Minnesota Department of Transportation
Office Memorandum

District: **Metro**
Date: 6/24/2022
To: Douglas Carter, PE, LEED AP BD+C
From: Dmitry Tomasevich MnDOT, Jerad Daul SRF Consulting Group
Subject: **Design Memorandum with Design Exceptions**

State Project Number(s) & T.H./Interstate Number(s): SP 1308-29 TH 8
Federal Aid Project Number(s): NA
FHWA Contact: NA
County(s): Washington and Chisago **City(s):** Forest Lake and Chisago City
Type of Work: Trunk highway reconstruction, intersection improvements, bridge median rehabilitation, ramp reconstruction
Project Termini: Jct I-35 to TH8/Karmel Ave Intersection
Project Reference Point 000+00.000 **To Reference Point** 008+00.456
This project is scheduled for a December 2023 letting.

Scoping and Design Standards Form(s) Attached:
Performance Based Practical Design
Highway Design Standards Form
Ramp Design Standards Form

I recommend approval/concur with approval of the Design Exception(s) for the following bridge element(s) as documented in this Design Memo.

- *Structural Loading Capacity*

_____
State Bridge Engineer Date

The Design Exceptions described in this Design Memo are recommended for approval by:

6/24/2022
_____
Jerad Daul, PE. Date

The Design Exceptions described in this Design Memo are recommended for approval by:

_____
Dmitry Tomasevich, P.E. Date

I concur/approve:

_____
District Engineer Date

Design Exceptions approved by:

_____
State Design Engineer Date

PROJECT BACKGROUND

TH 8 is an east-west, principal arterial highway that connects the twin cities metropolitan area, through Chisago County, to northwest Wisconsin and beyond. TH 8 is a national highway system (NHS) route, and serves as a major east-west transportation corridor for local, regional, and interregional traffic, including commercial and recreational traffic. TH8 provides one of the few St. Croix River crossings with a bridge in Taylor Falls. TH 8 from I-35 to east of TH 61 is a four-lane roadway divided by a raised median. TH 8 from east of TH 61 to Karmel Avenue is a two-lane, rural section roadway. the purpose of the project is to improve pavement conditions, vehicle safety, and vehicle mobility on TH 8 between I-35 in the city of Forest Lake and Karmel Avenue in Chisago City. In addition, the purpose of the project is to improve walkability/bike ability along the TH 8 corridor in the project area.

PROJECT INFORMATION

Highway Type

(X) Two Lane Highway, Rural (X) Multi-lane Divided Highway, Rural (High Speed)
( ) Two Lane Highway, Urban (X) Multi-lane Divided Highway, Urban (High Speed
( ) Freeway, Rural ( ) Multi-lane Divided Highway, Urban (Low Speed)
( ) Freeway, Urban ( ) Multi-lane Undivided Highway, Urban (Low Speed)

Functional Class (X) Principal Arterial ( ) Minor Arterial ( ) Collector
Number of Lanes ( ) Two Lane ( ) Four Lane ( ) Six or eight lane
(X) Single-lane ramp ( ) Multi-lane ramp
Terrain: (X) Level ( ) Rolling ( ) Mountainous

Traffic Volume: Current ADT 14,500 – 22,700 veh./day
Based on: ( ) actual counts, (X) traffic flow map, dated 2017
Forecast ADT (2040) -19,500 – 29,500 - based on Traffic Forecast # NA.
(Not required for Preservation projects)

Access Control ( ) Full (X) Partial ( ) none
Design Speed 60 mph Posted Speed 55 mph

( ) Existing and Proposed Typical Sections are included in the appendix.
( ) Reduced layout is included in appendix.

BRIDGE PROJECT INFORMATION

(X) This is a Bridge Preservation project
( ) This is a Bridge Improvement project
( ) This is a Bridge Replacement project
( ) This is a ramp bridge with radius of 190-ft or less, or volume of trucks greater than 10%.

