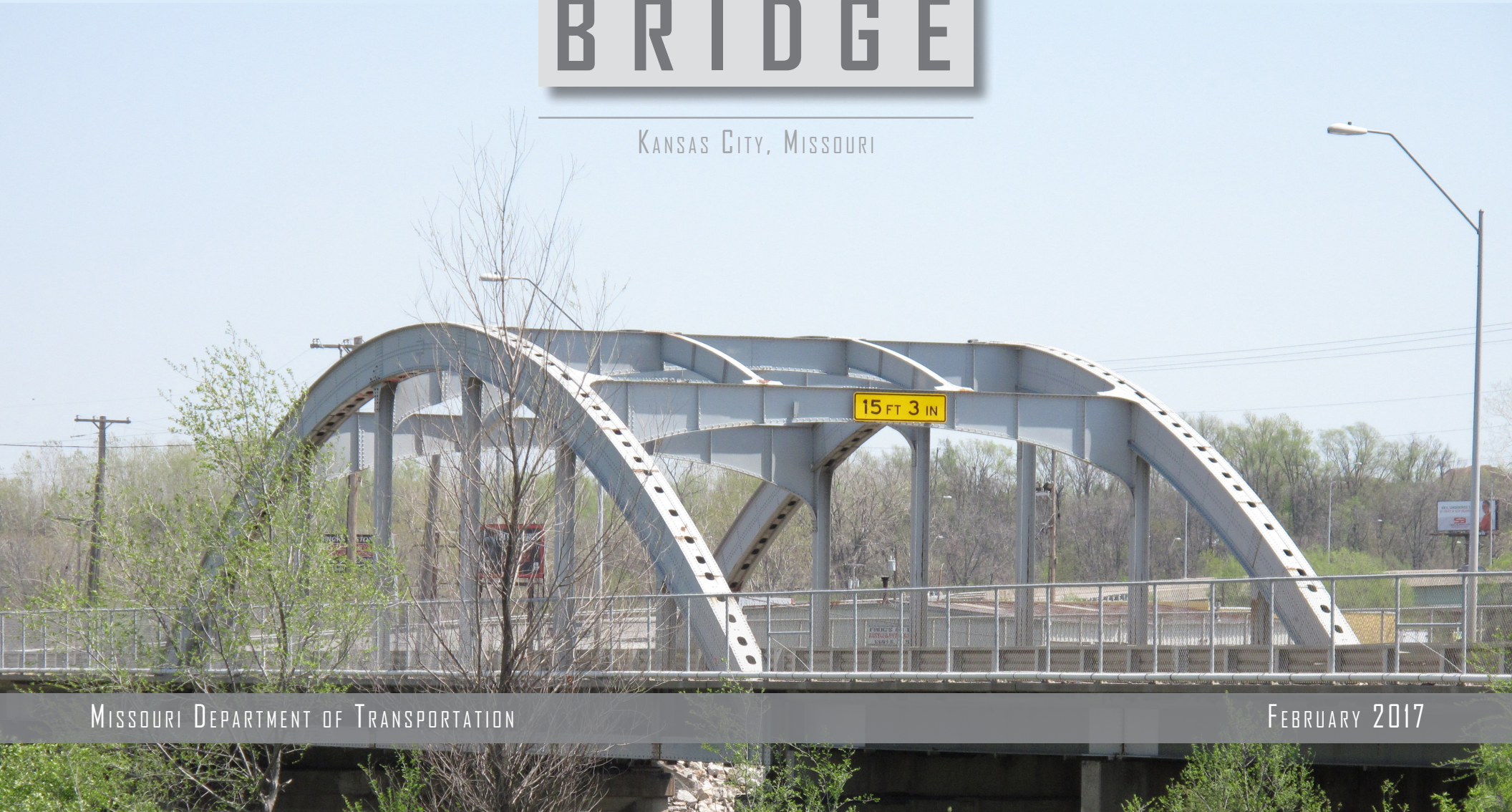
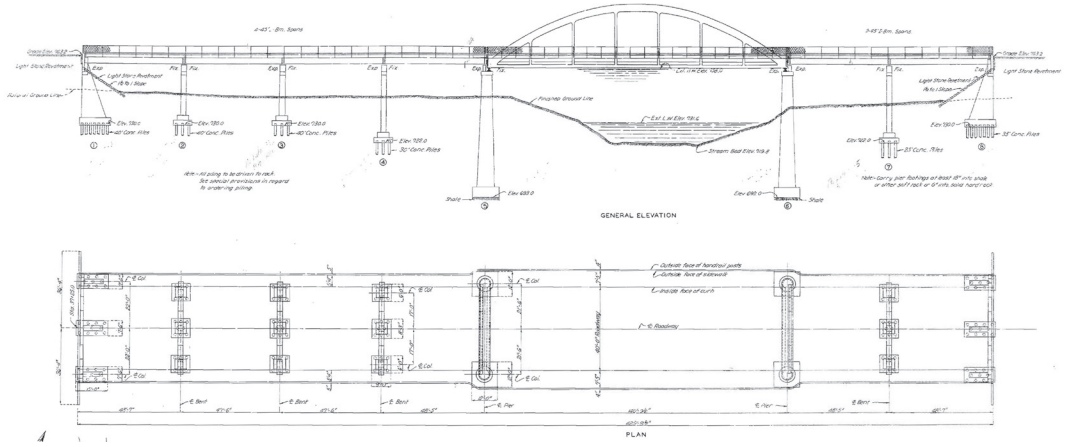
BLUE RIVER BRIDGE

Kansas City, Missouri



Missouri Department of Transportation

February 2017



BLUE RIVER
BRIDGE

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Workers dismantling the Blue River Bridge in 2015.
**Note: All photos and plans in document are courtesy of MoDOT unless otherwise noted.*

BLUE RIVER BRIDGE

Project Description

Join MoDOT in exploring an uncommon structural bridge type built in the 1930s.

The Missouri Department of Transportation (MoDOT) replaced Bridge J0526 crossing the Blue River along U.S. Route 40 (U.S. 40) due to safety concerns in 2015. The new bridge is adjacent to and suitable to carry I-70 traffic. The Blue River Bridge (BRB) was dismantled and relocated to storage at the Tail and Trails Dog Park in Grandview, Missouri, the location where it will be reconstructed.

