Five New Highway Bridges Across Mississippi River

New Crossings Being Built at Louisiana, Alton, Chain of Rocks, Cape Girardeau and Cairo

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INCREASING road traffic has created a demand for better crossing facilities over the Mississippi River between Missouri and Illinois. This demand is now being supplied by the building of five new substantial highway bridges.

Louisiana Bridge—Most northerly is that at Louisiana, Mo., now under construction and proposed for completion during the present year. Work is in progress on the main river piers, and erection of the two west spans is well under way. The bridge will consist of four steel through truss spans of 325 ft., a 150-ft. through truss approach span, and 410 ft. of steel trestle. There will be 1,800 ft. of earth embankment in the Illinois approach. The bridge will have a 20-ft. roadway paved with bituminous concrete. The total length of bridge and approaches is 4,450 ft., and the maximum grade 3.47 per cent. L. C. Stark of Louisiana is president of the company for which the bridge is being built. Plans were prepared by Harrington, Howard & Ash, of Kansas City. The estimated cost of the construction is $815,000, and this with the added cost of organizing and interest payments brings the total to $1,000,000. The bridge is located on U. S. Route 54.

Alton Bridge—The next bridge, as one descends the river, is that at Alton, Ill., which is also under construction. Its location is about 300 ft. downstream from the railroad bridge at this point. It will consist of seven through truss spans with a total length of 1,843 ft., the piers being caissons carried to rock.

This bridge is connected with the building of another bridge, some four miles away, over the Missouri River at Ft. Bellefontaine, Mo. The Bellefontaine bridge will be located a short distance downstream from the present C. B. & Q. railway bridge, about six miles from the mouth of the Missouri. These bridges, one over the Mississippi and one over the Missouri, are to be connected by four miles of 20-ft. pavement, with an additional 1.5 miles of pavement south of the Bellefontaine bridge to connect with the Bellefontaine road in St. Louis County. They will shorten the distance between Alton and St. Louis. Much additional traffic is expected from Illinois Highways 4 and 11 carrying travel from the north and east to the west.

Alton furnished $700,000 of the money necessary to build this St. Louis connection, and the project is well under way. H. H. Ferguson, of St. Louis, is president of the company. Promotion of the project was originally carried out by state senator A. L. McCawley of Carthage, Mo. The estimated cost of the two bridges is $2,650,000. Work has been started on the Alton bridge and the work will be pushed to early completion.

Chain of Rocks Bridge—The proposed Chain of Rocks-Kings Highway bridge has received War Department approval and financing is under way. Actual work may begin shortly. The bridge will be 300 ft. north of the new intake of the St. Louis water-works, at the Chain of Rocks. It will be 5,400 ft. long, consisting of seven 200-ft. spans, two 300-ft. spans, five 400-ft. spans, and two 700-ft. spans, all with 20-ft. roadway. It is estimated to cost $2,300,000, with highway connections. John R. Scott, of St. Louis, is the president of the company; plans were prepared by E. B. Ray and Baxter L. Brown, of St. Louis, Mo. The bridge will avoid numerous grade crossings found on present routes over the bridges at St. Louis.

Cape Girardeau Bridge—The Cape Girardeau bridge, under construction, will cost $1,600,000. Plans were prepared by Harrington, Howard & Ash. C. L. Harrison, of Cape Girardeau, Mo., is president of the company. The bridge will consist of seven through steel trusses on caissons sunk to rock, and with approaches will be 3,226 ft. long. It will have a 20-ft. roadway with bituminous pavement. It is estimated that 110,000 autos will be diverted over the bridge, that being approximately the number now using ferries over the Mississippi at this and adjacent points.

Cairo Bridge—A bridge is also under construction at Cairo, Ill., connecting that city with Bird's Point, Mo. It is a $2,000,000 project, and will connect Illinois Highway No. 2 (Bloomington to Cairo) with U. S. Highway 60 in Missouri, Bird's Point to Springfield, where it joins U. S. Highway 66. This structure also will consist of steel truss spans on caissons to rock. It will solve a definite traffic problem, as at this time several ferry companies are kept busy and considerable rivalry has existed over the increasing trade developing; special laws were enacted by the county officials to control the situation.

