MHPR No. RA-RVC-0026

MN/DOT BRIDGE NO. 5723 Carrying State Highway 36 over Lexington Ave Roseville Rose Township Ramsey County Minnesota

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

MEASURED DRAWINGS

PHOTOGRAPHS

Minnesota Historic Property Record State Historic Preservation Office Minnesota Historical Society 345 W. Kellogg Blvd. St. Paul, Minnesota 55102-1906

PART I. PROPERTY IDENTIFICATION and GENERAL INFORMATION

A. Name: Mn/DOT Bridge No. 5723

B. Identification Number: MHPR No. RA-RVC-0026

C. Location: Carrying State Highway 36 over Lexington Avenue in Roseville, Rose Township, Ramsey County, Minnesota; SE¹/₄ of the NE¹/₄ of the SE¹/₄ of Section 10 and the SW¹/₄ of the NW¹/₄ of the SW¹/₄ of Section 11, Township 29 North, Range 23 West; UTM coordinates: Zone 15; 488460E; 4984128N (WGS84/NAD83) (Figure 1).

D. Present Owner, Present Use: The present owner of Mn/DOT Bridge No. 5723 is the Minnesota Department of Transportation, 395 John Ireland Boulevard, St. Paul, Minnesota 55155-1899. The bridge carries vehicular traffic on Trunk Highway 36 over Lexington Avenue. The property is scheduled to be demolished between 2006 and 2008.

E. Significance

Bridge No. 5723 is historically significant as a virtually unaltered example of a rigid frame concrete bridge in Minnesota. Built in 1938, it was designed by the Minnesota Department of Highways. The bridge was erected by Charles R. Shepley, a Minneapolis civil engineer who was also responsible for the design of the Queen Avenue Bridge (1905) on West Lake Harriet Boulevard in south Minneapolis, a very early example of a reinforced concrete arch bridge in Minnesota.

Bridge No. 5723 is eligible for the National Register under Criterion C for its engineering design, within the historic context of "Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945" (Hess 1988). The Multiple Property Documentation Form (MPDF) associated with this context states in Registration Requirement 8 that a concrete rigid-frame bridge may be eligible under Criterion C if it "was built in 1938 or earlier and has a span length of 50 feet and over," because such a bridge "is an important engineering...solution to an unusual site condition and is rare in Minnesota." Bridge No. 5723 satisfies these conditions. The only other known example of an NRHP-eligible rigid frame bridge in Minnesota is Mn/DOT Bridge No. 5699 in Austin, Minnesota.

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Figure 1: Location of Mn/DOT Bridge No. 5723 (USGS New Brighton, Minnesota 7.5' Quadrangle, 1991).

PART II. HISTORICAL INFORMATION

A. Physical History

1. Date(s) of Erection: 1938

2. Engineer: Minnesota Highway Department Bridge Engineer W. H. Hoffman. Hoffman began his service with the Minnesota Highway Department in 1914 as an assistant engineer and rose to the rank of Chief Bridge Engineer in the 1920s. Soon after the construction of Bridge No. 5723, he became Commissioner of the Highway Department.¹ No additional biographical information about Hoffman could be located during research at the Mn/DOT Library, the University of Minnesota Libraries, or in genealogical databases.² The Chief Engineer's signature on Bridge No. 5723's construction plans is illegible.

3. Original and Subsequent Owners

Minnesota Highway Department 1938 – 1976

Minnesota Department of Transportation 1976 – present

4. Fabricator and Erector: The steel fabricator is unknown. The bridge was erected by the firm Fielding & Shepley, St. Paul, Minnesota. There is very little information in the Mn/DOT Library, the University of Minnesota Libraries, or the Minnesota Secretary of State's files regarding the firm of Fielding & Shepley. The firm was established in 1904 and one of the firm's partners was Charles R. Shepley.³ Shepley was a Minneapolis civil engineer responsible for the design of the Queen Avenue Bridge (1905) on West Lake Harriet Boulevard in south Minneapolis, a very early example of a reinforced concrete arch bridge in Minnesota (Hess 1988).

