

SPARKMAN STREET BRIDGE (Shelby Street Bridge)
Shelby Street Spanning Cumberland River
Nashville
Davidson County
Tennessee

HAER No. TN-38

HAER
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19-NASH,
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Southeast Region
Department of the Interior
Atlanta, Georgia 30303

HISTORIC AMERICAN ENGINEERING RECORD

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SPARKMAN STREET BRIDGE (Shelby Street Bridge)

HAER No. TN-38

Location: Shelby Street spanning Cumberland River
Bridge Number 19-3245-1.47
Downtown Nashville
Davidson County, Tennessee

USGS Nashville West Tennessee, quadrangle,
Universal Transverse Mercator Coordinates:
16 520500 4001740

Date of Construction: 1907-1909

Engineer/Fabricator: Howard Murfree Jones/Foster-Creighton-Gould

Present Owner: Metropolitan Government of Nashville and Davidson County,
Metropolitan Courthouse, Courthouse Square, Nashville, TN 37201

Present Occupant: N/A

Present Use: Closed Vehicular Bridge, Future Plans for Pedestrian Use

Significance: The bridge possesses state level engineering significance as an example of the through Parker and camelback truss types and for its uncommon concrete trusses. The bridge possesses local significance as a historic river crossing connecting downtown Nashville with East Nashville.

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I. Shelby Street Bridge -- Historical Overview

The Sparkman Street Bridge, more commonly known as the Shelby Street Bridge, has been called one of Nashville's best examples of modern technology and engineering from the beginning of the twentieth century. It is significant in the development of Nashville's transportation routes, as an example of the through Parker and Camelback truss types, and it continues to be an important part of Nashville's skyline.

A Nashville at the Turn of the Century (1900)

By the turn of the new century, Nashville was one of the fastest growing cities in the South. In the last two decades of the old century, the city's population doubled, to more than 80,000 residents. By 1910, Nashville had more than 110,000 residents.¹ Annexation of many of the burgeoning suburban areas around the city contributed to Nashville's development. In 1879, after several years of discussion, the City of Edgefield, situated just to the east of downtown across the Cumberland River, agreed to become a part of Nashville.²

Nashville boasted approximately 2,000 persons employed by sixteen businesses just after the turn of the century. The backbone of the city's economy was its strong industrial base. In 1900, Nashville was the state's chief manufacturing center, producing 17 percent of all products made in Tennessee.³ The largest industry was flour milling, fueled by the influx of raw materials raised on the surrounding farmlands.⁴

Transportation was key to the city's dramatic population and economic growth in this era. Having been founded on the banks of a major river, the Cumberland, the residents and businessmen of the city viewed quality river crossings as a vital component of the city's continued development. The earliest crossings were made by boat, including the use of commercial river ferries as early as 1787.⁵ By 1900, five bridges along a seven-mile stretch of the Cumberland River served the city. These five bridges included three railroad bridges and two vehicular and pedestrian bridges -- the Woodland Street Bridge built in 1886 and the Hydes Ferry Bridge built in North Nashville in 1889.⁶ The Woodland Street Bridge, replacing an older crossing, was built as a reward to the residents of the City of Edgefield for their agreement to be annexed into the City of Nashville.⁷

¹ Janice E. Nolen, "'Home-made Goods' Built to Last Forever: The Shelby Street and Jefferson Street Bridges in Nashville, Tennessee," Fall 1983, Unpublished Manuscript in Author's Possession, Nashville, Tennessee. p. 2.

² Wilbur F. Creighton, "Wilbur Fisk Foster: Soldier and Engineer," Tennessee Historical Quarterly, 31 (Fall 1972): 273.

³ Janice E. Nolen, "The Legacy of an Era in Transition: The Shelby Street and Jefferson Street Bridges in Nashville," Unpublished Manuscript in Author's possession, Nashville, Tennessee, Fall 1982, Nashville, TN, p. 2.

⁴ Nolen, Legacy, p. 2.

⁵ Arthur Weir Crouch, and Harry Dixon Claybrook, Our Ancestors Were Engineers, (Nashville: Nashville Section, American Society of Civil Engineers, 1976), p. 15.

⁶ Charles W Cook, Jr., "The Shelby Bridge: A Modern Engineering Marvel in Nashville," Tennessee Historical Quarterly, (Winter 1966): 321.

⁷ Nolen, "Legacy," p. 4.

The first automobile appeared in Nashville in 1897. By 1905, approximately 70 were operating in the city.⁸ A mere five years later, Nashvillians had registered more than a thousand cars to travel the city's brick streets.⁹ While the dominance of the automobile as the preferred transportation mode was soon to arrive, at the century mark, the electric streetcar was a major form of transportation in and around the city. The electric streetcar was introduced in Nashville in 1888, and by 1900, more than 50 miles of track were under electric power.¹⁰ This method of transportation replaced the mule-drawn trolleys of the previous century, resulting in the consolidation of transportation services under a single company, the Nashville Railway and Light Company.¹¹ One newspaper reported in 1909 that travelers could chose from a regular daily schedule of 100 cars running over 100 miles of tracks along city streets and through its newly annexed suburbs, for a fare of five cents.¹²

B. The Need for a New Connection

By 1904, traffic between downtown Nashville and East Nashville (formerly Edgefield) across the Cumberland River had increased to the point that citizens and politicians began to clamor for another bridge. The Woodland Street Bridge provided the only immediate connection to the downtown from the east. In its January 1905 term, the Davidson County Court appointed a committee to study the advisability of constructing an additional bridge to connect the downtown with the growing neighborhoods to the east.¹³

Between January and July, the committee laid the groundwork to ensure that the city could indeed move forward with the new bridge if indeed one was needed. Authorization was granted to Davidson County by the state legislature for the issuance of \$300,000 in bonds for the purpose of building a bridge or bridges across the Cumberland River.¹⁴ In July 1905, the committee reported back to the Court its conclusion that a new bridge was needed.

Accepting the committee's recommendation and ready to move the project forward, the County Court voted on two actions at its July term. First, the bond proposal would be submitted to the citizens in August 1906 as a referendum. Second, a new bridge committee was appointed to move forward with determining the location and cost of the new bridge.¹⁵

Decision to Build Two Bridges

The new bridge committee was intended to report its recommendations at the October 1905 Court term, but the immense controversy encountered with the determination of a location

⁸ Cook, "Shelby Street Bridge, A Modern Engineering Marvel," p. 322.

