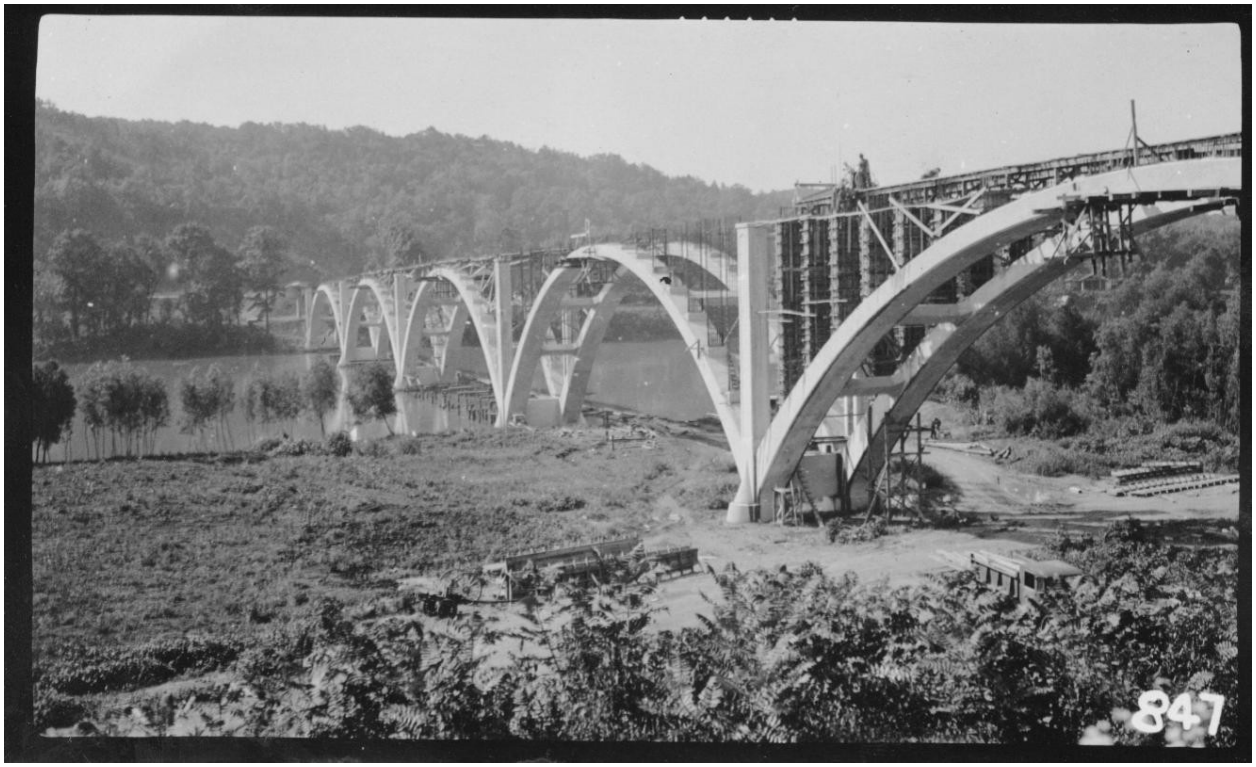
[31] "Procedure of Arch Investigations," in Correspondence File.

[32] D. C. Wolfe for N. R. Sack, "Memorandum to Mr. Levi," November 28, 1932, in Correspondence File.

[33] See "Report of Tests on Concrete Cylinders," "Beam Record," and "Identification and Concrete Mix Information Blank" forms; N. R. Sack to C. B. McCullough, Assistant State Highway Engineer, Oregon State Highway Commission, July 19, 1939, in Correspondence File.

after falling over 20', landing feet-first on solid concrete. The keys on the center arch span were poured on April 3; Span 5 was closed on May 3, and the arches on Span 6 were closed on May 30. The south deck girder approach span had also been built during May. Part of the floor slab on Span 2 was poured on July 15, and a portion of the deck for Span 3 on August 3, 1932.[34]



The White River Bridge under construction, circa late June 1932, after the centering had been struck. The bent columns above the piers had been built up, and workers were forming the spandrel bents on Span 2.[35]

Meanwhile, on June 18 the citizens of Branson celebrated the completion of the Roark Creek Bridge on Route 65 on the north side of town. An estimated crowd of 5,000 people, including Missouri Lieutenant Governor E. H. Winter, enjoyed a parade, ostrich races and 'coon races, carnival rides and concessions. Political candidates arrived, and officials of the State Highway Department took part. Branson's baseball team battled rivals from Aurora, Missouri, while swimmers raced in Lake Taneycomo. The festivities ended with an evening street dance.[36]

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[34] "Report of Tests on Concrete Cylinders," "Beam Record," and "Identification and Concrete Mix Information Blank" forms, in Correspondence File; *White River Leader*, February 18, 1932.

[35] Source of photograph unknown; copy at Historic Preservation Section, Design Division, Missouri Department of Transportation, Jefferson City.

[36] *White River Leader*, June 23, 1932; *Taney County Republican*, June 23, 1932.

Further records documenting the construction of the White River Bridge are lacking in the bridge project files. Neither Branson's nor Forsyth's newspapers reported on the bridge's ongoing progress. Apparently, after the arch ribs were finished in late May, the construction of the spandrel bents, bridge deck and balustrades proceeded through the summer without mishap. Upon its completion, the bridge engineers subjected the bridge to a 35-ton test load and found the deflections to be less than 1/16 of an inch at any point along the structure. The White River Bridge opened for traffic on Saturday, October 22, 1932, about ten days behind schedule. Part of the delay was incidental to the bridge itself, due to a change order requiring Luttjohann to construct some steps up Presbyterian Hill on the south side of the river to appease the local Presbyterians. The design for the steps was completed late in the process, on September 15. Luttjohann also scrambled at the end to procure some additional revetment stone. In noting the imminent bridge opening, the *White River Leader* remarked, "The whole structure is one of imposing grandeur in a setting of unusual scenic beauty." The newspaper even printed a front-page photograph of the magnificent new bridge.[37]

In anticipation of the October 22 bridge opening, the White River Booster League planned an elaborate dedication ceremony, not only for the White River Bridge but also for the Roark Creek Bridge in Branson and the Swan Creek Bridge on Route 76 at Forsyth. The day of the "Three-Bridge Dedication" on the 22nd brought Governor and Mrs. Henry S. Caulfield, State Highway Commissioner Charles Ferguson, Chief Engineer T. H. Cutler, and Senator Roy Milum representing Arkansas Governor Harvey Parnell. The dignitaries dedicated the Swan Creek Bridge first, then moved to the Roark Creek Bridge for its dedication, and lastly dedicated the White River Bridge. The accompanying crowds numbered some 6,000 to 7,000 people, "estimated as the largest crowd ever assembled in Taney County." Governor Caulfield praised the "great efficiency" of the highway department and lauded Chief Engineer Cutler. Various school groups provided the day's musical entertainment, and the evening culminated with a fireworks show from Presbyterian Hill.[38]

After some finishing cleanup on the job site in late October, engineers from Division No. 8 made a final inspection and approved the White River Bridge project on November 1. Through Bridge Engineer Sack, D. C. Wolfe commended the contractor Fred Luttjohann, citing the excellent workmanship he achieved on the White River Bridge and the cooperation his men extended to the highway department. Wolfe hoped that Luttjohann would be a successful bidder on future Missouri bridge projects. Luttjohann's cordial reply expressed his appreciation and pleasure in working with the Missouri State Highway Department.[39]

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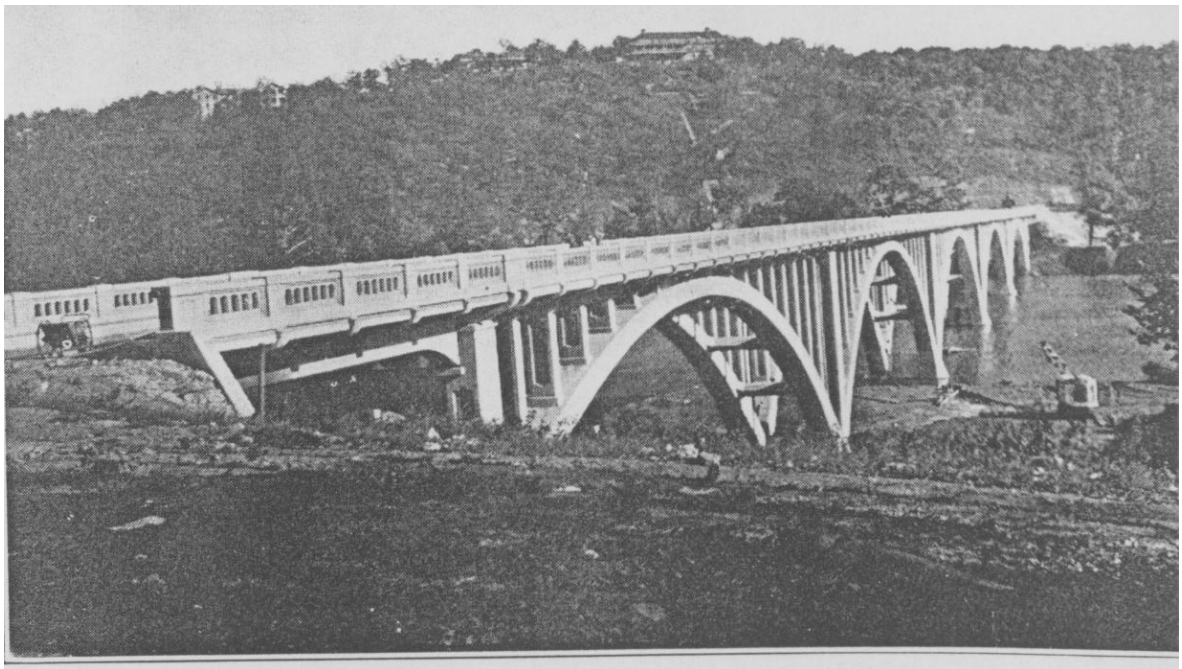
[37] D. C. Wolfe for N. R. Sack, "Memorandum to Mr. Levi," November 28, 1932; E. E. Dittbrenner for N. R. Sack to Hon. W. E. Freeland, House of Representatives, February 13, 1933, in Correspondence File; *White River Leader*, October 20, 1932;

[38] *Ibid*., August 11, 25, September 29, October 20, 27, 1932; *Taney County Republican*, October 27, 1932.

[39] D. B. Levi for T. H. Cutler to J. J. Corbett, Division Engineer, "Final Inspection and Final Acceptance," November 14, 1932; D. C. Wolfe for N. R. Sack to Fred Luttjohann, November 1, 1932; Fred Luttjohann to N. R. Sack, November 15, 1932, in Correspondence File.

Personnel from the department's Bureau of Bridges continued their investigations of the White River Bridge at least through the end of 1932, including the measurement of temperature stresses during a December cold snap. It is not known if afterwards anyone ever compiled the data collected from the investigations into a comprehensive study. But it seems not. Some years later in July 1939, Sack's office responded to an inquiry from the Oregon State Highway Department. Conde B. McCullough, a designer of several noteworthy concrete arch bridges in Oregon and coauthor of *Elastic Arch Bridges*, sought information on Missouri's arch bridges for a technical paper he was writing. In responding on behalf of Bridge Engineer Sack, H. H. Mullins, the co-designer of the White River Bridge, replied: "We believe that we have constructed only one masonry arch bridge of sufficient merit to warrant attention in your paper." Referring to the White River Bridge, Mullins outlined its significant features, the engineering assumptions used in its design, and the general methods employed in its construction. Alluding to the comprehensive investigations they had undertaken, Mullins continued, "We have obtained considerable information in regard to temperature, pier rotations, deflections, and stresses during and since the construction of this bridge. However, this data is not in shape for presentation at this time."[40]



The White River Bridge upon its completion in October 1932.[41]

[40] H. H. Mullins for N. R. Sack to C. B. McCullough, Assistant State Highway Engineer, Oregon State Highway Commission, July 19, 1939, in Correspondence File; McCullough and Thayer, *Elastic Arch Bridges*; Ray Bottenberg, *Bridges of the Oregon Coast* (Charleston, South Carolina: Arcadia Publishing, 2006).

[41] Missouri State Highway Commission, *Eighth Biennial Report*, 242.

Physical Description of the White River Bridge

The White River Bridge crosses the White River (Lake Taneycomo) at U.S. Business Route 65 and Missouri State Route 76 in Taney County. The bridge consists of five 195', reinforced concrete, open spandrel arch spans approached by one 56'-1" reinforced concrete deck girder span at each end. It is carried on reinforced concrete bents and piers set in bedrock. The overall bridge length is 1,087'-2", with a 1.7 percent climbing grade from south to north. The 20'-wide roadway is flanked on either side by 5'-wide sidewalks. The following physical description of the White River Bridge is based on the original design plans. Actual dimensions of some components of the substructure changed during construction when the depths to solid bedrock varied from the plans.[42]

The design for the north end abutment, Abutment No. 1, had to be altered during construction after excavations there encountered loose bedrock. The abutment footing was taken down about 5' deeper than planned to reach solid bedrock. Also the abutment's right wingwall was set back at a 30° angle. The original design called for a stub abutment set on an irregular-shaped, stepped footing 55' long in an east-west direction. At the west end the footing measured 6'-3" wide x 1'-6" high, and was to be set at the elevation of 754.30'. Four steps of varying lengths brought the footing's east end to an elevation of 760.21', where it measured 4' wide x 1'-6" high. The central portion of the footing between the wings measures 33' across, and is 2' deep to the backwall. It was built up to an elevation of 761.71' and serves as the seat to support the lower end of the deck girder span with fixed phosphor bronze bearing plates. A 1'-thick backwall with sloped wings extends 55' across. The central portion of the backwall supporting the upper end of the deck girder span measures 33'-6" across, with two 6" steps at each end. The roadway grade elevation at the north end abutment is 768.67'.

Abutment No. 2 forms the arch buttresses anchoring the north arch span. It has two semi-oval footings, with its right footing set at a deeper elevation of 723.5', and its left footing at 729.5'. The arch buttresses extend to the rear, set at the elevation of 731.5'. The footings measure 11'-8" across, are 18' long, and as deep as 14' at the right footing. The arches emerge at the springing line elevation of 737.5' where the footings are joined by a tie beam 6'-6" high and 2' thick. Two bent columns are 5' x 3'-9", temporarily ending at a construction joint above the arches. An 8" cast iron drain pipe is in the left-side column with its outlet at the top of the footing at the springing line. Cutwater cones, or "cockhats," are on the sides of the bent columns.

Pier No. 3 consists of two large semi-oval columns resting on rectangular footings set at the 684' elevation. The column bases are 15'-4" x 14', and are partially battered 3-3/4" per 1', ending with oblong pier caps set off-center that measure 11'-8" x 6'-8". The columns are 23'-6" high from the tops of the footings. Arch ribs emerge from the top of each pier at the springing line elevation of 711.5'. Note that the springing line at Pier No. 3 is 26' lower than the springing line at Abutment No. 2, making the northernmost arch

[42] Missouri State Highway Department, "Bridge Over White River," Sheet Nos. 1-20.

asymmetrical. The heights of the ribs at the skewbacks vary, as do the intrados radii at the piers. The ribs are 6' wide and are spaced 18' apart from their axes. The columns above the piers measure 5' x 3'-9", with their bases ending at a construction joint 10' above the springing line. A connecting tie beam between the arches and columns is 8' high and 2'-6" thick. The pier caps also are topped with cutwater cones 7'-8" high. The left-side column has an 8" cast iron drain pipe.

Pier No. 4's left footing was set at 681' elevation, and its right footing 1' deeper. They measure 15'-10-1/2" x 13'-1", with respective thicknesses of 4' and 5'. The column shafts are semi-oval and are 21'-6" high from the tops of the footings. The shafts' north sides are battered 1-1/2" per 1' and their south sides are battered 1" per 1', leaving the pier cap 9" off center. The beveled pier caps are oblong, measuring 11'-8" x 5'. The springing line at Pier No. 4 is at the elevation of 706.5', or 5' lower than the springing line at Pier No. 3. Thus Span 3 between Pier Nos. 3 and 4 is also asymmetrical. However, the thicknesses of the ribs are equal at the skewbacks at 5'-3-1/4". Again, the bent columns are 5' x 3'-9". The connecting tie beam is 8'-9" high and 2'-6" thick. Cutwater cones are on the tops of the piers against the sides of the columns. An 8" drainage pipe leads through the left column to an outlet at the top of the column shaft.

Pier Nos. 5 and 6 are essentially similar in dimensions. The footings of both piers are set at 681.5' elevation, and measure 15'-10-1/4" x 13'-1/2" x 4'. The semi-oval column shafts are 21' high and are battered 1-1/2" per 1' on the north sides and 1" per 1' on the south sides, leaving the pier caps off center by 10-1/2". Again, the oblong pier caps are 11'-8" x 5'. The arch springing line at both piers is at 706.5' elevation. However, the thicknesses of the arch ribs at the skewbacks vary, as do the radii of the arch ribs above the springing line. The tie beams are 8'-3" high x 2'-6" thick. The dimensions of the columns remain the same at 5' x 3'-9". Both piers have cutwater cones, and both have 8" drain pipes in the left columns.

Abutment No. 7 on the south bank has two footings in front resting at 702' elevation that measure 11'-8" x 6'-6-1/2" x 4'-6". Behind the front footings, arch buttresses extend downward at an angle for a distance of 10'-6", anchoring the south arch span. The arches emerge at the front of the footings at the springing line elevation of 706.5', tied together with a tie beam 8' high. The bent columns are fitted with cutwater cones. The left side column is equipped with an 8" cast iron drain pipe.

End Bent No. 8 is an open bent supporting the south deck girder approach span. Its two rectangular footings rest at the elevation of 702.5' and measure 14'-6" x 4'-6" x 2'-6". Two front-battered columns are 36'-8" high from the tops of the footings to the bridge seat. The columns are centered 24'-4" apart and are connected at the rear by a lower tie beam 2' high and an upper tie beam 5'-5" high. The bridge seat is backed by a stepped backwall and wings extending 48'-10" across. The roadway grade elevation at Bent No. 8 is at 749.98', or 18.69' lower than at Bent No. 1. End Bent No. 8 is backfilled and covered with a light stone revetment.

The two deck girder approach spans are both 56’-1” long and consist of four reinforced concrete girders. The two outside girders at Span 1 are 2’-8” thick and 3’-7-1/2” high at mid-section. Its two inside girders are 1’-8” thick and 3’-5-1/2” high. The outside girders at Span 7 are 1’-8” thick and 4’-7-1/2” high. Its two inside girders, also 1’-8” thick, are 4’-10-1/2” high. The girders are integrally constructed with the bridge deck, and have outer cantilevered supports for the adjacent sidewalks. The girder ends are flared and rest on fixed and expansion phosphor bronze bearing plates.

The bent columns, or pilasters, over the abutments and piers (Nos. 2 through 7) all measure 3’-9” x 5’. Their inner sides are spaced 17’-6” apart. As measured from the construction joints located 10’ above the arch springing lines up to the columns’ capitals, their heights range from 17’-8” at Abutment No. 2 to 41’-11-5/8” at Pier No. 4. Three sides of each column are embellished with decorative recessed panels. The columns are connected with semicircular arches all built to a radius of 8’-9” and with rises of 8’-9”. At Abutment Nos. 2 and 7, the connecting arches are 1’-3” thick and their spandrels are 4’ high above the arch crown. The arches on the two abutments support the deck girder approach spans. At the four piers, the connecting arches are 1’ thick and their spandrels are 3’ high above the crown. The 8” cast iron drain pipes continue up through all of the left-side bent columns.

All five of the arch spans are 195’ long as measured between the faces of the bent columns. Two arch ribs at each span are 6’ wide with beveled edges centered 18’ apart. The ribs were poured in five sequences at specified locations along each arch, ending with six 4’-wide key sections to close the arch. The specific thicknesses of the ribs vary at each span but in general the ribs gradually taper from the skewbacks to the crowns. For example, Span 2 has skewbacks of 5’-1-1/2” and 5’-9-1/2” thick, and has a crown thickness of 3’-0-1/4”. Each span also has a different rise, ranging from 40’-8-1/2” at Span 6 to 50’-11” at Span 3. Spans 2 and 3 are asymmetrical arches because of differing elevations in their springing lines. The remaining spans are symmetrical elliptical arches. Each pair of arch ribs is connected by four struts measuring 3’ high and 2’ wide.[43]

Seventeen spandrel bents are centered 10’-7-3/4” apart along the length of each span. The bases for the spandrel bent columns were constructed at the same time as the arch ribs, temporarily ending with construction joints. The bases are 4’ x 2’. The bent columns are 3’-6” x 1’-6”. Their heights vary according to their placement on the ribs. The taller bent columns are embellished with decorative recessed panels mimicking those on the main pilasters. The spandrel bent columns were built up to specified elevations where they are connected by tie beams 1’-9” high supporting the bridge deck, as well as by longitudinal arched brackets having rises of 1’-3”. Curvilinear brackets supporting the two pedestrian walkways extend 6’ outside the bent columns.

The bridge deck is 9” thick at the crown and has a roadway width of 20’, providing two 10’ driving lanes. Expansion joints over the piers are 13” x ¾” plates with angles and bent plates embedded within the piers. Drainage pipes are covered with open

[43] For the specific dimensions of the arch ribs see Missouri State Highway Department, “Bridge Over White River,” Sheet Nos. 11-13.

grates. Sidewalks on either side of the roadway are 10" higher than the bridge deck and are 5' wide. The details of the balustrades were evidently derived from a contemporary bridge at Ozark, Arkansas, built by the well-known contractor Maurice Gillioz for the Arkansas State Highway Department. During the design phase of the White River Bridge, Gillioz provided information to Missouri's Bureau of Bridges on adjustable steel forms that he had used for the Ozark bridge balustrades, which Sack's office decided to adopt.[44] The balustrades are 2'-10" high and 1'-1" wide, and feature decorative open panels between the top and bottom railings. Subposts with recessed panels occur above each of the spandrel bents. Main posts above the piers, also with recessed panels, are 5'-6" x 1'-9" x 2'-11-1/4". The main posts were fitted with electrical conduits for proposed lighting posts that were never installed. Metal plaques on the end posts designate the bridge designers and builders: "Missouri / Highway Dept / Bridge N^{o} J 705 / 1931" and "Fred Luttjohann / Contractor / Topeka, Kansas."

Only minor modifications have been made to the White River Bridge since its construction. One project in 1989 resurfaced the deck with a 1-1/2" layer of asphaltic concrete and a polymer modified asphalt seal coat, while the expansion plates at the sidewalks and the drainage grates were replaced.[45]

Conclusion

Even when viewed casually, the White River Bridge stands evident as a monumental structure. It's five, two-ribbed, open spandrel arch spans appear both imposing in their magnitude and graceful in their balanced proportions. Overall, it recalls the classical order while its subdued detailing further imparts a sense of an aesthetic. When studied closely, however, the White River Bridge becomes even more impressive as a testament to the historic employment of reinforced concrete technology in large-scale arch bridge construction. Its carefully detailed design considered both theoretical and actual constraints inherent to arch structures carried on elastic piers of relatively small mass, while the material properties of reinforced concrete also were taken into account. Algebraic methods, analytical geometry, and mechanical stress analysis overcame those design problems. Although of equal lengths, the five spans are in fact not identical. Two of the spans are asymmetrical, each span has a different rise, and the spandrel bents carry the bridge deck on a 1.7 percent grade. Each pier, each pair of arch ribs, and each spandrel bent are designed and built to variable but specific dimensions, down to the ¼". The concrete itself also was carefully proportioned to ensure its proper strength. The White River Bridge is unsurpassed among Missouri's other reinforced concrete, multiple-span arch bridges. It stands unequaled as a technological triumph.

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[44] M. E. Gillioz to N. R. Sack, May 25, 1931; M. E. Gillioz to N. R. Sack, June 9, 1931; N. R. Sack for T. H. Cutler to M. E. Gillioz, June 16, 1931, in Correspondence File. For a biography of Gillioz and a history of his construction company, see Austin, "Meramec River Bridge."

[45] Missouri State Highway Commission, "Bridge Over White River & Union Pacific R.R., State Road from Branson to Hollister, About .75 Mile South of Branson, Project No. RS-RSG-987(12), Job No. 8-S076-391, Route 76, Taney County." Bridge J-705R, May 18, 1989. Microfiche. Bridge Division, Missouri Department of Transportation, Jefferson City.

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Bridge over White River (Lake Taneycomo) at Branson
Bridge No. J0705R
Taney County, U.S. Business Route 65/ Missouri State Route 76
MoDOT Job No. J8P0764

Photographers: Randall Dawdy and Shaun Schmitz
Missouri Department of Transportation
Date: December 3-16, 2009
Location of Digital Images: Missouri State Historic Preservation Office

Photo Index

#1 of 60. Bridge J0705R. East side. Aerial view to northwest.

#2 of 60. Bridge J0705R. East side. Aerial view to northwest.

#3 of 60. Bridge J0705R. East side. Aerial view to northwest.

#4 of 60. Bridge J0705R. East side. View to northwest.

#5 of 60. Bridge J0705R. Spans 4 and 5. View to northwest.

#6 of 60. Bridge J0705R. Columns at Pier 6. View to northwest.

#7 of 60. Bridge J0705R. Span 6. View to southwest.

#8 of 60. Bridge J0705R. Spans 5 and 6. View to southwest.

#9 of 60. Bridge J0705R. East side. View to southwest.

#10 of 60. Bridge J0705R. West side. View to east.

#11 of 60. Bridge J0705R. North end. View to northeast.

#12 of 60. Bridge J0705R. Columns at Pier 4. View to east.

#13 of 60. Bridge J0705R. Spans 4, 5 and 6. View to southeast.

#14 of 60. Bridge J0705R. South end. View to southeast.

#15 of 60. Bridge J0705R. Spans 5 and 6. View to southeast.

#16 of 60. Bridge J0705R. Spans 4, 5 and 6. View to southeast.

#17 of 60. Bridge J0705R. Span 5. View to southeast.

#18 of 60. Bridge J0705R. Span 4. View to east.

#19 of 60. Bridge J0705R. Columns at Pier 5. View to southeast.

#20 of 60. Bridge J0705R. Column and deck detail at Pier 5. View to southeast.

#21 of 60. Bridge J0705R. Columns at Pier 4. View to southeast.

#22 of 60. Bridge J0705R. Column and deck detail at Pier 4. View to east.

#23 of 60. Bridge J0705R. North Approach Span 1. View to east.

#24 of 60. Bridge J0705R. North Abutment 1. View to northeast.

#25 of 60. Bridge J0705R. North Abutment 2. View to northeast.

#26 of 60. Bridge J0705R. Spandrel bents at Span 2. View to northeast.

#27 of 60. Bridge J0705R. Pier 3 and Span 2. View to northwest.

#28 of 60. Bridge J0705R. Sub-deck, spandrel bents at Span 2. View to north.

#29 of 60. Bridge J0705R. Pier 3. View to southeast.

#30 of 60. Bridge J0705R. Pier 3. View to south.

#31 of 60. Bridge J0705R. Pier 4. View to south.

#32 of 60. Bridge J0705R. Pier 4. View to southwest.

#33 of 60. Bridge J0705R. Pier 4 and Span 4. View to southwest.

#34 of 60. Bridge J0705R. Pier 4 and Span 4. View to southwest.

#35 of 60. Bridge J0705R. Spandrel bents at Span 4. View to southwest.

#36 of 60. Bridge J0705R. Columns and sub-deck at Span 4. View to southwest.

#37 of 60. Bridge J0705R. Sub-deck at Span 4. View to southwest.

#38 of 60. Bridge J0705R. Sub-deck at Pier 4. View to southwest.

#39 of 60. Bridge J0705R. North approach. View to south.

#40 of 60. Bridge J0705R. West balustrade. View to southeast.

#41 of 60. Bridge J0705R. West balustrade. View to southeast.

#42 of 60. Bridge J0705R. West balustrade detail. View to southeast.

#43 of 60. Bridge J0705R. Northeast end post. View to south.

#44 of 60. Bridge J0705R. North end of east balustrade. View to east.

#45 of 60. Bridge J0705R. East balustrade and expansion joint. View to east.

#46 of 60. Bridge J0705R. East balustrade typical section. View to east.

#47 of 60. Bridge J0705R. Movable inspection scaffold. View to south.

#48 of 60. Bridge J0705R. Southeast end post. View to north.

#49 of 60. Bridge J0705R. Southeast name plate. View to north.

#50 of 60. Bridge J0705R. South approach. View to north.

#51 of 60. Bridge J0705R. South Approach Span 7. View to northeast.

#52 of 60. Bridge J0705R. West side. View to north.

#53 of 60. Bridge J0705R. West balustrade and walkway. View to northeast.

#54 of 60. Bridge J0705R. West balustrade and walkway. View to northeast.

#55 of 60. Bridge J0705R. West balustrade detail. View to northeast.

#56 of 60. Bridge J0705R. Southwest end post. View to north.

#57 of 60. Bridge J0705R. Southwest name plate. View to north.

#58 of 60. Bridge J0705R. West balustrade and sidewalk. View to north.

#59 of 60. Bridge J0705R. West balustrade detail. View to south.

#60 of 60. Bridge J0705R. West balustrade detail. View to west.

Photographic Methods and Processing:

The archival photographs were taken and processed according to the standards for photographs accompanying NRHP documentation (NPS 2008). Randall Dawdy and Shaun Schmitz took the photographs on December 3-16, 2009 using two digital single lens reflex cameras. Images were captured in a raw (nef) format, which was manipulated for light contrast before being converted to a tagged image file format (.tiff) and printed. Images were numbered according to the NRHP Photographic Imaging Policy (NPS 2008) and burned onto compact discs, which were provided to the SHPO along with this report.

Prints were made on Epson Premium Glossy Photo Paper and used Epson Matte Black UltraChrome K3 Ink, both identified as "best" practices by the NRHP photo policy, and which Epson identifies as having an 85-year permanence under glass (NHRP 2009, Epson 2009). Kept in archival conditions the materials will exceed the 75 year permanence standard for the NRHP, which is the standard being used for this project. A copy of the Epson rating is attached.

The .tiff images were burned onto Delkin Archival Gold compact discs, and provided to the SHPO in that format. In addition, a copy of the .tiff file is maintained by the MODOT Environmental and Historic Preservation Section, and a copy was provided to the Taney County Historical Society.

