Double-Deck Bascule Bridge Over Chicago River

By Hugh E. Young*

SYNOPSIS—The new Lake St. bridge over the Chicago River will be a double-leaf bascule of 245 ft. span, carrying an elevated railway on the upper deck and a roadway (with car tracks) and sidewalks on the lower deck. The bridge itself is of interest, and its construction involved specially interesting and difficult problems, since the elevated railway had to be kept in operation over the old swing bridge during the construction of the new bascule bridge.

The Lake St. bridge, on one of the main thoroughfares entering the business district of Chicago, crosses the south branch of the Chicago River just south of the turning basin at the junction of the north and south branches with the main stem of the river. The present bridge has a three-truss swing span, which was built as a single-deck structure in 1888 and strengthened in 1893 to carry an upper deck for the Chicago & Oak Park Elevated R.R.

The river channel is 235 ft. wide at Lake St., but the swing bridge interferes seriously with navigation, giving a clear channel width of only 65 ft. on each side of the center pier. The United States War Department ordered the removal of the bridge several years ago, as an obstruction to navigation, but owing to the desirability of avoiding interruption to elevated-railway traffic and the difficulty of arranging for a temporary means of crossing the river, the city authorities procured an extension of time. Before this was done, however, studies were made for an incline from the elevated structure to the street level just west of the river, the trains crossing the river on the Washington St. bridge (two blocks south) and then rising again to the elevated structure in North Market St. This scheme was abandoned, as it would be too dangerous to run five-car trains on the streets in the busy district.

It was decided therefore to construct the new bridge in such a manner that the elevated traffic could be continued over the old swing bridge, except occasionally for a few hours at a time and when the inconvenience to passengers would be at a minimum. Plans for this new bridge were well-advanced by the end of 1912 and provided for three railway tracks, but later the elevated railway company decided to have only two tracks. The changed plans and specifications were finished in June, and bids were opened on Sept. 18, 1913, but the lowest bid exceeded the estimate for the bridge.

Owners of patents for movable bridges then claimed that a more economical bridge could be built on their plans, and a commission of three engineers was selected in accordance with a resolution passed by the Finance

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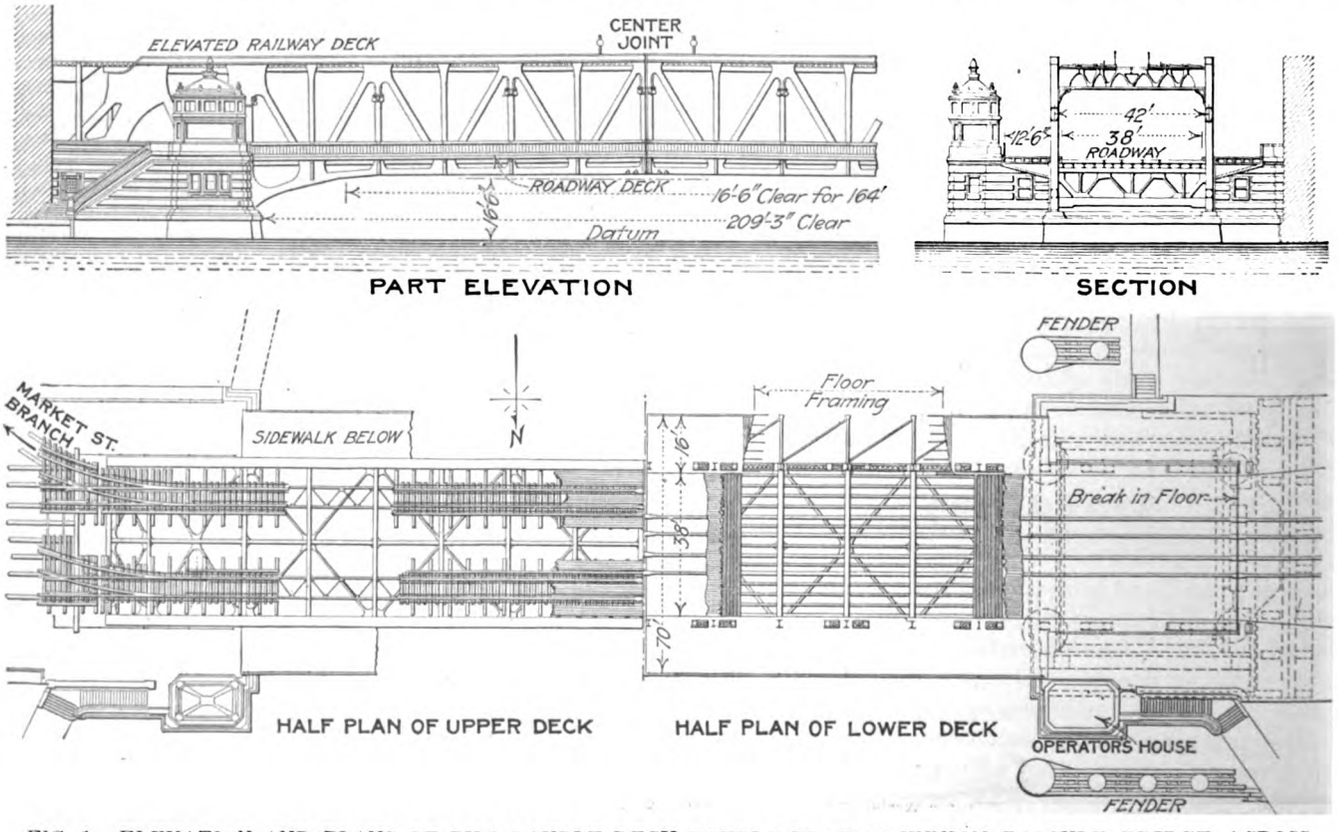

