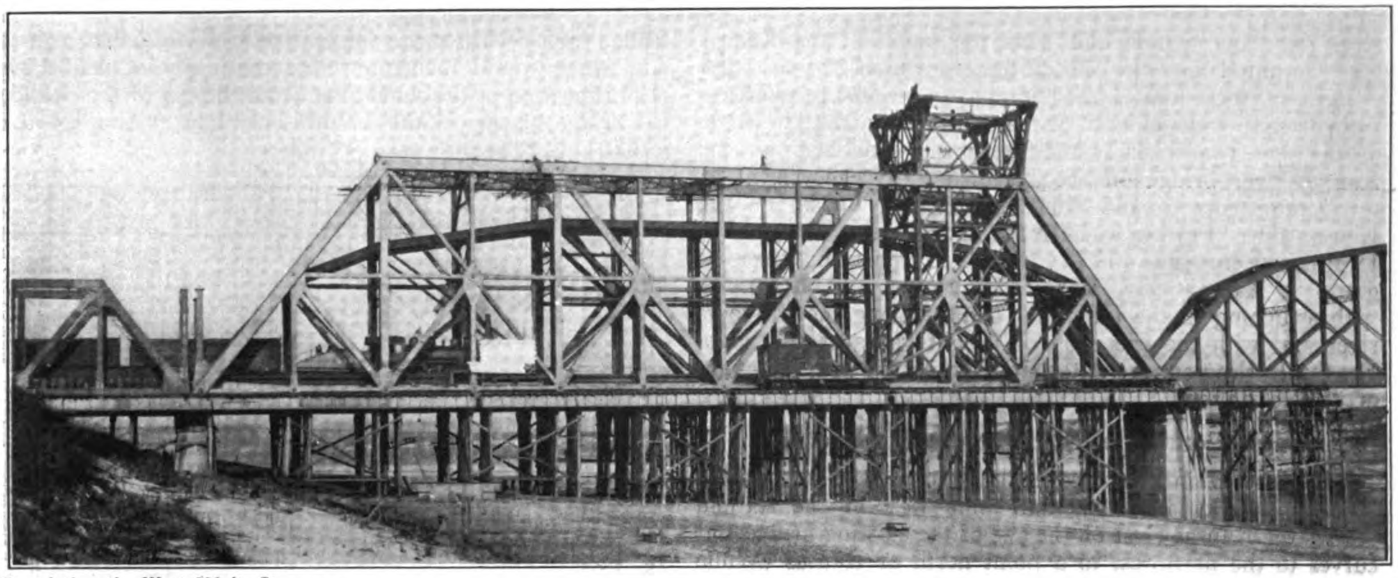
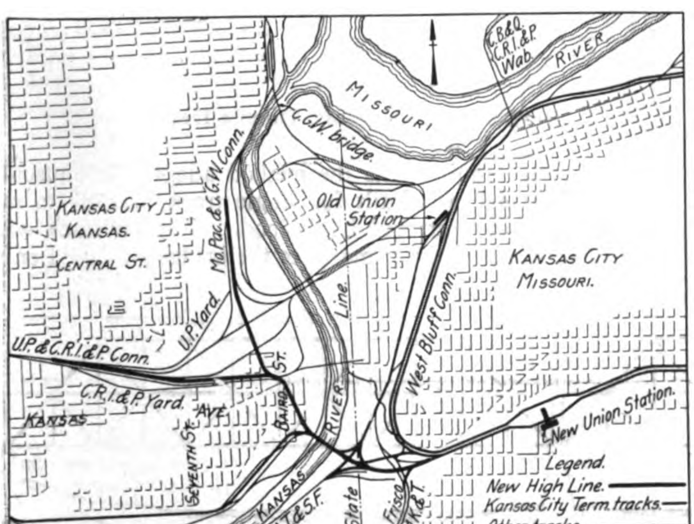


Completing the West 300-ft. Span.

Elevated Terminal Connection at Kansas City

Project Involves a Long Two-Track Steel Viaduct and a Heavy Double-Deck Bridge of Unique Design

THE KANSAS CITY TERMINAL RAILWAY is expending about $4,500,000 in constructing an approach to the Union station for the use of certain railways entering the city from the west which involves a double track elevated railway several miles in length across the bottoms of the Kansas river in Kansas City, Mo., and Kansas City, Kan., It also includes a double-deck railway bridge over the Kansas river, a project alone of no ordinary proportions which embodies a number of novel features of design and construction. This is the latest important step in the Kansas City Union station project. The work has been in progress since October, 1916, and its completion in 1918 will effect a marked improvement in the facilities for both freight and passenger traffic in the district immediately west of the station.



Location of the New Elevated Line Across the Kansas River Bottoms

The Union station project at Kansas City was brought about by the congested condition of the approaches to the old station, as well as by the inadequacy of the station facilities. Because of this fact the selection of a site for the new station at a distance of more than a mile from the old one left a number of the railroads without adequate means of access. Consequently the conclusion of the agreement between the several roads was largely contingent upon the formulation of satisfactory plans for adequate approaches to the station for all of the roads concerned. These plans embodied the West Bluff connection for the Chicago, Burlington & Quincy, the Wabash and the Chicago, Rock Island & Pacific, Chicago line, extending south from the Hannibal bridge past the old Union depot. It also provided for the reduction of grades and the four-tracking of the main line of the Kansas City Belt Railway to afford ample approach from the east for the Chicago & Alton, the Missouri Pacific, the Atchison, Topeka & Santa Fe, the Rock Island's St. Louis line, the St. Louis-San Francisco and the Kansas City Southern. A third provision was for an elevated railway to afford approach over the industrial district occupying the bottoms on both sides of the Kansas river between the bluffs of Kansas City, Mo., and Kansas City, Kan., for the trains of the Union Pacific, the Chicago Great Western, the Nebraska and northern Kansas lines of the Missouri Pacific, and the western lines of the Chicago, Rock Island & Pacific which enter Kansas City over the Union Pacific tracks.

The first two improvements were carried on simultaneously with the construction of the station but the building of this elevated railway or "High Line" was delayed. Consequently when the new station was opened the four railroads were compelled to seek temporary entrance to the station until such time as the approaches agreed upon would be ready. The Union Pacific and the Rock Island have been entering the new station via the tracks of the Kansas City Terminal from the Kansas side of the Kansas river, crossing that stream near the Santa Fe's western connection. The Missouri Pacific and the Chicago Great Western, which uses the tracks of the former from Leavenworth, Kan., now enter the station from Kansas City, Kan., by a route that crosses the Kansas river near its mouth, skirts the bank of the Missouri river for about a mile and joins the tracks of the Kansas City Terminal near the site of the old Union station.

Both of these routes are subject to serious interference from freight, transfer and switching movements. The route of the first two roads is most seriously congested at the Kansas river bridge on account of a heavy movement of refrigerator cars to and from the packing houses on the Kansas side. Further interference in this route is caused by 15 railroad crossings and 4 crossings of important streets at grade in Kansas City, Kan. The second route interferes with switching in the industrial district along the Missouri river and with the operation of freight yards of the Santa Fe, the Burlington, the Alton and the Frisco in the vicinity of the old station.

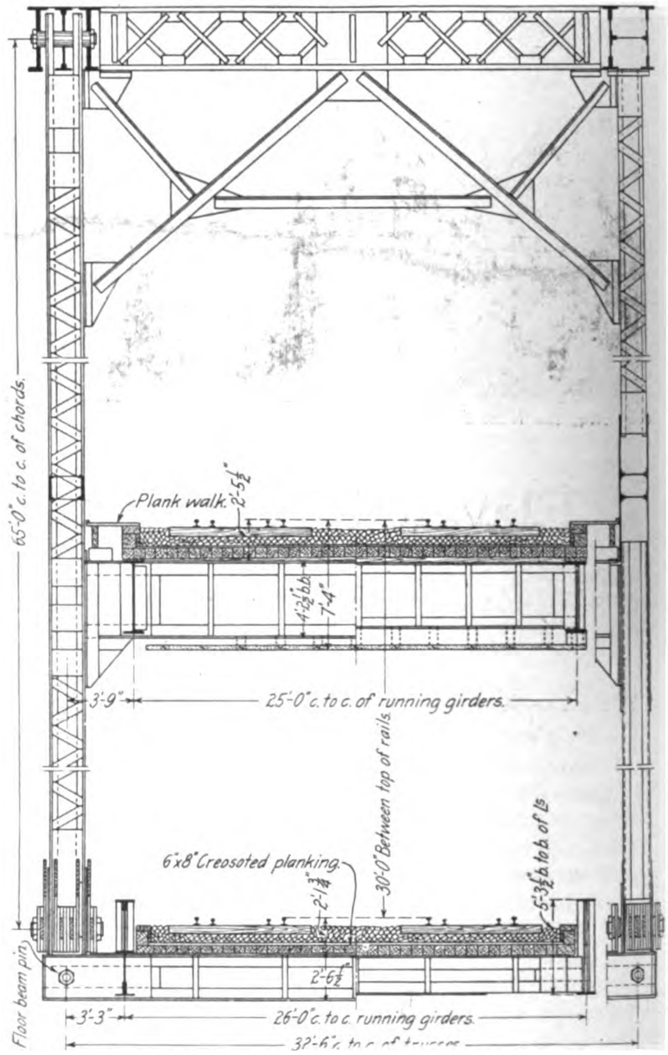
New Connection Eliminates Interference

The new "High Line" leaves the grade of the west station approach tracks about one-half mile west of the station, crosses the Kansas river on the site of the existing bridge and curves to the northwest to a point north of Kansas avenue where the structure divides, one branch for the Union Pacific and Rock Island turning to the west and the other continuing to the north to a connection with the Missouri Pacific tracks near Central avenue. The total length of this elevated railway is about 4 miles. Each of the branches is about 1½ miles long. It consists of 3,900 ft. of surface tracks, 8,800 ft. of embankment approaches, 8,500 ft. of steel viaducts and the bridge across the Kansas river, which in addition to providing a double track crossing for the elevated railway provides two tracks on a lower level for freight and switching movements.

The construction of this connection was delayed for a number of years in the negotiations for a franchise for the overhead street crossings in Kansas City, Kan., the primary difficulty being a difference of opinion as to the character of passenger station facilities to be provided by the railroads for that city. This feature was finally agreed upon and the plan which was approved by the people of Kansas City, Kan., in July, 1915, includes provision for two passenger stations to cost $100,000 each, in addition to the elevated railway. One of these stations will be located on the Union Pacific branch at Seventh street and the other on the Missouri Pacific branch at Central avenue.

The Kansas River Bridge

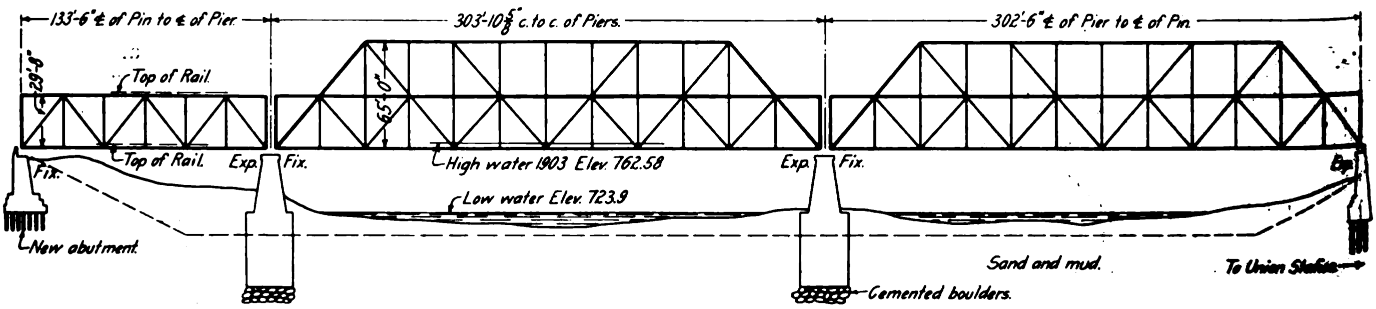
The bridge over the Kansas river is the most important single feature of the project and is distinctive in a number of features. It is a double-deck structure. The heavy loading which this implies on two spans of 300 ft. each required the use of a number of special details of design. As in the bridge each 24 hr. it was imperative to devise erection methods which would insure absolute continuity of traffic over the bridge and at the same time avoid the use of the track on the bridge for any of the erection operations. As a result of



Cross Section of 300-ft. Double-Deck Span

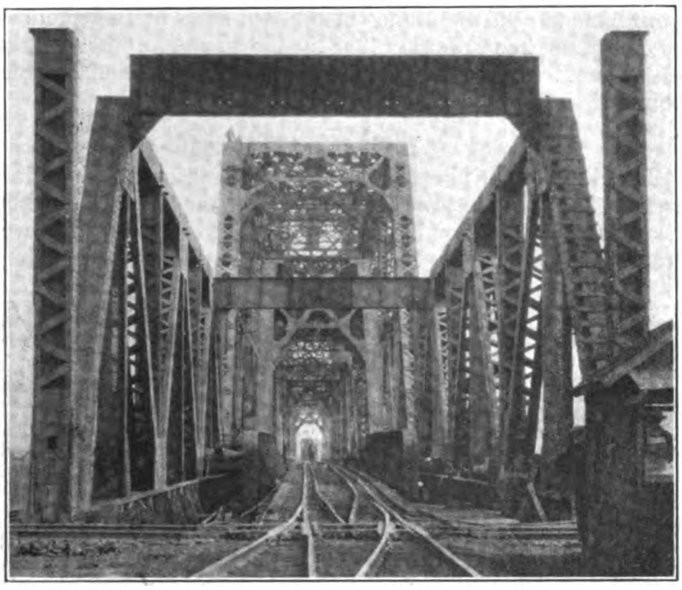
these exacting requirements the method adopted is unusual.

