



MMDOT

Michigan Department of Transportation



Bridge Design Manual

BRIDGE DESIGN MANUAL

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CHAPTER 1 • INTRODUCTION

1.00 INTRODUCTION

The Bridge Design Manual addresses the procedures involved in preparing plans of bridges and other major structures on the interstate/freeway, arterial, collector and local road system governed by the Michigan Department of Transportation (MDOT). Incorporation of or connectivity to other modes of transportation (pedestrian, bicycle, multi-use paths, etc.) must be considered.

In this manual a bridge is defined by the National Bridge Inspection Standards Federal Code of Regulations (23 CFR 650) as a structure that spans over a waterway, highway, or railway with an opening measured along the center of roadway of more than 20'. Structures that span distances under 20' are considered culverts.

In compiling these procedures, an effort was made to include all information related to plan preparation. The major portion of the manual is devoted to design criteria and the presentation of plan information. But other chapters deal with the routines of processing the work, the source material supporting design considerations, and the involvement of other agencies affected by the project. In general, the Bridge Design Manual is intended to be a single source reference for the MDOT Design Engineers and consultants assigned the responsibility of producing bridge plans. It is assumed that this manual is to be used in conjunction with the MDOT Road Design Manual. The Road Design Manual contains relative/pertinent information and procedures for both road designers and bridge designers. In general, the Bridge Design Manual is intended to be a reference for the MDOT Design Engineers and consultants assigned the responsibility of producing bridge plans of the requirements specific to structure design beyond those detailed in the Road Design Manual.

Much of the information presented originates from the Bridge Squad Leaders' Notes, for many years the reference manual for the MDOT Bridge Engineer. These notes were updated and rearranged to comprise several chapters of the volume. This was expanded with input from other MDOT divisions and outside agencies, the policies of which influence the design and geometry of bridges. Some contributions resulted from experience in fabricating, constructing, and maintaining bridges.

The design of highway bridges in Michigan is based on the ***Standard Specifications for Highway Bridges*** and ***LRFD Bridge Design Specifications*** published by the American Association of State Highway and Transportation Officials (AASHTO). Repetition of any of these specifications would be unnecessary and was avoided in preparing this manual. In some cases, however, the AASHTO specifications are vague or leave a decision to the judgment of the Engineer.

LRFD Guide Specifications for the Design of Pedestrian Bridges and ***Guide for the Development of Bicycle Facilities*** will aid in the design of other modes of transportation.

Guidelines in the Bridge Design Manual are provided as clarification and thus supplement the provisions of AASHTO. Some minimum requirements in the AASHTO specifications have been found through experience to be insufficient. In these instances, the Design Manual supersedes AASHTO with more rigorous controls.

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Procedures and guidelines continually change. The material in the Bridge Design Manual is continually updated and every attempt is made to keep the Manual as current as possible. When the need for an addition or change arises, the Manual is updated on a monthly basis. These updates will describe the revision, explain the reason, serve as a commentary, and assign the date of its implementation. (12-16-2019)

It is expected that many of the changes will be additions prompted by comments from those using the Manual. While considerable effort was made to compile all information that should be required to prepare plans, some points no doubt have been overlooked. For this reason, any questions or suggestions regarding the text of the Bridge Design Manual should be sent to the MDOT Standards Unit at MDOT-Bridge-Design-Standards@michigan.gov.

Many different resources are available for designing and detailing of bridges, structures, and all modes of transportation. Those include plan sheet examples, drafting details and practices and various types of specifications. A summary and link location to these is described in the subsequent sections.

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1.01 MDOT DEVELOPMENT GUIDE

The MDOT Development Guide is currently available only on the State of Michigan (SOM) SharePoint Site which is open to all SOM Employees. However, external access for design engineers that are not SOM Employees but are responsible for producing road or bridge plans in Michigan is available. Consultants should contact MDOT Engineering Support at MDOT-EngineeringSupportTraining@michigan.gov for instructions on how to create and maintain a SOM M365 guest account to receive access.

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1.02 PLAN SHEET EXAMPLES

Plan sheet examples can be found at [Guidelines for Bridge Plan Preparation \(MDOT Sample Plans Bridge\)](#). The document presents samples of detail sheets that can be used as guides in preparing plans of highway bridges. The samples were selected and tailored to provide as much reference data as possible on a limited number of sheets. Each of the detail sheets of a typical set of plans is represented. At the same time, detailing procedures for a variety of bridge types are illustrated. Commentary is provided for more clarity and background on guidelines and detailing procedures. Also included are abbreviations, symbols and naming conventions for files.

In general, adherence to these guides is recommended. Many of them result from past construction experience, and while other methods of presenting structural details may be equally effective, it is possible that they would create problems. The format shown is preferred if for no other reason than the familiarity that the state contractors have developed following it on previous jobs. On rare occasions, the guides may not be appropriate, but before electing to deviate, drafting personnel should be sure there is ample justification.

Additional information and Archived Bridge Sample Plans are available online from the [MDOT Development Guide](#).

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1.03 DRAFTING DETAILS AND PRACTICES

Drafting details and practices, cell libraries and other miscellaneous files can be found on the [MDOT Development Guide](#) and [MDOT Design Services Website](#).

Various details have been standardized and appear on specific sheets. See [Guidelines For Bridge Plan Preparation](#) (MDOT Sample Plans Bridge) and the [Bridge Support Resources](#) section of the [MDOT Development Guide](#) for various details, practices and sample plan sheets. It also contains drafting degrees of accuracy, abbreviations and symbols used on plans.

For naming convention of files see [Base File Name Conventions](#) of the MDOT Development Guide (CAD Standards).

Structure designations and additional bridge/structure information is available in the [Michigan Structure Inventory and Appraisal Coding Guide](#).

Checking all detail drawings must be done to ensure the accuracy of the plans. The drawings shall comply with the design calculations, existing design guides, and the practices listed in [Guidelines For Bridge Plan Preparation](#).

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1.04 SPECIFICATIONS

Specifications are to accompany the plans as part of the contract documents. They establish how the work is to be done, the materials and equipment that are to be used, and the method of measurement and payment for the work. It is the Design Engineer's responsibility to see that all relevant specifications are included in the contract.

Three types of specifications exist, all accomplishing the purposes stated above. These are [Standard Specifications for Construction](#), [Supplemental Specifications](#), and special provisions (including [The Frequently Used Special Provisions](#)).

For more detailed information on specifications including Special Provisions, supplemental specifications and proprietary items see [Chapter 11](#) of the Road Design Manual.

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CHAPTER 2

STEPS IN PRODUCING PLANS

2.00

STEPS IN PRODUCING PLANS

This chapter briefly outlines the steps that are followed in producing plans for building and rehabilitating bridges and other structures on the trunkline system. Subsequent chapters will expand on this overview.

2.01

SOURCES OF ASSIGNMENT

No work can be started until it has been approved for programming by the Chief Engineer/Deputy Director Bureau of Highway Technical Services and programmed by the Bridge Systems Manager. Programming is based on available funding as appropriated by the Federal and State Transportation legislation.

2.01.01

"Improve and Expand" Projects

Engineering Reports for new work and major relocations are produced by the Project Development Section of the Design Division or Region/TSC Development personnel and serve as sources of assignments for the structure work required in the plan preparation of the Bridge Design Section.

2.01.02

Rehabilitation Programs

MDOT Regions and Bridge Systems Manager prepare an annual program of work to be performed. The program is based on needs observed in the field and the availability of funds to correct conditions as needed. (11-19-99)

2.01.03

Traffic and Safety Programs

The Division of Operations Safety Programs Section prepares an annual program of work to be performed. Funding for Safety Programs is usually based on separate categories of funding.

2.01.04

Turnback Projects

When the State relinquishes jurisdiction of a highway to a local authority, the State usually agrees to perform certain work on that highway prior to relinquishment. Such work is known as a "Turnback Project" and will be defined in an agreement with the local jurisdiction known as the "Turnback Agreement". For additional information regarding "Turnback Projects" see [Chapter 12](#) of the Road Design Manual.

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2.01.05

Region/TSC Requests

The Region/TSC Engineer in consultation with the Region Bridge Engineer may request work to be performed on projects in the Region/TSC based on citizens' requests or based on field observations by Region/TSC personnel.

2.01.06

Privately-Owned Facilities

Occasionally MDOT will agree to perform work on privately-owned facilities at the request and expense of private parties. Such work must not be undertaken without a written agreement between the private parties and MDOT.

2.01.07

Bridges to Remain In Place

Bridges to remain in place criteria occurs when a bridge carrying road project traffic falls within a road project and no work is planned for the bridge (see AASHTO publication, ***A Policy on Design Standards - Interstate System*** or ***A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition***). If the bridge does not meet the criteria to “remain in place” the Road Designer or Road Project Manager must submit any necessary design exceptions or design variances for the bridge.

(10-22-2012) (3-21-2016) (8-22-2016)

(2-21-2017) (12-17-2018)

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2.02

DATA SOURCES

Prior to preparation of Contract plans, the Design Engineer will request data from various sources to assist in the development of a set of contract drawings. Sources to be used are listed in the following paragraphs.

2.02.01

Engineering Reports

If an Engineering Report has been prepared and published by MDOT, it will provide the Design Engineer with general information regarding the location of the project and the proposed horizontal and vertical alignment. It may also include miscellaneous design constraints such as traffic control, architectural treatment, Michigan Department of Environment, Great Lakes and Energy (MDEGLE) permit and mitigation consideration, etc. It is essential that the design parameters established in the Engineering Report be closely followed in the preparation of the plans.
(10-22-2012) (6-24-2019)

2.02.02

Environmental Impact Statement, Environmental Assessment or Categorical Exclusion

All three documents will provide the Engineer with valuable information regarding the project. For definitions see Section [14.12](#) and [14.13](#). If an Environmental Impact Statement has been issued, the restrictions listed in the document must be closely observed during preparation of the plans. Engineers should work with their Environmental Coordinator(s) early on to determine what impact category each job will be classified as, and how to proceed.
(11-19-99). (12-17-2018)

2.02.03

Asbestos Survey Data

A full structure asbestos survey is required to be on file for all elements of a bridge that are to undergo construction. This includes removal operations such as saw-cutting and chipping. The Design Engineer must check if there is an existing survey on file for the structure in MiBRIDGE at the start of a project. If there is not an existing survey on file, the Bridge Design Unit must submit a request as early as possible with the Environmental Services Section. For information on submitting a request for a survey see Section [14.13.05](#).
(11-24-2025)

2.02.04

Road Design

Road Design Plans will provide proposed alignments and grades in detail, and will provide cross-sections of the approaches.

2.02.05

Survey Data

The Design Engineer must determine whether sufficient survey data has been provided from other sources. If not, additional survey data such as a pickup survey must be requested from the Survey Section.

Normally, surveys should be ordered for all major reconstruction jobs, such as bridge widening. On stream or river crossings, survey requests should be combined/coordinated with those from the Hydraulics/Hydrology Unit to avoid duplication of effort by the Surveys Section. The Survey/Mapping Action Request, ([Form 0226](#)), is available from MDOT web site.
(8-20-2009) (10-22-2012) (5-28-2013)

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2.02.06

Geotechnical Data

The Design Engineer must request data from MDOT Geotechnical Services Section to determine soil conditions and nominal bearing resistance to be used in the design of the foundations. They will also indicate whether piles are required, and if so, the type, section, estimated length and minimum penetration and determine the effect of scour on the stability of the structure. For additional information, refer to Section [3.01](#). (3-26-2018)

For rehabilitation projects that may result in load increases on foundations, the Design Engineer must perform a foundation analysis and consult with the Geotechnical Services Section. A copy of the analysis will be kept in the project design folder. (11-19-99)
(10-22-2012)

2.02.07

Hydraulic and Scour Data

The Design Engineer must request hydraulic analyses from the Hydraulics/Hydrology Unit to determine required waterway openings, scour countermeasures, and backwater calculations for proposed stream crossings. In most cases, two waterway analyses will be required by the FHWA. To accomplish this in time, the Hydraulics/Hydrology Unit must be involved as early as possible. The Bridge Unit should request data from them immediately after the project is assigned.

The Hydraulics/Hydrology Unit will conduct a scour analysis and provide estimated total scour depths at the foundation for waterway crossings. This information will be forwarded to the Geotechnical Services Section.
(11-19-99)

2.02.08

Railroad Data

The Design Engineer must request information regarding frequency and speed of railroad movements, and information regarding clearances and loadings. Such requests must be submitted to the Railroad Coordination Unit – Office of Rail. See [Chapter 13](#), Railroad Crossings, for additional details. (10-22-2012)

2.02.09

Aesthetic Recommendations

Consideration should be given to providing motorists with an unobstructed view of surrounding scenery. Toward this end the Roadside Development Unit should be consulted to determine whether an open railing is appropriate for a structure spanning a river.

2.02.10

Utility Data

The Design Engineer must coordinate with corresponding Region/TSC Utility/Permit Engineer to determine whether there are utilities at the site of the structure and whether they will be affected by the proposed construction. The designer must also determine whether existing utilities may represent a safety hazard to the construction forces and work with corresponding Region/TSC Utility/Permit Engineer to arrange any necessary temporary or permanent relocations. (12-17-2018)

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2.02.11

Permits (11-19-99)

The Design Engineer, along with Environmental Services Section, must determine which permits and notice of coverages will be required for the proposed work and initiate actions to obtain those permits. See [Chapter 14](#), Permit Applications, for additional information. (12-17-2018)

Application for MDEGLE permits should include detailed plans of any proposed haul route necessary to access the project site. See Section [2.02.15](#) for additional information. (10-22-2012) (6-24-2019)

2.02.12

Screening Requests and Ornamental Fencing

When work is performed on structures in the Metro Region, the Region Project Development or Bridge Engineer must be contacted, to see if pedestrian screening should be added to the proposed work. In other areas of the state the Region Bridge Engineer should be contacted to determine if pedestrian screening should be added. (9-2-2003)

Requests to add ornamental fencing to structures is determined during the project planning process or at project scoping. Refer to the ornamental fencing guidelines in Section [7.05.06](#). Region Bridge Engineers and Bridge Design Project Managers may be involved in this process. (3-28-2022)

2.02.13

Maintenance Reports

Before starting work on an existing structure, the Design Engineer should review the Maintenance Report/Bridge Scoping Report. An in-depth inspection should be requested if the extent of repairs on specific bridge elements is unknown or may change the scope of programmed work. (11-19-99)

2.02.14

Traffic and Safety Data & Road Safety Audit

The Division of Operations Safety Programs Section or Region Traffic & Safety personnel will provide traffic counts, crash history, and posted speeds when this information is relevant to Design decisions and requested by the Design Engineer. (10-22-2012)

The Project Manager (Project Owner) will request ([Form #3767](#)) that a Road Safety Audit (RSA) be conducted on project types that fall under the Warranting Conditions of the [Road Safety Audit \(RSA\) Guidance document](#). This request will follow the process outlined in the guidance. RSAs should be conducted during the scoping process but are highly recommended to be scheduled prior to the Scope Verification meeting. (2-21-2017)

2.02.15

Preliminary Constructability Review

Constructability is taken into account during the scoping and early plan development process (and in conjunction with the Checklist for Constructability Review - Early Project Scoping ([Form 1961](#))). After the Job Concept Statement has been created in JobNet, the Project Manager/Concept Author should consult with the Region/TSC Delivery Engineer, the Region Bridge Engineer and Design Engineer/Cost and Scheduling Engineer concerning items such as Coordinating with other Agencies, Permits, Staging, Maintaining Traffic, Site Investigation, and Right of Way. Much of the work under this task should occur before the Scope Verification Meeting. On small projects this task may consist of only the transmittal of base plans to the Resident/Delivery Engineer for comment. On large projects with complex staging, one or more meetings with the Resident/Delivery Engineer, the Region/TSC Traffic and Safety Engineer, the Region Bridge Engineer and Design Engineer/Cost and Scheduling Engineer may be required throughout this task. In both instances the review and incorporation of any comments must occur prior to Preliminary Plan Development. Place completed and signed checklist in the Design project file and ProjectWise. (10-22-2012) (12-17-2018)

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2.02.16

Scope Verification Meeting (11-19-99)

Design Engineers should verify the scope of work that has been programmed accommodates all legal users of the bridge, structure, etc. If the scope is unacceptable, the Design Engineer will request a scope verification meeting that includes the Region/TSC Project Development Engineer/Cost and Scheduling Engineer, Resident/Delivery Engineer, Bureau of Bridges and Structures (BOBS) Bridge Construction Engineer, and the Region Bridge Engineer. (12-17-2018) (12-16-2019)

Where a bridge will cross a waterway or wetland, the Region/TSC Construction Engineer should also be consulted to determine a practical means of accessing the project site during construction. If a haul route is required, the details will be included on the plans and in MDOT's request for a MDEGLE permit. (10-22-2012) (6-24-2019)

After the "Scope Verification Meeting" the Design Project Manager will address any changes to the scope in a correspondence/letter to the involved attendees, including the Region Bridge Engineer. Once changes are agreed upon by all parties the Region Bridge Engineer or Design Project Manager will submit a Change Request in JobNet to reflect project changes. (8-20-2009)-(12-17-2018)

2.02.16 (continued)

After project scope has been agreed upon, the Project Manager should identify any Design Exceptions / Variances to MDOT standards that will be utilized in the design of the project. Exceptions / Variances to MDOT design standards should be identified, and, ideally, completed during the scoping process. However, if this has not been done, a Design Exception (DE) or Design Variance (DV) form should be completed. The Project Manager should consult with the Geometrics Unit of the Design Division when identifying and developing justification for design exceptions / variances. Previously completed Design Exceptions / Variances should also be reviewed for accuracy and revised at this time if needed. (8-20-2009)(10-22-2012)(2-21-2017)

For additional information see Sections [12.00-12.03](#) as well as [Chapter 3](#) of the Road Design Manual. See [Road Design Manual Section 14.11](#) for design exception / variance submittal procedures. (2-21-2017)

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2.02.17

The Plan Review Meeting (11-19-99) (12-17-2018)

During The Plan Review Meeting or field review of plans, Region/TSC engineers will again be consulted. Construction staging information should be reviewed by Region/TSC Field or Construction Engineer. The observations, discussions, and recommendations resulting from the meeting must be documented by a letter in the files. Generally, these letters are written by the Plans & Field Review Section representative who participated. However, if a Design Engineer arranges The Plan Review Meeting without someone from the Plans & Field Review Section, the Design Engineer will write the letter, addressing it to the Engineer of Design Operations - Structures Section.

At the time of The Plan Review Meeting, it is essential that Region/TSC personnel have had the opportunity to consider the nature and scope of work proposed by the Design Unit. Under ideal circumstances this is accomplished by distributing plans to provide 20 working days before the date of The Plan Review Meeting. Frequently, however, letting schedule changes leave insufficient time to "follow the book," and unit leaders must resort to alternatives.

1. If the plans are in a near-complete stage, that is, they clearly show all the proposed work, but they have not been reviewed for normal distribution, they can be transmitted as "advanced copies" to the Region/TSC with the notice of The Plan Review Meeting.
2. If plan preparation has not reached this stage, the unit should outline the proposed work with 8½" x 11" sketches. These then would accompany the notice of The Plan Review Meeting.

Project Managers should make an effort to combine The Plan Review Meetings for neighboring projects that have similar letting dates.

2.02.18

Region/TSC Maintaining Traffic Recommendations

During The Plan Review Meeting or by separate request, the Region/TSC Traffic Engineer should be asked for recommendations for controlling traffic during construction. The designer will provide current details of approaches within 1500' of bridge reference lines to the Traffic Engineer to facilitate the preparation of maintaining traffic details, quantities, special provisions, etc. (3-20-92)

2.02.19 (10-22-2012) (12-17-2018)

Final Constructability Review (Preconstruction Process Documentation (PPD) Task Description #3860)

Once the revisions from The Plan Review Meeting have been incorporated into the plans, Final Plans begin. After the final maintaining traffic special provision has been received, and staging typicals and/or plan sheets have been completed, this information plus any unique special provisions should be sent to the Resident/Delivery Engineer for review. Discussions concerning a Construction Critical Path Network, if applicable, should also occur at this stage. In conjunction with the Checklist for Constructability Review Project Development Phase ([Form 1960](#)), the work in this task must be addressed prior to the distribution of the final plan/proposal package for the OEC Meeting. Place completed and signed checklist in the Design project file and ProjectWise.

The final constructability review applies to all projects. On small projects this task may consist of only the transmittal of plans to the Resident or Delivery Engineer for comment. On large projects with complex staging, one or more meetings with the Resident/Delivery Engineer, the Region/TSC Traffic and Safety Engineer, Cost and Scheduling Engineer, and the Region Bridge Engineer may be required throughout this task. For projects in templates that do not require an OEC Meeting, the Final Constructability Review must be completed prior to Plan Completion.

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2.02.20 (12-17-2018)

Final Project Coordination Meeting

The review of final plans and proposal and project coordination is completed through Final Project Coordination (FPC) meeting. The comments and information gathered at this meeting are used to complete the project and bring plans to 100% final stages in preparation for the Omissions/Errors Check (OEC). For more information regarding the FPC see Section [3.03](#).

2.02.21 (12-17-2018)

Omissions / Errors Check (OEC)

The sign off for 100% completed final plans and proposal is done through an Omissions / Errors Check (OEC) Review. For more information regarding OEC sign off see Section [3.04](#). (11-19-99)

2.02.22 (12-17-2018)

Rehabilitation Project Scoping (11-19-99)

Project Scoping Documents will be provided for all bridge rehabilitation projects and submitted to the Bridge Systems Manager. The document package will contain different items depending on if the scoping work is done by consultants or MDOT.

A. Scoping by MDOT

Provide the following when scoping work is done by MDOT:

1. Program Revision Request
(within JobNet)
(5-28-2013) (3-26-2018)
2. Project Concept Statement
(from JobNet) (3-26-2018)
3. Bridge Cost Estimating Worksheet

For worksheet and key see Bridge Management and Scoping [website](#), under the "Project Estimating" menu. (2-22-2022)

4. Latest Bridge Inspection Report
5. Project Photos

Provide additional information if available, such as:

6. Detailed Inspection Report
7. Underclearance waiver information
8. Diver Inspection Report
9. Load Posting Form
10. Delamination Survey (10-22-2012)
11. Other pertinent information which will assist in the design

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2.02.22 (continued)

B. Scoping by Consultant

In addition to the above, provide the following when scoping work is done by consultant:

1. Field Inspection Findings, describing all site issues
2. Recommended repair alternative
3. At least three rehabilitation options with cost estimates
4. Life Cycle Cost Analysis

For worksheet see Bridge Management and Scoping [website](#), under the "Project Estimating" menu. (2-22-2022)

The proponent Region has the responsibility for entering the project in JobNet (internal information system) and for submitting the Project Scoping Document Package to the Bridge Systems Manager. The project must also have the approval of the Regional Systems Manager/Associate Region Engineer of Development. (3-26-2018) (12-17-2018)

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2.03

PLAN PREPARATION STEPS

Preparation of Plans for structures follows three steps. The first step is the development of a Study. The second step is the preparation of Preliminary Plans, and the third step is the development of Final Plans and accompanying specifications. A detailed discussion of each of these steps is covered in [Chapters 3 and 4](#) of this volume.

2.03.01

FHWA Oversight / MDOT Oversight (12-5-2005) (7-23-2018)

Section 2.03.01 is currently under review to adopt revised oversight definitions and procedures. Oversight responsibility for individual project elements is determined exclusively for each project and mutually agreed on by MDOT and FHWA. Any questions regarding the status of projects should be directed to the appropriate FHWA Area Engineer

2.03.02

Study

The study establishes the general design features such as the type of structure, cross-section, waterway opening (size), span arrangement, and alignment. For waterway crossings, hydraulic and scour analyses to determine the size of opening and the impact of scour on the design of the foundation must be part of the study. Studies of federally financed projects for new bridge construction and major rehabilitation must be approved by the FHWA before proceeding with preliminary plan preparation. Normally, the structure proposed should be the most cost effective of those considered based on a life cycle cost analysis. Studies are normally not required for rehabilitation projects. For additional information see section [3.01](#) and [4.01](#). (11-19-99) (12-28-2020)

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2.03.03

Preliminary Plans

Once the study is approved, preliminary plans and preliminary estimate of cost are prepared by the Design Unit for approval by the FHWA and other concerned agencies.

2.03.04

Final Plans

Work on final plans can begin after the FHWA has approved the preliminary plans and the project has been environmentally classified. The final plans consist of all the details necessary to build the structure, the quantities of the materials required for construction, and the specifications that must be included in the Bid Proposal.

2.03.05 (12-17-2018)

Changes During Plan Preparation

Before requesting changes in programming, the Project Manager should contact all persons, sections, Regions/TSCs or support areas having an interest in the project in order to include as many changes as possible in a single request. (9-1-88)

For bridge construction, rehabilitation, or preventative maintenance projects, a JobNet Change Request should be submitted to the Bridge System Manager for approval. Change Request may be submitted to request program revisions involving project costs, work revisions, work types, and scheduled dates. Program additions, deletions, project splits or consolidations (cost redistributions), and finance revisions must be requested and documented along with the Change Request submittal. All data and documentation supporting the requested change(s) should accompany any request submitted and can be attached in JobNet. A clear and concise justification (reason), which includes language indicating that the request was discussed and agreed with by the Region, must be submitted with all electronic Change Request submissions. (11-19-99)

2.03.05 (continued)

Where it appears that a change in work scope may affect a project's environmental clearance, the Environmental Services Section should be notified as soon as possible. Notification should include copies of any correspondence, memos or forms that will help describe the project revisions. (8-6-92)

Project designs and plans should not be changed prior to receiving the approval of the Program Administration Division and the Change Request pertaining to the modifications.

2.03.06

Changes after Plan Completion

If policy or specification changes occur after the details have been completed, such changes must be discussed with the Chief Structure Design Engineer to determine if they will be retroactive. Addenda to a contract should be avoided where they do not significantly affect the bidding. Where they are required, an effort should be made to consolidate several items in one addendum with bridge and road unit leaders coordinating their submittals. The deadline for addenda is 10 days preceding the date of the letting. Projects not meeting the 10 day limit, but needing an addenda, should be discussed with Design Engineer-Specifications and Estimates. (2-23-2026)

2.03.07 (2-22-2021)

Authority for Bridge Closures

The responsibility/authority to close bridges is shared by many individuals. After initial assessment, closure actions may be initiated by:

- The Engineer/Construction Administrator
- The Design Engineer of Record (EOR)
- The Contractor's Safety Supervisor, or Site Superintendent
- The Bridge Owner

Concerns or questions related to bridge closures should be directed to one of these individuals. Additional information can be found at MDOT's [Construction Manual](#) website, [Division 7 – Structures](#).

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.04

PLAN PRODUCTION PROCEDURE

It is the responsibility of the Project Manager and Design Engineer to produce sets of plans in a timely fashion and to be informed of the status of plans for a project at all times.

2.04.01

Unit Assignment

The Chief Structure Design Engineer will assign a project to a Design Unit and the Unit's Design Engineer will assign the project to an Engineer for plan preparation. The Engineer will gather information and data, perform necessary calculations, and run bridge program (internal only). (2-23-2026)

2.04.02

Plan Distribution

The plans are distributed for review to all interested agencies and parties according to the distribution schedules listed in [Chapter 3](#) of this Manual. The Design Engineer will forward the Final Plans to the Specifications & Estimates and Plans & Field Review Section for preparation of the cost estimate and the contract documents. Final contract documents are advertised for bids by the Contracts Section.

2.04.03

Estimating Man-Hours (12-17-2018)

For estimating man-hour requirements of future projects, the average values of recently similar projects will generally serve as a guide, as well as the budgeted dates generated in the Planisware system. If unusual features are anticipated, the man-hour estimate will be adjusted accordingly. (11-19-99)

In estimating the unit's man-hour capabilities, the effects of temporary absences should be anticipated. This accounts for intermittent personnel absences for alternate assignments, training, vacations, holidays, etc. Temporary training assignments for new hires may also be a consideration.

2.04.04

Project History

Unit Design Engineers should keep an accurate and thorough history record of each project. These records are necessary to explain design costs and letting delays. Among items documented should be the changes in scheduling, whether or not the unit leader is aware of the reasons.

2.04.05

Project Contact Person

Prior to Letting, all Contractor requests for information concerning the project should be directed to the engineer who has been designated in the proposal as the project contact person, generally the Project Manager/Cost and Scheduling Engineer. (11-19-99)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

2.05

BRIDGE DESIGN QUALITY ASSURANCE & QUALITY CONTROL (5-23-2016)

2.05.01

Overview

- A. To ensure bridges are designed correctly, with no errors once the design calculations, drawings, and specifications are finalized, MDOT requires QA/QC procedures in accordance with this section.
- B. The MDOT Bridge Design QA/QC program consists of organizational procedures established to ensure a deliberate and systematic program that reduces the risk of introducing errors and omissions into bridge design final contract documents. The MDOT QA/QC program provides checks and balances within the organization to assure quality in final contract plans and specifications. The MDOT QA/QC program is implemented at different levels or phases of project activity, as defined in the MDOT Bridge Design Manual, the [MDOT Road Design Manual](#), and the [MDOT Quality Assurance and Quality Control Process Guide for Project Managers](#) and as included in this section.
- C. The rigor and level of resources allocated to QA/QC applications on a given bridge are tempered by the size, complexity, and degree of redundancy in the structural system involved, and by the degree of standardization of the design. For major projects involving unusual, complex, and innovative features, a peer review may be desirable to raise the level of confidence in the quality of design and construction.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.02

Definitions

A. Quality Control (QC).

Procedures followed within a unit or working group to check the accuracy of the calculations, drawings, and specifications for the purpose of detecting and correcting design omissions and errors to accomplish the overarching goal of producing complete and error free final plans and specifications. QC occurs continuously throughout the course of a project.

B. Quality Assurance (QA).

Review procedures followed by staff outside the unit or working group to ensure the QC procedures were effective in preventing mistakes and promoting consistency in the development of bridge design calculations, drawings, and specifications.

C. Program Level Quality Assurance (PLQA).

Review procedures followed by management to assure the effectiveness of QC and QA procedures in verifying and measuring the level of quality of the entire bridge design QA/QC program.

D. Peer Review.

A review by a separate unit or consultant not intimately involved with the design of the structure. Determination of the need for a peer review is made by the Chief Structure Design Engineer, with guidance provided by the MDOT Bridges and Structure Committee. (2-23-2026)

E. Designer.

An individual directly responsible for the development of design calculations, drawings, specifications, and review of shop drawings related to a specific bridge design.

2.05.02

F. Checker.

An individual responsible for performing technical review of design calculations, drawings, and specifications.

G. Reviewer.

An individual responsible for performing QA procedures that ensure that QC procedures were performed properly.

H. Engineer of Record (EOR).

An individual responsible for all aspects of the design of the structure, including the design of all of the bridge's systems and components. This individual is appointed by the bridge owner, and must be a licensed Professional Engineer in the State of Michigan. For MDOT in-house projects, the bridge squad leader is the EOR, and signs, but does not seal the final contract plans. For consultant-designed projects, the EOR is the consultant Project Manager, and is required to seal and sign his/her portion of the final contract plans.

I. Peer Review Engineer

An individual who is a licensed Professional Engineer in the State of Michigan and has recent experience as either a Designer or Checker (as defined in this section of the MDOT Bridge Design Manual) with elements similar to those that will be included in the peer review. While it's preferred that the experience be on projects in Michigan, having Michigan experience is not required. (2-23-2026)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.03

Implementing and Documenting Procedures

A. Qualification of the Designer, Checker, and Reviewer.

The Designers, Checkers, and Reviewers are key personnel providing well-designed, accurate, and constructible plans for use in the construction of bridges. The Designers, Checkers, and Reviewers must be experienced in structural designs and familiar with the current AASHTO bridge design and construction specifications and the MDOT Bridge Design Manual, [Bridge Design Guides](#), and procedures.

1. Designer and Checker.

The following are the requirements for a bridge Designer and Checker.

- a. Possess a professional engineer (PE) license in Michigan with experience as a Bridge Engineer. A Designer or Checker without a PE license works under the direct supervision of a professional engineer licensed in Michigan who is the Reviewer and Engineer of Record for the project.
- b. Non-engineer staff are often utilized to design and check CADD drawings, develop quantity calculations and perform other non-structural design functions during the course of a project. As noted above, all work is done under the direct supervision of a professional engineer licensed in Michigan who is the Reviewer and Engineer of Record for the project.
- c. The Designers' and Checkers' experience is commensurate with the complexity of the bridge being designed. Whenever possible, the experience of the Checker exceeds the experience of the Designer.

2.05.03 A. (continued)

2. Reviewer.

The Reviewer possesses a professional engineer (PE) license in Michigan, and has significant experience in bridge design and is familiar with MDOT's bridge design and construction practices, procedures, and policies.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.03

Implementing and Documenting Procedures (continued)

B. Minimum Items/Areas Required to Be Checked.

Design calculations, design drawings, and contract documents are required to be verified by a Checker with a thorough and comprehensive understanding of the project and design methods. In particular, the following minimum items/areas must be checked:

1. Design Computations and Checks.

All structural components, including deck, superstructure, and substructure components. The assumptions of the bridge design including general conditions and loadings are documented. Computations needed to determine type, size, and location of the bridge are checked including grade and quantity calculations.

2.05.03 B. (continued)

2. Bridge Contract Drawings Checks.

All components (as described above) of bridge design drawings are checked in detail. Plan notes are checked, including verification of correct materials specified. Plan notes must not alter the work, materials, or method of payment for standard pay items. All quantities and pay items are verified to be in conformance with plan details, and pay item wording checked against [MDOT Standard Specifications for Construction](#) or associated special provisions. In cases where the Designer is not the drawing Checker, the Designer at least reviews the drawings to ensure that they are in conformance with the design. After any required changes are made, names or initials are placed on the drawings indicating the individual who prepared the drawing, the individual who modified the drawing (as needed), and the Designer. The plans include the name of the unit or work area responsible for the plans. Consultant plans include their company logo.

3. Bridge Design Contract Document Checks.

All special provisions are reviewed for appropriateness with respect to the contract plans and pay items and MDOT Standard Specifications for Construction. All permits, certifications, clauses and other supporting information are reviewed to ensure they are complete and correspond with the plans and remainder of contract package and that there are no conflicts between any documents.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.03

Implementing and Documenting Procedures (continued)

C. QC Procedures.

1. A supervisor or team leader is responsible for determining the necessary technical knowledge and experience of the Designer and Checker for that specific design. Designers and Checkers are assigned to bridge projects by matching experience and performance to project complexity.
2. The Checker is responsible to the supervisor for quality control of the design, which includes checking the design calculations, plans, and specifications to assure accuracy and constructability. One hundred percent of all design calculations, quantity calculations, plans, and specifications are checked as part of the QC process.
3. All bridge plan sheets include the names or initials of the person who drafted the details along with the Checker of the sheet and the date last revisions were made to that plan sheet. See [Guidelines For Bridge Plan Preparation](#) (MDOT Sample Plans Bridge) of Development Guide ([Design Submittal Requirements Chapter 7](#)) for guidelines related to drafting and plan preparation.

2.05.03 C. (continued)

4. All special provisions include the author's initials and work area identifier, and are subject to a well-defined review process facilitated by MDOT's Quality Assurance Section that includes various subject matter experts.
 - a. Unique special provisions authored specifically for a project are drafted by the Designer or support area and submitted for review and approval during the course of the project.
 - b. Previously approved special provisions can be used as long as approved in the current Standard Specifications for Construction edition year, and are reviewed by the Designer to assure that the entire content is appropriate for a project. (12-17-2018)
 - c. Frequently used special provisions are utilized on projects as noted in specific use statements and are incorporated into the project without any changes.
5. Software programs such as MDOT's Bridge Design System, MDX, or Leap Bridge, various finite element modeling programs, among others, are often too complex for a Designer and Checker to review and confirm directly. The Designer and Checker must fully understand the methodology, assumptions, and limitations of each program prior to utilizing output on a project. This can be accomplished through review of all available program documentation and independent verification with hand calculations, spreadsheets or other known and proven software.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.03

Implementing and Documenting Procedures (continued)

6. All design calculations include name or initials of the Designer and Checker along with the date designed and checked.
 - a. Hand calculations have a “prepared by”, and “checked by” notation for each page of the calculations.
 - b. Spreadsheets, MathCad calculations, and computer programs have a “prepared by” and “checked by” notation on the user input and results pages. These sheets are generated specifically for a project, or are utilized from a previous project, sometimes generated by others. The Checker is responsible for reviewing the data input, and the Designer and Checker must have a full understanding of the methodology, assumptions, and limitations of the program or spreadsheet and be able to verify that they are appropriate for the design.
7. All calculations are checked vs. the Final Package Submittal for the project.
 - a. All dimensions, member sizes, bar sizes from design calculations are verified to match plan dimensions.
 - b. Reinforcing steel takeoffs are performed and verified for consistency between detail drawings and Steel Reinforcement Detail sheets.
 - c. A final cost estimate (project verification estimate) is printed, and the wording for each pay item is verified for consistency between the cost estimate, plan drawings and (if applicable) special provisions.

2.05.03 C. (continued)

8. Calculations.

At the completion of the project, provide a set of design calculations for all elements of the bid package for the design file. All calculations include completed “prepared by” and “checked by” fields. Consultants provide calculations sealed/stamped and signed by the Engineer of Record for the project, who is licensed in Michigan. Design calculations are stored within the project file in ProjectWise and hard copies (if applicable) are stored in the MDOT Design Unit in accordance with the MDOT plan retention policy.

9. The design file includes (but is not limited to) the following.

- a. Design calculations.
- b. Check calculations (e.g. to verify computer output, if applicable).
- c. Supporting reports (e.g. geotechnical recommendations).
- d. Cost estimates including quantity calculations and supporting documentation
- e. Review comments/resolutions.
- f. Documentation substantiating the completion of Quality Control and Quality Assurance procedures in accordance with this document and other accepted standards.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.03

Implementing and Documenting Procedures (continued)

D. QA procedures.

1. The [MDOT Quality Assurance and Quality Control Process Guide for Project Managers](#) provides a deliberate and systematic process for plan development and quality assurance. These processes are further defined in other sections of the MDOT Bridge Design Manual and the [MDOT Road Design Manual](#).
2. The MDOT Design Division Quality Assurance Section performs QA during The Plan Review, Final Project Coordination (FPC), Plan Completion (Omissions and Errors Check) and Final Package Submittal stages of each project. The Quality Assurance Section reviews all project contract documents, facilitates department wide review, and documents all review comments in accordance with section 14 of the [MDOT Road Design Manual](#). (12-17-2018)
3. In accordance with National Bridge Inspection Standard requirements, a load rating is performed for each bridge rehabilitation and bridge replacement/new construction project. For bridge rehabilitation projects, a preliminary load rating is typically performed at The Plan Review stage, and finalized at the Plan Completion stage. For new or reconstructed bridges, load rating is typically performed at Plan Completion stage. Load rating calculations serve as a QA of structural design of the beams for projects, and feedback is provided to the Designer if deficiencies are discovered.
4. MDOT's Bridge Field Services (BFS) section performs QA at the Plan Completion (Omissions and Errors Check) stage of each project. BFS maintains a plan review checklist

2.05.03 D. (continued)

comprised of focus areas for plan reviews based on past experience with construction issues. BFS focuses specifically on constructability and structural fabrication aspects of bridge projects and provides feedback to the designer for incorporation into the final project package.

5. QA is performed by the project supervisor or team leader at various times during the project and at The Plan Review, Final Project Coordination, Plan Completion, and Final Package submittal stages. While QC is performed on one hundred percent of project documents, the level of QA performed by the supervisor or team leader is subject to the supervisor's discretion based on a combination of factors such as experience of the Designer and Checker, complexity of the project, uniqueness of project parameters and details. (12-17-2018)
6. PLQA is performed by the Chief Structure Design Engineer to ensure that the bridge design units, consultant coordinators, and consultant design teams are performing adequate QA/QC in accordance to this document. This involves periodic review of a representative sample of bridge design units and consultant coordinator projects at selected project milestones. The Chief Structure Design Engineer may assign peer reviews to promote consistency and uniformity between MDOT working units and between MDOT in-house and consultant designers. Performance measures will be developed and used to track progress in key areas. (2-23-2026)
7. If the QA review shows evidence that the proper QA/QC process is not being properly followed, a more rigorous review of the QA/QC process documentation is performed, and recommendations are provided.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.03

Implementing and Documenting Procedures (continued)

E. In-House Design Quality Control/Quality Assurance.

All bridges designed by MDOT are reviewed in compliance with this document and the referenced manuals and procedures. Each work unit documents a process for implementing the procedures to assure consistency within the Bridge Design Section.

F. Design Consultant Quality Control/Quality Assurance.

1. Every consultant performing bridge design for MDOT is required to have its own QA/QC process in place. As part of the prequalification application, each consultant must submit a Quality Control Plan in accordance with the [MDOT Consultant Prequalification Instructions](#). The QA/QC program document is available to the MDOT consultant coordinator to review as necessary throughout the course of a project.
2. Project proposals define the QA/QC program and responsibilities specific to a project. In general, each prime consultant and sub consultant follows their own documented QA/QC procedures on file with their prequalification. Additionally, the prime consultant for a project is responsible for project level QA of sub consultant's deliverables to assure uniformity within the project and to assure that sub consultant's procedures are being followed. Documentation of QA/QC procedures for a specific project will be furnished to MDOT at any point during a project upon request.

2.05.03 D. (continued)

3. At the completion of a project, the consultant furnishes the completed design package, including all design calculations, quantity calculations, and documentation of completed QA/QC along with a letter certifying completion of QA/QC.
4. Consultant design contracts have clauses protecting MDOT from design errors and omissions by requiring that the consultant's work meet "sound, prudent, appropriate, and required professional standards and practices," and that the consultant will promptly revise work that does not meet MDOT criteria, at no additional cost to MDOT.
5. The Consultant Coordinator or Project Manager assures that the documented QA and QC program is followed by the consultant in accordance with this document and the project QA/QC program by performing cursory checks of submittals and contract documents throughout the course of the project and requiring changes as appropriate. Additionally, consultant coordinators will verify reasonableness of the design based on knowledge of design standards and engineering judgement.
6. At the completion of each project, consultants are rated via performance evaluations. Past performance is a part of the scoring criteria for proposals for all Quality Based Selections. Consultants are also scored based on the experience of their QA/QC review team and the quality of their QA/QC plan as detailed in a project proposal.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.03

Implementing and Documenting Procedures (continued)

G. Corrective Actions.

QA/QC procedures are implemented on all projects. Through the PLQA, the overall program is continually monitored for effectiveness. When level of QC or QA is found to be insufficient, corrective actions are required.

1. The following actions are taken if QA or PLQA reviews indicate that a specific design unit, consultant, or consultant coordinator is not following the process.
 - a. The representative sample of projects for that unit or coordinator is increased until the Chief Structure Design Engineer is satisfied that the issue is corrected. (2-23-2026)
 - b. Concerns with consultant's performance are noted on consultant's review at the completion of the project.
 - c. Concerns with MDOT staff member's performance are reflected in the staff member's annual performance review or interim performance review, depending on severity.
2. If, during the review of project submittals, it is evident that the consultant team has not followed QA/QC practices, payment for hours associated with QA of a project as negotiated prior to the start of a project can be withheld.

2.05.04

Peer Reviews

Determine the need for a peer review based on the following factors:

- The Department's level of expertise relevant to the elements included in the design of the project.
- The use of new or innovative design or construction methodologies.
- The assessed risk on the project due to:

1. The redundancy of the structure.
2. The feature intersected by the structure, with features like navigable waterways, environmentally sensitive areas, and multi-level interchanges typically increasing the risk to the project.
3. The complexity of the required design details.
4. The existing geotechnical conditions.
5. The existing hydraulic conditions and the construction sequence required to permit the project.
6. The construction sequence.
7. The construction schedule.
8. The operational importance of the structure.

Other factors may also be used to assess the need for a peer review on a project. Consider a peer review of projects where the scope of work leads to increased risk to the Department. Consider factors such as:

- Work on bridges that are part of an international border crossing.
- Work on bridges with non-redundant steel tension members (NSTM).
- Work on bridges that are unique structure types or fall outside of the current design standards. This may include, but is not limited to:
 1. Bridges designed as a frame;
 2. Post-tensioned concrete box girders;
 3. Arches (excluding buried culverts);
 4. Suspension or cable stay spans.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.04 (continued)

- Work on bridges with movable spans.
- Accelerated Bridge Construction techniques including, but not limited to:
 1. Superstructure slide
 2. Self-propelled modular transporters (SPMTs)
- Girder launching to construct the superstructure.
- Straddle bent piers.

Potential scope of work items for a peer review includes, but is not limited to the following:

- Reviewing all relevant design calculations prepared by the EOR. Review the design calculations after all required QC checks have been completed by the EOR.
- If required on a project, review the Structure Study after all required QC and QA checks have been completed and before submittal to the Chief Structure Design Engineer.
- Review the plans at the Plan Review milestone to verify that the details reflect the calculations developed for the project, account for the existing conditions at the site, and reflect the agreed to construction sequence.
- Review the plans at the Final Plan Coordination (FPC) milestone to verify that the details reflect the calculations developed for the project, that the plans are complete and account for the existing conditions at the site, and reflect the agreed to construction sequence.

The Peer Review Engineer selected to complete the peer review must be independent from the in-house Bridge Design Unit or the Consultant serving as the EOR for the project.

2.05.04 (continued)

For in-house designed projects, it is desired to determine if a peer review is warranted on a project as part of the Scope Verification phase of the project. A peer review can be initiated after the Scope Verification is completed if a factor warranting a peer review is identified during a later phase of the project. The Chief Structure Design Engineer in consultation with the EOR for the project is responsible for evaluating the project and for making a recommendation if a peer review is warranted based on these guidelines. The Peer Review Engineer may be another in-house design unit or a Consultant meeting the minimum requirements specified in Section 2.05.02.I. (2-23-2026)

For Consultant designed projects, determine if a peer review is warranted prior to developing the Consultant Request for Proposal (RFP) documents. The Chief Structure Design Engineer in consultation with the Consultant Coordinator for the project is responsible for evaluating the project and for making a recommendation if a peer review is warranted based on these guidelines. The Consultant RFP documents must state that a peer review will be implemented on the project. The Peer Review Engineer must be another Consultant meeting the minimum requirements specified in Section 2.05.02.I. Select the Consultant Peer Review Engineer using a separate requisition and Contract. The Consultant Peer Review Engineer shall not be a subconsultant to the Consultant EOR. (2-23-2026)

A peer review does not relieve the EOR of ensuring that both Quality Control and Quality Assurance reviews are completed in compliance with Section 2.05 of the Bridge Design Manual. The EOR is still responsible for the completeness and accuracy of the work performed under their supervision.

The Peer Review Engineer is expected to participate as part of the project team from the beginning of the project, so they have the same understanding of the project scope of work, project goals and constraints, and project risks as the EOR.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

2.05.05

Role of Federal Highway Administration (FHWA)

A. Initial Review and Approval of Program.

The general role of FHWA Division Office is to review each State Highway Agency (SHA) QA/QC Program and to ensure the QA/QC program is thorough, effective, documented, and followed. Further, it is the role of the FHWA Office of Bridge Technology to assure uniformity within division offices regarding implementation of this guidance.

B. Periodic Program Reviews.

FHWA division offices may perform periodic reviews of the MDOT's programs. Upon request, MDOT will provide project documents to the FHWA division office for review, in accordance with the Federal-Aid Stewardship Agreement. The need of periodic reviews depends on the complexity of the bridge projects.

2.05.06

References and Other Sources of Information (11-24-2025)

A. MDOT Bridge Design Manual

The procedures involved in preparing bridge plans, quality control and quality assurance are interlaced within Chapters 1 – 5. (11-24-2025)

B. [MDOT Road Design Manual](#)

Specifications and Special Provisions guidance are addressed in Chapter 11. (12-17-2018)

Procedures for plan preparation are addressed in Chapter 14.

2.05.06 (continued)

C. [Preconstruction Process Documentation \(PPD\) Task Manual](#) (5-22-2023)

Documents the preconstruction process as it pertains to project development. Networks based on the PPD Tasks are used to plan and to track virtually every aspect of a project design schedule.

D. [Guidelines For Bridge Plan Preparation](#) (MDOT Sample Plans Bridge)

Bridge sample plans including plan sheet examples of typical plan set detailing preferred details and drafting procedures.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 3

PLAN COMPOSITION - NEW AND RECONSTRUCTION PROJECTS

3.00 GENERAL (8-20-2009)

3.01 STUDY (8-20-99)

3.01.01 [Composition](#) (8-20-99)

3.01.02 [Cost Estimate](#) (8-20-99)

3.02 PRELIMINARY PLANS

3.02.01 [Composition](#) (8-20-99)

3.02.02 [Preliminary Estimate](#) (8-20-99)

3.02.03 (Section Deleted) (12-17-2018)

3.02.04 [Reviews](#) (8-20-99)

3.02.05 [Act 51 Participation](#) (7-28-2025)

3.03 FINAL PROJECT COORDINATION (FPC) (12-17-2018)

3.03.01 [Composition](#) (8-20-99) (12-17-2018)

3.04 PLAN COMPLETION (OEC AND CERTIFICATION ACCEPTANCE) (12-17-2018)

3.04.01 [Plan Composition](#) (12-17-2018)

3.04.02 [Reference Information Documents](#) (1/17/2017) (12-17-2018)

3.05 PROGRAMMED COST ESTIMATES (8-20-99) (12-17-2018)

[Appendix 3.02.04 A. Sample Utility Coordination Letter](#) (8-20-99)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

CHAPTER 3

PLAN COMPOSITION - NEW & RECONSTRUCTION PROJECTS

3.00

GENERAL (12-17-2018)

New Construction and Reconstruction (4R) is defined as a new bridge, a bridge replacement, a superstructure replacement, a deck replacement or widening of at least one lane width (including a lane used for maintaining traffic or retained for use as a future lane). See also [Chapter 3](#) of Road Design Manual.

If a project includes 3R (See [Chapter 12](#)) and 4R work (See [Chapter 7](#)) the applicable standards are governed by the standards that correspond individually to each work type (3R or 4R). Work type overlap within a structure may cause a default to 4R standards within the overlap (entire structure). Identify each work type on the project information sheet to distinguish where 3R guidelines and 4R standards are separately applied.

When other work types are combined with 3R or 4R projects, they are also governed separately and identified as such on the project information sheet.

Projects categorized as CPM (capital preventive maintenance) projects are governed by guidelines that differ from 3R and 4R Guidelines. When CPM work types are packaged with a 3R or 4R project, the portion of the project that is outside the 3R or 4R work limits is governed by the guidelines that pertain to CPM work type. When describing the work type in the request for Plan Review Meeting, identify the work type separation so that the appropriate requirements are considered within each structure. Work type overlap within a structure may cause a default to 3R or 4R requirements.

Cross road over bridges shall be treated as individual segments regardless of project work type. (8-20-2009) (2-27-2012) (8-22-2016)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.01

STUDY (12-17-2018)

The first plan of a structure is a feasibility study showing the basic design concept and the topography in the immediate structure area. This study is prepared on a reproduction of the General Plan of Site Sheet.

The study is submitted by the Unit Leader to the Chief Structure Design Engineer for approval. FHWA Oversight projects that are federally financed must also be reviewed by the FHWA. For definition/clarification of oversight see [Chapter 2](#). These approvals must be obtained before Preliminary Plans can be started. The study, as approved, then becomes a permanent record and is to be kept by the Unit until the construction of the bridge is completed. (8-6-92)

A study must be completed for all new construction and reconstruction projects. Generally, structure studies are not required for deck replacements on slab and beam bridges unless the deck replacement involves widening requiring more than one beam line, the vertical alignment or horizontal alignment changes significantly, or the project has other unique characteristics that would benefit from the structure study process. Structure studies should be completed for deck replacements on complex bridges. (12-28-2020)

A study must be completed for all projects involving a culvert with a clear span between 10' and 20' that is constructed using staged construction. Construction of these ancillary structures using staged construction present unique challenges that must be considered, and a feasibility study showing the basic design concept for the selected culvert type is the first step in mitigating these challenges. Specific items that should be discussed include, but are not limited to, water diversion, ground water effects, and unique details required to connect the culvert sections at the stage line. (3-27-2023)

For rehabilitation, e.g., railing replacement and/or deck overlay projects see [Chapter 4](#).

3.01 (continued)

Where a project involves earth excavation, the Project Manager sends a project description and requests a list of potentially contaminated sites identified by the Environmental Assessment Unit, Project Coordination Unit of the Project Planning Division and the Region Resource Specialist. The Project Manager/Cost and Scheduling Engineer will locate identified potential sites of contamination on the preliminary plans. If earth excavation will impact a potential contaminated site, the Project Manager/Cost and Scheduling Engineer will request further investigation of the site to be done by MDOT Geotechnical Services Section, Bureau of Bridges and Structures. Geotechnical Services Section will provide information on the type and extent of the contamination, appropriate pay items and quantities for the Plans and Specifications. For more detailed information see Section [14.13](#) of the Road Design Manual. (5-1-2000)

Before starting and during the preparation of the study plans, the following information relevant to the design of the bridge should be considered:

- A. Engineering Report. (Including Environmental Impact Statement if applicable.) (8-20-99)
- B. Topography.
- C. Traffic data - If traffic data is unavailable at this time, it should be requested from Region/TSC Traffic and Safety personnel.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.01 (continued)

STUDY

- D. Soil Data - Soil borings should be ordered as soon as possible after receiving the project.

In general, one soil boring should be requested for each substructure unit less than 100' long and two borings for footings longer than 100'. For retaining walls, MSE walls and sewers, borings should be taken every 300'. If conditions are found to vary appreciably, additional borings will be required. Refer to the MDOT [Geotechnical Manual](#), on the MDOT Web site. (8-20-2009) (7-29-2019)

Soil boring requests should be submitted to MDOT Geotechnical Services Section. The request (electronic format preferred) should consist of [MDOT Form # 1088](#), Request for Foundation Investigation and the requirements set forth in the form. The General Plan of Site Sheet as described in [Section 3.01.01](#) shall include the following information:

1. Town, range and section number.
2. Scope of work.
3. Location of substructure units and borings.
4. Approximate bottom of footing elevations.
5. Notification when piles will be used regardless of soil character.
6. Indicate whether 400 kip nominal pile resistance (60 ton LFD) piles are appropriate (widening jobs). (8-20-2009)
7. Indicate if continuous superstructure is anticipated, and if integral abutments are being considered. (8-20-99)

If previous plans of an existing structure are available, the General Plan of Site and Log of Borings should be included.

(8-6-92) (12-17-2018)

3.01 (continued)

- E. Maintenance Reports (reconstruction projects). (8-20-99)

- F. Existing and/or proposed utilities.

- G. Waterway data for stream and river crossings.

1. Stream crossings are to be checked to determine whether they are a part of the county drain system, and the findings are to be recorded as part of the project history. Contact Design Engineer - Hydraulics/Hydrology or Region Drainage Coordinator.

2. Scour potential shall be investigated and design provisions may be needed to prevent undermining of the substructure. Contact Design Engineer - Hydraulics/Hydrology or Geotechnical Services Section.

A scour analysis is required at all stream crossings where reconstruction is proposed. (8-20-2009)

- H. Scoping Document and Region/TSC Scoping estimate. (8-20-99)

- I. Minutes of city, county, or other meetings that have been held relevant to the project.

- J. Correspondence files.

- K. Existing Plans (reconstruction projects) and web-based street level viewer.

- L. At all stream crossings, contact Roadside Development Unit to determine if an aesthetic or open railing should be considered.

- M. Project Safety Analyses - Requests should be made to Transportation Systems Management and Operations, Safety Programs Section in Lansing and the TSC Traffic and Safety Engineer. (8-20-99) (12-16-2019)

- N Capacity Analysis – Region/TSC Traffic and Safety (requested for deck replacement and reconstruction projects only). Also consider/evaluate all modes (users) of transportation. (2-27-2012)(12-16-2019)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

3.01 (continued)

STUDY

3.01.01

Composition (12-17-2018)

The following information shall be included on the study plans:

- A. The survey centerline showing horizontal alignment and stationing. The construction centerline, if different than the survey centerline.
- B. Topographical features and contour lines.
- C. Existing and proposed profiles along the construction centerlines of the roadways (and railroad, if the project includes one).
- D. Benchmarks and witnesses with corresponding coordinates. (Provide coordinates if they are available. If not, add note [8.03 Y.](#) to the study plans.) (12-5-2005) (8-23-2021)
- E. Alignment sketch where data cannot be clearly shown on the overall plan view.
- F. Utilities.
- G. Traffic Data.
- H. Concept of Maintenance of Traffic
- I. Non-Motorized traffic requirements. Future sidewalk or bike path plans and all other modes of transportation. (12-16-2019)
- J. Horizontal curve data, if any.

3.01.01 (continued)

- K. A plan view of the structure and proposed approaches superimposed on the topography.
- L. Elevation view of the structure, showing actual horizontal and vertical clearances.
- M. Typical approach cross section. Provide a road typical cross section sheet in lieu of adding the section to the bridge study plans.
- N. Deck cross section (see [Bridge Design Guide](#) 6.05 series).
- O. Standard note designating the design loading.
- P. Waterway information (stream and river crossing). Summary of Hydraulic Analysis must be on General Plan of Structure Sheet. See Section [8.05 F.](#) (8-20-1999) (8-23-2021)
- Q. In the title block, designate if this is Study A, B, C, etc., and above the title block indicate the proposed letting date. This is the only sheet on which these designations are required and will not be added to the Final Plans.

Generally, the above information is all that is required for the study. Other details and/or plan sheets may be added, if necessary or beneficial. The study is submitted by the Unit Leader to the Chief Structure Design Engineer for review. Major projects that are federally funded must also be reviewed by the FHWA. These approvals must be obtained before preliminary plans are started. (8-20-99) (12-17-2018)

3.01.02

Cost Estimate (8-20-2009) (12-19-2016)

Complete a Bridge Cost Estimating Worksheet (located on the [Bridge Management and Scoping website](#), Project Estimating section) for each study option considered.

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

3.02

PRELIMINARY PLANS

Preliminary Plans are the second set of plans prepared. They are for distribution to various agencies which are involved with the bridge project to show them our intent. This allows each agency to make its comments or requests and give approval where such is required.

Preliminary Plans are required for projects. For minor rehabilitation, e.g., railing replacement and/or deck overlay projects, see [Chapter 4](#).

Traffic volume information (if available) must be included in the Preliminary Plans.

When temporary structures are to be designed and made a part of the contract plans for FHWA Oversight jobs, Preliminary Plans for those structures must be submitted to the Federal Highway Administration (FHWA) for approval. MDOT Oversight jobs need not be sent to the FHWA. (8-20-99)

A public hearing must be held for all major projects or where we intend to close a portion of a route and detour all modes of transportation during construction. In general, the hearing will have been held as a prerequisite of the Environmental Impact Statement, and it is unnecessary for one to be requested by the Bridge Unit Leader. Should there be a question, contact the Public Hearings Officer, Hearings and Mitigation Section, Project Planning Division. (12-16-2019)

3.02.01

Composition (8-20-99) (12-17-2018) (2020)

Generally, plan sheets required are as follows:

- A. Title Sheet: Show job numbers, location map, notes and traffic data.
- B. General Plan of Site Sheet: If a bridge project doesn't have a Study, all information that was to be shown on the Study Sheet shall be shown on the General Plan of Site Sheet. The following information should be added to the General Plan of Site Sheet:

1. The plan view of the structure and approaches as shown on the approved study.
2. Typical approach roadway cross section is no longer required on bridge plans because duplicate information is shown on road plans. It can be added on a case-by-case basis for unique situations or if the road plans do not supply the information.
3. General notes.
4. Any proposed relocation of existing utilities. Because of legal problems in other states, Designers should not label abandoned or out of service utilities as "abandoned". Such utilities should be labeled "Utility Line Out of Service". The name of the utility owner, if known, should also be placed on the plans.
5. A note designating all major items of work that are part of the project. This note should also identify items that are not part of the bridge plans but are included in road plans which are part of the project.
6. Where a bridge will cross a waterway or wetland, the plans should show a plan view, profile and cross section for any haul route required to access the project site. See Section [2.02.15](#) for additional information. (8-20-99)

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BRIDGE DESIGN

3.02.01 (continued)

Composition (12-17-2018)

- C. Log of Boring Sheet:
(Required for all new bridges and widening projects.) In addition to soil data, the elevations of the bottoms of footings, minimum pile penetration, and estimated pile tips shall be shown. All borings are to be plotted to a common datum utilizing the proposed stationing whenever possible. See [Guidelines For Bridge Plan Preparation](#) (MDOT Sample Plans Bridge) of Development Guide ([Design Submittal Requirements Chapter 7](#)) for various details and sample plan sheets.

Any recommendations or comments by the Soils Section are to be attached to the Preliminary Plan set that is turned in to the Design Supervising Engineer.

- D. General Plan of Structure Sheet:
In general, the following views and sections shall be included:
1. Plan view of the structure including approach features such as pavement, shoulders, curb and gutter, and guardrail.
 2. An elevation of the structure taken perpendicular to the roadway under, or for stream crossings, parallel to the roadway over.
 3. A cross section of the deck showing the abutment, or half-abutment and half-pier.
 4. Typical cross sections through the substructure units showing excavation and backfill limits.
 5. Any other significant features peculiar to the project.
 6. If temporary supports are to be used, they should be shown or noted on this sheet.
- E. Existing General Plan of Site Sheet: If available, this sheet is required for all reconstruction and rehabilitation projects (4R). Create a new General Plan of Site for new structure or structure replacement projects and submit existing General Plan of Site as Reference Information Document (RID). See section [3.04.02](#). Include the existing General Plan of Site for all other projects. (12-17-2018)

3.02.01 (continued)

- F. Existing General Plan of Structure Sheet:
If available, this sheet is required for all reconstruction and rehabilitation projects (4R). Any removal of portion of structure is to be designated on this sheet. For projects with a new superstructure create a new General Plan of Structure, submit existing General Plan of Structure as Reference Information Document (RID). See section [3.04.02](#). For all other projects include the existing General Plan of Structure. (12-17-2018)
- G. Interchange Layout: An interchange layout is required for all projects where the bridge is in a complex interchange area.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.02.01 (continued)

Composition (12-17-2018) (12-16-2019)

H. Concept for Maintaining Traffic: Preliminary plans of structure should include a proposed concept for maintaining all modes of transportation through the construction zone. Depending on the method selected, the plans or attachments should show or note the following:

1. Detours
 - a. Show the proposed detour route
 - b. Indicate the use of expressway crossovers
2. Part-width Construction
 - a. Note the number of lanes to be maintained
 - b. Indicate one-way or two-way traffic
 - c. Note whether signals will be required
 - d. Note if traffic is diverted on existing shoulders or temporary widening
 - e. Show construction staging details
3. Traffic under a Grade Separation
 - a. Indicate the number of lanes to be kept open
 - b. Note if traffic is diverted on existing shoulders
 - c. Note any time restrictions on lane closures
4. Temporary Runaround
 - a. Show the centerline alignment
 - b. Show a cross section of the temporary road

5. Navigable Water Traffic (12-17-2018)

The Design Project Manager/Cost and Scheduling Engineer should consult with the Region/TSC Traffic Engineer and the Division of Operations in Lansing to arrive at the concept for maintaining traffic.
(8-20-99)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.02.02

Preliminary Estimate

The preliminary estimate consists of only the major items for the project. Unit prices are obtained from the Specifications, Estimates and Plan Review Section and used by the Unit to determine project costs.

The Specifications and Estimates Section requires a set of Preliminary Plans and an Engineer's Preliminary Estimate of Cost for Preliminary Plan, [Form 0287](#), with all major items listed before they can provide unit prices. (6-17-2013)

The Engineering and Contingencies on the Preliminary Estimate are to be approximately 15 percent for all projects. The total estimate is to be rounded off to the nearest \$100. (8-6-92)

3.02.02 (continued)

Preliminary Estimate Items (8-20-99)

1. Preliminary

- Temporary Structures
- Removal of Existing Structures
- Removal of Portions of Structures
- Cofferdams

2. Substructure

- Unclassified Excavation
- Temporary Steel Sheet Piling
- Permanent Steel Sheet Piling
- Foundation Piling
- Tremie Concrete
- Substructure Concrete
- Steel Reinforcement - Substructure
- Substructure Repair

3. Superstructure

- Superstructure Concrete
- Steel Reinforcement - Superstructure
- Structural Steel Fabrication & Erection
- Shear Developers
- Prestressed Concrete Beams
- Prestressed Concrete Deck
- Expansion Joint, if cost is a major item
- Bridge Railing
- Concrete, Bridge Deck Overlay
- Cleaning and Coating Structural Steel

4. Miscellaneous (12-17-2018)

- Structure Backfill
- Slope Protection
- Riprap
- Structure Embankment
- Drainage Items
- Temporary Supports
- Channel Excavation
- Approach Work
- (If included in Bridge Plans)
- Maintaining Traffic costs
- Miscellaneous Road Costs

Where some of the above items represent a minor percentage of project cost, they may be grouped and given a lump sum price.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.02.03 (deleted) (12-17-2018)

3.02.04

Reviews (8-20-99)

A. Utility Coordination and Review Process (12-17-2018)

This process should be initiated shortly after the project has been assigned.

The Lansing/Region/TSC design unit is responsible for requesting existing utility information from the utility companies. This will be accomplished by submitting the number of required sets of copies of the plans (which can be determined by using the Utility Relocation Tracking System Program (URTS) available to the Lansing/Region/TSC secretarial staff) along with the control section, job number, location (including township and county if appropriate) and a detailed description of the proposed work. The secretarial staff will complete the transmittal (form) letter(s) and distribute the plans and letters to all the appropriate entities. Plans should be sent to utility companies even if it may seem that their facility is far enough away so as not to be affected. All utility companies receive two sets of plans except Consumers Energy, which receives four sets and Region/TSC Utilities-Permits, which receives one set. Letter Requesting Utility Information at Base Plan Stage ([MDOT form #2480](#)) is available from the MDOT web site, or see [Appendix 3.02.04A](#).

3.02.04 A. (continued)

Once the existing utility locations are received and incorporated in the plans and the proposed work is shown on the plans, the Project Manager/Cost and Scheduling Engineer submits the plans to the Utilities-Permits Section in the Development Services Division, who will distribute the plans with a transmittal letter to the utility companies. Any possible utility conflicts should be identified at this stage. If it is obvious no conflicts exist, the Utilities-Permits Section may elect to eliminate this distribution.

If required, a Utility Meeting will be scheduled and held prior to The Plan Review Meeting. All utility conflicts are to be resolved prior to The Plan Review Meeting.

B. The Plan Review Meeting - Required (12-17-2018)

Preliminary plans are reviewed by the agencies affected by the project and by Department personnel responsible for various aspects of construction. Much of this review takes place at a Scope Verification or The Plan Review Meeting held at the site (if required) with many of the concerned parties present. Included are: Design and Region/TSC personnel, as well as, representatives from the FHWA on FHWA Oversight projects, counties, cities, and both municipal and private utility companies.

Design Division's Quality Assurance Supervising Engineer is responsible for the distribution of preliminary plans and estimates to those attending The Plan Review Meeting. The Design Engineer will provide the Plans & Field Review Section's administrative assistant with tracings (or reproducible copies) and a completed MDOT [form #0303](#); Plan Review Meeting. This form should include all utility companies in the area that either have received plans after completion of the Scope Verification or have responded indicating possible conflict. The administrative assistant will order and distribute the required sets of prints.

The Design Engineer will provide ProjectWise links to the plans to those not attending The Plan Review Meeting, or copies of the plans as requested. (8-6-92)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.02.04 B. (continued)

Reviews (8-20-99) (12-17-2018)

The job specific Supporting Documents folder in ProjectWise supplies a list of recommended invitees to receive an email invitation to view the plan set in electronic format. Hard copies of plans can be supplied upon request to individuals outside of the Department who do not have access to view the plans electronically.

After Preliminary Plan distribution, time should be taken to investigate and initiate any construction permits necessary for the project. Complete details are contained in [Chapter 14](#).

A written response is required to reply to any review recommendations made during preliminary plan review or The Plan Review Meeting. The response should verify compliance with review recommendations that will be incorporated into the plans, and provide an explanation for any comments received that cannot be included with the project. (8-6-92)

1. FHWA: Preliminary Plan prints are sent to the FHWA for all FHWA Oversight projects.

The FHWA requires two sets of Preliminary Plan prints with estimate.

2. Design Files:
A copy of The Plan Review Meeting letter is sent to the Design files.

3.02.04 B. (continued)

3. Railroad:

Preliminary Plan prints are sent to the railroad companies as follows:

Highway Over Railroad

Selected plan sheets (Title Sheet, General Plan of Site, General Plan of Structure, pier and crashwall detail sheets, plan sheets showing utilities within railroad right-of-way, and sheets showing how structure drainage is to be handled).

Railroad Over Highway

Also, the Preliminary Plans are sent to the Railroad Coordination Unit – Office of Rail for all railroad grade separations. (10-22-2012)

Contact the Railroad Separations Engineer for addresses of the affected railroads.

When it is expected that temporary steel sheet piling will be required, the railroad should be requested to submit any specified requirements as to the size and extent of the sheeting.

4. Design Engineer-Bridge Management: Preliminary Plans with estimate. No transmittal letter is required.
5. Design Engineer - Specifications and Estimates: One copy of the estimate and plans. No transmittal letter is required.

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3.02.04 B. (continued)

Reviews (8-20-99) (12-17-2018)

6. USGS Stream Gauges:
At sites where USGS stream gauges are located, two sets of Preliminary Plan prints should be sent to the U.S. Department of Interior for review and comments. If relocation of gauges is necessary, a letter requesting approval of relocation site, as shown on the plans, must accompany the prints.
7. Hydraulics/Hydrology Unit:
The Hydraulics/Hydrology Unit is included on the electronic notification send out of the Preliminary Plans for all projects involving waterways.
8. Unit Files:
The Design Unit is required to keep one set of Preliminary Plan prints with a Preliminary Estimate in its files. Also, the Design Unit should have one set of reproducible copies of the Preliminary Plans; these can be used in obtaining prints of the Preliminary Plan, if necessary, after final plan preparation has begun.

C. The Plan Review Meeting-Not Required (12-17-2018)

Occasionally, a project will not require The Plan Review Meeting. In this case, the Project Manager/Cost and Scheduling Engineer shall distribute the Preliminary Plans as shown previously, along with an additional distribution as follows:(8-6-92) (10-22-2012)

1. Region/TSC:
Send an electronic invitation to the Preliminary Plans and corresponding estimates for review and commenting to the Region/TSC Project Development /Cost and Scheduling Engineer and Construction for all bridge projects. (8-6-92)
2. Construction & Technology Division:
Send an electronic invitation to the Preliminary Plans and the corresponding estimate for review and commenting to the Engineer of Construction & Technology on all projects.

3.02.04 C. (continued)

3. Transportation Planning Services Division:
Send an electronic invitation to the Preliminary plans for review and commenting.
4. Road:
The Road Design Section is sent an electronic invitation to the plans for review and commenting. If the road design is being done by a consultant, please ensure access to view the electronic files is set up.
5. Municipally-Owned Utility Outside City Limits*:
If the project is located outside the corporate limits of a city, but there are city-owned utilities in the project vicinity, send one set of prints of the Preliminary Plans to the Utility Coordination, Permits and Agreements Section - Development Services Division for the file and two for each utility for forwarding. The Utility Coordination, Permits and Agreements Section - Development Services Division is to be notified whether the bridge project is combined with a road contract.
6. City of _____(any except Detroit):
Transmit the following to the Utility Coordination, Permits and Agreements Section - Development Services Division
 - one set for the files, plus
 - one set for each nonparticipating city (population less than 25,000), or
 - two sets and one estimate of cost for each participating city, except
 - three sets and one estimate for Flint, Lansing, or Warren (for a list of participating cities see Subsection 3.02.05).

