DAVIS AVENUE BRIDGE
Pennsylvania Historic Bridges Recording Project - II
Spanning Woods Run Ave. at Davis Ave.
Pittsburgh
Allegheny County
Pennsylvania

HAER No. PA-487

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
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HISTORIC AMERICAN ENGINEERING RECORD

DAVIS AVENUE BRIDGE

HAER No. PA-487

Location:	Spanning Woods Run Ave. at Davis Ave., Pittsburgh, Allegheny County, Pennsylvania.
USGS Quadrangle:	Pittsburgh West, Pennsylvania (7.5-minute series, 1993).
UTM Coordinates:	17/582600/4481690
Dates of Construction:	1898-99.
Designer:	City of Allegheny, Department of Public Works.
Fabricator:	Fort Pitt Bridge Works (Pittsburgh).
Builders:	Gustave Kaufman, superstructure; C. M. Driver, substructure.
Present Owner:	City of Pittsburgh.
Present Use:	Vehicular and pedestrian bridge.
Significance:	The Davis Avenue Bridge is a 396'-0"-long cantilever structure constructed for transportation, social, and municipal purposes. Constructed before Allegheny City was consolidated into greater Pittsburgh, the Davis Avenue Bridge represents Allegheny City's residential growth and progress in public works, often forgotten after the city's annexation.
Historian:	Haven Hawley, August 1998. Revised March 2001.
Project Description:	The Pennsylvania Historic Bridges Recording Project II was co-sponsored during the summer of 1998 by HABS/HAER under the general direction of E. Blaine Cliver, Chief; the Pennsylvania Department of Transportation, Bureau of Environmental Quality, Wayne W. Kober, Director; and the Pennsylvania Historical and Museum Commission, Brent D. Glass, Executive Director and State Historic Preservation Officer. The fieldwork, measured drawings, historical reports and photographs were prepared under the direction of Eric DeLony, Chief of HAER.

Introduction

As evening fell on 26 July 1874, "a storm of unprecedented violence closed over this vicinity, and continued for upwards of an hour, during which the fall of water was something enormous, and the display of electricity unparalleled within the memory of any living citizens," reported an almanac of local history in 1876. Butcher's Run, Spring Garden Run, Pleasant Valley, and Woods Run injected flood waters into the city of Allegheny, Pennsylvania. All four streams coursed down from the northern hillsides, spilling over their banks into lower urban areas. Butcher's Run and Spring Garden Run flooded from their confluence a half mile to the river, pouring water into a heavily populated section of the city.[1] Steep hillsides focused the swollen streams. An observer declared that the flooded valleys

> each contained a roaring river, carrying everything before it,— buildings and their contents, corpses of human beings, dead animals of every description, horses, cattle, hogs, sheep, and mules, household furniture, mountains of clay, sand, and gravel, street lamps, fences, etc., etc., all borne upon its raging bosom toward the river below.[2]

Residents caught in the storm that Sunday evening had no warning. Property lost in the Butcher's Run flood could not be accurately tallied, but contemporaneous sources estimated several million dollars of material damage. About seventy Allegheny residents died, with up to eighty more perishing outside of the city. The greatest devastation centered on the Butcher's Run and Spring Garden Run watersheds, although Woods Run, in what was to become Riverview Park, also left destruction its path. "It was a terrible visitation, and should be a most solemn warning to the people, teaching them not to neglect the necessary precautions, and to never disregard the possible power of the elements," summarized the 1876 almanac.[3]

In 1896, another inundation revived memories of the 1874 Butcher's Run flood, burying railways under debris and forcing Allegheny residents to evacuate from many of the same areas. "Within minutes after the storm broke, Woods Run avenue was covered with several feet of water and much damage was done between the cemeteries and Washington avenue," reported the *Pittsburg Post.* A particularly steep sewer along Woods Run Avenue carried so much water that

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[1] L. H. Everts & Co., *A History of Allegheny County, Pennsylvania* (Philadelphia: L. H. Everts & Co., 1876), 149.

[2] Everts, *History of Allegheny County,* 147.

