

MINNESOTA HISTORIC PROPERTY RECORD

PART I. PROPERTY IDENTIFICATION AND GENERAL INFORMATION

Common Name: Third Avenue Bridge
Bridge Number: 2440
Identification Number: HE-MPC-0165
Location:
Feature Carried: TH 65 (Third Avenue S.)
Feature Crossed: Mississippi River, railroad, and city streets
Descriptive Location: 0.3 Miles Northeast of Jct. TH 952A
Town, Range, Section: 29N-24W-23
Town or City: Minneapolis
County: Hennepin

UTM:

Zone: 15
Easting: 4981072
Northing: 479448

Quad:

Minneapolis
7.5 Minute Series
1983

Present Owner:

State

Present Use:

Mainline

Significance Statement:

The Third Avenue Bridge is individually eligible under Criterion C for its engineering significance and under Criterion A as a contributing element to the St. Anthony Falls Industrial Historic District.

The Third Avenue Bridge is an example of Melan arch construction. In 1894, Viennese engineer Josef Melan received an American patent for his innovative reinforcing system. It consisted "of a number of steel I-beams bent approximately to the shape of the arch axis and laid in a parallel series near the undersurface of the arch. The resulting structure might be regarded as a combination of the steel-rib arch and the concrete barrel, the concrete serving a protective as much as a structural purpose" (Frame 1988:3). The first American bridge to embody the Melan system reportedly was a small highway span designed by German-born engineer Fritz von Emperger and built by William S. Hewett at Rock Rapids, Iowa, the same year as the patent. Several small but early Melan bridges were built and designed by Hewett in Minneapolis and Saint Paul for the Twin Cities Rapid Transit and survive today as park structures (Frame 1988:3). The

Third Avenue Bridge is significant because it reflects the design and engineering of Josef Melan's reinforcing system.

In 1912, Minneapolis planners solicited designs for a concrete-arch bridge from a New York-based company, the Concrete-Steel Engineering Co. The Third Avenue Bridge was to be constructed just above the St. Anthony Falls, originally planned to be to the north of the final location. The proposal, which called for sinking piers into the weak stratum that had caused the collapse of the Eastman Tunnel in the 1860s, was not well received by the public or the power companies (since a collapse of the falls would impact its power capabilities).

Frederick W. Capellen, Minneapolis city engineer, devised a solution by altering the bridge location and leapfrogging the bridge arches over the dangerous limestone breaks (Westbrook 1983:18). As described by A. M. Richter in an Engineering News article from 1915 (pp. 1269-1270):

"While bridge engineer for the city in previous years, Capellen had built six bridges across the Mississippi River and acquired a thorough knowledge of river conditions. He refused to approve the proposed location. The City Council then rejected the plans and instructed him to design a steel bridge that could be constructed without endangering the falls or affecting water-power-rights.

"His proposed location is shown on the plan, and his design included one span of 434 feet to clear entirely the area of the limestone breaks. The trusses were to be of the parabolic through-truss type. In the face of many objections (based mainly on aesthetic considerations), the City Council approved the plans and directed the engineer to proceed with construction."

At this time, however, Mr. Cappelen conceived the idea that by adopting a curved location for the line of the bridge, a design satisfactory to all parties might be worked out. On investigation it was found that at one point the limestone break could be spanned by a concrete arch of 211-foot clear-span. A revised plan for the desired ornamental structure was then presented. This proved satisfactory to all parties and was finally adopted."

Construction began on the Third Avenue Bridge in 1914, and the total project cost was \$862,254.00.

PART II. HISTORICAL INFORMATION

Date of Construction:

1917

Contractor and/or Designer (if known):

Contractor: Unknown

Designer: Frederick W. Capellen

Historic Context:

Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945

National Register Criterion:

A, C

PART III. DESCRIPTIVE INFORMATION

Descriptive Information:

The Third Avenue Bridge is the last major reinforced-concrete bridge constructed in the Twin Cities using Melan ribs (Westbrook 1983:18). As explained by Condit (1982:174-175):

"In the Melan system, the reinforcing consisted of a number of steel I-beams bent approximately to the shape of the arch axis and laid in a parallel series near the undersurface of the arch. The resulting structure might be regarded as a combination of the steel-rib arch and the concrete barrel, the concrete serving as much as a structural purpose."

A detailed bridge description was presented in a 1915 article in Engineering News:

"There are five 211-ft. concrete arch spans with piers 20-ft. wide at the springing line and two 131-ft. spans with an intermediate pier 13.79-ft. wide. The two end, or abutment, piers and the pier between the 211-ft. and 134-ft. spans are 30-ft. wide. The approaches are steel girder spans on thin piers. All the river piers are skew to the center line. The 211-ft. spans are on the tangent of the 4° curves and the 134-ft. spans are on the 10° curves.