The old bridge was built for single track in 1907 to replace a structure destroyed by a flood. A single track was entirely adequate at that time since the bridge was used only



Profile of the Kansas River Bridge

old bridge, a preponderance of refrigerator car movements calls for the use of a water tight floor and the design of this was complicated seriously by the necessity for shallow construction on account of the unfortunate relation of high water in the river to the elevation of the tracks on the lower level. Because there are about 180 train movements over this for transfer and switching traffic. It consists of two pin connected Petit through truss spans 300 ft. long with an 80-ft. through girder span and 50 ft. of pile trestle on the west end. A timber ballast floor on a suspended floor system carries the track. Of the substructure for the old bridge, the two piers and the south abutment are used to support the new superstructure. These had been built to provide ultimately for double track. The two piers were carried to a cemented bowlder formation by the pneumatic process and the abutment is supported on a pile foundation. The decision to make use of the old masonry was based on a careful study which took into account the heavier loading to be obtained from the double-deck structure. It was necessary



New 132-ft. Span in Foreground with Old 80-ft. Girder Span Still in Place

to provide a new west abutment which is carried on a pile foundation.

In the new structure the old 300-ft. spans are replaced by spans of the same length consisting of pin connected Baltimore trusses of sufficient height to provide a through structure for the traffic on both levels. The girder span is replaced by a 132-ft. riveted Warren truss span of such a height that it is a through structure for the lower level tracks and a deck span for the upper level.

Because of the heavy loading the truss members in the two 300-ft. spans assumed proportions ordinarily to be found in spans of much greater length. Each of the spans weighs nearly 2,300 tons. The bottom chord and one set of the main diagonals are eye-bars of nickel steel with a required ultimate strength of 95,000 to 110,000 lb. per sq. in. and an elastic limit of 55,000 lb. All other web members are of a box- or I-sections made of the ordinary structural grade of steel. The top chords and the end posts are of an H-section similar to that used in the main members of the Metropolis bridge. They have two heavy girder sections for the sides connected by a diaphragm in the plane of the chords, and double plate lacing and channel battens on the top and bottom faces. The material in top chords and end posts is a high carbon steel similar to that used in the ribs of the Hell Gate arch and has an ultimate strength of 66,000 to 76,000 lb. per sq. in. and an elastic limit of 38,000 lb. per sq. in.

Ballast floors are provided for both decks. The thickness of the lower floor from top of rail to under clearance was limited to 4 ft. 10⅞ in., while that of the upper floor, which was not so limited, has a thickness of 7 ft. 4 in. However, the same general scheme of floor framing was used in each case. The main floor beams, spanning from truss to truss at the panel points, carry girders spanning longitudinally just inside the trusses on each side. These in turn carry intermediate floor beams 5 ft. center to center on which are supported the timbers of the ballast flooring. In the upper floor the depth is such that this system entails no departure from ordinary structural practice. The main floor beams are attached to the posts of the trusses with the usual bracket connections, lateral stiffness of the spans being obtained by these connections and heavy portal and sway bracing above the upper roadway.

In the lower deck the main floor beams could be made only 2 ft. 6½ in. deep, back to back of angles, making it necessary to construct them as box girders. For this reason the longitudinal girders, which are 5 ft. 3½ in. deep, could not be framed into them to make the connection, so it was necessary to notch the ends of the longitudinal girders to rest on the top flanges of the main floor beam. A departure from usual practice in the connection of the lower floor beams to the trusses was devised to avoid bending in the posts as a consequence of the material deflection in floor beams of so shallow a depth. The bottoms of the posts were

New 300-ft. Span Surrounding Old Span, Showing Also Gantry Traveler and a Derrick Car on Temporary Track

extended below the main truss pins and were equipped with a steel casting containing a pin hole at right angles to the floor beam, thus affording a pin connection between the post and floor beam and thereby making the truss member independent of flexure in the floor system.

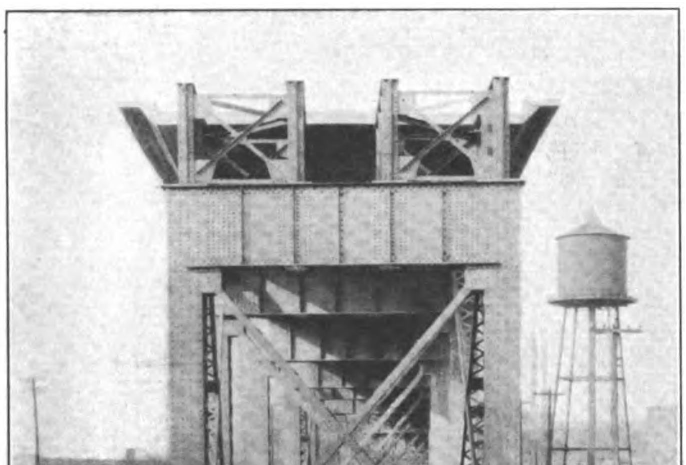
Erection Under Difficulty

The greater width and height of the new spans naturally suggested their erection around the old bridge while the latter remained in service. The old superstructure had been erected on the south side of the substructure with a view to future renewal of the structure by a double track bridge. The erection plan adopted for the new structure in consequence entailed the shifting of the old superstructure nine feet to a central location in which its axis would coincide with the axis of the new bridge. This measure, however, would not solve the problem of the erection of the new floor system for the lower deck, since the grade for the old track and that for the tracks on the lower level of the new bridge are identical. The piecemeal removal of the old floor system and its replacement by the new floor would be a slow and cumbersome process that would result in serious interference with the traffic. Another obstacle was the impracticability of driving piles for falsework in the space between the trusses of the old bridge since this would involve a disturbance of the ballast floor and interference with the heavy train movements.

The solution of these difficulties was attained by raising the old spans 27 in. so that the floor system for the new spans could be installed completely underneath the old floor before disturbing the old structure in any way. This plan has the further advantage that the old spans can be supported from the new and thus obviate the need of any falsework directly under the old span.

The erection method and falsework scheme are shown in several of the photographs. The space between the trusses of the new span was sufficient to permit the placing of the legs of the gantry traveler between the new and old trusses. The gantry is supported on rails carried on the top flanges of the two lines of longitudinal girders of the lower floor system.

The falsework consists of two bents of five piles each driven under each panel point of each truss of the new bridge. These bents are long enough to afford ample support for the new trusses, the girders carrying the gantry and also a temporary track outside the trusses on each side car-



Typical Sectional View of the Viaduct

ried on girders intended for use in the upper floor system. These temporary tracks are used to deliver all structural materials to the work on flat cars and to support the derrick cars in erecting the lower floor system.

The method of erection with the gantry may be seen from the photograph. The two main cross beams at the top of the gantry have a material overhang beyond the trusses on each side and are fitted with rails on which a pair of heavy longitudinal beams spanning between the cross members may be rolled transversely. The longitudinal beams are equipped with heavy tackle for lifting and are shifted transversely as found necessary for the raising of members from cars on the tracks alongside and for placing them in position in the trusses.

One of the photographs shows an end view of the partly completed viaduct and indicates the character of the construction. The bents consist of two vertical columns generally 20 ft. center to center, connected by a cross girder, a bottom tie and cross bracing. These carry four lines of longitudinal girders covered by a reinforced concrete slab for ballasted tracks. The columns are of a built up H-section and the cross girders of a box section, the two webs being approximately in the planes of the two sides of the columns to facilitate web splices. The flange angles of the girders also extend beyond the webs for riveted connections to the column.

The Viaduct

Longitudinal stiffness of the structure is provided at intervals by bracing two bents to form a tower. Where this could not be done on account of interference with surface tracks, streets, etc., masonry piers were introduced consisting

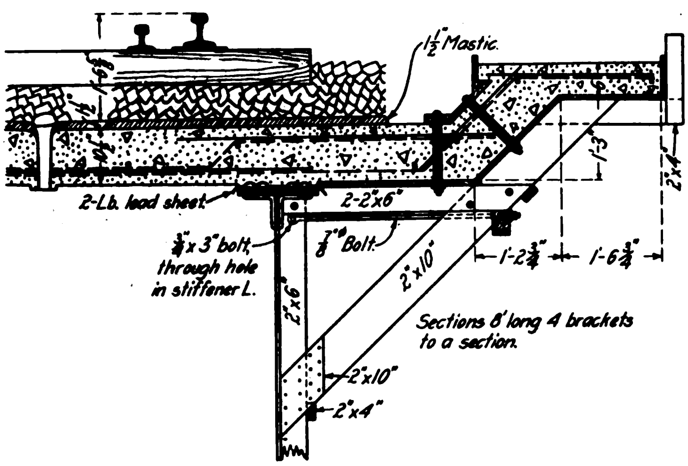
Special Tower Bracing Was Used Over a Team Yard

either of solid shafts or two pedestals connected by an arch. Another variation from the standard construction was used where the viaduct crosses a freight house and team yard at Baird street. To provide clear passage for tracks and roadways, the transverse bracing was omitted and the longitudinal bracing for the towers was arranged to form an "A" rather than an "X" to give a minimum interference.

The viaduct columns are carried on creosoted pile foundations with pedestals varying from 6 ft. square to 12 ft. square depending on the load and the allowable pile bearing as determined by pile driving records. The concrete deck is 10½ in. thick, and cantilevers out on each side for a walk with outside edges 9 ft. 3 in. from the center line of track. The slab was built in place to give monolithic construction but has a longitudinal joint on the center line between the tracks and a transverse joint at intervals of about 100 ft. It is covered with waterproofing consisting of four-ply felt and one ply of cotton drill laid down with asphalt and covered with a one-inch asphalt mastic. The slab is pitched from the walk and from a ridge at the center line between tracks to drain holes at intervals of 5 ft. on the center lines of track. One interesting feature in connection with this floor slab is the protection given to the top flanges of the girder where covered by the slab. This surface is treated with a coat of refined coal tar and then covered with a sheet of lead weighing 2 lb. per sq. ft. which is carefully pressed down over the rivet heads. The concreting of the slabs was materially cheapened by the use of an ingenious form system suspended from the steel work as shown in a drawing.

On the Missouri Pacific branch of the viaduct three truss spans, 147 ft., 117 ft. and 137 ft. in length respectively span a yard of the Union Pacific. These are riveted Pratt truss spans of the usual construction except that a floor of special construction is used on the northernmost span on account of the reduced headroom resulting from the descending grade of the tracks.

The embankments used in the three approaches to the viaduct contain 290,000 cu. yd. of material and were given two different forms according to the local conditions. Where space was available fills were built, having a 1¾ to 1 slope on each side with toe walls where the fill would encroach on streets or private property. These retaining walls are of a gravity broken-back type which has been used extensively on Kansas City Terminal work. Where but a limited amount of space could be used for the approach embankment, particularly where located between



Part Section of Viaduct Floor Slab Showing Form for Overhang

adjoining tracks, the embankment is supported between reinforced concrete walls 2 ft. thick, spaced 30 ft. apart and tied together at intervals of 14 to 16 ft. by concrete ties. These concrete ties were used to support the construction track required to place the filling material. The fill is all clay and will be planted with alfalfa on all exposed slopes.

Special mention is due the conduct of the engineering work for this structure. In the face of a rapidly advancing steel market it became imperative to award contracts for the structural steel for the entire viaduct, including the Kansas river bridge, as soon as the stage of work on the design, would reasonably allow, and was followed with the preparation of detail plans for the bridge companies at the rate of about 3,000 tons a month. This program entailed the perfection of an efficient organization and conduct of the work along systematic lines. Special measures were taken to insure accuracy of the field work. A standardized tape was procured from Washington and careful checks were made between the tapes used in the field and those used in the actual fabrication of the members.

This work was under the direction of J. V. Hanna, chief engineer, and G. E. Tebbetts, bridge engineer of the Kansas City Terminal. The general contractor for the entire project is the Arkansas Bridge Company of Kansas City, Mo. The steel work was fabricated by the American Bridge Company at the Gary plant, and is being erected by the Kelly Atkinson Construction Company, Chicago.

THE AUSTRIAN LOCOMOTIVE INDUSTRY IN 1917 delivered 398 locomotives and 326 tenders for Austrian State and private railways, but exported nothing. The car works delivered about 14,000 trucks and coaches to the state and private railways and to private industry.—*Commerce Reports.*

Rules for Handling Freight for the War Department

NEW INSTRUCTIONS AND REGULATIONS governing the shipment of freight for account of the War Department, which take the place of the old system of preference orders which were issued by the various government departments and which resulted in so much confusion, have been issued by the Car Service Section of the Railroad Administration and by H. M. Adams, director of inland transportation of the war department.

