HISTORIC AMERICAN ENGINEERING RECORD

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Detroit Superior High Level Bridge
.5 miles west of the Public Square
Cleveland
Cuyahoga County
Ohio

PHOTOGRAPHS AND HISTORICAL DATA

HISTORIC AMERICAN ENGINEERING RECORD

DETROIT-SUPERIOR HIGH LEVEL BRIDGE

Location: Spanning the Cuyahoga River between Detroit and Superior Avenues, approximately .5 mile west of the Public Square, Cleveland, Ohio

UTM: 17/441260/4593580
Quad: Cleveland South

Date of Construction: 1912-1917; rehabilitated 1965

Owner: Cuyahoga County Commissioners
1219 Ontario
Cleveland, Ohio 44114

Present Use: Highway and pedestrian bridge

Significance: The Detroit-Superior High Level Bridge is a combination reinforced-concrete and steel structure with a total length of 2,880 feet. The double-deck bridge was designed to carry four lanes of traffic on the upper roadway and six street railway tracks on the lower deck. The center span over the river was a 591-foot three-hinged steel arch of Pratt truss design. At the time of its completion in 1917, the Detroit-Superior Bridge held the record as the third longest steel arch in the country. The bridge also received attention for its unusual subway approaches beneath the streets at each end of the bridge. The lower streetcar deck was abandoned in 1955.

Historian: Carol Poh Miller, August 1978

By 1906, Cleveland's industrial and commercial growth had made it desirable to have a "high level" bridge over the Cuyahoga River, that is, a bridge high enough to permit both boats and highway traffic to proceed without having to stop and wait for the draw to swing. The Superior Avenue Viaduct, "the pride of the horse-and-buggy era," had become inadequate.[1]

Two bond issues to build the bridge sponsored by the City of Cleveland, once in 1908 and another in 1910, were voted down. On 13 July 1910, the Cuyahoga County Commissioners resolved that the county should build the bridge "upon the Cleveland Milan Road" connecting Detroit and Superior Avenues, both state roads. The Commissioners proposed to levy a tax on all taxable property in the county to finance the structure.[2] On 8 November 1910, county residents voted in favor of building the bridge. The County Commissioners resolved to purchase a strip of land 120 feet wide for the new bridge, and in February 1911 the County Surveyor was authorized to prepare complete plans.[3]

As designed, the Detroit-Superior High Level Bridge was a combination reinforced-concrete and steel structure with a total length of 2,880 feet and a width that varied from 81 feet, 6 inches at the center to 94 feet, 9 inches at the approaches (DSB Drwg.-1). The approach spans flared out in order to accommodate open wells in the center of the roadway through which ~~the~~ streetcars traveling on a lower level would surface at the ends of the bridge.[4] The double-deck bridge carried a four-lane roadway 44 feet, 9 inches wide and two sidewalks of varying width of 12 feet or more. The lower deck was designed to carry six street railway tracks (only four were ever installed), and had a vertical clearance of 15 feet.

The bridge crossed the wide, flat Cuyahoga River Valley, which was some 100 feet lower than the city grade on each side. By Federal law, the new bridge had to be designed so that it could be erected without interfering with navigation on the river. A 591-foot cantilevered three-hinged steel arch was chosen for the river span. This was flanked by approach spans consisting of multiple arches of reinforced concrete (DSB Drwgs.-2 & 3). There were twelve concrete arches, three on the west side of the river and nine on the east side. The arches varied in length; the longest had a clear span of 174 feet, the shortest a clear span of 58 feet. Each concrete arch consisted of four arch ribs, which supported the beam and slab streetcar deck on heavy spandrel columns spaced 10 feet apart on centers. The spandrel columns continued above the lower deck to support the roadway, also of beam and slab construction. Arch #12 (between Piers #11 and 12), which spanned the Big Four Railroad tracks, required a design different from that of the other arches. In order to avoid the the use of centering, which would interfere with rail traffic, a high-rise curve using three-hinged steel arches for both erection and reinforcement was used. The other arches were reinforced with the usual rods.[5]

Plans for the bridge were prepared under the direction of Cuyahoga County Engineer Frank R. Lander and County Bridge Engineer A. M. Felgate. It was built under the direction of W. A. Stinchcomb and A. W. Zesiger, who subsequently held these offices, and K. D. Cowen, who served as engineer of construction. Separate proposals and specifications were drafted for the construction of the substructure, superstructure, and steel arch. These contracts were held by four different firms: 1) The Great Lakes Dredge & Dock Company, of

