Kingshighway Viaduct
Spanning the Missouri Pacific, and the
St. Louis and San Francisco Railroad
tracks at Kingshighway Boulevard
between Manchester Avenue and McRee Avenue
City of St. Louis
Missouri

HAER No. MO-38

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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Location:	Spanning the Missouri Pacific and the St. Louis and San Francisco Railroad tracks at Kingshighway Boulevard between Manchester Avenue and McRee Avsnue, City of St. Louis, Missouri
Date of Construction:	1910-1912
Present Owner:	City of St. Louis City Hall St. Louis, Missouri 63103
Present Use:	Still in use as a viaduct.
Significance:	The Kingshighway Viaduct is a 1,857-foot-long reinforced concrete arched viaduct. It is an excellent example of bridge construction of its type and period and possesses artistic value among Missouri bridges.
Historian:	Diane V. Reeves Campbell Design Group December 1968

Introduction

The Kingshighway Viaduct is located in southwest St. Louis City between Manchester Avenue and McRee Avenue. It was built to carry Kingshighway Boulevard over the tracks of the St. Louis and San Francisco and the Missouri Pacific railroads. Kingshighway Boulevard is an important north-south arterial road, heavily trafficked to this day.

Due to the seriously deteriorated state of the viaduct, the city of St. Louis plans to replace it in the Spring of 1989. The existing bridge will be demolished and replaced with a new six-lane structure on the same alignment, to be open to traffic in 1990.

History

The city of St. Louis was founded in 1763 when Pierre Laclede Liquest landed at what is now the foot of Walnut Street. The original lots were verbally assigned by Laclede to the first settlers who had come to stay in St. Louis. The first lot sections were primarily along the riverfront, close to the water.

After the initial lot sections were established, the next step was to provide "Commons," or open fields, for the grazing of livestock. As the town grew, numerous outlying Common Fields were established and, by 1770, St. Louis subsidiary lands covered about 25 square miles. A Common Field called Prairie de Noyers was located southwest of the town, with its western limits at what is now Kingshighway Boulevard. Originally called Rue de Roi by the French and Camino Real by the Spanish, Kingshighway Boulevard served as a major north-south road, connecting the farm lands located west of town.[1]

After the Civil War, the city experienced a period of prosperity and physical expansion. Development began to extend rapidly in all directions, along established lines. New streets were adapted and upgraded from existing highways, and areas west of Grand Avenue began to develop primarily as large residential homes.

Forest Park was established in 1874, just west of Kingshighway Boulevard, and contained over 1,100 acres of virgin forest. Although Forest Park was considered an outer park at the time of its establishment, it gradually became the city's principle recreational area.[2]

Kingshighway was not incorporated into the city of St. Louis limits until the last extension of the boundaries in 1876. At this time, the new portion of the city west of Grand Avenue was largely open farm land and country homes of the landed gentry. With the appearance of local transit facilities in the 1880s and the automobile in the late 1890s, urban growth extended west of Grand, and eventually beyond Kingshighway. Kingshighway Boulevard was quickly becoming a major north-south arterial for the city and provided access from the south to Forest Park.

As this urban growth occurred, it became apparent by the Street Department of the city of St. Louis, that a viaduct was needed on Kingshighway Boulevard between McRee and Swan avenues, to separate vehicular and pedestrian traffic from rail traffic. The viaduct would carry the highway over the tracks of both the St. Louis and San Francisco and the Misaouri Pacific railroads. As traffic increased on Kingshighway, the crossing at the railroad tracks between McRee and Swan avenues became dangerously congested at peak timee. The viaduct became a necessity, according to the city's Bridge Engineer'a Report for 1891-92, prepared by First Deputy Street Commissioner Carl Gayler.[3]

In 1900, Kingshighway was established as a boulevard by city ordinance. The importance of Kingahighway is exhibited by the fact that the city established, by ordinance, the Kingshighway Boulevard Commission on July 12, 1902. The commission consisted of three citizens, assigned to prepare "a plan for the permanent improvement of Kingshighway throughout its length."[4]

Prior to the creation of the Kingehighway Boulevard Commission, Kingshighway existed ae a public etreet, 100 feet wide, from Gravois to Florissant avenues. Not all of thie portion of the street was completely open or improved, but the plan of the commission was to extend Kingshighway both north and south to the Mississippi, thus making a complete cross-town boulevard which would connect all of the city's principal parks. A City Plan Commission report in 1917 stated that if that plan had been carried out immediately, "a very different condition would exist than the present unhappy state of this thoroughfare."[5]