In addition, provide the Utility Coordination, Permits and Agreements Section - Development Services Division with two sets for each municipally-owned utility. The Utility Coordination, Permits and Agreements Section - Development Services Division is to be notified if the bridge is to be let without a road contract.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.02.04 C. (continued)

Reviews (8-20-99) (12-17-2018)

7. City of Detroit:
Transmit 13 sets of Preliminary Plans and two estimates to the Utility Coordination, Permits and Agreements Section - Development Services Division (one for file, 12 to be forwarded). If the bridge is to be let without a road contract, notify the Utility Coordination, Permits and Agreements Section - Development Services Division
8. County Drain Commission:
Two sets of Preliminary Plan prints are to be sent to the County Drain Commissioner for comments and/or approval. Also, a copy of the transmittal is sent to the MDOT Drainage Coordinator in the Design Division, Bureau of Highway Development. (5-1-2000)
9. County of _____ :
For all bridge projects involving county roads, two sets (three if Wayne County) of Preliminary Plan prints are to be sent to the county.
10. Consultant:
If a consultant is doing the design, one set of Preliminary Plan prints with Preliminary Estimate is returned to them.
11. Geometrics Coordination Engineer:
On all projects, the Geometrics Coordination Engineer is sent an electronic invitation to review and provide comments on the Preliminary Plans for comments.
12. Electrical Unit - Design:
The Electrical Unit Leader is sent an electronic invitation to review and provide comments on the Preliminary Plans for all bridge projects where lighting is involved.

3.02.04 C. (continued)

13. Utilities-Permits Engineers:

The Region/TSC Utilities/Permits Engineer and the Assistant Engineer of Utilities/Permits in Lansing are sent copies of the letters to the utility companies for all projects that involve utilities. No plans are required.
(8-6-92)

14. Municipal Utilities Unit - Design:

The Municipal Utilities Unit Leader is sent an electronic invitation to the Preliminary Plans for all bridge projects involving water main or sanitary sewer designed by that unit.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.02.05

Act 51 Participation (7-28-2025)

For bridge construction work, only certain activities qualify for participation by municipalities pursuant to [Act 51](#) and the [State Trunk Line Highway System excerpt](#). A list of the cities required to participate in accordance with Act 51 PA 1951 along with guidelines for determining types of work which should be included in Act 51 are posted in Section [14.41.03](#) of the MDOT Road Design Manual.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.03

Final Project Coordination (FPC) (12-17-2018)

The Final Project Coordination indicates 90-95% completion of the plans, proposal and supporting documents herein after referred to as the FPC package. See [Chapter 14](#) of the Road Design Manual for FPC Requirements and Procedures.

3.03.01

Composition

The FPC package should be as complete as possible to ensure that items essential to the FPC reviewers are present and complete. The FPC package must include all items in the Milestone Checklist and as noted in section [3.04](#) with the following exceptions/clarifications:

A. Final Plans

1. Project information sheet index should include all anticipated plan sheets, even if not included in FPC package.
2. Miscellaneous Quantities may be preliminary.
3. Abutment/Pier Details – rebar may not be finalized, and miscellaneous details may not be complete.
4. Superstructure Details – All details must be present. Rebar may not be finalized.
5. Reinforcement Details – sheet(s) may be omitted.
6. Slab and Screed Details – sheet(s) may be omitted.

B. Proposal

1. Progress clause will be Draft.
2. Unique Special Provisions must be submitted for approval but may not be approved.
3. Notice to Bidders, coordination clauses and permits will be submitted for approval but may not be approved.
4. Railroad Coordination – special provisions, coordination clause and agreement (if required) must be complete, pending final approval.
5. Cost Summary – some items may be estimated.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.04

Plan Completion (OEC and Certification Acceptance) (12-17-2018)

The Plan Completion date indicates 100% completion of the plans, proposal and supporting documents. See Chapter 14 of the Road Design Manual for Plan Completion Requirements and Procedures.

Final plans are required for all projects. For minor rehabilitation (3R), e.g., railing replacement and/or deck overlay projects, see [Chapter 4](#).

Also See Section [14.57](#) of the Road Design Manual for more details regarding plan completion and OEC/Certification Acceptance.

3.04.01

Plan Composition (12-17-2018)

The following list and ordering of sheets is suggested for final plans:

- A. Title Sheet - all projects.
- B. Project information Sheet
- C. Legend Sheet
- D. Note Sheet
- E. Miscellaneous Quantities
- F. Typical Cross Sections (if applicable)
- G. Miscellaneous Details
- H. Guardrail Details
- I. Survey Information Sheet
- J. Interchange Layout - for bridges in complex interchanges.
- K. Staging Plans - all part-width construction projects let separately from road projects. (May be shown on General Plan of Structure)
- L. Traffic Detail Sheets - where maintaining traffic is part of the project.

3.04.01 (continued)

Plan Composition

- M. General Plan of Site Sheet - all projects.
- N. Log of Borings Sheet - all new bridges and widening projects.
- O. General Plan of Structure - all projects.
- P. Abutment Details - all new bridges and widening projects.
- Q. Pier Details - all new bridges and widening projects.
- R. Structural Steel, Prestressed Concrete, etc., Detail Sheets - all new bridges and widening projects.
- S. Expansion Joint Detail Sheet (when applicable). (8-20-99)
- T. Superstructure Detail Sheets - all new bridges, widening, and slab replacement projects.
- U. Slab and Screed Data Sheet. (8-20-99)
- V. Steel Reinforcement Sheets - all projects.
- W. Standard detail sheets as required.
- X. Any road plans as applicable.

Existing General Plan of Site, existing General Plan of Structure and other existing sheets deemed necessary must be placed in Reference Information Document (RID) process as electronic data files. See Section [3.04.02](#) for process and definition.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.04.02 (12-172018)

Reference Information Documents

A. Process and Definition

The Reference Information Document (RID) process provides availability of electronic data files through the e-Proposal website. RID files are non-contractual items for prospective bidders and awarded contractor to use to gain a better understanding of the project. RID can include design CADD files, survey deliverable files and other miscellaneous items pertinent to the project.

Milestone reviews by [MDOT RID Support](#) are intended to be on the same timeline as other reviews mentioned in the previous sections. RID files will be submitted to the Specifications and Estimates Unit and [MDOT RID Support](#) for review prior to final turn in. The files are subsequently published at the same time as the Proposal and Plans. Any changes made to the RID files after this time, due to an addendum, will be the responsibility of the Project Manager. Each published 'set' released after the original publication must include a revised [RID_Index.xlsx](#) using the Project Changes tab that includes only the changed files and a brief explanation of the changes made to the files.

See the [Chapter 5](#) of Development Guide (Design Submittal Requirements) for more information.

3.04.02 (continued)

B. Common Bridge RID Files and Criteria for Use

The Design Project Manager/Cost and Scheduling Engineer is responsible for ensuring that all appropriate RID files (including files from resource areas outside of Bridge Design) are incorporated into the RID folder for the project and in the RID_Index.xlsx file. Below are several types of RID files that are common to bridge projects.

1. Geotechnical Recommendations – The final Geotechnical Foundation Engineering Report must be included in the RID if foundation analysis was performed for a project.
2. Existing Plans – PDF's of all applicable existing plans (including shop drawings) for a bridge should be included on all projects.
3. Pictures – If photos of the project would be helpful to illustrate the site or existing bridge conditions, they may be included.
4. CADD Files – For projects that are detailed on geospatial coordinates, CADD files including the general plan of site and structure as well as corresponding base files may be included.
5. Survey Information – If survey was performed for the project, the Survey Support Area will place final survey files in the RID folder in the survey deliverable folder structure. The Project Manager/Cost and Scheduling Engineer must copy this information to the RID folder for the project. Verify that the files contained in the folder are the latest version utilized on the project.
6. Other Information – If the Design Project Manager/Cost and Scheduling Engineer has other information not described above that may be useful to the contractor, [MDOT RID Support](#) or the Bridge Design Supervising Engineer should be consulted to confirm whether disclosing additional information causes any concerns for the Department.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

3.05 (12-17-2018)

PROGRAMMED COST ESTIMATES

The project estimate should be reviewed at the following stages of plan development:

- A. Upon completion of Study.
- B. Upon completion of Preliminary Plans.
- C. Whenever the scope of work changes.
- D. When lettings are delayed appreciably (review yearly).

The programmed cost estimate must be updated whenever the current cost estimate exceeds that shown on the Status of Plans by more than 10 percent.

Projects funded by bond issues may not be significantly altered in scope or cost. To avoid the need for a change, all items contributing to a project's cost should be conservatively evaluated and included in the Engineer's Estimate. (8-20-99)

Occasionally, the Estimating Engineer will notify the Project Manager that the difference between the final cost estimate and the programmed estimate exceeds the limits given in Section III of the Project Manager's Handbook. In this case, the Project Manager should request the Statewide Transportation Planning Division's approval of the final estimate. (8-6-92)



STATE OF MICHIGAN

DEPARTMENT OF TRANSPORTATION

RICK SNYDER
GOVERNOR

KIRK T. STEUDLE
DIRECTOR

Dear

Subject: Request for Utility Information

Project Location (Route, City or Township, County):

Scope of Work:

Control Section(s):

Job Number(s):

Proposed Plan Completion Date:

For your Information, the design of this project will be done by a consultant: ☐ No ☐ Yes

If Yes, the consultant is:

Please mark your utility facilities on one set of the enclosed plans for the above mentioned Michigan Department of Transportation project. These facilities should be dimensioned to known features, such as a right-of-way line or road centerline. One set of marked plans and the attached "Request for Utility Information – Return Form" should be sent to the Transportation Service Center (TSC) utility coordination engineer listed. If you do not have any facilities in the area, please send only the completed return form. Please respond by .

For all potential utility conflicts, especially underground, the department may require the exact field location of your facilities. The enclosed plans are incomplete, and any utility relocation design should be undertaken only after discussion with the TSC utility coordination engineer. If certain items of utility work, such as adjustment of manholes, placing of conduits, etc., are to be included in this project, please indicate this in the Request for Utility Information – Return Form's comments section.

Sincerely,

Enclosure
cc: TSC Utility Coordination Engineer (w/plans)
N. Lefke

Project Manager

MDOT 2480 (03/06)

REQUEST FOR UTILITY INFORMATION – RETURN FORM

Date: _____

To: _____

Please return this completed form and marked plans (if applicable) by
following utility coordinator:

to the

Control Section(s):

Job Number(s):

Utility Response Information

Utility facilities within project limits ☐ No ☐ Yes
Marked MDOT plans enclosed ☐ No ☐ Yes
Utility company maps enclosed ☐ No ☐ Yes
Facilities are dimensioned from ☐ Right-of-Way ☐ Road Centerline ☐ Other: _____
Facilities are ☐ Underground ☐ Aerial
If available, approximate vertical dimension(s) _____
Size and type _____ Year: _____
Facilities are ☐ Active ☐ Out of Service

Bridge(s)

Facilities attached to underside of bridge ☐ No ☐ Yes
Facilities located in bridge deck, sidewalk or barrier wall ☐ No ☐ Yes
Buried facilities near bridge ☐ No ☐ Yes
Aerial facilities near bridge ☐ No ☐ Yes

Municipal Utilities and County Drains Only

Any work proposed to be included in project? ☐ No ☐ Yes (If Yes, explain) _____

Utility Contact for Design Phase:

Utility Contact for Construction Phase:

(Information to be shown on MDOT Plans)

Name: _____ Name: _____
Address: _____ Address: _____
City, State and Zip Code: _____ City, State and Zip Code: _____
Telephone: _____ Telephone: _____
Fax: _____ Fax: _____
E-Mail: _____ E-Mail: _____
Comments: _____

CHAPTER 4

PLAN COMPOSITION - REHABILITATION PROJECTS

4.00 GENERAL (8-20-2009)

4.01 STUDY

4.01.01 Composition

4.01.02 Cost Estimate

4.01.03 Reviews (8-6-92)

4.01.04 Hydraulic and Scour Investigation (3-9-2000)

4.02 PRELIMINARY PLANS

4.02.01 Composition

4.02.02 Preliminary Estimate

4.02.03 Distribution

4.03 FINAL PLANS

4.03.01 Drafting Procedure

4.03.02 Composition

4.03.03 Final Plan Quantities

4.04 PROGRAMMED COST ESTIMATES

CHAPTER 4

PLAN COMPOSITION - REHABILITATION PROJECTS

4.00 GENERAL

Rehabilitation projects encompass all 3R types of work. Resurfacing, restoration and rehabilitation (**3R**) for bridge work is defined as bridge deck overlay and/or minor widening (no increase in number of through lanes), bridge painting, joint replacements and pin and hanger replacements. See also [Chapter 3](#) of Road Design Manual. (3-9-2000)

If a project contains 3R ([Chapter 12](#)) and 4R ([Chapter 7](#)) work, the determination of the work category will be based on the work type that is more than 50% of the total cost of the project. The whole project will be considered as the controlling dollar work type, either 3R or 4R.

The single classification of combined work does not necessarily dictate the standards that apply to the project. When it is determined by cost criteria that a project is classified as 4R, 4R standards will apply to the entire project regardless of individual work types. Projects classified as 3R are governed by the standards that correspond to each work type (3R or 4R). (8-20-2009)

4.01

STUDY

4.01.01

Composition

Where rehabilitation work is routine and conforms to our guidelines a study is not required. Where an unusual design treatment is proposed or construction staging bears consideration, a study showing these features should be prepared and submitted for review before beginning work on the Preliminary Plans. This study should consist of:

- A. Existing General Plan of Structure Sheet.
- B. Sketch (8½"x11") of the proposed bridge deck cross-section.

4.01.02

Cost Estimate

Listed below is a tabulation of bridge costs for various types of construction for making **rough** cost estimates. (3-9-2000)

Type of Construction	Without Maintaining Traffic	With Maintaining Traffic
Railing Replacement	\$110 per foot	\$175 per foot
Deck Overlay *	\$ 12 per SFT	\$ 14 per SFT
Pedestrian Fencing	\$ 6 per SFT	\$ 7 per SFT

* Includes the area of the approach pavement wedges.

4.01.03

Reviews

(8-6-92) The study is submitted by the unit leader to the Bridge Supervising Engineer for approval. Approval must be obtained before Preliminary Plans can be started.

4.01.04

Hydraulic and Scour Investigation

For structures with rehabilitation work including overlays, deck patching, etc., contact the Hydraulics/Hydrology Unit in the early stage of the project. If the project requires additional work, the project manager will be informed and requested to assign the project to the Hydraulics/Hydrology Unit for further investigation and a final recommendation. (3-9-2000)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

4.02

PRELIMINARY PLANS

4.02.01

Composition

- A. A deck cross section showing the existing bridge width.
- B. A deck cross section showing the proposed bridge width.
- C. A cross section of the approach roadway.
- D. On bridges over Interstate routes, indicate whether or not the structure carries Interstate traffic.
- E. Traffic Data (is required on resurfacing projects). For additional information see Section [3.02.01](#).

This information can be furnished by submitting either of the following:

- 1. The usual prints of the existing Plan of Site and Plan of Structure.
- 2. An 8½" x 11" sketch showing cross sections through the proposed bridge deck and the approach roadway.

The deck cross section should show the type of railing and/or resurfacing material proposed, as well as the number and width of traffic lanes and the width of the proposed shoulders.

The approach roadway cross section should show the number and width of lanes and the shoulder width.

One sketch will be required for each crossing except that two or more identical crossings in a package may be covered by a single sketch.

This format is to be used for all Preliminary Plan distributions of 3R projects.

4.02.02

Preliminary Estimate

The estimate is prepared in the same manner as described in Section [3.02.02](#).

4.02.03

Distribution

A. THE Plan Review Meeting - Required

(3-9-2000) In general, for projects where THE Plan Review Meeting will be held, a preliminary plan distribution as shown in Subsection [3.02.04](#) is to be sent to the following agencies:

- 1. Bridge Supervising Engineer. If 3R criteria is not met, design exception / variance should be requested and justification offered (see [Chapter 12](#) of this Manual and [Chapter 3](#) & [14](#) of Road Design Manual). Design Exceptions shall be requested if design loading structural capacity and/or vertical clearance are deficient. (2-21-2017)
- 2. Design Files
- 3. Railroad (no reproducibles)
- 4. Bridge Management Engineer, C&T Div.
- 5. Specifications and Estimates Engineer
- 6. Unit Files (no reproducibles)

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4.02.03 (continued)

Distribution

B. THE Plan Review Meeting - Not Required (3-9-2000)

Occasionally, a project will not require THE Plan Review Meeting. In this case, Preliminary Plans should be distributed as shown above, along with an additional distribution as follows:

1. Region/TSC
2. Construction and Technology Division
3. Road Design
4. Utility company
(where their conduits will be disturbed*)
5. City
(both participating and nonparticipating)
6. County
(where county roads are involved)

4.02.03 (continued)

7. Utilities Supervising Engineer
8. Region/TSC Utilities - Permits Engineer
9. Division of Operations
(one set of prints, no estimate)
10. On overlay projects in the Metro Region/TSC area where the Michigan Intelligent Transportation System (MITS) traffic sensor system is used, one set should be sent to each:

MDOT - MITS Center
1050 6th Street
Detroit, MI 48226

and

MDOT - Freeway Operations
1050 6th Street
Detroit, MI 48226

* Where utilities will not be disturbed, copies of the transmittal letter to the Region/TSC Project Development Engineer are sent to the Region/TSC Utilities-Permits Engineer and to the Assistant Engineer of Utilities-Permits in Lansing. (8-6-92)

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4.03

FINAL PLANS

4.03.01

Drafting Procedure

The existing General Plan of Site and Structure sheets are presented to the drafting supervisor with instructions. Drafting personnel within the unit will produce the necessary detail sheets. (3-9-2000)

4.03.02

Composition (3-9-2000)

- A. Title Sheet.
- B. Index Sheet - as required.
- C. Traffic Details - as required.
- D. General Plan of Structure Sheet - as required.
- E. Existing General Plan of Site Sheet.
- F. Existing General Plan of Structure Sheet.
- G. Detail Sheets - as required.

4.03.03

Final Plan Quantities

Payment for an incidental item of work should be included in a pay item for which quantities should not change significantly. Consideration should also be given to the sequence of operations, as payment for the incidental work will not be made until work on the pay item is complete.

4.04

PROGRAMMED COST ESTIMATES

The programmed estimate should be reviewed and updated, if required, as shown in Section [3.04](#).

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CHAPTER 5

CONSULTANT CONTRACTS

5.01 GENERAL (11-19-99)

5.02 PROJECT OVERSIGHT (11-19-99)

5.03 CONSULTANT SELECTION PROCESS

5.03.01 Advertisement for Professional Services

5.03.02 Prime Consultant and Subconsultant

5.03.03 Proposals

5.03.04 Final Selection

5.04 CONSULTANT COORDINATION

5.04.01 Agreement Preparation

5.04.02 Plan Information

5.04.03 MDOT Contacts

5.04.04 Consultant Identification on Plans

5.04.05 Plan Review/Quality Assurance

5.04.06 THE Plan Review Meeting (11-19-99)

5.04.07 Waterway Permit

5.04.08 Progress Schedules

5.04.09 Payment Vouchers

5.04.10 Status of Plans

5.04.11 Evaluation of Consultant Performance

5.04.12 Contract Completion Notice (8-6-92)

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CHAPTER 5 CONSULTANT CONTRACTS INDEX (continued)

[Appendix 5.03.01](#) [Advertisement for Professional Services](#)

[Appendix 5.03.03 A.1.e.](#) [Scope of Work Statement for Hydrologic, Hydraulic, and Scour Analyses \(PPD TASK 3520\) \(4-28-2025\)](#)

[Appendix 5.03.03 A.1.f.](#) [Scope of Work Statement for Foundation Structure Investigation \(PPD TASK 3530\) \(2-23-2001\)](#)

[Appendix 5.04.05](#) [Check List for Review of Consultant Plans \(8-6-92\)](#)

[Appendix 5.04.11](#) [Service Vendor Performance Evaluation form \(12-5-2005\)](#)

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BRIDGE DESIGN

CHAPTER 5

CONSULTANT CONTRACTS

5.01

GENERAL (11-19-99)

This section is a brief overview of the bridge consultant process. For detailed information regarding Consultant contracts, contract adjustments, prequalification and selection refer to the Design Contract Management Manual.

It is the policy of MDOT to select consultants when the existing staff of the Design Support Area cannot meet the workload, or when the degree of difficulty of a project requires expertise that is not available within the Design Support Area engineering staff.

5.02

PROJECT OVERSIGHT (11-19-99)

The Bridge Consultant Unit or an in-house Bridge Unit will manage the consultant bridge projects. This oversight will be general in nature and involve acceptance rather than approval of the design package. Final responsibility for accuracy and quality of work rests with the bridge consultant.

Consultants shall use AASHTO standards and MDOT guidelines to design all bridge work for MDOT. (When required by specific designs, Consultants will use other related design standards and guides such as AREMA, ASTM, ACI, etc.) Where conflicts arise between standards, the MDOT Bridge Project Manager will be the final authority as to the applicable design standards.

5.03

CONSULTANT SELECTION PROCESS

The selection process has been formalized by MDOT and shall be as indicated in the Design Contract Management Manual

5.03.01

Advertisement for Professional Services

The Engineer of Design Operations - Structures Section will decide when consulting services are required and submit information to the Bridge Consultant Unit leader. (Alternately, an in-house Bridge Unit may elect to consult out a bridge project - following a similar procedure as described in the following outline.) The Bridge Unit leader will work with the Contracts Officer to advertise for consulting services. The information will show the nature of the work, the location of the project and a detailed description of the work required. Requirements to be met by consultants are indicated in the solicitation and a request for letters of interest will show the address where the letters must be sent. The anticipated schedule of consultant evaluation and selection will also appear in the advertisement. The advertisement will be placed in the trade journals by the Contracts Officer. **Michigan Contractor and Builder**, **Michigan Roads and Construction**, and **Project Reports** are accepted trade magazines. Other journals may be used depending on the scope of work. A sample of an advertisement is shown in [Appendix 5.03.01](#). (11-19-99)

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5.03.02

Prime Consultant and Subconsultant

The prime consultant is the party responsible for the project and will be the primary contact for the project. The prime consultant will be responsible for the performance of the subconsultant.

5.03.03

Proposals

The MDOT Project Manager will be the official MDOT spokesperson concerning the request for proposal (RFP). Any changes, additions or deletions to the RFP or scope of work will be discussed with the Engineer of Consultant Coordination, and then put in writing and sent by the Project Manager to all consultants that are "short listed". Copies of the correspondence will be provided to the Selection Committee. (11-19-99)

Two copies of a detailed proposal shall be requested from each of the short listed firms. The proposal shall be in two parts: the Technical Proposal and the Cost Proposal.

In addition to the requirements listed in the Contract Management Manual, the consultant shall include the following items in their proposal.

5.03.03 (continued)

A. Technical Proposal

The Technical Proposal shall, as a minimum, cover the following information:

1. Scope of work. (8-6-92)

The description of the scope of work shall list elements of the project that are the responsibility of the consultant and all elements that are the responsibility of MDOT (or others). Some of the items that should be addressed, depending on the nature of the project, are:

- a. A complete design of the structure using applicable standards and current engineering practice. (Give a brief description of the structure, and number of structures.) (5-1-2000)
- b. Preparation of contract plans and bid item quantities.
- c. Preparation of any specifications required to supplement MDOT's Standard Specifications for Construction.
- d. Any pickup survey or field measurements required to supplement the data provided by MDOT (e.g. camber in existing beams). Any survey required for a hydraulic analysis.

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BRIDGE DESIGN

5.03.03 (continued)

Proposals

- e. A complete hydraulic analysis to determine the required waterway area at the structure and to determine scour potential. (Include a copy of MDOT's procedures).

Normally, two comparative hydraulic analyses are required by the FHWA. For scope of work statement for hydraulic study and scour analysis, see [Appendix 5.03.03 A.1.e.](#) and/or Consultant Manual for Consultants, Chapter 24(PPD task 3520).

- f. Soil borings of sufficient depth and number and a geotechnical analysis to perform the foundation design and/or scour analysis. For scope of work statement for geotechnical services, see [Appendix 5.03.03 A.1.f.](#) and/or Consultant Manual for Consultants, Chapter 24(PPD task 3530).
- g. Preparation of permit requests. (MDOT will submit these.)
- h. Necessary contacts with concerned agencies: e.g. Michigan Department of Environment, Great Lakes and Energy (MDEGLE), municipalities, utilities, railroad, State Historic Commission.
(02-16-2010) (6-24-2019)
- i. Participation in meetings and field reviews at the site.
- j. Solutions to any unique problems, e.g. utility interference, staging for part width construction.
- k. With concurrence from Region/TSC Traffic Engineer, provide plans and specifications for maintaining traffic during construction.

5.03.03 (continued)

- 2. Additional scope of work items:
Rehabilitation Projects

The following additional items should be considered for agreements involving rehabilitation.

- a. Inspect the existing bridge and job site to determine the extent and complexity of rehabilitation work and to determine the need for any additional work not included in the Description of Project.
- b. Prepare a life cycle cost comparison between the intended rehabilitation and complete replacement. (This item may have to be presented as "Stage I" of the agreement as the scope of the remaining services may depend on the results of this comparison.)
- c. Analyze the existing structure to determine if it conforms to current specifications and loading conditions.
- d. Perform a deck condition survey to determine the location and proportions of visible spalls and patches and also subsurface delaminations. With concurrence from MDOT's Region/TSC Traffic Engineer, provide traffic control to permit this work. (11-19-99)

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5.03.03 (continued)

Proposals

3. Construction Services

When contract award is to be made soon after plan completion, the following items should be considered. It should be made clear that the fees for each of these is clearly defined and not combined with the fee for plan preparation.

- a. Review of fabricator's shop drawings (structural steel, prestressed concrete beams, modular expansion joints).
- b. Provide design assistance with problems that may arise during construction. (This does not include problems which result from plan errors or omissions.) MDOT will provide an estimate of the number of hours that a total fee can be based upon. Payment, however, will be based on actual number of hours required.

In addition to the required services, the proposal shall also acknowledge the consultant's responsibility to maintain office records, submit monthly progress reports, and submit MDOT vouchers with their billings. The technical proposal shall include a schedule of plan preparation. The schedule shall make provisions for MDOT and FHWA reviews and approvals prior to proceeding with preparation of final plans.

5.03.03 (continued)

B. Cost Proposal

In general, the consultant fee shall be based on payroll plus overhead plus direct costs plus profit, as described in the Contract Management Manual. On small or unusual projects, the fee may be based on a lump sum amount proposed by the consultant.

When the consultant services include review of shop drawings and/or assistance with field engineering problems, the consultant shall be instructed to submit their fee in two parts: one for plan preparation, and one for construction services. (11-19-99)

5.03.04

Final Selection

MDOT will select a consultant based on criteria outlined in the Contract Management Manual. In addition, MDOT will consider the following items in selecting a bridge consultant:

- A. The consultant's familiarity with the scope of the project.
- B. The estimated number of man-hours projected to perform the work. Where man-hours have been assigned for surveys, delamination and deck analyses, hydraulic studies and geotechnical work, MDOT authorities should be contacted for verification. (8-6-92)
- C. The degree of competency of the consultant.

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BRIDGE DESIGN

5.04

CONSULTANT COORDINATION

Coordination between the consultant and MDOT is the responsibility of the Design Engineer (Project Manager) to whom the project has been assigned.

5.04.01

Agreement Preparation

The Project Manager provides assistance when the agreement is being prepared and reviews the "Scope of Work" as prepared by the consultant. (The "Scope of Work" becomes an exhibit to the agreement.) He reviews the final agreement for form and completeness.

5.04.02

Plan Information

A. MDOT Provided Materials

The Project Manager will provide the following material as needed by the consultant:

1. Engineering Reports and supplements
2. Supplemental Specifications and Special Provisions
3. Road Plans, survey notes, soil data
4. Plan materials; i.e., special detail sheets, expansion joint sheets, etc.
5. Coding for Payment Voucher
6. Payment Voucher forms
7. Prints of sample job for use as a guide

5.04.02 (continued)

B. Consultant Purchased Materials

The following material is available to the consultant by purchasing from the Contracts Division:

1. Bridge Design Guides
2. Bridge Design Manual
3. Road and Bridge Standard Plans
4. Construction Specifications
5. Pay Item Code Book

5.04.03

MDOT Contacts

The MDOT Project Manager is the contact between MDOT and the consultant in matters regarding the preparation of bridge designs and plans. Contacts between consultants and other personnel should be avoided.

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5.04.04

Consultant Identification on Plans

The following procedure shall be used on plans prepared by consultants:

- A. The title sheet shall be sealed by the consultant.
- B. The block on the title sheet marked "Plans Prepared By" shall be revised to say "Plans Reviewed By", and the name of the coordinating MDOT Design Engineer shall be indicated.
- C. All sheets shall bear the name or logo of the consultant in or adjacent to the title block.
- D. The initials appearing in each sheet's title block shall be those of the consultant's personnel.

5.04.05

Plan Review/Quality Assurance

All design calculations, computer input, and quantity computations must be independently checked by the consultant. Documents must be signed by both designer and checker. Computer output should be spot checked to see that results are reasonable. Consultants should be advised of these requirements, and MDOT review of their work shall assure compliance. The documents must be filed for future reference. For a check list of items to be reviewed, see [Appendix 5.04.05](#). This list is intended to be a guide, not a complete list for all cases. (11-19-99)

5.04.06

THE Plan Review Meeting (11-19-99)

After approval of preliminary plans by the Design Engineer, the consultant forwards reproducible copies of the plans and preliminary estimate to MDOT. The Design Engineer distributes prints of the preliminary plans and preliminary estimate to the appropriate agencies and keeps a record of the distribution and responses.

The Design Engineer-Road will make arrangements for THE Plan Review Meeting. If the bridge work is not included in a road project, the Design Engineer-Bridge will make the arrangements.

5.04.07

Waterway Permits

The consultant prepares the data required for the waterway permit. The Design Engineer in conjunction with Design Engineer - Hydraulics/Hydrology reviews the data and forwards it to the Evaluation and Mitigation Unit, Environmental Section of the Project Planning Division for review prior to sending the data to Michigan Department of Environment, Great Lakes and Energy (MDEGLE), U.S. Army Corps of Engineers or U.S. Coast Guard. For additional information regarding permits, see [Chapter 14](#). (12-15-2000) (02-16-2010) (6-24-2019)

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5.04.08

Progress Schedules

The consultant shall submit monthly progress schedules for MDOT review. The consultant should submit a Study, Preliminary Plans, and 100 percent complete OEC/Final Plans for our review.

5.04.09

Payment Vouchers

The consultant shall submit payment vouchers. The Project Manager shall check the vouchers for accuracy and see that they correspond to the progress schedules.

5.04.10

Status of Plans

The consultant shall submit progress schedules including PPD task updates. MDOT will use this information to determine the status of the project.

5.04.11

Evaluation of Consultant Performance

The Design Engineer will evaluate the performance of the consultant after final plans have been reviewed. Additional intermediate reviews are encouraged if the consultant's performance is not satisfactory. The additional evaluations can be done at the Study, Preliminary Plan, OEC Plan Review and after construction is complete. The Design Project Manager should contact the Construction Project Engineer to obtain his input for the evaluation after construction. (12-5-2005)

Consultant projects that extend beyond one year (or earlier when a consultant's performance is unsatisfactory) require interim evaluation. A consultant performance evaluation form will be filled out by the Project Manager and submitted at the end of one year and every six months thereafter. (11-19-99)

MDOT has prepared a standard evaluation form, Service Vendor Performance Evaluation, as shown in [Appendix 5.04.11](#). The completed evaluation form shall be sent to the consultant. The evaluations will be used as a reference when considering consultants for future projects. The evaluation will also be used to determine if a consultant shall continue to be pre-qualified to do work for MDOT. (12-5-2005)

5.04.12

Contract Completion Notice (12-5-2005)

MDOT classifies a project complete once it has received and accepted the design calculations, final plans and final estimate.

**MICHIGAN DESIGN MANUAL
BRIDGE DESIGN**

Appendix 5.03.01

**ADVERTISEMENT
FOR
PROFESSIONAL SERVICES**

The Michigan Department of Transportation will require professional engineering services to develop plans and related documents for (type and location project). Interested consultants are requested to advise the Department of their availability to perform services.

The anticipated schedule involves the choice of consultant by (date) entering into a consultant contract and commencement of design by (date) and completion of plans and advertising for construction by (date).

The project will consist of (detailed description of project elements). The design loading will be ____ and the roadway width ____ft - ____in plus ____ft - ____in sidewalks.

The Michigan Department of Transportation is an equal opportunity employer and a minimum of (%) DBE participation is required.

Interested professional firms possessing substantial expertise in (type) design are invited to submit a letter of interest. Included in the submittal should be a completed Standard Form 254 and a current brochure describing their firm. The form may be obtained by calling or writing to:

General Printing Office
Superintendent of Documents
North Capitol Street, N.W.
Washington, DC 20401
(Phone: 202/783-3238)

Letters of interest should be addressed to:

(Name)
Engineer of Design
Michigan Department of Transportation
P.O. Box 30050
Lansing, Michigan 48909

Letters of interest should be postmarked no later than (date).

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Appendix 5.03.03 A.1.e.
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SCOPE OF WORK STATEMENT FOR HYDROLOGIC, HYDRAULIC, AND SCOUR ANALYSES (PPD TASK 3520) (02-16-2010) (6-24-2019) (4-28-2025)

1. SCOPE:

This procedure addresses the Consultant's duties in the preparation of the hydrologic and hydraulic analyses for waterway crossings (bridges and culverts), and scour analysis with scour countermeasure design for bridges.

2. WORK STEPS:

2.1 HYDROLOGIC ANALYSIS

A. For waterway crossings with drainage areas equal to or greater than two square miles, send a request for the 10%, 2%, 1%, and 0.2% flood frequency discharges to the Hydrologic Studies Unit, Land and Water Management Division, Michigan Department of Environment, Great Lakes, and Energy.

For waterway crossings with drainage areas less than two square miles, compute the 2% and 1% flood frequency discharges using the methodology outlined in [Chapter 4](#) of the Road Design Manual. If the crossing is classified as a bridge (this includes culverts with spans equal to or greater than 20 feet and no bottom slab), the 0.2% flood frequency discharge must also be computed for the scour analysis.

B. Submit a copy of the MDEGLE flood frequency discharge estimates or the discharge calculations to the MDOT Project Manager for review and approval by the Hydraulic Unit Supervisor prior to starting the Hydraulic Analysis in work step 2.2.

2.2 HYDRAULIC ANALYSIS

Conduct hydraulic analyses to compute water surface profiles for the existing and proposed waterway crossings, using the 2% and 1% flood frequency discharges. A hydraulic analysis for the 0.2% flood frequency discharge is also required for any bridge or 3-sided culvert with a span greater than 20 feet. The hydraulic analyses must show no harmful interference to adjacent riparian owners and upstream properties. The results must be certified in writing by a licensed professional engineer and submitted with the appropriate MDEGLE permit applications. Examples of hydraulic certifications are in the Supplemental Information section of this task.

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Appendix 5.03.03 A.1.e.
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A hydraulic analysis is required for, but not limited to, any of the following conditions:

1. A new or replacement culvert or bridge
2. Culvert or bridge extensions
3. Proposed work on a culvert or bridge that has a drainage area greater than 2 square miles
4. A raise in road grade greater than the average thickness of a top course
5. Proposed bridge work that will potentially affect the energy grade line of the watercourse

In addition to the hydraulic analysis, a hydraulic report must be submitted when any of the above has a drainage area greater than 2 square miles. The required format for a hydraulic report can be found in the Supplemental Information section of this task. If the Consultant feels that a hydraulic analysis is unnecessary, they may request a written waiver from the Hydraulic Unit Supervisor. A hydraulic certification is still required if the hydraulic analysis is waived.

PROCEDURE:

- A. Obtain the results of the Hydraulic survey according to the work steps outlined in PPD TASK 3350 - CONDUCT HYDRAULIC SURVEY.
- B. Conduct and document a site investigation of the stream and surrounding area. Take photographs upstream and downstream of the site, including any existing structures modeled in the study and the upstream and downstream overbank areas at the crossing.
- C. For both existing and proposed conditions, determine the water surface profiles for the flood events listed in work step 2.1. For crossings with drainage areas greater than 2 square miles, use the U.S. Army Corps of Engineers Hydraulic Engineering Center's HEC-RAS personal computer program. For culverts with drainage areas less than 2 square miles, Hydraulic Design Series Number 5, Hydraulic Design of Highway Culverts, may be acceptable. Refer to [Section 4.05.03](#) of the Road Design Manual, Chapters 5 and 6 of the Drainage Manual, and the Supplemental Information section of this task.
- D. If a hydraulic report is not required, the results of the hydraulic analyses must be summarized in a table comparing data for existing and proposed conditions. A sample table is in Section 3.6 of the Supplemental Information.
- E. Submit copies of the hydraulic analysis, report, and certification to the MDOT Project Manager for review and approval by the Hydraulic Unit Supervisor prior to THE Plan Review Meeting. Include all design assumptions with the hydraulic analysis.
- F. Receive any items returned by the MDOT Project Manager as incomplete or deficient.
- G. Make necessary changes and resubmit the entire package including a written response to all comments. Keep copies of the MDOT comments and the revised materials for the project record.

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- H. Receive the MDOT Submittal Evaluation form. Contact the MDOT Project Manager if one is not received within two weeks of submitting the hydraulic analysis report.
- I. If the waterway crossing is classified as a bridge (see [Section 2.1.A](#)), proceed with work step 2.3.

2.3 SCOUR ANALYSIS AND SCOUR COUNTERMEASURE DESIGN FOR PROJECTS INVOLVING BRIDGES

The scope of this section is to prepare a scour analysis and design scour countermeasures for a bridge structure.

A. Obtain soil boring logs and test data.

- i. If PPD TASK 3530 - CONDUCT FOUNDATION STRUCTURE INVESTIGATION is a Consultant task, then coordinate the geotechnical investigation to include a minimum of three soil borings and representative samples of each stratum encountered to a depth of 25 feet. Obtain representative samples from each stratum encountered for identification and gradation analysis. Classify samples using ASTM D 2487-85 and determine particle size distribution using AASHTO T-88. Provide a cumulative particle-size plot for each sample tested.

Take one boring at the upstream face of the structure in the center of the channel; take the remaining borings at the abutments on the overbanks. These samples will provide data for estimating scour depths in work step 2.3.B. Site conditions, access restrictions, type and size of the structure, and engineering judgement may alter the location and number of borings; in general, the boring pattern shall be sufficient to determine the extent, thickness, and location in plan and profile of all soil layers within the potential scour zone.

Include a copy of all soil boring logs and test data as an appendix to the Scour Analysis Report of work step 2.3.B.

- ii. If PPD TASK 3530 - CONDUCT FOUNDATION STRUCTURE INVESTIGATION is **NOT** a Consultant task, then send a request for the soil boring logs and test data information to the MDOT Project Manager. Include a copy of all soil boring logs and test data as an appendix to the Scour Analysis Report of work step 2.3.B.

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- B. Do not finalize the scour analysis until approval is received from MDOT for the hydraulic analysis done in work step 2.2. Prepare a scour analysis for the 1% and 0.2% flood frequency discharges using the most recent versions of the Federal Highway Administration's Hydraulic Engineering Circulars Nos. 18 and 20. Complete the Level 2 worksheet as outlined in the "MDOT Guidelines For Evaluation of Scour at Structures" and include the worksheet in the Scour Analysis Report.
- C. If potential scour is identified in work step 2.3.B., design scour countermeasures per HEC-18. The proposed countermeasures must not cause a harmful interference to adjacent riparian owners and upstream properties, which may require additional hydraulic analysis. The Consultant is responsible to ensure adequate lateral stability exists for the bridge structure under all scour conditions (see PPD Task 3570).
- D. Submit copies of the Scour Report with final scour countermeasure design (see Section 3.8 in the Supplemental Information) to the MDOT Project Manager for review and approval by Hydraulic Unit Supervisor.
- E. Receive any items returned by the MDOT Project Manager as incomplete or deficient.
- F. Make necessary changes and resubmit the entire package including a written response to all comments. Keep copies of the MDOT comments and the revised materials for the project record.
- G. Receive the MDOT Submittal Evaluation form. Contact the MDOT Project Manager if one is not received within two weeks of submitting the Scour Analysis Report.
- H. Incorporate any review comments in the analysis and design of the bridge foundation (See PPD task 3530).

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3.0 SUPPLEMENTAL INFORMATION

3.1 MDOT's Road Design Manual, Chapter 4, Drainage

3.2 MDOT's Bridge Design Manual (various chapters)

3.3 HYDRAULIC SURVEY PPD TASK 3350 FOR BRIDGES AND CULVERTS

3.4 MDOT Guidelines for Evaluation of Scour at Existing Structures

3.5 Hydraulic Certification Forms (attached)

3.6 Example Table for Culverts with Drainage Areas Less Than 2 Square Miles (attached)

3.7 Hydraulic Report Format (attached)

3.8 Scour Report Format (attached)

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3.5 HYDRAULIC CERTIFICATION FORMS

HYDRAULIC CAPACITY CERTIFICATION (Replacement Crossing)

RE: *[Enter Road Name]*
 [Enter Stream Name]
 [Enter Town, Range, Section]
 [Enter Township]
 [Enter County]

I, Certifying Engineers Name & P.E. #, do hereby certify that the ___bridge/culvert___ replacement shown on plans dated _____ is designed with an equal or greater hydraulic capacity, that the existing bridge or culvert and its approaches do not cause a harmful interference (i.e. an increased stage or change in direction of flow that causes or is likely to cause any of the following: damage to property; a threat to life; a threat to personal injury; pollution, impairment, or destruction of water or other natural resources.) and that deletion of existing auxiliary openings and road overflow areas is not planned.

[P.E. Signature]
[Enter P.E. Name]

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3.5 HYDRAULIC CERTIFICATION FORMS (cont.)

HYDRAULIC CAPACITY CERTIFICATION
(NEW CROSSING)

RE: *[Enter Road Name]*
 [Enter Stream Name]
 [Enter Town, Range, Section]
 [Enter Township]
 [Enter County]

I, Certifying Engineers Name & P.E. #, do hereby certify that the new ____bridge/culvert____ shown on plans dated _____ is designed to pass the 100 - year flood without causing a harmful interference (i.e. an increased stage or change in direction of flow that causes or is likely to cause any of the following: damage to property; a threat to life; a threat to personal injury; pollution, impairment, or destruction of water or other natural resources.).

[P.E. Signature]
[Enter P.E. Name]

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3.5 HYDRAULIC CERTIFICATION FORMS (cont.)

DAMAGE ASSESSMENT CERTIFICATION

RE: *[Enter Road Name]*
 [Enter Stream Name]
 [Enter Town, Range, Section]
 [Enter Township]
 [Enter County]

I, Certifying Engineers Name & P.E. #, do hereby certify that I have inspected the upstream adjoining properties and find that the reduction in hydraulic capacity and resulting _____ foot increase to upstream flood stages or diversion of flow will not cause a harmful interference to flood flows or damage to adjacent structures, crop lands, or potential building sites. I further certify that the existing crossing has not caused environmental and/or property damage in the past nor are there any indications that the existing crossing is hydraulically inadequate.

[P.E. Signature]
[Enter P.E. Name]

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3.6 EXAMPLE TABLE FOR CULVERTS WITH DRAINAGE AREAS LESS THAN 2 SQUARE MILES

BY:
DATE:

STRUCTURE NUMBER :
 CONTROL SECTION :
 JOB NUMBER :
 WATERCOURSE :
 LOCATION :
 CITY :
 COUNTY :
 DISCHARGE : 50-YEAR:
 100-YEAR:
 DRAINAGE AREA :
 METHOD OF ANALYSIS :

	EXISTING	PROPOSED	CHANGE
CULVERT TYPE			
SIZE			
LENGTH			
ENTRANCE TYPE			
U/S INVERT ELEV.			
D/S INVERT ELEV.			
50-YEAR			
VELOCITY AT OUTLET			
HEADWATER			
100-YEAR			
VELOCITY AT OUTLET			
HEADWATER			
50-YEAR AND 100-YEAR FLOOD ELEVATIONS ARE FOR COMPARISON ONLY			

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3.7 HYDRAULIC REPORT FORMAT

Prepare a typed hydraulic report using the format outlined below. Bind the report in a folder, inserting any loose items into pockets contained within, and arrange the contents in the following order:

A. A tabulation of the following items:

1. Stream name
2. Township
3. County
4. Section, Town, and Range
5. Drainage area
6. Discharge rates for 50-, 100-, and 500-year flood events
7. Scope of study delineating the reach of channel covered and the method used to establish the starting water surface elevation
8. Description of and basis for coefficients and variables used
9. Comments pertaining to the study including the impacts of the proposed work on the water course

B. A summary table including the following items for existing and proposed conditions at each cross section within the study for the 100-year flood event:

1. Velocity in the channel
2. Top width
3. Energy gradient
4. Change in energy gradient
5. Computed water surface elevation
6. Change in water surface elevation

NOTE: A hydraulic summary table must be included on the plans in the format shown in [Section 4.05.10](#), Road Design Manual or [Section/Note 8.05 F.](#), General Plan of Structure Sheet, Bridge Design Manual. (8-23-2021)

C. Photographs taken upstream and downstream of the crossing labeled with their location in reference to the trunkline. Include photos of any other structures within the study limits.

D. A site sheet showing the study limits with the baseline and cross section locations plotted.

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- E. Plotted profile of the channel bottom and the existing and proposed 100-year water surface and energy grade lines. The profile shall include the existing and proposed structures, as well as all other structures within the study limits. Top of road and underclearance elevations shall be included for all structures.
- F. Plotted cross sections of the watercourse used in the study.
- G. Copies of the General Plan of Site and General Plan of Structure sheets for the existing (if available) and proposed structures.
- H. One copy of the model input and output files.
- I. Refer to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Hydraulic Report Guidelines to determine if a Damage Assessment Certification may be required.

3.8 SCOUR REPORT FORMAT (BRIDGE PROJECTS ONLY)

The scour analysis with proposed scour countermeasure design is a bound report. It contains a summary and recommendation for proposed scour countermeasures. This report includes a summary table, a plot of the potential scour, calculations with background data, and copies of the Level 2 worksheet from MDOT's "Guidelines for Evaluation of Scour at Existing Structures." Values automatically calculated by HEC-RAS are not acceptable. The calculations must be done by hand or using a spreadsheet, and printouts of the HEC-RAS or SMS output with the calculations parameters highlighted must be included in the report. The appendix of this report shall contain survey notes, soil borings, sieve analyses, protective treatment design, and plans. Any questions should be referred to the Hydraulic Unit Supervisor.

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SCOPE OF WORK STATEMENT FOR FOUNDATION STRUCTURE INVESTIGATION (PPD TASK 3530)

1. SCOPE

This procedure describes the Consultant's responsibilities in performing the FOUNDATION STRUCTURE INVESTIGATION (PPD TASK 3530). This task is typically part of bridge projects.

This procedure covers a geotechnical investigation that must be in accordance with MDOT's [Geotechnical Manual](#). This investigation is necessary for all new structures and those existing structures that are to be widened or subjected to increased loads. The product of this task is a Geotechnical Report. (02-16-2010) (7-29-2019)

2. WORK STEPS

- A. Review and evaluate existing information such as existing borings, existing recommendations, etc., if available.
- B. Plan any additional soil borings necessary.
- C. Consultants must obtain all necessary permits, including an up-to-date permit from the MDOT Utilities Coordination and Permits Section, required to perform this survey on any public and/or private property.
- D. For protection of underground utilities and according to Public Act 53, 1974, the Consultant shall place A FREE locate request for public facilities by using the online [e-Locate](#) application or dial Miss Dig (1-800-482-7171) a minimum of three full working days, excluding Saturdays, Sunday, and holidays, before beginning each excavation in areas where public utilities have not been previously located. Utility members will thus be routinely notified. This does not relieve the Consultant of the responsibility of notifying utility owners who may not be a part of the Miss Dig alert system. (7-29-2019)

The Department's freeway lighting system, the ITS, and other miscellaneous electrical systems are not a part of Miss Dig. Contractors must submit a staking request on [Form 5300](#) 72 hours before digging in or near MDOT freeway right-of-way. (7-29-2019)

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SCOPE OF WORK STATEMENT FOR FOUNDATION STRUCTURE INVESTIGATION (PPD TASK 3530) (Continued)

- E. Take soil borings, perform in-situ testing and collect soil samples.
- F. Perform laboratory analyses.
- G. Prepare the Geotechnical Report submittal package. Contact the MDOT Project Manager if you have questions regarding submittal requirements. The submittal package shall include the following:
 - i. A cover letter stating conformance to MDOT's [Geotechnical Manual](#). (02-16-2010) (7-29-2019)
 - ii. List of outstanding questions and/or considerations.
- H. Submit the report to the MDOT Project Manager.
- I. Receive any items returned by the MDOT Project Manager as incomplete or deficient.
- J. Make necessary changes and resubmit the revised materials. Keep copies of the MDOT Project Manager's comments and the revised materials for the project record.
- K. Receive the MDOT Submittal Evaluation form. Contact the MDOT Project Manager if one is not received within two weeks of submitting the Geotechnical Report.

3. SUPPLEMENTAL INFORMATION (7-29-2019)

For more information, refer to the following items available through the MDOT web site:

1. MDOT's [Geotechnical Manual](#) (02-16-2010)
2. [Michigan Design Manual, Bridge Design](#)

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CHECK LIST FOR REVIEW OF CONSULTANT PLANS

1. Are tracings sealed by a professional engineer? Does consultant's logo appear on each sheet?
2. Design (11-19-99)
 - a. Check structure design by comparing to MDOT Bridge Program.
 - b. Has Consultant provided copies of their design and quantity calculations with designer's and checker's signatures.
3. Title sheet must include: (11-19-99)
 - a. Notes and allowable stresses
 - b. Federal number, Job number, etc.
 - c. Description of work (in the title block)
 - d. List of Standard Plans
 - e. Plan Index
 - f. Project located on map
4. Site Sheet must include:
 - a. Alignment controls, witnesses. Correlate with alignment on road plans.
 - b. Benchmarks
 - c. Traffic data
 - d. Utility information
 - e. Cross section of approach
 - f. Profile and vertical controls
 - g. Necessary notes
 - h. Is staging required and shown? Is the concept for maintaining traffic shown?
5. Log of Borings must include:
 - a. Bottoms of footings
 - b. Minimum pile penetration
 - c. Estimated elevation of pile tips
 - d. Boring location sketch
 - e. Standard notes
 - f. Presence of water or water table
6. General Plan of Structure
 - a. Is cross section compatible with approaches?
 - b. Is deck grade a minimum 0.25 percent? (Desirable .4 percent)
 - c. Are curb and gutters correctly labeled and are there adequate downspouts?
 - d. Is slope of fill warped to 1:6 where traffic approaches below structure?
 - e. Are limits of riprap correctly shown for stream crossings?
 - f. Do underclearance elevations indicate adequate clearance?
 - g. Does elevation view show proper side clearances?
 - h. Are excavation and fill limits properly shown? Is undercut required?
 - i. Do dimensions agree with those on detail sheets?
 - j. Are footing pressures shown on preliminary plans appropriate for the soil description?
 - k. Is proper live loading noted?
 - l. Are cofferdams or subfootings required? Is sheet piling required? Is permanent sheet piling designed?
 - m. Is hydraulic data shown for stream crossings?
 - n. Is appropriate scour protection provided?

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CHECK LIST FOR REVIEW OF CONSULTANT PLANS

7. All Detail Sheets
 - a. Are there sufficient dimensions and details to construct the bridge?
 - b. Does reinforcement appear reasonable at critical points? Spot check laps and development lengths. (See item 2)
 - c. Is appropriate reinforcement epoxy-coated?
 - d. Is substructure detail of anchor bolt and/or dowel spacing compatible with Structural Steel Detail?
 - e. Are bolsters properly stepped for superelevated decks?
 - f. Has the Expansion Joint Detail sheet been included? Are construction and expansion joints properly located in the substructure?
8. Structural Steel Details
 - a. Does stationing and dimensions to centerlines of bearing on substructure details match the center-to-center of bearing dimensions shown on the beam elevation (i.e., will the beams fit in place)?
 - b. If a field splice is required, is it detailed?
 - c. Are stiffener and connection plate details according to MDOT guides?
 - d. Are bearing types appropriate for span lengths?
 - e. If rockers are used, has the tilt diagram been included?
 - f. Are welding symbols correct?
 - g. Has C&T reviewed Structural Steel Details?
9. Prestressed Concrete Beam Details (11-19-99)
 - a. Check beam depth and strand arrangement with MDOT charts.
10. All Sheets (11-19-99)
 - a. Are sheets properly numbered and identified?
 - b. Are existing plan sheets required?
 - c. Are all plan notes included?
 - d. Are quantities shown for each unit and is all required work covered by a pay item? Are all pay items covered by a specification or special provision?
 - e. Is north arrow correctly shown?
 - f. Are the detailer and checker indicated on all plan sheets?

*** SAMPLE ***

Michigan Department
of Transportation
SVES (06/05)

SERVICE VENDOR PERFORMANCE EVALUATION

CONTRACT NO.

AUTHORIZATION NO.
(if applicable)

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Notes to Evaluator: Rate service vendor from 1 to 10. Behavioral statements are provided for ratings of 10, 8, 5, and 1 as guidance. Comments must be given for all questions rated. A rating of 7 or less must be documented in the project files. Choose N/A for items which do not apply.

The evaluator is to send the original to the contract administration office, with copies to the vendor being evaluated, the evaluator's project file, and Contract Services Division.

Note to Vendor: Any appeal of this evaluation must be filed within 14 calendar days of the signature date on this evaluation form. The appeal process details are available in Guidance Document Number 10157, Service Vendor Performance Evaluation Appeal Process.

ORGANIZATION		VENDOR NAME		Prime Sub
VENDOR PROJECT MANAGER		SPECIAL PROJECT TYPE		
PREQUALIFICATION CLASSIFICATION		WORK TYPE		
EVALUATION TYPE		PROJECT COMPLEXITY		
PROJECT ROUTE AND DESCRIPTION				
CONTROL SECTION		EVALUATION JOB NO.	CONTROLLING JOB NO.	
SERVICE COMPLETION DATE		SERVICE ACCEPTANCE DATE	COST OF SERVICE	
RATING (Whole Number)	Indicate your appraisal of the Vendor's performance and add comments for each question.			
	Project Management			
	1. Was the vendor in control of the services provided to MDOT? Rating Description 10 - Vendor displayed outstanding knowledge and control of the services and provided superior advice and counsel to the department that improved MDOT's project approach, including but not limited to communication with the public, coordination with local governments, or the project management considerations. 8 - Vendor was always knowledgeable and in control of the services and clearly met the department's expectations. 5 - Vendor was usually knowledgeable and in control but required guidance from department personnel. 1 - Vendor demonstrated no control over the services and the project was harmed. Comments			
	2. Did the vendor communicate adequately with the department staff? Rating Description 10 - Vendor provided superior communications with the department, communicating in a thorough, concise and timely manner, and clearly exceeded the department's expectations by identifying problems and helping to define choices faced by the department. 8 - Vendor always communicated with the department in a thorough, concise and timely manner and clearly met the department's expectations. 5 - Vendor usually communicated with the department in a thorough, concise and timely manner. Department personnel occasionally had to initiate and clarify communications to move project forward. 1 - Communication was lacking and the project was harmed. Comments			

RATING (Whole Number)	Indicate your appraisal of the Vendor's performance and add comments for each question. (continued)
	<p>3. Was the vendor responsive to requests from the department, including requests for information and requests to make changes in the work?</p> <p>Rating Description</p> <p>10 - Vendor anticipated the need for information or changes and proactively initiated action.</p> <p>8 - Vendor was always responsive and promptly complied with all requests.</p> <p>5 - Vendor was usually responsive or was occasionally resistant to requests for information or minor changes.</p> <p>1 - Vendor was unresponsive and the project was harmed.</p> <p>Comments</p>
	Resources
	<p>4. Did the vendor have competent and sufficient personnel with the technical expertise needed to successfully complete the project?</p> <p>Rating Description</p> <p>10 - Vendor provided personnel with superior qualifications who were able to complete the scope of services with minimal guidance or expertise given by MDOT.</p> <p>8 - Vendor always provided personnel who were able to complete the scope of services with little more than the normal guidance or expertise given by MDOT.</p> <p>5 - Vendor usually provided personnel who were able to complete the scope of services with little more than the normal guidance or expertise given by MDOT. Occasionally, the vendor's personnel demonstrated lack of knowledge and skill.</p> <p>1 - Vendor did not provide competent and sufficient personnel to adequately perform the scope of services and the project was harmed.</p> <p>Comments</p>
	<p>5. Did the vendor have adequate and sufficient resources other than personnel (equipment, manuals, etc.) to fulfill the requirements of the scope of services?</p> <p>Rating Description</p> <p>10 - All resources exceeded requirements to perform the scope of services.</p> <p>8 - All resources met requirements to adequately perform the scope of services.</p> <p>5 - Resources usually were adequate and sufficient to perform the scope of services. On some occasions, the vendor had to be notified to provide resources to meet requirements.</p> <p>1 - Vendor did not have adequate and sufficient resources to perform the scope of services and the project as harmed.</p> <p>Comments</p>
	Work Performance
	<p>6. Did the vendor follow good safety practices?</p> <p>Rating Description</p> <p>10 - Vendor took the initiative to ensure the safety and health of the employees. Safety equipment and devices were in excellent condition and were used by all vendor employees.</p> <p>8 - Safety equipment and devices were in good condition and were used by vendor's employees. Vendor immediately carried out any requests by MDOT for changes in safety measures.</p> <p>5 - Vendor usually ensured the safety and health of employees. Safety equipment and devices were in good condition and were used by vendor's employees. Vendor carried out requests by MDOT for changes in safety measures after written notification.</p> <p>1 - Vendor's safety and health practices were unsatisfactory. MDOT imposed stoppages of work for safety issues. Vendor reluctantly made changes requested by MDOT or did not make the change.</p> <p>Comments</p>

RATING (Whole Number)	Indicate your appraisal of the Vendor's performance and add comments for each question. (continued)
	<p>7. Did the vendor provide a quality work product?</p> <p>Rating Description</p> <p>10 - Vendor's work product was excellent (complete, accurate, and professional in appearance) and MDOT requirements were exceeded.</p> <p>8 - Vendor's work product was acceptable and MDOT requirements were met without a need for MDOT to identify deficiencies.</p> <p>5 - Vendor's work product met minimum requirements but required notification of deficiencies from MDOT.</p> <p>1 - Vendor's work product was unacceptable and clearly did not meet MDOT requirements, and the project was harmed.</p> <p>Comments</p>
	<p>8. Did the vendor properly notify and coordinate work with other affected parties such as utility companies, property owners, local units of government, and other MDOT areas?</p> <p>Rating Description</p> <p>10 - Vendor was proactive in initiating and executing notifications and project coordination activities.</p> <p>8 - Vendor always provided proper notification and coordinated with each affected party.</p> <p>5 - Vendor usually coordinated with, or gave proper notification to, all affected parties.</p> <p>1 - Vendor did not provide proper notification nor coordinate with affected parties, and the project was harmed.</p> <p>Comments</p>
	<p>9. Did the vendor meet the applicable environmental requirements, such as documentation, enforcement, obtaining permits, studies, etc.?</p> <p>Rating Description</p> <p>10 - Vendor was proactive in initiating and executing activities to meet environmental requirements without prompting by MDOT.</p> <p>8 - Vendor always met environmental requirements.</p> <p>5 - Vendor usually met environmental requirements.</p> <p>1 - Vendor's failure to meet environmental requirements harmed the project.</p> <p>Comments</p>
	<p>10. Did the vendor meet deliverable date requirements?</p> <p>Rating Description</p> <p>10 - Acceptable deliverables were always received more than 15% ahead of schedule.</p> <p>8 - Acceptable deliverables were always within the schedule.</p> <p>5 - Acceptable deliverables were usually received no more than 10% behind schedule.</p> <p>1 - Acceptable deliverables were usually received more than 25% behind schedule.</p> <p>Comments</p>
	<p>11. To the best of my knowledge, did the vendor comply with applicable federal, state and local laws and regulations and/or MDOT guidelines and procedures? This includes, but is not limited to, compliance with prompt payment to subvendors (completing attachment G), submitting accurate and timely invoices, and responding to contractual issues.</p> <p>Rating Description</p> <p>10 - Vendor displayed outstanding knowledge of applicable federal, state and/or local laws and regulations. In addition, the vendor was proactive in assuring they complied with MDOT guidelines and procedures and therefore needed no MDOT intervention.</p> <p>8 - Vendor always knew and complied with applicable federal, state and/or local laws and regulations. In addition, the vendor always followed MDOT guidelines and procedures with normal guidance or expertise given by MDOT.</p> <p>5 - Vendor was usually knowledgeable of applicable federal, state and/or local laws and regulations, but MDOT had to intervene occasionally to assure compliance. The vendor usually followed MDOT guidelines and procedures but needed more than the normal guidance or expertise by MDOT. Any problems were corrected immediately upon notification by MDOT.</p> <p>1 - Vendor failed to comply with applicable federal, state and/or local laws and regulations and/or the vendor failed to comply with MDOT guidelines and procedures.</p> <p>Comments</p>

RATING (Whole Number)	Indicate your appraisal of the Vendor's performance and add comments for each question. (continued)
	Subvendor Management
	<p>12. Did the vendor coordinate work with subvendor's work, exercise authority over subvendors, provide notice of subvendor work schedule, and ensure that subvendors were in compliance with contract requirements?</p> <p>Rating Description</p> <p>10 - Vendor was proactive in exercising authority, coordinating and monitoring work operations of the subvendors to ensure acceptable completion of the scope of services.</p> <p>8 - Vendor always exercised authority, coordinated and monitored work operations with their subvendors to ensure acceptable completion of the scope of services.</p> <p>5 - Vendor usually exercised authority, coordinated and monitored work operations with their subvendors to ensure acceptable completion of the scope of services. Any problems were corrected immediately upon notification by MDOT.</p> <p>1 - Vendor's failure to exercise authority, coordinate and monitor work operations with their subvendors harmed the project.</p> <p>Comments</p>

OTHER COMMENTS

SAMPLE

PROJECT MANAGER HAS NOTIFIED ANY SPECIALTY AREAS TO COMPLETE AN EVALUATION

YES

NO

IS THIS A PRIMARY EVALUATION OR A SPECIALTY AREA EVALUATION?

EVALUATED BY: (Please print)

DATE

EVALUATOR'S SIGNATURE

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 6

Chapter has been removed. Relevant information has been relocated to Chapter 1. (11-24-2025)

**MICHIGAN DESIGN MANUAL
BRIDGE DESIGN - CHAPTER 7: LRFD**

CHAPTER 7 - LRFD

DESIGN CRITERIA - NEW AND RECONSTRUCTION PROJECTS

7.01 GENERAL

- 7.01.01 Design Specifications
- 7.01.02 Design Method
- 7.01.03 Design Stresses
- 7.01.04 Design Loading
- 7.01.05 Fatigue Resistance
- 7.01.06 Deflection
- 7.01.07 Temperature Range
- 7.01.08 Vertical Clearance
- 7.01.09 Longitudinal Deck Grades
- 7.01.10 Temporary Support Systems and Construction Methods (8-6-1992)
- 7.01.11 Clear Zone Considerations (8-6-1992)
- 7.01.12 Sight Distance Considerations (5-6-1999)
- 7.01.13 Concrete QA/QC (5-6-1999)
- 7.01.14 Skew Policy (8-20-2009)
- 7.01.15 Shoulder Widths for Work Zone Safety and Mobility (8-20-2009)
- 7.01.16 Redundancy (8-20-2009)
- 7.01.17 Part Width Construction (11-28-2011)
- 7.01.18 Horizontally Curved Girder Bridges (11-28-2011)
- 7.01.19 Accelerated Bridge Construction (6-17-2013)
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DESIGN CRITERIA - NEW AND RECONSTRUCTION PROJECTS

7.01

GENERAL

7.01.01

Design Specifications (8-20-2009)

In general, bridges in Michigan carrying vehicular traffic are designed according to the current edition of the LRFD Bridge Design Specification published by the American Association of State Highway and Transportation Officials (AASHTO). The exceptions to changes in AASHTO requirements are presented in this Design Manual.

The AASHTO specifications are also applied in the design of pedestrian bridges and major structures such as retaining walls and pumphouses. LRFD Guide Specifications for the Design of Pedestrian Bridges and Guide for the Development of Bicycle Facilities will aid in the design of other modes of transportation. (12-16-2019)

Bridges carrying railroads are designed according to the current specifications of the American Railway Engineering and Maintenance-of-Way Association Specifications (AREMA).

7.01.02

Design Method (8-20-2009)

The design of all structural elements shall satisfy Service Limit State and/or Strength Limit State requirements of the AASHTO LRFD Bridge Design Specifications.

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7.01.03

Design Stresses (5-27-2025)

Concrete: Grade 3500, 3500HP* $f'_c = 3000$ psi

Concrete: Grade 4000, $f'_c = 3500$ psi

Concrete: Grade 4500, 4500HP* $f'_c = 4000$ psi

Steel Reinforcement $f_y = 60,000$ psi

Steel Reinforcement:

Stirrups for Prestressed Beams

(including stainless steel (SD) bars)

$f_y = 60,000$ psi

Stirrups for 17" & 21" Box Beams

(including stainless steel (SD) bars)

$f_y = 40,000$ psi

Structural Steel:

AASHTO M270

Grade 36

$F_y = 36,000$ psi

Structural Steel (including H-Piles, splices and pile points):

AASHTO M270

Grade 50

$F_y = 50,000$ psi

Grade 50W

$F_y = 50,000$ psi

Structural Steel Pins:

ASTM A276

UNS Designation

S20161 or S21800

$F_y = 50,000$ psi

Temp Support Hanger Rods:

ASTM A193 Grade B7 (AISI 4140)

2 ½" and under

$F_u = 125,000$ psi

$F_y = 105,000$ psi

Over 2 ½" to 4"

$F_u = 115,000$ psi

$F_y = 95,000$ psi

Over 4" to 7"

$F_u = 100,000$ psi

$F_y = 75,000$ psi

Prestressed Concrete ** $f'_c = 6000 - 8000$ psi

Prestressed Concrete Compressive

Strength at Release $f'_{ci} = 7000$ psi (max)

Prestressing Strands $f_{pu} = 270,000$ psi

Foundation Piling (Steel Shells):

ASTM A252

Grade 3 Modified

$F_y = 50,000$ psi

Foundation Piling (Timber) $F_{CO} = 900$ psi

High Strength Bolts:***

Organic zinc rich primer (Class B)

(Type 4 coating system) $F_s = 32,000$ psi

* Use Grade 3500HP and 4500HP on all MDOT projects. Grade 3500 and 4500 may be used on Local Agency projects if desired by the Owner. (4-22-2024)

** See Subsection 7.02.03.

*** Value of F_s is Design Slip Resistance for Slip-Critical Connections with faying surfaces coated.

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7.01.04

Design Loading (6-27-2022)

The design loading is as specified in AASHTO LRFD 3.6.1.2 of with the exception that the design tandem as specified in 3.6.1.2.3 shall be replaced with a single 60 kip load.

A. Interstate and Trunklines (6-27-2022)

Vehicular live loading on the roadways of bridges designated HL-93 Mod, shall consist of 1.2 times the combination of the:

- Design truck or single 60 kip load
- Design lane load

Where 90% of two design trucks are combined with 90% of the effect of a lane load for both negative moment and pier reactions per 3.6.1.3 a 1.2 multiplier shall be applied to the resulting moment or load. Each design lane under consideration shall be occupied by either the design truck or single 60 kip load, coincident with the lane load, where applicable. The loads shall be assumed to occupy 10.0 ft. transversely within a design lane.

The design truck and design lane load are specified in AASHTO LRFD 3.6.1.2.2 and 3.6.1.2.4.

B. Local Roads and Streets (6-27-2022)

Structures carrying local roads or streets are to be designed according to county or city standards. The minimum design load acceptable for streets or primary county roads is HL-93 Mod loading as specified in this entire section. (8-6-92)

The load modifying factor, η (eta), for operational importance, may be considered for less important roads (AASHTO LRFD 1.3.2.1).

7.01.04 (continued)

C. Pedestrian and Bicycle (Nonmotorized) Bridges

Pedestrian and bicycle (nonmotorized) bridges shall be designed according to the current AASHTO LRFD Bridge Design Specifications 3.6.1.6. and current edition of the Guide Specifications for Design of Pedestrian Bridges. The assumed live load is 90 LBS/SFT. Consideration shall also be given to maintenance vehicles with regard to design loadings and horizontal clearances. For Clear Bridge Width, w , greater than 10'-0", use an H10 truck. For w between 7'-0" and 10'-0", use an H5 truck. Where vehicular access is prevented by permanent physical methods (bollards, gates, etc.) or for w less than 7'-0" the bridge does not need to be designed for a maintenance vehicle.] (8-20-2009) (11-28-2011) (5-25-2015)

D. Railroad Bridges

Railroad bridges are designed according to the current AREMA Specifications, with the Cooper loading established by the railroad company.

E. Section combined with 7.01.04 C. (5-25-2015)

F. Deck Replacement, Bridge Widening or Lengthening

When an existing deck is to be replaced or the structure is to be widened or lengthened, the proposed reconstruction should be designed according to LRFD where practicable. In cases where LRFD cannot be used, the design method shall be approved by the MDOT Chief Structure Design Engineer. (5-27-2020)

G. Ice Force on Piers

All piers that are subjected to the dynamic or static force of ice shall be designed according to the current AASHTO LRFD Bridge Design Specifications. (8-20-2009)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.01.04 (continued)

Design Loading

H. Future Wearing Surface

All new bridges and bridge replacements shall be designed for a future wearing surface load of 25 LBS/SFT. (5-6-99)

I. Stay In Place Forms (6-27-2022)

Generally, corrugations for stay-in-place forms are filled with polystyrene foam. If corrugations are not required to be filled with foam, a design load of 15 LBS/SFT should be added.

J. Barrier Loads

For purposes of beam design, the barrier dead load can be distributed equally to all beams. (AASHTO Std. Specs 17th edition 3.23.2.3.1.1 & AASHTO LRFD 4.6.2.2) However, when calculating superstructure loads on the substructure, particularly for cantilevered pier caps, 75% of the barrier dead load should be applied with the fascia beam load. The remaining 25% of the barrier load should be applied with the first interior girder load. (8-20-2009)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.01.04 (continued)

Design Loading

K. Vehicle Collision Force (7-24-2023)

Account for the AASHTO LRFD vehicle collision force in the design of all new bridges, bridge replacements, and pier replacements.

Locate the pier outside of the clear zone as defined in Section 7.01.11 of the MDOT Road Design Manual where possible. The clear zone used to determine the location of the pier must account for future roadway widening where applicable.

If a pier cannot be located outside of the clear zone design a multi-column pier with a base wall. Design the base wall with the minimum dimensions specified in MDOT Bridge Design Guide 5.22.01 and to meet the requirements outlined in Section 3.6.5.1 of the AASHTO LRFD Bridge Design Specifications.

Alternatively, a reinforced solid wall pier may be designed with the following minimum dimensions to meet the requirements outlined in Section 3.6.5.1 of the AASHTO LRFD Bridge Design Specifications:

1. The minimum width of the solid wall is 3'-0".
2. The minimum cross-sectional area of the wall is 30.0 square feet measured in the horizontal plan. Generally, a 10'-0" minimum length based on a width of 3'-0".