Cleveland, constructed the secondary Piers #1 and 2 and #5 through 11, and their contract included setting the grillage material for the cast-steel bolsters, or "shoes," that would carry the steel arch span. 2) The O'Rourke Engineering Construction Company, of New York, constructed Piers #3 and 4. 3) The Hunkin-Conkey Company, of Cleveland, built the east and west abutments and approaches, Pier #12, and all of the superstructure of the bridge on each side of the steel arch span. 4) The steel arch was fabricated by the King Bridge Company, of Cleveland, who subcontracted its erection to the Ferro Construction Company, of Chicago.[6]

The proposal and specifications for constructing the secondary piers show that the footings for Piers #1 and 2 were built by sinking rectangular caissons in open, dry excavation. Piers #5, 6, and 7, on the east side of the river, were sunk considerably lower "in order to provide for a possible diversion of the navigable channel." This was done by constructing a double row of steel sheeting to form a cofferdam and driving the inside sheeting to a base line elevation of -50 (or 50 feet below the average level of the river).[7] Piers #5 through 11 all rested on pre-cast reinforced-concrete piles varying in length from 25 to 50 feet. These were driven with a 5-ton Vulcan hammer. Piles under test were required to carry a load of 60 tons for seven days, with ¼ inch the maximum allowed settlement. The footings for Piers #3 and 4, which supported the river span, were built in open cofferdams constructed of interlocking steel sheet piling, with inner and outer rows spaced 20 feet apart and filled with concrete. These piers were 116 x 80 feet at the base, and rested on stiff blue clay 45 feet below the surface of the river (DSB Drwg.-4).[8]

Work on the bridge began in the fall of 1912. On 22 January 1913, County Engineer Frank R. Lander reported that "the work is progressing in a most satisfactory manner." The excavation for the east river pier had been substantially completed and the bottom was then being leveled for the deposit of concrete. Samples taken from the excavation showed a "hard, stiff clay" which in his opinion was "amply capable to take safely the loads imposed thereon."[9] By 18 June 1914, the caisson construction for Piers #1 and 2 was underway, excavation had begun for Pier #3, and Piers #4 and 9 were complete. The concrete piles had been driven for Pier #5, and the test piles for Pier #8 were down and the concrete piles were "about to be driven."[10]

The superstructure west of the river was built by means of towers and "Lakewood" chutes. The concreting materials were delivered in scows, then carried by motor truck to the mixing plant, where they were dumped into bins which fed by gravity into a "Lakewood" mixer of 1 cubic yard capacity. The concrete was spouted from the mixer into a hopper, then transported by truck to the place where it was needed. By the spring of 1915, the west approach was nearly completed.[11]

An interesting feature of the construction of the bridge's west approach was the then-novel use of motor trucks to solve the problem of transporting construction materials. All material was brought to the bridge site by water. It was then necessary to haul it up the 12% grade of the Detroit Avenue hill to the west end of the site. It was essential that deliveries be made with regularity in order to keep the concrete mixers running at capacity. Scientific

American reported on the successful use of motor trucks to build the bridge:

> The cost of tackling this job without the use of dependable motor trucks would have been prohibitive, engineers say, because it was estimated that in certain phases of the haulage work one truck could make four trips to a team's one, hauling 24 tons of material while a team [of horses] could haul but 3. The trucks performed a double duty, first hauling the cement, sand, gravel, slag and limestone to the mixers, and after it had been properly mixed rehauling the concrete to the forms. The speed of the trucks was important, because they offered the only means of transportation that enabled the contractors to secure the materials in sufficient quantities to keep the giant mixers busy . . ..
>
> The whole undertaking affords a remarkable demonstration of the value of the motor truck. . . . The county engineer in charge of the work says:
>
> "We have watched the work of the trucks with great interest and they have been very satisfactory. They have hauled enormous quantities of materials in the shortest possible time and are the only mode of transportation that could be depended upon to keep the mixers busy."[12]

On the east side of the river, the superstructure was built by means of a double "Lidgerwood" cableway with a span of 1200 feet. The head tower had a height of 180 feet, and the tail tower was 130 feet high. The cableway had an ordinary capacity of 8 tons, although segments of the steel arch centers weighing 12½ tons each were also handled. The cables were suspended above and midway between the pairs of arch ribs, thereby enabling the concrete and other material to be hoisted even after the arch ribs were concreted.

