LAMAR-MCKINNEY STREET VIADUCT
Continental Street Viaduct
Texas Historic Bridges Recording Project II
Spanning the Trinity River at Continental Street
Dallas
Dallas County
Texas

HAER No. TX-90

HAER
TEX
57-DAL,
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C St. NW
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HISTORIC AMERICAN ENGINEERING RECORD

LAMAR-McKINNEY STREET VIADUCT
(Continental Street Viaduct)

HAER No. TX-90

Location: Spanning Trinity River at Continental Street, Dallas, Dallas County, Texas
UTM: 14/704240/3628300
USGS Quad: Dallas, Tex.

Date of Construction: ca. 1931

Designer: Francis Dey Hughes, consulting engineer, Dallas, Texas.

Builder/Contractor: L. H. Lacy Company, Dallas, Texas.

Present Owner: Dallas County

Present Use: Roadway bridge

Significance: A major viaduct over the Trinity River in Dallas, the bridge was one element of a comprehensive levee and viaduct construction plan designed to eliminate the Trinity River as a barrier to transportation and communication while also controlling periodic flooding. It represents the work of an important bridge engineer who helped transform the urban landscape of the Dallas-Fort Worth metropolitan area.

Historian: Robert W. Jackson, Ph.D., August 2000

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INTRODUCTION

The Lamar-McKinney Viaduct is one of four highway viaducts built in the early 1930s as part of a plan to relieve traffic congestion on the Dallas-Oak Cliff (Houston Street) Viaduct, which had served since 1912 as the only reliable, all-weather road crossing of the Trinity River at Dallas. Along with the Commerce Street, Cadiz Street, and Corinth Street viaducts, the three other bridges funded by a bond issue approved by voters in 1928, the Lamar-McKinney Viaduct represents a notable victory in Dallas's long battle to overcome the physical barrier of the Trinity River.[1]

It has often been said that there is no particular reason for the existence of Dallas, at its particular location, other than the presence of a low water crossing of the Trinity River near the future site of the Commerce Street Viaduct. The American Indian inhabitants of the region had long used this crossing before it was developed as a ferry terminus in 1848 by Dallas pioneer John Neely Bryan. Four years later, Bryan sold all of his interest in Dallas real estate and his ferry franchise to Alexander Cockrell, an entrepreneur who first arrived in Dallas the year the ferry service began. Because the ferry was slow and unreliable, Cockrell formed the Dallas Bridge and Causeway Company late in 1854 to build a toll bridge at the site of the ferry terminus. This covered structure, completed in 1855, was approximately 520' long and constructed of red cedar. Neither Cockrell nor his bridge, however, would survive the decade. Cockrell was slain in a shootout with the city marshall in 1858, and a few months later the bridge collapsed during a flood.

Fortunately for Dallas, Cockrell's widow, Sarah, possessed a measure of energy and ambition equal to that of her husband. She reintroduced ferry service while planning for the eventual building of another bridge, and, despite considerable opposition, obtained a charter for the Dallas Bridge Company (a different company than that formed by her husband) from the state legislature on 9 February 1860. Her plans to build another toll bridge were postponed due to the Civil War, but by 1871 the directors of the company were able to move forward and hire a civil engineer named Wentworth to locate a new structure and superintend its construction.

By 1872 the company had succeeded in erecting a bridge composed of two wrought-iron bowstring arches, one approximately 140' long and 14' high, and the other about 160' long and 16' high, which Wentworth placed at the site of the former wood bridge.[2] Purchased from the

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[1] There are several histories of Dallas, each of which seems to contradict information found in the others. For information on Dallas in the nineteenth century, this report has relied primarily upon the following sources: John H. Cochran, *Dallas County: A Record of its Pioneers and Progress* (Dallas: Service Publishing Co., 1928); A. C. Greene, *Dallas: The Deciding Years - A Historical Portrait* (Austin: Encino Press, 1973); William L. McDonald, *Dallas Rediscovered: A Photographic Chronicle of Urban Expansion, 1870-1925* (Dallas: Dallas Historical Society, 1978); and, John William Rogers, *The Lusty Texans of Dallas* (Dallas: E. P. Dutton and Co., Inc., 1960). Other sources have been used, as noted in following citations.

