Sioux City's Grand Avenue Viaduct

1936 – 2010

by Jennifer A. Price

Tallgrass Historians L.C. – Iowa City, Iowa

with current photographs by Mike Whye

VALUABLE ASSISTANCE was provided by Paul Barnes, Sioux City Planning Division, City of Sioux City; Grace Linden and Matt Anderson, Pearl Street Research Center, Sioux City Public Museum, Sioux City; John McGuire, Mary J. Treglia Community House, Sioux City; Kenneth F. Dunker, P.E., Hank Zaletel, and Judy McDonald, Iowa Department of Transportation, Ames; Mary Bennett and Charles Scott, Special Collections Department, State Historical Society of Iowa, Iowa City; and Jan Olive Full, Tallgrass Historians L.C., Iowa City. Robert Burchfield copyedited the manuscript.

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ON THE COVER, front and back: Original piers and girders on north side of the viaduct, looking west. Photograph by Mike Whye, 2007. ABOVE: Postcard view of the new Grand Avenue Viaduct from Floyd Cemetery, c.1938. Jan Olive Full Collection.

Sioux City's Grand Avenue Viaduct, 1936-2010

Courtesy of the Sioux City Public Museum, Sioux City, IA

Original photograph for postcard view (opposite) of the new Grand Avenue Viaduct, c. 1938.

For almost 75 years, the Grand Avenue Viaduct (known today as the Gordon Drive Viaduct) has been a familiar feature of Sioux City's urban landscape. With the exception of bridges over the Mississippi River, the Grand Avenue Viaduct is Iowa's longest grade separation as well as its longest bridge. For nearly a mile, from the eastern suburbs west to the central business district, the viaduct carries Gordon Drive and the city route of U.S. 20 over the Floyd River valley, which includes the remnants of the city's famed stockyards and the South Bottoms neighborhood, as well as a maze of railroad tracks and the present channel of the Floyd River. Constructed in 1937 and known simply as "The Viaduct" to local residents, the massive structure is as fundamental to Sioux City as were its stockyards just a few decades ago.[1]

Throughout its life, the Grand Avenue Viaduct has been adapted to Sioux City's changing landscape. As originally designed, the Grand Avenue Viaduct was a continuous beam and plate girder deck bridge with 54 beam and plate girder spans, the longest of which reached 127 feet. The superstructure contained a 32-foot, two-lane roadway, two 4-foot sidewalks with handrails on each side, and 49 decorative light posts bracketing its entire length. Three pairs of staircases conducted pedestrians to and from the streets below. In 1962, the viaduct was partially rebuilt to accommodate the relocation of the Floyd River to control flooding. At that time, the Iowa State Highway Commission (ISHC) built new piers and added three spans to its length. Three years later, the ISHC adapted the Grand Avenue Viaduct to Interstate 29. The project required 57 new concrete piers and a four-lane road to keep up with the growing traffic volume, which today averages 26,400 vehicles daily.[2]

Although in its eighth decade of service, the Grand Avenue Viaduct remains an engineering achievement that solved one of Sioux City's worst traffic problems. In the late 1930s, Sioux City's new viaduct presented a nearly mile-long colonnade of elegant concrete piers, flowing arched girders, freshly painted roadway fixtures, and two unobstructed lanes of smooth concrete pavement. It lifted motorists 28 feet above congested city streets and carried them from one end of the Floyd River industrial valley to the other in a matter of minutes. At a time when urban highways and elevated motorways captivated city planners and the public alike, the Grand Avenue Viaduct brought Sioux City fully into the modern automobile age.

Sioux City's Historic Landscape

In 1804, Sergeant Charles Floyd, a member of the Lewis and Clark expedition, died and was buried beneath a marker on a high bluff overlooking the site that would become Sioux City. For nearly half a century thereafter, the place received little notice other than mentions of Floyd's grave by passing fur traders, before the first Euro-American settlers began arriving in 1849. In 1854, a government surveyor named John K. Cook recognized the advantages of the site near Floyd's grave, which lay at the confluence of three rivers – the Missouri, Floyd, and Big Sioux. Cook purchased a land claim and began to lay out Sioux City. Its location on the Missouri River made Sioux City a major steamboat port and gateway to the West for migrants bound for the Dakotas, Montana, Wyoming, and beyond. Surrounding prairies offered settlers good agricultural land for crops and grazing land for large herds of cattle, hogs, and sheep. Sioux City quickly became a trading center for a large territory producing a full range of agricultural products. The swampy floodplain between the Floyd and Missouri rivers, known locally as the South Bottoms, was platted in the 1850s as the Floyd City addition. The flat land proved ideal for constructing railroads into and through Sioux City, and the first line, the Sioux City & Pacific Railroad, arrived in 1868. In 1880, James Booge relocated his successful stockyards and meatpacking company to the Floyd City addition, taking advantage of the rail connections and space for expansion. Other meatpacking plants, mills, and factories soon followed, and in the process attracted a flood of immigrants eager for work and residence.[3]

By the end of the nineteenth century, Sioux City had become a major rail and industrial center, with eight trunk lines and five branch lines. Concentrated in the Floyd City/South Bottoms area, the railroads,

Iowa Geographic Map Server - ISU GIS Support & Research Facility

Circa 1938 aerial view shows Sioux City's historic landscape. Note the meandering course of the Floyd River, the width of the Missouri River, the maze of railroad tracks (north of viaduct), and the city's immense stockyards (south of viaduct, between the rivers).

streetcars, stockyards, and industries together created a congested district in the middle of town. With no less than 84 track crossings, the area was hazardous to pedestrians and horse-drawn vehicles alike. Urban expansion from the heart of city to the north, west, and east made travel through the streets of this industrial district unavoidable, but difficult at best. The periodic, sometimes catastrophic Floyd River floods made travel through the section at times impossible. For almost half a century, the situation in the South Bottoms remained Sioux City's worst traffic problem.[4]

Bridging the Floyd River Valley

A first attempt to solve the traffic problem in the South Bottoms was made in 1889, when a group of wealthy businessmen organized and built the Sioux City Elevated Railway. Only the third steam-powered elevated railway in the world, the Sioux City Elevated Railway connected the central business district with the city's newest fashionable suburb, Morningside, well east of the Floyd River. For a nickel a ride, the railway carried passengers from the downtown business district at Third and Jones streets east for two miles, 22 feet above the congested industrial district, across the Floyd River, and then south on Division Street to Leech Avenue, where the tracks descended to street level for the rest of the journey to Morningside. An initial success, the elevated railway began its decline in 1893, when the national financial panic that year abruptly ended plans for expansion. By 1899, the elevated railway was bankrupt and was eventually dismantled. Thus, the first large-scale attempt to separate crosstown ground transportation from obstacles in Sioux City's industrial district ultimately failed. Nearly four decades would pass before the city tried again.[5]

Meanwhile, Sioux City entered a golden age of

2002 aerial view. Note the relocated Floyd River channel and the tamed Missouri River. Railroad tracks have been consolidated and only remnants of the stockyards remain.

growth and prosperity, becoming Iowa's second largest city. Its population almost doubled from 47,000 in 1910 to nearly 80,000 in 1930. By the 1930s, six trunk railroads with a total of 20 distinct lines extended from Sioux City in every direction. These railroads were the Chicago & Northwestern; the Illinois Central; the Chicago, Milwaukee, St. Paul & Pacific; the Great Northern; the Chicago, Burlington & Quincy; and the Chicago, St. Paul, Minneapolis, & Omaha. The Sioux City Stockyards, with its countless pens, chutes, and livestock buildings, had grown so large it constituted "a city unto itself." The huge Armour and Cudahy meatpacking plants, joined by Swift and Company in the 1920s, dominated the local economy and the South Bottoms landscape, providing thousands of jobs to the newly arrived immigrants and the working class who populated the South Bottoms neighborhood. The railroads and industries built miles of spurs and sidings to keep the sprawling factories humming. In the mid-1920s, packinghouse workers unloaded over 300 carloads of livestock daily.[6]

At the same time, Sioux City's streets grew even more congested as automobiles became the primary mode of transportation in the United States. In Iowa alone, motor vehicle registration skyrocketed from 200,000 in 1916 to over 700,000 by 1930. Gridlock became the norm as cramped urban streets built for a slower, horse-powered past all but eliminated the time-saving capacity of automobiles. The narrow widths, sharp turns, dangerous grade crossings, confusing intersections, and lack of parking space made city streets anathema to the thousands of motorists vying for space and speed. Adding to the congestion, trucks began hauling livestock to Sioux City in 1916. That year, trucks delivered 6,000 head of cattle to the stockyards; by 1925, the number had risen to 80,000. With so many vehicles on the road, the number of automobile accidents, many fatal, began to climb. Among the many victims of automobiles were children walking to school in the South Bottoms neighborhood.[7]

During the 1920s, a few city planners advocated building viaducts and other elevated roadways to alleviate traffic congestion, eliminate dangerous grade crossings, and reduce automobile fatalities. Opposition to such massive structures, however, remained strong. In 1927, the City Club in New York objected to a proposed elevated highway on the west side of Manhattan, declaring that it would be "a cement centipede," both "ugly and expensive." James H. Nygren, a Detroit consulting engineer, listed a number of "drawbacks" to such structures, including noise, gasoline fumes, "the darkening effect of solid floors," and "the dangers to lower-level traffic caused by massive concrete supporting columns." City planner Edward H. Bennett, one of the few who pointed out the urban viaduct's degrading effect on the quality of life for nearby residents, thought the ground-level streets beneath these roadways would become "unsightly front yards for all buildings in their path."[8]

During the 1930s, the twin crises of the Great Depression and the high automobile mortality rate began to change attitudes toward elevated highways. In 1934, automobile technology took a giant leap forward; driving speeds of 30 to 40 miles an hour suddenly jumped to 50 to 60 miles an hour. Within a year, 75 to 100 miles per hour on highways became common practice. Along with higher speeds came improvements in brakes, tires, and steering, as well as stronger chassis, lower centers of gravity, and safety glass. The combination of safer and faster cars and older city streets and highways with few, if any, speed limits made the situation even worse. One automobile critic estimated that "every 13 minutes day and night in America, an auto kills a human being." Thus, while automobile engineering rushed toward the future, America's urban streets remained mired in the past.[9]

