NEW OHIO RIVER BRIDGE AT KENOVA, W. VA.

Replacing of Five Span, Double Track, Through Truss Structure on Same Piers Without Interrupting Traffic.

The old bridge which carried the Virginia and Ohio line of the Norfolk & Western over the Ohio river at Kenova, W. Va., and which has just been replaced, was built in 1891-2. It was 3,942 ft. long and consisted of five river spans, one 518 ft. long and four 298 ft. long, and a 2,210 ft. steel trestle approach on the east end. A minimum clearance of 40 ft. above extreme high water was required for navigation, making the four river piers nearly 100 ft. high. These piers were built of sandstone and local freestone. The bridge was built for a single track, but the trusses were spaced 34 ft. center to center, with the intention of adding a second track in the future by placing a third truss between the two original ones. This was never done, although when the line was double tracked east of Kenova, two gauntleted tracks were laid on the structure. As there are 60 to 70 train movements a day over this portion of the line, it was very important that the capacity of the bridge be increased by adding a second track, and it was necessary to accomplish this without interrupting traffic.

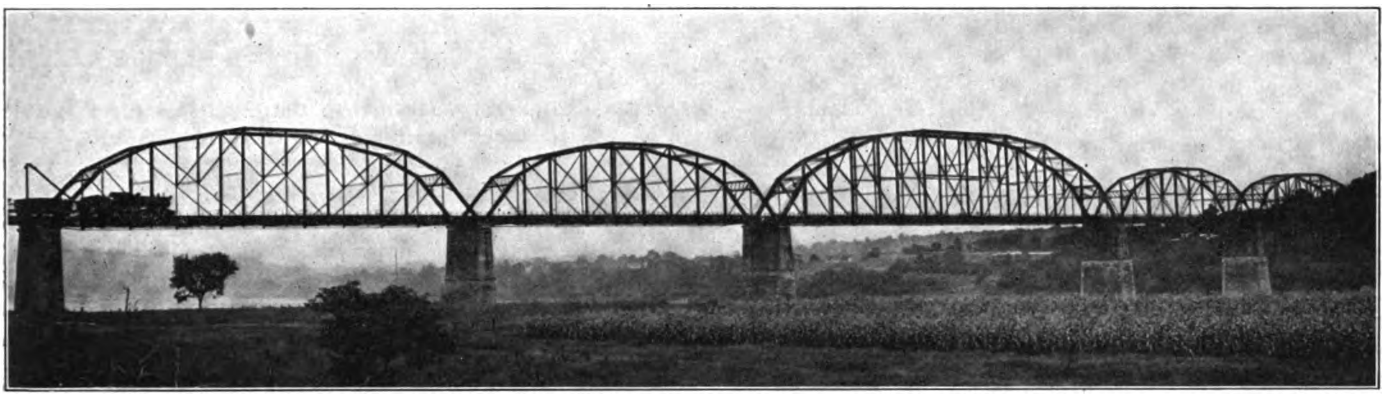

Fig. 1—The Old Norfolk & Western Bridge at Kenova.

THE OLD BRIDGE.

The old bridge was designed for Cooper's E-40 loading, the steel being heavy enough to carry two tracks if the third truss had been placed according to the original design. For present loadings, however, and the prospective increase in such loadings which must be taken into account in bridges built today, some strengthening of the bridge would have been necessary in any permanent improvement, and it was decided that it would be more advisable to build an entirely new double track structure. No change in location was feasible, as the present alinement approaching the bridge on the east is very good and any change would have involved the purchase of improved property in the city of Kenova at a high price. It would have been practically impossible to have made any line change which would not have introduced considerably more curvature, and thereby injured the operating qualities of the line. In addition to these considerations, the old piers were still in excellent condition and a considerable saving in the cost of the structure was made possible by their use.

In order to build the new bridge on the old alinement without interruption to traffic it was necessary to erect the new trusses outside of the old, and although the old bridge was of unusual width on account of the provision for the middle truss, the new bridge had to be made still wider. The piers which had a minimum length of 45 ft. over copings, sufficient for an ordinary double track bridge, were not long enough to carry the end bearings of the new trusses in the usual manner. On account of the fact that the river at this point is deep, the current swift and the piers high, it was not thought advisable to incur the expense of lengthening them, so special pier girders were designed to carry the bearings of the new trusses on cantilever arms. These girders are necessarily very deep, and as there was to be practically no change in grade on the bridge, it was necessary to cut off the tops of the old piers to provide clearance for the girders below the bottoms of the trusses. These changes involved some rather unusual substructure work and a number of interesting problems were encountered in the erection of the superstructure.

DESIGN OF NEW SUPERSTRUCTURE.

The new bridge has the same span lengths as the old, 518 ft. and 298 ft., respectively, the trusses being spaced 43 ft. center to center. Two assumed loadings were used in the design of the superstructure. The first assumed in the design of the trusses a uniform load of 8,500 lbs. per lineal feet per track, with the addition of two concentrations of 70,000 lbs. each, spaced about 30 ft. center to center; for the floor beams and hangers 8,500 lbs. per ft., with eight 85,000-lb. axles; and for the

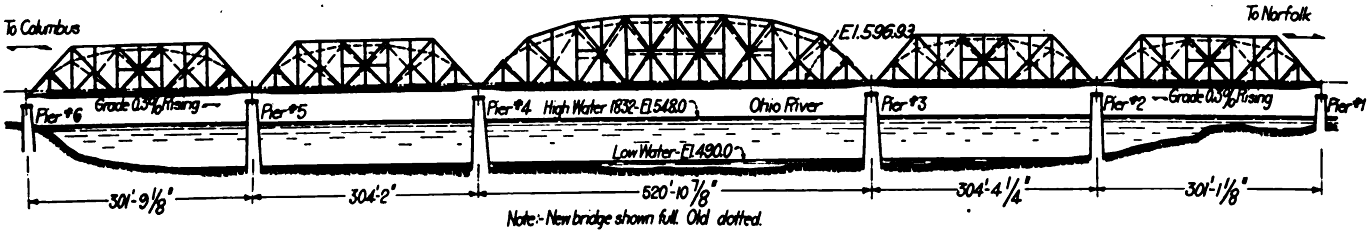

Fig. 2—General Elevation of New and Old Bridges.

stringers 8,500 lbs. per ft., with five 85,000-lb. axles. The impact in all parts of the structure for this assumed loading was added in accordance with the formula $I = \frac{300}{L + 300}$. The tensile strength in steel was assumed as 62,000 to 70,000 lbs. per sq. in., and in rivet steel 47,000 to 55,000 lbs. per sq. in. The permissible fiber stresses were as follows:

Tension, 20,000 lbs. per sq. in. (including dead, live and impact stresses).

