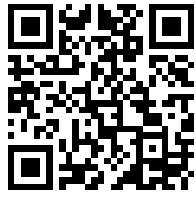
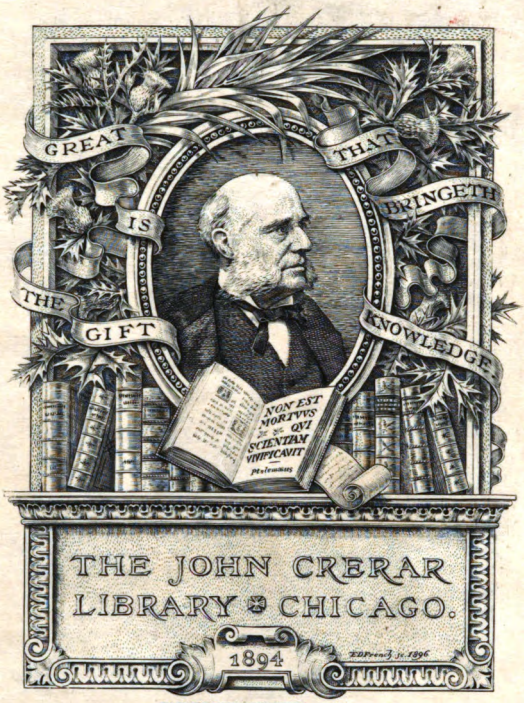




PRESENTED BY

St. Louis Public Library

THE MUNICIPAL BRIDGE OF ST. LOUIS:

A Record of Municipal Effort

BY

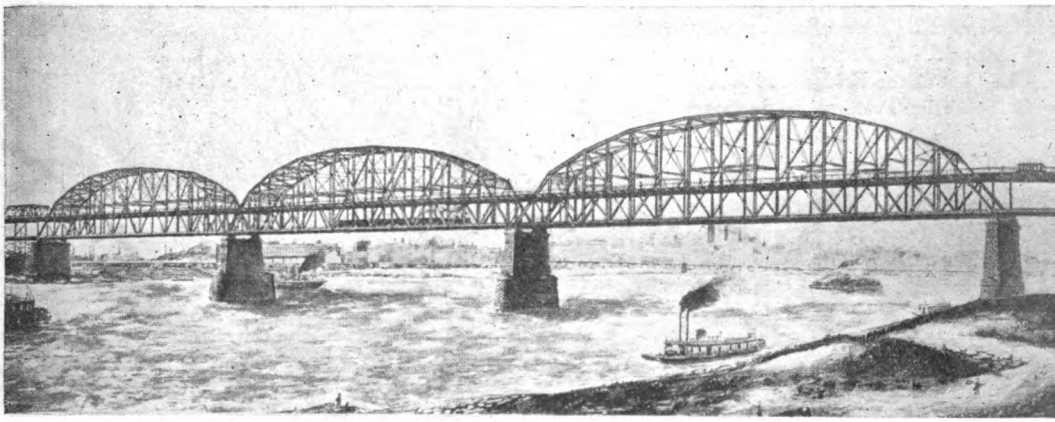
WILLIAM E. ROLFE,

Associate to the President of the Board of Public Service, St. Louis,

AND

LUCIUS H. CANNON,

Librarian, Municipal Reference Library.



ST. LOUIS PUBLIC LIBRARY

AUGUST, 1922.

Price, 15 Cents

TABLE OF CONTENTS.

APPENDICES.

INTRODUCTION

After the lapse of thirteen years since the first steps were taken toward the realization of the enterprise, the St. Louis Municipal Bridge across the Mississippi River stood, on May 15, 1918, complete and ready for the use of the railroads entering St. Louis from the east. The highway deck was opened to the public on January 20, 1917, and its subsequent use has fully justified the expectations of the promoters. The completed bridge was turned over to the Municipal Bridge Commission for maintenance on May 16, 1918.

Matters of policy incident to the local railway terminal situation have militated against bringing the structure into its full effectiveness. The bridge is favorably located; ample facilities exist for connections on both sides of the river, and industry demands its full use. But, on account of the strained relations existing between the city and the combination formed by its railroads, St. Louis has hardly begun to realize on its investment of six and one-quarter million dollars.

Data for the following historical sketch were compiled by Mr. Rudolph Weinberger, Engineer in Charge of Records of Construction of the Municipal Bridge. Mr. Lucius H. Cannon, Librarian of the Municipal Branch Library, rendered very able editorial assistance in preparing the matter for publication.

THE MUNICIPAL BRIDGE OF ST. LOUIS.

I.

THE EADS BRIDGE AND THE "BRIDGE ARBITRARY".

Early development in the Mississippi Valley had its impetus from the east. The first railroads of any importance reached the Mississippi in the fifties from the east, long before any bridge had been constructed across the river. At first, freight and passengers were transferred by ferry across the river and later, car transfer barges were installed.

Agitation for a bridge began after the Civil War, and resulted in the construction of the Eads Bridge, which was completed in 1874, funds being furnished by St. Louisans. This was a double deck structure providing railway and highway facilities, tolls being charged for railway, highway and pedestrian uses.

The necessity for terminals became immediately apparent, and companies operating under authority of municipal franchises were formed for the purpose of providing the facilities. The Union Railway and Transit Company assembled trains in freight yards in East St. Louis and hauled them over the bridge and through a tunnel under the downtown streets of the city. The St. Louis Bridge Company and St. Louis Tunnel Railroad Company transferred passenger trains in a similar manner to the Union Depot located at Twelfth and Poplar Streets, and owned and operated by the Union Depot Company. These various independent companies with related interests were combined to form the Terminal Railroad Association of St. Louis.

An early development in the operation of these utility companies, was the refusal of the eastern railroads to assume any portion of the extra cost of transferring freight and passengers across the river. This extra cost had to be met and resulted in an extra charge, commonly known as the "bridge arbitrary," being assessed against passengers and freight crossing the river, by the local transfer companies.

The Terminal Railroad Association of St. Louis was organized in 1889, with six proprietary lines, its object being to place the system of bridge terminals on a sound financial basis, the proprietary lines guaranteeing the bonds of the Association. Other lines have been added from time to time, and today the Association is made up of fifteen proprietary lines, and altogether, twenty-five railroads enter the terminal zone of St. Louis and utilize the service of the Association.

The properties of the Terminal Association have been consistently improved and developed. Among the more important projects may be mentioned the acquisition of the Merchants' Bridge and river front elevated railway originally built as a competitive enterprise, affording increased facilities for the handling of freight, and obviating in part, the hauling of passenger trains through the tunnel; the new Union Station; the construction of belt lines with locomotive shops and freight yards on both sides of the river; and the improvement of facilities for handling freight and passengers during the World's Fair of 1904.

The bridge toll, or "bridge arbitrary" has been a bone of contention since its introduction, and demands for its abolition have been continuous and insistent. No special activity on the part of the Terminal Association has been possible without a revival of the discussion. Ordinances authorizing improvements have repeatedly failed of passage because of its presence, and legal battles of great magnitude have raged over its prostrate but still animate body. Whatever may have been the beneficial accomplishments of the Terminal Railroad Association, this "old man of the sea" has always militated against their popular acceptance at face value.

The constant agitation against the "arbitrary" crystallized finally, about the time of the World's Fair, into a definite demand for a municipally owned bridge across the river, to be operated free from toll charges of any kind.

II.

THE DEVELOPMENT OF THE PLAN FOR A MUNICIPAL BRIDGE.

The scheme for the construction of a municipal bridge across the Mississippi River at St. Louis, had its inception, it will be observed, in a variety of causes, all arising primarily from the location of the city on the west bank of the river, and the necessity of crossing the river to reach all points in the populous east, and most of the principal points in the central United States. It was necessary that the bridge be "municipal" because it must be free to all users, from utilities to individuals. The existing toll bridge had created such strenuous antagonisms as to create a demand for a bridge that should be constructed by the city.

The matter had been discussed informally for years, but careful investigation and inquiry have failed to disclose earlier recorded action than that embodied in the platform of the Public Ownership Party, adopted by the Missouri State Convention, February 7, 1901. A plank in this platform declared in favor of a bridge, owned and operated by the City of St. Louis.

A list of the public-spirited citizens who have from time to time interested themselves in the matter of a "free bridge" as a means of abolishing the "arbitrary", would be a long one. The title "Father of the Free Bridge" has, at various times, been applied to a number of these gentlemen, but in all fairness, the paternity of the enterprise must of necessity be designated as a complex expression of the will of the people of St. Louis, to provide an entrance to the city from the east, free from tolls or transfer charges of any sort.

The first official step toward the construction of the bridge was the passage, on April 6, 1905,* of an act by the Missouri Legislature, authorizing cities in the state having populations of 100,000 or more to build and operate bridges over rivers forming boundaries with other states, and to acquire land for the purpose. On April 25,** of the same year, Mayor Rolla Wells appointed a Municipal Bridge Commission which was charged with the investigation of terminal facilities and the making of recommendations for improvement. This Commission,*** in a series of reports, reviewed the terminal question very thoroughly. It suggested the construction of a bridge at Poplar Street, but did not concern itself with the question of a "free" Municipal Bridge.

III.

INVESTIGATIONS FOR THE APPROACHES AND PRELIMINARY ESTIMATES OF BRIDGE COST.

An examination of the Chronology of the Municipal Bridge† will disclose long periods of apparent inactivity. An analysis of local events during these intervals, would be interesting to the student of mass psychology. Suffice it to say that the major portion of these periods of inactivity was taken up by discussions of two points, the location of the bridge, and, later, the location of the approaches.

Popular interest in the bridge project was at fever heat during the period from 1905 to 1909, and bridge sites were advocated from one end to the other of St. Louis' long water front.

A Joint Committee of the Municipal Assembly finally reported on March 22, 1907,†† after having made personal investigations, and enlisted the engineering services of Carl Gayler and Henry Rohwer of St. Louis, Ralph Modjeski of Chicago, and Waddell and Harrington of Kansas City.

The consensus of opinion of the consulting engineers and the committee, was that the bridge could be most effectively and economically located with its western approach at, or near Chouteau Avenue.††† The only alternative location approximating its possibilities was in the neighborhood of Cass Avenue or Mullanphy Street, north of the Eads Bridge. The principal points affecting the final decision in favor of Chouteau Avenue were:

(1) Lower first cost.

(2) Most convenient and natural access to the Mill Creek Valley, the established railroad center.

---

*Laws of Missouri, 1905, 94; Revised Statutes of Missouri, 1909, 3048, Sec. 9688.

**Journal of the Council, 1905-1906, 8; confirmed, 15.

***See first report of Bridge Commission, Journal of the Council, 1905-1906, 312-317.

†Appendix A.

††Journal of the House of Delegates, 1906-1907, 605; text of committee report, 607-609.

†††Mayor Rolla Wells opposed this choice in a message to Municipal Assembly. See Journal of the House of Delegates, 1907-1908, 341-344.

(3) Best conditions for approaches on both sides of the river.

The estimates of the cost of the bridge and approaches, prepared by the consulting engineers and submitted in their reports, were as follows:

Carl Gayler—

At Cass Avenue or Mullanphy Street	$4,600,000
At Chouteau Avenue	To exceed 4,520,000
Ralph Modjeski	3,016,836.80
Waddell and Harrington:	
At Cass Avenue	4,540,000
At Chouteau Avenue	4,602,000

These estimates did not include the incidental cost of damages to adjoining property, condemnation of land, etc.

In comparing the estimates of the engineers with the ultimate actual cost of the bridge, due consideration should be given to the details of design, cost of materials and labor at the different periods, the increased length of the eastern approaches as finally built, and the fact that the War Department required greater clearances and longer spans than had been anticipated.

IV.

LOCATION OF THE WESTERN APPROACHES.

An ordinance definitely locating the western terminus of the bridge at or near Chouteau Avenue was passed by the Municipal Assembly on November 22, 1907.*

The site of the bridge having been settled on, the next, and probably the more important question occupying the public mind, was the location of the approaches. The matter was under more or less acrimonious discussion in St. Louis from the time of the location of the bridge in 1907, up to, and until the authorization of the second bond issue in 1914. The inspiration of all discussion and action was the "bridge arbitrary". The St. Louis Municipal Bridge, from the inception of the project up to the time of its completion, was designed to destroy this "insurmountable obstacle to the progress of the city".

So, in the location of all suggested approaches on either side of the river, the primary consideration was public service independent of that of the Terminal Railroad Association with its "arbitrary" charge. But with many other contingencies and obstacles complicating this basic requirement, it must be borne in mind that the Terminal Railroad Association is composed of the railroads which would be required to use the Municipal Bridge to make it effective,—placing the City of St. Louis in a position closely paralleling that ancient, embarrassing and hopeless situation, "between the devil and the deep sea".