[2] Sam Acheson, "Toll Bridge of 1872 Ended Ferry," *Dallas Morning News* (4 September 1967); Cochran, *Dallas County;* 69; Darwin Payne, *Dallas: An Illustrated History* (Woodland Hills; Calif.: Windsor Publications, 1982), 23.

Moseley Iron Company of St. Louis through a mail-order catalog, the spans were shipped down the Mississippi River to Galveston, transported by rail to the northern terminus of the Houston & Texas Central Railway at Corsicana, and then carried by wagon to Dallas.[3]

According to Dallas historian Sam Acheson, this bridge "proved a powerful, if little remembered, stimulus in augmenting the growth of Dallas as a distributing center, ranking next in importance only to the arrival of the first two railroads in 1872-73."[4] He further states that the bridge "was to prove a vital trade link for Dallas with all of the territory south, southwest, and west as far as the Brazos River."[5] However, as vital to the local economy as the bridge may have been, the fact that it was a privately owned and operated toll bridge caused no small amount of rancor among area residents.

By December 1881, citizen protests against the bridge toll had become great enough to compel Dallas County to appoint a committee to ascertain on what terms the county could purchase the bridge. The county commissioners' court found that Cockrell's company had "failed to erect a good and substantial" bridge and ordered a suit to be filed to revoke the company's charter.[6] In May 1882, the county offered to purchase the bridge for $25,000 but the company wanted $41,600. The county made a second offer of $37,500 in July for the bridge and all property owned by the company, and a bond issue of $38,000 for that purpose was approved in August 1882.[7] The bridge was opened to free use later that year.[8]

Apparently finding this bridge to be inadequate, the commissioners' court awarded a contract for $9,875 to the Missouri Valley Bridge and Iron Works of Levenworth, Kansas, in September 1889, to erect a new bridge at the foot of Commerce Street, and also approved an additional $600 for "taking down and placing on high ground" the old bridge.[9] Despite the terms of this first contract with Missouri Valley, the county contracted with N. O. McAdams in August 1890 to remove the old Commerce Street Bridge, and also signed a new contract with Missouri Valley to construct two bridges using the spans of the old bridge; one to be erected north of Commerce Street across the Elm Fork of the Trinity at Grauwyler, and the other to be erected

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[3] Photographs of the bridge indicate that it was based on patented design of Zenas King, who was an agent for Thomas Moseley before establishing his own company in 1871. Although Moseley's bridge company was located in New York in 1872, it may be that he was selling King's design, and others, via a St. Louis-based agent in 1872.

[4] Sam Acheson, *Dallas Yesterday* (Dallas: SMU Press, 1977), 132.

[5] Acheson, 263.

[6] Dallas County Commissioners' Court Minute Book 2, 325(20 December 1882).

[7] County Commissioners' Court, 392 (12 May 1882); 420 (20 July 1882); 431 (22 August 1882).

[8] McDonald, *Dallas Rediscovered,* 15.

[9] Dallas County Commissioners' Court Book 4, 274 (20 September 1889).

south of Commerce Street at Miller's Ferry.[10]

On 15 May 1891, McAdams was appointed by the Commissioners' Court to superintend the building of an approach to the Commerce Street Bridge.[11] It is probable that this appointment was for the western approach, which is revealed by photographs to be a long, sloping trestle that drops from the height of the river spans to a level even with the streets of Oak Cliff.

As first constructed, the new Commerce Street Bridge was composed of two steel Pratt through trusses and a long wood and metal approach trestle. It replaced the iron bridge as the main public road bridge to Oak Cliff, a suburb located on the opposite side of the river from Dallas which was annexed in 1903. A long wooden bridge was also constructed near Cadiz Street, and the Zang Boulevard Turnpike, an earthen fill bridge with a single steel span across the river channel, was built just north of the present Houston Street Viaduct. The Cadiz Street Bridge, the Zang Boulevard Turnpike, and the western approaches of the Commerce Street Bridge were all washed away or inundated by the flood of 1908, leaving the residents of Oak Cliff once again temporarily dependent on ferry service.[12]