As an answer to unemployment, traffic congestion, and accidents, the construction of viaducts and longer elevated highways suddenly seemed both logical and practical road-building projects. By building one massive structure, cities could employ hundreds, reduce gridlock, and eliminate "a prolific source of accidents." Planners and engineers had learned from the few elevated highways built in the late 1920s how to avoid local opposition by locating the structures in industrial areas. They also had learned how to minimize their likeness to "cement centipedes" by giving them "a sleek and streamlined look," to make them, as one traffic expert envisioned, "beautiful." In this sense, viaducts and elevated highways must be viewed through a 1930s lens, when visions of future cities included automobiles speeding along smooth, curving roadways. Representing the speed and mobility associated with progress and modernity, a "sleek and streamlined" viaduct in Sioux City would lift motorists above the congested streets of the South Bottoms, and carry them – and by implication the city – swiftly toward the future. Only the expense of building such a massive structure stood in Sioux City's way.[10]

The New Deal and the Viaduct

After 1918, states and the federal government had shared highway building and improvement costs in rural areas, with funds for highways expended on transforming farm-to-market roads into highways. Municipalities, however, bore the costs of street improvements alone, even though federal-aid highway routes necessarily passed through cities on city streets. As one city planner observed, state and federal governments had "built the world's greatest system of highways up to the gates of our cities, and there they stop." As a result, highways jogged through cities along a confusing course of streets, bewildering out-of-town travelers and adding to traffic congestion and accidents. In Sioux City, the federal-aid highways 20, 75, and 77 were routed through town. Highways 20 and 75, which had been built in 1916 and 1917 respectively "as beautiful boulevards," were by 1931 "so congested with traffic that they were little better than cow paths." Travelers approaching Sioux City from the east on Highway 20 faced a tangled route that tried to avoid the worst sections of the industrial district by taking motorists through the equally congested business district instead. To cross Sioux City and the Missouri River into Nebraska, motorists had to go "west in Fourth street to Court street, turn north in Court street to Fifth street, travel in Fifth street to Wesley Way and reach the Combination bridge by driving southeast in Wesley Way." Thus, city officials and planners began to lobby for the extension of federal-aid highways through cities in order to receive state and federal highway money to fix the problem.[11]

These were the difficulties with which Sioux City and countless other urban areas struggled when Franklin D. Roosevelt became president in 1933. With cities across the nation demanding quick, pragmatic responses to both the traffic and unemployment crises, Roosevelt's New Deal continued and greatly expanded Herbert Hoover's highway projects, each capable of employing hundreds of people at a time. Through a series of legislative acts, the New Deal ushered in a golden age of road, highway, and bridge construction that put people to work and profoundly changed the landscape of urban America.[12]

During the first years of the New Deal, the U.S. Congress passed several acts of work-relief legislation: the National Industrial Recovery Act (NIRA) on June 16, 1933; the Hayden-Cartwright Act on June 18, 1934; and the Emergency Relief Appropriation Act on April 8, 1935. The funds provided by each of these acts were to be used for "highway and bridge construction, including the elimination of hazards to highway traffic, such as the separation of grades at crossings, the reconstruction of existing railroad grade crossing structures, the relocation of highways to eliminate railroad crossings, and the cost of any other construction that will provide safer traffic facilities or definitely eliminate existing hazards to pedestrian or vehicular traffic." Of the three, the Hayden-Cartwright Act of 1934 was the catalyst for the Grand Avenue Viaduct in Sioux City. The act allowed for the first time federal monies to be used for extensions of the federal-aid highway system into and through municipalities, with special attention given to eliminating dangerous grade crossings.[13]

In 1935, as Congress debated the bill, the chairman of the Iowa State Highway Commission (ISHC), Ollie J. Ditto, declared funding for the Grand Avenue Viaduct to be "virtually assured if the contemplated grade separation program is carried out in the new federal works program." The ISHC, Ditto explained, "felt construction of the viaduct would fit into the grade crossings elimination program." As of June 30, 1935, 158 railroad and highway grade-separation structures were completed, 75 more were under construction, and a number of others had been approved. One of those approved was the Grand Avenue Viaduct in Sioux City.[14]

Six months earlier, Sioux City officials had announced "tentative plans for a $250,000 viaduct." The "Stock Yards Viaduct," as the *Sioux City Journal* called it,

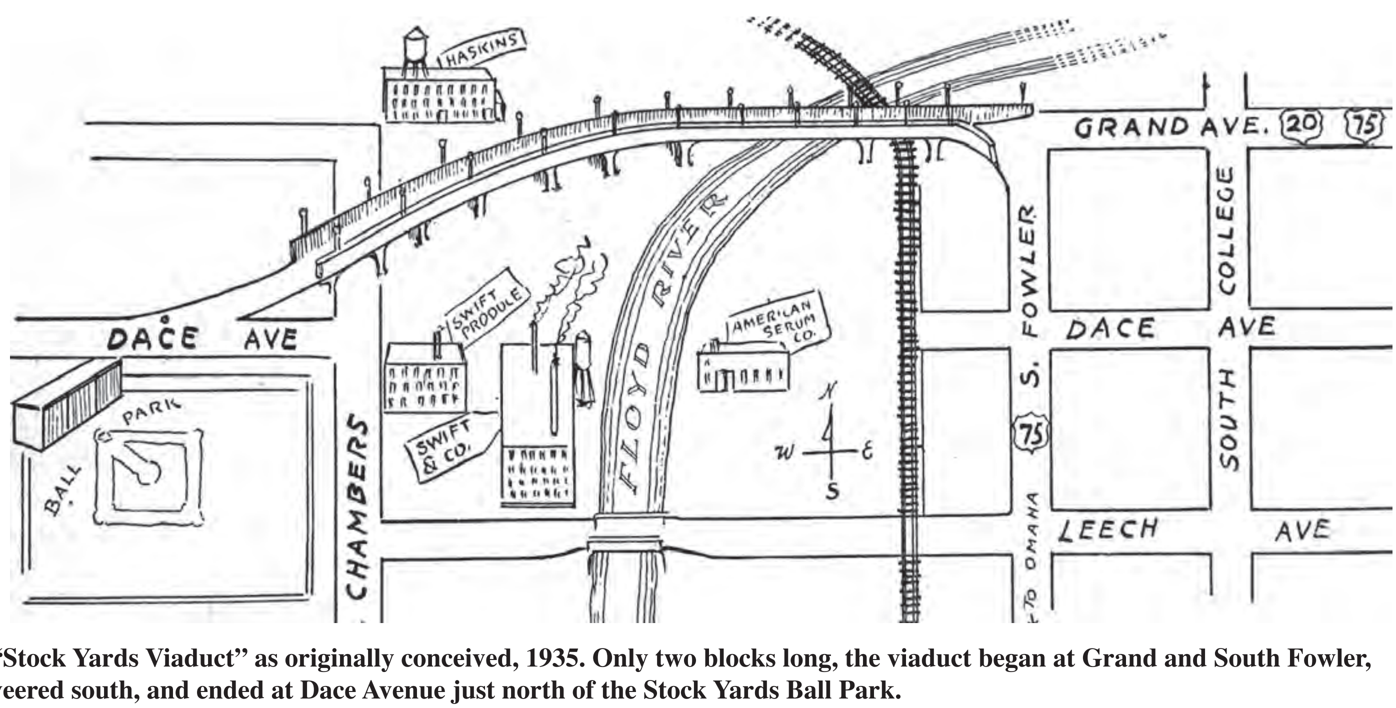
> would provide a shortcut from highway 20 to the Combination bridge, enabling tourists to avoid the congested downtown area through which the present highway is routed. It also would permit travelers in highway 75 to reach the Combination bridge more rapidly by avoiding the present route through the heavy business and industrial districts.[15]

Beginning at Dace and South Fowler streets, the viaduct "would provide an overhead crossing over the Chicago, St. Paul, Minneapolis and Omaha railroad tracks and over Floyd river just north of the Swift packing plant, and would enable motorists to reach the River road directly through Dace avenue." In addition, Highway 20 "would be rerouted close to the stock yards and would provide a direct connection at the Combination bridge with the proposed extension of highway 77, which would extend west along the river." City officials estimated the "proposed structure would be at least a block long." A month later, the block-long viaduct had grown to "approximately two blocks long," spanning the packing district, railroad tracks, and the Floyd River.[16]

Less than a year later, plans had changed drastically. The proposed Grand Avenue Viaduct, as it was renamed, would stretch "nearly a mile long" and would cost "considerably more than estimated." According to ISHC chairman Ditto, plans in March 1936 called "for a 32-foot structure to carry lanes of traffic with an average height of 27 feet to permit railroad and street car clearance." Included in the design was "a 4-foot pedestrian walk on either side of the viaduct," even though Ditto was opposed to them. At 4,580 feet in length, the viaduct, including both the east and west approaches, would be just two blocks shy of a mile. Ditto described the route as running "along Grand Avenue entirely, with the west approach built from the alley line between South Court and South Iowa streets and [running] as far as the alley line between South Iowa and South Wall streets where the viaduct proper will begin." From there, Ditto continued, the viaduct would "extend from that point to a point just east of South Fowler street where the east ramp will begin and lead into South College Street." The elevated portion, or grade separation, was to be 3,875 feet long, making the viaduct "the longest structure of its kind ever built in Iowa." On May 8, 1936, the city council agreed "to provide right-of-way for the proposed overpass on Highway No. 20, along Grand Avenue," and passed the ordinance officially rerouting the highway over the viaduct in mid-August. In June 1936, the Federal Bureau of Public Roads approved the final plans for the estimated $800,000 Grand Avenue Viaduct. That same month, the ISHC awarded the construction contract to the C. F. Lytle Construction Company of Sioux City for submitting the low bid of $783,932. In late July, the City Plan Commission gave the design its blessing.[17]

Technology and Design of the Viaduct

Because the Grand Avenue Viaduct would carry one primary road (U.S. 20) and connect with another (U.S. 75), the responsibility for its planning, design, and construction fell to the ISHC. Since 1916, the ISHC had used its own in-house bridge design standards to build the bridges along the state's primary road system. The ISHC never developed standard plans for the longer spans required for riveted plate girder bridges. Instead, ISHC engineers specially designed each one. The massive Grand Avenue Viaduct, however, exceeded the ISHC's standard bridge designs. Early in 1936, therefore, the ISHC commissioned the Kansas City/New York engineering firm of Ash Howard Needles & Tammen (AHNT) to design the nearly mile-long viaduct for Sioux City. A company of expert bridge engineers, AHNT had received "some of the first public works projects funded by the Emergency Reconstruction Finance Corporation and Public Works Administration," and was adept at managing large-scale federal relief projects.[18]



Sioux City Journal, February 7, 1935

"Stock Yards Viaduct" as originally conceived, 1935. Only two blocks long, the viaduct began at Grand and South Fowler, veered south, and ended at Dace Avenue just north of the Stock Yards Ball Park.