⁹ Nolen, "Home-Made Goods," p. 3.

¹⁰ Cook, "Shelby Street Bridge, A Modern Engineering Marvel," p. 321.

¹¹ Ibid.

¹² Nolen, "Legacy," p. 3, and; "Bridges Across the Cumberland," Nashville Banner, 22 May 1909, Part II, p.15.

¹³ Nolen, "Home-Made Goods," p. 3

¹⁴ Cook, "Shelby Street Bridge, A Modern Engineering Marvel," p. 322.

¹⁵ Nolen, "Legacy," p. 5.

delayed its recommendation until the January 1906 term. The issue pitted Edgefield residents against downtown merchants. Residents of North Edgefield preferred a location north of the Woodland Street Bridge while downtown merchants preferred a location that would land at or near Broad Street (Broadway today).¹⁶

In January 1906, the committee made its recommendation that two bridges were needed, one north and one south of the Woodland Street Bridge. The committee maintained that two new crossings would benefit the residents of Edgefield by opening up more of the community to downtown. In anticipation of objections by downtown businessmen, the committee stressed that the two additional crossings would prove "incalculable spurs to business which would generate enough increased taxes through increased property values to pay all costs of both bridges in a reasonable time without any increase in the present rate of taxation."¹⁷

Locating the Bridges

With the decision made to build two bridges, the committee still had to determine the exact location of the two crossings. Janice Nolen, in her 1983 unpublished work on the Shelby Bridge, observed that the second committee studied two different locations for each bridge.¹⁸ For the southern bridge, the two sites were at or near Broad Street and at Sparkman Street south of Broad. The committee determined that the Broad Street site, which had been promoted early on, was unacceptable because of the extensive amount of private property that would have to be acquired, and the "interminable lawsuits" that would be expected to result from the property damage.¹⁹ A bridge at the foot of Broad would have made the businesses along lower Broad less accessible since the approach necessary for the bridge to reach the required vertical clearance over the river would be right up against their stores. The merchants would also experience substantial disruption for the duration of the construction.²⁰

The second site considered for the south bridge was at the Hay Market at Sparkman Street. The Hay Market site offered substantial advantages as a bridge location since it was owned by the city and thus would avoid the threat of lawsuits. The City had opened the market on a vacant city block south of Broadway in the 1890s for farmers and traders. According to Jack Norman, a Nashville writer, the Hay Market "was principally used for the sale and swapping of horses, mules, and cows. It was from the large amount of hay brought here to feed the animals and for sale that gave the place its name. It was also the preferred place for carnivals and 'medicine shows'."²¹

The Hay Market site also offered the city the opportunity to resolve a long-standing troublesome situation. The city block south of McGavock between Second and Fourth Avenues was in a low alluvial valley known locally as "Black Bottom." The Black Bottom was a notorious slum,

¹⁶ Nolen, "Home-Made Goods," pp. 5-6.

¹⁷ Ibid., p. 7.

¹⁸ Ibid., p. 8.

¹⁹ Ibid., p. 8.

²⁰ Cook, "Shelby Street Bridge, A Modern Engineering Marvel," pp. 322-323.

²¹ Ibid., and Jack Norman, Sr., "Remember the Hay Market," Nashville Banner, 16 December 1982, p. A-19.

housing nearly 1,800 poor African American residents in the quarter-mile square. An indignant citizen described the area as "a conglomeration of dives, brothels, pawnshops, second-hand clothing stores, and filthy habitations accompanied by the daily display of lewdness and drunkenness on the sidewalks and redolent with the stench of every vile odor."²² Progressive-minded politicians and civic organizations had pushed for the redemption of Black Bottom, with efforts ranging from prohibition of liquor sales to conversion of land into a park. In 1893, the city had acquired the land by condemnation in a partial attempt to remove the "county trade" from the Public Square and to replace some of the Black Bottom tenements.²³ The location of a bridge at the Hay Market would have the added benefit of clearing out more of the slum and opening the area to new development.

Over the course of the year, arguments were heated as to the location of the additional bridge, but the matter was finally resolved in October 1906 when the County Court agreed to accept the committee's recommendation. Two bridges would be built -- one connecting Jefferson Street to Spring Street in North Nashville and the other at or near Sparkman Street and the Hay Market, south of Broad to connect with Shelby Street on the east side of the river.²⁴

The committee specified how the two new bridges could be used to improve traffic problems in the downtown. For the new bridge at the Hay Market (Sparkman Street Bridge), the western approach would begin at Cherry Street (Fourth Avenue today). Nolen notes that at that time, McGavock Street had not been extended from Sixth to Fourth Street, so all the traffic would have to use Fourth Avenue to reach the bridge from the downtown. Since Fourth Avenue was too narrow for the volume of traffic that would use it, the committee recommended that the street be widened between Broad Street and the western approach to the bridge in order to reduce traffic congestion along Broad Street.²⁵

During the November 6, 1906 election, the voters of Davidson County had the opportunity to vote on the proposition and the bonds necessary to finance their construction. Although the legislature had only authorized \$300,000 in bonds for the bridge, voters were asked to approve the issuance of \$800,000 in bonds. The issues carried by a margin of four to one.²⁶

C. Designing the Bridges

With the number and location of the new bridges thus decided, the County Court moved in the January 1907 term to establish a new five-member bridge committee, thereafter referred to as the Cumberland River Bridge Committee. The committee, which would continue to function through the construction of the new bridges, was originally created for the purpose of employing "a competent and reliable engineer to make plans and specifications for the construction of said bridges and supervise the work thereof. . ." The committee was directed to report their findings

²² Don H Doyle, Nashville in the New South: 1880-1930, (Knoxville: University of Tennessee Press, 1985), p. 91 and Cook, "Shelby Street Bridge," p. 323.

²³ Cook, "Shelby Street Bridge, A Modern Engineering Marvel," p. 323.

²⁴ *Ibid.*, p. 322.

²⁵ Nolen, "Home-Made Goods," p. 9.