It is uncertain how long the steel spans of the Commerce Street Bridge were in use, but at some point a concrete bridge was built to replace the metal trusses. In May 1916, the Commissioners' Court began selling scrap lumber from "the old Commerce Street Bridge," and in July authorized the county engineer to sell old creosoted blocks from it.[13] In October, the Court advertised for new bridge posts at Commerce Street, but no other mention was made of specific contracts for new construction.[14]

In his 1937 application for registration to practice professional engineering in Texas, George G. Wickline, who had been a bridge engineer for the City of Dallas until September 1916, states that in that month he began working as a bridge engineer for the County of Dallas. He also claims credit for the design and supervision of construction of a "Commerce Street Viaduct."[15] It is likely that the replacement of the old steel spans by a new concrete bridge took place sometime in 1916, and that George Wickline was the designer of the new bridge and any new approaches built at that time.

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[10] Dallas County Commissioners' Court, 436.

[11] Dallas County Commissioners' Court Minute Book 5, 19 (15 May 1891).

[12] Greene, 40, 114; Maxine Holmes and Gerald D. Saxon, ed., *The WPA Dallas Guide and History* (Denton, Tex.: University of North Texas Press, 1992), 154-55; Gene Wallis, "The Trinity's Swan Song Spree of 1908," *Dallas Morning News* (18 March 1931).

[13] Dallas County Commissioners' Court Minute Book 16, 40 (15 May 1916)

[14] Dallas County Commissioners' Court Minute Book 16, 106.

[15] George G. Wickline, "Application For Registration To Practice Professional Engineering," 1937, on file at Texas State Board of Registration for Professional Engineers, Austin, Tex. In 1918, Wickline became the first state bridge engineer for the Texas Highway Department.

This new concrete span over the river channel, however, provided no solution to the problem of Trinity River flooding. That challenge was met in two ways: first was the construction of high-level, flood-proof viaducts, beginning with the Dallas-Oak Cliff Viaduct in 1912; and second was the construction of a levee system during the early years of the Great Depression.

In response to the 1908 flood, plans were made for a permanent all-weather viaduct located at Houston Street that would stretch over the entire width of the Trinity floodplain. George Banneman Dealey, manager of the *Dallas Morning News*, was one of the leaders of this effort. Dealey had seen the Intercity Viaduct in Kansas City in August 1908 and envisioned a similar structure as the solution to his city's problems with the oft-flooded Trinity River. He launched a series of articles and photographs to win public support for a viaduct, a project that was also actively supported by Oak Cliff promoters Charles A. Mangold and J. F. Zang. Eventually, Dallas County voters passed a $609,797 bond issue in 1909.[16] However, the campaign for this viaduct engendered a considerable amount of bitterness and controversy, similar in nature to the debate that would later attend the 1929-34 construction of Trinity River levee district improvements.

Some commentators asserted that the tax burden created by the Dallas-Oak Cliff Viaduct project would become such an onerous burden on the community that "Dallas County wouldn't be fit to live in." As one chronicler of the effort has said, "the magnitude of it seemed to stun many residents of Dallas. They couldn't understand money that ran into such figures, and charges of graft were freely made and hotly denied."[17]

Despite strong opposition, construction began on the Dallas-Oak Cliff Viaduct in October 1910 and the bridge was officially opened in February 1912. This approximately 5,106' long structure, hailed by the community as the longest reinforced concrete highway viaduct in the world, cost approximately $675,000.[18]

In 1909, at approximately the same time that plans were being made for the Dallas-Oak Cliff Viaduct, the Dallas Chamber of Commerce established the City Plan and Improvement League and hired city planner and landscape architect George E. Kessler to draft a plan for long-range civic improvements. Kessler, who was born in Germany in 1862 and brought to Dallas by his widowed mother in 1865, had drawn up a plan for the development of Kansas City's park and boulevard system in 1893. He also designed and landscaped the grounds of the Louisiana Purchase Exposition at St. Louis in 1904, the grounds of Fair Park in Dallas in 1904, and provided plans for several other cities including Cincinnati, Memphis, Salt Lake City, and

[16] David Dillon, "A Bridge Linking Dallas With Its Past," *Dallas Morning News* (3 April 1986); Ernest Sharpe, *G. B. Dealey of the Dallas News* (New York: Henry Holt and Co., 1955), 145.

[17] Landrum, Lynn W. *Dallas and Trinity* (Dallas: A. H. Belo Corp., 1933), 2.