Tension, 24,000 lbs. per sq. in. (including dead, live, impact, wind and secondary stresses).

Compression, 20,000 lbs.—100 $\frac{L}{R}$.

Extreme fiber stress on pins, 30,000 lbs. per sq. in.
Shear on shop rivets and pins, 15,000 lbs. per sq. in.
Shear on air driven field rivets, 14,000 lbs. per sq. in.
Shear on hand driven field rivets, 12,000 lbs. per sq. in.
Shear on plate girder webs, 12,000 lbs. per sq. in.
Bearing on shop rivets and pins, 30,000 lbs. per sq. in.
Bearing on air driven field rivets, 28,000 lbs. per sq. in.
Bearing on hand driven field rivets, 24,000 lbs. per sq. in.
Bearing on masonry, 600 lbs. per sq. in.

The design as computed from the above assumptions was compared with the results secured from Cooper's E-60 loading, combined with the allowable unit stresses given in the specifications of the American Railway Engineering Association of 1910 and for a given member the maximum stress found by these methods was used in the design.

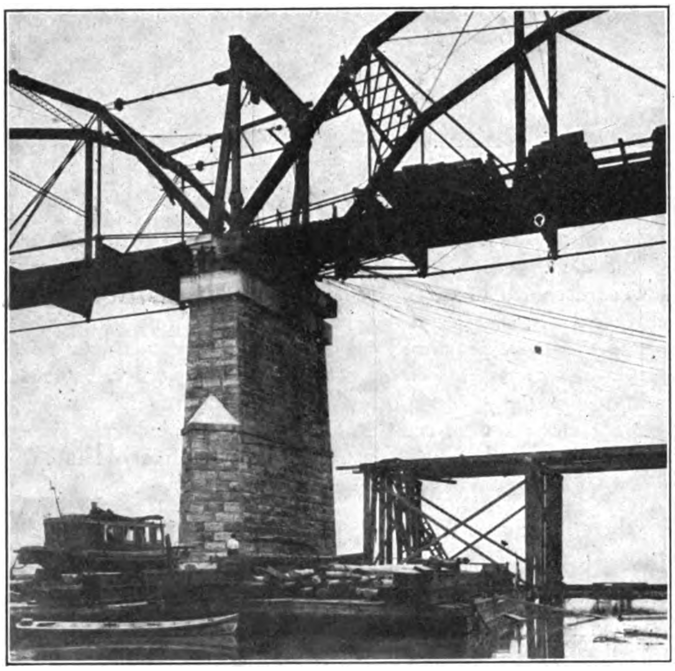

Fig. 3—Placing a Pier Girder Under Old Span after Cutting Away Half of the Top of Old Pier. The Right Hand Span Is Supported Temporarily by the Gallows Frame.

The new bridge is laid with 100-lb. rails on the westbound track and 85-lb. rails on the eastbound, white oak ties being used throughout. A special form of rail anchor is used on the viaduct approach which consists of two bent plates, one bolted to the top flange of the track girder and the other to the web of the rail, the two being joined by an insulated connection. This anchor has proved very efficient in preventing rail movement on this approach viaduct. The new bridge was painted with one shop coat of red lead and two field coats of carbon black. The work of cutting down the old piers was begun in April, 1912, and the erection of the new steel was begun in June.

ALTERATIONS TO OLD PIERS.

The old stone piers had to be cut down about 8 ft. to allow the placing of the new pier girders, but as there was a difference in the elevation of the old piers of about 1 ft. 7 in., and the courses of stone varied in thickness from 16 in. to 22 in., this total cut was somewhat irregular. On five of the piers five courses of stone were removed, and on the sixth pier four courses were taken off. The total cut varied from 6 ft. 9 in. to 8 ft. 3 in., the average being 7 ft. 10 in. The girders on piers 3 and 4 supporting the central span are 5 ft. deep. The other girders supporting the 298 ft. spans are 4 ft. 3 in. deep. The tops of all of these girders were located a uniform distance below the base of rail and on account of the variation in the elevation of the piers and the difference in depth of girders, a number of combinations of plates and I-beams had to be used under the cast steel pedestals supporting these girders. The distance from the bottom of pedestals to the top of masonry varied from 3 ft. 7/8 in., to 2 ft. 1/8 in. For depths less than 1 ft. a combination of plates was used under the pedestals and for depths more than 1 ft. 10 in., 12 in. or 20 in. I-beams were used with plates as required.

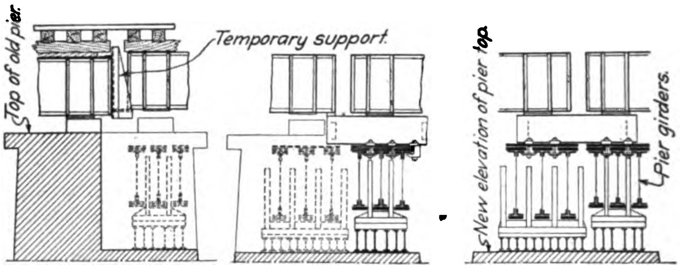

Fig. 4—Sequence of Operation in Cutting Down Piers Without Interference to Traffic.