The concrete plant was located on the east bank of the river opposite Arch #6. The concrete aggregates--"Peelie Island" sand and "Kelley Island" crushed limestone--were delivered by barges. The materials were unloaded into storage piles by two locomotive cranes equipped with "Owen" clam-shell buckets. The sand was carried by crane to a bucket elevator, and the stone was transported to its elevator by a belt conveyor operating in a tunnel under the storage pile. The bucket elevators raised the materials 50 feet into bins located above the mixer. One single-cylinder 12 x 20-inch steam engine supplied the power for both the elevators and the stone conveyor belt.

The cement was delivered by rail to a cement shed with a capacity of 6,000 barrels located about 100 feet from the mixing plant. A 36-inch gauge automatic dump car carried the cement up an incline trestle to the mixing platform, where it was recieved by a hopper with a capacity of 6 sacks. The proper amounts of sand, stone, and cement were obtained by filling the respective hoppers to the desired level.

A 6-cubic yard steam-driven "Smith" mixer, located on the floor beneath the mixing platform, was used for all of the concrete. The mixer dumped into a hopper directly above the 36-inch gauge track that served the cableway. One large flat car accommodated two 3-cubic yard "Haynes" buckets. This car was hauled by one drum of a reversing hoisting engine to various points under the cableway, as needed. When both cables were in use, as many as 55 cubic yards of concrete could be placed in one hour. A central boiler plant of 200 h. p. powered the cableway engines, the mixer, car hoist, bucket elevator hoist, and one of the locomotive cranes.

As far as possible, the forms for the concrete were made in sections at a central saw shed. This 25 x 40-foot shed consisted of a roof supported on four posts and open on all sides. It was equipped with a swing cut-off saw, a rip saw, a band saw, and a "Handy" woodworker, all electrically driven. Only three sets of arch-rib forms were needed (each of the larger arches was centered by using three-hinged steel arches). These were made in 12-foot sections of matched 2 x 6-inch sheeting, laid perpendicular to the arch rib and nailed to 3 x 6-inch studs braced two feet apart on centers. Six-by-six-inch whaling timbers placed perpendicular to the arch ribs on 5-foot centers were bolted above and below the concrete arch rib. When necessary, extra bolts encased in tin tubes were run through the concrete. After the arch rib had set, the side forms were removed with the aid of the cableway and transferred to their new positions without lowering them to the ground. "A 150-ft. rib has been stripped and the forms again set up in five hours," Engineering and Contracting reported.[13]

The larger arches were centered with three-hinged steel arches resting on a steel-covered runway supported from the concrete pier footings by steel columns.[14] Six sets of steel centers were used, which permitted work to proceed on three different pairs of ribs at the same time. After the arch ribs were poured and had set for about fourteen days, the centers were lowered by a toggle adjustment and rolled over into place for the other two ribs of the span. It was found that a settlement of 2 inches occured at the crown of the arch ribs as they were built, so this was taken into account in setting the steel centers.[15] Fig. (DSB Photo-1) shows the subway deck and Arch #12 as they appeared shortly after construction.

Probably the most significant aspect of the Detroit-Superior Bridge was the design and construction of the 591-foot steel arch that spanned the river. This was "one of the most important examples of a spandrel-braced, three-hinged steel arch truss bridge yet built," according to Engineering Record:

> Its most notable features are the general outlines of the trusses, the details of important members, the

> unusual truss and floor connections, the double-deck arrangement with four cantilever extensions providing for sidewalks, the wide driveways /roadways/ and six electric car lines, the heavy loads assumed and the various combinations provided for, and the combination of carbon and nickel steel and range of unit stresses adopted for them.[16]

The steel arch span consisted of Pratt trusses, the main members of which were box sections made up of plates and angles connected with lacing bars (DSB Drwg.-5). Lateral bracing was provided in the plane of each chord member. The curved top and bottom chords of the arch were spaced 49 feet, 3 inches apart on centers. The trusses varied in depth from 20 feet at the crown to 91 feet, 2½ inches at the ends. The span was divided into twenty-four 24-foot, 7-inch panels with one vertical and one diagonal member for each panel. Except for the crown and skew-back hinges, all connections were riveted. The lower-chord crown hinge joint was made with a 12-inch pin and the lower-chord skew-back hinges were made with 16-inch pins engaging cast-steel bolsters anchored by the grillage to the masonry piers.