The instructions by W. C. Kendall, manager of the Car Service section, were issued in Circular No. C. S. 3 and order that beginning March 1 the shipment of carload freight for account of the War Department be handled only in accordance with the regulations of the division of inland transportation.

The director of inland transportation has issued Order No. 1, general rules and regulations for the government of contractors and bureaus in shipping freight for the use of the war department, and Order No. 2, regulations for the shipment of freight for particular destinations and provisions for a system of transportation orders.

The circular of the Car Service Section provides:

It will be noted that under the provisions of Order No. 1, all negotiations conducted by the war department with respect to embargoes, special movement, failure to furnish cars, tracing and delivery of cars, etc., will be conducted by the Division of Inland Transportation with carriers through the Car Service Section.

Carriers affected by the restrictions in Order No. 2, section 1, or reissues thereof, should cover these restrictions by embargo, or by special instructions to agents and others interested, on their respective lines.

It will not be necessary to transmit such embargoes to zone chairmen or to connecting lines.

Carriers laying embargoes against points not designated in Order No. 2, or against points included in subsequent orders from the Director of Inland Transportation, will exempt freight for account of the war department, in accordance with Circular No. C. S. 1, dated February 11, 1918, or reissues thereof.

Where such general exemption is not made, carriers must honor all Transportation orders issued by the Director of Inland Transportation, except when the freight covered by such orders is of a perishable nature, and the route to destination is impassable by reason of physical obstructions.

Agents must in all cases endorse original and all copies of bills of lading, and waybills (including card bills if issued) with a reference to the transportation order in the following form:

TRANSPORTATION ORDER
No. U. S. W. D. ....

Agents honoring transportation orders will require the surrender of such orders when presented, filing them with station copies of bills of lading.

In cases of emergency, transportation orders will be issued by telegraph over the signature of the Director of Inland Transportation. These telegraphic transportation orders will be addressed to the shipper or railroad agent at point of origin and will give the number of the order with all necessary details. They will be confirmed by mail. Such telegraphic orders should be honored and the telegrams held by the agent until the supporting orders are received.

Failure of the shipper to make use of transportation orders after they have been presented to carrier's agent, or failure to comply with the instructions governing their use, should be covered by full report to the Car Service Section.

In the event that connecting carriers refuse to accept ship-

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"High Line" Construction for the Kansas City Passenger Terminal

The construction of the new Union passenger station terminal at Kansas City, Mo., some years ago, involved rearrangement of the connections of some of the railroads entering it which have only recently been completed. Such was the case with the Union Pacific R. R. and the Western Lines of the Chicago Rock Island and Pacific Ry., on the one hand (the latter road using the terminal tracks of the former) and the Nebraska and Northern Kansas Lines of the Missouri Pacific R. R. and the Chicago Great Western Ry., on the other hand, the Great Western using the entrance tracks of the Missouri Pacific.

The new Union Station is more than a mile distant from the old one, and before the former was constructed it was seen that some extraordinary provision would have to be made to bring the four roads named into the new station without encountering congested approaches. There was in contemplation, therefore, the construction of elevated tracks, so that the trains of these lines could enter the station without interference from numerous freight yards and switching tracks to be crossed on the bottom lands of the Kansas river, in Kansas City, Kans., and Kansas City, Mo. The work of this new project was started during the fall of 1916, but there were, for various reasons, serious delays, so that the new elevated line was not completed and put into service until February 15, last year. The new line is more

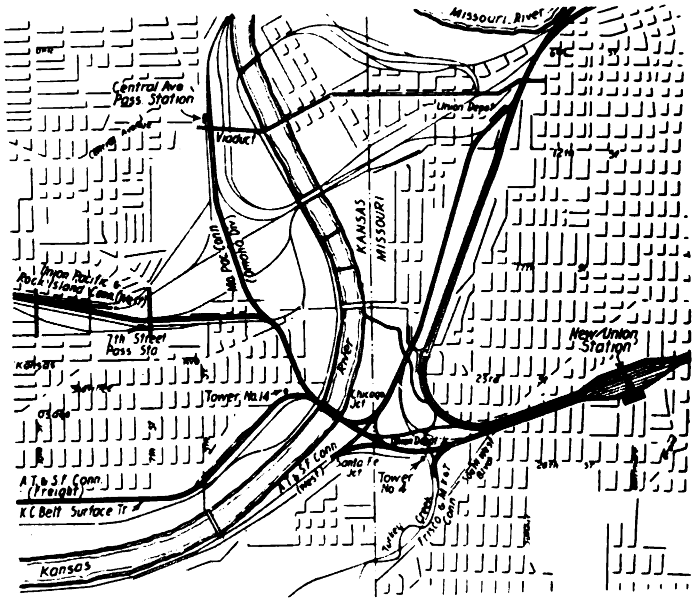


Fig. 1—Map Showing Route of "High Line" Connections of Union Pacific and Missouri Pacific Railroads, Kansas City Passenger Terminal.

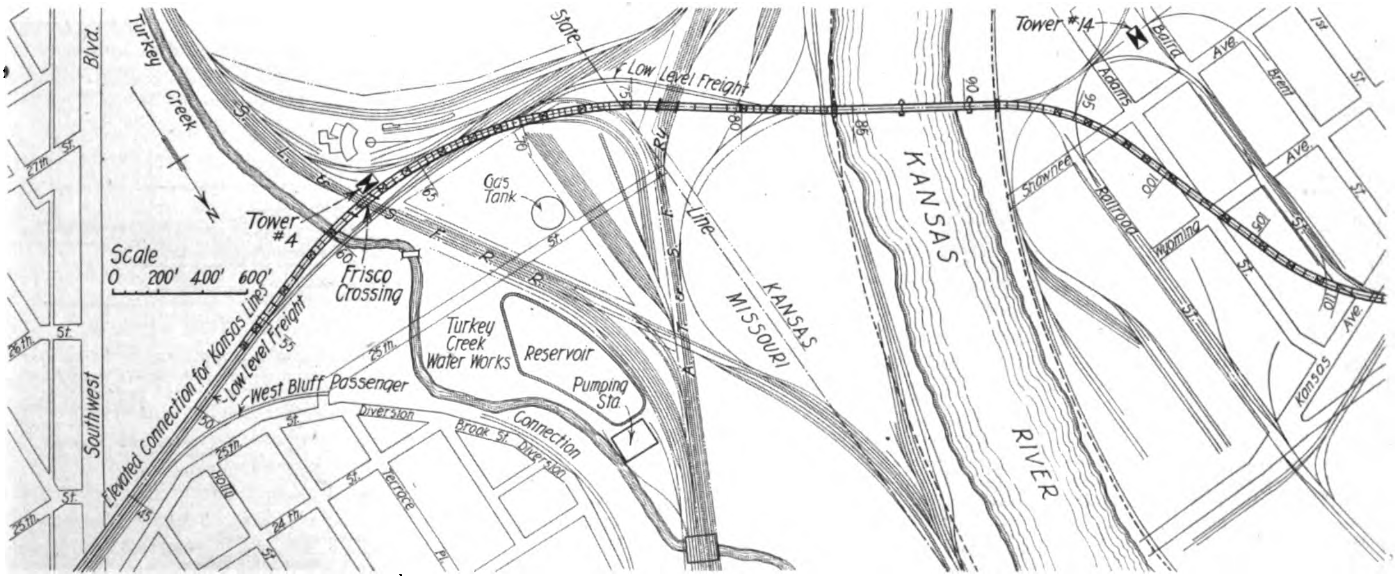


Fig. 2—Map Showing Elevated Connection with Kansas City Union Passenger Station for Kansas Lines, East of the Kansas River.

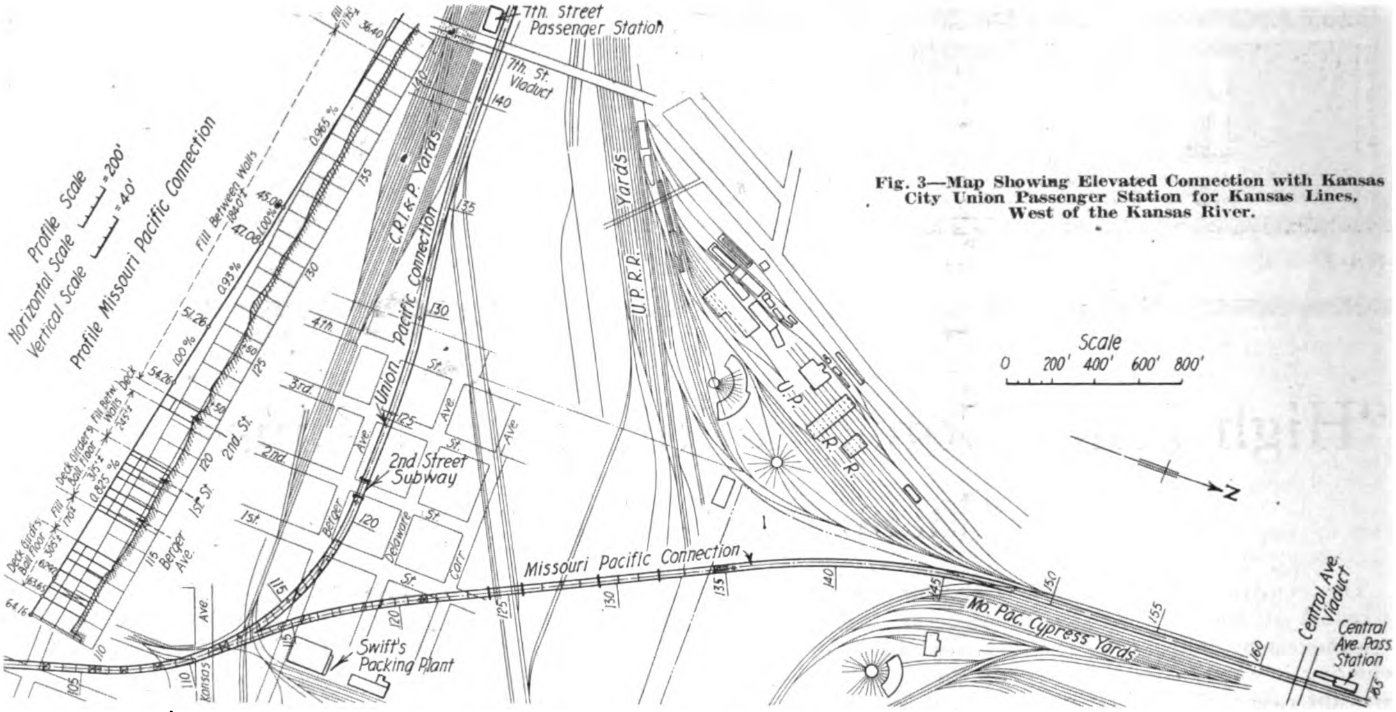


Fig. 3—Map Showing Elevated Connection with Kansas City Union Passenger Station for Kansas Lines, West of the Kansas River.

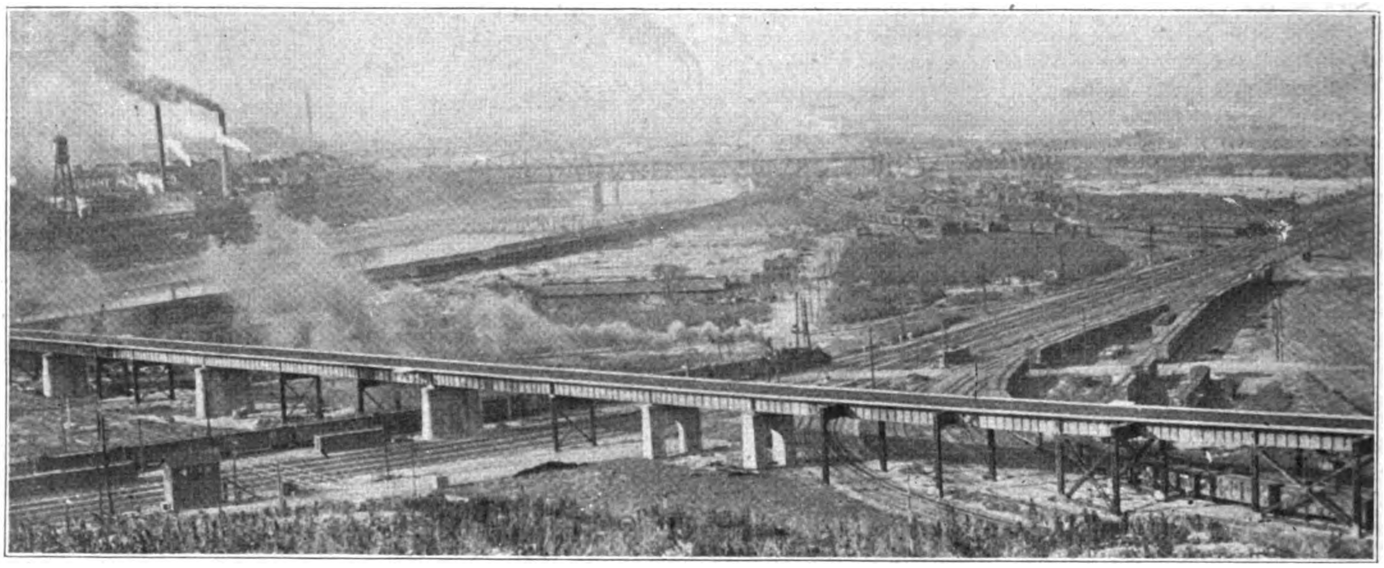


Fig. 4—Part of the Steel Viaduct Portion of the Completed Elevated Connection for Kansas Lines with the Kansas City Union Passenger Terminal.