As far as physical conditions were concerned, the location of the western approaches was relatively simple. The bridge being situated near the foot of Chouteau Avenue at the entrance to the Mill Creek Valley, the railway approach was planned to extend from the bridge to a point at Eighth and Gratiot Streets, readily available for connection by railroads operating over the Terminal right of way. Public protest against this "bottling of the approach" (an expression arising from the fact that the Terminal Association controlled the only available connection) resulted in its being extended as a surface line along Gratiot Street to Twenty-third Street, thus affording the city opportunity for the construction of independent terminals. The railway approach structure as completed, extends to Eighth Street, but practically nothing has been done toward constructing a permanent roadbed on the extension along Gratiot Street.

The original plans for a single deck bridge, contemplated bringing the western highway approach to the ground at Fourth Street near Chouteau Avenue. The later decision in favor of a double deck structure, with the highway approximately twenty-five feet above the railway level, made it necessary to extend this approach west as far as Seventh and Papin Streets.

*Journal of the Council, 1907-1908, 314, 474; Journal of the House of Delegates, 1907-1908, 318, 345.

The western approaches were built as a combined structure from the bridge to Broadway, in St. Louis. A determining factor in the construction was the necessity for providing a crossing at Broadway, with sufficient clearance to accommodate an elevated track contemplated by the Missouri Pacific Railroad, connecting its river front tracks with the Terminal elevated road and with its own tracks in the Mill Creek Valley.

Provision has been made in the construction of the western approaches, for future connections in St. Louis with the river front roads north and south of the bridge. A specific proposal for connection with the Manufacturers Railway extending southwardly along Second Street, has not been accepted by the city, up to the present time.

V.

LOCATION OF THE EASTERN APPROACHES.

The question of the location of the eastern approaches to the bridge in East St. Louis, afforded a fertile field for discussion, and it is safe to say that no one feature of the entire project excited so much interest, and no obstacle caused so much delay in the completion of the bridge.

The more important problems presented in connection with the location of the eastern approaches were as follows: —

Several railroads crossed the proposed lines from north to south, necessitating long spans, the one presenting the most serious difficulty being the Illinois Central, which was located nearest to the point at which it was desired to end the railway approach. The necessity for an overhead crossing at this point, with a clearance of twenty-two feet, materially lengthened the approach.

It was necessary to provide for ready access to important industrial territory in East St. Louis, and further to so locate the approach that the railroads radiating from East St. Louis in every direction could be tapped by means of a belt line, and connections established with the least possible expense and disturbance of traffic conditions.

On account of the importance of this question in the public mind, there is given the following brief description of the eastern railway approach plans more actively supported. It will be observed that the highway approach is eliminated from the discussion, and does not enter into the estimates.

The Northern, or Hale approach was recommended by Mr. Eugene Hale, a member of the House of Delegates. Its length was eighteen thousand six hundred five feet, and the estimated cost ten million dollars, including all expense of right of way, structure and consequential damages. The route proposed extended in the direct line of the bridge for about six hundred feet, then curved to the north along the Cakokia Creek to Main Street and Trendly Avenue. From this point it ran through the business district passing about three hundred feet to the west of the City Hall, thence between Third Street and Collinsville Avenue to a point three thousand five hundred feet beyond the city limits. The Hale approach was early abandoned as being impracticable from the standpoint of economy.

The Gerhart approach was proposed by Mr. Frank Gerhart. Its length was nineteen thousand eight hundred feet, extending along the line of the bridge to Fifteenth Street and Russell Avenue, thence running diagonally to Twenty-ninth Street and Illinois Avenue, thence to a point two thousand feet beyond the city limits. The estimated cost was two million four hundred seventy-eight thousand dollars exclusive of consequential damages. The Gerhart approach was abandoned as uneconomical, the Engineers' Club of St. Louis and many other organizations condemning it on account of its impracticability.

The Eilers approach suggested by Mr. Roy Eilers, was an extension of the Gerhart approach, running northeastwardly from Twenty-ninth Street and Illinois Avenue for a distance of seven thousand four hundred sixty feet. This approach was twenty-seven thousand two hundred sixty feet long and the estimated cost two million six hundred thirty-two thousand dollars, exclusive of consequential damages. The Eilers approach was abandoned for the same reasons as the Gerhart approach.

Somewhat different in its plan and extent was the Alton and Mississippi approach which was the subject of a great deal of discussion before its final abandonment.

Mr. Leo Scherrer, promoter of the Alton and Mississippi River Belt Railway and Transportation Company, offered to the City of St. Louis for the price of one dollar, a strip of land not less than one hundred feet wide, with the provision that the bridge approach be built on this right of way. The proposed line was twenty-one miles long and with a proposed extension to Alton, would have provided a belt line around the City of East St. Louis. The estimated cost was four million twenty-one thousand dollars.

Mr. Scherrer proposed to furnish a bond to cover all expense for acquiring the right of way by condemnation if necessary, the City of St. Louis to prosecute the suits, Mr Scherrer paying all costs. This offer was rejected.

A second proffer was made to the city in connection with the Alton and Mississippi scheme. The Brennan Construction Company of Chicago, offered to build the eastern railway and highway approaches to the bridge on a leasing plan, providing the railroad approach be built on land offered by the Alton and Mississippi River Belt Railway and Transportation Company. Under the proposed plan, the city was to make twenty annual payments of three hundred fifty thousand dollars each, and then become the owner of the approach.

The Alton and Mississippi right of way started at a point two thousand two hundred feet east of the east pier of the bridge on a prolongation of the bridge line. From this point it turned southeastwardly to the Iron Mountain and Southern Railway, thence eastwardly about six thousand feet south of and parallel to the present approach, to the Illinois bluffs. From this point it extended northeastwardly to the boundary line between St. Clair and Madison counties. It was proposed to build the approach as a steel structure, from the bridge to the Iron Mountain and Southern Railway, with timber trestle and earth fill to the bluffs. From the bluffs to the St. Clair County line it was to have been on earth fill and cut.

It may be said for the Alton and Mississippi scheme that it was extremely comprehensive and provided for municipal control of the one thing which must inevitably be provided to bring the bridge to its full effectiveness—a belt line crossing practically all the important railroads entering the City of East St. Louis, and affording easy access to the Municipal Bridge.

After considerable discussion, the offers of the Alton and Mississippi River Belt Railway and Transportation Company and the Brennan Construction Company, were finally rejected.

During the discussion of the approach question, an alternative scheme was suggested in 1913, by Honorable E. R. Kinsey, then President of the Board of Public Improvements, which would have afforded the shortest and cheapest railroad approach. It consisted of a connection from the point of divergence at the Mobile and Ohio Railroad, to the Illinois Central Railroad at the city limits of East St. Louis. This approach would have been approximately eight thousand feet long, and the estimated cost was $711,000.00. This plan was given no consideration by legislative authorities.

The Board of Public Improvements, headed by Honorable Maxime Reber, President, after exhaustive study planned the approaches as a combined structure, extending from the bridge to the crossing of the Mobile and Ohio Railroad. At this point the approaches separated, the highway extending northeastwardly to Tenth Street and Piggott Avenue and the railway eastwardly along the line of the bridge to Fifteenth Street and Russell Avenue, thence southeastwardly between Boismenue and Baker Avenues to Twenty-second Street. This was informally known as the "Reber Approach", the estimated cost being $1,148,000.00.

The location of the highway approach excited no comment, but the proposed railway connection provoked immediate opposition, objection being based primarily on the fact that the approach ended as a grade crossing on the tracks of the Illinois Transfer Railroad, the property of the Terminal Railroad Association.

As a result of the agitation, and largely through the activities of the Associated Retailers of St. Louis, this approach plan was later altered to provide for an overhead crossing at the Illinois Transfer Railroad, and an extension to Twenty-ninth Street. The eastern approach was finally built in accordance with this altered plan, being known as the "Extended Reber" or "Retailers" Approach. The estimated cost was $1,711,000.00.

The eastern railway approach, as finally constructed, was thirteen thousand three hundred twenty-eight feet long, and the entire cost of both approaches, together with the entire roadway system of both decks on bridge and approaches was approximately $2,700,000.00. In comparing this cost with the original estimates, it must be borne in mind that the estimates were made in 1911 and 1912, the apparent discrepancy being readily accounted for by the abnormal increase in the cost of labor and material during the interval between 1912 and 1917.

VI.

GENERAL DESCRIPTION OF THE BRIDGE.

The St. Louis Municipal Bridge across the Mississippi River connects the cities of St. Louis, Missouri, and East St. Louis, Illinois. The bridge is located about one mile below the Eads Bridge, and approximately three hundred feet north of Chouteau Avenue in St. Louis.

The bridge is a three span double deck structure, with trusses of the Petit type, each span having a length of six hundred sixty-eight feet, from center to center of end pins. The east end of each truss rests on segmental expansion rollers. The shore spans measure six hundred seventy-two and five-tenths feet, and the center span six hundred seventy-seven feet, from center to center of piers. All spans have a clearance of sixty-five feet above the high water level of 1903. The river spans rest on four piers of concrete and Bedford stone, carried on foundations sunk by means of pneumatic caissons to bed rock. The railway deck of bridge and approaches carries double tracks of standard construction using one hundred pound rails. The highway deck has a thirty-foot roadway of reinforced concrete with double electric railway tracks, and is paved with creosoted wood blocks. There are two reinforced concrete sidewalks six feet wide, carried on cantilever brackets outside the trusses. The approaches to the bridge are of standard steel construction except at the ends, where reinforced concrete retaining walls with earth fill are used, on account of the greater economy of construction.

Location of piers, minimum span and clearance above high water all conform to the requirements of the United States War Department.

VII.

PRELIMINARY AND FINAL PLANS.

During the period of preliminary planning, several designs were discussed, and a set of plans prepared by Messrs. Brenneke and Fay and submitted to the War Department on September 10, 1908. These plans provided for a single deck bridge with three truss spans of the Petit type, each about five hundred feet in the clear between piers at low water, with vertical clearances of fifty feet at the shore piers, and fifty-three and four-tenths feet at the center of the middle span, above the high water level of 1844. The spans proposed were about the same as those of the Merchants' and McKinley Bridges across the river at St. Louis, although the clearances were somewhat greater.

The War Department in rejecting these plans, ruled that the Eads Bridge was the dividing line between the upper and lower rivers, and that the clearances of the Municipal Bridge should conform to those of the first existing bridge below the Eads Bridge, located at Thebes, Illinois. The center span of the Thebes Bridge is six hundred fifty feet between piers, with a vertical clearance of sixty-five feet above the high water level of 1844. It was further required that the shore piers be located inside of the inner harbor lines instead of the outer lines as planned.

A second set of plans was prepared by Brenneke and Fay, and submitted to the War Department for approval on November 30, 1908. They provided for a single deck structure of the cantilever type, with three approximately equal spans, each about six hundred seventy-nine feet in the clear, with a vertical clearance of sixty-five above high water. These plans were approved.

The third and final set of plans, in accordance with which the bridge was completed, was prepared by Messrs. Boller and Hodge, New York, and substituted for the second set with the approval of the War Department. These plans provided for a double deck structure of three spans. The bridge was constructed under the supervision of Boller and Hodge (later Boller, Hodge and Baird) with Brenneke and Fay representing them as resident engineers.

VIII.

THE BOND ISSUE.

As a result of the agitation of the bridge question during 1905 and 1906, an item of $3,500,000 to cover the cost of erection of a Municipal Bridge, was included in a proposed bond issue for much-needed general improvements. So strong was the feeling in favor of the bridge project, that its advocates, with their slogan of "No Bridge, No Bonds," swept everything before them, and the issue was voted by an overwhelming majority at a special election held on June 12, 1906.

The amount of this bond issue was derived from the estimates submitted by the consulting engineers, cooperating with the special committee of the Municipal Assembly. It should be emphasized that these estimates were based on a considerably smaller and cheaper structure than the one finally built. The more expensive plan was substituted as the result of the War Department's insistence on more rigid requirements than had been anticipated.

Long before the completion of the river crossing and western approaches, it had become apparent that the bridge could not be finished with the funds available, and that a second bond issue would be necessary to complete the structure. In spite of the fact that ample warning of this condition had been given by reputable engineers, the public adopted an attitude of suspicion and criticism toward bridge matters. As a result, when the funds of the first bond issue were exhausted, three elections were held, each resulting in the defeat of a proposal for a second issue, before the city finally voted the bonds for the completion of the bridge.

Final action in this important matter was brought about through the presentation to the Municipal Assembly on April 3, 1914, of an initiative petition signed by more than 40,000 voters of the city. This petition reviewed the entire bridge question and urged the passage of a bill then pending, which provided for a bond issue for the completion of the bridge. This bill failed of passage because of differences of opinion relative to the location of the eastern railway approach, and a substitute bill, embodying the recommendations submitted in the petition was passed in its stead, thus obviating the necessity for an election on the question of holding a bond issue election.

The initiative petition dictated that the eastern railway approach be built in accordance with the plan known as the Extended Reber Approach.* The amount of the bond issue was fixed at $2,750,000.

A special election held on November 6, 1914, resulted in the approval of the second bond issue by a large majority.