[18] McDonald, William L. *Dallas Rediscovered: A Photographic Chronicle of Urban Expansion, 1870-1925. Dallas: Dallas Historical Society, 1978.* 227.

Denver.[19]

The primary aim of the Kessler Plan was the prevention of uncontrollable flooding of the Trinity River. A secondary purpose was the unification of those parts of Dallas separated by the river. However, the plan was not implemented at the time of its release due to a lack of support. Many people simply believed that it was not practical. Although the Dallas Property Owners Association asked Kessler to update the plan in 1919, the plan languished until severe flooding in 1921 and 1922 eventually led to the creation of a five-member board in June 1925.[20] The board was headed by C. E. Ulrickson, and they were charged with recommending a means of implementing some of Kessler's plan. The committee took approximately two years to complete the report.[21]

It was becoming evident to the citizens of Dallas at this time that increased traffic brought about by the rise in automobile ownership was exceeding design capacity of the Dallas-Oak Cliff Viaduct, thus necessitating the construction of additional bridges. This need was met by a $6,950,000 bond issue approved by voters on 3 April 1928, which provided for the construction of four roadway bridges, located at Cadiz Street (now Interstate 35E), Corinth Street, Commerce Street, and near the junction of Lamar and McKinney Streets.[22] A streetcar viaduct was also approved at this time. The $6,950,000 bond issue was tied to a larger $23,900,000 Ulrickson Plan bond issue, which called for civic improvements over a nine year period and incorporated elements of the earlier Kessler Plan.[23]

The crux of the Ulrickson bond issue was the straightening of the Trinity River and the construction of twenty-five miles of embankments approximately 30' high and about 154' thick at the base. These levees were designed to control floodwaters two and one-half times greater in volume than the record flood of 1908. The city and county formed the Flood Control District, responsible for constructing the levee system, with the city in charge of underpasses and storm drainage, and the county assumed the burden of paying for the viaducts.[24] This split of responsibilities led to problems when it became apparent that the City of Dallas revenue shortfalls caused by the depression would jeopardize completion of the approaches to the viaducts.

As the city commission charged with overseeing the 1930-31 budget completed its second overhaul of that document, it became evident that there would have to be either a drastic

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[19] McDonald, *Dallas Rediscovered.* 205; Lisa C. Maxwell, "Dallas, Texas." in *The New Handbook of Texas*, vol. 3. ed. Ron Tyler (Austin: Texas State Historical Assoc., 1996), 1081.

[20] Payne, *Dallas: An Illustrated History.* 23.

[21] Landrum, *Dallas and the Trinity.* 8.

[22] Charles. E. Gross, "Annual Report of County Auditor, Dallas County, 1 August 1928 to 31 July 1929."

[23] Holmes and Saxon, *WPA Dallas Guide and History.* 155.

[24] *Business Week* (12 March 1930), 13.

curtailment of progress towards completion of the Ulrickson Plan, a sharp cut in city salary schedules, or a tax increase. This problem was made more acute by the fact that the four new viaducts could not be opened until a $1,100,000 pressure storm sewer system was completed, tying the city into the Trinity levee. A group of large property owners, opposing any increase in taxes, recommended that the viaducts be opened without completion of the storm sewers. Community members, including various engineers and Trinity River industrial district developers, urged that the levee project be completed as planned. Each pointed out that flooding of the river would always be a problem if the system was not constructed as designed.

A budget was finally adopted that provided for the issuance and sale of $3,700,000 of Ulrickson Plan bonds, including those for the storm sewers.[25] The wisdom of this action was apparent when heavy rains north of Dallas in January 1932 caused the waters of the Trinity to rise nearly thirty-nine feet, flooding certain sections of the city and cutting off the almost completed Cadiz Street Viaduct. The flooding was caused by water pouring through gaps in the uncompleted east bank levees.[26]

Construction of temporary earthen approaches allowed the Commerce Street Viaduct to be opened briefly for traffic on 24 July 1930, just two days before the Democratic primary election at which County Commissioners J. W. Gill and George W. Ledbetter were seeking renomination. The public had become weary of delays and unfulfilled promises regarding bridge completion dates and were pressing officials for relief from traffic congestion on the Dallas-Oak Cliff Viaduct. The commissioners had their pictures taken with county engineer A. P. Rollins on the morning of the 24th and then motored across the bridge. But shortly after noon a truck became stuck in the loose dirt of the eastern approach and the bridge was again closed for traffic until the end of the year.[27] None of the three other viaducts, all originally slated to be opened by the end of 1930, would be completed until after the Commerce Street Viaduct was in daily use.