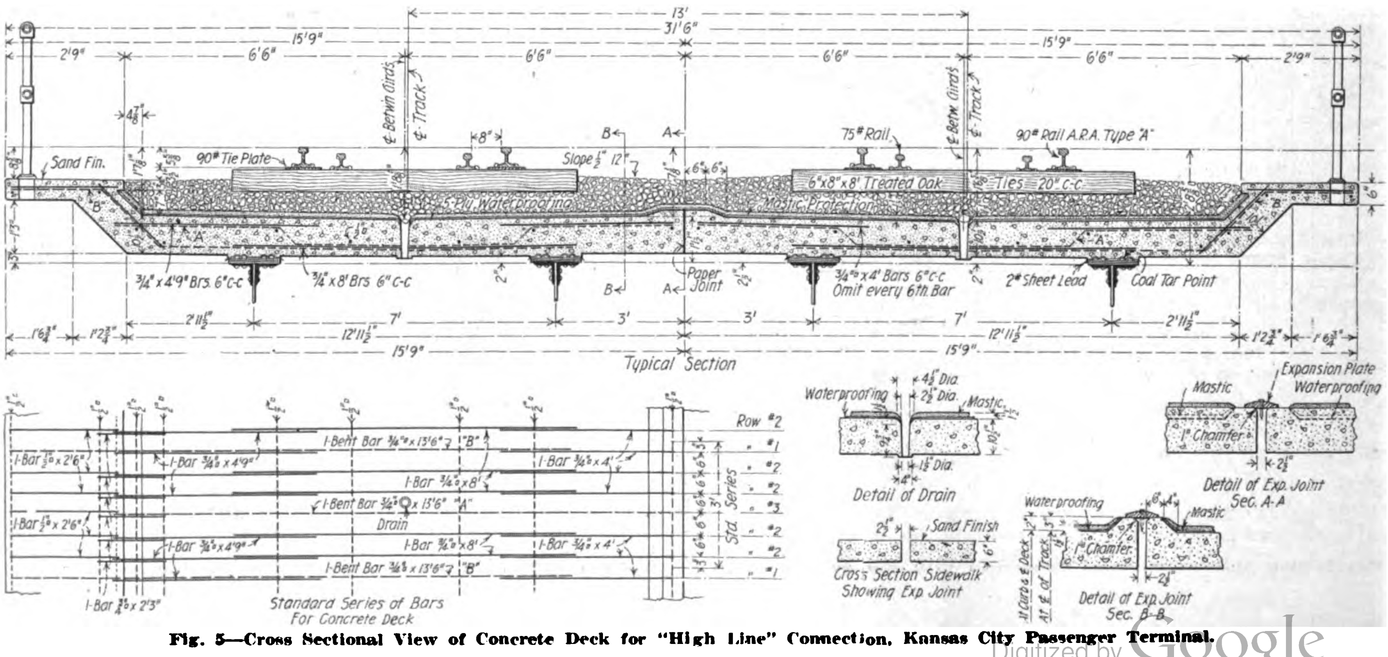


Fig. 5—Cross Sectional View of Concrete Deck for "High Line" Connection, Kansas City Passenger Terminal.

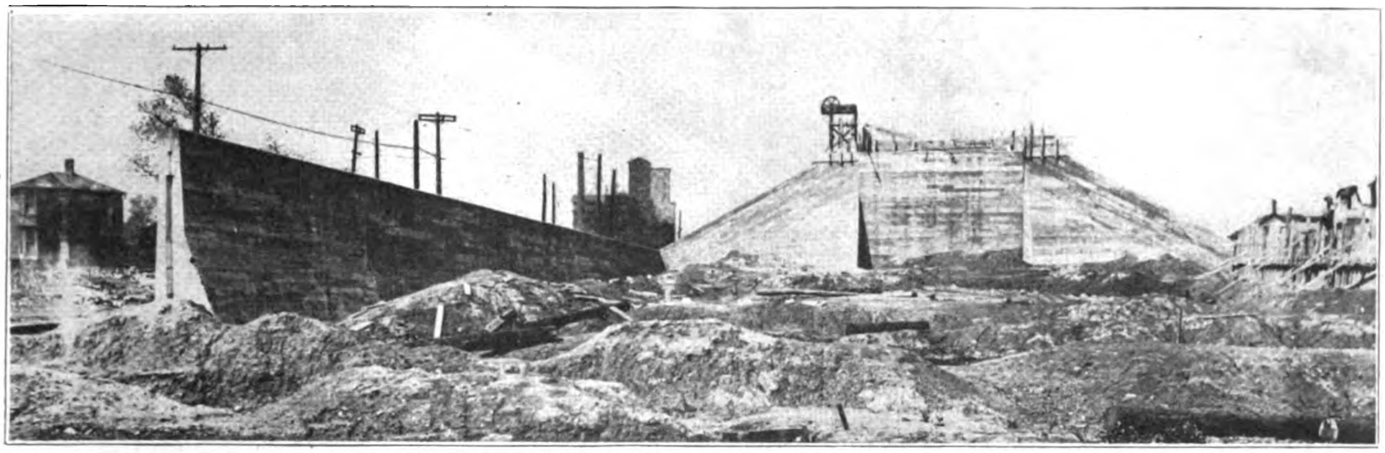


Fig. 6—Abutment and Toe Wall Construction for Embankment Filling, "High Line" Construction, Kansas City Passenger Terminal.

than four miles in total length, and was erected at a cost of about $3,000,000.

Starting from the station end, the tracks of the new elevated line leave grade about ½ mile west of the station. It ascends on a grade mainly of 1.48% on the east approach, is essentially level crossing the Kansas or Kaw river, somewhat undulating beyond, descending on grades mostly of 0.92% on the west approaches. The maximum curvature on the east end of the river is 2¾ deg. and on the west end 6 deg. The accompanying map, Fig. 1, shows the route of the elevated lines. It is a double-track road built in the shape of a "Y," with one double-track branch, about 1½ miles long, running to the north, for the use of the Missouri Pacific and Chicago Great Western lines, and the other branch of about the same length extending to the west for the use of the Union Pacific and Rock Island lines. The junction of these two branches is at a point north of Kansas avenue, northwest of the point where the line crosses the river.

The "High Line" consists of some 3,900 ft. of surface tracks, 8,800 ft. of approach embankment, 8,500 lineal ft. of steel viaduct and a double-deck bridge across the Kansas river. The east approach consists of reinforced concrete retaining walls filled with sand. The side retaining walls are built in sections of 30 ft. length and are tied with cross walls 14 and 16 ft. apart, built up to within 4½ ft. of the top of the structure. This portion of the line is ballasted track.

The steel viaduct (Fig. 4) is built mostly on steel bents and braced towers, in spans of 30 and 60 ft., with concrete piers, at intervals, where the surface tracks did not permit room for braced towers. In some instances the piers are solid shafts of masonry, while in others they consist of two massive columns united by an arch. The concrete foundations for the viaduct columns rest upon creosoted piling. The total weight of the steel work is 17,605 tons. On the Missouri Pacific branch of the viaduct there are three truss spans of 147 ft., 117 feet and 137 ft., respectively, spanning a surface yard of the Union Pacific R. R. These spans have riveted Pratt trusses.

The deck of the steel viaduct consists of concrete slabs 10½ inches thick, molded in place. These are cantilevered out 9 ft. 3 ins. from track center, on each side of the deck, to provide room for a walk and railing. On the center line of the deck there is a longitudinal joint, and a transverse joint at intervals of 100 ft. This slab work is covered with four-ply felt and one-ply of cotton drill laid down in asphalt and covered with 1 in. of asphalt mastic. On this floor ballast is placed, and the tracks are laid in ballast. Several of the views show the reinforcement of the floor slabs, the pouring of concrete into the same, the forms for erecting the concrete piers, the buttresses at the back of one of the concrete abutments and other views typical of the work. The tracks are spaced at 13 ft. centers, and the overall width of the concrete deck is 31½ ft. Drainage is provided for by holes at the center of each track, at intervals of 5 ft.

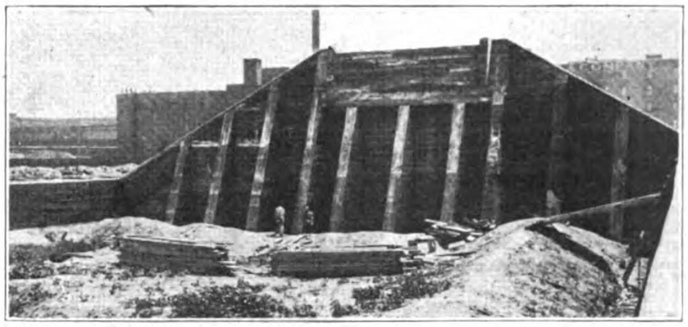


Fig. 7—Rear of First Street Abutment for Embankment Filling, "High Line" Construction, Kansas City Passenger Terminal.

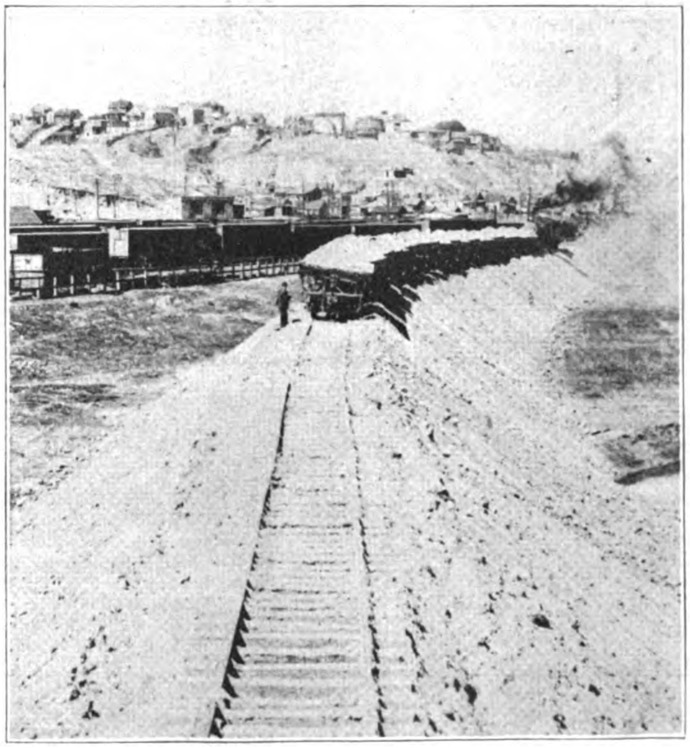


Fig. 8—Filling Embankment on the Missouri Pacific Connection, Kansas City Passenger Terminal, with Air Dump Cars.

In the earth embankment fills of the two legs of the "Y" there are 314,000 cu. yds. of material, of which 112,000 cu. yds. are in the Union Pacific connection and 202,000 cu. yds. in

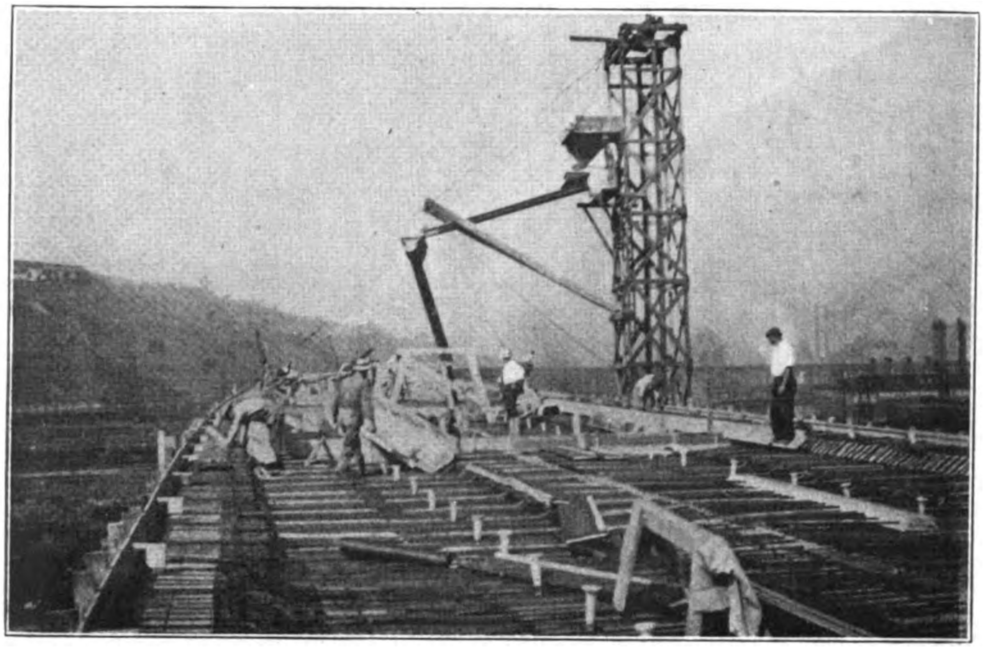


Fig. 9—Pouring Concrete Slab Deck of "High Line," Kansas City Passenger Terminal.