IX.

RIGHTS OF WAY.

The rights of way for the bridge in St. Louis and East St. Louis, were acquired by condemnation or purchase. In a general way they are of the following widths, exceptions existing where the acquisition of entire parcels of land became necessary on account of the impairment of property values due to the irregular cutting of property lines.

In St. Louis the right of way is one hundred feet wide for the combined approach from Pier 1 to Broadway, one hundred feet for the separate highway approach from Broadway to Seventh Street, and fifty feet for the separate railway approach from Broadway to Eighth Street.

In East St. Louis the right of way is eighty feet wide for the combined approach from Pier 4 to the point of divergence of the approaches east of the Mobile and Ohio Railroad, and seventy-five feet for the separate highway approach from the point of divergence to Piggott Avenue. For the separate railway approach it is forty feet wide from the point of divergence to Falling Springs Road. Beyond this point it is quite irregular in shape and width as far as Fifteenth Street. Beyond Fifteenth Street it is one hundred twenty feet wide to Twenty-second Street and sixty feet wide between Twenty-second and Twenty-ninth Streets.

The entire cost of the complete right of way, including all incidental expense, was $905,683.06.

*Page 171.

X.

OUTLINE OF CONSTRUCTION WORK.

The construction of an engineering work of the magnitude of the Municipal Bridge necessarily involves an enormous amount of technical detail. In the following description an attempt has been made to outline the more important and interesting features in the construction of the bridge and to give some idea of the difficulties encountered. Mention of many incidental items of interest are included in condensed form, in the appended chronology.

For convenience, the construction of the Municipal Bridge was divided into a number of sections, following a logical arrangement in the order of execution, as follows:

Section 1. Foundations and piers for the channel spans.

Section 2. Steel superstructure of the channel spans.

Section 3. Foundations and retaining walls for the combined western railway and highway approach, together with the separate highway approach.

Section 4. Steel superstructure for the portion of the western approaches included in Section 3.

Section 5. Foundations and retaining walls for the separate western railway approach.

Section 6. Steel superstructure for the separate western railway approach.

Section 7. Foundations and retaining walls for the combined eastern railway and highway approach, together with the separate highway approach.

Section 7a. Foundations and retaining walls for the separate eastern railway approach.

Section 8. Steel superstructure for the entire eastern approach system.

As a matter of convenience and economy, the construction of the floor system and roadway paving for the bridge and approaches, was conducted coincidently with work on Sections 7, 7a and 8, the cost being charged to funds available for these sections.

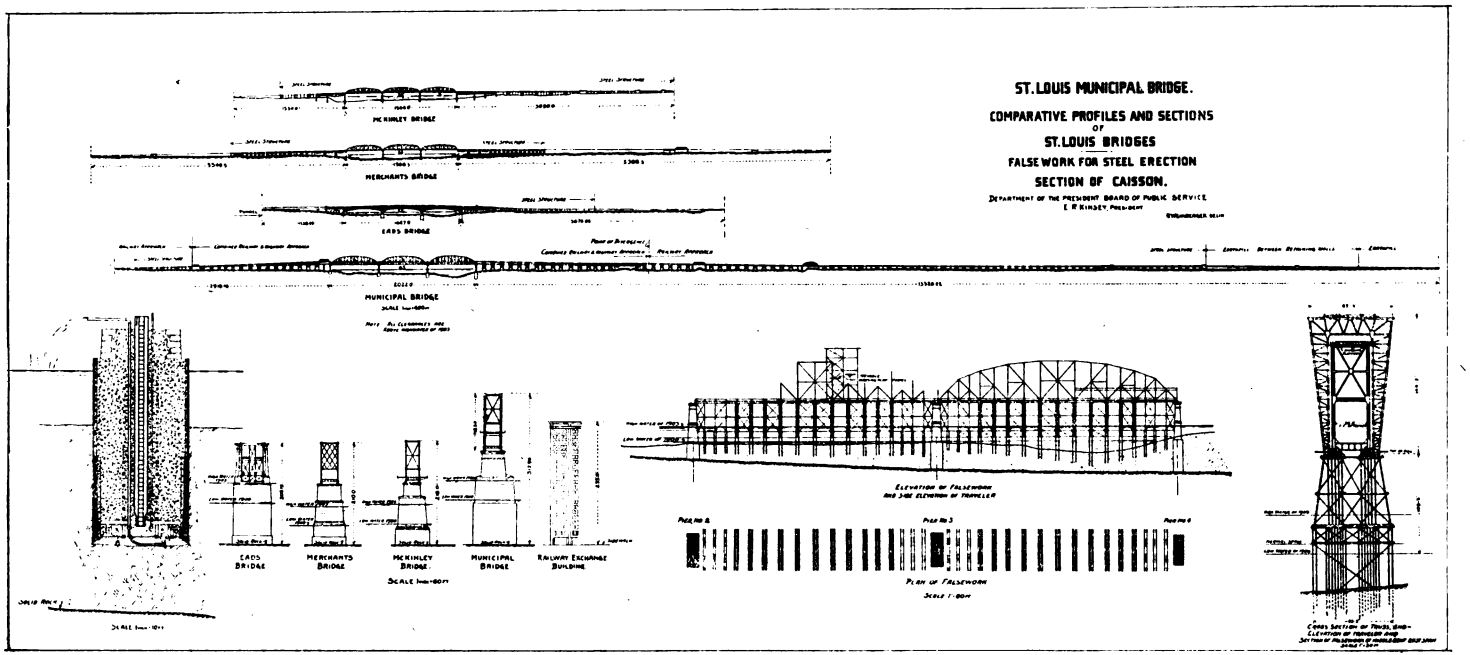
Work on Sections 1 to 6 inclusive, was done by contract. This plan was abandoned on Sections 7, 7a and 8, and the work was done by the City of St. Louis by the direct employment of labor and purchase of material, with the exception of the fabrication of steel, the driving of foundation piles, filling between retaining walls, and some minor items.

In explanation of this change in the method of procedure, it may be stated that the repeated defeat of the second bond issue left the structure incomplete for a period of four or five years. Civic sentiment made it necessary that something be done to finish the bridge, not only for its use, but to meet outside criticism of the city. In order to meet all possible objections the administration, in preparing for another vote on the bonds, agreed to the elimination of intermediate contracts, and to the direct employment of labor by the city.

XI.

THE RIVER PIERS.

General Construction. The substructure of the river spans, consists of four piers of concrete, faced with Bedford limestone masonry above the foundation concrete, except bridge seats, copings and upstream nosings, which are of Georgia granite. The two channel piers are hollow. Pier foundations are of concrete, sunk by means of pneumatic caissons to bed rock. On account of the sharp dip of the rock toward the east, the foundation for the Illinois shore pier is one of the deepest ever sunk by the pneumatic process, the highest indicated air pressure at the pumps being fifty pounds. The accompanying plan and profile indicate the general dimensions of the work.



During the year, 1908, sixty-five preliminary borings were made on both sides of the river and at the sites of the channel piers, to establish the nature of the ground and the depth of bed rock. The greatest depth attained was on the site of Pier 4 where the drills were driven one hundred ten feet.

A contract for the completion of the river piers within eighteen months, was let on July 28, 1909, to the Missouri Valley Bridge and Iron Company of Leavenworth, Kansas, for the amount of $459,835.63. Because of delay in securing land for the eastern shore pier, actual work was not begun until December 20, 1909, on which date the contractors assembled the first caisson cutting edge in their material yards on the Illinois side of the river.

The river piers were numbered consecutively from west to east. Piers 1 and 4 were located on the banks. The ground level at the sites of these piers was above the ordinary stage of the river; but underground conditions made it necessary that all foundations be laid by means of caissons. Work was started on Pier 4, followed by Piers 1, 3 and 2, in the order given.

Caissons—General Construction. All caissons were of the same general type, and identical methods were pursued in sinking, filling and sealing.

The construction included the caisson proper, with a surmounting crib of twelve by twelve yellow pine timbers, bolted to secure rigidity and tightness, and sheathed with two-inch by three-inch planking. A removable cofferdam was built on top of the crib.

The air chamber was seven feet in clear height with a roof of twelve by twelve-inch timbers. Access to the air chamber was provided through three air-shafts and locks, one for men and two for supplies.

The cutting edge consisted of an eight-inch channel riveted to reinforced steel plates.

The process of sinking the caissons consisted in excavating below the cutting edge from the inside of the air chamber, concrete being placed above to force the caisson down. As the concrete was placed, it was reinforced with steel bars to obviate an excessive use of timber.

In all caissons, concreting was kept up during the day time until the crib was filled nearly to the top. A timber cofferdam was then started on top of the crib and built up as the sinking progressed. No masonry was laid until bed rock was reached and sealing completed, except on Pier 4, where the work was started earlier in order to save time and to economize on cofferdam construction.

Frequent soundings were made in the air chamber and when within two or three feet of the rock, its elevation was accurately determined by soundings taken at intervals all around the caisson, as close to the cutting edge as the slope of the roof would allow. The caisson was then tilted slightly toward the highest point of the rock and allowed to settle slowly until the low cutting edge was landed, any further slight settlement in coming to a bearing, tending to level the caisson. The surface of the rock was then cleaned off, and all loose pieces removed preparatory to sealing. The rock was sufficiently uneven to make an excellent bond with the concrete.

No attempt was made to level off the rock so as to bring the caisson to a bearing throughout; but where depressions occurred, sacks loosely filled with concrete were tamped under the cutting edge, after removing the sand, the sacking being immediately followed by a bench of concrete carried up under the shoulders of the roof and well tamped.

In sealing, concrete was locked in through the material shafts, and dropped to the air chamber, the lock being located at the extreme top of the shaft. There it was shoveled back and stamped under the shoulders and roof of the air chamber, until only a small space remained unfilled. The size of the cavity was then measured, the air pressure in the entire shaft equalized, and sufficient grout locked in to fill the cavity, plus about one hundred per cent. This was followed by a charge of about one cubic yard of concrete and the sealing was completed. The concrete used in sealing was mixed in the proportion of one part of cement to two parts of sand and four of one-inch broken stone. Air pressure was maintained for twelve to fifteen hours after sealing was finished, in order to give the concrete time to set. It was then reduced at the rate of about five pounds per hour.

The cofferdam was next pumped out, the locks and shafts removed, and the surface of the concrete in the crib brought up to the proper elevation.

The hospital lock, for use in treating cases of caisson disease, was equipped with bunks, an electric battery and medical supplies. An attendant was in charge, and the company's physician could be summoned on short notice. The treatment consisted, first, in the application of air pressure about equal to that in the working chamber, then in massaging, rubbing with liniment, and applying hot cloths and stimulants. In cases of paralysis, the battery was used. The air pressure when released was reduced slowly. The treatment given in the lock was found to be very effective in cases of paralysis, but sometimes gave only temporary relief to cases of the "bends".

Caissons—Specific Work—Obstacles and Delays. Caissons for Piers 4 and 1 were erected on blocking on the sites, excavation prosecuted by hand, and the caissons lowered until the river water was encountered.

Work on Pier 4 was started on December 20, 1909, but on account of high water, work was temporarily abandoned when the caisson was a few feet above bed rock. Attention was then concentrated on Pier 1, the caisson being landed and sealed before returning to Pier 4.

The sinking of the caisson for Pier 1 was started on April 3, 1910, and proceeded without difficulty to its completion. On Pier 4, however, several serious delays were encountered.

On January 12, 1910, when the excavation was about to be started and while the caisson was still on blocking at the pier site, an ice gorge formed below the bridge backing up the water to an unusual height and displacing the caisson; the river rose ten feet in a few hours and an enormous quantity of ice was forced up on the shore causing considerable damage to the contractor's equipment. Upon the breaking of the gorge next day, the water fell rapidly, leaving this mass of ice and wreckage on the shore at the elevation of high water. Continued unfavorable weather and ice conditions prevented the completion of the work within the contract period, although excavation was resumed on February 21, and excellent progress made during the remainder of the year.

During the sinking of the caisson for Pier 4, a number of old barges were encountered. These barges had been towed into the cove, scuttled and sunk, from time to time, and were piled on top of each other three or four deep. Progress through this mass of wreckage was necessarily slow, as six-by-twelve-inch and twelve-by-twelve-inch oak timbers had to be cut off and passed out through the locks. Light charges of dynamite were used to break up the worst of the wreckage. When about five feet above bed rock, a mass of boulders and gravel, mixed with sand, was encountered, ranging in size from that of a baseball to about one cubic yard. Most of these boulders were locked out through the material shaft. Those left in the air chamber were imbedded in the concrete. The high pressure under which the men worked, and the consequent shortening of the shifts, added greatly to the difficulty and expense of the work. At one time the pressure in the air chamber reached fifty pounds per square inch, which is about the limit of human endurance.

Piers 3 and 2 being located in the channel, caissons were built at the river bank, on a pontoon, from which they were launched and towed to their positions in the stream. Work on these caissons was begun on August 15, and October 25, 1910, respectively.