Continuous Steel Girder Bridges

The Grand Avenue Viaduct represented an important step in the emergence of the continuous girder bridge from experimental to common use. The 1936 plans for the Grand Avenue Viaduct called for "a continuous beam and girder bridge of the deck type with approaches between retaining walls." When completed in 1937, the elevated structure was 3,875 feet long with 58 spans comprised of 18 continuous beam or girder bridges and two simple spans. The continuous sections extended from three to five piers, ranging in length from 126 to 327 feet. The simple spans were 40 feet each. The longest continuous sections, over the Floyd River and two other places, were formed of riveted plate steel girders. The other continuous sections were rolled steel beams. The combinations of spans in each continuous beam section were adjusted so that it was economical to use the same height of beam throughout.[19]

Continuous bridges held two advantages over more simply supported structures: greater stiffness and economy of materials. American engineers, however, condemned the continuous bridge as impractical because of its "vulnerability to the effects of pier settlement and the difficulty of calculating stresses involved." Although a few examples were built in North America and the theory found its way into textbooks, the continuous girder bridge was condemned in 1916 by J.A.L. Waddell, the leading authority on bridge engineering in the early twentieth century. Just one year later, Gustav Lindenthal completed the Sciotoville, Ohio, continuous truss, an impressive structure that caused American engineers to reconsider the practical possibilities of the continuous steel girder bridge.[20]

In Iowa, the first of these moderate continuous bridges was a three-span steel through plate girder designed by the ISHC to carry the Lincoln Highway over Squaw Creek in Ames in the early 1920s. Publicity at the time avoided labeling the structure "continuous," and instead noted the beauty of the "continuous curve" of the bridge's camber and the economy realized in the fewer number of supports needed on the top of the piers. As more states introduced continuous bridges, attitudes toward them quickly changed. By 1929, the *Engineering News-Record* concluded that "structural views have made distinct progress since the days when continuous bridges were considered bad practice." In the 1930s, Iowa was building continuous steel plate girder bridges regularly.[21]

Large and complex, the Grand Avenue Viaduct differed from the 1930s ISHC standards for smaller rolled steel beam bridges, making it in some ways ahead of its time and in other ways a product of it. For example, the viaduct's longer plate girders were "haunched" at each pier to be more efficient. A haunched (or variable depth) girder is a beam enlarged near its supported ends. Haunched girders not only increased the strength of bridges but also enhanced their beauty by adding flowing curves and movement to what were otherwise flat, inert designs. Today, the Iowa Department of Transportation (successor to ISHC) uses haunched girders for the same reasons, strength and aesthetics. The Grand Avenue Viaduct also differed from ISHC bridge standards in the spacing between its continuous girders: 11 feet instead of 3.67 feet to 7.50 feet between beams on ISHC's standard plans. More economical, widely spaced girders are generally a feature of Iowa's bridges today. The viaduct also had a thicker deck of 9 3/4 inches (necessitated by its more widely spaced girders) than the standard ISHC deck of about 8 inches. And instead of reinforcing bars used in standard decks, welded reinforcing trusses were used to strengthen the deck. Although common in longer deck spans during the 1930s and 1940s, when welding replaced riveting in bridge construction, welded reinforcing trusses are no longer used in deck spans of any length today.[22]

Courtesy of the Sioux City Public Museum, Sioux City, IA

Amateur photographer John Frost took this photo looking east on unpaved "Grand Street" from Wall Street in the South Bottoms neighborhood, September 1936. In the distance, construction activity on the viaduct is underway.

Rivets versus Welds

Many of the Grand Avenue Viaduct's unique features came from a mid-career bridge engineer from Iowa City named Edward "Ned" L. Ashton. In 1936, Ashton had rejoined the AHNT firm (since renamed HNTB) after a seven-year absence, arriving just in time to work on the Grand Avenue Viaduct project. Ashton, who would become one of Iowa's foremost bridge designers, was deeply interested in bridge aesthetics and bridge economy, both of which, Ashton firmly believed, could be enhanced by replacing riveting with welding in steel bridge construction. For the viaduct in Sioux City, Ashton designed and wrote the structural specifications for some of its most unique features: the Floyd River piers, the continuous haunched girders, and the camber (or positive upward curve) of the structure. Ashton also designed welded reinforcing trusses for the plate girders, the only welded components specified for the entire structure.[23]

Although welding played a minor role in the construction of the Grand Avenue Viaduct, Ned Ashton was a staunch advocate of replacing rivets with welds to reduce the structural weight and thus material costs of steel bridge construction. In professional lectures and papers, Ashton promoted what he called "The All Welded, All Steel Bridge of Tomorrow." Citing the Grand Avenue Viaduct as a study piece, Ashton called it a good example of a structure that could easily have been designed for and benefited from welding. "It cost only four dollars and eighteen cents ($4.18) per square ft. whereas most such structures cost five or six, yet I find that our all steel bridge of tomorrow will replace it for only three dollars and fifteen cents ($3.15) per square foot for the same spans in the same location." According to Ashton, the saving in costs through welding was realized mainly through the elimination of rivets, a metal fastener that "consisted of a solid, cylindrical shank with a manufactured head on one end." Rivets were used to connect multiple metal plates by passing the shank through aligned holes in the plates and hammering the plain end to form a second head. In the early days of steel construction, rivets, which could expand and fill holes during installation, were the most commonly used fastener for bridges and buildings. The riveting process, however, involved intensive labor, highly skilled workers, and painstaking quality control. The work required frequent and thorough inspections, and improperly installed rivets had to be cut out and replaced.[24]

Welding, on the other hand, joined materials, usually metal, through the application of heat or pressure. The two most common styles are fusion and pressure welding. Fusion welding essentially melts two metal items together. Pressure welding involves heating the metals to malleability and then forcing them together. In resistance welding, a subtype of pressure welding, the metal items are softened by their resistance to an electric current, and the two ends are then pressed together. Even as welding techniques improved in the 1920s, however, most engineers and builders continued to prefer rivets mainly "because their requirements and limitations were better understood."[25]

The extra weight and cost rivets added to steel bridges contradicted the modern design philosophy of the time that demanded "economy of form, at a minimum volume." As Ashton wrote, "Riveted structural steel is about the only place known today wherein everybody seems convinced that they should pay a dollar for only 75¢ worth of metal. With welding this bargain is improved." "We weld metal," Ashton explained, "so that you cannot find the joint and we guarantee one hundred cents worth of effective metal for every dollar's worth of metal you buy." Ashton's advocacy of welding and American engineers' gradual acceptance of the technique dates to the 1930s and the decade's overall taste for cost efficiency, simplicity of design, and honesty of materials.[26]

Courtesy of the Sioux City Public Museum, Sioux City, IA

John Frost of Sioux City captured this late afternoon scene of workers erecting haunched girders over the Floyd River piers, June 1937.

Engineer Edward “Ned” L. Ashton

Born in Clinton, Iowa, in 1903, Ned Ashton graduated from the University of Iowa (then the State University of Iowa) in Iowa City with a Master’s of Science degree in both hydraulics and structural engineering. Bridges caught his interest in graduate school.

As Ashton explained: “I was so taken with a book I read, that I went to Kansas City to take my first job with the firm with which the author had long been associated before his death.” Ashton was probably referring to a book by bridge engineer J.A.L. Waddell, who had been associated with the prestigious Kansas City firm Harrington, Howard & Ash. In 1928, Ashton became resident engineer on the firm’s $7,000,000 Mississippi River bridge project at Vicksburg, Mississippi. While there, Ashton worked closely with the firm’s senior partner, Louis Ash, who profoundly influenced the young engineer’s later work. One day at the job site, Ash remarked to his protégé: “If we could only extend one plate through another – welded together, how much better it would be.” Already aware of the wasteful riveting and bolting process used universally in bridge construction, Ashton seized on Ash’s comment and would eventually make the all-welded bridge a professional goal.

From 1929 to 1935, Ashton worked on other projects, including the doomed St. Louis Electric Terminal Railway project and several dam projects for the Bureau of Reclamation.

In 1936, Ashton returned “exclusively to bridge building,” rejoining the Kansas City firm, since renamed Howard Needles Tammen & Bergendoff (HNTB). He arrived in August, just in time to work with a team of engineers on the Sioux City viaduct project. Ashton stayed with HNTB for seven years, eventually becoming chief designer. He designed 20 other bridges with the Kansas City firm, of which the Mississippi River bridges at Dubuque, Iowa; Rock Island, Illinois; and Greenville, Mississippi, are considered his “crowning achievements.”

In 1943, he became professor of engineering at the University of Iowa, moving permanently to Iowa City. In addition to teaching, Ashton continued to design innovative bridges as a consulting engineer, even branching out into other projects such as radio telescopes and water treatment facilities.

Engineer Edward “Ned” L. Ashton, 1958.

In 1949, Ashton realized his 20-year-old dream with the completion of the first all-welded deck girder highway bridge in Iowa, the Benton Street Bridge in Iowa City. Almost a decade later, in 1958, Ashton received national acclaim for the first all-welded aluminum girder bridge in the world, the Clive Street Overpass in Des Moines.