The removal of the tops of the old piers made it necessary to reinforce the new tops in some manner to take the place of the coping which was removed. A new concrete coping was built around the piers at the elevation of the new top before the top courses were removed, this coping extending down three courses below the shoes of the pier girders. The old piers 1, 2, 5 and 6 were 12 ft. wide and 45 ft. long over the coping, and piers 3 and 4 were 14 ft. wide and 48 ft. long. The new concrete coping for the smaller piers is 13 ft. 6 in. x 46 ft. 6 in., and for the larger piers 15 ft. 6 in. x 49 ft. 9 in., a minimum thickness of 16 in. of concrete being allowed over the stone on the sides of all of the piers, and 18 in. on the ends. A 1:2:3 concrete mixture was used in these copings.

Three sets of reinforcement were provided in these belts. The first consists of six 2 in. bolts through each pier, set in holes drilled through the first and third stone courses below the new top of masonry. These are arranged in three pairs, each pair being connected by a 1 in. plate 6 in. wide. Each bolt is threaded 18 in. on each end and allowed to project into the concrete. Three hexagonal nuts are used on each end, one holding a 6 in. x 6 in. x 1/2 in. plate tight against the stone, and the other two holding the plate connecting each pair near the end of the bolts. Just outside of the ends of these bolts is the second set of reinforcement, which consists of 3/4 in. square bars set vertically on 12 in. centers. These bars are bent in at the bottom to form the surface reinforcement for the lower portion of the belt. The third set of reinforcement, which consists of 1 in. square bars on 6 in. centers placed horizontally entirely around the piers, is located just outside of the vertical bars. The lower portion of these concrete courses was placed up to the new top of masonry before the piers were cut, as shown by the dotted lines in the accompanying drawing. After the erection of the steel, the concrete was carried over the top of the stone masonry and filled in around the shoes and pier girders as shown in the cross sections herewith. The vertical reinforcement in the lower portion of the belt was allowed to extend above the concrete placed in the first operation and the bars forming the surface reinforcement for the upper portion were lapped over these. Horizontal reinforcement was provided in the top portion of the coping similar to that described above. The concrete over the pier girders is bonded to that between the webs by short sections of 1 in. bars set vertically, and it is surface reinforced by ½ in. bars in both directions. The girders which are on the two long piers, 34 ft. 9 in., and for the smaller girders 32 ft. 9 in. As the new trusses are 43 ft. center to center, the amount of cantilever at each end of the heavy girders is 4 ft. 1½ in., and for the smaller ones 5 ft. 1½ in. The girders are of very heavy construction, being built up with three webs, their depths as mentioned above being 5 ft. and 4 ft. 3 in., respectively.

GALLOWS FRAME FOR SUPPORTING OLD TRUSSES.

During the removal of the top courses of the old piers the old trusses were supported by a gallows frame, consisting of

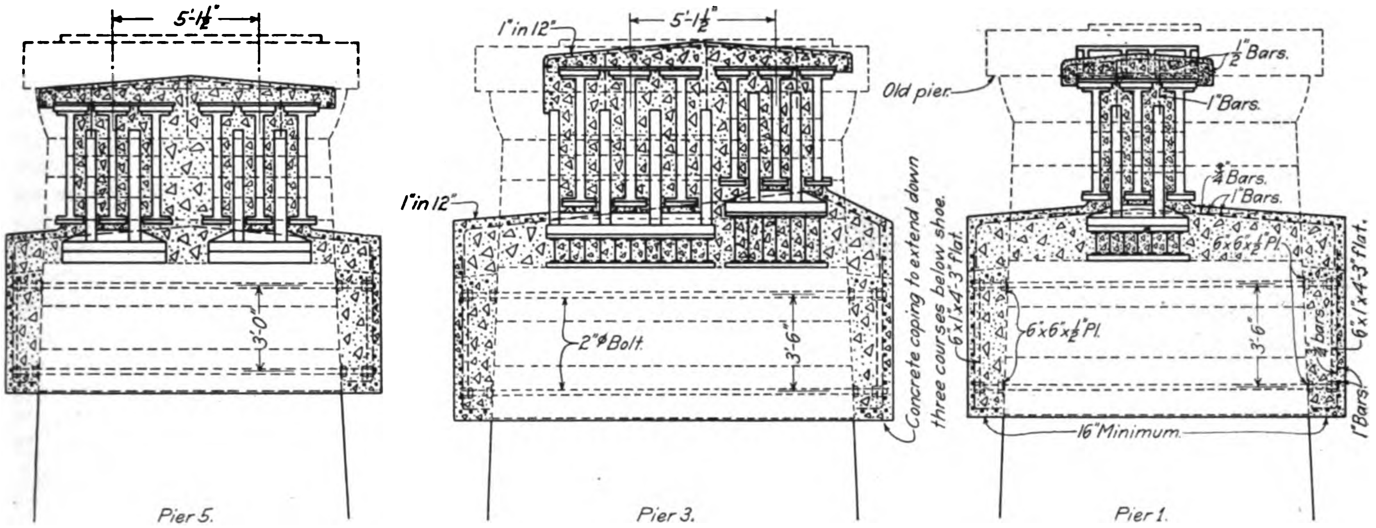

Fig. 5—Sections of Three of the Piers Showing Alterations Made in Cutting Off Old Tops.

upper surface of this concrete is battered 1 to 12 transversely in both directions from the centers of the piers.

The smaller girders are supported on cast steel pedestals having a bearing surface of 3 ft. 10 in. x 8 ft., and the larger ones on pedestals whose bearing surface is 6 ft. x 9 ft., the latter having four vertical ribs for the pin bearing. The pins in both cases are 18 in. in diameter. The outer edges of all the pedestals are thus placed about 1 ft. from the end of the old stone piers, making the distance center to center of pins for the large two built up columns supporting a transverse plate girder with diagonal bracing to give lateral stiffness. Near the top of these columns, hanger bars were connected to support the trusses to be raised. The posts were arranged to take a bearing on the end pins of the trusses adjacent to those which were to be raised, the tops of the posts being inclined towards the truss to be moved so that when they were pulled toward the vertical the truss would be raised off its bearings by means of the hanger bars described. In most cases the bearing for these gallows frame posts was secured by rearranging the packing on the end