( ) Preliminary Bridge Plan is included in appendix

Railroad: ( ) Yes (X) No
If yes: ( ) Highway over RR ( ) Highway under RR

Bridge is over:
( ) Non-navigable waterway ( ) Navigable waterway (X) Trunk Highway ( ) Local road

Special lanes on bridge: ( ) Auxiliary lanes ( ) Exit or Entrance ramps extending onto bridge

Median curb present: (X) Yes ( ) No

(X) Bridge is less than 250-ft. long and with no single span greater than 200-ft.
(X) Bridge is greater than 250-ft. long or with a single span greater than 200-ft.

DESIGN STANDARDS
Based on the criteria in Design Standards and Exceptions for Controlling Design Criteria, this project will be designed to MnDOT's PBPD Standards.
[NOTE: Some projects may require more than one category of standards for different parts of the project].

PRESERVATION PROJECTS
Safety Considerations
During project scoping, safety was considered.

- No crash clusters or crash problems were identified; however, the following safety improvements will be completed (list below): Concrete Median Barrier

Controlling Criteria –New Construction/Reconstruction Standard

List of Design Exception(s):

I. Left Shoulder Width WB TH 8 – Bridge No. 82001, 82002

- Standard 4-feet
- Existing 4-feet
- Proposed 2-feet from WBTH8 Sta 513+14.00 to Sta 521+92.00; RP 000+00.990 to 001+00.080

Justification of Design Exception:

1. Alternatives considered – Shifting the lane lines 2-ft out to meet the inside shoulder minimum of 4-ft but it would require a design exception because the outside shoulder on the bridge would be narrower than roadway leading up and the proposed design were the two alternatives considered.
2. Cost comparison (proposed versus full standard) – No difference in cost between the two alternatives.
3. Comparison of safety performance
    - The NCHRP Report 783 did not state any crash modification factors associated with inside (left) shoulder width on multilane divided highways. The 5-year (2014-2018) crash data shows 12 total crashes along this 900-foot section of Highway 8. The calculated crash rate for this segment is between the expected crash rate and the critical crash rate.
4. Comparison of operational performance
    - The Highway Capacity Manual (HCM) has methodology to estimate level of service (LOS) for multi-lane highways. The total lateral clearance on this section of Highway 8 is 12 feet (2-foot left-side shoulder, 10-foot right-side shoulder). According to Exhibit 12-22 in the HCM, the adjustment factor for a total lateral clearance of 12 feet is 0 mph for multilane highways. This adjustment factor is applied to the free-flow speed which is used to determine the highway LOS. Based on the adjustment factor for a total lateral clearance of 12 feet, 2-foot inside shoulders are expected to have no impact on the operations of the roadway.
5. The Compatibility with adjacent sections of roadway – The proposed design is compatible with the adjacent sections of road. The median barrier is replacing deteriorating median with curb and gutter.

6. Any proposed mitigation measures (for proposed design) – No current proposed mitigation measures. Will investigate wider pavement markings or rumble strips to help keep traffic away from concrete barrier.
7. Any other pertinent impacts (for proposed design): None

II. Design Structural Loading Capacity for Bridge 82002

- Standard: 1.0
- Existing: 0.69
- Proposed: 0.75

Justification of Design Exceptions – Refer to Appendix A for the signed bridge Repair Design Standards Form for justification.

III. Stopping Sight Distance at a 2˚00' curve from station 507+24.3 to 534+43.5 (EBTH8) RP 001+00.080 to 001+00.350.

- Standard: 570-feet
- Existing: 570-feet +
- Proposed: 481.7-feet (50 mph design)

Justification of Design Exception:

1. Alternatives considered – Leaving design as is or the proposed design which is adding median barrier to prevent head on collisions in this narrow stretch of roadway were the two alternatives considered.
2. Cost comparison (proposed versus full standard) – The cost of Median Barrier is $88,150 more than concrete median.
3. Comparison of safety performance
    - Table 13-26 in the HSM provides a summary of treatments related to roadway alignment elements, and the availability for different roadway facility types. According to this table, there is no crash modification factor available for multi-lane highways regarding horizontal curvature. The 5-year (2014-2018) crash data shows 19 total crashes along this 2,700-foot section of Highway 8, one of which was a minor injury crash. The calculated crash rate for this segment is between the expected crash rate and the critical crash rate.
    - Section 13.5.2.4. in the HSM provides information pertaining to the installation of a median barrier on rural multi-lane highways. According to Table 13-23, the crash modification factor associated with the installation of a median barrier on a multi-lane highway is 0.57 for fatal crashes, 0.70 for injury crashes, and 1.24 for all crashes. The crash modification factors indicate an expected reduction in fatal and injury crashes with the installation of a median barrier, but an increase in overall crashes.