The BRB was not only a successful crossing for U.S. 40 traffic but is also a beautiful, complex structure. The original 1933 bridge was determined eligible for the National Register of Historic Places under Criterion C for engineering due to its structural type, a steel tied arch and the amount of intact original materials.

The BRB was designed by the Missouri State Highway Department and constructed in 1933-34 by Davis Construction Company, Gerard Knutson Firm and Lay Construction Company.

It consisted of seven spans: four approach spans from the west, two approach spans from the east and one main span. The entire superstructure was 430 feet long with a forty-foot roadway. The main span, Span 5, was a steel, through, tied arch measuring 140 feet.

This document will go over the basic history leading to the plans for the BRB, the physical description of the BRB and what the future holds. Sit back, relax and enjoy the drive.

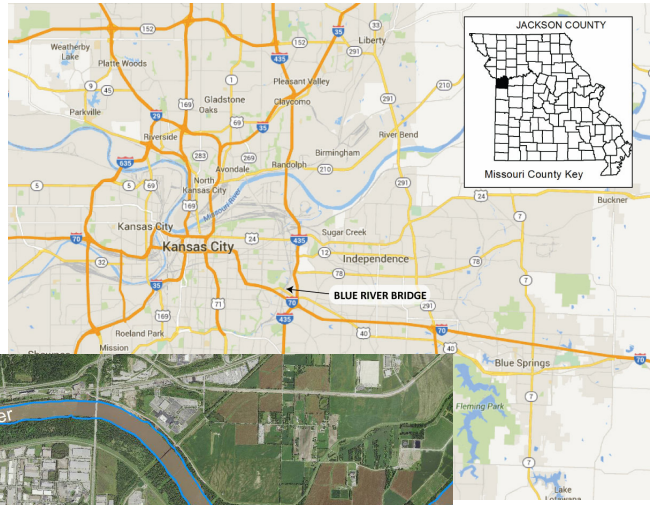
The Blue River

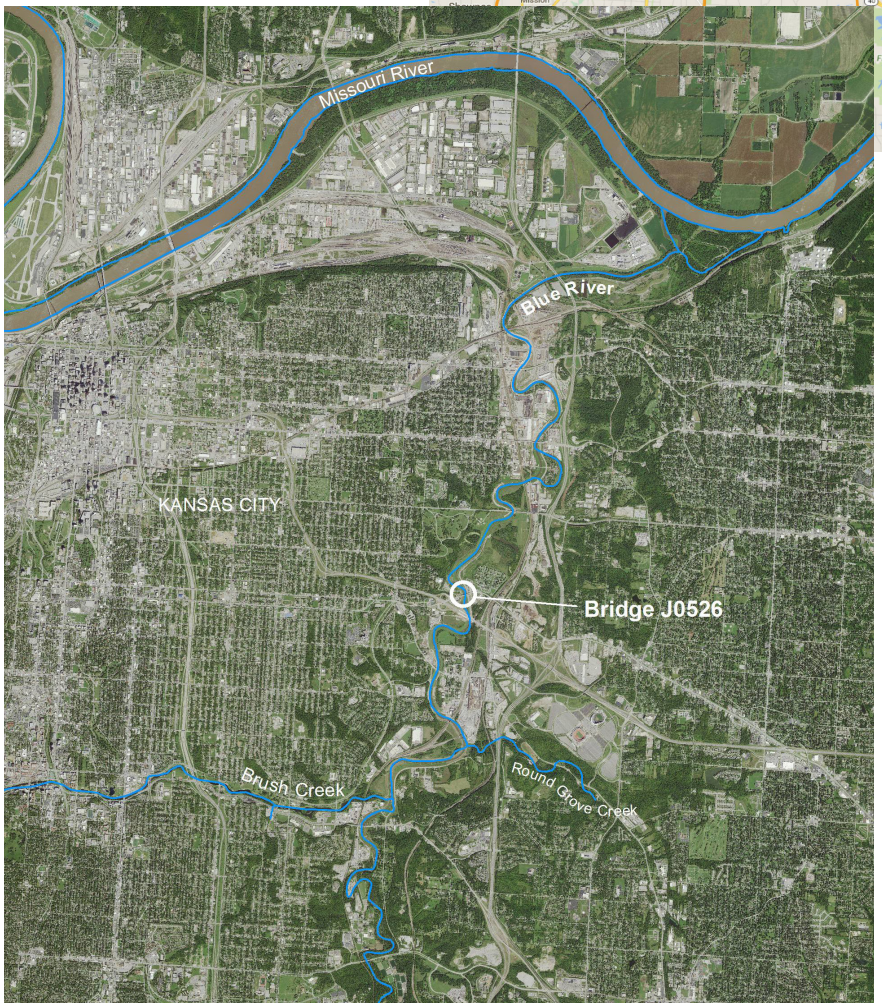
The Blue River is more than flowing water, but a destination for war, industry and activity seekers.

The BRB was important because it connected two areas. The BRB intersected the Blue River (River) near Kansas City, Missouri (see images). The forty-one mile Blue River's origins are at the confluence of Wolf and Coffee Creeks, three miles south of Stanley, Kansas. The River is a sub-basin of the Missouri River Basin.

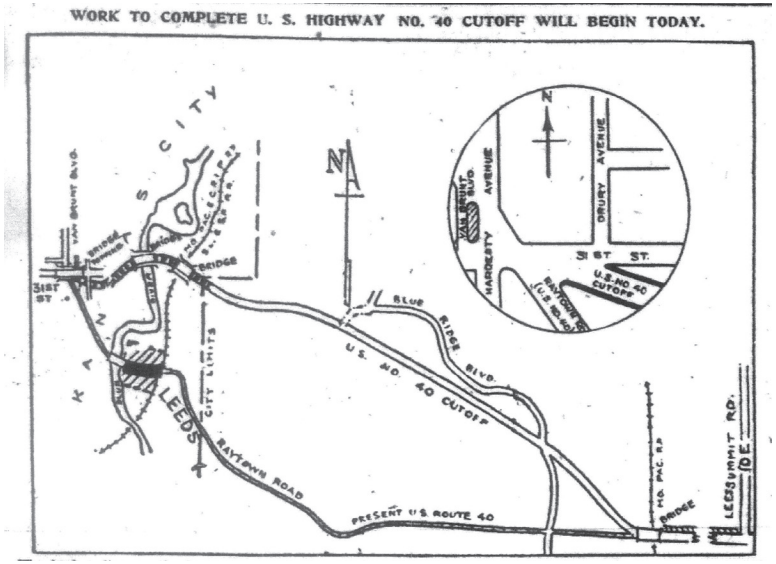
The area around the BRB has history as a battlefield area, natural area and industrial area. The Battle of the Big Blue occurred in the area during the Civil War. The River was described as "Big Blue," which has a deep channel, rapid current and "on both sides for nearly its whole course . . . timber of good quality, and . . . building stone . . . in endless quantities." This "timber of good quality" was cleared and floated to the Missouri River. Other industry included eastern manufacturers and real estate agents who facilitated the creation of factories and "towns" in the Blue River Valley in the 1880s. Then in 1920 the Blue Valley Industrial Area was formed which included the Fischer Body Plant, the Ford Motor Company and Sheffield Steel Corporation.