The bridge over the Kansas river, as already stated, is a double-deck structure of very heavy construction. It was built on the site of an existing single-deck, single-track bridge without interfering with traffic. Fig. 19 is a progress view of the erection of the new structure and Fig. 20 is a view of the completed structure. The bridge is in two spans of 300 ft. each, and one shore span of 132 ft. The traffic over this bridge is very heavy, amounting to about 180 train movements each 24 hours, so that unusual methods of erection had to be adopted. The old masonry for the original structure was retained, with the exception of the west abutment, which was rebuilt on a pile foundation. The new structure has pin-connected Baltimore trusses of sufficient height to provide a through structure for traffic on both levels. The girder span at the west end of the bridge was replaced with a riveted Warren truss span of 132 ft. length, with riveted connections. It serves as a through structure for the tracks

the Missouri Pacific connection. At some points, as is seen in Fig. 16, the earth embankment has a toe wall of concrete. This is at the end of the steel work in the Union Pacific connection. The subway, seen at the left in this view, is at Second street. A near view is seen in Fig. 17. It is a reinforced concrete structure. The floor is carried on eight reinforced concrete girders, a view of the same from underneath being shown in Fig. 18.

The project includes also new passenger station facilities for Kansas City, Kans., to be built at two different locations, at a cost of something like $100,000 each, on the basis of the pre-war prices. One of these will be located on the Union Pacific branch at Seventh street and the other at the point where the Missouri Pacific comes to the old grade at Central avenue.

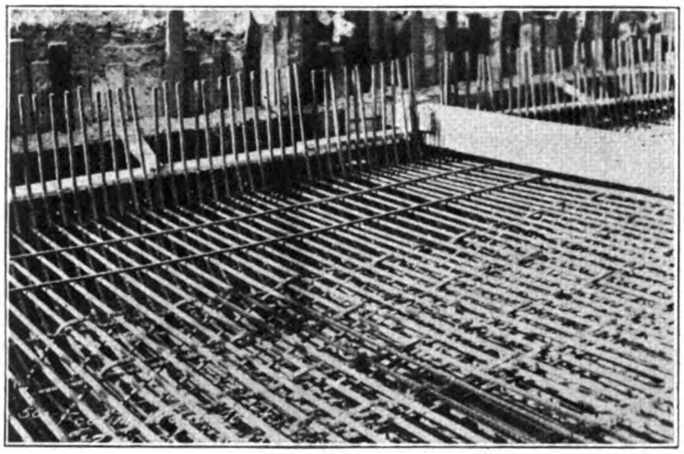


Fig. 10—Reinforcement for the Footing of the West Abutment, Second Street Subway, "High Line" Construction, Kansas City Terminal.

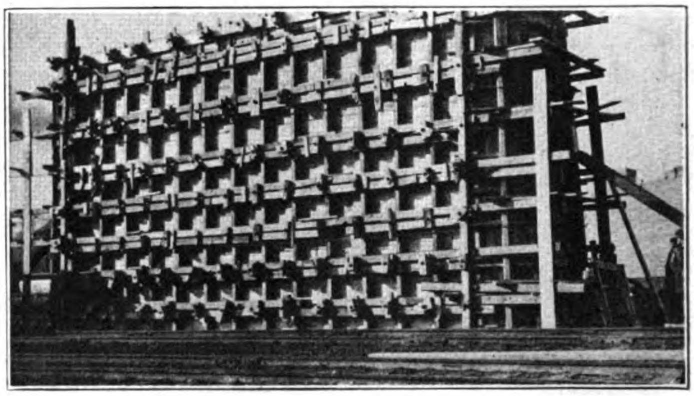


Fig. 11—Forms for Erection of Concrete Pier Under "High Line" Elevated Tracks for Connection of Kansas Lines Into the Kansas City Terminal.

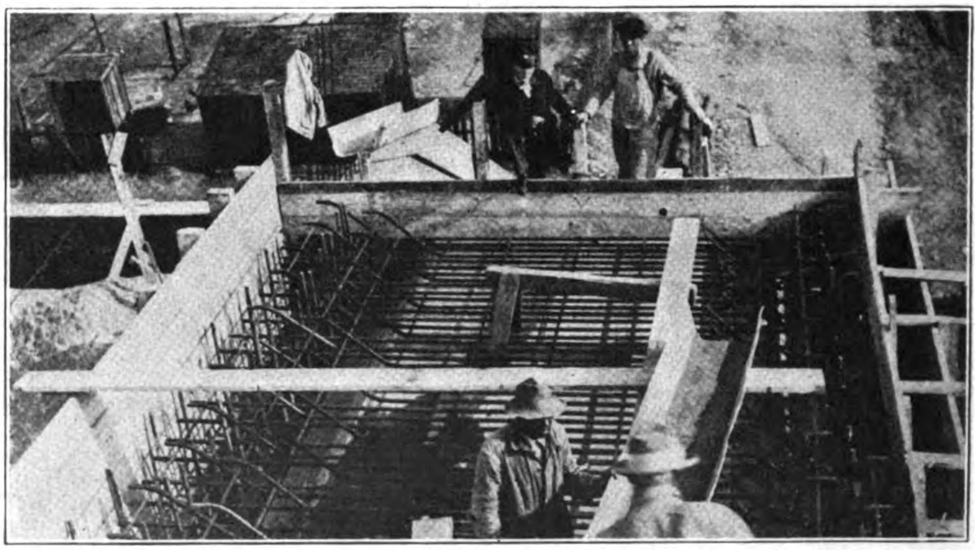


Fig. 12—Reinforcement for Deck Slab of Steel Viaduct, "High Line" Construction, Kansas City Passenger Terminal.

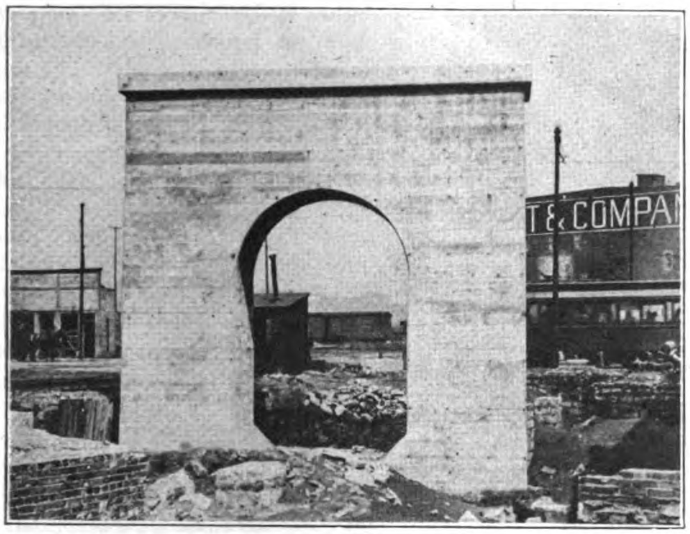


Fig. 13—Concrete Arch Pier for Steel Viaduct Construction of the High Line Connection, Kansas City Passenger Terminal.

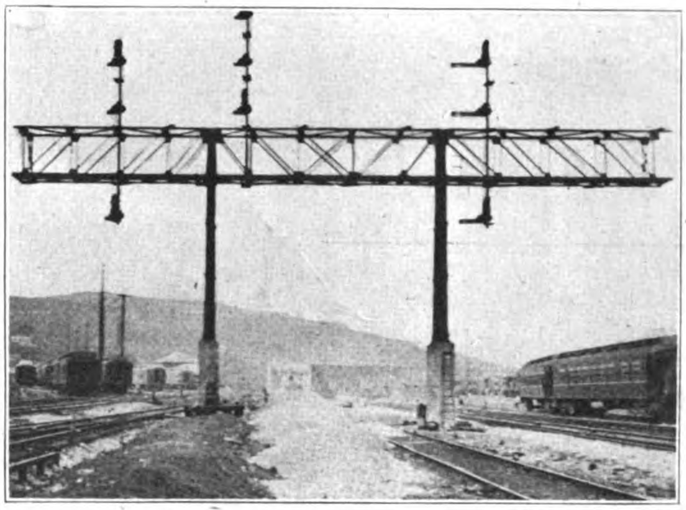


Fig. 14—East End of High Line, Kansas City Passenger Terminal, Before Approach Walls Were Erected.

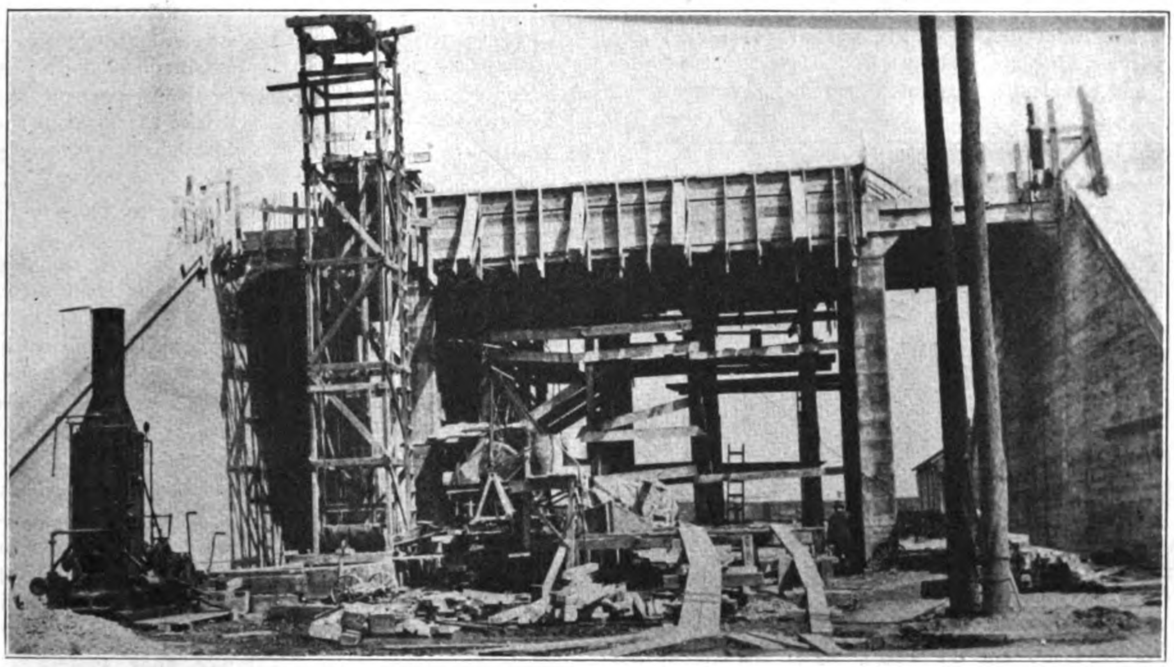


Fig. 15—Pouring of Concrete for West Abutment, Second Street Subway, Union Pacific Connection with "High Line" Entrance to Kansas City Passenger Terminal.

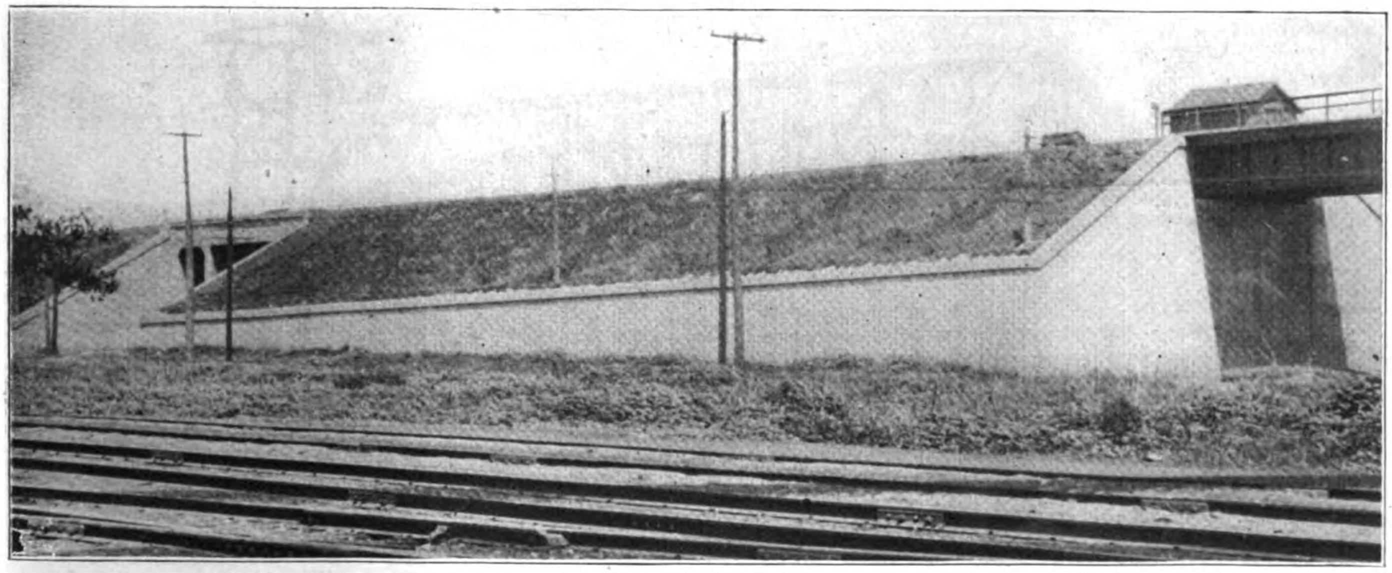


Fig. 16—End of Embankment and Beginning of Steel Viaduct on the Elevated Line of Union Pacific R. R. Connection with Kansas City Passenger Terminal.