The upper deck of the main span was located at about the level of the ends of the top chords, intersecting the lower chords at about the fifth panel point from the ends. The span carried an upper roadway 44 feet, 9 inches wide; two 15-foot sidewalks were cantilevered outside the arch. The lower deck, 80 feet wide overall, was of open stringer construction and carried four tracks between the arch span and two cantilevered tracks. Both the upper and lower decks between panel points L5 -L5 were located wholly below the bottom chords and were suspended from the latter by vertical eyebars. At panel points L5 the upper deck intersected the lower chords and its floorbeams were pin-connected to the vertical posts of the main truss. The upper deck floorbeams were single-web plate girders at these points, passing between the built channels composing the vertical posts and extending beyond them to provide the cantilevers for the exterior sidewalks. Eyebars, pins, and truss members (except the lacing bars and stay plates) were made of nickel steel. The floor beams, stringers, and all bracing were made of carbon steel. Cast steel was used for the bolsters supporting the arch, structural steel for the grillage. Nickel steel rivets were used in the arch, carbon steel rivets in the other portion of the bridge.[17]

The steel arch span was designed to carry a load of 10,000 lbs. per linear foot of bridge, plus impact varying for different positions from 14 to 36 per cent. Stresses due to a 24-ton truck, plus impact, were assumed in designing the floorbeams; stresses due to a 60-ton streetcar, plus impact, were assumed in designing the lower-deck floorbeams and hangers. Working stresses allowed for the nickel steel truss members in tension were 24,000 lbs. per square inch; for those in compression, 25,000 lbs. per square inch. This was increased about 30 per cent for wind and erection stresses (DSB Drwg.-6).[18]

The arch trusses and part of the floor, together with the lateral and transverse bracing, were erected from each river pier as a cantilever in order to avoid interfering with navigation on the river. The principal work was done by a timber top-chord traveler carrying two 25-ton stiff-leg derricks. The total weight of each traveler with derricks and a 52 h. p. engine was about 70 tons. The traveler rolled on a track made of two 8 x 16-inch timbers laid flat side by side, resting on 8 x 8-inch by 3½-foot ties laid on the top chord of the arch. Material for constructing the arch was hoisted from scows in the river. The travelers worked forward from both piers until they met at the center of the arch.

The erection of each arm of the arch was begun from 90-foot steel towers erected behind the abutment piers. The towers were erected with the aid of a gin pole. (This is a vertical pole guyed to the ground by cables; it is used in connection with blocks and tackle for raising weights.) After the gin pole was used to erect the east tower, it was dismantled and re-erected at the west pier to build the west tower. The traveler and its derrick were erected on these towers. Eyebar backstays held the half-arches in place until they were joined at the center.[19]

The erection of the steel arch began on 29 July 1915. It was completed on 8 October of the same year. On that day, the two arms were lowered beginning at 10:30 a.m. By 2:23 p.m., with a 2-hour intermission, the arch was closed. Telephones were used to synchronize the action at each hoisting engine, which turned the toggle screws that closed the arch. The two arms of the arch lined up within 1/8 of an inch. The small difference was adjusted "by a cable."[20] Cuyahoga County Engineer W. A. Stinchcomb, who supervised the completion of the bridge, later wrote:

> It was quite a site to watch the two great trusses, 290 feet long and weighing about 2000 tons each, slowly move into position. Like the hands of a watch, no movement could be seen, but the space between the two ends gradually lessened until the ends touched and the arch took its final position. . . . The work was so accurately fabricated and erected that the alignment and elevations were almost exact.[21]

The double-deck floor system was erected from the center of the bridge outward as the travelers returned to the piers (DSB Photo-2).

The material was hoisted from scows in the river and placed in the following sequence: First, the 8 x 1-3/8-inch eyebar hangers were placed in the arch chords. Next, the pin-connected floorbeams of the upper deck and the built-up hangers for the lower deck were erected. The lower-deck floorbeams were placed, then riveted to the hangers. Erection of the stringers and bracing followed. By 5 Novemebr 1915 all of the steel--about 4200 tons--had been placed.[22] The metal work was then cleaned and painted two coats (one coat had been applied in the shop).[23] Fig. (DSB Photo-3) shows the completed arch and floor system as it appeared during the winter of 1915-16.