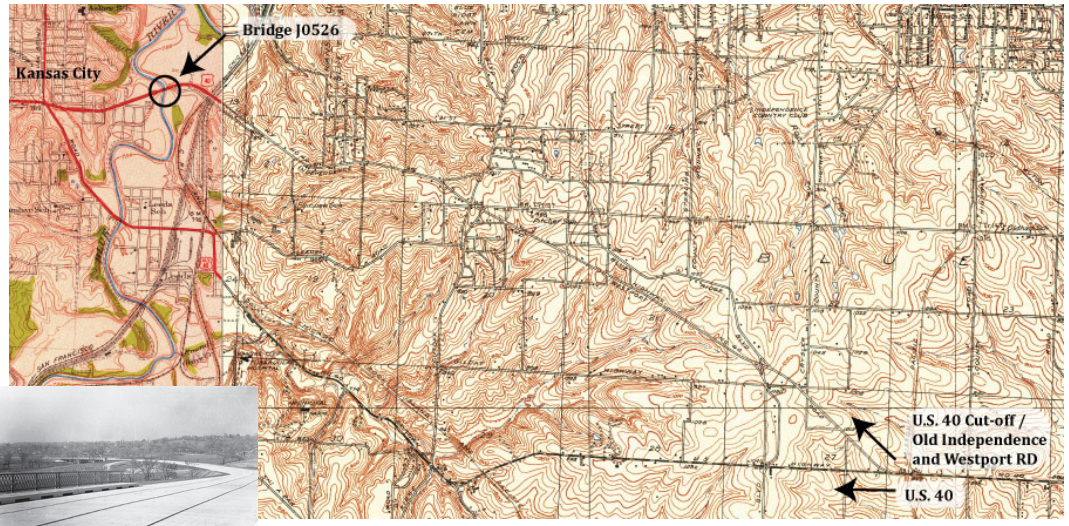
The River was also a leisure area for the people of the Kansas City Area in the 1920s-30s including the creation of the Kansas City Boating Club, Missouri Canoe Club, Kansas City Yacht Club and many more organizations all utilizing the Blue River for their recreation.





The BRB is located east of Kansas City adjacent to modern-day I-70. *Source: (Top) Google Maps 2015. (Left) Map drawn by author using ArcMAP.*





Far Left: Map of project details October 10, 1933. Top: Detail map showing where U.S. 40 cut-off and U.S. 40 diverge on U.S.G.S. topographic maps from 1934 and 1935. Inset: Picture of finished roadway circa 1934.

Source: (Far Left) The Kansas City Times, Octover 10, 1933, courtesy of the State Historical Society of Missouri. (Top) U.S.G.S. topographic maps from 1934 and 1935. (Inset) MoDOT Photo.

U.S. Route 40

The history of the origins of U.S. Route 40 date back to days when roads were not roads but named trails.

While the Blue River area was an important crossroads for industry and recreation, the route the BRB carried was an early embodiment of the history of road building in the Kansas City area. In Missouri, the Centennial Road Law was approved August 4, 1921. This Law called for the creation of a State Highway Commission which would oversee construction and maintenance of a state-wide connected system of hard-surfaced public highways. The oversight of the state-wide highway system required the Commission to name the routes on the system. One of the routes designated from existing roadways and newly constructed roadways in 1921 was Route (Rte.) 2. Rte. 2 was built on older highways including the Victory Highway, National Old Trails Road and Boone's Lick Road. This route was eventually renamed U.S. Route 40 due to a federal designation of U.S. routes in 1926.

A 1933 *Kansas City Star* article stated U.S. 40 as **"potentially Kansas City's most important motor vehicle traffic artery."**

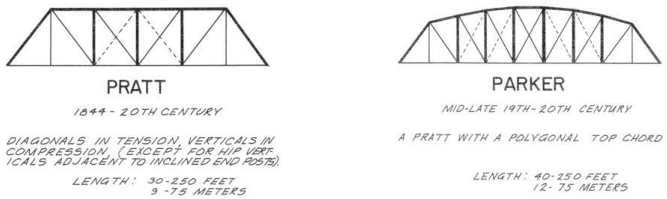
Two bridges previously existed in the area before construction of the BRB, the Old Westport / Independence Road Bridge and the bridge through Leeds. When the BRB was built, the Old Westport / Independence Bridge was decommissioned (see images above).

What is a Tied Arch?

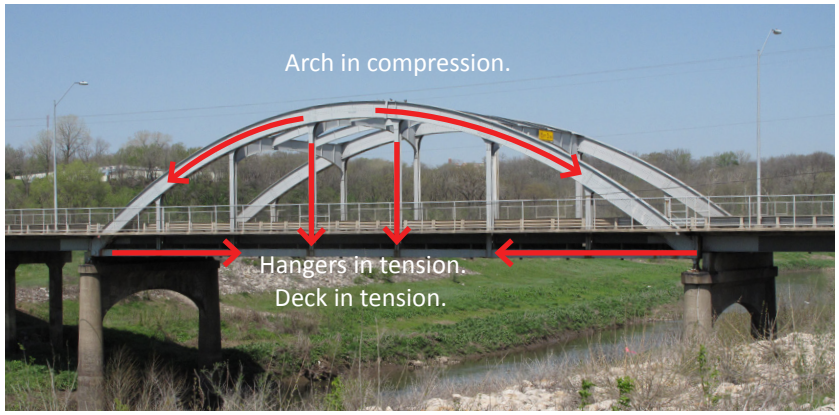
The BRB is a through, steel, rigid-connected, tied arch bridge. This made it a unique design for the Missouri State Highway Department.

