MAIN STREET VIADUCT
(Paddock Viaduct)
Texas Historic Bridges Recording Project
Spanning Trinity River at Main Street
Fort Worth
Tarrant County
Texas

HAER No. TX-50

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Location:	Spanning the Trinity River at Main Street, Fort Worth, Tarrant County, Texas. UTM: 14/655990/3625770 USGS: Haltom City, Texas, quadrangle.
Date of Construction:	1914.
Designer:	S. W. Bowen, Brenneke and Fay, Consulting Engineers, Saint Louis, Missouri.
Builder:	Hannan-Hickey Brothers Construction Company, Saint Louis, Missouri, general contractor; Virginia Bridge and Iron Company, Roanoke, Virginia, structural steel sub-contractor.
Present Owner:	City of Fort Worth.
Present Use:	Vehicular bridge.
Significance:	The Main Street Viaduct was the first concrete arch bridge in the United States to employ self-supporting reinforcing steel.
Historian:	Robert W. Jackson, August 1996.
Project Information:	This document was prepared as part of the Texas Historic Bridges Recording Project performed during the summer of 1996 by the Historic American Engineering Record (HAER). The project was sponsored by the Texas Department of Transportation (TxDOT).

Bridging the Trinity River

The city of Fort Worth is traversed by the Trinity River and its main branches, the Clear and West Forks. This stream wraps around the oldest section of the city, enclosing the central business district (CBD) on three sides. Toward the end of the first decade of the twentieth century, rapid growth of residential districts to the east and west of the CBD, and increased traffic between the city proper and North Fort Worth, where the Fort Worth Stockyards and associated meat packing plants were located, necessitated the construction of a new viaduct (the Main Street Viaduct) and the reconstruction of three older viaducts.[1]

Tarrant County passed a bond issue to fund these viaducts, the amount available for construction being about $656,000. The firm of Brenneke and Fay, Consulting Engineers, of Saint Louis was selected by the Commissioner's Court to prepare plans and specifications for, and to supervise construction of, these structures. S. W. Bowen, as principal assistant engineer for that firm, was chosen to design the viaducts and exercise executive supervision over the work of construction. L. H. Faidley had charge of the detailed work of preparing the plans and William Holden was in direct charge of construction as resident engineer.

Each viaduct was built by a separate contractor. The Saint Louis firm of Hannan-Hickey Brothers Construction Company received the general contract for the Main Street Viaduct, and the Virginia Bridge and Iron Company of Roanoke, Virginia, were sub-contractors for the structural steelwork. Work on the bridge began in December 1912 and was completed in March 1914. The total cost of the bridge, including paving, lighting, engineers' fees and removal of the old bridge, was $428,882.

The Main Street Viaduct was built to connect the Fort Worth CBD with the North Side, an area that had experienced explosive growth since the incorporation of the Town of North Fort Worth and the reorganization of the Fort Worth Stock Yards Company in 1902. The first bridge crossing the Trinity River at Main Street was a metal deck truss erected in 1889.[2] This structure

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[1] Unless otherwise noted, the information in this report is taken from S. W. Bowen, "The Design and Construction of Four Reinforced Concrete Viaducts at Fort Worth, Texas," *Transactions of the American Society of Civil Engineers* 77 (1915), pp. 1206-62. See also George A. Hool, *Reinforced Concrete Construction,* vol. III (New York: McGraw-Hill, 1916), pp. 260-67, 352-55.

[2] *Tarrant County Historic Resources Survey: Fort Worth, Near North Side and West Side; Westover Hills* (Fort Worth: Historic Preservation Council For Tarrant County, Texas, 1988), p. 4; Henry Wellge, "Perspective Map of Fort Worth, Tex. 1891" (Milwaukee: American Publishing Company, 1891), lithograph reproduced in John W. Reps, *Cities On Stone: Nineteenth Century Lithograph Images of the Urban West* (Fort Worth: Amon Carter Museum of Western Art, 1979).

was replaced by a two-lane wire suspension bridge which proved to be inadequate to handle the increased traffic.[3]

Design Constraints and Solutions

The principal constraints facing Bowen in the design of the Main Street Viaduct were related to the unstable soil conditions of the site and to the unpredictable nature of the Trinity River.

The bedrock at the Main Street site lies at a depth of from forty to fifty feet below the ground surface north of the river channel. On the south side of the river the rock rises and crops out at the surface on top of the bluff on which the CBD is located. Approximately twenty years prior to the letting of the contract for construction, a landslide occurred on the south side of the stream. Soil and loose rock overlying bed-rock slid toward the river, partially wrecking the existing bridge.