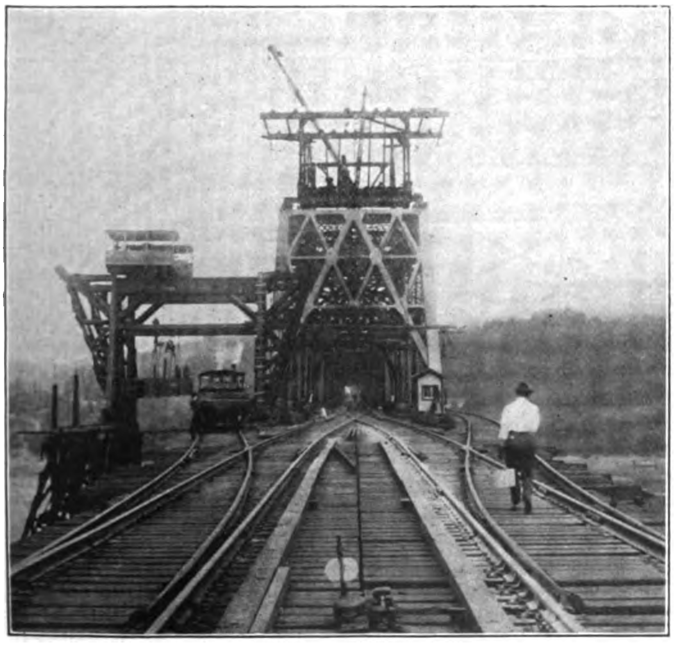

Fig. 6—End View from South Showing Material Tracks and Electric Hoist for Raising Materials to the Bridge from the Ground.

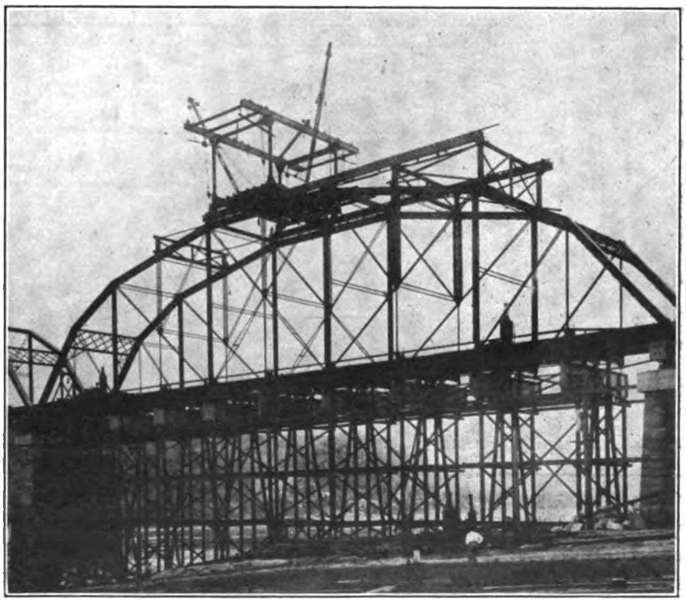

Fig. 7—Old Span 1 Showing False Work Carrying Traffic and Small Traveler Erected on Old Trusses to Place New Span.

pins so as to insert the bearing plates attached to the bottom of the posts. In some cases, however, instead of using bearing plates on the bottom of the posts, short transverse girders were attached to the posts a few feet from the bottom, which were supported by a short column at each end connected to bearing shoes placed on each side of the main truss shoe of the span

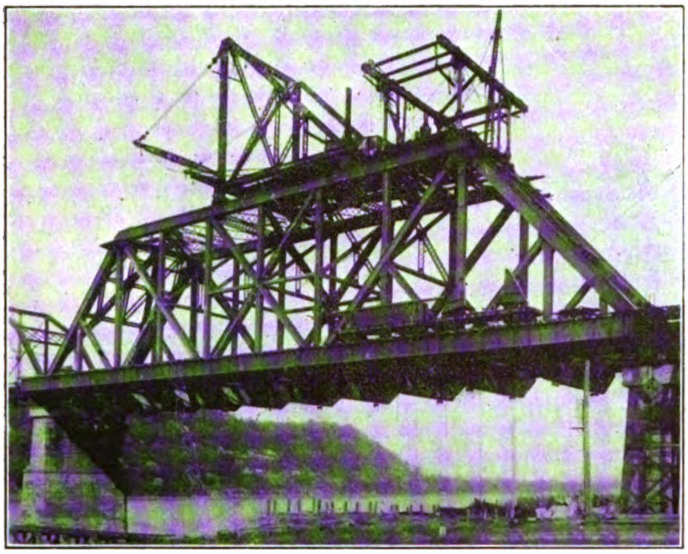

Fig. 8—New Span 1 After Removal of Old Trusses Showing Heavy Traveler Erected for Placing Spans 2 and 3.

adjacent to the one to be raised. The hanger bars were in two parts connected near their lower ends, allowing the lower section to be packed on the end pins of the span to be raised before the gallows frame was erected.

In designing this frame it was planned to tie the top of the frame back to the hip joint of the adjacent truss to hold the span in the raised position. It was found in carrying out the work, however, that it was advisable to lower the truss for each train so that the gallows frame was never allowed to carry the truss under live load. A 100 h. p. electric hoisting engine was kept on the span to raise and lower the trusses as required, using a six sheave steel block attached to the top of the gallows frame. Blocking was kept ready on which to drop the trusses whenever necessary, and they were only raised about 1 in. between trains to clear the wedges.

At the end piers where there were no adjacent trusses to provide a bearing for the gallows frame posts, this bearing was secured by erecting double timber bents back of the piers and placing blocking from the caps of these bents to notches cut in the stone piers on which the bearing shoes of the gallows frame were set. For pier one the gallows frame was guyed to the approach viaduct. It required 130,000 lbs. tension in the six lines to lift this end span.