The pontoon from which the caissons were launched was about forty feet by one hundred feet with sides eight feet high. The sides and bottom were of four-inch plank, braced and calked. The pontoon was divided into halves lengthwise, the sections being bolted together from the inside.

After the caisson was built up to a height of seventeen feet above the cutting edge, and the calking of the air chamber and friction planking completed, the halves of the pontoon were unbolted, plugs removed from holes in the bottom, and water allowed to enter. The pontoon slowly filled and sank, the buoyancy of the timber holding the two halves in position against the cutting edge of the caisson. One-half of the pontoon was then anchored to piles and a tug pulled the free half from under the caisson, which settled in the water clear of the pontoon. The caisson then floated free, and was built up to the full height, and towed to the site of the pier, where it was anchored to piles.

The bed of the Mississippi is composed of very unstable, constantly shifting silt and sand. To prevent scouring, the river bed around the upstream end of the caissons, and for some distance down each side, was covered with sacks of sand, deposited through a section of supply shaft twenty-four inches in diameter and long enough to reach the bottom. Concreting was then started, and the caisson gradually sank as the filling progressed, until the river bed was reached. Air pressure was then applied, the caisson raised slightly, moved into proper position by means of cables, and the air

released, allowing the caisson to settle to the river bed again. In placing the channel caissons care was taken to bring their axes parallel to the true axes of the pier. As the tendency of the caissons was to creep upstream and toward the east, they were set slightly to the south and west of the true position. Any shifting necessary during the sinking, was accomplished by listing the caisson in the desired direction. After the caisson had settled well into the river bed, the anchorage and adjusting cables were released, air was turned on and a working gang entered the air chamber. The caisson was then leveled and brought to a uniform bearing by excavating the material from under the cutting edges at the high points.

Owing to the low stage of the river, caissons for Piers 2 and 3 grounded before sufficient concrete could be placed to render them rigid, and great care was required to prevent them from warping. Levels were taken several times a day, and when warping was detected, it was corrected by loading the diagonally opposite high corners, and excavating under them until the four corners returned to a plane. After the caisson was well filled, no further trouble was experienced from this source.

When the caisson for Pier 3 had nearly reached rock, the cofferdam sprung a leak and filled. After sealing was finished, a diver located the leaks and covered them from the outside with one-inch boards covered with canvas securely battened down.

No further difficulties of moment were encountered and the sinking was completed in good time. All caisson work was complete on November 28, 1910. The work on each caisson is shown in the following table.

	Total sinking feet	Total days*	Average feet per day
Pier 1	50.27	67	0.75
Pier 2	48.14	29	1.66
Pier 3	77.90	40	1.95
Pier 4	108.67	161	0.68

*Including lay-offs.

The rate of progress in sinking caissons for Piers 1, 2 and 3 is in striking contrast to that on Pier 4. No obstructions were encountered on the first three piers. The material passed through was clean river sand with some gravel. The best sinking record was on Pier 3, which was thirty-four feet in seven days with a maximum of five feet two inches in twenty-four hours.

Masonry.—On completion of the foundation concrete to the tops of the cribs, work was started on the masonry of the piers. All piers were constructed of concrete, faced with Bedford stone in two-foot courses, with upstream nosing stones, coping and bridge seats, of Georgia granite. The stone was hauled from the material yard in cars by a locomotive crane, and loaded on barges. Stones were handled at the pier by means of a floating derrick with a ninety-foot boom.

On December 31, 1910, work on the piers was stopped for the winter and was not resumed until February 27, 1911. From this date on, the work progressed rapidly and the piers were completed on June 17, 1911, on which date a celebration was held by various civic organizations. The exercises were conducted on boats and barges in the neighborhood of Pier 2.

For purposes of comparison, the time consumed in constructing piers is given for several bridges near St. Louis, built under similar conditions: McKinley Bridge, one year and six months; Thebes Bridge, two years; Eads Bridge, four years and six months; Municipal Bridge, a little less than eighteen months' actual work.

The contract price of the piers was $459,835.63. The final cost was $468,923.73.

The unit prices under the contract were as follows:

Concrete below cutting edge, $27.00 per cubic yard.

Concrete in caissons and cribs, $12.90 per cubic yard.

Masonry, including backing, $9.50 per cubic yard.

Granite coping and nosing, $1.90 per cubic foot.

XII.

THE STEEL SUPERSTRUCTURE OF THE CHANNEL SPANS.

A contract for the completion of the steel superstructure of the channel spans within eighteen months, was let on November 16, 1909, to the American Bridge Company of New York for the amount of $1,394,043.00. Fabrication of the steel consumed about eighteen months, and the work of erection was started on May 9, 1911.

Falsework for all spans was practically the same, consisting of seventeen pile bents surmounted by two-story framed timber bents. Piles were of yellow pine, and varied in length from sixty to one hundred feet. Each bent consisted of a double row of piles, varying in number from twenty-eight to forty. The total number of piles in each span was six hundred ten, additional piles being driven on the upstream side, for protection of the falsework from drift.

Piles were figured for a maximum load of twenty tons each, and were driven by means of a ten thousand-pound hammer, until at least twenty blows were required to drive the pile one foot. The piles of each bent were braced together in both directions above the water and, where the depth of water exceeded twenty feet below the zero of the gauge, submarine bracing was put in by divers. Piles were capped at about the twenty-five-foot stage, the average high water level. The work was started with one floating driver, a second added after a short interval, and both used thereafter throughout the work.

The framed timber bents surmounting the pile foundations were constructed of twelve-by-twelve-inch yellow pine posts, caps and sills, with eight-by-twelve-inch longitudinal struts, and four-by-eight-inch transverse bracing. Sway bracing between bents consisted of one and one-quarter-inch round rods. All connections were bolted, so that bents could be readily dismantled. Timbers were framed in the material yard, each bent being assembled complete to guard against error.

Traveler tracks and camber blocking were supported on steel I beams, of which there were four lines of twenty-inch, sixty-five-pound beams under each track, and four lines of fifteen-inch, forty-two-pound beams under each truss to support the camber blocking. Beams were lapped eleven feet at panel joints.

On beginning construction, a mule traveler was assembled on a trestle erected just east of Pier 4. The two stories of the falsework bents were assembled separately on barges, placed in position on the piles, and bolted together. I beam stringers, camber blocking, traveler tracks, bridge shoes and a panel of the floor system followed, when the mule was moved forward a panel length on temporary tracks. When the center of the east span was reached, the gantry traveler, which had been previously framed on barges, was erected in sections by the mule. On completion of the gantry, the mule traveler proceeded with the placing of falsework while the gantry was moved back to Pier 4 and the erection of steel work was begun.

Lines were run and levels taken on the falsework at frequent intervals. The center of each bent was established and referred to the center line of the bridge at least once a week, thus insuring detection of any movement of the falsework up or down stream, the levels taken affording a regular check on any settlement

The piles of the falsework were driven as deeply into the river bed as possible but on account of the unstable sand and silt, there was always danger of their being undermined and washed out by the action of the current which sometimes attained a velocity of eight miles an hour. Soundings were taken at frequent intervals, at the ends and middle of each bent, and plotted. During high water a depth of sixty feet was frequently encountered, and it was not unusual to find a fill or scour of five or six feet in twenty-four hours.

In October, 1911, during the erection of the east span and after the middle panel was in place, the river rose, bringing down large quantities of drift, ranging in size from brushwood to logs two feet or more in diameter, and fifty feet or more in length. This drift caught on the falsework and was very difficult to dislodge. Panels of the bracing were removed to allow the drift to pass. At one time forty men were employed in removing the drift with a derrick barge and tug. This work went on constantly, day and night, during the period of high water. At times the drift came down faster than it could be dislodged, and extended to a considerable distance below the water surface. This created a very serious situation, as more than half of the steel work was erected on the span at the time. The accumulated mass of drift was gradually disposed of, and the new drift kept under control.

The river continued to rise, and the bed scoured to such an extent that some of the shorter piles worked loose and washed out, and several of the bents were displaced more than a foot. Bents were temporarily braced with timber and new piles driven. In an attempt to stop the scouring,

about a dozen barges of rip-rap and eight thousand sacks of sand were dumped between the two rows of piles forming the bents. This plan was only partially successful, however, and the scour continued for some time until a fortunate drop in the river, saved the situation. The damage was quickly repaired and no further difficulty experienced, and the steel work of the east span was completed on October 26, 1911.

The camber blocking of the east span was removed by boring and chiseling, beginning with the sub-panel, and following with the panel points. The fixed end of the span was then lowered to position and the blocking finally removed from the expansion end. The segmental expansion rollers were adjusted, before lowering the trusses, to stand vertically at the normal temperature of sixty-two degrees Fahrenheit.

Some difficulty was experienced in removing the blocking, on account of the great weight of the span. Several of the lateral were badly bent, due to uneven strains, and were straightened with great difficulty.

After the span was swung free on its bearings, the bents of the falsework were removed, piles drawn, and the channel dragged under inspection of the War Department, to remove any possible obstruction to navigation.

Work was prosecuted in a similar manner on the remaining spans. Some modifications of the camber blocking were introduced and sand jacks utilized at certain points, to avoid the difficulties experienced in swinging the first span. Construction progressed favorably except for delays caused by heavy ice during the winter of 1911-12. In order to protect the falsework of the west span, clusters of piles connected by a floating timber boom were driven on a line between Pier 2 and a point on the west shore diagonally up stream. As an additional precaution, a bent of the falsework near the end of the partially completed steel work was strengthened so as to carry the weight of steel in the event of the falsework being swept away.

On January 20, 1912, a thaw following a period of very low temperature, the ice below the bridge went out, and that above moved sufficiently to destroy the fender, and break a number of piles in the falsework. After this, the ice held until January 26. Work on the steel work was rushed, and the third span completed on January 23, 1912. All work on the channel spans was completed on August 21, 1912.

The trusses of the river spans of the Municipal Bridge were, at the time of the construction, the longest and highest single trusses ever built, and are further unique in being the first long spans with all main members of nickel steel. The secondary members, bracing and floor system are of carbon steel.

Alternate proposals were received at the time of letting the contract, for building the complete structure of carbon steel, and for using nickel steel as built. Bids were identical for both methods, and the nickel steel design was adopted as giving a lighter and stronger bridge. The price per pound was as follows:

Carbon steel design.....$4.28 cents
Nickel steel design..... 5.05 cents

The contract price of the river spans was $1,394,043.00. The final cost was $1,397,623.26.

XIII.

FOUNDATIONS AND SUPERSTRUCTURE FOR THE WESTERN APPROACHES.

No special difficulties were encountered in the construction of the western approaches of the bridge. Contracts were let as follows:

On August 16, 1911, to the Missouri Valley Bridge and Iron Company of Leavenworth, Kansas, for the foundations and retaining walls of the combined railway and highway approach, and the separate highway approach, for $52,097.34. Completed September 7, 1912, at a final cost of $52,-159.33.

On August 16, 1911, to the American Bridge Company of New York for the steel superstructure of the combined railway and highway approach, from Pier 1 to Broadway, and the separate highway approach, from Broadway to Seventh and Papin Streets, for $427,297.00. Completed April 14, 1913.

On September 3, 1912, to the Fruin-Colnon Contracting Company, St. Louis, for the foundations and retaining walls of the separate railway approach. Contract price $20,613.53. Completed March 13, 1913, at a final cost of $21,145.35.

On September 3, 1912, to the American Bridge Company of New York, for the steel superstructure of the separate railway approach, from Broadway to Seventh Street, for $50,277.00. Completed April 15, 1913, at a final cost of $51,887.75.

The western approaches in St. Louis are built as a combined structure located between Chouteau Avenue and Lombard Street extending from Pier 1 of the bridge, to Broadway, where they separate, the railway approach being continued to Eighth and Gratiot Streets and the highway approach to Seventh and Papin Streets. On the combined structure the highway approach is located south of the railway. The approaches are of railway viaduct construction with steel towers resting on concrete piers built on reinforced concrete piles, except between Second and Fourth Streets, where the piers extend to solid rock. The steel structure has girder spans, except immediately west of Pier 1, and at Broadway, where through-riveted truss spans are used, the span at Pier 1 being one hundred fifty-five feet long and that at Broadway one hundred twenty-five feet six inches for the railway approach, and one hundred five feet for the highway approach. Carbon steel was used throughout. The ends of the approaches are of earth fill between reinforced concrete retaining walls built in sections, with expansion joints. The walls extend from Seventh Street to Eighth Street on the railway approach, and from Sixth Street to Seventh Street on the highway approach.

Provision is made for a completely equipped passenger station on the elevated structure, between Fourth Street and Broadway, This station will afford convenient access to steam and electric railways, and to the sidewalks of the bridge.

The railway approach is constructed so as to permit the connection of north and south branches to existing railroads, turn-outs being provided immediately west of Pier 1.