5. Original Plans and Construction: On file at the Minnesota Department of Transportation Bridge Office, Oakdale. Original contract documents and specifications could not be located by the Mn/DOT Library, but may be in unaccessioned collections at the Mn/DOT Archives.

6. Alterations and Additions: The roadway wearing surface has been replaced several times and the original median has been replaced with concrete "Jersey barrier" traffic dividers. The underpass lighting system no longer functions.

B. Historical Context

The historical context for concrete rigid frame bridges is presented in *Reinforced-Concrete Highway Bridges in Minnesota*, *1900-1945* (Hess 1988), and is on file with the MHPR documentation files at the Minnesota Historical Society (MHS) Archives Department.

¹ Information from issues of the *Biennial Report of the Commissioner of Highways of Minnesota*.

² Subscription-level research performed at www.ancestry.com.

³ Incorporation files at the Minnesota Secretary of State's office, St. Paul.

"Based on European precedents, the rigid frame was developed in the United States in the early 1920s by Arthur G. Hayden for parkway construction in Westchester County, New York.⁴ According to Condit, the rigid frame was the most important innovation in concrete bridge design after Turner's mushroom slab, and it ranked "second only to prestressing as a money-saving method."⁵ In his 1931 text, Hayden stated that the concrete T-beam slab was probably more economical than the rigid frame for spans below 30 feet, but the concrete rigid-frame bridge was more economical from 35 to 80 feet. When built in steel, the rigid frame extended the economic advantage from 80 to 120 feet.

"Hayden pointed out some variations of the rigid frame, which gave it a deceptive appearance. At times, the curve of the floor slab (it always has a slight arch in rigid-frame design) was great enough to make it appear to be a low-rise arch bridge. Also, the rigid frame sometimes has been constructed with large ribs instead of a solid barrel or slab, giving a visual suggestion of a low-rise ribbed arch. Some have an elliptical intrados.⁶ In a narrow design, two rigid-frame ribs may have been used, one on each side of the bridge. The ribs may be extended above the road, creating a through version. As with other concrete spans, rigid frames could be used in a continuous design, sometimes termed "multi-span rigid frames."⁷ It is possible that the true nature of a rigid-frame bridge may not be known until the bridge plans are reviewed and the bridge structure may be studied without its additional decorative pilasters and walls.

"Within 15 years of its introduction, the rigid-frame bridge had gained wide popularity, replacing arches, slabs, and girders in many applications. In a 1938 address to the Concrete Reinforcing Steel Institute, 'What the Future Holds for Reinforced Concrete,' the president of the Portland Cement Association reported: 'At the present time the rigid frame bridge is being actively promoted and practically every state in the Union has now accepted this type of construction as standard where it fits the location economically'⁸" (Hess 1988). By the time Bridge No. 5723 was constructed in 1938, there had been approximately 400 such bridges built in the United States (Hayden 1950:184).

Although there are several forms of the rigid frame bridge (including the barrel, ribbed, and cellular types), the form remains among the simplest of engineering designs. "If a solid, horizontal slab is rigidly connected with vertical walls, a simple rigid-frame bridge has been created. The critical point is that the three sides are rigidly connected at the two "knees" or corners, and all work together in carrying a load. In sectional elevation, the rigid frame appears somewhat different from an abutment-supported slab. In the conventional slab arrangement, its abutments are heaviest at the bottom and lighter at the top where the bridge seat is located. In the rigid frame, the reverse tends to be true: the transverse vertical walls, which replace traditional abutments, are wedge-shaped, tapering downward to the footing. Overall, the rigid-frame bridge is considered much more economical than either the T-beam slab or the fixed arch, particularly when unyielding foundations are easily obtainable. In addition, the rigid frame employs a smaller depth of construction, a decided advantage where headroom is limited and the required elevation of the top of the bridge is fixed. This is why rigid-frame bridges often have been used in grade separations, such as in freeway construction⁹"(Hess 1988).