Lightfast Ratings From Wilhelm Imaging Research*

EPSON

Permanence rating for Epson prints framed under glass

MEDIA	6-Color Photo Dye Inks: Epson Stylus Photo 825/925/960/1280	6-Color Photo Dye Inks: Epson Stylus Photo R200/R300/R320/RX500/RX600	DURABrite® Ink: Epson Stylus C64/C66/C84/C86/CX4600/CX6400/CX6600	PictureMate™ Ink: PictureMate Personal Photo Lab	UltraChrome™ Ink: Epson Stylus Photo 2200	UltraChrome Hi-Gloss™ Inks: Epson Stylus Photo R1800/R800
EPSON PREMIUM PHOTO PAPERS						
Premium Glossy Photo Paper		23 years			85 years	104 years
Premium Luster Photo Paper – Cut Sheet		22 years			71 years	64 years
Premium Semigloss Photo Paper		22 years			77 years	In progress
EPSON MATTE PAPERS						
Double-Sided Matte Paper	15 years					
Enhanced Matte Paper			71 years		76 years	110 years
Matte Paper Heavyweight	18 years	30 years	105 years			Over 150 years
Photo Quality Ink Jet Paper		8 years				In progress
PremierArt™ Matte Scrapbook Photo Paper for Epson			94 years		108 years	In progress
Premium Bright White Paper		5 years	74 years			In progress
EPSON FINE ART PAPERS						
UltraSmooth Fine Art Paper					108 years	
Epson Velvet Fine Art Paper					61 years	
Watercolor Paper Radiant White					92 years	
PremierArt Water-Resistant Canvas for Epson					75 years	
EPSON GLOSSY PAPERS						
ColorLife™ Photo Paper	27 years	36 years				
DURABrite Ink Glossy Photo Paper			55 years			
PictureMate Photo Paper				104 years		
Semigloss Scrapbook Photo Paper	27 years	36 years				

* Lightfastness ratings are based on accelerated testing of prints on specialty media displayed indoors, under glass. Actual print stability will vary according to media, printed image, display conditions, light intensity and atmospheric conditions. Lightfastness ratings do not measure paper deterioration, such as yellowing. Epson does not guarantee the longevity of prints. For maximum print life display all prints under glass or lamination or properly store them. Ratings based on testing conducted by Epson and Wilhelm Imaging Research www.wilhelm-research.com

**Testing currently in progress. Projected time estimated on current progress of test.

As with traditional photos, proper care will maximize display life. For indoor display, Epson recommends that prints be framed under glass or in a protective plastic sleeve to protect the prints from atmospheric contaminants like humidity, cigarette smoke, and high levels of ozone. And, as with all photographs, the prints should be kept out of direct sunlight. For proper storage, Epson recommends that your prints be stored in a photo album (or plastic photo storage box or museum storage box) in acid free, archival sleeves commonly available from most camera shops and other retailers. By taking these steps to protect prints from direct sunlight and contaminants, you can preserve your photos for many years.

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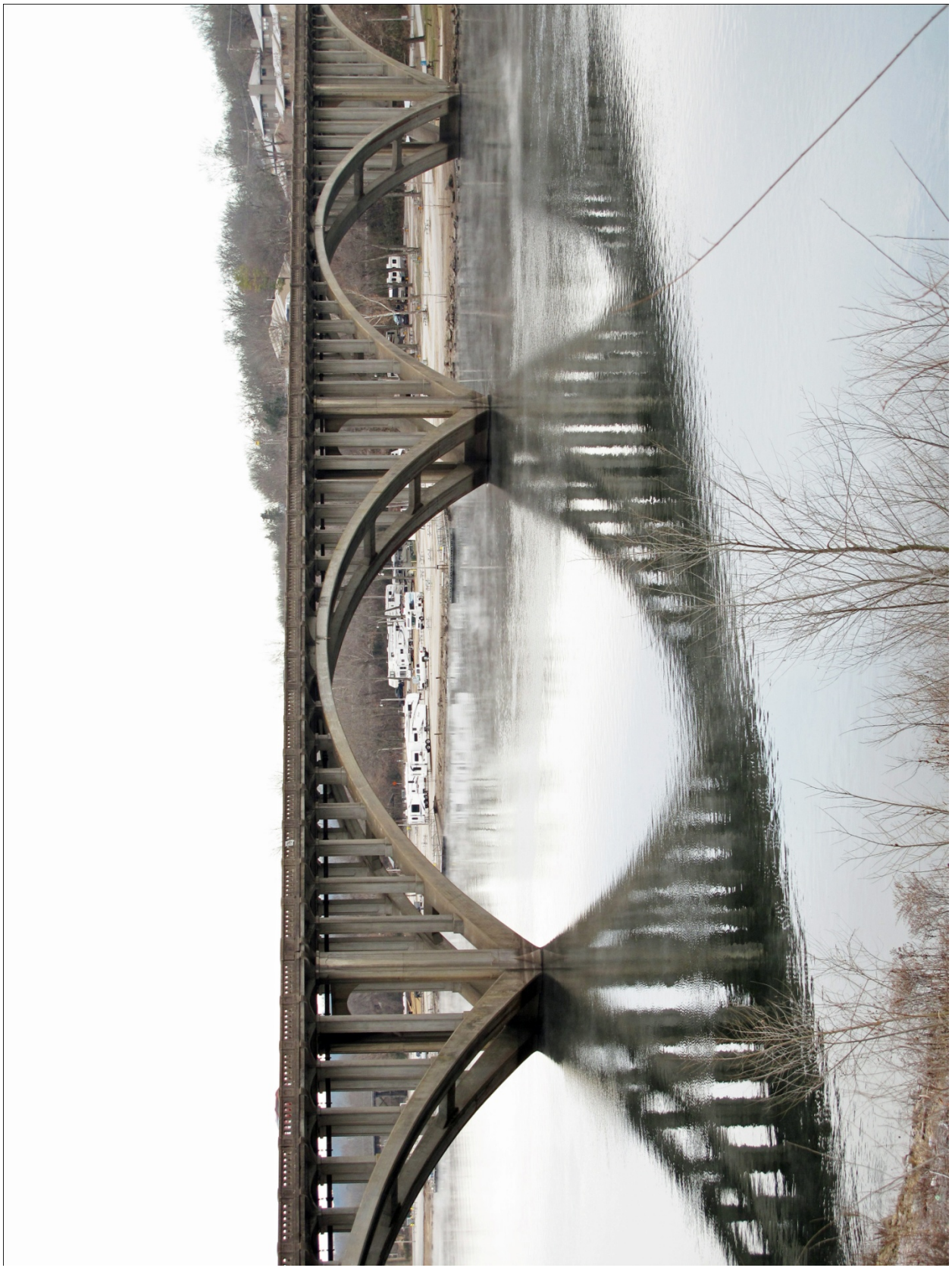

#5 of 60. Bridge J0705R. Spans 4 and 5. View to northwest.

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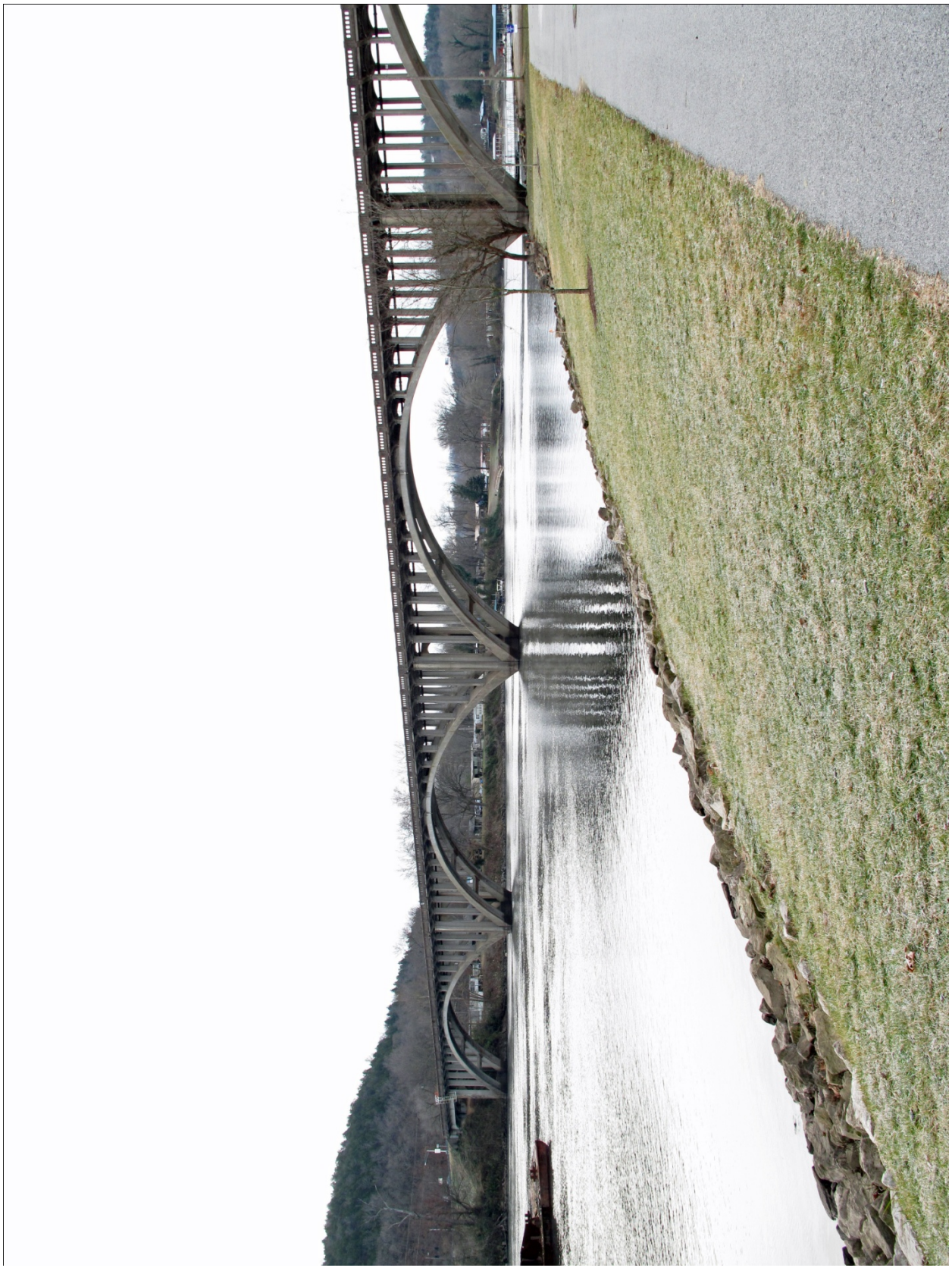

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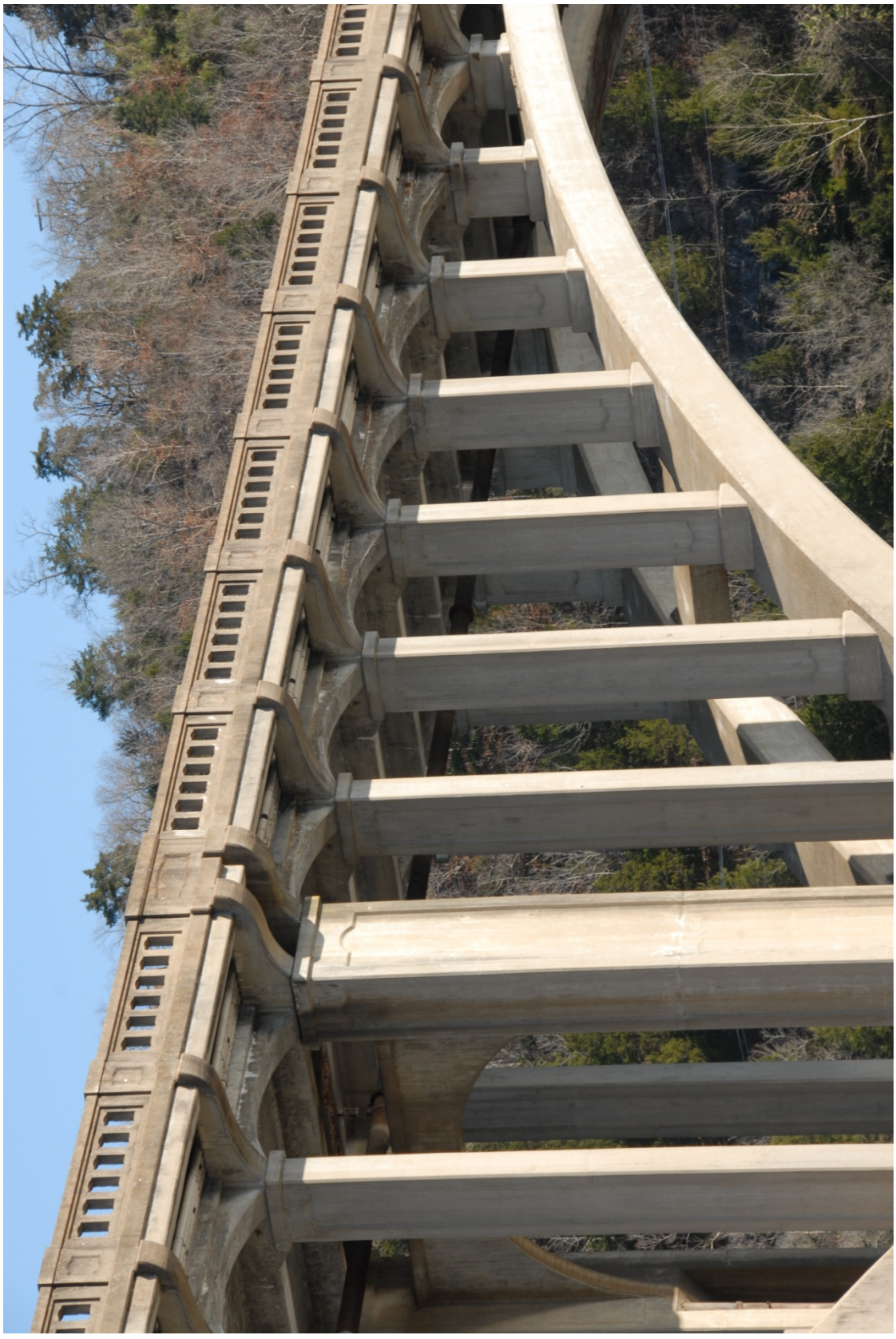

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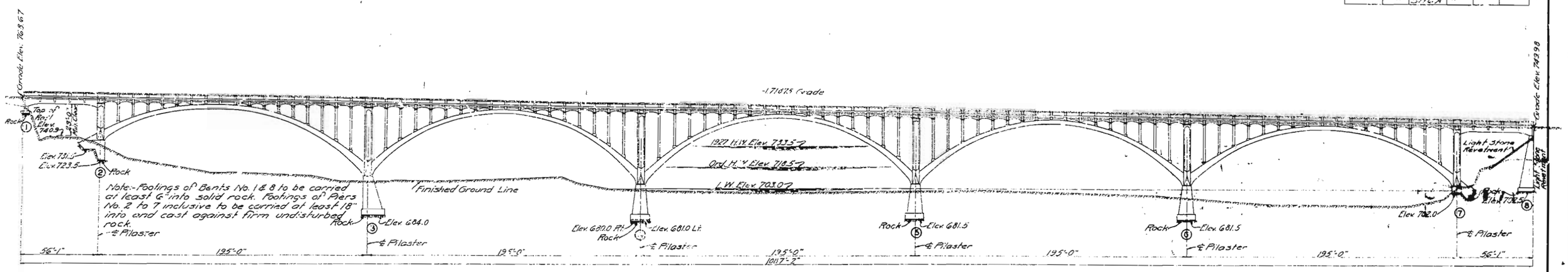
Bridge Plans and Rehabilitations

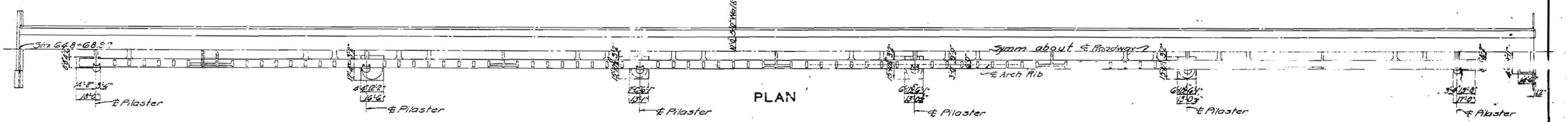
Bridge over White River (Lake Taneycomo) at Branson
Bridge No. J0705R
Taney County, U.S. Business Route 65/ Missouri State Route 76
MoDOT Job No. J8P0764

MISSOURI STATE HIGHWAY DEPARTMENT

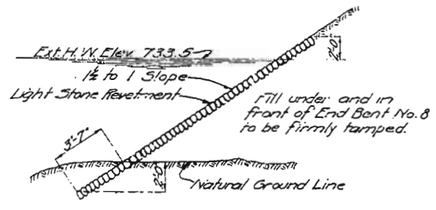
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-S(16)A	19		



GENERAL ELEVATION



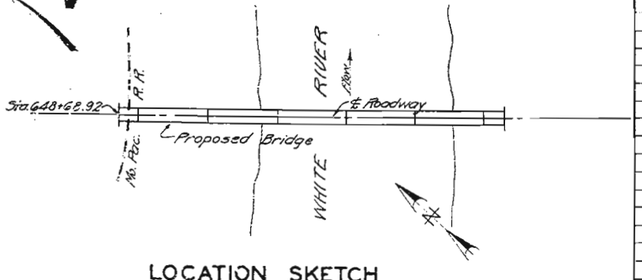
PLAN



Place light stone revetment on fills at End Bent No. 8 as shown on sketch above. Extend revetment 20'-0" back of end bent. Approximately 260 sq. yds. of light stone revetment work included in road contract.

LIGHT STONE REVETMENT DETAIL

156



LOCATION SKETCH

INDEX OF SHEETS

GENERAL NOTES:-

Concrete in handrail and handrail posts shall be Class "A"; concrete in deck girder spans and deck on arch spans shall be Class "X"; concrete in all substructure, including end bents, abutments, piers, pilasters, spandrel columns and arch rings shall be Class "B." All concrete shall be proportioned by the weight proportioning method. See Specifications.

Exposed edges to be beveled ¾" where no other bevel is noted.

Shop drawings for structural steel expansion joints shall be submitted in duplicate to the Missouri State Highway Department for approval before fabrication.

Two name plates, type "A" as shown on Std. 5818, to be furnished and placed by contractor. Cost of name plates to be included in price bid for other items.

Where bituminous felt is used in expansion or partition joints in concrete stitch felt in vertical joints, securely to one face of concrete with copper wire.

Bridge excavation in accordance with Section 1 of Standard Specifications issued April 1, 1930, except that quantities paid for will be computed from Extreme Low Water Elev. 703.0 where existing ground line is below this elevation, and for Piers No. 3, 4, 5 & 6 and Abut. No. 7 only, will include actual removal of any material lying within such plan limits as shown on Sheets No. 6, 7, 8 & 9, instead of allowing quantities to only 18" outside of footings.

Falsework for span over existing railroad track shall be constructed with a minimum vertical clearance of 20'-0" and a minimum lateral clearance of 8'-6" from centerline of tracks.

See Special Provisions in regard to use of admixture, early strength concrete in arch rings, sequence of pouring arch rings, removal of arch centering, metal forms for handrail, finishing concrete surfaces, bar chairs and spacers, placing electric light conduits, et cetera.

ESTIMATED QUANTITIES

ITEM	CONCRETE - CU. YDS. Class "A"	Class "X"	Class "B"
Handrail	155.0		
Deck Girder Spans		269.7	
Deck on Arch Spans		1293.4	
Spandrel Columns			289.7
Pilasters and Buttresses above Spr. Elev.			516.6
Arch Rings between Springing Lines of Arch Ribs			1634.7
Piers and Abutments below Springing Elev.			1151.7
End Bents No. 1 & 8			137.3
Totals :-	155.0	1563.1	3730.0

Excavation, Class 1	Cu. Yds.	590
Excavation, Class 2	Cu. Yds.	2390
Fabricated Structural Steel	Lbs.	16,300
Reinforcing Steel	Lbs.	920,240
8" Cast Iron Pipe	Lin. Ft.	310
Phosphor Bronze Bearings (8" x 20") 4-Sets, 5-plates each		
Phosphor Bronze Bearings (8" x 32") 2-Sets, 5-Plates each		
Phosphor Bronze Bearings (12" x 20") 2-Sets, 5-Plates each		
Phosphor Bronze Bearings (8" x 18") 20-Sets, 3-Plates each		

Bridge Excavation above Elev. 705.0 will be paid for as Class 1 Bridge Excavation.
Bridge Excavation below Elev. 705.0 will be paid for as Class 2 Bridge Excavation.

B.M. Elev. 703.42. Nail in root of twin 18" Elm 150' Left of Sta. 658+80.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILE SOUTH OF BRANSON

PROJECT NO. U.S.65-S(16)A STA. 648 + 68.92

TANEY COUNTY

SUBMITTED BY ..... DATE 7/22/31 BRIDGE ENGINEER

APPROVED BY ..... DATE 7/20/31 CHIEF ENGINEER

STD. S818

J-705

Designed May 1931 by H.H.M.
Drawn July 1931 by C.A.F. & H.D.
Checked July 1931 by R.O. & F.C.L.

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U 565 SUB 13			

BILL OF REINFORCING STEEL

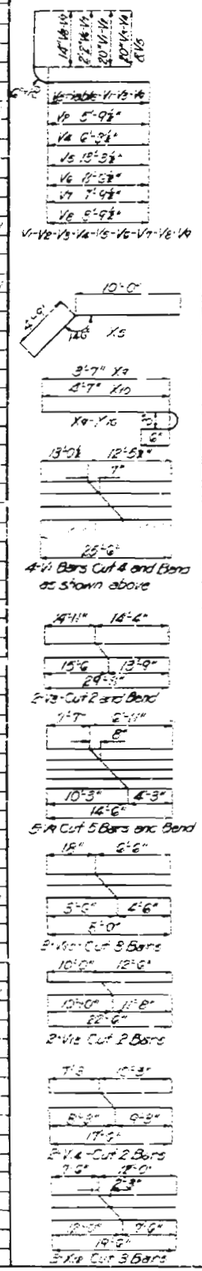
No.	Size	Length	Mark	Location
		Abutments No 2 & No 7		
36	1"ø	22'-9"	P1	Pile & Ftg.
32	1"ø	15'-9"	P2	" "
16	⅞"ø	18'-0"	P3	Web Wall
32	1"ø	6'-0"	P4	Pilaster
64	1"ø	23'-9"	P22	Pile & Ftg.
32	1"ø	19'-0"	P23	Pilaster
12	⅞"ø	17'-0"	N27	Web Wall
8	⅞"ø	20'-0"	N28	" "
58	¾"ø	5'-6"	A1	Kibs
		Piers No 3, 4, 5 & 6		
24	⅞"ø	18'-0"	P3	Web Wall
120	1"ø	6'-0"	P4	Pilaster
112	1"ø	25'-6"	P5	Web Wall
30	1"ø	27'-0"	P6	Shafts
30	1"ø	28'-6"	P7	"
240	1"ø	6'-0"	P8	Footings
176	1"ø	6'-0"	P9	"
64	1"ø	16'-9"	P10	Ribs
24	1"ø	14'-0"	P11	"
11	1"ø	27'-9"	P12	Shafts
16	1"ø	27'-9"	P13	"
40	⅞"ø	8'-3"	P14	"
60	1"ø	14'-6"	P15	Ribs
60	1"ø	17'-3"	P16	"
80	1"ø	20'-9"	P18	"
126	1"ø	16'-9"	P19	Ribs
126	1"ø	15'-9"	P20	"
120	1"ø	26'-3"	P21	Shafts
24	⅞"ø	21'-6"	N30	"
2	⅞"ø	5'-3"	N31	Shafts
2	⅞"ø	49'-6"	N32	"
2	⅞"ø	48'-0"	N33	"
2	⅞"ø	46'-3"	N34	"
2	⅞"ø	44'-7"	N35	"
2	⅞"ø	43'-3"	N36	"
2	⅞"ø	41'-6"	N37	"
2	⅞"ø	40'-0"	N38	"
2	⅞"ø	7'-3"	N39	"
2	⅞"ø	36'-9"	N40	"
2	⅞"ø	34'-3"	N41	"
2	⅞"ø	31'-9"	N42	"
6	⅞"ø	44'-5"	N43	"
6	⅞"ø	42'-0"	N44	"
6	⅞"ø	42'-0"	N45	"
6	⅞"ø	40'-9"	N46	"
6	⅞"ø	39'-0"	N47	"
6	⅞"ø	38'-6"	N48	"
6	⅞"ø	37'-0"	N49	"
6	⅞"ø	36'-6"	N50	"
6	⅞"ø	35'-6"	N51	"
6	⅞"ø	33'-6"	N52	"
6	⅞"ø	31'-5"	N53	"
12	⅞"ø	2'-0"	N60	Web Wall
112	¾"ø	5'-0"	A1	Kibs
172	¾"ø	2'-0"	C50	Footings

No.	Size	Length	Mark	Location
		Arch Ring - Span 2-3		
300	¾"ø	5'-5"	A1	Rings
34	1"ø	18'-3"	A2	"
34	1"ø	18'-0"	A3	"
34	1"ø	17'-6"	A4	"
34	1"ø	36'-3"	A5	"
34	1"ø	33'-0"	A6	"
34	1"ø	33'-6"	A7	"
34	1"ø	38'-0"	A8	"
34	1"ø	37'-6"	A9	"
34	1"ø	35'-3"	A10	"
34	1"ø	34'-7"	A11	"
34	1"ø	41'-0"	A12	"
34	1"ø	40'-3"	A13	"
34	1"ø	19'-0"	A14	"
34	1"ø	18'-6"	A15	"
92	⅞"ø	28'-9"	B1	"
48	⅞"ø	24'-3"	B2	"
384	½"ø	20'-6"	B3	"
80	⅞"ø	26'-0"	B4	"
42	⅞"ø	32'-6"	B5	"
		Arch Ring - Span 3-4		
300	¾"ø	5'-6"	A1	Rings
30	1"ø	20'-0"	A16	"
30	1"ø	19'-3"	A17	"
30	1"ø	41'-3"	A18	"
30	1"ø	40'-9"	A19	"
30	1"ø	34'-9"	A20	"
30	1"ø	34'-3"	A21	"
30	1"ø	37'-9"	A22	"
90	1"ø	37'-3"	A23	"
30	1"ø	34'-6"	A24	"
30	1"ø	42'-6"	A25	"
30	1"ø	41'-6"	A26	"
30	1"ø	20'-6"	A28	"
30	1"ø	20'-0"	A29	"
80	⅞"ø	24'-3"	B6	"
96	⅞"ø	19'-3"	B7	"
416	⅞"ø	16'-0"	B8	"
		Arch Ring - Span 4-5		
300	¾"ø	5'-6"	A1	Rings
60	1"ø	20'-0"	A30	"
60	1"ø	19'-6"	A31	"
60	1"ø	41'-6"	A32	"
60	1"ø	40'-9"	A	"
60	1"ø	34'-0"	A34	"
60	1"ø	34'-3"	A35	"
30	1"ø	37'-9"	A36	"
30	1"ø	37'-6"	A37	"
80	⅞"ø	24'-3"	B6	"
96	⅞"ø	19'-3"	B7	"
416	⅞"ø	16'-0"	B8	"
		Arch Ring - Span 5-6		
300	¾"ø	5'-6"	A1	Rings
32	1"ø	37'-9"	A38	"
32	1"ø	37'-2"	A39	"
64	1"ø	19'-6"	A38	"
64	1"ø	19'-0"	A36	"
64	1"ø	40'-6"	A40	"
64	1"ø	39'-9"	A41	"

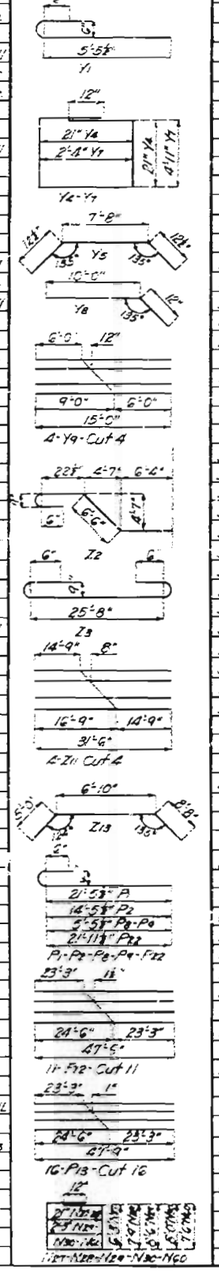
No.	Size	Length	Mark	Location
		Arch Ring - Span 5-6 cont'd		
64	1"ø	34'-9"	A42	Rings
64	1"ø	34'-6"	A43	"
80	⅞"ø	25'-6"	B9	"
96	⅞"ø	20'-6"	B10	"
416	⅞"ø	17'-0"	B11	"
		Arch Ring - Span 6-7		
300	¾"ø	5'-6"	A1	Rings
32	1"ø	37'-9"	A36	"
32	1"ø	37'-6"	A37	"
64	1"ø	19'-0"	A44	"
64	1"ø	18'-6"	A45	"
64	1"ø	40'-3"	A46	"
64	1"ø	39'-6"	A47	"
64	1"ø	34'-6"	A48	"
64	1"ø	34'-0"	A49	"
80	⅞"ø	25'-6"	B4	"
96	⅞"ø	20'-6"	B10	"
416	⅞"ø	17'-0"	B11	"
		Struts Between Pilz		
228	1"ø	18'-0"	C1	Strut
228	⅞"ø	10'-0"	C2	Haunch
152	⅞"ø	10'-0"	C3	strut
		Spandrel Columns - Span 2-3		
40	1"ø	17'-0"	D2	Columns
40	1"ø	12'-3"	D3	"
40	1"ø	9'-0"	D4	"
40	1"ø	17'-3"	D5	"
40	1"ø	15'-0"	D6	"
40	1"ø	20'-9"	D7	"
40	1"ø	27'-0"	D8	"
40	1"ø	34'-0"	D9	"
292	⅞"ø	9'-6"	E1	"
20	1"ø	13'-0"	E2	Base
40	1"ø	8'-0"	E3	"
16	1"ø	19'-3"	E4	"
2	1"ø	9'-3"	E5	"
16	1"ø	14'-9"	E6	"
8	1"ø	7'-3"	E7	"
32	1"ø	11'-9"	E8	"
32	1"ø	9'-3"	E9	"
16	1"ø	10'-3"	E10	"
16	1"ø	17'-6"	E11	"
8	1"ø	8'-3"	E12	"
16	1"ø	22'-6"	E13	"
8	1"ø	11'-6"	E14	"
48	1"ø	14'-3"	E15	"
24	1"ø	9'-6"	E16	"
54	⅞"ø	9'-6"	E17	Curtain Wall
		Spandrel Columns - Span 3-4		
40	1"ø	32'-9"	D10	Columns
80	1"ø	24'-9"	D22	"
40	1"ø	18'-3"	D13	"
40	1"ø	18'-9"	D14	"
40	1"ø	9'-0"	D15	"
40	1"ø	13'-6"	D16	"
40	1"ø	10'-9"	D17	"
40	1"ø	26'-0"	D18	"
40	1"ø	24'-3"	D19	"