Both the steelwork and the travelers used to erect the arch were fabricated by the King Bridge Company. Harry Fuller, chief engineer for the company, was in charge of its design and fabrication. The actual work of erecting the arch was subcontracted to the Ferro Construction Company. F. F. Buck, who was in charge of field work for Ferro, supervised its construction.[24]

There are no published accounts of the finishing work on the bridge. Photographs and drawings show that there was a spindle and post balustrade, made of marble. Decorative marble pylons originally stood on the upper roadway at each of the four points of intersection with the steel arch span, and street lights of the "Cleveland lantern" type were spaced at uniform intervals on each side of the bridge.

* * *

The original plans called for carrying the streetcars from the lower deck back to street level by constructing inclines and open wells at the center of the approaches. This idea was abandoned in February 1916, after the Cleveland City Plan Commission resolved that "traffic conditions at the east and west ends of the new high-level bridge . . . are such that both approaches should be provided with subways . . . ."[25] County Engineer Stinchcomb proposed that short subways be built for a length of several hundred feet at each approach. The Cuyahoga County Commissioners, noting that construction of the approaches as originally planned would "materially interfere with the utility [of the bridge]," endorsed the new plan.[26]

The revised plans show that, on the east side of the bridge, the streetcar subway continued for a distance of 185 feet to a point on Superior Avenue just beyond W. 9th Street. On the west side, there were two subways. One continued west under Detroit Avenue to W. 28th Street for a distance of 725 feet; another subway continued south beneath W. 25th Street to Church Avenue for a distance of 560 feet (DSB Drwgs.-7 & 8). Streetcars entered the subways through open wells located in the center of the roadways (DSB Photo-4).

There were four pedestrian entrances to the subway at the intersection of Detroit Avenue and W. 25th Street (one of these was located in the Forest City Building on the southwest corner) and one on the south side of Superior Avenue at the bridge's east approach. The Electric Railway Journal briefly described the underground system:

> At each end of the bridge is a paved area large enough to accommodate several cars on each track, the floor being of stone blocks grouted with cement. The tracks of each line are separated by a light fencing . . ..
> Long flights of easy steps lead from the street level to the track deck with attractive housings over the stairways at the street level.

The "attractive housings" were small wood frame buildings with hipped roofs (DSB Drwg.-9). Below ground, the station and tunnel walls were supported by reinforced-concrete retaining walls, while a system of closely spaced beams and columns supported the upper roadway. Each station consisted of a waiting area, boarding platforms, circuit control and storage rooms, and public toilets. The stations featured white glazed tile walls with recessed lighting and were very plain in appearance (DSB Photo-5). Tunnels under the tracks at both stations gave pedestrians access to east-, west-, and (on the west side of the bridge) south-bound trains. "Especially fortunate is the opportunity for loading and unloading cars away from street level, which has been taken full advantage of," Electric Railway Journal concluded. The railway installation was constructed by the Cleveland Railway Company, with track work under the direction of Charles H. Clark and overhead work under the direction of L. P. Crecelius.[27]

The Detroit-Superior High Level Bridge was opened to automobile traffic on Thanksgiving Day, 1917. Because it opened during wartime, no ceremony marked the occasion.[28] The first streetcar crossed the bridge on Christmas Eve of the same year. The car carried some fifty persons, including Cleveland Mayor Harry L. Davis, County Engineer Stinchcomb, Street Railroad Commissioner Fielder Sanders, and Cleveland Railway Company engineer Charles Clark. The car left W. 25th Street and headed east over the bridge shortly before 4:00 p.m. "'Wonderful,' and 'it's getting more and more like New York in Cleveland' were some of the ejaculations heard in the car," according to the Cleveland Plain Dealer.[29]

* * *

Cleveland was proud of its new bridge which, upon completion, was the longest double-deck, reinforced-concrete highway bridge in the world. The bridge was celebrated in post cards of the period (DSB Photo-6). Scientific American declared that the 591-foot steel arch represented "the new school of American engineering which has eliminated the draw-bridge from our municipal economy along with the grade crossing and the ferry-boat."[30]