"Each of the 211-ft. spans is carried by three arched ribs of 36-ft. rise. The outside ribs are 12-ft. wide in the two end spans and 10 ft. in the intermediate spans, while all center ribs are 16 ft. wide. The reinforcing is of the Melan type, consisting of ribs of 4 x 4 x ½-in. angles laced with 3 x 3 x 5/16-in. angles (at haunches) and 2½ x -in. bars. There are six of these ribs in each 16-ft. arch rib, five in the 12-ft. and four in the 10-ft. ribs. They are braced every 30 ft. with 3 x 3 x 5/16-in. angles.

"The two 134-ft. spans over the east channel are full-barrel arches with Melan ribs of 3 x 3 x 5/16-in. angles laced with 2½ x ¼-in. bars. These are spaced 34 in. center to center and cross-braced every 30 ft. with 3 x 3 x 3/8-in. angles.

"Carrying the floor system from the ribs are transverse walls and girders supporting the floor slab and brackets supporting the sidewalk slabs and parapet-wall beam.

"The piers were constructed in open coffer-dams of Lackawanna steel sheeting, some of the sheeting being used three and four times. The coffer-dam dimensions were as follows: Pier No. 2, 46 x 121-ft.; Nos. 3 to 6, inclusive, 37 x 113-ft.; No. 8, 24 x 101.5-ft.; No. 7 (between the larger and smaller arches), 46 x 131-ft.; east abutment pier, 42 x 110-ft.

"The construction of pier No. 2 is described in what follows and is typical of all the work. After placing the underbracing for the coffer-dam, the sheetpiling was driven. On this pier (also No. 3) it was necessary at the upstream end of the coffer-dam, because of the strong current, to anchor 15-in. I-beam sills to the rock bottom with 2-in. rods to hold the lower end of the sheeting in place.

"The steel sheeting was very tight and was made entirely water-tight by a filling of coal dust and fine cinders. Sandbags were placed around the bottom of the sheeting and then pumping was started. If water came in through fissures in the rock, pumping was stopped and the bottom course of the concrete, 5 to 6 ft. thick, was placed under water. After this had set, the coffer-dam was pumped out and the remainder of the work placed dry. This was done on piers Nos. 2, 6 and 8 and partly on No. 3. Excavating for piers Nos. 6 and 8 was done entirely with orange-peel buckets. The rock in those coffer-dams was cleaned by divers with water jets. The other

foundations were placed dry, but always in sections, and generally four sections to each coffer-dam.

"After the footings were completed, the piers were concreted in forms which were used over and over again. The first section above the footing was carried above water level, generally leaving a center space considerable below water level to receive the ends of the steel ribs. Finally this part of the pier containing the ribs was cast in one continuous pouring. This amounted to about 7,000 yd. on piers Nos. 3, 4, 5, and 6; 1,266 yd. on Nos. 7 and 9; and 750 yd. on pier No. 8. The record run was 1,000 yd. in 22 hr.

"Pier construction was carried on through the winter except when the temperature was below zero, special precautions being taken against freezing. The forms were entirely inclosed [sic] with tarpaulins and heated with coke stoves. The sand and rock bins were supplied with heaters, and when necessary the cableway buckets for handling concrete were dipped in hot-water tanks on shore. Careful records were kept of temperatures of materials at deposit points. As a result, there was no trouble from frozen concrete.

"Concrete deposited under the water was 1:2:4 mixture. All other concrete in the piers was 1:3:6. It was mixed in batches of about 1 yd. (24 ft. of stone, 12 of sand and 4 sacks of cement), two batches to each bucket. The stone was mostly traprock from Dresser Junction, Wis., crushed to a maximum size of 3 ½ in. The sand was a Minnesota product. A timber tower about 50 ft. high, with crib bottom for anchorage, was placed adjacent to the pier, standing on the river bottom. The tower had a hopper near the top, with a chute to the forms. The cableway buckets delivered concrete to the hopper, where a man regulated the discharge to the chute. The towers were picked up bodily by the cableway and moved from place to place.

"The first coffer-dam (pier No. 2) was begun Aug. 2, 1914, and the pier work was finished June 28, 1915. The river froze solid early in December, and the ice left the west channel in March and the east channel in April. Between the dates mentioned, 27,000 yd. of concrete was laid in pier construction.

"Falsework for the arches was begun Apr. 19, after the ice was out. One set of falsework was designed for the center ribs for the five 211-ft. spans. It was made in seven sections per span, supported by 24-in. 70-lb. I-beams, 28 ft. long on the inside sections and 26 ft. on the two end sections. The I-beams were supported on cribs made of eight 10 x 10-in. posts braced and capped and having open plank bottoms for loading with sandbags to sink them into place. These cribs were placed 28 ft. 11 in. c. to c.