A pier base wall with the minimum dimensions specified in MDOT Bridge Design Guide 5.22.01 and a solid wall pier with the minimum dimensions specified above are components with adequate structural resistance and do not need to be designed to withstand the vehicle collision force required by the AASHTO LRFD Bridge Design Specifications. (11-27-2023)

For situations where the above criteria cannot be satisfied, design the pier to withstand the full vehicle collision force required by the AASHTO LRFD Bridge Design Specifications.

7.01.04 (continued)

Design the pier footing or the pile group or drilled shafts supporting the pier to withstand the vehicle collision force using the appropriate limit states and load combinations. (11-27-2023)

The vehicle collision force may be redirected or absorbed with Type C single face concrete barrier in accordance with MDOT Standard Plan R-54-Series if the pier cannot be located outside of the clear zone. Locate the Type C single face concrete barrier relative to the pier to meet the requirements outlined in Section 3.6.5.1 of the AASHTO LRFD Bridge Design Specifications. Provide appropriate barrier end treatments in accordance with the MDOT Road Design Manual. If the Type C single face concrete barrier encroaches on the required lane or shoulder widths for the roadway under the bridge shielding the pier shall not be considered. Design the pier with a base wall, as a reinforced solid wall pier, or to withstand the full vehicle collision force required by the AASHTO LRFD Bridge Design Specifications. If the pier is designed to withstand the full vehicle collision force design the pier footing or the pile group or drilled shafts supporting the pier to withstand the vehicle collision force using the appropriate limit states and load combinations. (11-27-2023)

Site and project specific conditions must be considered by the Bridge Engineer when determining the option for accounting for the vehicle collision force. This may include, but is not limited to foundation limitations, the estimated cost of each option, and the construction schedule for the project.

New bridges, bridge replacements, and pier replacements shall not be exempted from the application of the AASHTO LRFD vehicle collision force.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.01.04 (continued)

Design Loading

K. Vehicle Collision Force

Where existing piers are to be widened, design the widened portions of the pier to account for the vehicle collision force. See Section 12.08.08 of the MDOT Bridge Design Manual for guidance on accounting for the vehicle collision force at existing piers to remain in place. If the existing portion of the pier is being protected with single face concrete barrier (R-49-Series) extend the concrete barrier to protect the proposed portion of the pier as well.

A Local Agency has the discretion to define their policy for accounting for the AASHTO LRFD vehicle collision force in the design of bridges within their inventory in accordance with Section 3.6.5 of AASHTO LRFD. In the absence of published guidance from a Local Agency the applicability of the AASHTO LRFD vehicle collision force shall be determined using the same criteria that is used for classifying bridges under MDOT jurisdiction.

Bridges spanning over railroad right-of-way shall meet the requirements outlined in the AREMA Manual for Railway Engineering or local railroad company guidelines.

7.01.05

Fatigue Resistance

Determine nominal fatigue resistance using a structure design life of 75 years and the truck ADTT averaged over the design life. Add note 8.05 P. providing this information on the General Plan of Structure sheet. Design according to AASHTO LRFD Bridge Design Specifications 3.6.1.4 & 6.6.1. (8-20-2009) (8-23-2021)

7.01.06

Deflection

A. Deflection Limits (6-27-2022)

Deflection limits shall be as specified in the current AASHTO LRFD Bridge Design Specifications 2.5.2.6.2.

The live load shall be taken from AASHTO LRFD 3.6.1.3.2.

B. Cantilever Deflection Computation

In computing the live load plus dynamic load allowance deflection of cantilevers of composite anchor span, the gross section of the anchor span is to be used. The length of the composite section for this analysis is to be assumed to extend from the bearing line to the point of dead load contraflexure. (5-27-2020)

7.01.07

Temperature Range

- A. The temperature range used to determine thermal forces and movements shall be in conformance with AASHTO "cold climate" temperature range per AASHTO LRFD 3.12.2.
- B. The type of structure used in determining the temperature range, per AASHTO, shall be defined by the material of the main supporting members of the superstructure or substructure being considered.

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7.01.08

Vertical Clearance

A. Requirements

The desired vertical bridge underclearances should be provided as indicated in the following table. If the desired underclearances cannot be provided, then the minimum underclearances shall be met. Where it is considered not feasible to meet these minimums, a design exception shall be requested from the Engineer of Road Design and subsequently to the FHWA (approvals designated in the [Risk Based Project Involvement](#) Stewardship and Oversight (RBPI S&O) plan) and from MDOT Bureau of Bridges and Structures, Chief Structure Design Engineer on "MDOT Oversight" projects (see Section [12.03](#) also). See the vertical clearance design exception matrix in [Appendix 12.02.01](#). Requests to further reduce the underclearance of structures with existing vertical clearance less than indicated in the following table should be made only in exceptional cases.

(12-27-2021)

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7.01.08 (continued)

Vertical Clearance

A. Requirements

VERTICAL CLEARANCE REQUIREMENT TABLE (8-20-2009) (6-22-2015)

Route Classification Under the Structure	All Construction (Desired)	New Construction (Min *)	Road 4R Construction (Min *)	Bridge 4R Construction (Min *)	3R Construction (Min *)
Freeways	16'-3"	16'-0"	16'-0"	16'-0"	16'-0" ***
NHS Arterials (Local & Trunkline)	16'-3"	16'-0"	Maintain Existing** and 14'-6" Min	16'-0"	Maintain Existing** and 14'-0" Min
Non NHS Arterials (Local & Trunkline)	16'-3"	14'-6"	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-0" Min
Collectors, Local Roads & Special Routes ⁽¹⁾	14'-9"	14'-6"	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-0" Min

3R = Rehabilitation, Restoration, Resurfacing

* Minimum Vertical Clearance must be maintained over complete usable shoulder width.

** Existing vertical clearances greater than or equal to the minimums shown may be retained without a design exception. Vertical clearance reductions that fall below the minimums for new construction require a design exception. (6-22-2015)

*** Existing vertical clearances may be retained (or increased) without a design exception unless a pattern of high load hits exist. Vertical clearance reductions below the standard (table value) require design exceptions. (5-27-2020)

(1) Special Routes are in Highly Urbanized Areas (where little if any undeveloped land exists adjacent to the roadway) where an alternate route of 16'-0" is available or has been designated. Bridges located over [Special Routes in Highly Urbanized Areas](#) can be found on the MDOT website. (5-23-2022)

Ramps and roadways connecting a Special Route and a 16'-0" route require a vertical clearance minimum of 14'-6" (14'-9" desired). Ramps and roadways connecting two 16'-0" routes require a vertical clearance minimum of 16'-0" (16'-3" desired). (8-20-2009)

4R = Reconstruction

Information on the NHS systems can be obtained by contacting the Statewide Planning Section, Bureau of Transportation Planning or found on the MDOT website at:

<http://www.michigan.gov/mdot/programs/highway-programs/nfc> . (5-23-2022)

Pedestrian bridges are to provide 1'-0" more underclearance than that required for a vehicular bridge. For Freeways (Interstate and non-Interstate), including Special Route Freeways, the desired underclearance shall be 17'-3" (minimum 17'-0"). (8-20-2009)

A vertical underclearance of 23'-0" is required for highway grade separations over railroads when constructing a new bridge or removing the existing superstructure. For preventative maintenance, rehabilitation and deck replacement projects the existing railroad vertical underclearance does not need to be increased unless requested by the Railroad. (11-28-2011)

Clearance signs are to be present for structures with underclearance of 16'-0" or less (show dimensions 2" less than actual). See MDOT Traffic and Safety [Sign Design, Placement, and Application Guidelines](#) for additional information and guidelines. (5-23-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.01.08 (continued)

Vertical Clearance

A. Requirements

For shared use paths (pedestrian and bicycle), the vertical clearance to obstructions, including overhead fencing, shall be a minimum of 8'-6" (10'-0" desired). However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In undercrossings and tunnels, 10'-0" is desirable for vertical clearance. See AASHTO's Guide for the Development of Bicycle Facilities. (9-2-2003)

B. Interstate Vertical Clearance Exception Coordination (5-23-2022)

In addition to normal processing of design exceptions, all proposed design exceptions pertaining to vertical clearance on Eisenhower Interstate System (Interstate) routes including shoulders, and all ramps and collector distributor roadways of Interstate to Interstate interchanges will be coordinated with the Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA). All exceptions to the 16'-0" vertical clearance standard on Eisenhower Interstate System are coordinated with SDDCTEA. The Eisenhower Interstate System designated routes can be found at the FHWA NHS Maps website (https://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/michigan/index.cfm). This requirement does not apply to Special Routes (1).

7.01.08 (continued)

MDOT (or its Consultant) is responsible for coordinating exceptions on all projects regardless of oversight responsibilities. MDOT will send a copy of all requests, and responses, to the FHWA. Michigan Interstate Vertical Clearance Exception Coordination, MDOT [Form 0333](#), is available from MDOT web site.

Requests for coordination shall be emailed to: usarmy.scott.sddc.mbx.tea-hnd@mail.mil

Contact with inquiries:

Douglas E. Briggs, P.E., 618-220-5229
douglas.e.briggs.civ@mail.mil

or

Jamie Todt, P.E., 618-220-5216
jamie.l.todt.civ@mail.mil

Physical mailings:

Highways for National Defense
ATTN: SDDCTEA
1 Soldier Way
Scott AFB, IL 62225

Fax: 618-220-5125

MDOT (or its Consultant) shall verify SDDCTEA receipt of the request. If no comments are received within ten working days, it may be assumed that the SDDCTEA does not have any concerns with the proposed design exception.

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7.01.09

Longitudinal Deck Grades (9-23-2024)

Provide longitudinal grades to facilitate deck surface drainage. While it is desired to design bridges with steeper longitudinal grades the minimum grade (or minimum projected tangent grade for vertical curves) is 0.5%. Providing longitudinal grades at or near the minimum grade may necessitate the need for deck drainage with drains and downspouts. Generally, it will be necessary to perform bridge deck drainage design calculations in accordance with MDOT [Drainage Manual](#). In addition, close attention to drainage is critical for sag and crest vertical curves when the K value (rate of grade change) is greater than 167 where,

$$K=L/A$$

L= Length of vertical curve, feet

A= Algebraic difference in grades, percent

Consider alignments that locate vertical curves outside the limits of the structure where the desirable minimum longitudinal grades can be achieved. When a vertical curve must be located on the bridge, avoid placing the high point (or low point) of the vertical curve on the bridge.

Structure on 1% or steeper grades should be fixed to the substructure at the lower end of structure where practicable. (9-2-2003)

7.01.10

Temporary Support Systems and Construction Methods

Where construction procedures will require a temporary support system, the plans shall note the loading that will be imposed on the system and the allowable stresses that can be assumed for the supporting soil. (8-6-92)

Where a construction sequence is critical, where there are restrictions on access for construction, or where the method of temporary support is not obvious, the plans shall provide an acceptable system that the contractor may employ. Alternatives may be proposed by the contractor, but these must be reviewed and approved by the Engineer if they are to be substituted.

This review is to insure that:

- A. appropriate design specifications and permit limitations have been complied with, and
- B. any temporary or permanent stresses imposed on the completed structure are within allowable limits.
- C. possible vibration induced damage to existing structures and utilities is identified and mitigated. (11-28-2011)

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7.01.11

Clear Zone Considerations

(8-6-92) If possible, substructure units should be located outside the clear zone, as defined by current AASHTO Roadside Design Guide. Where this is not feasible, the unit shall be shielded from impact by errant vehicles.

7.01.12

Sight Distance Considerations

When designers are developing shoulder widths on structures or pier offsets from pavement edges, sight distance should be considered. MDOT policy has set bridge (shoulder) widths 2' (offset) greater than AASHTO widths for safety considerations of the traveling public. Consult with Traffic & Safety Geometric Section for guidance and see [Bridge Design Guides](#) 6.05 Series & 6.06 Series. (5-6-99) (9-21-2015)

7.01.13

Concrete QA/QC

The provisions for Concrete QA/QC do not apply to bridge deck overlay mixtures or substructure patching. (12-5-2005)

7.01.14

Skew Policy (12-5-2005)

Skewed cross sections and stresses resulting from them must be considered when designing structures. Where possible, avoid excessive skews by moving abutments back and squaring them off (decreasing skew angle). Where the skew cannot be avoided, the engineer shall perform the necessary analyses to account for the skew.

θ = skew angle = angle measured from line perpendicular to bridge centerline to support reference line = 90° - angle of crossing.

Skew Angle	Design Requirements
$\theta \leq 30^\circ$	Standard design using approximate methods
$30^\circ < \theta \leq 45^\circ$	Special design using refined methods.*
$\theta > 45^\circ$	Use of angles greater than 45° must be approved through Bridge Design. Refined methods of design are also required.*

*Refined methods shall include using finite element methods of analysis to address girder roll, torsion, bearing restraints, bearing rotations, thermal movement direction and amount, cross frame loading, camber detailing and deck edge/end reinforcement.

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7.01.15

Shoulder Widths for Work Zone Safety and Mobility (8-20-2009) (6-16-2014)

For 2 lane freeway and interstate new bridge construction and superstructure replacements the standard bridge shoulder widths shall be 14'-10". This will provide increased safety and mobility for future maintenance of traffic. The cross section will provide part width bridge construction with traffic being maintained on two 11 ft. lanes with 1 ft. shy distance on each side. For cross section see Bridge Design Guide [6.05.01A](#). A design exception will be required when the shoulder width is not met. The Region shall determine the required shoulder width at the scoping of the projects. (9-25-2023)

For shoulder widths for deck replacements, see section 7.02.31. A design exception will be required when the shoulder widths provided on deck replacement projects do not meet those required in section 7.02.31. Shoulders wider than those specified in section 7.02.31 may be required to accommodate corridor mobility needs and to accommodate the future maintenance of traffic needs for projects affecting infrastructure adjacent to the bridge. The Region shall determine the required maintenance of traffic needs for the corridor at the scoping of the projects and will document how the corridor mobility needs have been considered in the Scoping Report for the structure. The corridor mobility needs and the proposed clear roadway width for the deck replacement project will be confirmed during the Scope Verification Meeting for the project and the discussion must be documented in the minutes for the meeting. (9-25-2023)

Designers should layout beam spacing to accommodate future part width reconstruction. Beams may be located under the crown of the bridge deck provided there is no construction joint in the bridge deck at the crown. (11-27-2023)

Bridge approach guardrail and bridge approach curb and gutter will be affected as a result of the widened shoulders and must be addressed in the design of the approaches. If the increased shoulder width is deemed necessary on reconstruction projects substructure widening may become necessary.

7.01.16

Redundancy

(8-20-2009) (9-17-2012) (3-23-2020)

Any proposed elements, or systems that do not meet AASHTO and FHWA redundancy requirements are prohibited. Bridge superstructures (beam/slab type) must have a minimum of 3 longitudinal beams or girders.

7.01.17

Part Width Construction (11-28-2011)

For existing bridges used to maintain traffic, the structural performance of the in-service portion of the structure shall be evaluated with respect to stage demolition and adjacent construction.

To the extent possible, plans shall show location of existing spread footings with respect to proposed construction.

Unbraced excavations for new substructures shall not extend below the bearing elevation of adjacent spread footing foundations.

Drilled excavations adjacent to in-service spread footing foundations shall be cased to prevent undermining.

For part-width construction of bridges, provide a minimum of 6' between the centerline of temporary sheeting (along the stage line) and the existing substructure sawcut line. This will allow for the width of sheeting and any required walers and/or tiebacks. (2-26-2018)

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7.01.18

Horizontally Curved Girder Bridges

(6-27-2022)

At a minimum, refined analysis shall address primary structural members, including the beams and cross frames of horizontally curved steel beams during all phases of the construction process. Special consideration shall be given to avoid part width construction of structures. At a minimum, refined methods shall address camber detailing, girder stress, cross frame loading, girder roll, and torsional load on the beams/girders.

Shoring (temporarily supporting) may be necessary to prevent deflections during part width construction and maintenance of traffic. Interior girders in the final structure will be exterior girders in a part width situation and shall be designed accordingly.

Use refined methods when the skew angle exceeds 30 degrees, the span length of any one span is greater than 150 feet or the radius of the beam/girder is less than 2000 feet (degree of curvature, "D", is greater than three degrees (3°)).

Constructability Reviews shall be done on all projects especially those with part width construction and curved steel girders. See [Chapter 2](#).

Refined methods include finite element, method, finite strip method, finite difference method, analytical solution to differential equations, and slope deflection method.

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7.01.19

Accelerated Bridge Construction (ABC) (6-17-2013)

A. Background and Process

Accelerated Bridge Construction (ABC) techniques, including Prefabricated Bridge Elements & Systems (PBES) and Full Structural Placement Methods, are recognized by the Michigan Department of Transportation (MDOT) and the Federal Highway Administration (FHWA) as important and effective methods to construct or rehabilitate highway structures, while reducing the impact of bridge construction activities on mobility, the economy, and user delay.

ABC may include new technologies in the form of construction and erection techniques, innovative project management, high performance materials, and pre-fabricated structural elements to achieve the overall goals of shortening the duration of construction impacts to the public, encouraging innovation, ensuring quality construction, and expected serviceability of the completed structure.

All major rehabilitation or reconstruction bridge projects should be evaluated at the Scoping Process, see [Chapter 6](#) of the Scoping Manual, to determine if ABC is suitable and provides a benefit; taking into consideration safety, construction cost, site conditions, life cycle cost of the structure, MDOT's mobility policy and user delays, and economic impact to the community during construction.

7.01.19 (continued)

All proposed ABC candidate projects are subject to Statewide Alignment Team Bridge (Bridge Committee) approval. Candidate projects during the scoping phases are to be presented at the monthly Bridge Committee meeting. The Bridge Committee will review candidate projects for further evaluation, and grant approval to pursue ABC techniques and determine availability of Bridge Emerging Technology funding. Once the Bridge Designer is assigned the project they shall determine if the ABC methodology is feasible from a design aspect. Issues shall be discussed with the Bridge Development Engineer, Bridge Field Services Engineer, and subsequently the Bridge Committee. A Scope Verification meeting may be necessary to resolve design and constructability issues (see [Section 2.02.14 & 15](#) of Bridge Design Manual).

If the determination has been made that ABC will be implemented on a specific project, the next step is to choose the methods that are technically and economically feasible.

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7.01.19 (continued)

Accelerated Bridge Construction (ABC)

B. Prefabricated Bridge Elements & Systems (PBES)

Prefabricated Bridge Elements & Systems (PBES) can be built on site away from traffic if site conditions warrant, or they can be fabricated off site and shipped to the site. Both methods offer advantages in quality control compared to cast in place construction where schedule or staging dictate the work progression. Non-prestressed reinforced concrete elements can be considered for on-site, or near site fabrication. Prestressed elements must be fabricated in a Prestressed Concrete Institute (PCI) certified plant.

1. Constructability

Erection of prefabricated elements and the connection details will require special attention being paid to the following:

a. Dimensional Tolerances:

- (1) Connections between elements must accommodate field erection. This may require staggering, or mechanically splicing connection or closure pour reinforcement or grouted splicers.
- (2) Elements fabricated off site should be test fit or otherwise confirmed to be of the correct dimensions prior to shipping.
- (3) Templates should be used to ensure correct fit-up between prefabricated elements or between a prefabricated element and a cast in place element.
- (4) Connection details should be standardized.

7.01.19 (continued)

b. The weight and size of precast elements:

- (1) Need to ensure elements can be erected with contractor's equipment. Typically, PBES element weights should be limited to 40 tons.
- (2) Need to ensure elements can be shipped to the site.
- (3) Need to ensure elements can be erected without long term lane closures.

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7.01.19 (continued)

**Accelerated Bridge Construction
(ABC)**

**B. Prefabricated Bridge Elements &
Systems (PBES)**

2. Prefabricated Element Types

The following prefabricated elements may be considered for use on MDOT bridge projects:

a. Precast full depth deck panels.

- (1) Panels may be connected by reinforcement splice with closure pours using high strength concrete or ultra-high performance concrete or they may be transverse or longitudinally post tensioned.
- (2) Panels are sensitive to skew and beam camber and haunches.
- (3) Panels using post tensioning may have long term maintenance concerns.
- (4) Riding/wearing/sealing surface should be provided such as epoxy overlay or HMA overlay with waterproofing membrane.
- (5) Dimensional tolerances are very tight.
- (6) Additional geometry control will be required, and should be stated in the plans to be included in the Contractor Staking pay item.
- (7) Match casting may be used to assure proper fit-up when complex geometry is required.

7.01.19 (continued)

b. Decked Beam elements. (12-17-2018)

- (1) Two steel beams connected with deck (modular beams).
- (2) Decked Bulb Tee beams.
- (3) Decked prestressed spread box beams.
- (4) These systems rely on full shear and moment capacity joints and closure pours.

Ultra High Performance Concrete may be used to reduce the lap length of the connection detail.

- (5) Camber control may require pre-loading of erected modular units, or partial post tensioning until all dead load deflections are applied.
- (6) Casting the roadway cross slope and/or vertical alignment curvature on modular units may be difficult, consider variable thickness overlays to develop required geometry.

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7.01.19 (continued)

Accelerated Bridge Construction

B. Prefabricated Bridge Elements & Systems (PBES)

c. Pier Elements.

- (1) Precast pier caps.
- (2) Precast columns.
- (3) Precast pile caps.
- (4) These systems rely on grouted or mechanical reinforcement splices to develop reinforcement sufficiently to transfer reactions from one element to the next.
- (5) Consider multiple smaller caps spanning two columns as opposed to one large cap.
- (6) Pier columns that directly support beams without pier caps may be considered.
- (7) Pier column voids can be considered to reduce weight. Weight of PBES elements should be limited to 40 tons where possible.

7.01.19 (continued)

d. Abutment and Wall Elements.

- (1) Precast abutment panels.
- (2) Precast footings.
- (3) Precast backwalls and wingwalls.
- (4) These systems rely on grouted or mechanical reinforcement splices to develop reinforcement sufficiently to transfer reactions from one element to the next
- (5) Voids can be considered to reduce weight. Weight of PBES elements should be limited to 40 tons where possible.

e. Precast Approach Slabs

Dimensional tolerances are very tight for all Prefabricated Bridge Elements & Systems (PBES). The tolerance sensitivity required when erecting prefabricated elements may require dual or independent survey contracts to ensure proper fit up, camber, deflections and finished grades.

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7.01.19 (continued)

Accelerated Bridge Construction

C. Full Structural Placement Methods

The following full structural placement methods may be considered for use on MDOT bridge projects:

1. Self-Propelled Modular Transport (SPMT):
 - a. Computer controlled platform vehicle with movement precision to within a fraction of an inch.
 - b. Capable of lifting 165 to 3,600 tons.
 - c. Vertical lift range of 36 to 60 inches.
 - d. Axle units can be rigidly coupled longitudinally and laterally.
 - e. Move costs can be up to \$500,000 (mobilization costs are significant, so SPMTs should be considered on corridors where multiple bridges may be moved).
 - f. Limited to use on sites with minimal grade changes.
2. Lateral Bridge Slide:
 - a. Bridge section is built on temporary supports adjacent to existing substructure.
 - b. Bridge section bears on stainless steel, or other low friction surface such as Teflon.
 - c. Existing substructure units can be reused, or new units constructed with minimal impact to traffic. Consider converting multiple span bridges into single spans so that proposed substructure units can be constructed in different locations from existing without impacting the operation of the existing structure.

7.01.19 (continued)

- d. Bridge section is laterally jacked, or rolled into place.
- e. Required jacking forces must overcome static and kinetic friction.
- f. Consideration shall be given for the need to push and pull the bridge to meet movement tolerances. The hydraulic ram or cable with rollers shall be sized to accommodate both movements.
- g. Cost to slide a bridge is approximately \$50,000 to \$100,000 depending upon size of the bridge, and the number of spans.
- h. Additional stiffeners may be required on beams at point of jacking force application.
- i. Additional reinforcement in concrete elements may be required to control jacking stresses.
- j. Grade raises can be accommodated by casting backwalls and abutment portions on the proposed superstructure, and sliding over proposed sawcut elevations on existing abutments.
- k. Deflections of temporary substructure units must be considered, and the connection from the temporary substructure units to the permanent substructure units must be sufficiently rigid as to allow minimal deflections at the transition.

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7.01.19 (continued)

Accelerated Bridge Construction

C. Full Structural Placement Methods

3. Incremental (Longitudinal) Launching:

- a. Bridge section is built near approaches, and then longitudinally launched into place.
- b. Prestressing may be required for concrete elements due to alternating bending moments generated during launch.
- c. Launching trusses, gantries, and hydraulic systems may be considered.

Allowing the contractor to select methods of placement may also lead to additional innovations and acceleration to the project schedule. Depending on the complexity of the overall project, innovative contracting methods may also be used in conjunction with ABC/PBES techniques. Innovative contracting methods are approved on a project by project basis by the MDOT Innovative Contracting Committee, and the MDOT Engineering Operations Committee. For more information see the [Innovative Construction Contracting Manual](#).

The Federal Highway Administration provides additional information about ABC and PBES at the following website:
<http://www.fhwa.dot.gov/bridge/abc/index.cfm>.

7.01.20

Stream/River Crossing Low Chord Elevation for Navigation (11-25-2024)

Provide for navigation, where practicable (possible or capable of being done), a minimum clearance of 2 feet from the low chord to the design high water elevation. Clearance should conform to Federal requirements based on normally expected flows during the navigation season. Navigation includes using canoes, small boats and wading by fishermen.

7.01.21

Structural Cold Joints & Construction Joints (3-23-2020)

Cold joints and construction Joints in structural members resisting lateral loads must have a shear key, or other mechanical means of force transfer through the interface area, in addition to the fully developed steel reinforcement on both sides of the interface.

For additional information on substructure joint spacing see section [7.03.01 C.](#), [7.03.02 C.](#), [7.03.03 B.&C.](#) and [7.04.01 B.&E.](#)

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7.02

SUPERSTRUCTURE

7.02.01

Structure Type (5-6-99)

Whenever possible, multispan steel structures shall be continuous to avoid having expansion joints over piers. Consideration shall also be given to integral or semi-integral structures. Suspended cantilever design shall be avoided. When simple spans of an existing bridge are being replaced, consideration should be given to replacement with continuous beams and continuous for live load superstructure.

Where supporting members are prestressed concrete beams, decks should be cast continuous over piers where possible. Consideration shall also be given to integral or semi-integral structures.

Beam designs with complex layout may require the contractor to provide provisions and design any falsework required to ensure proper erection of beams. (11-28-2011)

Include the special provision, Complex Steel Erection, Shoring and Falsework, when one of the following situations may occur during the erection of structural members:

- A.** Construction of continuous spans > 200'.
- B.** Girders with horizontal curvature.
- C.** Field assembled suspension, movable bridge, cable-stayed, truss, tied arch, or other non-typical spans.

(11-23-2015)

7.02.02

Beam Spacing (5-6-99) (11-28-2011)

Space all beams so that the center to center distance does not exceed 10'-0". If the spacing is exceeded the designer shall perform an analysis to ensure that the structure meets load rating criteria specified in MDOT Bridge Analysis Guide. Space spread box beams such that the center to center distance is not less than 6'-0". (8-20-2009)

7.02.03

Beam Material Selection

The following is a guide for beam or girder material selection:

A. Prestressed Concrete (12-27-2021)

Use concrete with 28-day strengths of 6000-8000 psi concrete. For greater strengths, approval is required from MDOT Chief Structure Design Engineer. Strengths greater than 10,000 psi are not allowed.

1. Spread box beams, 36" wide, up to 42" deep
2. Spread box beams, 48" wide, up to 60" deep
3. I-beams (Types I thru IV, 28" to 54" deep)
4. I-beams (Wisconsin type, 70" deep)
5. I-beams (Michigan 1800 Girder, 70.9" deep)
6. Bulb Tee Beams (36" to 72" deep, 49" and 61" top flange)

B. Steel (4-17-2017)

1. Rolled Beams, AASHTO M270 Grade 36, 50 or 50W.
2. Welded plate girders AASHTO M270 Grade 36, 50 or 50W.

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7.02.03 (continued)

Beam Material Selection

C. New Structures

The choice of girder material is generally to be governed by the economics of design and expected span lengths. For structures over depressed freeways or other areas where there is a high concentration of salt spray or atmospheric corrosion, concrete is preferred.

D. Reconstruction of Existing Structures

The new portions are to be similar in appearance to the existing structure. Current materials and construction procedures are to be used with considerations given to matching the beam deflections of the existing structure. (5-6-99)

E. False Decking

False decking shall be erected prior to deck removal or repair on reconstruction projects and after beam erection on new or reconstruction projects. (12-5-2005)

7.02.04

Structural Thickness	Steel (5-6-99)	Grades-	Available
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- A. AASHTO M270 Grade 36 up to 8" in thickness.
- B. AASHTO M270 Grade 50 up to 4" in thickness.
- C. AASHTO M270 Grade 50W (painted) steel up to 4" in thickness may be substituted for Grade 50 steel.

7.02.05

Bearings

A. Sole Plates

Plate thicknesses are to be specified in $\frac{1}{4}$ " increments. For beveled sole plates, this $\frac{1}{4}$ " increment is based on the maximum thickness.

For steel beams, sole plates are to be beveled when the calculated bevel is greater than 1% for curved steel bearings and greater than 0.5% for elastomeric bearings. For requirements for prestressed concrete beams, see Subsection [7.02.18](#). (8-6-92)

B. Elastomeric Pads

Elastomeric pads ($\frac{1}{8}$ ") are required under all steel masonry plates and are to be $1\frac{1}{2}$ " longer and wider than the masonry plates. (10-24-2001)

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7.02.05

Bearings (continued)

C. Elastomeric Bearings

Plain bearings shall have a shear modulus, G , of 200 (± 30 psi), laminated bearings shall have a shear modulus of 100 psi (± 15 psi). Pads shall be 4" minimum (generally 6") by beam width - 3" with $\frac{3}{4}$ " minimum thickness (increase in $\frac{1}{4}$ " increments). (6-27-2022)

Design steel-reinforced elastomeric bearings with AASHTO LRFD Method A. Method B shall not be used unless approved by MDOT Structural Fabrication Engineer. (11-28-2011) (3-26-2018)

Fabric laminated (cotton-duck or other fiber reinforcement) bearings shall not be used unless approved by MDOT Structural Fabrication Engineer or MDOT Chief Structure Design Engineer. (3-20-2017) (3-26-2018) (5-27-2020)

All fabrication and material property tolerances must be accounted for in the design of elastomeric bearings. (9-22-2025)

Additional information (polymer type, minimum low-temperature grade, etc.) can be found at MDOT's [Elastomeric Bearing Guidance Document](#). (3-20-2017)

D. Anchor Bolts

Calculated lengths of bridge anchor bolts should be based on a bolt projection of 1" beyond the nut. (5-6-99)

7.02.06

Precamber - Steel Beams

Where dead load deflection, vertical curve offset, and deflection due to field welding (rare occurrence) is greater than $\frac{1}{4}$ ", the beams shall have a compensating camber. Camber is to be figured to the nearest $\frac{1}{4}$ " and shall be parabolic.

In certain instances, such as for continuous spans or long cantilevers, reverse camber should be called for in order to obtain uniform haunch depths.

When several beams in a bridge have corresponding camber ordinates which differ only slightly from each other, the Engineer should attempt to average these into one set for all beams.

7.02.07

Moment of Inertia - Composite Beam

The composite moment of inertia shall be used throughout positive moment regions. This moment of inertia is to be used in negative moment regions to compute beam stiffness only.

7.02.08

Multiple Span Design

A. Beam Depth (6-27-2022)

Generally, use the same depth beams for all spans with the longest span controlling the beam depth. Site constraints and conditions may lead to differing beam depths.

B. Composite Design

Composite design shall be used on all spans. Composite design uses the entire deck/slab thickness versus deck/slab stand-alone design which eliminates the top 1 $\frac{1}{2}$ " wearing surface. (5-6-99) (8-17-2015)

C. Suspended Spans

The suspended span should be poured first (see Section [7.02.01](#)).

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7.02.09

Rolled Beam Design (6-27-2022)

Cover plates for rolled beams are to be designed according to the following information and current AASHTO LRFD Bridge Design Specification 6.10.12.

- A. The cover plate width for a new beam should be equal to the beam flange width minus 1½" and for an existing beam should be equal to the beam flange width plus 1½".
- B. The minimum cover plate thickness shall be the greater of ⅜" or 1/24 of the plate width.
- C. Cover plate steel should be the same as the beam steel or matched as closely as possible.

7.02.10

Plate Girder Design (Welded)

A. Web Plates (6-27-2022)

When necessary, web plate depths are varied in 2" increments and the thickness shall be a minimum of 7/16".

B. Flange Plates

Flange plate widths may be varied to achieve a more economical design when required. The minimum width shall be 12". The minimum thickness shall be ½" when shear connectors are not used and ¾" when shear connectors are welded to the flange in the field.

C. Hybrid Designs

Hybrid designs using a combination of quenched and tempered steel according to ASTM A514 (AASHTO M244) & A852 (AASHTO M313) shall not be used. (5-6-99)

7.02.11

Stiffeners

A. Orientation and Size

Stiffeners are to be set normal to the web; however, when the angle of crossing is between 70° and 90°, the stiffeners may be skewed so that the diaphragms or crossframes may be connected directly to the stiffeners. Minimum thickness shall be 7/16". (9-2-2003)

B. Bearing Stiffeners

In general, bearing stiffeners should be eliminated at abutments with a dependent backwall, and the lower portion of the backwall should be poured and allowed to set before the deck is cast.

C. Bearing Stiffeners at Temporary Supports

To prevent the possibility of web buckling, bearing stiffeners should be provided at temporary supports for all plate girders. They need be placed on one side only; and on the fascia girders, they are to be placed on the inside.

D. Bearing Stiffeners for Rolled Beams

Even though bearing stiffeners are not required by design, if a beam end is under a superstructure transverse joint, two ½" x 4" bearing stiffeners should be provided as a safety factor in the event of corrosion and section loss of the web. (8-6-92)

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7.02.12

Welding

All welding details are to be according to AWS specifications, except for minimum fillet weld sizes, which should be as shown in the Standard Specifications. Any intended deviations are to be called to the attention of the MDOT Chief Structure Design Engineer. (5-6-1999) (5-27-2020)

Plans should show welding details but should not show the size unless a deviation from AWS specifications is intended.

Plans should also show beam or girder top flange tension zones. Tension zones should be labeled as the longest dimension for all load cases. Generally, welding of lifting lugs, contactor attachments, etc. will not be permitted in tension zones. (6-27-2022)

7.02.13

Field Splices in Plate Girders

A. General

Girder Length	Field Splice
0' to 125'	None provided.
Over 125' to 160'	Field splice is shown on plans as optional; it is designed and detailed, but not paid for.
Over 160'	Field splice is designed, detailed, and paid for. *

Fabricators that wish to field splice other than as called for on the plans will need prior Bridge Design Project Manager approval. (5-27-2020)

* Additional steel weight from splices will be added to quantity for "Structural Steel, Plate, Furn and Fab". (12-22-2011)

B. Location

Field splices are to be located at low-stress areas at or near the point of contraflexure for continuous spans.

7.02.13 (continued)

Where practical avoid locating field splices at locations where inspections and future maintenance work may be difficult including, but not limited to, within the horizontal clearance limits of railroads, directly over the navigable channel of a waterway, or over environmentally sensitive areas. (2-24-2025)

C. Bolts

All high strength bolts are to be hot-dip galvanized. (3-18-2013)

D. Bridge Deck Haunches

Minimum haunches must be maintained along the entire length of the beams. See Section 7.02.19.C for additional information. (9-22-2025)

7.02.14

Diaphragms and Cross-frames

A. Orientation (8-20-2009) (11-25-2024)

Provide diaphragms or cross-frames at abutments, piers and hinge joints. Intermediate diaphragms may be used between beams in curved systems or where necessary to provide torsional resistance and support the deck at points of discontinuity or at angle in girders.

Investigate the need for diaphragms or cross-frames for all stages of assumed construction procedures and the final condition. Diaphragms or cross-frames required for conditions other than the final condition may be specified to be temporary bracing.

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7.02.14 (continued)

B. End Diaphragms(11-25-2024)

End diaphragms or cross-frames are required at ends of beams to support the end of slab unless it is supported by other means. Provide diaphragms or cross-frames at the centerline of support for curved girders.

Use steel end diaphragms or cross-frames at independent backwalls. End diaphragms are to be no closer than 2'-0" from the center line of bearing to provide access for painting and inspection. (3-24-2025)

Check edge of slab capacity. If deemed necessary, strengthen with edge beam - a strengthened strip of slab made to act as a vertical frame with the beam ends. Design edge beam in accordance with AASHTO LRFD. (3-24-2025)

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7.02.15

Shear Developers

Use shear developers in all steel beam spans. See Section 7.02.31 D. for the treatment of existing shear developers when replacing a deck. (12-27-2022)

A. Type Used (6-27-2022)

Shear developers are to be the stud type shown in Bridge Design Guide 8.07.01. Show details and spacing for $\frac{3}{4}$ " studs on the plans. Generally, shear developers are 12" or less in length. Provide additional longitudinal reinforcement when haunch becomes greater than 6" and longer than 12" shear developers are required.

B. Spacing

1. Standard Bridge Slabs

The spacing is to be constant along the beam as required by the design. Shear developers are not to be used in areas of negative moment. They should extend through the positive moment area and to, or slightly beyond, the point of contraflexure. This point should be determined for the loading condition that will place it closest to the support over which negative moment will occur. In the event of a special case in which shear developers are used in negative moment areas, maximum tensile stress at the point of attachment is not to exceed that which is allowed by the current AWS specifications.

Shear developers (acting as slab ties) shall be placed in at least one half of all spans regardless of contraflexure points and moment orientations. In end spans with all negative moments place shear developers from abutment towards pier at 24" spacing. In interior spans with all negative moments place shear developers in middle half of span at 24" spacing. (12-5-2005)

7.02.15 (continued)

2. Empirical Bridge Slabs (6-27-2022)

For empirical bridge slabs, the studs shall be placed on the entire length of beams. This includes the negative moment regions. The design of the studs shall be based on the positive moment area as critical. (5-6-99)

A minimum of two shear connectors at 24" shall be provided in the negative moment regions of continuous steel superstructure (AASHTO LRFD 9.7.2.4). Where composite girders are noncomposite for negative flexure, additional shear connectors shall be provided in the region of points of permanent load contraflexure. The additional shear connectors shall be placed within a distance equal to one-third of the effective slab width on each side of the point of permanent load contraflexure.

Field splices should be placed so that they do not interfere with the shear connectors.

When detailing empirical slabs on plans designate them as an "Empirical Slab". (9-27-2021)

C. Fatigue Life (5-22-2023)

Design shear developers for an infinite fatigue life on all structures regardless of the projected Average Daily Truck Traffic (ADTT). When determining if additional shear developers are needed to meet the interface shear requirements for partial or complete deck replacement projects assume that the existing stud type shear developers to remain in place were initially designed for an infinite fatigue life (over 2,000,000 cycles). A reduction in the fatigue capacity of the existing stud type shear developers to remain in place is not necessary to account for the fatigue cycles the existing shear developers have already experienced.

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7.02.16

Lifting Lugs

The contractor will be permitted to use lifting lugs to transport and erect beams, subject to the requirements of the Standard Specifications. Our plans should indicate the tension zones where lifting lugs will not be permitted.

7.02.17

Painting and Galvanizing (6-27-2022)

Structural steel will be painted light gray. [AMS-STD-595](#) color #16440.

The Roadside Development Unit may request color # 15488 or another variety from AMS-STD-595 and obtain Region/TSC concurrence. Indicate the color number on the plan notes. See Section [12.07.06](#) for information regarding performance warranties.

Galvanizing (without top coat) of steel beams may be practicable if site conditions warrant it.

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7.02.18

Prestressed Concrete Design

A. General

1. Strand Selection (7-28-2025)

The design and detail sheets shall specify only ASTM A416 (AASHTO M203) Grade 270 low relaxation strands. Strands shall be 0.6 inches in diameter with a release force of 44,000 pounds.

MDOT has begun using CFRP strands in some locations. If CFRP strands are desired, the provisions of MDOT guidance for [Concrete Structures with CFRP Reinforcement](#) shall be followed. CFRP strand use must be approved by the Chief Structure Design Engineer.

2. Draping Strands (7-28-2025)

Draped Strands are pretensioned strands that control stresses at the end of beams by varying the height of the prestressing strand along the length of the beam to more closely follow the moment envelope from the applied loads.

Location of draped strands at beam ends shall start 3" down from the top for I-Beams and Michigan 1800 girders and 5" down from the top for Bulb-T beams downward. Draped strands at beam end shall correspond to the highest available strands at beam center.

If using draped strands limit the vertical force at the strand hold down point to 4,000 pounds per strand and the strand angle of inclination to less than 6 degrees. The calculation of the vertical force at the strand hold down point and the angle of inclination of the draped strands must take into account all applicable fabrication tolerances.

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7.02.18 (continued)

Prestressed Concrete Design

A. General

3. Bond Breakers/Debonding (7-28-2025)

As defined in Section 5 of AASHTO LRFD, a debonded strand is a pretensioned strand that is bonded for a portion of its length and intentionally debonded elsewhere through the use of mechanical or chemical means.

Where debonding is used to control stresses at the end of prestressed concrete Bulb Tee and I (PCI) beams, strands should be debonded in pairs. A maximum of 44% (52% for continuous for live load structures) of the strands may be debonded. Limits and restrictions on the debonding of stands are outlined in AASHTO LRFD 5.9.4.3.3. Additional MDOT specific requirements are included in the paragraphs below.

The debonding should be staggered by placing the debonded strands into groups similar to the table below.

Number Debonded	Shortest	2nd	3rd	Longest
4	2			2
6	4			2
8	4	2		2
10	6	2		2
12	6	2	2	2
14	6	4	2	2

The above table has been developed to meet the requirements outlined in AASHTO LRFD 5.9.4.3.3. The shortest point refers to the closest point to the beam end that any debonding can be terminated without overstressing the beam. The longest point refers to the point that all debonding can be terminated. Consultant debonding schemes shall follow a similar rational method.

From the end of the debonding to the point where the strands are no longer required to control stresses or provide ultimate capacity, a double development length (minimum) of bonding shall be provided.

7.02.18 (continued)

Spans less than 30'-0" need not be debonded. It is realized that the continuity moments of continuous for live load structures may reduce the effectiveness of debonding & increase the number of draped strands.

If placing strands in the bottom row, they should be placed on every third strand with the corner strands being bonded.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.02.18 (continued)

Prestressed Concrete Design

A. General

4. To aid in stabilizing transverse reinforcement in the beam, a bar or strand shall be located in the bottom corners of the beam. Second row up for box beams and certain PCI beams. (8-20-2009)

5. PCI beams under open joints are susceptible to corrosion from brine intrusion into the strands and mild reinforcement. This is the most prevalent distress to PCI beams. This can be mitigated by sealing the beam ends with an elastomeric sealer as described in Section [7.03.11A](#).

PCI beams and spread box beams under expansion joints should be coated per the special provision for Warranty on Concrete Surface Coating. Apply the coating from the beam end a length the greater of twice the beam depth, or five feet. In addition, where the coating operation will have a minimal effect on the maintaining traffic schedule, and the cost of the project, the entire outside face of the fascia beam and its bottom flange, should be coated. On new construction or superstructure replacement the fascia beam can be coated prior to erection. (6-27-2022)

6. Continuous for live load prestressed concrete beams shall be designed as simple span beams for all positive dead load and live load moments. (9-2-2003)

7.02.18 (continued)

7. Slab Ties (6-27-2022)

Ensure slab ties sufficiently penetrate haunches and slab to facilitate composite action of beams and slab. See Bridge Design Guide [6.42.03A](#) for details and section [7.02.20 G](#). In some instances, the number of slab ties can be minimized due to the shear resistance resulting from the contact area of the top flange of some beams. See AASHTO LRFD 5.7.4.2. Avoid use of EK04 slab ties in Bulb Tee beams unless this provision cannot be met.

8. Confinement Reinforcement (7-28-2025)

- a. Primary Confinement Reinforcement. Provide reinforcement at the ends of I-Beams and Bulb Tee beams placed to confine the prestressing steel in the bottom flange for a distance equal to 1.0 times the beam depth. Provide #3 epoxy coated deformed bars with a spacing of 3" and shaped to enclose the strands.
- b. Secondary Confinement Reinforcement. Beyond the primary confinement reinforcement, provide additional reinforcement placed to confine the prestressing steel in the bottom flange of I-Beams and Bulb Tee beams. Extend the secondary confinement reinforcement from the end of the primary confinement reinforcement to a minimum distance of

- 1) 1.5 times the beam depth beyond the end of the longest debonded strand where debonded strands are required.
- 2) 1.0 times the beam depth where debonded strands are not required.

Provide #3 epoxy coated deformed bars with a spacing of 6" and shaped to enclose the strands.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.02.18 (continued)

Prestressed Concrete Design

9. Stability During Lifting and Transportation (7-28-2025)

Investigate the buckling and stability of prestressed concrete beams during handling, transportation and erection on all projects. When deemed necessary by calculations, include any temporary measures needed to ensure the stability of the proposed beams in the plans for the project. Base the analysis on the stress limits specified in AASHTO LRFD.

Alternate means for ensuring the stability of prestressed concrete beams during handling, transportation and erection may be proposed by the Contractor or Fabricator. Any deviations from the details included in the plans must be submitted to the Engineer for review and approval as specified in Section 104 of the MDOT Standard Specifications for Construction.

7.02.18 (continued)

B. Prestressed Concrete Box Beam Design

1. Skew Bridges (6-27-2022)

The ends of the box beams shall be skewed to be parallel to the reference line. In extreme cases the ends of box beams can be set at a lesser skew, dependent upon substructure unit width.

2. Spacing (6-27-2022)

Spread box beams may be used and shall be treated similar to prestressed concrete I-beams (PCI). Space spread box beams such that the center to center distance is not less than 6'-0".

3. Bridge Seats (12-17-2018)

For spread box beams the bridge seat shall be bolstered and level.

4. Bearings (6-27-2022)

Where the pressure is less than 100 psi, ½" joint filler may be used for a bearing pad. Where bearing pressures are greater than 100 psi, 4" minimum (generally 6") by (beam width - 3") elastomeric pads shall be used (¾" minimum thickness, increase in ¼" increments). Cast steel sole plate (¾" generally) in all beams. When the calculated bevel exceeds 1%, tilt sole plate as required. All position dowels for doweling beam to the substructure will be placed by drilling as described in the Standard Specifications.

5. Beam steel reinforcement, including stirrups, is Grade 60 (ksi) for all box beams except 17" & 21" box beams. For 17" & 21" box beams the design of transverse beam steel reinforcement, stirrups and slab ties (epoxy coated ED bars & stainless steel SD bars) is based on Grade 40 (ksi); the use of either Grade 40 or Grade 60 is allowed in fabrication of the beam. Longitudinal beam steel reinforcement (EA bars) is Grade 60 for 17" & 21" box beams. See note [8.07.03 P](#). For 21" and 27" beams shear requirements/values may dictate the use of a greater than 7600 psi concrete compressive strength (21") or the use of stainless steel SD bars (27"). For additional information see [Bridge Design Guides 6.65.10-12A](#). (12-27-2021)

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7.02.18 (continued)

Prestressed Concrete Design

C. Prestressed Concrete Bulb Tee and I-Beam Design (6-27-2022)

1. Bearing Pads

For single-span structures 40'-0" or less in length, use dependent backwalls with 1" elastomeric pads under the beams and joint filler under the backwall.

For single- and multiple-span structures with spans over 40'-0", allowance for expansion is required in designing the bearing pads.

2. Sole Plates

Sole plates (3/4" generally) are to be cast in all beams and shall be tilted as required when the calculated bevel exceeds 1%. (11-24-2014)

3. Skew Bridges

On skewed structures, the ends of the beams shall be made square regardless of the angle of skew. The top corners may be clipped in order to accommodate a straight expansion joint across the structure.

One flange at each end of a Bulb-Tee beam can be shortened and/or clipped to accommodate a large skew and minimum clearances to a pavement seat. See Bridge Design Guide [6.60.03 Series](#) and [6.60.13](#). (1-23-2023)

7.02.18 (continued)

4. Concrete Diaphragms(11-25-2024)

Only consider concrete diaphragms when replacing existing concrete diaphragms. For new construction, concrete diaphragms are not permitted.

Set back concrete end diaphragms 10" to 12" from the end of beam in order to permit the removal of the forms after the diaphragms are poured.

The bottoms of all diaphragms are to bear on the bottom of the lower beam fillet.

All diaphragms are to be cast separately from slab except with continuous for live load structures (optional construction joint). (5-6-1999)

5. Steel Diaphragms

Steel intermediate diaphragms and steel end diaphragms are required at independent backwalls for shorter construction duration. Locate end diaphragms no closer than 2'-0" from the centerline of bearing to provide access for painting and inspection.

Check edge of slab capacity. If deemed necessary, strengthen with edge beam - a strengthened strip of slab made to act as a vertical frame with the beam ends. Design edge beam in accordance with AASHTO LRFD. (3-24-2025)

Use details from [Bridge Design Guide 6.60.12 A. - H.](#) and include Special Provision in proposal. (11-26-2012)

6. Battered Beam Ends

Detail the ends of beams to be vertical when sitting on the substructure. When beam ends are battered to meet this requirement and the batter exceeds 3" (the "L" ("L' ") dimension on the MDOT concrete beam typical detail sheet exceeds 3") additional reinforcement may be required to meet AASHTO requirements and to ensure the durability of the beam ends. Based on coordination with Michigan prestressed concrete beam Fabricators, a feasible solution has been included on the MDOT concrete beam typical detail sheets. (3-24-2025)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.02.19

Slabs

For information on Ride Quality on new slabs see section [7.02.32](#).

A. Design (8-20-2009)

MDOT standard LRFD slab is designed using the following criteria:

1. The design loads for decks and deck systems should be specified depending on the method of analysis. When the approximate strip method is used, force effects should be determined on the following basis:
 - a. Where primary strips are transverse and their span does not exceed 15.0 ft., the transverse strip shall be designed for the wheels of the 32.0-kip axle.
 - b. Where primary strips are transverse and their span exceeds 15.0 ft., the transverse strip shall be designed for the wheels of the 32.0-kip axle and the lane load together.
 - c. Where primary strips are longitudinal, the transverse strips shall be designed for all loads specified above, including the lane load.
2. The design truck shall be positioned transversally such that the center of any wheel load is not closer than:
 - a. One foot (1.0 ft.) from the face of the curb or railing for the design of the deck overhang.
 - b. Two Feet (2.0 ft.) from the edge of the design lane for the design of all other components.
3. Where the strip method is used, the extreme positive moment in any deck panel between girders shall be taken to apply to all positive moment regions. The extreme negative moment over any girder shall be taken to apply to all negative moment regions.

7.02.19 (continued)

4. For deck/slab design only, the top 1½" of slab is considered a wearing surface and is not included in the design depth, but is included in the dead load. See section [7.02.08 B.](#) for composite action of deck slabs. (8-17-2015)

Design of deck slabs using the Empirical Design Method according to AASHTO LRFD 9.7.2 is an approved or allowed alternative. (6-27-2022)

When detailing empirical slabs on plans designate them as an "Empirical Slab". (9-27-2021)

B. Overhang

Design slab overhangs for all applied loads and all applicable limit states on every project regardless of the width of the overhang. Horizontal loads on the slab overhang resulting from vehicle collision with the barrier shall be based on a TL-4 railing test level as specified in AASHTO LRFD Chapter 13. (3-27-2023)

Design overhang according to AASHTO LRFD 9.7.1.5. If the deck overhang with cantilever does not exceed 6.0 ft. from the centerline of the exterior girder to the face of a structurally continuous concrete railing, the outside row of wheel loads may be replaced with a uniformly distributed line load of 1.0 klf intensity, located 1.0 ft. from the face of the railing. (6-27-2022)

Limit overhang widths to 2'-6" if possible. Avoid overhangs greater than 6 feet. (3-27-2023)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.02.19 (continued)

Slabs

C. Slab Haunches (9-22-2025)

Plans are to provide for the deck slab to be haunched at each beam to provide for variance in actual top of beams. The design should normally make allowance for a 1" minimum uniform haunch for steel beam bridges and a 2" minimum haunch for prestressed concrete beam bridges; however, the details should show the haunch as variable. A nominal 2" haunch should be used on structures with span lengths exceeding 100'-0". Minimum haunches must be maintained along the entire length of the beams. For steel beam bridges this should account for varying top flange plate thicknesses as well as any splice plates and filler plates at field splice locations. Accounting for these components of the superstructure may require deeper haunches to ensure that no part of the beam encroaches into the bottom of the bridge deck.

To aid in the construction of the haunched slab, the plans should include bottom of slab elevations over each beam and at equal intervals across the spans. These elevations should apply at the time that all structural steel has been erected, but no other loads applied; however, they should include allowance for additional deflection due to forms, steel reinforcement, deck concrete, and railing. For additional criteria when the haunch exceeds 6" see section [7.02.20 G.](#) and Bridge Design Guide [6.42.03A](#).

D. Slab Thicknesses (6-27-2022)

Slab thicknesses are typically 9" and are to be uniform thickness with beams stepped to follow the crown of the roadway.

E. Slab Under Sidewalk

If the roadway slab extends underneath the sidewalk, it should be designed for full highway loading.

F. Nighttime Casting of Superstructure Concrete

All bridge deck pours are to be designated nighttime casting of superstructure concrete on all bridge decks. (5-6-99)

7.02.19 (continued)

G. Bridge Crown/Slope

Use 2% cross-slope on all projects with a deck replacement or greater scope except those that have compelling reasons to meet the existing cross-slope. Maintain constant slope across lanes of travel and shoulders, including bridges with full superelevation and ramp bridges. This will allow for ease of construction and deck screeding.

Bridge overlays and railroad and bridge approach projects may use 1.5 %. Local roads over may also use 1.5% unless the road approaches are or may become 2%.

Parabolic crowns being overlaid should be corrected to a minimum of 1.5%; otherwise a design exception or variance must be submitted. Deck replacement bridges with parabolic crowns shall be corrected to a 2% cross-slope. See [Chapter 12](#) for criteria and procedure.

(12-5-2005) (11-28-2011) (2-21-2017)

The road approach shoulder slope shall be transitioned to meet the bridge shoulder slope. The transition shall be based on superelevation transition slope ($\Delta\%$) from Standard Plan R-107 Series. The procedure is outlined in section [6.05.05](#) of the Road Design Manual. (8-20-2009) (11-28-2011)

Finishing bridge decks with varying cross slopes present challenges in construction. As a result, it is desired to avoid cases where superelevation transitions or crown runouts fall on a bridge. Where having superelevation transitions or crown runouts on a bridge is unavoidable contact the BOBS Construction Section to ensure that appropriate mitigation is included in the plans and Proposal to minimize the risk of problems occurring in the field. (9-22-2025)

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7.02.19 (continued)

Slabs

H. Superelevation Using a Straight Line Friction Ratio

Standard Plan R-107-Series shall be used to incorporate superelevations on structures. When Standard Plan R-107-Series cannot be used, the straight line method on overlay projects and on a very limited basis for deck replacements can be considered. The straight line method allows for a lesser superelevation and thus decreases the HMA wedging on the high side of a bridge overlay. It also reduces the haunch depth on deck replacements. See Bridge Design Guide [6.11.02](#) for straight line chart. (12-5-2005)

I. Link Slabs (1-25-2021)

Design Requirements and Considerations

Link slabs may be used to eliminate deck joints at piers. A link slab is comprised of a reinforced concrete deck with a length that includes 7.5% of each adjacent span, not necessarily the same length for each span. Saw cut lines are located at centerline of pier and at 5% of link slab length in each individual span. Link slabs are not designed to transmit live load effects from one span to another. As a result, the bridge (beams) is analyzed as simply supported spans for all vertical loads. Thus, shear stud connectors shall be omitted within the limits of the link slab and a 0.31 LBS/SFT roofing paper bond breaker is applied between the top flange and the link slab to prevent composite action. The total number of shear stud connectors per span required to meet strength requirements shall still be provided. If required, increase deck removal limits to permit placement of additional shear developers beyond the link slab. The link slab reinforcing is replaced (transverse) and lapped with existing reinforcement (longitudinal) to minimize crack widths based on the anticipated strains due to live load rotations for a girder.

7.02.19 (continued)

While the changes to the live load and dead load effects from link slabs are usually not significant, changing the articulation of the superstructure may significantly change the thermal and braking loads on the bearings, piers, and abutments. Evaluate the bearings, substructures, or foundations to determine if they can accommodate the new force configurations. It may be necessary to convert fixed bearings to expansion, increase capacity of expansion bearings and replace fixed bearings to increase capacity for longitudinal forces, etc. of the spans being linked together. Evaluate existing substructure elements in accordance with the load requirements of the AASHTO bridge design specifications in effect when the bridge was built.

MDOT link slabs are designed using the following maximum bridge lengths and widths criteria:

1. Straight, no skew concrete bridge:
Length \leq 300 ft.
2. 45° max. skew concrete bridge:
Length \leq 200 ft., Width \leq 100 ft.
3. Straight, no skew steel bridge:
Length \leq 275 ft.
4. 45° max. skew steel bridge:
Length \leq 175 ft., Width \leq 100 ft.

See Bridge Design Guides [6.44.01](#), & [01A](#).

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7.02.20

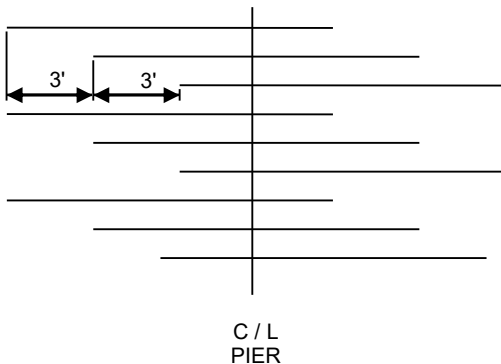
Slab Reinforcement

For general steel reinforcement information applying to both superstructure and substructures, see Steel Reinforcement (Section 7.04).

A. Negative Moment Reinforcement (12-5-2005) (12-17-2012)

Where additional longitudinal reinforcement is required in regions of negative moment see AASHTO LRFD 6.10.1.7. If the longitudinal reinforcement is considered to be a part of the composite section, shear connectors shall be provided in negative flexure regions. Where shear connectors are used in negative flexure regions, the longitudinal reinforcement shall be extended into positive flexure region (AASHTO LRFD 5.10.8.1.2c). (6-27-2022)

Bar ends should have two 3' staggers (see below) to minimize transverse cracking at bar terminations.



With continuous beam design, the bar length should be according to AASHTO LRFD 5.10.8.1.2c. (6-27-2022)

B. Bar Spacing (6-27-2022)

See AASHTO LRFD 5.10.3 and 9.7, section 7.02.19 and Bridge Design Guide 6.41.01.

C. Bar Laps

See Bridge Design Guide 7.14.02A.

Transverse slab reinforcement, if possible, is to be lapped as follows: top steel between the beams and bottom steel over the beams.

7.02.20 (continued)

D. Cover

All decks will provide 3" of clear concrete cover to the top of transverse reinforcement. See Bridge Design Guide 6.41.01. (5-6-99)

E. Placing of Transverse Bars

Transverse bars are generally placed perpendicular to the beams; however, where the angle of crossing is 70° or greater, transverse bars may be placed parallel to the reference lines if "S along the skew" falls in the same beam spacing range as "S normal to the beams" or the next larger range (see Bridge Design Guide 6.41.01).

Dimensioning is to be perpendicular to reference lines when the transverse bars are laid parallel to the reference line.

F. Epoxy-Coated Reinforcement

All bars in the superstructure are to be epoxy coated.

G. Additional Reinforcement When Haunch is Excessive (>4" concrete or >6" steel) (6-27-2022)

Add additional transverse and longitudinal reinforcement when haunch depths exceed 4" on prestressed concrete beams. Space additional transverse haunch reinforcement (EW05 or EK05 bars) between transverse bars, and ensure bars sufficiently penetrate haunch and slab. See Bridge Design Guide 6.42.03A for details.

Add additional longitudinal reinforcement when haunch exceeds 6" on steel beams. See Bridge Design Guide 6.42.03 and 8.07.01 for details.

7.02.21

Continuous Beam Design - Steel

A. Pour Sequence

Where temporary supports are not provided under continuous beams, a pour sequence is to be given to ensure that deflections occur as assumed in the design.

B. Preloading (Section Deleted.)(6-27-2022)

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7.02.22

Screeding

A. Transverse Screeding (1-29-2024)

Transverse screeding shall be used for finishing all bridge decks.

When the skew angle is greater than or equal to 15°, the strike equipment is placed parallel to the reference lines.

For spans with different skew angles at each end, use the greater skew angle for equipment orientation.

B. Screed Elevations

In computing screed elevations, the specified camber should be used.

The following dead loads should be used in computing beam deflection for screed elevations:

- 10 LBS/SFT for formwork
- 10 LBS/SFT for reinforcing steel
- 145 LBS/CFT for plain concrete
- 150 LBS/CFT for reinforced concrete

Screed elevations for suspended spans are to be figured for the case of no deck concrete having been poured in any span.

Screed elevations for prestressed concrete beams are to account for long term effects by modifying the beam deflections using the following factors:

Factor applied to prestressing force at release = $1.9 + 0.6(I_{\text{Girder}} / I_{\text{Composite}})$

Factor applied to beam self-weight at release = $2.1 + 0.7(I_{\text{Girder}} / I_{\text{Composite}})$

Factor applied to slab when poured (including SIP forms, diaphragms and utility loads) = $1.0 + 1.1(I_{\text{Girder}} / I_{\text{Composite}})$

Factor applied to barrier and sidewalk when poured = 2.3

I_{Girder} = moment of inertia of girder

$I_{\text{Composite}}$ = moment of inertia of composite section

(6-27-2022)

7.02.23

Stay-In-Place Forms

A. Use (9-2-2003)

Because of the design accommodations, any need for stay-in-place forms should be anticipated in the Contract Plans and Specifications.

The criteria for the use of metal stay-in-place forms are safety and economy in construction. Where practical, they should be included as a contractor option.

The use of concrete stay-in-place forms is not allowed.

B. Design (5-6-99) (9-21-2015)

The design of metal stay-in-place forms is the responsibility of the contractor. The corrugations for all stay-in-place forms should be filled with polystyrene. Use note [8.07.01 G](#). (6-27-2022)

When the use of stay-in-place forms cannot be economically justified the designer shall prohibit their use by including note [8.07.01 H](#). on the plans. (9-2-2003) (8-23-2021)

Detail steel beam tension zones on plans. Welding or mechanically fastening permanent metal deck forms or accessories to structural steel is prohibited. (6-16-2014) (3-26-2018)

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7.02.24

Joints in Deck Slabs

A. Longitudinal Joints

Deck widths greater than 100'-0" require a longitudinal open/expansion joint. (5-6-1999)

1. Centerline (Median) Joint

For bridges requiring a longitudinal open joint, which are also on roadways having a median barrier, the barrier is to be split, with the open joint extending up between the two halves.

2. Valley Gutter Joint

To facilitate the construction of bridges with valley gutters, we will show an optional longitudinal construction joint 2'-0" inside or outside the gutter centerline (depending on beam placement), and the reinforcing steel will be detailed with a splice at the gutter centerline.

3. Construction Joints

An optional longitudinal construction joint is to be shown on the plans when the bridge width exceeds 75'-0". For skews greater than or equal to 45°, this 75'-0" is measured parallel to the reference lines. This optional joint is to be placed at the edge of a pavement lane, regardless of location of the crown of the road.

Longitudinal construction joints are not to be placed over the flange of a beam.

4. Part-Width Construction (6-27-2022)

Where possible, longitudinal construction joints used to facilitate part-width construction should be placed at the edge of a pavement lane. This greatly improves ride quality and aesthetics. Do not place joints over a beam. Joints eventually leak, and subject beams to deterioration.

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7.02.24 (continued)

Joints in Deck Slabs

B. Transverse Joints (9-27-2021)

1. Construction Joints and Reference Joints

At construction joints where movement is anticipated, an expansion joint device shall be used.

Construction joints over piers at fixed bearings are to be a sawed joint 1½" deep by ⅛" wide (minimum) in the top of slab. The joint is to be sawed within 24 hours of placing the curing and is to be filled to ¼" below top of concrete with polyurethane or polyurethane hybrid sealant. Included in the bid item "Superstructure Conc, Form, Finish, and Cure, Night Casting." Add note [8.07.01 K.](#) to the plans. (8-23-2021) (8-24-2020)

Typical construction joints (transverse, longitudinal and at fixed pin & hangers) are to be a sawed joint ½" deep by ⅛" wide (minimum) in the top of slab and is to be filled to ¼" below top of concrete with polyurethane or polyurethane hybrid sealant. Included in the bid item "Superstructure Conc, Form, Finish, and Cure, Night Casting." Add details and note [8.07.01 M.](#) to the plans. (8-24-2020) (8-23-2021)

For simple spans, transverse construction joints may be needed when the volume of concrete required to construct the bridge deck (including haunches) exceeds 300 cubic yards. The MDOT BOBS Bridge Construction Unit must be contacted to confirm the need for the construction joints based on the project specific conditions. When deemed necessary, locate the transverse construction joints at the 1/4 and 3/4 points of the span. (1-27-2025)

7.02.24 (continued)

Reference joints located over integral and semi-integral backwalls are required joints and are not to be labeled as optional on plan details. Casting the approach slabs separate from the bridge deck and after the bridge deck has been cast is critical to proper movement and durability of the bridge. Reference joints are to be a sawed joint ½" deep by ⅛" wide (minimum) in the top of slab and filled ¼" below top of concrete with polyurethane or polyurethane hybrid sealant. Included in the bid item "Superstructure Conc, Form, Finish, and Cure, Night Casting." Add note [8.07.01 M.](#) to the plans. See Bridge Design Guides [6.20.03 A, B, & C](#) and [6.20.04](#) for details. (8-24-2020) (8-23-2021)(1-27-2025)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.02.24 (continued)

Joints in Deck Slabs

2. Expansion Joints

The maximum single opening in an expansion joint device shall be no more than 4", measured in the direction of traffic. When movement required is greater than 4" a modular expansion joint shall be used. (5-6-99)

Expansion joint devices shall be installed $\frac{1}{4}$ " to $\frac{3}{8}$ " below the adjacent deck elevation. This fact shall be taken into account during design. This recess is to prevent damage to the joint from snow plows. (5-6-99) (2-16-2015)

The EJ3 Sheet included with the plans will designate the total travel that is required at each joint, measured along the centerline of bridge, and the angle of crossing rounded off to the nearest 10°. The length of the device required at each location will be shown, and these lengths totaled for one bid item, "Expansion Joint Device." The fact that the one item includes several minimum travel requirements should not affect the bid price since we currently find little or no difference when we list minimum travels separately. The EJ4 Sheet shall be used with replacement of existing neoprene expansion joint devices. Use of EJ4 Sheet (device) requires [Form 0304](#) (Proprietary Item Certification (PIC) and Public Interest Finding (PIF)) be filled out and placed in the project file for Delcrete Elastomeric Concrete (D.S. Brown, 300 East Cherry Street, North Baltimore, OH 45872, Telephone: 419.257.3561). Delcrete is a PIC with "No Equally Suitable Alternative". See section [15.04](#) and section [11.08](#) of the Road Design Manual. (8-20-2009) (2-16-2015)

7.02.24 (continued)

After contract award and before placing the order, the contractor shall inform the Construction Engineer which devices and models they intend to install. The standard shop drawings of the joint devices are located at [Miscellaneous Bridge Details](#) site. (6-27-2022)

When an expansion joint device is used on a sidewalk it shall be fitted with a cover plate as described and detailed in Section [7.02.27](#) and EJ3 and EJ4 Sheets. (8-20-09)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.02.25

Pavement Seats

Pavement seats are to be provided on all bridges except integral and semi-integral structures with continuous pour over reference lines (also see Section [7.03.01 C](#)). (5-6-99)

7.02.26

Drain Castings

A. Location

Drain castings in bridge decks should be avoided where practicable. Where drain castings are necessary, they are to be spaced as required but located so as not to allow water to fall on slopes and/or roadways below. Design is to be based on Hydraulic Engineering Circular No. 21 (HEC 21), "Design of Bridge Deck Drainage", or an equal. (5-6-99)

B. Special Reinforcement Steel

Where drain castings are called for in bridge decks, plans are to show that two epoxy coated reinforcing bars are to be placed diagonally at each corner of the drain casting (one top, one bottom). (5-6-99)

7.02.27

Sidewalks (9-2-2003) (11-25-2019)

In general, on a bridge where pedestrians must be accommodated and where maximum posted speed is 40 mph or less, a raised sidewalk should be provided if there is a raised sidewalk on the approach. Where posted speed is greater than 40 mph or there is no raised sidewalk on the approach, a walkway at roadway level should be provided and protected from traffic by an MDOT approved bridge railing.

Where sidewalks are required, they should be 5'-2" or greater in width. However, in circumstances where a 5'-2" width is not achievable a 4'-2" minimum width is permissible if crash tests allow. (8-20-2009)

7.02.27 (continued)

When the bridge railing length is greater than 200 feet, to adhere to Americans with Disabilities Act (ADA), the sidewalk must be 5'-0" wide (@ 2.1% maximum slope)* or a 5' square passing space shall be located at intervals not exceeding 200 feet. The requirement is valid with a raised sidewalk as on Standard Plan B-25-Series, B-26-Series or B-27-Series and anywhere where the sidewalk is located behind a railing that separates pedestrians from traffic. For railing lengths less than 200 feet the sidewalk width may be 4'-2" if crash tests allow and does not require passing spaces. * Use a target cross slope (2.0%) less than the maximum to account for inconsistencies in concrete finishing. (2-26-2024)

Expansion joints located on sidewalks shall be fitted with cover plates to eliminate vertical depressions caused by the joint. See Expansion Joint sheets (EJ3 or EJ4). Detail cover plates that require a length greater than 11' to be fabricated from two equal length pieces with a joint located at the centerline of the sidewalk or path. Provide a ¼" wide gap at the joint that is parallel to the centerline of the sidewalk or path. (1-23-2023)

For additional information refer to Bridge Design Guides [6.05.02](#), [6.29.10C](#), [6.29.17E](#) and Road Design Manual Section [6.08](#).

Where a shared (multi) – use path or other mode of transportation is anticipated or proposed for the bridge, verify that all users have been accommodated and refer to appropriate specifications for design criteria. (12-16-2019)

A. Sidewalk Joints

Space sidewalk joints to match any joints in the slab. (9-25-2017)

B. Independent Sidewalk

If the sidewalk is independent of the roadway slab, the sidewalk is to be designed for maximum wheel loading for the bridge with overstressing as allowed by the current AASHTO Standard Specifications for Highway Bridges.

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7.02.28

Railing (9-2-2003) (11-25-2019)

Where bridge railing is to be installed, and no sidewalks are present or the sidewalk is located behind the railing, install one of the bridge railing types currently approved for use by MDOT. The only MDOT-approved bridge railing types are Type 6 Barrier (see Standard Plan B-29-Series), Type 7 Barrier (see Standard Plan B-28-Series), 2 Tube railing (see Standard Plan B-21-Series), 4 Tube railing (see Standard Plan B-26-series), Aesthetic Parapet Tube railing (see Standard Plan B-25-Series) and 3 Tube With Pickets (see Standard Plan B-27-Series).