[3] Quote from Everts, *History of Allegheny County,* 147; cf. G. M. Hopkins, *Map of the Cities of Pittsburgh, and Allegheny, Showing the New Arrangement of the Wards, from Official Records and Actual Surveys* (Philadelphia: G. M. Hopkins, 1876); J. M. Kelly, *Handbook of Greater Pittsburgh,* 1st ed. (Pittsburgh: J. M. Kelly, 1895), 29.

effluent backed up through a manhole, creating a sewer fountain shooting six feet into the air. Fortunately the few and dispersed industries of the area suffered little property damage.[4]

Although a reminder of the previous disaster, the 1896 flood occurred during a distinctly different era in municipal development. Public works projects in the mid-1890s increasingly controlled drainage in the city's northern wards, abating the risk that waterways would dangerously flood during deluges. The alluvial plains over which the flood had spread were soon claimed as lots for construction. The main danger in crossing Woods Run lay in the rugged slopes framing Woods Run Avenue, blocking residential areas west of the road from Riverview Park. The Davis Avenue Bridge, completed in 1898, joined residents in expanding areas of Allegheny and symbolized emerging movements in urban parks and city beautification. Its construction, however, symbolized continuing reliance on old methods of jobbing for bridge construction at a time just before the industry was consolidated. Functional but not fabulously appointed, the Davis Avenue Bridge represents a snapshot of one city's response to social, political, and technological developments of the late nineteenth century.

Riverview Park

Allegheny had long preceded its neighbor Pittsburgh in making public parks available to area residents. The two cities had competed for a century commercially, and the late nineteenth-century emphasis on urban beautification and recreation areas represented yet another facet of their rivalry. Public recreation areas were created out of the "common ground" that had fenced in four sides of Allegheny since it was laid out in 1787. Allegheny's downtown parks included a lush conservatory donated by Henry J. Phipps, Jr., and its sculpted landscaping and walkways were "the resort of thousands of Pittsburgers until the park mania, after years of agitation, took hold of the city officials of Pittsburg and induced them to act."[5] Pittsburgh therefore created Schenley Park out of donated land, and in the 1890s tilled and shaped it into a scenic respite for citizens, with steel arch bridges crossing rugged, verdant ravines much like Allegheny's Woods Run.[6]

Like the more famous Schenley Park, Allegheny's Riverview Park was created from land donated by wealthy, civic-minded benefactors. Mayor William M. Kennedy piloted an 1867 drive to create a park out of gifts from citizens, garnering 217 acres of hilly terrain in the northern section of Allegheny City. One hundred and seventy-nine acres of land in the Tenth Ward were formed into Riverview Park, comprising the largest city-owned area set aside for

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[4] "Stormswept Allegheny," *Pittsburg Post,* 16 Jul. 1896; U.S. Works Progress Administration (WPA), comp., *Story of Old Allegheny City* (Pittsburgh: Allegheny Centennial Committee, 1941), 33.

[5] Kelly, *Handbook,* 49.

[6] On Schenley Park and its bridges, see U.S. Department of the Interior, Historic American Engineering Record (HAER) No. PA-489, "Schenley Park Bridge over Panther Hollow," 1998, Prints and Photographs Division, Library of Congress, Washington, D.C.

recreation.[7] Despite the growing parks movement in Allegheny and the city's efforts to emulate public beautification efforts in Philadelphia, New York, and other cities, Riverview Park remained relatively unimproved until the last years of the century.[8] Riverview Park's relatively unimproved land had a value of only $87,500 in 1895, while the downtown parks of eleven and thirty-four acres, whose existence stimulated Pittsburgh's development of Schenley Park, each had land valued at $100,000 per acre.[9]

Private sources had paid for cleaning Riverside Park and making it ready for recreational uses until the city began funding projects in 1894. The city removed fences and undergrowth blocking use of the park, built springs, constructed a picnic area, and began grading and paving drives and footpaths. Riverview Park provided an elevated perch for viewing the city's stretch of development along the Ohio River, and served as the site of the Allegheny Observatory and the Western University of Pennsylvania in the late nineteenth century.[10] Residential and industrial expansion, combined with the parks movement, created demand for a bridge across Woods Run along the line of Davis Avenue. A less corroborated explanation is plausible, however. Building the bridge may have been one of several municipal improvements to keep the Western University of Pennsylvania, today's University of Pittsburgh, from relocating to Pittsburgh. Along with grading Davis Avenue to the western slopes of Riverview Park, the city approved widening Clayton Avenue, which passed through university grounds. Attempts by the city to turn over land in Riverview Park to the university were rebuffed by the state supreme court. One year after Allegheny's 1907 annexation by Pittsburgh, the university moved to a new location donated by the Schenley family, citing the availability of land for campus expansion.[11]

Expansion in Northern Allegheny

The Pleasant Valley Railway's streetcars served the Riverview Park area in the early 1890s. Better known by that appellation than by its full name, the Federal Street and Pleasant Valley Passenger Railway, it carried Allegheny residents to and from Pittsburgh via the Ninth Street Bridge, which the company owned.[12] The electric streetcar line swung through downtown

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[7] Hopkins, *Map of the Cities of Pittsburgh and Allegheny,* 3; and Kelly, *Handbook,* 7.

