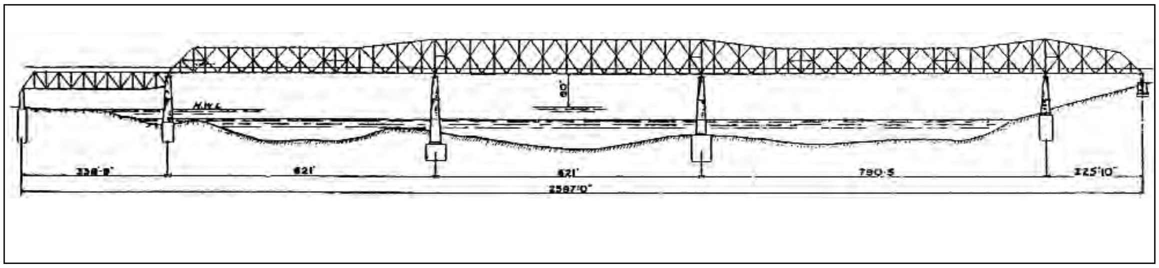
(#14) 79-NonHighway-3: Frisco Bridge spanning Mississippi River on the Tennessee Arkansas state line, Memphis, Shelby County, (Northwest Memphis Quad, 404 NE).



Significant under Criterion A for role in expanding rail traffic between South and Midwest, under Criterion B due to Morison's close involvement with the bridge project, and under Criterion C as Morison's most important bridge design and as an innovative cantilevered continuous truss bridge.

Until the 1880s the engineering profession deemed it impossible to build a bridge to span the "true" Mississippi River as far south as Memphis. But as the engineering profession advanced, it became clear that such an engineering achievement was possible, and in early 1885 Congress granted a charter to two Arkansas and Tennessee corporations to build and maintain a toll bridge over the Mississippi River. At that time, rail lines crossed the river using a transfer steam operation, a situation that created a bottleneck and limited transcontinental traffic between the South and the Midwest. These firms contacted New Yorker George Shattuck Morison, one of the most prominent engineers in the United States in the nineteenth century. [In 1986, Clayton Fraser completed for the Historic American Engineering Record an intensive study of Morison, *Behemoths: The Great River Bridges of George S. Morison*. Much of the material in this section is summarized from his substantial study.]

George Shattuck Morison, was born in 1843 in Massachusetts, the son of an eminent Unitarian minister. Morison attended the prestigious preparatory school Phillips Exeter Academy and Harvard College and Harvard Law School. After receiving a Bachelor of Law degree in 1866 and being admitted to the New York Bar, Morison began working with a New York law firm. Almost immediately Morison regretted his career choice but worked for nearly a year until making a final decision to change professions. Morison had long been interested in civil engineering, and through the influence of family friends, railroad entrepreneur James F. Joy hired Morison to work under engineer Octave Chanute on the Kansas City Bridge spanning the Missouri River. With no formal training in engineering, Chanute first assigned Morison menial tasks. However, Morison developed a study regimen, and as his natural abilities became evident, Chanute gave him more challenging tasks and eventually appointed Morison assistant engineer for the project.

Through the mid-1870s Morison worked on different rail lines owned by Joy. In 1875 he formed his own consulting firm, Morison, Field and Company, and gradually built a national reputation. The reputation was based as much, if not more, on his managerial skills rather than on his skills as an engineer. However, in 1880 Morison resigned from his firm to develop a practice based more on engineering design and decreased his participation in railroad operations while focusing on bridge design.

Before his death in 1903, Morison had achieved national recognition for his truss designs, primarily for rail lines. He was extremely prolific and designed a variety of bridges of which the Frisco Bridge was considered his most outstanding design. Historian Carl Condit says of this bridge:

> The cantilever truss reached its greatest size in the United States before the end of the century with the construction of the first Mississippi River bridge at Memphis, Tennessee…Its designing engineers, George S. Morison and Alfred Noble, were in the front rank of their profession at the time, and they planned the structure on a heroic scale.
>
> …After the Memphis bridge the cantilever spans erected during the remainder of the century seem anti-climatic" (Condit 1960:159-160).

One of the first major bridges to be built by Morison spanned the Genesee River at Portagee, New York, for the New York and Erie Railroad in 1875. In the 1880s Morison designed seven Whipple-Murphy bridges spanning the Missouri River at Plattsmouth, Blair Crossing, Bismarck, Omaha, Nebraska City, Sioux City, and Rulo. In 1887-1889 he designed a Whipple-Murphy truss to span the Ohio River at Cairo for the Illinois Central. He also designed the Bellefontaine Bridge, which contained a Baltimore Petit truss, and the 1890-1891 Swing Bridge at Winona spanning the Mississippi River. Morison's last design was also his only major concrete arch bridge, the Connecticut Avenue Bridge spanning Rock Creek in Washington, D.C. (Condit 1960, 1968; Fraser 1986; Plowden 1974).

When approached, Morison was at the peak of his career and quite interested in being the chief engineer for the first bridge to span the lower Mississippi River. Morison carefully evaluated the Memphis area and selected a river crossing that he believed was the least likely to be affected by shifting channels. However, he had reservations about the ability of the Arkansas and Tennessee corporations to complete such an expensive and complicated project.