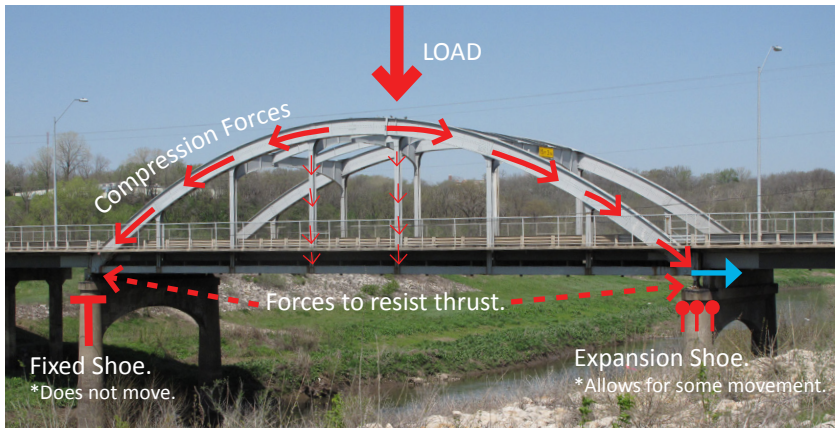
According to the *Context for Common Historic Bridge Types*, steel arch types are fixed, hinged or tied. The BRB is a through, steel, tied arch. Tied arches were used for a century before the BRB was built beginning with the bowstring arch-truss patented by Squire Whipple in 1840. Whipple's bowstring overhead truss was made of cast-iron with intermediate members of wrought iron. The 1860s and 70s brought bowstrings to Missouri but were replaced with pinned Pratt trusses as the standard bridge for "medium and long-span wagon bridges in Missouri" in the 1880s. In the 1930s timber and steel beam spans became standard designs for the Highway Department. Clayton Fraser stated, "Special designs [were] also necessary for [the] traffic relief program in St. Louis and Kansas City. Stream crossings, railroad grade separations and highway intersections required innovative designs."

In the 1930s the Missouri State Highway Department decided to use the tied arch for the 140-foot span over the Blue River instead of a typical Pratt or Parker configuration (see below), but the reason for this choice of design is unknown. This bridge type is inferred as chosen because the construction does not require large abutments; horizontal reactions for the bridge are transferred through horizontal ties connecting the ends of the arch together or the ties are a tension member, similar to a bowstring.

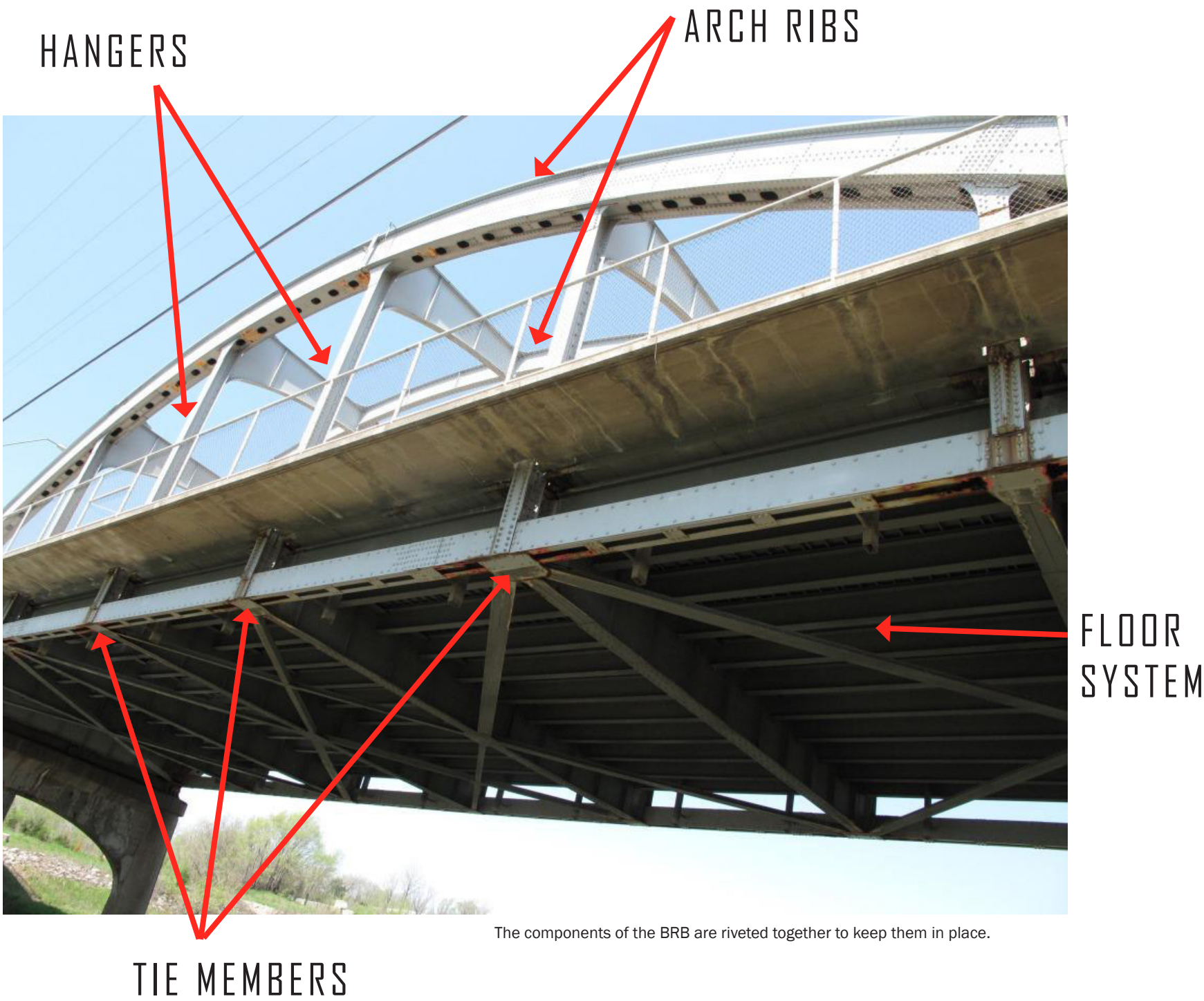


Source: (Images above) Historic American Enginerring Record, National Park Service, "Trusses: A Study by the Historic American Engineering Record," 1976.





Diagrams showing how the BRB acts similar to a bowstring.