Where bridge railing is to be installed on raised sidewalks, use only 4 Tube railing (see Standard Plan B-26-series), Aesthetic Parapet Tube railing (see Standard Plan B-25-Series), or 3 Tube with Pickets (see Standard Plan B-27-Series).

A. Railing Types and Their Use (9-2-2003) (11-25-2019) (10-24-2022)

In general, use Bridge Barrier Railing, Type 6, on all new structures and reconstruction (major rehabilitation) bridge projects without sidewalks (see Standard Plan B-29-Series). Substitute Type 7 Barrier on structures where sight distance or clear roadway width is a problem (see Standard Plan B-28-Series). Bridge Barrier Railing, Type 6 and Type 7 are preferred on freeways and interstate routes. At stream crossings or scenic areas, use Bridge Railing, 2 Tube, Aesthetic Parapet Tube, 4 Tube or 3 Tube with Pickets (see Standard Plan B-21-Series, B-25-Series, B-26-Series or B-27-Series). Do not use Bridge Railing, 2 Tube on freeways and interstate routes or adjacent to pedestrian traffic because the height is insufficient. On bridges where pedestrian or bicycle traffic is separated from vehicular traffic by a standard barrier, it is not necessary to provide a vehicular railing at the fascias. In such cases, pedestrian fencing is desirable.

For structures without sidewalks, but where some pedestrian traffic is likely, install a Bridge Railing, 4 Tube, Aesthetic Parapet Tube or 3 Tube with Pickets.

7.02.28 (continued)

B. Joints (6-27-2022)

To avoid cracking, an open joint is required in concrete railings at all deck joints where reinforcing steel is not continued through the joint. False joints are not required in barrier railing.

Use a 1" joint in all concrete railings over the piers of continuous decks, at midspan on all structures with a span greater than 100'-0" and cantilever decks where the cantilever is more than 10'-0" long. The joint must be perpendicular to the centerline even on skewed bridges. Use a 1" joint filler to fill the joint to ½" from the bevels of the railing. Seal the remaining ½" with a polyurethane or polyurethane hybrid sealant. (5-1-2000) (2-21-2017)

C. Median Barrier vs. Bridge Barrier Railing (5-6-99)

Criteria for use:

1. Concrete barrier on a bridge must be reinforced and attached to the structure.
2. Barriers that function as railings must be at least 3'-6" in height.
3. Barriers that function as median barriers must be at least 2'-8" in height.
4. Concrete glare screens required on approaches must be continued across structures.
5. When structures are spaced 150'-0" apart or less along the traveled roadway, install a concrete barrier (Concrete Barrier, Single Face or approved alternate) between the two structures, in lieu of guardrail, to provide continuity. Approval by the agency having jurisdiction of the approaches is required.

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7.02.29

Fencing

A. MDOT's Policy

For protective screening, follow AASHTO's A Guide for Protective Screening of Overpass Structures.

Consider protective screens under any of the following conditions:

1. Reported incidents of objects being dropped from an overpass.
2. On overpasses with walks where experience on nearby structures indicates a need for screens.
3. On overpasses in large urban areas used exclusively by pedestrians.
4. On overpasses near a school, a playground, or elsewhere where it would be expected that the overpass would be frequently used by children unaccompanied by adults.

B. Metro Region Criteria (9-2-2003)

Contact the Region Project Development or Bridge Engineer to determine if pedestrian screening/fencing must be added to projects. General criteria:

1. Include bridge screening when major bridge rehabilitation is scheduled for a structure.
2. Railroad structures must have bridge screening due to the presence of ballast and discarded rail spikes.
3. Screening is not required for structures without designated pedestrian access. This includes, but is not limited to, freeway to freeway connecting structures and all freeway ramp structures.

For additional information on pedestrian fencing, see Section [7.05](#) and Section [2.02.11](#).

7.02.30

Bridge Mounted Noise Walls (3-23-2026)

While the guidance provided herein is specific to bridge mounted noise walls, it may be relevant to noise walls mounted on other types of structures. Follow the guidance herein where relevant and consider all other applicable design criteria and structure-specific issues.

A. General Considerations

In addition to the guidance provided in this section, refer to the design criteria outlined in the **MDOT Noise Barrier Wall Design Guidelines** as it is applicable to bridge mounted noise walls or when specified herein.

1. Naming Bridge Mounted Noise Walls

Refer to the structure number naming convention in the **Michigan Ancillary Structures Inspection Manual (MiASIM)** when providing a name for bridge mounted noise walls on plans.

2. Wall Height

Avoid steps in the noise wall height. Designers must follow the requirements outlined in the **MDOT Noise Barrier Wall Design Guidelines Section 2.03.03**.

3. Zone of Intrusion

Place bridge mounted noise walls outside the zone of intrusion (ZOI) as defined by the **AASHTO Roadside Design Guide Section 5.5.2** when possible.

When designers must locate noise walls inside the ZOI, it is preferred to anchor posts to the back face of bridge barriers to better accommodate ZOI requirements.

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7.02.30 (continued)

4. Wall Endings

Avoid blunt ends by providing a sloped panel at the end of the bridge. If the noise wall must continue off of the bridge, then extend the bridge mounted wall onto the bridge approach in order to provide an overlap with the adjacent ground-mounted wall satisfying the 4D rule as defined in the **MDOT Noise Barrier Wall Design Guidelines Section 2.01.02**. This may require use of a moment slab to provide the required overlap. Provide a sloped panel at the end of the structure-mounted noise wall. Adhere to the **MDOT Noise Barrier Wall Design Guidelines Section 2.03.02** for crash protection beyond the extents of the bridge.

5. Expansion Joints

Bridge mounted noise walls and their connections must adequately accommodate the expansion, contraction, rotation, and increased stiffness of the bridge superstructure it is attached to. Determine locations of wall expansion joints according to **AASHTO LRFD Section 15.6**.

B. Wall Types

Coordinate the noise wall type selection with the project noise analysis and ensure the selected system provides the noise abatement used in the analysis. For example, the noise analysis may include use of absorptive noise barriers which must be considered in the selection of noise wall type.

Regardless of wall type, avoid gaps between the noise wall and bridge to prevent debris from falling onto traffic below. Include a joint in the noise wall wherever there is a joint in the barrier system, including expansion joints.

The most common bridge mounted noise walls include:

1. Metal post and concrete panel systems mounted to the back of concrete railings.

7.02.30 (continued)

2. Cast-In-Place concrete noise walls on top of concrete railings.
3. Metal post and composite or acrylic panel systems mounted to the back of concrete railings.

Various proprietary and non-proprietary systems of these noise wall types exist. If the designer uses a system with posts, they must detail the posts to be vertical.

Designers must only use systems that have successfully passed crash testing consistent with MASH criteria for both proprietary and non-proprietary systems. Crash testing documentation must consist of an FHWA letter or certified crash testing facility report. The MDOT Chief Structure Design Engineer must approve the crash testing documentation.

When roadway design speeds are 40 mph or less, design walls and their components for MASH TL-2 or higher. When design speeds are 45 mph or more, design walls and their components for MASH TL-4 or higher.

C. Non-Proprietary Wall Design Criteria

Design and detail non-proprietary noise walls and their connections per the requirements specified in **AASHTO LRFD Section 15**. Design and detail the associated bridge railing per the requirements specified in **AASHTO LRFD Section 13**.

See the **MDOT Noise Barrier Wall Design Guidelines Section 2.04.03** for guidance on handling, hauling, and lifting of precast wall elements.

The following information is supplemental to design guidance provided in **AASHTO LRFD**.

1. Wind Load

Designers should determine wind loading using **AASHTO LRFD Section 15**.

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7.02.30 (continued)

2. Snow and Ice Load

Designers do not need to consider horizontal or vertical snow and ice loading on the noise wall as vehicle collision and live loads will govern.

3. Fatigue

Avoid details with poor fatigue performance. Evaluate fatigue caused by wind loading using **Section 11 of AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals**.

D. Proprietary Wall Design Criteria

If a proprietary system is used, it must meet the specifications provided in the previously approved special provision for Structure-Mounted Lightweight Noise Barrier Wall.

Designers must ensure that the bridge barrier is consistent with the barrier used during crash testing of the proprietary noise wall system.

E. Bridge Design Considerations

Designers must consider the effects bridge mounted noise walls have on the entire structure, both proposed and existing components, in particular but not limited to the deck and beams.

Designers may mount noise walls to existing bridges when the bridge is receiving a deck or superstructure replacement, or deck widening. Mounting noise walls to existing bridges outside of these circumstances is not permitted unless the designer replaces the existing bridge barrier. They must also remove and replace a portion of the existing bridge deck along the fascia to ensure applicable loads can be transferred accordingly. Determine the width of deck removal based on the beam spacing and the development length needed to provide adequate connection to the existing bridge deck reinforcement in accordance with **AASHTO LRFD 5.10**.

7.02.30 (continued)

Designers must consider the existing condition, original loading, and design criteria of the bridge's existing components to remain when attaching noise walls to existing bridges. If adding a noise wall to an existing bridge requires strengthening of the existing beams, consider other alternatives including but not limited to a superstructure replacement or beam replacement. See the following sections for additional considerations.

The following guidance applies to both existing and new bridges.

1. Dead Loads

When noise walls are mounted to bridges the increased dead load at the fascia requires the checking of various items:

a. Potential Negative Camber

Designers must account for the expected dead load of the noise wall when designing camber of steel members for new bridges. For prestressed members, negative camber must be checked in the final condition and avoided if possible.

With existing bridges, designers must check for negative camber. If present, consider issues including, but not limited to, whether vertical clearance is reduced below required limits and possible public perception of "sagging" beams. Consider lightweight wall types or superstructure strengthening to avoid negative camber.

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7.02.30 (continued)

b. Slab and Screed Adjustments

Designers must account for the weight of the noise wall system when calculating slab and screed elevations. Consider that contractors may set the screed machine to the cross-slope of the final slab surface when they construct the slab. When the wall and bridge barrier are placed after the deck is poured, the added weight may cause additional deflection or negative camber at the fascia beam. As a result, final deck cross slopes may vary producing potential ponding areas, and compromised ride quality. These issues may increase maintenance needs and shorten the service life of the bridge.

Evaluate the potential discrepancy in final cross-slopes and provide mitigation measures if the deviation from the proposed cross-slopes would exceed normal construction tolerances.

c. Dead Load Assumptions

Designers utilizing proprietary systems must estimate the noise wall dead load using the special provision requirements for the various noise wall components and include an allowance to address uncertainties in the actual provided weight of the system.

When proprietary noise wall system shop drawings are submitted, the designer must compare the actual dead load of the system with the assumed design load to confirm the actual load is less. Consider if any changes to slab and screed elevations are necessary given the actual weight of the provided system.

7.02.30 (continued)

d. Dead Load Distribution

Apply noise wall dead loads by distributing 75% of the load to the fascia beam and 25% to the first interior beam and apply this distribution to all bridge components impacted by the noise wall.

Use the least favorable loading cases, load factors, and combinations in all design checks.

2. Slab Overhang Design

Design slab overhangs for all loads induced by the noise wall as required by **AASHTO LRFD** and the provisions herein, including but not limited to dead load, wind load, and vehicular collision loads. Design slab overhangs per the requirements outlined in **Section 13** of **AASHTO LRFD**.

Additionally, consider the impacts on the first interior slab bay and the fascia rebar cut off lengths from all noise wall loadings. If the capacity is not adequate for an existing bridge, retrofit the interior slab bay to accommodate the increased load.

3. Uplift and Overturning

Bridge mounted noise walls can introduce unbalanced mass to the structure which can impact the load distribution across the girders and overall structural behavior.

Designers must consider overturning forces generated by horizontal wind loads on the wall in all applicable load combinations alongside vertical wind loads per **AASHTO LRFD Section 3.8.2**.

Ensure that all bridge components supporting either proprietary or non-proprietary noise wall systems resist the vehicular collision loads from **AASHTO LRFD Section 15.8.4**.

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7.02.30 (continued)

Bridges with horizontally curved girders or complex geometries may require refined analysis to accurately capture the distribution of overturning forces. Ensure that uplift at bearings does not occur under any load combination. Consider using a lightweight noise wall system or selectively increasing the size of components to act as a counterweight in order to eliminate uplift.

4. Torsionally Stiff Fascia Beams

Torsionally stiff fascia beams such as box beams are often assumed to resist minimal torsional loading and may not be explicitly checked for torsional effects. They may be required to resist significant torsional moments due to wind load effects when noise walls are mounted on bridges. Thus, designers must evaluate the torsional demand on the fascia beams and design them as specified in **AASHTO LRFD Sections 4.6, 5.7, and 6.11**. Consider a lighter noise wall system or provide additional load paths to distribute the torsion such as adding cross frames if beams are unable to be designed to resist the effects of torsion.

7.02.31 (8-23-2021)

Precast Box/Three Sided/Arch Culverts

Design criteria and considerations:

- A. Verify with manufacturers the maximum span length available.
- B. The number of manufacturers of the specified span length needs to be at least two.
- C. When selecting culvert rise, consider all users of the waterway, along with normal water surface under clearance and freeboard at high water.

7.02.31 (continued)

D. For structure (culvert) lengths that can accommodate a clear span between guardrail posts of 25'-0" or less use "Guardrail Long Span, Detail MGS-1, MGS-2 or MGS-3" (Standard Plan R-72-Series) to span the culvert. Ensure that the requirements of Standard Plan R-72-Series (e.g., headwall location and size, guardrail post locations, etc.) are met prior to specifying the use of the standard. Otherwise, extend height of headwalls to 36" above plan grade elevation and attach guardrail to headwall as detailed on the plans.

E. Add a PVC (polyvinyl chloride) liner that covers entire top and sides of all buried culverts. For precast boxes, extend the liner to the top of the culvert bedding and turn out 6" horizontally across the top of the culvert bedding. For three sided and arch culverts, extend the liner down the leg of the culvert, horizontally across the top of the pedestal wall, and down the vertical face of the pedestal wall 18" or to the top of the footing, whichever is less. Extend the liner a minimum of 3 feet beyond the construction joint between culvert and wingwalls and turn up at back side of headwalls. At the ends of the culvert, adhere the perimeter of the liner with an adhesive as recommended by the PVC liner manufacturer. (1-29-2024)

Where staged construction is used to install the culvert and a temporary MSE wall is required at the stage line, stop the PVC liner a horizontal distance equal to the temporary MSE wall height away from the temporary MSE wall face and adhere the perimeter of the liner with an adhesive as recommended by the PVC liner manufacturer. If a temporary MSE wall is not required at the stage line, the PVC liner may be installed across the stage line joint, or two pieces of PVC liner may be welded together as recommended by the PVC liner manufacturer. (1-29-2024)

Include Special Provision for Polyvinyl Chloride Liner in proposal. (2-22-2022)

Additional information and criteria are included in the current Standard Specifications.

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7.02.32 (11-28-2011)

Deck Replacements

With deck replacements or widening projects (or reconstruction projects), the structural adequacy of the entire structure shall be evaluated. In addition to the criteria listed below, deck replacements shall meet all requirements listed in this chapter (e.g. slopes, shoulder width, stay in place deck forms and approach items). Consider all modes of transportation and evaluate whether deck replacement or widening can accommodate all users. (12-16-2019)

A. Beams

1. On concrete T-Beam bridges the deck slab is an integral part of the support system and cannot be removed without dismantling the entire superstructure. The cost of deep chipping (or hydrodemolishing) combined with the installation of a cathodic protection system should be weighed against the cost of complete superstructure replacement.
2. On steel stringer bridges, the tops of beams shall be blast cleaned and coated with an organic zinc-rich primer. Shear connectors shall be placed to upgrade the capacity of existing non-composite decks. (12-5-2005)
3. On prestressed concrete side by side box beam decks, the existing wearing course is replaced with a 6" reinforced deck.
4. On older steel stringer bridges, lateral bracing was often added as a part of the original construction. If lateral bracing was removed subsequent to the original construction, consider whether the beams require temporary lateral bracing during the deck replacement. (6-27-2022)

B. Railings

Railings shall be upgraded when bridge deck replacements are planned. See section [7.02.28](#).

7.02.32 (continued)

C. Geometrics

Criteria for roadway widths and design loading have been established in ***A Policy on Design Standards - Interstate System***, 2016, and ***A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition*** published by AASHTO. These criteria are based on the type of roadway carried by the structure and are summarized in this section. Non Interstate structures with deck replacements or widening projects (or reconstruction projects) shall adhere to ***A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition*** design criteria (standards). Interstate structures shall adhere to ***A Policy on Design Standards - Interstate System***, 2016. MDOT policy has set bridge (shoulder) widths 2' (offset) greater than AASHTO widths for safety considerations of the traveling public. See [Bridge Design Guides 6.05 Series & 6.06 Series](#). (6-27-2022)

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7.02.32 Deck Replacements (Cont.)

CLEAR ROADWAY WIDTHS AND DESIGN LOADING FOR DECK REPLACEMENTS			
Type of Roadway		Minimum Clear Roadway Width	Minimum Design Loading
Non-Interstate Freeway		A, C	HL-93
Interstate Freeway		B, C	HL-93
Arterial (Non-Freeway Trunkline)	Rural	Table 7-3.	HL-93
	Urban	D, C	HL-93
Collector (Non-Trunkline)	Rural	Table 6-6.	HL-93
	Urban	Table 6-5., E	HL-93
Local (Non-Trunkline)	Rural	Table 5-6.	HL-93
	Urban	Table 5-5., E	HL-93

- (A) The minimum clear roadway provided shall accommodate the pavement and full shoulders of the approach roadway or the minimum AASHTO requirements for lane and shoulder widths, whichever is greater.
- (B) The minimum clear roadway provided shall accommodate the pavement and full shoulders of the approach roadway.
- (C) For bridges in excess of 200'-0" in length, where the nearest offset from the edge of traveled way to either curb or barrier is greater than 4'-0" on the approaches, the nearest offset on the bridge shall be at least 4'-0" on each side. (12-5-2005)
- (D) The minimum clear width on the bridge shall be the same as the curb-to-curb width of the street.
- (E) The minimum clear roadway shall be the traveled way plus 1'-0" to each curb face. However, consideration should be given to providing the same width as the curb-to-curb approach width if it is cost effective to do so.

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The tables shown below are derived from A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition published by AASHTO and do not include clearances for bridge rail offset. See the Bridge Design Guides for MDOT offset criteria. (6-27-2022)

MINIMUM WIDTH OF TRAVELED WAY FOR RURAL ARTERIALS (FROM Table 7-3.)				
Design Speed(mph)	Design Traffic Volume (veh/day)			
	Under 400	400-1500	1500 -2000	over 2000
	Width of Traveled Way (ft) ^(a)			
40-45	22	22	22	24
50-55	22	22	24	24
60-75	24	24	24	24
^(a) On roadways to be reconstructed, a 22 ft traveled way may be retained where the alignment is satisfactory and there is no crash pattern suggesting the need for widening.				

MINIMUM CLEAR ROADWAY WIDTHS FOR RURAL ARTERIAL BRIDGES BEING RECONSTRUCTED (FROM Table 7-3.)	
Design Traffic Volume(veh/day)	Min. Clear Roadway Width of Bridge
under 400	Traveled way + 4 ft (ea. side)
400-2000	Traveled way + 6 ft (ea. side) ^(b)
over 2000	Traveled way + 8 ft (ea. side) ^(b)
^(b) For bridges in excess of 200 ft in length, a minimum width of traveled way + 4 ft on each side will be acceptable.	

MINIMUM WIDTH OF TRAVELED WAY FOR COLLECTOR ROADS (From Table 6-5)				
Design Speed(mph)	Design Traffic Volumes (veh/day)			
	Under 400	400-1500	1500 -2000	over 2000
	Width of Traveled Way (ft)			
20-30	20 ^(a)	20	22	24
35-40	20 ^(a)	22	22	24
45-50	20	22	22	24
55-60	22	22	24	24
On roadways to be reconstructed, a 22 ft traveled way may be retained where the alignment is satisfactory and there is no crash pattern suggesting the need for widening.				
^(a) A 18 ft minimum width may be used for roadways with design volumes under 250 veh/day.				

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MINIMUM ROADWAY WIDTHS FOR NEW AND RECONSTRUCTED BRIDGES CARRYING RURAL COLLECTOR ROADS (From Table 6-6)		
Design Traffic Volume(veh/day)	Minimum Roadway Width of Bridge	Design Loading Structural Capacity
400 and Under	Traveled way + 2 ft (each side)	HL-93
400 to 1500	Traveled way + 3 ft (each side)	HL-93
1500 to 2000	Traveled way + 4 ft (each side) ^(a)	HL-93
over 2000	Traveled way + shoulders ^(a)	HL-93
Where the approach roadway width (traveled way plus shoulders) is surfaced, that surface width should be carried across the structures.		
^(a) For bridges in excess of 100 ft in length, the minimum width of traveled way plus 3 ft on each side is acceptable.		

MINIMUM WIDTH OF TRAVELED WAY FOR LOCAL ROADS (from Table 5-5)					
Design Speed(mph)	Design Traffic Volumes (veh/day)				
	Under 400	400-1500	1500 -2000	over 2000	
	Width of Traveled Way (ft)				
	15	18	20	20	22
	20-40	18	20	22	24
	45-50	20	22	22	24
	55-60	22	22	24	24
Where the width of traveled way is shown as 24 ft, the width may remain 22 ft m on reconstructed highways where there is no crash pattern suggesting the need for widening.					

MINIMUM CLEAR ROADWAY WIDTHS AND DESIGN LOADINGS FOR NEW AND RECONSTRUCTED BRIDGES CARRYING RURAL LOCAL ROADS (From Table 5-6)		
Design Traffic Volume(veh/day)	Min. Clear Roadway Width of Bridge	Design Loading Structural Capacity
ADT 400 & under	Traveled way + 2 ft (ea. side)	HL -93
ADT 400-2000	Traveled way + 3 ft (ea. side)	HL -93
ADT over 2000	Traveled way + shoulders	HL -93

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7.02.32 Deck Replacements (Cont.)

D. Salvaging Shear Developers

(10-24-2022)

For full or partial deck replacements on steel superstructures with stud type shear developers, shear developers should be left in place and reused whenever possible to minimize the risk of damage (and associated delays) to the steel beams/girders. For steel superstructures with spiral/coil type shear developers, remove the spirals/coils and install stud type shear developers using the appropriate pay items included in the MDOT Standard Specifications for Construction. If shear developer type cannot be confirmed with existing plans, contact the MDOT Bridge Construction Engineer to request a field investigation to confirm existing shear developer type.

The removal, furnishing, and installation of the additional shear developers is included in the special pay items listed in the Frequently Used Special Provision for Bridge Deck Removal and Salvaging Shear Developers on Steel Beams. Include a quantity equal to approximately 5% of the original shear stud total to account for existing damaged or deteriorated studs that must be removed and replaced. If additional studs are needed to meet strength requirements per AASHTO and Section [7.02.15](#), add quantity and detail proposed studs in relation to the existing studs on the plans. The location of the additional shear developers must account for the minimum spacing and edge distance requirements specified in AASHTO LRFD. If additional beam lines are being added to the superstructure as part of the deck replacement project the studs required on the new beam are included in the pay items listed in the Frequently Used Special Provision. Detail the transverse spacing and longitudinal pitch as part of the structural steel details.

(3-27-20223)

Where the existing shear developers are not tall enough to extend sufficiently into the new bridge deck per Bridge Design Guide [8.07.01](#), add EA04, EW05, and EK05 bars to haunch, similar to Bridge Design Guide [6.42.03A](#).

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7.02.32 Deck Replacements (Cont.)

E. Pour Sequence for Superstructures with Pin and Hanger Assemblies (5-28-2024)

When replacing the bridge deck on superstructures with pin and hanger assemblies the pour sequence must be carefully considered. Generally, the sequence should call for the deck over the suspended spans to be poured first followed by the positive moment areas of the remaining spans. If the length of the cantilever (measured from the centerline of bearing at the pier to the centerline of the pin and hanger assembly) is relatively short, the negative moment areas over the piers and the cantilever can be poured with the positive moment area. If the length of the cantilever is relatively long, the negative moment area over the piers and the cantilever should be poured separate from the positive moment area of the cantilever span. Short cantilevers are considered 10 feet or less in length.

7.02.32 (continued)

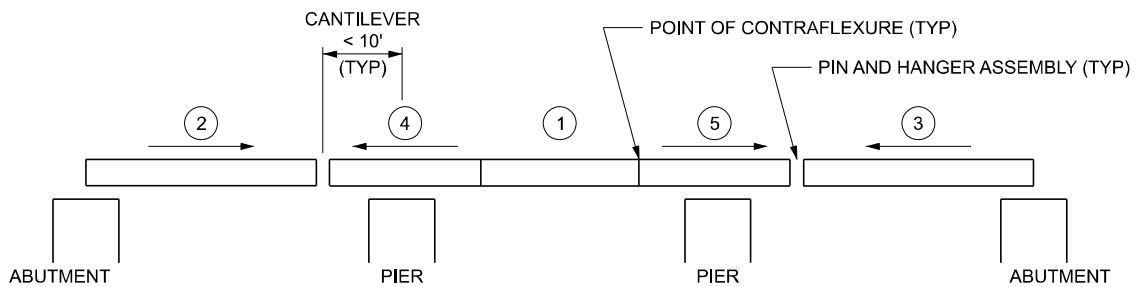
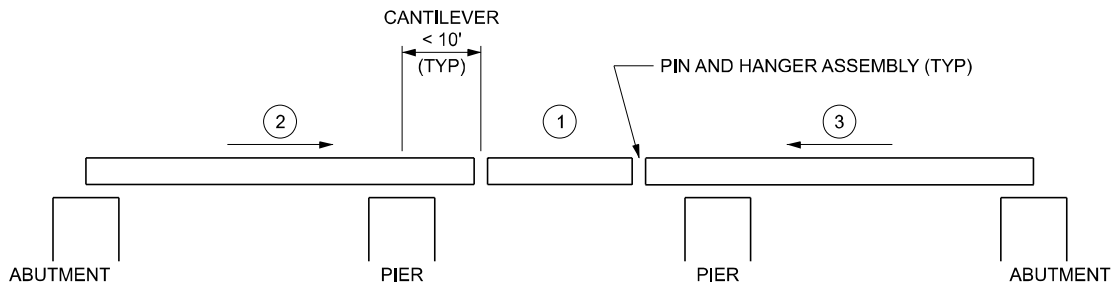
The direction of the pour must also be considered. Generally, the following pour directions should be called for on the plans:

1. Suspended spans with pin and hanger assemblies at both ends – the pour can progress in either direction and should be left to the Contractor to decide based on their preferred means and methods.
2. Suspended spans supported on one end by an abutment and on the other end by a pin and hanger assembly - the pour should progress from the abutment toward the pin and hanger assembly.
3. Positive moment areas of cantilever spans with one end supported by an abutment – the pour should progress from the abutment toward the cantilever.
4. Positive moment areas of cantilever spans with both ends supported by piers and with cantilevers on both ends – the pour can progress in either direction and should be left to the Contractor to decide based on their preferred means and methods.
5. Negative moment areas of cantilever spans – the pour should progress from the point of dead load contraflexure toward the pin and hanger assembly.

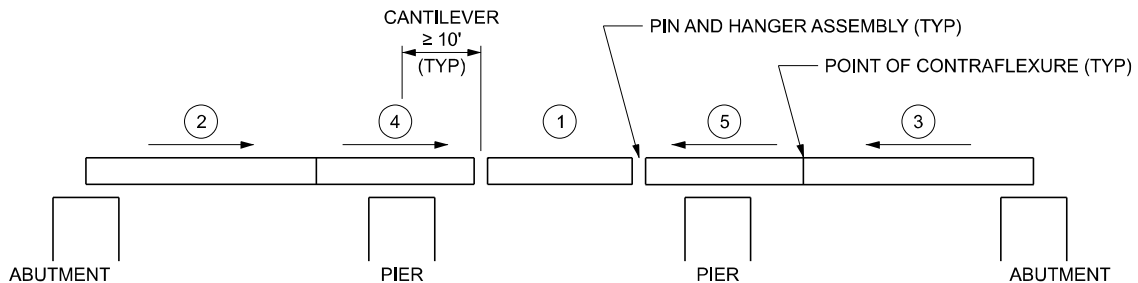
Diagrams illustrating the pour sequence and pour direction for different superstructure configuration can be found in Figures 7.02.31 E.-A & -B.

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Figure 7.02.31 E.-A



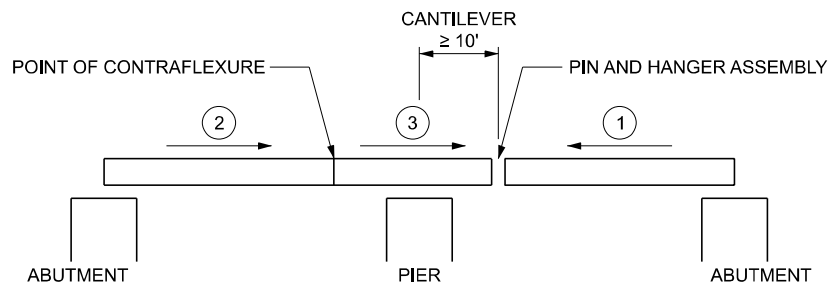
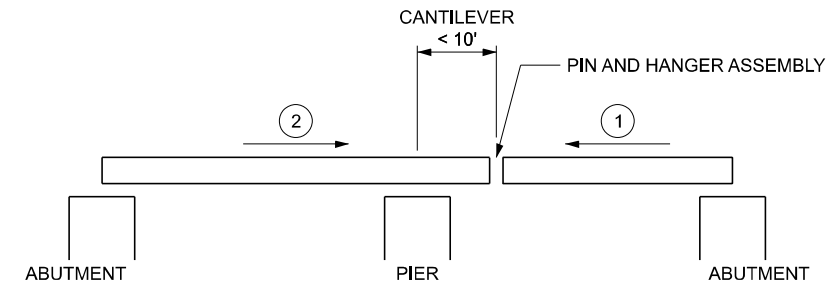
POUR (1) FIRST, (2) OR (3) IN ANY ORDER, THEN PIER POUR (4) CLOSEST TO POUR (2) AND FINALLY REMAINING PIER POUR (5).



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Figure 7.02.31 E.-B



NOTES:

CONCRETE POURS WITHOUT A POUR DIRECTION ARROW MAY PROGRESS IN EITHER DIRECTION AND SHOULD BE LEFT TO THE CONTRACTOR TO DECIDE BASED ON THEIR PREFERRED MEANS AND METHODS.

LEGEND

(2) POUR SEQUENCE NUMBER
→ POUR DIRECTION

PIN AND HANGER ASSEMBLY POUR SEQUENCES

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7.02.33

Ride Quality

The purpose of a ride quality specification is to obtain a smoother riding pavement than is typically obtained with the traditional 10 foot straightedge smoothness requirements. Michigan first adopted a ride quality specification in 1979. The current specification prescribes classified levels of ride quality requirements described in subsequent paragraphs of this section.

Specific requirements for ride quality are identified by classification. Each classification (Class I, II, III & IV) specifies criteria for roughness, method of measurement, applicable incentives, disincentives, and corrective action. The matrix on the following page provides instructions for assigning ride quality classification based on scope of work, design speed, grade control and adaptability to production paving.

Ride quality requirements are not intended for application with stand-alone bridge projects. However, bridge deck replacements, and shallow or deep concrete bridge overlays included within the limits of a Class I ride quality section in a corridor project will be subject to ride quality requirements.

Using these criteria, the road designer will assign a ride quality classification to each applicable section of paving throughout the project. The locations and classifications are then tabulated for inclusion in the Notice to Bidders (generally done by the road designer).

The bridge designer will recommend if the bridge portions of a Class I section are to also be designated as Class I or are to be excluded by designation as Class II based on the type of work and adaptability to corrective deck grinding,

Within Class II, III, and IV areas, bridges are predetermined excluded areas from ride quality specifications between the two end reference lines or between the outermost limits of any structure expansion joint devices.

7.02.33 (continued)

The only pay item associated with ride quality is bump grinding. A small quantity should be included for each location where the contractor may be directed to grind *existing* pavement (i.e.: pavement not placed as part of the contract) in order to smooth the transition from old to new pavement. This includes the POB, the POE, and any *existing* bridge or railroad approaches within the project limits. 25 square yards for each lane at each of the above locations should suffice.

Bump grinding is normally not paid for in areas excluded from ride quality. Instead the pavement is accepted or rejected based on the 10 foot straightedge criteria. (**Standard Specifications for Construction**) If it does not meet the straightedge criteria, it is the contractor's responsibility to grind or replace at their cost.

For additional information on ride quality see the Road Design Manual section [6.04.05](#).

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7.02.33 (continued)

Ride Quality Classification Selection Matrix

How To Use This Matrix		Contractor has control over grades		Contractor has limited or no control ⁽²⁾ over grades				
Divide the project into Sections ⁽¹⁾ based on the amount of control the contractor will have over the final surface grades, the scope of work, and the design speed. Determine the recommended ride specification type for each section. Confer with Construction Field Services staff for exceptions or unique circumstances.		3R ⁽³⁾	4R ⁽³⁾	3R ⁽³⁾	4R ⁽³⁾	Single Course of Flexible Pavement (with/without milling)	Diamond Grinding Projects	Flexible Ultra Thin, Paver Placed Surface Seal
		Class II	Class II	Class II	Class II	Class III	Class III	Class III
Section length allows for production paving ⁽⁴⁾	Design Speed below 50 mph	Class I or II	Class I or II	Class II	Class II	Class III	Class III	Class III
	Design Speed 50 mph or above	Class III	Class II	Class IV	Class IV	Class IV	N/A	Class IV
Section length does not allow production paving ⁽⁴⁾	Design Speed below 50 mph	Class II	Class I or II	Class IV	Class IV	Class IV	N/A	Class IV
	Design Speed 50 mph or above	Class II	Class I or II	Class IV	Class IV	Class IV	N/A	Class IV

Key:

Class I Ride Quality: Complete Projects (mainline only) where no excluded areas are allowed, a thresh hold IRI criteria must be met, and incentives and disincentives apply. Use Class I only on limited access roadway with design speeds 50 mph or greater and where most or all bridges include deck replacement, shallow concrete overlays, or deep concrete overlays. Investigate the feasibility of diamond grinding (at MDOT cost) any bridge decks not being replaced or overlaid. Where diamond grinding a bridge deck is not feasible, a limited section of the project can be designed as Class II Ride Quality such that the bridge would be a pre-determined excluded area within a project that would otherwise meet Class I ride Quality criteria.

Class II Ride Quality: Sections where threshold IRI criteria must be met, but incentives and disincentives do not apply. (Use Class II if all of the above requirements for Class I are not met.)

Class III Ride Quality: Sections where the pre-construction IRI must be maintained or improved by a certain percentage. Disincentives may apply.

Class IV Ride Quality: Sections where acceptance is based on a 10 foot straightedge criteria. Incentives and disincentives do not apply.

N/A = Not Applicable

Footnotes:

- (1) A Section is defined as a length of paving which has the same characteristics (grade control, type of work, design speed).
- (2) Locations where a contractor might not have control of grades include locations where they must pave adjacent to an existing lane with marginal ride quality, locations where there are existing curbs to match, and locations where there are frequent existing manholes or structures to meet.
- (3) 3R means resurfacing, restoration, and rehabilitation. Primary examples include multiple course resurfacing, milling or profiling, concrete overlays and inlays (without removing subbase). 4R means new construction or reconstruction. A primary example is complete removal and replacement of pavement (including subbase). See Chapter 3 for further definition and examples including projects with combined 3R and 4R work for classifications purposes on projects with multiple fixes.
- (4) Production paving means a slipform paver can be used for concrete paving and that a HMA paver can be used without frequent stopping and starting and there is room for a haul truck to unload directly into the paver or a material transfer device while in motion. MDOT imposed construction staging requirements should be considered when making this determination

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7.02.34

Bridge Mounted Sign Connections (2-24-2025)

On all projects that include the installation of a traffic sign supported by a bridge, the Bridge Engineer must confirm that the additional loading will not result in overstresses in the beam/girder based on AASHTO LRFD. If the analysis finds that the bridge beam/girder will be overstressed, design modifications to the bridge superstructure to keep the applied stresses below the allowable limits. This may include, but is not limited to installing stiffeners, installing additional diaphragms or cross frames, or installing lateral bracing.

The [MDOT Sign Support Standard Plans](#) for bridge sign connections with a plan date of 01/10/2024 or later have considered the capacity of the beam/girder and include any modifications required to keep the applied stresses below the allowable limits for the following conditions:

1. One sign is attached to the bridge beam/girder at any location along the span of the bridge.
2. For steel beams/girders the thickness of the web is equal to or greater than the minimum thickness specified in the MDOT Sign Support Standard Plans.
3. For concrete beams the concrete compressive strength of the deck and beam is greater than the minimum strength specified in the MDOT Sign Support Standard Plans.
4. The size of the sign falls within the maximum limits included in the applicable MDOT Sign Support Standard Plan.

7.02.34 (continued)

Any conditions outside of those listed above have not been considered in the development of the MDOT Sign Support Standard Plans and must be analyzed by the Bridge Engineer.

Generally, a traffic sign attached to a bridge will have a minor impact on the overall superstructure and on the substructure and it is typically not necessary to investigate the global effect of the bridge sign connection. The Bridge Engineer must determine whether project specific conditions outside of those listed above warrant a more detailed review that includes an analysis of the overall superstructure and the substructure.

For rehabilitation projects, see Section [12.07.11](#), Existing Bridge Sign Connections.

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7.03

SUBSTRUCTURE

Design structures by placing all substructure units (piers & abutments) and slopes outside of the clear zone. For clear zone distances see [Chapter 7](#) of the Road Design Manual. For substructure clearances also see [Bridge Design Guide](#) 6.06.01-.04. Provide guardrail protection for units or slope that cannot be placed outside of the clear zone. Place guardrail at a distance that will allow deflection as defined in [Chapter 7](#) of the Road Design Manual. Design piers with base walls and guardrail approach terminals to maximize clear roadside distance in lieu of shielding piers with guardrail. Attach guardrail to base walls as detailed on Standard Plan R-67-Series. (7-24-2023)

Do not use steel sheet piling as support elements for substructures unless approved by the MDOT Geotechnical Section. (3-28-2022)

7.03.01

Abutment Design

A. Design Cases

The following cases must be considered in the design of an abutment:

Case I

Construction state: abutment built and backfilled to grade.

Case II

Bridge open to traffic with traffic loading on the approach only.

Case III

Bridge with traffic on it and no load on approach.

Case IV

Contraction: Loading forces of Case II plus the effects of temperature contraction in the deck transmitted to the abutment. Tom.

Expansion: For integral abutments Case IV instead assumes the loading forces of Case III with the addition of an expansion force transmitted from the deck. (8-20-2009)

7.03.01 (continued)

B. Types

Fill material (lightweight fill or other low-density materials) can aid in the design of abutments. (6-27-2022)

1. Cantilever Abutment

The maximum wall height for cantilever abutments is approximately 25'-0".

2. Counterfort Abutment

Counterfort abutments should be considered when wall heights exceed 25'-0".

3. Curtain Wall Abutment

Curtain wall abutments are to be considered where piles are required under the abutment and the abutment height does not exceed 9'-6" (see Bridge Design Guide [5.18.01](#)).

Curtain wall abutments of sufficient length to require expansion joints are to have the end piles battered outward parallel to the reference line. The purpose of this is to prevent the expansion joint from opening excessively.

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BRIDGE DESIGN - CHAPTER 7: LRFD

7.03.01 (continued)

Abutment Design

B. Types

4. Integral and Semi - Integral Abutments

Integral and semi-integral abutments shall be used where practical to avoid deck joints. (5-1-2000)

Integral Abutment

Abutment walls (stub type) supported by one row of piles that allow movement through pile flexure (see [Bridge Design Guide](#) 6.20.04 series). Walls shall be a minimum of 5'-0" and 12'-0" maximum in height. The H-Pile webs shall be oriented parallel to the bridge reference lines and embedded a minimum of 30" into the abutment wall. Upon recommendation from Geotechnical Services Section pile holes shall be prebored. CIP piles may also be used if recommended by the geotechnical engineer. Embed CIP piles a minimum of 30" into the abutment wall. In general, integral abutments do not have return wingwalls that are attached to the abutment. (6-27-2022)

A separate design analysis needs to be performed on the abutment wall for active and passive pressures. Additional vertical dowels may be required at the abutment and backwall interface to resist the active surcharge and the passive resistance that have been introduced into the wall from bridge expansion. Additional vertical reinforcement may be required in the abutment wall and should also be designed. The pile spacing may need to be adjusted to prevent shear stress failure in the pile.

Due to scour considerations, the designer should usually avoid using Integral abutments at stream crossings unless spill through abutment criteria can be satisfied ([Bridge Design Guide](#) 5.47.01) or if abutments are placed outside of the scour limits of the stream crossing. (9-25-2023)

7.03.01 (continued)

Semi-Integral Abutment

Conventional abutment walls fixed in position with expansion and contraction movement of the bridge superstructure (see [Bridge Design Guide](#) 6.20.04 series). Abutments with a single row of piles should not be used.

The following design criteria are valid for both types of abutments.

- a. Steel bridges are to be less than 300'-0" and concrete bridges are to be less than 400'-0" in length.
- b. Use approach slab details on Standard Plan R-45-Series when the length of bridge contributing to expansion at an abutment is less than 50'-0" for concrete beam bridges and less than 25'-0" for steel beam bridges. (8-20-2009)
- c. Angle of crossing shall be 60 degrees minimum and 120 degrees maximum. See Section [7.01.14](#) for MDOT skew policy. (12-5-2005)
- d. Backfill shall be "Backfill, Structure, CIP" as per Standard Specifications.

Place aggregate base or open graded drainage course (OGDC) over structure backfill to support approach slabs, sleeper slabs and approach curb and gutter. (10-22-2012) (12-28-2015)

- e. Pavement seats are 9" wide for dependent backwalls, and approach slabs project to the bridge slab over independent backwalls. Avoid cantilevered pavement seats. (1-24-2022)

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7.03.01 (continued)

Abutment Design

B. Types

4. Integral and Semi-Integral Abutments

- f. (1-24-2022) Approach slabs are 20'-0" in length whenever possible.

Approach slabs 20'-0" in length are based on a longitudinal unsupported length of 10 feet measured along the centerline of the roadway, a slab thickness of 12" and a maximum concrete cover to the centerline of the bottom longitudinal reinforcement of 3". Deviation from these design parameters for specific projects requires a complete redesign of the approach slab.

Approach slabs with independent backwalls can be 6'-6" minimum length. For design speeds greater than 45 mph (posted > 40 mph) approach slabs may be up to 20' in length (measured along roadway centerline) as project and geometric limitations allow. Use shorter approach slab length (6'-6" min) if service road is in close proximity to the bridge abutment. (12-28-2015)

Abutments with skew angle maintain the same skew angle at the end of the bridge approach slab and at the sleeper slab. Standard Plan [R-45-Series](#) reinforced approach pavements are cast perpendicular (90°) to the roadway centerline on the opposite end of the sleeper slab. See Standard Plan [R-43-Series](#). (12-28-2015)

Cast 12" minimum thickness (9" for independent backwalls) bridge approach slab from sleeper slab towards reference lines at night with "Superstructure Conc, Night Casting (High Performance)" and match the road approach thickness (9" minimum). (9-27-2021)

Use a 20' concrete approach pavement as detailed on Standard Plan [R-43](#) & [R-45](#) - Series located on the road approach side of the sleeper slab. (10-22-2012)

7.03.01 B. 4. f. (continued)

Designate approach slabs as separate pours in the pour sequence of the superstructure. (9-21-2015)

See Bridge Design Guide [6.20.03A](#), [.03B](#), [6.20.04](#) & [.04B](#) for approach slab details. (12-28-2015)

- g. Continue bottom mat of deck reinforcement past reference joint into the approach slab with independent backwalls. See Bridge Design Guides [6.20.03A](#) & [.03B](#). For dependent backwalls lap or develop EA bars from deck slab to bridge approach slab. See Bridge Design Guides [6.20.04](#) & [.04B](#). Provide adequate lap/development according to Bridge Guide [7.14.02](#) Series. (12-26-2023).
- h. Add extra reinforcement over beams at the reference joint that extend into the approach slab and into the bridge deck slab. Lap or develop extra EA bars over beams according to Bridge Guide [7.14.02](#) Series. (12-26-2023)
- i. Attach approach curb and gutter to the approach slab with bottom mat transverse reinforcement and to the bridge deck with bottom mat longitudinal reinforcement. Do not attach curb and gutter to the approach slab or the bridge deck on structures with return wingwalls. Using a bond breaker and sliding the approach slab over the return wingwalls is a design consideration. The extension of bridge railing to the sleeper slab will eliminate the need for curb and gutter in the bridge approach slab area. (1-24-2022)
- j. An inverted "T" sleeper slab shall be used with all approach slabs (except when Standard Plan [R-45-Series](#) approach is used by itself). Concrete to concrete slabs shall have an EJ3 (or EJ4) joint on the bridge side of the stub and an E3 joint on the road side. Place [R-45-Series](#) reinforced concrete slab on the road side of the inverted "T" sleeper slab. Provide elevations along stub of sleeper slab at construction centerline, lane lines and edge of metal. Provide elevations at toe of curb/barrier and top of curb if present. (1-24-2022)

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7.03.01 (continued)

Abutment Design

B. Types

5. Spill – Through Abutment (9-24-2018)

A spill-through abutment has fill-slope with a revetment on the streamward side.

a. Definitions

- 1) Fill slope: side or end slope of an earth-fill embankment. Where a fill slope forms the streamward face of a spill-through abutment, it is regarded as part of the abutment.
- 2) Revetment: rigid or flexible material designed and placed to inhibit scour or erosion.

7.03.01 (continued)

b. Design Considerations

- 1) The dimensions and elevations of the revetment must be as defined by the Hydraulics Unit.
- 2) If the Hydraulics Unit determines there is a high probability of the river laterally migrating over time, consideration shall be given to:

- a) Design the span lengths and substructure locations to accommodate the future path of the river.

and/or

- b) Resist migration with stream armoring and/or design the abutment to remain stable at the 500-year flood event after stream migration has occurred.
- 3) Additional ROW may be necessary to provide sufficient revetment, as defined by the Hydraulics Unit.

A multidisciplinary team consisting of the Hydraulics Engineer, Geotechnical Engineer and the Structural Engineer (Bridge Designer) should convene to determine the best design option when stream meandering is likely.

See Bridge Design Guide [5.47.01](#) for details and MDOT Drainage Manual section [6.4.5.6](#) for additional design criteria.

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7.03.01 (continued)

Abutment Design

B. Types

6. Geosynthetic Reinforced Soil - Integral Bridge System (GRS-IBS) Abutment (10-28-2024)

GRS-IBS abutments may be considered on projects meeting the following criteria:

- a. The anticipated foundation is a shallow foundation (spread footing).
- b. Traffic over the bridge will be detoured during the construction of the project or the bridge is being constructed on a new alignment.
- c. The proposed bridge is a single span or two span structure. Using GRS-IBS abutments on bridges with more than two spans is not desired currently due to a lack of national experience and history with these span configurations.
- d. There are no existing or proposed utilities that will be attached to the proposed structure or located within the reinforced soil zone behind the proposed abutments. This includes storm sewers, traffic signals, and lighting.
- e. The anticipated traffic growth is not expected to necessitate future widening of the bridge. If the need for future widening is likely the final full width substructure should be constructed as part of the project.
- f. The skew angle of the substructure is 30 degrees (30°) or less. Zero-degree (0°) skew angles are preferred, if possible.

7.03.01 (continued)

GRS-IBS abutments at bridges over water must be designed to account for the estimated scour in accordance with the MDOT Drainage Manual.

Back to back GRS-IBS abutments may be considered in the median between two bounds of traffic and may be beneficial to minimize differential settlement between the structures over each bound. When considered, wingwalls should generally be used in lieu of returnwalls due to constructability and to provide Contractor access to build the abutments. Back to back GRS-IBS abutments should not be considered in waterways.

When the criteria listed above are met a more detailed discussion with the Geotechnical Engineer should take place to confirm that GRS-IBS abutments are a feasible solution. Generally, this discussion should take place during the development of the Structure Study.

GRS-IBS piers will not be considered at this time.

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7.03.01 (continued)

Abutment Design

C. Wall Design

1. Wall Thickness

The minimum wall thickness for abutments is 2'-0". This is to be increased in 2" increments when required to provide 4½" minimum clearance between edge of masonry plate (or elastomeric pad) and front face of the abutment. (8-6-92)

2. Cantilever Wall Design

Cantilever walls 16'-0" or higher are to be designed for both bending and direct stress.

3. Steel Reinforcement

All wall reinforcement shall be epoxy coated. Horizontal bars in the front faces of abutment walls should be continued around the corners at the wingwalls. EC#6 bars are to be placed diagonally across the inside corners. (5-6-99)

4. Vertical Construction Joints

a. There is to be vertical continuity of all construction joints from the footing upward; however, a wall joint does not require a footing joint below.

b. Spacing

(1) Curtain wall abutments - 35'-0" maximum spacing.

(2) Cantilever abutments - 25'-0" maximum spacing.

5. Horizontal Construction Joints

For walls over 30'-0" high, there should be a horizontal construction joint approximately at mid-height. (9-2-2003)

7.03.01 (continued)

6. Vertical Expansion Joints

Vertical expansion joints shall be spaced approximately 90'-0" apart. There should be a construction joint in the footing directly below each expansion joint in the wall.

7. Bridge Seat Steps

Where the bridge seat is stepped, the ends of the steps shall be at 45° to the bridge seat and parallel to the centerline of the bridge to accommodate any movement due to temperature changes. (5-6-99)

8. Pavement Seats

Pavement seats are to be provided on all bridges. They should be cantilevered from the rear face of independent backwalls. (5-6-99)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN - CHAPTER 7: LRFD

7.03.02

Footing Design

A. Footing Thickness

The minimum thickness of footings is normally 2'-6"; however, this may be reduced to 2'-0" for short walls. When the wall thickness at its base becomes 3'-0" or greater, the footing thickness is to be increased to 3'-0". Footing thicknesses are to be increased in 6" increments.

B. Footing Width (12-5-2005)

Spread footings should be sized so that the safety factor for overturning about the toe of footing is at least 2.0. The minimum footing width is 6'-0" for cantilever abutments and 4'-0" for curtainwall abutments. Footings with piles should be sized so that the resultant force is located between rows of piles.

C. Footing Joints

Construction joints should be placed in footings to limit concrete pours to 90 CYD. These joints are provided for construction convenience and should be labeled "optional." Where a footing joint is used, it should be located directly under a wall joint.

D. Footing Elevations

Bottoms of footings are normally set 4'-0" below existing or proposed ground line to avoid frost heave. For substructure units in or adjacent to a waterway, bottoms of footings are normally to be set 4'-0" below bottom of channel; where tremie seals are used, the bottoms of footings may be set higher. For substructure units in or adjacent to a waterway, The Hydraulics/Hydrology Unit shall be consulted for an estimate of the total potential scour depths at the foundations. The tops of footings shall be set at or below the estimated elevation of contraction scour (scour resulting from the constriction of the waterway at the crossing). Structure stability shall be analyzed based on the estimate of total scour at each substructure unit with the advice of geotechnical engineers. If necessary, countermeasures to prevent scour will be incorporated according to FHWA and AASHTO standards. (5-6-99)

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7.03.02 (continued)

E. Steel Reinforcement

Where a tremie seal is used and there are no piles, the bottom footing reinforcement shall be 9" above bottom of footing. Where a tremie seal is used and there are piles, the reinforcement shall be 1'-3" above the bottom of footing.

F. Passive Soil Pressure

1. Passive soil pressure may be used in the footing design for retaining, wing and return walls, but not for abutments, to resist sliding and overturning forces. Generally, these resisting forces shall be relied upon only when the footing is in a cut and the soil is not disturbed. The location of utility trenches and edge drains should be considered in making a determination of undisturbed soil. In a river environment, passive soil pressure shall not be used.

Use resistance factors for sliding of spread footings as defined in AASHTO LRFD Table 10.5.5.2.2.-1. Use resistance factor of 0.80 for cast in place concrete on sand and use (where allowed) resistance factor of 0.50 for passive earth pressure component of sliding resistance.
(8-20-2009)

2. When the passive soil is on a slope, the soil height shall be reduced as follows:
 - a. Berm with 1V:2H slope - reduced 1'-0"
 - b. 1V:2H slope - reduced 2'-0"

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7.03.02 (continued)

Footing Design

G. Bearing Resistance – Spread Footings (8-20-2009)

1. Geotechnical Engineer shall provide:
 - a. Nominal Bearing Resistance (q_n)
 - 1) For foundations on rock, a single value of nominal bearing resistance (q_n) will be provided for all footing widths.
 - 2) For foundations on soil, nominal bearing resistance (q_n) will be provided graphically, by plotting nominal bearing resistance (q_n) versus effective footing width (B').
 - b. Strength limit state resistance factor for bearing resistance (ϕ_b) and sliding resistance (ϕ_τ). Refer to AASHTO LRFD Table 10.5.5.2.2-1.
 - c. Service limit state resistance factors shall be taken as 1.0, except as provided for overall stability.
2. Foundation recommendation memo/report investigates nominal bearing resistance (q_n) based on:
 - a. Bearing failure – Strength Limit State
 - b. Tolerable settlement criteria – Service Limit State (1.5" max settlement recommended by MDOT)

7.03.03

Pier Design

A. Future Widening

On bridges where we are to provide for future widening, a vertical construction joint, as shown in Bridge Design Guide [5.27.03](#), is to be provided in the pier cap.

B. Column

1. Size

In general, 3'-0" diameter columns should be used. Columns with a diameter of less than 3'-0" may be used, when necessary, but the height of the base wall must be increased in accordance with MDOT Bridge Design Guide [5.22.01](#) to provide additional protection in the event the pier is struck by a heavy vehicle. Column diameters less than 2'-6" are not permitted. (7-24-2023)

2. Reinforcement

Care should be used in spacing vertical column bars in order to avoid excessive interference with the pier cap reinforcement. Double rows of column bars or larger diameter columns should be considered to alleviate this problem.

3. Construction Joint

If pier columns are over 30'-0" high, a construction joint should be placed at approximately mid-height.

4. Spacing

Columns should be spaced far enough apart so as to be appealing to the eye; if beam spacing is far enough apart, a column may be placed under each bearing. (7-24-2023)

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7.03.03 (continued)

Pier Design

C. Pier Caps

Pier caps meeting the requirements outlined below shall be included in the design of all multi column piers. (7-24-2023)

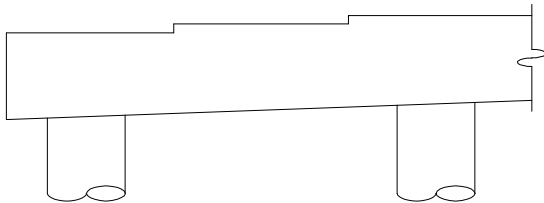
1. Size

The pier cap is to be approximately 3" wider than the diameter of the column and should provide 4½" minimum clearance between the edge of masonry plate (or elastomeric pad) and the face of the cap.

Hammer head pier caps are occasionally used on MDOT projects. These piers have a greater tendency for cracking in the tension zone than standard pier caps. Design procedures to prevent cracking (especially in tension zone), including post tensioning the caps, must be investigated. (9-2-2003)

2. Bolsters

When one end of the pier cap is on a considerably different elevation than the other, the difference shall be provided for by increasing the column heights as shown below.



Ends of bolsters are perpendicular to the faces of the cap and rise at 90° from the top of the pier.

3. Joints

Construction joints should be provided at 25'-0" maximum spacing. A 1" open joint may be required to control temperature moments in long piers with short columns.

7.03.03 (continued)

4. Reinforcement Steel Spacing

In order to permit the vibrator to adequately penetrate and vibrate the concrete in pier caps, the clear distance between the top bars should not be less than 3½". This may, in some cases require the use of special size bars or double rows of bars.

5. Part Width Construction of Cantilevered Pier Caps (12-5-2005)

To reduce potential problems with large pier cap cantilevers during construction base design on the following criteria:

- Avoid splicing reinforcement at points of maximum stress. Where this is not practical, stagger the splices.
- Calculate the clear distance between contact lap splices assuming the bars are placed in a horizontal plane unless otherwise noted on the plans.
- Use temporary supports during staged construction to shore cantilevered pier caps exceeding five feet in length.
- Design structural elements using a dead load factor of 1.5 if live loads (unanticipated construction loads) are not applied to elements.

D. Pier Base Walls

Account for the AASHTO LRFD vehicle collision force in the design of all new bridges, bridge replacements, and pier replacements. Design piers that are within the clear zone to account for the AASHTO LRFD vehicle collision force as outlined in Section 7.01.04.K. The base wall is to be 3" wider than the column to prevent vehicle snagging and should extend 5'-0" (min.) above the ground line. Any approach guardrail is to be anchored to the base wall according to Standard Plan R-67-Series. (7-24-2023)

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7.03.04

Cofferdams (8-6-92)

Cofferdams shall be used on all substructure units where tremie concrete is required for water control. When shallow water is present; i.e., less than 2'-0", other methods of water control that allow the contractor maximum flexibility may be appropriate. The Geotechnical Services Section should be contacted in this case to determine if a cofferdam is required. (2-26-2018)

The driving line for cofferdam sheet piling shall be 1'-6" outside the footing outline or at the edge of the tremie concrete. Deep excavations may use driving line greater than 1'-6" outside the footing outline to allow for more efficient bracing schemes. Consult with Geotechnical Services Section. (8-20-2009)

Since a cofferdam is generally a sheeted enclosure, the plans should show and note the limits of the enclosure. The contractor must know if he will be required to completely enclose the excavation or whether sheeting on three sides will suffice.

Often, a portion of a sheet pile cofferdam is to remain in place. On these projects, there will be two bid items. "Steel Sheet Piling, Temp, Left in Place" will be measured and paid for in the specified manner. The remainder of the enclosure along with dewatering, etc., will be paid for as "Cofferdams." This division of pay items should be clarified by a plan note. (9-27-2021) When cofferdams are not used on structures crossing streams or encroaching on water courses, Plan Note [8.05 Q](#) shall be used. (8-23-2021)

Where a sheet piling enclosure is required for lateral soil support but not for the exclusion of water, "Steel Sheet Piling, Temporary" should be called for.

For additional information see Subsection [7.01.10](#).

7.03.05

Subfootings

Use subfootings under footings for all substructure units regardless of their location unless a differing means to support forming, reinforcement and concrete during placement is specified by the geotechnical engineer. Extend subfootings 1'-3" outside of footing lines and in general provide a thickness of 3½"; subfootings may be 5½" thick where water and/or soil conditions are such that unsuitable conditions might arise. Maintain foundation excavation limits of 1'-6" outside of footings in all cases. Concrete for subfootings is to be bid separately as "Conc, Grade 3500, Subfooting" and has the material properties of Concrete, Grade 3500. (6-24-2024)

7.03.06

Tremie Seal Design

Generally, tremie seals should be called for on all structures where it is expected that difficulty will be encountered in pumping the water down below the bottom of footing. Do not include weight of tremie when computing pile loads except when the estimated scour depth is below the bottom of tremie. (5-6-99)

A. Design

The tremie seal shall be designed to resist the hydrostatic pressure at the bottom of the tremie by a combination of its weight, plus the bond on the cofferdam and piles. The allowable bond stress is 10 psi on the piles and 5 psi on the cofferdam, providing the piles and the sheeting have sufficient resistance from dead weight and soil friction to resist the load thereby induced. Where shells are used or permitted as an option, the total resistance available will be the weight of the shell plus soil friction less any buoyancy force exerted on the shell. Allowable tension in bending on the tremie seal is 30 psi.

B. Hydrostatic Head

Hydrostatic head should be figured from bottom of tremie seal to ordinary water surface elevation. Include note [8.05 R](#) on plans. (8-23-2021) (5-6-1999)

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7.03.07

Excavation

All foundation excavation is to be "Excavation, Fdn" unless there is a considerable amount of rock excavation involved; in this case, excavation is to be divided into two bid items: "Excavation, Rock Fdn" and "Excavation, Fdn." (9-27-2021)

Unbraced excavations adjacent to in-service spread footings shall not be permitted. Earth retention designs shall be sealed by a licensed engineer. (11-28-2011)

7.03.08

Steel Sheet Piling

For additional information see Subsection [7.01.10](#).

Evaluate the potential for vibration induced damage to existing structures and utilities. (11-28-2011)

A. Driving Line

1. Temporary Steel Sheet Piling

The driving line for temporary steel sheet piling is 1'-6" outside the footing outline or at the edge of the tremie seal.

2. Permanent Steel Sheet Piling

The inside face of permanent steel sheet piling is to be along the footing outline. Allowance for additional concrete and excavation is to be made due to the structural shape of the sheet piling.

B. Lateral Limits

Lateral limits of open-ended permanent sheeting must be extended beyond the limits of the required excavation. For estimating this extension, use a 1V:1H slope from bottom of excavation to existing ground.

C. Temporary Steel Sheet Piling Left in Place

On some projects requiring temporary sheeting, it is specified that the sheeting be left in place. The sheeting is not required for permanent support, but disturbance caused by its removal could be damaging. The bid item "Steel Sheet Piling, Temp, Left in Place" is used in these instances. (5-6-99) (9-27-2021)

In general, sheeting at stage lines that is adjacent to permanent backfills should be specified as left-in-place and cut off to approximately 3' below the final pavement grade. If sheeting must be removed, contact the Geotechnical Services Section to determine feasibility. (2-26-2018)

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7.03.08 (continued)

D. Permanent Steel Sheet Piling (10-24-2001)

1. Design

A required section modulus is calculated based upon a piling design. (MDOT Geotechnical Services Section may recommend a section modulus.) A section is chosen from [Appendix 7.03.08 D](#). (Sheet Piling Section Moduli) using the tabulated "effective" modulus in place of the calculated section modulus. (2-26-2018)

Cold rolled sections have an additional reduction factor, thus it is possible to have a cold rolled section with a higher nominal section modulus, but a lower effective section modulus. To avoid field substitutions resulting in less than designed "effective" section modulus, the plans shall indicate the minimum acceptable nominal section modulus for both hot and cold rolled sections based on values given in [Appendix 7.03.08 D](#). (see note [8.06.06 C](#)). (8-23-2021)

In addition to [Appendix 7.03.08 D](#), which is to be used for all permanent installations, sheet piling sections subject to severe environments should also be hot dipped galvanized.

Designers are responsible to determine the domestic production and availability of the sheet piling sections they specify. (2-26-2018)

7.03.08 (continued)

2. Background/Commentary

[Appendix 7.03.08 D](#) was developed by the Illinois DOT. It contains sheet pile sections and their effective section modulus. This effective modulus was calculated by reducing the nominal value for the effects of corrosion, and in some cases for a Hartman reduction factor.

Hartman Reduction Factor - tests by Hartman Engineering indicate that cold rolled sections failed at 83% of the expected value based on conventional bending theory. The Hartman study concluded that these failures were because the cold rolled sections have larger widths, depths, and width to depth ratios which promote failure prior to yielding the tension flanges. Cold rolled sections shown on the table have their section modulus reduced by 17% to account for the lower yield values. Illinois DOT took the report's conclusion a further step and applied the Hartman reduction factor to "light duty" hot rolled sections also.

Corrosion - all tabulated sections were reduced to mitigate the effects of corrosion. Illinois DOT assumed a 50 year service life and a corrosion of about 0.00059 inches per year. This translates to about 1/17" of total corrosion (two sides) for the service life.

MDOT requires a 75 year service life and a slightly higher corrosion rate, thus the requirement for hot dipped galvanized sections in severe environments.

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7.03.09

Piles

A. General

1. River and Stream Crossing

Both vertical and battered piles should be used under abutments where footings are higher than the river stream bed. The abutments must be protected from scour. The appropriate riprap design as specified by the Design Engineer - Hydraulics/Hydrology will be provided by special provision. A well graded riprap will be provided for foundations subject to pressure flow or velocities greater than 7 feet per second. Piers must have the top of the footing or pile cap below the stream bed a depth equal to the estimated contraction scour depth. (5-6-99)

2. Biaxial Bending and Compression of Piles (8-20-2009)

The combined biaxial bending and compression of piles shall be checked and analyzed for integral abutments and all river structures according to current AASHTO LRFD Bridge Design Specifications 2.6.4, 6.9 & 10.7.

7.03.09 (continued)

3. Economic Analysis to Determine Nominal Pile Driving Resistance (R_{ndr}) (8-20-2009)

For driven pile, an economic analysis of the foundation support system shall be completed optimizing pile type, pile section and construction quality control method pertinent to the particular project in question. The Resistance Factor for Driven Piles (ϕ_{dyn}) used in design determines the construction quality control method that must be used to certify the Nominal Pile Driving Resistance (R_{ndr}). Do not specify dynamic testing with signal testing (P.D.A. testing) for H-piles driven in non-cohesive soil profiles where the driven pile length is expected to exceed 80 feet. Use AASHTO LRFD Tables 10.5.5.2.3 - 1, 2 & 3 in analysis and resistance factor determination and coordinate findings with Geotechnical Services Section. For additional information on pile resistance see section [7.03.09 B](#). (6-27-2022)

General rules for Resistance Factor (ϕ_{dyn}) (detailed analysis shall be performed):

Project Driven Pile Cost	Pile Certification Method	Resistance Factor(ϕ_{dyn})
<\$300,000	FHWA-Modified Gates Formula	0.50
≥\$300,000	Dynamic Testing/ Signal Matching (PDA Testing)	0.65 *
>\$500,000	Static Load Test with Dynamic Testing/ Signal Matching (PDA Testing)	0.80

* This resistance factor applies to the Beginning of Redrive (BOR) case. Do not specify PDA testing for End of Drive (EOD). (11-28-2011) (9-21-2015)

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7.03.09 (continued)

Piles

A. General

4. Test Piles

Test piles are to be provided for all projects using piles unless the Geotechnical Services Section determine that they are not necessary. (2-26-2018)

At least two test piles shall be provided for at each substructure unit placed on piles. Test piles are to be vertical piles unless otherwise approved by the Geotechnical Services Section. (6-27-2022)

Timber test piles shall be located in a manner that will best serve as a basis for ordering the balance of the piles.

5. Pile Embedment

Piles are to be extended into the footing a distance of 6". When a tremie seal is used, the piles are to be extended into the footing a distance of 1'-0".

6. Concrete Displaced by Piles

No deductions in concrete quantities will be made for steel pile embedments or for pipe pile embedments of 1'-0" or less.

7. Edge Distance

The usual minimum edge distance for piles is 1'-6". This may be reduced to 1'-3" where special conditions require.

8. Abutment Piling

When piling is required for abutments, a careful study should be made to ensure that the piling will clear previously placed or proposed culvert pipe.

7.03.09 (continued)

9. Pile Batter

Generally, piles are to be battered no flatter than 3V:1H. Where soil conditions are not good enough to provide sufficient lateral pile resistance, we may increase the angle of batter to 2.5V:1H or even 2V:1H. This measure, however, should be a last resort since it is difficult to maintain driving accuracy when the batter is flatter than 3V:1H

For CIP piles, do not batter flatter than 3V:1H. (1-27-2025)

10. Pile Numbering

A pile numbering scheme shall be shown on the plans for those units having piles. Each pile shall be assigned a number in a particular row or on an individual basis.

11. Lateral Pile Resistance (8-20-2009)

Lateral pile resistance as determined by a Geotechnical Engineer may be used to resist horizontal forces on substructure. See AASHTO LRFD Bridge Design Specification 10.7.

Scour potential for the structure shall be accounted for when the Geotechnical Engineer determines nominal horizontal pile resistance.

12. Pile Driving Vibration Evaluation (11-28-2011)

Driven piles located within a distance of 100 ft of historic or vibration sensitive structures shall be evaluated for damage potential from vibration and/or vibration induced settlement.

Driven piles shall not be located within a 25 ft radius of existing spread footings, critical utilities, or in-service pavements without mitigation and/or vibration and settlement monitoring specifications.

13. Loads Applied to Piles

Piles are to be designed for compression, shear, and/or moment loads only. Piles are not to be designed for tension loads unless approved by the MDOT Geotechnical Services Section. (10-28-2019)

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7.03.09 (continued)

Piles

B. Nominal Pile Resistance (R_n) (8-20-2009)

Design substructures with an initial nominal pile resistance of 500 kips. In some cases, the soil profile will indicate that a higher or lower nominal pile resistance would be more economical. The recommendation from the Geotechnical Services Section will indicate what nominal pile resistance to use.
(6-27-2022)

1. Pile Designation/Maximum Nominal Pile Driving Resistance (R_{ndr})

a. Steel H Piles (11-28-2011)

<u>Pile</u>	<u>(R_{ndr})</u>
HP 10X42	275 kips
HP 10X57	350 kips
HP 12X53	350 kips
HP 12X74	500 kips
HP 12X84	600 kips
HP 14X73	500 kips
HP 14X89	600 kips

b. Metal Shell Piles (5-24-2021)

<u>Pile</u>	<u>(R_{ndr})</u>
Metal Shell 12" O.D. w/0.312" Walls	250 kips
Metal Shell 14" O.D. w/0.312" Walls	350 kips
Metal Shell 16" O.D. w/0.375" Walls	400 kips
Metal Shell 16" O.D. w/0.500" Walls	500 kips

c. Timber Piles

<u>Pile</u>	<u>(R_{ndr})</u>
Timber Pile	150 kips

7.03.09 B. (continued)

A wave equation analysis, which uses typical pile types and driving equipment known to be locally available, shall be performed by the Geotechnical Engineer to verify drivability. (11-28-2011)

Use steel H-Piles meeting the requirements of AASHTO M270 Grade 50. Use metal shell piles for CIP piles meeting the requirements of ASTM A252 Grade 3 (45 ksi) or Grade 3 Modified (50 ksi).
(5-24-2021)

- In general, the Resistance Factor for Driven Piles (ϕ_{dyn}) = 0.50 assuming that the Nominal Pile Driving Resistance (R_{ndr}) is verified using the FHWA-modified Gates Dynamic Formula. The Resistance Factor (ϕ_{dyn}) = 0.65 when dynamic testing with signal matching (P.D.A. testing) is used and (ϕ_{dyn}) = 0.80 with static load tests. (See AASHTO LRFD Table 10.5.5.2.3-1 Resistance Factors for Driven Piles)
(11-28-2011) (11-23-2015)

For piles with a R_{ndr} between 150 kips and less than 250 kips verified using the FHWA-modified Gates Dynamic Formula, use a resistance factor (ϕ_{dyn}) = 0.40.
(6-27-2022)

For piles with a R_{ndr} less than 150 kips verified using the FHWA-modified Gates Dynamic Formula, use a resistance factor (ϕ_{dyn}) = 0.25. (6-27-2022)

- In general, Resistance Factor (ϕ_{dyn}) times the Nominal Pile Resistance (R_n) = Factored Nominal Resistance (R_R).

$$(\phi_{dyn}) \times (R_n) = (R_R)$$

The above equation does not hold true in the case of possible downdrag, and/or scour.

- The nominal pile resistance to be shown on the plans should be equal to the actual demand, based on the final pile layout, divided by the appropriate Resistance Factor for Driven Piles (ϕ_{dyn}), rounded up to the nearest 10 kips. Do not simply use the Maximum Nominal Pile Driving Resistance (R_{ndr}) for the pile type.
(2-26-2018)

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7.03.09 (continued)

Piles

C. Pile Quantities

1. Cast-in-Place Concrete Piles

The following items shall be shown on the plans:

- Length of each pile - Furnished and Driven.*
- Total length of piles - Furnished and Driven.
- Test piles - Each (Furnished and Driven length plus 10').*
- Number of pile points - Each. (Use when a special pile point is required.)
- Furnishing equipment for driving piles - Lump Sum.