Fig. 17—Completed Reinforced Concrete Viaduct at Second Street, "High Line" Connection with Kansas City Passenger Terminal.

on the lower level, and as a deck structure for the tracks on the upper level.

Because of the loading, the trusses in the two main spans are of unusually heavy construction. The bottom chord and one set of the main diagonals are eyebars of nickel steel designed for an ultimate strength of 95,000 to 110,000 lbs. per sq. in. and an elastic limit of 55,000 lbs. per sq. in. All other web members are either of box or I-section, of structural steel of ordinary grades. The top chords and end posts are of H-section, with heavy girders for the sides connected by a diaphragm in the plane of the chords, and double plate lacing and channel battens on the top and bottom faces. The material in these parts (top chords and end posts) is a high-carbon steel similar to that used in the Hell Gate arch bridge at New York, the ultimate strength being 66,000 to 76,000 lbs. per sq. in. and the elastic limit 38,000 lbs. per sq. in. The three spans of this bridge weigh 5,311 tons, and the heaviest member weighs 63 tons.

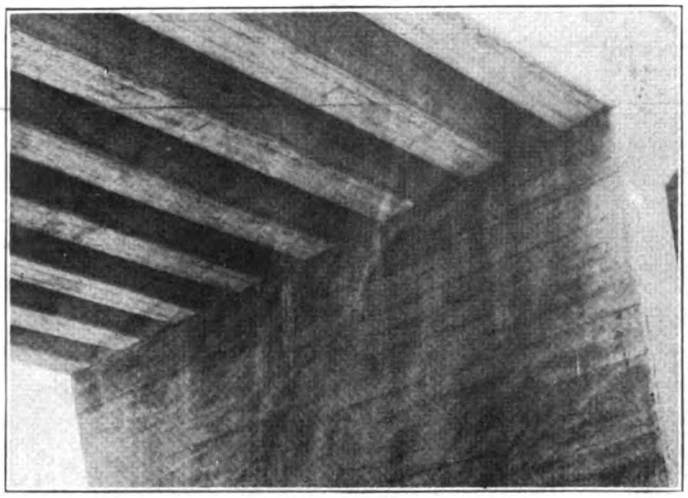


Fig. 18—View of Under Side of Second Street Subway, Showing Reinforced Concrete Girders of Floor System.

The decks of this bridge, both above and below, are of creosoted timbers, carrying ballast for the tracks. The main floor beams, spanning from truss to truss the panel points, carry longitudinal girders just inside the trusses on each side. These, in turn, carry intermediate floor bears, laid 5 ft. center to center, on which are placed the longitudinal timbers of the ballast floor. To take the blast of the locomotives, the under side of the upper deck is protected with a suspended concrete slab.

The new double-track bridge was erected around the old single-track structure continued under traffic, as stated. The latter had been built on the south half of the double-track foundation. The details of the work of erection will not be described here, but it is interesting to note that the old spans were shifted 9 ft. laterally, to bring them to a central location with reference to the new superstructure; and at the same time they were raised 27 inches, to permit the floor system of the new bridge to be assembled completely underneath the old floor. The erection was carried on from a gantry traveler, the legs of which came in the spaces between the old and the new trusses. The falsework consisted of two 5-pile bents under each panel point of each truss of the new bridge. These bents projected far enough outside of the structure to carry a temporary track, each side, for delivering the structural materials on flat cars and to carry the derrick cars used in erecting the lower floor system. The main

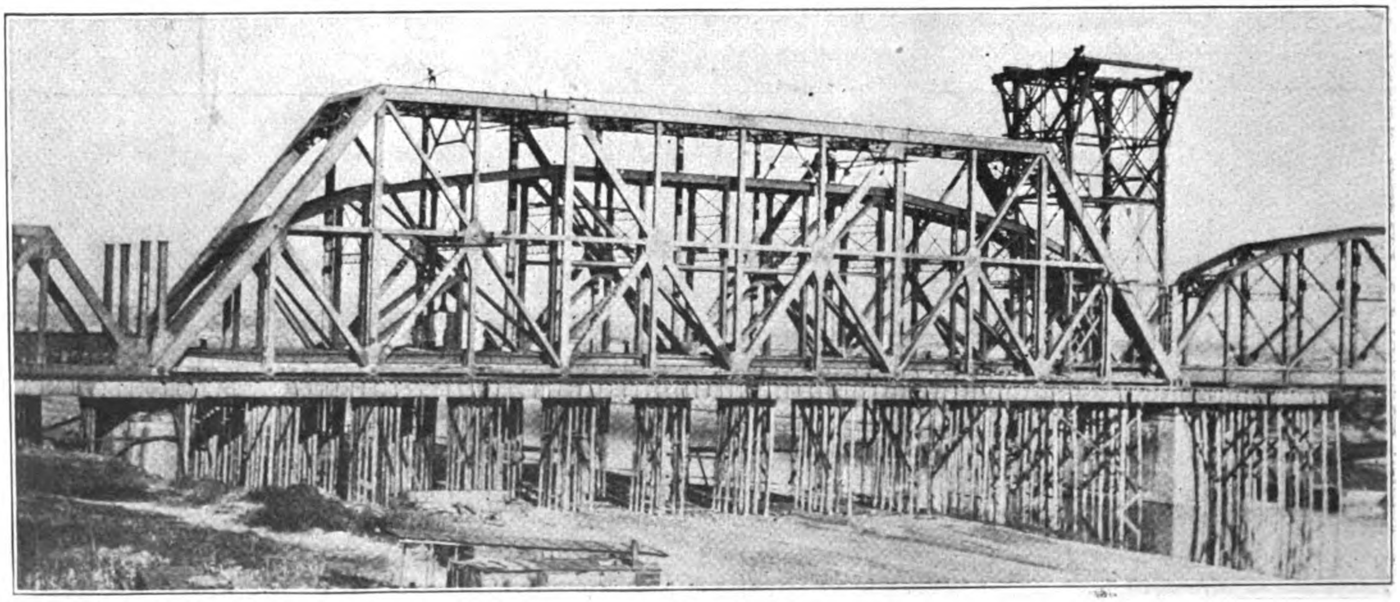


Fig. 19—Method of Erecting New Spans Around Old Bridge, at Crossing of Kansas River, "High Line" Construction, Kansas City Passenger Terminal.

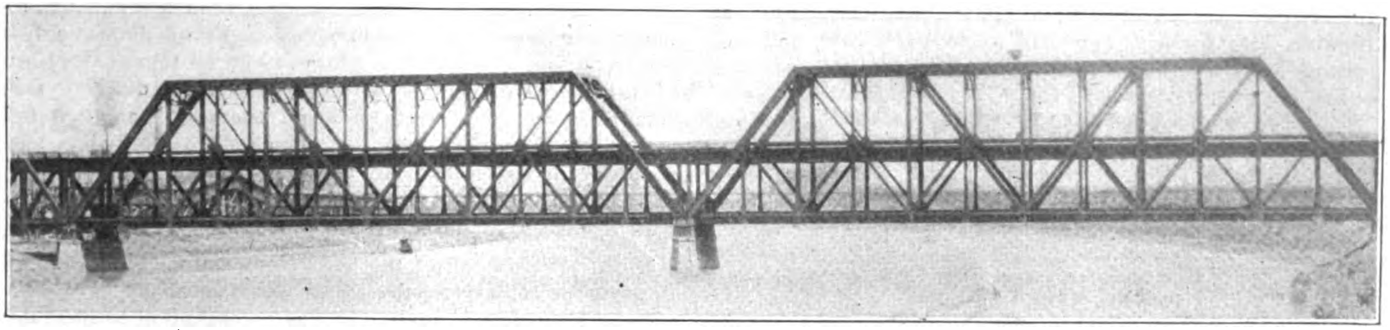


Fig. 20—New Double-Deck Bridge Carrying "High Line" of Kansas City Passenger Terminal Over Kansas River.

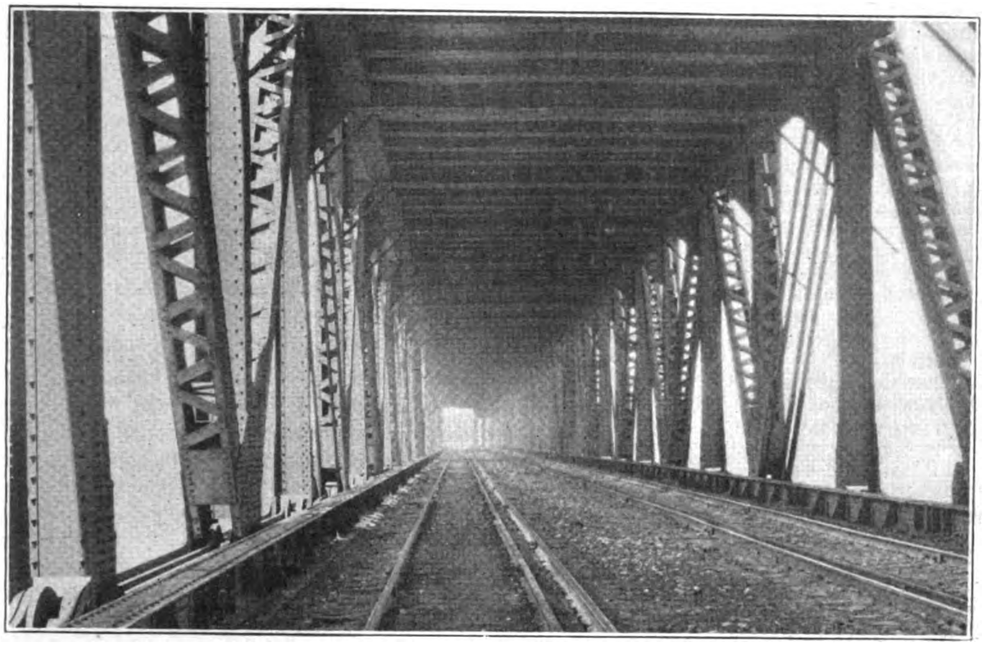


Fig. 21—View Looking Through Lower Deck of Kansas River Bridge, "High Line" Connection with Kansas City Passenger Terminal.

cross beams at the top of the traveler were long enough to overhang the trusses on each side.

All the work of building this "High Line" has been under the supervision of Chief Engineer J. V. Hanna, of the Kansas City Terminal Ry., with Mr. G. E. Tebbetts bridge engineer. The general contractor for the whole project was the Arkansas Bridge Co., of Kansas City, Mo. The steel work was furnished by the American Bridge Co., from its Gary plant, and it was erected by the Kelly Atkinson Construction Co. of Chicago.

First Published Timetable of the Oldest Railroad in America

Writing in a recent issue of the Baltimore & Ohio Magazine, James T. Doyle says:

"It seems a fitting coincidence that the oldest newspaper of continuous publication in America, the Baltimore American, should be the one to have featured, editorially and in advertising, the first published time-table of the oldest railroad in America, the Baltimore & Ohio. Hand-in-hand these two organizations have 'grown up' together, comrades in industrial development, associates in patriotism.

"A few days ago, when in search of some information bearing upon the early part of the nineteenth century, I entered the file room of the Baltimore American, containing historical information which is beyond price. General Agnus, the publisher, guards this section with double locks, for therein is carefully kept an unduplicated record of notable events; a history of the city of Baltimore, of the state of Maryland, and of the United States, daily written and daily published from August 22, 1773, down to today—with not a day's record missing.

"A search of these files discloses many things, quaint and curious. There are advertisements from the hand of George Washington for runawal slaves; there are notices of commodity sales, wherein the medium of exchange was a certain number of pounds of tobacco. But the article that appealed to my fancy as bearing a deep interest, not alone for railroad executives and operatives, but for all men engaged in commerce and industry, and linking the past with the present in an unusually significant manner, was a combination news item and advertisement. It was the first advertisement of a railway passenger train in the world, and appeared in the issue of the Baltimore American for May 21, 1830, signed by P. E. Thomas, the first president of the Baltimore & Ohio Railroad, which at that time was operated between Baltimore and Ellicott's Mills, Md., 13 miles distant.

"Here was a union between the oldest railroad and the oldest newspaper of the country, manifesting a mutuality of hope and confidence; of goodwill and helpfulness.

"This shows that at the very inception of its career, the Baltimore & Ohio appreciated the value of the press as an agency for bringing the public and the railroad into closer relationship, with the great objective of developing this virgin continent—an objective realized in its twentieth century magnificence and power. The policy that the company thus inaugurated in 1830 has been continuous throughout the nine decades that have passed, and this is evidenced by the constant use of the advertising columns of the newspapers of the country. Furthermore, its early trust in the enterprise, patriotism and fairmindedness of the press has been vindicated and justified.