⁴ For the Bronx Parkway Commission (Wessman 1950, p. 193).

⁵ Condit, *American Building Art: The Twentieth Century*, p. 213.

⁶ Hayden, pp. 170-73.

⁷ Taylor, Thompson, Smulski, p. 321 (separate frame, ribs); pp. 148-62 (multi-span).

⁸ Remarks of Frank T. Sheets, reported in "Trend Toward Continuity in Bridge Design," in Concrete 46 (Nov. 1938): p. 8.

⁹ See discussions in Arthur G. Hayden, *The Rigid-Frame Bridge* (New York: John Wiley and Sons, Inc., 1931), pp. 1-4; Condit, *American Building: The Twentieth Century*, pp. 213-14; and Taylor, Thompson, and Smulski, *Reinforced Concrete Bridges*, pp. 268-69.

PART III. DESIGN AND ENGINEERING INFORMATION

A. General Statement

Minnesota Highway Department Bridge No. 5723 is a single-span, 138.00' long, concrete rigid frame bridge with a parabolic curve built to the American Association of State Highway Officials (AASHO) Bridge Design Specifications of 1935 for a Class H-20 live load, and Minnesota State Specifications of April 1, 1929 (Concrete) and May 13, 1936 (Bituminous Materials). It was approved for construction by Bridge Engineer W. H. Hoffman on October 8, 1937, and completed in 1938 (MHPR Measured Drawing No. 1) as State Project No. 36-118-21-4 and Federal Aid Project NRS No. 464-E.

Situated in a suburban environment, Bridge No. 5723 carries TH 36 over Lexington Avenue in the community of Roseville. The concrete roadway is 56' wide and is flanked by 3'2" sidewalks. The current concrete deck width is 73'-4" wide. The bridge's substructure includes concrete rigid frame assemblies set on pile-stabilized concrete footings and reinforced-concrete sidewalls with Art Deco style stepped reinforced concrete main pillars at the corners of the main span (MHPR Photograph Nos. 6, 8, 9; MHPR Measured Drawing No. 5). The reinforced-concrete deck supports ornamental metal-pipe railings on a low, reinforced-concrete base. The railings terminate in stepped reinforced-concrete endposts. The under-deck profile is a gentle parabolic arch that follows the profile of the rigid steel structural elements. The current posted speed limits are 35 mph for Lexington Avenue and 55 mph for TH 36.

B. Description

Overall Dimensions: The bridge, including the sidewall structures, measures 138' long east/west and 73'-4" wide north/south (MHPR Measured Drawing No. 2).

Main Span: The main span's parabolic arch measures 56' wide (east/west) and 73'-4" long (north/south) (MHPR Photograph Nos. 1 and 3; MHPR Measured Drawing No. 2). Lexington Avenue's traffic lanes occupy 48' of the main span's width and are flanked by 4'-wide sidewalks (MHPR Measured Drawing No. 12).

Pilings and Footings: 242 treated wood piles (comprising 6110 lineal feet) were used to stabilize the concrete footings for the rigid frame assemblies and for the sidewalls (MHPR Photograph Nos. 14 and 15; MHPR Measured Drawing No. 10). Each was driven to refusal at approximately 25' depth. Concrete footings for the rigid frames are 3'6" deep, 7'-6" wide east-west, and 71'-3" long north-south (MHPR Measured Drawing No. 3). Copper sheet waterstops were installed in the four sockets designed to receive the rigid frames (socket locations are illustrated in MHPR Measured Drawing No. 4, but the existing copy is illegible).

