BRIDGES

Design Features of the East Kansas Ave. Bridge Over the Kansas River at Kansas City, Kan.

(Staff Article.)

Construction work has started on an important highway bridge over the Kansas (Kaw) River at East Kansas Ave., Kansas City, Kan., the design of which presents a number of interesting and unusual features. The requirements of the Government, and those due to the conditions existing at the site, made it difficult to meet these requirements and still keep the cost within reasonable limits. The total length of the structure is 1,635 ft. Beginning at the west end of the bridge this length is made up as follows: Concrete retaining walls and sand fill, 358 ft.; steel viaduct, 401 ft.; main deck-truss river spans, 727 ft.; and steel viaduct, 149 ft. The contract price for the bridge is $479,700, which includes the removal of the present structure.

GENERAL REQUIREMENTS.

Following the disastrous flood of 1903 the Kaw Valley Drainage District was formed for the purpose of carrying out measures to prevent damage from future floods. After much litigation and negotiations between the interests affected the Drainage Board, working in conjunction with the War Department, established harbor lines, which, for a distance of about three miles above the mouth of the river, are parallel and 724 ft. apart. Levees have been constructed on each bank, with a slope of 2 to 1 on the river side. After the construction of these levees the Drainage Board ordered the reconstruction of all bridges over this part of the river, subject to the following general requirements:

(1) There shall be only two piers in the river between harbor lines, the upstream and downstream axes of which shall be approximately parallel to the current.

(2) The shafts, or "neat-work" of the piers shall extend "as clean masonry" (with no offsets) to at least 45 ft. below the levee grade.

(3) The lowest point of the superstructure (except shoes) shall be at or above the levee grade.

A further restriction imposed by the War Department was that the two river piers must be opposite the two piers of the Rock Island bridge, which is a short distance downstream, i. e., they must be at the same distance from the harbor lines. The present bridge is to be removed as soon as the new structure is completed.

The state line between Kansas and Missouri is about 90 ft. east of the east harbor line. The St. Louis & San Francisco Railway Co. has a 50-ft. right-of-way along and parallel to the state line, 28.35 ft. of which is on the Kansas side and 21.65 ft. on the Missouri side. It was necessary to span this right-of-way, and consequently a portion of the new bridge will be in Missouri. The bridge is being constructed by Wyandotte County, Kansas, except the part which extends beyond the Kansas state line; that part will be paid for by the city of Kansas City, Mo.

From the foregoing description it will be noted that the structure being built by Wyandotte County will end "up in the air," at the east side of the Rock Island right-of-way. From this point the bridge will ultimately be continued by the city of Kansas City, Mo., across a number of railway tracks to the bluff at 23rd St., a distance of about 1,750 ft. The present Allen Ave. viaduct over these tracks near the site of the new bridge will be torn down after the completion of the new structure. As there are no funds available for the construction of the Missouri portion of the bridge, it is planned to build a temporary wooden structure on piling to connect with the Allen Ave. viaduct, a distance of about 1,000 ft., at an estimated cost of $40,000.

The combined viaduct in Kansas and Missouri was so located as to afford the most direct route practicable between the Kansas side and the new Union Station. For that reason the Kansas River bridge crosses the river at an angle of 10° 26′ with the perpendicular between harbor lines. This arrangement gives the further advantage that the heavy traffic across the river can be provided for by the present bridge until the completion of the new structure and of the temporary structure on the Missouri side.

GENERAL DESIGN FEATURES.

As the piers are set at an angle of 10° 26′ with the longitudinal axis of the bridge, and because of the requirement that they be placed opposite the piers of the Rock Island bridge, a very awkward and unsymmetrical arrangement of spans resulted, there being two spans of about 317 ft. 6 ins. each on the west side of the river, thus leaving a distance to the east harbor line of only about 120 ft. Figure 1 is a general elevation of the bridge. This drawing shows the types of structure used, and gives a profile of the site; it also shows the subsoil conditions.

The west approach begins near the intersection of Kansas Ave. and Berger Ave., about 800 ft. west of the west harbor line, at which location the Union Pacific Ry. tracks are crossed at grade, it being found practicable to raise the grade of these tracks about 2 ft. Along the west harbor line the approach spans the right-of-way of the Kansas City Southern Ry., giving a minimum clearance of 21 ft. The span used here was made very shallow to reduce the approach grade as much as practicable—to 4.25 per cent. The grade thus fixed left available space for a depth of only 25 ft. 9 ins., center to center of chords, at the west end of the west river span. As this depth was much too shallow for the long span required, the ascending grade was continued to a point 191.58 ft. east of the west harbor line, the grade being broken at three points, so as to approximate a vertical curve (see Fig. 1). From this point eastward the grade is level, the available truss depth being 30 ft., center to center of chords.

If simple truss spans had been adopted the length of the two main spans would have been about 314 ft., and the trusses would have been less than one-tenth of the span, thus necessitating very heavy chord sections. For this reason it was decided to adopt a cantilever design.

The anchor span, which has a length of 317 ft. 6 ins., rests on the two river piers, and has a cantilever arm projecting from it at each end to receive the ends of the simple spans (see Fig. 1). The west cantilever arm has a length of 58 ft. for the north truss and 48 ft. for the south truss. The east cantilever arm is 95 ft. long for the north truss and 88 ft. long for the south truss. The north truss of the west simple span has a length of 262 ft. 6⅛ ins., while the south truss has a length of 267 ft. 4⅛ ins. The east suspended span is a plate girder type, the north girder having a length of 88 ft. 6¼ ins. and the south girder a length of 100 ft. 8¼ ins.

The lengths of the cantilever arms were so chosen as to make the negative moments over the supports and the positive moments at the center of the anchor span approximately equal. Another advantage of the cantilever design is that no pier is required at the east harbor line, the suspended plate girder span extending over the right-of-way of the A., T. & S. F. Ry. and that of the C., B. & Q. Ry. and resting on columns supported on small piers having pile foundations. A further advantage is secured by the use of a cantilever system, namely, the required width of piers is less than would be required with simple spans, as only one shoe is required under each truss.

The bridge carries two street railway tracks, one of which is bracketed from the north trusses, while the other is located at an equal distance inside of these trusses; it also provides a 36-ft. clear roadway (10 ft. 2 ins., of which cantilevers beyond the south trusses), and a 6-ft. sidewalk along the south side of the structure. The sidewalk does not extend throughout the west approach, but is carried to the street level in front of the Cudahy Packing Co.'s plant by means of a stairway (see Fig. 1).

The trusses and the east approach girders are spaced 38 ft. on centers to secure economy in the cross girders and piers. The trusses are so located that the total load on each is approximately the same. Due to the unsymmetrical cross section the dead load on the south, or highway, truss is much greater than that on the north, or street railway, truss; the reverse is true of the live loads.