The material on the south side consists of loam and clay interspersed with loose rock and boulders brought down by the slide. This material is underlaid with ledges of rock of varying thickness. The material on the north side of the river, to a depth of ten or twelve feet, consists of a black clay-like substance which is very hard when moist. Under this material there is a dense layer of yellow clay, underlain with sand.

Because of the different soil properties on the north and south sides of the river, and due to the possibility of further shifting between the looser surface material and bedrock on the south side, it was deemed necessary to design a structure that would not be injured by unequal settlement of the foundations.

The second major design constraint faced by Bowen was the propensity of the Trinity River for sudden flooding. Normally shallow and sluggish, the river is subject to frequent freshets, and often carried large quantities of drift at the time the viaduct was being planned. Due to the dangers presented by these conditions, it was thought advisable to use, at least for the river spans, a method of construction that would not require falsework in the stream.

After considering the various types of bridge that could be built at the site, Bowen decided to use three-hinged, ribbed arches, with structural steel reinforcement designed to support the weight of the forms and wet concrete of the ribs and braces during construction. Girders were used for the approach spans.

The three-hinged arch was selected because it would not be strained by unequal settlement. Also, the three-hinged arch is a statically determinate form, meaning that stresses can be easily computed for design and secondary temperature stresses are eliminated. Ribbed

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[3] Ruby Schmidt, ed., *Fort Worth & Tarrant County: A Historical Guide* (Fort Worth: Texas Christian University Press, 1984), p. 17; Tarrant County, Texas, *Commissioner's Court Minutes,* vol. 19 (Tarrant County Courthouse, Fort Worth, Texas), p. 166 (15 June 1904).

construction was adopted because it is light and best adapted to the use of hinges, and also because no waterproofing would be required.

Description

The distance from the north end of the bridge to the center line of the south abutment is 1,745'-3". To this may be added another 118'-9", which is the distance from the centerline of the abutment to the end of the concrete retaining walls of the south end. An additional 225'-0" of lighted approach on the south side must be added to determine the total length of the entire project. From the north end of the bridge there are five earth-filled concrete retaining wall panels of 37'-6" each; two panels of 25'-0"; two concrete girders of 25'-0"; five retaining-wall panels of 27'-6"; seven 50'-0" concrete girders; two 62'-6" concrete girders; one 68'-9" concrete girder; one 150'-0" arch span; one 175'-0" arch span; one 225'-0" arch span over the main river channel; another 175'-0" arch span; and then the 118"-9" of southern retaining walls.

The bridge was built with a 54'-0"-wide roadway and two 8'-0" sidewalks. The width of the roadway was selected to allow four wagons and two streetcars to pass abreast, with the streetcar tracks laid in the middle of the roadway. The sidewalks are carried on cantilevered extensions of the floorbeams outside of the outer girders or ribs. Railings were of reinforced concrete, cast in place, except the railing panels and hand rails, which were cast in molds and then erected.

In addition, stairways were provided on either side of the bridge north of the river adjacent to the girder spans. These stairways, with the exception of the steps leading to the lower landing built on independent foundations, are supported entirely from the piers and girders by structural steel cantilever beams encased in concrete. This method was adopted, instead of partially supporting the stairs on piers and girders and partially on independent posts and foundations, in order to avoid damage from unequal settlement.

In February, 1913, while the Main Street Viaduct was still under construction, the Commissioner's Court decided to name it in honor of Buckley Boardman Paddock. Paddock was an editor of the Fort Worth *Democrat,* president of the Texas Press Association, and a member of the Texas legislature from 1881 to 1883. His editorials on the need for civic improvement, and his leadership in bringing the first railroad to Fort Worth in 1876, helped elect him to four terms as Mayor.

The Main Street Viaduct has been altered from its original construction by removal of the original railings. However, the basic structure of the bridge remains unchanged. As one of the oldest reinforced concrete viaducts in Texas, it remains as a an excellent example of early twentieth-century concrete bridge building practice, and continues to serve its original function as the main crossing of the Trinity River between the Fort Worth CBD and neighborhoods to the north.

SOURCES CONSULTED

Bowen, S. W. "The Design and Construction of Four Reinforced Concrete Viaducts at Fort Worth, Texas." *Transactions of the American Society of Civil Engineers* 77 (1915).

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APPENDIX: Suggestions for Further Research

Due to limitations in the scope of the Texas Historic Bridges Recording Project, several questions which arose during the research and writing of this report remain unanswered. It is suggested that scholars interested in this bridge consider pursuing the following:

1. Where was the first bridge across the Trinity river at Fort Worth built, and what is the full history of the two bridges known to have been built across the Trinity at Main Street prior to the Main Street Viaduct?

2. What was the methodology of construction?

3. What other bridges did Bowen design?