FIG. 1. ELEVATION AND PLANS OF THE DOUBLE-DECK DOUBLE-LEAF TRUNNION BASCULE BRIDGE ACROSS THE CHICAGO RIVER AT LAKE ST., CHICAGO, ILL.

This bridge will carry a roadway, sidewalks and street-car tracks on the lower deck, and a double-track elevated railway on the upper deck

Committee of the City Council on Oct. 24, 1913. This commission consisted of John Ericson, City Engineer; J. E. Greiner, Consulting Engineer, of Baltimore, Md., representing the elevated railway, and W. H. Finley, Chief Engineer of the Chicago & Northwestern Ry. Mr. Finley was selected by the other two members. Competitive plans and estimates were received by this commission for various types of bridges which could be erected without materially interfering with the operation of the existing bridge. These included a double-deck lift bridge and double-deck single-and-double-leaf trunnion bascule bridges.

The lift-bridge design placed the towers straddling the elevated structure on the approaches. The lift span could be erected in place in the open position or erected at the north side of the turning basin and floated into place on scows. The bascule bridges could be erected in the open position without interfering with the swing bridge, by omitting part of the floor system, thus allowing the trains to pass between the trusses. When the bridge was ready to be lowered, traffic would be interrupted long enough to complete the floor system and remove the swing bridge.

The commission recommended a vertical-lift design submitted by the city. On considerations of public policy, however, the City Council recommended the double-leaf bascule bridge (according to the city's plans somewhat revised). Accordingly, the various bids were rejected and the plans and specifications were revised.

Description of the New Bridge

The new bridge (Fig. 1) will have the following main dimensions: 245 ft. c. to c. of trunnions, 217 ft. c. to c. of bearings; clear width of channel, 195 ft.; clear distance between masonry piers, 209 ft. 3 in.; length of counterweight arms, 39 ft.; truss spacing, 42 ft. c. to c.; width over sidewalks, 70 ft.; depth of trusses at center, 30 ft.; clear headway over the water, 16 ft. 6 in. for a width of 164 ft. The lower deck, 70 ft. wide, has two 16-ft. walks and a clear roadway of 38 ft. with two lines of street-car tracks. The upper deck carries the double-track elevated railway.

This type of bridge was chosen mainly because it could be treated architecturally better than any other type, being symmetrical and having the counterweight under the roadway. The counterweight lowers into a tailpit between the river pier and anchor pier. The operating machinery will be placed under the sidewalks at each corner of the bridge and will be inclosed with concrete walls treated with suitable ornamentation. The new bridge is located symmetrically about the center of the present swing bridge and is being erected in the open position. During the construction, traffic on the lower (street) deck of the present bridge is discontinued, street cars being diverted to the Randolph St. bridge, one block south.