Ned Ashton died in Iowa City in 1985. Although his all-welded Benton Street Bridge was demolished and replaced just a few years after his death in 1989, the Grand Avenue Viaduct continues to serve Sioux City.

SOURCES: Richard FitzGerald, “Bridges Are His Business,” *Iowa Alumni Review* (December 1958): 12-17. “Benton Street Bridge, Spanning Iowa River at Benton Street, Iowa City, Johnson County, Iowa,” Historic American Engineering Record, Library of Congress, Prints and Photograph Division, Washington, D.C. (accessed at http://memory.loc.gov/ on August 9, 2007). Iowa State Highway Commission, “As Built” Design Plans for Grand Avenue Viaduct, Sioux City, Iowa, sheets 15, 16, 24, 25, 26, and 36, Iowa Department of Transportation, Ames. See also Clayton B. Fraser and John J. Roberts, “Highway Bridges in Iowa 1868-1945: The Evolution of Iowa’s Highway Bridges 1868-1945” (Multiple Property Documentation Form prepared for the National Register of Historic Places, National Park Service, United States Department of Interior, Washington, DC, July 1995), E25-26.

Aesthetics of the Grand Avenue Viaduct

The Grand Avenue Viaduct is the earliest Ashton-influenced bridge in Iowa, and a structure in which the engineer himself took great pride. He called the Grand Avenue Viaduct "most modern in design," and used it for over a decade to illustrate his lectures on bridge design and construction. Focusing specifically on the Floyd River spans that he designed, Ashton presented the Grand Avenue Viaduct as the structure that introduced and proved "the economy and beauty of long span variable depth plate girder construction." The haunched girder spans not only lent a pleasing arched flow to the overall design, they added strength and saved money as well. Ashton also noted the concrete piers, showing fellow engineers "the simple beauty that can be gained in ordinary rolled beam viaduct construction by adding a little architectural concrete treatment to the substructure." Moreover, the curve offsets of the concrete piers emphasized, rather than disguised, their support function.[27]

Elements of the Grand Avenue Viaduct's modern design continued to echo in Ashton's subsequent bridges. For example, the following year the flowing haunched girders appeared in his much shorter Manchester Avenue Bridge in Kansas City. In 1939, Ashton used the same "little architectural concrete treatment" for the piers beneath the Davenport approach to his magnificent Centennial Bridge over the Mississippi River. And over a decade later, in 1949, Ashton's all-welded Benton Street Bridge in Iowa City paid homage to the Grand Avenue Viaduct. In the Benton Street Bridge, "the gently curved arch of the variable depth girder not only presented an aesthetically pleasing profile, but also efficiently distributed the metal according to the actual lines of stress." As an example of modern design, Ashton referenced the Grand Avenue Viaduct as a model of form aligned precisely with function.[28]

State Historical Society of Iowa-Iowa City

This photograph of WPA Floyd River flood control efforts beneath the Grand Avenue Viaduct, 1940, offers a good view of Ned Ashton's Floyd River piers and haunched girder spans.

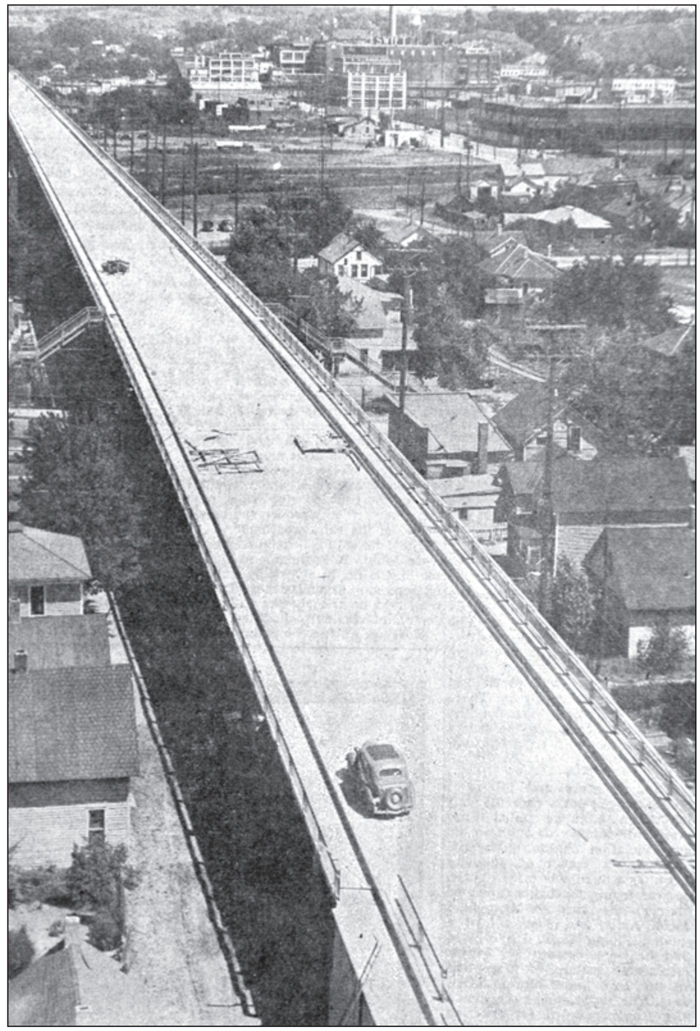
The South Bottoms and the Viaduct

Although the Grand Avenue Viaduct was located in Sioux City's industrial district, the South Bottoms contained much more than just the city's chief industries. From the 1890s through the 1920s, the stockyards, railroads, packinghouses, mills, and factories had attracted a flood of new residents to the South Bottoms neighborhood. Situated between Third Street, the stockyards, and the original channel of the Floyd River, the South Bottoms neighborhood functioned as Sioux City's port of entry for immigrants, which included the Irish, Germans, Russians, Italians, Greeks, Scandinavians, Syrians, and Mexicans, and was a bastion for Sioux City's Native Americans and African Americans as well. In the South Bottoms, workers and their families "lived in small, wooden houses on dirt streets surrounded by the thick smells and sounds of stock yards, packing plants and railroads," where most of them worked for low wages. Grand Street, as the avenue was formerly called, was one of several unpaved streets in the neighborhood. In 1890, Cyrus E. Robinson, purchasing agent for the Booge Packing Company, described the whole area as "drab and cheerless."[29]

Despite the frequent floods and sometimes poor housing, residents in the South Bottoms formed a strong, close-knit community. Seven resident-owned grocery stores, a day nursery for working mothers, a crowded but excellent grade school, churches, a settlement house, and several active missions reinforced neighborhood stability. In 1935, however, a city-wide housing report conducted by the Iowa State Planning Board and funded by the Works Progress Administration (WPA) found much of Sioux City's South Bottoms neighborhood essentially unfit to live in, noting the building inspections department had officially condemned many of its dwellings. Connecting poor housing to rampant social evils, the housing report recommended "a concentrated effort be made to eradicate the sore spots that breed social and economic contempt." The South Bottoms, according to the report, was the primary "sore spot" in Sioux City. Thus, opinions of the South Bottoms in 1936 depended greatly on one's perspective. To city planners, it was a slum; to out-of-towners and Sioux City residents forced to drive through it, it was an obstacle and eyesore; to South Bottoms residents, it was home.[30]

In 1936, a majority of the South Bottoms residents whose dwellings were in or near the path

Nearing completion in late summer 1937, the Grand Avenue Viaduct stretches east above the houses in the South Bottoms.



Sioux City Journal, August 8, 1937

of the planned Grand Avenue Viaduct were either unemployed or worked as low-wage laborers at the nearby stockyards and meatpacking plants. A few worked at Sioux City Gas & Electric Co. or for the Chicago, Milwaukee, St. Paul, and Pacific Railroad. Despite hard times, the South Bottoms continued to be a strong community, with residents looking after each other. Home owners, many of them widows or working women, shared space with extended family members or sublet spare rooms to friends. Other families doubled up, pooling their low wages to pay one monthly rent. A very few lucky property and small business owners in the neighborhood had managed to survive the Depression.[31]

With the ISHC and federal relief funds paying for viaduct construction, securing the right-of-way for the massive structure fell to Sioux City officials. Securing the right-of-way, literally clearing the path, included paying all costs associated with relocating power lines, water pipes, and sewers and acquiring private property in the project's path. Although the city already had acquired most of the land needed to build the viaduct, "property at the extreme east and west ends of the proposed viaduct still [was] being held by individual owners."[32]