4. Comparison of operational performance
    - According to Chapter 12 in the HCM, drivers may become accustomed to certain types of obstructions, and their influence on traffic is often negligible. Median clearances of 2 ft or more on the left side of the travel lanes generally have little impact on traffic. According to Exhibit 12-23 in the HCM, the adjustment factor for an undivided multi-lane highway is 1.6 mph and the adjustment factor for a divided multi-lane highway is 0 mph. The adjustment factors indicate that this section of Highway 8 will have better operations with a median barrier present.
5. Compatibility with adjacent sections of roadway – The proposed design is compatible with the adjacent sections of road. The median barrier being installed is to eliminate crossover traffic and head on collisions.

6. Any proposed mitigation measures (for proposed design) – No current proposed mitigation measures. Will investigate wider pavement markings or rumble strips to help keep traffic away from concrete barrier.
7. Any other pertinent impacts (for proposed design): None

IV. Stopping Sight Distance at a 1˚30' curve from station 571+37.5 R3 to 595+46.4 R3 (WBTH8) RP 002+00.057 to 002+00.481

- Standard: 570-feet
- Existing: 570-feet +
- Proposed: 552.9-feet (55 mph design)

Justification of Design Exception:

1. Alternatives considered – Widening out roadway and shifting proposed median barrier to meet design standards and the proposed design were the two alternatives considered.
2. Cost comparison (proposed versus full standard) – The cost to widen the road would be around $750,000. We needed to keep a narrow footprint to allow frontage road in front of property. Any further widening would result in a buyout.
3. Comparison of safety performance
    - Table 13-26 in the HSM provides a summary of treatments related to roadway alignment elements, and the availability for different roadway facility types. According to this table, there is no crash modification factor available for multi-lane highways regarding horizontal curvature.
    - Section 13.5.2.4. in the HSM provides information pertaining to the installation of a median barrier on rural multi-lane highways. According to Table 13-23, the crash modification factor associated with the installation of a median barrier on a multi-lane highway is 0.57 for fatal crashes, 0.70 for injury crashes, and 1.24 for all crashes. The crash modification factors indicate an expected reduction in fatal and injury crashes with the installation of a median barrier, but an increase in overall crashes. The 5-year (2014-2018) crash data shows seven total crashes along this 2,110-foot section of Highway 8, one of which was a minor injury crash. The calculated crash rate for this segment is between the expected crash rate and the critical crash rate.
4. Comparison of operational performance
    - According to Chapter 12 in the HCM, drivers may become accustomed to certain types of obstructions, and their influence on traffic is often negligible. Median clearances of 2 ft or more on the left side of the travel lanes generally have little impact on traffic. According to Exhibit 12-23 in the HCM, the adjustment factor for an undivided multi-lane highway is 1.6 mph and the adjustment factor for a divided multi-lane highway is 0 mph. The adjustment factors indicate that this section of Highway 8 will have better operations with a median barrier present.
5. Compatibility with adjacent sections of roadway – The proposed design is compatible with the adjacent sections of road. The median barrier being installed is to eliminate crossover traffic and head on collisions.
6. Any proposed mitigation measures (for proposed design) – No current proposed mitigation measures.
7. Any other pertinent impacts (for proposed design): None

V. Stopping Sight Distance at a 1˚45' curve from station 685+55.3 to 713+19.0 (EBTH8) RP 004+00.311 to 004+00.651

- Standard: 570-feet
- Existing: 570-feet +
- Proposed: 522.0-feet (55 mph design)

Justification of Design Exception:

1. Alternatives considered – Widening out roadway and shifting proposed median barrier to meet design standards and the proposed design were the two alternatives considered.
2. Cost comparison (proposed versus full standard) – The cost to widen the road would be around $250,000. However, we needed to keep a narrow footprint to limit the impacts to Comfort Lake and Little Comfort Lake.
3. Comparison of safety performance
    - Table 13-26 in the HSM provides a summary of treatments related to roadway alignment elements, and the availability for different roadway facility types. According to this table, there is no crash modification factor available for multi-lane highways regarding horizontal curvature.
    - Section 13.5.2.4. in the HSM provides information pertaining to the installation of a median barrier on rural multi-lane highways. According to Table 13-23, the crash modification factor associated with the installation of a median barrier on a multi-lane highway is 0.57 for fatal crashes, 0.70 for injury crashes, and 1.24 for all crashes. The crash modification factors indicate an expected reduction in fatal and injury crashes with the installation of a median barrier, but an increase in overall crashes. The 5-year (2014-2018) crash data shows 42 total crashes along this 2,800-foot section of Highway 8. When removing crashes that are associated with the traffic control at the intersection of Highway 8 and Pioneer Road, there are 12 total crashes along this segment, two of which are minor injury crashes. The calculated crash rate for this segment is between the expected crash rate and the critical crash rate.

4. Comparison of operational performance
    - According to Chapter 12 in the HCM, drivers may become accustomed to certain types of obstructions, and their influence on traffic is often negligible. Median clearances of 2 ft or more on the left side of the travel lanes generally have little impact on traffic. According to Exhibit 12-23 in the HCM, the adjustment factor for an undivided multi-lane highway is 1.6 mph and the adjustment factor for a divided multi-lane highway is 0 mph. The adjustment factors indicate that this section of Highway 8 will have better operations with a median barrier present.
5. Compatibility with adjacent sections of roadway – The proposed design is compatible with the adjacent sections of road. The median barrier being installed is to eliminate crossover traffic and head on collisions.
6. Any proposed mitigation measures (for proposed design) – No current proposed mitigation measures.
7. Any other pertinent impacts (for proposed design): None

VI. Stopping Sight Distance at a 2˚00’ curve from Station 790+65.0 to 809+73.1 (EBTH8) RP 006+00.343 to 006+00.719

- Standard: 570-feet
- Existing: 570-feet +
- Proposed: 491.2’-feet (50 mph design)

Justification of Design Exception:

1. Alternatives considered – Widening out roadway and shifting proposed median barrier to meet design standards and the proposed design were the two alternatives considered.
2. Cost comparison (proposed versus full standard) – The cost to widen the road would be around $1,100,000. However, we needed to keep a narrow footprint to allow frontage road for adjacent houses. If we widen out the road anymore, we will need to buyout properties.
3. Comparison of safety performance

- Table 13-26 in the HSM provides a summary of treatments related to roadway alignment elements, and the availability for different roadway facility types. According to this table, there is no crash modification factor available for multi-lane highways regarding horizontal curvature.
- Section 13.5.2.4. in the HSM provides information pertaining to the installation of a median barrier on rural multi-lane highways. According to Table 13-23, the crash modification factor associated with the installation of a median barrier on a multi-lane highway is 0.57 for fatal crashes, 0.70 for injury crashes, and 1.24 for all crashes. The crash modification factors indicate an expected reduction in fatal and injury crashes with the installation of a median barrier, but an increase in overall crashes. The 5-year (2014-2018) crash data shows two total crashes on this 1,900-foot section of Highway 8. The calculated crash rate for this segment is less than the expected crash rate.

4. Comparison of operational performance
   - According to Chapter 12 in the HCM, drivers may become accustomed to certain types of obstructions, and their influence on traffic is often negligible. Median clearances of 2 ft or more on the left side of the travel lanes generally have little impact on traffic. According to Exhibit 12-23 in the HCM, the adjustment factor for an undivided multi-lane highway is 1.6 mph and the adjustment factor for a divided multi-lane highway is 0 mph. The adjustment factors indicate that this section of Highway 8 will have better operations with a median barrier present.
5. Compatibility with adjacent sections of roadway – The proposed design is compatible with the adjacent sections of road. The median barrier being installed is to eliminate crossover traffic and head on collisions.
6. Any proposed mitigation measures (for proposed design) – No current proposed mitigation measures.
7. Any other pertinent impacts (for proposed design): None

LAYOUT STATUS

( ) A geometric layout is not required for this project.
(X) A Level _1_ Geometric Layout (and profile) ( ) will be prepared for this project
(X) has been prepared for this project

The layout has received Mn/DOT:
(X) Staff review and concurrence ( ) Staff approval (approved __/__/__)

Municipal consent (layout approval) is required: YES _____ NO__X_____
If YES, Municipal consent has been obtained: YES_____ received on __/__/__
NO_____

INTERSTATE/STRAHNET SYSTEM

(X) This project does not involve work on the Interstate/STRAHNET system.