No.	Size	Length	Mark	Location
		Spandrel Columns - Span 3-4 cont'd		
370	⅞"ø	9'-6"	E1	Columns
64	1"ø	13'-0"	E2	Base
32	1"ø	8'-0"	E3	"
32	1"ø	5'-9"	E4	"
16	1"ø	10'-3"	E15	"
80	1"ø	14'-3"	E15	"
40	1"ø	5'-9"	E16	"
36	⅞"ø	7'-6"	E17	Curtain Wall
16	1"ø	23'-9"	E18	Base
8	1"ø	12'-6"	E19	"
16	1"ø	17'-3"	E20	"
8	1"ø	9'-3"	E21	"
32	1"ø	11'-9"	E22	"
16	1"ø	18'-3"	E23	"
8	1"ø	7'-9"	E24	"
		Spandrel Columns - Span 4-5		
40	1"ø	34'-6"	D21	Columns
40	1"ø	26'-6"	D12	"
40	1"ø	17'-6"	D23	"
40	1"ø	8'-0"	D24	"
40	1"ø	9'-6"	D25	"
40	1"ø	12'-3"	D26	"
40	1"ø	17'-6"	D27	"
40	1"ø	24'-3"	D28	"
40	1"ø	31'-9"	D29	"
362	⅞"ø	9'-6"	E1	"
48	1"ø	13'-0"	E2	Base
24	1"ø	8'-0"	E3	"
12	1"ø	9'-9"	E4	"
				"
96	1"ø	14'-3"	E15	"
48	1"ø	8'-9"	E16	"
36	⅞"ø	9'-6"	E17	Curtain Wall
16	1"ø	23'-9"	E18	Base
16	1"ø	12'-3"	E19	"
16	1"ø	17'-0"	E20	"
8	1"ø	9'-0"	E21	"
16	1"ø	17'-6"	E22	"
16	1"ø	18'-3"	E23	"
8	1"ø	7'-0"	E24	"
		Spandrel Columns - Span 5-6		
370	⅞"ø	9'-6"	E1	Columns
342	⅞"ø	9'-6"	E1	"
48	1"ø	13'-0"	E2	Base
24	1"ø	8'-0"	E3	"
16	1"ø	9'-9"	E3	"
80	1"ø	10'-3"	E10	"
80	1"ø	14'-3"	E15	"
40	1"ø	8'-9"	E16	"
48	1"ø	9'-9"	E17	Curtain Wall
32	⅞"ø	9'-6"	E17	Curtain Wall
16	1"ø	8'-9"	E24	Base
8	1"ø	9'-9"	E25	"
16	1"ø	14'-0"	E26	"
16	1"ø	15'-3"	E27	"
16	1"ø	16'-3"	E28	"
8	1"ø	7'-9"	E29	"
16	1"ø	18'-3"	E30	"
8	1"ø	7'-9"	E31	"
16	1"ø	15'-9"	E32	"
8	1"ø	8'-6"	E33	"
16	1"ø	20'-9"	E34	"
8	1"ø	11'-6"	E35	"

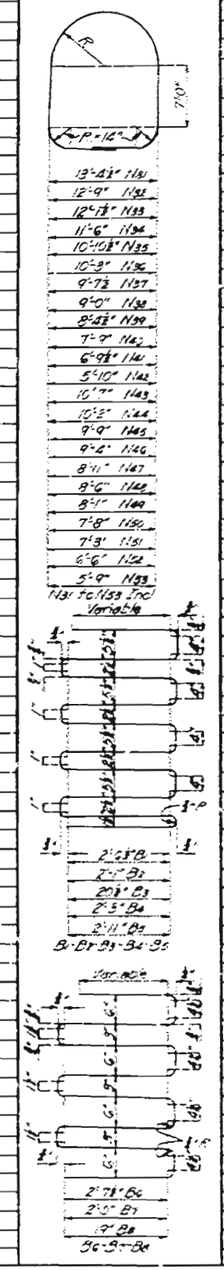
Bending Sketches & Cutting Diagrams



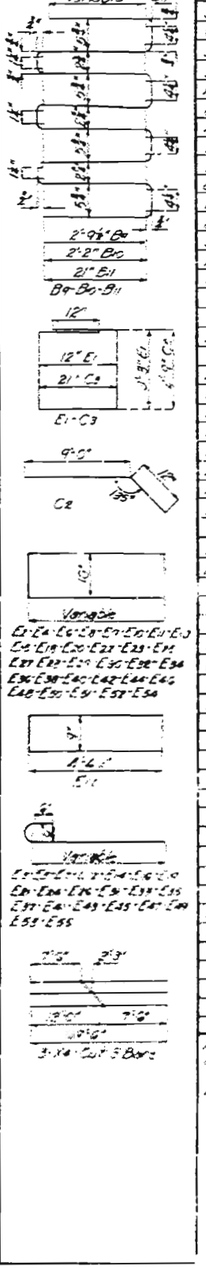
Bending Sketches & Cutting Diagrams



Bending Sketches & Cutting Diagrams



Bending Sketches & Cutting Diagrams



Note: All reinforcing bars shown 1" or larger in diameter, which are bent to an angle greater than 90°, shall be of structural grade.

Dimensions are given along the bars and are the computed lengths.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U 5 65-5(16)A STA. 648+68.92

TANEY COUNTY

STD 5-818

J-705

Sheet No. 2 of 20

Checked June 1951 By W.C.
Tracked July 1951 By M.M.R.
Checked July 1951 By W.C. M.M.R.

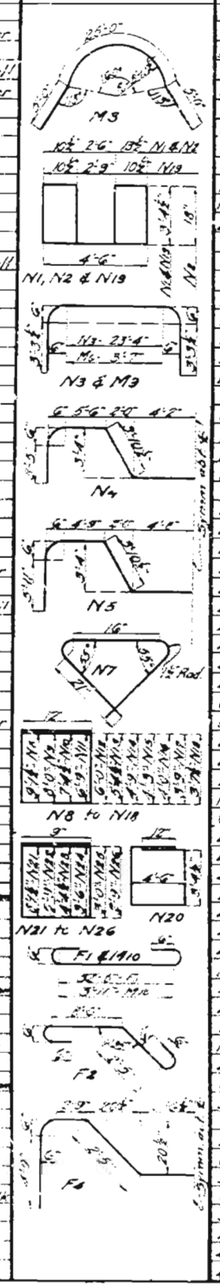
MISSOURI STATE HIGHWAY DEPARTMENT

FED ROAD DIST NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO	1535 3(16)	19		

BILL OF REINFORCING STEEL — CONTINUED FROM SHEET NO. 2

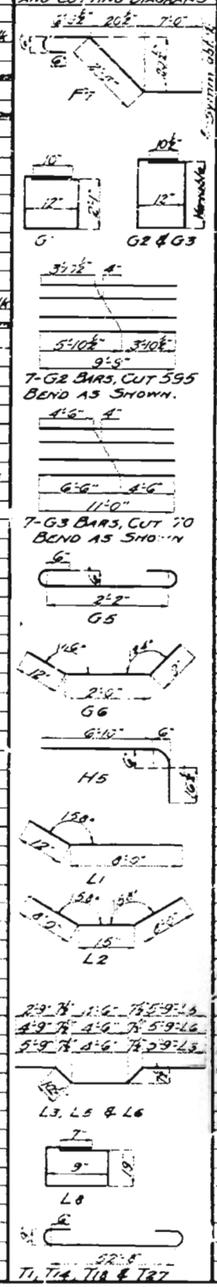
No.	Size	Length	Mark	Location
		PILASTERS		
5	1" ø	15'-0"	M1	Pilaster
5	1" ø	25'-9"	M2	"
12	3/4" ø	35'-0"	M3	Web Wall
132	1" ø	4'-3"	M4	Pilaster
1	1" ø	27'-0"	N5	-
6	1" ø	28'-6"	N6	-
6	1" ø	25'-3"	N7	-
6	1" ø	22'-0"	N8	-
8	3/4" ø	11'-9"	N9	-
16	3/4" ø	6'-6"	N10	-
54	5/8" ø	20'-0"	N11	-
12	5/8" ø	12'-6"	N12	-
20	1" ø	31'-6"	N13	Web Wall
4	1" ø	35'-6"	N14	-
4	1" ø	40'-0"	N15	-
12	1" ø	42'-5"	N16	-
52	5/8" ø	2'-3"	N17	-
4	5/8" ø	21'-3"	N18	-
4	5/8" ø	19'-0"	N19	-
4	5/8" ø	17'-3"	N20	-
4	5/8" ø	16'-6"	N21	-
4	5/8" ø	15'-0"	N22	-
4	5/8" ø	13'-9"	N23	-
4	5/8" ø	12'-6"	N24	-
4	5/8" ø	11'-6"	N25	-
4	5/8" ø	11'-0"	N26	-
4	5/8" ø	10'-6"	N27	-
2	5/8" ø	10'-3"	N28	-
130	5/8" ø	13'-9"	N29	Pilaster
80	5/8" ø	16'-9"	N30	-
8	5/8" ø	18'-6"	N31	Web Wall
8	5/8" ø	9'-3"	N32	-
8	5/8" ø	11'-0"	N33	-
8	5/8" ø	9'-3"	N34	-
8	5/8" ø	5'-3"	N35	-
8	5/8" ø	7'-9"	N36	-
26	1" ø	17'-3"	D1	Pilaster
24	1" ø	40'-0"	D30	-
24	1" ø	41'-6"	D30	-
24	1" ø	38'-3"	D30	-
24	1" ø	36'-9"	D40	-
26	1" ø	31'-6"	D29	-
		SANDRAL BEAMS & BRACKETS		
190	5/8" ø	35'-11"	F1	Sandral Beam
340	3/4" ø	13'-6"	F2	-
170	1" ø	21'-0"	F3	-
170	1" ø	31'-0"	F4	-
350	5/8" ø	7'-0"	F5	Bracket
40	5/8" ø	20'-9"	F6	Sandral Beam
20	1" ø	33'-6"	F7	-
1415	5/8" ø	7'-0"	G1	-
595	5/8" ø	9'-9"	G2	Bracket
70	5/8" ø	11'-0"	G3	-
75	5/8" ø	8'-9"	G5	Sandral Beam
80	5/8" ø	3'-9"	G6	-
		DECK OVER ARCHES		
2162	5/8" ø	6'-3"	H1	Sidewalk
2396	5/8" ø	35'-0"	H2	Slab
262	5/8" ø	23'-6"	H3	"
530	5/8" ø	34'-0"	H4	"
266	5/8" ø	9'-0"	H5	"

Bending Sketches



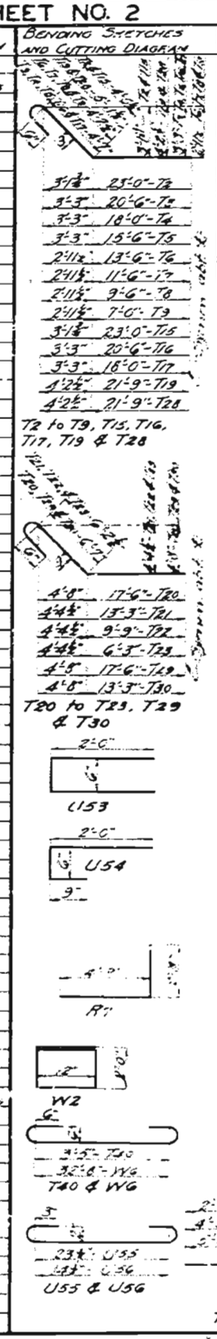
No.	Size	Length	Mark	Location
		DECK OVER ARCHES (CONT'D)		
360	5/8" ø	34'-6"	K1	Sidewalk
1092	5/8" ø	21'-9"	K2	Slab
120	5/8" ø	9'-0"	L1	Spdrl Arches
41a	5/8" ø	17'-3"	L2	-
320	5/8" ø	17'-9"	L3	Fascia Beam
360	5/8" ø	11'-0"	L4	-
24	5/8" ø	14'-9"	L5	-
16	5/8" ø	16'-9"	L6	-
270	5/8" ø	27'-0"	L7	-
181	5/8" ø	5'-3"	L8	-
3620	5/8" ø	15"	L9	Curb
		GIRDER SPANS		
304	5/8" ø	6'-3"	H1	Sidewalk
200	5/8" ø	5'-3"	L8	Fascia Beam
304	5/8" ø	12"	L10	-
336	5/8" ø	21'-9"	S1	Slab
110	5/8" ø	18'-6"	S2	-
80	5/8" ø	28'-3"	S3	-
45	5/8" ø	29'-3"	S4	-
10	5/8" ø	20'-9"	S5	-
28	5/8" ø	2'-0"	S6	-
16	1 1/8" ø	56'-6"	T1	Girders
4	1 1/8" ø	58'-3"	T2	-
4	1 1/8" ø	53'-6"	T3	-
4	1 1/8" ø	48'-6"	T4	-
4	1 1/8" ø	43'-6"	T5	-
4	1 1/8" ø	38'-9"	T6	-
4	1 1/8" ø	34'-3"	T7	-
4	1 1/8" ø	30'-9"	T8	-
4	1 1/8" ø	25'-9"	T9	-
2	1 1/8" ø	36'-0"	T10	-
4	1 1/8" ø	24'-0"	T11	-
6	1 1/8" ø	20'-0"	T12	-
10	1 1/8" ø	56'-0"	T14	-
6	1" ø	28'-3"	T15	-
4	1" ø	53'-6"	T16	-
2	1" ø	48'-6"	T17	-
10	1 1/8" ø	56'-0"	T18	-
6	1 1/8" ø	58'-3"	T19	-
6	1 1/4" ø	56'-6"	T20	-
4	1 1/2" ø	42'-3"	T21	-
2	1 1/8" ø	35'-3"	T22	-
2	1 1/8" ø	28'-3"	T23	-
4	1" ø	53'-6"	T24	-
4	1 1/8" ø	32'-0"	T25	-
4	1 1/8" ø	24'-0"	T26	-
10	1" ø	56'-0"	T27	-
4	1" ø	50'-9"	T28	-
4	1" ø	51'-6"	T29	-
2	1" ø	43'-0"	T30	-
16	1" ø	27'-6"	T31	-
4	1" ø	53'-6"	T32	-
8	1" ø	13'-6"	T33	-
32	1" ø	11'-9"	T35	-
6	1" ø	14'-9"	T25	-
26	1" ø	17'-9"	T36	-
8	1" ø	16'-9"	T37	-
32	1" ø	11'-6"	T38	-
8	1" ø	38'-0"	T39	-
32	1" ø	6'-0"	T40	-
4	1" ø	17'-3"	U1	-
4	1" ø	16'-6"	U2	-
4	1" ø	16'-0"	U3	-

Bending Sketches and Cutting Diagrams



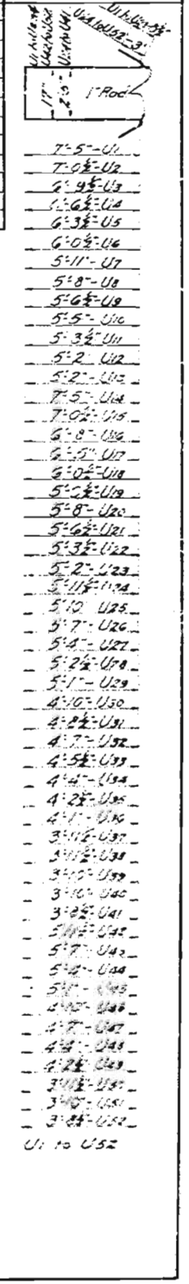
No.	Size	Length	Mark	Location
		GIRDER SPANS (CONT'D)		
4	1" ø	15'-6"	U4	Girders
4	1" ø	15'-0"	U5	-
4	1" ø	14'-6"	U6	-
4	1" ø	14'-3"	U7	-
4	1" ø	13'-9"	U9	-
4	1" ø	13'-6"	U9	-
4	1" ø	13'-3"	U10	-
4	1" ø	13'-0"	U11	-
4	1" ø	12'-9"	U12	-
62	1" ø	12'-9"	U13	-
4	1" ø	17'-3"	U14	-
4	1" ø	16'-6"	U15	-
4	1" ø	15'-9"	U16	-
4	1" ø	15'-3"	U17	-
4	1" ø	14'-6"	U18	-
4	1" ø	14'-0"	U19	-
4	1" ø	13'-9"	U20	-
4	1" ø	13'-6"	U21	-
4	1" ø	12'-9"	U22	-
52	1" ø	12'-9"	U23	-
4	1" ø	15'-3"	U24	-
4	1" ø	15'-0"	U25	-
4	1" ø	14'-6"	U26	-
4	1" ø	14'-0"	U27	-
4	1" ø	13'-9"	U28	-
4	1" ø	13'-6"	U29	-
4	1" ø	13'-0"	U30	-
4	1" ø	12'-9"	U31	-
4	1" ø	12'-6"	U32	-
4	1" ø	12'-3"	U33	-
4	1" ø	12'-0"	U34	-
4	1" ø	11'-3"	U35	-
4	1" ø	11'-6"	U36	-
4	1" ø	11'-3"	U37	-
4	1" ø	11'-3"	U38	-
4	1" ø	11'-0"	U39	-
4	1" ø	11'-0"	U40	-
88	1" ø	10'-9"	U41	-
8	1" ø	14'-3"	U42	-
4	1" ø	13'-6"	U43	-
4	1" ø	13'-0"	U44	-
8	1" ø	12'-6"	U45	-
4	1" ø	12'-0"	U46	-
4	1" ø	11'-6"	U47	-
4	1" ø	11'-0"	U48	-
4	1" ø	10'-9"	U49	-
4	1" ø	10'-3"	U50	-
4	1" ø	10'-0"	U51	-
58	1" ø	9'-9"	U52	-
138	1" ø	4'-6"	U53	-
38	1" ø	9'-3"	U54	-
54	1" ø	3'-0"	U55	-
46	1" ø	2'-3"	U56	-
24	1" ø	21'-6"	W1	Necks & Brackets
102	1" ø	7'-0"	W2	-
34	1" ø	9'-9"	W3	-
48	1" ø	7'-0"	W4	-
48	1" ø	13'-6"	W5	-
24	1" ø	35'-3"	W6	-

Bending Sketches and Cutting Diagrams



No.	Size	Length	Mark	Location
		HANDRAIL		
1568	1/2" ø	8'-3"	R1	Rail
1396	1/2" ø	7'-0"	R2	-
372	5/8" ø	7'-6"	R3	Posts
558	5/8" ø	5'-0"	R4	-
48	5/8" ø	7'-6"	R5	-
68	1/2" ø	4'-9"	R6	-
24	5/8" ø	7'-0"	R7	-
24	5/8" ø	3'-0"	R8	-
32	5/8" ø	7'-3"	R9	Rail

Bending Sketch



U1	7'-5"
U2	7'-0½"
U3	6'-9½"
U4	6'-6½"
U5	6'-3½"
U6	6'-0½"
U7	5'-11"
U8	5'-8"
U9	5'-6½"
U10	5'-5"
U11	5'-3½"
U12	5'-2"
U13	5'-2"
U14	7'-5"
U15	7'-0½"
U16	6'-8"
U17	6'-5"
U18	6'-0½"
U19	5'-5½"
U20	5'-8"
U21	5'-6½"
U22	5'-3½"
U23	5'-2"
U24	5'-11"
U25	5'-10"
U26	5'-7"
U27	5'-4"
U28	5'-2½"
U29	5'-1"
U30	4'-10½"
U31	4'-8½"
U32	4'-7"
U33	4'-5½"
U34	4'-4"
U35	4'-2½"
U36	4'-1"
U37	3'-11½"
U38	3'-10½"
U39	3'-10"
U40	3'-8½"
U41	5'-11½"
U42	5'-7"
U43	5'-4"
U44	5'-1"
U45	4'-10½"
U46	4'-8½"
U47	4'-7"
U48	4'-5½"
U49	4'-4"
U50	4'-2½"
U51	4'-1"
U52	3'-11½"

Note - Reinforcing bars over ¾" in diameter, which are bent to an angle greater than 90° shall be of structural grade. Dimensions are given along ℄ of bars and are for computed lengths.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILE SOUTH OF BRANSON

PROJECT NO U.S 65-5(16)A STA 644+88.92

TANEY COUNTY

STD. SHT. B

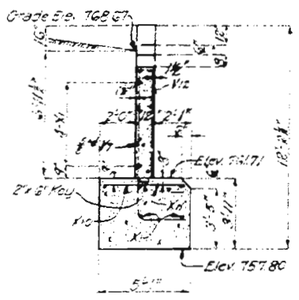
J-705

Sheet No 3 of 20

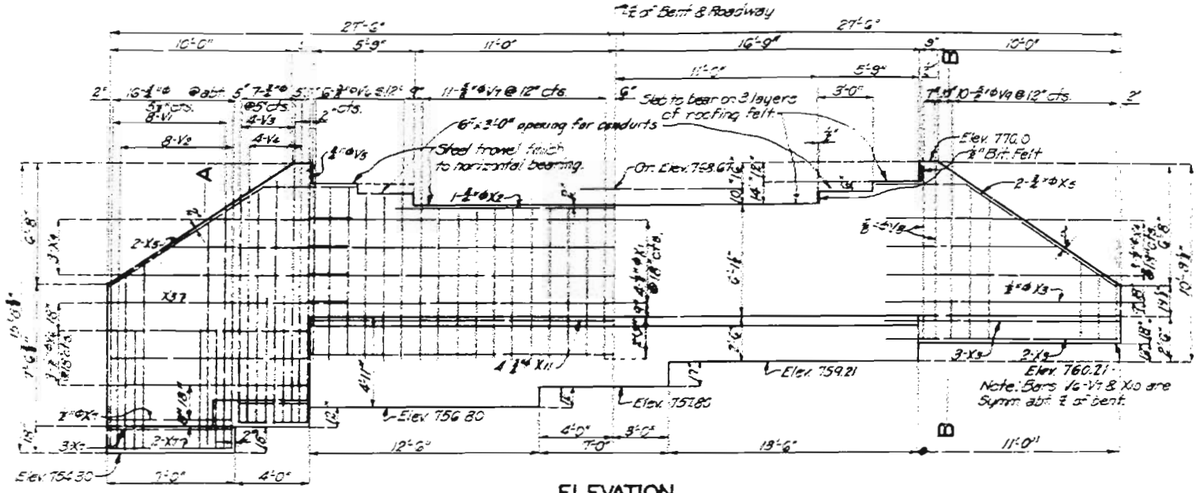
Drawn June 1938 by H.D.
Traced July 1938 by J.H.F.
Checked July 1938 by C.C.L.

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	US65-3(164) 193			

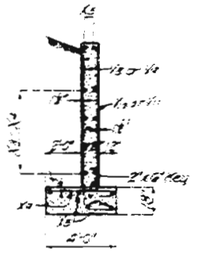


SECTION AT ℄ ROADWAY



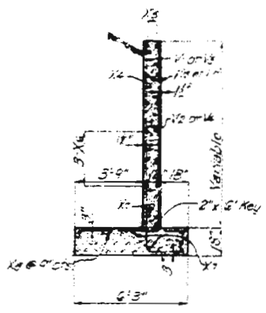
ELEVATION

Showing Reinforcing in Fill Face only.



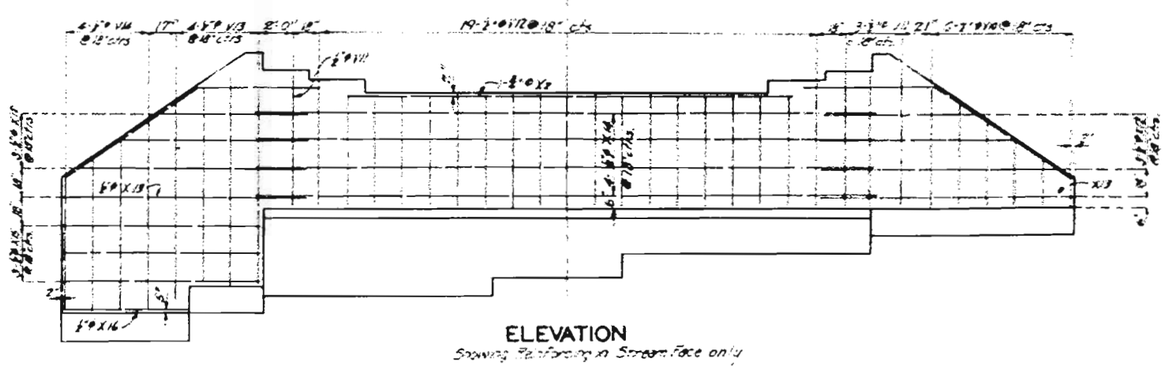
SECTION B-B

Note: Concrete in wings and cap shall be kept at same elevation throughout pouring. Wings to be at least 6" into solid rock



SECTION A-A

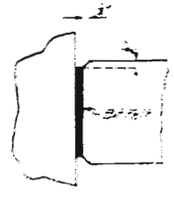
PLAN



ELEVATION

Showing Reinforcing in Stream Face only

DETAILS OF ABUTMENT NO. 1



Note: Use Level on wings for checking forms and joints preceding the placing of bituminous felt

DETAIL OF BEVEL FOR BIT. FELT JOINTS

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILE SOUTH OF BRANSON

PROJECT NO. US65-5(15)A STA. 548+88.92

TANEY COUNTY

APPROVED BY _____ DATE 7-20-51

APPROVED BY _____ DATE 7-20-51

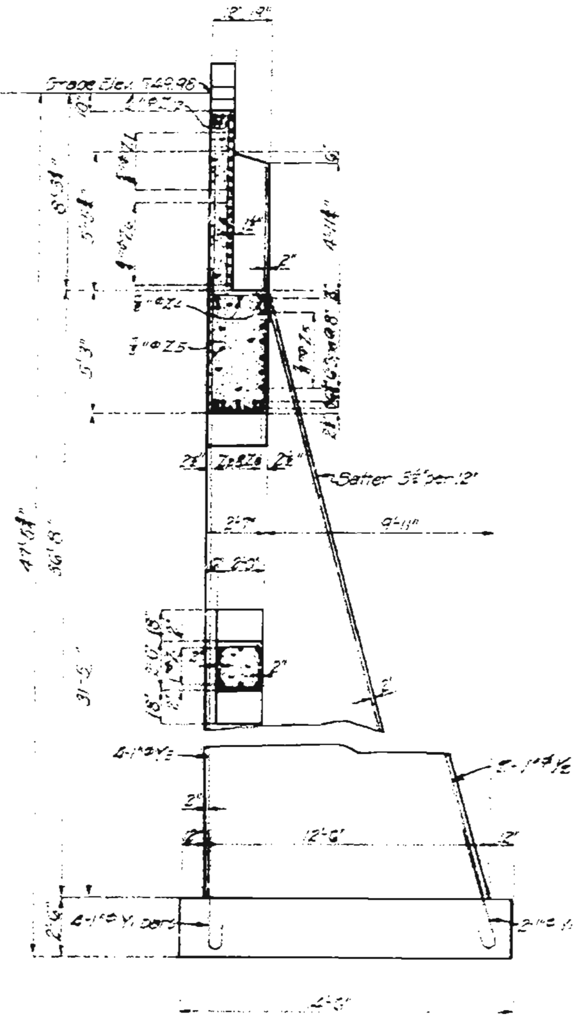
STD. SB.8

J-705

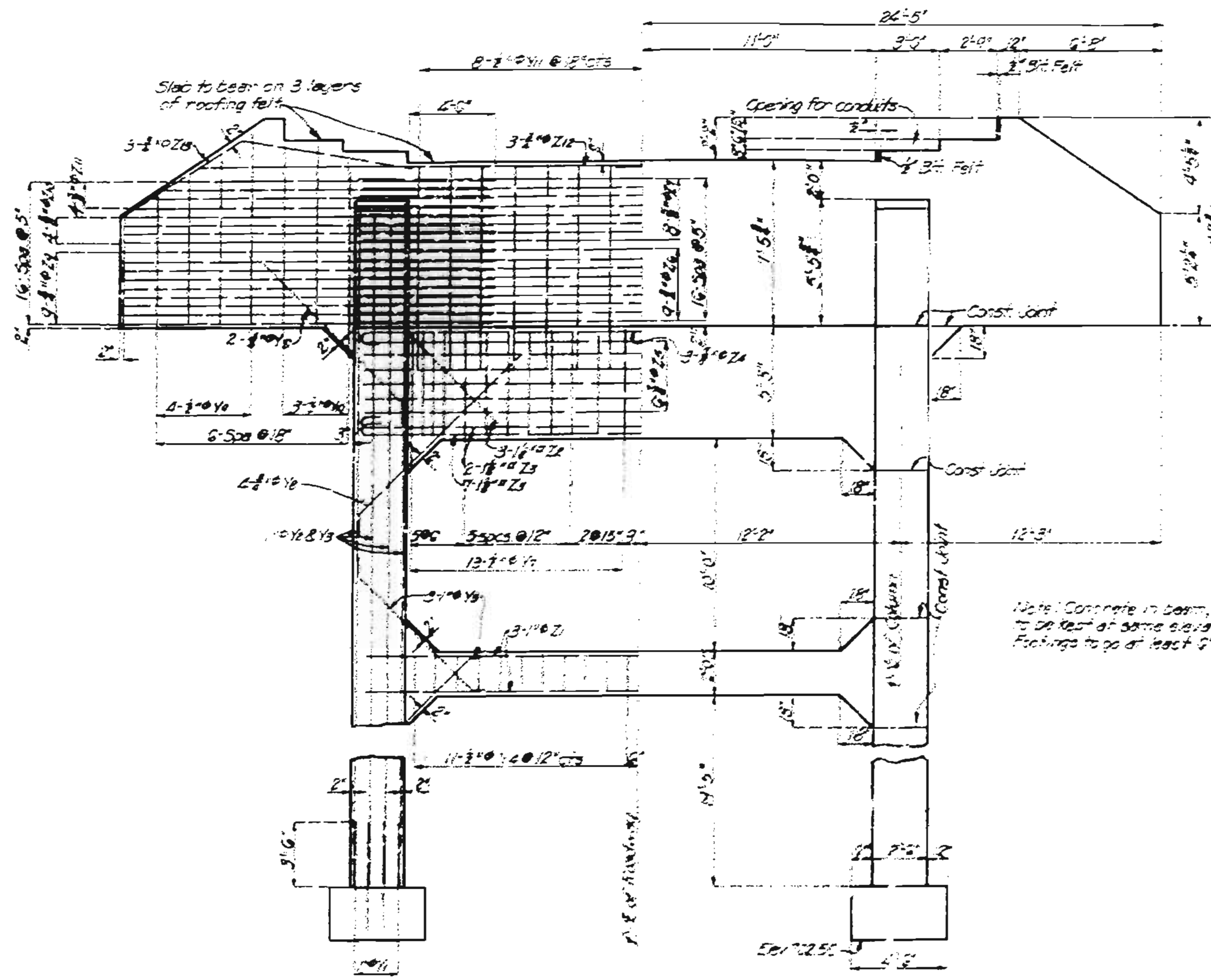
Sheet No. 4 of 30

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S. 65-SII6A	15		

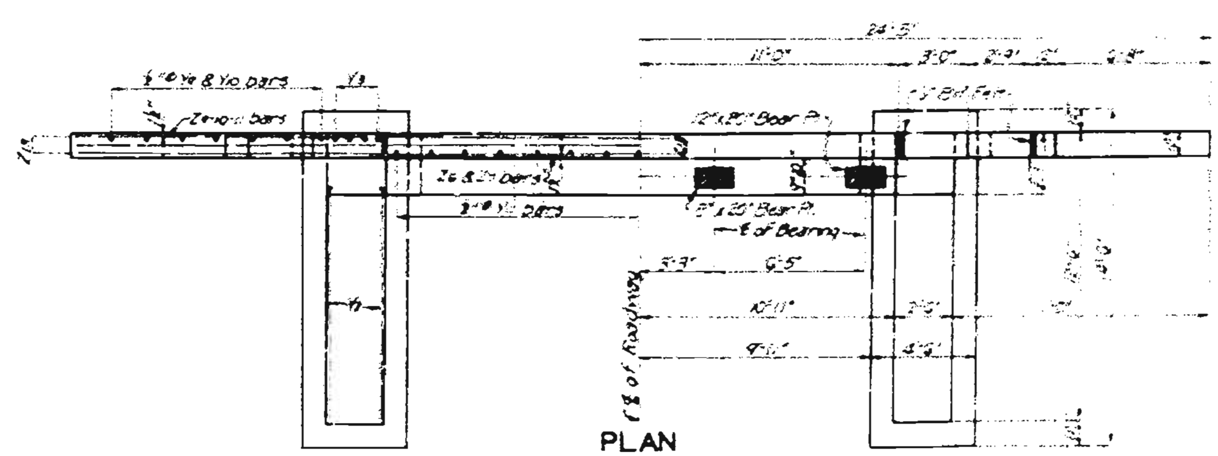


SECTION AT ℄



Note: Concrete in beam, wings and columns to be kept at same elevation thru out pouring. Footings to go at least 3" into solid rock.