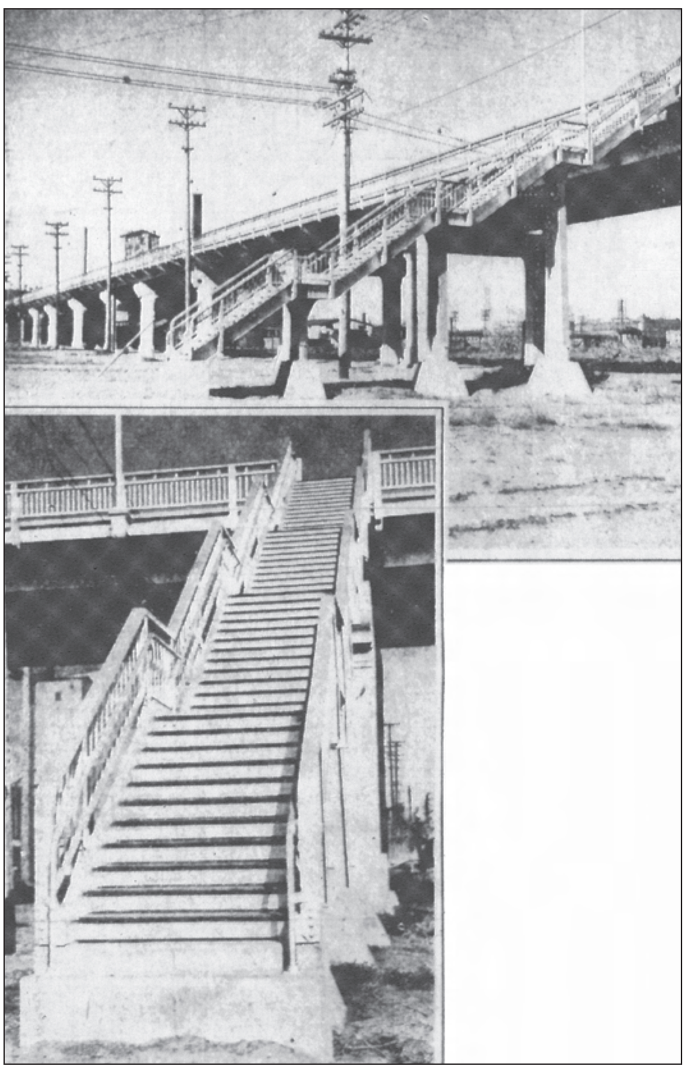
In late July 1936, with viaduct plans accepted and contracts let, the city council sent corporation counsel H. C. Harper and city engineer Paul D. Cook to Ames to meet with an ISHC attorney regarding "the proposed condemnation of property along the proposed route of the grade separation on Grand Street." Up to that time, no precedent had been set in Iowa "for acquiring property through condemnation proceedings for overhead streets." At the end of the month, the city council voted "to proceed with condemnation of certain properties necessary for opening Grand Avenue from Jennings Street west to the River Road and from Prospect Street east." Although Sioux City compensated large industries such as American Serum Company for lost property, the city let many homes and small businesses remain just feet from the viaduct's concrete piers without compensation. Not surprisingly, several Grand Avenue residents and property owners protested, eventually filing lawsuits against the city, the ISHC, and the C. F. Lytle Construction Company, the general contractor.[33]

The first hint of opposition from South Bottoms residents came from Syrian immigrant George D. Solomon, a longtime resident who lived at 1212 Grand Avenue and owned a grocery store at the corner of Grand and South Wall Street. His brother, Joseph, operated another store at the corner of South Iowa and Grand, just a block away to the west. George Solomon and his wife, Mary, owned a total of four properties at the corner of Grand and South Iowa Street, all of which stood in or very near the path of the western approach to the Grand Avenue Viaduct. In March 1936, with the viaduct plans literally on the drawing board, Solomon wrote a letter of protest to the ISHC, becoming the first South Bottoms resident to voice opposition. The city council subsequently read the letter at their March 16 meeting but took no action.[34]

Courtesy of the Sioux City Public Museum, Sioux City, IA

John Frost of Sioux City took this photo in March 1937, showing viaduct construction within feet of George and Dorothy Solomon's house at South Iowa Street and Grand Avenue.

In early September, Solomon filed in district court an injunction to restrain the city, the ISHC, and the C. F. Lytle Construction Company from proceeding with construction. The injunction alleged "that the viaduct would greatly damage his property and no offer to reimburse him or settle the matter by condemnation proceedings has been made to him by any of the defendants." Solomon also appeared before the city council with "an appeal for promise of recompense for anticipated lower values." Over three dozen owners and renters joined Solomon in the protest. Attorneys for some of the property owners stated their cases. Ralph Prichard, a former county attorney, "expressed an opinion that 'if an assurance can be given to the utilities who may be damaged . . . these people are entitled to some such assurance before the damage is done.'" Mayor W. D. Hayes explained to them that the council was not empowered to pay recompense and advised all property owners to obtain counsel. The next day, a second injunction was filed by Sam Bass, owner of properties on South Wall Street and Grand Avenue. As the concrete piers marched down Grand Avenue, more property owners began to realize their fate. Etta Johnson, a widow, filed suit in October seeking $900 in damages. Johnson "contended that a large concrete pillar had been constructed in front of her home, cutting off her view." Veronica, Mike, and Phillip Boyok asked for $1,000 in damages. The Boyoks, who owned two homes at the east approach near South College Street, stated "that living conditions in their houses will be unbearable when traffic passes over the new structure." They believed "that dirt and debris from passing automobiles will fall on their homes." Photographs of the viaduct's construction progress showed the structure's proximity to South Bottoms homes, giving mute testimony to residents' complaints. In December 1937, the district court awarded more than $57,000 in damages to sixteen litigants, more than $24,000 of which went to George and Mary Solomon.[35]



Sioux City Tribune, October 14, 1937

Four sets of stairs leading up to viaduct sidewalks made the structure accessible to South Bottoms residents.

The Grand Avenue Viaduct was completed in October 1937. Subsequent litigation, however, prevented the state from building permanent paved approaches to the structure and thus connecting it to paved city streets. Although planned and built under Mayor W. D. Hayes, the incomplete Grand Avenue Viaduct dogged the mayor's 1938 reelection campaign as his "bridge to nowhere." Hayes lost to attorney David Loepp, who contended the "orphan" viaduct "was of no practical use." Loepp made sure both approaches to the viaduct were completed in 1939, early in his first term.[36]

Meanwhile, the South Bottoms neighborhood remained mostly intact, and the massive Grand Avenue Viaduct soon faded into the background of residents' daily lives. Despite its obviously intrusive size, engineers designed the viaduct in part with South Bottoms residents in mind. With sidewalks on both sides of its roadway and stairs to street level at three main intersections, the modern elevated roadway maintained ties to the past and the slower, mostly pedestrian community below. Thus, the South Bottoms neighborhood ended not with the construction of the Grand Avenue Viaduct, but over twenty years later, between the building of Interstate 29 in 1958 and the relocation of the Floyd River channel to control flooding in 1962.[37]

The Grand Avenue Viaduct, 1958-1965

In 1956, President Dwight D. Eisenhower signed the Federal-Aid Highway Act, creating the interstate highway system. Two years later, Interstate 29 was built through Sioux City. The highway's wide footprint, cloverleaf interchanges, and ample entrance ramps required an enormous amount of land in Sioux City's urban core. Some of this land was created with fill near the mouth of the Floyd River. The rest of the land was obtained by removing most of the residents and homes in the South Bottoms neighborhood. Officials expected the interstate to increase traffic on adjacent thoroughfares, including the Grand Avenue Viaduct (renamed Gordon Drive Viaduct in 1948) and began making plans to create a four-lane viaduct.[38]

Meanwhile, Sioux City experienced another catastrophic flood in 1953 when the WPA Floyd River flood control project of the 1930s failed, killing 14 people. The city redoubled its efforts, and in 1959 completed plans for a comprehensive flood control project. The plans called for straightening and relocating the Floyd River channel to the west, through the heart of what was left of the South Bottoms neighborhood. The few residents who had escaped the construction of Interstate 29 through their neighborhood finally surrendered their homes to the new Floyd River channel.[39]

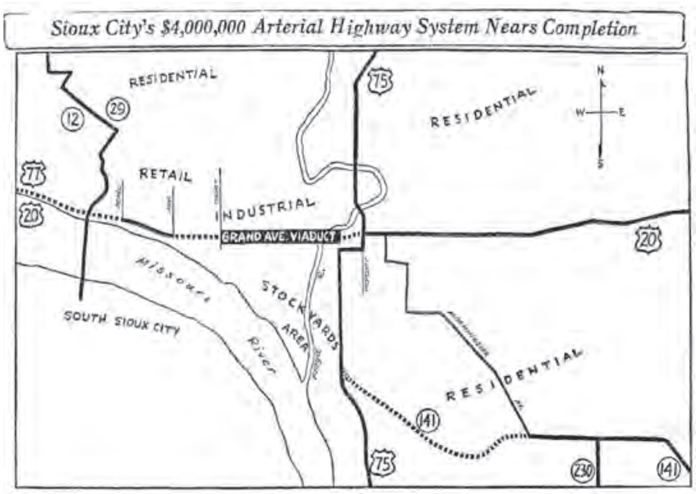
To accommodate the new river channel, the city closed the Grand Avenue Viaduct on February 1, 1963, as work crews demolished a large section of the structure that would span the river channel. They constructed new river piers and three new spans, lengthening the viaduct to 3,970 feet. The project took seven months, after which city and state officials ceremoniously reopened the viaduct to traffic on September 13, 1963.[40]

Less than two years later, in March 1965, the ISHC moved forward with the $2 million federal-state viaduct widening project. Instead of widening both sides, the highway commission decided to build two new lanes on the south side.

Courtesy of the Sioux City Public Museum, Sioux City, IA

The South Bottoms neighborhood and the Grand Avenue Viaduct, c. 1959. View is from Dace Avenue and South Lafayette Street, looking northwest toward South Howard Street, the Wall Street Viaduct (upper center), and the Sioux City Gas & Electric Co. (upper left) at the corner of South Iowa Street. Within four years, most of the houses and businesses in this photo would be replaced by the new channel of the Floyd River.