But the bridge, built at a final cost of $3,720,000, served for just ten years before cries were heard to relieve ~~the~~ traffic congestion ~~that had developed~~. Clearly its planners had not counted on the proliferation of the automobile that would occur during the decade of post-war prosperity. In 1927, there was a proposal to pave and use a portion of the lower streetcar deck for auto traffic. County Bridge Engineer A. M. Felgate reported that the unused portion of the lower deck could be opened at a cost of $1,100,000, and that it could accommodate 4,000 automobiles an hour. The Cleveland Times supported the proposal, saying that it would give relief to the "almost hopeless traffic congestion."[31] Nothing was done about the proposal, and the problem of traffic congestion persisted. The completion of the Lorain-Carnegie Bridge (1932) one half mile to the south offered some relief, as did the Main Avenue Bridge in 1939. The construction of Bulkley Boulevard in connection with the latter bridge necessitated the widening of the west approach to the Detroit-Superior Bridge. The wooden subway house on the northeast corner of Detroit Avenue and W. 25th Street was razed, the stairwell to the subway was relocated, and a new sandstone subway house was built.[32]

The original designs of those who planned the Detroit-Superior High Level Bridge were increasingly undermined by the growing popularity of the automobile and the subsequent abandonment of streetcars by anyone who could afford to do so. The trend continued unabated. By 1946, the "attractive housings" over the subway entrances had become deteriorated and vandalized and subway station photographs taken during this period show that they had become dirty and neglected.[33] On 29 December 1953, the Cleveland Plain Dealer reported Mayor Anthony J. Celebrezze's proposal to use the lower bridge deck exclusively for autos. The idea was dismissed by Cuyahoga County Engineer Albert S. Porter as "engineered murder," although a trial roadway was established for a brief time during February 1954.[34]

Meanwhile, Cleveland's trolley age officially ended on 24 January 1954 with the "last free ride" celebration from Public Square across the bridge to W. 65th Street and Bridge Avenue. The last streetcar on the Detroit Avenue line had run on 25 August 1951; the last car on the W. 25th Street line on 15 August 1953.[35] In May 1955, the Cleveland City Council passed an emergency ordinance granting its consent "that Superior Ave. be improved by filling in the existing street car wells leading to the Detroit-Superior Bridge."[36] Closure walls were constructed at the ends of the subway tunnels and the open wells were filled with gravel and paved over in 1955. The spandrel arches closest to both approaches were closed up with cinder block to keep out trespassers. The stairwells to the subways were closed and covered , and the wood frame station houses were removed.

In 1965, consulting engineers hired by the county to make an inspection and rehabilitation study of the Detroit-Superior Bridge reported that "Because of age and corrosive atmosphere the bridge has deteriorated to the point that normal maintenance is no longer adequate and the structural stability of some members has become questionable." The engineers noted that the upper deck slab and sidewalk had failed in some places and had been covered with steel plates. "Extensive rehabilitation is needed in the near future if the bridge is to be continued in service," they wrote.[37]

The Detroit-Superior Bridge was rehabilitated in 1965. The roadway was widened to six traffic lanes, from 44 feet, 9 inches to 72 feet, and the sidewalks were reduced from 14 to 5 feet on each side. The extra lanes were added by cantilevering them on the outside of the steel arch span. The upper deck roadway slab, sidewalks, railings, and light standards ~~all~~ were replaced, and the ornamental pylons were removed. Aside from normal maintenance, no further work is planned for the bridge. Cuyahoga County Bridge Engineer Eugene A. Halupnik predicts that it will continue in service through the 1980s.[38]

* * *

At the time of its completion, Engineering News noted that the "main novel features" of the Detroit-Superior High Level Bridge were its double-deck design of concrete arches, its unusual subway approaches, and the "very large steel arch" across the river.[39] Engineering Record reported that the Cleveland bridge held "third place in span length in this country, being exceeded only by the Hell Gate arch and the Niagara arch."[40]

In later years, the records set by the Detroit-Superior Bridge, New York City's Hell Gate Bridge, and the Niagara-Clifton Bridge over the Niagara River were surpassed by even longer steel arches. The Bayonne Bridge over the Kill Van Kull (1928-31), linking New Jersey and Staten Island, and the McKees Rock Bridge (1930-32) at Pittsburgh are two important examples; the former bridge, with a clear span of 1,652 feet, still holds the record as the longest steel arch in the world. In recent times, steel arches have been used frequently for short highway and pedestrian bridges but are now rarely employed for very long spans; the flat terrain usually associated with navigable waterways makes it difficult to gain the necessary clearance and, according to Carl Condit, "the arch must be raised to such a height that the provision of proper approaches becomes highly expensive . . . ."[41]

The final importance of the Detroit-Superior Bridge to Cleveland lies not in the engineering records it set during the early years of long-span steel arch construction, but in its impact on the city's growth. The bridge prompted a real-estate boom on Cleveland's West Side and in the suburb of Lakewood. Cleveland historian William Ganson Rose links Lakewood's growth directly to the opening of the bridge, which facilitated travel to downtown and points east.[42] The Detroit-Superior High Level Bridge is still an important river crossing to anyone living or working on the city's West Side. Finally, the story of its planning, construction, and later modification succinctly illustrates many of the cultural and technological forces that shaped this city during the years between 1910 and 1965.