[8] City of Allegheny, Park Commission, *Second Annual Report of the Park Commission of the City of Allegheny, January 1st, 1870* (Pittsburgh: W. G. Johnston & Co., 1870), 8-9.

[9] Kelly, *Handbook,* 36.

[10] Kelly, *Handbook,* 50-51; WPA, *Old Allegheny,* 81, 163.

[11] "Allegheny Surveys, New Ordinances Printed for Use of Councils," *Pittsburg Post,* 2 Sep. 1896; and Steve Pietzak, senior staff librarian, Allegheny Regional Branch, Carnegie Library of Pittsburgh, telephone interviews by author, Aug. 1998.

[12] On the Ninth Street Bridge, see U.S. Department of the Interior, HAER No. PA-490, "Three Sisters Bridges," 1998, Prints and Photographs Division, Library of Congress, Washington, D.C.

Pittsburgh before returning to the North Side. For five cents a ride, passengers could travel into the northernmost parts of Allegheny steep enough for inclines; to western neighborhoods including Woods Run, where passengers could disembark at Perrysville Avenue for a day of picnicking or taking in city views in Riverside Park; to the Troy Hill section near the eastern wharves; or into Pittsburgh's central business district. In 1897, the Second Avenue Traction Company arranged to lease the Pleasant Valley operation, retaining the line's name.[13]

City records indicate that the Tenth and Eleventh wards received more infrastructural improvements than any other portion of Allegheny during the late 1890s. Many of the streets graded, adjusted to uniform widths, and fit into the city's road system by the Department of Public Works were in the hilly terrain of the Tenth Ward, home to Riverview Park. In 1896, the City Council approved grading of Davis Avenue from New Brighton Road to Riverview Park.[14] Such a route would have given residents a western approach to the park's periphery, but it ended abruptly at Woods Run ravine near the current location of the Davis Avenue Bridge. In the Eleventh Ward, viewers assessed properties along Woods Run in the vicinity of Riverview Park for new sewer lines, deciding that the city should bear the majority of the cost.[15] These improvements spurred new construction in the area, as can be discerned from a number of lot plans registered with the city in the summer of 1898. The properties lay along Woods Run Avenue, in the valley between the two wards and beneath the planned bridge site.

Demand for public works projects in the northern districts of Allegheny City helps explain why a bridge would be needed to accommodate growing traffic. The position of area representatives on relevant City Council committees also aids in understanding how it was approved. Men from the Eleventh Ward held numerous posts influential to decisions regarding public works projects. John C. Oliver served as the Eleventh Ward's Select Council member during the period in which the Davis Avenue Bridge was planned and constructed. From 1895 to 1899, he was Corporations Chair and member of the Finance and Public Works committees. During the same period, Common Council representative John M. Goehring held positions on the Finance, Grade Crossings, and Public Works committees. Common Council representative John R. Henricks, on Finance and Public Works from 1895 to 1897, was replaced by James Lowrie from 1897 to 1899, who was appointed to Finance and Charities.[16]

A local newspaper reported in 1896 that "in Allegheny there is also a vast amount of money to be put into circulation in the way of municipal expenditures and other improvements." During 1896, the city continued work on the $1,500,000 municipal water system, and in

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[13] Kelly, *Handbook*, 58; "Big Traction Deal Closed," *Pittsburg Post*, 24 Jan. 1897.

[14] *Pittsburg Post*, "Allegheny Surveys."

[15] City of Allegheny, *Municipal Reports for the Fiscal Year Ending February 28th, 1899* (Oil City, Pa.: Derrick Publishing Company, 1899), 280, 284, 305-10.

[16] City of Allegheny, *Municipal Reports for the Fiscal Year Ending February 28th, 1897* (Oil City, Pa.: Derrick Publishing Company, 1897), 3-6; Allegheny, *Municipal Reports ... 1899*, 3-6.

September almost $300,000 remained to be spent on streets and sewers, in addition to tens of thousands of dollars of work carried over from the previous year.[17] In Mayor Charles Geyer's annual report for the fiscal year ending 28 February 1897, he noted that public works had aided the city during the economic downturn of the mid-1890s "when opportunities of obtaining employment on private work were extremely limited." The mayor added that providing employment to buffer citizens from a fluctuating economy was a concern for his administration.[18]