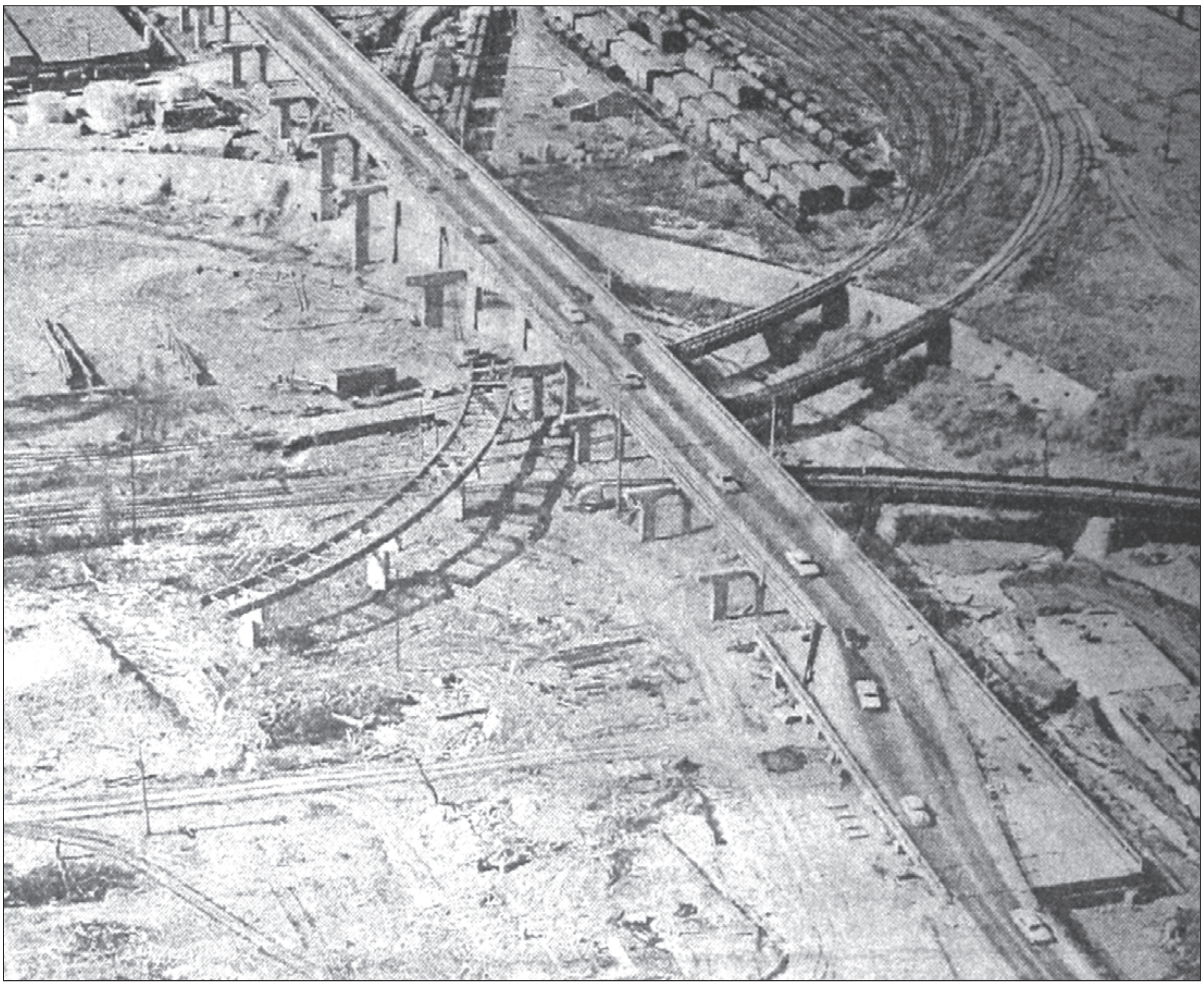
The Grand Avenue Viaduct was "the key" to Sioux City's highway and street system. Dashed lines on either side, however, show the incomplete sections of the system and why the viaduct was dubbed in 1937 "the bridge to nowhere."



Sioux City Tribune, December 1, 1937

Hobson School students and teacher gather for a class photo with the Grand Avenue Viaduct as backdrop, 1940.

Courtesy of the Sioux City Public Museum, Sioux City, IA



Sioux City Journal, March 22, 1966

Aerial view, 1966, shows the new "T" piers lining the south side of the Grand Avenue Viaduct (renamed Gordon Drive Viaduct in 1948). An exit ramp (center) to U.S. 75 is under construction.

The ISHC solicited bids, and Christensen Bros. Construction Co. of Cherokee, Iowa, won the contract. Over the next year, Christensen Bros. erected 57 new concrete "T" piers, widened the deck by three girders to 56 feet to accommodate two new traffic lanes and a median, removed the sidewalk and handrail on the south side, and replaced all the light poles. In November 1966, all four lanes of the Grand Avenue Viaduct were opened to traffic. The ISHC had accomplished the first stage of its multimillion dollar, two-year project to construct an interchange at the east end of the viaduct with U.S. Highway 75.[41]

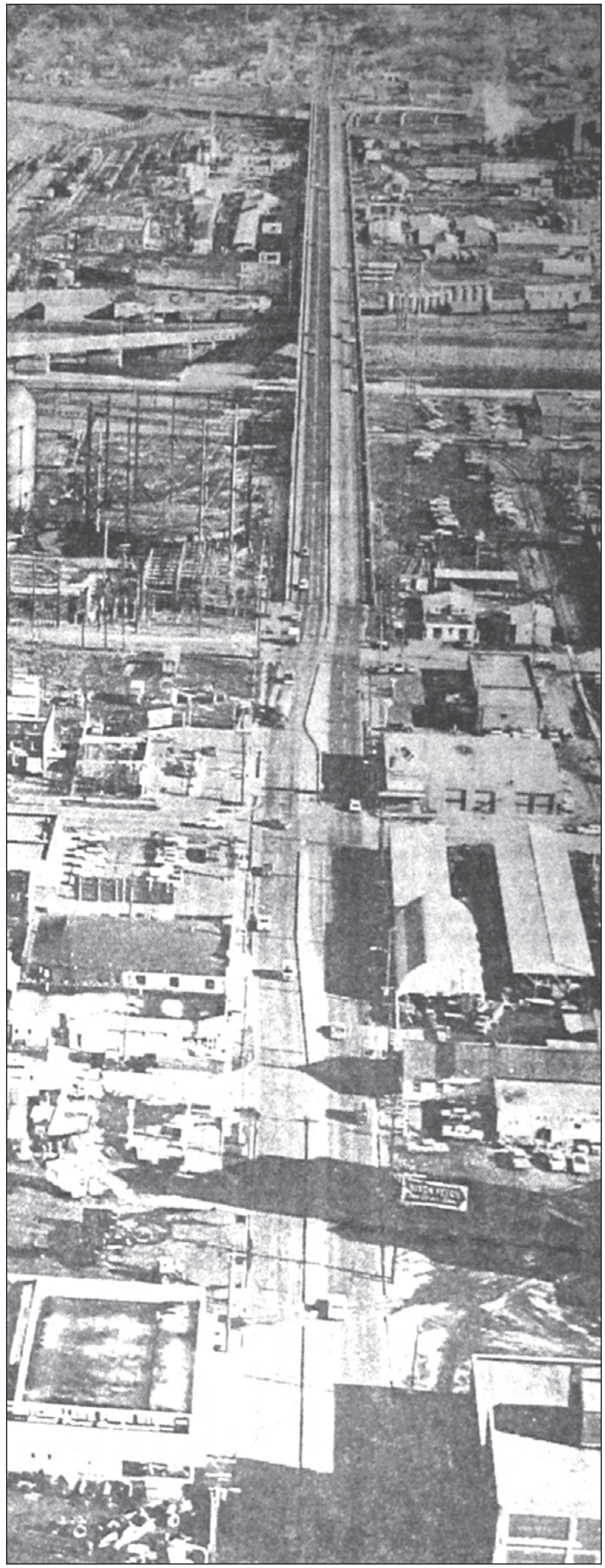
The Future of the Viaduct

As Sioux City and the Iowa Department of Transportation (IDOT) debated its future in early 2001, the Grand Avenue Viaduct continued to need attention and repairs. When the sidewalk began to crumble, IDOT first decided to save money and simply closed it to pedestrians. But many people, used to walking or bicycling across the viaduct, ignored the barriers, leaving the IDOT no choice but to make the necessary repairs. Maintenance and repairs of the structure continue, as plans for a new viaduct await the rebuilding of Interstate 29 through Sioux City. In the meantime, the Grand Avenue Viaduct remains fundamental to the urban landscape, as residents try to imagine Sioux City without it.[42]

Photograph by Mike Whye, 2007

West approach to viaduct, looking southeast.

Aerial view east of the newly widened Grand Avenue Viaduct, 1966.



Sioux City Journal, December 22, 1966

Glossary

BEAM (see also GIRDER) – A horizontal structure member supporting vertical loads by resisting bending. A girder is a larger beam, especially when made of multiple plates. Deeper, longer members are created by using trusses. A "rolled steel beam" is a structural member formed by heating steel and passing it through a series of rollers to achieve a desired shape.

BEARING – A device at the ends of beams that is placed on top of a pier or abutment. The ends of the beam rest on the bearing.

BENT (also called PIER) – Part of a bridge substructure. A rigid frame commonly made of reinforced concrete or steel that supports a vertical load and is placed transverse to the length of a structure. Bents are commonly used to support beams and girders. An end bent is the supporting frame forming part of an abutment. Each vertical member of a bent may be called a column, pier, or pile. The horizontal member resting on top of the columns is a bent cap. The columns stand on top of a foundation or footer, which is usually hidden below grade. A bent commonly has at least two or more vertical supports. Another term used to describe a bent is "capped pile pier." A support having a single column with a bent cap is sometimes called a "hammerhead," or "T" pier.

BRIDGE (see also VIADUCT) – A raised structure built to carry vehicles or pedestrians over an obstacle.

CONTINUOUS SPAN BRIDGE – A series of two or more beam or girder bridges joined together, creating what is known as a "continuous span." Continuous spans are used to bridge long distances.

ELEVATED ROADWAY (see also GRADE SEPARATION) – A roadway elevated above grade level to allow traffic to flow uninterrupted, to which access is gained by entrance and exit ramps.

GIRDER (see also BEAM; VARIABLE DEPTH GIRDER) – A girder (also called "plate girder") is a larger beam, especially when made of multiple metal plates. The plates are usually riveted or welded together. Typical girder bridges are constructed so that the deck rests on bearings atop the bents, or piers.

GRADE SEPARATION (see also ELEVATED ROADWAY) – Specifically, a road intersection where the direct flow of traffic on one or more of the roads passes over or under the other(s), allowing traffic to continue uninterrupted by grade-level intersections.

RIVET – A metal fastener with a large head on one end, used to connect multiple metal plates by passing the shank through aligned holes in the plates and hammering the plain end to form a second head.

SPAN – The horizontal space between two supports of a structure. Also refers to the structure itself. May be used as a noun or a verb. The clear span is the space between the inside surfaces of piers or other vertical supports. The effective span is the distance between the centers of two supports.

SUBSTRUCTURE – The portion of a bridge structure including abutments and piers that supports the superstructure.

SUPERSTRUCTURE – The portion of a bridge structure that carries the traffic load and passes that load to the substructure.