Detroit-Superior High Level Bridge--footnotes

[1]William Ganson Rose, Cleveland: The Making of a City (Cleveland and New York: The World Publishing Company, 1950), p. 758.

In 1906, a 29-member Bridge Committee published a map proposing the construction of a high level bridge that would link Franklin Avenue on the west side of the Cuyahoga River with Superior Avenue on the east. The map, titled "The New High Level Bridge," is located in the library of The Western Reserve Historical Society, Cleveland. It was prepared by J. B. Davis & Son, Civil Engineers (Cleveland: n.p., 8 February 1906).

[2](Cuyahoga County) Commissioners' Journal Record, Vol. 27, pp. 251-252, Cuyahoga County Archives, Cleveland, Ohio.

[3]Commissioners' Journal Record, Vol 28, pp. 13-14, 84. A taxpayers' suit, filed to restrain the county from building the bridge on the grounds that the proposed structure did not follow the crooks and turns of the old State road, and that a viaduct connecting one high bank of the river with another was not a "bridge" within the meaning of the statute, was promptly dismissed. See E. J. Landor, "The High Level Bridge," Proceedings of the Ohio Engineering Society 33 (1912): 26.

[4]The constantly varying width of the approaches made both design and construction of the bridge difficult, according to Cuyahoga County Engineer W. A. Stinchcomb, because "no two beams were of the same length, requiring separate calculation and forms for each as well as varying column loads." See "The Detroit-Superior and Brooklyn-

Brighton Bridges," Proceedings of the Ohio Engineering Society 37 (1916):124.

5"Detroit-Superior Bridge, Cleveland, Ohio," Engineering News 71 (18 June 1914):1350-1351. Because of the angle of the railroad right of way, two ribs of this arch were advanced ten feet beyond the other two in order to obtain the necessary clearance. Engineer Stinchcomb ("Detroit-Superior and Brooklyn-Brighton Bridges," p. 122) notes that, as a result, "The construction work at this arch was somewhat complicated."

6"Detroit-Superior Bridge," p. 1352. The Hunkin-Conkey Construction Company, incorporated in 1900, succeeded a partnership founded by Samuel and William J. Hunkin. Rose (Cleveland, p. 615) writes: "Having built many of Cleveland's larger industrial plants, the Detroit-Superior High Level Bridge, and Akron rubber plants, in addition to hotels, banks, power plants, and office buildings, the War Department engaged the company, prior to World War II, to construct the seventy-million-dollar Ravenna Ordnance Plant. In 1946 the company was engaged in the largest railroad construction and relocation job in the country for the Pennsylvania Railroad east of Pittsburgh."

7Cuyahoga County, Ohio, Frank R. Lander, County Engineer, "Proposal, Contract and Specifications for Secondary Piers, Detroit-Superior Bridge," pp. 3-4. All of the proposals, contracts, and specifications for the Detroit-Superior Bridge are located in the Office of the Cuyahoga County Engineer, Standard Building, Cleveland, Ohio.

8Stinchcomb, "Detroit-Superior Bridge and Brooklyn-Brighton

Bridges," pp. 122-123.

[9]Commissioners' Journal Record, Vol. 32, p. 67.

[10]"Detroit-Superior Bridge," p. 1349.

[11]"Methods and Equipment Used in Constructing the Superstructure of the Detroit-Superior High Level Bridge in Cleveland, O.," Engineering and Contracting 44 (7 July 1914):10-11. Unless otherwise noted, details of the construction of the bridge superstructure are taken from this article.

[12]"Cleveland's New Bridge--The Role of the Motor Truck in Its Construction," Scientific American, 25 Novemebr 1916, p. 480.

[13]"Methods and Equipment," p. 12.