The components of the BRB are riveted together to keep them in place.

Elements of the Bridge

Superstructure

The superstructure supports the deck as well as transmits loads across the spans to the bridge supports. It consists of the
(1) Floor System - receives traffic loads from the deck and distributes it to the main supporting elements, and;
(2) Main Supporting Elements - transfers loads to the substructure units.

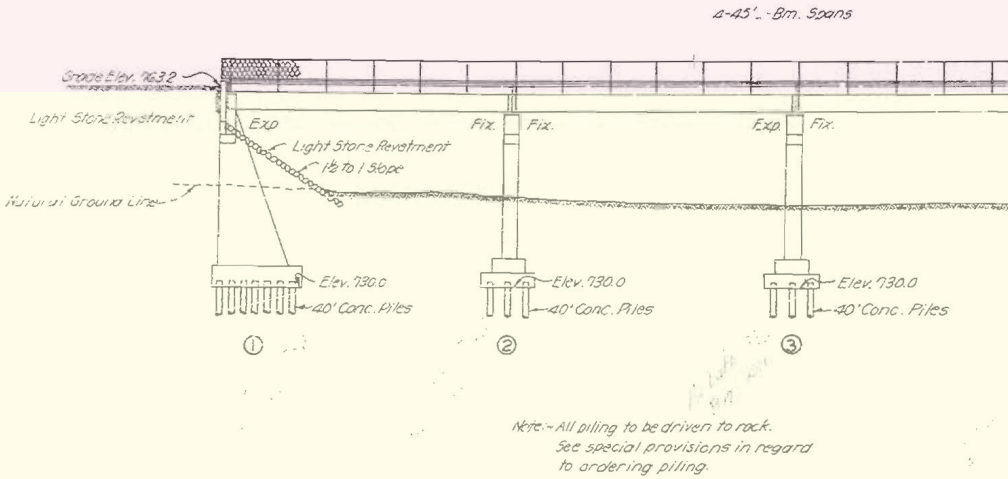
Main Supporting Element
Steel, through, tied arch

The arch was a riveted through truss and consisted of seven panels each twenty feet in length. The highest point between the deck and the top of the arch was the geometric height of twenty-eight feet, six inches. The maximum clearance for the through truss was fifteen feet, three inches. The end of the arch met Piers 5 and 6 with expansion shoes on the east end and fixed shoes on the west end.

Deck

The superstructure carries the deck whose function is to transfer live loads and dead loads off the deck to other bridge components.

The BRB deck is a polymer concrete overlay deck with a steel grid floor half concrete filled. The main span originally opened wider than the approach spans and the deck had sidewalks with a seven-foot, five-inch sidewalk with four-inch curbs on the north and south side of the truss, cantilevered from the bridge.



Substructure

The substructure functions as both axially-loaded and as bending members. The substructure contains three components.
(1) Abutments - retaining walls supporting the ends of a bridge.
(2) Piers - have only one footing at each substructure unit.
(3) Bents - have several footings or no footings at the substructure units.

Abutments

The west abutment (No. 1) included a footing atop seven, forty-foot concrete piles driven to rock. The stub abutment included a poured concrete wingwall, backwall and ledge for the bridge seat. Abutment No. 8 on the east end of the BRB had a footing consisting of seven, thirty-five-foot concrete piles driven to rock with a wingwall, backwall and abutment stem. Both were dressed with a light stone revetment at a 1.5:1 slope.

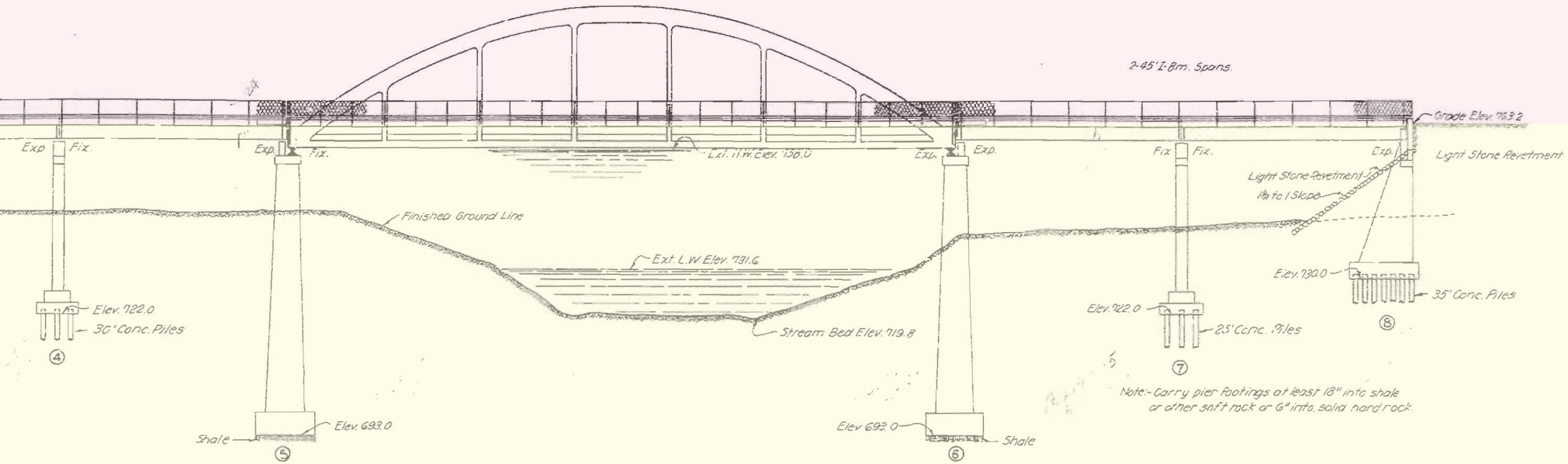
Main Supporting Element

Hangers

The hangers for the BRB consisted of riveted steel built-up I-beams riveted to the floor beams. The six hangers were thirteen feet eleven inches, twenty-three feet two inches and twenty-seven feet nine inches tall repectively and the same mirrored on the other side.

Floor System

The floor system consisted of ten stringer beams including cross lower lateral bracing with floor beams tied to the hangers on the lower chord.



Piers

Piers No. 5 and 6 consisted of two round columns with a rectangular footing. Each column was battered with fluting. The columns in Pier 5 were fifty-eight feet, five inches tall and in Pier 6 were fifty-eight feet with oval-shaped bent caps. In between each column was a shear reinforcement arch or a partial web wall.