ELEVATION



PLAN

DETAILS OF BENT NO. 8

Designed May 1935 By H.D.
Drawn June 1935 By ...
Traced June 1935 By ...
Checked July 1935 By ...

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S. 65-SII6A STA. 648+58.32

TANEY COUNTY

Submitted by: ... Bridge Engineer

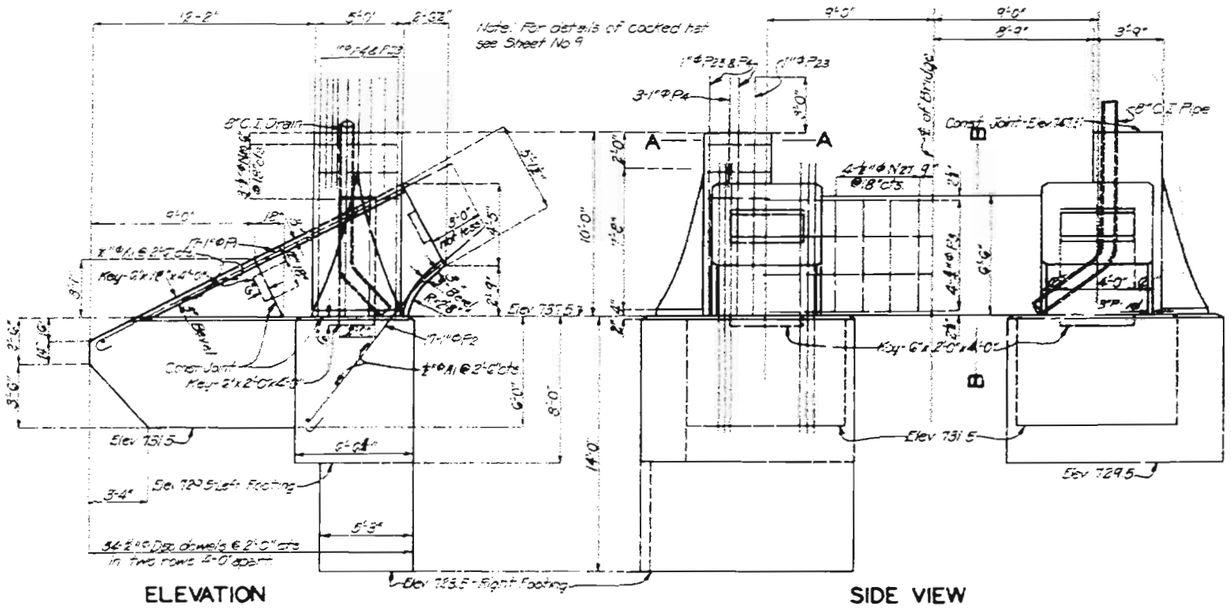
Approved by: ... Chief Engineer

STD. S-8.8

J-705

MISSOURI STATE HIGHWAY DEPARTMENT

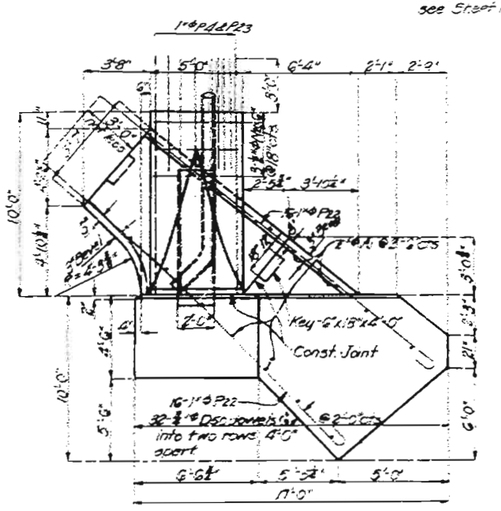
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
S	MO.	BRF-S-(2)	39		



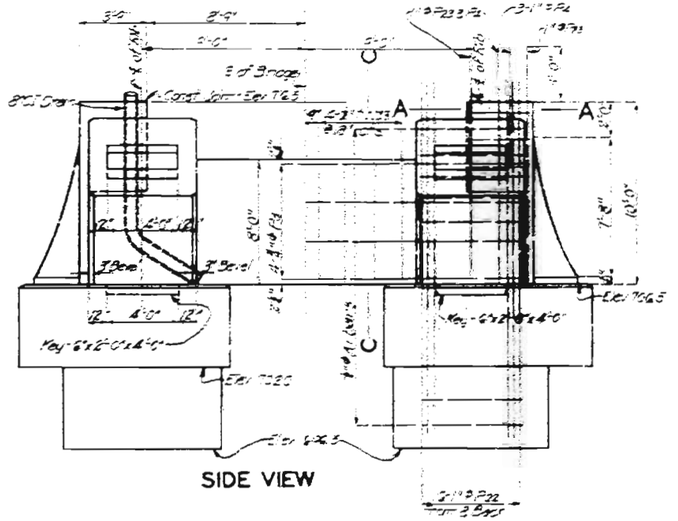
ELEVATION

SIDE VIEW

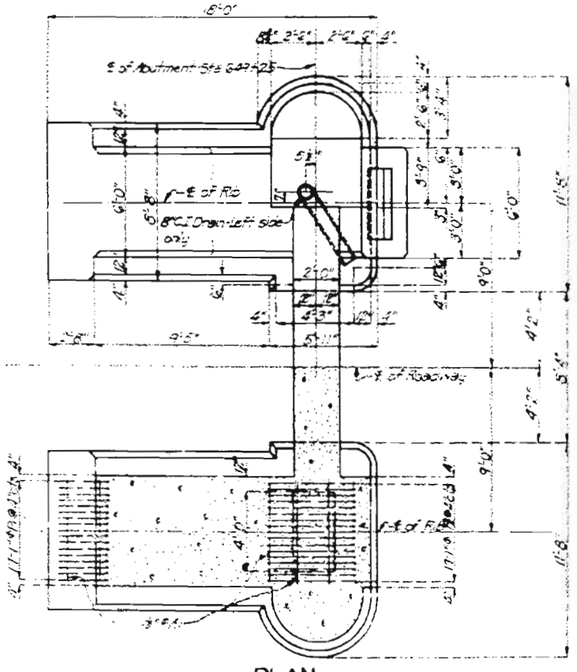
Note: Holes to be drilled 12' into solid rock, filled with cement grout and 1 #8 bars driven into grout.



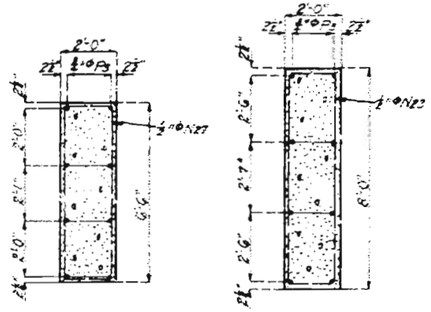
ELEVATION



SIDE VIEW

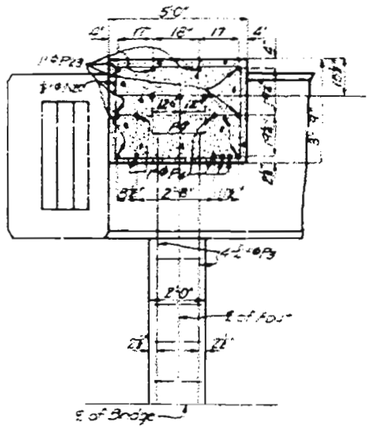


PLAN



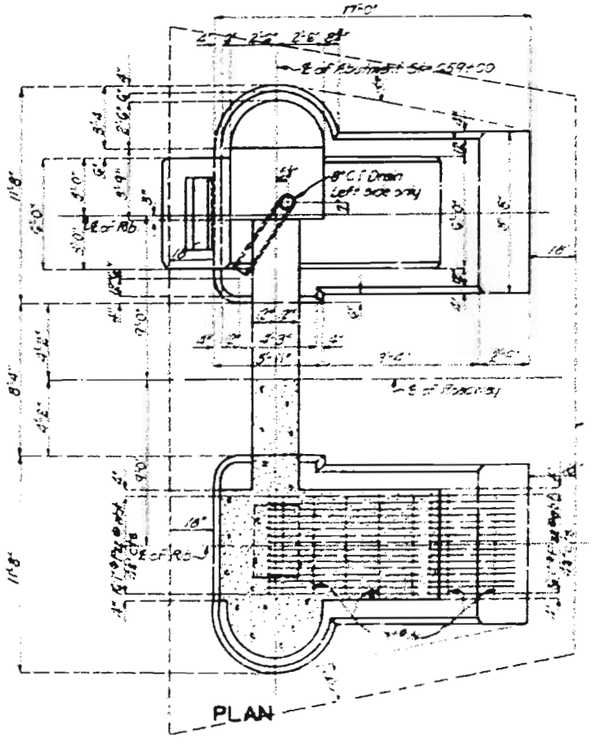
SECTION B-B

SECTION C-C



SECTION A-A

DETAILS OF ABUTMENT NO. 2



PLAN

Note: Keys in arch ring to be 2' deep, 6'-0" long and one third ring thickness in width.

Note: Rock to be excavated as near as possible to lines of footings, and concrete cast against firm solid rock.

Maximum horizontal limits of excavation to be paid for.

DETAILS OF ABUTMENT NO. 7

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S. 65-SIR&A STA. 644+88.92

TANEY COUNTY

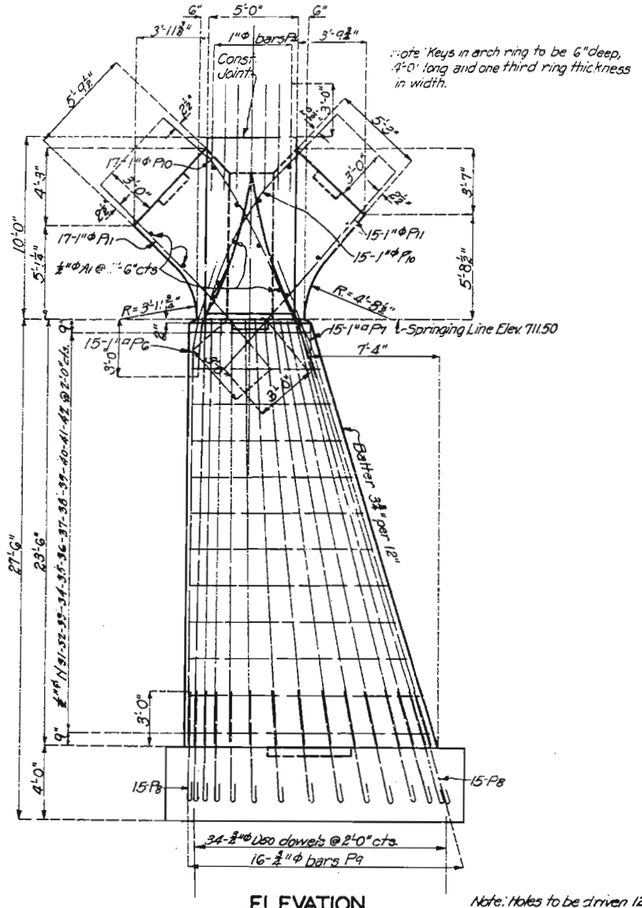
STD. S-3.0

J-705

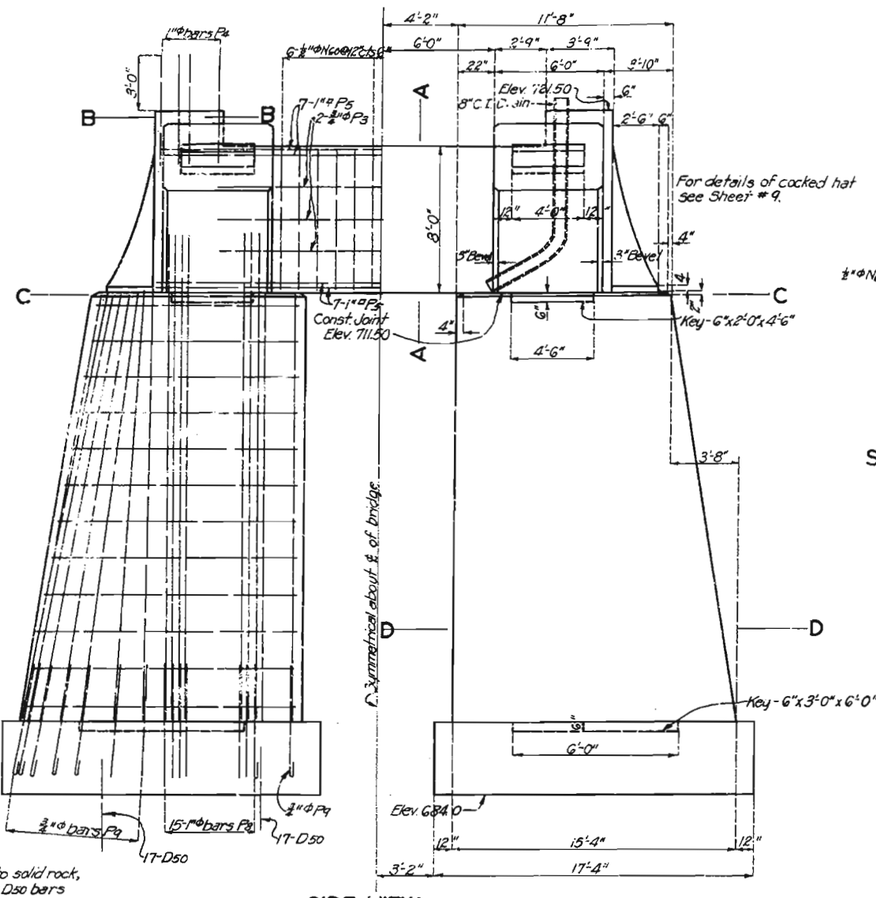
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-5116A	19		

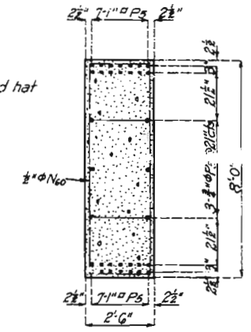
Note: Keys in arch ring to be 6" deep, 9'-0" long and one third ring thickness in width.



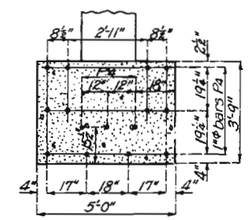
ELEVATION



SIDE VIEW



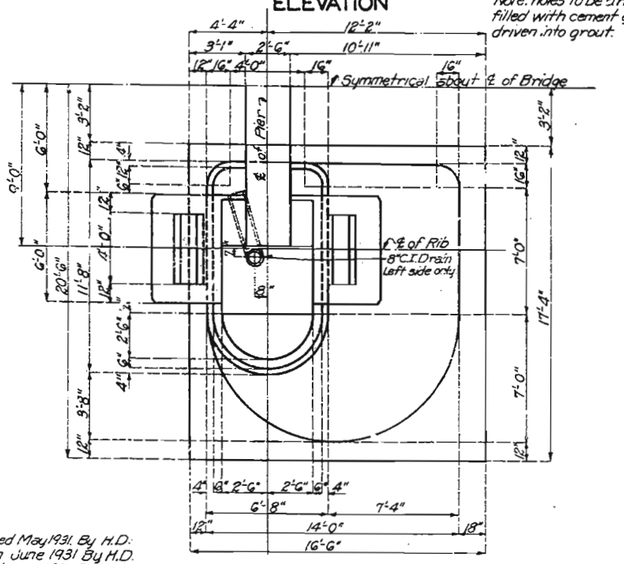
SECTION A-A



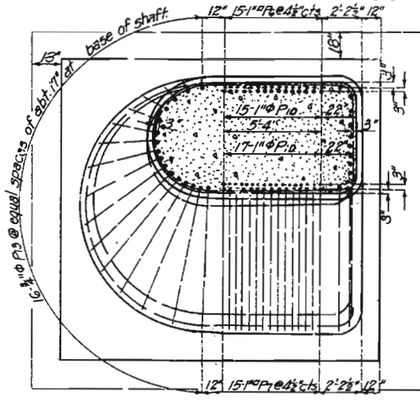
SECTION B-B

Note: Footings to go at least 18" into solid rock.

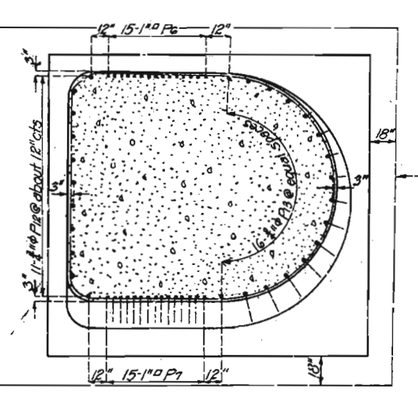
Note: Holes to be driven 12" into solid rock, filled with cement grout and D50 bars driven into grout.



HALF PLAN



HALF SECTION C-C



HALF SECTION D-D

Designed May 1931 By H.D.
Drawn June 1931 By H.D.
Traced June 1931 By H.W.H.
Checked July 1931 By A.L. & F.C.L.

DETAILS OF PIER NO. 3

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER
ABOUT 0.75 MILES SOUTH OF BRANSON
PROJECT NO. U.S.65-5116A STA. 648+68.92

TANEY COUNTY

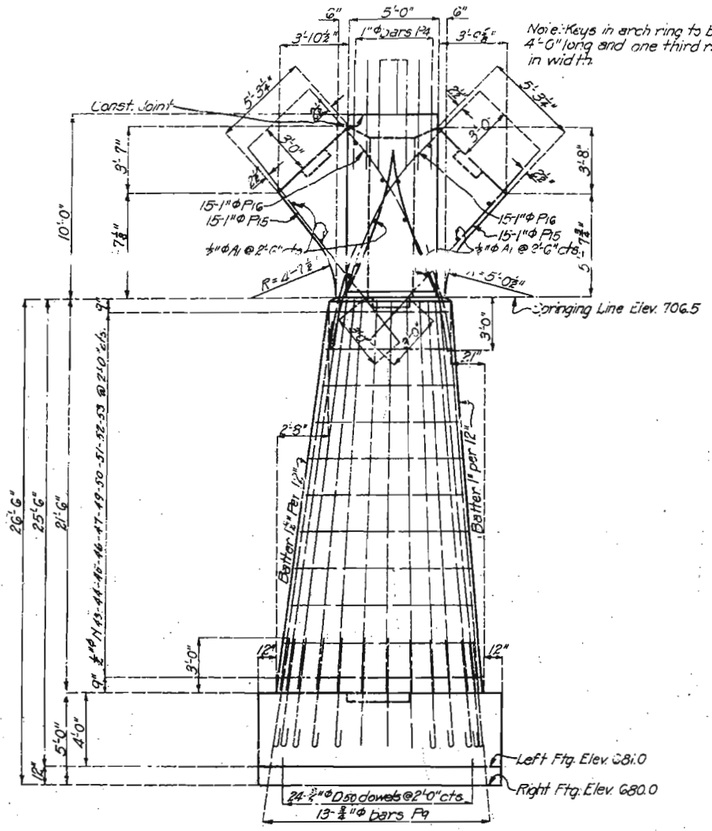
SUBMITTED BY N. R. Lacy, BRIDGE ENGINEER, DATE 7/20/31
APPROVED BY T. A. Reilly, CHIEF ENGINEER, DATE 7/20/31

FINISHED

STD. S-818
J-705

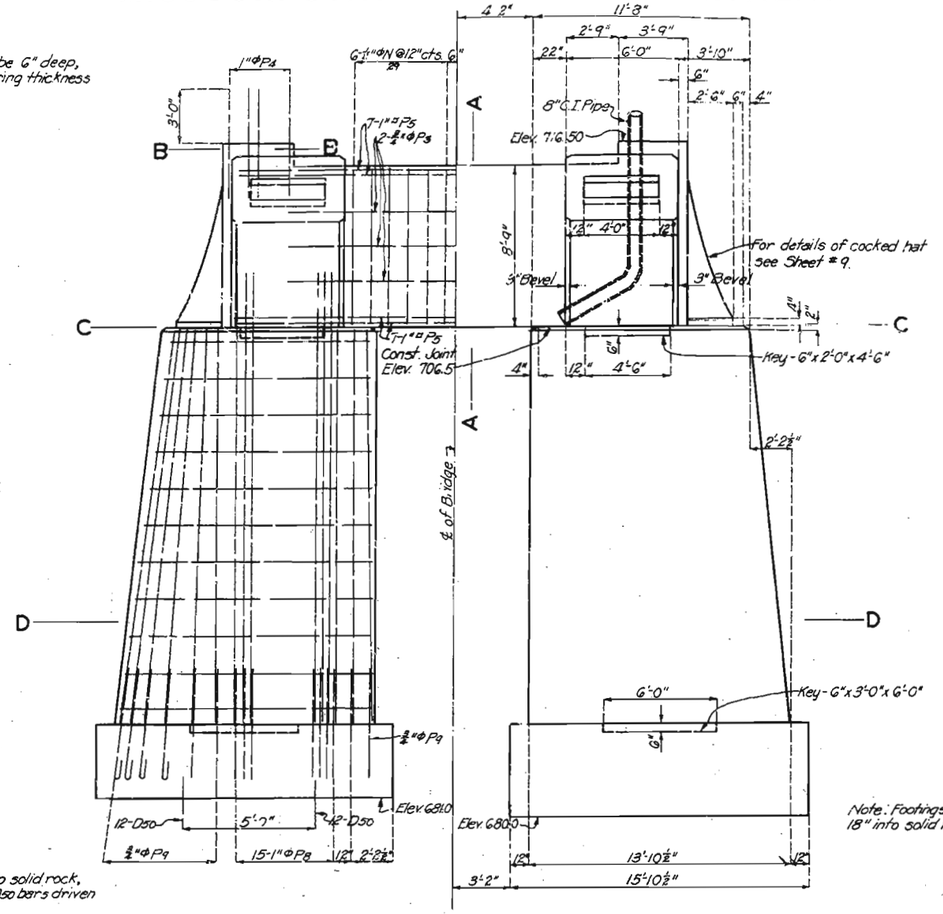
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U565-5(16A)	19		

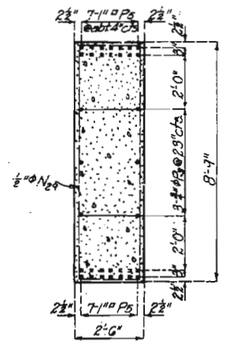


ELEVATION

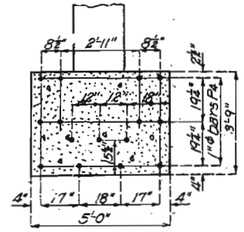
Note: Holes to be drilled 12" into solid rock, filled with cement grout and Dso bars driven into grout.



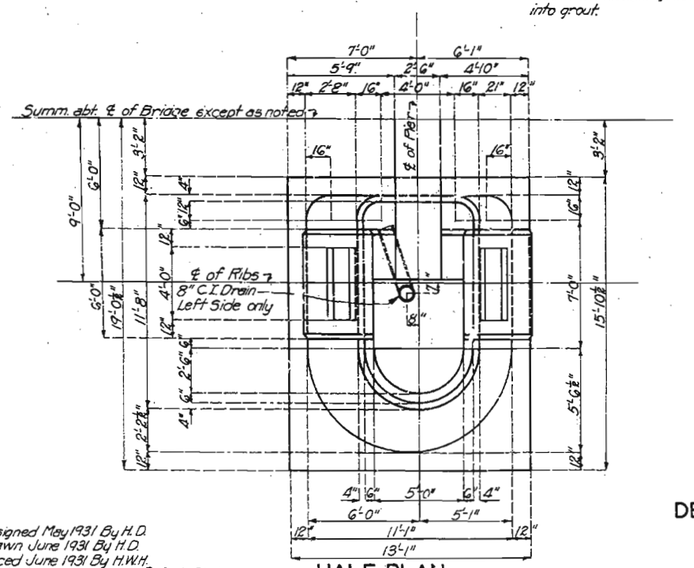
SIDE VIEW

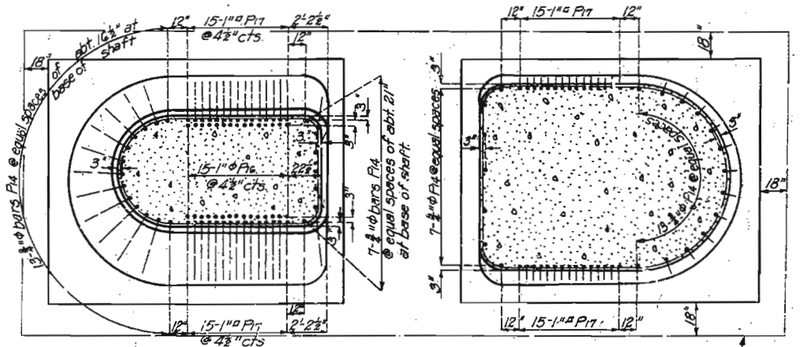


SECTION A-A



SECTION B-B





HALF SECTION C--C

HALF SECTION D-D

DETAILS OF PIER NO. 4

Designed May 1931 By H.D.
Drawn June 1931 By H.D.
Traced June 1931 By H.W.H.
Checked July 1931 By R.C. & F.C.L.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S. 65-S116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY M.R. Lack DATE BRIDGE ENGINEER 7/20/31

APPROVED BY H.S. Kelly DATE CHIEF ENGINEER 7/20/31

FINISHED

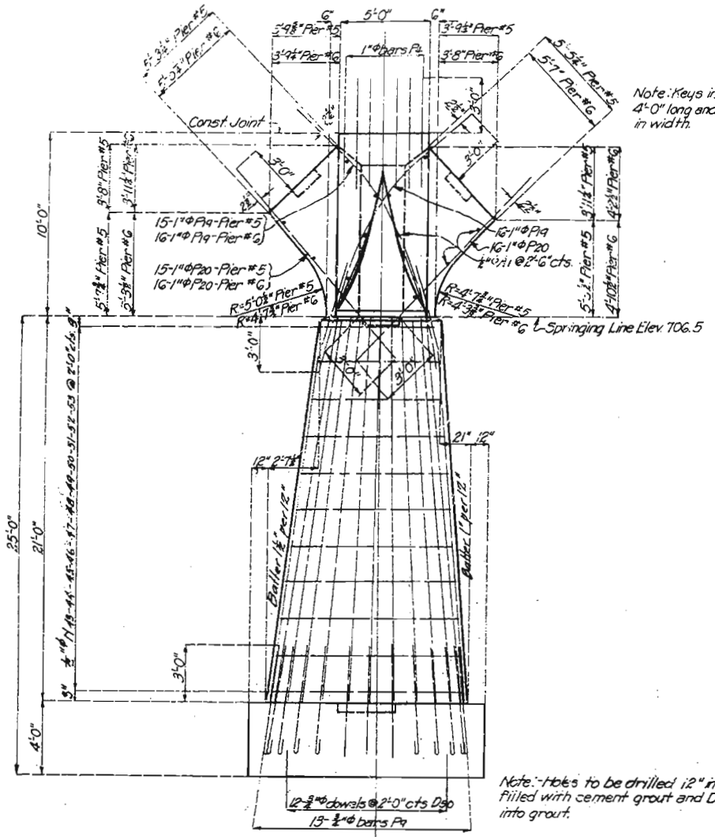
FINISHED

STD. S-818

J-705

MISSOURI STATE HIGHWAY DEPARTMENT

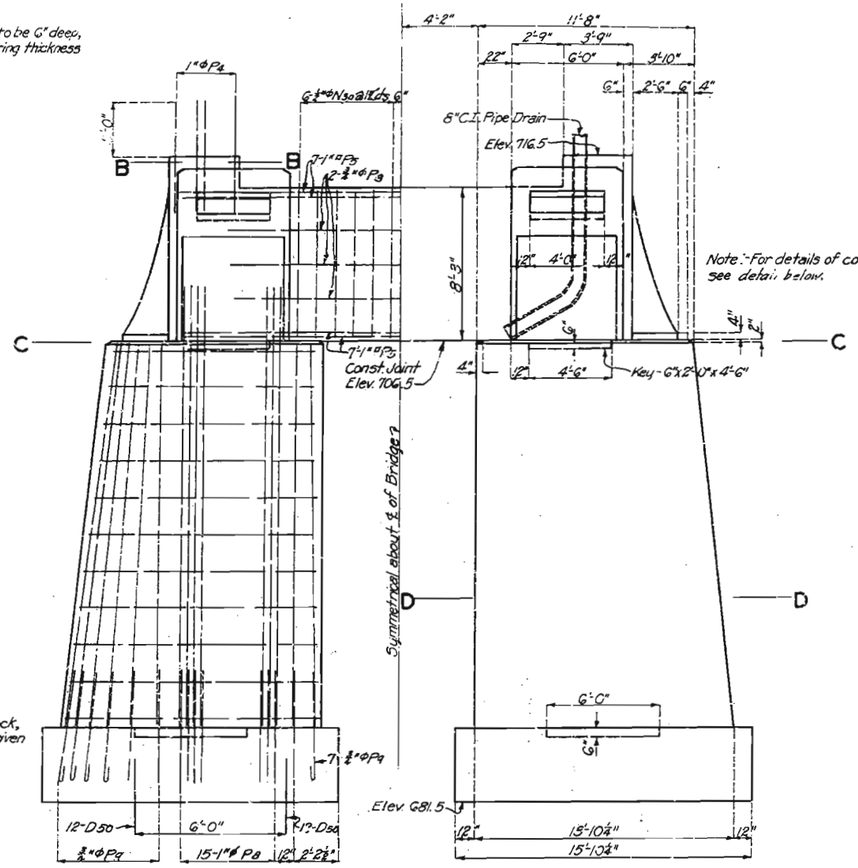
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-S116A	19		



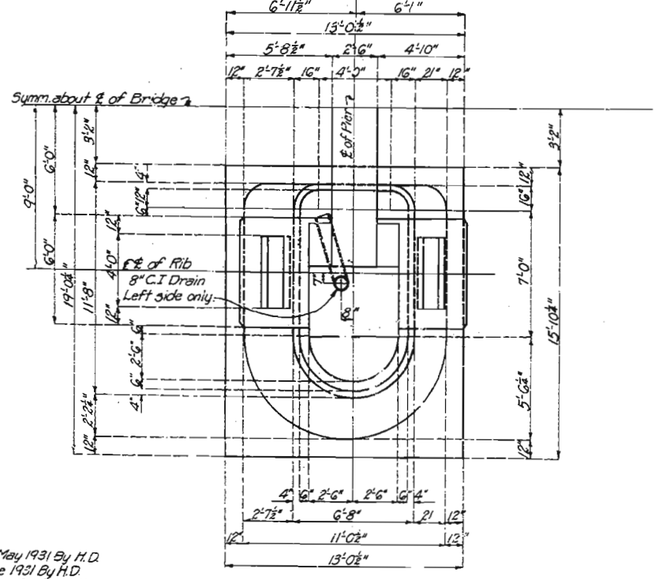
ELEVATION

Note:- Keys in arch ring to be 6" deep, 4'-0" long and one third ring thickness in width.