In spite of the appeals from Carl Gayler, a bridge would not be constructed until 1904, when the city finally allocated funds for conatruction of a viaduct between McRee and Swan avenues. The city appropriated $40,000 and contracted Quigley Construction to build a 1,203-foot timber and steel structure. This type of viaduct proved to be a poor choice for such a heavily-trafficked route. Five years after its completion, the bridge department began planning a replacement viaduct, made of reinforced concrete. In 1909, City Staff Engineer, A. C. Janni, began designing the new viaduct to be the longeat span length of its structural type in the State of Missouri.[6]

Concrete Arch Construction

The Kingshighway Viaduct waa conatructed of reinforced concrete--a structural method which had become prevalent in America in the early 1900s. Concrete, a man-made stone composed of sand, gravel, water and cement, has been in existence for over two thouaand years, Concrete by itself, however, has limitations as to the length it can span, due to its heavy weight and relatively low tensile atrength. Reinforced concrete, on the other hand, has a skeleton of metal that resists the tension stresses that concrete can not.

Reinforced concrete was invented in the 1860s by a French gardener named Joseph Monier. Monier built one of the firet reinforced concrete bridges in 1877, with a span of 50 feet long and 13 feet wide.[7] Uae of the material for bridge construction increased through the years, as did the span length. Concrete was found to be economical, readily available and had the advantage of a plastic quality which enabled it to be cast into any desired form. This does not mean that construction is simple in reinforced concrete. Every stage requires a great deal of skill, care and sensitivity from the workmen who make the forms, placing the reinforcing steel and mix the concrete, and from those responsible for design and supervision.[8]

One of the first large concrete bridges to be built in the United States is the Connecticut Avenue Bridge in Washington, D. C. Completed in 1904, this bridge is 1,341 feet long and contains seven semicircular arches, five of which span 150 feet.[9]

Description of the Kingshighway Viaduct

Using the reinforced concrete structure, the viaduct on Kingshighway was designed by Janni to have primary arches longer than any other concrete arch built before in Missouri. The two outside arches each spanned 140 feet and the center arch spanned 170 feet (see photo MO-38-14). The arches were of the open-spandrel design, resembling the style of many steel arched bridges previouskly built around the world. Although other concrete bridges had used the open-spandrel design, the filled spandrel arch was more common, particularly for shorter span arches.

City Staff Engineer, A. C. Janni, designed the three primary spans of the Kingshighway Viaduct as a singlr elastic system, with the arches tied solidly to the piers, using horizontal steel diaphrams. He established the maximum compression of the concrete at 800 pounds per square inch, and the maximum tensile strain on the steel reinforcing at 12,000 pounds per square inch. Janni engineered the viaduct to support a live load of 150 pounds per square foot, with a 24-ton concentrated load on four wheels, and used steel reinforcing throughout the arches and roadway deck (see photo MO-38-14). The viaduct utilizrd arch reinforcement, consisting of rows of 7/8-inch steel bars spaced closely together. These bars extended continuously over the length of the arch and were held in place by 1/4-inch steel stirrups.[10]

The total length of the viaduct was 1,857 feet. The south abutment began at McRee Avenue, and was originally marked with monuments standing more than 15 feet high on either side of the entrance to the bridge approach. These monuments, like those placed at the north entrance, had bronze plaques mounted on them, commemorating the year it was built. The style of the monuments were of the Neoclassical genre, symmetrical with restraine details and use of pure geometrical forms like the pyramid and the cube (see photos MO-38-7, MO-38-10, MO-38-11, and MO-38-17).

The entrance monuments were followed by the south abutment which consisted of an inclining approach ramp commencing with five panels of concrete retaining walle eeparated by five architectural concrete pilasters (see photo MO-38-5). The fifth panel ended with a large pier which contained a 10 foot by 12-foot windowless room, in the middle of which a cast-iron door was placed with a bronze frame and stone sill (see photo MO-38-14). It ie not known if the door was ever functional or whether thie room had a purpose. Most likely this was an ornamental feature only. The fifth panel was followed by six filled spandrel, approach arches spanning 25 feet each (eee photos MO-38-6 and MO-38-15). The fill at the approach arches wae held by continuous vertical retaining walls. The approach spans were followed by the three main spans of 140 feet, 170 feet and 140 feet, reepectively (see photos MO-38-3 and MO-38-8). The viaduct then continued on the north end with six additional arch approach spans (25 feet each), followed by nine panels of concrete retaining walls, separated by nine architectural concrete pilasters (see photos MO-38-1 and MO-38-2). The first of these panels contained a room identical to the one on the south end. The north abutment finiehed at Manchester Avenue, with entrance monuments like that at McRee Avenue.[11]