"There has never been a period in the history of the country, certainly during the last three or four decades, when the real railroad situation has been presented to the public by the newspapers with such clearness, insistence and strong support as now. * * *

"The May issue of the Baltimore & Ohio Magazine contained a copy of what was thought to be the first timetable of the Baltimore & Ohio Railroad, dated June 17, 1830.

The Contractor

For the Man on the Job

Volume 25 CHICAGO, FEBRUARY 1, 1918 Number 3

Derrick and Hoist Stunts in Big Bridge Erection

Derrick Car With Outrigger Wheels and Side Boom Erects Viaduct—Gantry Traveler Erects New Trusses Enveloping Old Trusses—Traveler on Rollers Takes Down Old Steel and Erects New Second Deck Steel in One Operation—Twin Derrick Cars Operating Together Erect New First Deck Steel—Derrick Cars With Swinging Leads Build Pile Falsework—Five Sheave Block Hoist Pulls Old Piles

By W. J. Howard

In Charge of Erection for Contractors

SEVERAL traveling derrick arrangements, each designed for a distinctive task, have been successfully co-ordinated in the erection of the high line viaduct and bridge work of the Kansas City Terminal Railway. Some of these travelers, as the big gantry for truss erection, perform a single task; others, like the little mule traveler, which builds second deck and takes down old structure in alternate steps, perform double tasks; and still others, as the twin travelers erecting first deck steel, work together on a single task. The several traveler rigs were worked out by the writer for the erection contractors.

The Kansas City highline work comprises a two-deck four-track railway bridge across the Kansas River and at each end several thousand feet of steel tower and girder viaduct. The bridge proper has two 300-ft. spans and one 132-ft. span and occupies the piers of an old single track bridge. The old bridge, which sat to one side of the piers, was first moved to the center and then the new spans were erected around the old spans as indicated by the pictures. This permitted the old bridge to carry traffic during the construction of the new bridge; four lines used it. The bridge erection was a separate problem from the viaduct work, although some of the travelers were fitted to serve both tasks.

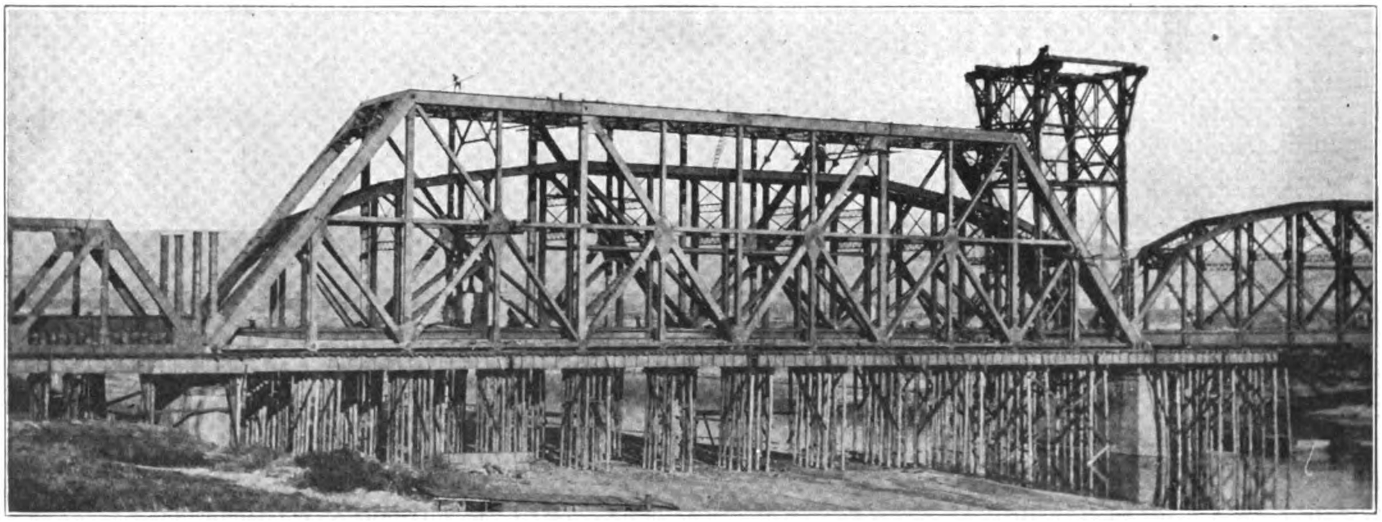
In viaduct erection the material track on which the steel is brought in runs down the center line of the viaduct and is blocked by the cross-braces as soon as the bents are erected. It is best, therefore, for the erection derrick to work from above. The rig to do this must be able to set cast bases, braces, columns and cross girders weighing as much as 20 tons at the end of a span calling for a 78-ft. longitudinal girder. To meet these conditions a special rig has been designed and built which can be moved about over standard gage track like a derrick car, but with auxiliary wheels, making it act as a 9 ft. 6 in. gage traveler, when working.

The traveler has a 36-ft. A-frame and an 82-ft. steel boom set in a special Vulcan mastless casting. It has erected 20-ton cross-girders out 78 ft. and 34-ton 80 ft. longitudinal girders with ease and speed. To get the benefit of a wider track than standard when lifting off side, and still avoid the constant blocking and adjusting of outriggers, six extra 30-in. wheels have been added. There are four of these in front and two in back. They are two-flanged (the rail being in the groove) so there is no danger of slipping off the rail when the car is slightly tipped. The wheels are mounted on two 8x18's running longitudinally on each side of the car. The front four are set opposite the corresponding wheels of the car truck and the back two opposite the middle of the back truck. These auxiliary wheels on the front of the car are set to clear the rail a quarter inch when the derrick is not loaded, so that the car is moving under its own weight is carried on the railway trucks only. Under load the springs compress until most of the weight is on the auxiliary wheels.

To make the car as rigid as possible without sacrificing its ability to turn a curve, the springs have been removed and oak blocks put in their places. These compress slightly, giving the desired limberness and allowing the car body to lower enough under load so that the auxiliary wheels take bearing.

The car is 56 ft. long over all; it has a 30 H. P. American engine and a small slewing engine for moving the boom. To prevent the rear of the car from kicking up under heavy load with the boom pointing nearly straight ahead, two 2½-in. eye bolts each with a set of girder clamps, are provided to hold it to the girders on which it stands.

There is a small stiff leg set amidships and to one side of the car which picks the ties from the track over which the car has already moved and swings them ahead of the rig for the next section to be laid. The rails are pulled through under the car with a runner line. It takes about 1½ hours to shift track for an 80-ft. move. The



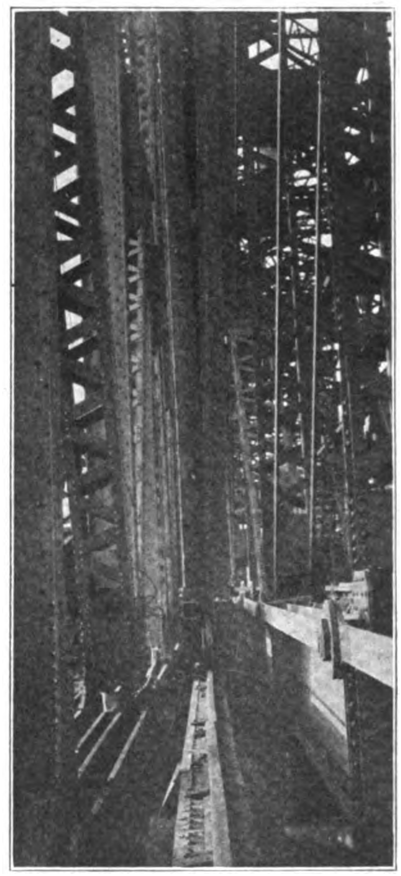
GANTRY TRAVELER PASSED FROM ONE SPAN TO NEXT ERECTING NEW TRUSSES.

track shifting derrick is operated on one of the engine spools with a manila rope for a load line. The boom is fastened at the top with another line which is hitched to the mast and only loosened when a different height of boom is desired. This change cannot be made during the time that the rig is at work. Besides moving the track ahead the auxiliary rig is very handy to hoist coal, rivets, etc.

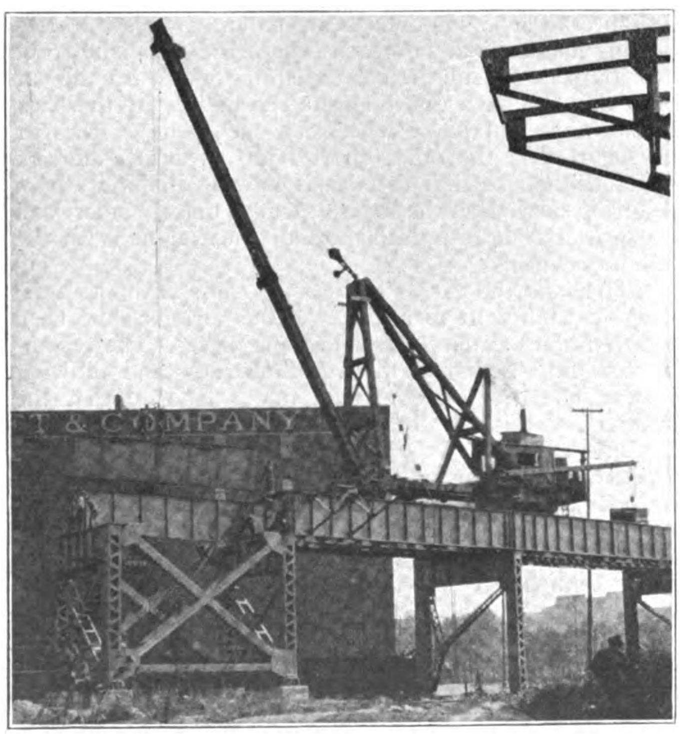
The derrick car traveler averages 120 tons of steel erection per day and has erected 200 tons. Most of the viaduct steel is comparatively heavy, there being no piece under 5 tons weight, except the cross frames, laterals and tower bracing.

As stated before the wider and higher spans of the new bridge were erected around the spans of the old bridge. The order of operations in general was putting in falsework and setting lower deck floor steel and bottom chords; erecting trusses and lateral bracing; putting in second deck floor system and taking down old spans.

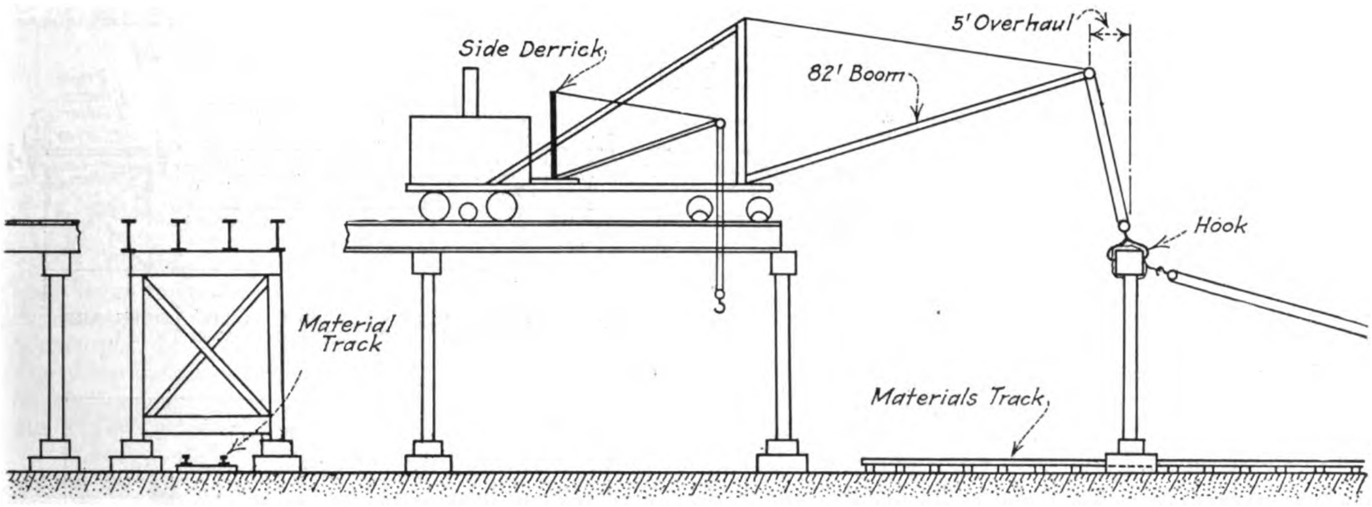
One of the sketches shows the general scheme of twin falseworks on each side of the bridge. The falsework piles were 55 to 65 ft. long and were driven till they stopped, the average penetration being about 19 ft. Particular care was used in bracing and capping the bents so that there should be a minimum of sway and settlement. This extra work was more than justified by the time saved by the increased ease with which the joints were made in the truss. No trouble whatever was experienced in connecting up. The floor system of the new trusses is so wide that it was possible to drive all the piles for falsework outside of the old single span bridge. This driving was accomplished by a derrick car, which drove piles with swinging leads, while another derrick car capped the piles and braced them. The piles were spaced and guided from the deck by a barge in the river. While the one car was driving piles on one side of the span, the other was capping piles and laying girders and track out on the finished bents. The pile-driving car drove about 15 piles per day (1½ bents). The cars changed sides when they had done their work. For the materials tracks on the falsework girders were used from the parts of the new work not yet ready for erection. To pull the falsework piles a five-sheave block reeved up with ⅝-in. wire rope and hung from the eye-bars of the new span was used, as shown by the sketch.