During the interval between the completion of the channel spans and the eastern approaches, the Municipal Bridge lay idle, except for its limited use by pedestrians. A board walk with hand rails was laid on the railway deck, and passes issued to responsible persons desiring to cross the river. An average of one hundred persons crossed the bridge daily during a period of three or four years.

XIV.

FOUNDATIONS, RETAINING WALLS AND STEEL SUPERSTRUCTURE FOR ALL EASTERN APPROACHES.

General Construction. The erection of the approaches presented a unique problem to the City of St. Louis.

It had been arranged that union labor should be employed, without intermediary contracts, and the city was entirely without plant or equipment suitable for construction work of this nature and magnitude.

Preliminary work was started immediately after the passage of the bond issue on November 6, 1914, exhaustive consideration having been given previously to plans of procedure, estimates of cost, and the acquiring of the necessary plant. General supervision of the work was assumed by the President of the Board of Public Service. Direct charge was assigned to a chief engineer reporting to the President, with a resident general superintendent. Assistant superintendents handled the separate divisions of caisson work, concrete work, carpentry, steel erection and roadway paving. Temporary offices were erected on the site of the work, and an office force of assistant engineers, bookkeepers, timekeepers, etc., installed.

Eight connections were made with existing railroads, to facilitate handling of material, and a central power plant erected, equipped with two one hundred H. P. boilers, and one seven hundred fifty-foot and one five hundred ninety-foot air compressor, together with the necessary water heaters and feed pumps, reserve water supply tank, store room, carpenter shop, blacksmith shop, pipe shop, etc.

The plant for work on foundations and steel superstructure, consisted of standard equipment of locomotive cranes, derricks, hoisting engines, concrete mixers and buckets, clam shells, air locks, caisson tools and equipment.

The plant for erection of steel work consisted of a large two-boom mule traveler, one sixty-ton and one thirty-ton locomotive crane, and a gantry traveler erected on the work.

For construction of the floor system of the bridge and approaches there were installed hoisting engines, concrete mixers, gasoline locomotives, and material cars.

On completion of the work, much of this equipment was in excellent shape for continued use. Several of the items were disposed of to excellent advantage, by sale, and others transferred to various city departments.

The general plan of operation consisted in a concentration on the foundations of the combined approach between Pier 4 and the point of divergence near the crossing of the Mobile and Ohio Railroad, followed by those of the highway approach, and the separate railway approach. Steel erection, floor construction and paving followed closely on the completion of foundations, the object being to complete the highway approach as early as possible in order to make the bridge available for vehicle traffic.

Actual construction work began on March 17, 1915, and the original schedule of construction called for the completion of the highway deck by October 1, 1916. A number of obstacles were encountered in the early stages of the work. Chief among them was a period of unusually high water, causing the Mississippi to overflow into the low land traversed by the approaches. The site of the combined approach was under water from May to August, 1915. Flood conditions were not nearly so bad in 1916, but further delays were caused by shortage of labor and slow delivery of material during the year.

In spite of these obstacles, work on the approaches was so conducted as to offset the delays to a great extent, and the highway deck was ready for traffic on January 3, 1917, only three months behind the original schedule.

The eastern bridge approaches were constructed of material purchased by the City of St. Louis and erected by union labor employed directly by the City, except for the following items, which, it was agreed between the city and the labor unions, could be more satisfactorily handled by contract:

The fabrication of the structural steel, which included the delivery, and all material for the completion of the entire floor system of the bridge and approaches, was let to the American Bridge Company of New York, for the contract price of $1,039,000.00. The final cost of the entire structure, including an addition for rails, was $1,099,453.00.

Furnishing and driving concrete piles was let to Charles N. Lund at the following prices per lineal foot: $0.83 for 25 ft. piles; $0.94 for 20 ft. piles; $1.07 for 15 ft. piles. Final cost, $120,279.07.

Filling between the retaining walls of the highway approach was let to John Beaird for the price of sixty cents per cubic yard. Final cost, $4,545.30.

Filling between the retaining walls of the railway approach was let to List and Gifford, Kansas City, for the price of thirty-eight cents per cubic yard. Final cost, $29,614.92.

Reinforced concrete hand rails on the highway approach were let to Henry B. Dawson for the price of three dollars and forty cents per lineal foot. Final cost, $3,675.40.

The eastern approaches were built as originally planned, along the right of way known as the "Extended Reber Approach".* They consist of a combined structure extending eastwardly to a point two thousand three hundred sixty-three feet from Pier 4, along a direct line with the bridge. At this point they separate the highway approach, located north of the railway approach, extending northeastwardly to Tenth Street (East St. Louis), and Falling Springs Road, thence parallel with Tenth Street to Piggott Avenue. The length of the highway extension from the point of separation is two thousand nine hundred forty-five feet.

*See page 171.

The separate railway approach extends along the line of the bridge to a point six thousand feet east of Pier 4, thence southeastwardly between Baker and Boismenue Avenues to Twenty-ninth Street, crossing the East St. Louis City Limits at Twenty-sixth Street. The length from the point of separation is ten thousand nine hundred seventy-three feet.

The approaches are of carbon steel except at the ends, where earth fill and retaining walls were used. The highway ends in a fill between retaining walls extending from Baker to Piggott Avenues. The extreme end of the railway approach is of earth-fill construction, without retaining walls, beyond which retaining walls extend to Twenty-first Street.

All steel work is supported on pedestal piers except a special tower immediately east of Pier 4, and several long spans, necessary to provide clear passage over existing railroads. These spans are supported on special piers, sunk an average depth of forty feet, to a stratum of coarse sand and gravel. On twelve of these piers the pneumatic process was used, and four were excavated by dredging.

Retaining walls and pedestal piers are built on reinforced concrete piles, numbering from fourteen to thirty to each pier according to the load, and varying in length from fifteen to twenty-five feet. Approximately six thousand piles were used on this particular work. Piers vary in height above ground from two to nineteen feet, and, as much of the ground traversed by the approaches is subject to overflow, all are built with a top elevation above the high water level of 1903. Retaining walls vary in height from two and one-half feet to twenty-seven feet.

A feature of the construction of the retaining walls and pedestal piers, was the use throughout of collapsible steel forms of special construction, which greatly facilitated the progress of the work and materially cheapened construction. These forms were furnished by the Hydraulic Pressed Steel Company of Cleveland, Ohio.

The steel work of the approaches is of typical railroad viaduct construction with towers and girder spans, except for special work as follows:

A three-truss through and deck span, two hundred ninety-six feet long, on the combined structure, crossing the Mobile and Ohio Railroad, and the Southern Railroad.

On the separate highway approach: A deck span one hundred twenty-six feet long over the St. Louis, Belleville and Southern right of way; a deck span one hundred feet long immediately west of the above; a deck span one hundred feet long over Mississippi Avenue; a deck span ninety-eight feet long between Mississippi Avenue and the St. Louis, Belleville and Southern right of way; and a through span two hundred sixty-three feet long over the Illinois Central Railroad.

On the separate railway approach: A pin-connected through span one hundred eighty-four feet six inches long, over the St. Louis, Belleville and Southern Railroad, and a similar span two hundred twenty-seven feet three inches long, over the Illinois Central Railroad. All spans over railroads have a minimum clearance of twenty-two feet.

Four turn-outs are provided for future connections to the railway approach, located as follows:

To the north, nine hundred feet east of Pier 4.

To the south, two thousand three hundred thirty-three feet east of Pier 4.

To the south, three thousand four hundred ninety-four feet east of Pier 4.

To the south between Eighteenth and Nineteenth Streets.

XV.

ROADWAY AND SIDEWALKS.

The construction of the roadway and sidewalks of the highway deck was unique in the use of thin steel arched forms placed between roadway stringers. The steel reinforcing, previously spot welded to form mats, was placed on these forms and the concrete deposited by special cars, operating over the rails of the electric railway tracks which had been previously laid. The forms are expected to rust out in time, leaving the concrete to support the roadway.

The entire roadway, on bridge and approaches, is paved with creosoted wood blocks on a one-inch sand cushion.

The highway was opened to traffic on January 20, 1917, the interval between the third and twentieth being consumed in the installation of wiring for the lighting system.

After the completion of the highway deck, the entire force was concentrated on the work of completing the eastern railway approaches, work on which had progressed irregularly theretofore. A feature of the construction of the railway deck resulting in marked economy, was the installation of a complete plant for boring and dapping the ties of the roadbed. This plant was installed in East St. Louis in a position convenient to connecting railroads and the steel structure. The ties, previously creosoted, were milled, hoisted to the superstructure, and distributed to the work.

XVI.

PAINTING.

All steel work of the bridge and approaches received a priming coat of red lead in the mills, and the channel spans and the western approaches received two coats of graphite paint on completion.

On the completion of the eastern approaches, the entire structure was again painted in 1917 with two coats of Detroit Graphite "No. 500", the first coat being green and the second black. Before applying the paint, the steel was thoroughly cleaned with wire brushes and scrapers, of all rust, dirt, grease, scale and cement droppings.

XVII.

THE COST OF THE BRIDGE.

In closing an account of this history of the St. Louis Municipal Bridge, it may be well to meet several criticisms of its construction which have been made at various times.

The more common of these criticisms is that the bridge, being a municipal enterprise, was constructed without regard to economy, and at a cost in excess of that of similar bridges at St. Louis, erected by private corporations. This criticism is clearly unjust and based on a misapprehension of facts and conditions. When comparison is made on a basis of unit cost, the St. Louis Municipal Bridge is the cheapest viaduct ever constructed across the Mississippi River.

Several elements enter into the consideration of greater cost, as compared with other bridges near St. Louis.

The requirements of the War Department made the clearance above high water and the length of the spans, materially greater than those of any other bridge in the vicinity.

The bridge is double-decked, and designed for the heaviest traffic, whereas the Merchants' and McKinley Bridges have single decks and are consequently lighter throughout.

The eastern approaches traverse very low ground, and this, with the passage of the bridge over railroads in East St. Louis with the necessary clearances, made the approaches longer and higher, and also entailed increased expense for the acquisition of rights of way.

The criticism has been made that the construction consumed an unreasonable amount of time. It should be recalled that the delays which have been the source of criticism were due to the time spent in consideration of the furnishing of funds to continue the work of construction. These considerations were constantly aggravated by the interjection of the "bridge arbitrary" as a basis of prolonged and fruitless discussion. When funds were provided, however, it is demonstrable that the work of construction was prosecuted as rapidly as that of any structure of a similar nature in the vicinity of St. Louis.

All things considered, it may be finally stated that in the Municipal Bridge, the City of St. Louis possesses an economically constructed viaduct of the highest type, offering in full the potentiality for which it was built. There remains to be developed, the cooperation of the railroads centering in the City of East St. Louis, to bring the bridge to its full usefulness.

APPENDICES

APPENDIX A.

CHRONOLOGY.

General authority was given the City of St. Louis, in Article 1, Section 1 of the old charter, to construct a bridge over the Mississippi River, and to acquire land for approaches in East St. Louis, Ill.

April 6, 1905. Act of Missouri State Legislature authorizing cities in the state having populations of 100,000 or more to build and operate bridges over rivers forming boundaries with other states, and to acquire land for the purpose.

April, 1905. Rolla Wells, Mayor.
Andrew J. O'Reilly, President of the Board of Public Improvements.
Hamilton A. Forman, President of the Council.
John J. O'Brien, Speaker of the House of Delegates.

April 8, 1905. Ordinance No. 22026, authorizing the Mayor to appoint a Municipal Bridge and Terminals Commission, which was charged with the investigation of St. Louis Terminals and with making recommendations for improvements. The ordinance appropriated $25,000 for expenses.

April 25, 1905. Mayor Rolla Wells appointed a commission as authorized by the above ordinance, consisting of

Rolla Wells, Chairman.
Andrew J. O'Reilly, President of the Board of Public Improvements.
Robert H. Whitelaw, Vice Chairman.
Joseph D. Bascom.
C. W. S. Cobb.
R. S. Colnon.
Homer P. Knapp.
Hugh McKittrick.
R. W. Shapleigh.

November 15, 1905. The Municipal Bridge and Terminals Commission submitted a preliminary report, reviewing conditions, but making no recommendations.

March 23, 1906. Act of Congress regulating the construction and operation of bridges over navigable waters. Chapter 1130.

April 3, 1906. Ordinance No. 22366, authorizing an election on the issuance of bonds in the amount of $3,500,000 for a Municipal Free Bridge over the Mississippi River. This ordinance covered a proposed bond issue of $11,200,000 for various municipal improvements, of which the bridge was a single item.

April 16, 1906. Proclamation by Mayor Wells, calling a special election on the proposed bond issue for June 12, 1906.

June 1, 1906. Second report by the Municipal Bridge and Terminals Commission. No recommendations were made in this report.

June 12, 1906. Bond issue election held. The proposition carried by a large majority. The vote was 51,988 for, and 6491 against the issue.

June 25, 1906. Act of Congress, Chapter 3539, authorizing the City of St. Louis to construct, maintain, and operate a combination railway, highway, and foot passenger bridge with approaches thereto, across the Mississippi River, and to acquire land in Missouri and Illinois for approaches.