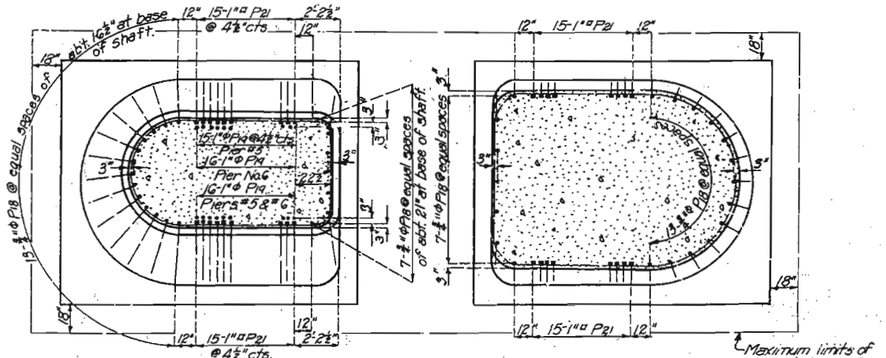
Note:- Holes to be drilled 12" into solid rock, Filled with cement grout and D50 bars driven into grout.



SIDE VIEW



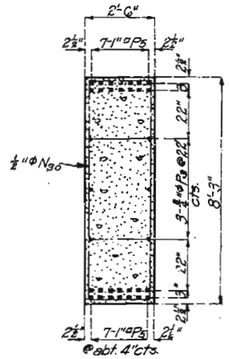
HALF PLAN



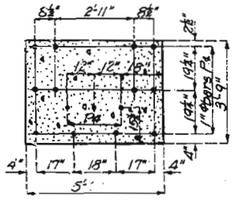
HALF SECTION C-C

HALF SECTION D-D

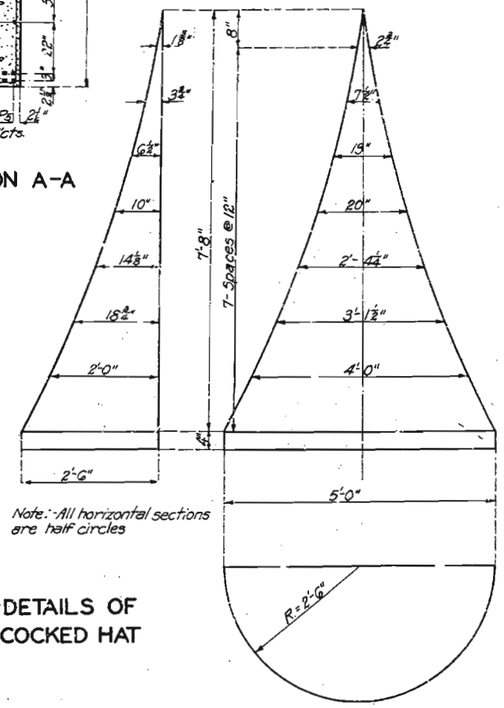
Note:- Footings to go at least 18" into solid rock.



SECTION A-A



SECTION B-B



Note:- All horizontal sections are half circles

DETAILS OF COCKED HAT

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S. 65-S116A STA. 643+68.92

TANEY COUNTY

SUBMITTED BY M.R. Lowe DATE 7/20/31 BRIDGE ENGINEER

APPROVED T.H. Hartley DATE 7/20/31 CHIEF ENGINEER

Designed May 1931 By H.D.
Drawn June 1931 By H.D.
Traced June 1931 By H.W.H.
Checked July 1931 By R.C.S. & F.C.L.

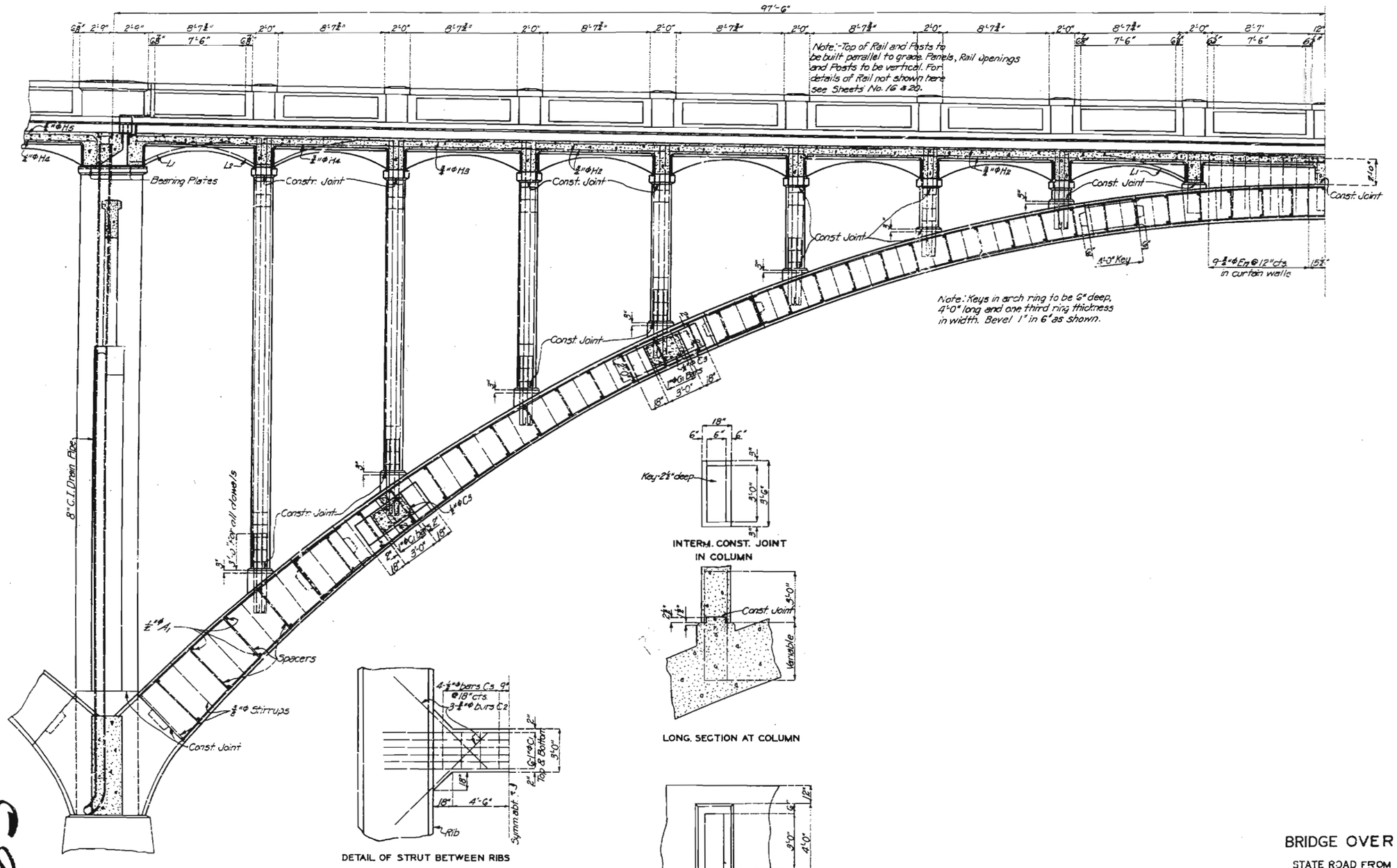
DETAILS OF PIERS NO. 5 & NO. 6

STD. S-818

J-705

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U565-5(16)	193		



DETAIL OF STRUT BETWEEN RIBS

INTERM. CONST. JOINT IN COLUMN

LONG. SECTION AT COLUMN

SECTION AT TOP OF BASE

DETAILS OF CONST. JOINTS IN SPANDREL COLUMNS

TYPICAL HALF SECTION THRU ARCH SPAN AT CENTERLINE OF ROADWAY

165

Designed May 1931 by H.H.M.
Drawn May 1931 By H.D.
Traced June 1931 By H.W.H.
Checked July 1931 By F.C.L.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER
ABOUT 0.75 MILE SOUTH OF BRANSON
PROJECT NO. US65-S116A STA. 648 + 68.92

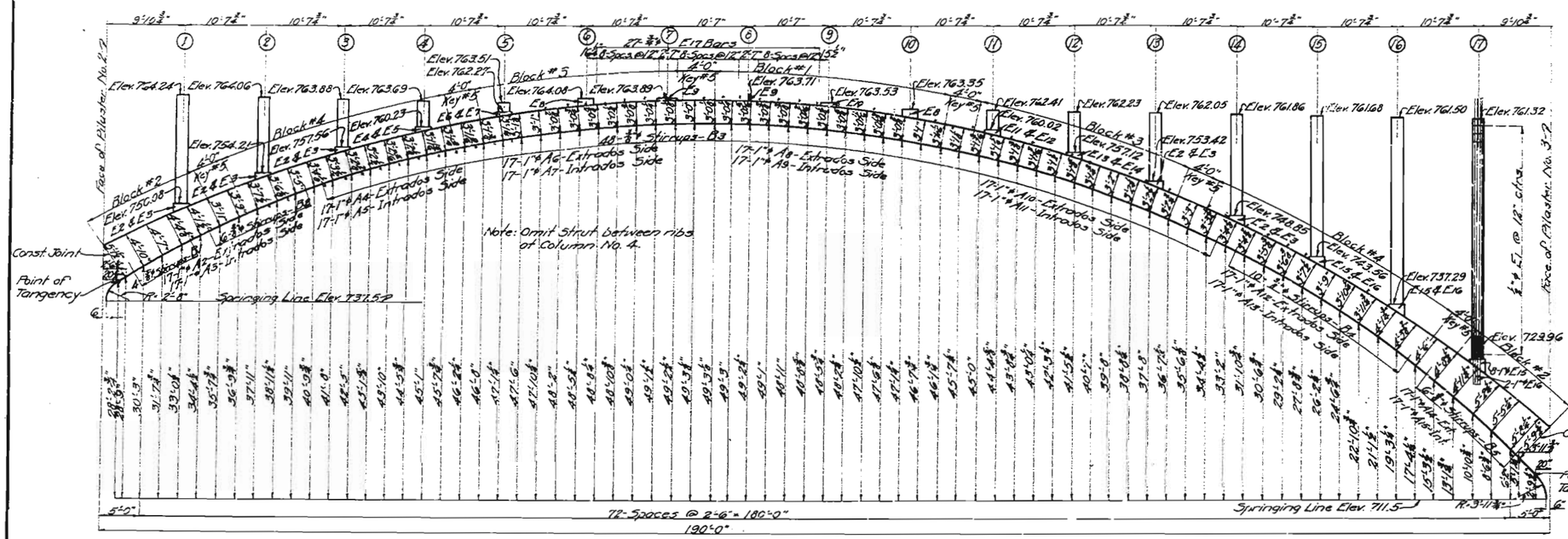
TANEY COUNTY

SUBMITTED BY ... DATE 7/20/31 ... BRIDGE ENGINEER
APPROVED BY ... DATE 7/20/31 ... CHIEF ENGINEER

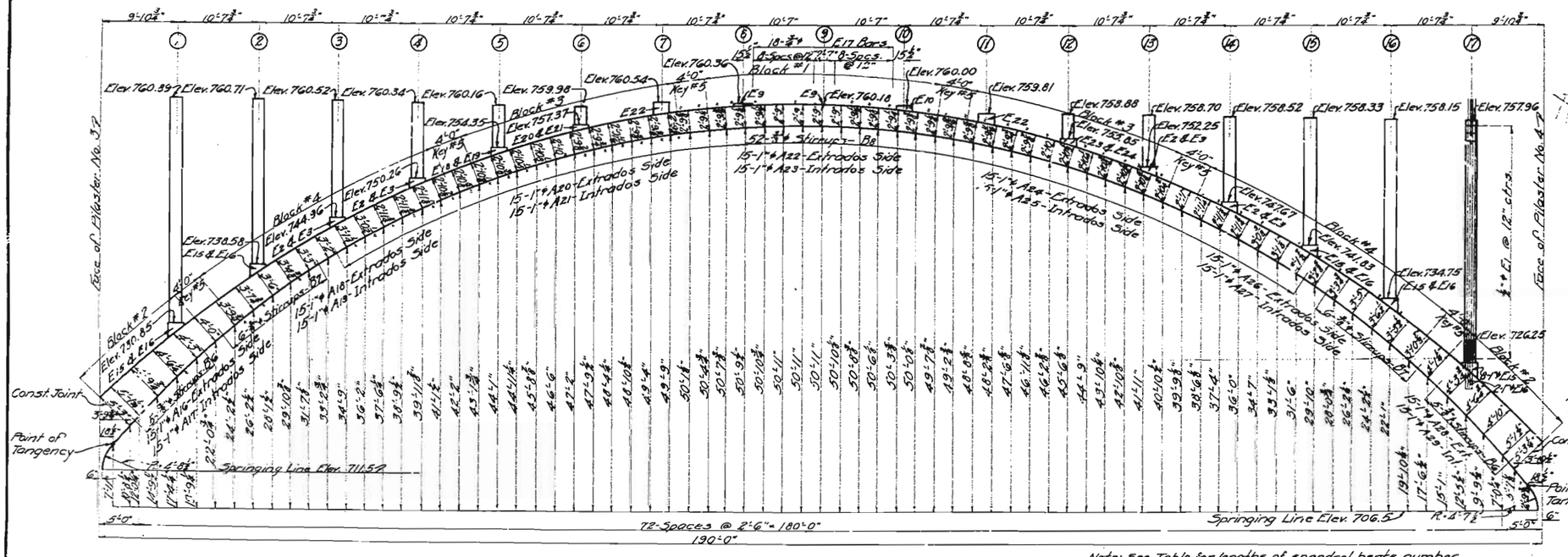
STD. S818
J-705

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-116A	19		



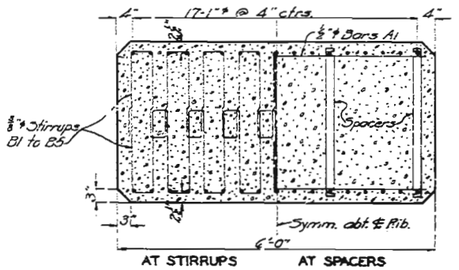
SPAN 2-3



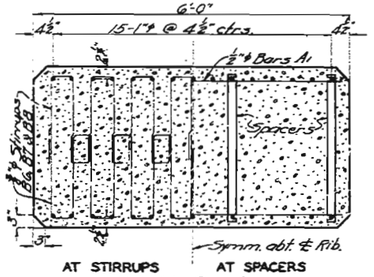
SPAN 3-4

Designed May 1931 by H.H.M.
Drawn June 1931 by R.J.G. & C.A.F.
Checked July 1931 by F.C.L. & H.H.M.

DETAILS SHOWING DIMENSIONS OF ARCH RINGS



SPAN 2-3



SPAN 3-4

HALF SECS. THRU RIBS SHOWING REINF.

Note:- Spacers and ½"ϕ bars A1 at 2'-6" ctrs. measured horizontally, to be placed in ribs at points where ordinates are shown in "Details Showing Dimensions of Arch Rings." Stirrups to be placed midway between spacers.
Wire spacers securely to both main and transverse steel.
See Table on Sheet No. 12 for number and length of spacers.

TABLE OF SPANDREL BENT DATA

	SPAN 2-3			SPAN 3-4			
Bent No.	Column Length	No. E Bars	D-Bars	Bent No.	Column Length	No. E Bars	D-Bars
1	14'-1⅞"	15	D2	1	30'-0½"	31	D11
2	9'-10½"	10	D3	2	22'-1⅜"	23	D12
3	6'-3⅝"	7	D4	3	15'-6⅜"	16	D13
4	3'-5½"	4		4	10'-1"	11	D14
5	1'-2⅞"	2		5	5'-9⅜"	6	
6	0	0		6	2'-7⅞"	3	
7	0	0		7	0	0	
8	0	0		8	0	0	
9	0	0		9	0	0	
10	0	0		10	0	0	
11	2'-4⅝"	3		11	0	0	
12	5'-1⅞"	6		12	3'-0⅞"	4	
13	8'-7⅛"	9	D5	13	6'-4⅜"	7	D15
14	13'-0⅛"	14	D6	14	10'-10⅝"	11	D16
15	18'-1⅛"	19	D7	15	16'-6"	17	D17
16	24'-2⅛"	25	D8	16	23'-4⅜"	24	D18
17	31'-4⅜"	32	D9	17	31'-8⅝"	32	D19

Note: See Bill of Reinforcing Steel, Sheet No. 2 for length of "D" Bars in Spandrel bent.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER
ABOUT 0.75 MILES SOUTH OF BRANSON
PROJECT NO. U.S.65-116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY M.R. Lark, BRIDGE ENGINEER, DATE 7/20/31
APPROVED BY T. Hatley, CHIEF ENGINEER, DATE 7/20/31

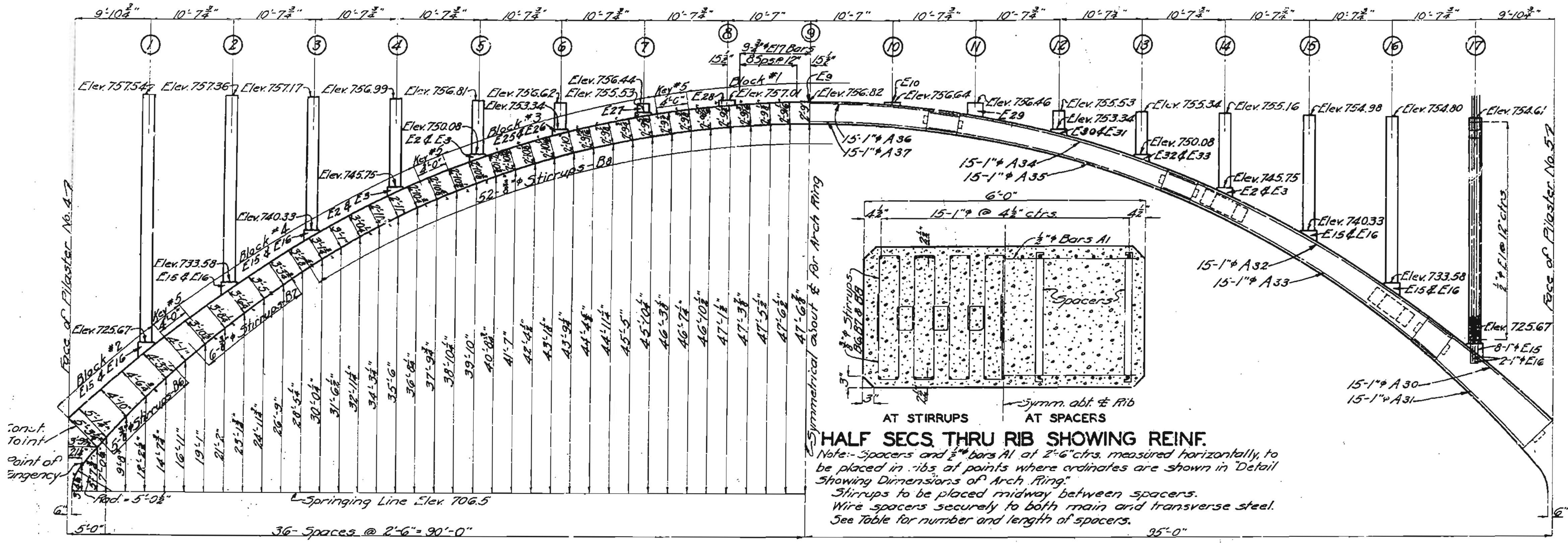
FINISHED

STD. S-818
J-705

Sheet No. 11 of 20.

106

MISSOURI STATE HIGHWAY DEPARTMENT

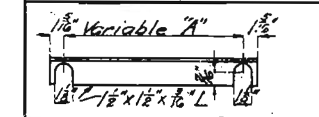


HALF SECS. THRU RIB SHOWING REINF.

Note:- Spacers and 1/2"φ bars A1 at 2'-6" ctrs. measured horizontally, to be placed in ribs at points where ordinates are shown in "Detail Showing Dimensions of Arch Ring."
Stirrups to be placed midway between spacers.
Wire spacers securely to both main and transverse steel.
See Table for number and length of spacers.

DETAIL SHOWING DIMENSIONS OF ARCH RING, SPAN 4-5

TABLE OF BAR SPACERS



SPAN 2-3

No. Bars	Dim. "A"	No. Bars	Dim. "A"
8	4'-5 5/8"	8	2'-8"
8	4'-2 5/8"	16	2'-8 1/8"
8	3'-11 1/4"	16	2'-8 1/4"
8	3'-8 5/8"	8	2'-8 3/8"
8	3'-6 5/8"	16	2'-8 1/2"
8	3'-4 1/2"	8	2'-8 5/8"
8	3'-2 3/8"	8	2'-8 3/4"
8	3'-1 1/4"	8	2'-8 7/8"
8	3'-0 1/8"	8	2'-9 1/8"
8	2'-11 1/4"	8	2'-9 3/8"
8	2'-10 5/8"	8	2'-9 5/8"
8	2'-10"	8	2'-9 7/8"
8	2'-9 5/8"	8	2'-10 1/8"
16	2'-9 1/4"	8	2'-10 5/8"
16	2'-8 7/8"	8	2'-11 1/4"
16	2'-8 1/2"	8	3'-0"
8	2'-8 3/8"	8	3'-0 1/2"
8	2'-8 1/4"	8	3'-1 1/2"
8	2'-8 1/8"	8	3'-2 5/8"
8	2'-8"	8	3'-4 1/8"
8	2'-7 7/8"	8	3'-5 3/8"
8	2'-7 3/4"	8	3'-6 5/8"
8	2'-7 5/8"	8	3'-8 5/8"
8	2'-7 1/2"	8	3'-11"
8	2'-7 3/8"	8	4'-1 1/8"
8	2'-7 1/4"	8	4'-3 5/8"
8	2'-7 1/8"	8	4'-6 3/8"
8	2'-7 1/4"	8	4'-9 3/8"
16	2'-7 3/8"	8	5'-0 5/8"
24	2'-7 1/2"	8	5'-3 3/8"
8	2'-7 5/8"		
8	2'-7 3/4"		
16	2'-7 7/8"		

SPAN 3-4

No. Bars	Dim. "A"	No. Bars	Dim. "A"
8	4'-0 3/4"	8	2'-4 1/2"
8	4'-4 3/8"	16	2'-4 5/8"
8	4'-1 3/8"	16	2'-4 3/4"
8	3'-10 5/8"	8	2'-4 7/8"
8	3'-7 5/8"	8	2'-5"
8	3'-4 3/8"	8	2'-5 1/8"
8	3'-2 3/8"	8	2'-5 1/4"
8	3'-1 1/8"	8	2'-5 3/8"
8	2'-11 1/4"	8	2'-5 1/2"
8	2'-10 3/8"	8	2'-5 5/8"
8	2'-9 1/2"	8	2'-5 3/4"
8	2'-8 7/8"	8	2'-5 7/8"
8	2'-7 5/8"	8	2'-6 1/8"
8	2'-6 7/8"	8	2'-6 3/8"
8	2'-6 1/2"	8	2'-6 5/8"
8	2'-6 1/8"	8	2'-6 7/8"
8	2'-6"	8	2'-7 1/2"
8	2'-5 3/4"	8	2'-8 1/4"
8	2'-5 5/8"	8	2'-9"
8	2'-5 1/2"	8	2'-9 3/4"
8	2'-5 3/8"	8	2'-10 5/8"
8	2'-5 1/4"	8	3'-0 1/8"
8	2'-5 1/8"	8	3'-1 3/8"
8	2'-5"	8	3'-3 5/8"
8	2'-4 7/8"	8	3'-6"
16	2'-4 3/4"	8	3'-8 3/8"
16	2'-4 5/8"	8	3'-10 5/8"
8	2'-4 1/2"	8	4'-1 1/8"
8	2'-4 3/8"	8	4'-5 1/8"
16	2'-4 1/4"	8	4'-8 5/8"
48	2'-4 1/8"		
8	2'-4 1/4"		
8	2'-4 3/8"		

SPAN 4-5

No. Bars	Dim. "A"	No. Bars	Dim. "A"
16	4'-8 3/8"	16	2'-5 3/8"
16	4'-5 1/8"	16	2'-5 3/8"
16	4'-1 7/8"	16	2'-5 3/8"
16	3'-10 5/8"	16	2'-5 1/2"
16	3'-8 1/8"	16	2'-5 3/8"
16	3'-5 5/8"	32	2'-5 1/4"
16	3'-3 3/8"	32	2'-5 1/8"
16	3'-1 3/8"	32	2'-5"
16	3'-0 1/8"	16	2'-4 7/8"
16	2'-10 7/8"	16	2'-4 3/4"
16	2'-9 3/4"	16	2'-4 5/8"
16	2'-8 7/8"	16	2'-4 1/2"
16	2'-8 1/8"	32	2'-4 3/8"
16	2'-7 3/8"	32	2'-4 1/4"
16	2'-6 5/8"	24	2'-4 1/8"
16	2'-6 1/8"		

SPAN 5-6

No. Bars	Dim. "A"	No. Bars	Dim. "A"
16	4'-10 1/2"	16	2'-7 1/8"
16	4'-7"	16	2'-6 7/8"
16	4'-3 5/8"	16	2'-6 3/4"
16	4'-0 5/8"	16	2'-6 5/8"
16	3'-9 5/8"	16	2'-6 1/2"
16	3'-7 3/8"	16	2'-6 3/8"
16	3'-4 7/8"	16	2'-6 1/4"
16	3'-2 7/8"	32	2'-6 1/8"
16	3'-1 1/8"	32	2'-6"
16	3'-0 3/8"	16	2'-5 7/8"
16	2'-10 7/8"	16	2'-5 3/4"
16	2'-10"	32	2'-5 5/8"
16	2'-9 3/8"	16	2'-5 1/2"
16	2'-8 3/4"	16	2'-5 3/8"
16	2'-7 7/8"	32	2'-5 1/4"
16	2'-7 1/2"	24	2'-5 1/8"

SPAN 6-7

No. Bars	Dim. "A"	No. Bars	Dim. "A"
16	5'-0 3/8"	16	2'-8 3/8"
16	4'-8 5/8"	16	2'-8 1/8"
16	4'-5 3/8"	16	2'-7 7/8"
16	4'-2 5/8"	16	2'-7 5/8"
16	3'-11 5/8"	16	2'-7 1/2"
16	3'-9 1/2"	48	2'-7 3/8"
16	3'-6 5/8"	16	2'-7 1/4"
16	3'-4 5/8"	16	2'-7 1/8"
16	3'-2 7/8"	16	2'-7"
16	3'-1 5/8"	16	2'-6 7/8"
16	3'-0 5/8"	16	2'-6 3/4"
16	2'-11 5/8"	32	2'-6 5/8"
16	2'-10 3/8"	16	2'-6 1/2"
16	2'-9 7/8"	16	2'-6 3/8"
16	2'-9 1/8"	32	2'-6 1/4"
16	2'-8 5/8"	24	2'-6 1/8"

Note:- Weight of spacers included in weight of reinforcing steel.

Note:- Spacers in spans 2-3 and 3-4 to be placed in ribs in same order as listed above, beginning at Piers 2 and 3 respectively.
Spacers as listed above to be billed and tagged separately and identified as to their length and the number of the arch span where used.