At the intermediate piers half of the masonry was removed at one operation. The gallows frames were first set on one truss and used to raise the other, while the longitudinal half of the stone pier under the truss thus supported was cut away. The pier girder for this location was then brought out in the river on an old car ferry and hoisted into place by falls from the transverse girder of the gallows frame, outhaul lines being attached to a floor beam of the old structure to hold the girder away from the pier. The smaller girders weighed 87 tons each and required one hour to place. The heavier ones weighed 127 tons each and required only a slightly longer time to place. When this first girder was in place on the new top of pier, the old span was blocked up on it at the proper elevation, the gallows frame was reversed so as to bear on the truss over the completed half of the pier, the other truss was raised, the remaining portion of the stone removed and the other pier girder placed.

Special provision had to be made for supporting the end stringers during the removal of the pier tops at all intermediate piers. During the removal of the first half of the stone, the stringers bearing on that side of the pier were supported by plate and angle shelf connections from the ends of the corresponding stringers of the adjacent span which were still carried on their bearings on the undisturbed half of the pier. After the first girder had been placed the stringers were blocked up from these girders, and the shelf connections were reversed so that these stringers in their new position would support the stringers of the adjacent span while the stone was cut away below them. After the placing of the second girder these stringers were also carried by blocking from that girder and the temporary shelf connections were entirely removed.

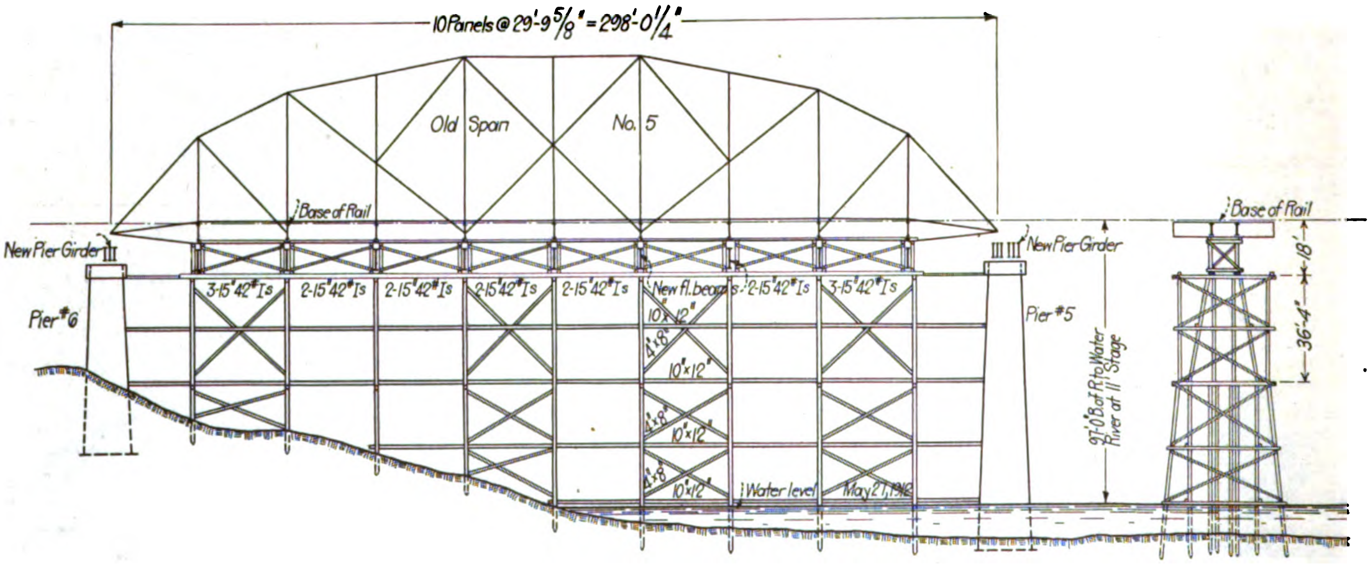

Fig. 9—False Work Used in Erecting End Spans Showing Pony Bents Supporting New Floor Beams.

METHOD OF HANDLING NEW STEEL.

The superstructure of the five river spans required about 10,000 tons of steel and the approach viaduct required about 2,500 tons additional. All steel was delivered to a material yard on the south side, located on a belt line owned by the Norfolk & Western, around the city of Kenova. A stiff leg derrick of 40 tons capacity and a large traveler which was used in the erection of the Queen & Crescent bridge at Lexington, Ky., were kept in this yard for handling material, unloading from road cars, assembling the parts and loading on material cars for transfer to the bridge. A material track connecting with this steel yard was built along the entire length of the approach viaduct and extended under an electric hoist which was used to raise the steel from the ground to the level of the bridge deck about 50 ft. above. This hoist consisted of two 2-drum, 4-spool engines, each having a capacity of 65 tons and mounted on separate gallows frames which spanned the material track on the ground and a spur track from the main line on the bridge level, being supported on timber bents built up from the ground. One of these frames was fixed and the other was arranged to travel along the supporting bents to allow the handling of pieces of any desired length. The engines also had a transverse movement on the girders of the gallows frames so that they could first be spotted over the track on the ground and after hoisting the load they could be moved over to a point above the track on the bridge deck, from which they could lower the steel directly to the material cars. The lighter material was brought up on flat cars, a number of which were provided with hanger stirrups for receiving the hooks from the falls of the hoisting engines. The heavy material was transferred from cars or trucks on the lower level to other cars or trucks on the bridge, the pieces that were too heavy for a car being carried on two standard trucks.