( ) This project involves work on the Interstate/STRAHNET system. At the completion of this project:

( ) All bridges will meet the 16-foot standard for vertical clearance over Interstate highways.

( ) All bridges over designated OSOW Super Load Corridors will meet the 16 feet 6 inch standard for vertical clearance.

( ) The vertical clearance of the bridge(s) **is less than 16 feet** and will remain unchanged. FHWA will be requested to coordinate with the Department of Defense/MTMCTEA at least three months before letting.

TRAFFIC HANDLING DURING CONSTRUCTION
During construction, we will try to utilize existing roadway while widening and new alignments are constructed. Bridge work will utilize lane closures remove median and replace with concrete barrier.

BICYCLE and PEDESTRIAN CONSIDERATIONS
(X) Bicycles are legally permitted on this roadway.
(X) Preliminary layouts have been provided to the CO Bicycle/Pedestrian Section for comment.
(X) Improvements to bicycle/pedestrian access are planned for this project.
( ) Existing access for bicycles or pedestrians will be eliminated by this project.

GEOMETRIC PERFORMANCE-BASED PRACTICAL DESIGN (PBPD) SCOPING & PROCESS FORM

PERFORMANCE-BASED PRACTICAL DESIGN PROCESS

Purpose and Need

The purpose of the project is to improve pavement conditions, vehicle safety, and vehicle mobility on Highway 8 between I-35 in the City of Forest Lake and Karmel Avenue in Chisago City. In addition, the purpose of the project is to improve walkability/bikeability along the Highway 8 corridor in the project area.

1. Pavement quality
2. Mobility
3. Walkability/bikeability

Opportunities

1. Variable centerline spacing to limit right-of-way impacts.

Risks

1. NA

Goals and Objectives

1. Improve pavement Life
2. Improve mobility

Safety Performance Outcomes Desired/Expectations

1. Reduce the number of crashes at non-signalized intersections
2. Extend the Swedish Immigrant Trail
3. Improve access Control

DESIGN PARAMETERS

Design year(s)

20 Year Forecast - 2040

Design/control vehicles

Design Vehicle: Passenger car, WB-62, SU-30, S-BUS-40, 2015 Tandem Plow Truck

Control Vehicle: Tractor Trailer, Mobile Home Transport (Roundabout thru movement)

Traffic operational measures and parameters

Quality of service: Improvement to capacity, delay, trip/travel

Design speeds

Existing Design Speed: 55 mph

Proposed Design Speed: 60 mph (I-35 to Sta. 901+00); 45 mph (Sta. 901+00 to Karmel Ave)

Major cross-sectional features

Median barrier is introduced along the corridor. There are 4 curves that do not meet the 570' minimum Stopping Sight Distance. These curves will require a design exception. See **List of design exceptions** on page 3-6 for these locations and Stopping Sight Distance design exceptions.

Overall widths – Curb to Curb 74 ft = 8'+12'+12'+4'+2'+4'+12'+12'+8'
Curb to Curb 109 ft = 14'+12'+14'+23'+14'+12'+12'+8'

Lane widths – 12' Thru, 12' RTL, 12' LTL

Shoulder widths:

Rural: 8-12ft paved, 10-16-ft usable right shoulder; 2-19.5 ft paved and usable left shoulder. (See design exception on page 3 for left shoulder width design exception.)

Urban: 8-14-ft paved right shoulder, 2-4-ft paved left shoulder.

Median width – 6'-33'

Bridge widths – 82' Wide, BR. NO. 82001 & 82002

Roadside geometry- 1:4 fill within clear zone

Conceptual alignment and profile

New EB and WB alignments and profiles. Existing TH 8 is a 2-lane section, but the new divided highway follows the existing alignment and profile.