On account of the long cantilever brackets at each side the deck is loaded differently for each truss. The deflections of the trusses, which are considerable (due to the shallow trusses and to the cantilever construction), are quite different; and it was therefore deemed advisable to omit sway bracing except at the piers. The trusses are of the cantilever type,

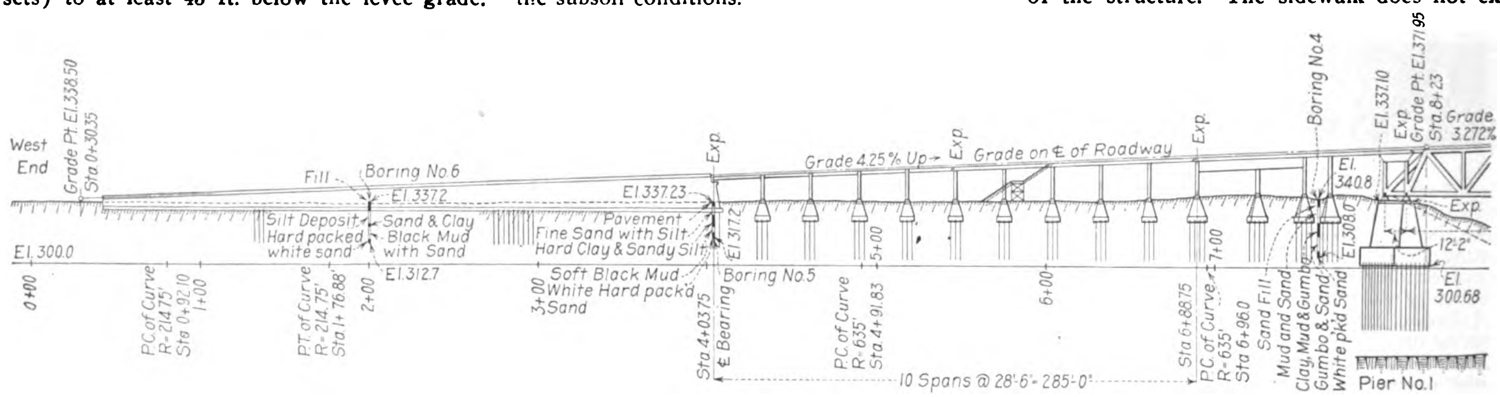


Fig. 1. General Elevation of East Kansas Ave. Bridge, Kansas City, Kan.

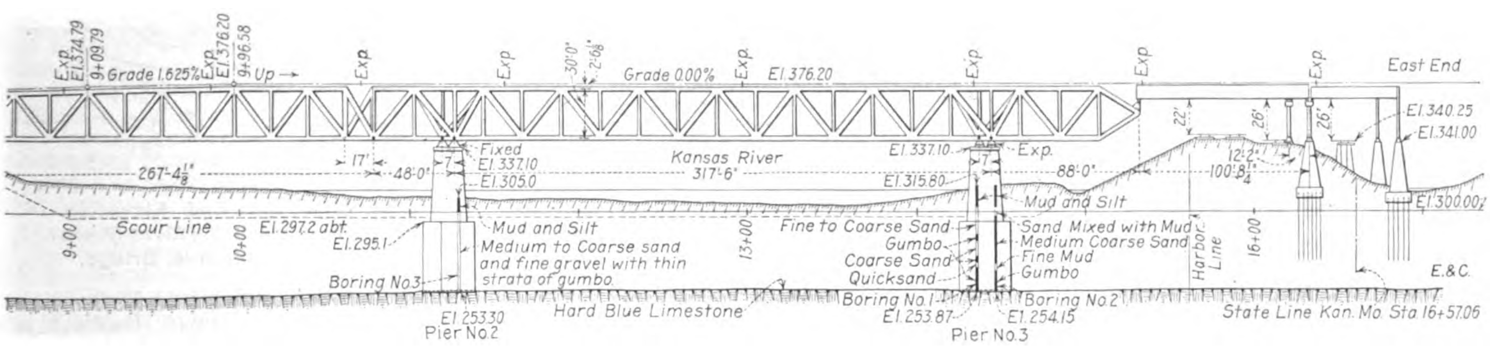
and are riveted throughout. The chords are spliced for 110 per cent of the strength of the sections, with the exception of the top chord splices in the west suspended span, which are spliced for the live and impact loads only.

The roadway will be paved with creosoted wood blocks, the pavement on the steel spans resting on a reinforced concrete base. The sidewalk also will be of reinforced concrete construction. The street railway tracks on the steel portion of the structure will have open decks of creosoted timber. There will be two lines of heavy gas pipe railing throughout the structure and on both sides of the stairway. Since the roadway slab is of reinforced concrete it was necessary to provide a number of expansion joints in the floor for each span.

SUBSOIL CONDITIONS AND FOUNDATIONS.

The subsoil under the retaining walls of the west approach, as shown by borings, consists mainly of successive strata of: silt deposit; sand mixed with clay, fairly well packed; black mud containing some sand; and white sand, packed hard, the latter being encountered at a depth of from 20 to 25 ft. Near pier No. 1 (see Fig. 1) the top surface consists of a thin layer of sand, followed by successive strata of partial fill, with mud and sand; soft yellow clay, changing to mud and gumbo; gumbo mixed with sand; and white sand, the latter being found at a depth of about 30 ft. The depth to rock at pier No. 1 is about 90 ft. At pier No. 2 rock lies at a depth of about 48 ft. below the bed of the river. At the location of this pier, mud and silt are found to a depth of about 5 ft.; from this level to the rock surface the material consists of medium to very coarse sand and fine gravel, with occasional thin strata of gumbo. At pier No. 3 the depth to rock is about 62 ft. At this pier, mud and silt are found to a depth of about 14 ft., followed by medium to coarse sand to a depth of about 52 ft.; below this level there is a comparatively thin layer of fine gravel and quicksand, between which and the rock there is a stratum of gumbo.

The pedestals and retaining walls of the west approach are to be founded on concrete piles, while the four pedestals at the east end will have timber pile foundations. Pier No. 1 will be founded on timber piles and piers Nos. 2 and 3 (see Fig. 1) are to be sunk to bedrock by the pneumatic process.



Showing Types of Structure and Subsoil Conditions.

LOADS AND ALLOWABLE STRESSES.

Loads.—The assumed live load on the two street car tracks consisted of two 50-ton cars on each track, or a continuous line of 40-ton cars on each track. In the 50-ton cars the axles of the front and also of the rear trucks are spaced 6 ft. 6 ins. on centers, the trucks of each car being spaced 31 ft. 6 ins. on centers, while distance between the center of the rear truck and the center of the front truck of the car following is 22 ft. 6 ins. In the 40-ton cars the axles of both trucks are spaced 6 ft. on centers, the distance between the centers of trucks on the same car is 26 ft. and that between the centers of front and rear trucks of adjacent cars 20 ft. The axle loads of each car of each class are equal.

For the roadway floor system the assumed live load was either a 20-ton road roller or a uniform load (the one which gave the larger stresses), the latter being expressed by the formula,

$$w_1 = \frac{79{,}200}{720 + L}$$

where w_1 = uniform load per square foot, and L = span in feet.

The road roller has 16,000 lbs. concentrated on the front drum, which is 4 ft. wide, and 24,000 lbs. on the two rear wheels, the latter having a width of 20 ins. and a capacity of 5 ft. on centers.