SPANDREL BENT DATA

SPAN 4-5

Bent No.	Column Length "B"	No. E1 Bars	D-Bars
1	31'-10 1/2"	32	D21
2	23'-9 3/8"	24	D22
3	16'-10 1/8"	17	D23
4	11'-2 5/8"	12	D24
5	6'-8 3/4"	7	D25
6	3'-3 3/8"	4	
7	10 7/8"	0	
8	0	0	
9	0	0	
10	0	0	
11	0	0	
12	2'-2 1/4"	3	
13	5'-3 1/8"	6	
14	9'-4 3/8"	10	D26
15	14'-7 7/8"	15	D27
16	21'-2 3/8"	22	D28
17	28'-11 1/4"	29	D29

Note: See Bill of Reinforcing Steel, Sheet No. 2, for length of "D" Bars in spandrel bent.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER
ABOUT 0.75 MILES SOUTH OF BRANSON
PROJECT NO. U.S.65-S116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY N. R. Sack DATE 7/20/31 BRIDGE ENGINEER
APPROVED BY T. H. Cutler DATE 7/20/31 CHIEF ENGINEER

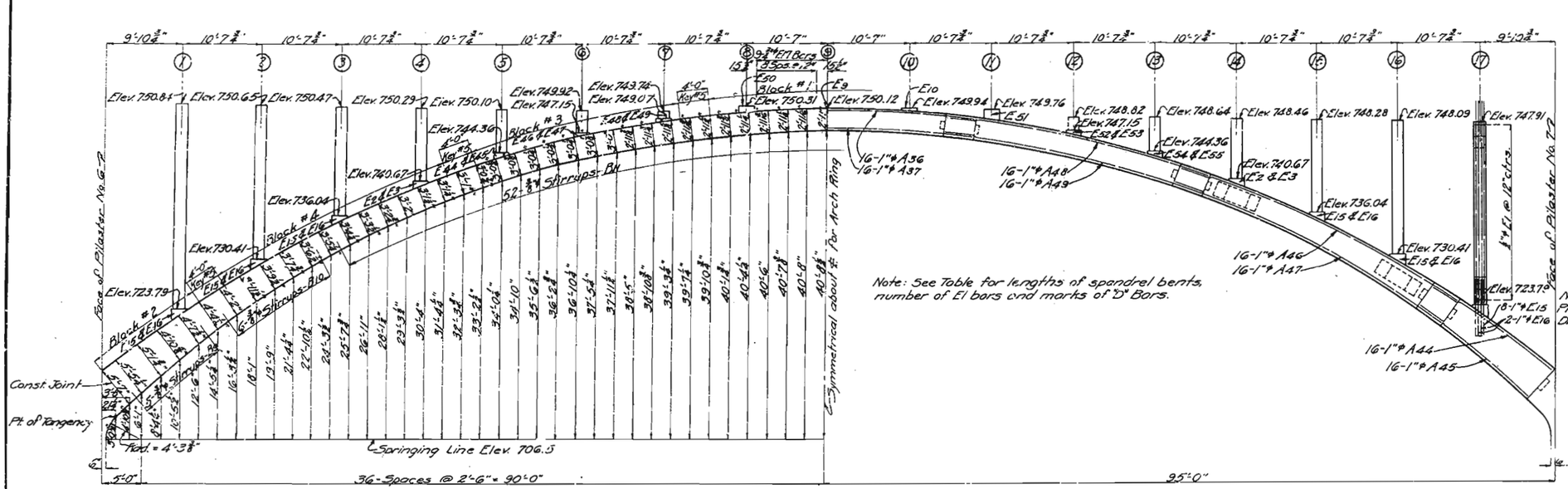
STD. S-818

J-705

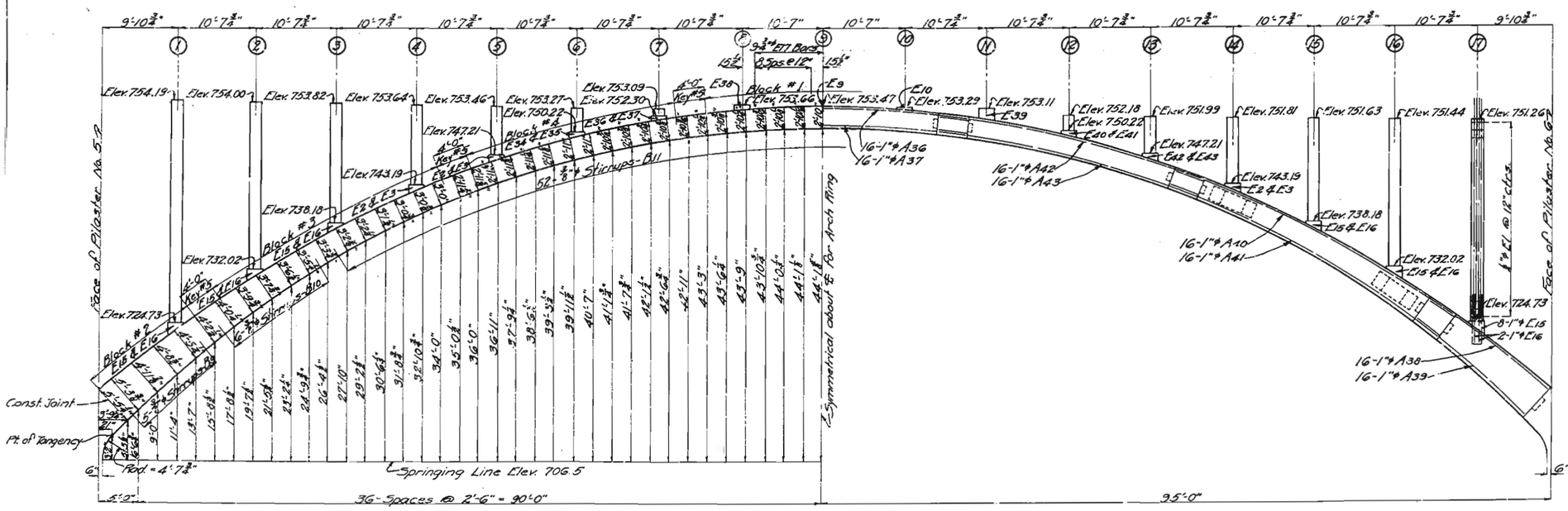
Designed May 1931 by H.H.M.
Drawn June 1931 by C.A.F.
Checked July 1931 by F.C.L. & H.H.M.

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-S116A	19		

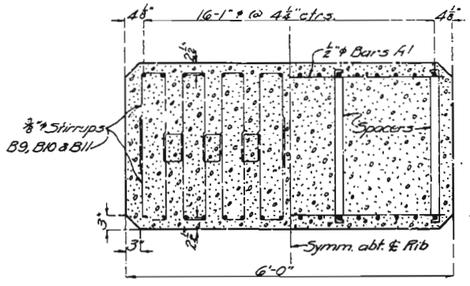


SPAN 6-7



SPAN 5-6

DETAILS SHOWING DIMENSIONS OF ARCH RINGS



HALF SECS. THRU RIB SHOWING REINFORCING

Note:- Spacers and 1" ϕ bars A1, at 2'-6" ctrs. measured horizontally, to be Placed in ribs at points where ordinates are shown in Details Showing Dimensions of Arch Rings."
Stirrups to be placed midway between spacers.
Wire spacers securely to both main and transverse steel.
See Table on Sheet No. 12 for number and length of spacers.

TABLE OF SPANDREL BENT DATA

	SPAN 5-6			SPAN 6-7			
BENT NO.	COLUMN LENGTH "A"	No. E1 BARS	D-BARS	BENT NO.	COLUMN LENGTH "A"	No. E1 BARS	D-BARS
2	21'-11⅜"	23	D32	2	20'-2⅝"	21	D42
3	15'-7⅝"	16	D33	3	14'-5⅛"	15	D43
4	10'-5⅜"	11	D34	4	9'-7½"	10	D44
5	6'-3"	7	D35	5	5'-8⅞"	6	
6	3'-0⅝"	4		6	2'-9¼"	3	
7	9½"	2		7	8"	0	
8	0	0		8	0	0	
9	0	0		9	0	0	
10	0	0		10	0	0	
11	0	0		11	0	0	
12	23½"	3		12	20"	2	
13	4'-9¾"	5		13	4'-3⅜"	5	
14	8'-7½"	9	D36	14	7'-9½"	8	D45
15	13'-5⅜"	14	D37	15	12'-2⅝"	13	D46
16	19'-5"	20	D38	16	17'-8⅝"	18	D47
17	26'-6⅜"	27	D39	17	24'-1½"	25	D48

Note: See Bill of Reinforcing Steel, Sheet No. 2 for length of "D" Bars in Spandrel Bents.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER
ABOUT 0.75 MILES SOUTH OF BRANSON
PROJECT NO. U.S. 65-S116A STA. 648+68.92

TANEY COUNTY

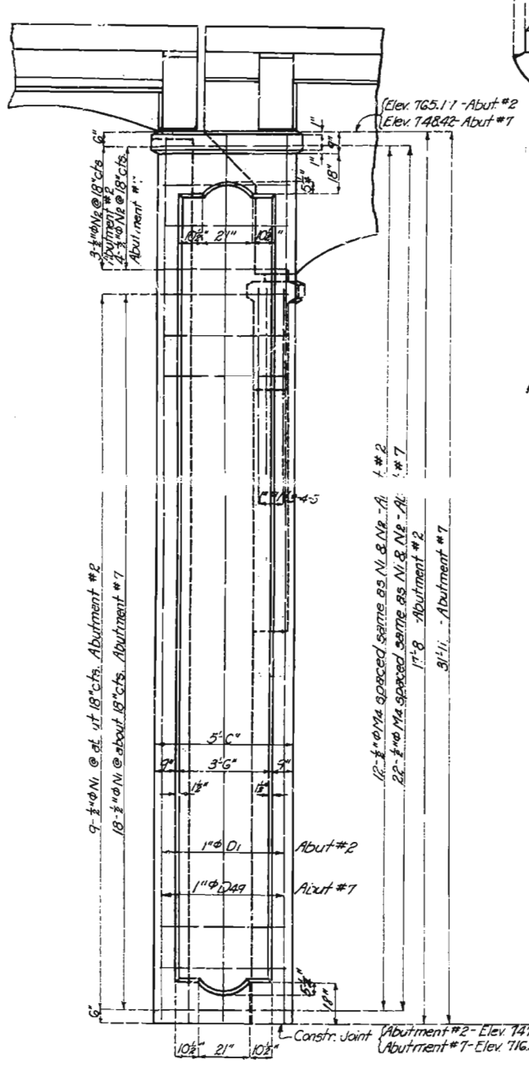
SUBMITTED BY M R Long, RESIDENT ENGINEER DATE 7/20/31
APPROVED BY T H Cutler, CHIEF ENGINEER DATE 7/20/31

STD. S-818
J-705

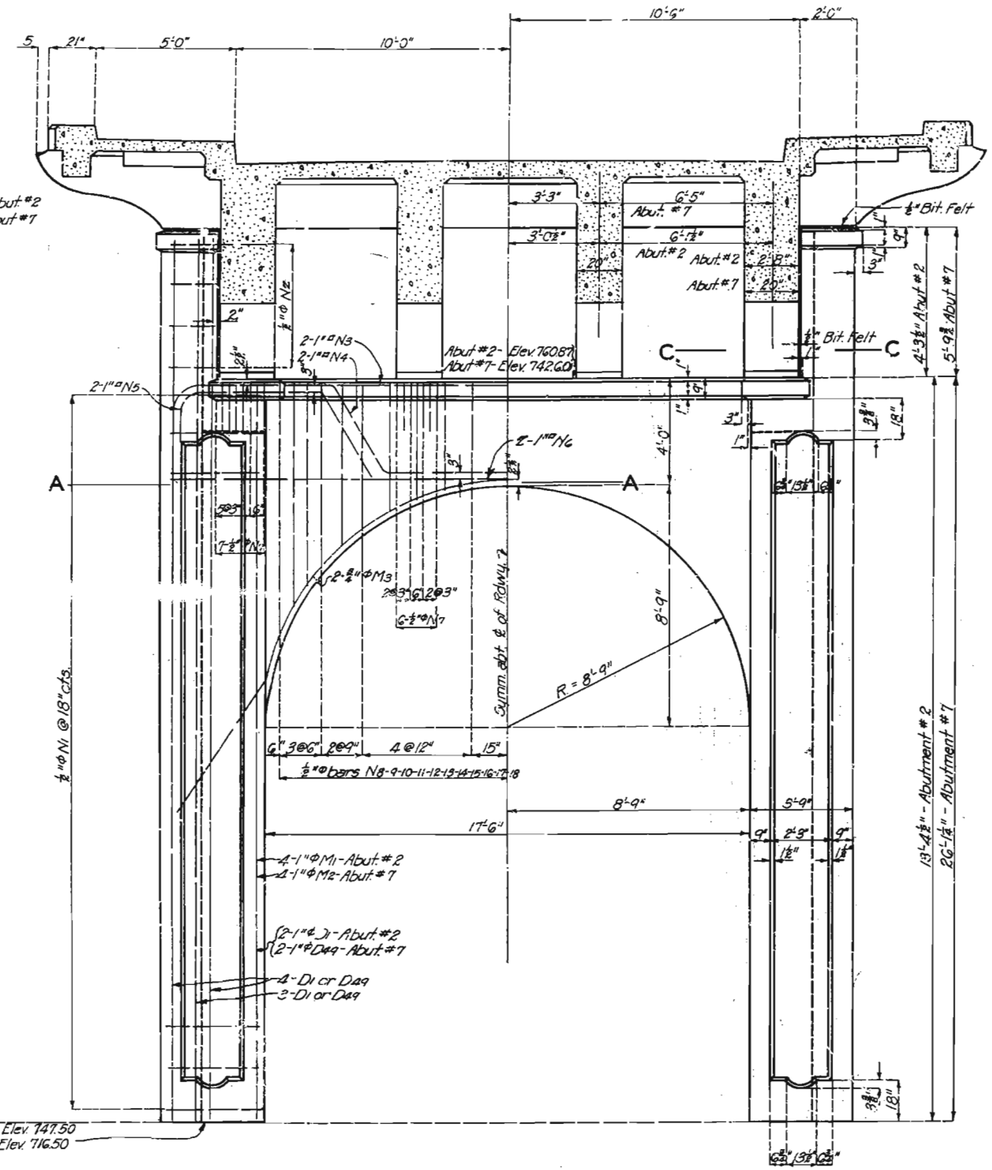
Designed May 1931 by H.H.M.
Drawn June 1931 by C.A.F.
Checked July 1931 by F.C.L. & H.H.M.

MISSOURI STATE HIGHWAY DEPARTMENT

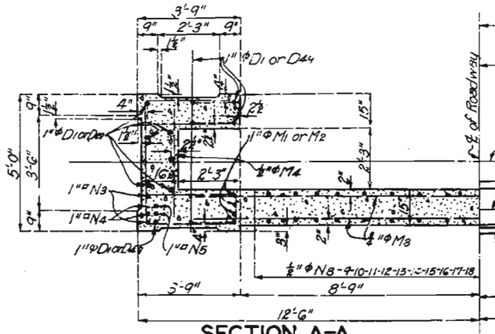
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-S.M.	19		



ELEVATION



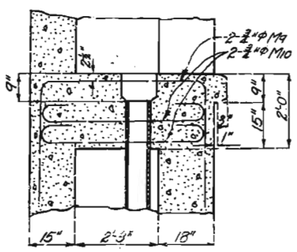
SIDE VIEW - GIRDER SPAN SIDE



SECTION A-A

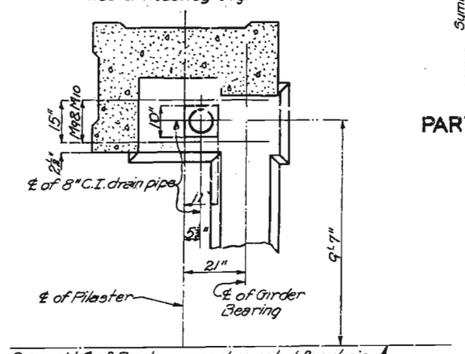
HALF PLAN OF BRIDGE SEAT

Note:- Top of pilasters to be horizontal.

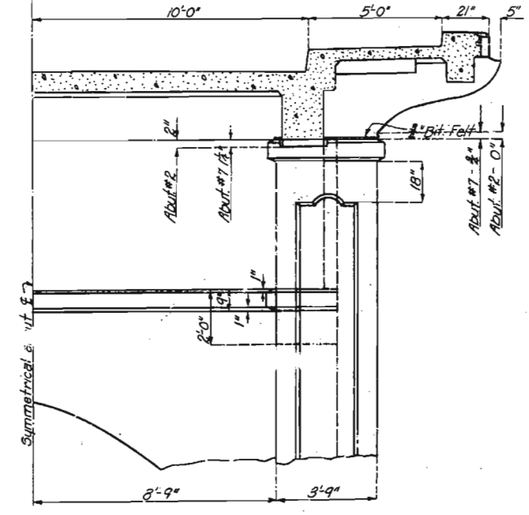


PART SECTION B-B

Note: C.I. Drain pipe to be placed on left side of Roadway only.



SECTION C-C



PART SIDE VIEW - ARCH SPAN SIDE

DETAILS OF BENT OVER ABUTMENTS NO. 2 & NO. 7

Note: This drawing is not to scale. Follow dimensions.

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S. 65-S116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY M.R. Sorg, BRIDGE ENGINEER, DATE 7/20/31

APPROVED BY T.H. Cutler, CHIEF ENGINEER, DATE 7/20/31

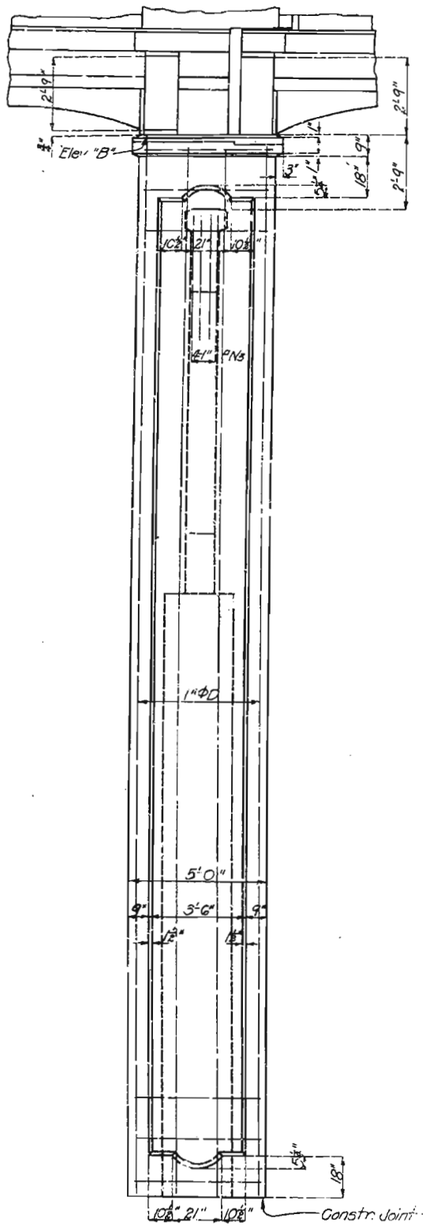
STD. S-818

J-705

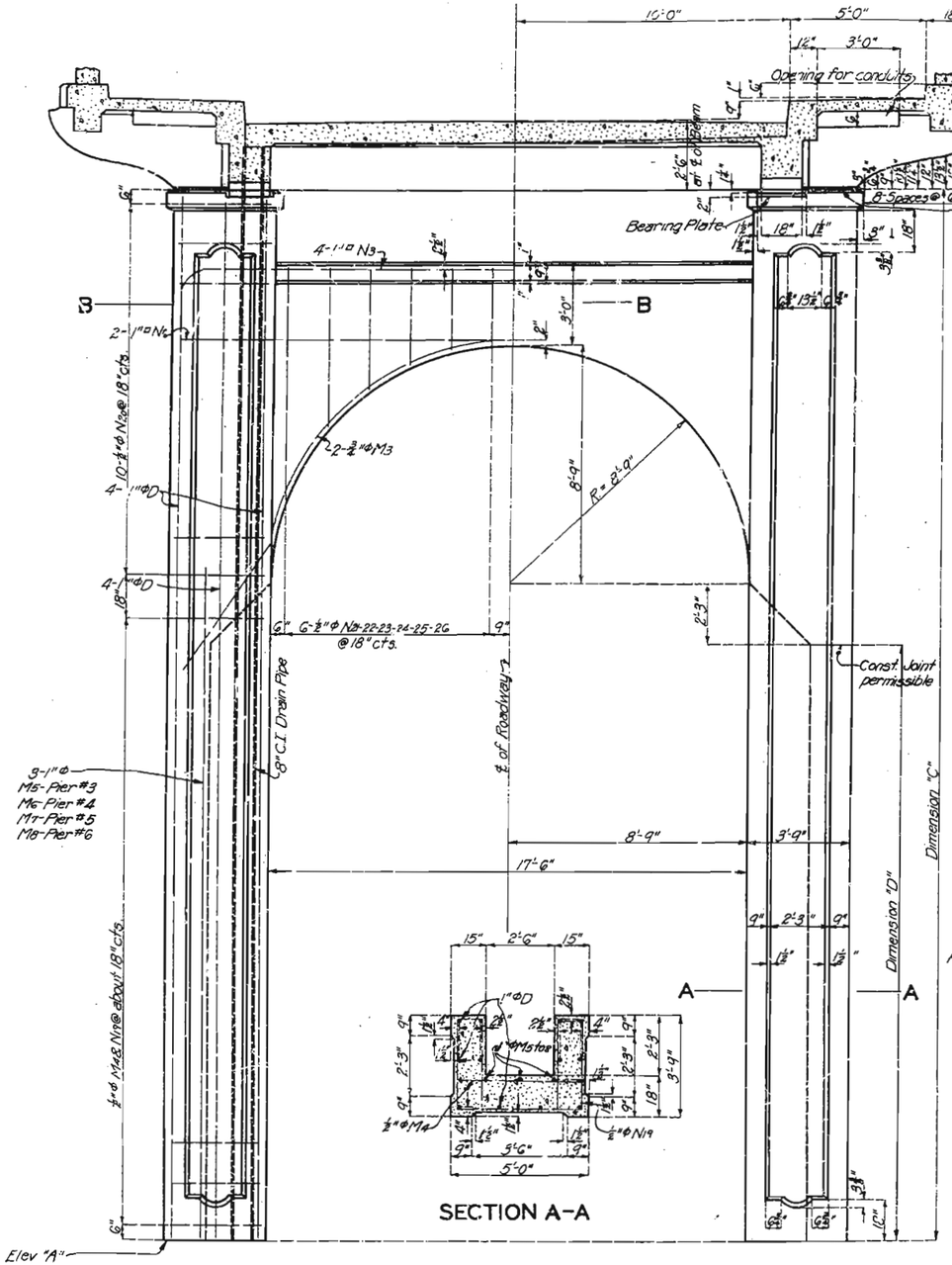
Designed May 1931 By H.H.M.
Drawn June 1931 By H.D.
Traced June 1931 By H.W.H.
Checked July 1931 By F.C.L.

MISSOURI STATE HIGHWAY DEPARTMENT

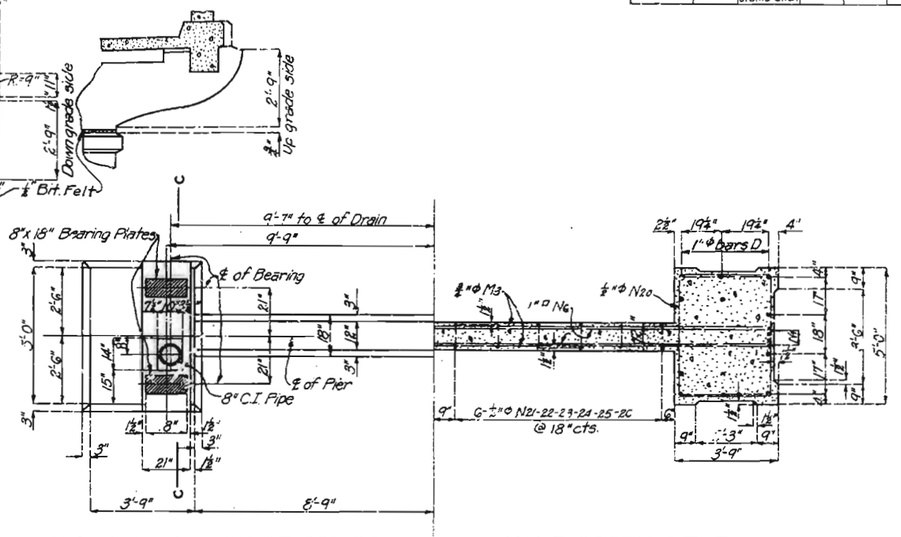
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-5(16)A	19		



ELEVATION



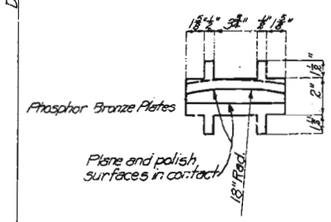
SIDE VIEW

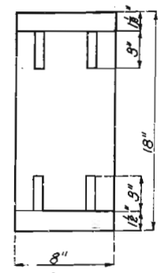


HALF PLAN AT TOP OF COLUMN

HALF SECTION B-B

Pier No.	Elev. "A"	Elev. "B"	Dim. "C"	D-bars	M4&N9 Bars	Dim."D"
3	721.50	761.82	40'-3⅜"	D10	17	23'-6⅜"
4	716.50	758.47	41'-11⅝"	D20	18	25'-2⅝"
5	716.50	755.12	38'-7⅞"	D30	16	21'-10⅛"
6	716.50	751.77	35'-3⅛"	D40	14	18'-6⅜"

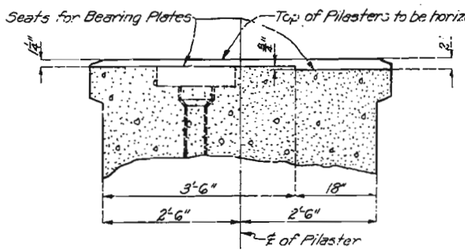




Note: A mixture of flake graphite and oil to be placed between plates before placing in concrete.

DETAILS OF 8"X18" BEARING PLATES

20-Sets of 3 plates each required. Each set consisting of 1 top plate, 1 floater plate and 1 bottom plate.



SECTION C-C

DETAILS OF COLUMNS OVER PIERS NO. 3, 4, 5 & 6

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S.65-5116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY M.R. Tarr, BRIDGE ENGINEER, DATE 7/20/31

APPROVED BY P.H. Kelly, CHIEF ENGINEER, DATE 7/20/31

STD.S-816

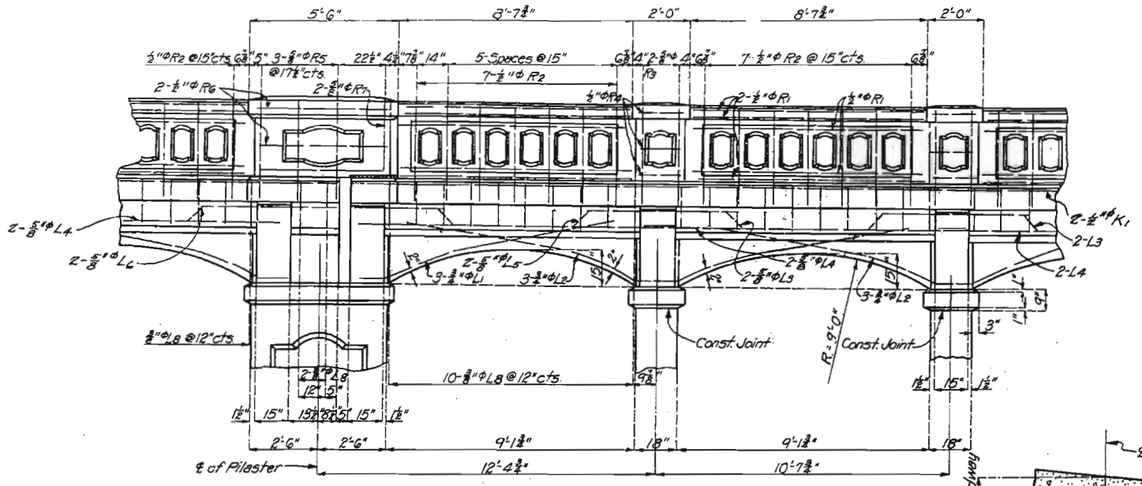
J-705

Designed May 1931 By H.H.M.
Drawn May 1931 By H.D.
Traced June 1931 By H.W.H.
Checked July 1931 By F.C.L.