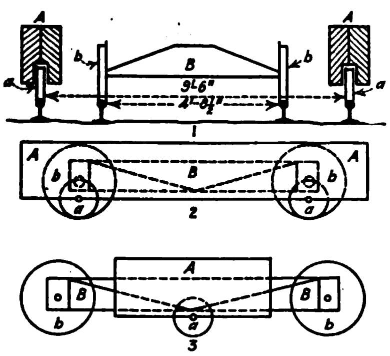
LEGS OF GANTRY MOUNTED ON DOUBLE FLANGE WHEELS



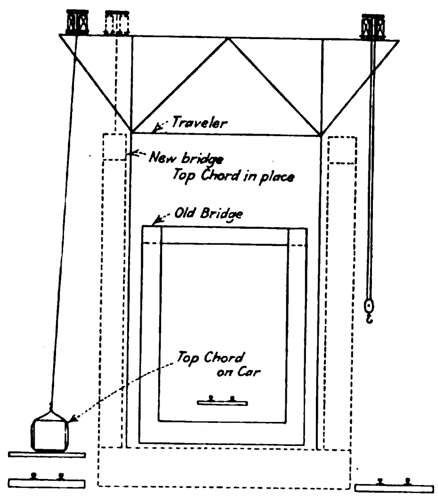
DERRICK CAR WITH OUTRIGGER WHEELS AND AUXILIARY SIDE DERRICK PLACED VIADUCT STEEL.



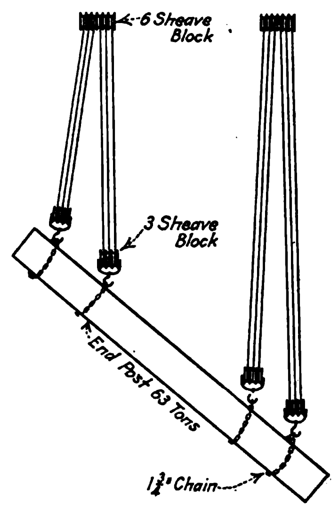
WITH A LITTLE OVERHAUL, THIS RIG HANDLED ALL LENGTHS OF GIRDERS.



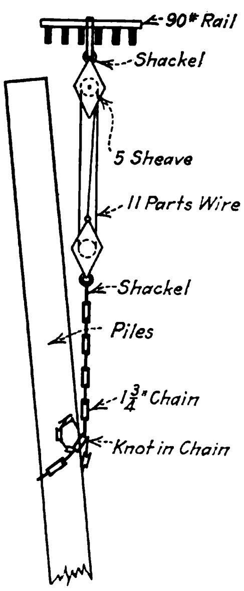
OUTRIGGER TRUCK ARRANGEMENT: (1) END VIEW OF BOTH TRUCKS; (2) SIDE OF FRONT TRUCK; (3) SIDE OF REAR TRUCK; B AND b INDICATE REGULAR TRUCK PARTS AND A AND a INDICATE OUTRIGGER TRUCK PARTS.



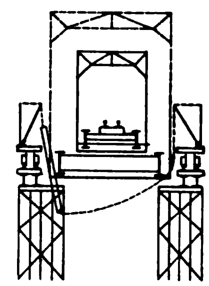
GANTRY TRAVELER RIDING BETWEEN NEW AND OLD SPANS SERVED BY OUTSIDE SPAN TRACKS.



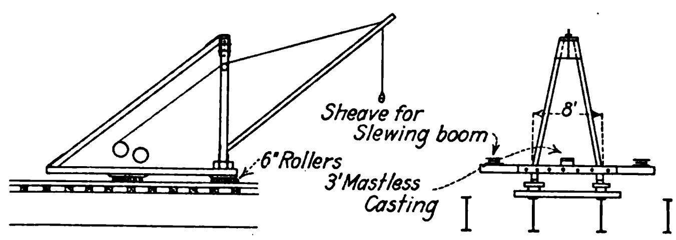
BIG END POSTS HOISTED BY TWO SIX-SHEAVE BLOCKS REEVING TO FOUR THREE-SHEAVE BLOCKS.

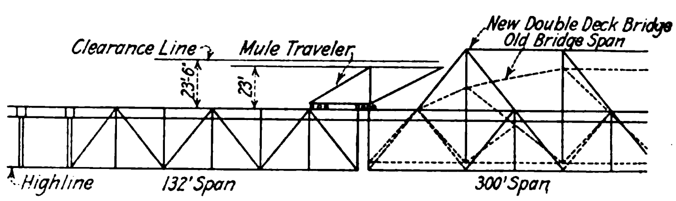


FIVE SHEAVE BLOCK TACKLE HUNG FROM STEEL SPAN PULLED



FALSEWORK PILES. TWIN DERRICK CARS WORKING TOGETHER PLACED FIRST DECK STEEL.

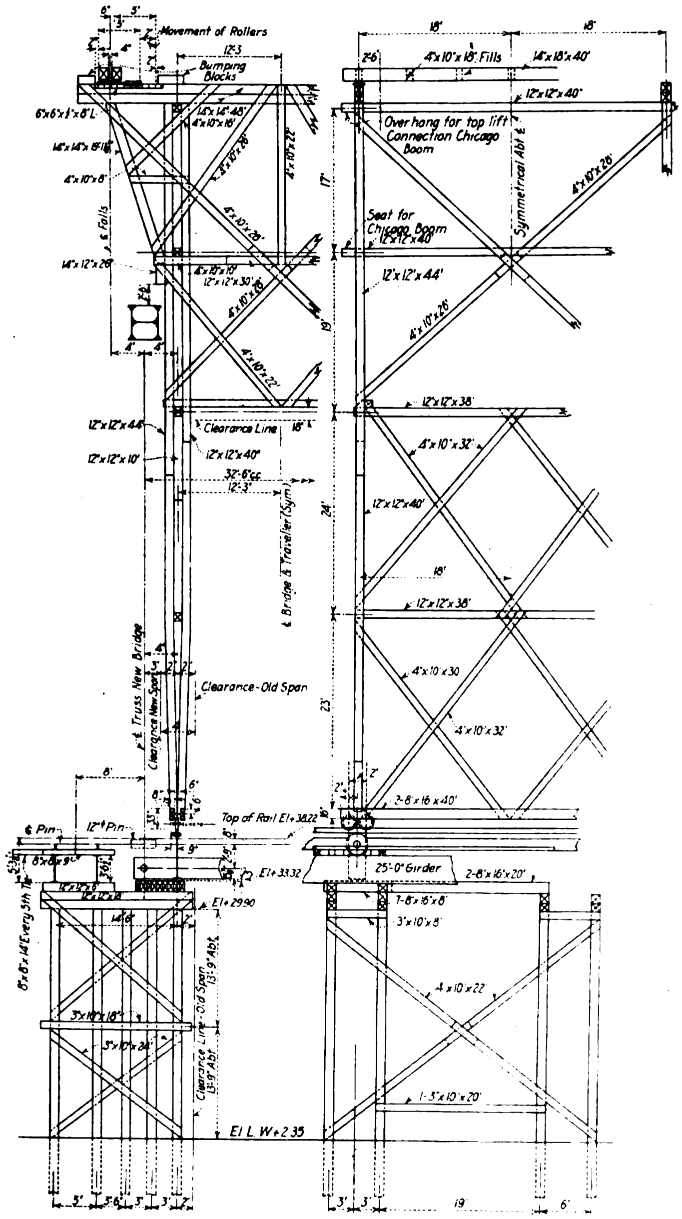




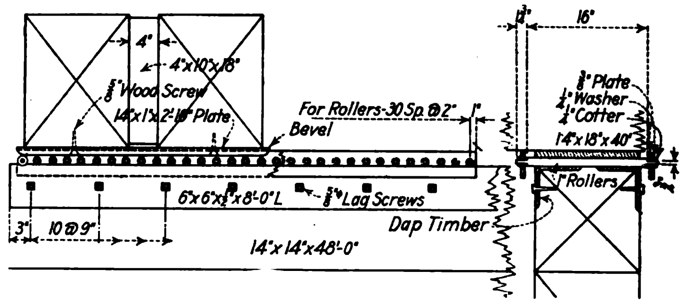
TRAVELER ON ROLLERS ERECTED SECOND DECK AND TOOK DOWN OLD TRUSSES IN ALTERNATE STEPS.

The 300-ft. span erection of the new bridge was performed by the gantry treveler shown in detail by the drawings and pictures. Two grooved wheels, like the ones used on the viaduct derrick car, are set on each corner of the traveler and it is braced so stiffly that a 1½-in. line on one corner will move it without racking. Yellow pine 3x10 and 4x10 plank braces were used and very carefully and securely fastened to get this stiffness. This rig is erecting steel at the rate of 100 tons a day. It erected the 63-ton end posts with ease. The two operating engines, one on each side, are set on the bottom chord eye-bars of the new span and of the old span. One engine was a 40 H. P. Lidgerwood and the other a 30 H. P. American.

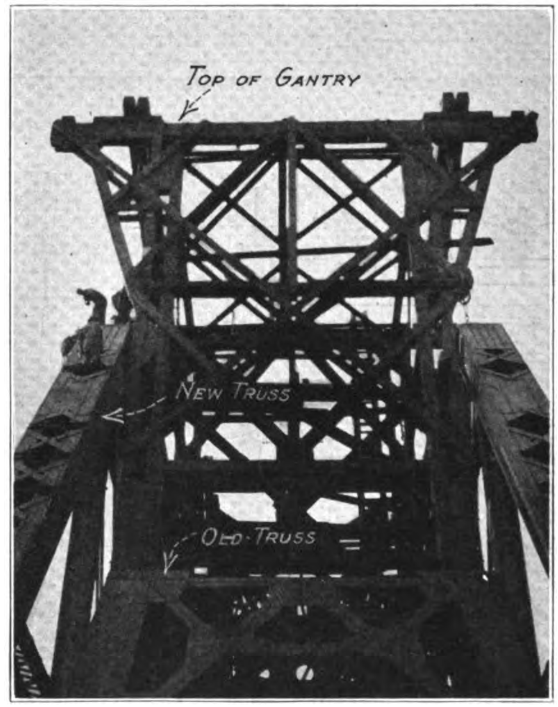
The gantry traveler erected only the main truss members. Working from the tracks on either side of the new bridge on which the steel is brought out to the gantry, derrick cars set the lower floor system, the bottom chords and the stub hangers of each of the 300-ft. spans. This



DETAILS OF GANTRY TRAVELER FOR ERECTING LARGE RIVER SPANS



DETAIL OF ROLLERS ON WHICH LOAD BLOCKS ARE ROLLED FROM OVER TRACK TO OVER TRUSS.



CAP OF GANTRY OVERTOPPED BIG TRUSSES AT HIGHEST POINTS.

was done, as shown by the sketch, by hitching the second derrick line to each piece after it had been lowered below the bridge by the first derrick.

The second deck erection and the taking down of the old spans were alternate steps in a continuous operation. As shown by the sketches, the old trusses will be taken down by a derrick on rollers working from the upper deck of the new spans. In order to clear the new laterals this rig has been built with a clearance of 23 ft., or 6 in. less than the minimum afforded by the sway braces. This rig will start out on the highline, 500 ft. west of the new bridge, erect that, then put in the top floor system of the 132-ft. span, from which it will begin the removal of the old bridge. When one section of old steel has been taken out as much as possible of the new upper deck will be erected. The derrick will then roll out into this new floor and take down the next section of the old bridge. The rig is a "mule traveler," having an 8-ft. spread of A-frame at the sills and a 14x16 Oregon Fir boom 56 ft. long, set in a St. Paul mastless coating 3 ft. square. To hold this three 12x12-in. cross timbers are used at the base of the A. The center one is extended far enough on either side so that it will serve to hold sheaves for slewing the boom from the engine spools. The longitudinal sills are 14x14 in. and carry 4x10 in. oak sleds 5 ft. long under the engine and A-frame, which takes the rollers and releases them, each roller traveling but the 5 ft. instead of the length of the sill.

The erection of both the Kansas River bridge and the Highline viaduct is being done by the Kelly-Atkinson Company, as a subcontract under the Arkansas Bridge Company. The writer is in charge of the erection work. The derricks and travelers were designed by him for the contractor, while the general scheme of erection of the river spans was worked out as a part of the design of the new structure by the bridge department of the Kansas City Terminal Railway Company. G. E. Tebbetts, bridge engineer, has direct supervision of both design and construction under John V. Hanna, chief engineer for the railway.

What are Chicago's reasonable requirements as a war-material center for internal growth? This is the intent of the industrial survey which a committee of the Chicago Association of Commerce has under consideration. This investigation, which is the result of a meeting attended by engineers, bankers, architects, material dealers and others, will take up the following points: Demand for buildings, financial aspect, cost and supply of material, legislation and labor.