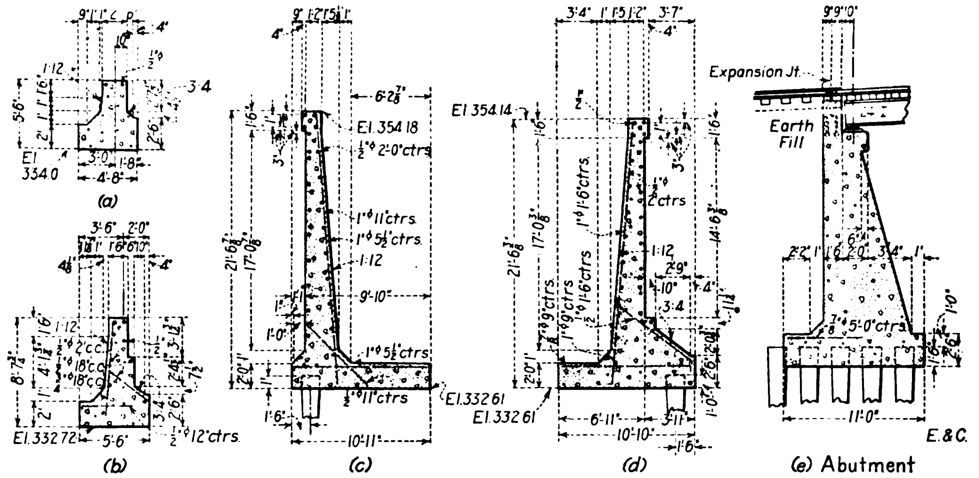


Fig. 2. Cross Sections Showing Types of Retaining Walls and Abutment Used in West Approach of East Kansas Ave. Bridge.

In designing the floor system of the sidewalk the assumed uniform load was w_1, given above. For computing the stresses in girders, trusses and columns, the sidewalk load used is expressed by the formula,

$$w_2 = \frac{68{,}400}{720 + L},$$

where w_2 = uniform load per square foot, and L = span in feet.

The impact increment is expressed by the formula,

$$I = \frac{300}{800 + L + \frac{L^2}{10}},$$

where I = impact increment, and L = loaded length in feet.

No impact was considered for the roller loading.

The dead load used was the actual weight of the materials in the structure.

The wind load was taken at 30 lbs. per square foot of exposed vertical area plus 300 lbs. per linear foot on the upper deck, the entire wind load being treated as a moving load.

Allowable Stresses.—The following allowable stresses were used in designing the sections:

	Lbs. per sq. in.
Tensile stresses:	
Bottom chords and main diagonals, built sections	16,000
Floorbeam hangers, built sections	12,000
Laterals	17,000
Flanges of floorbeams, stringers and plate girders (considering one-eighth of gross area of web as effective flange area)	16,000
Reinforcing bars	16,000
Compressive stresses:	
Chord sections	$16{,}000 - 70\frac{l}{r}$
Vertical posts of trusses	$14{,}000 - 60\frac{l}{r}$
Compression in extreme fiber of reinforced concrete members	650
Shearing stresses:	
Webs of plate girders, gross section	10,000
Shop rivets	10,000
Field rivets	8,000
Bending stresses:	
Extreme fiber for rolled sections of medium steel	16,000
Extreme fiber of pins	24,000
Extreme fiber of creosoted timber	1,600
Bearing stresses:	
Shop rivets	20,000
Field rivets	16,000
Pins	20,000

In considering reversals of stress, the following procedure was specified: Compute the required area for both tension and compression and add one-half of the lesser area to the greater, except for web members of trusses, for which use three-fourths instead of one-half. The rivets for end constructions and splices are to be computed in a similar manner.

For compression members of trusses the maximum value of $\frac{l}{r}$ was taken as 100, except for laterals and members whose main function is to resist tensile stresses; in such members $\frac{l}{r}$ was taken as 1.40.

RETAINING WALL DETAILS.

The reinforced concrete cantilever type of retaining wall was adopted, the heights of which vary from 5 ft. 6 ins. at the west end to 21 ft. 6 ins. at the beginning of the steel viaduct (see Fig. 1). These walls are to be founded on reinforced concrete piles. Figs. 2 (a), (b), (c) and (d) are cross sections of the retaining walls taken at various points. Fig. 2 (a) shows the type of retaining wall used at the west end of the approach; Fig. 2 (d) is a cross section of the wall near the abutment at the east end of the retaining wall approach, and Fig. 2 (e) is a cross section of the abutment. The concrete specified for all retaining walls consists of 1 part cement, 3 parts sand and 5 parts broken stone.

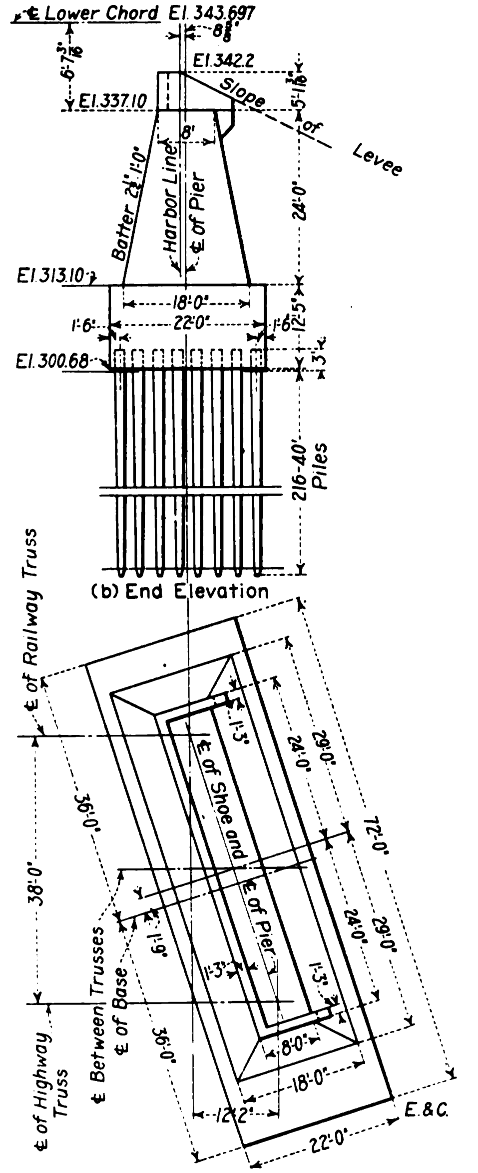


Fig. 3. Plan and End Elevation of Pier No. (at West Harbor Line) of East Kansas Ave. Bridge.

SUBSTRUCTURE DETAILS.

Piers for Steel Viaduct.—The concrete piers for the steel viaduct of the west approach are to be founded on 24-ft. reinforced concrete piles, the number of piles in each pier being either, 9, 12 or 16. Where 9 piles are used the pier footings are 9 ft. square by 3 ft. thick; while the pier shafts are 7 ft. 9⅝ ins. square at the base and 3 ft. square at the top, their height varying from 10 to 16 ft. Where 12 piles are used, the footings are 9× 12 ft. × 3 ft. thick, the top and bottom dimensions of the pier shaft being the same as for the 9-pile piers. For the 16-pile piers the footings are 12 × 12 ft. × 3 ft. 9 ins. thick, while the pier shafts are 6 ft. 8⅛ ins. square at the bottom, 3 ft. square at the top and 12 ft. 3 ins. high. The piers are to be constructed of 1:3:5 concrete, with the exception of the top 1 ft. of the pier shafts, where a 1:2:4 mix is to be used.