Web Stresses in Concrete Beams

Tests of 139 reinforced-concrete beams to investigate shear failures and web stresses are reported by Prof. F. E. Richart in Illinois Engineering Experiment Station Bulletin 166, just issued. The tests extended over a 12-year period, and dealt with spans of 6 to 10 ft., depths of 10 to 21 in., and flange widths up to 20 in., loaded usually at the third-points. In the beams which had no web reinforcement, failure was by diagonal tension at shearing unit stresses from 130 to 580 lb. per sq.in. (most of them between 130 and 250); failure occurred suddenly, without display of toughness. Beams with web reinforcement always showed gradual yielding. They exhibited the largest amounts of diagonal tension in the region between load-point and support, while near load and support the diagonal tension was relatively small. The diagonal tension reached large values in those beams which were under heavy shearing stress compared to the bending stress—that is, short and deep beams and those having large percentages of longitudinal steel. However, these beams also showed the highest shear capacity. Adequate anchorage of both longitudinal and web steel was found to be important. Generally the observed stresses in the web steel were well below the stresses calculated on the assumption that the web steel carries all the shear, and approximated those corresponding to division of the shear between concrete and steel sections (with 100 lb. per sq.in. shear for ordinary concrete and 200 lb. per sq.in. for strong concrete). But with increasing percentage of web reinforcement the proportion of the total shear carried by the web steel increased. Vertical web members were about equally effective with those inclined at 45 degrees.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Structural Building Stressed at Meeting Of Welding Society

Papers Also Presented on Aircraft Frames and Metallurgy—Research Active

STRUCTURAL matters were strongly represented at the fall meeting of the American Welding Society in Detroit, Sept. 19-22, by two papers on welded buildings, one on steel plate welding work and an interesting and instructive session of the Structural Welding Research Committee. There were also several papers on structural welding of aircraft frames and a paper of general interest on the metallurgy of welds.

At the structural welding research committee session, it was reported that all of the requested funds have been promised by the gas and electric welding interests. The committee's program was outlined and a detailed report given on the 342 pilot specimens that have been prepared (and some tested) by Professor Gillespie of the University of Toronto.

The meeting was unusually well attended. Inspection tours were made to the River Rouge plant of the Ford Motor Co. and to the Ford airport where many of the members took flights in the large all metal Ford planes.

Arc Welding in Buildings

"Arc Welding in Buildings" was the title of a paper presented by Joseph Matte, Jr., construction engineer, Albert Kahn, Inc., Detroit. After an ever-enlarging experience with welding, Mr. Matte has come to the conclusion that "In the present state of the art, steel welding is more expensive than riveting unless some advantage resides inherently in the welding which offsets or overbalances the extra cost." This principle he is using when designing structural connections which lend themselves either to riveting or to welding.

Another present condition is that it is necessary to charge against a large structural job all equipment which it is found necessary to purchase and in this connection Mr. Matte states, "Some new method of co-operation between the welders and the welding supply companies may eventually be worked out, resulting in a material cost reduction." Mr. Matte does not agree with the welding supply manufacturers who state that it is not their job to design the structures. "It is not only necessary for the structural engineer to understand welding, but for the welding engineer to be thoroughly familiar with construction work." At the present stage of the art "it is the province of the welder to come and show us (structural engineers) where, when and how welding is advantageous." Otherwise the structural engineer has no reason to depart from the past orthodox designs.

Among the examples of welding work with which he has been personally connected since 1916, Mr. Matte described a number of interesting structural details. Welding column caps and bases is now done in practically all of the work of his company. It also specifies that all lining rings in large stacks be tack welded in place. For buildings designed and built for the future addition of stories, it has eliminated the costly waterproofing and flashing that had to be provided around the projecting column and now stops the steel columns flush with the temporary roof construction, allowing the waterproofing to run straight across. The column extensions when required can be welded directly to the top of the existing column.

Uses in Concrete Construction

The same solution applies to reinforced-concrete building where a small plate can be anchored in the top of the column flush with the roof slab. The rods for the extension column section can be built up as a unit, set in place and the bottom of the rods welded to this plate. In another case, shear bars in concrete girders were required in such quantities that given their proper anchorage to the top and bottom bars there would hardly be room left to pour the concrete into the forms. The solution was found by welding the ends of the diagonal shear bars between the top and bottom bars. A plan was proposed in Detroit to use welded wind bracing in a building, this to be placed by the welding contractor, thus relieving the steel contractor of the fabrication and erection of these complicated details. As a result a rather elaborate series was carried out which will be described in more detail in an early issue of *Engineering News-Record*.