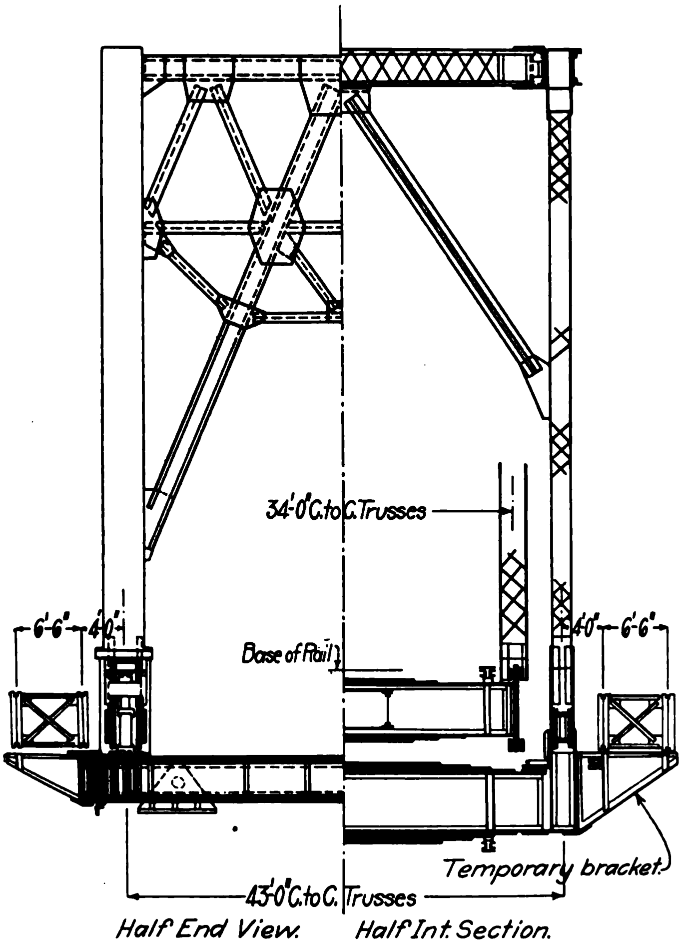

Fig. 10—Elevation and Section Showing Relation of New Bridge to Old and the Temporary Material Tracks Outside of Trusses.

The spur track on the bridge level, which was served by the hoist, was connected to the main line just back of the end of the bridge and was also continued across the bridge outside the truss, a similar track being carried across outside of the other truss. These were supported on temporary cantilever brackets from the new floor beams which were erected below the bottom chords of the new trusses. These connections of floor beams and material track brackets were made to temporary gusset plates dropped from the bottom chord. The stringers designed for the new bridge were used during erection in these material tracks, being supported directly on the cantilever brackets, and were transferred from this position in the material track to their final position in the floor after the trusses were completely erected, by changing one or two panels at a time, depending on the allowable delay to traffic and the amount of time required to make the change. Since the floor beams were so far below their final position during erection, temporary struts had to be provided to brace the bottom chords against transverse buckling. The material tracks were built

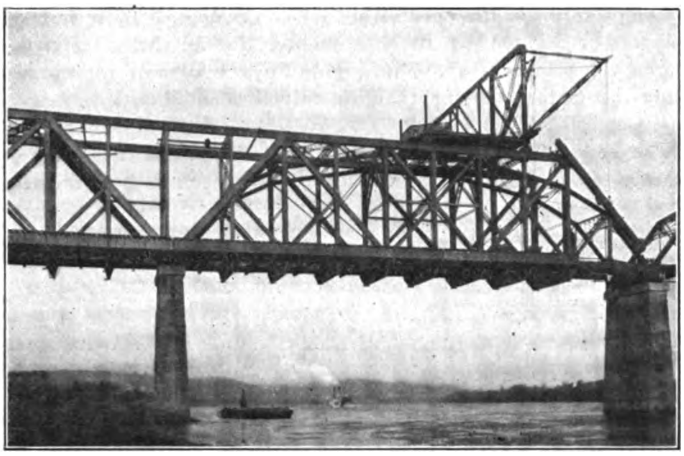

Fig. 11—Placing End Post of Span 2 by Cantilever Method Showing Erection Ties Between Spans 1 and 2.

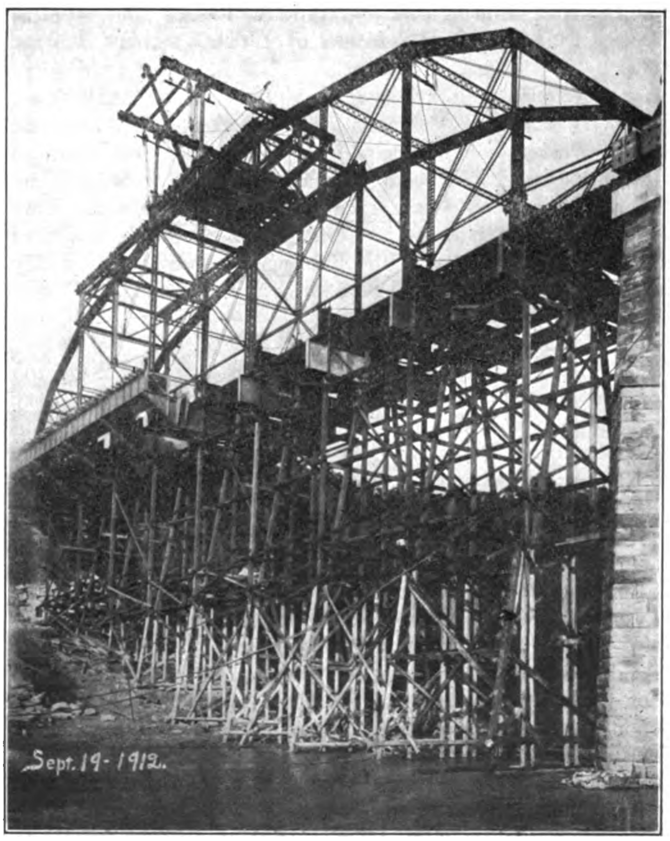

Fig. 12—False Work Under Span 5 Showing Connection of New Floor Beams to Old Ones and the Brackets Supporting Material Track.

from both ends of the bridge as the erection progressed, and connections with the main line were maintained at both ends so that steel brought up on the hoist could be run out on either side of the bridge from that end, or could be carried across the bridge on the main line and out on either material track from the other end. The movements of the dinky engine pushing these material cars were the only movements over the main track required for erection purposes.

Compressed air for pneumatic tools was supplied by a single compressor located on the east shore, the air being carried across the bridge in a 3½ in. pipe. Electric current for operating the motor equipment of the travelers and hoists was secured at 550 volts d. c.

The new steel was erected around the old without any interference with the old superstructure. In general, the bracing was so designed as to clear the old steel 12 in. in all cases. Some very careful calculations of deflections of both the old and new trusses were necessary to make sure that this clearance would be secured. In some cases the design provided for the placing of temporary sway bracing, the material removed from old spans being remodeled to suit. These temporary members were kept in service until the old superstructure was entirely removed, allowing the placing of the permanent members.