With a roadway grade of 1.13% and a steeper ground elope, the bridge still provided only minimal vertical separation between the roadway deck and the tracke below. Thie necessitated the use of very shallow arches--14 feet of arch rise above springline on the 140-foot spane and 17 feet on the 170-foot span. Because of this shallow configuration, the open-spandrel design was not carried out and, therefore, the center columns were encased in solid fill.[12]

The maeeive piers were deeigned to resist the horizontal thrust of the arches. BecAuse of the weight of the bridge and the heavy volume of traffic it had to carry, Janni had to design the reinforcing pattern in the bridge substructure to distribute the load over ae wide an area ae poesible. Thie technique brought attention to the viaduct. The May 1911 Engineering News stated the following about the viaduct:

> "A concrete arch of importance ie being built on Kingshighway in the City of St. Louie. The three large spans are 140, 170 and 140 feet, respectively. On account of the character of the foundation bed, it was necessary to adopt an unueual construction to epread the load over a large area by means of reinforced footing slabs, and vertical partitione and eidewalls forming a kind of cellular conetruction."[13]

The total width of the bridge was 44 feet 6 inches. The roadway deck of the viaduct was originally creosoted wood blocks, laid over a reinforced concrete base, crowned for drainage. On either side of the roadway, 14-foot-wide concrete eidewalks were placed for pedestrian traffic (eee photo MO-38-11). These sidewalks were eurfaced with a graniloid finieh and edged with granite curbs. The guardrail wae also poured-in-place concrete, divided into panels with oval-shaped cutouts, grouped in threee (eee photoe MO-38-2 and MO-38-7).

This rail added to the architectural detail of the bridge, as did the addition of a bracked ornamental balcony on piers 6 and 9, on both the east and west sides (see photos MO-38-3, MO-38-9, and MO-38-12). Much of the credit for the architectural treatment on the bridge can be given to Frederick M. Mann, who had been selected by the city ae the coneulting architect for ths project. The city wanted to ensure an architectural treatment of the viaduct that would integrate it into the urban landscape. Horizontal grooves were placed on the piers and arches to represent masonry coursing (see photos MO-38-12, MO-38-15 and MO-36-16), and Mann specified three textural treatments for the surface of the bridge. The filled spandrels of the arches were bush hammered. The arch rings and the areas on the piers and walls around the horizontal bands of rusticated joints were finished with a smooth mortar-like texture. Finally, all exposed concrete above the roadway level, including the guardrail and pylons, was textured with the widely-used Quimby method of scrubbing, until the selected aggregate appeared on the surface.[14]

In addition, elaborate lampposts were designed, two large, five-light lamps for the north entrance and 68 single lamp posts, to be spaced along the length of the viaduct.

On June 28, 1910, after soliciting competitive bids for the construction of the viaduct, the city contracted with St. Louis builder, William P. Carmichael. On July 10, two weeks after receiving the construction contract, Carmichael began building the new viaduct. Workers removed the original bridge for salvage in September 1910. They completed the superstructure of the concrete bridge in November 1912, and by the end of the year, the viaduct was opsn to traffic. It was not until the following year that the lamp posts were installed on the bridge.

The bridge received a favorable rating from the public. A local magazine called Forward St. Louis described as follows:

> "There has recently been completed the Kingshighway viaduct, a massive and magnificent concrete viaduct, with spans of almost unprecedented length for this class of work, and beautiful in design. Its broad upper roadway has an ornamental balustrade, with lamp standards. The viaduct is very suggestive of some bridges which have made European cities famous."[15]

The viaduct turned out to be an expeneive endeavor, costing almost a half million dollars. City records indicate costs to be broken down as follows:

Concrete work-William P. Carmichael Co., Contract	$380,587.81
Additional concrete work-Carmichael	6,486.86

Waterproofing and fill-Reprecht & Voirol Construction Co.	4,212.36
Roadway foundation, paving, curbing-Harry F. Heman	26,152.95
Repair of fallen wall-Heman	1,277.86
Supervision of construction	7,731.37
Architect	1,500.00
Widening north approach between Swan and Manchester Ave.	32,000.00
Construction and installation of lamp posts	8,370.00
Painting and repAir of lamp posts	1,785.87
Total	470,605.08[16]

Compared to other bridges built elsewhere in the United States and those built over the Mississippi River in St. Louis, the Kingshighway Viaduct was built for less per linear foot (about $250 per linear foot, as compared to between $400 to almost $2,400 per linear foot elsewhere). Nevertheless, at the time of its completion, the Kingshighway Viaduct was one of the most costly bridges built in the city and the State of Missouri, because of its length. The sheer size of the bridge made it expensive.