Bents

Bents No. 2, 3, 4 and 7 consisted of three reinforced concrete piles. Each pile was separated seventeen feet on center and the reinforced concrete pile footings on the north and south were rectangular. Piles were haunched to meet the bent cap. Each footing also had three reinforced concrete piles driven to rock.

"Show Me" the Money

The construction of the BRB had both state and federal funding, specifically in response to the Great Depression.

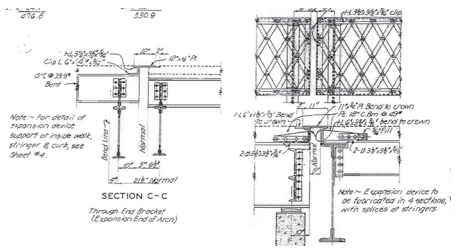
On August 11, 1931 the Missouri State Highway Commission discussed U.S. Route 40 over the Blue River for the first time.

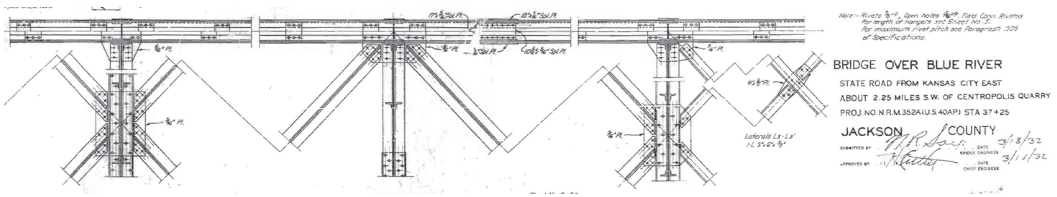
> *The recent decision of the Missouri Supreme Court in the Kansas City mandamus case authorizes the Commission to construct new highways within the city limits of Kansas City under the 300-mile provision of Proposition No. 3. He recommended that the Commission designate 1.42 miles from the 300-mile system for the construction of U.S. 40 AP, beginning at Thirty-First Street at Raytown Road and thence in an easterly direction to the east city limits of Kansas City, at a point approximately one hundred and eighty feet north of the Old Independence Westport Rd.*

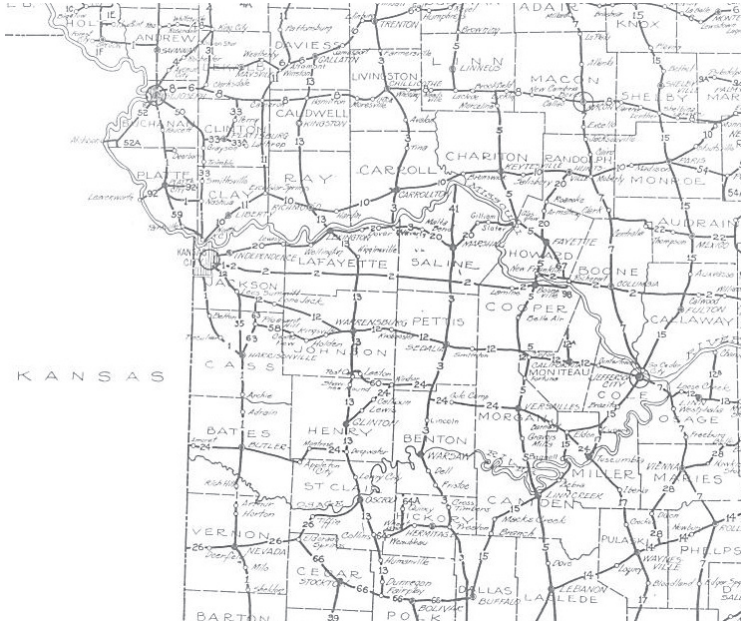
The 300-Mile System

The "300-mile system," is a reference to Proposition No. 3 passed in 1928, which was an amendment to the State Constitution authorizing the sale of $75,000,000 in additional state road bonds. This was to complete the state highway system and 300 miles of additional state roads including traffic relief roads around Kansas City and St. Louis.

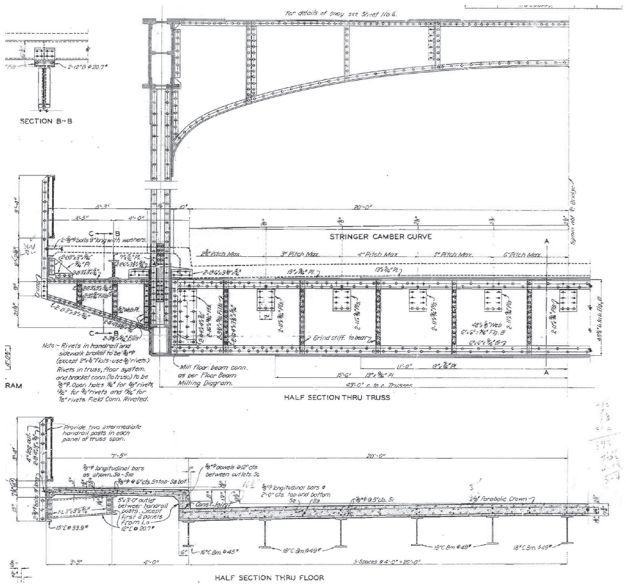
While all the funding for the project did not come from the Proposition No. 3 bonds, it was the catalyst for planning and designing the new U.S. Route 40.







Missouri numbered routes circa 1920. Route 2 on map is now U.S. Route 40.
Source: Missouri State Highway Commission, "Map of Missouri Showing State Highway System," September 19, 1922, Fourth Biennial Report of the State Highway Commission of Missouri for the Period Ending December 1, 1924.



Excerpts from the bridge plans for the BRB including a lattice railing.

The Great Depression

In addition to funding from Proposition No. 3, funding was also influenced by monies received from the Great Depression. Due to massive industrial production loss and job loss, President Roosevelt signed the National Industrial Recovery Act of 1933. The states were able to get federal funding for certain projects through the Public Works Administration (PWA). The BRB construction was part of one of these PWA projects, under Federal Number NRM 352A. On December 29, 1933, the State Highway Commission discussed, "$2,500,000 of NRH, NRM and NRS Funds" and authorized the Chief Engineer to make a request for the money as soon as possible "under the provisions of Section 204, Title II of the National Industrial Recovery Act." Because the project was labeled "NRM" meaning "National Recovery Municipal," and the State received $2,500,000 from the program, it can be deduced that the BRB was funded by federal funds from the National Recovery Act matched by Proposition No. 3 state bonds.