"The falsework to carry the ribs was of 8 x 8-in. posts braced with 2 x 10-in. planks. The bents were capped and furnished with wedges under caps supporting the joists which carried the lagging and the framework for the rib. The lagging and side forms were 1-in. tongued-and-grooved plank, the forms being supported by 4 x 4-in. posts and 4 x 6-in. longitudinal timbers.

"The I-beams rested on 8-in. blocking, so that when the centering had been used for one rib, the entire falsework could be moved into place for the next rib by replacing the blocking with rollers. This falsework was placed in position for the upstream rib first and cribs were placed also for the center ribs at the same time. Trouble was experienced in placing them because of high water and because several cribs were located on the roll dams and aprons. The use of the 24-in. I-beams of 26- and 28-ft. length was decided upon in order to utilize the material for the floor spans of the approaches.

"The first arch rib, between piers Nos. 2 and 3, was poured July 8, 1915; 240 yd. of concrete was handled on one cableway in 11 hr. over the center section of the rib. The steel ribs were then

riveted at the haunches during the next night and the two end sections poured simultaneously the following day, both cableways being used for 9 hr. to handle 340 yd. of concrete. The last upstream rib was poured Aug. 5. Two days later the centering was struck under the first rib and the falsework rolled over by means of a crab on pier No. 2, with block and tackle hitched to each section. The whole centering for one span was thus moved in one day.

"On Aug. 16 the centering for the next span was moved into position and on Aug. 19 and 21 the center rib was poured – 768 yd. in 24 hr. A record run was made on the center rib finished Aug. 28, when 450 yd. was poured in 7½ hr. with both cableways, or one bucket every 2 min., at a distance of 1,600 ft. from the mixers. The concrete for the ribs is a 1:2:4 mix, using ¼ to ½-in. stone.

"The program for the rest of the work provided for pouring one rib a week until all 15 were completed. The cribs for the upstream ribs were moved and used again for the third ribs on the downstream side. The centering of the last rib was moved over into place in 2 hr. 40 min.

"In October, 1915, the timber for the first three 211-ft. spans was moved over to the 134-ft. spans in order to finish the arches before cold weather sets in. The transverse walls are being put in, and only the floor proper will remain to be put in next spring. It is expected that the new bridge will be opened to travel not later than June 1, 1916.

"The alignment of the bridge and skew of the piers necessitated an elaborate system of location. The triangulation had for its base the center tangent line of the bridge. A series of large triangles was laid out on either side of this base line, regard being given to prominent points as targets for the apices of the triangles.

"A secondary triangulation system was calculated, with proper attention to balancing errors for the location of the instrument platforms. Upon this the intersection points of pier, transverse center lines and base line of platforms were accurately established. These intersections were established with ordinary transits reading to 30 sec. Seconds were interpolated on the platforms by means of thread intersections; the minute next great and that next smaller to the actual triangle calculated to the nearest second were ready by the instrument man and recorded on the platform. Actual measurements show a maximum error of ¼-in. in 211 ft."

The bridge had ornamental railing installed in 1939, and was remodeled in 1979-1980. The rehabilitation consisted of complete deck removal; new light standards; raising of the spandrel columns; raising of the roadway grade by 5 feet; new approach pads; removal, cleaning and reinstallation of the 1939 railing; and pier repair.

PART IV. SOURCES OF INFORMATION

References:

Bridge Inventory Files, Bridge no. 2440, Minnesota Department of Transportation Office; Condit, C.W. "Reinforced Concrete: Buildings and Bridges," in *American Building: Materials and Techniques from the First Colonial Settlements to the Present*, 2d ed. Chicago and London: University of Chicago Press, 1982; Frame, Robert M. "Reinforced-Concrete Highway Bridges of Minnesota," National Register of Historic Places Multiple Property Documentation Form, Sec. F, 8, 1988, in files of State Historic Preservation Office, Minnesota Historical Society, St. Paul, Minnesota; Richter, A.M. "A 2,223-Ft. Concrete-Arch Bridge Built on Reverse Curve," *Engineering News* 74, no. 27 (1915):1268-1273, on file at the State Historic Preservation Office, Bridge no. 2440 property file, Minnesota Historical Society, St. Paul, Minnesota; Westbrook, N., ed. *A Guide to the Industrial Archaeology of the Twin Cities*. 1982, prepared for the Twelfth Annual Conference of the Society for Industrial Archaeology, on file at the State Historic Preservation Office, Bridge no. 2440 property file, Minnesota Historical Society, St. Paul, Minnesota.

PART V. PROJECT INFORMATION

Historians:

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Form Preparer:

Mead & Hunt, 2006

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