Structural System: Bridge No. 5723 is a concrete rigid frame as discussed by Arthur G. Hayden (1931). The framing system consists of eight identical L-shaped, riveted steel bent assemblies (MHPR Photograph No. 15; MHPR Measured Drawing Nos. 5 and 13), measuring 21'-4" tall and 38' long. The eight "knee frames" are paired together to form two inner, or "intermediate" girders and two outer, or "fascia" girders upon which the reinforced concrete deck structure rests. Although the steel frame assemblies are

concealed within reinforced concrete, their locations are visible as narrow concrete panels on the bridge's underside (MHPR Photograph Nos. 14 and 15). The original design of the rigid assemblies was modified in February 1938 to widen the longitudinal dimension of each frame base from 2' to 2'-4", presumably to provide greater load support and stability.¹⁰

Sidewalls: The bridge has four, 37'-long, earth-backed, reinforced concrete sidewalls, two on the north façade and two on the south façade (MHPR Photographs 14 - 15; MHPR Measured Drawing Nos. 6 and 7). The sidewalls retain the earth required to support the deck approach loads and help buttress the rigid frame structures.

Pillars: There are four Art Deco style, stepped and fluted, reinforced concrete main pillars at the corners of the main span (MHPR Photograph Nos. 6, 8, 9; MHPR Measured Drawing Nos. 6 and 7). Each serves to anchor the junctions of the sidewalls and main arch walls and is integral to the bridge railing system.

Intermediate Posts and Endposts: There are sixteen concrete intermediate railing posts in the bridge railing assembly that are structurally joined to the sidewalls. The railings terminate in stepped reinforced-concrete endposts (MHPR Photograph Nos. 7 and 11; MHPR Measured Drawing Nos. 6, 7, and 9).

Railings: Bridge No. 5723 has 213 lineal feet of ornamental, metal-pipe railings with 16 stepped-back, concrete intermediate posts and four terminal endposts (MHPR Photograph Nos. 6, 7, 10, 11, and 13; MHPR Measured Drawing No. 9). The bridge's main pillars also support the railing assembly, which is fitted into 88 cast bronze sockets shimmed with lead. A cast bronze plaque on the west face of the southwest railing endpost bears the inscription: "Federal Aid Project No. 464-E, Minnesota, 1938" (MHPR Photograph No. 11). A similar plaque on the east face of the northeast railing endpost reads "Minnesota State Highway Department, Bridge No. 5723, 1938."

Wearing Surface: The bridge's original concrete wearing surface (as depicted in MHPR Measured Drawing No. 4) has been replaced multiple times, although the general dimensions of the roadway have not changed significantly (MHPR Photograph No. 13).

Median: A 4'-0" wide concrete median with battered curbs was originally built into the centerline of the bridge deck (MHPR Measured Drawing No. 4). It has since been replaced by concrete "Jersey barrier" traffic dividers (MHPR Photograph No. 12).

Drainage: Cast iron floor drains are located near the four bridge endposts. Each drains into an 8" cast iron pipe that connects to the stormwater mains under Lexington Avenue (MHPR Measured Drawing No. 10).

Lighting: Four 200-watt Benjamin Pit Light fixtures (#5917) were originally installed at equidistant point in the main arch ceiling (over Lexington Avenue) (MHPR Photograph No. 15; MHPR Measured Drawing No. 11), but no longer function.

¹⁰ Although there is no direct evidence to support it, this modification may have been made in response to results obtained during the extensive stress testing of rigid frame girders by the University of Illinois Engineering Experiment Station in 1938 (F. E. Richart, et al. 1938 and W. M. Wilson, et al. 1938).

C. Site

1. Landscape Design/Grading Plan: The ground surface was graded to an 8:1 slope descending from the TH 36 wearing surface at each endpost to the Lexington Avenue grade (MHPR Photograph Nos. 2, 4, and 7; MHPR Measured Drawing No. 12)

PART IV. SOURCES OF INFORMATION

A. Original Engineering Drawings

Reduced photocopies of original engineering drawings for Bridge No. 5723 were obtained from the Mn/DOT Bridge Office and are attached to this document. The plans were approved by Chief Engineer W. H. Hoffman on October 8, 1937.

B. Early Views

No early photographs depicting Bridge No. 5723 were located during this documentation.

C. Interviews

No Interviews were conducted as part of this documentation.

D. Bibliography

1. Primary and Unpublished Sources

Mn/DOT Bridge No. 5723 construction plans and elevations. On file at the Mn/DOT Bridge Office, Oakdale.