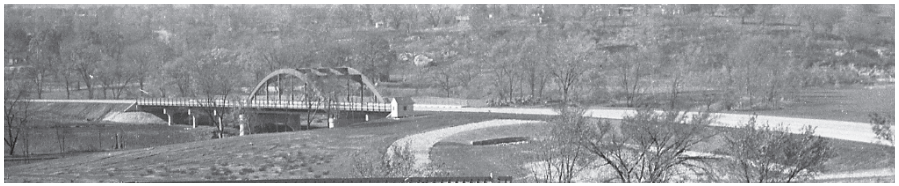
The states were able to get **federal funding** for certain projects through the **Public Works Administration (PWA)**.

Young men painting a bridge circa 1930.

Source: Courtesy of the Missouri State Archives, MoDOT negative collection.

Constructing the BRB

Little coverage of the BRB construction made it to newspapers due to its smaller size and designation as a cut-off route.



Completed Bridge 1934/35.

On October 7, 1933, a contract for construction of the BRB was awarded to Davis Construction Company, Gerard Knutson and Lay Construction Company for a total of $346,658.99. Yet, the total cost to construct the BRB is mentioned in the *Ninth Biennial Report* as $118,492.30. The BRB was part of a larger project as shown in the project plans, the project history maps and due to the discrepancies in cost.

Equipment had been moved to the location of the project on October 7, 1933, but the construction would not start until the next week. The first bridge in the project was to be started over four railroads east of the Blue River and then the BRB next. Contractor Gerard Knutson was asked how many men were employed but he stated that was impossible to know at the time of his interview on October 7.

The exact ending date for construction of the BRB is unknown after research in the Missouri State Highway Commission Minutes, the Missouri State Highway Commission Biennial Reports, the *Kansas City Star* and other local newspapers. The BRB can be deduced as being completed sometime in the spring of 1934 because it shows up on the 1934 USGS topography map and the *Kansas City Star* stated the contract would go to July 15, 1934. A 1934/35 photo shows the completed bridge (see image above). The project may have been completed in sections which did not warrant a large "grand opening" celebration or warrant newspaper coverage. The Missouri State Highway Commission Minutes noted the contractors getting paid February of 1936.

Contractors

Not much information on the contracting companies who built the BRB exists. The Correspondence and Construction Files on the BRB were not found at the MoDOT Bridge Division or with the Kansas City MoDOT District files. According to Bridgehunter.com, Davis Construction Company is noted to have worked on three bridges in the state of Missouri during the time frame of 1933-1934. When searched on the Missouri Secretary of State's business search, Davis Construction Company completed a "Registration of Fictitious Name" Form in October of 1925. The Form includes the location of the business, "southeast corner of Sixth and Spring Streets," and the person who filed, "Ellis E. Davis, 416 Seventh, Boonville, MO."

Gerard Knutson is also marked as working on three bridges in Missouri during the time frame 1932-1934 on Bridgehunter.com. Lay Construction Company had worked on three bridges, which included the Blue River Bridge; even though Bridgehunter.com has the company spelled as "Lam." A *Kansas City Star* article stated the addresses of the winning contractors as, Gerard Knutson, 3520 Main Street, the Lay Construction Company, North Kansas City and the Davis Construction Company, Boonville, Missouri. It also stated they were joint bidders for the work.

Davis Construction Company and Gerard Knutson completed many road projects throughout 1931-1936 as noted in the Highway Commission Minutes in "final payments to contractors." While not much on the workings of the contractors for the BRB exist, it is known they were active with the Highway Department so they were not an unusual choice contractor to choose for the bridge construction.

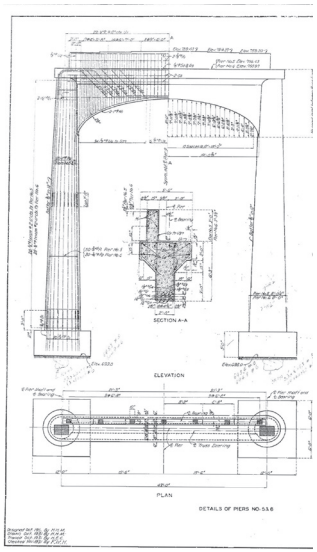
Timeline

COMMISSION DISCUSSES A TRAFFIC RELIEF ROUTE FOR U.S. 40.

August 1931

BRIDGE PLANS DRAWN OCT. 1931 AND APPROVED MARCH 1932.

October 1931



March 1932

CONSTRUCTION STARTS.

October 1933

A 40 CUTOFF START

Contractors Begin Work Tomorrow to Bring This Important Artery Into the City.

THREE BRIDGES TO BUILD

New Road Is to Be Ready by Next July 15, the Contract Let Saturday Provides.

CONCERNS UNITE FOR JOB

The $347,150 Award Includes Spans Over Blue, Topping Avenue and Four Railroads.

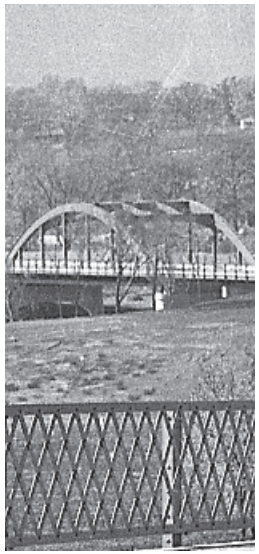
The work of completing U. S. highway 40 cutoff, potentially Kansas City's most important motor vehicle traffic artery, is to get under way tomorrow.

Announcement that the contract for the work has been let was made today at Jefferson City by the state highway commission, the announcement stating the expenditure would be $347,150.

Source: "A 40 Cutoff Start," The Kansas City Star, October 9, 1933, State Historical Society of Missouri.

CONSTRUCTION ENDS.