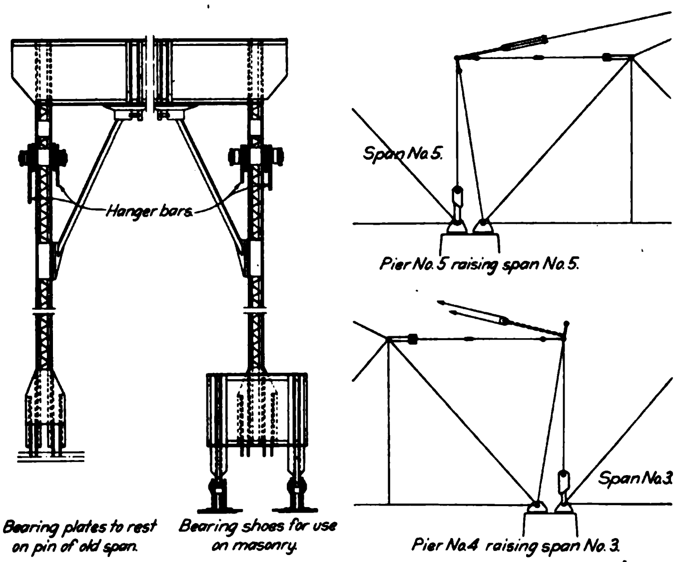

Fig. 13—Half End Views of Gallows Frame and Typical Diagrams of Operation of Lifting Spans.

ERECTION OF TWO END SPANS.

Spans 1 and 5 were erected by travelers placed on the top chords of the old trusses, falsework being provided to carry the live load, and the new span being supported on the old during erection. Bents of eight piles each were driven under the panel points to support framed bents 34 ft. wide at the top with a deck 18 ft. below the base of rail. On this deck two lines of four 15 in. 42 lb. I-beams were laid 8 ft. 6 in. apart center to center, on which were placed pony bents 10 ft. 9 in. high to support the ends of the old stringers. Two pony bents were placed at each panel point as near as possible to the floor beams and suitable longitudinal bracing was put in to connect the two bents under each panel. The stringers were blocked up on these bents and the rivets cut out of the floor beam connections so that all live load was carried through the stringers down into the temporary falsework. The new floor beams were then hung from the old by stirrup hangers of 3 in. rods with cross channels at the top and bottom.

Temporary timber falsework was used on the old trusses to keep the traveler track level. This was carried from the panel points of the old trusses and supported longitudinal I-beams on which the traveler track was laid. The traveler had a boom on each end and also two cantilever arms extending over the material tracks on each side. Two falls were provided on each of these arms, one over the material track and the other over the center line of the new truss. A steel member to be placed was held by both lines, being picked up from the car on the material track by the outer one, drifted over to place and lowered by the inner one. The traveler was equipped with two 75 h. p. engines.

After the new floor beams had been hung, temporary brackets for the material track were attached to them and this track was laid continuously along both sides of the span. It was then possible to spot steel for the trusses on these tracks opposite its final location and the erection of the lower chord and web members proceeded continuously in this manner. Before the erection of the top chords and end posts, the new floor beams were blocked up on the caps of the timber falsework over the outside legs of the trestle so that the falsework would take the additional load imposed by the erection of the top chords and end posts. When the trusses were completed they were blocked up on their own bearings and the old stringers were blocked up on the new floor beams, allowing the new truss to carry the live load. The old truss was then dismantled, piece by piece, down to the floor system, the steel being removed over the material track. Work was carried on simultaneously on spans 1 and 5, duplicate travelers being used. Spans 2, 3 and 4 were erected by the cantilever method, the two shorter ones entirely from one end and the longer one from both ends. The heaviest member handled was the end post of span 3, which weighed about 108 tons. Spans 2 and 4 were erected simultaneously by two large travelers of a special design prepared for this bridge. Each of these travelers had two booms with a capacity of 65 tons each at a radius of 75 ft. They were equipped with two 4-drum, 8-spool hoists and 100 h. p. motors. The type of these travelers is well shown in the accompanying photographs. Adjustable legs at the rear of the travelers served to keep the masts vertical while working over the inclined top chords, a condition which is necessary to the successful operation of the revolving boom type of traveler.

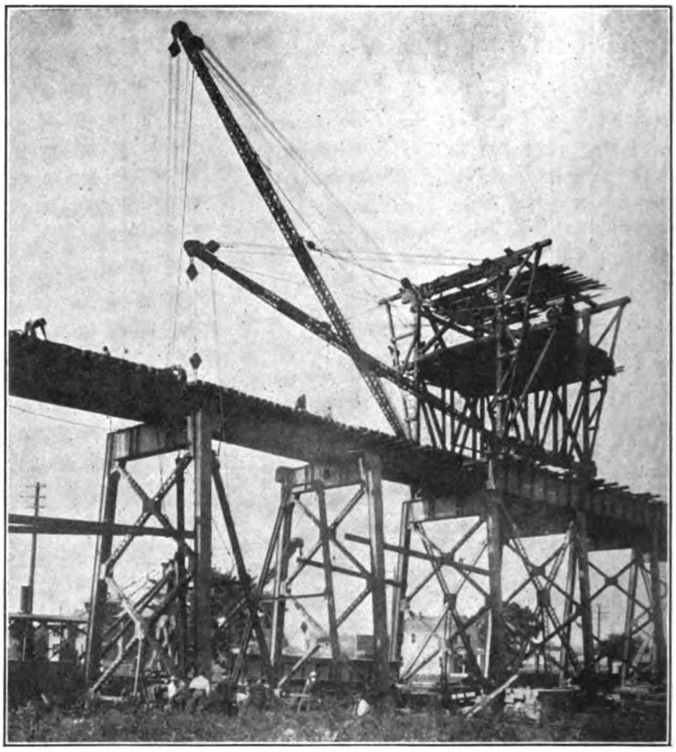

Fig. 14—Erecting New Double Track Viaduct and Removing Old Members Without Interruption to Traffic.