*Length to the nearest 5'. (5-6-1999)

If a maximum pile penetration elevation is shown on the plans do not call for pile lengths extending beyond the maximum pile penetration elevation. (6-27-2022)

2. Steel H Piles

Use the same items as cast-in-place concrete piles except exclude pile points.

3. Piles of Designated Nominal Pile Resistance

Use the same items as cast-in-place concrete piles except exclude pile points and pile splices.

7.03.10

Slope Treatment Under End Spans

A. Type

1. New Bridges

On all new grade separations, "Slope Paving, Conc" is to be placed under the end spans on the berm and backslope to the bottom of ditch. (5-6-1999) (9-27-2021)

2. Widening Projects

On widening projects, match existing slope protection if the material is reasonably available.

If pier widening is located within the clear zone, follow the requirements outlined in Section 7.01.04 K. (7-24-2023)

3. Stream or River Bridges (5-6-1999)

The Hydraulics/Hydrology Unit will specify riprap to be used as a scour countermeasure. A special provision for well-graded riprap for foundations shall be included in the proposals of projects where there is either pressure flow or velocities exceeding 7 feet per second. See Subsection 8.05 for hydraulic analysis and design guides for approved methods of stream diversion.

B. Dual Structures

For dual structures on a common abutment, call for slope protection on the slope and berm between the structures.

C. Limits

The slope protection is to be extended 1'-6" beyond the slab fascias or for structures with turnback wingwalls, it should extend to outside face of the wingwalls.

Generally, riprap is to be placed on all disturbed slopes to an elevation of 2'-0" above extreme high water. Under the deck riprap shall extend to the face of the abutment.

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7.03.11

Concrete Sealers (5-1-2000)

When substructure units are new or patched; the entire surface of the substructure unit shall be coated (sealed) to prevent deterioration.

The following materials are used as sealers or waterproofing agents:

A. Elastomeric Surface Coating(6-27-2022)

These materials are a rubberized coating. They create a uniform color and texture making them a good aesthetic treatment. Use Elastomeric coatings on all substructure surfaces where aesthetics are important. (Where aesthetics are an issue, consult the Roadside Development area for coloring considerations.) Use elastomeric coatings on patching projects to mask the mottled look of the patching.

B. Penetrating Waterproofing Sealers

Clear sealers with the consistency of water. Provide sufficient protection for vertical surfaces of substructure units but offer no aesthetic value. Use to seal substructure units where aesthetics are not important. Use on top surfaces only where the substructure unit is not under an expansion joint.

C. Epoxy Sealers

Opaque sealers offer a (nearly) impenetrable barrier. Use epoxy sealers to coat the top horizontal surface of pier caps and abutment bridge seats under expansion joints. (All top surfaces should be considered, even those not under joints.) This material should not be used to encapsulate the entire substructure unit as it does not "breathe" and can cause concrete degradation in such instances.

7.03.11 (continued)

D. Silane Coating (6-27-2022)

A sprayed-on film/coating for the inhibition of water ingress into the pores of concrete. Silane coating is an effective surface treatment method to extend the durability of a concrete elements. Generally, barriers, deck slab fascias, piers, abutments, retaining walls or beams. Do not specify its use on traffic surfaces or with other coatings/sealers. Use when requested by Region Bridge Engineer. Include Special Provision for Silane Treatment for Bridge Concrete.

It is advisable to erect beams prior to coating horizontal surfaces. Areas underneath bridge bearings shall not be coated with elastomeric or epoxy sealers. Coating under bridge bearings with penetrating waterproofing sealers is allowed. (9-2-2003)

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7.03.12

Mechanically Stabilized Earth (MSE) Wall Requirements (8-20-2009)

Design, construction and other considerations related to permanent and temporary MSE walls shall be according to Load and Resistance Factor Design (LRFD) method as defined by AASHTO and MDOT. (2-26-2018)

A. Wall Design Criteria:

1. The bridge designer and geotechnical engineer are responsible for providing the MSE fabricator with the following information:
 - a. Factored bearing resistance at the base of the reinforced soil mass.
 - b. Vertical dead and live loads, horizontal loads, and factored bearing pressure applied to the reinforced soil mass from the bridge or other structures/appurtenances. (6-27-2022)
2. The geotechnical engineer is responsible for performing a global stability analysis, estimating the factored bearing pressure, calculating factored bearing resistance, settlement analysis, checking sliding stability and overturning. Global stability must be checked for all stages of construction, including for temporary MSE walls that are utilized to permit part-width construction operations. (2-26-2018)
3. In addition, the engineer shall incorporate all design aspects of the special provision for MSE Retaining Wall System in the design for the MSE walls.

7.03.12 (continued)

Mechanically Stabilized Earth (MSE) Wall Requirements

B. Wall Configuration:

1. The preference of wall geometry at bridges is as follows:
 - a. Straight walls, in line with the abutment wall.
 - b. Walls turned back at 45 degrees, or turned back with a large radius.
 - c. Walls turned back 46 to 90 degrees.
 - d. Acute angles should not be used.
2. The use of complex geometries such as tiered walls or back-to-back walls must be approved by MDOT's Geotechnical Services Section. For back to back MSE walls the base width, (W_b) distance between walls, divided by the height of the taller wall (H_1) shall be greater than or equal to 1.1 ($W_b/H_1 \geq 1.1$). (11-28-2011)

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7.03.12 (continued)

Mechanically Stabilized Earth (MSE) Wall Requirements

C. Bridge Abutments at MSE Walls

1. Pile supported abutments are required in most cases.
 - a. Maximize pile spacing to reduce interference with soil reinforcement.
 - b. Incorporate/consider pile bending in design (loose soil vs. stiff soil).
 - c. Use pile liner/pile protection to eliminate downdrag between MSE wall backfill and abutment pile as well as to allow slightly more lateral movement in the pile. (6-27-2022)
2. Spread footings may be allowed if either of the following conditions are met:
 - a. The MSE wall is on bedrock.
 - b. The bridge is single-span, not constructed part-width, and spread footings are recommended by the Geotechnical Section.
3. Embed footings 1'-6" below the top of coping to allow a minimum of 6" clearance above the top of soil reinforcement. Four foot (4') minimum embedment is decreased due to free draining ability of Backfill, Select material required behind MSE walls.
4. The use of sliding slab abutments (BDG 6.20.03A) and integral/semi-integral abutments with a sleeper slab closer than 20' to the abutment (BDG 6.20.04 series) is allowed with a 20' concrete approach pavement as detailed on Standard Plan R - 43&45 - Series located on the road approach side of the sleeper slab.
(11-28-2011) (2-26-2018)

7.03.12 (continued)

D. Abutment Footing Clearances and Setbacks

1. The edge of pile supported footings shall be located with a minimum clearance of 2 feet from the back face of the MSE facing panels.
2. The edge of spread footings shall be located with a minimum clearance of 5 feet from the back face of the MSE facing panels.
3. The centerline of the front row of piles shall be setback a minimum of 4.5 feet from the back face of the MSE facing panels. (6-27-2022)

E. Soil reinforcement length requirements

1. Soil reinforcement length is determined by design, but shall not be less than 0.7 times the wall height (H), or 8 feet whichever is greater.
2. The wall height (H) is to be measured from the proposed finished grade where it intersects the back of the wall face, to the top of the leveling pad.
3. For walls supporting a sloping surcharge, the value H1 shall be substituted for H in the above minimum requirements, where
$$H1 = H + (\tan \beta \times 0.3H) / (1 - 0.3 \tan \beta)$$
$$\beta = \text{angle of backslope}$$
4. For walls with abutments within 0.5 times the wall height, the height (H') of wall shall be measured from finished roadway surface to the top of the leveling pad. The value H' shall be substituted for H in the above minimum requirements.
(12-22-2011)
5. For any section of MSE wall, the soil reinforcement will be the same length from top to bottom.
6. Attaching soil reinforcement to substructure as a means to provide horizontal resistance/anchorage is not allowed.

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7.03.12 (continued)

Mechanically Stabilized Earth (MSE) Wall Requirements

F. Drainage around MSE walls

Consideration shall be given to drainage at design phase to decrease the possibility of issues at MSE wall construction.

1. A 30 mil thick PVC Liner (impervious membrane) is required between the roadbed and the soil reinforcement. It should be located a minimum of 8 inches above the soil reinforcement. The liner should extend 6 feet beyond the ends of the soil reinforcement. Extend liner transversely to 8 inches from slope line or return wall (if present). Place an underdrain 1 foot from the end of the PVC liner running transverse to the road and 1 foot from each end of liner running longitudinally along the roadway. Connect the underdrains and dispense drain 3 feet minimum from any soil reinforcement. (12-19-2016)
2. Foundation underdrains should be used, and located as low as possible to provide positive flow.
3. Curb and gutter at the edge of the roadway with a catch basin should be used to collect the drainage. Locate the catch basin a minimum of 25 feet past the end of the MSE wall reinforcement, if possible. The curb and gutter should continue 10 feet past the catch basin.

Other means to collect and dispense water may need to be used if the 4" maximum curb height on Standard Plan R-32 Series is insufficient. (11-25-2019)

See Section [7.07.02](#) for additional information

4. Use a minimum 20' concrete approach slabs (to reduce voids under approaches) for structures with MSE walls at the abutments. This includes sliding slab approaches (Bridge Design Guide [6.20.03A](#)). (11-23-2015)

7.03.12 (continued)

G. Utilities and MSE Walls

1. Avoid utilities through or underneath MSE walls.
2. If utilities cannot be avoided, encase the utility in a protective conduit that extends 10 feet beyond the limits of the Backfill, Select.
3. Pipe culverts through MSE walls should be avoided.
4. Water and sewer lines within 10 feet of an MSE wall should be encased.
5. Do not place foundations for other structures/appurtenances in the reinforced soil zone unless approved by the Geotechnical Services Section. (6-27-2022)
6. Avoid utilities, pipe culverts, water and sewer lines parallel with the MSE wall and within the 1:1 load bearing area of the reinforced soil zone. If this cannot be avoided, then provide separation between the utility and the MSE wall with permanent steel sheet piling. Design the permanent steel sheet piling to support the MSE wall for the scenario when the utility needs to be installed with an open excavation. (6-27-2022)

H. Leveling Pad Dimensions:

1. Minimum length is 10 ft
2. Maximum height change for each step is 3 ft or ½ panel height

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7.03.12 (continued)

Mechanically Stabilized Earth (MSE) Wall Requirements

I. Miscellaneous Requirements

1. Obstructions, such as footing piles, utilities, catch basins, etc. need to be shown on the plan, elevation, and section drawings for the MSE walls.
2. The limits of the Backfill, Select should extend 1 foot beyond the end of the straps at the bottom of the wall, and slope upward at a 45 degree angle.
3. The Plans should clearly identify the MSE wall horizontal alignment, top of coping elevations, proposed ground line in front of wall, limits of concrete surface coating, texturing notes, design height (H), PVC liner, foundation underdrains, areas where cast-in-place coping is required, moment slab/barrier details, utilities, appurtenances, obstructions to the soil reinforcement and notes from BDM [Chapter 8](#).
4. On return walls, keep the barrier inside of the MSE wall, not on top.
5. The water table must be considered by the geotechnical engineer during his/her investigation. Fluctuations in the water table must be accounted for in the investigation and must also be specified on the Plans (i.e. 100 year flood even should be labeled on the plans).
6. Terminate woven wire fence (Standard Plan R-102-Series) and high tensile eight wire fence (Standard Plan R-97-Series) against the side of the wall opposite the stabilized earth, PVC liner and the soil reinforcement. Do not drive fence posts in mechanically stabilized earth. Detail fence termination on plans. (1-27-2025)

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7.03.13

Drilled Shafts (3-26-2018)

Due to relative ease of construction and economy, driven piles are generally preferred for most deep bridge foundations. For unique structures with high vertical or lateral loads, limited footprint, or at sites with deep scour, shallow rock or hardpan, or where foundations are to be built adjacent to vibration sensitive structures, drilled shaft foundations may be appropriate. Drilled shafts are most ideal for sites where short, permanently cased shafts can be socketed into rock or hard pan.

Feasibility of drilled shafts for bridge foundations is subject to the approval of the MDOT Foundation Analysis Engineer. Guidelines used for feasibility evaluation follow:

- A.** Avoid use of drilled shafts if soil boring logs indicate the presence of gas pockets, artesian/confined aquifers, or nested cobbles/boulders.
- B.** Shafts up to 50 feet in length, bearing in hard pan or rock, are acceptable. Longer shafts are difficult to case and should be avoided with one possible exception; that being sites where deep lacustrine clay overlies hardpan or rock.
- C.** Due to increased construction risk, avoid uncased shafts in the drift. Permanent casing, sealed into the competent strata below the drift, is the preferred construction scenario. Temporary cased or uncased designs will be evaluated based on the merits of the site and typical contractor tooling.

7.03.13 (continued)

- D.** In the absence of a site specific load test program, shafts must be sized such that the full factored geotechnical resistance, is derived from either shaft resistance or end resistance.
 - 1. Friction shafts must develop the full factored vertical side resistance in hardpan and/or rock.
 - 2. End-bearing shafts must be sized such that the full factored vertical resistance is derived from end- bearing on rock or hard pan.
- E.** Belled drilled shafts are prohibited.
- F.** Drilled shafts in gas bearing formations are prohibited.
- G.** Drilled shafts are to be designed for compression, shear, torsion, and/or moment loads only. Drilled shafts are not to be designed for tension loads unless approved by the MDOT Geotechnical Services Section. (10-28-2019)

Contact MDOT's Geotechnical Services Section with questions.

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7.04

REINFORCEMENT

7.04.01

Steel Reinforcement (11-28-2011)

A. Epoxy-Coated Reinforcement (6-27-2022)

All reinforcement is epoxy coated. This includes, but is not limited to, abutments, return walls, curtainwalls, pier columns, pier crash walls and backwalls.

B. Steel Reinforcement at Joints

Steel reinforcement is to extend through construction joints and stop at expansion joints.

C. Allowable Length

Generally, bar lengths should be limited to 50'-0" but may be increased to 60'-0" to avoid excessive lapping. These lengths are based on transportation charges.

Normally, #3 reinforcement is not available in lengths greater than 40'-0". Therefore, unless unusual conditions warrant an exception, the maximum length of #3 bars shown on the plans should be 40'-0". (8-6-92)

D. Fabricating Tolerance

The permissible tolerance for cutting reinforcing bars to length is 1". The bars should be made long enough to ensure that the minimum lap and proper edge distance is provided in case the bars are cut 1" short of the plan dimension.

The permissible tolerance for fabricating the "B" bars in pier columns is 1". The bars should be detailed with a gap between the bottom of bars and the top of footing in case the bars are fabricated 1" longer than shown on the plans.

7.04.01 (continued)

E. Wall or Column Vertical Steel Reinforcement (5-6-99)

In order to facilitate placing and supporting long reinforcing bars that are anchored in footings, splices in vertical reinforcement should be provided. Short dowels can be used for wall front reinforcement, with laps just above the footings.

Laps for reinforcement in back of walls or in columns should be at least 4'-0" or 5'-0" above top of footing so as not to be in the area of maximum stress. Laps should not normally be provided for bars that do not extend to full height of wall or pour.

Where walls or columns are of such height as to require horizontal construction joints, bar laps should be provided above these joints.

F. Bar Size Substitutions

When using Grade 60 reinforcing, the AASHTO specification for distribution of flexural reinforcement may require using small bars at close spacing. Therefore, it may not always be permissible to make a total area substitution with fewer larger bars.

G. Minimum Bar Size

To avoid handling damage, the minimum bar size shall be #4. An exception to this is the temperature steel in decks. These bars are to be #3.

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7.04.02

Stainless Steel Reinforcement (11-28-2011)

A. Criteria For Use

As an alternative to epoxy coated reinforcement, stainless-clad and solid stainless steel reinforcement should be selectively used in bridge deck construction. Designers will need to examine whether the additional expenditure is warranted for enhanced durability of the structure. The designer should consider use of stainless-clad and solid stainless reinforcement under one or more of the following circumstances.

1. The additional expenditure for stainless-clad and solid stainless reinforcement, including cost savings from reduced cover requirements, should be no more than eight percent of the programmed structure cost.
2. For structures on trunkline roads where future repair and maintenance would be very disruptive to traffic and where mobility analysis defines the project as significant and mitigation measures to minimize travel delay are needed (See Work Zone Safety and Mobility Policy).
3. Over navigable waterways or protected wetlands sensitive to environmental impact from construction activity.
4. Where the deck cross section is less than 9 inches, due to local geometric restrictions or in widening projects where the dead load is limited to the capacity of the existing substructure.
5. Bridges located over high volume railway lines where access and right of way restrictions exist.

7.04.02 (continued)

When using stainless-clad or solid stainless steel reinforcement for new bridge deck construction, the designer should consider using empirical deck design when that type of design reduces the amount of steel reinforcement.

Combine stainless-clad reinforcement with solid stainless reinforcement to optimize the material costs.

B. Cost

In estimating the cost of stainless-clad and solid stainless steel reinforcement, current prices should be obtained from suppliers. Stainless-clad and solid stainless steel reinforcement costs are more volatile and variable than for carbon steel and are sensitive to bar length, diameter and the waste when cutting from relatively short stock bars. Prices may vary significantly between suppliers.

C. Detailing and Availability

Stainless-clad and solid stainless steel reinforcement is similar to normal carbon steel reinforcement in the design, detailing and construction process. Use stainless-clad and solid stainless steel reinforcement in both reinforcement mats in the bridge deck, and in other locations as warranted. Dissimilar metals contact, whether with epoxy coated reinforcement, uncoated reinforcement, or galvanized steel, is not considered detrimental when embedded in concrete. The standard cover requirement of three inches can be reduced to two inches.

Stainless-clad reinforcement is available in standard U.S. customary sizes of #5 or greater, with maximum lengths of 40'-0", and available in Grade 60. Solid stainless steel reinforcement is available in all standard sizes and lengths, and available in both Grade 60 and Grade 75.

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7.05

PEDESTRIAN, ORNAMENTAL AND RAILROAD FENCING (8-6-92)

7.05.01

Electrical Grounding System

Pedestrian bridges, pedestrian screening and ornamental fencing (8'-0" or greater in overall height) are to be grounded as specified in the standard specifications. Details described in the specifications need not be shown on the plans.

7.05.02

Pedestrian Fence Fabric

Use 2" mesh size opening unless 1" opening is recommended by the Region. Mesh size opening of 1" is preferred on pedestrian fencing for structures in the Detroit metropolitan area and it should be noted on the plans. When 1" mesh size opening is proposed in close proximity to an intersection, consult with the Geometric Design Unit, Design Division, Bureau of Development, to evaluate potential conflict with intersection sight distance. For limits of the metropolitan area see [Appendix 12.01.01](#). (3-28-2022)

Six, eight or ten foot fence fabric is generally used to design pedestrian fencing for structures. Ten foot fabric is used for metal and post and tube railings. Six and eight foot fabric are used in combination with concrete railing to attain desired height. (3-28-2022)

7.05.03

Pedestrian Fence Posts

Posts for bridge fencing should be 2½" (2.875" O.D.) steel pipe. The steel type and maximum post spacing should be as shown below.

Maximum Unsupported Post Height	Mesh Size	Steel Type (ASTM)	Maximum Post Spacing
9'-0"	1"	F1043	8'-6"
9'-0"	2"	F1043	10'-0"
7'-0"	1"	F1083	8'-6"
7'-0"	2"	F1083	10'-0"

(10-24-2001)

7.05.04 (3-28-2022)

Pedestrian Fence Height

Fence is straight and 10 feet total height minimum when no pedestrian traffic is expected on a structure or when an existing sidewalk or brush block is less than 3'-0" in width. Type 6 & 7, 2 Tube, Aesthetic Parapet Tube flush mount (without sidewalk), 4 Tube with brush block, 3 Tube With Pickets with brush block, Concrete Block Retrofit and existing Type 4 & 5 fall into this category.

Fence is curved and 9 feet (+/-) total height when pedestrian traffic is expected on a structure or when an existing sidewalk or brush block is 3'-0" or greater in width. Aesthetic Parapet Tube with sidewalk, 4 Tube with sidewalk and 3 Tube With Pickets with sidewalk fall into this category.

Existing open parapet, existing solid parapet, existing R4, R5 and R9, existing 3 Tube or 5 Tube can use either straight or curved fence depending on sidewalk or brush block width (less than 3'-0" or 3'-0" or greater).

7.05.05 (3-28-2022)

Anti-Climb Shield

Place anti-climb shields with all pedestrian fencing to prevent climbing on the outside of the fence (over traffic or precipitous drop). Shields are generally located at the second or third vertical fence post from each end of the pedestrian fencing.

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7.05.06 (3-28-2022)

Ornamental Fencing Guidelines

Approval for structural adequacy for all proposed ornamental fence installations on MDOT bridges and bridge railings is required by MDOT's Bureau of Bridges and Structures (BOBS). Ornamental fences installed on new bridges and bridge railings must be designed according to the current edition of the AASHTO LRFD Bridge Design Specifications. Contact BOBS Chief Structure Design Engineer for questions concerning the design requirements for ornamental fences on MDOT bridge railings. Contact MDOT BOBS Bridge Construction Unit and Structural Fabrication Unit for questions related to the materials and construction of ornamental fences on MDOT bridges and bridge railings.

Contact MDOT's Geometric Design Unit, Design Division, Bureau of Development (BOD), for questions regarding the crashworthiness of proposed ornamental fence installations on MDOT bridge railings.

Do not attach ornamental fences to steel tube bridge railings (e.g., 2 Tube railing, 4 Tube railing, and 3 Tube With Pickets railing).

The use of ornamental fencing does not alleviate the need to protect the motoring and pedestrian traffic. Use pedestrian fence with fabric in addition to ornamental fences as described in this section and section [7.02.29](#). If pedestrian fence is not required, ornamental fence can be used on its own.

Include anti-climb shields with ornamental fencing, regardless of pedestrian fence with fabric use. Anti-climb shields can simulate ornamental fence or pedestrian fence.

When an entity other than MDOT requests an integration of ornamental fencing or other highway aesthetic elements within the MDOT right-of-way (ROW) they shall also follow the Highway Aesthetic Element Guidelines. Review of any structures integrating ornamental fencing should be routed through the BOBS Chief Structure Design Engineer.

7.05.06 (continued)

Unless proven crashworthy by full-scale crash testing, as determined by MDOT, under NCHRP 350 or MASH criteria and under the appropriate test level, the proposed ornamental fence and/or combined bridge railing and ornamental fence must meet the following requirements:

- A.** Regardless of design speed, ornamental fences may be placed on bridge railings or bridge decks without the installation of additional barrier protection when located beyond the clear zone based on the design speed and average daily traffic at the proposed installation site.

See Road Design Manual Section [7.01.11](#) for Clear Zone chart. (7-24-2023)

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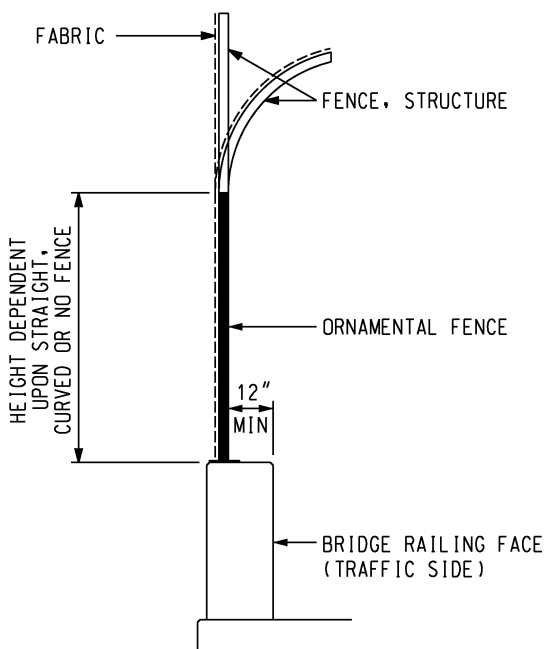
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7.05.06 (continued)

B. On roadways with design speeds of 40 mph or less, ornamental fences on bridge railings and bridge decks located within the clear zone may be installed when meeting all of the following conditions:

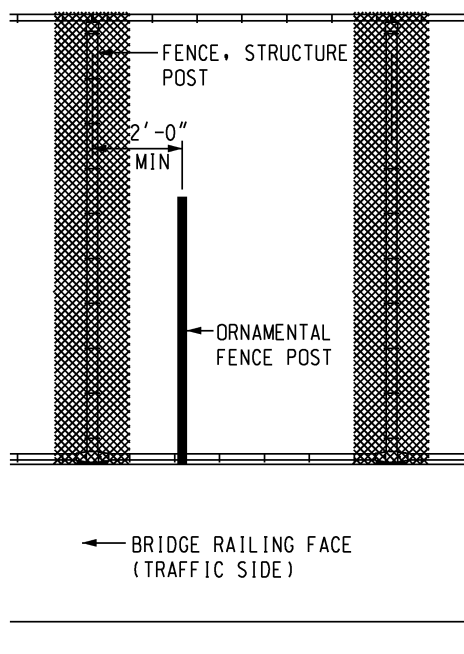
1. Fence is installed on top of or behind the bridge railing.
2. Fence is placed at least 12 inches from the top of the bridge railing face (i.e., the portion facing traffic).

Bridge rail widening and/or ornamental fence placement behind the bridge railing may be necessary to provide the 12 inch minimum offset from the ornamental fence to the bridge railing face.



7.05.06 (continued)

3. Locate fence posts between (2'-0" minimum laterally from) railing structural posts (Aesthetic Parapet Tube railing), not directly behind. When ornamental and pedestrian fence posts are both used on a railing, locate posts 2'-0" minimum laterally from one another.



4. Fence components that could become an occupant compartment intrusion threat, as determined by MDOT, are not allowed. Contact MDOT's Geometric Design Unit, Design Division, BOD, for questions.

Tapering the ends of ornamental fence components to minimize snagging potential is one way to alleviate occupant compartment intrusion.

- C.** On roadways with design speeds of 45 mph or greater, ornamental fences on bridge railing and bridge decks located within the clear zone may only be installed if an additional bridge railing or roadside barrier is installed between the traveled way and the ornamental fence.

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7.05.07 (3-28-2022)

Railroad Fencing and Splashboard

- A.** For railroad bridges over roadways or rivers, Region Project Development or Bridge Engineer will determine whether to provide bridge screening due to the presence of ballast and discarded rail spikes.
- B** For bridges over railroad grades, splashboards are placed on top of railings to prevent snow, ice, or other debris from being thrown onto the tracks and passing trains. The final height of the railing and splashboard must satisfy the railroad's requirements. The railroad may request the use of splashboards possibly in combination with fencing.

Contact the Railroad Grade Separations Engineer of MDOT Office of Rail to coordinate these and other design parameters with the railroad.

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7.06

RECONSTRUCTION PROJECTS

Include saw cut depth dimensions when removing portions of abutments, piers and columns on the plans. (8-20-2009)

7.06.01

Placement of Temporary Barrier (9-21-2015)

A. 26" or More Laterally Available

For widening jobs or part-width construction of a new bridge, when 26" or more laterally is available between the toe of a temporary barrier on the construction side and a precipitous drop-off, place standard temporary concrete barrier or temporary steel barrier meeting MDOT specifications near the drop-off. No special hardware or procedures are necessary. See Standard Plan R-126-Series.

B. Less Than 26" Laterally Available

When there is less than 26" laterally between the toe of the barrier on the construction side and the precipitous drop-off, place an appropriate limited deflection temporary barrier detail meeting the requirements of Standard Plan R-53-Series, or an approved alternative. Refer to Standard Plan R-126-Series for placement and to Standard Plan R-53-Series for additional information regarding limited deflection temporary barrier details.

For more definitive write-up and discussion of detailed placement options see Section [7.01.70](#) of Road Design Manual.

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7.06.02

Concrete Anchors (5-6-99)

A. Expansion Anchored Bolts

In addition to field testing, we will ensure sound anchorage by reducing the design loads. The values to be used will vary with the application as shown below:

PULLOUT VALUES OF EXPANSION ANCHORED BOLTS IN POUNDS						
Application	Approx. Safety Factor	3/8"	1/2"	5/8"	3/4"	7/8"
Noncritical Design Loads (Including noncritical, static or shock loads)	4	875	1,620	2,565	3,775	5,240
Vibratory Loads (e.g., Sign Supports)	12	290	540	855	1,260	1,755

Design details should always call for two or more anchors for redundancy.

B. Bonded Anchors (Adhesive and Grout Anchors)

All bonded anchors shall be **detailed** for embedment depth on the contract plans. For A307 bolts the embedment depth shall be taken as "9d" (9 times the nominal bolt diameter). For Grade 60(ksi) reinforcing steel the embedment depth shall be taken as "12d" (12 times the bar diameter). (5-1-2000)

In addition to field testing, we will ensure sound anchorage by reducing the design loads. For all applications a safety factor of 4 should be applied to 125% of the threaded rod/reinforcements yield strength to obtain the allowable design tensile load on the anchor. The allowable tensile load shall be computed per:

$$\text{Allowable tensile load} = (125\% f_y A_T)/4$$

A_T = tensile stress area
= net section through threads
(for reinforcing steel use nominal area)

For a list of qualified products (bonded anchors) see [Materials Source Guide](#).

(6-27-2022)

C. Allowable Shear for Post Installed Concrete Anchors (Expansion and Bonded Anchors) (per AASHTO Table 10.32.3A)

$$\text{Allowable Shear} = 0.30 f_y A_T$$

A_T = tensile stress area
= net section through threads
(for reinforcing steel use nominal area)

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7.06.03

Substructure Protection (6-27-2022)

Where we are reconstructing an existing substructure unit; i.e., capping or extending it, and there is a transverse joint in the superstructure directly above, the entire top existing and proposed, and all other existing faces of the unit shall be coated with penetrating water repellent treatment or another concrete surface coating. See Section [7.03.11](#).

7.06.04

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

For additional information on temporary supports see Subsection [7.01.10](#).

A. Construction Methods

The choice of method can best be made during an on-site inspection, preferably the Scope Verification or Plan Review, where Region/TSC personnel can offer opinions. (5-6-99)

1. Temporary Support From Below Using Column and Footing Arrangement
 - a. Does not require lane closure above; i.e., traffic over work area.
 - b. May require lane closure below depending on location of suspender.
2. Temporary Support From Above Using Multiple or Single Beam Suspension Arrangement
 - a. Requires lane closure above.
 - b. May require lane closure below because of underclearance restrictions.
 - c. Joint replacement at expansion end and removal of portions of deck at fixed end will probably be required for multiple beam suspension.

7.06.04 (continued)

B. Preliminary Investigation for Temporary Support From Below

1. Request Borings and Factored Nominal Soil Pressures from Geotechnical Services Section if pressures are unknown or pressures greater than 2500 psf is required. (6-27-2022)
 - a. Consideration should be given to possible differential settlement below temporary support footing.
 - b. Borings are not required if footing is placed on paved surface. Assume a bearing pressure of 17 psi. (5-6-99)
2. Determine Utility Locations

Underground utilities may be damaged by settlement of temporary support footing pressure.
3. Determine Obstructions of Temporary Support Footing

Consider pier location and skew.
4. Read Current Specifications for This Type of Work Prior to Starting Design.

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7.06.04 (continued)

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

C. Design of Temporary Support From Below (see [Appendix 7.06.04](#) for nomenclature):

1. Loading (9-26-2022)
 - a. When traffic is detoured or is being maintained on a portion of the structure that does not cause load on the temporary supports and construction equipment will be used on the span being temporarily supported, base the design on the following:
 - 1) Use the appropriate Allowable Stress Design (ASD) load factors and load combinations specified in the AASHTO Guide Design Specifications for Bridge Temporary Works to obtain the maximum design load effects.
 - 2) Use a uniformly distributed personnel and equipment load (CP) of 25 pounds per square foot applied to the tributary width of the beam being temporarily supported unless a project specific load has been determined to be appropriate.
 - 3) Unless the actual rated reactions of the equipment to be used by the Contractor in the construction of the project are known, an equipment reaction (CR) should be selected from Appendix 7.06.04.C based on the span length of the beam being temporarily supported. If the actual rated reactions of the equipment to be used by the Contractor are known, they should be used in the design and distributed in accordance with the AASHTO Standard Specifications for Highway Bridges.

7.06.04 C. (continued)

- 4) For the design of the column, column base plate, jack base plate, hydraulic jack capacity, channel shims, and jack bearing plate increase the reactions of the equipment by 30 percent to account for impact on the structure being supported. Impact does not need to be included in the design of the footing (timber and concrete).
- 5) If the equipment to be used by the Contractor in the construction of the project is known, the load factor applied to the reaction from the construction equipment may be reduced to 1.00 for all load combinations.
 - b. For all other cases base the design on the following:
 - 1) Use 1.25 (DL+LL+I) for column, column base plate, and jack base plate design.
 - 2) Use 1.0 (DL+LL+I) for channel shim and jack bearing plate design.
 - 3) Use 1.25 (DL+LL) for footing design (timber and concrete).
 - 4) Use 1.25 (DL+LL+I) for hydraulic jack capacity.
 - 5) If traffic is detoured or is being maintained on a portion of the structure that does not cause load on the temporary supports live load can be omitted from the design of the temporary support.

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7.06.04 (continued)

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

2. Materials (5-6-99)

- a. Use AASHTO M270 steel,
 $f_y = 36,000$ psi. (Do not mix steel types used for temporary support.)
- b. Use Concrete Grade 3500,
 $f'_c = 3000$ psi. (6-28-2021)
- c. Use Structural Grade Timber,
 $F_b = 1200$ psi.
 F_v (horiz.) = 100 psi.

3. Column Design

- a. Size for axial load plus bending in both perpendicular directions.
- b. Use 0.1 x flange width and 0.1 x beam depth rounded up to nearest 1/2" for assumed eccentricity.
- c. Use pinned-pinned end condition (restraint at base plate small). Effective length factor, $K = 1.0$.
- d. Check lateral loading on column from thermal movement of bridge. Use 75°F temperature variation. Combine thermal load with (DL+LL+I).

4. Column Base Plate Design

- a. Avoid use of stiffeners (high welding cost).
- b. Size for axial load plus bending. Use eccentricity assumed in column design.
- c. Do not attach base plate to footing.
- d. Use $F_b = 0.75 F_y$.

7.06.04 (continued)

5. Jack Base Plate Design

- a. Design as plate fixed on three sides, free on one side. (See Young, W.C., Roark's Formulas for Stress and Strain, pg. 469. Available in MDOT Library. See [Appendix 7.06.04](#) for excerpt.) (5-6-99)
- b. Use equivalent rectangular uniform load from jack bearing area.
- c. For uniform load 2/3 of plate width, use $f_b = 60 q/t^2$ (see item a above, q = load per unit area in psi and t = plate thickness in inches).
- d. For uniform load 1/3 of plate width, use $f_b = 17 q/t^2$ (see item a above, q = load per unit area).
- e. Linear interpolate for uniform load between 1/3 and 2/3 of plate width.
- f. Use $F_b = 0.75 F_y$ in psi.
- g. Weld to column.

6. Channel Shims Design (two per support)

- a. Size for axial load plus bending perpendicular to web.
- b. Use 0.1 x flange width rounded up to nearest 1/8" for assumed eccentricity.
- c. Weld to jack base plate.

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7.06.04 (continued)

**Hanger Assembly Replacement and
Temporary Support Guidelines for
Redundant Bridges**

7. Jack Bearing Plate Design

- a. Size for bending about centerline existing girder or beam web.
- b. Use load on channel shims for bending calculations.
- c. Use $F_b = 0.75 F_y$.

8. Hydraulic Jack Capacity

- a. Specify minimum jack capacity required (based on axial load only).

9. Timber Footing Design

- a. Use double mat (minimum) with square or rectangular timbers.
- b. Size for axial load plus bending. Use eccentricity assumed in column design. Use allowable soil pressure from Geotechnical Services Section. On a paved surface assume a bearing pressure of 17 psi. (5-6-99) (2-26-2018)
- c. Check flexure and horizontal shear. Allow 25 percent overstress to account for short duration of loading.
- d. Column base plate full width across top mat.
- e. Top mat full width across bottom mat.
- f. Specify channels lag-bolted to timbers across top of both mats, each end (lag-bolt to each timber).

7.06.04 (continued)

10. Concrete Footing Design

- a. Use bottom mat steel reinforcement only, both directions.
- b. Size for axial load plus bending. Use eccentricity assumed in column design. Use allowable soil pressure from Geotechnical Services Section. (2-26-2018)
- c. Check flexure, beam (one way) shear and slab (punching) shear.
- d. Specify concrete to be stenciled with "top" on side opposite steel reinforcement. Stencil "bottom" as required.

11. Footing Placed on Soil

- a. Specify compaction of original ground to not less than 95 percent of its maximum unit weight to a depth of 9" and to 1'-6" outside footing outline.
- b. Specify Structure Embankment (CIP), if required, to 1'-6" outside footing outline.
- c. Specify level under footing.
- d. Specify Granular Material Class III, compacted to not less than 95 percent of its maximum unit weight, to 1'-6" outside footing outline for leveling.
- e. Specify 1V:1H slope down to natural ground for all required fill material.

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7.06.04 (continued)

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

12. Footing Placed on Pavement or Paved Shoulder

- a. Specify level under footing.
- b. Specify 21AA aggregate, HMA cold patch material, or approved equal to 1'-6" outside footing outline for leveling.
- c. Specify 1V:1H slope down to pavement for required fill material.

13. Placement of Temporary Support

- a. Centerline temporary support under area where pin plate exists.
- b. Centerline temporary support under stiffener, if possible.
- c. Show location on plans.

14. Bracing for Temporary Support (10-27-2025)

- a. Bracing may be required to ensure the stability of the temporary support or temporary support system while in use. Reasons why bracing may be required include, but are not limited to, providing resistance to lateral movements or limiting the unbraced length for tall temporary support columns.
- b. Design bracing for the temporary support or temporary support system to resist all loads required by the applicable AASHTO design specifications.
- c. Design and detail bracing and bracing connections to account for and accommodate any settlement that may be experienced while the temporary support system is installed and in use.

7.06.04 (continued)

15. Shop Drawing Review (3-26-2018)

- a. Send temporary support shop drawings to MDOT Structural Fabrication Unit for review.
- b. Check all weld sizes and member sizes against plan requirements.

16. Maintaining Traffic

- a. Temporary supports must be completely shielded from traffic.
- b. Place temporary concrete barrier in area of temporary support in all cases (both sides if narrow median).

17. Hanger Assembly Removal Sequence

- a. Minimize risks in case of support failure or excessive settlement.
- b. Adjacent beam suspender operational.
- c. Opposite end suspender operational.

D. Checks on Existing Girder or Beam, Temporary Support From Below

1. Loads: Use design axial load of column for checks.
2. Web Checks
 - a. Web buckling - distribute load on 45° from edge of jack bearing plate (effective length factor, $K = 1.0$).
 - b. Web crippling.
 - c. Specify bolted stiffener (not included in payment for temporary supports), if required, bearing against bottom flange.(6-27-2022)

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7.06.04 (continued)

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

3. Diaphragm Clearance
 - a. On sharply skewed bridges, determine if diaphragm needs to be cut to allow placement of new pin (note on plans if cutting is required).
 - c. Determine if repair of cut diaphragm is required. Use field bolted cover plate if repair is necessary.

E. Design of Temporary Support From Above

1. Consideration should be given to providing redundancy in temporary support. Avoid nonredundant schemes if possible.
2. Multiple Beam Support Loading

Use $1.25 \text{ DL} + 2.0 (\text{LL} + \text{I})$ maximum.
3. Single Beam Support Loading

Use $1.25 (\text{DL} + \text{LL} + \text{I})$.
4. Materials (5-6-99)

Use AASHTO M270 steel,
 $F_y = 36,000 \text{ psi}$.
(Do not mix steel types used for temporary support if the pieces are to be joined by welding.)
5. Hanger Assembly Removal Sequence
 - a. Minimize risks in case of temporary support failure.
 - b. Adjacent beam suspender operational.
 - c. Opposite end suspender operational.
 - d. Maintaining traffic may demand deviation from items b and c.

F. Checks on Existing Beam or Girder, Temporary Support From Above

1. See Article D for required checks to be made.

7.06.04 (continued)

G. Hanger Assembly Plan Dimensions and Field Measurements

1. Dimensions on Plans
 - a. Pins - give diameter and length.
 - b. Link plate - give length, width, thickness and C-C pins.
 - c. Other details and dimensions shown on Bridge Design Guides [8.14.02](#), [8.15.01](#) and [8.15.01A](#). Specify stainless steel washers and cotterpins.
 - d. If existing suspender must be shown on the detail sheets, this detail shall be shown accurately.
2. Field Measurements
 - a. If field measurements differ from plan dimensions, correct shop drawings to reflect actual dimensions.
 - b. Use average C-C pin distance for specific hanger locations where one side is different from the other.
 - c. Increase pin length to account for girder or beam offset, if required. Select longest length required and use for all pins.
3. Shop Drawing Review (3-26-2018)
 - a. Send suspender assembly shop drawings to MDOT Structural Fabrication Unit, for review.

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BRIDGE DESIGN - CHAPTER 7: LRFD

7.07

APPROACH ITEMS

7.07.01

Guardrail

All new guardrail anchorages to bridges will utilize three beam guardrail according to Standard Plan R-67-Series and will be anchored directly to the bridge railing or pier filler walls. (5-6-99)

Where there are independent backwalls, that is, where there will be thermal deck movement at the abutments, the movement will be accommodated by the slots in the expansion section of the guardrail anchorage.

For additional information see Road Design Manual Section [7.01.16](#).

7.07.02

Curb and Gutter for Rural Bridges (6-27-2022)

The types and lengths of bridge approach curb and gutters (including valley gutter, where required) shall be determined by the road/bridge designer and shown on the General Plan of Structure Sheet.

For additional information see Road Design Manual Section [6.06.08](#) and MDOT Drainage Manual.

7.07.03 (5-6-99)

Bridge Approach Pavement

To eliminate approach pavement settlement, a concrete approach section will be used for all new bridges and bridge replacements, deck and superstructure replacement projects and concrete overlays. For hot mix asphalt (HMA) deck overlays, a concrete approach section is not necessary. The details of the approach slab shall be as specified on Standard Plan R-45-Series except on existing structures, where the grade will not be raised; the length of the approach slab shall match the existing slab joint. (9-2-2003)

Use approach pavements for integral and expansion bearing semi-integral abutment designs according to [Bridge Design Guide 6.20.04 Series](#). At semi-integral abutments with fixed bearings use approach pavement as specified on Standard Plan R-45-Series. (3-27-2023)

Use approach pavements for sliding slab over backwall designs according to [Bridge Design Guides 6.20.03 Series](#). (1-24-2022)

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7.08 (6-27-2022)

UTILITY ITEMS

7.08.01

General

For additional information regarding utilities see:

[Chapter 9](#) and Sections 14.16, 14.26, 14.39 and various other [Chapter 14](#) sections of the Road Design Manual

MDOT Development Services Division's Utility Coordination Procedure Manual.

MICHIGAN DESIGN MANUAL

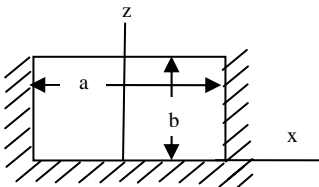
BRIDGE DESIGN – CHAPTER 7:LRFD

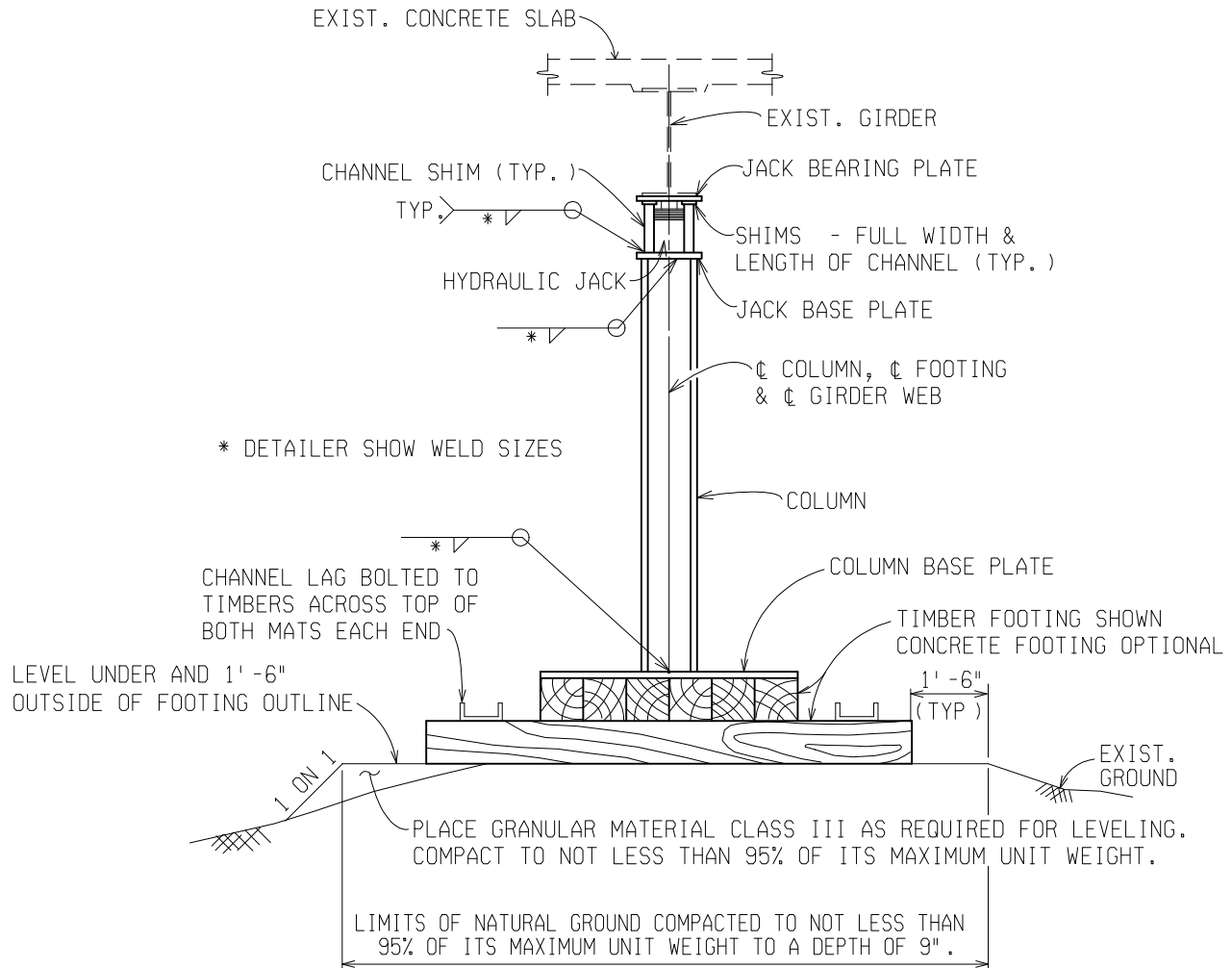
HOT ROLLED SHEET PILING SECTION MODULI		
Sheet Pile Designation	Section Modulus in ³ /ft.	
	Nominal	Effective
PZ-22	18.1	15.3
AZ 12	22.3	19.2
PZC-12	22.4	19.2
AZ 12-770	23.2	19.9
PLZ-23	30.2	20.7
AZ 13-770	24.2	21.0
AZ 13	24.2	21.2
PZC-13	24.2	21.3
AZ 14-770	25.2	22.0
AZ 14	26.0	23.0
PLZ-25	32.8	23.0
PZC-14	26.0	23.1
PZ-27	30.2	25.5
PZC-17	31.0	26.6
AZ 17	31.0	26.6
AZ 17-700	32.2	27.7
AZ 18-700	33.5	29.0
AZ 18	33.5	29.3
PZC-18	33.5	29.5
AZ 19-700	34.8	30.4
AZ 19	36.1	32.0
PZC-19	36.1	32.1
AZ 24-700	45.2	40.4
AZ 25	45.7	40.7
PZC-25	45.7	41.1
AZ 26	48.4	43.5
AZ 26-700	48.4	43.6
PZ-35	48.5	43.6
PZC-26	48.4	44.0
AZ 28	51.2	46.4
AZ 28-700	51.3	46.6
PZC-28	51.2	46.9
PZ-40	60.7	54.6
PZC-34	63.8	58.3
PZC-36	67.0	61.6
AZ 37-700	68.9	61.7
PZC 37-CP	68.8	64.1
PZC-38	70.6	65.3
AZ 39-700	75.5	68.2
PZC 39-CP	73.0	68.3
AZ 41-700	76.2	69.4
PZC 41-CP	75.8	71.0
AZ 46	85.5	77.7
AZ 48	89.3	81.7
AZ 50	93.3	85.9

COLD ROLLED SHEET PILING SECTION MODULI		
Sheet Pile Designation	Section Modulus in ³ /ft.	
	Nominal	Effective
SZ-12	8.6	5.2
SZ-14	9.8	6.2
CZ-67	10.7	6.5
SZ-15	10.4	6.6
CZ-72	11.7	7.3
SPZ-16	13.2	8.4
SPZ-84	13.6	8.9
CZ-95RD	15.2	10.2
SZ-18	16.2	10.2
CZ-95	15.5	10.5
SPZ-19.5	16.6	11.2
CZ-101	16.5	11.3
SZ-20	17.8	11.4
CZ-107	17.5	12.2
SPZ-22	18.3	12.7
SZ-22	19.6	12.7
CZ-113	18.4	12.9
SCZ 19	18.8	13.0
SPZ-23.5	19.3	13.6
SCZ 21	19.9	14.1
SZ-222	26.8	16.6
SZ-24	29.5	18.6
SCZ 22	29.8	19.4
CZ-114RD	31.6	20.1
SKZ 20	31.7	20.7
SZ-27	32.4	20.7
SCZ 23	31.6	21.3
SPZ-23	31.3	21.5
CZ-114	31.6	21.7
SKZ 22	33.4	22.5
SCZ 25	33.5	23.2
SPZ-26	34.8	24.4
SKZ 23	35.6	24.6
CZ-128	35.5	24.8
SCZ 26	35.3	25.1
CZ-134	37.2	26.3
SKZ 24	37.7	26.7
CZ-141	39.1	27.9
SCZ 29	39.1	28.7
SKZ 25	40.1	29.2
CZ-148	40.9	29.4
SCZ 30	40.9	30.6

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BRIDGE DESIGN - CHAPTER 7: LRFD

<div>10. Rectangular plate; three edges fixed, one edge (a) free</div> <div></div>	<div>COEFFICIENTS FOR DESIGNING BASE PLATES</div> <div>Roark's Formulas for Stress and Strain, (Sixth Edition), page 469</div> <div>Warren C. Young</div>							
10a.Uniform over entire plate	(At $x = 0, z = 0$)		$\text{Max } \sigma_b = \frac{-\beta_1 q b^2}{t^2}$		and		$R = \gamma_1 q b$	
	(At $x = 0, z = b$)		$\sigma_a = \frac{\beta_2 q b^2}{t^2}$					
	(At $x = \pm \frac{a}{2}, z = b$)		$\sigma_a = \frac{-\beta_3 q b^2}{t^2}$		and		$R = \gamma_2 q b$	
	a / b	0.25	0.50	0.75	1.0	1.5	2.0	3.0
	β_1	0.020	0.081	0.173	0.321	0.727	1.226	2.105
	β_2	0.016	0.066	0.148	0.259	0.484	0.605	0.519
	β_3	0.031	0.126	0.286	0.511	1.073	1.568	1.982
γ_1	0.114	0.230	0.341	0.457	0.673	0.845	1.012	
γ_2	0.125	0.248	0.371	0.510	0.859	1.212	1.627	
10aa. Uniform over 2/3 of plate from fixed edge	(At $x = 0, z = 0$)		$\text{Max } \sigma_b = \frac{-\beta_1 q b^2}{t^2}$		and		$R = \gamma_1 q b$	
	(At $x = \pm \frac{a}{2}, z = 0.6b$ for $a > b$ or $z = 0.4b$ for $a \leq b$)		$\sigma_a = \frac{-\beta_2 q b^2}{t^2}$		and		$R = \gamma_2 q b$	
	a / b	0.25	0.50	0.75	1.0	1.5	2.0	3.0
	β_1	0.020	0.080	0.164	0.277	0.501	0.710	1.031
	β_2	0.031	0.110	0.198	0.260	0.370	0.433	0.455
	γ_1	0.115	0.230	0.334	0.424	0.544	0.615	0.674
	γ_2	0.125	0.250	0.344	0.394	0.399	0.409	0.393
10aaa. Uniform over 1/3 of plate from fixed edge	(At $x = 0, z = 0$)		$\text{Max } \sigma_b = \frac{-\beta_1 q b^2}{t^2}$		and		$R = \gamma_1 q b$	
	(At $x = \pm \frac{a}{2}, z = 0.2b$)		$\sigma_a = \frac{-\beta_2 q b^2}{t^2}$		and		$R = \gamma_2 q b$	
	a / b	0.25	0.50	0.75	1.0	1.5	2.0	3.0
	β_1	0.020	0.068	0.110	0.148	0.202	0.240	0.290
	β_2	0.026	0.063	0.084	0.079	0.068	0.057	0.040
	γ_1	0.115	0.210	0.257	0.291	0.316	0.327	0.335
	γ_2	0.111	0.170	0.194	0.185	0.174	0.170	0.180
<div>Notation:</div> <div>"a" and "b" refer to plate dimensions, and when used as subscripts for stress, they refer to the stresses in directions parallel to the sides "a" and "b", respectively. "Φ" is a bending stress in pounds/square inch which is positive when tensile on the bottom and compressive on the top if loadings are considered vertically downward. "R" is the reaction force, in pounds/inch, normal to the plate surface exerted by the boundary support on the edge of the plate. "q" is the load per unit area in pounds/square inch.</div>								
BRIDGE DESIGN MANUAL Appendix 7.06.04								



ELEVATION

(FOOTING PLACED ON SOIL SHOWN)

**MICHIGAN DESIGN MANUAL
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Construction Equipment				
Table of Lane Reactions on Simple Spans. Impact not included.				
Span (ft)	Reaction (pounds)		Span (ft)	Reaction (pounds)
20	15,000		90	17,600
25	15,600		100	17,600
30	16,100		120	17,700
35	16,400		140	17,800
40	16,600		160	17,900
45	16,800		180	17,900
50	17,000		200	18,000
60	17,200		300	18,100
70	17,300		400	18,100
80	17,500			

09-26-2022

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CHAPTER 7

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BRIDGE DESIGN

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MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 7

DESIGN CRITERIA - NEW AND RECONSTRUCTION PROJECTS

7.01

GENERAL

7.01.01

Design Specifications

In general, bridges in Michigan carrying vehicular traffic are designed according to the current edition of the Standard Specifications for the Design of Highway Bridges published by the American Association of State Highway and Transportation Officials (AASHTO). The exceptions to changes in AASHTO requirements are presented in this Design Manual.

The AASHTO specifications are also applied in the design of pedestrian bridges and major structures such as retaining walls and pumphouses. LRFD Guide Specifications for the Design of Pedestrian Bridges and Guide for the Development of Bicycle Facilities will aid in the design of other modes of transportation. (12-16-2019)

Bridges carrying railroads are designed according to the current specifications of the American Railway Engineering and Maintenance-of-Way Association Specifications (AREMA).

7.01.02

Design Method

In general, elastomeric pad designs, as well as footing pressure and pile load determinations, are done by the Allowable Stress Method. All other elements of the structure are designed by the Load Factor Method. (12-5-2005)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.03

Design Stresses (12-27-2021)

Concrete: Grade 3500, 3500HP* $f'_c = 3000$ psi

Concrete: Grade 4000 $f'_c = 3500$ psi

Concrete: Grade 4500, 4500HP* $f'_c = 4000$ psi

Steel Reinforcement $f_y = 60,000$ psi

Steel Reinforcement:

Stirrups for Prestressed Beams

(including stainless steel (SD) bars)

$f_y = 60,000$ psi

Stirrups for 17" & 21" Box Beams

(including stainless steel (SD) bars)

$f_y = 40,000$ psi

Structural Steel:

AASHTO M270

Grade 36 $F_y = 36,000$ psi

Structural Steel (including H-Piles, splices and pile points):

AASHTO M270

Grade 50 $F_y = 50,000$ psi

Grade 50W $F_y = 50,000$ psi

Structural Steel Pins:

ASTM A276

UNS Designation

S20161 or S21800 $F_y = 50,000$ psi

Temp Support Hanger Rods:

ASTM A193 Grade B7 (AISI 4140)

2 1/2" and under $F_u = 125,000$ psi

$F_y = 105,000$ psi

Over 2 1/2" to 4" $F_u = 115,000$ psi

$F_y = 95,000$ psi

Over 4" to 7" $F_u = 100,000$ psi

$F_y = 75,000$ psi

Prestressed Concrete ** $f'_c = 6000 - 8000$ psi

Prestressed Concrete Compressive

Strength at Release $f'_{ci} = 7000$ psi (max)

Prestressing Strands $f_{pu} = 270,000$ psi

Foundation Piling (Steel Shells):

ASTM A252

Grade 3 $F_y = 45,000$ psi

Grade 3 Modified $F_y = 50,000$ psi

Foundation Piling (Timber) $F_{CO} = 900$ psi

High Strength Bolts:***

Organic zinc rich primer (Class B)

(Type 4 coating system) $F_s = 32,000$ psi

* Use Grade 3500HP and 4500HP in all trunkline projects in Metro, University, Grand, Bay, Southwest and North Regions. Use Grade 3500 and 4500 in Superior Region and on non-trunkline projects.

** See Subsection 7.02.03.

*** Value of F_s is Design Slip Resistance for Slip-Critical Connections with faying surfaces coated.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.04

Design Loading

The axle loads and configuration of the HS20-44 design truck are as depicted in section 3.6.1.2.2 of the AASHTO LRFD Bridge Design Specifications.

A. Interstate and Trunklines

Use HS25 loading for all structures carrying interstate or trunkline routes, and on and off ramps for these routes. Also use HS25 for all structures in an interchange regardless of the route type. (5-6-99)

HS25 truck or lane loading is 125 percent of the corresponding HS20-44 loading.

1. Alternate Military Loading:
FHWA requires that all interstate routes be able to carry alternate military loading. Our current design requirement of HS25 loading for all interstate structures is greater than the alternate military loading, thereby eliminating the need to investigate the design for alternate military loading. The standard note on loading shall include alternate military loading to show compliance with FHWA requirements.
2. HS20-44 Loading:
Use HS20-44 loading on members designed for a single wheel or axle load, such as slabs and end diaphragms. (HS20-44 Loading is used because actual axle loads do not change from HS20-44 and HS25.) (5-6-99)

B. Local Roads and Streets

Structures carrying local roads or streets are to be designed according to county or city standards. The minimum design load acceptable for streets or primary county roads is HS20-44 loading. (8-6-92)

C. Pedestrian Bridges

Pedestrian bridges shall be designed according to the current AASHTO Standard Specifications for Highway Bridges and current edition of the Guide Specifications for Design of Pedestrian Bridges. The assumed live load is 85 LBS/SFT. Consideration shall also be given to maintenance vehicles. (11-28-2011)

D. Railroad Bridges

Railroad bridges are designed according to the current AREMA Specifications, with the Cooper loading established by the railroad company.

E. Bicycle (Nonmotorized) Bridges

Bicycle bridges shall be designed for a 5 ton truck. This truck shall consist of one axle of 1 ton and one axle of 4 ton spaced 7' apart. The wheels shall be 6' apart.

F. Deck Replacement, Bridge Widening or Lengthening

When an existing deck is to be replaced or the structure is to be widened or lengthened, the proposed reconstruction should be designed according to the provisions of this chapter regardless of the design criteria used for the existing portion. (11-28-2011)

G. Ice Force on Piers

All piers that are subjected to the dynamic or static force of ice shall be designed according to the current AASHTO Specifications. (8-6-92)

H. Future Wearing Surface

All new bridges and bridge replacements shall be designed for a future wearing surface load of 25 LBS/SFT. (5-6-99)

I. Stay In Place Forms

For new bridges or superstructure replacements a design load of 15 LBS/SFT should be added for the use of stay in place metal forms. (5-6-99)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.04(continued)

Design Loading

J. Barrier Loads

For purposes of beam design, the barrier dead load can be distributed equally to all beams. (AASHTO Std. Specs 17th edition 3.23.2.3.1.1 & AASHTO LRFD 4.6.2.2) However, when calculating superstructure loads on the substructure, particularly for cantilevered pier caps, 75% of the barrier dead load should be applied with the fascia beam load. The remaining 25% of the barrier load should be applied with the first interior beam load. (11-28-2011)

7.01.05

Fatigue Stresses

Determine allowable stress range using a structure design life of 75 years and the truck ADT expected at bridge opening. Add note [8.05 P.](#) providing this information on the General Plan of Structure sheet. (8-23-2021) (8-6-92)

7.01.06

Deflection

A. Deflection Limits (5-6-99)

LOADING	SIMPLE AND CONTINUOUS SPANS	CANTILEVER
HS25	L/800	L/300
HS20-44	L/1000	L/375
Pedestrian only	L/800	L/300
Timber Bridges	L/375	-----

B. Cantilever Deflection Computation

In computing the live load plus impact deflection of cantilevers of composite anchor span, the gross section of the anchor span is to be used. The length of the composite section for this analysis is to be assumed to extend from the bearing line to the point of dead load contraflexure.

7.01.07

Temperature Range

- The temperature range used to determine thermal forces and movements shall be in conformance with AASHTO "cold climate" temperature range.
- The type of structure used in determining the temperature range, per AASHTO, shall be defined by the material of the main supporting members of the superstructure or substructure being considered.

7.01.08

Vertical Clearance

A. Requirements

The desired vertical bridge underclearances should be provided as indicated in the following table. If the desired underclearances cannot be provided, then the minimum underclearances shall be met. Where it is considered not feasible to meet these minimums, a design exception shall be requested from the Engineer of Road Design and subsequently to the FHWA (approvals designated in the [Risk Based Project Involvement](#) Stewardship and Oversight (RBPI S&O) plan) and from MDOT Bureau of Bridges and Structures, Chief Structure Design Engineer on "MDOT Oversight" projects (see Section [12.03](#) also). See the vertical clearance design exception matrix in [Appendix 12.02.01](#). Requests to further reduce the underclearance of structures with existing vertical clearance less than indicated in the following table should be made only in exceptional cases. (12-27-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.08 (continued)

Vertical Clearance

A. Requirements

VERTICAL CLEARANCE REQUIREMENT TABLE (11-28-2011) (6-22-2015)

Route Classification Under the Structure	All Construction (Desired)	New Construction (Min *)	Road 4R Construction (Min *)	Bridge 4R Construction (Min *)	3R Construction (Min *)
Freeways	16'-3"	16'-0"	16'-0"	16'-0"	16'-0" ***
NHS Arterials (Local & Trunkline)	16'-3"	16'-0"	Maintain Existing** and 14'-6" Min	16'-0"	Maintain Existing** and 14'-0" Min
Non NHS Arterials (Local & Trunkline)	16'-3"	14'-6"	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-0" Min
Collectors, Local Roads & Special Routes ⁽¹⁾	14'-9"	14'-6"	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-0" Min

3R = Rehabilitation, Restoration, Resurfacing

* Minimum Vertical Clearance must be maintained over complete usable shoulder width.

** Existing vertical clearances greater than or equal to the minimums shown may be retained without a design exception. Vertical clearance reductions that fall below the minimums for new construction require a design exception. (6-22-2015)

*** Existing vertical clearances may be retained (or increased) without a design exception unless a pattern of high load hits exist. Vertical clearance reductions below the standard (table value) require design exceptions. (5-27-2020)

(1) Special Routes are in Highly Urbanized Areas (where little if any undeveloped land exists adjacent to the roadway) where an alternate route of 16'-0" is available or has been designated. Bridges located over [Special Routes in Highly Urbanized Areas](#) can be found on the MDOT website. (5-23-2022)

Ramps and roadways connecting a Special Route and a 16'-0" route require a vertical clearance minimum of 14'-6" (14'-9" desired). Ramps and roadways connecting two 16'-0" routes require a vertical clearance minimum of 16'-0" (16'-3" desired). (8-20-2009)

4R = Reconstruction

Information on the NHS systems can be obtained by contacting the Statewide Planning Section, Bureau of Transportation Planning or found on the MDOT website at:

<http://www.michigan.gov/mdot/programs/highway-programs/nfc> . (5-23-2022)

Pedestrian bridges are to provide 1'-0" more underclearance than that required for a vehicular bridge. For Freeways (Interstate and non Interstate), including Special Route Freeways, the desired underclearance shall be 17'-3" (minimum 17'-0"). (11-28-2011)

A vertical underclearance of 23'-0" is required for highway grade separations over railroads when constructing a new bridge or removing the existing superstructure. For preventative maintenance, rehabilitation and deck replacement projects the existing railroad vertical underclearance does not need to be increased unless requested by the Railroad. (11-28-2011)

Clearance signs are to be present for structures with underclearance of 16'-0" or less (show dimensions 2" less than actual). See MDOT Traffic and Safety [Sign Design, Placement, and Application Guidelines](#) for additional information and guidelines. (5-23-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.08 (continued)

Vertical Clearance

A. Requirements

For shared use paths (pedestrian and bicycle), the vertical clearance to obstructions, including overhead fencing, shall be a minimum of 8'-6" (10'-0" desired). However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In undercrossings and tunnels, 10'-0" is desirable for vertical clearance. See AASHTO's Guide for the Development of Bicycle Facilities. (9-2-2003)

B. Interstate Vertical Clearance Exception Coordination (5-23-2022)

In addition to normal processing of design exceptions, all proposed design exceptions pertaining to vertical clearance on Eisenhower Interstate System (Interstate) routes including shoulders, and all ramps and collector distributor roadways of Interstate to Interstate interchanges will be coordinated with the Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA). All exceptions to the 16'-0" vertical clearance standard on Eisenhower Interstate System are coordinated with SDDCTEA. The Eisenhower Interstate System designated routes can be found at the FHWA NHS Maps website (https://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/michigan/index.cfm). This requirement does not apply to Special Routes (1). (5-23-2022)

7.01.08 (continued)

MDOT (or its Consultant) is responsible for coordinating exceptions on all projects regardless of oversight responsibilities. MDOT will send a copy of all requests, and responses, to the FHWA. Michigan Interstate Vertical Clearance Exception Coordination, MDOT [Form 0333](#), is available from MDOT web site. (11-28-2011)

Requests for coordination shall be emailed to: usarmy.scott.sddc.mbx.tea-hnd@mail.mil

Contact with inquiries:
Douglas E. Briggs, P.E., 618-220-5229
douglas.e.briggs.civ@mail.mil
or
Jamie Todt, P.E., 618-220-5216
jamie.l.todt.civ@mail.mil

Physical mailings:
Highways for National Defense
ATTN: SDDCTEA
1 Soldier Way
Scott AFB, IL 62225

Fax: 618-220-5125

MDOT (or its Consultant) shall verify SDDCTEA receipt of the request. If no comments are received within ten working days, it may be assumed that the SDDCTEA does not have any concerns with the proposed design exception.

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7.01.09

Longitudinal Deck Grades (11-28-2011)

Longitudinal grades should be provided to facilitate deck surface drainage. A desirable minimum grade (or minimum projected tangent grade for vertical curves) is typically 0.5%, but grades of 0.3% may be used. When it is necessary to use grades that are flatter than 0.3%, provide adequate deck drainage with drains and downspouts. In addition, close attention to drainage is critical for sag and crest vertical curves when the K value (rate of grade change) is greater than 167 where,

$$K=L/A$$

L= Length of vertical curve, feet

A= Algebraic difference in grades, percent

Consider alignments that locate vertical curves outside the limits of the structure where the desirable minimum longitudinal grades can be achieved.

Structure on 1% or steeper grades should be fixed to the substructure at the lower end of structure where practicable. (9-2-2003)

7.01.10

Temporary Support Systems and Construction Methods

Where construction procedures will require a temporary support system, the plans shall note the loading that will be imposed on the system and the allowable stresses that can be assumed for the supporting soil. (8-6-92)

Where a construction sequence is critical, where there are restrictions on access for construction, or where the method of temporary support is not obvious, the plans shall provide an acceptable system that the contractor may employ. Alternatives may be proposed by the contractor, but these must be reviewed and approved by the Engineer if they are to be substituted.

This review is to insure that:

- A. appropriate design specifications and permit limitations have been complied with, and
- B. any temporary or permanent stresses imposed on the completed structure are within allowable limits.
- C. possible vibration induced damage to existing structures and utilities is identified and mitigated. (11-28-2011)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.11

Clear Zone Considerations

(8-6-92) If possible, substructure units should be located outside the clear zone, as defined by current AASHTO Roadside Design Guide. Where this is not feasible, the unit shall be shielded from impact by errant vehicles.

7.01.12

Sight Distance Considerations

When designers are developing shoulder widths on structures or pier offsets from pavement edges, sight distance should be considered. MDOT policy has set bridge (shoulder) widths 2' (offset) greater than AASHTO widths for safety considerations of the traveling public. Consult with Traffic & Safety Geometric Section for guidance and see [Bridge Design Guides](#) 6.05 Series & 6.06 Series. (5-6-99) (9-21-2015)

7.01.13

Concrete QA/QC

The provisions for Concrete QA/QC do not apply to bridge deck overlay mixtures or substructure patching. (12-5-2005)

7.01.14

Skew Policy (12-5-2005)

Skewed cross sections and stresses resulting from them must be considered when designing structures. Where possible, avoid excessive skews by moving abutments back and squaring them off (decreasing skew angle). Where the skew cannot be avoided, the engineer shall perform the necessary analyses to account for the skew.

θ = skew angle = angle measured from line perpendicular to bridge centerline to support reference line = 90° - angle of crossing.

Skew Angle	Design Requirements
$\theta \leq 30^\circ$	Standard design using approximate methods
$30^\circ < \theta \leq 45^\circ$	Special design using refined methods.*
$\theta > 45^\circ$	Use of angles greater than 45° must be approved through Bridge Design. Refined methods of design are also required.*

*Refined methods shall include using finite element methods of analysis to address girder roll, torsion, bearing restraints, bearing rotations, thermal movement direction and amount, cross frame loading, camber detailing and deck edge/end reinforcement.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.15

Shoulder Widths for Work Zone Safety and Mobility (11-28-2011) (6-16-2014)

For 2 lane freeway and interstate new bridge construction and reconstruction (superstructure replacement and deck replacement) the standard bridge shoulder widths shall be 14'-10". This will provide increased safety and mobility for future maintenance of traffic. The cross section will provide part width bridge construction with traffic being maintained on two 11 ft. lanes with 1 ft. shy distance on each side. For cross section see Bridge Design Guide [6.05.01A](#). An MDOT internal design exception will be required for 4R projects when the shoulder width is not met. The Region Systems Manager shall determine the required shoulder width at the scoping of the projects.

Designers should layout beam spacing to accommodate future part width reconstruction. In most cases beams at centerline of structure should be avoided. (11-28-2011) (12-17-2018)

Bridge approach guardrail and bridge approach curb and gutter will be affected as a result of the widened shoulders and must be addressed in the design of the approaches. If the increased shoulder width is deemed necessary on reconstruction projects substructure widening may become necessary.

7.01.16

Redundancy

(11-28-2011) (9-17-2012) (3-23-2020)

Any proposed elements, or systems that do not meet AASHTO and FHWA redundancy requirements are prohibited. Bridge superstructures (beam/slab type) must have a minimum of 3 longitudinal beams or girders.

7.01.17

Part Width Construction (11-28-2011)

For existing bridges used to maintain traffic, the structural performance of the in-service portion of the structure shall be evaluated with respect to stage demolition and adjacent construction.