The mayor announced in his report a $15,000 appropriation for Riverview Park improvements and requested $25,000 a year for continuing the program.[19] Thomas M. Marshall's donation of land to the city for a new entrance to Riverview Park had stipulated that Allegheny build a 60'-0"-wide "boulevard" within two years of the gift, spurring the councils to combine an expansion of public works projects with meeting Marshall's deadline. In July 1897, the city approved purchasing fill from William E. Howley at 15 cents a cubic yard as part of the park's improvement. The city resurfaced Riverview Park's drives that year, with the Wadsworth Stone and Paving Company pouring 800 square yards of concrete and installing 4,000 square yards of sheet asphalt. Personnel also bought plants, gravel, sand, and zoo supplies, in addition to completing regular maintenance for the recreation area. At the end of the year, Riverview Park construction amounted to just under the amount that the mayor had recommended.[20]

By the close of the nineteenth century, the deep valley adjacent to the park — where Woods Run had flooded into northern Allegheny only a quarter century before — had become one of the city's growing neighborhoods. Steep hillsides framed the lowland road where new sewers and house lots were being laid, but the valley's depth prevented access to the park, which had its main eastern entrance in the Tenth Ward. With no indications of a western entrance prior to 1897, the Davis Avenue Bridge appears to have been built to facilitate development and park access in the Eleventh Ward, spurred by Marshall's land donation.

In May 1898, one year after the mayor's speech, the Department of Public Works finalized plans for a bridge crossing the Woods Run ravine. Bidders received elevations, cross-sections, strain sheets, and specifications, which appear to have been prepared by an engineer on contract with the city rather than working within the Department of Public Works.[21] Within a

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[17] "Lots Of Money Is Being Spent," *Pittsburg Post,* 6 Sep. 1896.

[18] Allegheny, *Municipal Reports ... 1897,* 13.

[19] Allegheny, *Municipal Reports ... 1897,* 13.

[20] City of Allegheny, *Municipal Reports for the Fiscal Year Ending February 28th, 1898* (Allegheny, Pa.: T. A. McNary, 1898), 1288, 1300; ibid., *Municipal Reports ... 1899,* 327, 337.

[21] City of Allegheny, "Letting Plan 377," Drawing No. F-1083 (3 May 1898), in City of Pittsburgh, Department of Engineering and Construction, Bridge Division, vault drawings files (hereinafter DEC Vault). The letting plan also is labeled "Iron Work." It includes a portion of City of Allegheny, "Cross Section etc.," Drawing No. H-27 (12 Apr. 1898), DEC Vault; and all of Allegheny City, "Strain Sheet," Drawing No. H-26 (12 Apr. 1898), DEC Vault. Both were signed by "H. & McN.," perhaps a consulting engineer working for Allegheny City. Hiring

month, Gustave Kaufman provided the low bid of $25,754.00 for the Davis Avenue Bridge's construction. The city accepted his bid on 20 June 1898.[22]

Gustave Kaufman

The engineer who supervised construction of the Davis Avenue Bridge may have arrived at his project in Woods Run via the Pleasant Valley Railway, in a manner of speaking. In 1890, Kaufman's firm, which then included a partner named Ferris, completed an iron and steel bridge at Ninth Street to replace a covered wooden structure dating from 1840.[23] The Pleasant Valley Railway purchased controlling stock in the company that owned the Ninth Street Bridge in order to construct a new structure with clearances and rigidity to accommodate heavy electric railcars.[24]

During the 1890s, Kaufman was a member of the Engineers' Society of Western Pennsylvania, where he presented at least one paper and was known for his association with the Ninth Street Bridge replacement.[25] With his partner Ferris, he supervised construction of a new structure around the wooden bridge, meeting requirements that the bridge be continuously accessible to railway traffic, include a pair of lanes each for fast and slow traffic, and carry 5'-2-1/2"-gauge rails for the company's cars. They also carried out the company's stipulation that "the structure be designed on strictly economical principles, no ornament of any kind to be used." When the bridge was ordered torn down by the War Department in 1917 because it obstructed navigation on the Allegheny River, wits insinuated that the unadorned Pratt trusses themselves might be reason enough to consider replacing the 1890 bridge.[26] Although Ferris, Kaufman and Company advertised its bridge construction services in 1896, Kaufman billed himself as an independent bridge contractor in 1898, when the Davis Avenue Bridge was constructed. The circumstances of his parting with Ferris are unclear.[27]

Kaufman subcontracted work on the Davis Avenue Bridge to the Fort Pitt Bridge Works, a practice that appears anachronistic in light of the consolidation movements sweeping industries

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short-term consultants for engineering work was common practice in the 1890s.

[22] Allegheny, *Municipal Reports ... 1899,* 1149.

[23] Ninth Street was previously known as Hand Street. See U.S. Department of the Interior, HAER No. PA-490, "Three Sisters Bridges."