The two piers at the east end of the bridge (see Fig. 1) are each to be founded on twenty-five 40-ft. timber piles. The footings of these piers are 15 ft. × 15 ft. × 6 ft. thick, while the pier shafts are 10 ft. 9 ins. square at the bottom, 4 ft. square at the top, and have a height of 27 ft. With the exception of the upper 1 ft. of these piers (where a 1:2:4 mix is to be used), the concrete proportions are to be 1 part cement, 3 parts sand and 5 parts broken stone.

The two pier shafts between those at the east end of the structure and pier No. 3 (see Fig. 1) are each to be supported on 30 timber piles. Their footings are 15 × 16 ft. × 16 ft. high, while the pier shafts are 10 ft. 3 ins. × 11 ft. 3 ins. at the base, 4 ft. 6 ins. × 3 ft. 6 ins. at the top, and 27 ft. high.

Piers for Truss Spans.—Pier No. 1, which is located at the west harbor line (see Fig. 1), is to be founded on 216 40-ft. timber piles. The footing of this pier is 22 × 72 ft. × 12 ft. 6 ins. thick, while the pier shaft, which is 18 × 58 ft. at the base and 8 × 48 ft. at the top, is 24 ft. high. An 18-in. parapet wall extends 5 ft. 1 3/16 ins. above the pier shaft. The parapet wall and the upper 2 ft. of the pier shaft are to be composed of 1:2:4 concrete, while a 1:3:5 mix is to be used for the remainder of the pier. Fig. 3 shows a plan and an end elevation of this pier.

The two river piers (Nos. 2 and 3, see Fig. 1) are to have pneumatic caisson and crib foundations, the tops of which are to be about 2 ft. below the scour line of the river bed. For pier No. 2 the caisson and crib is 20 × 60 ft. × 43 ft. 4 ins. high, while for pier No. 3 the caisson has the same section but is 42 ft. 6 ins. high. The caissons are to be founded on solid rock, into which they are to project about 18 ins. The pier shafts of these piers have semi-circular ends, while the sides and ends of the shafts have a batter of ½ in. in 1 ft. Fig. 4 shows a plan and end elevation of these piers and their caissons.

SUPERSTRUCTURE DETAILS.

West Approach.—Starting at the east end of the retaining wall construction, the west approach consists of a series of ten 28-ft. 6-in. spans, followed by four spans of irregular lengths (see Fig. 1). The floorbeams of these 28-ft. 6-in. spans are supported directly on steel columns, the 24-in. I-beam stringers spanning the spaces between the floor beams. The columns are braced together in pairs, to form bents, and are anchored to the concrete piers with four anchor bolts, each 2 ins. in diameter and 8 ft. long.

East Approach.—The east approach consists of two deck plate girder spans, as shown in Fig. 1. One end of the longer of these two spans rests on the cantilever arm of the adjacent truss span, while the other end rests on a steel bent, which in turn is supported on concrete piers. The girders in the longer span are of unequal lengths, one having a length of 99 ft. 10½ ins. and the other 87 ft. 8½ ins., center to center of bearings. The girders in

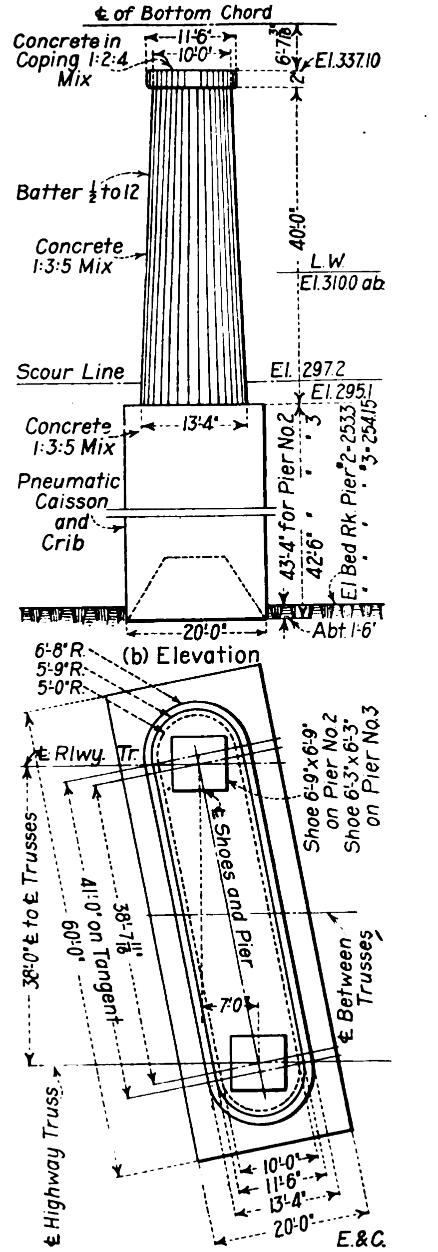


Fig. 4. Plan and End Elevation of Piers Nos. 2 and 3 (River Piers) of East Kansas Ave. Bridge.

the east span have a length of 52 ft. 2¾ ins., center to center of bearings. Figure 6 is a cross section of the floor system of these girder spans. This drawing gives the details of the floor system and shows the relative positions of the sidewalk, roadway and street car tracks.

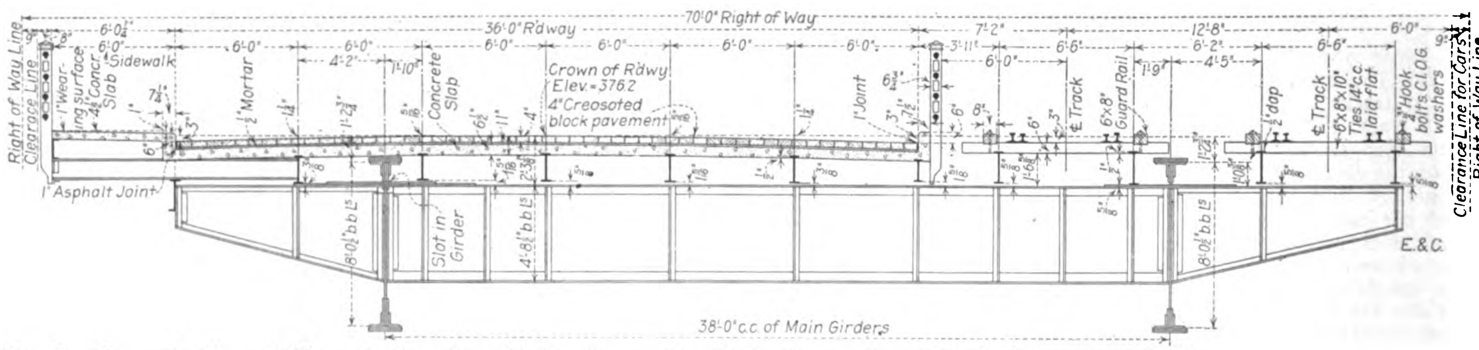


Fig. 5. Cross Section of Floor System for Girder Spans in East Approach of East Kansas Ave. Bridge.