To the extent possible, plans shall show location of existing spread footings with respect to proposed construction.

Unbraced excavations for new substructure s shall not extend below the bearing elevation of adjacent spread footing foundations.

Drilled excavations adjacent to in-service spread footing foundations shall be cased to prevent undermining.

For part-width construction of bridges, provide a minimum of 6' between the centerline of temporary sheeting (along the stage line) and the existing substructure sawcut line. This will allow for the width of sheeting and any required walers and/or tiebacks. (2-26-2018)

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7.01.18

Horizontally Curved Girder Bridges (11-28-2011)

At a minimum, refined analysis shall address primary structural members, including the beams and cross frames of horizontally curved steel beams during all phases of the construction process. Special consideration shall be given to part width construction structures. At a minimum, refined methods shall address camber detailing, girder stress, cross frame loading, girder roll, and torsional load on the beams/girders.

Shoring (temporarily supporting) may be necessary to prevent deflections during part width construction and maintenance of traffic. Interior girders in the final structure will be exterior girders in a part width situation and shall be designed accordingly.

Use refined methods when the skew angle exceeds 30 degrees, the span length of any one span is greater than 150 feet or the radius of the beam/girder is less than 2000 feet (degree of curvature, "D", is greater than three degrees (3°)).

Constructability Reviews shall be done on all projects especially those with part width construction and curved steel girders. See [Chapter 2](#).

Refined methods include finite element, method, finite strip method, finite difference method, analytical solution to differential equations, and slope deflection method.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.19

Accelerated Bridge Construction (ABC) (6-17-2013)

A. Background and Process

Accelerated Bridge Construction (ABC) techniques, including Prefabricated Bridge Elements & Systems (PBES) and Full Structural Placement Methods, are recognized by the Michigan Department of Transportation (MDOT) and the Federal Highway Administration (FHWA) as important and effective methods to construct or rehabilitate highway structures, while reducing the impact of bridge construction activities on mobility, the economy, and user delay.

ABC may include new technologies in the form of construction and erection techniques, innovative project management, high performance materials, and pre-fabricated structural elements to achieve the overall goals of shortening the duration of construction impacts to the public, encouraging innovation, ensuring quality construction, and expected serviceability of the completed structure.

All major rehabilitation or reconstruction bridge projects should be evaluated at the Scoping Process, see [Chapter 6](#) of the Scoping Manual, to determine if ABC is suitable and provides a benefit; taking into consideration safety, construction cost, site conditions, life cycle cost of the structure, MDOT's mobility policy and user delays, and economic impact to the community during construction.

7.01.19 (continued)

All proposed ABC candidate projects are subject to Statewide Alignment Team Bridge (Bridge Committee) approval. Candidate projects during the scoping phases are to be presented at the monthly Bridge Committee meeting. The Bridge Committee will review candidate projects for further evaluation, and grant approval to pursue ABC techniques and determine availability of Bridge Emerging Technology funding. Once the Bridge Designer is assigned the project they shall determine if the ABC methodology is feasible from a design aspect. Issues shall be discussed with the Bridge Development Engineer, Bridge Field Services Engineer, and subsequently the Bridge Committee. A Scope Verification meeting may be necessary to resolve design and constructability issues (see [Section 2.02.14](#) & [15](#) of Bridge Design Manual).

If the determination has been made that ABC will be implemented on a specific project, the next step is to choose the methods that are technically and economically feasible.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.19 (continued)

Accelerated Bridge Construction (ABC)

B. Prefabricated Bridge Elements & Systems (PBES)

Prefabricated Bridge Elements & Systems (PBES) can be built on site away from traffic if site conditions warrant, or they can be fabricated off site and shipped to the site. Both methods offer advantages in quality control compared to cast in place construction where schedule or staging dictate the work progression. Non-prestressed reinforced concrete elements can be considered for on-site, or near site fabrication. Prestressed elements must be fabricated in a Prestressed Concrete Institute (PCI) certified plant.

1. Constructability

Erection of prefabricated elements and the connection details will require special attention being paid to the following:

a. Dimensional Tolerances:

- (1) Connections between elements must accommodate field erection. This may require staggering, or mechanically splicing connection or closure pour reinforcement or grouted splicers.
- (2) Elements fabricated off site should be test fit or otherwise confirmed to be of the correct dimensions prior to shipping.
- (3) Templates should be used to ensure correct fit-up between prefabricated elements or between a prefabricated element and a cast in place element.
- (4) Connection details should be standardized.

7.01.19 (continued)

b. The weight and size of precast elements:

- (1) Need to ensure elements can be erected with contractor's equipment. Typically, PBES element weights should be limited to 40 tons.
- (2) Need to ensure elements can be shipped to the site.
- (3) Need to ensure elements can be erected without long term lane closures.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.19 (continued)

Accelerated Bridge Construction (ABC)

B. Prefabricated Bridge Elements & Systems (PBES)

2. Prefabricated Element Types

The following prefabricated elements may be considered for use on MDOT bridge projects:

a. Precast full depth deck panels.

- (1) Panels may be connected by reinforcement splice with closure pours using high strength concrete or ultra-high performance concrete or they may be transverse or longitudinally post tensioned.
- (2) Panels are sensitive to skew and beam camber and haunches.
- (3) Panels using post tensioning may have long term maintenance concerns.
- (4) Riding/wearing/sealing surface should be provided such as epoxy overlay or HMA overlay with waterproofing membrane.
- (5) Dimensional tolerances are very tight.
- (6) Additional geometry control will be required, and should be stated in the plans to be included in the Contractor Staking pay item.
- (7) Match casting may be used to assure proper fit-up when complex geometry is required.

7.01.19 (continued)

b. Decked Beam elements. (12-17-2018)

- (1) Two steel beams connected with deck (modular beams).
- (2) Decked Bulb Tee beams.
- (3) Decked prestressed spread box beams.
- (4) These systems rely on full shear and moment capacity joints and closure pours.

Ultra High Performance Concrete may be used to reduce the lap length of the connection detail.

- (5) Camber control may require pre-loading of erected modular units, or partial post tensioning until all dead load deflections are applied.
- (6) Casting the roadway cross slope and/or vertical alignment curvature on modular units may be difficult, consider variable thickness overlays to develop required geometry.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.19 (continued)

Accelerated Bridge Construction

B. Prefabricated Bridge Elements & Systems (PBES)

c. Pier Elements.

- (1) Precast pier caps.
- (2) Precast columns.
- (3) Precast pile caps.
- (4) These systems rely on grouted or mechanical reinforcement splices to develop reinforcement sufficiently to transfer reactions from one element to the next.
- (5) Consider multiple smaller caps spanning two columns as opposed to one large cap.
- (6) Pier columns that directly support beams without pier caps may be considered.
- (7) Pier column voids can be considered to reduce weight. Weight of PBES elements should be limited to 40 tons where possible.

7.01.19 (continued)

d. Abutment and Wall Elements.

- (1) Precast abutment panels.
- (2) Precast footings.
- (3) Precast backwalls and wingwalls.
- (4) These systems rely on grouted or mechanical reinforcement splices to develop reinforcement sufficiently to transfer reactions from one element to the next
- (5) Voids can be considered to reduce weight. Weight of PBES elements should be limited to 40 tons where possible.

e. Precast Approach Slabs

Dimensional tolerances are very tight for all Prefabricated Bridge Elements & Systems (PBES). The tolerance sensitivity required when erecting prefabricated elements may require dual or independent survey contracts to ensure proper fit up, camber, deflections and finished grades.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.19 (continued)

Accelerated Bridge Construction

C. Full Structural Placement Methods

The following full structural placement methods may be considered for use on MDOT bridge projects:

1. Self-Propelled Modular Transport (SPMT):
 - a. Computer controlled platform vehicle with movement precision to within a fraction of an inch.
 - b. Capable of lifting 165 to 3,600 tons.
 - c. Vertical lift range of 36 to 60 inches.
 - d. Axle units can be rigidly coupled longitudinally and laterally.
 - e. Move costs can be up to \$500,000 (mobilization costs are significant, so SPMTs should be considered on corridors where multiple bridges may be moved).
 - f. Limited to use on sites with minimal grade changes.
2. Lateral Bridge Slide:
 - a. Bridge section is built on temporary supports adjacent to existing substructure.
 - b. Bridge section bears on stainless steel, or other low friction surface such as Teflon.
 - c. Existing substructure units can be reused, or new units constructed with minimal impact to traffic. Consider converting multiple span bridges into single spans so that proposed substructure units can be constructed in different locations from existing without impacting the operation of the existing structure.

7.01.19 (continued)

- d. Bridge section is laterally jacked, or rolled into place.
- e. Required jacking forces must overcome static and kinetic friction.
- f. Consideration shall be given for the need to push and pull the bridge to meet movement tolerances. The hydraulic ram or cable with rollers shall be sized to accommodate both movements.
- g. Cost to slide a bridge is approximately \$50,000 to \$100,000 depending upon size of the bridge, and the number of spans.
- h. Additional stiffeners may be required on beams at point of jacking force application.
- i. Additional reinforcement in concrete elements may be required to control jacking stresses.
- j. Grade raises can be accommodated by casting backwalls and abutment portions on the proposed superstructure, and sliding over proposed sawcut elevations on existing abutments.
- k. Deflections of temporary substructure units must be considered, and the connection from the temporary substructure units to the permanent substructure units must be sufficiently rigid as to allow minimal deflections at the transition.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.01.19 (continued)

Accelerated Bridge Construction

C. Full Structural Placement Methods

3. Incremental (Longitudinal) Launching:

- a. Bridge section is built near approaches, and then longitudinally launched into place.
- b. Prestressing may be required for concrete elements due to alternating bending moments generated during launch.
- c. Launching trusses, gantries, and hydraulic systems may be considered.

Allowing the contractor to select methods of placement may also lead to additional innovations and acceleration to the project schedule. Depending on the complexity of the overall project, innovative contracting methods may also be used in conjunction with ABC/PBES techniques. Innovative contracting methods are approved on a project by project basis by the MDOT Innovative Contracting Committee, and the MDOT Engineering Operations Committee. For more information see the [Innovative Construction Contracting Manual](#).

The Federal Highway Administration provides additional information about ABC and PBES at the following website:
<http://www.fhwa.dot.gov/bridge/abc/index.cfm>.

7.01.20

Stream/River Crossing Low Chord Elevation for Navigation (9-24-2018)

Provide for navigation, where practical, a minimum clearance of 2 feet from the low chord to the design high water elevation. Clearance should conform to Federal requirements based on normally expected flows during the navigation season. Navigation includes using canoes, small boats and wading by fishermen.

7.01.21

Structural Cold Joints & Construction Joints (3-23-2020)

Cold joints and construction Joints in structural members resisting lateral loads must have a shear key, or other mechanical means of force transfer through the interface area, in addition to the fully developed steel reinforcement on both sides of the interface.

For additional information on substructure joint spacing see section [7.03.01 C.](#), [7.03.02 C.](#), [7.03.03 B.&C.](#) and [7.04.01 B.&E.](#)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02

SUPERSTRUCTURE

7.02.01

Structure Type (5-6-99)

Whenever possible, multispan steel structures shall be continuous to avoid having expansion joints over piers. Consideration shall also be given to integral or semi-integral structures. Suspended cantilever design shall be avoided. When simple spans of an existing bridge are being replaced, consideration should be given to replacement with continuous beams and continuous for live load superstructure.

Where supporting members are prestressed concrete beams, decks should be cast continuous over piers where possible. Consideration shall also be given to integral or semi-integral structures.

Beam designs with complex layout may require the contractor to provide provisions and design any falsework required to ensure proper erection of beams. (11-28-2011)

Include the special provision, Complex Steel Erection, Shoring and Falsework, when one of the following situations may occur during the erection of structural members:

- A.** Construction of continuous spans > 200'.
- B.** Girders with horizontal curvature.
- C.** Field assembled suspension, movable bridge, cable-stayed, truss, tied arch, or other non-typical spans.

(11-23-2015)

7.02.02

Beam Spacing (5-6-99) (11-28-2011)

Space all beams so that the center to center distance does not exceed 10'-0". If the spacing is exceeded the designer shall perform an analysis to ensure that the structure meets load rating criteria specified in MDOT Bridge Analysis Guide. Space spread box beams such that the center to center distance is not less than 6'-0". (8-20-2009)

7.02.03

Beam Material Selection

The following is a guide for beam or girder material selection:

A. Prestressed Concrete (12-27-2021)

Use concrete with 28-day strengths of 6000-8000 psi concrete. For greater strengths, approval is required from MDOT Chief Structure Design Engineer. Strengths greater than 10,000 psi are not allowed.

1. Spread box beams, 36" wide, up to 42" deep.
2. Spread box beams, 48" wide, up to 60" deep.
3. I-beams (Types I thru IV, 28" to 54" deep)
4. I-beams (Wisconsin type, 70" deep)
5. I-beams (Michigan 1800 Girder, 70.9" deep)
6. Bulb Tee Beams (36" to 72" deep, 49" and 61" top flange)

B. Steel (4-17-2017)

1. Rolled Beams,
AASHTO M270 Grade 36, 50 or 50W.
2. Welded plate girders
AASHTO M270 Grade 36, 50 or 50W.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.03 (continued)

Beam Material Selection

C. New Structures

The choice of girder material is generally to be governed by the economics of design and expected span lengths. For structures over depressed freeways or other areas where there is a high concentration of salt spray or atmospheric corrosion, concrete is preferred.

D. Reconstruction of Existing Structures

The new portions are to be similar in appearance to the existing structure. Current materials and construction procedures are to be used with considerations given to matching the beam deflections of the existing structure. (5-6-99)

E. False Decking

False decking shall be erected prior to deck removal or repair on reconstruction projects and after beam erection on new or reconstruction projects. (12-5-2005)

7.02.04

Structural Thickness (5-6-99)	Steel Grades-	Available
----------------------------------	------------------	-----------

- | | | |
|----|--|--|
| A. | AASHTO M270 Grade 36 up to 8" in thickness. | |
| B. | AASHTO M270 Grade 50 up to 4" in thickness. | |
| C. | AASHTO M270 Grade 50W (painted) steel up to 4" in thickness may be substituted for Grade 50 steel. | |

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7.02.05

Bearings

A. Sole Plates

Plate thicknesses are to be specified in $\frac{1}{4}$ " increments. For beveled sole plates, this $\frac{1}{4}$ " increment is based on the maximum thickness.

For steel beams, sole plates are to be beveled when the calculated bevel is greater than 1% for curved steel bearings and greater than 0.5% for elastomeric bearings. For requirements for prestressed concrete beams, see Subsection [7.02.18](#). (8-6-92)

B. Elastomeric Pads

Elastomeric pads ($\frac{1}{8}$ ") are required under all steel masonry plates and are to be $1\frac{1}{2}$ " longer and wider than the masonry plates. (10-24-2001)

C. Elastomeric Bearings

Plain bearings shall have a shear modulus, G, of 200 (± 30 psi), laminated bearings shall have a shear modulus of 100 psi (± 15 psi). Pads shall be 4" minimum (generally 6") by 34" with $\frac{3}{4}$ " minimum thickness (increase in $\frac{1}{4}$ " increments). (11-28-2011)

Fabric laminated (cotton-duck or other fiber reinforcement) bearings shall not be used unless approved by MDOT Structural Fabrication Engineer or MDOT Chief Structure Design Engineer. (3-20-2017) (3-26-2018) (5-27-2020)

Additional information (polymer type, minimum low-temperature grade, etc.) can be found at MDOT's [Elastomeric Bearing Guidance Document](#). (3-20-2017)

D. Anchor Bolts

Calculated lengths of bridge anchor bolts should be based on a bolt projection of 1" beyond the nut. (5-6-99)

7.02.06

Precamber - Steel Beams

Where dead load deflection, vertical curve offset, and deflection due to field welding (rare occurrence) is greater than $\frac{1}{4}$ ", the beams shall have a compensating camber. Camber is to be figured to the nearest $\frac{1}{4}$ " and shall be parabolic.

In certain instances, such as for continuous spans or long cantilevers, reverse camber should be called for in order to obtain uniform haunch depths.

When several beams in a bridge have corresponding camber ordinates which differ only slightly from each other, the Engineer should attempt to average these into one set for all beams.

7.02.07

Moment of Inertia - Composite Beam

The composite moment of inertia shall be used throughout positive moment regions. This moment of inertia is to be used in negative moment regions to compute beam stiffness only.

7.02.08

Multiple Span Design

A. Beam Depth

Use the same depth beams for all spans with the longest span controlling the beam depth.

B. Composite Design

Composite design shall be used on all spans. Composite design uses the entire deck/slab thickness versus deck/slab stand-alone design which eliminates the top 1 $\frac{1}{2}$ " wearing surface. (5-6-99) (8-17-2015)

C. Suspended Spans

The suspended span should be poured first (see Section [7.02.01](#)).

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.09

Rolled Beam Design

Cover plates for rolled beams are to be designed according to the following information and current AASHTO Standard Specifications:

- A. The cover plate width for a new beam should be equal to the beam flange width minus 1½" and for an existing beam should be equal to the beam flange width plus 1½".
- B. The minimum cover plate thickness shall be the greater of ⅜" or 1/24 of the plate width.
- C. Cover plate steel should be the same as the beam steel or matched as closely as possible.

7.02.10

Plate Girder Design (Welded)

A. Web Plates

Web plate depths shall be in 2" increments and the thickness shall be a minimum of 7/16". (9-2-2003)

B. Flange Plates

Flange plate widths may be varied to achieve a more economical design when required. The minimum width shall be 12". The minimum thickness shall be ½" when shear connectors are not used and ¾" when shear connectors are welded to the flange in the field.

C. Hybrid Designs

Hybrid designs using a combination of quenched and tempered steel according to ASTM A 514 (AASHTO M 244) & A 572 (AASHTO M 313) shall not be used. (5-6-99)

7.02.11

Stiffeners

A. Orientation and Size

Stiffeners are to be set normal to the web; however, when the angle of crossing is between 70° and 90°, the stiffeners may be skewed so that the diaphragms or crossframes may be connected directly to the stiffeners. Minimum thickness shall be 7/16". (9-2-2003)

B. Bearing Stiffeners

In general, bearing stiffeners should be eliminated at abutments with a dependent backwall, and the lower portion of the backwall should be poured and allowed to set before the deck is cast.

C. Bearing Stiffeners at Temporary Supports

To prevent the possibility of web buckling, bearing stiffeners should be provided at temporary supports for all plate girders. They need be placed on one side only; and on the fascia girders, they are to be placed on the inside.

D. Bearing Stiffeners for Rolled Beams

Even though bearing stiffeners are not required by design, if a beam end is under a superstructure transverse joint, two ½" x 4" bearing stiffeners should be provided as a safety factor in the event of corrosion and section loss of the web. (8-6-92)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.12

Welding

All welding details are to be according to AWS specifications, except for minimum fillet weld sizes, which should be as shown in the Standard Specifications. Any intended deviations are to be called to the attention of the MDOT Chief Structure Design Engineer. (5-6-99) (5-27-2020)

Plans should show welding details but should not show the size unless a deviation from AWS specifications is intended.

Plans should also show beam or girder flange tension and stress reversal zones where lifting lugs will not be permitted.

7.02.13

Field Splices in Plate Girders

A. General

Girder Length	Field Splice
0' to 125'	None provided.
Over 125' to 160'	Field splice is shown on plans as optional; it is designed and detailed, but not paid for.
Over 160'	Field splice is designed, detailed, and paid for. *

Fabricators that wish to field splice other than as called for on the plans will need prior Bridge Design Project Manager approval. (5-27-2020)

* Additional steel weight from splices will be added to quantity for "Structural Steel, Plate, Furn and Fab". (12-22-2011)

7.02.13 (continued)

B. Location

Field splices are to be located at low-stress areas at or near the point of contraflexure for continuous spans.

C. Bolts

All high strength bolts are to be hot-dip galvanized. (3-18-2013)

7.02.14

Diaphragms and Crossframes

A. Orientation

When bridges are on grades, the diaphragm or crossframe connection plates are to be set normal to the flange.

B. End Diaphragms

End diaphragms or crossframes are required at ends of beams to support the end of slab unless it is supported by other means. Curved girders shall have diaphragms or crossframes placed at the centerline of support. To provide access for painting, these diaphragms or crossframes shall be no closer than 2'-0" from the beam end at independent backwalls and shall have no less than 2'-0" of clearance at simple supports. (5-6-99)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.15

Shear Developers

Shear developers shall be used in all steel beam spans. When replacing a deck, the existing shear developers shall be removed and not salvaged. (5-6-99)

A. Type Used

Shear developers shall be the stud type shown in Bridge Design Guide [8.07.01](#). Details and spacing for $\frac{3}{4}$ " studs shall be shown on the plans. Generally shear developers are 8" or less in length. Provide additional longitudinal reinforcement when haunch becomes greater than 6" and longer than 8" shear developers are required. (5-6-99) (12-19-2016)

B. Spacing

1. Standard Bridge Slabs

The spacing is to be constant along the beam as required by the design. Shear developers are not to be used in areas of negative moment. They should extend through the positive moment area and to, or slightly beyond, the point of contraflexure. This point should be determined for the loading condition that will place it closest to the support over which negative moment will occur. In the event of a special case in which shear developers are used in negative moment areas, maximum tensile stress at the point of attachment is not to exceed that which is allowed by the current AWS specifications.

Shear developers (acting as slab ties) shall be placed in at least one half of all spans regardless of contraflexure points and moment orientations. In end spans with all negative moments place shear developers from abutment towards pier at 24" spacing. In interior spans with all negative moments place shear developers in middle half of span at 24" spacing. (12-5-2005)

7.02.15 (continued)

2. Empirical Bridge Slabs

For empirical bridge slabs, the studs shall be placed on the entire length of beams. This includes the negative moment regions. The design of the studs shall be based on the positive moment area as critical. (5-6-99)

Studs shall be omitted from bolted splice plates (see AASHTO Specs., Article 10.38.5.1.3).

When detailing empirical slabs on plans designate them as an "Empirical Slab". (9-27-2021)

7.02.16

Lifting Lugs

The contractor will be permitted to use lifting lugs to transport and erect beams, subject to the requirements of the Standard Specifications. Our plans should indicate the tension zones where lifting lugs will not be permitted.

7.02.17

Painting (5-1-2000)

Structural steel will be painted light gray. [AMS-STD-595](#) color #16440.

The Roadside Development Unit may request color # 15488 or another variety from AMS-STD-595 and obtain Region/TSC concurrence. The Bridge Design Unit Leader will then indicate the color number on the plan notes. See Section [12.07.06](#) for information regarding performance warranties. (5-1-2000) (11-28-2011) (10-23-2017) (12-26-2017)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.18

Prestressed Concrete Design

A. General

1. Strand Selection

The design and detail sheets shall specify only ASTM A416 (AASHTO M 203) Grade 270 low relaxation strands. Strands shall be 0.6 inches in diameter with a release force of 44,000 pounds. (5-6-99)

2. Bond Breakers/Debonding (5-1-2000)

Draped strands shall be avoided where possible. Debonding is MDOT's preferred method of controlling stresses at the end of prestressed I beams. Strands should be debonded in pairs. A maximum of 40% of the strands may be debonded. Amounts more than that require draped strands. The debonding should be staggered by placing the debonded strands into groups similar to the table below.

Number Debonded	Shortest	2nd	3rd	Longest
4	2			2
6	4			2
8	4	2		2
10	6	2		2
12	6	2	2	2
14	6	4	2	2

The shortest point refers to the closest point to the beam end that any debonding can be terminated without overstressing the beam. The longest point refers to the point that all debonding can be terminated. The above table was developed from the MDOT bridge program. Consultant debonding schemes shall follow a similar rational method.

From the end of the debonding to the point where the strands are no longer required to control stresses or provide ultimate capacity, a double development length (minimum) of bonding shall be provided (AASHTO 9.28.3).

Spans less than 30'-0" need not be debonded. It is realized that the continuity moments of continuous for live load structures may reduce the effectiveness of debonding & increase the

7.02.18 (continued)

number of draped strands. Wherever possible debonding shall not be placed on peripheral strands. If placing strands in the bottom row, they should be placed on every third strand with the corner strands being bonded.

3. To aid in stabilizing transverse reinforcement in the beam, a bar or strand shall be located in the bottom corners of the beam. Second row up for box beams and certain PCI beams. (11-28-2011)

4. Draping of strands shall be the last option to reduce stresses at the end of beams. Location of draped strands at beam ends shall start 2" from the top of the beam downward. Draped strands at beam end shall correspond to the highest available strands at beam center. (11-28-2011)

5. PCI beams under open joints are susceptible to corrosion from brine intrusion into the strands and mild reinforcement. This is the most prevalent distress to PCI beams. This can be mitigated by sealing the beam ends with an elastomeric sealer as described in Section 7.03.11A.

Prestressed I beams and spread box beams under expansion joints should be coated per the special provision for Concrete Surface Sealers. Apply the coating from the beam end a length the greater of twice the beam depth, or five feet. In addition, where the coating operation will have a minimal effect on the maintaining traffic schedule, and the cost of the project, the entire outside face of the fascia beam and its bottom flange, should be coated. On new construction or superstructure replacement the fascia beam can be coated prior to erection.

(12-17-2018)

6. Continuous for live load prestressed concrete beams shall be designed as simple span beams for all positive dead load and live load moments. (9-2-2003)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.18 (continued)

Prestressed Concrete Design

B. Prestressed Concrete Box Beam Design

1. Skew Bridges

The ends of the box beams shall be skewed to be parallel to the reference line.

2. Spacing (12-17-2018)

Spread box beams may be used and shall be treated similar to prestressed concrete I-beams. Space spread box beams such that the center to center distance is not less than 6'-0". The slab shall be according to Bridge Design Guide [6.41.01](#). (5-6-99) (11-28-2011)

3. Bridge Seats (5-6-99) (12-17-2018)

For spread box beams the bridge seat shall be bolstered and level.

4. Bearings

Where the pressure is less than 100 psi, ½" joint filler may be used for a bearing pad. Where bearing pressures are greater than 100 psi, 4" minimum (generally 6") by 33" elastomeric pads shall be used (¾" minimum thickness, increase in ¼" increments). Cast steel sole plate (¾" generally) in all beams. When the calculated bevel exceeds 1%, tilt sole plate as required. All position dowels for doweling beam to the substructure will be placed by drilling as described in the Standard Specifications. (8-20-2009) (11-28-2011) (11-24-2014)

7.02.18 (continued)

5. Beam steel reinforcement, including stirrups is Grade 60 (ksi) for all box beams except 17" & 21" box beams. For 17" & 21" box beams the design of transverse beam steel reinforcement, stirrups and slab ties (epoxy coated ED bars & stainless steel SD bars) is based on Grade 40 (ksi); the use of either Grade 40 or Grade 60 is allowed in fabrication of the beam. Longitudinal beam steel reinforcement (EA bars) is Grade 60 for 17" & 21" box beams. See note [8.07.03 P](#). For 21" and 27" beams shear requirements/values may dictate the use of a greater than 7600 psi concrete compressive strength (21") or the use of stainless steel SD bars (27"). For additional information see [Bridge Design Guides 6.65.10-12A](#). (12-27-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.18 (continued)

Prestressed Concrete Design

C. Prestressed Concrete I-Beam Design

1. Bearing Pads

For single-span structures 40'-0" or less in length, use dependant backwalls with 1" elastomeric pads under the beams and joint filler under the backwall.

For single- and multiple-span structures with spans over 40'-0", allowance for expansion is required in designing the bearing pads.

2. Sole Plates

Sole plates (3/4" generally) are to be cast in all beams and shall be tilted as required when the calculated bevel exceeds 1%. (11-24-2014)

3. Skew Bridges

On skewed structures, the ends of the I-beams shall be made square regardless of the angle of skew. The top corners may be blocked out in order to accommodate a straight expansion joint across the structure.

4. Concrete Diaphragms

End diaphragms are to be set back 10" to 12" from the end of beam in order to permit the removal of the forms after the diaphragms are poured.

The bottoms of all diaphragms are to bear on the bottom of the lower beam fillet.

All diaphragms are to be cast separately from slab except with continuous for live load structures (optional construction joint). (5-6-99)

7.02.18 (continued)

5. Steel Diaphragms

Steel intermediate diaphragms and steel end diaphragms at independent backwalls with a sliding slab are preferred over concrete diaphragms due to shorter construction duration. (8-27-2018)

Use details from [Bridge Design Guide](#) 6.60.12 A. - H. and include Special Provision in proposal. (11-26-2012)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.19

Slabs

For information on Ride Quality on new slabs see section [7.02.32](#).

A. Design

Our standard slab (see Bridge Design Guide 6.41.01) is designed using the following criteria:

1. HS20-44 loading (16kip wheel).
2. Continuous over three or more beams of similar structural capacity.
3. Load Factor design method. (5-6-99)
4. For deck/slab design only, the top 1½" of slab is considered a wearing surface and is not included in the design depth, but is included in the dead load. See section 7.02.08 B. for composite action of deck slabs. (8-17-2015)

B. Overhang

For standard overhang, see various guides in [Bridge Design Guides](#) 6.29 Series.(1-14-2013)

Overhangs greater than standard should be avoided, if possible. If not, the slab design shall be checked in this region for negative movement.

7.02.19 (continued)

C. Slab Haunches

Plans are to provide for the deck slab to be haunched at each beam to provide for variance in actual top of beams. The design should normally make allowance for a 1" uniform haunch for steel beam bridges and a 2" minimum haunch for prestressed concrete beam bridges; however, the details should show the haunch as variable. A nominal 2" haunch should be used on structures with span lengths exceeding 100'-0". To aid in the construction of the haunched slab, the plans should include bottom of slab elevations over each beam and at equal intervals across the spans. These elevations should apply at the time that all structural steel has been erected, but no other loads applied; however, they should include allowance for additional deflection due to forms, steel reinforcement, deck concrete, and railing. For additional criteria when the haunch exceeds 6" see section [7.02.20 G.](#) and Bridge Design Guide [6.42.03A.](#) (5-6-99) (4-23-2012)

D. Slab Thicknesses

Slab thicknesses are to be according to Bridge Design Guide [6.41.01](#) and are to be uniform thickness with beams stepped to follow the crown of the roadway.

E. Slab Under Sidewalk

If the roadway slab extends underneath the sidewalk, it should be designed for full highway loading.

F. Nighttime Casting of Superstructure Concrete

All bridge deck pours are to be designated nighttime casting of superstructure concrete on all bridge decks. (5-6-99)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.19 (continued)

Slabs

G. Bridge Crown/Slope

Use 2% cross-slope on all projects with a deck replacement or greater scope except those that have compelling reasons to meet the existing cross-slope. Maintain constant slope across lanes of travel and shoulders, including bridges with full superelevation and ramp bridges. This will allow for ease of construction and deck screeding.

Bridge overlays and railroad and bridge approach projects may use 1.5 %. Local roads over may also use 1.5% unless the road approaches are or may become 2%.

Parabolic crowns being overlayed should be corrected to a minimum of 1.5%; otherwise a design exception or variance must be submitted. Deck replacement bridges with parabolic crowns shall be corrected to a 2% cross-slope. See Chapter 12 for criteria and procedure. (12-5-2005) (2-21-2017)

The road approach shoulder slope shall be transitioned to meet the bridge shoulder slope. The transition shall be based on superelevation transition slope ($\Delta\%$) from Standard Plan R-107 Series. The procedure is outlined in section [6.05.05](#) of the Road Design Manual. (8-20-2009) (11-28-2011)

H. Superelevation Using a Straight Line Friction Ratio

Standard Plan R-107-Series shall be used to incorporate superelevations on structures. When Standard Plan R-107-Series cannot be used, the straight line method on overlay projects and on a very limited basis for deck replacements can be considered. The straight line method allows for a lesser superelevation and thus decreases the HMA wedging on the high side of a bridge overlay. It also reduces the haunch depth on deck replacements. See Bridge Design Guide [6.11.02](#) for straight line chart. (12-5-2005)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.19 (continued)

Slabs

I. Link Slabs (1-25-2021)

Design Requirements and Considerations

Link slabs may be used to eliminate deck joints at piers. A link slab is comprised of a reinforced concrete deck with a length that includes 7.5% of each adjacent span, not necessarily the same length for each span. Saw cut lines are located at centerline of pier and at 5% of link slab length in each individual span. Link slabs are not designed to transmit live load effects from one span to another. As a result, the bridge (beams) is analyzed as simply supported spans for all vertical loads. Thus, shear stud connectors shall be omitted within the limits of the link slab and a 0.31 LBS/SFT roofing paper bond breaker is applied between the top flange and the link slab to prevent composite action. The total number of shear stud connectors per span required to meet strength requirements shall still be provided. If required, increase deck removal limits to permit placement of additional shear developers beyond the link slab. The link slab reinforcing is replaced (transverse) and lapped with existing reinforcement (longitudinal) to minimize crack widths based on the anticipated strains due to live load rotations for a girder.

While the changes to the live load and dead load effects from link slabs are usually not significant, changing the articulation of the superstructure may significantly change the thermal and braking loads on the bearings, piers, and abutments. Evaluate the bearings, substructures, or foundations to determine if they can accommodate the new force configurations. It may be necessary to convert fixed bearings to expansion, increase capacity of expansion bearings and replace fixed bearings to increase capacity for longitudinal forces, etc. of the spans being linked together. Evaluate existing substructure elements in accordance with the load requirements of the AASHTO bridge design specifications in effect when the bridge was built.

7.02.19 (continued)

MDOT link slabs are designed using the following maximum bridge lengths and widths criteria:

1. Straight, no skew concrete bridge:
Length \leq 300 ft.
2. 45° max. skew concrete bridge:
Length \leq 200 ft., Width \leq 100 ft.
3. Straight, no skew steel bridge:
Length \leq 275 ft.
4. 45° max. skew steel bridge:
Length \leq 175 ft., Width \leq 100 ft.

See Bridge Design Guides [6.44.01](#), & [01A](#).

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

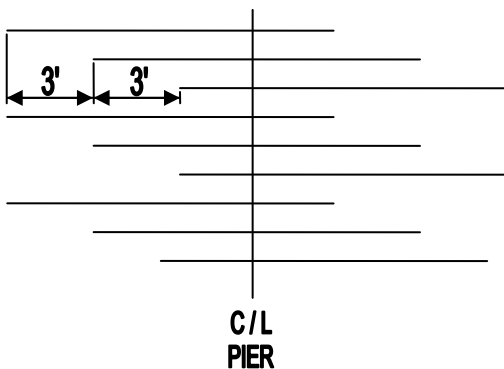
7.02.20

Slab Reinforcement

For general steel reinforcement information applying to both superstructure and substructures, see Steel Reinforcement (Section 7.04).

A. Negative Moment Reinforcement (12-5-2005) (12-17-2012)

Additional longitudinal reinforcement is required in regions of negative moment (see AASHTO 10.38.4.3). Bar ends should have two 3' staggers (see below) to minimize transverse cracking at bar terminations.



With continuous beam design, the bar length should be according to AASHTO 10.38.4.4.

Negative moment reinforcement on 6" decks shall be limited to #6 maximum bar size. The #3 bar longitudinal reinforcement shall be considered in available area for negative moment slab reinforcement. If needed the #3 longitudinal reinforcement in the negative moment region can be replaced with larger bars and combined with added negative moment reinforcement. (11-28-2011)

B. Bar Spacing

See Bridge Design Guide [6.41.01](#).

7.02.20 (continued)

C. Bar Laps

See Bridge Design Guide [7.14.02A](#).

Transverse slab reinforcement, if possible, is to be lapped as follows: top steel between the beams and bottom steel over the beams.

D. Cover

All decks will provide 3" of clear concrete cover to the top of transverse reinforcement. See Bridge Design Guide [6.41.01](#). (5-6-99)

E. Placing of Transverse Bars

Transverse bars are generally placed perpendicular to the beams; however, where the angle of crossing is 70° or greater, transverse bars may be placed parallel to the reference lines if "S along the skew" falls in the same beam spacing range as "S normal to the beams" or the next larger range (see Bridge Design Guide [6.41.01](#)).

Dimensioning is to be perpendicular to reference lines when the transverse bars are laid parallel to the reference line.

F. Epoxy-Coated Reinforcement

All bars in the superstructure are to be epoxy coated.

G. Additional Reinforcement When Haunch Exceeds 6 Inches

Additional transverse and longitudinal reinforcement shall be required when haunch depths exceed 6". Space additional transverse haunch reinforcement (EW05 or EK05 bars) between transverse bars, and ensure bars sufficiently penetrate haunch and slab. See Bridge Design Guide [6.42.03A](#) for details. (4-23-2012)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.21

Continuous Beam Design - Steel

A. Pour Sequence

Where temporary supports are not provided under continuous beams, a pour sequence is to be given to ensure that deflections occur as assumed in the design.

B. Preloading

In order to prevent flexural cracking of deck slabs of composite, continuous-span bridge structures, where shoring is not practical; it is suggested that preloading be considered and that the concrete pouring sequence be carefully designated. Generally, the positive dead load moment areas in the tail spans should be poured first with a preload in place in the center span. For simplicity, the weight of the preload may be chosen equal to that of the concrete deck to be poured in the center span. Removing the preload prior to placing the center span concrete would induce compressive stresses in the concrete in the tail spans that would offset the tensile stresses induced when the middle span concrete is placed.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.22

Screeding

A. Transverse Screeding

Transverse screeding shall be used for finishing all bridge decks.

When the skew angle is greater than or equal to 45°, the strike equipment is placed parallel to the reference lines.

B. Screed Elevations

In computing screed elevations, the specified camber should be used.

The following dead loads should be used in computing beam deflection for screed elevations:

- 10 LBS/SFT for formwork
- 10 LBS/SFT for reinforcing steel
- 145 LBS/SFT for plain concrete
- 150 LBS/SFT for reinforced concrete

Screed elevations for suspended spans are to be figured for the case of no deck concrete having been poured in any span.

Screed elevations for prestressed concrete beams are to account for long term effects by modifying the beam deflections using the following factors:

Factor applied to prestressing force at release = $1.9 + 0.6(I_{\text{Girder}} / I_{\text{Composite}})$

Factor applied to beam self-weight at release = $2.1 + 0.7(I_{\text{Girder}} / I_{\text{Composite}})$

Factor applied to slab when poured (including SIP forms, diaphragms and utility loads) = $1.0 + 1.1(I_{\text{Girder}} / I_{\text{Composite}})$

Factor applied to barrier and sidewalk when poured = 2.3

I_{Girder} = moment of inertia of girder

$I_{\text{Composite}}$ = moment of inertia of composite section

(4-23-2018)

7.02.23

Stay-In-Place Forms

A. Use (9-2-2003)

Because of the design accommodations, any need for stay-in-place forms should be anticipated in the Contract Plans and Specifications.

The criteria for the use of metal stay-in-place forms are safety and economy in construction. Where practical, they should be included as a contractor option.

The use of concrete stay-in-place forms is not allowed.

B. Design (5-6-99)

The design of metal stay-in-place forms is the responsibility of the contractor. If the beams on a deck replacement project can't accommodate an increased dead load of 15 LBS/SFT (7.01.04 I.) then note 8.07.01 G. shall be used on the plans. Because of the load and deflection limits of the forms, it may be necessary to reduce the beam spacing resulting in the use of one or more additional rows of beams. This additional cost should be justified by the improved safety and/or in the cost reduction of maintaining traffic on the roadway below. (8-23-2021)

When the use of stay-in-place forms cannot be economically justified the designer shall prohibit their use by including note 8.07.01 H. on the plans. (9-2-2003) (8-23-2021)

Detail steel beam tension zones on plans. Welding or mechanically fastening permanent metal deck forms or accessories to structural steel is prohibited. (6-16-2014) (3-26-2018)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.24

Joints in Deck Slabs

A. Longitudinal Joints

Deck widths greater than 100'-0" require a longitudinal open/expansion joint. (5-6-99)

1. Centerline (Median) Joint

For bridges requiring a longitudinal open joint, which are also on roadways having a median barrier, the barrier is to be split, with the open joint extending up between the two halves.

2. Valley Gutter Joint

To facilitate the construction of bridges with valley gutters, we will show an optional longitudinal construction joint 2'-0" inside or outside the gutter centerline (depending on beam placement), and the reinforcing steel will be detailed with a splice at the gutter centerline.

3. Construction Joints

An optional longitudinal construction joint is to be shown on the plans when the bridge width exceeds 75'-0". For skews greater than or equal to 45°, this 75'-0" is measured parallel to the reference lines. This optional joint is to be placed at the edge of a pavement lane, regardless of location of the crown of the road.

Longitudinal construction joints are not to be placed over the flange of a beam.

4. Part-Width Construction

Where possible, longitudinal construction joints used to facilitate part-width construction should be placed at the edge of a pavement lane. This greatly improves ride quality and aesthetics. (5-1-2000)

7.02.24 (continued)

Joints in Deck Slabs

B. Transverse Joints (9-27-2021)

1. Construction Joints and Reference Joints

At construction joints where movement is anticipated, an expansion joint device shall be used.

Construction joints over piers at fixed bearings are to be a sawed joint 1½" deep by ⅛" wide (minimum) in the top of slab. The joint is to be sawed within 24 hours of placing the curing and is to be filled to ¼" below top of concrete with polyurethane or polyurethane hybrid sealant. Included in the bid item "Superstructure Conc, Form, Finish, and Cure, Night Casting." Add note [8.07.01 K.](#) to the plans. (8-23-2021) (8-24-2020)

Typical construction joints (transverse, longitudinal and at fixed pin & hangers) are to be a sawed joint ½" deep by ⅛" wide (minimum) in the top of slab and is to be filled to ¼" below top of concrete with polyurethane or polyurethane hybrid sealant. Included in the bid item "Superstructure Conc, Form, Finish, and Cure, Night Casting." Add details and note [8.07.01 M.](#) to the plans. (8-24-2020) (8-23-2021)

Reference joints located over integral and semi-integral backwalls are to be a sawed joint ½" deep by ⅛" wide (minimum) in the top of slab and is to be filled to ¼" below top of concrete with polyurethane or polyurethane hybrid sealant. Included in the bid item "Superstructure Conc, Form, Finish, and Cure, Night Casting." Add note [8.07.01 M.](#) to the plans. See Bridge Design Guides [6.20.03 A, B, & C](#) and [6.20.04](#) for details. (8-23-2021)(8-24-2020)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.24 (continued)

7.02.24 (continued)

Joints in Deck Slabs

B. Transverse Joints

2. Expansion Joints

The maximum single opening in an expansion joint device shall be no more than 4", measured in the direction of traffic. When movement required is greater than 4" a modular expansion joint shall be used. (5-6-99)

Expansion joint devices shall be installed $\frac{1}{4}$ " to $\frac{3}{8}$ " below the adjacent deck elevation. This fact shall be taken into account during design. This recess is to prevent damage to the joint from snow plows. (5-6-99) (2-16-2015)

The EJ3 Sheet included with the plans will designate the total travel that is required at each joint, measured along the centerline of bridge, and the angle of crossing rounded off to the nearest 10°. The length of the device required at each location will be shown, and these lengths totaled for one bid item, "Expansion Joint Device." The fact that the one item includes several minimum travel requirements should not affect the bid price since we currently find little or no difference when we list minimum travels separately. The EJ4 Sheet shall be used with replacement of existing neoprene expansion joint devices. Use of EJ4 Sheet (device) requires [Form 0304](#) (Proprietary Item Certification (PIC) and Public Interest Finding (PIF)) be filled out and placed in the design folder for Delcrete Elastomeric Concrete (D.S. Brown, 300 East Cherry Street, North Baltimore, OH 45872, Telephone: 419.257.3561). Delcrete is a PIC with "No Equally Suitable Alternative". See section [15.04](#) and section [11.08](#) of the Road Design Manual. (11-28-2011) (2-16-2015)

After contract award and before placing the order, the contractor shall inform the Engineer which devices and models they intend to install. The Engineer will provide standard shop drawings of the joint device. (2-16-2015)

When an expansion joint device is used on a sidewalk it shall be fitted with a cover plate as described and detailed in Section [7.02.27](#) and EJ3 and EJ4 Sheets. (11-28-2011)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.25

Pavement Seats

Pavement seats are to be provided on all bridges except integral and semi-integral structures with continuous pour over reference lines (also see Section [7.03.01 C](#)). (5-6-99)

7.02.26

Drain Castings

A. Location

Drain castings in bridge decks should be avoided where practicable. Where drain castings are necessary, they are to be spaced as required but located so as not to allow water to fall on slopes and/or roadways below. Design is to be based on Hydraulic Engineering Circular No. 21 (HEC 21), "Design of Bridge Deck Drainage", or an equal. (5-6-99)

B. Special Reinforcement Steel

Where drain castings are called for in bridge decks, plans are to show that two epoxy coated reinforcing bars are to be placed diagonally at each corner of the drain casting (one top, one bottom). (5-6-99)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.27

Sidewalks (9-2-2003) (11-25-2019)

In general, on a bridge where pedestrians must be accommodated and where maximum posted speed is 40 mph or less, a raised sidewalk should be provided if there is a raised sidewalk on the approach. Where posted speed is greater than 40 mph or there is no raised sidewalk on the approach, a walkway at roadway level should be provided and protected from traffic by an MDOT approved bridge railing.

Where sidewalks are required, they should be 5'-2" or greater in width. However, in circumstances where a 5'-2" width is not achievable a 4'-2" minimum width is permissible if crash tests allow. (11-28-2011)

When the bridge railing length is greater than 200 feet, to adhere to Americans with Disabilities Act (ADA), the sidewalk must be 5'-0" wide (@ 2% slope) or a 5' square passing space shall be located at intervals not exceeding 200 feet. The requirement is valid with a raised sidewalk as on Standard Plan B-25-Series, B-26-Series or B-27-Series and anywhere where the sidewalk is located behind a railing that separates pedestrians from traffic. For railing lengths less than 200 feet the sidewalk width may be 4'-2" if crash tests allow and does not require passing spaces. (11-28-2011)

Expansion joints located on sidewalks shall be fitted with cover plates to eliminate vertical depressions caused by the joint. See Expansion Joint sheets (EJ3 or EJ4). (11-28-2011)

For additional information, refer to Bridge Design Guides [6.05.02](#), [6.29.10C](#), [6.29.17E](#) and Road Design Manual Section [6.08](#).

Where a shared (multi) – use path or other mode of transportation is anticipated or proposed for the bridge, verify that all users have been accommodated and refer to appropriate specifications for design criteria. (12-16-2019)

7.02.27 (continued)

A. Sidewalk Joints

Space sidewalk joints to match any joints in the slab. (9-25-2017)

B. Independent Sidewalk

If the sidewalk is independent of the roadway slab, the sidewalk is to be designed for maximum wheel loading for the bridge with overstressing as allowed by the current AASHTO Standard Specifications for Highway Bridges.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.28

Railing (9-2-2003) (11-25-2019)

Where bridge railing is to be installed, and there are no sidewalks or the sidewalk is behind the railing, the railing shall be one of the bridge railing types currently approved for use by MDOT. The only types of railings currently used by MDOT are the Type 6 Barrier (see Standard Plan B-29-Series), Type 7 Barrier (see Standard Plan B-28-Series), the 2 Tube railing (see Standard Plan B-21-Series), 4 Tube railing (see Standard Plan B-26-series), Aesthetic Parapet Tube railing (see Standard Plan B-25-Series) and 3 Tube With Pickets (see Standard Plan B-27-Series).

Where bridge railing is to be installed on raised sidewalks it must be 4 Tube railing (see Standard Plan B-26-series) Aesthetic Parapet Tube railing (see Standard Plan B-25-Series) or 3 Tube With Pickets (see Standard Plan B-27-Series).

A. Railing Types and Their Use (9-2-2003) (11-25-2019)

Generally, Bridge Barrier Railing, Type 6, is used on all new structures and reconstruction (major rehabilitation) bridge projects without sidewalks (see Standard Plan B-29-Series). On structures where sight distance or clear roadway width is a problem, Type 7 may be substituted (see Standard Plan B-28-Series). At stream crossings or scenic areas, Bridge Railing, 2 Tube, Aesthetic Parapet Tube, 4 Tube or 3 Tube With Pickets may be used (see Standard Plan B-21-Series, B-25-Series, B-26-Series or B-27-Series). On bridges where pedestrian or bicycle traffic is separated from vehicular traffic by a standard barrier, it is not necessary to provide a vehicular railing at the fascias. In such cases pedestrian fencing is desirable.

For structures without sidewalks, but where some pedestrian traffic is likely, a Bridge Railing, 4 Tube, Aesthetic Parapet Tube or 3 Tube With Pickets is to be used.

7.02.28 (continued)

B. Section Deleted (8-23-2021)

C. Joints

To avoid cracking, an open joint is required in concrete railings at all deck joints where reinforcing steel is not continued through the joint. False joints are not required in barrier railing.

A 1" joint shall be used in all concrete railings over the piers of continuous decks, at midspan on all structures with a span greater than 100'-0" and cantilever decks where the cantilever is more than 10'-0" long. The joint shall be perpendicular to the centerline even on skewed bridges. A 1" joint filler shall be used to fill the joint to ½" from the bevels of the railing. The remaining ½" shall be sealed with a polyurethane or polyurethane hybrid sealant. (5-1-2000) (2-21-2017)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.28 (continued)

Railing

D. Median Barrier vs. Bridge Barrier Railing (5-6-99)

Criteria for use:

1. Concrete barrier on a bridge shall be reinforced and attached to the structure.
2. Barriers that function as railings shall be at least 3'-6" in height.
3. Barriers that function as median barriers shall be at least 2'-8" in height.
4. Concrete glare screens required on approaches shall be continued across structures.
5. When structures are 150'-0" or less apart (along traveled roadway) a concrete barrier (Concrete Barrier, Single Face or approved alternate) should be used between the two structures, in lieu of guardrail to provide continuity. Approval by the agency having jurisdiction of the approaches is required.

7.02.29

Fencing

A. MDOT's Policy

For protective screening MDOT utilizes AASHTO's A Guide for Protective Screening of Overpass Structures.

The guide provides that screens should be considered under any of the following conditions:

1. Reported incidents of objects being dropped from an overpass.
2. On overpasses with walks where experience on nearby structures indicates a need for screens.
3. On overpasses in large urban areas used exclusively by pedestrians.
4. On overpasses near a school, a playground, or elsewhere where it would be expected that the overpass would be frequently used by children unaccompanied by adults.

B. Metro Region Criteria (9-2-2003)

The Region Project Development or Bridge Engineer shall be contacted to determine if pedestrian screening/fencing should be added to projects. General criteria:

1. When major bridge rehabilitation is scheduled for a structure, bridge screening shall be included.
2. Railroad structures shall have bridge screening due to the presence of ballast and discarded rail spikes.
3. Screening is not required for structures which do not normally have pedestrian access. This includes, but is not limited to, freeway to freeway connecting structures and all freeway ramp structures.

For additional information on pedestrian fencing, see Section [7.05](#) and Section [2.02.11](#).

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7.02.30 (8-23-2021)

Precast Box/Three Sided/Arch Culverts

Design criteria and considerations:

- A. Verify with manufacturers the maximum span length available.
- B. The number of manufacturers of the specified span length needs to be at least two.
- C. When selecting culvert rise, consider all users of the waterway, along with normal water surface under clearance and freeboard at high water.
- D. For structure (culvert) lengths that can accommodate a clear span between guardrail posts of 25'-0" or less use "Guardrail Long Span, Detail MGS-1, MGS-2 or MGS-3" (Standard Plan R-72-Series) to span the culvert. Ensure that the requirements of Standard Plan R-72-Series (e.g., headwall location and size, guardrail post locations, etc.) are met prior to specifying the use of the standard. Otherwise, extend height of headwalls to 36" above plan grade elevation and attach guardrail to headwall as detailed on the plans.
- E. Add a PVC (polyvinyl chloride) liner that covers entire top and sides of all buried culverts. For precast boxes, extend the liner 3" into culvert bedding and turn out 6" horizontally. For three sided and arch culverts, extend the liner 3" below the top of footing and turn out 6" horizontally. Extend the liner a minimum of 3 feet beyond the construction joint between culvert and wingwalls and turn up at back side of headwalls. At the ends of the culvert, adhere the perimeter of the liner with an adhesive as recommended by the PVC liner manufacturer.

Include Special Provision for Polyvinyl Chloride Liner in proposal.

(2-22-2022)

Additional information and criteria is included in the current Standard Specifications.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.31 (11-28-2011)

Deck Replacements

With deck replacements or widening projects (or reconstruction projects), the structural adequacy of the entire structure shall be evaluated. In addition to the criteria listed below, deck replacements shall meet all requirements listed in this chapter (e.g. slopes, shoulder width, stay in place deck forms and approach items). Consider all modes of transportation and evaluate whether deck replacement or widening can accommodate all users. (12-16-2019)

A. Beams

1. On concrete T-Beam bridges the deck slab is an integral part of the support system and cannot be removed without dismantling the entire superstructure. The cost of deep chipping (or hydrodemolishing) combined with the installation of a cathodic protection system should be weighed against the cost of complete superstructure replacement.
2. On steel stringer bridges, the tops of beams shall be blast cleaned and coated with an organic zinc-rich primer. Shear connectors shall be placed to upgrade the capacity of existing non-composite decks. (12-5-2005)
3. On prestressed concrete box beam decks, the existing wearing course shall be replaced with a 6" reinforced deck.

B. Railings

Railings shall be upgraded when bridge deck replacements are planned. See section [7.02.28](#).

7.02.31 (continued)

C. Geometrics

Criteria for roadway widths and design loading have been established in ***A Policy on Design Standards - Interstate System***, 2005, and ***A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition*** published by AASHTO. These criteria are based on the type of roadway carried by the structure and are summarized in this section. Non Interstate structures with deck replacements or widening projects (or reconstruction projects) shall adhere to ***A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition*** design criteria (standards). Interstate structures shall adhere to ***A Policy on Design Standards - Interstate System***, 2005. MDOT policy has set bridge (shoulder) widths 2' (offset) greater than AASHTO widths for safety considerations of the traveling public. See [Bridge Design Guides](#) 6.05 Series & 6.06 Series. (11-23-2015) (3-21-2016)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.02.31 Deck Replacements (Cont.)

CLEAR ROADWAY WIDTHS AND DESIGN LOADING FOR DECK REPLACEMENTS			
Type of Roadway		Minimum Clear Roadway Width	Minimum Design Loading
Non-Interstate Freeway		A, C	HS-20
Interstate Freeway		B, C	HS-20
Arterial (Non-Freeway Trunkline)	Rural	Exhibit 7-3.	HS-20
	Urban	D, C	HS-20
Collector (Non-Trunkline)	Rural	Exhibit 6-6.	HS-20
	Urban	Exhibit 6-5., E	HS-20
Local (Non-Trunkline)	Rural	Exhibit 5-6.	HS-20
	Urban	Exhibit 5-5., E	HS-20

- (A) The minimum clear roadway provided shall accommodate the pavement and full shoulders of the approach roadway or the minimum AASHTO requirements for lane and shoulder widths, whichever is greater.
- (B) The minimum clear roadway provided shall accommodate the pavement and full shoulders of the approach roadway.
- (C) For bridges in excess of 200'-0" in length, where the nearest offset from the edge of traveled way to either curb or barrier is greater than 4'-0" on the approaches, the nearest offset on the bridge shall be at least 4'-0" on each side. (12-5-2005)
- (D) The minimum clear width on the bridge shall be the same as the curb-to-curb width of the street.
- (E) The minimum clear roadway shall be the traveled way plus 1'-0" to each curb face. However, consideration should be given to providing the same width as the curb-to-curb approach width if it is cost effective to do so.

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The tables shown below are derived from A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition published by AASHTO and do not include clearances for bridge rail offset. See the [Bridge Design Guides](#) for MDOT offset criteria. (7-20-2015) (3-21-2016)

MINIMUM WIDTH OF TRAVELED WAY FOR RURAL ARTERIALS (FROM Exhibit 7-3.)				
Design Speed(mph)	Design Traffic Volume (veh/day)			
	Under 400	400-1500	1500 -2000	over 2000
	Width of Traveled Way (ft) ^(a)			
40-45	22	22	22	24
50-55	22	22	24	24
60-75	24	24	24	24
^(a) Where the width of traveled way is shown to be 24 ft, it may remain 22 ft on reconstructed bridges where alignment and safety record are satisfactory.				

MINIMUM CLEAR ROADWAY WIDTHS FOR RURAL ARTERIAL BRIDGES BEING RECONSTRUCTED (FROM Exhibit 7-3.)	
Design Traffic Volume(veh/day)	Min. Clear Roadway Width of Bridge
under 400	Traveled way + 4 ft (ea. side)
400-2000	Traveled way + 6 ft (ea. side) ^(b)
over 2000	Traveled way + 8 ft (ea. side) ^(b)
^(b) For bridges in excess of 200 ft in length, a minimum width of traveled way + 4 ft on each side will be acceptable.	

Exhibit 6-5. MINIMUM WIDTH OF TRAVELED WAY FOR COLLECTOR ROADS				
Design Speed(mph)	Design Traffic Volumes (veh/day)			
	Under 400	400-1500	1500 -2000	over 2000
	Width of Traveled Way (ft)			
20-30	20 ^(a)	20	22	24
35-40	20 ^(a)	22	22	24
45-50	20	22	22	24
55-60	22	22	24	24
On roadways to be reconstructed, a 22 ft traveled way may be retained where the alignment and safety records are satisfactory.				
^(a) A 18 ft minimum width may be used for roadways with design volumes under 250 veh/day.				

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

Exhibit 6-6. MINIMUM ROADWAY WIDTHS FOR NEW AND RECONSTRUCTED BRIDGES CARRYING RURAL COLLECTOR ROADS		
Design Traffic Volume(veh/day)	Minimum Roadway Width of Bridge	Design Loading Structural Capacity
400 and Under	Traveled way + 2 ft (each side)	HS -20
400 to 1500	Traveled way + 3 ft (each side)	HS -20
1500 to 2000	Traveled way + 4 ft (each side) ^(a)	HS -20
over 2000	Traveled way + shoulders ^(a)	HS -20
Where the approach traveled way plus shoulders is surfaced, that surfaced width shall be carried across all structures. ^(a) For bridges in excess of 100 ft in length, the minimum width of traveled way plus 3 ft on each side will be acceptable.		

Exhibit 5-5. MINIMUM WIDTH OF TRAVELED WAY FOR LOCAL ROADS				
Design Speed(mph)	Design Traffic Volumes (veh/day)			
	Under 400	400-1500	1500 -2000	over 2000
	Width of Traveled Way (ft)			
15	18	20	20	22
20-40	18	20	22	24
45-50	20	22	22	24
55-60	22	22	24	24
Where the width of traveled way is shown as 24 ft, the width may remain 22 ft m on reconstructed bridges where alignment and safety records are satisfactory.				

Exhibit 5-6. MINIMUM CLEAR ROADWAY WIDTHS AND DESIGN LOADINGS FOR NEW AND RECONSTRUCTED BRIDGES CARRYING RURAL LOCAL ROADS		
Design Traffic Volume(veh/day)	Min. Clear Roadway Width of Bridge	Design Loading Structural Capacity
ADT 400 & under	Traveled way + 2 ft (ea. side)	HS -20
ADT 400-2000	Traveled way + 3 ft (ea. side)	HS -20
ADT over 2000	Traveled way + shoulders	HS -20

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7.02.32

Ride Quality (8-20-2012)

The purpose of a ride quality specification is to obtain a smoother riding pavement than is typically obtained with the traditional 10 foot straightedge smoothness requirements. Michigan first adopted a ride quality specification in 1979. The current specification prescribes classified levels of ride quality requirements described in subsequent paragraphs of this section.

Specific requirements for ride quality are identified by classification. Each classification (Class I, II, III & IV) specifies criteria for roughness, method of measurement, applicable incentives, disincentives, and corrective action. The matrix on the following page provides instructions for assigning ride quality classification based on scope of work, design speed, grade control and adaptability to production paving.

Ride quality requirements are not intended for application with stand-alone bridge projects. However, bridge deck replacements, and shallow or deep concrete bridge overlays included within the limits of a Class I ride quality section in a corridor project will be subject to ride quality requirements.

Using these criteria, the road designer will assign a ride quality classification to each applicable section of paving throughout the project. The locations and classifications are then tabulated for inclusion in the Notice to Bidders (generally done by the road designer).

The bridge designer will recommend if the bridge portions of a Class I section are to also be designated as Class I or are to be excluded by designation as Class II based on the type of work and adaptability to corrective deck grinding,

Within Class II, III, and IV areas, bridges are predetermined excluded areas from ride quality specifications between the two end reference lines or between the outermost limits of any structure expansion joint devices.

7.02.32 (continued)

The only pay item associated with ride quality is bump grinding. A small quantity should be included for each location where the contractor may be directed to grind *existing* pavement (i.e.: pavement not placed as part of the contract) in order to smooth the transition from old to new pavement. This includes the POB, the POE, and any *existing* bridge or railroad approaches within the project limits. 25 square yards for each lane at each of the above locations should suffice.

Bump grinding is normally not paid for in areas excluded from ride quality. Instead the pavement is accepted or rejected based on the 10 foot straightedge criteria. (***Standard Specifications for Construction***) If it does not meet the straightedge criteria, it is the contractor's responsibility to grind or replace at their cost.

For additional information on ride quality see the Road Design Manual section 6.04.05.

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BRIDGE DESIGN

7.02.32 (continued)

Ride Quality Classification Selection Matrix

How To Use This Matrix		Contractor has control over grades		Contractor has limited or no control ⁽²⁾ over grades				
		3R ⁽³⁾	4R ⁽³⁾	3R ⁽³⁾	4R ⁽³⁾	Single Course of Flexible Pavement (with/without milling)	Diamond Grinding Projects	Flexible Ultra Thin, Paver Placed Surface Seal
Section length allows for production paving ⁽⁴⁾	Design Speed below 50 mph	Class II	Class II	Class II	Class II	Class III	Class III	Class III
	Design Speed 50 mph or above	Class I or II	Class I or II	Class II	Class II	Class III	Class III	Class III
Section length does not allow production paving ⁽⁴⁾	Design Speed below 50 mph	Class III	Class II	Class IV	Class IV	Class IV	N/A	Class IV
	Design Speed 50 mph or above	Class II	Class I or II	Class IV	Class IV	Class IV	N/A	Class IV

Key:

Class I Ride Quality: Complete Projects (mainline only) where no excluded areas are allowed, a thresh hold IRI criteria must be met, and incentives and disincentives apply. Use Class I only on limited access roadway with design speeds 50 mph or greater and where most or all bridges include deck replacement, shallow concrete overlays, or deep concrete overlays. Investigate the feasibility of diamond grinding (at MDOT cost) any bridge decks not being replaced or overlaid. Where diamond grinding a bridge deck is not feasible, a limited section of the project can be designed as Class II Ride Quality such that the bridge would be a pre-determined excluded area within a project that would otherwise meet Class I ride Quality criteria.

Class II Ride Quality: Sections where threshold IRI criteria must be met, but incentives and disincentives do not apply. (Use Class II if all of the above requirements for Class I are not met.)

Class III Ride Quality: Sections where the pre-construction IRI must be maintained or improved by a certain percentage. Disincentives may apply.

Class IV Ride Quality: Sections where acceptance is based on a 10 foot straightedge criteria. Incentives and disincentives do not apply.

N/A = Not Applicable

Footnotes:

- (1) A Section is defined as a length of paving which has the same characteristics (grade control, type of work, design speed).
- (2) Locations where a contractor might not have control of grades include locations where they must pave adjacent to an existing lane with marginal ride quality, locations where there are existing curbs to match, and locations where there are frequent existing manholes or structures to meet.
- (3) 3R means resurfacing, restoration, and rehabilitation. Primary examples include multiple course resurfacing, milling or profiling, concrete overlays and inlays (without removing subbase). 4R means new construction or reconstruction. A primary example is complete removal and replacement of pavement (including subbase). See Chapter 3 for further definition and examples including projects with combined 3R and 4R work for classifications purposes on projects with multiple fixes.
- (4) Production paving means a slipform paver can be used for concrete paving and that a HMA paver can be used without frequent stopping and starting and there is room for a haul truck to unload directly into the paver or a material transfer device while in motion. MDOT imposed construction staging requirements should be considered when making this determination

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.03

SUBSTRUCTURE

Design structures by placing all substructure units (piers & abutments) and slopes outside of the clear zone. For clear zone distances see Bridge Design Guide [6.06.06](#) or [Chapter 7](#) of the Road Design Manual. For substructure clearances also see [Bridge Design Guide 6.06.01-.04](#). Provide guardrail protection for units or slope that cannot be placed outside of the clear zone. Place guardrail at a distance that will allow deflection as defined in [Chapter 7](#) of the Road Design Manual. Design piers with base walls and guardrail approach terminals to maximize clear roadside distance in lieu of shielding piers with guardrail. Attach guardrail to base walls as detailed on Standard Plan R-67-Series. (11-28-2011)

Do not use steel sheet piling as support elements for substructures unless approved by the MDOT Geotechnical Section. (3-28-2022)

7.03.01

Abutment Design

A. Design Cases

The following cases must be considered in the design of an abutment:

Case I

Construction state: Abutment built and backfilled to grade.

Case II

Bridge open to traffic with truck loading on the approach only.

Case III

Bridge with traffic on it and no load on approach.

Case IV

Contraction: Loading forces of Case II plus the effects of temperature contraction in the deck transmitted to the abutment.

Expansion: For integral abutments Case IV instead assumes the loading forces of Case III with the addition of an expansion force transmitted from the deck. A 25% overstress is allowed for this case. (11-28-2011)

7.03.01 (continued)

B. Types

1. Cantilever Abutment

The maximum wall height for cantilever abutments is approximately 25'-0".

2. Counterfort Abutment

Counterfort abutments should be considered when wall heights exceed 25'-0".

3. Curtain Wall Abutment

Curtain wall abutments are to be considered where piles are required under the abutment and the abutment height does not exceed 9'-6" (see Bridge Design Guide [5.18.01](#)).

Curtain wall abutments of sufficient length to require expansion joints are to have the end piles battered outward parallel to the reference line. The purpose of this is to prevent the expansion joint from opening excessively.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.01 (continued)

Abutment Design

B. Types

4. Integral and Semi - Integral Abutments

Integral and semi-integral abutments shall be used where practical to avoid deck joints. (5-1-2000)

Integral Abutment

Abutment walls (stub type) supported by one row of piles that allow movement through pile flexure (see [Bridge Design Guide](#) 6.20.04 series). Walls shall be a minimum of 5'-0" and 12'-0" maximum in height. The H-Pile webs shall be oriented parallel to the bridge reference lines and embedded 30" into the abutment wall. Upon recommendation from Geotechnical Services Section pile holes shall be prebored. In general, integral abutments do not have return wingwalls.

A separate design analysis needs to be performed on the abutment wall for active and passive pressures. Additional vertical dowels may be required at the abutment and backwall interface to resist the active surcharge and the passive resistance that have been introduced into the wall from bridge expansion. Additional vertical reinforcement may be required in the abutment wall and should also be designed. The pile spacing may need to be adjusted to prevent shear stress failure in the pile.

Due to scour considerations, the designer should usually avoid using Integral abutments at stream crossings. (5-1-2000)

Semi-Integral Abutment

Conventional abutment walls fixed in position with expansion and contraction movement of the bridge superstructure (see [Bridge Design Guide](#) 6.20.04 series). Abutments with a single row of piles should not be used.

7.03.01 (continued)

The following design criteria are valid for both types of abutments.

- a. Steel bridges are to be less than 300'-0" and concrete bridges are to be less than 400'-0" in length.
- b. Use approach slab details on Standard Plan R-45-Series when the length of bridge contributing to expansion at an abutment is less than 50'-0" for concrete beam bridges and less than 25'-0" for steel beam bridges. (11-28-2011)
- c. Angle of crossing shall be 60 degrees minimum and 120 degrees maximum. See Section [7.01.14](#) for MDOT skew policy. (12-5-2005)
- d. Backfill shall be "Backfill, Structure, CIP" as per Standard Specifications.

Place aggregate base or open graded drainage course (OGDC) over structure backfill to support approach slabs, sleeper slabs and approach curb and gutter. (10-22-2012) (12-28-2015)

- e. Pavement seats are 9" wide for dependent backwalls, and approach slabs project to the bridge slab over independent backwalls. Avoid cantilevered pavement seats. (1-24-2022)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.03.01 (continued)

Abutment Design

B. Types

4. Integral and Semi-Integral Abutments

- f. (1-24-2022) Approach slabs are 20'-0" in length whenever possible.

Approach slabs 20'-0" in length are based on a longitudinal unsupported length of 10 feet measured along the centerline of the roadway, a slab thickness of 12" and a maximum concrete cover to the centerline of the bottom longitudinal reinforcement of 3". Deviation from these design parameters for specific projects requires a complete redesign of the approach slab.

Approach slabs with independent backwalls can be 6'-6" minimum length. For design speeds greater than 45 mph (posted > 40 mph) approach slabs may be up to 20' in length (measured along roadway centerline) as project and geometric limitations allow. Use shorter approach slab length (6'-6" min) if service road is in close proximity to the bridge abutment. (12-28-2015)

Abutments with a skew angle maintain the same skew angle at the end of the bridge approach slab and at the sleeper slab. Standard Plan [R-45-Series](#) reinforced approach pavements are cast perpendicular (90°) to the roadway centerline on the opposite end of the sleeper slab. See Standard Plan [R-43-Series](#). (12-28-2015)

Cast 12" minimum thickness (9" for independent backwalls) bridge approach slab from sleeper slab towards reference lines at night with "Superstructure Conc, Night Casting (High Performance)". (9-27-2021)

Use a 20' concrete approach pavement as detailed on Standard Plan [R-43](#) & [R-45-Series](#) located on the road approach side of the sleeper slab. (10-22-2012)

7.03.01 B. 4. f. (continued)

Designate approach slabs as separate pours in the pour sequence of the superstructure. (9-21-2015)

See Bridge Design Guide [6.20.03A](#), [.03B](#), [6.20.04](#) & [.04B](#) for approach slab details. (12-28-2015)

- g. Continue bottom mat of deck reinforcement 2'-0" past reference line into the approach slab with independent backwalls. See Bridge Design Guides [6.20.03A](#) & [.03B](#). For dependent backwalls lap or develop EA bars from deck slab to bridge approach slab. See Bridge Design Guides [6.20.04](#) & [.04B](#). (1-24-2022)
- h. Add extra reinforcement over beams at the reference line that extend 2'-0" into the approach slab and 2'-0" into the bridge deck slab with independent backwalls. For dependent backwalls lap or develop extra EA bars over beams. (1-24-2022)
- i. Attach approach curb and gutter to the approach slab with bottom mat transverse reinforcement and to the bridge deck with bottom mat longitudinal reinforcement. Do not attach curb and gutter to the approach slab or the bridge deck on structures with return wingwalls. Using a bond breaker and sliding the approach slab over the return wingwalls is a design consideration. The extension of bridge railing to the sleeper slab will eliminate the need for curb and gutter in the bridge approach slab area. (1-24-2022)
- j. An inverted "T" sleeper slab shall be used with all approach slabs (except when Standard Plan [R-45-Series](#) approach is used by itself). Concrete to concrete slabs shall have an EJ3 (or EJ4) joint on the bridge side of the stub and an E3 joint on the road side. Place [R-45-Series](#) reinforced concrete slab on the road side of the inverted "T" sleeper slab. Provide elevations along stub of sleeper slab at construction centerline, lane lines and edge of metal. Provide elevations at toe of curb/barrier and top of curb if present. (1-24-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.01 (continued)

Abutment Design

B. Types

5. Spill – Through Abutment (9-24-2018)

A spill-through abutment has fill-slope with a revetment on the streamward side.

a. Definitions

- 1) Fill slope: side or end slope of an earth-fill embankment. Where a fill slope forms the streamward face of a spill-through abutment, it is regarded as part of the abutment.
- 2) Revetment: rigid or flexible material designed and placed to inhibit scour or erosion.