2. Secondary and Published Sources

Biennial Report of the Commissioner of Highways of Minnesota for 1937-1938, Minneapolis, 1939.

Condit, Carl W., *American Building: The Twentieth Century*. University of Chicago Press, Chicago, 1982.

Hayden, Arthur G. and Maurice Barron. *The Rigid-Frame Bridge*. John Wiley & Sons, Inc., New York, 1931.

Hess, Jeffery, Minnesota Historic Bridge Inventory, Bridge No. 5723.

Richart, F. E., T. J. Dolan, and T. A. Olson, "Tests of Reinforced Concrete Knee Frames and Bakelite Models. *Bulletin 307*, University of Illinois Engineering Experiment Station, Urbana.

Sheets, Frank T., remarks in "Trend Toward Continuity in Bridge Design," in *Concrete* Vol. 46, November 1938. Concrete Publishing Corporation, Detroit, Michigan.

Taylor, Frederick W., Sanford E. Thompson, and Edward Smulski, *Reinforced Concrete Bridges*. John Wiley & Sons, Inc., New York, 1939.

Wessman, Harold E., "Research in Rigid-Frame Bridges," in Arthur G. Hayden's *The Rigid-Frame Bridge* (third edition), 1950.

Wilson, W. M., R. W. Kluge, and J. V. Coombe, "Laboratory Tests of Reinforced Concrete Rigid Frame Bridges." *Bulletin* 307, University of Illinois Engineering Experiment Station, Urbana.

E. Likely Sources Not Yet Investigated.

According to the Mn/DOT Library, original contract documents related to the construction of Bridge No. 5723 and/or early photographs of the bridge may be stored in unaccessioned collections at the Mn/DOT Archives.

F. Supplemental Material

None.

PART V. PROJECT INFORMATION

A. Research Strategy

The historic context for this documentation was obtained from the Mn/DOT CRU and original engineering drawings were obtained from the Mn/DOT Bridge Office. Comprehensive large-format photographic documentation was proposed for the bridge and its immediate surroundings. In general, in accordance with the MHPR guidelines, lengthy written descriptions were not made where the large-format photographs and original engineering drawings were sufficient to depict the subject.

B. Actual Research Process

The historical context for concrete rigid frame bridges is presented in *Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945* (Hess 1988), and is on file with the MHPR documentation files at the Minnesota Historical Society (MHS) Archives Department. Descriptions of steel and other structural materials were based on information provided on the bridge's original engineering drawings. Large-format photographs of the bridge were made with a Cambo Legend 4"x5" view camera with perspective and vignetting correction.

C. Archives and Repositories Used

Minnesota State Historic Preservation Office, St. Paul, MN

Minnesota Department of Transportation Library, St. Paul, MN

University of Minnesota Library System, Minneapolis and St. Paul, MN

D. Research Staff

- 1. Primary Preparer: Daniel R. Pratt
- 2. Photographer: Daniel R. Pratt

MINNESOTA HISTORIC PROPERTY RECORD

Index to Photographs

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MN/DOT BRIDGE NO. 5723 Carrying State Highway 36 over Lexington Ave. Roseville Township Ramsey County Minnesota

Photographs by Daniel R. Pratt, November, 2005.