These bridges, which are very similar in design and execution, were each constructed by a different company. All, however, were designed by consulting engineer Francis Dey Hughes of Dallas. Hughes, who preferred to be identified during his professional life as "F. D.," was born in Sibley, Missouri, on 13 September, 1872. Three years after graduating from the public school system of Jackson County, Missouri, he found employment as a rodman, levelman, draftsman, and chief of surveyor's party in the county engineer's of office Kansas City, Missouri. In about 1895, he advanced to the position of office engineer, and continued in that capacity until 1897. From 1897 to 1898 he worked as a draftsman and estimator for the Kansas City Bridge Company, occasionally doing design work. From 1898 to 1899, he worked as a shop detailer and designer for the Clinton Bridge and Iron Works of Clinton, Iowa, working on bridges, water

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[25] Dorothy Dell DeMoss, "Dallas, Texas During the Depression: The Hoover Years, 1929-1933" (M.A. thesis, University of Texas at Austin, 1966), 36-37.

[26] DeMoss, "Dallas,", 132.

[27] Albert Jackson, "4 Idle Viaducts Monuments to Empty Promises," *Dallas Times Herald* (5 October 1930).

tanks, and towers. After leaving Clinton, he briefly worked at the Lafayette Bridge Company of Lafayette, Indiana, as a detailer and checker on road and railroad bridge designs before moving on to the Midland Bridge Company of Kansas City, Missouri, in 1901. While at Midland he functioned as an assistant engineer, working on almost every class of bridge and structural work, including road and railroad bridges, water works, and pneumatic foundations. He took courses at Spalding College in Kansas City during his employment at Midland, including a special night class in mathematics, and he may have also briefly attended Lafayette College (Purdue University) during his stay in Indiana.

From 1903 to 1904, Hughes served as chief engineer and plant manager of the small fabricating plant of Southwestern Bridge and Iron Company in Enid, Oklahoma. After the facility went into receivership, Hughes moved to Roanoke, Virginia, where he worked as a special squad foreman and checker in the drafting room for the Virginia Bridge and Iron Company. His stay in Roanoke was shorter than in Enid, and in 1905 he relocated to Kansas City to work for Illinois Steel Bridge Company, which had its home office at Jacksonville, Illinois.

Hughes spent more than nineteen years at this company, which was his longest period of employment by a single firm. He was contract and construction manager for all territory west of the Mississippi River and south of the Missouri River. After ten years in Kansas City, he moved to the St. Louis office, were he served as design engineer for both the St. Louis and home offices. He designed highway and railway bridges, viaducts, mill buildings, auditoriums, mine frames and tipples, and foundries.

From 1924 to 1926, Hughes was chief engineer, secretary, and general manager for Concrete & Steel Construction Company of Joplin, Missouri, a firm that specialized in highway and building construction, and mine structures. He purchased an interest in this company in 1925 but sold out in 1926. From 1926 to 1927, he was contracting and chief engineer for Pioneer Construction Company of Kansas City, Missouri.

In 1928, Hughes and wife Callie moved to Dallas, where he began his career as a consulting engineer. Hughes maintained an office in Kansas City until October 1930, even though he had an office in Dallas. During his career as a consultant, he worked on the following projects:

National Avenue Subway, Springfield, Mo.
Benton Avenue Viaduct, Springfield, Mo.
Arkansas River Bridge, Sedgwick Co., Ks.
Corinth Street Underpass, Dallas, Tx..
Cadiz Street Underpass, Dallas, Tx.
Oakes Street Bridge, San Angelo, Tx.
Trinity River Bridges (eighteen), Tarrant Co., Tx.
Belknap Street Viaduct, Ft. Worth, Tx.
Triple Underpass, Dallas, Tx.
T.A.T. shop and hanger, Love Field, Dallas, Tx.