Truss Spans.—The types of riveted truss spans used are shown in Fig. 1. It will be noted that the anchor span, which rests on piers Nos. 2 and 3, cantilevers beyond both piers. The trusses of this span have a depth, center to center of chords, of 30 ft., the spacing of trusses being 38 ft., center to center.

The floorbeams and cantilever brackets, which support that part of the floor system extending outside of the trusses, have their tops

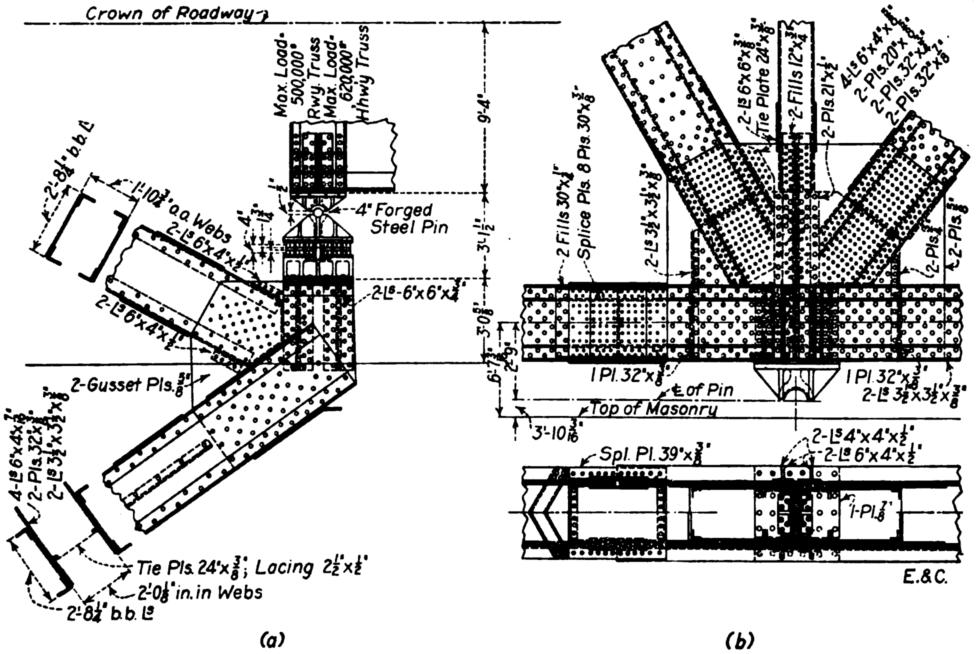


Fig. 6. (a) Detail of Connection Between East Cantilever Arm of North Truss Span and Approach Girder; (b) Detail of Lower Chord Joint at Pier No. 2 of North Truss of East Kansas Ave. Bridge.

at the elevation of the top chords of the trusses. The stringers frame into the floorbeams, projecting above the tops of the latter from ½ in. to 5¼ ins., depending on their position in the floor system. This position of the stringers requires a different detail for supporting the sidewalk from that used on the girder spans. With the exception of these points the floor system for the trusses is similar to that shown in Fig. 5.

Figure 6 (a) is a detail of the lower chord joint over the bearing at pier No. 2; and Fig. 6 (b) is a detail of the connection between the east cantilever arm of the anchor span and the adjacent girder span.

Figure 7 is a detail of one of the shoes at the expansion end of the anchor span, these shoes resting on pier No. 3 (see Fig. 1). The drawing also shows details of the 10-in. segmental rollers.

The details of the floor system and shoes of the simple span between piers Nos. 1 and 2 are similar to those shown for the anchor span. The feature of the simple span is that the trusses have different depths at the two ends, due to changes in grade.

PERSONNEL.

The plans and specifications for the bridge were prepared by Hedrick & Cochrane, consulting engineers, Kansas City, Mo., to whom we are indebted for the data upon which this article is based. The work is being done under the direction of R. L. McAlpine, county engineer of Wyandotte County, Kan. The Kansas City Structural Steel Co. has the general contract for the structure. The construction of the three main piers has been sublet to the Missouri Valley Bridge & Iron Co., and the remainder of the substructure to the Horton Construction Co.

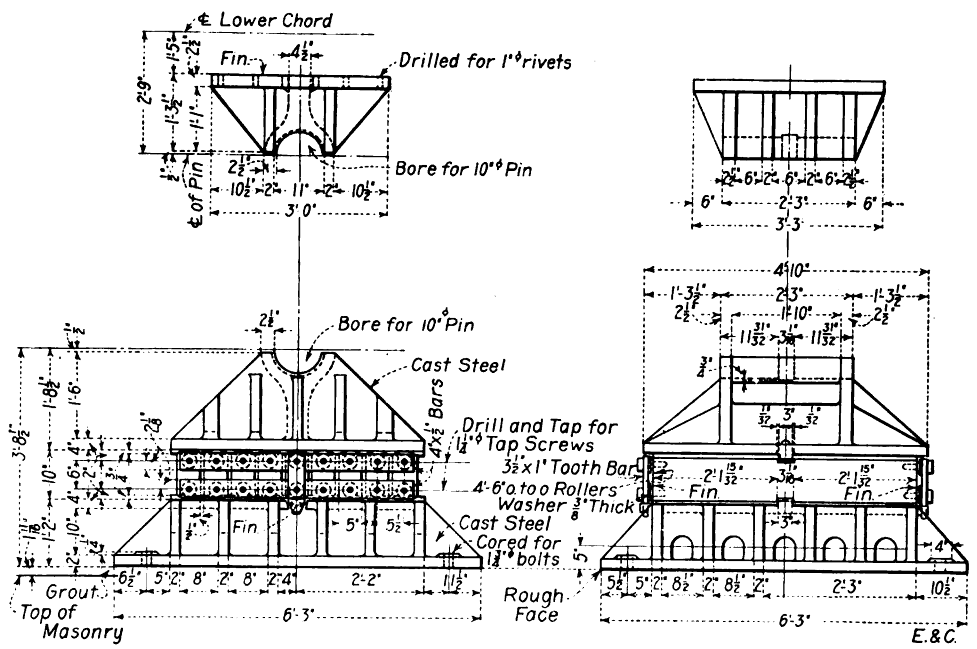


Fig. 7. Details of Roller Shoes for Truss Span at Pier No. 2 of East Kansas Ave. Bridge.

The city treasury of Vancouver, B. C., will feel the effect of the reduction of travel over the street car lines, resulting from the growth of the jitney bus traffic. It is said that the city's revenue from the street car lines will be decreased this year about $30,000.

The Use and Care of Lifting Jacks.

The following instructions in the use and care of lifting jacks were issued by the engineering and inspection division of The Travelers Insurance Co. of Hartford, Conn.:

The demands of modern construction and transportation for portable mechanical appliances for raising and supporting heavy weights are adequately supplied by the lifting jacks of various types that are now so commonly employed. Screw jacks and reduction-gear jacks are capable of lifting loads up to 20 tons or so, while pneumatic jacks, and those operated by hydraulic power, range in capacity from a few hundred pounds up to 500 tons.