- RA-RVC-0026-1 SOUTH ELEVATION OF BRIDGE IN SETTING, LOOKING NORTH FROM LEXINGTON AVENUE MEDIAN.
- RA-RVC-0026-2 SOUTH ELEVATION OF BRIDGE IN SETTING, OBLIQUE VIEW, LOOKING NORTHEAST.
- RA-RVC-0026-3 NORTH ELEVATION OF BRIDGE IN SETTING, LOOKING SOUTH FROM LEXINGTON AVENUE MEDIAN.
- RA-RVC-0026-4 NORTH ELEVATION OF BRIDGE IN SETTING, OBLIQUE VIEW, LOOKING NORTHWEST.
- RA-RVC-0026-5 NORTH ELEVATION OF BRIDGE, LOOKING SOUTH FROM LEXINGTON AVENUE MEDIAN.
- RA-RVC-0026-6 SOUTH ELEVATION, NORTHWEST PIER, AND RAILING, OBLIQUE VIEW, LOOKING EAST-NORTHEAST.
- RA-RVC-0026-7 SOUTH ELEVATION OF NORTHWEST SIDEWALL, LOOKING NORTH.
- RA-RVC-0026-8 NORTH ELEVATION OF NORTHEAST PIER, LOOKING SOUTH.
- RA-RVC-0026-9 SOUTH ELEVATION OF NORTHWEST PIER, OBLIQUE VIEW LOOKING NORTHEAST.
- RA-RVC-0026-10 SOUTH ELEVATION OF NORTHEAST PIER AND NORTHEAST SIDEWALL, OBLIQUE VIEW, LOOKING NORTHWEST.
- RA-RVC-0026-11 DETAIL OF SOUTHWEST RAILING POST, OBLIQUE VIEW, LOOKING NORTHEAST.
- RA-RVC-0026-12 TRUNK HIGHWAY 36 ROADWAY/BRIDGE No. 5723 DECK, OBLIQUE VIEW, LOOKING NORTHWEST.

- RA-RVC-0026-13 DETAIL OF BRIDGE RAILING AT SOUTHEAST POST, LOOKING NORTH.
- RA-RVC-0026-14 WEST-FACING ELEVATION OF RETAINING WALL UNDER BRIDGE, LOOKING EAST.
- RA-RVC-0026-15 WEST-FACING ELEVATION OF RETAINING WALL UNDER BRIDGE, OBLIQUE VIEW, LOOKING SOUTHEAST.

MINNESOTA HISTORIC PROPERTY RECORD

Index to Measured Drawings

MN/DOT BRIDGE NO. 5723 Carrying State Highway 36 over Lexington Ave. Roseville Township Ramsey County Minnesota

Measured Drawings on File at the Mn/DOT Bridge Office, Oakdale, Minnesota.

- RA-RVC-0026-1 BRIDGE No. 5723: TITLE SHEET. BRIDGE No. 5723: GENERAL PLAN AND ELEVATION, 56 Ft. RIGID RA-RVC-0026-2 FRAME BRIDGES OVER LEXINGTON AVE. (SHEET 1). RA-RVC-0026-3 BRIDGE No. 5723: PILING PLAN AND DETAILS (SHEET 2). RA-RVC-0026-4 BRIDGE No. 5723: DETAILS OF FRAME AND WEARING SURFACE (SHEET 3). RA-RVC-0026-5 BRIDGE No. 5723: SECTIONS AND REINFORCEMENT OF FRAME (SHEET 4). (PORTIONS OF THIS SHEET ARE ILLEGIBLE.) RA-RVC-0026-6 BRIDGE No. 5723: SIDE WALL FRAMING PLAN (SHEET 5). RA-RVC-0026-7 BRIDGE No. 5723: SIDE WALL REINFORCING PLAN (SHEET 6). BRIDGE No. 5723: REINFORCING BAR DETAILS (SHEET 7). RA-RVC-0026-8 RA-RVC-0026-9 BRIDGE No. 5723: RAILING DETAILS (SHEET 8). RA-RVC-0026-10 BRIDGE No. 5723: DRAINAGE SYSTEM (SHEET 9). RA-RVC-0026-11 BRIDGE No. 5723: LIGHTING PLAN (SHEET 10). RA-RVC-0026-12 BRIDGE No. 5723: GRADING PLAN (SHEET 11).
- RA-RVC-0026-13 BRIDGE No. 5723: MODIFICATION OF BASE OF LEG OF FRAME (SHEET 12).
- RA-RVC-0026-14 BRIDGE No. 5723: CONSTRUCTION SKETCH SHOWING CUTTING OF REINFORCING BARS TO FACILITATE WORK AT BULKHEADS (SKETCH 4-A) (SHEET 13).

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