The new substructure consists of a tailpit and an abutment on each side of the river. This will be described in a separate article.

Temporary Supports for Elevated Approaches

After the street-railway company had removed trolley wires, rails, etc., from the swing span and approaches, the sidewalk brackets of the swing span were cut off with the acetylene torch, in order to obtain a wider channel with the bridge opened. The operator's house, situated over the sidewalks, had to be removed and a new one erected on the roadway of the lower deck. This involved no great amount of work as the bridge is operated electrically. The old protection (which was almost all broken away) was removed, and a new protection constructed to suit the new channel lines on each side of the center pier.

The approach spans on the street level were removed, the steel being cut with the acetylene torch and removed from the site by scows. Excavation was then started on both

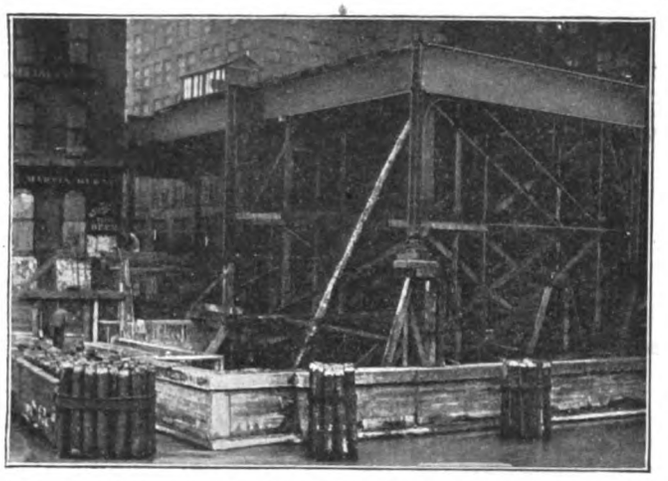

FIG. 2. TEMPORARY SUPPORTS FOR END OF THE EAST APPROACH OF ELEVATED RAILWAY

approaches back of the old abutment. The center part of the old east abutment was removed first. The ends of the abutment were left in place temporarily, as the columns of the elevated structure rested on them.

Timber bents were then erected under the elevated structure, as shown in Fig. 2, which illustrates the east approach. Bents were erected just back of the river pier and in front and back of the abutment. These bents consisted of 12x12-in. posts directly under each girder of the elevated structure, which rested on piles capped just above the water-level surface. Old foundation piles uncovered during the excavation were used for supporting the bents, if suitably located. These were first tested by placing jacks between the bottom of the 12x12-in. posts and the piles. The piles were observed for settlement under this load, and if none occurred during an interval of about a day they were considered suitable for use.

The number of these old piles was due to the fact that, previous to the construction of the present bridge (1888), there had been at least two bridges, both supported on pile foundations. These piles were of a kind not common today, ranging from 18 to 24 in. in diameter at the butt. They were in a remarkable state of preservation, being practically as good as when driven, which must have been nearly 50 years ago. The bents were capped with 12x12-in. timbers, braced with 2x12-in. sway bracing. A batter pile was used in the bent at the river pier.

The columns of the elevated structure were supported on girders spanning the space for the tailpit. These girders rested on groups of piles driven in line with the first and second bents of the elevated structure east of the swing span, as shown in Fig. 3. Each girder consisted of two separate plate girders connected by cross-bracing. Each girder had a 96x¼-in. web plate and four angles 6x6x$\frac{7}{16}$ in.; it was stiffened at points of local load and about every 4½ ft. at other parts, by 5x3x⅜-in. stiffener

angles. Webs were spliced for moment. The overall length of these girders was 78 ft. The double girder for the rear bent was placed first, the abutments having been entirely removed. The girders supporting the front bent and the end of the swing were placed when it was convenient to close elevated traffic for a few hours, as the masonry of the old river pier had to be removed when the swing bridge was open and the bridge could not be closed again for traffic until a new end bearing could be provided.