Because of the enormous weights sustained by lifting jacks, it is essential that all possible precautions be taken to insure their proper use and maintenance, so that accidents may be avoided.

In some operations, and notably in track repair, unskilled labor is employed, and workmen of this class cannot be depended upon to exercise the best judgment in the use of jacks. A competent man should be in charge of the work so that by his advice and under his direction the safety of the workmen may receive due consideration.

The first procedure toward safety in the use of jacks is frequent and thorough inspection of the mechanical parts. Particular attention should be given to the racks and reduction gears, in jacks of this type, for a defect in one of these parts is apt to cause an accident. A broken, excessively worn, or otherwise defective gear or rack tooth may give way as pressure is applied on the handle, thus causing the operator to fall headlong. A broken or defective tooth, when it gives way, permits the total weight being lifted to fall until the next firm tooth is engaged, and the shock or pounding effect on this tooth may be sufficient to fracture it also. The remaining teeth are then apt to give way in a similar manner, thus permitting the load to fall to its original resting place. When such a break occurs during the raising of a railway coach or trolley car, the short interval of time that elapses between the breaking of the first tooth and the fall of the car affords little opportunity for the workmen to reach a safe place.

The top of the jack and the rack column should be frequently inspected and tested, for a defect in one of these sections would precipitate the whole load without any warning. Some jacks are equipped with a swivel claw attached to the jack by a ball-and-socket joint. This permits the use of the jack in close quarters, and low headroom. It is important that both the joint and the claw be in first class condition, as they are both likely to be subjected to extra stresses by reason of the fact that the claw can swing in a vertical angle of 30 to 40° from the frame. A claw that has a safe lifting capacity of 20 tons in a vertical plane, is very apt to be stressed beyond the safe limit if the same weight is applied at a 30° angle, and for this reason the manufacturers generally will not guarantee the full capacity of the jack when the load is applied on the claw at a vertical angle greater than 15°. Notwithstanding this fact jacks are often abused in this way, so that accidents frequently occur.

Even when this caution is kept in mind, it is very important to see that the base of the jack has a firm bearing surface. This is best accomplished by inserting a wedge between the ground and the bottom of the jack. If the workmen are thoroughly impressed with the importance of a full bearing surface on the bottom of the jack, and a wedge is provided which will not give a full bearing surface when the claw is swung more than 15° from the frame, reasonably safe practice may be expected.

Wood Preservers' Convention

The twelfth annual convention of the American Wood Preservers Association, with its large attendance and an active discussion of its long list of papers, was indicative of the growing importance of the wood-preserving industry in this country, as well as of the rapid growth of the association. The meeting was held at the Sherman Hotel, Chicago, Jan. 18 to 20.

In addition to the regular papers and committee reports there were two addresses of special interest—one by J. W. Kendrick, formerly vice-president of the Atchison, Topeka & Santa Fe Ry. and now a consulting railway expert; the other by F. H. Newell, professor of civil engineering at the University of Illinois (and formerly Director of the United States Reclamation Service).

As president for the ensuing year the association elected Carl G. Crawford, general manager American Creosoting Co. (of Chicago), Louisville, Ky. John Foley, forester, Pennsylvania R.R., Philadelphia, was elected first vice-president, and F. J. Angier, Mt. Royal Station, Baltimore, Md., was reëlected secretary-treasurer. The next meeting will be held in New York City.

Preservation and Specifications

The foreign creosote-oil situation was discussed by G. A. Lembcke. About 35,000,000 gal. of oil was imported from Great Britain, the embargo on this material being raised and aid extended to the distillers to get ships for their accumulating stocks. A total of about 43,000,000 gal. was imported in 1914 and 60,000,000 gal. in 1913.

The Committee on Specifications for the Purchase and Preservation of Timber presented a code that placed restrictions on knots, shakes, checks, cross-grain, density, sapwood, etc., in purchased timber, defined desirable seasoning for various woods, recommended permitting use of lower grades of oil under present conditions, gave general specifications for full-cell, empty-cell, zinc chloride, zinc-creosote and tar-creosote processes.

A special Committee on Preservative for Paving Blocks gave specifications for testing coal-gas and coke-oven derivatives, which are required to be of 1.06 to 1.12 sp.gr. at 38° C. and not over 3% insoluble in benzol and chloroform.

Fixing the quantity of zinc chloride per cubic foot of timber was called unscientific by W. F. Goltra, who proposed specifying 3.5° Bé. strength of solution at 70° F. for all species of wood and all kinds of ties. This is to be injected to refusal.

Ties and Paving Blocks

Woods suitable for crossties were classified by R. Van Metre according to a scheme based on combined mechanical properties—static and impact bending, compression parallel to grain and perpendicular to grain, side and end hardness.

The Committee on Wood-Block Paving submitted specification for wood blocks and their laying. The size, treatment, inspection, foundation, joint filler, expansion joint and method of placing the blocks are restricted.

A paper on treated-block factory floors, by C. H. Teesdale, gave the results of two mail investigations. The first covered manufacturers; 13 replied to the letters. The consensus of opinion was to use a distillate creosote except for wet situations, for which heavier half-tar compound was recommended. For ordinary work, light absorptions (5 to 10 lb. per cu.ft.) were generally used. Most plants desired air-dried material, and only a few steamed the timber. Most of those replying preferred a concrete base and bituminous filler.

From the users 160 replies were secured, and these were tabulated. In general 3-in. Southern yellow-pine blocks were treated with 15 lb. of oil per cubic foot and laid on a sand cushion with bituminous joint filler. Use of expansion joints depended on local conditions.

An investigation of municipal practice with wood-block pavements was reported by F. W. Cherrington. From 155 letters to cities 79 replies were received. The data were tabulated. In only very few cases was the sand or mortar cushion eliminated or a cement-grout joint filler used. The favored cushion was equally divided between sand and mortar. Heavy creosote was the most popular preservative—16 lb. per cu.ft.

Service Tests; Miscellaneous Papers

The Committee on Service Tests of Bridge and Structural Timber handed in the specifications of the Illinois Central R.R., the Norfolk & Western Ry. and the United States War Department for creosoted piling and timber. Records were tabulated of bridge and structural timber used by several railroads.

The most important part of the report of the Committee on Service Tests of Crossties was a compilation of 1,200 records of treated and untreated ties—made by C. P. Winslow and C. H. Teesdale, of the United States Forest Products Laboratory, Madison, Wis.

A paper by O. P. M. Goss showed how Douglas fir was being treated satisfactorily by (1) heating in oil to 190° for 5 hr., (2) boiling at 190° and 27-in. vacuum for 16 hr. and (3) finishing under pressure of 135 lb. per sq.in. for 6 hr. By this scheme 10 to 14 lb. of oil per cubic foot can be forced in. Tests of two shipments of bridge stringers, as to modulus of rupture, fibre stress at elastic limit and modulus of elasticity, showed results very close together for treated and natural sticks.

Bridge Falsework Washed Out; Kansas City, Mo.