[14]The use of three-hinged steel arch centers had been pioneered by Cleveland consulting engineer Wilbur Watson. See Carol Poh Miller, "The Rock River Bridge: Triumph in Concrete," IA, The Journal of the Society for Industrial Archeology 2 (1976): 50, 56-57.

[15]Each arch consisted of four ribs. The steel centers were placed for two arch ribs in each of three spans simultaneously. According to engineer Stinchcomb, variations in the size of each arch was made up by removing certain sections of the steel centers. See "Detroit-Superior and Brooklyn-Brighton Bridges," p. 126.

[16]"Main Span of Detroit-Superior Bridge over Cuyahoga River at Cleveland," Engineering Record 70 (28 November 1914):591.

[17]Cuyahoga County, Ohio, Frank R. Lander, County Engineer, "Proposal, Contract and Specifications for Steel Arch, Detroit-Superior Bridge," p. 6.

[18]Stinchcomb, "Detroit-Superior and Brooklyn-Brighton Bridges," p. 127. A detailed account of the calculations made for assumed loadings and wind stresses can be found in " ain Span of Detroit-Superior Bridge," pp. 571-573, cited above.

[19]Diagrams of the gin pole and the erection traveler can be found in "Erection of Steel Arch Span, Detroit-Superior Viaduct," Engineering News 74 (19 August 1915):366.

[20]"Detroit-Superior 591-Foot Steel Arch Successfully Swung by Toggle Adjustment," Engineering Record 72 (25 December 1915):791. Apparently the "toggle adjustment" used to close the arch of the Detroit-Superior Bridge differed from the method used for New York City's Hell Gate Bridge, then under construction. The hinged arch ribs of the Hell Gate Bridge, which also were erected by cantilevering them out from towers, were closed by hydraulic jacks of 2,500-ton capacity. These were used to lift the halves of the arch into exact alignment, according to Carl W. Condit (American Building Art: The Twentieth Century (New York: Oxford University Press, 1961), p. 121). Unfortunately, the "toggle adjustment" used to close the Cleveland arch is not described clearly enough to permit further elaboration here.

[21]"Detroit-Superior and Brooklyn-Brighton Bridges," p. 128.

[22]"Detroit-Superior 591-Foot Arch," p. 791.

[23]"Proposal, Contract and Specifications for Steel Arch," p. 7.

[24]"Detroit-Superior 591-Foot Steel Arch," p. 791.

[25]The full text of the resolution can be found in the Commissioners' Journal Record, Vol. 36, p. 535.

[26]Ibid., pp. 622-623.

[27]"Electric Railway Construction on the Detroit-Superior Bridge," Electric Railway Journal 52 (27 July 1918):145-146.

[28]Rose, Cleveland, p. 758.

[29]25 December 1917

[30]"Cleveland's New Bridge," p. 480.

[31]7 February 1927.

[32]This building is now part of the Cuyahoga County Engineer's West Superior maintenance yard.

[33]Photographs of the stations are located in the "Detroit-Superior High Level Bridge" file in the library of the Cleveland Press, 901 Lakeside Avenue, Cleveland, Ohio.

[34]Ibid. A photograph in the Cleveland Press collection dated 4 February 1954 illustrates the trial use of the bridge subway for auto traffic.

[35]Harry Christiansen, Trolley Trails Through Greater Cleveland and Northern Ohio From 1910 to Today (Cleveland: The Western Reserve Historical Society, 1975), p. 446.

[36]Ordinance No. 1225-55, 9 May 1955, The (Cleveland) City Record, vol. 42 (1955), p. 1145.

[37]Howard, Needles, Tammen & Bergendoff, Consulting Engineers, "Detroit-Superior Bridge: Inspection and Rehabilitation Studies," Cleveland, March 1965 (Mimeographed), p. 1. This report contains a complete summary of the condition of the bridge in 1965.

[38]Interview, Office of the Cuyahoga County Engineer, Cleveland,

Ohio, 18 July 1978.

[39]"Detroit-Superior Bridge," p. 1348.

[40]"Detroit-Superior 591-Foot Steel Arch," p. 790.

[41]Condit, American Building Art, p. 116.

[42]Cleveland, p. 1081.

ADDENDUM TO
DETROIT SUPERIOR HIGH LEVEL BRIDGE
Cleveland
Cuyahoga County
Ohio

HAER No. OH-6

HAER
OHIO
18-CLEV,
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