This work was done July 3, 1914, traffic being closed on the elevated structure from 9 a.m. to 4 p.m. Passengers used the Canal St. station, two blocks west of the river. As soon as the girders were in place, the temporary timber supports under the elevated structure (Fig. 2) were removed.

After the construction of the tailpit, temporary timber bents were erected to support the elevated structure on the east side (Fig. 2). These rested on timbers laid on the pit floor. When these were ready for the elevated structure the box girders were transferred to similar positions on the west side. The girder under the first bent was transferred Dec. 29, when traffic was shut off on the elevated for 7½ hr. The temporary timber bents were removed as soon as the girders were in place.

The contractor for the superstructure started on Jan. 13, 1915, to erect falsework for the erection derrick on the east side and had this practically finished on Jan. 30. This falsework, or tower, required careful study, as the position of supports was not only limited by vertical headroom over the elevated structure, but by lateral clearances of a car swinging around the curve into the North Market St. branch (Fig. 1). This derrick is shown in Fig. 4.

The structural steel began to arrive at the site on Feb. 8. It was delivered on flat cars and unloaded at the railway yard on the north side of the turning basin (just north of the bridge site) where it was stored until needed. Thence it was delivered on scows.

The contractor started as soon as possible to erect the steel of the fixed parts upon which the movable structure rests. These parts consist of two carrying trusses, 48 ft. c. to c., parallel with and just outside the movable trusses.

The machinery girders are 7 ft. back from and parallel with the carrying trusses. The carrying trusses and machinery girders span from river pier to anchor pier, a distance of 53 ft.

The carrying trusses are the supports for the cross-girders (Fig. 5). They also carry the gear trains which are located opposite the racks in the rear arm truss members. The cross-girders are located 14 ft. back of the river pier; they carry the entire dead-load of the bridge, and have a span of 48 ft. c. to c. of carrying trusses, spanning the entire distance across the tailpits.