VARIABLE DEPTH GIRDER (see also GIRDER) – A beam enlarged near its supported ends, increasing the strength of the bridge and therefore allowing longer spans. Continuous variable depth girders add wide flowing arches to what is an otherwise flat design. Variable depth girders are also called "deepened" or "haunched" girders.

VIADUCT (see also BRIDGE) – A long, multispan, concrete bridge that carries motor vehicles over obstacles such as bodies of water, city streets, and grade crossings (for railroads, the structure is called a "trestle").

WELD – Joining two metal pieces by heating them and allowing them to flow together. The continuous deposit of fused metal created in these processes is called a bead.

SOURCES: "A Context for Common Historic Bridge Types," NCHRP Project 25-25, Task 15 (report prepared by Parsons Brinckerhoff and Engineering and Industrial Heritage for the National Cooperative Highway Research Program, Transportation Research Council, National Research Council, October 2005). Bridge Terminology, "Bridges and Tunnels of Allegheny County and Pittsburgh, PA" (accessed at http://pghbridges.com on August 6, 2007) Erich Edward Reichle, "Rivet Replacement Analysis," Computer-Aided Structural Engineering (CASE) Project, Technical Report ITL-99-5 (prepared for U.S. Army Corps of Engineers, Washington, D.C., December 1999).

Notes

1 In 1948, Grand Avenue and Grand Avenue Viaduct were renamed Gordon Drive and Gordon Drive Viaduct, respectively. The historic name – Grand Avenue Viaduct – is used throughout this publication for clarity and consistency. Historic American Engineering Record (HAER) card, 1993: The location of Grand Avenue Viaduct is Section 33, T89N-R47W. Mary Bennett, Special Collections Coordinator, State Historical Society of Iowa, Iowa City, personal communication to Jennifer Price, May 10, 2007.

2 HAER card, 1993. Historic Bridges Database, Iowa Department of Transportation (accessed at www.ole.dot.state.ia.us on March 15, 2007). Iowa State Highway Commission, "As Built" Design Plans for Gordon Drive Viaduct, Sioux City, Iowa, 1965, Iowa Department of Transportation (hereafter ISHC, "As Built" Design Plans for Gordon Drive Viaduct, 1965, IDOT). Iowa Structure Inventory and Appraisal Sheet, Iowa Department of Transportation (accessed at http://www.transdata.dot.state.ia.us on July 20, 2007). *Sioux City Journal*, December 21, 1965.

3 C. R. Marks, "Stories of Early Sioux City," in S. O. Rorem, *Sioux City and Its Government* (Sioux City: the author, 1922), 162-64. Richard Vidutis and James Hippen, "Grand Avenue Viaduct (Gordon Avenue [sic] Viaduct), HAER No. IA-87" (unpubl. document prepared as part of the Iowa Historic Bridges Recording Project for the Historic American Engineering Record [HAER], 1996), 3-4.

4 Vidutis and Hippen, "Grand Avenue Viaduct," 3-4. Scott Sorensen and B. Paul Chicoine, *Sioux City: A Pictorial History* (Virginia Beach, VA: Donning, 1982), 82, 93.

5 "Transportation: Elevated Railway," Sioux City History (accessed at Sioux City Public Museum web site http://www.siouxcityhistory.org on August 10, 2009): "The idea for an elevated railway originated with Sioux City businessman and promoter Arthur Garretson. He owned property in Morningside and would profit if a convenient connection to Morningside could be created. Garretson convinced other local businessmen such as E. C. Peters and William Gordon. Along with Eastern investors, this group of Sioux City promoters organized the Sioux City Rapid Transit Company. The money for the elevated was quickly raised, and construction was planned." Sorensen and Chicoine, *Sioux City*, 79. Vidutis and Hippen, "Grand Avenue Viaduct," 4.

6 Vidutis and Hippen, "Grand Avenue Viaduct," 3-4. Sorensen and Chicoine, *Sioux City*, 133.

7 Sorensen and Chicoine, *Sioux City*, 133. Vidutis and Hippen, "Grand Avenue Viaduct," 4. Report of Highway Investigation Committee, Chapter 351, Fifty-second General Assembly, State of Iowa (November 15, 1948), 100; Mark S. Foster, *From Streetcar to Superhighway: American City Planners and Urban Transportation*, 1900-1940 (Philadelphia: Temple University Press, 1981), 92. See Richard Longstreth, *City Center to Regional Mall: Architecture, the Automobile, and Retailing in Los Angeles, 1920-1950* (Cambridge, MA: MIT Press, 1998), for a discussion of responses to the parking crisis in cities, especially Los Angeles, and the consequences. Sorensen and Chicoine, *Sioux City*, 133. *Sioux City Journal*, April 11, 1926.

8 Robert M. Fogelson, *Downtown: Its Rise and Fall, 1880-1950* (New Haven, CT: Yale University Press, 2003), 277. "City Club Objects to Motor Highway," *New York Times*, May 16, 1927: The club eventually failed to stop the West Side Elevated Highway, which was completed in 1936. Foster, *From Streetcar to Superhighway*, 112-13.

9 "50th Anniversary of the Interstate Highway System," Federal Highway Administration, Department of Transportation (accessed at http://www.fhwa.dot.gov/interstate/artgallerytext.htm on May 24, 2007). H. T. Ames, "Very Fast Cars Safest at Usual Touring Speeds on Open Highway," *New York Times*, January 6, 1935 (Ames is identified as "President [of] Duesenberg, Inc., and Vice President [of] Auburn Automobile Co."). J. George Frederick, "Too Many Automobiles," *Forum and Century 100* (December 1938): 278.

10 "1935 – Viaducts in Cities," in "50th Anniversary of the Interstate Highway System." Fogelson, *Downtown*, 280-81: Miller McClintock, the nation's leading expert on traffic congestion, noted that a "correctly designed elevated Limited Way would actually add to the total architectural value of the area traversed." Paul Mason Fotsch, "The Building of a Superhighway Future at the New York World's Fair," *Cultural Critique* 48 (Spring 2001): 67: "Problems of the 'modern world' were linked to the problem of traffic congestion. So superhighways, by creating 'a free flowing movement of people and goods,' could resolve the nation's problems and bring prosperity."

11 Foster, *From Streetcar to Superhighway*, 92, 107. Sidney D. Walton, quoted in Foster, *From Streetcar to Superhighway*, 92. "Road Project in Woodbury County," *Sioux City Journal*, June 15, 1931 (S.C. Clip Files, Sioux City Public Library, Sioux City, Iowa; hereafter SCPL). "Explain Plan for Viaduct," *Sioux City Journal*, January 25, 1935. Bruce E. Seeley, *Building the American Highway System: Engineers as Policy Makers* (Philadelphia: Temple University Press, 1987), 88: When the Hoover administration sought to relieve mass unemployment caused by the financial crash of 1929 and the Great Depression, the automobile essentially dictated many of the projects. Though Hoover generally opposed large-scale relief projects, he supported federal-aid road building for relief "because the money went to an existing program that produced physical improvements, not make-work." "Road Project in Woodbury County," *Sioux City Journal*, June 15, 1931 (SCPL).

12 Foster, *From Streetcar to Superhighway*, 132. Seeley, *Building the American Highway System*, 88, 150-51.

13 Vidutis and Hippen, "Grand Avenue Viaduct," 5. "1935 – Viaducts in Cities." See William H. Thompson, *Transportation in Iowa: A Historical Summary* (Ames: Iowa Department of Transportation, 1989), 178-80. Emergency Relief Appropriation Act, 1935, quoted in "1935 –Viaducts in Cities." "A Context for Common Historic Bridge Types," NCHRP Project 25-25, Task 15 (report prepared by Parsons Brinckerhoff and Engineering and Industrial Heritage for the National Cooperative Highway Research Program, Transportation Research Council, National Research Council, October 2005), 2-24: "The federal government's work programs of the Great Depression years were a boon for highway and bridge construction. The 1934 National Industrial Recovery Act (NIRA) funded a comprehensive program of public works. NIRA provided grants for highway work that were intended to increase employment through implementation of road and bridge projects, with no state money required. That same year, Congress passed the 1934 Hayden Cartwright Act, which one author heralded as 'the most outstanding piece of highway legislation since the Federal Aid Highway Act of 1916. This Act extended NIRA and for the first time allowed the use of federal dollars for highway improvements in municipalities; it also permitted funding of highway planning surveys. Subsequent legislation encouraged grade separating railroads and roads and widening bridges." "Explain Plan for Viaduct."

14 "Explain Plan for Viaduct."

15 Ibid.

16 Ibid.

17 Ibid. "…Stock Yards Viaduct…," *Sioux City Journal*, February 7, 1935. "Ditto Tells of Viaduct Plans," *Sioux City Journal*, March 12, 1936. Resolution 12161, May 8, 1936, Sioux City-City Council Minutes, Book 1-3, Roll M-10, City Clerk's Office, Sioux City, Iowa (hereafter City Council Minutes). "Contract for Viaduct Here Goes to Lytle," *Sioux City Journal*, June 30, 1936. City Council Minutes, July 21, 1936. "To Confer on Condemnation," *Sioux City Journal*, July 22, 1936. Resolutions 12899,

12900, and 12901, City Council Minutes, July 31, 1936. City Council Minutes, August 26, 1936: Almost a month later, the city council passed Ordinance 12953, widening Grand Avenue "by adding a strip along the north side of Grand Avenue between South Fowler street and South College street, 8 feet wide at the west line of South College street and tapering to one foot wide at the east line of South Fowler Street." See "Map of Southeast Part of Business District, Sioux City, Iowa," in Urban Land Use, Sioux City, Iowa (prepared by Iowa State Planning Board and Sioux City Zoning & Planning Commission in cooperation with the Works Progress Administration, 1936), 17: Grand Avenue appears to have been an unpaved road up to the time the city began constructing the viaduct. "Clearing Path for Viaduct," *Sioux City Journal*, August 12, 1936: The new route for highway 20 would proceed on the ground street west to the Missouri River, once Grand Avenue was opened, extended, and paved to that point. This part of the new highway route was not completed until 1939. "Viaduct Plans Move Forward," *Sioux City Journal*, July 31, 1936.