[24] Gustave Kaufman, "The Reconstruction of the Ninth Street Bridge, Pittsburg, Pa.," *Proceedings of the Engineers' Society of Western Pennsylvania* 8 (1892): 75. The Pleasant Valley Railway was also known by a third name, the Pleasant Valley Electric Street Railway Company.

[25] Kaufman, "Ninth Street Bridge," 189-226; W. G. Wilkins, "The Reconstruction of the Sixth Street Bridge at Pittsburg, Pa.," *Proceedings of the Engineers' Society of Western Pennsylvania* 9 (1895): 144.

[26] Kaufman, "Ninth Street Bridge," 196, 202.

[27] Victor C. Darnell, *A Directory of American Bridge-Building Companies, 1840-1900,* Occasional Publication No. 4 (Washington, D.C.: Society for Industrial Archeology, 1984), 65, 67.

as diverse as paper making and steel fabrication at the turn of the century. As a way of organizing labor for projects, jobbing (or subcontracting units of work) increasingly dropped out of favor in the late nineteenth century as the engineering profession became more distinct from construction around the mid-1880s.[28] The possibilities for individuals to coordinate bridge projects declined with the American Bridge Company's incorporation in 1900. The next year, the American Bridge Company consolidated twenty-four firms under its control, encompassing half of the national bridge fabrication output.[29] As municipal departments of public works became more established, they provided bureaucracies in which engineers solidified the status of their profession. Kaufman's exceptional persistence with individual jobbing at the century's end shows continued possibilities for lone, entrepreneurial-minded engineers despite industrial and occupational trends toward consolidation.

Fort Pitt Bridge Works

Formed out of the merger of an iron works and an engineering-and-contracting firm in 1896, the Fort Pitt Bridge Works encompassed a body of experience predating its organization. Theodore A. Straub, a young engineer who had worked with Pittsburgh firms including the Keystone Bridge Works, Pittsburgh Bridge Company, and Shiffler Bridge Works, joined with his cousin H. R. Blickle to become bridge contractors in Texas in 1894. They opened an office the following year in Pittsburgh as Straub and Blickle, offering engineering and contracting services. When the Pittsburgh Architectural Iron Works fell into financial difficulties soon after building a plant at Canonsburg, Pennsylvania, stockholders of the iron works contacted Straub and Blickle to help them pluck the new facility from the troubled company. Fort Pitt Bridge Works was incorporated in 1896, acquiring the Pittsburgh Architectural Iron Works' Canonsburg plant at a sheriff's auction on 7 May. The Fort Pitt Bridge Works subsequently produced steel components for a number of Pittsburgh bridges, including those at McKee's Rocks, the Point, Smithfield Street, Sixteenth Street, and Thirty-first Street, not to mention numerous buildings in the vicinities of Pittsburgh and Canonsburg.[30]

Cantilever Construction

Scotland's Firth of Forth railroad bridge, completed in 1889, renewed interest in cantilever construction methods, which are well-suited to long-span work over difficult terrain. By 1930, cantilever construction was considered to save money when used on spans of more than 700'-0" unless falsework was unusually inexpensive. Engineers in the early 1900s used rules of

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[28] Darnell, *Directory,* viii.

[29] Darnell, *Directory,* 85.

[30] "History of Fort Pitt Bridge Works of Pittsburg," typescript ca. 1946, FF 1, Box 1, Group A, Fort Pitt Bridge Works Collection, Archives of Industrial Society 63:27, Hillman Library, University of Pittsburgh, Pittsburgh, Pa.; and Darnell, *Directory,* 65.

thumb to decide on construction methods, weighing the difficulty of constructing falsework, the structure's length, and whether it spanned a body of water on which navigation had to be maintained. Cantilever methods make erection possible without falsework, for longer spans, and without obstructing navigation.[31]

Cantilevered structures share four general characteristics, although many variations are possible. Trusses or girders serve as the major carrying members. Cantilever arms extend inward from main piers, with anchor arms extending outward to counterbalance them. The cantilever arms either meet at mid-span or support a suspended span between them. Hinges at these connections resist shear but not bending moment. The result is that primary trusses or girders convey loads to the supports through shear, with vertical reactions dominating stresses in the structure. Trusses rely upon diagonal web members to carry shear, which chords must be able to transfer. Anchor spans exert uplift forces, requiring that the ends be fastened securely to anchorages.[32] The Davis Avenue Bridge is an unusual variant that defied easy classification, although it was common enough to be pictorially represented in a 1908 textbook on trusses.[33]