²⁶ *Ibid.*, p. 11.

and recommendations at the Court's April term.²⁷ At this meeting, the Court reaffirmed that the southern bridge would be built south of Broad Street at the Hay Market site at or near Sparkman Street.²⁸

The Cumberland River Bridge Committee wasted no time in performing its charge. On January 14, the committee held its first meeting to organize, and on January 20, at their second meeting, they selected the project engineer.²⁹ The committee also worked to obtain authorization from the State Legislature for the \$800,000 bond issue for the two bridges.

In April 1907, the Cumberland River Bridge Committee reported back to the County Court that it had selected Howard Jones to design the bridges and oversee their construction. The committee noted that Jones presented "very strong endorsements from the leading engineers of the community and submitted evidence that convinced the Committee he was fully qualified to handle the work."³⁰

Project Engineer Howard M. Jones

Howard Jones was just 33 years old when he was selected as project engineer for Nashville's new Cumberland River bridges. Jones was a native of Murfreesboro, some thirty miles south of downtown Nashville. He had studied engineering at Vanderbilt University in Nashville for three years under Professor Olin H. Landreth, Vanderbilt's first professor of engineering. When Professor Landreth moved to Union College in Schenectady, New York, at the end of Jones' third year, Jones transferred there to complete his degree in 1895.³¹ After college, Jones returned to Tennessee to work as an engineer with the Nashville, Chattanooga and St. Louis Railway in Nashville, where he worked from 1895 to 1902. He spent a year at the Louisville Bridge and Iron Company to complete a special study in steel truss bridge design and construction. He returned to Nashville in July 1903 to take charge of the design work of the chief engineer's office, where he continued to work until 1907 when he accepted the position with the Cumberland River Bridge Committee.³² The design of the two Cumberland River bridges was his first major bridge commission.

After the Shelby and Jefferson Street Bridges were completed and opened, Jones returned to private engineering practice. He designed at least one other bridge in Nashville, the White Bridge in West Nashville, which carried vehicular traffic across the Louisville and Nashville Railroad. His work included the design of other types of structures; in 1912 he designed a large reinforced concrete chemical plant in Niagara Falls, New York.³³ In 1913 Jones was appointed

²⁷ Cook, "Shelby Street Bridge, A Monument to Howard M. Jones," Unpublished Manuscript in Author's possession, Nashville, Tennessee, November 16, 1995, p. 8, quoting from the Davidson County Quarterly Court Minutes, Book G, 50

²⁸ Cook, "Shelby Street Bridge, A Monument to Howard Jones," p. 8.

²⁹ Ibid., p. 24.

³⁰ Cook, "Shelby Street Bridge, A Monument to Howard Jones," p. 9, quoting from the Davidson County Quarterly Court Minutes, Book G, 86.

³¹ Nolen, "Legacy," p. 13 and ; Cook, "Shelby Street Bridge," p. 321.

³² "Splendid New Bridge Thrown Open Across the Cumberland River," Nashville Banner, 5 July 1909, p. 1.

³³ Nolen, "Home-Made Goods," pp. 23-24.

as the southeastern representative to a five-member national Board of Engineers selected by the Interstate Commerce Commission. The task of the Board was to direct inventories and engineering reports for the railroad and telegraph systems. After the Board of Engineers was abolished in 1921, Jones was appointed by the ICC as supervising engineer in charge of completing the engineering work for the five districts that the board had overseen. He was serving in that capacity at the time of his death in 1924.³⁴

Design Requirements for the New Bridges

The Cumberland River Bridge Committee had recommended in January 1906 the construction of a "first class" bridge, a designation used in that era to indicate a high design standard.³⁵ In addition to the charge to design a "first class" bridge, the committee imposed upon the project engineer and his team four requirements for the design of the two bridges:

1. The bridges should be 60 feet wide with a 40-foot roadway and two 10-foot sidewalks;
2. The grade on the approaches should not exceed five percent, and if possible be less;
3. The floors on the structures should be strong enough to carry the heaviest steel railway trains likely to operate on the structures; and
4. The bridges should meet the standards enacted by Congress for bridges over navigable waterways.

The U. S. Army Corps of Engineers, under the Congressional mandate, required that the vertical clearance of the main channel span must be 110 feet above the river's low water pool in Nashville and the horizontal clearance between piers at the water line must be 300 feet. These requirements would necessitate very long bridges over the Cumberland River.³⁶ Along with these clearance requirements, the Corps of Engineers also required that a map be made of the river and its banks for a distance of a mile above and a mile below the proposed bridge sites.³⁷ The Corps of Engineers required that this information, together with the general plans of the bridges be submitted for approval by the War Department.³⁸

Jones and his crew had begun work on the surveys of the selected bridge sites on February 4, 1907. By the April 1907 Court term, he had completed the preliminary studies, including plans showing the properties that would be taken for the bridges, and maps showing the surveys and soundings of the river above and below the bridge sites. Jones had also completed some preliminary design work, including much of the stress calculations. He presented his proposed design for the two bridges and estimated the costs of the structures. According to Jones' estimates, the Sparkman Street Bridge, which would be about 3,150 feet long, would cost \$531,000 including \$60,000 in property damages. The cost of the Jefferson Street Bridge was

³⁴ Cook, "Shelby Street Bridge, A Modern Engineering Marvel," p. 329.

³⁵ Nolen, "Home-Made Goods," p. 8.

³⁶ Arthur Weir Crouch and Harry Dixon Claybrook, Our Ancestors Were Engineers, page 17.

³⁷ Nolen, "Home-Made Goods," pp. 13-14.