In another structural building paper, G. H. Danforth, Jones & Laughlin Steel Corp., described the work done on a one-story shop building in which most of the steel was shipped direct from the mill to the site of the building with the usual $\frac{3}{8}$-in. mill variation.

In a paper entitled "Design of Steel Plate Welding" L. J. Sforzini of the engineering and maintenance department, Eastman Kodak Co., made a com-

(Continued on p. 526)

Mississippi River Bridge Span in Ohio Falls During Erection

Semi-Cantilever Method Being Used to Set 314-Ft. Span—Piles Under Temporary Bent Give Way

ON SEPT. 6 a serious erection accident interrupted the construction of the Mississippi River bridge being built for the Missouri-Illinois Bridge Co., at Louisiana, Mo. Erection was in progress from the west or Missouri end. The semi-cantilever method of erection being used is made clear by the picture herewith taken before the collapse. One span had been swung and riveting was in progress; the second span was about two-thirds erected, when the two temporary bents carrying it gave way and the span fell into the river. One man of the erecting force lost his life in the fall.

The bridge will consist of four spans of about 314-ft. length between end pins, one span of 150 ft., and 410 ft. of steel viaduct, with an embankment approach on the east or Illinois side. The spans are riveted through spans, designed to provide a 20-ft. roadway on concrete floor. Harrington, Howard & Ash, of Kansas City, designed the bridge (see *Engineering News-Record*, Sept. 15, p. 431). The piers were being built by the Missouri Valley Bridge & Iron Co., of Leavenworth, Kan., and the superstructure was being furnished and erected by the Wisconsin Bridge & Iron Co., of North Milwaukee, Wis. F. A. Ross, erection manager of the latter company, devised the erection scheme, falsework, and equipment.

In erecting each span, the trusses were cantilevered out progressively over two steel temporary bents carried on pile tower substructures. The first bent was set four panels (about 90 ft.) out from the pier and was connected to the pier by small temporary trusses formed

Pratt Institute 40 Years Old

The Pratt Institute of Brooklyn began its 41st year on Sept. 26. The school of science and technology is considered outstanding in practical technical instruction, laying, as it does, emphasis on practical vocational training in both day and evening instruction. Among the subjects taught are structural design, strength of materials, steam power plant operation, automotive engine maintenance and repair, tool making, etc. The director of the school is Samuel S. Edmands.

by a king-post construction riveted to the under side of the bottom chords. When the span had been erected to this bent it was continued by cantilevering to the second bent, and thence continued on to the far pier by cantilevering over the second bent.

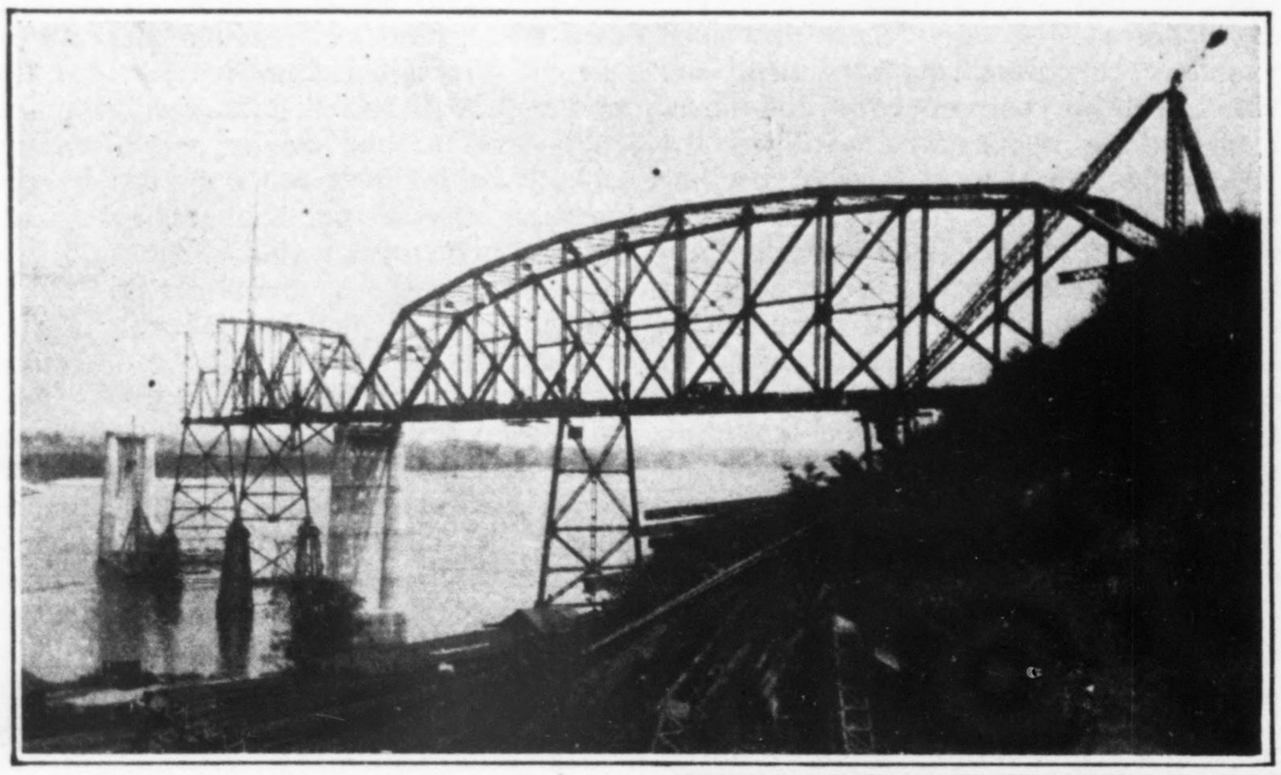
E. E. Howard, of Harrington, Howard & Ash, describes the circumstances of the accident as follows:

The bed of the river between pier 1 and pier 2 is in large part of shale without any cover. The pile towers supporting the steel bents were made of groups of substantial timber piles with metal points set on the shale, and braced in all directions above the water line. The piles were unsupported from the water line down to the shale. A few days before the collapse it was observed that the pile falsework towers were being distorted, and were leaning out of correct position. Operations were in progress to provide additional bracing by cables when the span fell. It is the general belief that falsework piles of the outer bent failed by sliding or otherwise, and this bent collapsed, throwing excess load on the bent nearest pier 1, so that this in turn collapsed and dropped the span.

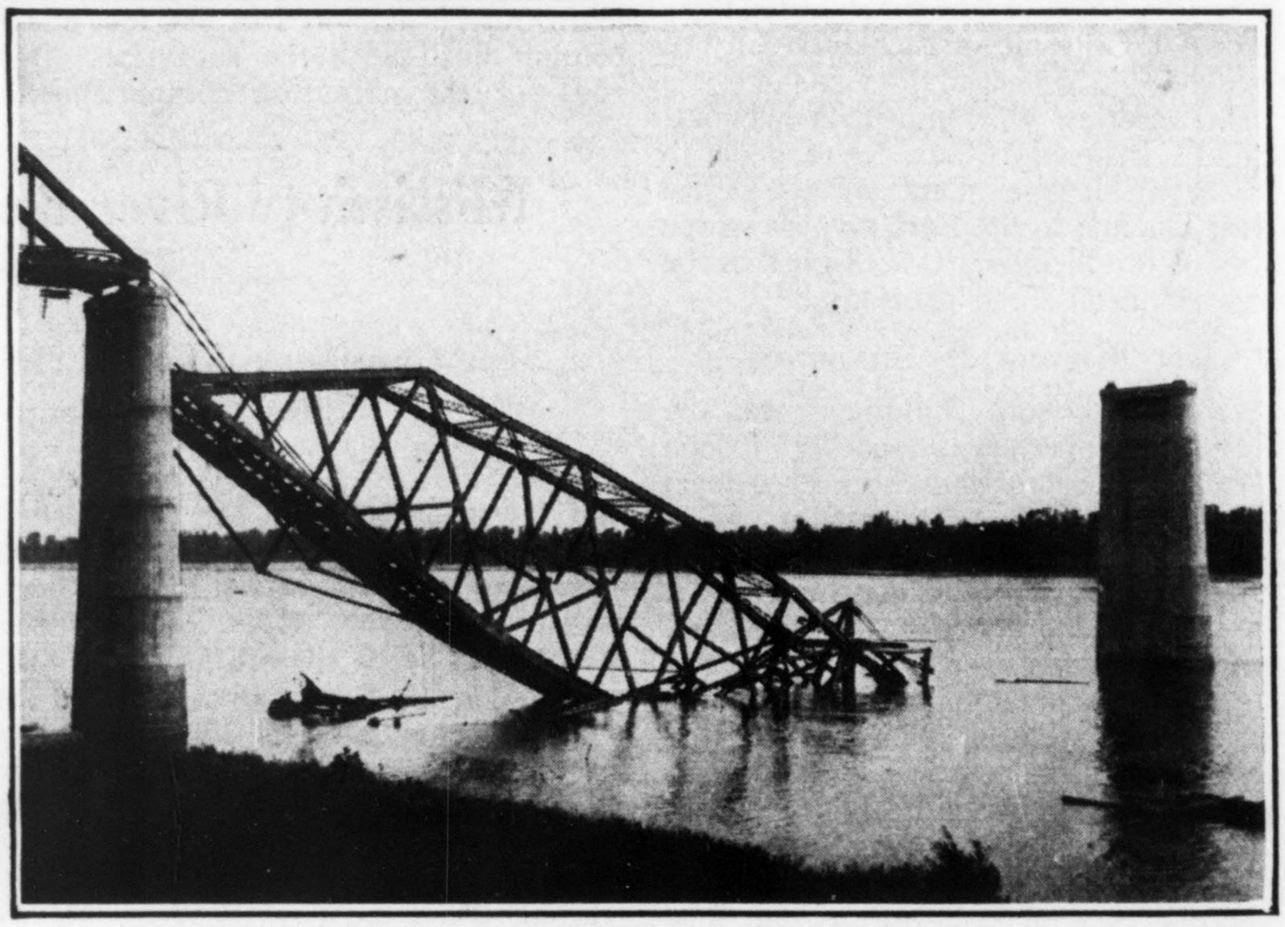
No rivets had been driven, and operations are in progress for raising the span slightly in its present position, removing bolts and taking it apart as far as possible.