He was also hired as a consulting engineer to check the designs of various projects in Oklahoma and Texas, and in April 1935 accepted a position with the St. Louis & San Francisco Railway as special design engineer for grade separation projects in Fort Worth, Arkansas, and Birmingham.

With no formal education in engineering, Hughes was an example of a type of engineer rapidly fading from professional practice in the 1930s. Whereas most of his contemporaries had either an engineering degree or at least some college credits in engineering, Hughes acquired all of his engineering education through actual practice or private study. He learned how to design bridges by working for companies that built bridges, thus benefiting from a tradition of American bridge building and design that was based on practical knowledge derived from empirical observation of what worked or didn't work in the field. On the basis of this practical knowledge, Hughes became an associate member of the American Society of Civil Engineers in 1902, a member in 1912, and a life member in 1937. His application for registration as a professional engineer in Texas was approved based on his practical experience, and he was issued certificate number 2372 in April 1938.[28]

In contrast to Hughes, the assistant engineer for the four Dallas viaducts, Jean Howard Knox, had formal engineering education. He received a B.S. in mechanical engineering from the University of Illinois in 1907, a program that was considered to be one of the best and most prestigious in the country. After a brief stint with the Pacific Appraisal Company of Portland, Oregon, Knox went to work for Portland Concrete Pile and Equipment Company in Portland. While employed by this firm from 1908 to 1912, Knox worked on construction and design of seawalls, docks, bridges, and foundations. He would later claim to have been construction engineer for the Dallas-Oak Cliff Viaduct, constructed between 1910 and 1911 (officially opened in February 1912), although his firm is not listed as being a sub-contractor on the project.

From 1912 to 1927, Knox worked on a variety of road, bridge, dam, and building projects in Illinois, Oklahoma, Georgia, Virginia, and Texas, and also served during World War I in the U.S. Navy Civil Engineering Corps. In 1927, he moved to Dallas to begin a long career as a consulting engineer in the Dallas-Fort Worth area. In 1929, the year that the design contract for the viaducts was awarded, Knox was listed in the Dallas city directory at the same business address as Hughes. He continued to share office space with Hughes, at different addresses, for several years after the viaducts were constructed, even though he was also listed in the directory as being associated with the engineering firm of Rollins and Clinger.

Robert H. Clinger was appointed Dallas County engineer in 1925 and served in that capacity for many years. Andrew P. Rollins became associated with Clinger in 1928, and both

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[28] Most of the information concerning Hughes contained in this report is obtained from his 1937 application for professional registration in Texas, on file at the Texas State Board of Registration for Professional Engineers, Austin, Tex. See also *Research Data, Fort Worth and Tarrant County, Texas* (Fort Worth: Texas Writer's Project, Fort Worth Public Library Unit, 1941), 18297, 20684, 20776, 21102; John F. Worley, ed., *Worley's Dallas (Texas) City Directory* (Dallas: John F. Worley Directory Co., 1929), 41, 1101, 1263, and subsequent volumes for 1930-35; *The State of Texas Registered Professional Engineers July 1939 Roster* (Austin: State Board of Registration for Professional Engineers, 1939), 47, and subsequent volumes for 1940-46; *Austin American Statesman*, 3 July 1953; *Dallas Morning News*, 3 July 1953.

Rollins and Clinger were listed on the construction plans of the four Dallas viaducts as "district engineers."

After assisting Hughes on the design of the four roadway viaducts across the Trinity, Knox secured additional work as a consultant on the Dallas Railway and Terminal Viaduct, the fifth project funded as part of the Ulrickson Plan bond package. He later served as a consulting engineer to the Dallas Park Board, as a consulting engineer and executive committee member of the Oak Cliff-Dallas Commercial Association, as a member of the aviation and highway committee of the Dallas Chamber of Commerce, and as a member of the City Plan Commission. He was a member of several professional societies or organizations, including the American Society of Civil Engineers. A street in Dallas is named for him.[29]

In contrast to Knox, Hughes was nearing the end of his professional life by the time the viaducts were completed. He was sixty-five years old in 1938, when he received his certificate as a registered professional engineer in Texas, and transferred his registration to Amarillo, Texas, the following year. In 1940 he again transferred his registration, this time to Austin, Texas, the home of his son, Frank Miller Hughes.[30] Although he was associated with the Dallas engineering firm of Koch and Fowler at the time of his official retirement in 1952, it appears that he worked on few large projects after 1938. He died in 1953 and is buried in Austin, Texas.