³⁸ Cook, "Shelby Street Bridge, A Modern Engineering Marvel," p. 324.

estimated at \$476,000, about \$55,000 lower than the Sparkman Bridge because of less property damage.³⁹

The total project cost was over one million dollars, substantially more than the \$800,000 the General Assembly had authorized in bonds. Jones explained to the Court that the higher cost was the result of the extra bridge width and the heavier deck that were necessary to permit the bridges to carry the heavy steel streetcars. He offered to the Court that if they wished to revise the concept and provide bridges that would only carry ordinary street traffic, the bridges could be constructed within the \$800,000 bond limit.⁴⁰

The higher than anticipated cost estimates prompted considerable debate in the Court term. Several diverse points of view were expressed by the justices during that session. Some justices argued that only one bridge be built in order to learn more about bridge construction over the Cumberland River, suggesting that the Jefferson Street Bridge as the smaller bridge be built first. Others went on record opposing the construction of the two bridges because of the impact on the county's indebtedness; some of this group argued that no bridge should be built while others argued for only one bridge. Still others suggested that the street railway company not be permitted to use the bridges thus allowing the two bridges to be built within the \$800,000 bond limit.⁴¹

The Cumberland River Bridge Committee firmly recommended that the County build both bridges as proposed by Howard Jones. Recognizing that the additional cost would be a problem, the committee suggested several alternatives for raising the remainder, including having the street railway company pay an equitable portion of the initial construction costs and annual maintenance costs.⁴² When questioned by the Court, Jones predicted that even if the bridge were not initially built to carry street railway traffic, eventually there would be the need for streetcars to run over the bridges, and retrofitting the bridges to carry the heavier load would cost more than if it were done initially.⁴³

After considerable discussion, the Court finally voted at its April meeting to accept the Cumberland River Bridge Committee's recommendation for the two bridges. It was decided that the County would request the additional bonding capacity from the next Legislature in order to fund the bridges as designed by Howard Jones.⁴⁴

An Innovative Design

Integral to Jones's design of the Sparkman Street Bridge was the use of reinforced concrete. He used concrete for the piers, not an unusual decision at the time; the unusual feature was the

³⁹ Ibid., p. 14.

⁴⁰ Ibid., p. 15.

⁴¹ Ibid., pp. 15-17.

⁴² Ibid., p. 15.

⁴³ Ibid., p. 17.

⁴⁴ Ibid.

six arched deck trusses that would form two spans of the western approach over the curved and unparallel Tennessee Central railroad lines.⁴⁵

Nolen notes that the design was so novel at that time that local civil engineers publicly questioned the stability of the truss. In an article in *Engineering News* in November of 1909, Jones publicly defended his use of concrete in the bridge design:

The writer [Jones] is well aware that the use of concrete in truss construction has been criticized by prominent engineers, and the lack of accurate knowledge of the distribution of stresses under eccentric loading seems to be the chief point of attack. It is also true that there was much criticism of reinforced-concrete arches when they were first introduced, yet such construction has continued to grow in favor, and so it is believed by the writer the concrete truss will be found to be an economical solution to many problems of the future, and it will soon cease to be experimental and will graduate with honors from the "freak" list. Another decided point in favor of the truss is that it lends itself to improving the beauty of a bridge. For instance, on this bridge the location of these trusses is such that they are in plain view up and down the river for a long distance, and they add very materially to the architectural effectiveness of the structure.⁴⁶

To prove that his truss concept would work, in June 1907, Jones built an 11-foot scale model (one-tenth the size of the longest truss). The model was loaded with bricks to test it to its destruction; however, when the load reached 17,000 pounds, it became top heavy and the test was concluded for fear that the model might topple over and hurt some of the workmen who were loading it. Since the load of 17,000 pounds was six times greater than the heaviest load the truss would ever be expected to sustain, the test was determined to be a success, although the model was not tested to destruction as originally planned.⁴⁷

Charles W. Cook, Jr., the grandson of Howard Jones, explains in his recent article on the Shelby Street Bridge, that crucial to understanding the importance of the Jones' innovative bridge design for the new Nashville bridges, "it should be noted that only one other reinforced concrete truss bridge was known to have been built at about this same point in time anywhere in North America." This other concrete truss bridge was completed in Ontario Canada in 1909, to span 80 feet over a creek, compared with the Shelby Street Bridge's concrete trusses spanning more than 100 feet over railyards.⁴⁸ Both bridges remain in place today.

⁴⁵ Ibid., p. 19.

⁴⁶ Howard M. Jones, "The Design of the Broadway or Sparkman Street Bridge, Nashville, Tennessee," *Engineering News* 62 (25 November 1909): 575.

⁴⁷ Ibid.

⁴⁸ Cook, "Shelby Street Bridge, A Monument to Howard M. Jones," p.20.

D. Building the Bridges

The Contractors

By June 1907, the plans and specifications for the bridge were complete and ready to be bid. Competitive bids for the substructure (piers, abutments and earth fills) were taken on July 10, 1907 from ten companies. The lowest bidder was E. T. Lewis of Nashville, with a bid of \$435,000. The Foster-Creighton Company also of Nashville submitted a bid of \$250,000 for the substructure work only. The other bids ranged from \$620,000 to \$753,000.⁴⁹ When the committee met to consider the bids, the lowest bidder withdrew, and the committee voted to split the contract, awarding the contract for the piers to one firm and the contract for the viaducts and earth-fill approaches to the Foster-Creighton Company. The total cost of that arrangement would have been \$510,000.

The contracts could not be officially awarded, however, until the sale of the bonds occurred. Since 1907 was the year of a business panic, the County was unable to sell its bonds for par (the four percent maximum set by the enabling legislation) when they were offered on July 23, 1907. The Bond Committee decided to let the bonds float and then offer them at a private sale.⁵⁰ On August 5, 1907, the Foster-Creighton Company, in cooperation with three local banks, made the County an offer to buy the bonds for \$800,000 provided the company be awarded the entire contract and the bonds bear a 4.5 percent interest rate from the date of delivery.⁵¹ Meeting in special session, the Court voted to offer the total contract for the substructure to the Foster-Creighton Company in order to get the projects underway. Wilbur F. Creighton Sr., a principal in the Foster-Creighton Company, noted that the company was fortunate to have sold the bond issue shortly after their purchase to a broker in Cincinnati at a slightly higher price than the company paid for them. Within a few months the economy was so bad "that no broker would have bought them except at a price so low that it would have bankrupted the company."⁵²

In January 1908, the County awarded the contract for the superstructure (trusses) to the Foster-Creighton Company in association with the American Bridge Company, a major bridge company of the early 20th century. J. D. Foy of Dothan, Alabama was subcontracted for the concrete substructures.⁵³

Up to that time, Foster-Creighton had built only a few railroad bridges and most of the company's experience had been with coffer dams, dewatering and other techniques of bridge construction, but not much in the use of concrete. After receiving the contract for the two bridges, Foster-Creighton sold one-third of the contract to the Gould Construction Company of Louisville, in order to gain the use of Gould's well recognized experience in large-scale bridge

⁴⁹ Nolen, "Home-Made Goods," p. 17.