In January 1886, he approached George Nettleton, president of the Kansas City, Fort Scott to Memphis system of railroads to encourage him to finance and sponsor the bridge. Meanwhile opposition from the steamboat lobby blocked construction, and for various reasons, the private corporations dropped the project. In April 1888, Congress granted the railroad a charter but with a new stipulation—that the bridge also carry highway traffic. This new charter also specified a 700 foot clear channel span (150 feet longer than in the 1884 charter) and a height of 75 feet (10 feet more than in 1884). This latter stipulation troubled Morison the most, and he argued vigorously to have it reduced but to no avail. Morison incorporated these new restrictions into his plans, and the Secretary of War approved them 25 August 1888. Construction began in October.

For this massive job, Morison chose a group of experienced assistants and contractors, many of whom had worked with him previously. His three main assistants were Alfred Noble as resident engineer, M. A. Waldo as assistant engineer, and Ralph Modjeski who was chief draftsman and later chief inspector of the superstructure. (This was Modjeski's last job with his mentor Morison and afterwards he too became a leading bridge engineer and was the chief engineer of the 1913-1917 Harahan Bridge, #77, 79-NonHighway-4. Although Modjeski himself died in 1940, his firm, Modjeski and Masters, would also design the 1949 Memphis and Arkansas Bridge (#156, Memphis and Arkansas Bridge, 79-1055-12.00).

Between October 1888 and February 1889, workers completed the foundation. The piers rested on heavy timber caissons (92' long x 47' wide) which were founded on hard clay. The deepest foundations extended nearly 131 feet below the high water level and a maximum immersion depth of 108 feet during construction, which was the second greatest depth at that time in which the pneumatic process had been used. Men worked only three 45 minute shifts within a 24-hour period to guard against "caisson fever." Even so, four died and the bends left several others crippled.

Morison let the contract for the granite piers in April 1889 to Lewis Loss of New York. Loss finished the piers in April 1891. During this period the only major disaster occurred when a towboat became lost in fog-like smoke from nearby factories and struck a partially completed but still submerged pier. The impact destroyed the towboat, scattered the seven barges it was towing, and killed six of the thirty-four people aboard.

On 24 January 1890, Morison awarded the contract for the fabrication of the superstructure to the Union Bridge Company. In May 1890 he awarded the contract to erect the superstructure to the Baird Brothers who had served as the erectors on most of Morison's major bridges. A notable feature of the trusses was that Morison chose to exclusively use steel made in the open-hearth process that Carnegie, Phipps and Company (later Carnegie Steel) produced. Carnegie Steel shipped the uncut steel sections to the fabricator Union Bridge. Unfortunately, the scale of the project was more than Union (or probably any single company) could handle, a problem compounded by Morison's careful inspection and repeated rejections of some of the steel, and Union fell behind schedule. As a result, eight other companies did about 36% of the fabrication work. However, due to the success of this bridge, Morison's specifications for the fabrication and erection of steel soon came to be the recognized standard for railroad bridges in this country. In March 1891 the last structural contract was awarded to the Pennsylvania Steel Company to manufacture the iron viaduct on the west end.

Truss erection occurred between March 1891 and April 1892. Finishing touches included laying the deck and final riveting. Tens of thousands took part in elaborate dedication ceremonies on 12 May 1892. Completion of the highway deck and viaduct delayed Morison's officially turning over the bridge to the railroad until 1 May 1893. The total cost was $3 million. Morison was closely involved with the construction of this bridge, and many historians consider it Morison's greatest bridge design in his thirty-year career (Fraser 1986).

Known as the Frisco Bridge because the original rail companies later merged with the St. Louis and San Francisco Railroad ("Frisco Lines"), the bridge contains one 790-foot Double Intersection Warren (Lattice) continuous through truss with pinned connections. When built, it was the longest span in the United States and the third longest in the world. It was Morison's desire to build three equal spans of 675 feet or to center the longest span, but the Secretary of War's stipulations required that the main span be on the Tennessee side of the river, which resulted in an asymmetrical truss arrangement. Thus (beginning on the east side), the bridge contains an anchorage span above land 225.9 feet long. The next span is the 790 foot channel span. The next two truss spans are each 621 feet long. The last truss span is a simple deck Warren with verticals, a "mere" 339 feet long. West of the deck truss is a 2,290 foot iron viaduct of plate girders supported by iron towers on concrete foundations. The bridge contains a single rail track.

This is one of only a few bi-modal bridges in Tennessee, in this case for railroad and vehicular traffic. The Congressional Charter for the bridge stipulated that the railroad would provide an independent roadway for wagons and animals on each approach of said bridge, and, for the entire length of the bridge proper, a roadway of sufficient width for wagons to pass each other without inconvenience, to be used by wagons and animals in common with the railroad. That said bridge shall be open for the passage of wagons and animals at all times except when trains are actually passing.

However, it appears that wagon traffic did not widely use the bridge, in part due to the high tolls but also possibly due to its heavy usage by rail traffic. The steep design of the western viaduct, which reputedly required multiple teams to pull a wagon up it, may have also been a significant factor. By the early 1910s, when discussions began in earnest about the Harahan Bridge (#77, 79-NonHighway-4), the Frisco Bridge had essentially ceased operating as a wagon road bridge (Tennessee 1940:48). The bridge no longer carries vehicular traffic but is an active railroad bridge and was pivotal in expanding rail traffic in this region. When completed, it was the only bridge to span the lower Mississippi River and had the longest span in the country until 1917.

The American Society of Civil Engineers has designated three resources in Tennessee as National Historic Civil Engineering Landmarks: the Montgomery Bell Tunnel, the Norris Dam, and the Frisco Bridge.