H. A. Wagner, president of the Wisconsin Bridge & Iron Co. states that the cause of the falsework failure has not yet been definitely determined, but that further information may be obtained when the span is raised and the piles are examined. He suggests that the river bottom, of hard gravel or soft rock, may not have been penetrated by the piles when driven, and may have permitted uneven settlement later when the maximum load was applied, this settlement transferring load to other piles of the tower and overloading them.

At the inquest on the accident the superintendent of the erectors stated that the falsework was twice as strong as the plans and specifications prepared by the engineers of the company required. He was on the bridge and shortly before the collapse noticed that the falsework was yielding, and thereupon took some men and began to brace the supports. The supports had not slipped or moved before that time, and no evidence of weakness had been observable on the day before (Sept. 5). The closing section of the bottom chord connecting the outer end of the uncompleted truss with pier 2 had been placed in position just before the collapse, but there was no jar or other disturbance during this operation.



LOUISIANA BRIDGE DURING ERECTION OF SECOND SPAN FROM WEST



UNCOMPLETED SPAN AFTER ITS COLLAPSE DUE TO FALSEWORK FAILURE ON SEPT. 6

Americans Take Prominent Part in Management Congress

Americans took a prominent part in the third International Congress of Scientific Management which was held in Rome during the week of Sept. 5. The Congress attracted 13,000 delegates which included 28 from Great Britain and 32 from the United States. The work of the congress was divided into four sections: industry, agriculture, public services and domestic economy.

Particularly prominent on the program was Morton C. Tuttle of Boston, Mass., who described the organization and management of an engineering construction firm doing from $5,000,000 to $7,500,000 worth of business yearly. Charles R. Hook, of the American Rolling Mill Co., described the application of scientific management principles to the selection and training of employees in the organization with which he is associated.

Evening Classes in Engineering at U. of Cincinnati

An extensive program in evening courses in commerce, engineering and applied arts has been organized by the University of Cincinnati, including civil, mechanical and electrical engineering, architecture, metallurgy, chemistry, traffic management, landscape architecture, radio, advertising, business journalism and real estate. These courses are under the direction of the Dean of the College of Engineering and Commerce.

Ohio Builds Highway to Test Concrete Curing Methods

The Ohio State Highway Department has approved the building of an experimental road in Tuscarawas County for the purpose of testing certain curing processes used on concrete construction. The project is 1.288 miles in length and is located on the New Philadelphia-Millersburg road. The construction is being done by Leroy Springer & Co., of New Philadelphia.

The experimental part of the work will consist of curing certain sections with calcium chloride applied to the surface; calcium chloride as an admixture, sodium silicate on the surface, wet earth and wet straw on the surface.

The experimental work is under the charge of Albert S. Beightler, chief engineer of the bureau of construction. A. S. Rea, chief engineer of tests and Prof. R. C. Sloan, of Ohio State.