While economical in many situations, the lack of graceful curves and predominant linear features of most cantilevers were considered unattractive. The support systems often produced a stark frame.[34] The Davis Avenue Bridge, a modest cantilever spanning 396'-0" across a ravine in a wooded residential setting, imposed a riveted steel structure with little embellishment on verdant Riverview Park. Its functional beauty did not impress bridge critic Henry G. Tyrrell. He made a passing mention of the Davis Avenue Bridge in his 1911 *History of Bridge Engineering,* grouping the Allegheny City structure with another cantilever as "two highway bridges with outlines which cannot be commended."[35] As Tyrrell described it, "The Davis Ave. Cantilever ... has two lines of trusses 22 feet apart, with 20-foot panels and a road 36 feet wide, paved with asphalt on buckle plates. It is about 400 feet long with 156-foot center span and cost $26,700."[36] He gave no indication why he so disliked the structure, assuming that his readers shared his appreciation for elegance in both appearance and design. His diagram of the Davis Avenue Bridge clearly indicated the suspended span placed between the two cantilever arms by using dotted lines for those members superfluous to the design's structural integrity, as in Figure 1.

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[31] John Lyle Harrington, "Recent Developments in Bridge Superstructures," *Proceedings of the Engineers' Society of Western Pennsylvania* 46, No. 3 (Mar. 1930): 60.

[32] Wilbur J. Watson, "Bridge Architecture," *Proceedings of the Engineers' Society of Western Pennsylvania* 46, No. 3 (Mar. 1930): 90, 92, 94.

[33] A. H. Heller, *Stresses in Structures and the Accompanying Deformations* (New York: John Wiley & Sons, 1908), 212-13.

[34] Harrington, "Recent Developments," 61.

[35] Henry Grattan Tyrrell, *History of Bridge Engineering* (Chicago: self-published, 1911), 281.

[36] Tyrrell, *History,* 282.

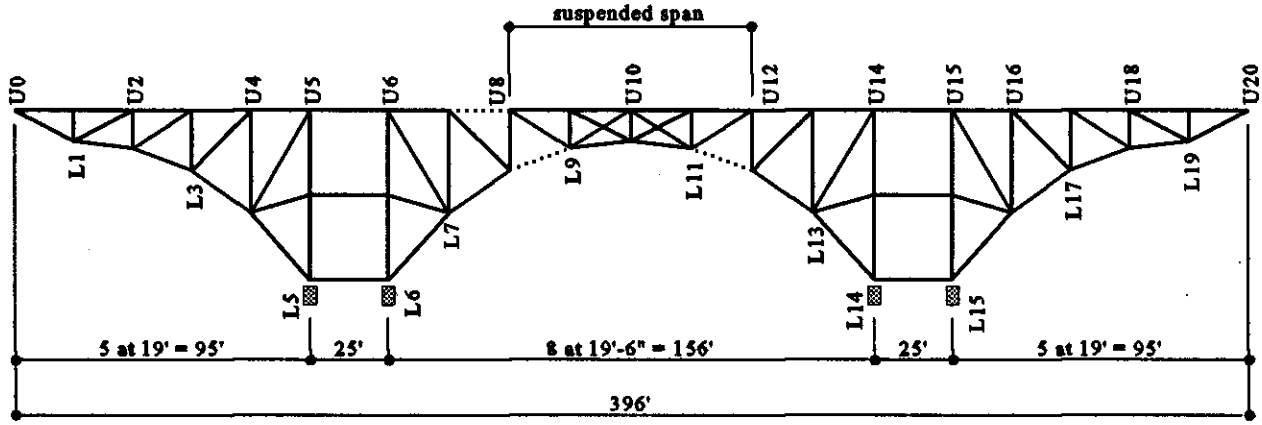

Figure 1 Elevation of Davis Avenue Bridge. Sketch by Justin M. Spivey.

Tyrrell's harsh criticism belied a concern with form over function, and must be taken in perspective. Like a growing number of engineers active during the civic improvement movements of the late nineteenth and early twentieth centuries, Tyrrell rejected strict utilitarianism as the measure by which to judge engineering achievements. That the bridge served a transportation goal at a modest cost mattered less in his eyes, perhaps, than the imposing yet somewhat ungainly appearance of the structure.

The Davis Avenue Bridge

The Davis Avenue Bridge stretches 396'-0" across the Woods Run ravine, with the bottom chord 70'-0" above the ground at mid-span. The unevenness of the ravine bottom forced workers to grade slopes before constructing the piers. Plans called for regrading the slope near the east main pier, then sinking the piers and setting all of the truss bearing pads at nearly the same elevation. The piers had to be constructed to accommodate a 2 percent grade on the eastern side of the bridge, making the task of laying masonry more exacting.[37]

A local contractor named C. M. Driver installed masonry for the Davis Avenue Bridge. The work ranged from Rose Avenue to Riverview Park, crossing the ward boundary along with the bridge. Driver used 687 cubic yards of masonry for abutments and pier foundations at a cost of $4,985.26 to the city, and he completed his work in July 1898.[38] Unfortunately, the final cost was not broken down into separate categories to reveal why Driver's original bid of $5,630.55 to complete 760 cubic yards of masonry for $6.93 a unit and 75 cubic yards of concrete for $4.85 a unit was reduced.[39]

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[37] City of Allegheny, "Elevation of Bridge," Drawing No. D-49 (Oct. 1898), DEC Vault.