A 2½-in. rainfall, over a short period, caused most of the falsework under the west span of the East Kansas Ave. highway bridge over the Kansas River, Kansas City, to be washed out or pushed out by ice on Jan. 21. The north truss of the west span had been erected and bolted for five panels beyond the pin (or for 65 ft. west of pier 2) and rested on six bents of falsework when the sudden rise came. Four of the bents were washed out. The south truss of the west span is erected four panels beyond the pin (or for 48 ft. west of pier 2) and rested on four falsework bents, which washed out. The west end of the unsupported truss was lowered 9 ft., coming to rest on a partly constructed 1-panel bent. A few pin plates and some lateral members were bent; but according to a report from the job, no main truss members were damaged. Repairs should not exceed $1,000 or $2,000. The river had fallen 5 ft. on Jan. 22.

This crossing over the Kansas River is 1,635 ft. long and consists of the following elements, beginning at the west end: Concrete retaining walls and sand-fill, 358 ft.; steel viaduct, 401 ft.; main deck-truss river spans, 727 ft.; steel viaduct, 149 ft. The contract price, which included the cost of removing an existing structure, was $479,700. The west span is 267 ft. long, while the length of the east span is 317 ft. exclusive of a cantilever at each end—58 ft. on the west end of the north truss and 45 ft. on the south truss; 95 ft. on the east end of the north truss and 88 ft. on the south truss. The east span, with the cantilever ends, has been erected and riveted.

The bridge is designed to carry two street-railway tracks, one of which will be bracketed from the north trusses, while the other will be laid inside the trusses. There will also be a 36-ft. clear roadway and a 6-ft. sidewalk along the south side of the structure.

The plans and specifications of the bridge were prepared by Hedrick & Cochrane, Kansas City. The work is being done under the direction of R. L. McAlpine, County Engineer of Wyandotte County, Kansas. The general contractor is the Kansas City Structural Steel Co.

Rain and Flood Conditions

A remarkably heavy rainfall occurred in Los Angeles and vicinity during the six days ending Jan. 20, giving rise to serious flood conditions. There were also flood conditions in a number of other parts of the country at about the same time. Local records of the storm in southern California, as given in a table published in the Los Angeles *Times* of Jan. 19, show that the highest precipitations were 4.79 in. at Monrovia and 4.47 in. at Pomona. The Los Angeles figures, as reported to *Engineering News* by the United States Weather Bureau from Washington, showed a total of 7.14 in. in the six days ending Jan. 20, distributed as follows: Jan. 14, 0.30 in.; 15, 0.60; 16, 0.36; 17, 4.06; 18, 1.40; 19, 0.60; 20, 0.32. The Los Angeles *Times* record already mentioned gave a total rainfall for the storm (up to Jan. 19) of 14.73 in. at Upland, 11.51 in. at Monrovia, 10.37 in. at Sierra Madre and 9.07 in. at Pomona, and from this down to 0.97 in. at El Centro in the Imperial valley. The rainfall record for the season throughout this whole southern California district was in most instances far in excess of that for last season.

The floods caused by the storms in southern California resulted in apparently heavy damages to railroads, bridges, country roads and city streets, the latter more particularly at Pomona. There was also much damage to land under cultivation. A dam was reported washed out near Pomona. Apparently it was a small structure. Large quantities of silt were carried into the Los Angeles harbor.

A part of the Colorado River levee near Yuma is reported to have been washed out early in the week of Jan. 23 with a resulting flood in Yuma. There was also an unverified report of the carrying away of the headgate in the irrigation canal leading from the Colorado River to the Imperial Valley. Farther north than California much trouble was reported from heavy rains.

At Chicago a rainfall of 2 in. on Jan. 19 to 21 (0.06, 1.04, and 1.90 in.) was reported. At this time, the Weather Bureau states, there was a layer of 3 to 6 in. of snow on the upper and middle parts of the Illinois River drainage area. On the day of heaviest rainfall the temperature was 50° F. This combination of rain and snow threatened to reverse the flow of the Chicago River and the drainage canal and imperil the water-supply of Chicago. Warnings to boil the water were given. The effect of the rain and melting snow conveyed through the Des Plaines River raised the Illinois River at Peoria 10 ft. above flood stage on Jan. 21, although only 0.52 in. of rain fell at Peoria in the three days ending with that date.

High water and ice at Kansas City, Mo., last week damaged a bridge under construction there, as reported elsewhere in these news pages. The Ohio and Mississippi Rivers were also reported in flood at various points last week, and flood stages were predicted on the Arkansas.

Estimates for a New Water-Supply Conduit for Seattle, Wash., are to be made by A. H. Dimock, City Engineer, in compliance with a unanimous vote of the city council on Jan. 17. Apparently parts of the conduit are to be of steel and other parts of concrete. It is to extend from the present Cedar River intake at Landsburg to the city. Each of the present two wood-stave pipe conduits is about 30 mi. long. A break in one of them occurred a few weeks ago, as noted in "Engineering News," Jan. 20, 1916, p. 141. In Mr. Dimock's annual report for 1915, made just before he received the instructions here noted, he recommended (1) the building of two dams about 20 ft. high to raise the level of Swan Lake and impound a four to five months' supply for Seattle and (2) the enlargement of the present Volunteer Park and Lincoln Park storage reservoirs and the construction of a rservoir and standpipes in West Stattle, which is now dependent upon a single pipe line for its supply. Ultimately, Mr. Dimock stated in this report, a third conduit with a capacity of 100,000,000 to 150,000,000 gal. should be built—the larger part of steel and the remainder of concrete. Evidently the city council prefers to reverse the order of Mr. Dimock's program, or to ignore part of it entirely. The Swan Lake storage plan would be independent of the present source of supply, but would connect with the existing conduits until a new one was built.

More Memphis Bridge Falsework Washed Out—Seven more bents of falsework under the cantilever arm of the Harahan Bridge at Memphis, Tenn., were carried away, two of them shortly after the accident of Dec. 23 (described in "Engineering News," Jan. 6, 1916, p. 43), five more several days later. Several tons of temporary steel was lost. No damage was done to any of the permanent construction, as the lower chord of the cantilever arm, extending out from Pier 3 and temporarily supported by the bents that were carried away, had been held guyed back to the fixed span (completed) by steel cables. The last failure is attributed to the wash of packets coming along the Arkansas shore, as there was practically no current on this side. It is believed that the danger to the bridge is now at an end.

Settling the Spokane Bridge Damages—Conferences are being held between city officials of Spokane, Wash., and the Washington Water Power Co., jointly interested in the Division St. bridge, which recently collapsed, to settle the victims' claims for damages. This legal work is delaying determination of the engineering questions involved. The claims are said to aggregate over $400,000, but officials think they can be settled by compromise for less than one-fourth as much. A press account says: "The first step necessary is to bring the city and the power company together, after which overtures looking to a compromise can be taken up with the claimants. Where compromises cannot be worked out, the plan is to have the city and the company jointly fight the cases through the courts."

PERSONALS

Mr. Thomas Swithin has been appointed Commissioner of Public Works of Quincy, Mass.

Mr. Francis J. Brennan has been appointed Street Commissioner of Boston, to fill the vacancy caused by the death of the late Salem D. Charles.

Mr. Henry G. Vollmer, Assoc. M. Am. Soc. C. E., City Engineer of Burlington, Iowa, has been chosen as the first City Manager of Webster City, Iowa, by the city council.