Sight distances

Intersection RCI and Signalized Intersections use Case B2 – b = 573.3' for 60 mph Design Speed

Stopping: 570 ft for 60 mph. (See List of Design Exception section of page 3-6 for design exceptions.)

Passing if applicable 1000' for 60 mph Design Speed

Vertical clearances

NA

Interchange/Intersection Improvements

The side street stops were upgraded to Median U-turns, signalized intersections stayed signalized, and a roundabout is proposed at TH 8/Karmel Ave intersection. The TH 8 on/off ramps to TH 61 were also brought up to current design standards.

Horizontal curves and/or modifications

There is a 2˚00' curve from station 507+24.3 to 534+43.5 (EBTH8) that does not meet the 570' minimum Stopping Sight Distance. The Stopping Sight Distance is 481.7' which is a 50 mph SSD. This will require a design exception.

From station 574+37.5 R3 to 595+46.4 R3 (WBTH8) there is a 1˚30' curve that does not meet the 570' minimum Stopping Sight Distance. The Stopping Sight Distance is 552.9' which is a 55 mph SSD. This will require a design exception.

From station 685+55.3 to 713+19.0 (EBTH8) there is a 1˚45' curve that does not meet the 570' minimum Stopping Sight Distance. The Stopping Sight Distance is 522.0' which is a 55 mph SSD. This will require a design exception.

From station 790+65.0 to 809+73.1 (EBTH8) there is a 2˚00' curve that does not meet the 570' minimum Stopping Sight Distance. The Stopping Sight Distance is 491.2' which is a 50 mph SSD. This will require a design exception.

Vertical curves and/or modifications

Brought all vertical curves up to a minimum 60 mph design speed from I-35 to Sta. 901+00 and 45 mph minimum to the TH8/Karmel Ave roundabout.

Superelevations and/or modifications

Curves were flattened to reduce or maintain existing superelevation.

Turn lanes

Turn lanes are all at a minimum of 300’ at the intersections with a 500’ turn lane on EB TH 8 to Viking Blvd.

Innovative Design or Best Practice

Utilized Median U-Turns at the existing side street stop locations. We also utilized a roundabout at the intersection of TH 8/Karmel Ave.

Highway Design Standard Form

Critical Design Element	Existing Condition, Minimum	Proposed Condition, Minimum	MnDOT Standard for New Construction/ Reconstruction	Road Design Manual or LRFD Bridge Design Manual or Technical Memorandum
Design Speed	Design Speed selected for this project is 60 mph.			TM 17-13-TS-06
Lane Width	12 ft	12 ft	12 ft min. 12 ft max.	TM 18-08-TS-06
Shoulder Width: Rural • Right • Left Urban • Right • Left	 7-10 ft paved 7-15 ft usable 2-ft curb reaction 10-ft paved 2-ft curb reaction	 8-12 ft paved 10-16-ft usable *2-19.5 ft paved 2-19.5 ft usable 8-14-ft paved 2-4 ft	 8-ft paved 9.5- ft usable 4 ft paved 5.5 ft usable 8-ft paved Curb reaction	TM 17-12-TS-05
Design Loading Structural Capacity	1.0	*Less than 0.9 deadload	All new bridges: HL-93 Minimum design load	(Scroll to Page 3.4)
# Stopping Sight Distance	495 ft	* 481.7 ft	570 ft min.	Tables 2-5.08A & B (Chapter 2, Page 37)
Horizontal Curve, Radius	2290 ft	2865 ft	1200 ft min.	RDM Chapter 3-2
Maximum Grade Rural Urban	 2.75% 4 % maximum	 2.75% 4 % maximum	 3% maximum 5% maximum	Table 3-4.02A (Chapter 3, Page 3-4(2))
Cross Slope	0.02 ft/ft	0.02 ft/ft	0.015 – 0.020 ft/ft	RDM Chapter 4-3
Superelevation	____0.04_ ft/ft	0.048 ft/ft	0.08 ft/ft maximum	RDM Chapter 3-3
Vertical Clearance • Highway under bridge • Railroad under bridge • Highway under sign or pedestrian bridge	 NA ft NA ft NA ft	 NA ft NA ft NA ft	 __ ft-_ in __ ft-_ in 17 ft-4 in	(Page 11)