Present Condition

The Kingshighway Viaduct currently still functions as designed, in its original location. Modifications have been made to the viaduct, primarily in the way of improvements and replacements of the roadway deck. The entrance monuments have been modified and only the southwest monument remains in full. The northeast and northwest monuments have only the base remaining (see photo MO-38-1), and the southeast monument has been removed entirely. The deteriorated state of the bridge has altered its once smooth concrete appearance. In fact, a report submitted in 1925 by C. E. Smith, a consulting engineer, indicated that the bridge had undergone settlement of about 3-1/2 inches in the grown of the north and south main arches resulting from the outward movement of the end abutment piers (6 and 9). That movement has arrested itself, but the report stated several problems with the bridge, which are evident today. The concrete has become cracked, stained and worn away to the point that architectural features are obscured, and the reinforcing bars have been exposed in several places, particularly on the underside of the main arches (see photo MO-38-13).

Repairs were made in 1955, which included removal and replacement of defective concrete surfaces and the opening of expansion joints. Since that time, occasional resurfacing and repairs have been made to the handrail. The sidewalks have been repaired and replaced with concrete slabs and asphalt to create an inconsistent patchwork and the decorative light fixtures were removed long ago.

Then, in the summer of 1987, the retaining walls at the approach arch spans at the north end of the bridge collapsed on both the east and west sides, allowing part of the earth fill to spill out. A large portion of the handrail fell to the ground. Additionally, this collapse caused major cracks to occur on Pier 10 (east side) and on much of the handrail and pilasters. The city took measures to retard further collapse of the bridge, but it was never fully repaired. The bridge was reduced from six to four lanes, due to the outer collapse of the bridge (see photos MO-38-9 and MO-38-12).

In addition, chainlink fencing has been placed across several of the approach arches and space under the arches is used for outdoor storage (see photo MO-38-6). The fencing and unsightly storage items could be removed; however, major restoration would have to be done to the deteriorated concrete to revive the bridge to its full beauty and integrity.

Conclusion

The Kingshighway Viaduct, despite its condition, is a fine example of a reinforced concrete arched bridge of its era. The span length for concrete arch bridges was not exceeded in Missouri until 1932 with the construction of the White River Bridge in Taney County. The Kingshighway Viaduct has yet to be exceeded in terms of total length for an arched concrete bridge in Missouri. Furthermore, significant architectural treatment was designed for this viaduct at Kingshighway to integrate the structure into the urban fabric which surrounded it and to give it a style and presence of importance on this major thoroughfare.

Footnotes

[1] St. Louis City Plan Commission, History: Physical Growth of the City of St. Louis, 1969.

[2] Ibid.

[3] Bridge Engineer's Report, 1891-1892, prepared by Carl Gayler, First Deputy Street Commissioners in Charge of Bridges and Culverts, St. Louis, Missouri, April 11, 1892.

[4] St. Louis City Plan Commission, The Kingshighway, January 23, 1917, p. 3.

[5] Ibid., p. 4.

6 Cultural Resource Survey, Kingshighway and Arsenal Street Viaducts, St. Louis, Missouri, prepared by FraserDesign for Booker Associates, Inc., April 1986.

7 Silverberg, Robert, Bridges, Philadelphia: Macrae Smith Company, 1966, p. 106.

8 Mock, Elizabeth B, The Architecture of Bridges, New York: Museum of Modern Art, 1949, p. 85.

9 Watson, Wilbur Jay, Bridge Architecture, New York: W. Helbrum, 1927, p. 201.

10 Cultural Resource Survey, Kingshighway and Arsenal Street Viaducts, St. Louis, Missouri, prepared by Fraserdesign for Booker Associates, Inc. April 1986.

11 Description of the viaduct taken from the original construction drawings, dated from 1910, by A. C. Janni, Street Department, Office of the Bridge Engineer, St. Louis, Missouri.

12 Cultural Resource Survey, Kingshighway and Arsenal Street Viaducts, St. Louis, Missouri, prepared by Fraserdesign for Booker Associates, Inc., April 1986.

13 Jacoby, Henry S., "Some Observations On Recent Bridge Construction in America," Engineering News, May 18, 1911, p. 599.

14 Cultural Resource Survey, Kingshighway and Arsenal Street Viaducts, St. Louis, Missouri, prepared by Fraserdesign for Booker Associates, Inc., April 1986.

15 E. R. Kinsey, President, Board of Public Improvements, "St. Louis Has Important Public Improvements in Progress," Forward St. Louis, November 3, 1913, p. 3.

16 Kingshighway Bridge, Cost Ledger and Record of Construction, Board of Public Service, City of St. Louis, Missouri.