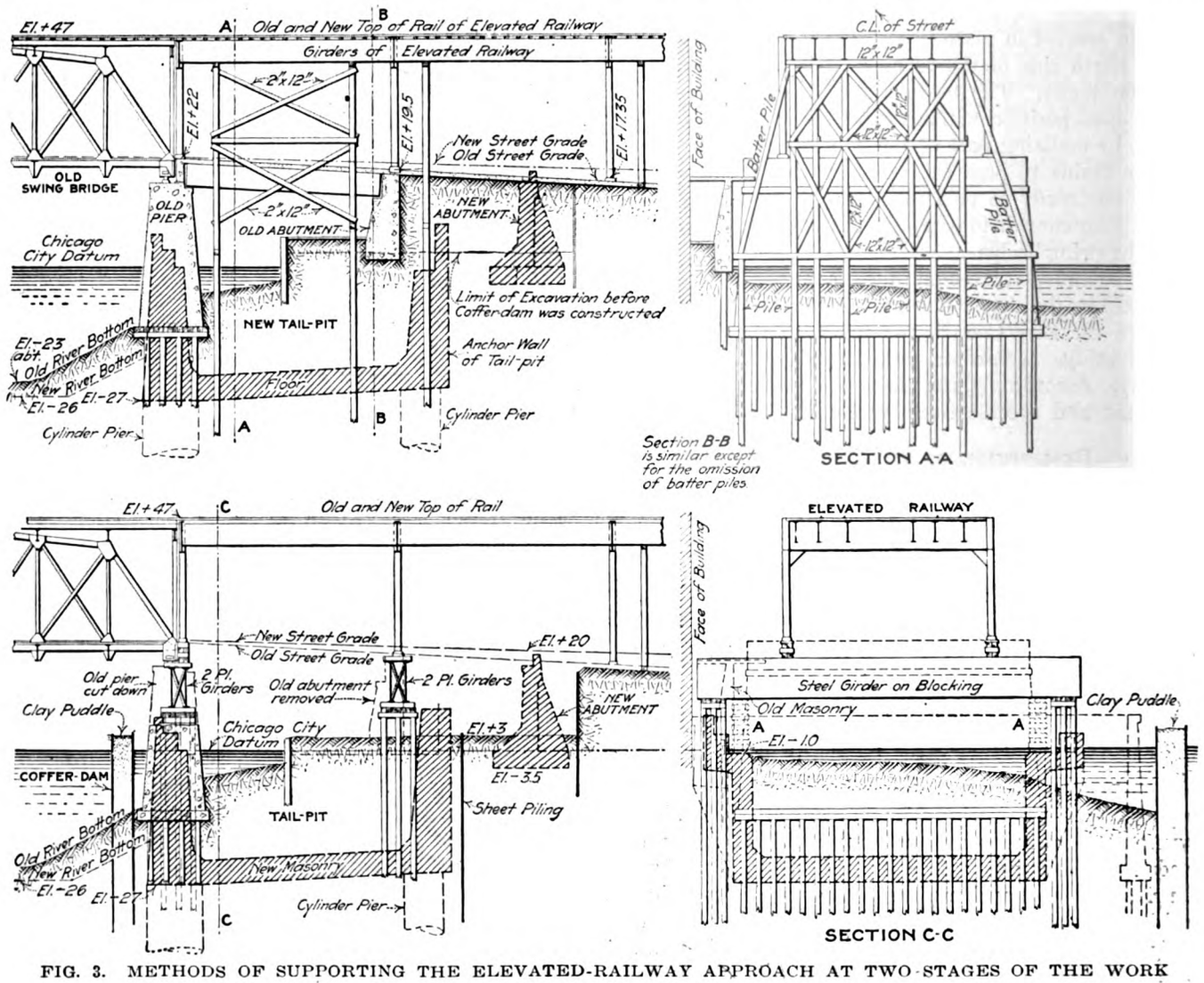

FIG. 3. METHODS OF SUPPORTING THE ELEVATED-RAILWAY APPROACH AT TWO STAGES OF THE WORK

At the time the superstructure contractor began work on the east side the elevated structure was supported on timber bents resting on the floor of the pit (as shown in Fig. 2). These bents were so placed that the contractor could erect the carrying trusses and machinery girders without difficulty. These trusses and girders, being outside of the elevated structure, could be handled by the derrick. The erection of the cross-girder, on account of its weight and its position under the elevated structure, was more difficult.

Additional falsework was built to place the cross-girder. This consisted of A-frames resting on the floor of the tailpit. On the frames were placed two 15-in. channels, forming a runway for sliding the girder across the pit. The girder was lowered from the A-frame to its final position on the carrying trusses by means of jacks.

The fixed portion of the new elevated structure over the tailpits will be supported on new columns, which rest on the carrying trusses about 7 ft. from the center line of the anchor pier (Fig. 1). These columns are in the same place as the old floor-beams, but are located a greater distance out from center line of structure. The old floor-beam was therefore lengthened in order to provide a connection for the new columns.

The steel columns in the bent at the river pier were also moved out, lengthened by splicing on portions of the