⁵⁰ Ibid., p. 18.

⁵¹ Creighton, Wilbur F., Building of Nashville, Revised and enlarged by Wilbur F. Creighton, Jr. and Leland R. Johnson. (Nashville: Self-published, 1969; revised ed., Wilbur F. Creighton Jr., 1975.), p. 84.

⁵² Ibid., p. 85.

⁵³ Ibid.

construction. The new firm of Foster-Creighton-Gould Company would be the bridge contractors.⁵⁴

After the completion of the two bridges (Sparkman Street and Jefferson Street), the Foster-Creighton-Gould Company remained in partnership for four more years. During that time, the company built Lock No. 3 on the Cumberland River, the Kentucky and Indiana Railroad Company Bridge in Louisville and numerous other buildings and bridges. Under Gould's excellent salesmanship, the number of contracts held by the company increased rapidly, but by 1914, the volume of work was too large for the company to accomplish successfully. Gould wanted to increase the staff, but others disagreed, so Gould sold his interest in the company to Wilbur F. Creighton, Sr. The company reverted to the name Foster and Creighton, and under that name continued to operate for several decades as a Nashville construction firm.⁵⁵

The Construction Years (1907-1909)

Initial construction of the substructure of the Sparkman Street Bridge began in mid-August, 1907 after the contracts were signed with the Foster-Creighton Company. Wilbur F. Creighton, Sr. noted in his Building of Nashville that no unusual difficulties were encountered in building the cofferdams.⁵⁶ As with any major construction project, however, work is almost never accomplished without some unusual circumstances encountered.

The construction of a high steel bridge was a dangerous job in the first decade of the twentieth century. One quote from the 1930s was for every one million dollars spent, it would be expected that one man would die in the construction.⁵⁷ According to that ratio, only one man would have been expected to die during the construction of the two Nashville Bridges. In actuality, four men died while building the Sparkman Street Bridge. One fell from the bridge, another was struck in the head by a falling timber, and the third and fourth were killed by a falling girder.

Most of the laborers employed on this job were inexperienced ex-convicts or parolees. Inmates from the state penitentiary were paroled to form 100-man gangs with a foreman. Each job officer carried medical provisions in order to care for injured workers. Since most of the work was done by hand, Mr. Creighton later observed that nail punctures were very common. Other common injuries were caused by the types of tasks involved in building a bridge, such as tossing rocks into wagons.⁵⁸

One major problem encountered during the two-year construction related to the vagaries of nature - - flooding. On September 5, 1908, the Saturday before Labor Day, a cloudburst in the Stone's River valley caused a record-breaking flood in what was a normally dry month. Driftwood and other debris including fence rails, outhouses and dead cattle poured into the Cumberland River upstream of Nashville. The falsework that had been erected to support the

⁵⁴ Nolen, "Home-Made Goods," pp. 18-19; and Creighton, Building of Nashville, 1969 ed., p. 85.

⁵⁵ Nolen, "Home-Made Goods," p. 24.

⁵⁶ Creighton, Building of Nashville, 1969 ed., p. 87.

⁵⁷ Nolen, "Home-Made Goods," p. 20.

⁵⁸ *Ibid.*, pp. 20-21.

trusses during erection stretched across the river. All but two of the steel panels had been connected by the time the debris making its way downstream dammed up against the falsework, threatening the loss of \$90,000 worth of steel hanging precariously over the river. The working crew was not scheduled to report to work on Sunday or on the Monday of Labor Day. The engineers rounded up the few men they could find, chartered two steamboats and used lines to pull the larger pieces of driftwood through the bents of the falsework. Fortunately the river did not rise more, and by Tuesday, when the working crews returned, work resumed on connecting the two remaining steel panels. Creighton in Building of Nashville notes that large crowbars were used temporarily for pins since they could be driven more quickly than pins. By Thursday of that week, the span rested on the pier, and three bents of falsework were removed from the center of the span, thus allowing the pile of drift to move downstream.⁵⁹

While the construction team had expertise in bridge erection in the person of Harry Gould, the founder and president of Gould Construction, the incorporation of concrete trusses as bridge components was something that had never been tried. The following story related to Janice Nolen by Wilbur F. Creighton Sr.'s son illustrates just how apprehensive everyone was when the concrete was first poured for the trusses on the Sparkman Street Bridge:

It was early morning when Wilbur F. Creighton Sr. left his home on Porter Road in Nashville to return in his buggy to the site of the most ambitious project his family's construction firm had yet attempted. He probably had not slept well the night before; the erection of the new bridges across the Cumberland River had reached a critical step, using a new material -- reinforced concrete -- in a new way. As he crossed the old Woodland Street Bridge into downtown Nashville, he must have been anxious to see how well the makeshift forms and bailing wire were holding the freshly poured concrete trusses. Creighton has researched all available sources to determine how to build the unique spans. His searches had proven fruitless, for as he wrote later, "Nothing like them had ever been built before." Forced to rely on his own ingenuity and engineering skills, he devised a system by "slow trial and error" to pour the "bowstring" upper chord of the first truss. He knew risks were involved with the innovative design, not the least of which were the financial losses to the Foster-Creighton-Gould Company. Believing in the design of the trusses, his firm had bid only \$17.25 per cubic yard for the concrete trusses for which another, less adventurous company had bid \$100 per cubic yard.

As he turned onto First Avenue, he would have been keenly aware of the risks involved. Traveling south to the construction site, he heard a tremendous crash. As he later told his son, he thought that his worst fears had come true: the span had collapsed. Only after he got to the site did he discover the concrete intact; the crash he heard had been a water tank falling from one of the buildings along Second Avenue. The first of the six concrete deck trusses had held. . .⁶⁰

⁵⁹ Creighton, Building of Nashville, 1969 Ed., pp. 87-88.

⁶⁰ Nolen, "Home-Made Goods," pp. 1-2.