July 6, 1906. Third report by the Municipal Bridge and Terminals Commission. In this report, the Commission recommended the construction of a bridge (not specified to be a Municipal bridge) at or near Poplar Street. Messrs. Robert Moore and Albert T. Perkins had been retained as consulting engineers, by the Commission.

November 2, 1906. Message from Mayor Wells to the Municipal Assembly, recommending early passage of an ordinance authorizing the sale of bridge bonds, and suggesting the appointment of a joint committee of the Assembly, to recommend a site for the proposed bridge.

November 30, 1906. Concurrent resolutions by both houses of the Municipal Assembly, in favor of naming a committee as recommended by the Mayor. Committee appointed, consisting of
Messrs. Lesser, Moellman, and Rolfes of the Council, and
Messrs. Connell, Heffernan, and Simmons of the House of Delegates.

January 30, 1907. Injunction proceedings instituted by H. A. Haeussler, et al., to restrain the City of St. Louis from issuing bridge bonds, and attacking the validity of the authorizing ordinance. Appealed to the Supreme Court of the State of Missouri on March 5, 1907.

February 8, 1907. Act of Congress authorizing the City of St. Louis to construct a bridge in accordance with the Act of 1906, same to be completed within three years from date of Act.

February 12, 1907. Ordinance No. 22799 authorizing a joint committee of the Municipal Assembly to select a site for the Municipal Bridge, and to employ experts. This ordinance appropriated $10,000 to defray expenses.

March 22, 1907. Joint committee reported, recommending that the bridge be built at Chouteau Avenue.

April, 1907. Rolla Wells, Mayor.
A. J. O'Reilly, President of the Board of Public Improvements.
Hamilton A. Forman, President of the Council.
John F. O'Brien, Speaker of the House of Delegates.

May 24, 1907. Fourth report by the Municipal Bridge and Terminals Commission, including a statement of expenditures in the amount of $22,823.53.

July 2, 1907. Supreme Court of the State of Missouri rendered a decision upholding the validity of the Bridge bond ordinance. Injunction refused.

July 5, 1907. A. J. O'Reilly, President of the Board of Public Improvements, requested the Municipal Assembly to definitely locate the Municipal Bridge, and to indicate a city official to negotiate with the War Department for approval of plan.

July 15, 1907. Ordinance No. 23133 appropriating an additional $15,000 for expenses of the Municipal Bridge and Terminals commission.

November 22, 1907. Ordinance No. 23315 (passed over veto of Mayor Wells) locating the western terminus of the bridge at, or near Chouteau Avenue. (This ordinance was later amended by ordinance No. 24283.)

December 18, 1907. Ordinance No. 23330 authorizing and directing the Board of Public Improvements to prepare plans and specifications for the bridge, and to procure the approval of same by the War Department. The President of the Board and the Street Commissioner were later advised by the City Counselor, Charles W. Bates, that this authority and responsibility rested with the President of the Board. Upon receipt of this advice, President O'Reilly proceeded at once with the preliminary work. Temporary offices were established on both sides of the river, and extensive surveys made including about 300 plans and the drilling of 65 holes.

January 3, 1908. Messrs. Brenneke and Fay applied for appointment as engineers for the bridge. President O'Reilly, of the Board of Public Improvements, requested formally the opinion of the city official responsible for the construction of the bridge. In an opinion dated January 29, 1908, the Counselor held that the City Charter imposed this duty on the President of the Board of Public Improvements.

January 31, 1908. Ordinance No. 23383 authorizing the President of the Board of Public Improvements, with the approval of the Mayor, to employ an engineer on such terms as he might be able to make, together with additional assistants to aid the President in the preparation of plans and specifications for the bridge and approaches. This ordinance appropriated $5000 for the employment of such assistants.

February 11, 1908. Fifth report of the Municipal Bridge and Terminals commission. No reference to the Municipal Bridge report in this report.

April 28, 1908. Council bill No. 69 authorizing the Joint Committee of the Municipal Assembly to employ experts for plans and specifications, and appropriating money to defray expenses. Bill vetoed by Mayor June 30, same in violation of the City Charter.

May 13, 1908. Messrs. Brenneke and Fay appointed as engineers of the Municipal Bridge on a 5% commission as authorized by ordinance No. 23383. This appointment was sent to Mayor Wells, who requested an opinion of the City Counselor as to its legality. An opinion of City Counselor Bates, dated May 21, 1908, declared such an appointment to be illegal.

May 26, 1908. Mayor Wells, in a message to the Municipal Assembly directed attention to the lack of authority by the President of the Board of Public Improvements to appoint bridge engineers and submitted a draft of an ordinance conferring such power, with the approval of the Mayor. This draft was introduced as Council Bill No. 138. It was passed by the Council and later by the House of Delegates with amendments. Later it was filed on recommendation of the Committee on conference, and House Bill No. 203 substituted therefor. It was finally passed on December 1, 1908, as ordinance No. 24119.

July 24, 1908. Concurrent resolution of the Municipal Assembly directing the President of the Board of Public Improvements to immediately prepare plans for the Municipal Bridge to be built at or near Chouteau Avenue, and to present such plans when complete, to the War Department, for approval.

September 5, 1908. General plans for the bridge were presented by Brenneke and Fay, and forwarded to the War Department on September 10, 1908. Detailed plans, specifications and estimates were delivered by Brenneke and Fay on October 7 and 9, 1908.

October 13, 1908. Public hearing at the United States Engineers Office on bridge plans.

November 20, 1908. Plans submitted on September 10, 1908, were returned by the War Department with the statement that no plans be considered providing for more than three spans and two piers within 2000 feet of waterways; no span to provide for less than 600 feet in the clear between piers, and no part of the superstructure over the waterways to be less than 65 feet in the clear upon the highwater level of 1903.

November 28, 1908. Revised plans submitted by Brenneke and Fay and forwarded to the War Department on November 30, 1908.

December 8, 1908. Conference between Brenneke and Fay, President O'Reilly, and United States Engineers, on revised plans.

December 17, 1908. Plans approved by the War Department.

December 21, 1908. Ordinance 24119 authorizing the President of the Board of Public Improvements, with the approval of the Mayor, to employ an engineer, or engineers, at a commission of 4%, the total cost to prepare plans and superintend the erection of the Municipal Bridge, said engineers to give a bond of $100,000.

December 30, 1908. President O'Reilly appointed Brenneke and Fay under authority of the above ordinance. Mayor Wells failed to approve this appointment.

January 9, 1909. Act of Congress extending the time of completion of the bridge three years from date of Act.

January 18, 1909. Boller & Hodge of New York, appointed engineers under authority of ordinance No. 24119, and appointment approved by the Mayor. This firm later appointed Brenneke and Fay as resident engineers.

March 24, 1909. Ordinance No. 24283 amending ordinance No. 23315 and locating the western terminus of the bridge at a point where the southern line of the bridge should be, not more than 325 feet north of the northern line of Chouteau Avenue. This ordinance also located the western highway approach.

March 30, 1909. Sixth report by the Municipal Bridge and Terminals Commission including a statement of expenditures of $37,000.

April, 1909. Frederick H. Kreismann, Mayor.
Maxime Reber, President of the Board of Public Improvements.
John H. Gundlach, President of the Council.
Edgar Rombauer, Speaker of the House of Delegates.

April 7, 1909. Final plans of the bridge with request for permission to shift the superstructure northwardly from the location approved December 17, 1908, submitted to the War Department by President Reber of the Board of Public Improvements.

May 20, 1909. Final plans approved by the War Department, new permit issued and original permit revoked.

June 4, 1909. Board of Public Improvements presented plans of the location of the bridge, river spans, combined highway and river approaches and separate highway approaches on both sides of the river. The Board also presented detailed plans and specifications and introduced an ordinance for the construction of the first section of the bridge consisting of the channel piers.

June 23, 1909. Ordinance No. 24457 authorizing and directing the Board of Public Improvements to let a contract for the construction of the first section.

July 28, 1909. Contract let to the Missouri Valley Bridge and Iron Company of Leavenworth, Kansas, for the construction, within eighteen months, of the channel piers of the bridge, in the amount of $459,835.63. (Work on this contract was started December 20, 1909, and completed June 17, 1911, final cost $468,923.73.)

September 24, 1909. Board of Public Improvements approved detailed plans and specifications and introduced an ordinance for the construction of the second section of the bridge consisting of the steel superstructure of the channel spans.

October 23, 1909. Ordinance No. 24583 authorizing and directing the Board of Public Improvements to let a contract for the second section.

November 16, 1909. Contract let to the American Bridge Company of New York for the construction of the steel superstructure of the three channel spans of the bridge, in the amount of $1,394,043. (Work started May 9, 1911, and completed August 21, 1912, final cost $1,397,623.26.)

December 1, 1909. Proffer by Mr. Leo Scherrer on behalf of the Alton and Mississippi River Belt Railway and Transportation Company of a strip of land in East St. Louis on condition that the eastern railway approach to the Municipal Bridge be constructed thereon.

December 20, 1909. Work started on construction of channel piers.

January 7, 1910. Act of Congress extending the time for the completion of the bridge three years from date of Act.

February 17, 1910. Ordinance No. 24803 indicating method of payment for engineer's fees.

July 19, 1910. Council bill No. 172 introduced by John H. Gundlach, by request, authorizing the Manufacturers' Railway Company to construct and operate a double track railway approach connecting with the Municipal Bridge approach. Filed.

January 17, 1911. Message to Municipal Assembly by Mayor Frederick Kreismann, reporting progress on bridge construction, and advising that completion be financed by bond, rather than by suggested sale of city property.

April 3, 1911. Ordinance No. 24773 authorizing an election on the issuance of bonds in the amount of $2,250,000 for the completion of the Municipal Bridge. Amended by Ordinance No. 25821, changing date of election to November 7, 1911.

April 11, 1911. Ordinance No. 25810, authorizing the Southern Traction Company of Illinois to operate an interurban electric railway on the Municipal Bridge for a franchise period of fifty years. Ordinance to become effective upon deposit by the company of $25,000, to guarantee its presentation of $200,000 bond. This ordinance amended by ordinance No. 26679.

April, 1911. Frederick H. Kreismann, Mayor.
Maxime Reber, President of the Board of Public Improvements.
John H. Gundlach, President of the Council.
John H. Sommerich, Speaker of the House of Delegates.

May 9, 1911. Work started on falsework construction, under contract for steel superstructure of channel spans.

June 2, 1911. Board of Public Improvements approved detailed plans and specifications and introduced ordinances for the construction of the third and fourth sections of the bridge, consisting respectively of the foundations and retaining walls, and the steel superstructure of the combined western railway and highway approach and the separate western highway approach.

June 17, 1911. Formal exercises on completion of the channel piers.

July 10, 1911. Ordinance No. 25947 authorizing and directing the Board of Public Improvements to let a contract for the construction of the third section of the bridge.

Ordinance No. 25948, authorizing a contract for the fourth section.

July 11, 1911. Ordinance No. 1737 City of East St. Louis, granting overhead easements, grade crossings and other privileges for the construction of the eastern approaches of the Municipal Bridge. The ordinance was for the original Reber approach. This ordinance supplemented by ordinances Nos. 1836 and 1994.

July 17, 1911. Ordinance No. 25979 fixing location of western railroad approach.

July 25, 1911. Council passed a bill locating the Reber approach. This bill failed of passage in the House of Delegates.

August 16, 1911. Contract let to the Missouri Valley Bridge and Iron Company of Leavenworth, Kansas, for the construction of the foundations and retaining walls of the western approach, in the amount of $52,097.34. (Work started September 14, 1911, and completed September 7, 1912. Final cost $52,159.33.)

Contract let to the American Bridge Company of New York for the construction of the steel superstructure of the western approaches in the amount of $427,297. (Work started April 11, 1912, and completed April 14, 1913. Final cost $427,297.)

September 14, 1911. Work started on foundation and retaining walls of western combined approach and separate highway approach.

September 29, 1911. Special committee for consideration of Municipal Bridge bills appointed by House of Delegates. This committee, on October 20, reported in favor of the northeast (Gerhart) eastern approach to the bridge, and on October 27, the House passed a bill locating this approach. This bill was defeated in the Council.

November 7, 1911. Bond issue election held. Proposition defeated by a vote of 31,624 for, and 20,323 against, favorable votes falling short of the necessary two-thirds. Issue proposed, $2,250,000.

November 20, 1911. The East St. Louis Real Estate Exchange passed a resolution against the northeast (Gerhart) approach to the bridge in East St. Louis.

December 15, 1911. Message to Municipal Assembly by Mayor Kreismann reviewing the acquisition of land for the Reber approach and urging the passage of an ordinance locating same.

December 19, 1911. Joint Committee appointed by the Municipal Assembly to consider the Municipal Bridge approach.

February 17, 1912. Act of Congress extending the time for the completion of the Municipal Bridge three years, from date of Act.