[18] HAER card, 1993: The viaduct was ISHC project WPGM 604. Historic Bridges database, Iowa Department of Transportation (accessed at www.ole.dot.state.ia.us on March 15, 2007). ISHC, "As Built" Design Plans for Gordon Drive Viaduct, 1965, IDOT. Kathi Ann Brown, *Diversity by Design: Celebrating 75 Years of Howard Needles Tammen & Bergendoff, 1914-1989* (Kansas City: Howard Needles Tammen & Bergendoff, 1989), 26.

[19] Vidutis and Hippen, "Grand Avenue Viaduct," 9.

[20] Ibid., 6-7. J.A.L. Waddell, *Bridge Engineering I* (New York: Wiley, 1916), 482.

[21] Vidutis and Hippen, "Grand Avenue Viaduct," 7-8.

[22] Kenneth F. Dunker, PE, Office of Bridges and Inspections, Iowa Department of Transportation, to Jennifer Price, Tallgrass Historians L.C., May 18, 2007, via e-mail. Bridge Terminology, "Bridges and Tunnels of Allegheny County and Pittsburgh, PA" (accessed at http://pghbridges.com/termsMet.htm on August 6, 2007). Elizabeth B. Mock, *The Architecture of Bridges* (New York: Museum of Modern Art, 1949), 65; Dunker (IDOT) to Price (Tallgrass Historians L.C.), May 18, 2007, via e-mail: "The viaduct has riveted plate girders in at least the longer spans. (I haven't been able to verify the construction in all spans)." Dunker (IDOT) to Price (Tallgrass Historians L.C.), May 18, 2007, via email: "(Today we might try to use an 8-inch deck for an 11-foot beam or girder spacing.)"

[23] Richard FitzGerald, "Bridges Are His Business," *Iowa Alumni Review* (December 1958): 14-15. "Benton Street Bridge, Spanning Iowa River at Benton Street, Iowa City, Johnson County, Iowa," Historic American Engineering Record, Library of Congress, Prints and Photograph Division, Washington, D.C. (accessed at http://hdl.loc.gov/loc.pnp/hhh.ia0198 on August 9, 2007), 12-13. Iowa State Highway Commission, "As Built" Design Plans for Grand Avenue Viaduct, Sioux City, Iowa, 1936, sheets 15, 16, 24, 25, 26, and 36, Iowa Department of Transportation.

[24] Ned L. Ashton, "The All Welded, All Steel Bridge of Tomorrow," 18, lecture presented at the Sixth Annual Welding Conference, University of Kansas, Lawrence, April 5, 1940, typescript, Box 31B, MS 167, Ashton Collection, Special Collections, State Historical Society of Iowa, Iowa City (hereafter Ashton Collection). Erich Edward Reichle, "Rivet Replacement Analysis," Computer-Aided Structural Engineering (CASE) Project, Technical Report ITL-99-5 (prepared for U.S. Army Corps of Engineers, Washington, D.C., December 1999), 7-8: To install, the riveter heated the rivet in the field to a cherry-red color (approximately 1800-2300° Fahrenheit), inserted it into the hole and, using a pneumatic rivet gun fitted with the proper die, formed a head on the blunt end of the rivet by rapid, successive blows to the rivet. As the rivet cooled, it shrank and created a clamping force between the metal parts it connected.

[25] "Benton Street Bridge," 2-3. Reichle, "Rivet Replacement Analysis," 6-7: "The joining of materials through 'a localized coalescence of metals or nonmetals produced either by heating the materials to suitable temperature with or without the application of pressure or by application of pressure alone and with or without the use of a filler material.'" "In 1951, the American Society for Testing and Materials (ASTM) issued its first specification for structural joints using high-strength bolts. Since then, the use of structural rivets has steadily declined and today they are rarely used except in historical restoration projects."

[26] Siegfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History* (New York: W. W. Norton, 1969), 610. Ashton, "The All Welded, All Steel Bridge of Tomorrow," 11. Martin Greif, *Depression Modern: The Thirties Style in America* (New York: Universe Books, 1975), 32.

[27] Greif, *Depression Modern*, 34. Ned L. Ashton, "Comments on Design and Construction of Various Mississippi Bridges," 13, typescript, lecture presented at Tri-Cities Section of the American Society of Civil Engineers, Mississippi Hotel, Davenport, Iowa, April 6, 1944, Box 31B, MS 167, Ashton Collection. See also Mock, *Architecture of Bridges*, 65: "The plate girder was long dismissed as a humbly utilitarian kind of construction, useful enough for out-of-the-way railroad viaducts but definitely unworthy of creative attention. Only in the last fifteen years or so, when its economy for small spans has made the steel plate girder universally popular for highway bridges and overpasses, have its potentialities for beauty begun to be recognized along with its practical advantages." Ned L. Ashton, "Arc Welded Steel Plate Floors Applied to Bridges and Viaducts," in *Arc Welding in Design, Manufacture and Construction* (Cleveland: James F. Lincoln Arc Welding Foundation, 1939), 557. Ashton, "Comments on Design," 13-14.

[28] "Benton Street Bridge," 14.

[29] Mabel F. Hoyt, "History of Community House, Sioux City, Iowa," *Annals of Iowa* 21 (January 1938): 191-93. Marcia Poole, *The Yards: A Way of Life, vol. I, A Story of the Sioux City Stockyards* (Sioux City, IA: Sioux City Lewis & Clark Interpretive Center Association, 2005), 63. "Carried Bible to Packington," *Sioux City Journal*, March 29, 1942, Pearl Street Research Center, Sioux City Public Museum, Sioux City, Iowa (hereafter PSRC). See Suzanne O'Dea Schenken, "The Immigrants' Advocate: Mary Treglia and the Sioux City Community House, 1921-1959," *Annals of Iowa* 50 (Fall 1989/Winter 1990): 180-213.

[30] "Students Learn of South Bottoms Area to Help Design Stockyards' Projects," *Sioux City Journal*, November 14, 2003. "Documentary Explores City's 'South Bottoms,'" *Sioux City Journal*, September 19, 2002, PSRC. "Miss Treglia Praises East Side Neighborhood," *Sioux City Journal*, October 1944, PSRC. See "Sioux City Was Tops to Them," *Sioux City Journal*, April 13, 2005, PSRC: Former residents succeeded in erecting a memorial to the South Bottoms at the foot of Floyd Boulevard in the circle drive of Larsen Park Road. See also "Documentary Explores City's 'South Bottoms.'" "A Report on Housing: Sioux City, Iowa, Project 1039" (unpubl. report prepared by Committee on Health and Housing, Iowa State Planning Board, March 1935), 4, map between 34 and 35, 37. Hoyt, "History of Community House," 191-93.

[31] *Polk's Sioux City Directory*, 1936.

[32] "To Confer on Condemnation."

[33] "Contract for Viaduct Here Goes to Lytle." City Council Minutes, July 21, 1936. "To Confer on Condemnation." Resolutions 12899, 12900, and 12901, July 31, 1936, City Council Minutes. "Viaduct Plans Move Forward." "Begin Viaduct Work Monday," *Sioux City Journal*, August 29, 1936. "Opposition to Viaduct Looms," *Sioux City Journal*, September 2, 1936. The massive highway building of the 1930s brought the ISHC many lawsuits from disgruntled property owners. A search of Iowa Supreme Court cases on Lexus Nexus revealed a few cases went all the way to Iowa's top court.

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[35] "Opposition to Viaduct Looms." "3 More Suits Over Viaduct," *Sioux City Journal*, September 6, 1936. "More Viaduct Suits Filed," *Sioux City Journal,* April 4, 1937. See "Aerial View of New Viaduct," *Sioux City Journal*, August 8, 1937. "Viaduct Awards Total $57,175," *Sioux City Journal*, December 1, 1937.

[36] "'Orphan' Viaduct Soon to Have Usable Approaches," *Sioux City Journal*, May 21, 1937. Sorensen and Chicoine, *Sioux City*, 182. Scott Sorensen interview with Frank Margolin and Ralph W. Crary, for "Sioux City Lawyers during the 1930s," Sioux City Public Museum, 1975, PSRC. Loepp campaign brochure, 1940, PSRC.

[37] Sorensen and Chicoine, *Sioux City*, 203.

[38] Seeley, *Building the American Highway System*, 213-14. Jan Olive Nash, "Sioux City I-29 Corridor Study: Historical/ Architectural Intensive Level Survey, Sioux City, Woodbury County, Iowa" (unpubl. report prepared for Howard R. Green Company, Cedar Rapids, Iowa, August 2005), 26. See "River Front Road Will Be Named for William Gordon," *Sioux City Journal*, November 30, 1948, PSRC: After ten years of building, in 1948 Sioux City's River Road neared completion. The city council passed an ordinance formally naming the new highway in honor of William Gordon, an early prominent citizen and real estate developer from the Corn Palace era. Gordon had helped organize Sioux City's famous elevated railroad in the late 1880s. The real estate board suggested Gordon's name for a river road as early as 1929, when such a road had been nothing more than a civic dream. See "Formal Opening of Gordon Drive Scheduled Tonight," *Sioux City Journal*, August 11, 1949, PSRC; see also "City's Dream Comes True as Gordon Drive Is Opened before Huge Crowd," *Sioux City Journal*, August 12, 1949, PSRC, and "Thousands Cheer as City's New Gordon Drive is Dedicated," *Sioux City Journal*, August 13, 1954, PSRC: Gordon Drive was formally opened on August 11, 1949, with a parade, bathing beauties, ribbon-cutting ceremony, and a dance at Riverview Park. "Four-Lane Viaduct Contemplated," *Sioux City Journal*, February 2, 1958, SCPL.

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Photograph by Mike Whye, 2007

The postcard view of Sioux City's Grand Avenue Viaduct (see front inside cover) as it looks today. View is from Floyd Cemetery, looking southwest.

Photograph by Mike Whye, 2007

North side of the Grand Avenue Viaduct, looking southeast. The line of original curved piers is interrupted by the "T" piers and three spans built in 1963 over the relocated Floyd River channel.


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