Work on the Sparkman Street Bridge, along with the widening of Fourth Avenue South, was completed in June 1909 for a total cost of \$570,000, less than two years after the work was begun. The Jefferson Street Bridge did not open until April 4, 1910 because of weather and other problems; its total cost was \$478,000.⁶¹

Grand Opening

In its July 1909 session, the County Court moved to name the bridge at Sparkman Street the "Broadway Bridge," having rejected the names of the Hay Market Bridge and Shelby Street Bridge.⁶² It is not known when the bridge assumed its current name as the Shelby Street Bridge.

With considerable fanfare, the new Broadway Bridge was officially turned over from the engineers to the County and then to the City during a grand ceremony on July 5, 1909. Robert Creighton, the president of Foster-Creighton-Gould Company, and his wife were the first to cross the bridge in a car.⁶³ Speeches were made extolling the structure and those persons who had a part in its conception and construction. Among the accolades, the bridge was described by one newspaper as a "Nashville-made product, 'Home-made goods.'"⁶⁴

At the bridge opening, Nashville Mayor James Brown, who had personally not supported the bridge at the Sparkman Street location, or even the need for two bridges, admitted he had become "a friend of two bridges or as many more as Nashville needs," and he urged that the City immediately open McGavock Street between Fourth and Sixth Avenues to make an appropriate approach for the new Broadway Bridge.⁶⁵

E. Shelby Bridge 1909 to February, 1998

It is ironic that with all the controversy and discussion at the April 1907 County Court term concerning the extra cost to make the Shelby Street Bridge strong enough to carry street railway cars, no street car ever used the structure. The era of the streetcar was peaking as the bridge was being completed. By 1910, automobiles were becoming increasingly more popular, and streetcar lines were never extended from downtown east across the bridge. Nolen noted that the decision of the County Court to fund a heavier bridge was a wise decision, however, in that the bridge safely carried heavier loads than its designer had foreseen, and it has outlasted other bridges built at the same time elsewhere in the state.⁶⁶

Recurrent Concrete Problems

Throughout much of its service life, the Shelby Street Bridge has been plagued by problems related to the original concrete. Nolen notes that although the concrete was tested during the

⁶¹ Ibid., p. 23.

⁶² Ibid., p. 22.

⁶³ Ibid.

⁶⁴ Ibid., p. 22, quoting from "Broadway Bridge Thrown Open to Public Travel," Nashville Tennessean, July 6, 1909, p. 1.

⁶⁵ Ibid.

⁶⁶ Ibid., p. 24-25.

construction, the tests of that period were not as sophisticated as they later became. At the time of the construction of the bridge, the tests could only consider some characteristics of the material, and the crushed limestone as an aggregate was not tested. During construction, the inconsistent quality of the concrete was evident. When large weights were accidentally dropped on the bridge, sections of the bridge reacted differently, in some areas merely chipping a slight hole, and in other areas, cause gaping holes.⁶⁷ In one instance, a ten-pound hammer dropped accidentally on the concrete slab deck broke through the deck and fell into the river.⁶⁸

In the 1920s, disintegration of the concrete in the handrails was observed. The weathering led to wide discussion in engineering circles about the failure of the concrete on the bridge. A committee was appointed by the mayor to determine the cause of the deterioration and to suggest remedies. The committee, chaired by Hunter McDonald, Chief Engineer of the Nashville, Chattanooga and St. Louis Railway, reported that the damage was due to the poor quality stone found around Nashville. The committee suggested chipping off the weathered surfaces and replacing them with gunite, a procedure adopted and applied between 1927 and 1930 at a cost of \$275,000.⁶⁹

In 1949, the Tennessean ran a series of articles on the history of the Cumberland River Bridges and the present day problems involved in their upkeep. One article reported that the "same old ailment - failing concrete - cropped up again, and temporary emergency measures were made until such a time as the problem can be solved permanently."⁷⁰ According to one article, "because of defects requiring repair in the Sparkman and Jefferson Street Bridges, heavy trucks and busses of more than 5,000 pounds gross weight are prohibited from crossing, and other vehicles are limited to speeds of 10 miles per hour."⁷¹ The article noted ironically that the Woodland Street Bridge, the oldest of the three, was the only bridge that was functioning properly.

The problems with the concrete were eventually traced to the limestone quarry near Newsom Station, outside of Nashville, which supplied the limestone for the two bridges in 1907-1909. By the 1940s the limestone from this pit was considered to be unfit for use in concrete because of the soft, shaly layer of rock permeating the quarry. Upon observing the area from which the limestone for the two bridges was taken, while most of the wall showed no change from the time it had been left by the bridge builders 40 years earlier, a 10-inch vein of shaly limestone near the bottom of the pit had deteriorated considerably since that time. According to Wilbur Creighton, that vein was not apparent when the bridges were being built. It was this vein of poor quality limestone that was the culprit in the cement mixture.⁷² Foster Creighton explained in the Building of Nashville that "in short, the deterioration of the bridge was due to the

⁶⁷ Ibid.

⁶⁸ "Bridge Troubles Traced Back to Faulty Limestone," Nashville Tennessean, 17 April 1949, A-14.

⁶⁹ Creighton, Building of Nashville, 1969 ed., p. 89.

⁷⁰ "Bridge Troubles Traced Back to Faulty Limestone."

⁷¹ "Crossing the Cumberland Has Been a Problem," Nashville Tennessean, 10 April 1949, A-2.

⁷² "Bridge Troubles Traced Back to Faulty Limestone."

ignorance at that time of cement manufacturing, engineering design, and concrete mixing and placing."⁷³

The concrete problems continued to plague the bridge. Around 1970, gunite was applied to the bridge to repair some of the original concrete.⁷⁴ Since then, severe concrete loss has occurred in the concrete truss spans over First and Second Avenues, resulting in the placement of netting around the spans to protect pedestrians and parked cars from the not infrequent falling debris. Other problems with the bridge include signs of impact damage on some of the piers on the east approaches.

The Tennessee Department of Transportation (TDOT), which has responsibility for inspecting bridges, found in 1992 that the condition of the bridge had worsened from the department's previous inspection a year earlier. The TDOT required the Metropolitan Government of Nashville and Davidson County Public Works Department to post weight limits on the bridge in order to reduce the potential for a bridge failure. Quarterly inspections were conducted, and in a follow-up inspection in May 1995, the DOT found that the bridge was in poor condition. The weight limits remained in place, restricting two axle vehicles to 14 ton gross weight and those with three or more axles to 20 tons gross weight.⁷⁵ In February of 1998, the bridge was closed to all forms of traffic, including pedestrian traffic.