[38] Allegheny, *Municipal Reports ... 1899*, 279.

[39] Allegheny, *Municipal Reports ... 1898*, 1185.

Driver's work included rough coursed stone piers at elevations ranging from 170.61' to 174.63'. The two main piers each consist of four stone columns, 5'-0" wide and battered 1:12 on each side, in a 22'-0" by 25'-0" rectangle, with the longer dimension parallel to the bridge. These main piers are spaced 157'-0" apart. Rough coursed stone abutments also varied in elevation, with the west at 220.18' and east at 228.10'. A distance of 96'-0" separates the west pier from the west abutment, with 93'-10" between the east pier and the east abutment.[40] During masonry work, wing walls were added to accommodate the steep site. Workers added a nearly perpendicular and an acute wing wall at the west abutment, and parallel wing walls at the east abutment.[41]

The main piers support 25'-0"-wide truss towers at L5-L6 and L14-L15, from which cantilever and anchor arms project. The tower columns are attached by two 1-1/4" bolts or tie rods to pier shoes.[42] The cantilever and anchor arms are asymmetrical, the latter being much longer. The anchor spans are comprised of five truss panels, each 19'-0" long, while the cantilever arms have but two 19'-6" panels. The suspended span between them has four additional panels the same length. Panel points U8 through U12 describe the suspended span's upper chord, and L9 through L11 its lower chord, essentially a Pratt deck truss supported by vertical members at U8 and U12. The suspended span may have been lifted into place as a unit, although no extant plans indicate the method used. Expansion dams were placed in the deck at U0, U8, and U20. The cantilever construction made members L8-L9 and L11-L12 superfluous in terms of structural support.[43] These members were added merely to continue the arc of the lower chord, providing a consistent appearance of strength. Because of the expansion joint at U8, member U7-U8 does not carry any axial load, although it is of course necessary for continuing the roadway.

The bridge could have been built with equal cantilever and anchor arms and no suspended span, but pinning the cantilever arms to each other at mid-span would have caused excessive uplift at the end spans. Instead, the Davis Avenue Bridge has cantilever arms truncated to include a suspended span, which allows uplift to be resisted by anchor arms attached to 3'-0" rocker posts at the abutments.[44] Pins 4-1/8" in diameter join the rocker posts to the truss and to the shoes, which are anchored by 12"-long, 3"-wide, and 3/4"-thick anchor plates embedded in

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[40] City of Allegheny, "Masonry Plans," Drawing No. F-1085 (26 Apr. 1898), DEC Vault; and City of Pittsburgh, "Owner and Maintenance Responsibility — Various Bridges," Drawing No. B-061, attached to letter from Department of Law to Department of Public Works, 27 Oct. 1972, in bridge inspection files, City of Pittsburgh, Department of Engineering and Construction, Bridge Division, Pittsburgh, Pa.

[41] City of Allegheny, "Alterations to Masonry Work," Plan No. F-1084 (Oct. 1898), DEC Vault.

[42] Allegheny, "Cross Section etc."

[43] Pittsburgh, "Owner and Maintenance"; Allegheny, "Letting Plan 377."

[44] Allegheny, "Cross Section etc."

concrete.[45] Holes for pins were reamed to size, but sections were either pinned or riveted as indicated in plans prepared by the Fort Pitt Bridge Works, apparently as shop drawings.[46] Lateral bracing is held by gusset plates pinned at truss member connections. The braces are 7/8" square rods, except for 1-7/16" square rods at the towers.[47]

The 22'-0"-wide roadway is supported by nine lines of 15"-deep built-up stringers (18" deep in the 25'-0" tower panels), carried on 5'-0"-deep latticed deck beams. As originally built, the lattice work extended under the cantilevered sidewalks.[48] The only extant picture of the Davis Avenue Bridge with the original lattice work, which was painted a lighter color than the bridge (perhaps to mimic wood lattice), appears in a Fort Pitt Bridge Works promotional brochure.[49] A plan prepared before construction showed a cross-section of two possible options for surfacing the roadway. On top of the stringers, engineers debated letting bids for a two-layer wood surface, or for buckle plates topped with concrete and 1-1/2" of asphalt.[50] For the sidewalks, each cantilevered 8'-0" with a 3'-6" railing, the options were two 4" x 16" wooden stringers supporting a single layer of timber decking, or three I-beam stringers (one a roadway member) supporting a two-layer wooden wearing surface. Bids were accepted on the latter options, as indicated in a letting plan and completed drawings. The final letting plan also noted roadway and sidewalk live loads of 100 pounds per square foot on stringers and floor beams, and 70 pounds per square foot on the trusses.[51]