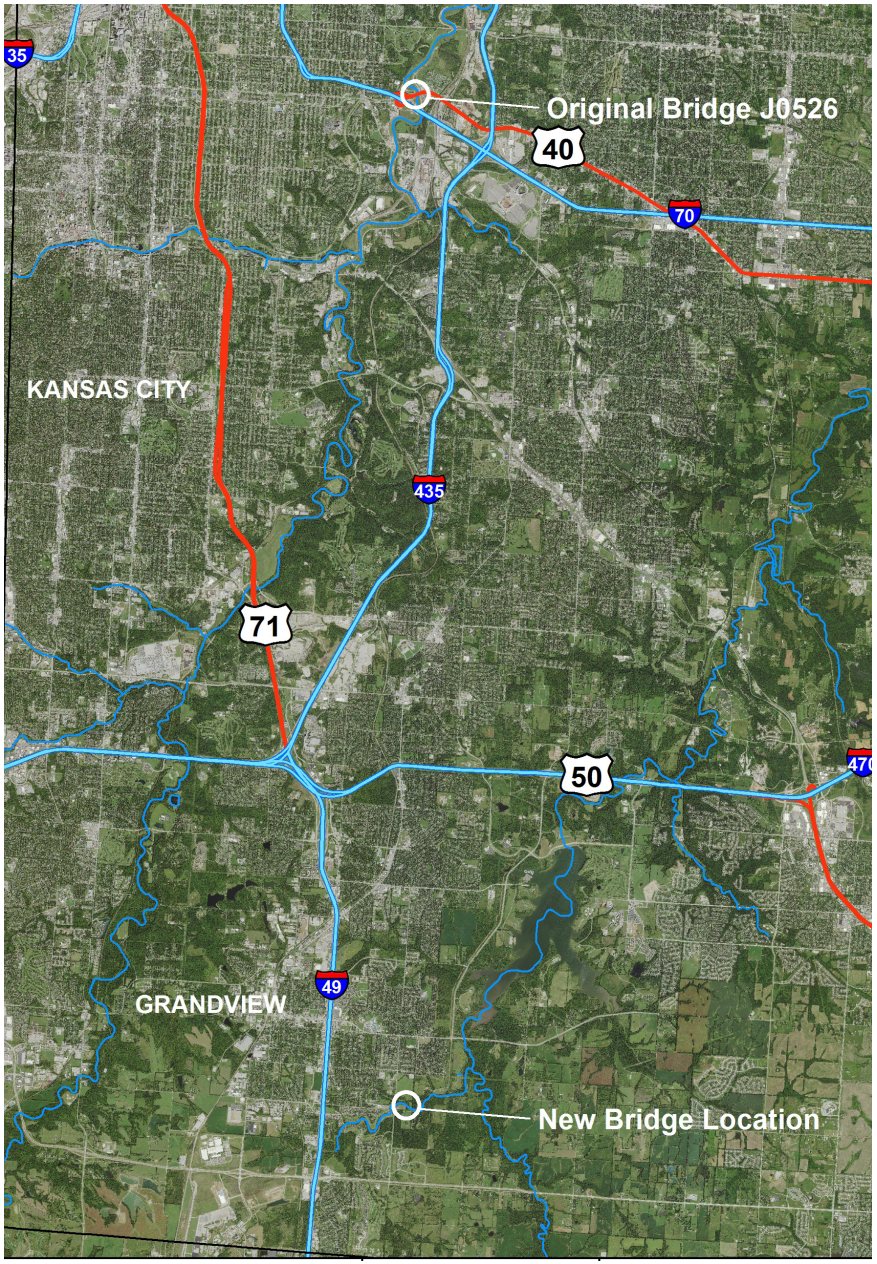
July 1934



CONTRACTORS PAID.

February 1936

1931 1932 1933 1934 1935 1936



Future location map. *Source: Map drawn by author using ArcMAP.*

The Next Chapter

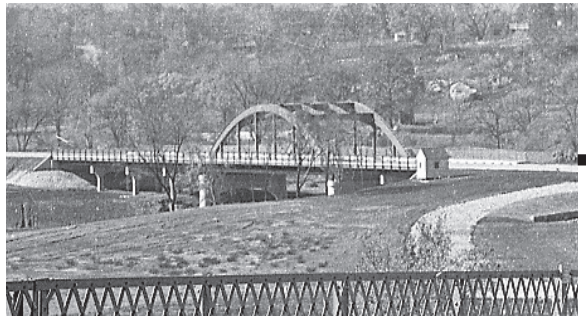
The BRB's relocation to
Grandview, Missouri is a positive next chapter for the notable structure.

While exact numbers and build dates of tied arch bridges on the Missouri state road system are not available, a survey investigation has led to the conclusion that Missouri has nine extant tied arch bridges: the Broadway Bridge in Jackson County (1955), the pair of Page Avenue Bridges in St. Louis County (1999), the pair of U.S. 54 Jefferson City bridges (1955 and 1991) in Cole County, the pair of Jefferson Barracks bridges (1984 and 1990) in St. Louis County and Meramec River MO 21 Bridge (1940) in St. Louis County.

According to the *The Context for Common Historic Bridge Types*, steel tied arches were not built in great numbers. They possess significance if character-defining features remain, including the curved top girder or truss, suspenders, ties and the bottom chord and the floor system. The BRB had a new deck, yet the floor system was still the girder system. The ties, truss and bottom chord remained for the BRB, making it a significant example of a steel tied arch in Missouri.

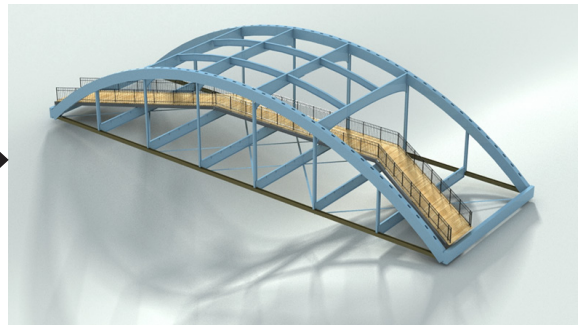
During the "Missouri Historic Bridge Inventory" the BRB was evaluated as a "unique example in Missouri of uncommon structural type, in well-preserved condition." The BRB was an uncommon instance of experimentation by the Missouri State Highway Department, not usually known for such innovations. The reconstruction of the BRB will allow future generations to enjoy its innovative type.

THE BRB WILL BE RELOCATED TO TAIL AND TRAILS DOG PARK EAST OF BYARS ROAD IN GRANDVIEW, MISSOURI AND WILL CONNECT THE PARK TO THE LONGVIEW LAKE TRAIL.



Circa 1934.

2015.



Future rendering. *Source: Rendering from the City of Grandview, received March 9, 2016.*

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BLUE RIVER BRIDGE

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