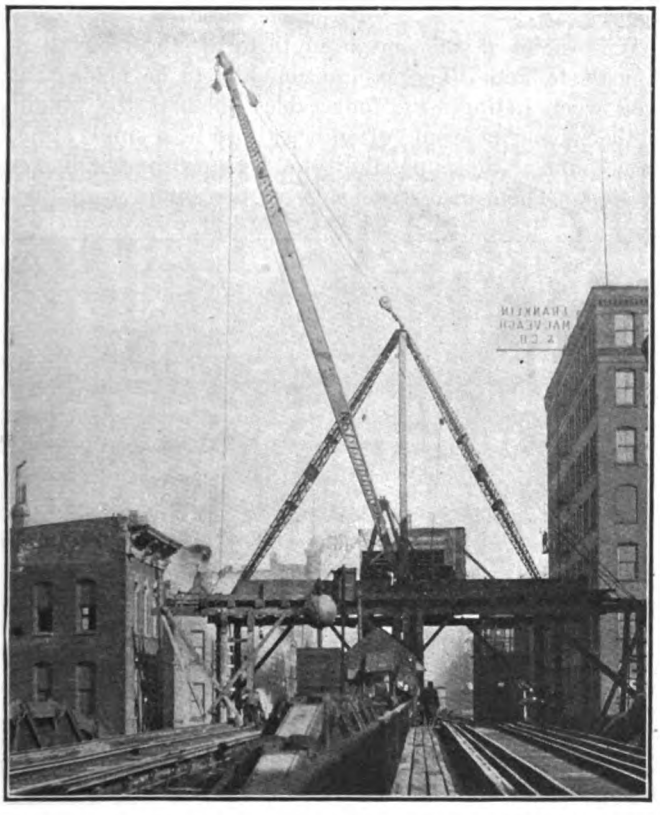

FIG. 4. STIFF-LEG DERRICK OVER THE ELEVATED RAILWAY APPROACH

old columns, removed from the bent near the anchor pier and carried down to a bearing on the carrying truss, the floor-beam of the elevated structure being lengthened as before.

The temporary timber bents under the elevated structure were then removed and the elevated structure carried on the new steel. The erection of the tail end of the bridge was then started, and part of the trusses had been assembled at the time a strike of the structural iron workers was called at the end of April.

During the week ending Apr. 17, 1915, the contractor began erecting his derrick on the west side. This was not placed over the elevated structure but in the tailpit, the mast resting on the floor and the stiff-legs being anchored to the sidewalls of the pit. A strike stopped the work in April and from that time until work was resumed on July 8, 1915, the elevated structure on the west side

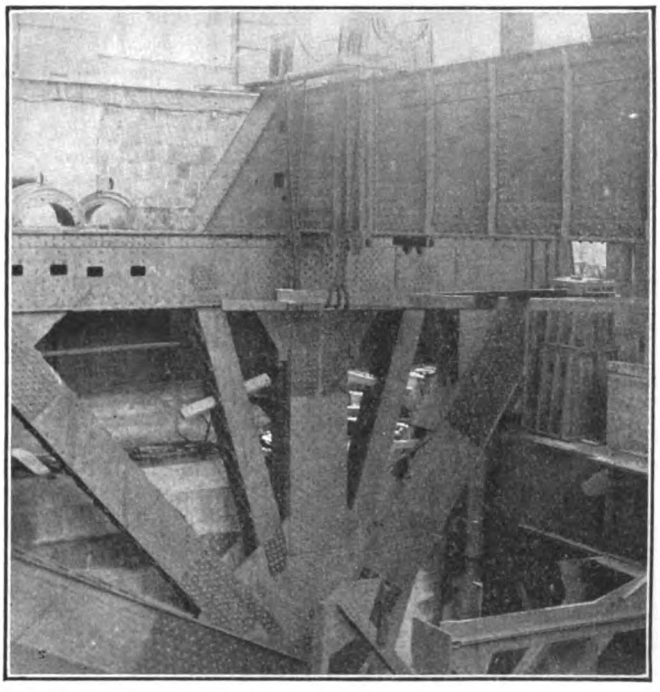

FIG. 5. ONE OF THE TRUSSES OVER THE TAILPIT

rested on two temporary cross-girders, and on the east side on the new carrying trusses with the permanent columns in place for the bent near the anchor pier and temporary bent in place near the river pier.

The leaves will be erected in the open position, a portion of the floor system being omitted to permit of passage of trains. When the leaves are lowered the two spans of the elevated structure over the pits will be removed and the floor system on the upper deck completed.

Engineers and Contractors

The work is under the Department of Public Works, the head of which is W. R. Moorhouse, Commissioner of Public Works. The City Engineer, John Ericson, is head of the Bureau of Engineering, and Thomas G. Pihlfeldt is Engineer of Bridges and Harbor. The final plans were prepared in the Designing Section, under the immediate direction of A. von Babo, Engineer of Bridge Design, and the writer. The construction is supervised by the Construction-by-Contract Section, under Clarence S. Rowe, Assistant Engineer, and the resident engineer on the work is William A. Mulcahy, Assistant Engineer.

The contract for the substructure was awarded to the FitzSimons & Connell Dredge and Dock Co., of Chicago, on Mar. 14, 1914. The contract for the erection of the superstructure was let Mar. 18, 1914, to the Ketler-Elliott Erection Co., of Chicago. The contract for the steel was let to the American Bridge Co.