April 11, 1912. Prof. C. M. Woodward, in an investigation of the eastern approach question, recommended the Reber approach.

April 11, 1912. Work started on steel superstructure of western combined approach and separate highway approach.

May 28, 1912. Report by the Joint Committee of the Municipal Assembly on the various approach propositions and recommending an extension to the Reber approach. This extended approach was approved by the Retailers Association and Business Men's League.

June 12, 1912. Ordinance No. 26433 authorizing an election on the issuance of bonds, in amount not to exceed $2,750,000 for the completion of the bridge.

June 14, 1912. Southern Traction Company indicated its willingness to conform to any rules for the use of the bridge established by the Municipal Assembly.

June 27, 1912. Ordinance No. 26586 extending the right of way for the eastern railway approach to the Municipal Bridge, and authorizing the purchase of land and arrangements for easements.

July 5, 1912. Bill No. 177 introduced in the House of Delegates, fixing the location of the Southern Railway approach to the bridge in St. Louis. Bill No. 178 also introduced authorizing the condemnation of land for this approach. Both bills failed.

July 13, 1912. Ordinance No. 26592 fixing terms under which railways, street railways and interurban lines are to be permitted to use the Municipal Bridge, placing the control of the bridge under the jurisdiction of the Municipal Bridge Commission. This ordinance amended by ordinance No. 28814 and later repealed by No. 29501.

July 26, 1912. Board of Public Improvements approved detailed plans and specifications for the construction of the fifth and sixth sections of the bridge, consisting, respectively, of the foundations and retaining walls and steel structure of the western railway approach, from Broadway to Eighth and Gratiot Streets.

August 3, 1912. Ordinance No. 26635 authorizing and directing the Board of Public Improvements to let a contract for the construction of the fifth section of the bridge, and ordinance No. 26636 authorizing contract for the sixth section.

August 5, 1912. Bond issue election held. Proposition defeated by a vote of 43,025 for, and 24,643 against—failed to receive the necessary two-thirds favorable vote. Issue proposed, $2,750,000.

August 21, 1912. Steel superstructure of channel spans completed.

September 6, 1912. Contract let to the Fruin-Colnon Contracting Company for foundations and retaining walls of the separate western railway approach, in the amount of $20,613.53. (Work started December 20, 1912, and completed March 13, 1913. Final cost, $21,145.35.)

Contract let to the American Bridge Company of New York for the steel superstructure of the separate western railroad approach, in the amount of $50,227. (Work started March 6, 1913, and completed April 15, 1913. Final cost, $51,887.75.)

September 7, 1912. Work completed on foundation and retaining walls of western combined approach and separate highway approach.

October 7, 1912. Ordinance No. 26642, widening Seventh Street from Chouteau Avenue to Cerre Street to accommodate traffic at bridge approach. This ordinance repealed by Ordinance No. 27806.

October 16, 1912. Ordinance No. 26650 authorizing an election on the issuance of bonds, in the amount not to exceed $2,750,000, for the completion of the bridge.

November 5, 1912. Bond issue election held. Proposition defeated by a vote of 58,891 for, and 49,953 against—failed to receive the necessary two-thirds favorable vote. Issue proposed, $2,750,000.

November 19, 1912. Ordinance No. 26679 amending the franchise of the Southern Construction Company of Illinois. (This ordinance, together with ordinance No. 25810, repealed later.)

December, 1912. Several orders by the Illinois Railroad and Warehouse Commission granting overhead crossings for eastern bridge approaches.

December 20, 1912. Work started on foundation and retaining walls of separate west railway approach.

February 15, 1913. Temporary board walk on railway deck of bridge, purchased from the American Bridge Company and opened to the public.

March 6, 1913. Work started on steel superstructure of separate west railway approach.

March 13, 1913. Work completed on foundation and retaining walls of separate west railway approach.

April, 1913. Henry W. Kiel, Mayor.
E. R. Kinsey, President of the Board of Public Improvements.
Sam Lazarus, President of the Council.
Andrew Gazzolo, Speaker of the House of Delegates.

April 14, 1913. Work completed on steel superstructure of western combined approach and separate highway approach.

April 15, 1913. Joint Committee of Municipal Assembly appointed to consider the bridge approach question.

April 15, 1913. Work completed on steel superstructure of separate west railway approach.

April 22, 1913. President Kinsey of the Board of Public Improvements reported and estimated a cost of $944,000 to complete highway approaches to the bridge.

May 8, 1913. City Counselor Baird rendered an opinion to the effect that the repeal of the Southern Traction Company franchise would be illegal.

May 14, 1913. Bill increasing tax rate ten cents per $100 for the completion of railway approaches to the bridge, vetoed by Mayor Kiel. Bill failed of passage over this veto.

June 27, 1913. Report of President Kinsey of the Board of Public Improvements comparing the merits of various eastern approach plans and pointing out the desirability of a belt line connecting with the eastern approach encircling East St. Louis, to be owned and operated by the City of St. Louis.

August 1, 1913. Municipal Assembly failed to agree on an item of $750,000 in a proposed bond issue, for a southern approach in St. Louis for a connection to the Manufacturers' Railway.

August 22, 1913. Special session of the Assembly called by Mayor Kiel for consideration of bridge problem

September 2, 1913. Special session convened, and Joint Committee of Municipal Assembly appointed.

September 10, 1913. Proffer of Brennan Construction Company of Chicago to build a belt line and railroad and highway approaches in Illinois, and lease same to the City of St. Louis.

September 30, 1913. Opinion by Dillon Thompson and Clay of New York to the effect that the City of St. Louis could legally lease the proposed Alton and Mississippi approach.

November 21, 1913. Report to special session of Municipal Assembly by J. E. Allison, estimating the cost of the Alton and Mississippi Belt Line approach at $4,321,081.87. The Committee on this date agreed to recommend the Alton and Mississippi leasing plan.

Bill passed by the Council authorizing an election on the issuance of bonds, in the amount of $2,750,000, for the completion of the bridge. The Assembly "deadlocked", the Council favoring the extended Reber approach, and the House the Alton and Mississippi plan.

January 27, 1914. Message to Assembly by Mayor Kiel, urging the authorizing of a bond issue election and announcing the impracticability of obtaining Federal aid in the solution of the approach question.

January 27, 1914. Bill authorizing the adoption of the Alton and Mississippi plan, failed of passage in the Council. The Council also refused to act on the repeal of the Southern Traction franchise.

House of Delegates amended Council bill authorizing a bond issue election in the amount of $2,750,000, for the construction of the extended Reber approach, so as to provide $4,450,000 for the Alton and Mississippi approach, and passed same.

January 30, 1914. House of Delegates' amendments to bill rejected by Council. House and Council "deadlocked" on the issue.

February 6, 1914. Joint Committee of Municipal Assembly appointed, majority of which favor the Alton and Mississippi plan.

February 18, 1914. A brief favoring the extended Reber approach submitted to the Committee by the Business Men's League. Rejected by Committee.

February 19, 1914. Decision by a citizens' committee to circulate initiative petition for ordinance authorizing an election on the issuance of bonds, in the amount of $2,750,000, for the construction of the Extended Reber approach.

April 3, 1914. Petition filed containing 40,935 valid signatures, 10,275 more than necessary.

Council passed a bill in conformity with the initiative petition.

April 7, 1914. Board of Election Commissioners filed initiative petition with the Council. Bill authorizing bond issue election as a result of the initiative petition introduced in the Council.

April 14, 1914. Bill passed by the Council April 3, 1914, failed of passage by the House of Delegates.

April 28, 1914. Bill introduced by initiative petition passed by the Council.

House of Delegates passed a bill repealing the Southern Traction franchise.

Council passed a bill reducing the terms of the Southern Traction franchise to 25 years.

May 12, 1914. House of Delegates passed the Council bill introduced by initiative petition. Ordinance No. 27662 finally approved May 15, 1914. As a result of this action, no election on the ordinance was necessary.

June 30, 1914. New Charter adopted by the City of St. Louis, becoming effective August 29, 1914. Board of Public Improvements replaced by Board of Public Service. Council and House of Delegates replaced by Board of Aldermen.

October 13, 1914. Mayor Kiel announced an agreement to use only Union labor on bridge work.

October 16, 1914. Council passed a bill repealing the Southern Traction franchise. Ordinance No. 27740 approved November 7, 1914.

November 6, 1914. Bond issue election held. Proposition to issue bonds in the amount of $2,750,000 approved by a vote of 88767 to 13151. The City of St. Louis at this time adopted the policy of executing the work of completing the eastern approaches of the Municipal Bridge, by the direct purchase of material and employment of labor, eliminating contracts except where same were plainly more expedient. Detailed plans were approved by the Board of Public Service from time to time, and ordinances prepared and passed, appropriating funds for the various sections of the work. All construction ordinances authorized the Board of Public Service to let contracts, purchase material, employ labor, or otherwise provide for the execution of the work. While final bond issue ordinance specifically refers to the completion of the eastern approach only, the work done included the completion of the entire construction, embracing the railway construction and paving, ties, and rails, sidewalks, etc.

December 29, 1914. Ordinance No. 27796 declaring the result of the bond issue election and directing an issue of bonds, in the amount of $2,750,000, for the construction of the eastern approaches of the Municipal Bridge.

February 8, 1915. Ordinance No. 1994 of the City of East St. Louis establishing regulations with respect to traffic on the bridge. Accepted by Mayor Kiel on March 6, 1915.

February 9, 1915. Ordinance No. 27806 repealing previous ordinances and authorizing the widening of Seventh Street, from Chouteau Avenue to Cerre Street, for bridge terminus and plaza.

February 15, 1915. Act of Congress extending the time for completion of bridge three years from date of Act.

March 17, 1915. Work started by the City of St. Louis on the eastern approaches.

April, 1915. Henry W. Kiel, Mayor.
E. R. Kinsey, President of the Board of Public Service.
A. S. Aloe, President of Board of Aldermen.

April 16, 1915. Ordinance No. 28060 authorizing the Board of Public Service to let a contract for the eighth section of the bridge, consisting of the steel superstructure for the entire system of eastern approaches.

Ordinance No. 28061 appropriating an additional $360,000 for the eastern combined approach and separate highway approach.

April 20, 1915. Contract let to Chas. L. Lund for driving concrete piles for the entire system of foundation for the eastern approaches. Final cost, $120,279.07.

July 21, 1915. Contract let to American Bridge Company of New York for fabricating and delivering steel for the entire superstructure of the eastern approaches of the bridge, in the amount of $1,039,000. Final cost including rails for the entire bridge, $1,099,453.

October 30, 1915. Contract let to John Beaird, Jr., for earth fill between retaining walls of the highway abutment. Final cost, $4,545.30.

December 3, 1915. Ordinance No. 28377 appropriating $630,000.00 for section 7a, consisting of foundations and retaining walls for the separate eastern railway approach.

April 27, 1916. Ordinance No. 28814 revising ordinance No. 26592, fixing regulations for railroads using the bridge. This ordinance was repealed later.

September 2, 1916. Contract let to the List & Gifford Construction Company of Kansas City for earth fill between retaining walls on the eastern railway approach. Final cost, $29,614.92.

November 6, 1916. Contract let to Henry B. Dawson for concrete hand rails on the east highway approach. Final cost, $3,675.40.

January 3, 1917. Ordinance No. 29364 appropriating an additional $90,000 for superstructural steel for the eighth section of the bridge, and the payment of engineers' fees.

Ordinance No. 29365 appropriating an additional $561,000 for sections 7 and 7a of the bridge.

January 20, 1917. Public exercises on the completion and opening to traffic of the entire highway deck and approaches of the Municipal Bridge.

February 21, 1917. Ordinance No. 29501 prescribing terms and regulations under which traffic lines may use the Municipal Bridge, and creating a Municipal Bridge Commission to conduct bridge affairs after completion. This ordinance repeals all existing ordinances relating to the same subject. The Bridge Commission consists of the Mayor, the President of the Board of Aldermen, the Comptroller, the Director of Streets and Sewers and the Director of Public Utilities of the City of St. Louis.

April, 1917. Henry W. Kiel, Mayor.
E. R. Kinsey, President of the Board of Public Service.
A. S. Aloe, President of the Board of Aldermen.

June 2, 1917. Contract let to Beal & McNamara Painting Company, in the amount of $73,100, for painting the entire steel superstructure of the Municipal Bridge.

December 7, 1917. Resolution by Board of Aldermen calling on Congress to hasten the passage of an act extending the time for the completion of the bridge before the expiration of the existing grant.

February 11, 1918. Act of Congress extending the time for the completion of the Municipal Bridge three years from the date of Act.

A number of ordinances authorizing the purchase of land and condemnation of property for bridge purposes, and appropriating funds for same, have been passed from time to time, but are omitted from this chronology on account of its bulk.

May 16, 1918. The Municipal Bridge was formally transferred to the Municipal Bridge Commission by President Kinsey of the Board of Public Service, all work covered by existing plans and specifications being complete. The transfer was accompanied by an inventory of all material on hand, a final report by Boller, Hodge & Baird, and a financial statement covering the entire bridge.