7.03.01 (continued)

b. Design Considerations

- 1) The dimensions and elevations of the revetment must be as defined by the Hydraulics Unit.
- 2) If the Hydraulics Unit determines there is a high probability of the river laterally migrating over time, consideration shall be given to:

- a) Design the span lengths and substructure locations to accommodate the future path of the river.

and/or

- b) Resist migration with stream armoring and/or design the abutment to remain stable at the 500-year flood event after stream migration has occurred.

- 3) Additional ROW may be necessary to provide sufficient revetment, as defined by the Hydraulics Unit.

A multidisciplinary team consisting of the Hydraulics Engineer, Geotechnical Engineer and the Structural Engineer (Bridge Designer) should convene to determine the best design option when stream meandering is likely.

See Bridge Design Guide [5.47.01](#) for details and MDOT Drainage Manual section [6.4.5.6](#) for additional design criteria.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.01 (continued)

Abutment Design

C. Wall Design

1. Wall Thickness

The minimum wall thickness for abutments is 2'-0". This is to be increased in 2" increments when required to provide 4½" minimum clearance between edge of masonry plate (or elastomeric pad) and front face of the abutment. (8-6-92)

2. Cantilever Wall Design

Cantilever walls 16'-0" or higher are to be designed for both bending and direct stress.

3. Steel Reinforcement

All wall reinforcement shall be epoxy coated. Horizontal bars in the front faces of abutment walls should be continued around the corners at the wingwalls. EC#6 bars are to be placed diagonally across the inside corners. (5-6-99)

4. Vertical Construction Joints

a. There is to be vertical continuity of all construction joints from the footing upward; however, a wall joint does not require a footing joint below.

b. Spacing

(1) Curtain wall abutments - 35'-0" maximum spacing.

(2) Cantilever abutments - 25'-0" maximum spacing.

5. Horizontal Construction Joints

For walls over 30'-0" high, there should be a horizontal construction joint approximately at mid-height. (9-2-2003)

7.03.01 (continued)

6. Vertical Expansion Joints

Vertical expansion joints shall be spaced approximately 90'-0" apart. There should be a construction joint in the footing directly below each expansion joint in the wall.

7. Bridge Seat Steps

Where the bridge seat is stepped, the ends of the steps shall be at 45° to the bridge seat and parallel to the centerline of the bridge to accommodate any movement due to temperature changes. (5-6-99)

8. Pavement Seats

Pavement seats are to be provided on all bridges. They should be cantilevered from the rear face of independent backwalls. (5-6-99)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.02

Footing Design

A. Footing Thickness

The minimum thickness of footings is normally 2'-6"; however, this may be reduced to 2'-0" for short walls. When the wall thickness at its base becomes 3'-0" or greater, the footing thickness is to be increased to 3'-0". Footing thicknesses are to be increased in 6" increments.

B. Footing Width

Spread footings should be sized so that the safety factor for overturning about the toe of footing is at least 2.0. The minimum footing width is 6'-0" for cantilever abutments and 4'-0" for curtainwall abutments. Footings with piles should be sized so that the resultant force is located between rows of piles. (12-5-2005)

C. Footing Joints

Construction joints should be placed in footings to limit concrete pours to 90 CYD. These joints are provided for construction convenience and should be labeled "optional." Where a footing joint is used, it should be located directly under a wall joint.

D. Footing Elevations

Bottoms of footings are normally set 4'-0" below existing or proposed ground line to avoid frost heave. For substructure units in or adjacent to a waterway, bottoms of footings are normally to be set 4'-0" below bottom of channel; where tremie seals are used, the bottoms of footings may be set higher. The Hydraulics/Hydrology Unit shall be consulted for an estimate of the total potential scour depths at the foundations. The tops of footings shall be set at or below the estimated elevation of contraction scour (scour resulting from the constriction of the waterway at the crossing). Structure stability shall be analyzed based on the estimate of total scour at each substructure unit with the advice of geotechnical engineers. If necessary, countermeasures to prevent scour will be incorporated according to FHWA and AASHTO standards. (5-6-99)

7.03.02 (continued)

E. Steel Reinforcement

Where a tremie seal is used and there are no piles, the bottom footing reinforcement shall be 9" above bottom of footing. Where a tremie seal is used and there are piles, the reinforcement shall be 1'-3" above the bottom of footing.

F. Passive Soil Pressure

1. Passive soil pressure may be used in the footing design for retaining, wing and return walls, but not for abutments, to resist sliding and overturning forces. Generally, these resisting forces shall be relied upon only when the footing is in a cut and the soil is not disturbed. The location of utility trenches and edge drains should be considered in making a determination of undisturbed soil. In a river environment, passive soil pressure shall not be used.

When passive soil pressure is used for sliding resistance a factor of safety (F.S.) against sliding of 2.0 shall be used. Use a F.S. against sliding of 1.5 when passive soil pressure is not used. (12-5-2005)

2. When the passive soil is on a slope, the soil height shall be reduced as follows:
 - Berm with 1V:2H slope - reduced 1'-0"
 - 1V:2H slope - reduced 2'-0"

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.02 (continued)

Footing Design

G. Allowable Soil Pressures

1. Granular Soils

The Soils Engineer will normally provide only one allowable soil pressure; the average pressure for dead load plus live load. Our footing shall be proportioned so that the DL+LL case does not develop a pressure at the center of the footing which exceeds this value.

Footing proportions shall also be such that the maximum edge (usually toe) pressure does not exceed 1.3 x this value.

2. Cohesive Soils

The Soils Engineer will provide two allowable soil pressures: the average pressure for dead load only and the average pressure for dead load plus live load. Our footing shall be proportioned so that in either case the pressure at the center does not exceed the allowable.

Footing proportions shall also be such that the maximum edge (usually toe) pressures do not exceed 1.3 x these values.

7.03.03

Pier Design

A. Future Widening

On bridges where we are to provide for future widening, a vertical construction joint, as shown in Bridge Design Guide [5.27.03](#), is to be provided in the pier cap.

B. Column

1. Size

In general, 3'-0" diameter columns should be used with 42" or greater beam depths and 2'-6" diameter columns with beams less than 42", unless loading conditions or bearing areas dictate larger columns.

2. Reinforcement

Care should be used in spacing vertical column bars in order to avoid excessive interference with the pier cap reinforcement. Double rows of column bars or larger diameter columns should be considered to alleviate this problem.

3. Construction Joint

If pier columns are over 30'-0" high, a construction joint should be placed at approximately mid-height.

4. Spacing

Columns should be spaced far enough apart so as to be appealing to the eye; if beam spacing is far enough apart, a column may be placed under each bearing. Use a maximum column diameter(or width) to column spacing ratio of 1:8. (5-6-99)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.03.03 (continued)

Pier Design

C. Pier Caps

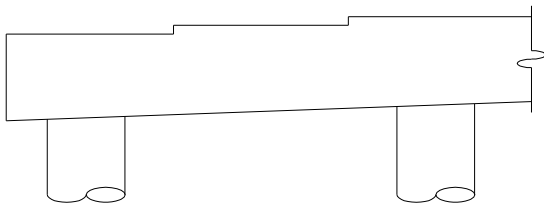
1. Size

The pier cap is to be approximately 3" wider than the diameter of the column and should provide 4½" minimum clearance between the edge of masonry plate (or elastomeric pad) and the face of the cap.

Hammer head pier caps are occasionally used on MDOT projects. These piers have a greater tendency for cracking in the tension zone than standard pier caps. Design procedures to prevent cracking (especially in tension zone), including post tensioning the caps, must be investigated. (9-2-2003)

2. Bolsters

When one end of the pier cap is on a considerably different elevation than the other, the difference shall be provided for by increasing the column heights as shown below.



Ends of bolsters are perpendicular to the faces of the cap and rise at 90° from the top of the pier.

3. Joints

Construction joints should be provided at 25'-0" maximum spacing. A 1" open joint may be required to control temperature moments in long piers with short columns.

7.03.03 (continued)

4. Reinforcement Steel Spacing

In order to permit the vibrator to adequately penetrate and vibrate the concrete in pier caps, the clear distance between the top bars should not be less than 3½". This may, in some cases require the use of special size bars or double rows of bars.

5. Part Width Construction of Cantilevered Pier Caps (12-5-2005)

To reduce potential problems with large pier cap cantilevers during construction base design on the following criteria:

- Avoid splicing reinforcement at points of maximum stress. Where this is not practical, stagger the splices.
- Calculate the clear distance between contact lap splices assuming the bars are placed in a horizontal plane unless otherwise noted on the plans.
- Use temporary supports during staged construction to shore cantilevered pier caps exceeding five feet in length.
- Design structural elements using a dead load factor of 1.5 if live loads (unanticipated construction loads) are not applied to elements.

D. Pier Base Walls or Filler Walls

Piers that are within the clear zone or in a median where barriers are required should have base walls. Piers that will have guardrail attached to or concrete barrier butted up to piers shall have base walls (new construction) or filler walls (existing piers). Piers with filler wall are acceptable but not preferred on new construction or reconstruction projects. Piers behind guardrail or concrete barrier do not need filler or base walls. The base wall is to be 3" wider than the column to prevent vehicle snagging and should extend 3'-6" (min.) above the ground line. Any approach guardrail is to be anchored to the base wall or filler walls according to Standard Plan R-67-Series. (5-1-2000) (11-28-2011)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.04

Cofferdams (8-6-92)

Cofferdams shall be used on all substructure units where tremie concrete is required for water control. When shallow water is present; i.e., less than 2'-0", other methods of water control that allow the contractor maximum flexibility may be appropriate. The Geotechnical Services Section should be contacted in this case to determine if a cofferdam is required. (2-26-2018)

The driving line for cofferdam sheet piling shall be 1'-6" outside the footing outline or at the edge of the tremie concrete. Deep excavations may use driving line greater than 1'-6" outside the footing outline to allow for more efficient bracing schemes. Consult with Geotechnical Services Section. (11-28-2011)

Since a cofferdam is generally a sheeted enclosure, the plans should show and note the limits of the enclosure. The contractor must know if he will be required to completely enclose the excavation or whether sheeting on three sides will suffice.

Often, a portion of a sheet pile cofferdam is to remain in place. On these projects, there will be two bid items. "Steel Sheet Piling, Temp, Left in Place" will be measured and paid for in the specified manner. The remainder of the enclosure along with dewatering, etc., will be paid for as "Cofferdams." This division of pay items should be clarified by a plan note. (9-27-2021)

When cofferdams are not used on structures crossing streams or encroaching on water courses, Plan Note [8.05 Q](#). shall be used. (8-23-2021)

Where a sheet piling enclosure is required for lateral soil support but not for the exclusion of water, "Steel Sheet Piling, Temporary" should be called for.

For additional information see Subsection [7.01.10](#).

7.03.05

Subfootings

Subfootings are only to be used under footings placed in streams, rivers, or below the ground water table. Subfootings are to extend 1'-3" outside of footing lines and normally are to be 3½" thick; where water and/or soil conditions are such that unsuitable conditions might arise, subfootings may be 5½" thick. Foundation excavation limits are still to be only 1'-6" outside of footings. Concrete for subfootings is to be bid separately as "Conc, Grade 3500, Subfooting" and has the material properties of Concrete, Grade 3500. (6-28-2021)

7.03.06

Tremie Seal Design

Generally, tremie seals should be called for on all structures where it is expected that difficulty will be encountered in pumping the water down below the bottom of footing. Do not include weight of tremie when computing pile loads except when the estimated scour depth is below the bottom of tremie. (5-6-99)

A. Design

The tremie seal shall be designed to resist the hydrostatic pressure at the bottom of the tremie by a combination of its weight, plus the bond on the cofferdam and piles. The allowable bond stress is 10 psi on the piles and 5 psi on the cofferdam, providing the piles and the sheeting have sufficient resistance from dead weight and soil friction to resist the load thereby induced. Where shells are used or permitted as an option, the total resistance available will be the weight of the shell plus soil friction less any buoyancy force exerted on the shell. Allowable tension in bending on the tremie seal is 30 psi.

B. Hydrostatic Head

Hydrostatic head should be figured from bottom of tremie seal to ordinary water surface elevation. Include note [8.05 R](#). on plans. (5-6-99) (8-23-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.07

Excavation

All foundation excavation is to be "Excavation, Fdn" unless there is a considerable amount of rock excavation involved; in this case, excavation is to be divided into two bid items: "Excavation, Rock Fdn" and "Excavation, Fdn." (9-27-2021)

Unbraced excavations adjacent to in-service spread footings shall not be permitted. Earth retention designs shall be sealed by a licensed engineer. (11-28-2011)

7.03.08

Steel Sheet Piling

For additional information see Subsection [7.01.10](#).

Evaluate the potential for vibration induced damage to existing structures and utilities. (11-28-2011)

A. Driving Line

1. Temporary Steel Sheet Piling

The driving line for temporary steel sheet piling is 1'-6" outside the footing outline or at the edge of the tremie seal.

2. Permanent Steel Sheet Piling

The inside face of permanent steel sheet piling is to be along the footing outline. Allowance for additional concrete and excavation is to be made due to the structural shape of the sheet piling.

B. Lateral Limits

Lateral limits of open-ended permanent sheeting must be extended beyond the limits of the required excavation. For estimating this extension, use a 1V:1H slope from bottom of excavation to existing ground.

C. Temporary Steel Sheet Piling Left in Place

On some projects requiring temporary sheeting, it is specified that the sheeting be left in place. The sheeting is not required for permanent support, but disturbance caused by its removal could be damaging. The bid item "Steel Sheet Piling, Temp, Left in Place" is used in these instances. (5-6-1999) (9-27-2021)

In general, sheeting at stage lines that is adjacent to permanent backfills should be specified as left-in-place and cut off to approximately 3' below the final pavement grade. If sheeting must be removed, contact the Geotechnical Services Section to determine feasibility. (2-26-2018)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.03.08 (continued)

D. Permanent Steel Sheet Piling (10-24-2001)

1. Design

A required section modulus is calculated based upon a piling design. (MDOT Geotechnical Services Section may recommend a section modulus.) A section is chosen from [Appendix 7.03.08 D](#). (Sheet Piling Section Moduli) using the tabulated "effective" modulus in place of the calculated section modulus. (2-26-2018)

Cold rolled sections have an additional reduction factor, thus it is possible to have a cold rolled section with a higher nominal section modulus, but a lower effective section modulus. To avoid field substitutions resulting in less than designed "effective" section modulus, the plans shall indicate the minimum acceptable nominal section modulus for both hot and cold rolled sections based on values given in [Appendix 7.03.08 D](#). (see note [8.06.06 C](#)). (8-23-2021)

In addition to [Appendix 7.03.08 D](#)., which is to be used for all permanent installations, sheet piling sections subject to severe environments should also be hot dipped galvanized.

Designers are responsible to determine the domestic production and availability of the sheet piling sections they specify. (2-26-2018)

7.03.08 (continued)

2. Background/Commentary

[Appendix 7.03.08 D](#). was developed by the Illinois DOT. It contains sheet pile sections and their effective section modulus. This effective modulus was calculated by reducing the nominal value for the effects of corrosion, and in some cases for a Hartman reduction factor.

Hartman Reduction Factor - tests by Hartman Engineering indicate that cold rolled sections failed at 83% of the expected value based on conventional bending theory. The Hartman study concluded that these failures were because the cold rolled sections have larger widths, depths, and width to depth ratios which promote failure prior to yielding the tension flanges. Cold rolled sections shown on the table have their section modulus reduced by 17% to account for the lower yield values. Illinois DOT took the report's conclusion a further step and applied the Hartman reduction factor to "light duty" hot rolled sections also.

Corrosion - all tabulated sections were reduced to mitigate the effects of corrosion. Illinois DOT assumed a 50 year service life and a corrosion of about 0.00059 inches per year. This translates to about 1/17" of total corrosion (two sides) for the service life.

MDOT requires a 75 year service life and a slightly higher corrosion rate, thus the requirement for hot dipped galvanized sections in severe environments.

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.03.09

Piles

A. General

1. River and Stream Crossing

Both vertical and battered piles should be used under abutments where footings are higher than the river stream bed. The abutments must be protected from scour. The appropriate riprap design as specified by the Design Engineer - Hydraulics/Hydrology will be provided by special provision. A well graded riprap will be provided for foundations subject to pressure flow or velocities greater than 7 feet per second. Piers must have the top of the footing or pile cap below the stream bed a depth equal to the estimated contraction scour depth. (5-6-99)

2. Bidding Piles

Piles shall be bid by a designated capacity unless otherwise noted in the recommendation from the Geotechnical Services Section. (2-26-2018)

It may be necessary to specify steel piles because of difficult driving conditions or to prevent damage to existing sewers and/or utilities. These piles are to be bid as "Pile, Steel, Funn and Driven, (12) (14) inch." This will necessitate two separate bid items if the remainder of the piles are to be bid by a designated capacity or Cast-in-Place Concrete Piles. (9-27-2021)

7.03.09 (continued)

3. Test Piles

Test piles are to be provided for all projects using piles unless the Geotechnical Services Section determine that they are not necessary. (2-26-2018)

At least two test piles shall be provided for at each substructure unit placed on piles.

Timber test piles shall be located in a manner that will best serve as a basis for ordering the balance of the piles.

4. Pile Embedment

Piles are to be extended into the footing a distance of 6". When a tremie seal is used, the piles are to be extended into the footing a distance of 1'-0".

5. Concrete Displaced by Piles

No deductions in concrete quantities will be made for steel pile embedments or for pipe pile embedments of 1'-0" or less.

6. Edge Distance

The usual minimum edge distance for piles is 1'-6". This may be reduced to 1'-3" where special conditions require.

7. Abutment Piling

When piling is required for abutments, a careful study should be made to ensure that the piling will clear previously placed or proposed culvert pipe.

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.03.09 (continued)

Piles

A. General

8. Pile Batter

Generally, piles are to be battered no flatter than 3V:1H. Where soil conditions are not good enough to provide sufficient lateral pile resistance, we may increase the angle of batter to 2.5V:1H or even 2V:1H. This measure, however, should be a last resort since it is difficult to maintain driving accuracy when the batter is flatter than 3V:1H.

If a 2.5V:1H or 2V:1H batter is used, use steel for H-Piles and splices that have a yield strength not less than 50,000 psi. (8-23-2021)

9. Cast-in-Place Concrete Pile Shells

The minimum pile shell thickness shall be 0.312". (8-20-2012)

10. Pile Numbering

A pile numbering scheme shall be shown on the plans for those units having piles. Each pile shall be assigned a number in a particular row or on an individual basis.

11. Pile Driving Vibration Evaluation (11-28-2011)

Driven piles located within a distance of 100 ft of historic or vibration sensitive structures shall be evaluated for damage potential from vibration and/or vibration induced settlement.

Driven piles shall not be located within a 25 ft radius of existing spread footings, critical utilities, or in-service pavements without mitigation and/or vibration and settlement monitoring specifications.

12. Loads Applied to Piles

Piles are to be designed for compression, shear, and/or moment loads only. Piles are not to be designed for tension loads unless approved by the MDOT Geotechnical Services Section. (10-28-2019)

7.03.09 (continued)

B. Pile Capacity

In general, the specified capacity shown on the plans and used in the substructure design should be 60 tons. In some cases, the soil profile will indicate that a higher or lower specified capacity would be more economical. The recommendation from the Geotechnical Services Section will indicate what pile capacity to use. (2-26-2018)

1. Steel H Piles

The maximum design load on steel H piles shall not exceed the following:

HP 8x36	45 tons
HP 10x42	55 tons
HP 12x53	70 tons
HP 14x73	95 tons

2. Cast-in-Place Concrete Piles

The maximum design load on cast-in-place concrete piles shall not exceed the following:

10 ³ / ₄ " O.D.	45 tons
12" O.D.	65 tons
12 ³ / ₄ " O.D.	75 tons
14" O.D.	90 tons

Use steel H-Piles meeting the requirements of AASHTO M270 Grade 50. Use metal shell piles for CIP piles meeting the requirements of ASTM A252 Grade 3 (45 ksi) or Grade 3 Modified (50 ksi). (5-24-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.09 (continued)

Piles

C. Pile Quantities

1. Cast-in-Place Concrete Piles

The following items shall be shown on the plans:

- a. Length of each pile - Furnished and Driven.*
- b. Total length of piles - Furnished and Driven.
- c. Test piles - Each (Furnished and Driven length plus 10').*
- d. Number of pile points - Each. (Use when a special pile point is required.)
- e. Furnishing equipment for driving piles - Lump sum.

*Length to the nearest 5'. (5-6-99)

2. Steel H Piles

Use the same items as cast-in-place concrete piles except exclude pile points.

3. Piles of Designated Capacity

Use the same items as cast-in-place concrete piles except exclude pile points and pile splices.

7.03.10

Slope Treatment Under End Spans

A. Type

1. New Bridges

On all new grade separations, "Slope Paving, Conc" is to be placed under the end spans on the berm and backslope to the bottom of ditch.
(5-6-1999) (9-27-2021)

2. Widening Projects

On widening projects, match existing slope protection if the material is reasonably available.

If pier widening is located within the clear zone shielding (or filler walls) with guard rail is required. (11-28-2011)

3. Stream or River Bridges (5-6-99)

The Hydraulics/Hydrology Unit will specify riprap to be used as a scour countermeasure. A special provision for well-graded riprap for foundations shall be included in the proposals of projects where there is either pressure flow or velocities exceeding 7 feet per second. See Subsection 8.05 for hydraulic analysis and design guides for approved methods of stream diversion.

B. Dual Structures

For dual structures on a common abutment, call for slope protection on the slope and berm between the structures.

C. Limits

The slope protection is to be extended 1'-6" beyond the slab fascias or for structures with turnback wing walls, it should extend to outside face of the wingwalls.

Generally, riprap is to be placed on all disturbed slopes to an elevation of 2'-0" above extreme high water. Under the deck riprap shall extend to the face of the abutment.

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7.03.11

Concrete Sealers (5-1-2000)

When substructure units are new or patched; the entire surface of the substructure unit shall be coated (sealed) to prevent deterioration.

The following materials are used as sealers or waterproofing agents:

A. Elastomeric Sealers

These materials are a rubberized coating. Besides sealing, they create a uniform color and texture making them a good aesthetic treatment. Use Elastomeric sealers on all substructure surfaces where aesthetics are important. (Where aesthetics are an issue, consult the Roadside Development area for coloring considerations.) Use elastomeric sealers on patching projects to mask the mottled look of the patching.

B. Penetrating Waterproofing Sealers

Clear sealers with the consistency of water. Provide sufficient protection for vertical surfaces of substructure units but offer no aesthetic value. Use to seal substructure units where aesthetics are not important. Use on top surfaces only where the substructure unit is not under an expansion joint.

C. Epoxy Sealers

Opaque sealers offer a (nearly) impenetrable barrier. Use epoxy sealers to coat the top horizontal surface of pier caps and abutment bridge seats under expansion joints. (All top surfaces should be considered, even those not under joints.) This material should not be used to encapsulate the entire substructure unit as it does not "breathe" and can cause concrete degradation in such instances.

It is advisable to erect beams prior to coating horizontal surfaces. Areas underneath bridge bearings shall not be coated with elastomeric or epoxy sealers. Coating under bridge bearings with penetrating waterproofing sealers is allowed. (9-2-2003)

7.03.12

Mechanically Stabilized Earth (MSE) Wall Requirements (11-28-2011)

Design, construction and other considerations related to permanent and temporary MSE walls shall be according to Load and Resistance Factor Design (LRFD) method as defined by AASHTO and MDOT.

A. Wall Design Criteria:

1. The bridge designer and geotechnical engineer are responsible for providing the MSE fabricator with the following information:
 - a. Factored bearing resistance at the base of the reinforced soil mass.
 - b. Vertical dead and live loads, horizontal loads, and factored bearing pressure applied to the reinforced soil mass from the bridge.
2. The geotechnical engineer is responsible for performing a global stability analysis, estimating the factored bearing pressure, calculating factored bearing resistance, settlement analysis, checking sliding stability and overturning. Global stability must be checked for all stages of construction, including for temporary MSE walls that are utilized to permit part-width construction operations. (2-26-2018)
3. In addition, the engineer shall incorporate all design aspects of the special provision for MSE Retaining Wall System in the design for the MSE walls.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.12 (continued)

Mechanically Stabilized Earth (MSE) Wall Requirements

C. Bridge Abutments at MSE Walls

1. Pile supported abutments are required in most cases.
 - a. Maximize pile spacing to reduce interference with soil reinforcement.
 - b. Incorporate/consider pile bending in design (loose soil vs. stiff soil).
 - c. Use pile liner to eliminate downdrag between MSE wall backfill and abutment pile.
2. Spread footings may be allowed if either of the following conditions are met:
 - a. The MSE wall is on bedrock.
 - b. The bridge is single-span, not constructed part-width, and spread footings are recommended by the geotechnical unit.
3. Embed footings 1'-6" below the top of coping to allow a minimum of 6" clearance above the top of soil reinforcement. Four foot (4') minimum embedment is decreased due to free draining ability of Backfill, Select material required behind MSE walls.
4. The use of sliding slab abutments (BDG 6.20.03A) and integral/semi-integral abutments with a sleeper slab closer than 20' to the abutment (BDG 6.20.04 series) is allowed with a 20' concrete approach pavement as detailed on Standard Plan R - 43&45 - Series located on the road approach side of the sleeper slab.
(11-28-2011) (2-26-2018)

7.03.12 (continued)

D. Abutment Footing Clearances and Setbacks

1. The edge of pile supported footings shall be located with a minimum clearance of 2 feet from the back face of the MSE facing panels.
2. The edge of spread footings shall be located with a minimum clearance of 5 feet from the back face of the MSE facing panels.
3. The centerline of the front row of piles shall be setback 4.5 feet from the back face of the MSE facing panels.

E. Soil reinforcement length requirements

1. Soil reinforcement length is determined by design, but shall not be less than 0.7 times the wall height (H), or 8 feet whichever is greater.
2. The wall height (H) is to be measured from the proposed finished grade where it intersects the back of the wall face, to the top of the leveling pad.
3. For walls supporting a sloping surcharge, the value H1 shall be substituted for H in the above minimum requirements, where $H1 = H + (\tan \beta \times 0.3H) / (1 - 0.3 \tan \beta)$
 β = angle of backslope
4. For walls with abutments within 0.5 times the wall height, the height (H') of wall shall be measured from finished roadway surface to the top of the leveling pad. The value H' shall be substituted for H in the above minimum requirements.
(12-22-2011)
5. For any section of MSE wall, the soil reinforcement will be the same length from top to bottom.
6. Attaching soil reinforcement to substructure as a means to provide horizontal resistance/anchorage is not allowed.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.12 (continued)

Mechanically Stabilized Earth (MSE) Wall Requirements

F. Drainage around MSE walls

Consideration shall be given to drainage at design phase to decrease the possibility of issues at MSE wall construction.

1. A 30 mil thick PVC Liner (impervious membrane) is required between the roadbed and the soil reinforcement. It should be located a minimum of 8 inches above the soil reinforcement. The liner should extend 6 feet beyond the ends of the soil reinforcement. Extend liner transversely to 8 inches from slope line or return wall (if present). Place an underdrain 1 foot from the end of the PVC liner running transverse to the road and 1 foot from each end of liner running longitudinally along the roadway. Connect the underdrains and dispense drain 3 feet minimum from any soil reinforcement. (12-19-2016)
2. Foundation underdrains should be used, and located as low as possible to provide positive flow.
3. Curb and gutter at the edge of the roadway with a catch basin should be used to collect the drainage. Locate the catch basin a minimum of 25 feet past the end of the MSE wall reinforcement, if possible. The curb and gutter should continue 10 feet past the catch basin.

Other means to collect and dispense water may need to be used if the 4" maximum curb height on Standard Plan R-32 Series is insufficient. (11-25-2019)

See Section [7.07.02](#) for additional information

4. Use a minimum 20' concrete approach slabs (to reduce voids under approaches) for structures with MSE walls at the abutments. (11-23-2015)

7.03.12 (continued)

G. Utilities and MSE Walls

1. Avoid utilities through or underneath MSE walls.
2. If utilities cannot be avoided, encase the utility in a protective conduit that extends 10 feet beyond the limits of the Backfill, Select.
3. Pipe culverts through MSE walls should be avoided.
4. Water and sewer lines within 10 feet of an MSE wall should be encased.

H. Leveling Pad Dimensions:

1. Minimum length is 10 ft
2. Maximum height change for each step is 3 ft or ½ panel height

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.03.12 (continued)

Mechanically Stabilized Earth (MSE) Wall Requirements

I. Miscellaneous Requirements

1. Obstructions, such as footing piles, utilities, catch basins, etc. need to be shown on the plan, elevation, and section drawings for the MSE walls.
2. The limits of the Backfill, Select should extend 1 foot beyond the end of the straps at the bottom of the wall, and slope upward at a 45 degree angle.
3. The Plans should clearly identify the MSE wall horizontal alignment, top of coping elevations, proposed ground line in front of wall, limits of concrete surface coating, texturing notes, design height (H), PVC liner, foundation underdrains, areas where cast-in-place coping is required, moment slab/barrier details, utilities, appurtenances, obstructions to the soil reinforcement and notes from BDM [Chapter 8](#).
4. On return walls, keep the barrier inside of the MSE wall, not on top.
5. The water table must be considered by the geotechnical engineer during his/her investigation. Fluctuations in the water table must be accounted for in the investigation and must also be specified on the Plans (i.e. 100 year flood even should be labeled on the plans).
6. Terminate woven wire fence (Standard Plan R-102-Series) against the side of the wall opposite the stabilized earth, PVC liner and the soil reinforcement. Do not drive fence posts in mechanically stabilized earth. Detail fence termination on plans. (3/29/2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.03.13

Drilled Shafts (3-26-2018)

Due to relative ease of construction and economy, driven piles are generally preferred for most deep bridge foundations. For unique structures with high vertical or lateral loads, limited footprint, or at sites with deep scour, shallow rock or hardpan, or where foundations are to be built adjacent to vibration sensitive structures, drilled shaft foundations may be appropriate. Drilled shafts are most ideal for sites where short, permanently cased shafts can be socketed into rock or hard pan.

Feasibility of drilled shafts for bridge foundations is subject to the approval of the MDOT Foundation Analysis Engineer. Guidelines used for feasibility evaluation follow:

- A.** Avoid use of drilled shafts if soil boring logs indicate the presence of gas pockets, artesian/confined aquifers, or nested cobbles/boulders.
- B.** Shafts up to 50 feet in length, bearing in hard pan or rock, are acceptable. Longer shafts are difficult to case and should be avoided with one possible exception; that being sites where deep lacustrine clay overlies hardpan or rock.
- C.** Due to increased construction risk, avoid uncased shafts in the drift. Permanent casing, sealed into the competent strata below the drift, is the preferred construction scenario. Temporary cased or uncased designs will be evaluated based on the merits of the site and typical contractor tooling.

7.03.13 (continued)

- D.** In the absence of a site specific load test program, shafts must be sized such that the full factored geotechnical resistance, is derived from either shaft resistance or end resistance.
- 1.** Friction shafts must develop the full factored vertical side resistance in hardpan and/or rock.
- 2.** End-bearing shafts must be sized such that the full factored vertical resistance is derived from end- bearing on rock or hard pan.
- E.** Belled drilled shafts are prohibited.
- F.** Drilled shafts in gas bearing formations are prohibited.
- G.** Drilled shafts are to be designed for compression, shear, torsion, and/or moment loads only. Drilled shafts are not to be designed for tension loads unless approved by the MDOT Geotechnical Services Section. (10-28-2019)

Contact MDOT's Geotechnical Services Section with questions.

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7.04

REINFORCEMENT

7.04.01

Steel Reinforcement (11-28-2011)

A. Epoxy-Coated Reinforcement (5-6-99)

All reinforcement above footings shall be epoxy coated. This includes, but is not limited to, abutment walls, return walls, curtainwalls, pier columns, pier crash walls and backwalls.

B. Steel Reinforcement at Joints

Steel reinforcement is to extend through construction joints and stop at expansion joints.

C. Allowable Length

Generally, bar lengths should be limited to 50'-0" but may be increased to 60'-0" to avoid excessive lapping. These lengths are based on transportation charges.

Normally, #3 reinforcement is not available in lengths greater than 40'-0". Therefore, unless unusual conditions warrant an exception, the maximum length of #3 bars shown on the plans should be 40'-0". (8-6-92)

D. Fabricating Tolerance

The permissible tolerance for cutting reinforcing bars to length is 1". The bars should be made long enough to ensure that the minimum lap and proper edge distance is provided in case the bars are cut 1" short of the plan dimension.

The permissible tolerance for fabricating the "B" bars in pier columns is 1". The bars should be detailed with a gap between the bottom of bars and the top of footing in case the bars are fabricated 1" longer than shown on the plans.

7.04.01 (continued)

E. Wall or Column Vertical Steel Reinforcement (5-6-99)

In order to facilitate placing and supporting long reinforcing bars that are anchored in footings, splices in vertical reinforcement should be provided. Short dowels can be used for wall front reinforcement, with laps just above the footings.

Laps for reinforcement in back of walls or in columns should be at least 4'-0" or 5'-0" above top of footing so as not to be in the area of maximum stress. Laps should not normally be provided for bars that do not extend to full height of wall or pour.

Where walls or columns are of such height as to require horizontal construction joints, bar laps should be provided above these joints.

F. Bar Size Substitutions

When using Grade 60 reinforcing, the AASHTO specification for distribution of flexural reinforcement may require using small bars at close spacing. Therefore, it may not always be permissible to make a total area substitution with fewer larger bars.

G. Minimum Bar Size

To avoid handling damage, the minimum bar size shall be #4. An exception to this is the temperature steel in decks. These bars are to be #3.

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7.04.02

Stainless Steel Reinforcement (11-28-2011)

A. Criteria For Use

As an alternative to epoxy coated reinforcement, stainless-clad and solid stainless steel reinforcement should be selectively used in bridge deck construction. Designers will need to examine whether the additional expenditure is warranted for enhanced durability of the structure. The designer should consider use of stainless-clad and solid stainless reinforcement under one or more of the following circumstances.

1. The additional expenditure for stainless-clad and solid stainless reinforcement, including cost savings from reduced cover requirements, should be no more than eight percent of the programmed structure cost.
2. For structures on trunkline roads where future repair and maintenance would be very disruptive to traffic and where mobility analysis defines the project as significant and mitigation measures to minimize travel delay are needed (See Work Zone Safety and Mobility Policy).
3. Over navigable waterways or protected wetlands sensitive to environmental impact from construction activity.
4. Where the deck cross section is less than 9 inches, due to local geometric restrictions or in widening projects where the dead load is limited to the capacity of the existing substructure.
5. Bridges located over high volume railway lines where access and right of way restrictions exist.

7.04.02 (continued)

When using stainless-clad or solid stainless steel reinforcement for new bridge deck construction, the designer should consider using empirical deck design when that type of design reduces the amount of steel reinforcement.

Combine stainless-clad reinforcement with solid stainless reinforcement to optimize the material costs.

B. Cost

In estimating the cost of stainless-clad and solid stainless steel reinforcement, current prices should be obtained from suppliers. Stainless-clad and solid stainless steel reinforcement costs are more volatile and variable than for carbon steel and are sensitive to bar length, diameter and the waste when cutting from relatively short stock bars. Prices may vary significantly between suppliers.

C. Detailing and Availability

Stainless-clad and solid stainless steel reinforcement is similar to normal carbon steel reinforcement in the design, detailing and construction process. Use stainless-clad and solid stainless steel reinforcement in both reinforcement mats in the bridge deck, and in other locations as warranted. Dissimilar metals contact, whether with epoxy coated reinforcement, uncoated reinforcement, or galvanized steel, is not considered detrimental when embedded in concrete. The standard cover requirement of three inches can be reduced to two inches.

Stainless-clad reinforcement is available in standard U.S. customary sizes of #5 or greater, with maximum lengths of 40'-0", and available in Grade 60. Solid stainless steel reinforcement is available in all standard sizes and lengths, and available in both Grade 60 and Grade 75.

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7.05

PEDESTRIAN, ORNAMENTAL AND RAILROAD FENCING (8-6-92)

7.05.01

Electrical Grounding System

Pedestrian bridges, pedestrian screening and ornamental fencing (8'-0" or greater in overall height) are to be grounded as specified in the standard specifications. Details described in the specifications need not be shown on the plans.

7.05.02

Pedestrian Fence Fabric

Use 2" mesh size opening unless 1" opening is recommended by the Region. Mesh size opening of 1" is preferred on pedestrian fencing for structures in the Detroit metropolitan area and it should be noted on the plans. When 1" mesh size opening is proposed in close proximity to an intersection, consult with the Geometric Design Unit, Design Division, Bureau of Development, to evaluate potential conflict with intersection sight distance. For limits of the metropolitan area see [Appendix 12.01.01](#). (3-28-2022)

Six, eight or ten foot fence fabric is generally used to design pedestrian fencing for structures. Ten foot fabric is used for metal and post and tube railings. Six and eight foot fabric are used in combination with concrete railing to attain desired height. (3-28-2022)

7.05.03

Pedestrian Fence Posts

Posts for bridge fencing should be 2½" (2.875" O.D.) steel pipe. The steel type and maximum post spacing should be as shown below.

Maximum Unsupported Post Height	Mesh Size	Steel Type (ASTM)	Maximum Post Spacing
9'-0"	1"	F1043	8'-6"
9'-0"	2"	F1043	10'-0"
7'-0"	1"	F1083	8'-6"
7'-0"	2"	F1083	10'-0"

(10-24-2001)

7.05.04 (3-28-2022)

Pedestrian Fence Height

Fence is straight and 10 feet total height minimum when no pedestrian traffic is expected on a structure or when an existing sidewalk or brush block is less than 3'-0" in width. Type 6 & 7, 2 Tube, Aesthetic Parapet Tube flush mount (without sidewalk), 4 Tube with brush block, 3 Tube With Pickets with brush block, Concrete Block Retrofit and existing Type 4 & 5 fall into this category.

Fence is curved and 9 feet (+/-) total height when pedestrian traffic is expected on a structure or when an existing sidewalk or brush block is 3'-0" or greater in width. Aesthetic Parapet Tube with sidewalk, 4 Tube with sidewalk and 3 Tube With Pickets with sidewalk fall into this category.

Existing open parapet, existing solid parapet, existing R4, R5 and R9, existing 3 Tube or 5 Tube can use either straight or curved fence depending on sidewalk or brush block width (less than 3'-0" or 3'-0" or greater).

7.05.05 (3-28-2022)

Anti-Climb Shield

Place anti-climb shields with all pedestrian fencing to prevent climbing on the outside of the fence (over traffic or precipitous drop). Shields are generally located at the second or third vertical fence post from each end of the pedestrian fencing.

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7.05.06 (3-28-2022)

Ornamental Fencing Guidelines

Approval for structural adequacy for all proposed ornamental fence installations on MDOT bridges and bridge railings is required by MDOT's Bureau of Bridges and Structures (BOBS). Ornamental fences installed on new bridges and bridge railings must be designed according to the current edition of the AASHTO LRFD Bridge Design Specifications. Contact BOBS Chief Structure Design Engineer for questions concerning the design requirements for ornamental fences on MDOT bridge railings. Contact MDOT BOBS Bridge Construction Unit and Structural Fabrication Unit for questions related to the materials and construction of ornamental fences on MDOT bridges and bridge railings.

Contact MDOT's Geometric Design Unit, Design Division, Bureau of Development (BOD), for questions regarding the crashworthiness of proposed ornamental fence installations on MDOT bridge railings.

Do not attach ornamental fences to steel tube bridge railings (e.g., 2 Tube railing, 4 Tube railing, and 3 Tube With Pickets railing).

The use of ornamental fencing does not alleviate the need to protect the motoring and pedestrian traffic. Use pedestrian fence with fabric in addition to ornamental fences as described in this section and section [7.02.29](#). If pedestrian fence is not required, ornamental fence can be used on its own.

Include anti-climb shields with ornamental fencing, regardless of pedestrian fence with fabric use. Anti-climb shields can simulate ornamental fence or pedestrian fence.

When an entity other than MDOT requests an integration of ornamental fencing or other highway aesthetic elements within the MDOT right-of-way (ROW) they shall also follow the Highway Aesthetic Element Guidelines. Review of any structures integrating ornamental fencing should be routed through the BOBS Chief Structure Design Engineer.

7.05.06 (continued)

Unless proven crashworthy by full-scale crash testing, as determined by MDOT, under NCHRP 350 or MASH criteria and under the appropriate test level, the proposed ornamental fence and/or combined bridge railing and ornamental fence must meet the following requirements:

- A. Regardless of design speed, ornamental fences may be placed on bridge railings or bridge decks without the installation of additional barrier protection when located beyond the clear zone based on the design speed and average daily traffic at the proposed installation site.

See Bridge Design Guide [6.06.05](#) for Clear Zone chart.

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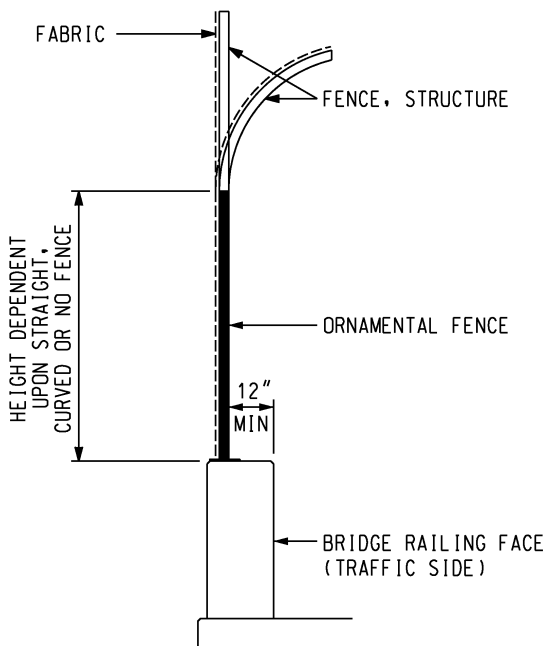
BRIDGE DESIGN

7.05.06 (continued)

B. On roadways with design speeds of 40 mph or less, ornamental fences on bridge railings and bridge decks located within the clear zone may be installed when meeting all of the following conditions:

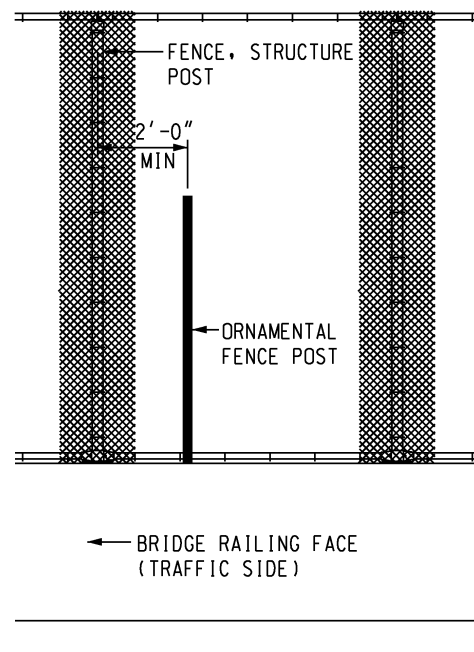
1. Fence is installed on top of or behind the bridge railing.
2. Fence is placed at least 12 inches from the top of the bridge railing face (i.e., the portion facing traffic).

Bridge rail widening and/or ornamental fence placement behind the bridge railing may be necessary to provide the 12 inch minimum offset from the ornamental fence to the bridge railing face.



7.05.06 (continued)

3. Locate fence posts between (2'-0" minimum laterally from) railing structural posts (Aesthetic Parapet Tube railing), not directly behind. When ornamental and pedestrian fence posts are both used on a railing, locate posts 2'-0" minimum laterally from one another.



4. Fence components that could become an occupant compartment intrusion threat, as determined by MDOT, are not allowed. Contact MDOT's Geometric Design Unit, Design Division, BOD, for questions.

Tapering the ends of ornamental fence components to minimize snagging potential is one way to alleviate occupant compartment intrusion.

- C.** On roadways with design speeds of 45 mph or greater, ornamental fences on bridge railing and bridge decks located within the clear zone may only be installed if an additional bridge railing or roadside barrier is installed between the traveled way and the ornamental fence.

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7.05.07 (3-28-2022)

Railroad Fencing and Splashboard

- A.** For railroad bridges over roadways or rivers, Region Project Development or Bridge Engineer will determine whether to provide bridge screening due to the presence of ballast and discarded rail spikes.
- B** For bridges over railroad grades, splashboards are placed on top of railings to prevent snow, ice, or other debris from being thrown onto the tracks and passing trains. The final height of the railing and splashboard must satisfy the railroad's requirements. The railroad may request the use of splashboards possibly in combination with fencing.

Contact the Railroad Grade Separations Engineer of MDOT Office of Rail to coordinate these and other design parameters with the railroad.

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7.06

RECONSTRUCTION PROJECTS

Include saw cut depth dimensions when removing portions of abutments, piers and columns on the plans. (11-28-2011)

7.06.01

Placement of Temporary Barrier (9-21-2015)

A. 26" or More Laterally Available

For widening jobs or part-width construction of a new bridge, when 26" or more laterally is available between the toe of a temporary barrier on the construction side and a precipitous drop-off, place standard temporary concrete barrier or temporary steel barrier meeting MDOT specifications near the drop-off. No special hardware or procedures are necessary. See Standard Plan R-126-Series.

B. Less Than 26" Laterally Available

When there is less than 26" laterally between the toe of the barrier on the construction side and the precipitous drop-off, place an appropriate limited deflection temporary barrier detail meeting the requirements of Standard Plan R-53-Series, or an approved alternative. Refer to Standard Plan R-126-Series for placement and to Standard Plan R-53-Series for additional information regarding limited deflection temporary barrier details.

For more definitive write-up and discussion of detailed placement options see Section [7.01.70](#) of Road Design Manual.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.06.02

Concrete Anchors (5-6-99)

A. Expansion Anchored Bolts

In addition to field testing, we will ensure sound anchorage by reducing the design loads. The values to be used will vary with the application as shown below:

PULLOUT VALUES OF EXPANSION ANCHORED BOLTS IN POUNDS						
Application	Approx. Safety Factor	$\frac{3}{8}"$	$\frac{1}{2}"$	$\frac{5}{8}"$	$\frac{3}{4}"$	$\frac{7}{8}"$
Noncritical Design Loads (Including noncritical, static or shock loads)	4	875	1,620	2,565	3,775	5,240
Vibratory Loads (e.g., Sign Supports)	12	290	540	855	1,260	1,755

Design details should always call for two or more anchors for redundancy.

B. Bonded Anchors (Adhesive and Grout Anchors)

All bonded anchors shall be detailed for embedment depth on the contract plans. For A307 bolts the embedment depth shall be taken as "9d" (9 times the nominal bolt diameter). For Grade 60(ksi) reinforcing steel the embedment depth shall be taken as "12d" (12 times the bar diameter). (5-1-2000)

In addition to field testing, we will ensure sound anchorage by reducing the design loads. For all applications a safety factor of 4 should be applied to 125% of the threaded rod/reinforcements yield strength to obtain the allowable design tensile load on the anchor. The allowable tensile load shall be computed per:

Allowable tensile load = $(125\% f_y A_T)/4$
 A_T = tensile stress area
 = net section through threads
 (for reinforcing steel use nominal area)

(1-29-2018)

C. Allowable Shear for Post Installed Concrete Anchors (Expansion and Bonded Anchors) (per AASHTO Table 10.32.3A)

Allowable Shear = $0.30 f_y A_T$
 A_T = tensile stress area
 = net section through threads
 (for reinforcing steel use nominal area)

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7.06.03

Substructure Protection

Where we are reconstructing an existing substructure unit; i.e., capping or extending it, and there is a transverse joint in the superstructure directly above, the entire top existing and proposed, and all other existing faces of the unit shall be coated with penetrating water repellent treatment or another concrete surface sealer. See Section [7.03.11](#).

7.06.04

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

For additional information on temporary supports see Subsection [7.01.10](#).

A. Construction Methods

The choice of method can best be made during an on-site inspection, preferably the Scope Verification or Plan Review, where Region/TSC personnel can offer opinions. (5-6-99)

1. Temporary Support From Below Using Column and Footing Arrangement
 - a. Does not require lane closure above; i.e., traffic over work area.
 - b. May require lane closure below depending on location of suspender.
2. Temporary Support From Above Using Multiple or Single Beam Suspension Arrangement
 - a. Requires lane closure above.
 - b. May require lane closure below because of underclearance restrictions.
 - c. Joint replacement at expansion end and removal of portions of deck at fixed end will probably be required for multiple beam suspension.

7.06.04 (continued)

- B. Preliminary Investigation for Temporary Support From Below
 1. Request Borings and Allowable Soil Pressures from Geotechnical Services Section. (2-26-2018)
 - a. Consideration should be given to possible differential settlement below temporary support footing.
 - b. Borings are not required if footing is placed on paved surface. Assume a bearing pressure of 17 psi. (5-6-99)
 2. Determine Utility Locations

Underground utilities may be damaged by settlement of temporary support footing pressure.
 3. Determine Obstructions of Temporary Support Footing

Consider pier location and skew.
 4. Read Current Specifications for This Type of Work Prior to Starting Design.
- C. Design of Temporary Support From Below (see [Appendix 7.06.04](#) for nomenclature):
 1. Loading
 - a. Use 1.25 (DL+LL+I) for column, column base plate, and jack base plate design.
 - b. Use 1.0 (DL+LL+I) for channel shim and jack bearing plate design.
 - c. Use 1.25 (DL+LL) for footing design (timber and concrete).
 - d. Use 1.25 (DL+LL+I) for hydraulic jack capacity.

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BRIDGE DESIGN

7.06.04 (continued)

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

2. Materials (5-6-99)

- a. Use AASHTO M270 steel,
 $f_y = 36,000$ psi. (Do not mix steel types used for temporary support.)
- b. Use Concrete Grade 3500,
 $f'_c = 3000$ psi. (6-28-2021)
- c. Use Structural Grade Timber,
 $F_b = 1200$ psi.
 F_v (horiz.) = 100 psi.

3. Column Design

- a. Size for axial load plus bending in both perpendicular directions.
- b. Use 0.1 x flange width and 0.1 x beam depth rounded up to nearest $\frac{1}{2}$ " for assumed eccentricity.
- c. Use pinned-pinned end condition (restraint at base plate small). Effective length factor, $K = 1.0$.
- d. Check lateral loading on column from thermal movement of bridge. Use 75°F temperature variation. Combine thermal load with (DL+LL+I).

4. Column Base Plate Design

- a. Avoid use of stiffeners (high welding cost).
- b. Size for axial load plus bending. Use eccentricity assumed in column design.
- c. Do not attach base plate to footing.
- d. Use $F_b = 0.75 F_y$.

7.06.04 (continued)

5. Jack Base Plate Design

- a. Design as plate fixed on three sides, free on one side. (See Young, W.C., Roark's Formulas for Stress and Strain, pg. 469. Available in MDOT Library. See [Appendix 7.06.04](#) for excerpt.) (5-6-99)
- b. Use equivalent rectangular uniform load from jack bearing area.
- c. For uniform load 2/3 of plate width, use $f_b = 60 q/t^2$ (see item a above, q = load per unit area in psi and t = plate thickness in inches).
- d. For uniform load 1/3 of plate width, use $f_b = 17 q/t^2$ (see item a above, q = load per unit area).
- e. Linear interpolate for uniform load between 1/3 and 2/3 of plate width.
- f. Use $F_b = 0.75 F_y$ in psi.
- g. Weld to column.

6. Channel Shims Design (two per support)

- a. Size for axial load plus bending perpendicular to web.
- b. Use 0.1 x flange width rounded up to nearest $\frac{1}{8}$ " for assumed eccentricity.
- c. Weld to jack base plate.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.06.04 (continued)

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

7. Jack Bearing Plate Design

- a. Size for bending about centerline existing girder or beam web.
- b. Use load on channel shims for bending calculations.
- c. Use $F_b = 0.75 F_y$.

8. Hydraulic Jack Capacity

- a. Specify minimum jack capacity required (based on axial load only).

9. Timber Footing Design

- a. Use double mat (minimum) with square or rectangular timbers.
- b. Size for axial load plus bending. Use eccentricity assumed in column design. Use allowable soil pressure from Geotechnical Services Section. On a paved surface assume a bearing pressure of 17 psi. (5-6-99) (2-26-2018)
- c. Check flexure and horizontal shear. Allow 25 percent overstress to account for short duration of loading.
- d. Column base plate full width across top mat.
- e. Top mat full width across bottom mat.
- f. Specify channels lag-bolted to timbers across top of both mats, each end (lag-bolt to each timber).

7.06.04 (continued)

10. Concrete Footing Design

- a. Use bottom mat steel reinforcement only, both directions.
- b. Size for axial load plus bending. Use eccentricity assumed in column design. Use allowable soil pressure from Geotechnical Services Section. (2-26-2018)
- c. Check flexure, beam (one way) shear and slab (punching) shear.
- d. Specify concrete to be stenciled with "top" on side opposite steel reinforcement. Stencil "bottom" as required.

11. Footing Placed on Soil

- a. Specify compaction of original ground to not less than 95 percent of its maximum unit weight to a depth of 9" and to 1'-6" outside footing outline.
- b. Specify Structure Embankment (CIP), if required, to 1'-6" outside footing outline.
- c. Specify level under footing.
- d. Specify Granular Material Class III, compacted to not less than 95 percent of its maximum unit weight, to 1'-6" outside footing outline for leveling.
- e. Specify 1V:1H slope down to natural ground for all required fill material.

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BRIDGE DESIGN

7.06.04 (continued)

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

12. Footing Placed on Pavement or Paved Shoulder

- a. Specify level under footing.
- b. Specify 21AA aggregate, asphaltic cold patch material, or approved equal to 1'-6" outside footing outline for leveling.
- c. Specify 1V:1H slope down to pavement for required fill material.

13. Placement of Temporary Support

- a. Centerline temporary support under area where pin plate exists.
- b. Centerline temporary support under stiffener, if possible.
- c. Show location on plans.

14. Shop Drawing Review (3-26-2018)

- a. Send temporary support shop drawings to MDOT Structural Fabrication Unit for review.
- b. Check all weld sizes and member sizes against plan requirements.

15. Maintaining Traffic

- a. Temporary supports must be completely shielded from traffic.
- b. Place temporary concrete barrier in area of temporary support in all cases (both sides if narrow median).

7.06.04 (continued)

16. Hanger Assembly Removal Sequence

- a. Minimize risks in case of support failure or excessive settlement.
- b. Adjacent beam suspender operational.
- c. Opposite end suspender operational.

D. Checks on Existing Girder or Beam, Temporary Support From Below

1. Loads: Use design axial load of column for checks.

2. Web Checks

- a. Web buckling - distribute load on 45° from edge of jack bearing plate (effective length factor, $K = 1.0$).
- b. Web crippling.
- c. Specify bolted stiffener, if required, bearing against bottom flange.

3. Diaphragm Clearance

- a. On sharply skewed bridges, determine if diaphragm needs to be cut to allow placement of new pin (note on plans if cutting is required).
- b. Determine if repair of cut diaphragm is required. Use field bolted cover plate if repair is necessary.

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BRIDGE DESIGN

7.06.04 (continued)

Hanger Assembly Replacement and Temporary Support Guidelines for Redundant Bridges

E. Design of Temporary Support From Above

1. Consideration should be given to providing redundancy in temporary support. Avoid nonredundant schemes if possible.
2. Multiple Beam Support Loading
Use $1.25 \text{ DL} + 2.0 (\text{LL} + \text{I})$ maximum.
3. Single Beam Support Loading
Use $1.25 (\text{DL} + \text{LL} + \text{I})$.
4. Materials (5-6-99)
Use AASHTO M270 steel,
 $F_y = 36,000 \text{ psi}$.
(Do not mix steel types used for temporary support if the pieces are to be joined by welding.)
5. Hanger Assembly Removal Sequence
 - a. Minimize risks in case of temporary support failure.
 - b. Adjacent beam suspender operational.
 - c. Opposite end suspender operational.
 - d. Maintaining traffic may demand deviation from items b and c.

F. Checks on Existing Beam or Girder, Temporary Support From Above

1. See Article D for required checks to be made.

7.06.04 (continued)

G. Hanger Assembly Plan Dimensions and Field Measurements

1. Dimensions on Plans
 - a. Pins - give diameter and length.
 - b. Link plate - give length, width, thickness and C-C pins.
 - c. Other details and dimensions shown on Bridge Design Guides [8.14.02](#), [8.15.01](#) and [8.15.01A](#). Specify stainless steel washers and cotterpins.
 - d. If existing suspender must be shown on the detail sheets, this detail shall be shown accurately.
2. Field Measurements
 - a. If field measurements differ from plan dimensions, correct shop drawings to reflect actual dimensions.
 - b. Use average C-C pin distance for specific hanger locations where one side is different from the other.
 - c. Increase pin length to account for girder or beam offset, if required. Select longest length required and use for all pins.
3. Shop Drawing Review (3-26-2018)
 - a. Send suspender assembly shop drawings to MDOT Structural Fabrication Unit, for review.

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BRIDGE DESIGN

7.07

APPROACH ITEMS

7.07.01

Guardrail

All new guardrail anchorages to bridges will utilize three beam guardrail according to Standard Plan R-67-Series and will be anchored directly to the bridge railing or pier filler walls. (5-6-99)

Where there are independent backwalls, that is, where there will be thermal deck movement at the abutments, the movement will be accommodated by the slots in the expansion section of the guardrail anchorage.

For additional information see Road Design Manual Section [7.01.16](#).

7.07.02

Curb and Gutter for Rural Bridges

The types and lengths of bridge approach curb and gutters (including valley gutter, where required) shall be determined by the bridge designer and shown on the General Plan of Structure Sheet.

A. Bridge approach curb and gutter will be according to Standard Plan R-32-Series **with a 4" maximum curb height**. It should be emphasized that this criteria is only a guide and that the designer should use engineering judgement in determining the type of structure to use.

1. Bridge Approach Curb and Gutter, Detail 5 will be used on the high end of a bridge where the bridge drains away from the curb and gutter or on departing end of bridges when guardrail is not needed.
2. Bridge Approach Curb and Gutter, Detail 6 and 6A will be used on the low ends of a bridge where the paved area draining to the curb and gutter is less than 2,500 SFT and the fill height is less than 10'-0". Where the drainage area exceeds 2,500 SFT, use Detail 7. (5-6-99)

7.07.02 (continued)

3. Bridge Approach Curb and Gutter, Detail 7 and 7A will be used on the low ends of a bridge where the fill height is over 10'-0". One downspout header shall be provided for each 3500 SFT of paved drainage area or fraction thereof. If it is not readily apparent whether to use Detail 6 or Detail 7, use Detail 7. (5-6-99)

If the bridge railing is other than the standard shape, the approach curb and gutter should be modified or transitioned to fit the bridge curb.

- C. Payment for all types of bridge approach curb and gutter will be included in the pay item "Curb and Gutter, Bridge Approach". The quantities shall be included in the Road Plans when bridge and road work is "packaged" together. (5-6-99)

For additional information see Road Design Manual Section [6.06.08](#) and MDOT Drainage Manual. (11-25-2019)

7.07.03 (5-6-99)

Bridge Approach Pavement

To eliminate approach pavement settlement, a concrete approach section will be used for all new bridges and bridge replacements, deck and superstructure replacement projects and concrete overlays. For hot mix asphalt (HMA) deck overlays, a concrete approach section is not necessary. The details of the approach slab shall be as specified on Standard Plan R-45-Series except on existing structures, where the grade will not be raised; the length of the approach slab shall match the existing slab joint. (9-2-2003)

Use approach pavements for integral and semi-integral abutment designs according to [Bridge Design Guide 6.20.04 Series](#).

Use approach pavements for sliding slab over backwall designs according to [Bridge Design Guides 6.20.03 Series](#). (1-24-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.08 (5-6-99)

UTILITY ITEMS

7.08.01

General (11-28-2011)

For additional information regarding utilities
see:

[Chapter 9](#) of the Road Design Manual

MDOT Real Estate Division's
Utility Coordination Manual
(Real Estate UCM)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.08.02

Plan Distribution Process for Utility Coordination (11-28-2011)

A. Request for Utility Information

General

This process outlines the responsibilities and procedures for gathering utility information early in a project's design phase. Gathering utility information typically occurs after the project scope verification has been completed. For this procedure, utility is defined as any type of private, public, municipal, or county drain commission facility that is within or near the limits of the proposed construction project.

Capital preventive maintenance and pavement parking projects are examples of projects that do not require plan distribution to utilities. The project must not include any guardrail work or any work beyond the outside edge of the shoulder, or require any excavation, trenching, boring, etc., into the aggregate base or subbase material. The Project Manager (PM) shall evaluate each project and use discretion on whether plans need to be distributed for utility coordination.

Subsurface Utility Engineering (SUE) projects that use a consultant to provide the underground utility information may not need to follow this entire procedure. The PM may need to coordinate this request for utility information with the SUE vender.

7.08.02 (continued)

Procedure

Project Manager

1. Contact the TSC Utility Coordinator to request Letter Requesting Utility Information at Base Plan Stage, (MDOT Form 2480). Provide the following information:

- Project Location
- Scope of Work
- Control Section(s)
- Job Number(s)
- Proposed Plan Completion Date
- Consultant Information, if applicable

Note: When project information exceeds the allowed space on Form 2480 an additional document shall be supplied by the PM detailing this information. The applicable field(s) on Form 2480 shall state "see attached sheet" when this occurs

TSC Utility Coordinator

2. Receive request for Form 2480 letters from the PM.
3. Generate Form 2480 letters, for all applicable utilities within the project limits, using the Utility Relocation Tracking System (URTS).

Note: Form 2480 shall include a "Please respond by" date. It is recommended the "Please respond by" date be no earlier than 30 days after the date of the letter.

4. Generate the standard Cover Letter using URTS. The Cover Letter contains all applicable utility names, contacts, addresses and the number of plan sets requested.
5. Provide the Cover Letter and all Form 2480 letters to the PM within 7 working days of receiving the request for Form 2480 letters.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.08.02 (continued)

A. Request for Utility Information

Procedure

Project Manager

6. Receive the Cover Letter and all Form 2480 letters from the TSC Utility Coordinator.
7. Review and sign Form 2480 letters.
8. Send Form 2480 letters and plans to the utilities with courtesy copies to TSC Utility Coordinator:

Note: Old plans, Right-of-Way maps, or MDOT Construction Base Plans are acceptable for sending to the utilities. The plans must provide the project's location and limits of work. Vicinity maps may be included for general information, but shall not be used as the sole project plans as they provide inadequate information for the utilities to plot their facilities. This includes log jobs that may affect a utility.

7.08.02 (continued)

TSC Utility Coordinator

9. Receive a courtesy copy of all signed Form 2480 letters and plans from the PM.
10. Receive Request for Utility Information – Return Form, (Form 2480) and plans from utilities.

11. Evaluate returned Form 2480 and plans from the utilities.

Note: If it is determined that the information received from a utility is not useful, the TSC Utility Coordinator shall contact the utility for additional information.

12. Forward returned Form 2480 and plans to the PM.

13. Follow-up with non-responsive utilities.

Notes: One method used to follow-up with non-responsive utilities is to send a second request for utility information letter. See the Request for Utility Information Follow-Up Example.

14. Contact PM with the status of utility responses within two weeks of the "Please respond by" date on Form 2480.

Project Manager

15. Receive returned Form 2480 and plans from the TSC Utility Coordinator.
16. Plot all utility facilities on the MDOT Construction Preliminary Plans.
17. Follow Preliminary Plan Distribution (MDOT Forms 2481 & 2482), (Real Estate UCM Procedure 1802.02) for sending preliminary plans to utilities.

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.08.02 (continued)

B. Preliminary Plan Distribution

General

Preliminary plan distribution to utilities shall be completed whether or not utility conflicts have been identified. It is important to provide preliminary plans because it allows the utilities an opportunity to review the proposed project, to ensure facilities are plotted accurately, and provides notification to relocate facilities in conflict.

Distribution of preliminary plans takes place after Request for Utility Information (Form 2480) (Real Estate UCM Procedure 1802.01), is complete. It typically occurs during the design process after the Plan Review Meeting and before the Omissions and Errors Check (OEC) Meeting.

The preferred method for preliminary plan distribution is to send separate letters to public/private and municipal utilities that address the following:

- The Letter to Public/Private Utilities at Preliminary Plan Stage, (Form 2481) includes the following:
 - References Highway Obstructions and Encroachments; Use of Highway by Public Utilities, Public Act (PA) 368 of 1925
 - Gives legal notification to relocate
 - Authorizes preliminary engineering
- The Letter to Municipal Utilities at Preliminary Plan Stage, (Form 2482) is used because MDOT may be responsible for the relocation costs associated with municipal utility relocations within their corporate limits. This may require MDOT to complete the following:
 - Perform the relocation design
 - Include relocation work in the project plans
 - Formalize an agreement

If Forms 2481 and 2482 are not sent to the utilities, the Utility Coordination Meeting Invitation letter must cite PA 368, authorize preliminary engineering, provide relocation reimbursement information, and be accompanied by preliminary plans. See Utility Coordination Meeting, (Real Estate UCM Procedure 1802.05)

Procedure

TSC Utility Coordinator

1. Ensure all utility facilities have been plotted on the preliminary plans in accordance with Real Estate UCM Procedure 1802.01.
 2. Determine if the project has potential utility conflicts. This may include discussion with the Project Manager.
 3. Send preliminary plans to the utilities with one of the following:
 - Utility Coordination Meeting Invitation letter citing PA 368, authorizing preliminary engineering, and providing relocation reimbursement information. See Utility Coordination Meeting Invitation with PA 368 Info Example, (Real Estate UCM Exhibit 1802.05a).
 - Forms 2481 and/or 2482
- Note: If a Utility Coordination Meeting is deemed necessary at a later date the Utility Coordination Meeting Invitation letter will not require citing PA 368, authorizing preliminary engineering, and providing relocation reimbursement information. See Utility Coordination Meeting Invitation, (Real Estate UCM Exhibit 1802.05b).
4. Conduct the Utility Coordination Meeting, if necessary. See Real Estate UCM Procedure 1802.05.

Note: It is desirable to schedule the utility coordination meeting after the Plan Review Meeting and before the Omissions and Errors Check (OEC) Meeting.

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

7.08.03

Including Utility Work in Contracts (11-28-2011)

The Utilities Coordination & Permits Section of Real Estate established a procedure for billing utility companies for expenses incurred as part of a construction project. The Designer should be aware of this procedure as it includes information on which items may be reimbursable.

A. General

Utility companies occupying trunkline right-of-way by virtue of Act 368, P.A. 1925, and the Michigan Department of Transportation's Utility Accommodation Policy are subject to relocating their facilities at their expense if a conflict exists due to a Department project. If during the preliminary design and utility coordination meetings it is determined that the Department can make adjustments to its plans which would allow either the utility company's facilities to remain in place or reduce their relocation cost, efforts should be made to do so if the overall Department project is not affected. If the utility company is located in MDOT right-of-way by permit, costs incurred by the Department to revise its plans in order to accommodate a utility company are billable to that utility company. Such adjustments will require coordination and concurrence with the Utilities Coordination and Permits Section of Real Estate.

Utility companies with facilities that have manholes within the roadway are responsible for adjusting these manholes if required by the project. Most utility companies will adjust their own manholes during the course of the project which will require a Notice to Bidders Utility Coordination in the proposal. However, provisions may be made at the utility company's request to include adjustment of their manholes in the work items of the project. Including manhole adjustments or any other utility work or project re-design costs, will be charged to the utility as per the procedure outlined in Section [7.08.02 B](#).

7.08.03 (continued)

Municipal utilities shall not be charged any relocation costs due to project conflicts within their corporate limits except as provided for in the water main relocation policy. (See Road Design Manual Section [9.02.01B](#)) If they are operating outside their corporate limits, relocation costs would be at their expense and any chargeable project expenses are to be administered through the Governmental Coordination Engineer.

The Governmental Coordination Engineer is to be contacted if a project involves relocation of municipal utilities or chargeable expenses are incurred and the municipal utility is operating outside the corporate limits of the municipality.

An agreement shall be required in the event chargeable expenses are involved.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.08.03 (continued)

B. Procedures

This procedure shall be used when work on behalf of a non-municipal utility is to be performed by MDOT contractor during construction. Upon a mutual agreement between a utility and MDOT, work items are incorporated in MDOT road and/or bridge construction projects and charged to the utility.

Note: Municipal utility work shall be coordinated with the MDOT Design, Municipal Utility Section. See Municipal Utility Relocation, (Real Estate UCM Procedure 1802.03).

Example Work Items

Example work items that may be chargeable to a utility through this process include adjustment of utility manholes, existing facility removals, supporting utility poles, and utility bridge attachments.

Project Manager / TSC Utility Coordinator

1. Convene a meeting with the TSC Utility Coordinator, Project Manager (PM), and each utility to determine whether any work on behalf of the utility shall be included in the project. The following utility coordination issues shall be discussed:

- Proposed construction schedule
- Type of work required
- Plan Completion Date

7.08.03 (continued)

Project Manager

2. Ensure the agreed upon utility work is included in the plans and appropriate contract documents.
3. Complete Utility Charge Estimate, (Form 223). See Utility Charge Estimate, (Form 223) Sample, (Real Estate UCM Exhibit 1802.06a).

Note: When the total estimated cost of the utility work is less than \$1,000, MDOT shall not charge the utility. MDOT shall incorporate the utility work into the project at no cost to the utility. If a pay item(s) is not federally participating, it shall be funded 100% by MDOT.

4. Send Form 223 to TSC Utility Coordinator if the total estimated cost of the utility work is greater than \$1,000 and less than \$100,000. The appropriate plan sheets that indicate or illustrate that the utility work has been included in the project shall also be sent, if available.

Note: For costs greater than \$100,000, an individual agreement shall be required. The PM shall contact MDOT Design's Agreements Section to initiate this request.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.08.03 (continued)

B. Procedures

TSC Utility Coordinator

5. Receive Form 223 and plan sheets from the PM.
6. Schedule and conduct a meeting with utility to review plans prior to acceptance, if necessary.
7. Prepare the Utility Approval Letter. See Utility Charge Estimate, (Form 223) Utility Approval Letter Example, (Real Estate UCM Exhibit 1802.06c).
8. Send Form 223 and the Utility Approval Letter to the utility for review and approval. Courtesy copies shall be sent to the Central Office Utility Coordination and Permits Section.
9. Receive signed copy of Form 223 from the utility.
10. Notify the utility to perform any necessary relocation work prior to construction if either:
 - Utility work is not included in the MDOT contract
 - Utility does not approve the estimated

Note: If relocation is not possible prior to construction and the utility chooses to do the work themselves, complete a Notice to Bidders – Utility Coordination document for the project.

11. Send copy of signed Form 223 to the PM and Central Office Utility Coordination and Permits Section.

7.08.03 (continued)

Central Office Utility Coordination and Permits

12. Receive copy of signed Form 223 from the TSC Utility Coordinator.
13. Establish a file and add Form 223 information to the statewide tracking spreadsheet.
14. Send copy of signed Form 223 to MDOT Financial Operations, Project Accounting Unit.

