Technical Memorandum

To: **Electronic Distribution Recipients**

From: **Mark A. Gieseke, P.E.** Digital signature on file
Assistant Commissioner, Engineering Services

Subject: Under-Bridge Typical Section

Expiration

This memorandum supersedes TM 20-03-TS-01 and will remain in effect until November 1, 2026 unless superseded or published in the MnDOT Facility Design Guide prior to that date.

Implementation

The design guidance contained in this Technical Memorandum is effective immediately and is applicable to all MnDOT projects that include new bridge construction. Incorporate this guidance into existing projects to the extent practical.

Introduction

Based on the results of the work completed by the Transportation Finance Advisory Committee, MnDOT recognizes the need to optimize value as a system-wide approach in order to ensure the long-term financial sustainability of its assets. The Performance Based Practical Design (PBPD) Policy was created to institutionalize an evidence and performance-based approach to maximize the impact of limited resources without undue risk to the traveling public.

Considering the expected long service life and considerable capital investment for new bridges, performance-based design decisions are one of the critical elements in improving the design process to achieve balanced functionality of the system while realizing financial benefits. A thoughtful balance is necessary to achieve the appropriate design. Sufficient multimodal capacity and/or expandability consistent with the lifespan of the structure must be considered, while being mindful of the large cost impacts associated with decisions on design criteria such as lateral clearance.

Purpose

The purpose of this Technical Memorandum is to document design considerations and provide guidance outlining the approach MnDOT expects from its designers as it relates to the under-bridge typical section. The Office of Project Management and Technical Support and the Bridge Office will coordinate with the designers on this approach, but ultimately the District Office will make the final decisions regarding these considerations.

Historic Background

MnDOT's general design practice since the 1970s has been to provide clear zone up to a practical maximum of 30-ft under new bridges. Recognizing that it was impractical to provide the recommended design value for clear zone, a "practical maximum" dimension of 30-ft was established as an improvement in roadside safety over earlier practices. This methodology had the added benefit of encompassing the needs for walking and biking infrastructure, construction staging, inspection, maintenance, and future expansion. Many examples of these decisions are present within the system today.

MnDOT's system also includes many examples of structures that do not meet the current design practice of locating substructure elements outside of the practical maximum lateral clearance.

Current practice is to utilize side piers only when other options are not feasible. MnDOT's system includes many examples of side piers or abutments located at or within the practical maximum lateral clearance. Some are shielded and some are not.

AASHTO guidance does not indicate that paved cut slopes up to 1V:1.5H represent a hazard warranting shielding within the clear zone.

50+ years of crash history is available through the Office of Traffic Engineering and indicates that under-bridge designs not meeting the current preferred practice have not represented a disproportionate crash problem.

Changed Way of Thinking

The current design practice of providing the 30-ft practical maximum lateral clearance under bridges can limit the flexibility to reduce lateral clearance and the associated bridge cost, where appropriate. Reducing the flexibility to vary the lateral clearance may result in fewer system-wide safety improvements being addressed. In addition, the practical maximum lateral clearance under bridges may not meet clear zone requirements in all situations.

Based on MnDOT's crash history, and information from other states, MnDOT does not consider paved cut slopes up to 1V:1.5H to be hazards necessitating shielding within the clear zone. MnDOT considers paved cut slopes up to 1V:1.5H within the roadway clear zone to be an acceptable risk that do not require shielding.

The distance from the travelled way to the toe of the cut slope will be determined based on the approaching shoulder width, necessary snow storage width, and sidewalk or side path width, if present. Additional width to the paved cut slope may be provided based on future needs, constructability issues, and maintenance and operational needs. For the instances where paved cut slopes may need to be steeper than 1V:2H consult with the Bridge Office and the District Bridge Maintenance Unit to determine if these slopes are acceptable and/or present challenges.

Identifying and managing roadside hazards within project limits is the responsibility of the District Project Manager, District Traffic Engineer, or Engineer of Record. These elements may require shielding, subject to risk analysis and engineering judgment.

In some cases the superstructure may be considered a hazard, when the clear zone extends into the paved slope; this could lead to an errant vehicle impacting the underside of the bridge superstructure. If the minimum

shoulder and snow storage area is provided, MnDOT believes vehicles will be redirected by the paved slope with the risk of a superstructure strike at an acceptable level.

Selection of Under-Bridge Typical Section

MnDOT designers are directed to take a PBPD approach to under-bridge typical section to make the best use of available financial resources. The process for determining an appropriate section is outlined below:

1. Begin by defining a roadway typical section consistent with current multimodal guidance. If a designer has questions they can contact the Geometric Design Support Unit, the Bridge Office, or the Office of Transit and Active Transportation (OTAT). Cross section element widths under the bridge shall meet the approaching roadway widths to maintain a consistent corridor.

2. Project Managers should consult with maintenance staff to verify appropriate widths. Provide space for snow storage and maintenance operations typically ranging from 6 to 16-feet. Snow storage is generally based on the width of adjacent pavement being cleared but, there may be instances where additional or less width is needed for maintenance operations.

    a. 6-ft of snow storage is often sufficient for pavement width's up to 22-ft and should be considered the minimum width in constrained areas.

    b. 10-ft of snow storage is sufficient for adjacent pavement widths up to 44-ft.

    c. Snow storage widths up to 16-ft for wider roadways.

3. Take snow storage into account in the placement and width of multimodal facilities, as these facilities should not be used for snow storage.

4. Due to the long service life of bridges, consider realistic future expansion of the corridor and how it would be accommodated.

5. For locations with high traffic volumes and without reasonable alternative routes, consider the cost vs. benefit of providing additional space for construction staging.

6. For instances on divided multilane facilities where a bridge center pier crash strut encroaches into the inside shoulder width, resulting in the shoulder width under the bridge to be less than the standard for that corridor/facility, a formal design exception may not be required. Coordinate with the Bridge Office for methods to reduce the encroachment to the maximum extent possible and coordinate with the Geometric Design Support Unit for approval on the amount of encroachment prior to proceeding.

    a. This allowance is based on Standard Plan 5-297.754 and 5-297.681 for sign bridge foundations. Provided the overall encroachment of the center pier crash strut and the leading and following taper rates of the center pier crash strut do not exceed the encroachment and taper rates identified in the above-referenced Standard Plan, a detailed justification will not be required. The sign bridge foundation leading taper rates and intrusion "shape" are MASH tested. It is recommended to limit this intrusion to the best of the designer's abilities.

The Office of Project Management and Technical Support and the Bridge Office will work with the designers and the District on this approach. Ultimately the District Office will make the final decision on the under-bridge typical section.

The under-bridge typical section identified in the process above, along with the roadway typical section to be carried on the proposed bridge, is to serve as the basis of bridge design. Bridge Scoping and Preliminary Design will identify the most efficient and cost-effective structure for the given site. The determined bridge information will initiate the Form A Bridge Scoping Cost Estimate process. Bridge Office staff will utilize the information and develop bridge cost estimates for scoping that reflect these decisions.

Questions

Any questions regarding the technical provisions of this Technical Memorandum can be addressed to either of the following:

> **Nathan Blanchard, P.E.,** Assistant Preliminary Bridge Plans Engineer, Office of Bridge, **(651) 366-4462**
>
> **Douglas Carter, P.E., LEED AP BD+C,** State Geometrics Engineer, Office of Project Management and Technical Support **(651) 366-4623**

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards Unit, DesignStandards.DOT@state.mn.us. A link to all active and historical Technical Memoranda can be found at http://techmemos.dot.state.mn.us/techmemo.aspx.

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