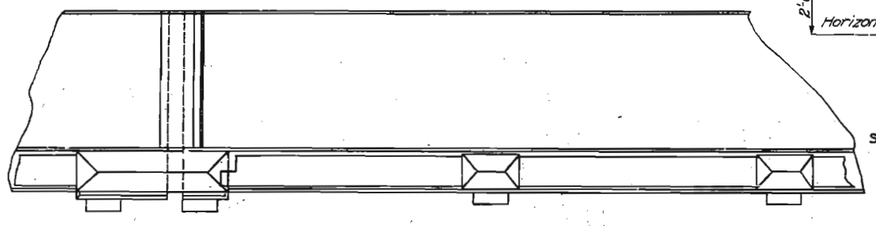
Sheet No. 15 of 20

MISSOURI STATE HIGHWAY DEPARTMENT

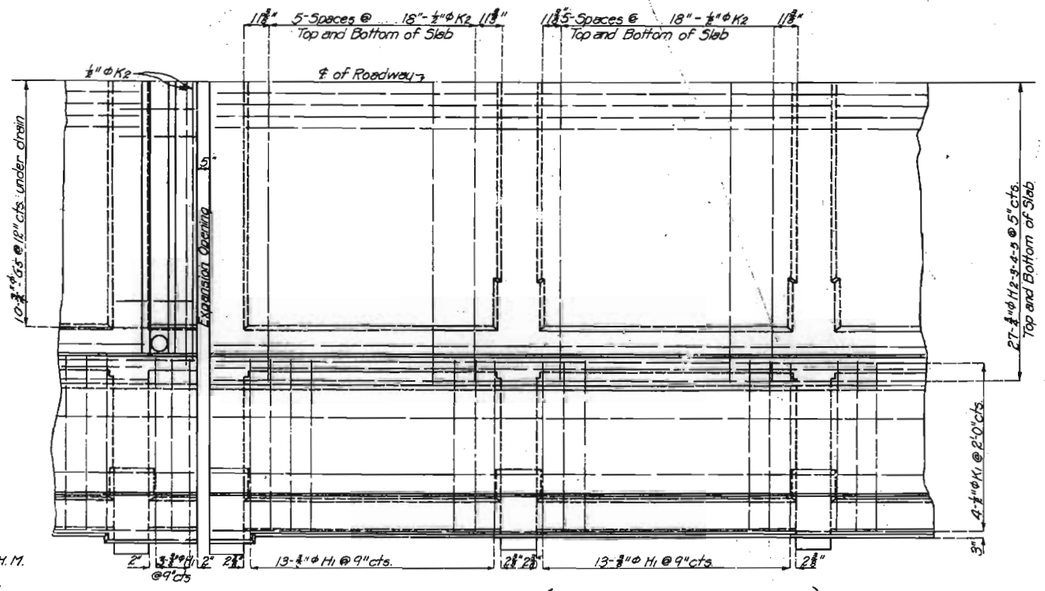
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	USGS-51(6)1	19		



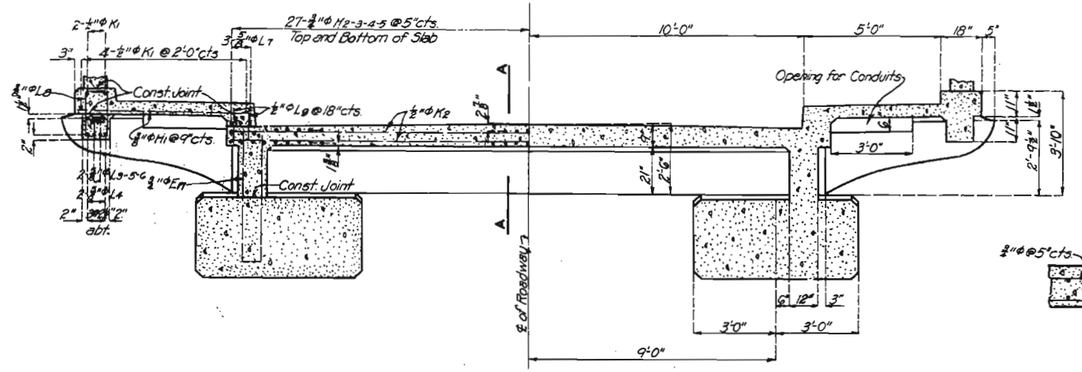
TYPICAL PART ELEVATION



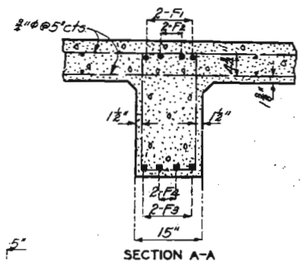
PART PLAN OF RAIL AND SIDEWALK



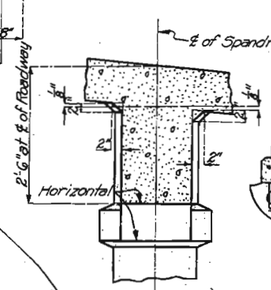
TYPICAL PART PLAN OF DECK (HANDRAIL NOT SHOWN)



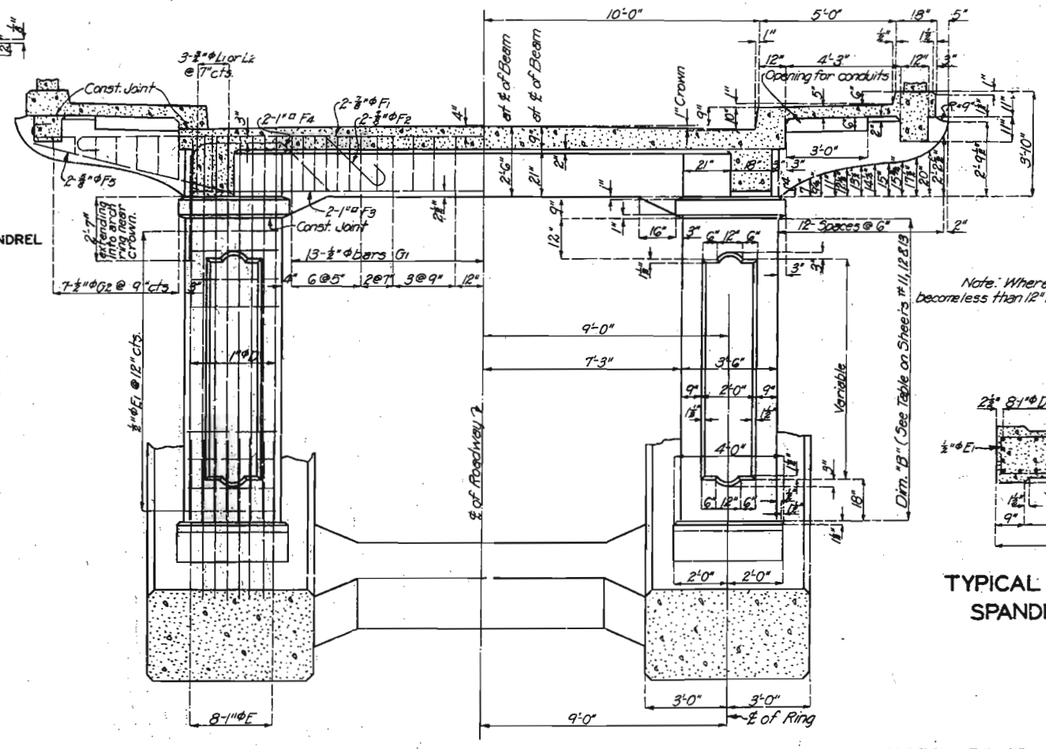
TYPICAL SECTION NEAR CROWN - SHOWING REINFORCEMENT IN SLABS



SECTION A-A

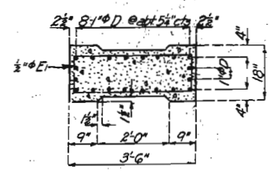


SECTION THRU SPANDREL BEAM



TYPICAL SECTION- SHOWING REINFORCEMENT IN BRACKET AND SPANDREL BENT

Note: Where panels in spandrel bents becomeless than 12" in height, omit panel.



TYPICAL SECTION THRU SPANDREL COLUMN

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S.65-S116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY T. K. Sayre DATE BRIDGE ENGINEER 7/20/31

APPROVED BY T. H. Cutler DATE CHIEF ENGINEER 7/20/31

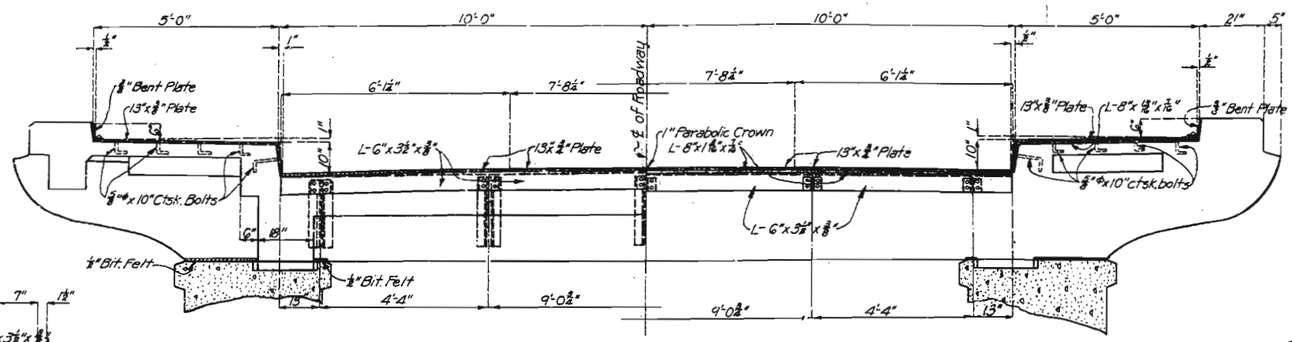
FINISHED

Designed May 1931 By H.H.M.
Drawn May 1931 By H.O.
Traced June 1931 By H.W.H.
Checked July 1931 By F.C.L.

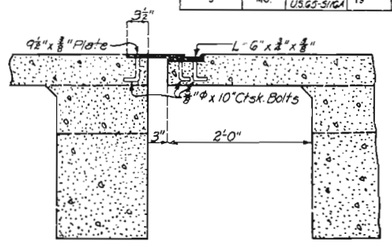
STD. S-818
J-705

MISSOURI STATE HIGHWAY DEPARTMENT

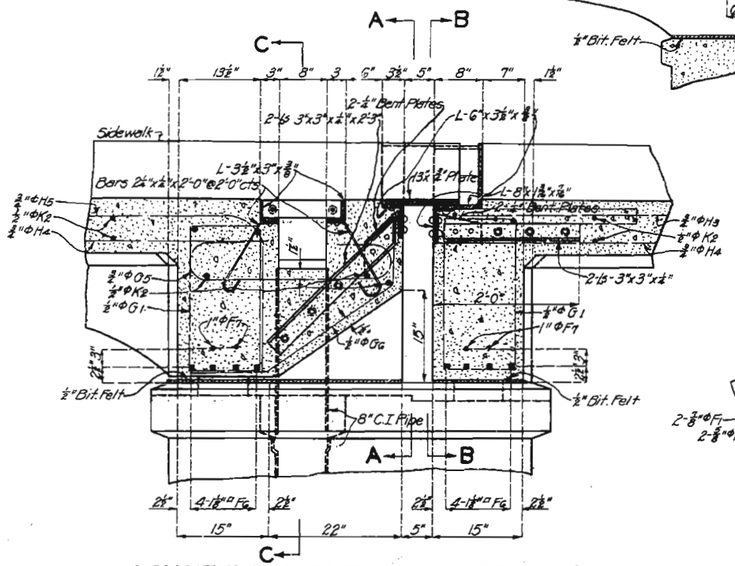
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	US65-5116A	19		



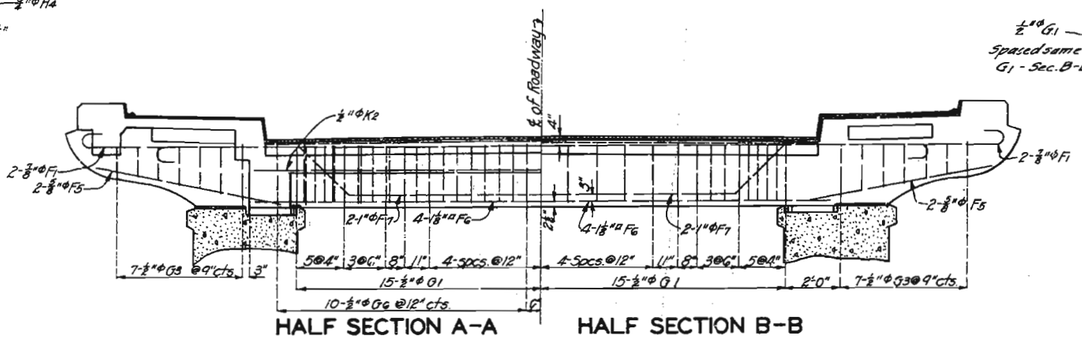
HALF SECTION A-A HALF SECTION B-B



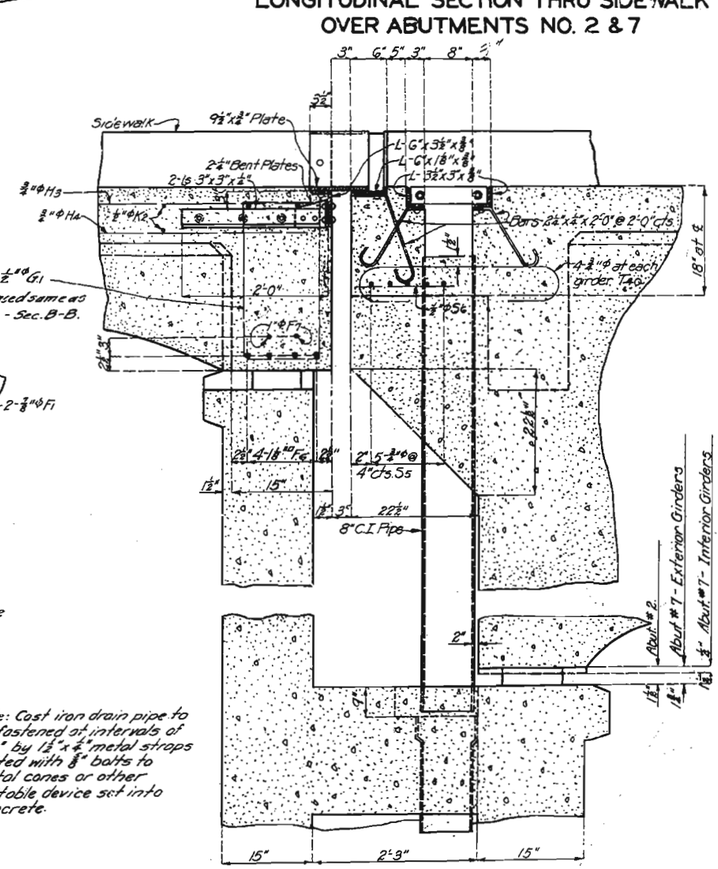
LONGITUDINAL SECTION THRU SIDEWALK OVER ABUTMENTS NO. 2 & 7



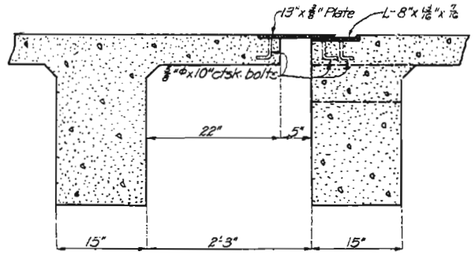
LONGITUDINAL SECTION THRU ROADWAY OVER PIERS NO. 3, 4, 5 & 6



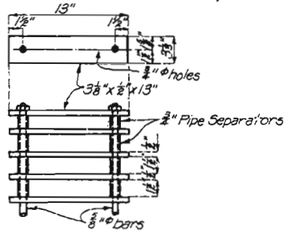
HALF SECTION A-A HALF SECTION B-B



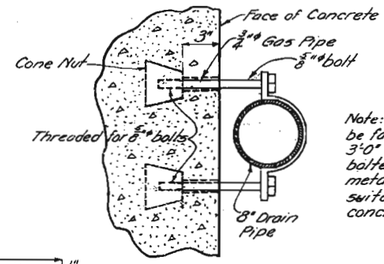
LONGITUDINAL SECTION AT ABUTMENTS NO. 2-7



LONGITUDINAL SECTION THRU SIDEWALK OVER PIERS NO. 3, 4, 5 & 6

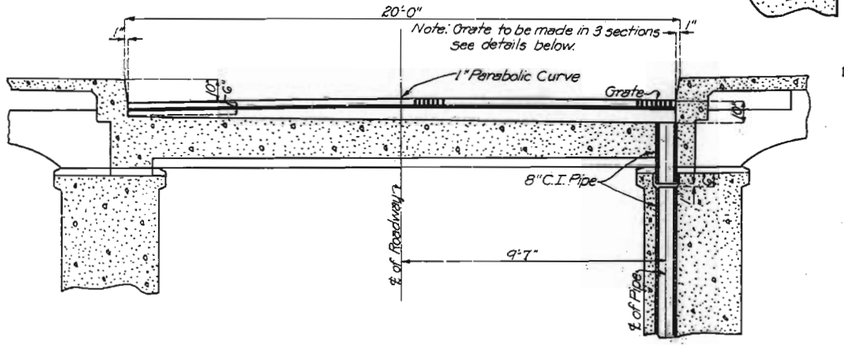


DETAILS OF GRATE



Note: Cast iron drain pipe to be fastened at intervals of 3'-0" by 1½"x¼" metal straps bolted with ⅝" bolts to metal cones or other suitable device set into concrete.

DETAILS OF DRAIN PIPE FASTENERS



SECTION C-C SHOWING INLET

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S.65-5116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY M. K. Lacy BRIDGE ENGINEER DATE 7/20/31

APPROVED BY T. H. Cutler CHIEF ENGINEER DATE 7/20/31

FINISHED

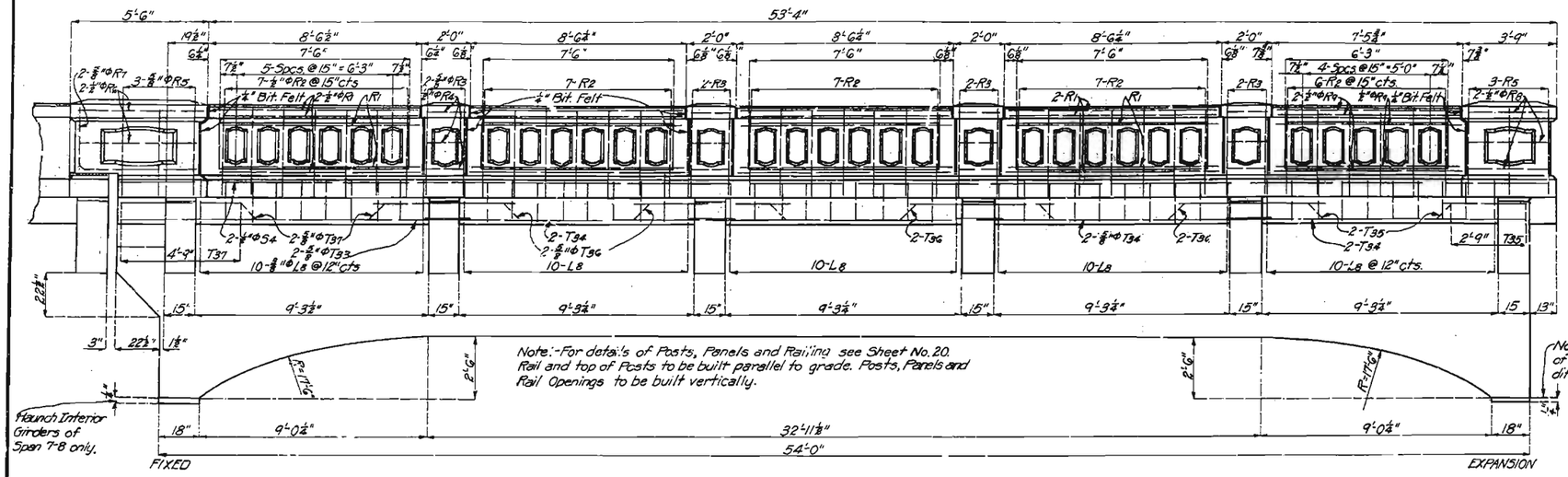
STD. S-818

J-705

Designed May 1931 By H.H.M.
Drawn May 1931 By H.D.
Traced June 1931 By H.W.H.
Checked July 1931 By F.C.L.

MISSOURI STATE HIGHWAY DEPARTMENT

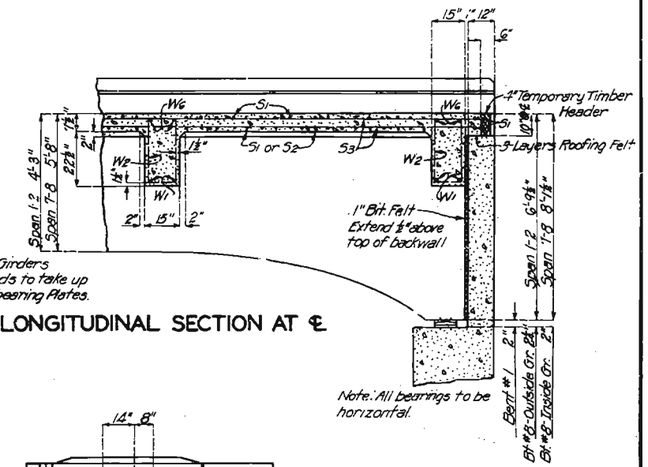
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-S116A	19		



ELEVATION

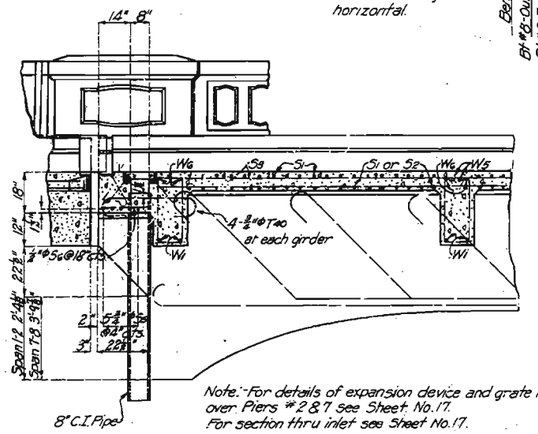
Note:-Posts to be paneled on inside and outside.

Note:-Cost of timber header to be included in price bid for other items.

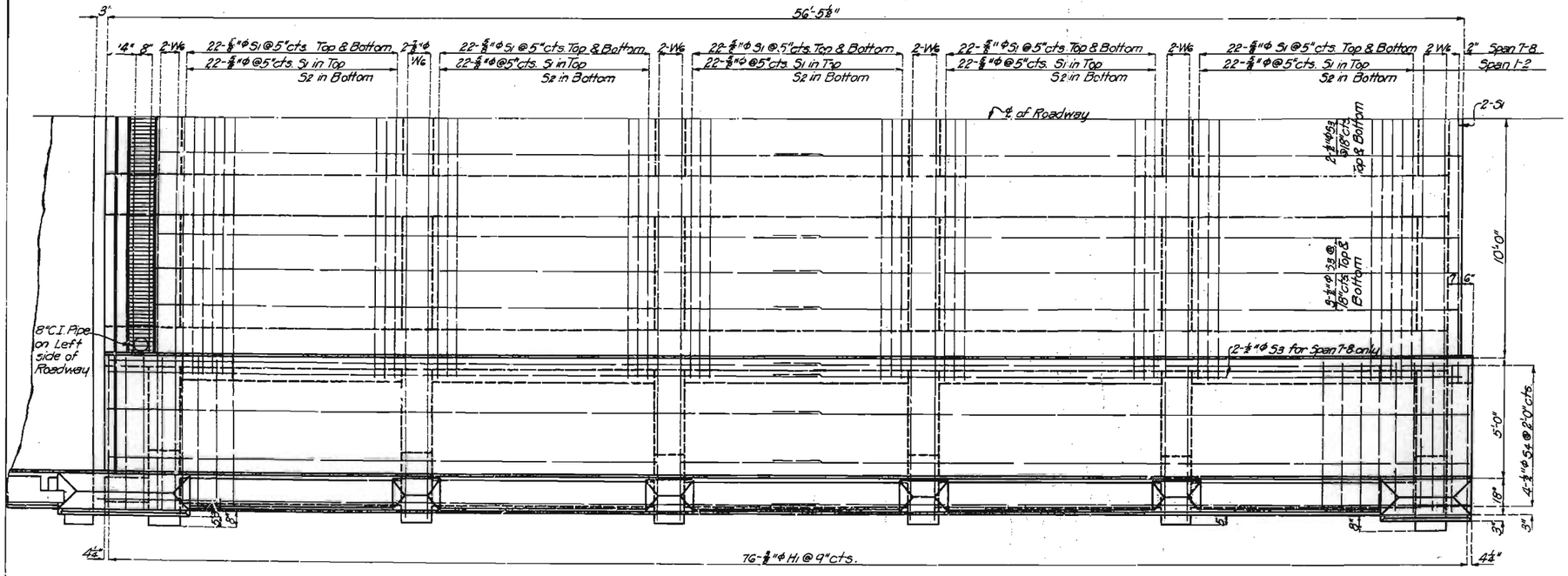


Note:-Haunch Interior Girders of Span 7-8 at both ends to take up difference in depth of bearing Plates.

PART LONGITUDINAL SECTION AT ℄



PART LONGITUDINAL SECTION AT ℄



HALF PLAN

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S.65-S116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY M.R. Sharp DATE 7/22/31 BRIDGE ENGINEER

APPROVED BY T.H. Cutler DATE 7/22/31 CHIEF ENGINEER

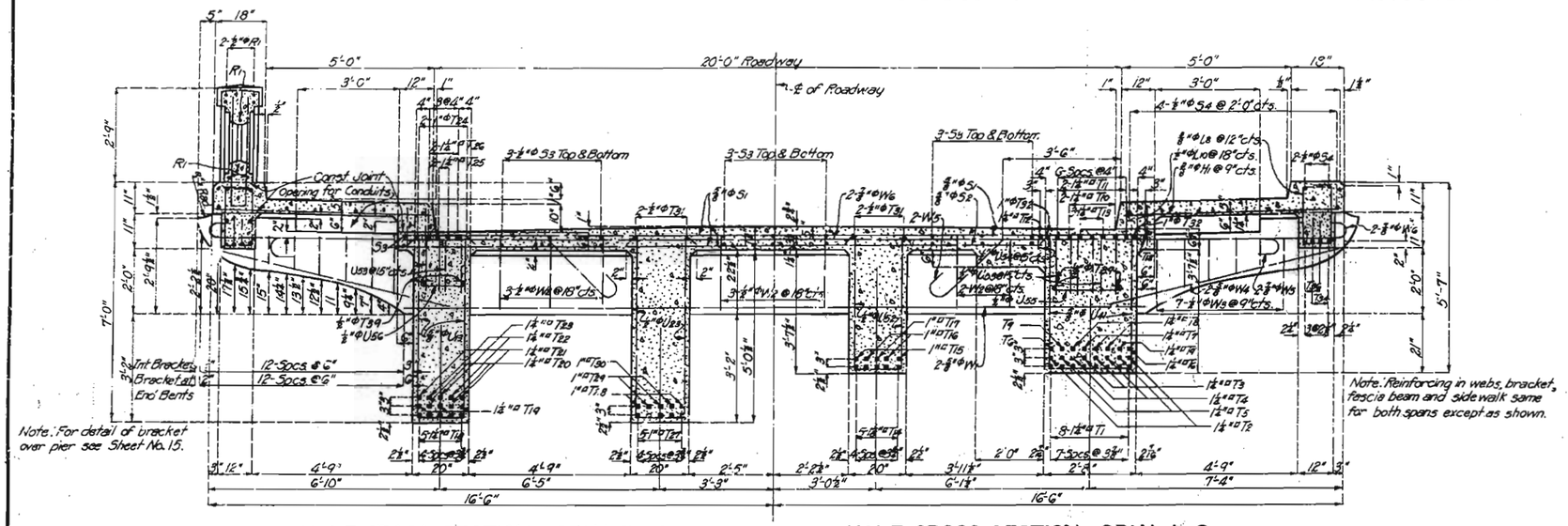
STD. S-818

J-705

Designed May 1931 By H.M.M.
Drawn June 1931 By I.B.
Traced June 1931 By H.W.H.
Checked July 1931 By F.C.L.

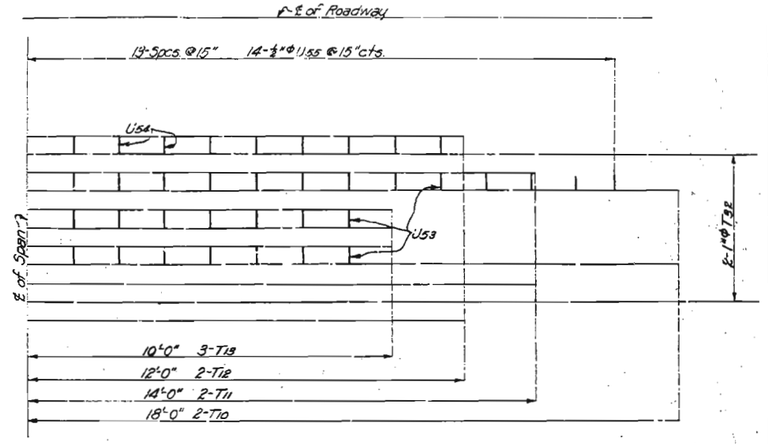
MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S.65-S11A	19		

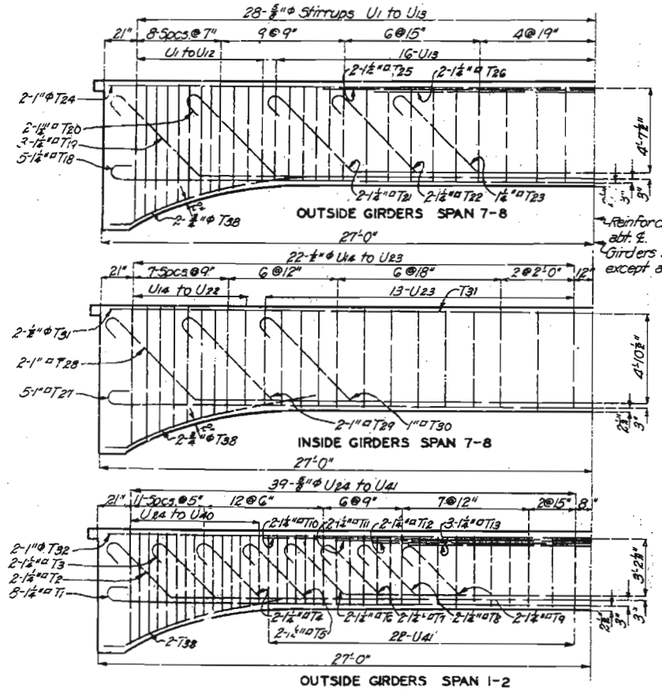


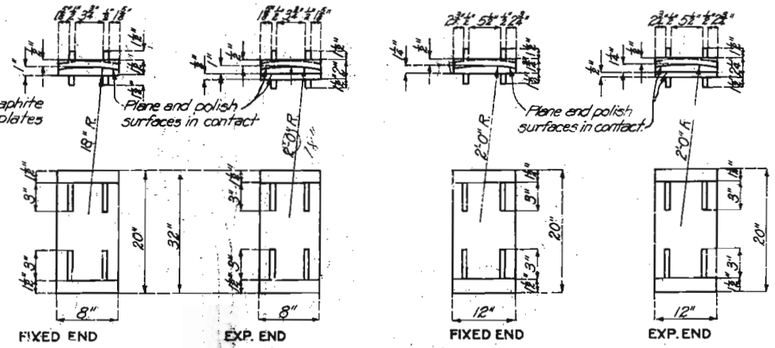
HALF CROSS SECTION - SPAN 7-8

HALF CROSS SECTION - SPAN 1-2



OUTSIDE GIRDER - SPAN 1-2

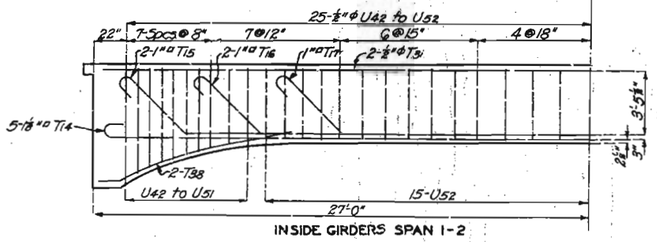


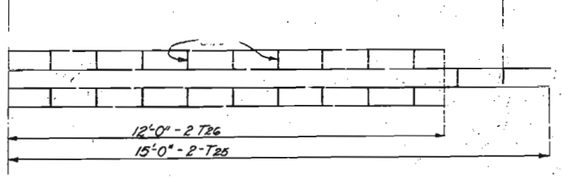


Note: A mixture of flake graphite and oil to be placed between plates before placing in concrete.