F. New Opportunities for the Shelby Street Bridge

Structural deficiencies of the Shelby Street Bridge on the east side of the downtown as well as structural deficiencies of the Demonbreun Street Viaduct on the west side of the downtown, have provided Nashville the opportunity to assess the roadway connections in the southern corridor of the downtown. In 1993 the Metropolitan Government initiated a corridor study to address transportation options south of Broadway. The preferred alternative emerging from that study involves the replacement of the Shelby Street Bridge for vehicular traffic, intersecting with a new western terminus at a widened Franklin Street.⁷⁶

While rehabilitation of the existing bridge for vehicular traffic has been determined to be unfeasible, widespread support for keeping the Shelby Street Bridge in place has emerged. The bridge was placed on the National Register of Historic Places in 1986, and supporters of the nearly eighty year old bridge have promoted it as a pedestrian link between Downtown and areas to the east side of the river. Although it would no longer serve as a vehicular connection, it could serve bicycle and pedestrian traffic, satellite parking lots and, possibly as a viewing area for activities along the riverfront.

Two new developments in the south end of the downtown have helped to build the momentum to preserve the Shelby Street Bridge as a pedestrian bridge. In 1996, a new arena was

⁷³ Creighton, Building of Nashville, 1969 ed., p. 92.

⁷⁴ Federal Highway Administration, "Final Environmental Impact Statement, Shelby Avenue/Demonbreun Street from I-65 North to I-40 West, Nashville, Davidson County, Tennessee," EIS NO. FHWA-TN-EIS-96-01-F, p. G-5.

⁷⁵ Cook, "Shelby Street Bridge, A Modern Engineering Marvel," p. 330.

⁷⁶ Ibid.

completed between Broadway and Demonbreun Streets and Fifth and Sixth Avenues. This resulted in the permanent closing of McGavock Street, which becomes Shelby Street at Fourth Avenue. The city is now constructing a NFL football stadium on the east bank of the Cumberland, just north of Shelby Street. Mayor Phil Bredesen's plans for the football stadium included about \$6 million to renovate the bridge so that it could be used for pedestrian traffic.⁷⁷

Studies are now underway concerning future uses of the Shelby Street Bridge. Plans may entail some structural alterations to the historic bridge but the bridge is slated to remain in place. When asked as the opening ceremony to comment on how long he thought the bridge would last, Howard Jones described the Sparkman Street Bridge as a bridge that would last forever (Nolen 1983, p. 25). While forever may have been an exaggeration, it may be possible for it to continue to be an important part of Nashville's transportation system into the next century.

II. Description of Structure

A. Historical Description of Structure

A lengthy November 25, 1909 article in Engineering News written by bridge engineer Howard Jones provides a detailed description of the Shelby Street Bridge, as built. Below are excerpts from that article:

[Bridge] The bridge [is] on the line of Sparkman St., [and is] now known as the "Broadway" bridge. . . The west approach begins at Fourth Ave. and rises on a 4.8% grade 388 feet to Third Avenue., this part being made an earth fill retained by a U-shaped reinforced-concrete wall; thence it continues to rise on a 4.1% grade to the west bank pier, crossing three streets and the freight yards of the Tennessee Central Railway. From Sta. 3 + 88 to 9 + 60, the construction is of the reinforced concrete trestle type with steel plate girders at the street crossings and from 9 + 60 to 11 + 50 it is composed of two spans of concrete bow-string trusses. These spans are on a skew, the longest being 103 feet c. to c. of end bearings, and the shortest 90 feet. The river proper is crossed by means of three steel truss spans, two 175 feet c. to c. of end pins and one main channel span 318 feet c. to c of end pins. The short spans are on 1.0% grade, and the long spans is 0.5% grade, the high point of the grade being the east channel pier. From Sta. 18 + 28 to 31 + 50 the east approach descends on a 4% grade ending at the intersection of Shelby Avenue and Second St. This portion is of the reinforced concrete trestle type except for the three deck spans of steel construction, and the end is an earth fill. All steel spans are floored with concrete, and side elevations of all steel spans on approaches made a similar finish to the concrete viaduct. The alinement [sic] is straight from Sta. 0 + 11 + 50 to where it has an angle 14° to the north; it continues on this latter line to the end, at Sta. 31 + 50.

[Reinforced Concrete Trestles] In the approaches, 1,060 lin. feet is of the reinforced concrete trestle type structure. The height ranges from 18 to 50 feet

⁷⁷ Ibid.

above the surface. This is thought to be the longest concrete trestle bridge of its character in the United States, and being designed for heavy city traffic, which included double track steel railway. It is being built mainly in 30-foot bays, every other bay being braced by horizontal struts both longitudinally and transversely with the axis of the bridge, at points approximately half height of columns above the surface.

[Hand Railing] It was the purpose of the engineer to make the general lines of the bridge as pleasing as conditions permitted and to design more on its appearance as a whole than on multiplicity of ornamental details. It is no easy task to make a trestle type of bridge architecturally attractive, and it is thought the goal was met in this structure with at least a degree of success. . . The open panel work gives it the appearance of lightness, a very desirable end to attain on a structure. . . A simple cornice was made on the outside stringers where the stringers joined the bracket. . . All struts between the columns were also curve filleted at the ends with the double purpose of ornamentation and strengthening the struts.

[Lighting] Special attention was given to the lighting scheme for the bridge. The main goals to attain were to have all wires in . . . concealed positions, and yet have an arrangement of posts and lights which would add to the architectural effectiveness of the bridge and yet at the same time to furnish plenty of light at as a low a cost as possible. . . The latest improved tungsten lights are used throughout, and slightly frosted globes cover the lights.