The particular element of interest in terms of the design selected by Hughes for the Dallas viaducts centers on the steel plate girder spans over the main river channel, which are haunched cantilever girders 200'-0" long all over, made up of two 40'-0" cantilever arms and a 120'-0" center span. Use of a variable depth steel plate girder over the river channel keeps the grade of the viaduct as low as possible, while still providing certain minimum vertical and horizontal clearances above the high water mark.

Anyone looking at the sluggish and shallow Trinity River might question whether it was, in fact, a navigable waterway, but the perceived potential of the river as a commercial outlet to the Gulf of Mexico is one of the oldest and most persistent myths in Dallas. That vision was very much alive in 1929 when the specifications for the Commerce, Corinth, Cadiz, and Lamar-McKinney viaducts were drawn up. Therefore, despite changes made in the river channel as part of the levee improvement project underway while the four Hughes-designed viaducts were under construction, it is likely that Hughes faced essentially the same design constraints as did the designers of the Dallas-Oak Cliff Viaduct. The community had not yet given up on the notion that the Trinity could be made navigable, and this meant that there had to be a minimum clearance of the channel span. By using a variable-depth, haunched cantilever girder, Hughes

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[29] Most of the information concerning Knox contained in this report is obtained from his 1937 application for professional registration in Tex., on file at the Texas State Board of Registration for Professional Engineers, Austin, Texas. See also "Builders of Dallas - Their Careers," *Dallas Morning News*, n.d., Bridges the vertical file, Local History Collection, of the Dallas Public Library; and John F. Worley, ed., *Worley's Dallas (Texas) City Directory* (Dallas: John F. Worley Directory Co., 1929), 1263, and subsequent volumes for 1930-35.

[30] Frank Miller Hughes inherited his father's love of engineering, and worked many years as a bridge engineer for the Texas Highway Department.

provided a certain minimum clearance above high water without raising the overall level of the viaduct, while also saving weight and material.

Another element of interest in terms of the design of the steel plate girder spans is that the cantilever arms are not fixed to the adjoining concrete girders. Having an expansion joint instead of a fixed connection means that the steel girders are statically determinate structures. Thus, the calculations necessary to determine stresses in the structure are simplified. If the ends of the cantilever arms had been fixed, thus making the channel spans statically indeterminate structures, the calculations would have been considerably more complex. However, the load rating for the plate girders in the constant-depth portion of the center span is less than one-third the load rating at the pier and in the cantilevered arms.[31] Therefore, the advantages of this design, in terms of simplification of mathematical calculation, are outweighed by the lower load rating factor.

The bridge is composed, from west to east, of two 45'-0" spans, sixteen 50'-0" spans, one 120'-0" main channel span, nineteen 50'-0" spans, one 45'-0" span, and five 20'-0" spans between the levee and the end of the bridge. At the west end of the bridge concrete rails were off set approximately 8" from the edge of the roadway. This feature was not replicated on the east end of the bridge.

Due to the duplication of spans and piers, the cost per square foot of the four viaducts was very low, about $3.60 per square foot, including lighting and paving. The bids for construction were about twenty-seven percent below estimated cost.[32]

Problems in the construction of approaches caused by Dallas City budget constraints and difficulty in obtaining right-of-way resulted in delayed openings for all of the viaducts funded by the Ulrickson Plan bond issue. The Lamar-McKinney Viaduct, completed about 1931, was probably the last of the four viaducts to be finished and the last open to traffic.

The Lamar-McKinney Viaduct has been altered throughout the years with replacements of the roadway, removal of the original light standards, and periodic repairs to the entire bridge. The basic structure, however, is essentially the same as erected in the early 1930s. It is significant as a surviving element of a comprehensive transportation improvement and flood control plan, and as an example of the work of an important bridge engineer who helped transform the urban landscape of the Dallas-Fort Worth metropolitan area.

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[31] The information regarding the load rating has been obtained from Charles E. Walker, P.E., "Structural Rehabilitation Report," 12 July 2000, in the files of the Environmental Affairs Division, Texas Department of Transportation, Austin, Tex.

[32] *Engineering News-Record* (16 June 1932): 850.

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