Erection of Spans 2, 3 and 4.

After the completion of the two end spans, the small travelers used for these spans were left on the top chords of the new trusses as near the outer ends as possible. The large travelers for the cantilever erection of the three central spans were then erected on these new trusses just inside the small travelers which were left in that position during the erection of spans 2 and 4 to serve as counterweights. The end members of spans 2 and 4 and the temporary steel work connecting these spans with the shore spans were placed by the large travelers from the erection position on the end spans, after which they traveled out over the temporary work onto the top chords of spans 2 and 4 as the work progressed.

The connections of the hip ties from the trusses of spans 1 and 5 to spans 2 and 4 during erection were made by round pins and crescent shaped plugs in slotted holes so that when spans 2 and 4 were completed the outer ends of spans 1 and 5 respectively, could be jacked up, allowing the inner ends of spans 2 and 4 to rest on piers 3 and 4, thus removing the tension from the hip ties and allowing the crescent plugs to be driven out. Spans 1 and 5 could then be lowered and the temporary work between the spans removed. The closure of the 518 ft. truss erected from both ends was also accomplished by jacking up the outer ends of the adjacent spans, the difference in length of the chords due to erection stresses being temporarily taken up in the four middle panels of the lower chords which are of I bars. The raising of these spans was accomplished by 500 ton hydraulic jacks, two of which were used under each truss, one under each end of a short transverse jacking girder attached to the end of the lower chord.

The material tracks along the three central spans were erected as each panel was completed so that the members for the next panel could be run out on these tracks and reached by the traveler above. After the completion of the new trusses the old floor beams were cut away from the old trusses and blocked up on the new floor beams which had been erected below the lower chords in the same manner as in the end spans described above. The old trusses were then dismantled and removed, piece by piece, over the material tracks.

Erection of New Approach Viaduct.

In connection with the replacing of the bridge, the 2,210 ft. of steel viaduct approach on the east side and a 300 ft. section of similar viaduct over two streets in the town of Kenova were rebuilt for double track. The old viaduct was built with inclined posts, special lugs being provided at the bottom of these posts to receive vertical columns in case it should be desired to double track the structure. The spacing of the pedestals under this viaduct was such that track girders carried on vertical posts would be at the proper distance from the track girders on the old structure to support the outer rails of a new double track.

For much the same reasons that it was decided to replace the bridge, it was also decided to build a new viaduct instead of taking advantage of this feature of the design of the old. The pedestals under the old viaduct were in very good condition, having been recently replaced on concrete piles. In order to utilize these pedestals, a design of viaduct in which the posts have a slight batter was adopted. Under the station platforms the posts are vertical and a third row of columns is provided. It was desired to reduce the grade of this viaduct approach from 0.5 to 0.3 per cent. by raising the east end of the viaduct about 5 ft., and the remainder of it by correspondingly lesser amounts, reaching the old grade line about over the second pier of the bridge.

This change in grade was made before the erection of the new viaduct was begun. A material track was first laid the full length of the trestle and timber blocking was distributed on which the old steel was blocked up to the new grade. The new steel was then distributed along the structure. The two spans next to the bridge were first erected on falsework and the remainder were placed by a two boom traveler operating from the bridge outward on the new viaduct. The new bents were erected complete in the spaces between towers of the old viaduct alongside the old bents which they were to replace. The bracing in one tower of the old viaduct was then removed and temporary 6 in. x 12 in. timbers were placed from the bents of this tower to the adjacent bents of the towers on each side. The traveler then lifted the old girders clear of the old towers with the two booms. With an outhaul line on the ground the old bents were pulled over and the new ones pulled into place, the booms then dropping the girders on the new bents. It required from five to eight minutes to make the change in each bent, and it was possible to allow trains to pass between the placing of the two bents in each tower. The traveler was supported on girders erected over the posts of the new viaduct, sufficient clearance being allowed under the traveler to permit the free operation of trains on the two middle girders which remained in the same position as on the old viaduct.

On account of the change in grade at the Kenova station, which is located at the crossing of the Chesapeake & Ohio just west of the end of the approach viaduct, some alterations to the station were made necessary. A new baggage and express station was built and a new elevator installed for handling this traffic between the upper and the lower levels.

The reconstruction of this bridge was handled under the supervision of Charles S. Churchill, chief engineer, and C. C. Wentworth, principal assistant engineer. J. E. Crawford, acting chief engineer and formerly bridge engineer, was in charge of the design of the alterations to the substructure and the checking of the superstructure. F. P. Turner was the assistant engineer in charge of the work in the field. The methods used were worked up by the American Bridge Company under the direction of C. W. Bryan, chief engineer, and C. G. E. Larsson, assistant chief engineer, F. P. Witmer and Wm. G. Grove being the engineers on the design. The steel work was fabricated at the Ambridge plant. J. B. Gemberling was in charge of the erection, and H. Taylor was the engineer in the field.

A CORRECTION.

Through a mistake the name of the author of the article entitled "Nomographic Method for Finding Center of Gravity and Moment of Inertia," which appeared in the issue of last week, page 381, was omitted. The author was M. J. Eichorn, Chicago, who is entitled to all credit for its preparation.

South African Railway Trouble.—Sir David Graaf, acting minister of railways, South African Union, notifies that the government will constitute a commission to inquire into a number of railwaymen's grievances, including the immediate introduction of the eight-hour day, a minimum wage for white employees from $2 upwards per diem, the revision of local allowances, the abolition of piece work, the decentralization of management, and other grievances connected with pay.

Railways and the State.—The *Pall Mall Gazette* states that it has reason to believe that the preliminary steps in connection with one of the most important and far-reaching inquiries ever instituted in England has been taken on behalf of the government by the board of trade. During the past few years, in the House of Commons and elsewhere, appeals have been made to the government to endeavor by commission or committee to arrive at a more clear definition of the relations between the state and the railways of the country, both as regards directors and employees. The appeals for such an inquiry have not been confined to any particular section of the country, and railway directors and railway employees have shown no disposition to resent such action.