Note: Total plates required: 4-sets of 8"x20", 2-sets 12"x20", and 2-sets 8"x32". Each set consisting of 1 top plate and 1 bottom plate for fixed end and 1 top plate, 1 floater plate and 1 bottom plate for expansion end.

PHOSPHOR BRONZE BEARING PLATES





OUTSIDE GIRDER - SPAN 7-8

PLAN OF TOP REINFORCING SHOWING LOCATION OF BARS U53 AND U54

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT 0.75 MILES SOUTH OF BRANSON

PROJECT NO. U.S.65-S11A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY M.K. Hoyt DATE 7/22/31 BRIDGE ENGINEER

APPROVED BY T.H. Cutler DATE 7/20/31 CHIEF ENGINEER

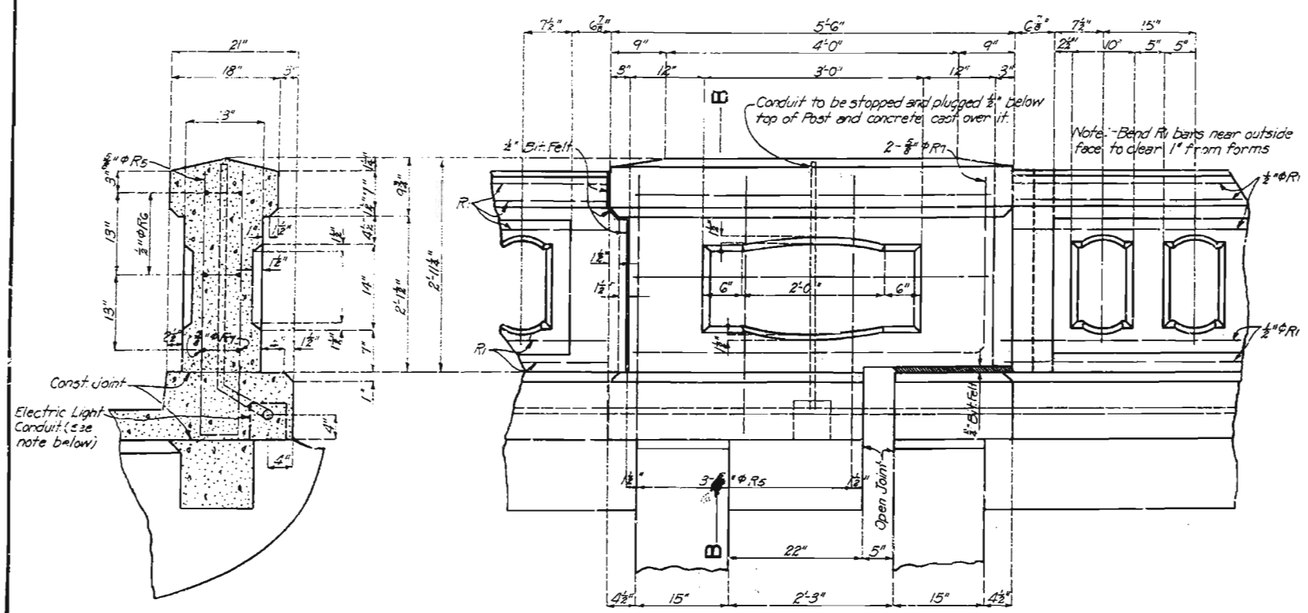
STD. S-818

J-705

Designed May 1931 By H.H.M.
Drawn June 1931 By I.B.
Traced June 1931 By H.W.H.
Checked July 1931 By F.C.L.

MISSOURI STATE HIGHWAY DEPARTMENT

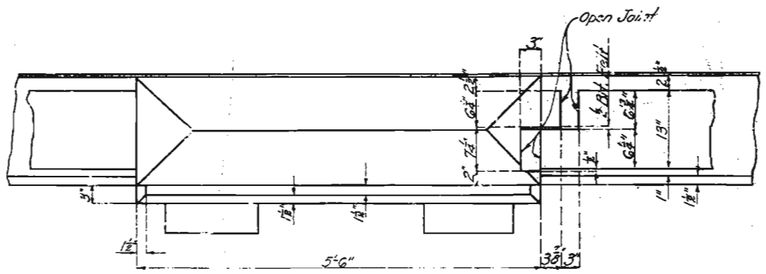
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	U.S. 65 S116A	19		



SECTION B-B

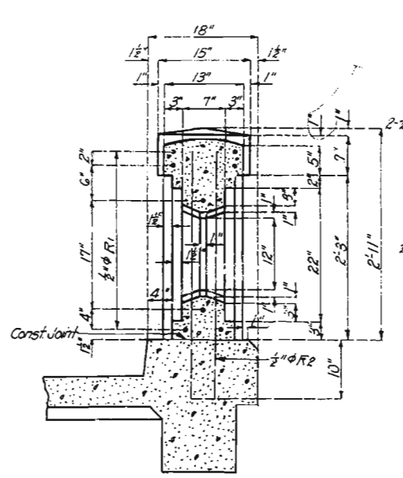
ELEVATION

Note:-Electric light conduits will be furnished to the contractor for [illegible] to have sleeve expansion joint's over [illegible] Pull boxes to be placed in curb at each lamp or where directed by wiring company. Cost of placing conduits and pull boxes to be included in cost of concrete.

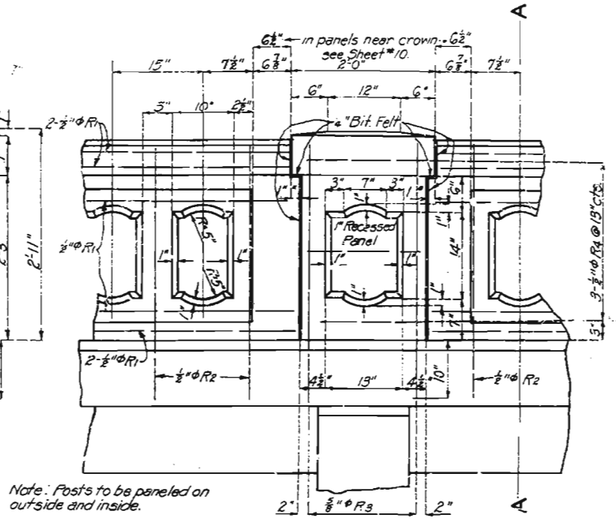


PLAN

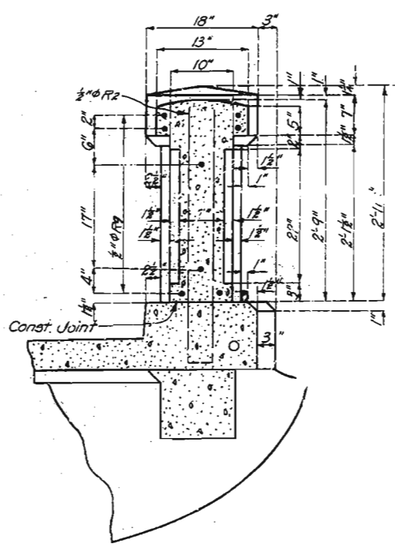
DETAILS OF POST OVER PILASTERS



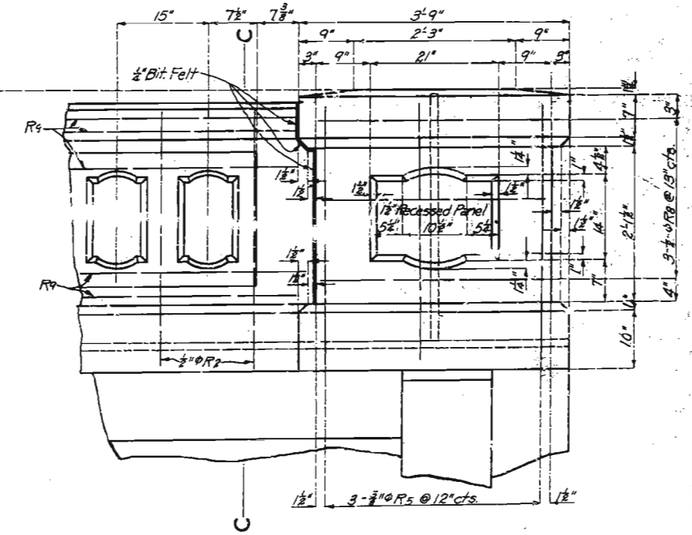
SECTION A-A



DETAILS OF POST OVER SPANDREL BENTS



SECTION C-C



DETAILS OF END POST ON GIRDER SPAN

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT .75 MILE SOUTH OF BRANSON

PROJECT NO. U.S.65-S116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY M.R. Sharp BRIDGE ENGINEER DATE 7/20/31

APPROVED BY H. Heath CHIEF ENGINEER DATE 7/20/31

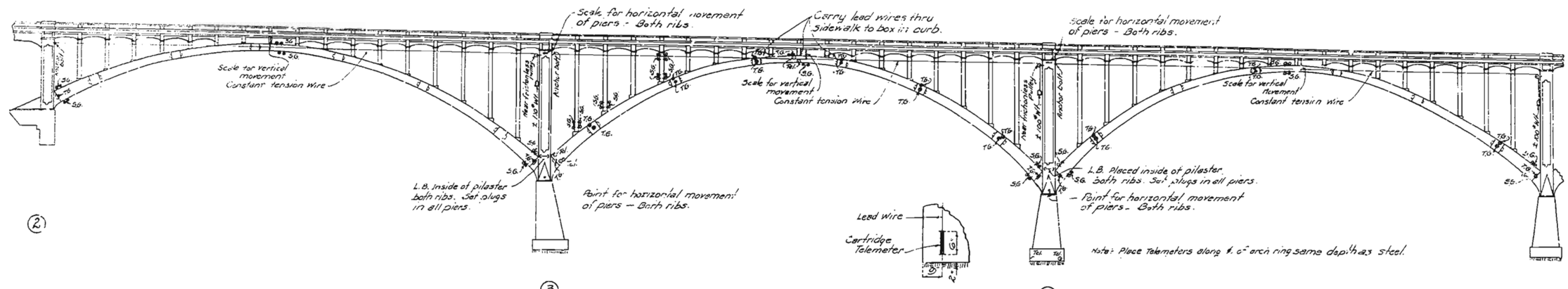
STD. S818

J-705

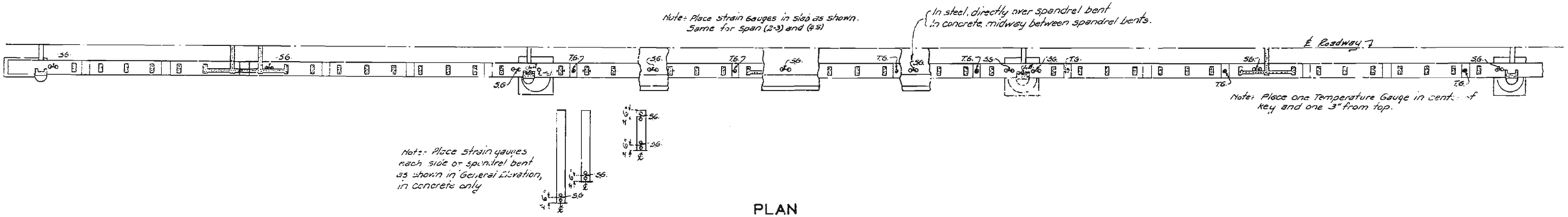
Drawn June 1931 By H.D.
Traced June 1931 By H.W.H.
Checked July 1931 By F.C.L.

MISSOURI STATE HIGHWAY DEPARTMENT

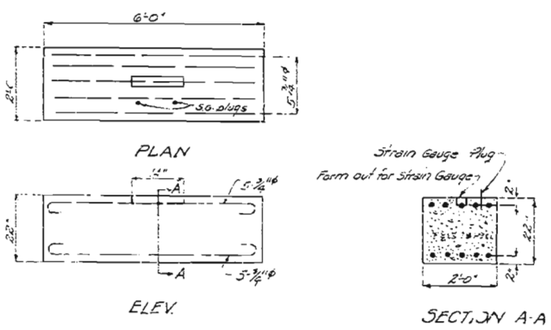
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	US65-S116A	19		



ELEVATION
SHOWING LOCATION OF TEST INSTRUMENTS



PLAN
SHOWING LOCATION OF TEST INSTRUMENTS



DETAIL OF TEST BEAM

SYMBOLS
- ○ Tel. - Telemeter
- • T.G. - Temperature Gauge.
- ⊶ S.G. Strain Gauge.
- ↔ L.B. Level Bar

BRIDGE OVER WHITE RIVER

STATE ROAD FROM BRANSON TO HOLLISTER
ABOUT 0.75 MILES SOUTH OF BRANSON
PROJECT NO. U.S.65-S116A STA. 648+68.92

TANEY COUNTY

SUBMITTED BY . . . . . DATE
BRIDGE ENGINEER

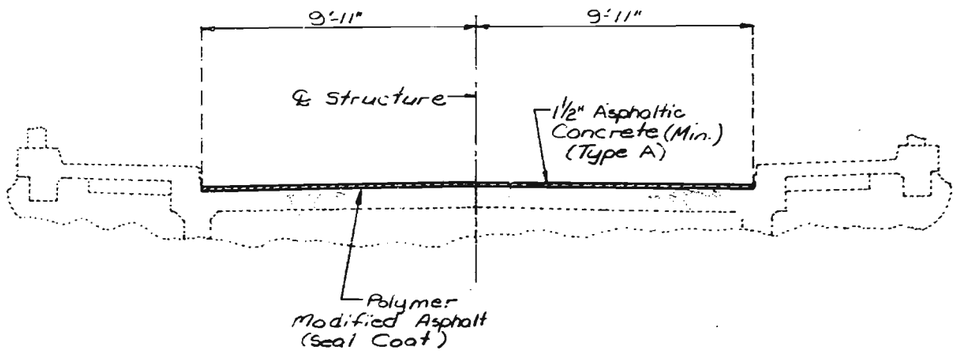
APPROVED BY . . . . . DATE
CHIEF ENGINEER

J-705

Sheet Tes

MISSOURI HIGHWAY AND TRANSPORTATION COMMISSION

STATE	PROJ. NO	SHEET NO.
MO.	RS-RSG-087(12)	42
SEC./SUB. 4	TWP. 22N	RGE. 21W



PART SECTION THRU SLAB

ESTIMATED QUANTITIES		
ITEM		TOTAL
Steel Bar Dams	Each.	5
Modified Deck Repair	Sq. Ft.	245
Asphalt Cement (60-70 or ACRP)	Ton	13
Mineral Aggregate (Asph. Conc.) (Type A Mix)	Ton	139
Polymer Modified Asphalt (Seal Coat)	Gal.	852
Cover Aggregate (Grade 3)	Tons	5.8
Special Work	Lump Sum	

NOTES:

Outline of old work is indicated by light dashed lines. Heavy lines indicate new work.

One lane of traffic over structure to be maintained during construction.

The bituminous material shall be a polymer modified asphalt emulsion Grade CRS-2P or EA-90P applied at a rate of 0.35 Gal. per Sq. Yd.

The cover aggregate (See Spec. Prov.) shall be applied at a rate of 0.015 Ton per Sq. Yd.

Deck Drain Repair includes removal of existing drain grates, fabrication and installation of new drain grates. (See Special Prov.)

Expansion Device Repair includes removal of existing sidewalk expansion plates, old concrete removal, fabrication and installation of new expansion plates. (See Special Provisions)

SEE FINAL PLANS

BRIDGE OVER WHITE RIVER & UNION PACIFIC R.R.

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT .75 MILE SOUTH OF BRANSON

PROJECT NO. RS-RSG-087(12) STA. 648+68.92

JOB NO. 8-5076-391 RTE. 76

TANEY COUNTY

DATE 5/18/89

STD.
STD.
J-705R

DESIGNED Oct. 1984

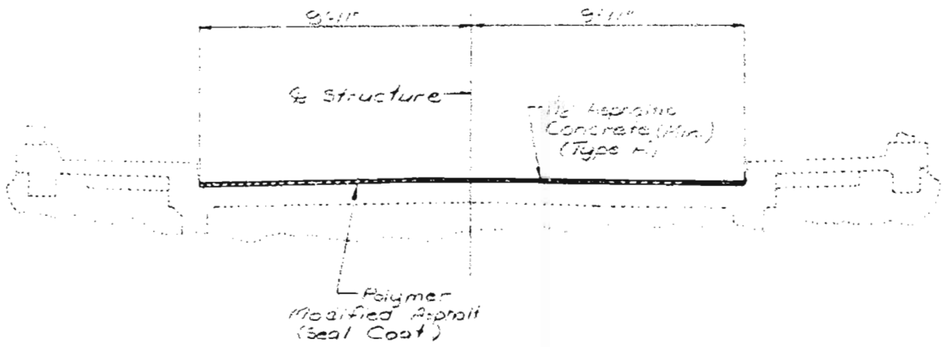
DETAILED Oct. 1984

CHECKED Oct. 1984

NOTE: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 8

MISSOURI HIGHWAY AND TRANSPORTATION COMMISSION



PART SECTION THRU SLAB

ESTIMATED QUANTITIES		
ITEM		TOTAL
Steel Bar Dams	Each	5
Modified Deck Repair	Sq. Ft.	130
Asphalt Cement (150-70 or AC20)	Ton	9.8
Mineral Aggregate (Asph. Conc.) (Type A Mix)	Ton	235
Polymer Modified Asphalt (Seal Coat)	Gal.	630
Cover Aggregate (Grade 3)	Tons	36
Special Work	Lump Sum	1

NOTES:

Outline of old work is indicated by light dashed lines. Heavy lines indicate new work.

One lane of traffic over structure to be maintained during construction.

The bituminous material was polymer modified asphalt emulsion Grade CRS-2P applied at a rate of 0.35 Gal. per Sq. Yd.

The cover aggregate (See Spec. Prov.) applied at a rate of 0.015 Ton per Sq. Yd.

Deck Drain Repair included removal of existing drain grates, fabrication and installation of new drain grates. (See Special Prov.)

Expansion Device Repair included — removal of existing sidewalk expansion plates, old concrete removal, fabrication and installation of new expansion plates. (See Special Provisions)

DESIGNED Oct. 1984
DETAILED Oct. 1984
CHECKED Oct. 1984

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1A of 5

BRIDGE OVER WHITE RIVER & UNION PACIFIC R.R.

STATE ROAD FROM BRANSON TO HOLLISTER

ABOUT .75 MILE SOUTH OF BRANSON

PROJECT NO. ~~RS-856-987(12)~~ STA. 648+68.92

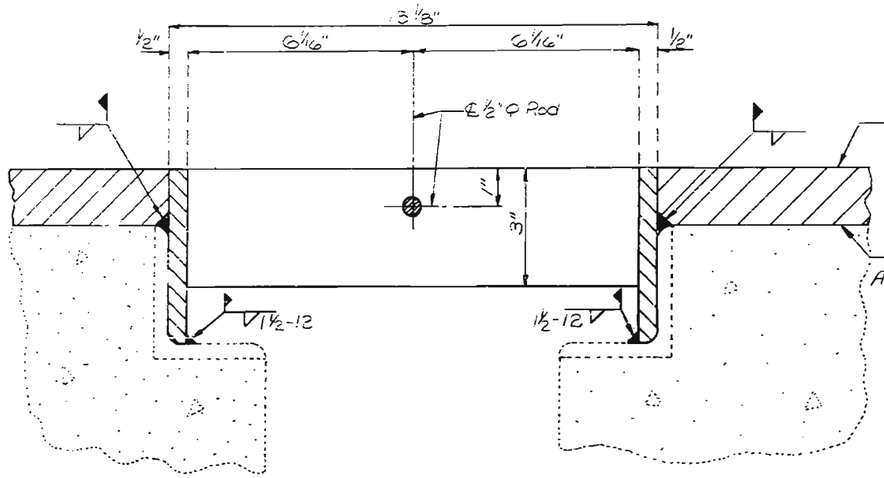
JOB NO. 8-5076-391 RTE. 76

TANEY **COUNTY**

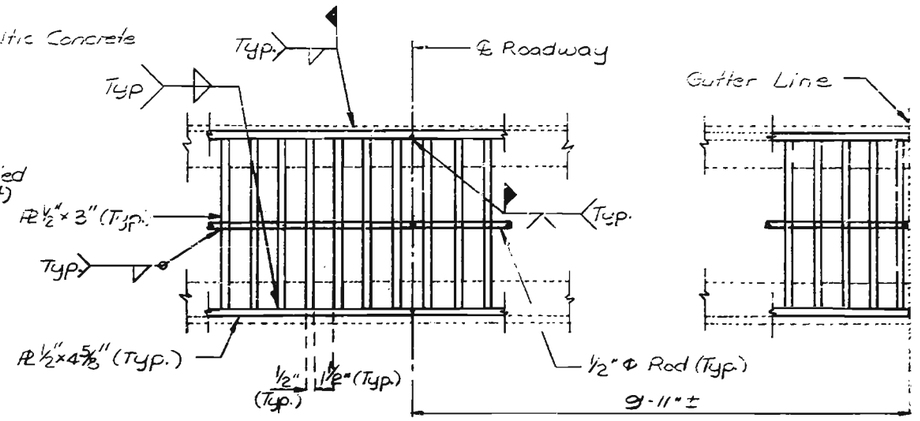
DATE 5/18/89

STD.	
STD.	
J-705R	

STATE	PROJ NO	SHEET NO
MO.		47



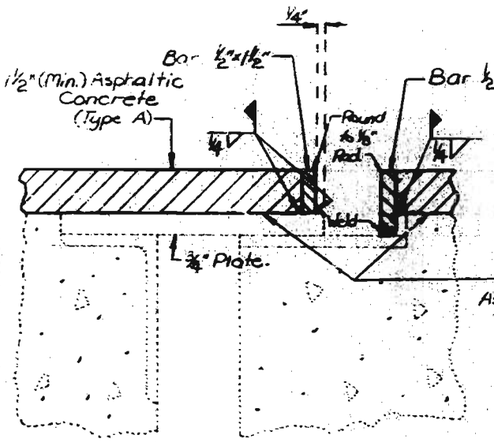
PART SECTION THRU DRAIN GRATE AT ABUTS. 2 & 7 AND PIERS NO. 3,4,5 & 6



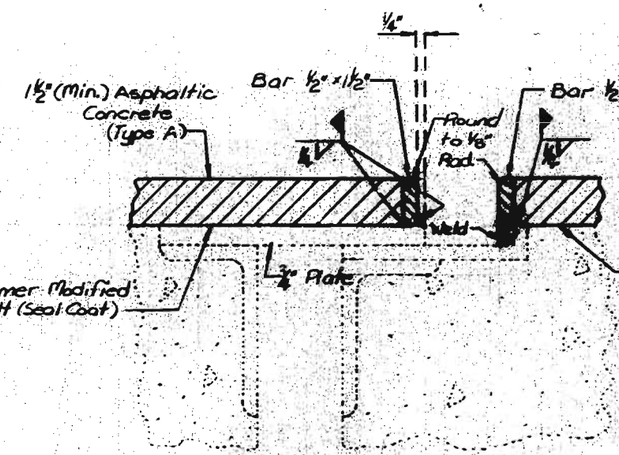
PART PLAN OF DRAIN GRATE

Note: Contractor shall verify all dimensions in field.

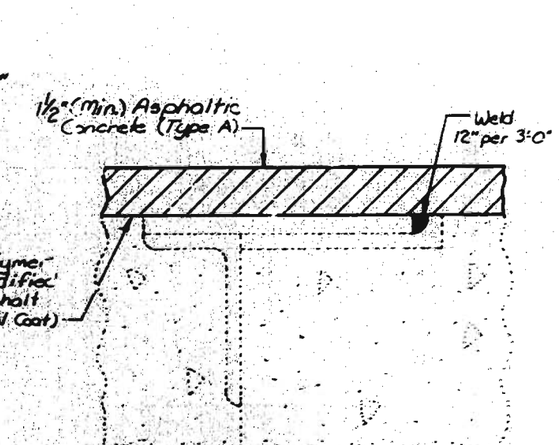
DETAILS OF DRAIN GRATE REPAIR



PART SECTION THRU EXPANSION DEVICE AT ABUTMENT NO. 2



PART SECTION THRU EXPANSION DEVICE AT PIERS NO. 3, 4, 5 & 6



PART SECTION THRU EXPANSION DEVICE AT ABUTMENT NO. 7

DETAILS OF EXP. DEVICES

NOTES

All Structural Steel to be A-36.
Qualification of welding operators will be required.
E 7016 or E 7018 welding electrodes shall be used.
Steel bars on both sides of expansion joint, for full width of roadway, shall be considered as a steel dam assembly and paid for as one steel bar dam.
Steel dams and drain grates shall conform to crown of roadway.
The steel dams and drain grates shall extend full roadway width between curbs but shall be installed in sections of such lengths to permit at least one way traffic at all times. Before traffic is permitted to cross over sections of dams or drain grates in place, sufficient bituminous surfacing shall be placed on roadway slab adjacent to both sides of expansion device and drain grates to prevent any damage to either the steel dams, drain grates or tires of vehicles.
Paint: None required, except drain grates. (See Special Provisions)
Outline of old work is indicated by light dashed lines. Heavy lines indicate new work.

DETAILED Oct. 1954
CHECKED Oct. 1954

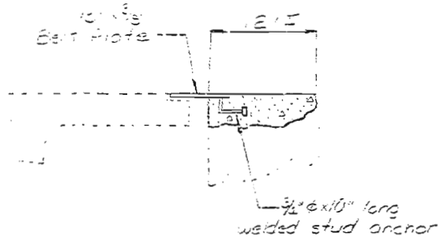
Note: This drawing is not to scale. Follow dimensions.

Sheet No. 2 of 3

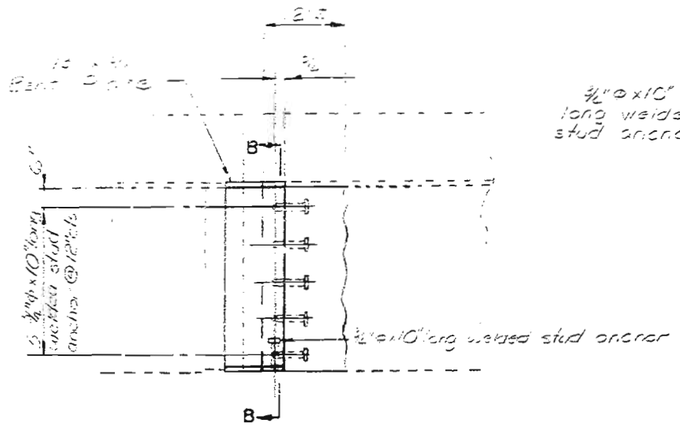
TANEY COUNTY

J-705R

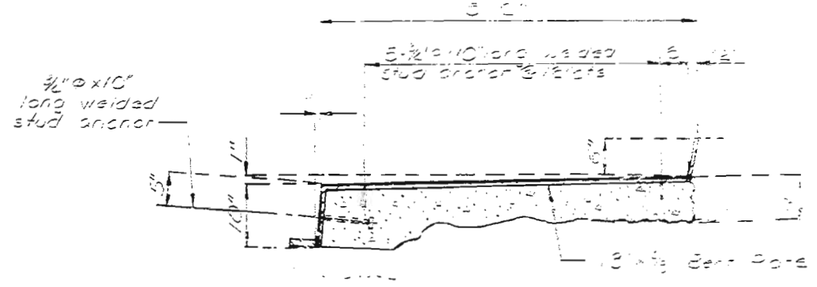
STATE	PROJ. NO.	SHEET NO.
MO.		4 5



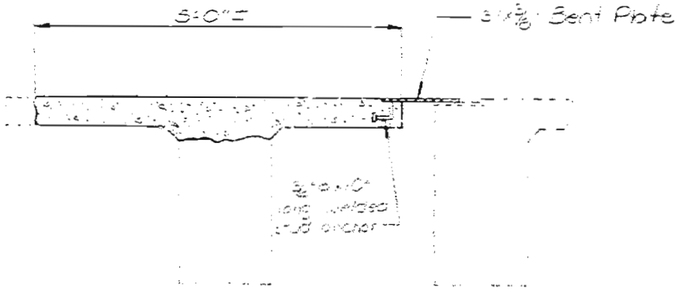
LONGITUDINAL SECTION THRU SIDEWALK OVER ABUT. NO. 3&5 (WEST SIDE)



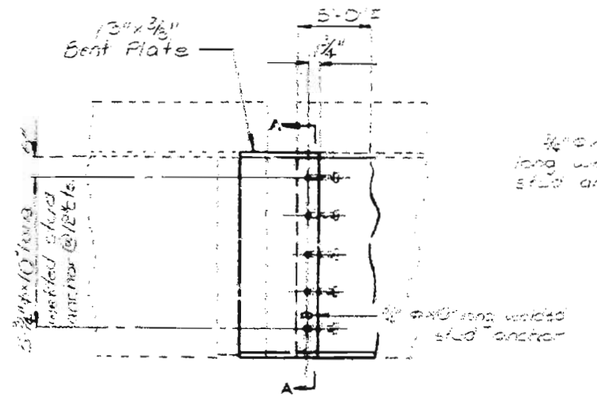
PART PLAN OF SIDEWALK OVER ABUT. NO. 3&5 (WEST SIDE)



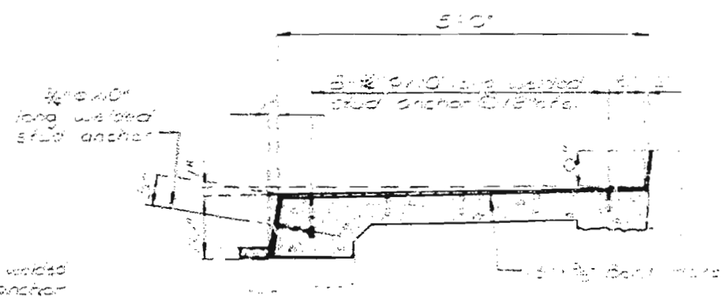
SECTION B-B



LONGITUDINAL SECTION THRU SIDEWALK OVER PIER NO. 4 (WEST SIDE)



PART PLAN OF SIDEWALK OVER PIER NO. 4 (WEST SIDE)



SECTION A-A

DETAILS OF REPAIR TO EXPANSION DEVICE AT SIDEWALKS

DETAILED
CHECKED

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 5 of 5

TANEY COUNTY

J-705P