Mr. Maynard D. Church, M. Am. Soc. M. E., formerly Chief Engineer of the Dayton Turbine Pump Co., Cleveland, Ohio, is now Chief Engineer of the Terry Steam Turbine Co., Hartford, Conn.

ment will be provided to perfect further the facilities of the library for the use of engineers.

The present house of the civil engineers in West 57th St. has been appraised by experts at $325,000, of which, however, $290,000 is in the land and only $35,000 in the building, which has cost the society about $175,000. By the sale of its present property, the society could pay all the cost of its entrance to the Engineering Societies' Building, would have between $115,000 and $140,000 in its treasury and would own in addition an interest in the Engineering Societies' Building, valued at about half a million dollars.

In addition to the financial and business aspects of the proposition the Board of Direction remarks: "It is one of the purposes of this movement to strengthen the bonds of brotherhood which should exist between all engineers."

Further Notes on Kansas River Bridge Falsework Collapse

The accompanying photographs show the extent of the damage to the East Kansas Ave. bridge over the Kansas River at Kansas City, Mo. As reported in last week's issue of *Engineering News,* high water and floating ice pushed out some of the falsework bents under the suspended trusses of the bridge on Jan. 21.

The bridge was erected from the Missouri side (the far side in the views) and had been completed to the end of the cantilever arm on the Kansas side. The first three panels of the Kansas shore span had been partly erected on rather light separate pile bents under each truss when the ice flow carried away all but the two end bents, which were nearly at the shore line.

The north truss (on the left, Fig. 1) had been practically all assembled to its bent, which held sufficiently to prevent any visible damage to this truss; but the south truss had only the lower chord member resting on the falsework. This dropped 7 or 8 ft., eventually coming to rest on the two inner piles of the bent, the cap being

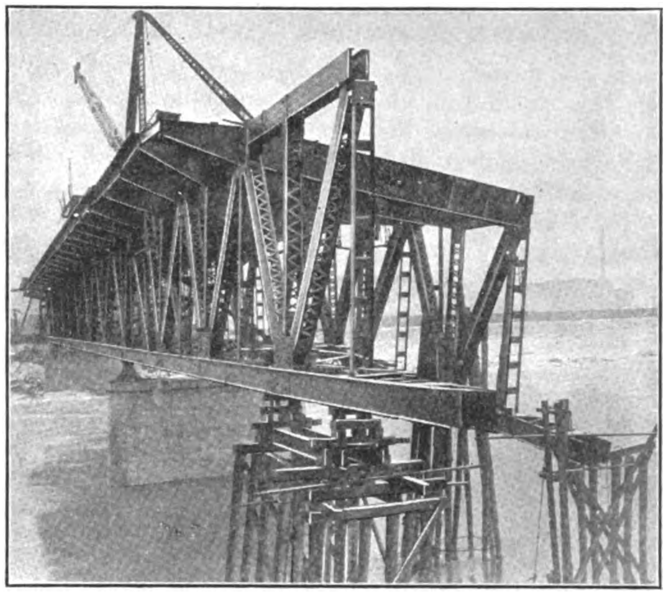


FIG. 1. KANSAS AVE. BRIDGE AFTER WASHOUT OF FALSEWORK
Looking toward Missouri shore. North truss on left

raised from the tops of the other three piles as shown in the views. The fall of the south truss caused the loss of six stringers and a 50-ton jack, which were on the superstructure, sheared off several pin plates and badly twisted the end floor-beam and crossbracing of the two end panels. These members had not been riveted, or the damage would have been greater, as the structure dropped by shearing off the bolt heads and breaking of pin plates without distorting many of the main members.

For the week following the collapse, rain and freezing weather made it impossible to work on the structure, and to Jan. 27 nothing had been done save to assemble some groups of piles under the distorted truss. The contractor proposes to drive groups of piles under this truss, cap them and bring the truss back into line by jacks.

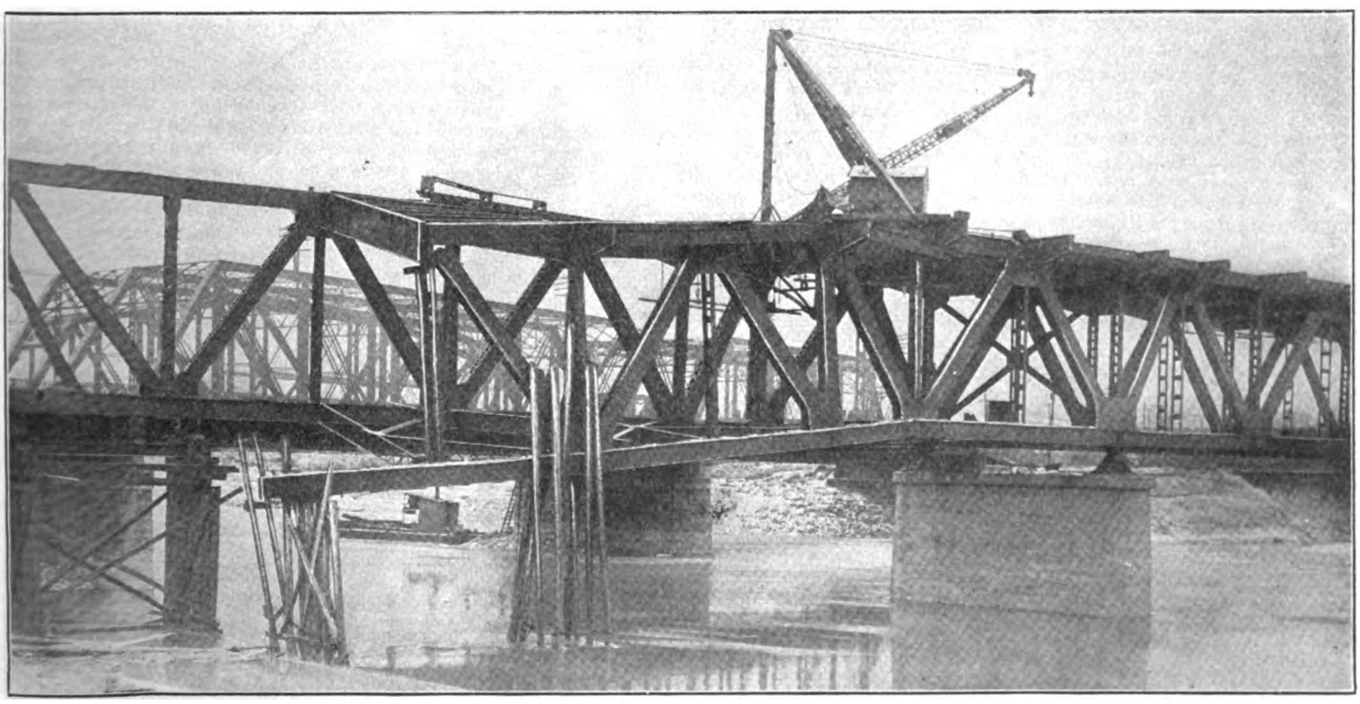


FIG. 2. LOOKING NORTHERLY TOWARD KANSAS AVE. BRIDGE AT KANSAS CITY