The Chester B. Albree Iron Works prepared drawings for the railings and lamp posts, which were installed in 1898. The railing design features riveted lattice in the lower two-fifths of each panel, with overlapping arcs in the upper three-fifths. Lamp posts, since removed, featured a leaf motif encircling the posts just above the railing joints.[52] Albree's firm advertised as a bridge builder in Allegheny from 1896 to 1899, but by 1901 the company specialized in railings.[53] Commemorating the bridge's completion in 1898, two name plates listed Robert McAfee, Allegheny's directory of the Department of Public Works; G. C. Langenheim,

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[45] City of Allegheny, "Details of Built Shoes," Drawing No. F-1112 (Oct. 1898), DEC Vault; ibid., "Masonry Plans."

[46] City of Allegheny, "Details of Trusses," Drawing No. F-1090 (Oct. 1898), DEC Vault.

[47] Allegheny, "Strain Sheet."

[48] Allegheny, "Strain Sheet."

[49] "Records (1896-1949) of the Fort Pitt Bridge Works," FF 1, Box 1, Group A, Fort Pitt Bridge Works Collection, Archives of Industrial Society 63:27, Hillman Library, University of Pittsburgh, Pittsburgh, Pa.

[50] City of Allegheny, "Buckle Plates," Drawing No. F-1094 (Oct. 1898), DEC Vault.

[51] Allegheny, "Cross Section etc."

[52] City of Allegheny, "Detail of Lower Part of Lamp Posts," No. F-1086 (Oct. 1898), DEC Vault.

[53] Darnell, *Directory*, 58.

superintendent of the Bureau of Engineering; Gustave Kaufman, engineer and contractor; and Fort Pitt Bridge Works of Pittsburgh, the builder.[54]

William E. Howley received the contract for grading Davis Avenue up to the bridge, leveling the roadway between Brighton Road and Rose Avenue in Ward Eleven, improving the street up to the abutments. He moved 24,449 cubic yards of earth for the 50-foot wide section, completing the project in February 1899 at a cost of $8031.81.[55] It is possible that Howley's services were employed earlier in grading the pier slopes. W. O. Plank, a contractor with previous experience on bridge projects in the Pittsburgh area, completed paving on the structure's roadway.[56]

Conclusion

The litany of small contractors who assisted Kaufman in constructing the Davis Avenue Bridge and improved the adjacent roadway in 1898-99 were soon eclipsed by the consolidation of bridge companies into a single entity that soon dominated the industry in Pittsburgh and across the country. Within two years of the Davis Avenue structure's completion, half of the country's bridge-building capacity combined into one company as part of the first great merger movement that swept America. The fabrication, financing, and technical resources available to immense engineering firms made it more difficult for independent contractors like Kaufman to compete. The bridge's construction gives evidence of Allegheny's growth and the place of public works at the end of the nineteenth century. Within a decade, Allegheny would be annexed and overshadowed by the more powerful city of Pittsburgh across the river. Corporate and municipal consolidation made projects like the Davis Avenue Bridge seem insignificant when compared to grander structures sometimes produced by large business and governmental entities. Unlike the elaborate steel arch constructed over Panther Hollow in Pittsburgh's Schenley Park in 1895-96, the Davis Avenue Bridge was a modest structure, designed for function more than form. The latter serves as a reminder of success measured by standards of the community in which it was built, not those imposed by later generations.

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[54] City of Allegheny, "2-Name Plates for Davis Ave. Bridge," Drawing No. D-43 (ca. 1898), DEC Vault.

[55] Allegheny, *Municipal Reports ... 1899,* 278.

[56] City of Pittsburgh, *Annual Reparts af the Executive Departments of the City af Pittsburgh far the Year Ending January 31, 1912,* vol. 1 (Pittsburgh: Pittsburgh Publishing Co., 1912), Table 3, "Tabulated Data Relating to the Free Bridges Located Within the Corporate Limits of Greater Pittsburgh, Pennsylvania." Table 3 is an invaluable reference that lists all city-owned bridges as of 1912, with dimensions, contractors, contract prices, dates of construction, and limited data about previous bridges at certain sites.

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