APPENDIX B.

FINANCIAL STATEMENT.

Prepared by Mr. Jas. M. Jones, Supervising Accountant, May 16, 1919.

Appropriations:

Appropriation for preliminary work	$ 35,775.80
First Bond Issue	3,500,000.00
Second Bond Issue	2,750,000.00
Appropriation for watchmen's services	1,200.00
Appropriation for extra work	1,459.96

Expenditures:		
Preliminary work—Borings, title investigations, etc	$ 35,775.80	
Section 1—Foundations and piers for the channel spans	472,447.14	
Section 2—Steel superstructure of the channel spans	1,397,623.26	
Section 3—Foundations and retaining walls for the combined western railway and highway approach, together with the separate highway approach	52,516.58	
Section 4—Steel superstructure for the portion of the western approaches included in Section 3	427,297.00	
Section 5—Foundations and retaining walls for the separate western railway approach	22,359.57	
Section 6—Steel superstructure for the separate western railway approach	51,887.75	
Section 7 and 7a—Foundations and retaining walls for the eastern approaches	1,592,879.16	
Section 8—Steel Superstructure of the eastern approaches together with the floor system of the entire bridge structure	1,099,453.54	
Engineers' fees	203,605.04	
Miscellaneous expenditures	3,975.90	
Land for right of way, attorneys' fees, etc., expended through Comptroller's Office	905,683.06	
Balance transferred to Municipal Bridge Commission	22,931.96	
	$6,288,435.76	$6,288,435.76

ST. LOUIS OFFICIALS DIRECTLY IN CHARGE OF AND RESPONSIBLE FOR THE CONSTRUCTION OF THE MUNICIPAL BRIDGE.

ANDREW J. O'REILLY, President of the Board of Public Improvements, during the period of preliminary work, preparation of plans, etc., 1905 to 1909.

MAXIME REBER, President of the Board of Public Improvements, during the construction of the river spans and western approaches. 1909 to 1913.

EDMUND R. KINSEY, President of the Board of Public Improvements (later Board of Public Service), during the construction of the eastern approaches, and the completion of the bridge. 1913 to 1918.

CHARLES M. TALBERT, Associate to the President, Board of Public Improvements (later Board of Public Service), during the tenure of Messrs. O'Reilly and Reber.

WILLIAM E. ROLFE, Associate to the President, Board of Public Improvements (later Board of Public Service), during the tenure of Mr. Kinsey.

ENGINEERS IN CHARGE OF DESIGN AND CONSTRUCTION OF THE MUNICIPAL BRIDGE.

BOLLER AND HODGE (later Boller, Hodge and Baird) of New York, engineers in charge of design and construction of the entire bridge project.

BRENNEKE AND FAY of St. Louis, resident engineers, representing Boller, Hodge and Baird, throughout the duration of the work.

PHILIP AYLETT (1909 to 1910) and SHERMAN W. BOWEN (1910 to 1913), engineers representing Brenneke and Fay, as Supervisors of Construction.

CLINTON H. FISK, Chief Engineer, and W. F. COLLAR, Superintendent of Construction, in charge of construction of the eastern approaches, and the completion of the bridge.

APPENDIX C.

LAWS RELATING TO THE BRIDGE.

Laws of the State of Missouri, 1905; page 94; approved April 6, 1905.

Charter of the City of St Louis, Adopted August 22, 1876.

Article 1, Section 1.

Authorizes the City of St. Louis to build a bridge across the Mississippi River.

"The City of St. Louis may purchase, receive and hold property, real or personal, within said City, and beyond the limits, to be used for the establishment of hospital, poorhouse, house of correction, etc., *or for any other purpose.*"

Charter of the City of St. Louis. Adopted August 29, 1914.

Article 1—Powers.

Clause 9; "to condemn private property within or without the City or State."

Clause 11; "to acquire, construct, own, operate and maintain or sell, lease, mortgage, pledge or otherwise dispose of public utilities or any estate or interest therein, or any other utility of service to the City, its inhabitants or any part thereof."

Clause 13; "to regulate the construction, maintenance, equipment, operation, service, rates and charges of public utilities, and compel, from time to time, reasonable extensions of facilities for such service."

Clause 15; "to acquire, provide for, construct, regulate and maintain and do all things relating to all kinds of public buildings, structures, markets, places, works and improvements."

Ordinances authorizing the appointment of a Municipal Bridge and Terminals Commission to investigate, and to determine the nature and extent of, the hindrance to the commerce of St. Louis by existing freight charges, methods of shipping, etc., and to make recommendations. 22026, 23133.

Ordinance authorizing a Joint Committee of the Municipal Assembly to select a site for a Municipal Bridge. 22799.

Ordinances locating the Municipal Bridge and approaches. 23315, 24283, 25979.

Location of the eastern approaches is covered by condemnation and purchase ordinances.

Ordinances of the City of East St. Louis relating to easements for bridge construction. 1737, 1836, 1994.

Acts of Congress regulating the construction of bridges over navigable waters, and authorizing the City of St. Louis to construct a Municipal Bridge across the Mississippi River.

Act approved March 23, 1906.—Chapter 1130.

Act approved June 25, 1906. U. S. Statutes at Large, 59th Congress, 1905-8.—Chapter 3539, Page 467.

Acts of Congress extending the time for completion of the Bridge.

Act approved February 8, 1907.

Act approved January 9, 1910.

Act approved February 17, 1912.

Act approved February 9, 1915.

Act approved February 11, 1918.

Ordinances authorizing Bond Elections and sale of bonds. 22366, 22674, 25773, 25821, 26433, 26650, 27662, 27796.

Ordinances authorizing purchase and condemnation of property for Municipal Bridge approaches, dedicating certain lands for public streets, and appropriating money for purchase, condemnation proceedings, and taxes. In St. Louis: 24456, 25105, 25362, 25980, 25996, 26037, 26637, 26642, 27126, 27593, 27806, 27887, 28663, 29949, 29962, 30236. In East St. Louis: 24736, 24737, 25018, 25365, 25390, 25392, 25482, 25490, 25559, 25617, 25676, 25792, 25801, 25819, 25854, 25875, 25969, 25970, 25971, 26379, 26486, 26967.

Ordinances authorizing the employment of engineers for the Municipal Bridge. 23383, 24119, 24803, 29500.

Ordinance authorizing the preparation of plans and specifications, and their submission for approval to U. S. Government authorities. 23330.

Ordinances authorizing the Board of Public Improvements and later, the Board of Public Service, to let contracts for the construction of the Municipal Bridge and approaches, and appropriating money therefor. 24457, 24583, 25947, 25948, 26336, 26635, 26636, 26896, 27762, 28060, 28061, 28377, 29364, 29365, 30039, 30201.

Ordinances granting a franchise to the Southern Traction Company to operate an electric railway over the Municipal Bridge; also repealing same. 25810, 26679, 27740.

Ordinances creating a Municipal Bridge Commission, and establishing regulations for the maintenance and operation of the bridge. 26592, 28814, 29501.

APPENDIX D.

PHYSICAL DATA.

RIGHT OF WAY.

In St. Louis:

Width, combined approach from Pier 1 to Broadway	100 ft.
Width, separate highway approach from Broadway to Seventh Street	100 ft.
Width, separate railway approach from Broadway to Eighth Street	50 ft.
Total Acreage	7.2 A.
Private Property	5.13 A.
Public Streets	2.07 A.

In East St. Louis:

Width, combined approach from Pier 4 to the point of divergence	80 ft.
Width, separate highway approach from the point of divergence to Tenth Street and Piggot Avenue	75 ft.
Width, separate railway approach from the point of divergence to Falling Springs Road	40 ft.
Same, from Falling Springs Road to Fifteenth Street	Variable
Same, from Fifteenth Street to Twenty-second Street	120 ft.
Same, from Twenty-second Street to Twenty-ninth Street	60 ft.
Total Acreage	37.35 A.
Private Property	35.89 A.
Public Streets	1.46 A.

RIVER SPANS.

Piers.

Preliminary Borings:

Number in St. Louis	13
Number in the river channel	12
Number in East St. Louis	38
Range of depth	19.6 ft. to 110.0 ft.
Average depth	40 ft.
Total depth	3028 ft.
Deepest boring, on site of Pier 4	110 ft.

Caissons:	Lateral Dimensions	Height
Pier 1	23 ft. by 60 ft.	47.0 ft.
Pier 2	33 ft. by 90.25 ft.	46.5 ft.
Pier 3	33 ft. by 90.25 ft.	74.2 ft.
Pier 4	26.5 ft. by 79 ft.	88.9 ft.

Concrete Foundations:

Lateral dimensions same as caissons.

Height from bed rock to bottom of pier masonry, same as height of caissons.

Masonry of Piers:	Lateral dimensions Top	Bottom	Height above Foundations
Pier 1	15′ 4″ by 52′ 4″	17′ 2″ by 54′ 2″	67.4 ft.
Pier 2	22′ 4″ by 52′ 4″	27′ 8″ by 86′ 0″	108.0 ft.
Pier 3	22′ 4″ by 52′ 4″	27′ 8″ by 86′ 0″	110.25 ft.
Pier 4	16′ 4″ by 52′ 4″	21′ 4″ by 74′ 0″	105.75 ft.

Height of Piers, from bed rock to bridge seats:

Pier 1	114.40 ft.
Pier 2	154.50 ft.
Pier 3	184.45 ft.
Pier 4	194.65 ft.

Distances between piers at high water level of 1903:

Pier 1 to Pier 2	652.11 ft.
Pier 2 to Pier 3	653.38 ft.
Pier 3 to Pier 4	651.88 ft.

Distances center to center of piers:

Pier 1 to Pier 2	672.5 ft.
Pier 2 to Pier 3	677.0 ft.
Pier 3 to Pier 4	672.5 ft.

Distance between inner harbor lines, as established by the U. S. Government: 2000 ft.

Distance of center of Pier 1 west of west harbor line: 10.5 ft.

Distance of center of Pier 4 east of east harbor line: 11.5 ft.

STEEL SUPERSTRUCTURE.

General:

Length of each span from center to center of end pins	668 ft.
Distance between end pins of adjacent spans, on river piers	9 ft.
Total length of river spans	2022 ft.
Height of bottom of steel work above high water level of 1903	65 ft.
Same above low water level of 1900	105.5 ft.
Width of bridge, center to center of trusses	35.0 ft.
Width of roadway	30.0 ft.
Width of sidewalks	6.0 ft.
Height of railway deck above bottom pins of trusses	5 ft. 9 in.
Height of highway deck above bottom pins of trusses	33 ft. 9 in.

Trusses:

Petit type, with 9 full panels, each divided into 2 sub panels.

Height of trusses at hips (center to center of pins)	60.0 ft.
Same at center	110.0 ft.
Extreme height of trusses	114.5 ft.
Full panel length at end of truss	60.0 ft.
Same at center	96.0 ft.
Diameter of end pins	15 inches
Length of end pins	5 ft. 4 in.
Area of bearing surface of bed plates on piers	56 sq. ft.
Number of segmental expansion rollers at end of each span	16
Diameter of rollers	15 inches

EASTERN APPROACHES.

Length of combined approach from Pier 4 to the point of divergence, east of the Mobile & Ohio Railroad	2,363.0 ft.
Separate railway approach, from the point of divergence to Twenty-ninth Street.	
Length of steel work	7,690.22 ft.
Length of retaining walls and embankment	3,275.0 ft.
Separate highway approach, from the point of divergence to Tenth Street and Piggott Avenue.	
Length of steel work	2,393.37 ft.
Length of retaining walls	550.0 ft.

WESTERN APPROACHES.

Length of combined approach from Pier 1 to the point of divergence at Broadway	1,854.0 ft.
Separate railway approach from the point of divergence to Eighth and Gratiot Streets.	
Length of steel work	798.0 ft.
Length of retaining walls and embankment	266.48 ft.
Separate highway approach from Broadway to Seventh and Papin Streets.	
Length of steel work	329.37 ft.
Length of retaining walls and embankment	273.33 ft.

COMBINED MEASUREMENTS.

Railway:

Length of eastern railway approach	13,328.22 ft.
Length of river spans	2,022.00 ft.
Length of western railway approach	2,918.48 ft.
Total length of railway deck	18,268.70 ft.
	or 3.459 miles

Highway:

Length of eastern highway approach	5,306.37 ft.
Length of river spans	2,022.00 ft.
Length of western highway approach	2,456.70 ft.
	9,785.07 ft.
	or 1.853 miles

GRADES.

Railway:

West approach	0.655% to 1.3855%
Channel spans	Level
East approach	0.0% to 0.983%

Highway:

West approach	1.0% to 3.443%
Channel spans	Level
East approach	0.983% to 4.156%

WEIGHT OF STEEL.

Western approaches (estimated)	7,938.446 tons
Channel spans (actual)	13,925.660 tons
East approaches (actual)	23,919.786 tons

INDEX.