[Concrete Trusses] When this idea first suggested itself, the writer began to investigate engineering literature for light on the subject and found very little. Here and there he found brief descriptions of some work of this kind has been done in Europe. These examples, however, seemed to be more complicated than necessary, and usually followed closely the construction of steel trusses, using diagonal members, without having satisfactory connections on these diagonals to chords. It was not possible to locate an American precedent, so it was decided to design a truss of the bowstring type, but omitting all diagonal members. . . . The writer is well aware that the use of concrete in truss construction has been criticized by prominent engineers, and the lack of accurate knowledge of the distribution of stresses under eccentric loading seems to be the chief point of attack. . . It is believed by the writer the concrete trusses will be found to be an economical solution of many problems of the future, and it will soon cease to be experimental and will graduate with honors from the "freak" list. Another decided point in favor is that it lends itself to improving the beauty of the bridge.

[River Piers] There are two bank piers and two main channel piers. All are founded on solid rock. . . . The piers [are] . . . concrete towers extending from the seat to footing course and battered on average of 1/2 inch to 1 foot being braced together by reinforced-concrete arch and corbeled coping courses at the top, and by reinforced side curtain walls from the footing course up to the high water

line. The curtain walls are 2 foot thick at the top carried down plumb on the inside, and battering with the towers on the outside. The walls are reinforced with a heavy meshed fabric placed near both inside and outside faces, this fabric extending also entirely around the towers to the top of the curtain walls.

[Steel Trusses] The steel trusses spanning the river follow in general design present day practice. The main river span . . . is, however, unusual enough to call attention to a few points. . . . The weight of the structural steel only in this span exceeded 800 tons. The exceptional heavy dead loads keep the counter stresses very low, and it was decided to omit all tension counters and to take care of such stresses by making stiff diagonals. In order to prevent excessive size and bending on pins at the central panel points the bottom chord joints were made combination pin and riveted connections. The depth of the truss was chosen with a view to economy and appearance. A somewhat deeper truss would have required some less steel, but after several trial depths were viewed it was thought those chosen best harmonized with the end spans. The floors on all the steel spans are of reinforced concrete.

B. Description of Existing Structure

The Shelby Street Bridge spans the Cumberland River in the central business district of Nashville, Davidson County, Tennessee. (See map on page 24.) On the east, the bridge is on Shelby Street and rises from First Street. On the west, the bridge rises from Fourth Avenue, South. West of Fourth Avenue, Shelby Street becomes McGavock Street. (See page 25 for bridge layout and elevation.)

The bridge has a total length of 3,150 feet, including the approaches and abutments. The bridge length between centerlines of bearings at abutments is 2,280 feet and 9.5 inches. The bridge is composed of 48 spans as described below:

<i>Span #</i>	<i>Description</i>	<i>Length</i>
1	Approach Span	*
2	Concrete Deck Girder over Third Avenue	52'-1"
3-9	Concrete Deck Girders	Total-211'
10	Concrete Deck Girder over Second Avenue	55'-1"
11-19	Concrete Deck Girder (#19 over First Avenue)	Total-254'-7"
20	Concrete Deck Truss	97'-5"
21	Concrete Deck Truss	91'-6"
22	Through Camelback Truss	178'
23	Through Parker Truss	321'
24	Through Camelback Truss	178'
25-29	Concrete Deck Girder	54'-9"
30	Deck Pratt Truss	100'-3"
31	Concrete Deck Girder	54'-9"
32-46	Concrete Deck Girder	Total 442'-9"
47	Concrete Deck Girder over First Street	70'
48	Approach Span	*

*The lengths of Spans 1 and 48 comprise the balance of the total length.

The steel girder and truss spans are supported on concrete piers founded on bedrock. The three through truss channel spans (spans 22-24) are steel with pin connections. Top chords, end posts are channels with lacing; diagonals are angles with lacing and paired eyebars; counters are large angles with lacing. The channel spans have three traffic lanes with a 41-foot curb-to-curb width. Two 10'-6" wide sidewalks are cantilevered on the outside of the trusses resulting in an out-to-out width of 60 feet. The approach spans provide a 40-foot wide roadway with eight to nine-foot wide sidewalks on each side. There is also a 100-foot long inverted deck Pratt truss span on the east bridge approach. This span is encased within a building historically associated with the Nashville Bridge Company, however, this building is currently being demolished.

An interesting feature of the bridge is the six reinforced concrete trusses that support the two west approach spans over the former freight yards of the Tennessee Central Railway, today a parking lot for Nashville's Riverfront Park. The concrete trestles have superstructures comprised of closely spaced concrete T-beams with a monolithic concrete deck. The superstructure is integral with the substructure that is composed of concrete bents. The concrete bents are spaced at 30.0-foot center to center.

Summary of Major Repairs

Over the bridge's 91-year history, numerous repairs have been made to the structure. Below is a summary of the major repairs.

Year	Description of Major Repairs
1923	<ul style="list-style-type: none"> • Repaired sidewalks and bridge rail • Replaced concrete slab in steel girder span nos. 1, 2, 3, 11, 32, 48 • Encased certain bent columns • Extensive pneumatic concrete repairs to beams, bents and piers
1960	<ul style="list-style-type: none"> • Replaced sidewalks and bridge rail for full length of bridge • Replaced concrete bridge deck and replaced or repaired steel girders in spans nos. 1, 2, 3, 11, 32 and 48 • Added steel stringers in the concrete truss spans (#21 and 22) • Extensive pneumatic concrete repairs to the concrete truss spans, concrete beams, bottom of the concrete deck and all substructures
1990	<ul style="list-style-type: none"> • Blast cleaning and painting of girder spans and steel truss spans
1994	<ul style="list-style-type: none"> • Repairs to concrete trusses (spans 21 and 22) included removal of several spots of loose material—concentrating on the truss verticals and struts, sand-blasting, shotcreting and sealing of removal areas, installation of new netting • Repairs to piers and bent caps included removal of considerable amounts of concrete/gunite and application of 29 square feet of shotcrete; gunite removal and repairs at the bearing areas of piers 20 and 21, scale loose gunite and repairs with shotcrete to upper half of pier 11, and installation of a new shotcrete collar around the cap of pier 25. • Welding steel plates onto the beams webs that had rust holes in span 1 • Concrete repairs to each of the 13 expansion joints • Remove loose concrete from T-beams of Span 32 (Over Nashville Bridge Company mezzanine) and painting of exposed rebars.

Source: *TDOT Bridge Inspection Files, Nashville, TN*

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