 # Stopping sight distance applies to horizontal and vertical alignments **except for sag vertical curves**.

*** An asterisk in front of the proposed condition indicates a Design Exception.**

Ramp Design Standard Form

Ramp Locations **Ramp Types**

Highway	Reference Point	Station	Intersecting Road	Ramp Alignment Name	Diagonal	Loop	Semi-Direct	Direct
TH 8		531+00	TH 61	SE Ramp				X
TH 8		529+19	TH 61	NE Ramp	X			

Design Parameters:
Drainage Type: (X) Urban (curb and gutter) (X) Rural (ditches)

Mainline Design Speed (Tech Memo 17-13-TS-06)**:** The Design Speed selected for the parent roadway is 60 mph.
(This speed will be used to look up the value for Ramp Design Speed)

Ramp Traffic Control: ( ) Metered ( ) Metered with HOV Bypass (X) Traffic Signal at ramp terminal
(X) none

Critical Design Elements	Do all ramps of each type meet MnDOT Standards for New Construction / Reconstruction? (Yes or No)		MnDOT Standard for New Construction / Reconstruction		MnDOT Road Design Manual or MnDOT LRFD Bridge Design Manual or Technical Memorandum
	Ramp Direct	**Ramp Diagonal**	**Ramp Direct**	**Ramp Diagonal**	
Ramp Design Speed	Yes	Yes	_45_ mph minimum	45 mph minimum	Table 6-3.04A (Scroll to page 48)
Ramp Pavement Width (Single Lane)	Yes	Yes	16 ft min.	16 ft min.	Table 6-3.04C (Scroll to page 50)
Ramp Acceleration Length[1]	Yes	NA	Length(s) meet(s) or exceeds required length(s).	Length(s) meet(s) or exceeds required length(s).	Tables 6-2.04B & C (Scroll to page 36)
Deceleration Length[2]	NA	Yes			Tables 6-2.03A & B (Scroll to page 27)

Critical Design Elements	Do all ramps of each type meet MnDOT Standards for New Construction / Reconstruction? (Yes or No)		MnDOT Standard for New Construction / Reconstruction		MnDOT Road Design Manual or MnDOT LRFD Bridge Design Manual or Technical Memorandum
	Ramp Direct	**Ramp Diagonal**	**Ramp Direct**	**Ramp Diagonal**	
Stopping Sight Distance [3]	Yes	Yes	425 ft min.	360 ft min.	Tables 2-5.08A & B (Scroll to page 37)
Horizontal Curve Radius	Yes	Yes	600 ft min.	600 ft min.	RDM Section 6-3.04.01
Maximum Grade	Yes	Yes	5% maximum	5% maximum	Table 6-3.04B (Scroll to page 49)
Cross Slope	Yes	Yes	0.015 – 0.020 ft/ft	0.015 - 0.020 ft/ft	TM 18-03-TS-02
Superelevation	Yes	Yes	0.08 maximum	0.08 maximum	TM 17-11-TS-04
Design Loading Structural Capacity	NA	NA	All new bridges to have HL-93 minimum design load	All new bridges to have HL-93 minimum design load	LRFD Bridge Design Manual, Section 3.4
Vertical Clearance Highway under bridge Railroad under bridge Highway under sign or pedestrian bridge	NA	NA	__ ft-__ in __ ft-__ in 17 ft-4 in	__ ft-__ in __ ft-__ in 17 ft-4 in	(Page 11)

[1] Measure **Ramp Acceleration Length** from the entrance terminal to the ramp terminal to the point where the taper reduces the ramp width to 12-feet. If a speed limiting horizontal curve is present, acceleration length is measured from the end of the limiting curve to the point where the taper reduces the ramp width to 12-feet.

[2] Measure **Ramp Deceleration Length** from the point where the taper increases the ramp width to 12-feet to the point of initial curvature of the exit ramp (i.e. the beginning of the ramp exit curve).

[3] **Stopping sight distance** applies to horizontal and vertical alignments, not including for sag vertical curves.

Appendix A