MDOT Financial Operations, Project Accounting Unit

15. Receive copy of approved Form 223 from Central Office Utility Coordination and Permits Section.
16. Input estimate information into MDOT Financial Operations, Project Accounting Unit (PAU) Utility Database.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

7.08.03 (continued)

B. Procedures

Project Manager

17. Receive copy of approved Form 223 or notification of utility denial from TSC Utility Coordinator.
18. Develop a special provision that covers all work for the utility. See Special Provision for Utility Coordination and Utility Work Sample, (Real Estate UCM Exhibit 1802.06b). The pay item shall be established as a lump sum pay item, with an established maximum based on the line titled as "Maximum Contract Bid Amount (125% of Subtotal)" from Form 223.

Note: The maximum contract bid amount is not the "Total Maximum Charge to the Utility."

Note: Lump sum pay item(s) for utility work are the preferred method. However, per unit pay item(s) can be considered for items of work that are not suitable as lump sum.
19. Establish a separate non-federally participating category in AP Preconstruction for each utility. (3-26-2018)
20. Ensure JobNet reflects the utility funding, (3-26-2018)

7.08.03 (continued)

MDOT Financial Operations, Project Accounting Unit

21. Run report from AP Preconstruction monthly to determine what projects have been awarded. (3-26-2018)
 22. Review awarded contracts to:
 - Verify signed copy of Form 0223 has been received
 - Ensure amounts are comparable to approved Form 0223
 - Ensure utility funding is established in JobNet (3-26-2018)
 23. Update the PAU Utility Database monthly with current cost-to-date information on all projects that have been awarded.
 24. Invoice utility throughout duration of construction for contract cost-to-date plus prorated actual preliminary (PE) and construction engineering (CE) on approved utility pay items.
 25. Send courtesy copy of utility invoice to Central Office Utility Coordination and Permits Section.
- #### **Central Office Utility Coordination and Permits**
26. Receive copy of utility invoice from MDOT Financial Operations, Project Accounting Unit.
 27. File the utility invoice with the utility signed Form 223.
 28. Contact MDOT Financial Operations, Project Accounting Unit to discuss:
 - Paid and unpaid invoices
 - Contract Modifications for utility pay items
 - Projects that do not have utility approved Form 223

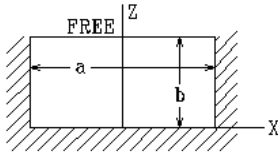
MICHIGAN DESIGN MANUAL BRIDGE DESIGN

HOT ROLLED SHEET PILING SECTION MODULI		
Sheet Pile Designation	Section Modulus in ³ /ft.	
	Nominal	Effective
PZ-22	18.1	15.3
AZ 12	22.3	19.2
PZC-12	22.4	19.2
AZ 12-770	23.2	19.9
PLZ-23	30.2	20.7
AZ 13-770	24.2	21.0
AZ 13	24.2	21.2
PZC-13	24.2	21.3
AZ 14-770	25.2	22.0
AZ 14	26.0	23.0
PLZ-25	32.8	23.0
PZC-14	26.0	23.1
PZ-27	30.2	25.5
PZC-17	31.0	26.6
AZ 17	31.0	26.6
AZ 17-700	32.2	27.7
AZ 18-700	33.5	29.0
AZ 18	33.5	29.3
PZC-18	33.5	29.5
AZ 19-700	34.8	30.4
AZ 19	36.1	32.0
PZC-19	36.1	32.1
AZ 24-700	45.2	40.4
AZ 25	45.7	40.7
PZC-25	45.7	41.1
AZ 26	48.4	43.5
AZ 26-700	48.4	43.6
PZ-35	48.5	43.6
PZC-26	48.4	44.0
AZ 28	51.2	46.4
AZ 28-700	51.3	46.6
PZC-28	51.2	46.9
PZ-40	60.7	54.6
PZC-34	63.8	58.3
PZC-36	67.0	61.6
AZ 37-700	68.9	61.7
PZC 37-CP	68.8	64.1
PZC-38	70.6	65.3
AZ 39-700	75.5	68.2
PZC 39-CP	73.0	68.3
AZ 41-700	76.2	69.4
PZC 41-CP	75.8	71.0
AZ 46	85.5	77.7
AZ 48	89.3	81.7
AZ 50	93.3	85.9

COLD ROLLED SHEET PILING SECTION MODULI		
Sheet Pile Designation	Section Modulus in ³ /ft.	
	Nominal	Effective
SZ-12	8.6	5.2
SZ-14	9.8	6.2
CZ-67	10.7	6.5
SZ-15	10.4	6.6
CZ-72	11.7	7.3
SPZ-16	13.2	8.4
SPZ-84	13.6	8.9
CZ-95RD	15.2	10.2
SZ-18	16.2	10.2
CZ-95	15.5	10.5
SPZ-19.5	16.6	11.2
CZ-101	16.5	11.3
SZ-20	17.8	11.4
CZ-107	17.5	12.2
SPZ-22	18.3	12.7
SZ-22	19.6	12.7
CZ-113	18.4	12.9
SCZ 19	18.8	13.0
SPZ-23.5	19.3	13.6
SCZ 21	19.9	14.1
SZ-222	26.8	16.6
SZ-24	29.5	18.6
SCZ 22	29.8	19.4
CZ-114RD	31.6	20.1
SKZ 20	31.7	20.7
SZ-27	32.4	20.7
SCZ 23	31.6	21.3
SPZ-23	31.3	21.5
CZ-114	31.6	21.7
SKZ 22	33.4	22.5
SCZ 25	33.5	23.2
SPZ-26	34.8	24.4
SKZ 23	35.6	24.6
CZ-128	35.5	24.8
SCZ 26	35.3	25.1
CZ-134	37.2	26.3
SKZ 24	37.7	26.7
CZ-141	39.1	27.9
SCZ 29	39.1	28.7
SKZ 25	40.1	29.2
CZ-148	40.9	29.4
SCZ 30	40.9	30.6

Bridge Design Manual Appendix 7.03.08 D.

10. Rectangular plate; three edges fixed, one edge (a) free



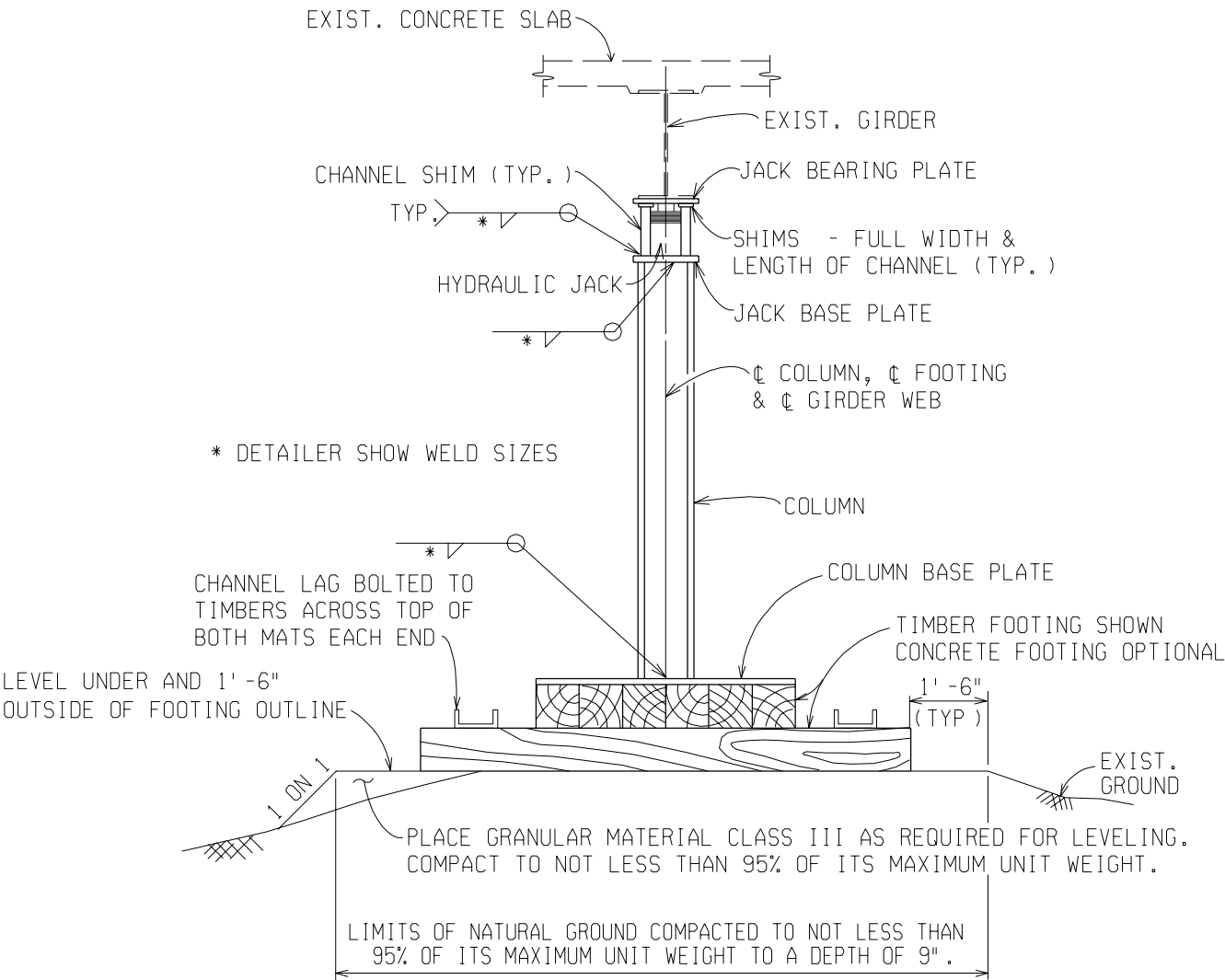
COEFFICIENTS FOR DESIGNING BASE PLATES

Roark's Formulas for Stress and Strain, (Sixth Edition), page 469
Warren C. Young

10a. Uniform over entire plate	<div><div>(At x = 0, z = 0) Max $\sigma_b = \frac{-\beta_1 q b^2}{t^2}$ and R = $\gamma_1 q b$</div><div>(At x = 0, z = b) $\sigma_a = \frac{\beta_2 q b^2}{t^2}$</div><div>(At x = $\pm \frac{a}{2}$, z = b) $\sigma_a = \frac{-\beta_3 q b^2}{t^2}$ and R = $\gamma_2 q b$</div><table><tr><th>a / b</th><th>0.25</th><th>0.50</th><th>0.75</th><th>1.0</th><th>1.5</th><th>2.0</th><th>3.0</th></tr><tr><td>β_1</td><td>0.020</td><td>0.081</td><td>0.173</td><td>0.321</td><td>0.727</td><td>1.226</td><td>2.105</td></tr><tr><td>β_2</td><td>0.016</td><td>0.066</td><td>0.148</td><td>0.259</td><td>0.484</td><td>0.605</td><td>0.519</td></tr><tr><td>β_3</td><td>0.031</td><td>0.126</td><td>0.286</td><td>0.511</td><td>1.073</td><td>1.568</td><td>1.982</td></tr><tr><td>γ_1</td><td>0.114</td><td>0.230</td><td>0.341</td><td>0.457</td><td>0.673</td><td>0.845</td><td>1.012</td></tr><tr><td>γ_2</td><td>0.125</td><td>0.248</td><td>0.371</td><td>0.510</td><td>0.859</td><td>1.212</td><td>1.627</td></tr></table></div>	a / b	0.25	0.50	0.75	1.0	1.5	2.0	3.0	β_1	0.020	0.081	0.173	0.321	0.727	1.226	2.105	β_2	0.016	0.066	0.148	0.259	0.484	0.605	0.519	β_3	0.031	0.126	0.286	0.511	1.073	1.568	1.982	γ_1	0.114	0.230	0.341	0.457	0.673	0.845	1.012	γ_2	0.125	0.248	0.371	0.510	0.859	1.212	1.627
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10aa. Uniform over 2/3 of plate from fixed edge	<div><div>(At x = 0, z = 0) Max $\sigma_b = \frac{-\beta_1 q b^2}{t^2}$ and R = $\gamma_1 q b$</div><div>(At x = $\pm \frac{a}{2}$, z = 0.6b for a > b or z = 0.4b for a ≤ b) $\sigma_a = \frac{-\beta_2 q b^2}{t^2}$ and R = $\gamma_2 q b$</div><table><tr><th>a / b</th><th>0.25</th><th>0.50</th><th>0.75</th><th>1.0</th><th>1.5</th><th>2.0</th><th>3.0</th></tr><tr><td>β_1</td><td>0.020</td><td>0.080</td><td>0.164</td><td>0.277</td><td>0.501</td><td>0.710</td><td>1.031</td></tr><tr><td>β_2</td><td>0.031</td><td>0.110</td><td>0.198</td><td>0.260</td><td>0.370</td><td>0.433</td><td>0.455</td></tr><tr><td>γ_1</td><td>0.115</td><td>0.230</td><td>0.334</td><td>0.424</td><td>0.544</td><td>0.615</td><td>0.674</td></tr><tr><td>γ_2</td><td>0.125</td><td>0.250</td><td>0.344</td><td>0.394</td><td>0.399</td><td>0.409</td><td>0.393</td></tr></table></div>	a / b	0.25	0.50	0.75	1.0	1.5	2.0	3.0	β_1	0.020	0.080	0.164	0.277	0.501	0.710	1.031	β_2	0.031	0.110	0.198	0.260	0.370	0.433	0.455	γ_1	0.115	0.230	0.334	0.424	0.544	0.615	0.674	γ_2	0.125	0.250	0.344	0.394	0.399	0.409	0.393								
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β_1	0.020	0.068	0.110	0.148	0.202	0.240	0.290																																										
β_2	0.026	0.063	0.084	0.079	0.068	0.057	0.040																																										
γ_1	0.115	0.210	0.257	0.291	0.316	0.327	0.335																																										
γ_2	0.111	0.170	0.194	0.185	0.174	0.170	0.180																																										

Notation:

"a" and "b" refer to plate dimensions, and when used as subscripts for stress, they refer to the stresses in directions parallel to the sides "a" and "b", respectively. "σ" is a bending stress in pounds/square inch which is positive when tensile on the bottom and compressive on the top if loadings are considered vertically downward. "R" is the reaction force, in pounds/inch, normal to the plate surface exerted by the boundary support on the edge of the plate. "q" is the load per unit area in pounds/square inch.



ELEVATION

(FOOTING PLACED ON SOIL SHOWN)

**MICHIGAN DESIGN MANUAL
BRIDGE DESIGN**

CHAPTER 8

PLAN NOTES

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MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 8 PLAN NOTES INDEX (continued)

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MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 8

PLAN NOTES

8.01

INTRODUCTION (4-19-2021)

This section contains general notes that should be placed on the sheet indicated or where applicable. The notes on each plan sheet should be grouped according to subject matter.

Blanks are to be filled in with the appropriate word or words. Words in parentheses show the most common options used in the note; other wordings may be necessary to fit the particular option. Words in brackets give instruction on when to use the note or give a general description of additional information that may be needed in the note. ***These notes are intended as a guide, not as a complete list for all cases.***

Care should be taken when writing unique plan notes. Do not use notes to add work to standard pay items or to add requirements to the contractor that are not already included in the spec book or special provisions. Use unique plan notes for the following cases:

- Convey information regarding design methodology.
- Explain the purpose or intent of an unusual item of work so that the project engineer or contractor can judge the accuracy required or whether alternatives are suitable.
- Coordinate details across the plan set.
- Specify extents of application of standard and special pay items.
- Indicate specific materials or items to be used when the Standard Specifications language provides for a broader application.

8.01 (continued)

- Specify intended sequence of activities.
- Emphasize (but not modify) critical elements of Standard Specification language.
- Convey information that cannot be reasonably included in plan details.

Care should be taken to ensure that the notes appearing on plan sheets apply to the work being performed on the project. A few notes contained herein are for Load Factor Design (LFD) projects. Most notes are for LRFD projects and some are specifically designated for LRFD projects.

Use caution when modifying notes contained herein or adding non-standard plan notes. If modifying a standard plan note, consider rewording the entire note in lieu of changing a single word or phrase to ensure that it is clear that the note is unique.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.02

TITLE SHEET

- A. The design of (this) (these) structure(s) (except the railroad overpass(es) (is) (are) based on 1.2 times the current AASHTO LRFD Bridge Design Specification HL-93 loading with the exception that the design tandem portion of the HL-93 load definition is replaced by a single 60 kip axle load before application of this 1.2 factor. The resulting load is designated HL-93 Mod. Live load plus dynamic load allowance deflection does not exceed $(1/425^*)$ $(1/800)$ $(1/1000^{**})$ of span length (and $(1/375)$ $(1/300)$ of cantilever arm). [*Wood construction.] [****Use** for structures with pedestrian loads.] (8-20-2009)
- B. The design of this structure is based on current AASHTO LRFD Bridge Design Specification pedestrian loading of 90 psf (and a maintenance vehicle (H5) (H10) loading, not acting concurrently). Live load deflection does not exceed $1/360$ of span length and $1/220$ of cantilever arm. [Use for pedestrian bridges. For Clear Bridge Width, w , greater than 10'-0", use an H10 truck. For w between 7'-0" and 10'-0", use an H5 truck. For w less than 7'-0" the bridge does not need to be designed for a maintenance vehicle.] (5-25-2015)
- C. The design of the deck slab is based upon the (strip) (empirical) method as defined in the current AASHTO LRFD Bridge Design Specification, utilizing HL-93 Loading. (8-20-2009) (9-27-2021)

8.02 (continued)

- D. The (reconstruction) (rehabilitation) design is based on 1.2 times the current AASHTO LRFD Bridge Design Specification HL-93 loading with the exception that the design tandem portion of the HL-93 load definition is replaced by a single 60 kip axle load before application of this 1.2 factor. The resulting load is designated HL-93 Mod. Live load plus dynamic load allowance deflection does not exceed $(1/425^{**})$ $(1/800)$ $(1/1000^{***})$ of span length (and $1/375)$ $(1/300)$ of cantilever arm. The original structure was designed for _____ (and alternate military*) loading (based on AASHTO Standard Specifications for Highway Bridges). [*Used only for structures on interstate routes.] [****Wood construction.**] [*****Use** for structures with pedestrian loads.] [See Subsection [7.01.06](#) for deflection limits.] (8-20-2009)
- E. [Load Factor Design (LFD)]
The (reconstruction) (rehabilitation) design is based on the 17th Edition of AASHTO Standard Specifications for Highway Bridges (HS25) (HS20-44) (and alternate military*) loading. Live load plus impact deflection does not exceed $(1/425)$ $(1/800)$ $(1/1000)$ of span length (and $1/375)$ $(1/300)$ of cantilever arm. The original structure was designed for _____ (and alternate military*) loading based on AASHTO Standard Specifications for Highway Bridges. [*Use only for structures on interstate routes.] [See 17th Edition of AASHTO for deflection limits.] [Use note for Load Factor Design (LFD) method of design.] (8-20-2009)
- F. Except where otherwise indicated on these plans, or in the proposal and supplemental specifications contained herein, perform all work according to the Michigan Department of Transportation Standard Specifications for Construction _____ Edition.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.02 (continued)

TITLE SHEET

- G. The stationing as shown on these plans for the intersection of the centerline of bridge and the (roadway) (railroad) centerline is believed to be correct. Check stationing at the time of starting construction. If the stationing shown on the plans is incorrect, notify the Engineer, and stake out the structure using the actual intersection of the centerline of bridge and the (roadway) (railroad) centerline as the control point. [Use when the project includes proposed survey stationing.]
- H. This contract is for "Structural Steel, _____, Furn and Fab" only. Other items of work indicated on these plans are not a part of this contract. [Use when structural steel furnishing and fabricating must be done early in project to ensure timely delivery for construction.] (12-5-2005)
- I. The Regulated Waste Activity Identification Numbers for this project are as follows:

Control Section	Number

[Use when hazardous material removal, cleaning or working on painted steel structure constructed prior to 1978 or when hydrodemolition is part of the project work. Place note directly above title block and use lettering twice the size of the other notes.] (1-27-2020)

8.02 (continued)

- J. The design of the structural members is based on material of the following grades and stresses:

Concrete:

Grade 3500, 3500HP* $f'_c = 3,000$ psi
 Grade 4000 $f'_c = 3,500$ psi
 Grade 4500, 4500HP* $f'_c = 4,000$ psi

Steel Reinforcement $f_y = 60,000$ psi

Steel Reinforcement:

(Stirrups for Prestressed Beams
 (including stainless steel (SD) bars)
 $f_y = 60,000$ psi)

(Stirrups for (17") (21") Box Beams
 (including stainless steel (SD) bars)
 $f_y = 40,000$ psi)

Structural Steel:

AASHTO M270

Grade 36 $F_y = 36,000$ psi

Structural Steel (including H-Piles, splices and pile points):

AASHTO M270

Grade 50, 50W $F_y = 50,000$ psi

Structural Steel Pins:

ASTM A276

UNS Designation

S20161 or S21800 $F_y = 50,000$ psi

Temp Support Hanger Rods:

ASTM A193 Grade B7 (AISI 4140)

2½" and under $F_u = 125,000$ psi
 $F_y = 105,000$ psi

Over 2½" to 4" $F_u = 115,000$ psi
 $F_y = 95,000$ psi

Over 4" to 7" $F_u = 100,000$ psi
 $F_y = 75,000$ psi

Prestressed Concrete $f'_c =$ _____ psi

Prestressed Concrete Compressive

Strength at Release $f'_{ci} =$ _____ psi

Prestressing Strands $f_{pu} = 270,000$ psi

Foundation Piling (Steel Shells):

ASTM A252

Grade 3 Modified $F_y = 50,000$ psi

Foundation Piling (Timber)

$F_{CO} = 900$ psi

[* Use Grade 3500HP and 4500HP on all MDOT projects. Grade 3500 and 4500 may be used on Local Agency projects if desired by the Owner.] (5-27-2025)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.02 (continued)

TITLE SHEET

- K. Bevel all exposed concrete corners shown square on the plans with ½" triangular moldings except as otherwise noted. (8-20-99)
- L. Old plans do not exist for this structure. [Use on all projects where the designer is unable to verify that existing structure plans exist.] (8-20-2009)
- M. The bridge paint may contain lead. [Use on all projects with existing painted structural steel regardless of work type. If no bridge Title Sheet is present with project place note on road Note Sheet. Also place on existing structural steel sheets (see note [8.09.06 D.](#))] (8-20-2009)
- N. Unless otherwise shown on the plans, provide minimum concrete clear cover for reinforcement according to the following:

Concrete cast against earth:	3 in.
Prestressed Beams:	1 in.
All other unless shown on plans:	2 in.

(8-20-2009)
- O. The bridge deck surface has an HMA overlay, HMA cap or HMA patches. Removal of HMA as a result of removal of other superstructure items is included in the removal of those items. (8-20-2009)
- P. An FAA Determination (,) (and) (Michigan Tall Structure permit) (,) (and) (Local Airport Zoning permit) (have) (has) been obtained for this project. Perform all work in compliance with (this) (these) permit(s). [Use when a FAA determination is received and applicable permits have been obtained for the project. See Section 14.14 of the MDOT Bridge Design Manual for guidance and information on applicable permits and filing Notice with the FAA.] (6-23-2025)

8.02 (continued)

- Q. This project has been evaluated using the FAA Obstruction Evaluation Pre-Screening Tool for a structure height of ____ feet above a ground level elevation of ____ feet and no permits are required. [Use when FAA Notice, Michigan Tall Structure or Local Airport Zoning permits are not required for the project. See Section 14.14.05 of the MDOT Bridge Design Manual for information on the FAA Obstruction Evaluation Pre-Screening Tool.] (6-23-2025)
- R. Do not open structure(s) to traffic until all proposed concrete attains 100% of its specified strength. [Use for all projects that have proposed superstructure or substructure concrete, bridge barrier railings, or any other concrete material that has a strength specified in the contract.] (10-24-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.03

GENERAL PLAN OF SITE SHEET

Urgent Needs and Request for Action projects do not require a Geometrics review for design exceptions / variances. Use notes A. or B. to identify project classification as defined below on the General Plan of Site Sheet:

Urgent Needs Project - projects intended to return an existing structure to its full capacity or to address immediate safety needs resulting from high load hits, inspection findings or other incidents. These projects typically have abbreviated design periods and quick turnarounds.

Request for Action Project - projects intended to address a specific condition identified during a routine inspection as a Request for Action but not the result of a high load hit, or other outside incident that qualifies it as an Urgent Needs Project. (11-24-2025)

- A. The work covered by (this Urgent Needs project) (this Request for Action project) (these plans) includes (channel excavation), (maintaining traffic), construction of the proposed bridge and placing (slope protection) (scour countermeasures) (riprap) to the limits shown. All other work is included in the road plans that are a part of this contract. [Used where bridge is part of a road-bridge package.] (11-24-2025)

8.03 (continued)

- B. The work covered by (this Urgent Needs project) (this Request for Action project) (these plans) includes (clearing), (grubbing), (tree removal), (channel excavation), (earth excavation), (maintaining traffic), (construction of the temporary road), (construction and removal of temporary trestle), (grading for temporary and permanent track work), construction of the proposed bridge and placing (granular material), (sodding or seeding) and (slope protection) (scour countermeasures) (riprap) to the limits shown. All other work is to be done by others and is not a part of this contract. [Used where bridge contractor constructs bridge only and approach work is done by a separate contract. Any work that is to be done by others prior to starting work on bridge contract is to be noted.] (11-24-2025)
- C. Removal of (fences and) buildings is not a part of this contract.
- D. Removal of temporary structure and approaches (is) (is not) a part of this contract.
- E. Locate all active underground utilities prior to starting work and conduct operations in such a manner as to ensure that those utilities not requiring relocation will not be disturbed.
- F. Remove unsuitable material under _____ and backfill with _____.
- G. Remove (_____ cubic yards of) peat and other unsuitable material below proposed approach fill location and backfill with (_____ cubic yards of) "Embankment, Structure, CIP" (see Road Plans for treatment limits, method and quantity). [Use when large peat deposits must be removed by surcharging.] (12-5-2005)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.03 (continued)

GENERAL PLAN OF SITE SHEET

- H. (Scarify*) (Remove) roadway surfacing in area beneath proposed abutments prior to placing of fills. [Use for pile-supported abutments or where fill is 3'-0" or less.] [*Use when roadway surfacing is gravel or crushed stone with or without a seal coat.] (8-6-1992)
- I. Construct and backfill piers 1 and ____ prior to the placement of abutment fills. [Use where piers are within or at toes of slope.]
- J. Grade the ground adjacent to the tracks and structure to provide drainage.
- K. (Maintain) (Detour) traffic over (the bridge) (the bridge by part-width construction) (other existing roads) (the temporary road). [Specify facility and other modes of transportation on the project. Use multiple notes if modes are detoured or maintained in separate ways.] (12-16-2019)
- L. This bridge is part of an interchange and all area shown is within MDOT right-of-way.
- M. (Proposed) Plan elevations refer to ____ datum. (To obtain ____ elevations from existing plans, subtract ____ feet from existing plan elevations.) [Use correction parts of note when proposed plan elevations are not normal MDOT convention.] (10-24-2022)
- N. Topography shown here represents conditions existing at the time the field survey was made. However, these conditions (may) have been materially altered by the operations of others prior to this contract. [Use when definite information exists that work has been done in the area.]
- O. The train movement and speed information shown in the proposal does not represent a commitment by the ____ railroad and is subject to change without notice.
- P. Excavate crosshatched area to El _____. [Place this note in the vicinity to which it applies.]
- Q. Fill hatched area to El ____ with material from channel excavation. [Place this note in the vicinity to which it applies.]
- R. Water level is subject to change. Make a determination of water levels that may exist during construction. [Use on all projects over water where the water level may impact the project work.]
- S. Remove ____ cubic yards of topsoil (and unsuitable material) and place ____ cubic yards of "(Embarkment, Structure,) (*Embarkment,) CIP". [*Use with pile supported footing.] (12-5-2005)
- T. Undercut soil classified as ____ and replace with "Embarkment, Structure, CIP" compacted to 100 percent of maximum unit weight. Excavation and backfill quantities are based on an estimated undercut to elevation _____. The Engineer will determine actual limits of excavation at the time of construction. (12-5-2005)
- U. Railroad owned items (fittings, ties, rails, etc.) that are salvaged become the property of the railroad. [List specific items, as necessary.] (5-24-2021)
- V. Implement measures to prevent debris from falling from the structure. (*If debris falls into the waterway, remove it within 24 hours. Since disturbance of the waterway bottom may be as harmful as the debris itself, the preventive measures must be effective.) Removal of debris is included in related items of work. [*Use for bridges over waterways.] (4-19-2021)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

8.03 (continued)

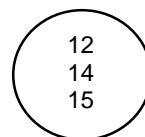
GENERAL PLAN OF SITE SHEET

- W. Immediately after the construction of an abutment is completed, place slope protection and seeding or sodding on the adjacent embankment slopes. [Use for bridges over waterways.] (9-1-1988)
- X. The haul route shown has been approved by the Michigan Department of Environment, Great Lakes and Energy (MDEGLE). If desired, propose a detailed alternate route for MDOT review and submittal to the appropriate permitting agency. No payment will be made for additional time, project costs and project delays resulting from submittal, approval, and/or denial of an alternate route request. Implementation will be the responsibility of the contractor. [Use for bridges over waterways or wetlands.] (6-24-2019)
- Y. Coordinates are not available for this project. [Use when coordinates not available due to lack of survey for project.] (12-5-2005)

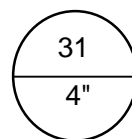
8.04

LOG OF BORING SHEET

- A. Numbers in circles denote number of blows required to drive a 2" O.D. (1½" I.D.) split spoon sampler 3 successive 6" increments using a 140 lbs. (automatic)(safety) hammer falling 30".



(Where the sampler is driven distances other than 18", the distance is shown in the circle with the number of blows in the form of a fraction.) [Indicate actual hammer type used] (4-19-2021)



Number of blows
Distance driven

- B. Consistency was determined by inspection of samples and substantiated by soils resistance to drilling tools. [This note shall be as written in field notes.]
- C. Bottom of footing (Abut. ____) (Pier ____), El. ____.*
- D. Estimated total scour limit (Abut. ____) (Pier ____), El. ____.* (8-6-1992)
- *Show on plotted borings.
- E. Minimum pile penetration (Abut. ____) (Pier ____), El. ____.*
- F. Estimated bottom of piles (Abut. ____) (Pier ____), El. ____.*

MICHIGAN DESIGN MANUAL

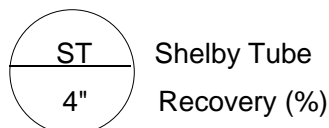
BRIDGE DESIGN

8.04 (continued)

- G. Water levels may be influenced by residual boring water. [Use when borings are made by hydraulic, rotary, or coring methods.]
- H. Free water was first noted ____ feet below the surface. The water level was ____ feet below ground (____ hours after) (at) completion with the casing (in) (out). [Place under each soil boring log if applicable.] (9-1-1988)
- I. The soil boring logs represent point information. Presentation of this information in no way implies that subsurface conditions are the same at locations other than the exact location of the boring.
- J. See General Plan of Structure Sheet for soil boring locations. (4-19-2021)
- K. Drilling was performed with a ____ drill rig utilizing ____ drilling methods. [Include hammer type and drilling method. Include changes in drilling methods and/or coring as well]. (4-19-2021)
- L. Elevations reference the top of the standard penetration test (SPT), rock core run interval or Shelby tube sample. (4-19-2021)
- M. The numbers in split circles denote rock recovery and rock quality designation (RQD) for each rock core run. (4-19-2021)



- N. Circles with ST are Shelby tube samples pushed 2 ft unless otherwise noted. (4-19-2021)



8.05

GENERAL PLAN OF STRUCTURE SHEET

- A. The design of this structure is based on 1.2 times the current AASHTO LRFD Bridge Design Specification HL-93 loading with the exception that the design tandem portion of the HL-93 load definition is replaced by a single 60-kip axle load before application of this 1.2 factor. The resulting load is designated HL-93 Mod. Live load plus dynamic load allowance deflection does not exceed $(1/425^*)$ $(1/800)$ $(1/1000^{**})$ of span length (and $1/375$ $(1/300)$ of cantilever arm. [*Wood construction.] [**Use for structures with pedestrian loads.] [See Subsection 7.01.06 for deflection limits.] (8-20-2009)
- B. The design of this structure is based on current AASHTO LRFD Bridge Design Specification pedestrian loading of 90 psf (and a maintenance vehicle (H5) (H10) loading, not acting concurrently). Live load deflection does not exceed $1/360$ of span length and $1/220$ of cantilever arm. [Use for pedestrian bridges. For Clear Bridge Width, w , greater than 10'-0", use an H10 truck. For w between 7'-0" and 10'-0", use an H5 truck. For w less than 7'-0" the bridge does not need to be designed for a maintenance vehicle.] (5-25-2015)
- C. The design of the deck slab is based upon the (strip) (empirical) method as defined in the current AASHTO LRFD Bridge Design Specification, utilizing HL-93 Loading. (5-27-2020) (9-27-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.05 (continued)

- D. The (reconstruction) (rehabilitation) design is based on 1.2 times the current AASHTO LRFD Bridge Design Specification HL-93 loading with the exception that the design tandem portion of the HL-93 load definition is replaced by a single 60 kip axle load before application of this 1.2 factor. The resulting load is designated HL-93 Mod. Live load plus dynamic load allowance deflection does not exceed $(1/425^{**})$ $(1/800)$ $(1/1000^{***})$ of span length (and $1/375)$ $(1/300)$ of cantilever arm. The original structure was designed for _____ (and alternate military*) loading (based on AASHTO Standard Specifications for Highway Bridges). [*Used only for structures on interstate routes.] [**Wood construction.] [***Use for structures with pedestrian loads.] [See Subsection 7.01.06 for deflection limits.] [Use note for **LRFD** method of design.] (8-20-2009)
- E. [Load Factor Design (LFD)]
The (reconstruction) (rehabilitation) design is based on the 17th Edition of AASHTO Standard Specifications for Highway Bridges (HS25) (HS20-44) (and alternate military*) loading. Live load plus impact deflection does not exceed $(1/425)$ $(1/800)$ $(1/1000)$ of span length (and $1/375)$ $(1/300)$ of cantilever arm. The original structure was designed for _____ (and alternate military*) loading based on AASHTO Standard Specifications for Highway Bridges. [*Use only for structures on interstate routes.] [See 17th Edition of AASHTO for deflection limits.] [Use note for Load Factor Design (LFD) method of design.] (8-20-2009) (4-19-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.05 (continued)

GENERAL PLAN OF STRUCTURE SHEET

F. [Place charts similar to the following on all plans where applicable:] [See section 4.05.10 of the Road Design Manual for hydraulic analysis tables for culverts.] (6-27-2022)

SUMMARY OF HYDRAULIC ANALYSIS							
EXISTING				PROPOSED			
FLOOD DATA	DISCHARGE (CFS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE (FT)	VELOCITY AT D/S FACE (FT/S)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE (FT)	VELOCITY AT D/S FACE (FT/S)	WATERWAY AREA AT D/S FACE (SQ. FT)	CHANGE IN WSEL FROM U/S FACE OF PROPOSED STRUCTURE (FT)
10-YEAR							
50-YEAR							
100-YEAR							
500-YEAR							
PROPOSED BRIDGE AREA BELOW LOW CHORD IS ____ SQUARE FEET							

The water surface and/or energy grade elevations shown on the above hydraulic table are to be used for comparison purposes only and are not to be used for establishing a regulatory floodplain. The elevations may be used, provided they are verified with the Land and Water Management Division, Michigan Department of Environment, Great Lakes, and Energy.

SUMMARY OF SCOUR ANALYSIS						
FLOOD DATA		ABUT. A ELEVATION (FT.)	ABUT. B ELEVATION (FT.)	PIER 1 ELEVATION (FT.)	PIER 2 ELEVATION (FT.)	PIER 3 ELEVATION (FT.)
100-YEAR	DESIGN					
500-YEAR	CHECK					
	OVERTOP					
ITEM 113 RATING - ____						

The Item 113 rating is based on properly installing the countermeasure and filter as shown on plans and per specifications. Any deviation must be reviewed and approved by the Hydraulic Unit. [Use only for countermeasure installations on existing structures.]

G1. The drainage area contributory to this crossing is ____ square miles.

G2. The existing bridge area below the low chord is ____ square feet.

G3. Existing overtopping elevation is ____ feet.

G4. Proposed overtopping elevation is ____ feet.

G5. Do not use broken concrete for riprap.

(6-27-2022)

H. Note Deleted (6-27-2022)

I. The (existing) (adjacent) structure, (feet) (miles) (upstream) (downstream), provides a waterway area of ____ square feet to (high water) (underclearance*) elevation _____. [*Use only if high water elevation is not available.]

J. Note Deleted (6-27-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.05 (continued)

GENERAL PLAN OF STRUCTURE SHEET

- K. Place geotextile liner on all slopes prior to placing riprap. Payment for geotextile liner is included in payment for riprap. [Use when recommended by the Hydraulics/Hydrology Engineer.] (9-18-1998)
- L. The (abutment) (pier) maximum average foundation pressure(s) is (are) calculated to be _____ psf for Service Limit State, and _____ psf for Strength Limit State and are based on a gross footing width of _____ ft. [Use for **LRFD** projects when **gross footing width** assumptions are used for footing designs. Create one note for abutments and one note for piers. MDOT designed projects.] (8-20-2009)
- M. The (abutment) (pier) maximum foundation pressure(s) is (are) calculated to be _____ psf for Service Limit State based on an effective footing width of _____ ft, and _____ psf for Strength Limit State based on an effective footing width of _____ ft. [Use for **LRFD** projects when **effective footing width** assumptions are used for footing designs. Create one note for abutments and one note for piers. Consultant designed projects.] (8-20-2009)
- N. [Load Factor Design (LFD)]
The maximum unfactored foundation pressures are calculated to be:

Avg. D.L. only Case

Abutments _____ psf
Piers _____ psf

Avg. D.L. + L.L. Case

Abutments _____ psf
Piers _____ psf

[Note only on Preliminary Plans][Use Avg. D.L. Case for cohesive soils only.][Use for Load Factor Design (LFD) projects.] (4-19-2021)

8.05 (continued)

- O. For details of concrete slope paving protection, see Standard Plan B-102-Series. [Use for projects with slope paving.] (6-29-2020)
- P. The nominal fatigue resistance is based on a design life of 75 years (and an average daily truck traffic of _____). [Use for steel bridges only and add ADTT if applicable/available.] (3/16/2015)
- Q. A cofferdam has not been provided for this structure. Use other means of water control as approved by the Engineer. Do not disturb the stream bed. Water control, whether it be by cofferdam or other approved means, is included in the bid item "Excavation, Fdn". [Use on stream crossings when water control measures other than a cofferdam are appropriate. See Subsection 7.03.04.] (12-5-2005)
- R. The tremie seal design was based on a water surface at El. _____.
- S. Place (standard) (and) (limited deflection) temporary barrier according to (Standard Plan R-53-Series,) Standard Plan R-126-Series or as approved by the Engineer. (Place portable water-filled barrier as specified by the Engineer.) [Use on all projects requiring standard temporary barrier, limited deflection temporary barrier, and/or portable water-filled barrier. Modify paragraph as needed depending on the temporary barrier type(s) required on each project. Delete references to Standard Plan R-53-Series when limited deflection temporary barrier is not required according to Standard Plan R-126-Series. Place note on staging sheet(s) where applicable.] (12-28-2015)
- T. The riprap quantity is based on the lateral dimensions of the area to be protected, regardless of the number of layers required. The estimated weight of riprap is tons. [Use only if riprap is paid by the square yard.] (4-19-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.05 (continued)

GENERAL PLAN OF STRUCTURE SHEET

- U. Submit alternate methods of stream diversion to the Engineer for approval. [Use when stream diversion method is detailed on Plan Sheet.] (9-18-1998)
- V. Place riprap from El ____ to El _____. [Place this note in the vicinity to which it applies, when lateral limits are not fixed.]
- W. False decking includes the area bounded by (Reference Lines ____ & ____) (edges of shoulders) and outside flange fascias of fascia beams. The estimated area is ____ square feet during removal (and ____ square feet during proposed construction). [Detail limits on the plans and include areas in note.] (4-19-2021)
- X. When casting items into structural precast concrete to facilitate bridge construction (forming, finishing, etc.) use items that are galvanized in accordance with ASTM B633, Service Condition 4 or epoxy coated. Cast inserts with the beams. Do not field install inserts. [Use for box and three-sided culverts, MSE walls, sound walls, precast bridge element systems, etc.](4-19-2021)
- Y. Do not use wheeled, roller based or machine mounted compaction equipment to compact the subgrade, subbase, and base within 10' of the sleeper slab after it is built. Use only hand/plate compactors. Use only hand/plate compactors with a contact pressure that does not exceed 10 psi. [Use on all projects with a sleeper slab.] (3-17-2014)
- Z. Design headwalls to develop an ultimate moment capacity (about the horizontal axis) to resist a horizontal load of 24 k (kips) distributed over 3.5 feet applied 32 inches above top of pavement, and to develop an ultimate moment capacity (about the vertical axis) of 16.7 kft (kip feet), per foot of headwall height. Design headwall connection to deck and/or other precast units to resist these loads. Space blockouts for thrie beam guardrail at a distance of 10'-7¾" or less, center to center, along headwall. [Use when thrie beam guardrail is attached to the culvert headwalls and/or return walls. Use with Standard Plan B-23-Series.] (5-27-2014)
- AA. Contact the Region Soils Engineer to perform a footing check at least 48 hours prior to excavating to the bottom of the excavation. [Use this note for spread footings and box culverts]. (4-19-2021)
- BB. Contact the Region Soils Engineer to witness the Design Builder's Geotechnical Engineer perform a footing check at least 48 hours prior to excavating to the bottom of excavation. [Use this note for spread footings and box culverts on Design-Build projects only]. (4-19-2021)
- CC. Install sheet piling using either an impact hammer or a variable moment driver/extractor operated to minimize vibrations. Do not use vibratory hammers that are not variable moment. [Use this note at the direction of the Geotechnical Engineer when there is concerns regarding potential vibration and/or settlement issues. For sensitive structures, alternate non-vibratory means should be considered instead of sheet piling.] (4-19-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.06

SUBSTRUCTURE

8.06.01

Miscellaneous Notes

- A. (Bolts) (Position dowels) may be adhesive anchored in holes drilled in the concrete at (Pier __) (Abutment __). [Use this note for steel beam or prestressed concrete beam bridges, where drilling holes will not damage substructure reinforcement.] (9-18-1998)
- B. Uplift will occur at abutment(s) ____ (and pier(s) _____) during construction of the superstructure. Place anchor bolt nuts and jam nuts immediately after erection of the girders in Span(s) ____.
- C. Apply low temperature protection of concrete according to Section 706.03 J. of the Standard Specifications for Construction. Low temperature protection of concrete is included in the related items of work. [Use when possibility of pouring concrete during cold weather. With known cold weather pours use the pay item for cold weather protection.] (4-19-2021)

8.06.02

Abutment Notes

See Section [7.03.11](#) for usage and descriptions of concrete sealers.

- A. Apply Substructure Horizontal Surface Sealer to the top horizontal surface of abutment ____ (and __) (prior to placing masonry plates) (after the elastomeric bearings have been placed in final position on the structure). Clean accidentally coated vertical surfaces at the contractor's expense. [Use when joint in deck exists above.] (12-5-2005)
- B. Apply (Penetrating Water Repellent Treatment) (Concrete Surface Coating) (Silane) to the entire exposed surface of abutment__ (and __) (except the tops) and the front face of independent backwall (prior to placing new masonry plates) (after the new elastomeric bearings have been placed in final position on the structure). (Use concrete surface coating [AMS-STD-595](#) color number [insert number], [insert color].) [Use when no joint exists above. Apply to tops when Horizontal surface sealer is not applied to tops. Use Concrete Surface Coating when requested by Region or Roadside Development section.] (4-19-2021)
- C. Prior to erecting the beams, do not backfill the backside of the abutment higher than the backfill on the front side. [Use on integral abutments.] (8-20-1999)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.06.03

Pier Notes

See Section [7.03.11](#) for usage and descriptions of concrete sealers.

- A. Apply Substructure Horizontal Surface Sealer to the top horizontal surface of pier (and __) (prior to placing masonry plates) (after the elastomeric bearings have been placed in final position on the structure). Clean accidentally coated vertical surfaces at the contractor's expense. [Use only when superstructure transverse joints are directly above the pier.] [Use for new construction.] (12-5-2005)
- B. Apply (Penetrating Water Repellent Treatment) (Concrete Surface Coating) (Silane) to the entire exposed surface of piers__ (except the tops) (prior to placing new masonry plates) (after the new elastomeric bearings have been placed in final position on the structure.) (Use concrete surface coating [AMS-STD-595](#) color number [insert number], [insert color].) [Use when no joint exists above. Apply to tops when Horizontal Surface Sealer is not applied to tops. Use Concrete Surface Coating when requested by Region or Roadside Development section.] (4-19-2021)

8.06.04

Footing Notes

- A. Pour footings against undisturbed soil. No allowance will be made in concrete quantities due to excavation outside of the footing neat lines. [Use when required by design.]
- B. Construction joints in footings are optional. [Use unless design considerations deem the joints necessary.]
- C. The footings are designed specific to the detailed (Box-Arch) (Arch) (Flat Top) structure. [Use for precast concrete three-sided or arch culverts.] (12-28-2015)
- D. The footings are designed to resist an applied vertical load of _____ kip/ft and horizontal load of _____ kip/ft (toward the center of the structure) (away from the center of the structure). [Use for precast concrete three-sided or arch culverts.] (12-28-2015)
- E. Water mains and sewers must be cased within the influence zone of spread footings. [Use on project with water mains and sewers beneath spread footings.] (4-19-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.06.05

Pile Notes

- A. Drive all piles to a nominal pile driving resistance not less than _____ kips. Determine nominal pile driving resistance (R_{ndr}) using (the FHWA Modified Gates Dynamic Formula) (dynamic test with signal matching (P.D.A. testing)) (static load tests). [Provided by MDOT Geotechnical Services Section or Geotechnical consultant. See section [7.03.09](#) for values and criteria. Use for **LRFD** projects only.] (8-20-2009)
- B. [Load Factor Design (LFD)]
Drive all piles to a minimum bearing capacity of _____ tons. [Use for Load Factor Design (LFD) projects]
- C. [Load Factor Design (LFD)]
Do not use the pile driving formulas in the Standard Specifications to determine battered pile capacity. Drive battered piles to the elevation established for vertical piles. [Use on Load Factor Design (LFD) projects when piles are driven to a 2.5V:1H batter or flatter.]
- D. Use pile shells with a minimum of (0.500") (0.375") (0.312) nominal wall thickness, (16") (14") (12") O.D. [Use with C.I.P. concrete piles.] (5-24-2021)
- E. The estimated pile length is based on the static analysis. (8-20-2009)
- F. Drive batter piles for Abutment(s) _____ to a 3V:1H (2.5V :1H) batter angle. (9-18-1998)
- G. Use (HP 10X42) (HP 10X57) (HP 12X53) (HP 12X74) (HP 12X84) (HP 14X73) (HP 14X89) Steel piles. (11-28-2011)
- H. Drive piles to such accuracy that the ends of the piles to be embedded in the concrete are within 3" of the location shown on the plans. [Use for pile bents and integral abutments with one row of piles.] (4-19-2021)

8.06.05 (continued)

- I. Drive piles in a sequence that begins with the center of the pile group and proceeds outward in both directions or from one side of the pile group to the other side. The contractor may request Engineer approval to sequence the pile driving from the center of the pile group outward in a clockwise or counterclockwise pattern if four or more rows of piles exist. [Use for pipe piles to alleviate soil pressure from driven piles. A pile driving sequence will minimize detrimental effects of heave and lateral displacement of the ground as well as the influence the new construction has on adjacent structures.] (8-20-2009)
- J. The estimated loss of nominal pile resistance due to scour after driving is _____ kips. [For information only. Use for **LRFD** projects only.] (8-20-2009)
- K. The estimated factored downdrag after pile driving is _____ kips. [For information only. **LRFD** projects only.] (8-20-2009)
- L. The factored pile resistance available to resist all factored loads (including the estimated factored downdrag) is equal to (50) (65) percent of nominal pile driving resistance (that is reduced by the loss due to scour). [For information only. Add downdrag and scour when appropriate. See section [7.03.09](#) for values and criteria. Use for **LRFD** projects only.] (11-28-2011)
- M. Pier (s) _____ (is) (are) considered pile bent(s). Steel piles used for pile bents are considered main members and all welding must be according to AASHTO/AWS D1.5 Bridge Welding Code, as modified by the current Special Provision for Structural Steel and Aluminum Construction. [Use only when piles project above surface and function as a true pile bent. Do not use for integral abutment piles.] (5-28-2024)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.06.05 (continued)

Pile Notes

- N. Use only the pile splice details within the plans. [Use on piles for integral abutment, pile bents or any other piles that must resist bending. Do not include alternate splice (sleeve) details in plans]. (4-19-2021)

8.06.06

Steel Sheet Pile Notes

- A. The substructure excavation and concrete quantities take into consideration the additional concrete and excavation necessary to excavate and pour to the Permanent Steel Sheet Piling. [Use on all projects where concrete is to be poured against Permanent Steel Sheet Piling.]
- B. Provide hot-dip galvanized sheet piling at _____. [Specify location and use when sheet piling will be subjected to heavy chlorides or sulfates. Include a Special Provision.] (3-18-2013)
- C. Provide _____ Permanent Steel Sheet Piling. Where allowed by the Engineer, select alternate hot rolled sheet piling with a nominal section modulus of at least _____ in³/ft or cold rolled sheet piling with a nominal section modulus of at least _____ in³/ft. [Specify designation and appropriate section modulus. Refer to Section [7.03.08 D.](#) for design criteria.] (12-5-2005)
- D. Provide hot rolled permanent steel sheet piling. Do not use cold rolled piling. [Use when recommended by the geotechnical engineer.] (4-19-2021)

8.06.07

Substructure Repair Notes

- A. Apply (Penetrating Water Repellent Treatment) (Concrete Surface Coating) (Silane) to the entire exposed surface of abutment__ (and __) (except the tops) (and the front face of the independent backwall). (Use concrete surface coating [AMS-STD-595](#) color number [insert number], [insert color].) [Use when no joint exists above or the abutment is adjacent to a pavement. Apply to tops when Horizontal Surface Sealer is not applied to tops. Use Concrete Surface Coating when requested by Region or Roadside Development section.] (2-26-2018)
- B. Apply (Penetrating Water Repellent Treatment) (Concrete Surface Coating) (Silane) to entire exposed surfaces of pier(s) ____ (except top). (Use concrete surface coating [AMS-STD-595](#) color number [insert number], [insert color].) [Use when no joint exists above or the pier is adjacent to a pavement. Apply to tops when Horizontal Surface Sealer is not applied to tops. Use Concrete Surface Coating when requested by Region or Roadside Development section.] (4-19-2021)
- C. Apply Substructure Horizontal Surface Sealer to the top of (all) Pier(s) (____ & ____) (and) Abutment(s) (____ & ____). Clean accidentally coated vertical surfaces at contractor's expense. [Use when the abutment or pier has been repaired and there is a superstructure transverse joint directly above or the unit is adjacent to a pavement.] (12-5-2005)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.06.08

MSE Wall Notes (8-20-2009)

- A. Use soil reinforcement for MSE walls of a length not less than _____ percent of the wall height (H), as defined by these plans, or 8 feet (whichever is greater). [Use this note when the soil reinforcement length required by the Geotechnical investigation exceeds the minimum length (0.7H) required by the specifications.]
- B. The factored bearing resistance of the subgrade is _____ psf at abutment A and _____ psf at abutment B.
- C. Adjust MSE soil reinforcement to avoid foundation piles. Do not cut soil reinforcement.
- D. Use precast concrete facing panels with a nominal height of _____ feet and nominal width of _____ feet for MSE walls. [Use this note if aesthetic or design concerns dictate the panel size beyond what is allowed by the MSE specifications.]
- E. Use either precast or cast in place (CIP) MSE wall coping unless specified to be cast in place. [Include this note only if there are areas where cast in place coping is required and other areas may utilize precast coping.]
- F. Use cast in place (CIP) MSE wall coping. [Use this note only if coping is required to be cast in place.]
- G. Texture the exposed face of the precast concrete facing panels with a _____ pattern meeting the approval of the Engineer. Payment for texturing panels is included in the bid item "Mechanically Stabilized Earth Wall, Precast, Form". (4-19-2021)
- H. Coordinate placement of soil reinforcement with drainage structures and pipes and other obstructions.

8.06.08 (continued)

- I. The 100 year flood elevation is _____. [Use where MSE walls are placed near areas subject to fluctuations in water level.]
- J. Do not cut MSE soil reinforcement.
- K. Set the top row of soil reinforcement a minimum of 6" below the bottom of footing. [Use on abutment sheet.]
- L. Water mains and sewers must be cased within the influence zone of MSE walls. [Use on projects with water mains and sewers beneath MSE walls.] (4-19-2021)
- M. Do not place electric lines within or near MSE walls. [Use on projects with electric lines.] (4-19-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.07

SUPERSTRUCTURE

8.07.01

Miscellaneous Notes

- A. Alphabetical designation of deck pours is not to be construed as a pour sequence. [Use for simple spans.]
- B. Place deck pours according to the following sequence: Pour __, then Pour __ and Pour __ in any order. Pour __ and Pour __ in any order. Do not begin placement of subsequent pours for a minimum of 15 hours after completing placement of adjacent pours. This includes sections separated by longitudinal as well as transverse joints. [Use with simple spans regardless of beam and superstructure type and continuous steel spans. Approach slabs shall be cast separate from and after the deck is poured on the bridge. Modify note as required based on number of spans and pours.] (2-24-2025)
- C. Alphabetical designation of deck pours is not a pour sequence. Cast deck pours over piers after other deck pours have been cast. Do not begin placement of subsequent pours for a minimum of 15 hours after completing placement of adjacent pours. This includes sections separated by longitudinal as well as transverse joints. [Use for prestressed concrete beams that are continuous for live load.] (8-20-2009)
- D. Apply low temperature protection of concrete according to Section 706.03 J. of the Standard Specifications for Construction. Low temperature protection of concrete is included in the related items of work. [Use when possibility of pouring concrete during cold weather. With known cold weather pours use the pay item for cold weather protection.] (4-19-2021)
- E. Over active roadbeds, maintain formwork above the bottom of beams. [Use where bridge deck is to be cast over traffic.] (4-19-2021)

8.07.01 (continued)

- F. Notify the utility company one week prior to beginning installation of the ducts in the (sidewalk) (barrier). [Use when ducts are to be installed by others.] (9-18-1998)
- G. The contractor may use permanent metal deck forms. If used, corrugations must be filled with polystyrene foam. [Use when metal stay in place forms are permitted.] (4-19-2021)
- H. Do not use permanent metal deck forms. Remove all materials used to form the deck prior to opening the bridge to traffic. [Use where beam spacing or form loads preclude the use of stay-in-place forms.] (9-2-2003)
- I. Saw-cut the deck on both the top and bottom surface prior to deck removal procedures. [Use with bridge widening or with removal procedures required for stage construction.] (8-20-2009)
- J. Note Deleted. (6-26-2023)
- K. Provide a sawed joint 1½" deep by ¼" wide (minimum) in the top of slab at the locations shown in section(s)_____. Saw the joint within 24 hours of placing the curing and fill to ½" below top of concrete with polyurethane or polyurethane hybrid sealant. (Included in the bid item "Superstructure Conc, Form, Finish, and Cure, Night Casting (Structure Identification)"). [Use at all locations shown for continuous for live load slabs (generally at piers).] (6-26-2023)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.07.01(continued)

Miscellaneous Notes

- L. In order to maintain the integrity of the existing structure during Stage ____ construction, saw cut entirely through the (abutment) (pier) and a minimum of 4" into the top of footing for removal purposes. [Used with part width construction]. (12-17-2012)
- M. Provide a sawed joint 1 1/8" deep by 1/4" wide (minimum) in the top of slab at [transverse] [and longitudinal] [construction joints] [and] [reference joints] [and at fixed pin & hanger joints] . Saw the joint within 24 hours of placing the curing and fill to 1/2" below top of concrete with polyurethane or polyurethane hybrid sealant. (Included in the bid item "Superstructure Conc, Form, Finish, and Cure, Night Casting (Structure Identification)"). [Use at all bridge deck slab construction joints and reference joints over integral and semi-integral backwalls.] (6-26-2023)
- N. Apply (Concrete Surface Coating) (Silane) to the (entire concrete portion of bridge railing (including brush block),)(front face and top of concrete bridge barrier) (back face of concrete bridge barrier) (slab fascia,) (sidewalk fascia,) (underside of deck from slab fascia to fascia beam flange,) (exterior face and bottom of bottom flange of fascia beam). (See Special Provision for coating color.) (Use concrete surface coating [AMS-STD-595](#) color number [insert number], [insert color].) * The estimated area of coating is ____ syd. [Include any and all parts that are to be coated. Add sketch to plans for clarity if desired. Use note twice if applying silane and surface coating to differing faces of barriers. *Specify color in note if Frequently Used Special Provision is not used.] (4-19-2021)

8.07.01(continued)

- O. Salvage and reuse the existing stud type shear developers. See the Special Provision for Bridge Deck Removal and Salvaging Shear Developers on Steel Beams for limitations on the equipment that may be used during demolition of the existing bridge deck. Remove and replace damaged shear developers identified by the Engineer. [Install additional shear developers at the locations shown on the plans.] [Use on full and partial deck removal projects with existing stud type shear developers.] (4-19-2021) (11-28-2022)
- P. The slab haunches on this project are estimated to range from ____" to ____". Actual haunches may vary based on construction tolerances and the fabricated camber of the beams.[For information only. See Section [7.02.19 C.](#) for design criteria.] (2-24-2025)

8.07.02

Elastomeric Bearings

- A. If the position dowels at (Abutment ____)(Pier ____) are misaligned, in relationship to the centerline of bearings, due to temperature effects on the (beams) (girders), place elastomeric bearings with holes centered on the dowels. [Use for elastomeric expansion bearings. See Design Guide [8.43.01](#) and [8.43.01A.](#)] (9-1-1988)
- B. The design of the bearings at (Abutment ____)(and Pier ____) is based on AASHTO LRFD Method ____ . [Use on all projects with plain or laminated elastomeric bearings. Method B shall not be used unless approved by MDOT Structural Fabrication Engineer. This note is not required for elastomeric leveling pads.] (9-26-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.07.03

Prestressed Concrete I-Beam, Bulb-Tee Beam and Box Beam Notes

- A. The contractor is responsible for accurately locating the rod connection between box beams. [Use when widening box beam structures.]
- B. Use 0.6" nominal diameter prestressing strand meeting the requirements of AASHTO M203 (ASTM A416), Grade 270, low relaxation strand. (4-19-2021)
- C. Tension 0.6" dia. prestressing strands to an initial prestress of 44,000 lbs. (4-19-2021)
- D. Provide concrete inserts for drain casting assembly brackets according to Standard Plan B-101-Series. Cast inserts with the beams. Do not field install inserts. (9-1-1988)
- E. End blocks are (required) (optional). [Use for I-Beams.] (9-1-1988)
- F. Total estimated change of length of bottom flange at transfer of prestress force is ____".
- G. The estimated beam camber at release is ____". This camber is due to prestress and dead load of the beam only and is measured in the erected position. (8-6-1992)
- H. During handling and transportation, support beams ____ feet from the end. If two additional strands are draped, support beams ____ feet from the end. [Use with 70" deep beam, Michigan 1800 beam and Bulb-Tee beams.] (4-17-2017)
- I. Beams in span(s) ____ may be laterally unstable. Take precautions to ensure that beams are not damaged during handling and transportation. [Use when factor of safety for lateral buckling is 1.2 or less.] (8-6-1992)

8.07.03 (continued)

- J. Threading of reinforcement and installation into concrete inserts is included in the bid item ("Prest Conc I Beam, Furn, ____ inch") ("Prest Conc Box Beam, Furn, ____ inch") ("Prest Conc 1800 Beam, Furn") ("Prest Conc Bulb-Tee Beam, Furn, ____ inch by ____ inch"). (5-24-2021)
- K. Remove lifting devices after beams are erected. Cut lifting devices 1" above steel reinforcement and protect reinforcement from damage. Removal is included in the bid item ("Prest Conc I Beam, Erect, ____ inch") ("Prest Conc 1800 Beam, Furn") ("Prest Conc Box Beam, Erect, ____ inch") ("Prest Conc Bulb-Tee Beam, Erect, ____ inch by ____ inch"). (12-22-2025)
- L. Fill holes cast or formed in the beam with non-shrinking grout. Included in the bid item ("Prest Conc 1800 Beam, Erect") ("Prest Conc Bulb-Tee Beam, Erect, ____ inch by ____ inch"). [Use for Michigan 1800 Prestressed I-Beam and Bulb-Tee Beams.] (4-17-2017)
- M. At the locations shown on the plans, apply Silane to the beam ends for a distance of ____ feet, starting from the beam end at the joint, coating both sides, bottom and ends of beams (Do not coat outside and bottom of fascia beams.). [Use on Prestressed I-Beam, Michigan 1800 beam, Bulb-Tee Beams and spread box beam projects with expansion joints. Show the locations to be coated on the erection diagram. If concrete surface coating is being applied to fascia beams, do not apply silane in areas that will receive Concrete Surface Coating. Include Special Provision for Silane Treatment for Bridge Concrete.] (2-26-2018) (8-29-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.07.03 (continued)

Prestressed Concrete I-Beam, Bulb-Tee Beam and Box Beam Notes

- N. Apply concrete surface coating to the entire outside and bottom of the fascia beams. (Use concrete surface coating [AMS-STD-595](#) color number [insert number], [insert color].) [Use on Prestressed I-Beam, Michigan 1800 beam, Bulb-Tee Beams and spread box beam bridges where coating fascia beams will not significantly affect the maintaining traffic and when requested by the Region or Roadside Development Section.] (2-26-2018) (8-29-2022)
- O. Provide Grade 60 (ksi) beam steel reinforcement, including stirrups. (*Provide stainless steel reinforcement according to Section 905 of the Standard Specifications for bars denoted/detailed as "SD". Add Special Provision for Stainless Steel Reinforcement to the proposal.) [Use for Prestressed I-Beams, Michigan 1800 beam, Bulb-Tee Beams and all box beams except 17" & 21" box beams.] [*Use for box beams using stainless steel reinforcement.] (12-27-2021)
- P. Provide Grade 60 (ksi) longitudinal beam steel reinforcement (EA bars). The design of transverse beam steel reinforcement, slab ties (epoxy coated ED bars) and stirrups (stainless steel SD bars or epoxy coated ED bars) is based on Grade 40 (ksi); use either Grade 40 or Grade 60 in fabrication of the beam. (*Provide stainless steel reinforcement according to Section 905 of the Standard Specifications for bars denoted/detailed as "SD". Add Special Provision for Stainless Steel Reinforcement to the proposal.) [Use for 17" & 21" box beams.] [*Use for box beams using stainless steel reinforcement.] (12-27-2021)
- Q. Field drilling is allowed for sign support anchors only. Location of anchors is as detailed on Traffic & Safety Sign Support Special Details. Repair any damage to the beams at the contractor's expense as approved by the Engineer. (8-20-2009)
- R. Note Deleted. (3-24-2025)
- S. Use ($\frac{3}{4}$ ") (1") diameter concrete inserts; Dayton Superior, Type B-1 Two Strut Coil Tie - (Heavy) [$\frac{3}{4}$ "] (Standard) [1"] or Type B18 Single Flared Coil Loop Insert; Williams Form, Type C12 Two Strut Coil Tie or Type C19 Flared Coil Loop Insert; Meadow Burke, Type CX-4 Coil Loop Insert-Flared; or Engineer approved equal. Electroplate galvanize coil inserts in accordance with ASTM B633, Service Condition 4. Cast inserts with the beams. Do not field install inserts. [Use for Prestressed I-Beams, Bulb-Tee beams and spread box beams at backwalls or concrete diaphragms.] (4-19-2021)
- T. Use ($\frac{3}{4}$ ") (1") diameter concrete inserts; Dayton Superior, F63 Flared Thin Slab Coil Insert; Williams Form, C18 Coil Wingnut Insert; Meadow Burke, CX-28 Coil Wingnut Insert; or Engineer approved equal. Electroplate galvanize coil inserts in accordance with ASTM B633, Service Condition 4. Cast inserts with the beams. Do not field install inserts. [Use for Michigan (MI) 1800 beams at backwalls or concrete diaphragms.] (4-19-2021)
- U. Use $\frac{7}{8}$ " bolt diameter concrete inserts; Dayton Superior, F42 or F64 Ferrule Loop Insert; Williams Form, F15 or F16 Ferrule Loop Insert; Meadow Burke, FX-2 or FX-5 Ferrule Insert - Loop; or Engineer approved equal. Electroplate galvanize ferrule inserts and bolts in accordance with ASTM B633, Service Condition 4. Cast inserts with the beams. Do not field install inserts. [Use with 70" deep beam, Type III & IV beams and Bulb-Tee beams with steel diaphragms.] (4-19-2021)
- V. Use $\frac{7}{8}$ " bolt diameter, 4 $\frac{1}{2}$ " (4 $\frac{5}{8}$ ") long concrete inserts; Dayton Superior, F42 or F64 Loop Ferrule Insert; Williams Form, F15 or F16 Ferrule Loop Insert; Meadow Burke, FX-2 or FX-5 Ferrule Insert - Loop; or Engineer approved equal. Electroplate galvanize ferrule inserts and bolts in accordance with ASTM B633, Service Condition 4. Cast inserts with the beams. Do not field install inserts. [Use for Michigan 1800 beams and Type I & II beams with steel diaphragms.] (4-19-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.07.04

Screed Notes

- A. Bottom of slab elevations (are at right angles to the beam centerline and*) are based on the condition that the beams and diaphragms are completely erected with no other loads applied. (No temporary supports are allowed at this time.) These elevations include allowance for vertical curve and deflection due to forms, steel reinforcement, concrete slab, (sidewalks, railing) (barrier) and utilities. [*Use when dual bottom of slab elevations are shown.]
- B. If screeds are affected by loads in other spans, set to the elevations shown before casting any concrete. Cast concrete in the suspended span(s) before the concrete in the anchor spans.
- C. Screed elevations are based on the condition that no slab concrete has been cast and that formwork (shear developers) and steel reinforcement are in place (and the temporary supports are brought to a snug fit under each beam).
- D. (On span(s) _____,) provide transverse finishing parallel to reference lines. [Use when the angle of crossing is less than or equal to 75° or greater than or equal to 105° (skew angle greater than or equal to 15°).] (1-29-2024)
- E. Locate (outer*) screed rails for finishing of structural concrete over fascia beams (and over the beam adjacent to the open joint**).

* Omit the word "outer" on narrow decks, one pour wide.

** Add this where diaphragms are not continuous across wide decks.

8.07.04 (continued)

- F. Stage A is beams and diaphragms erected with no other loads applied. [For use with top of beam elevations.] (9-1-1988)
- G. Stage B is forms and steel reinforcement in place (all spans complete). [For use with top of beam and bulkhead elevations.] (9-1-1988)

8.07.05

Deck Replacement Notes (4-19-2021)

- A. Obtain the Engineer's written approval for proposed sequence and methods of removal before removing portions of the bridge superstructure according to Subsection 712.03 of the Standard Specifications.
- B. If removal operations result in damage to the retained portions of the structure, submit a corrective action plan to the Engineer according to Subsection 712.03 C. of the Standard Specifications. (9-18-1998)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.07.06

Structural Steel Notes

- A. Elastomeric bearing pads (1/8") used under steel masonry plates are included in the quantity for Structural Steel. (9-2-2003)
- B. Anchor bolt lengths shown are minimum. Bolts longer than those shown may be furnished at no additional cost.
- C. Coat structural steel according to Section 716 of the Standard Specifications. Use light gray urethane protective coat, [AMS-STD-595](#) color number 16440. [Use with shop or field coating. Check with Roadside Development Unit if other color is desired.] (12-26-2017)
- D. Provide structural steel conforming to AASHTO M270, Grade 50, or AASHTO M270, Grade 50W. (AASHTO M270, Grade 36, steel may be used in lieu of these steels for bearings, diaphragms, and cross frames.) (9-18-1998)
- E. Use steel for cross frames meeting the impact test requirements for main structural members shown in Subsection 906.04 of the Standard Specifications. [Use when bridge has horizontally curved girders.]
- F. Field splice(s) _____, if used, is (are) optional and will not be paid for.
- G. The following steel bridge members and member components have been designated as fracture critical, regardless of the direction of stress: ____*. Steel and fabrication procedures and requirements are according to the Standard Specifications. [*Identify component] [Use for structures that have fracture critical members other than pins and link plates.] (6-28-2021)

8.07.06 (continued)

- H. Field drill and bolt end diaphragms to the existing beams prior to pouring the deck. Field drill and bolt intermediate diaphragms to the existing beams after pouring the deck. [Use when widening structural steel bridge with diaphragms.] (9-18-1998)
- I. The plate surfaces of the main girder splices, and all other bolted connections are considered Slip Critical Connections unless noted otherwise. (8-20-2009)

8.07.07

Treatment of Epoxy-Coated Bars

- A. Shop cut reinforcement as shown. Repair the epoxy coating according to Subsection 706.03.E.8 of the Standard Specifications. [Place near cutting diagrams.] (8-6-1992)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.08

RAILROAD OVERPASS

8.08.01

Introduction

The railroad overpass general notes are to be used in conjunction with the general notes.

8.08.02

Title Sheet

- A. The design of the railroad overpass(es) is based on the current American Railway Engineering and Maintenance-of-Way Association Specifications, Cooper's E 80 * Loading, and ____ percent of the specified impact. [This note is to replace or be used in conjunction with general note [8.02 A.](#)]

* Or as specified by the railroad company

- B. Except where otherwise indicated on these plans or in the proposal and supplemental specifications contained herein, perform all work according to the current American Railway Engineering and Maintenance-of-Way Association Specifications.

8.08.03

General Plan of Site Sheet

- A. Railroad traffic will be maintained on a temporary trestle.
- B. The railroad will furnish all ties, ballast, rails, and all necessary materials and labor for all track work on a force account basis. [This note should be amended for each job by consulting the railroad agreement on each project.]
- C. The information concerning the movements of trains and speed thereof does not represent any commitment on the part of the railroad to continue them unchanged, inasmuch as they are subject to change without notice.

8.08.03 (continued)

- D. Details of temporary steel sheet piling and bracing must meet with the approval of the railroad.

8.08.04

General Plan of Structure Sheet

- A. The design of this structure is based on the current American Railway Engineering and Maintenance-of-Way Association Specifications, Cooper's E 80 * Loading, and ____ percent of the specified impact.

* Or as specified by the railroad company

8.08.05

Structural Steel Notes

- A. Shop and field coat steel according to Subsections 716 & 715 of the Standard Specifications.

8.08.06

Temporary Trestle

- A. Maintain the temporary trestle throughout the entire construction period as directed by the Engineer.
- B. The design of the temporary trestle is based on the American Railway Engineering and Maintenance-of-Way Association Specifications, Cooper's ____ Loading, and ____ percent of the specified impact.
- C. At any stage of construction, do not cause unreasonable delay to the railroad traffic, as per the agreement with the ____ railroad.
- D. Coating of structural steel is not required on the temporary trestle.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.09

8.09.01 (continued)

REHABILITATION PROJECTS

8.09.01(4-19-2021)

Miscellaneous Notes

- A. The work covered by these plans includes (resurfacing the existing bridge deck), (replacing the existing barriers) (removing) (retaining) the existing railing and constructing a new concrete block retrofit railing, B-50-Series, at the curb line atop the existing sidewalk or brush block), and maintaining traffic. (11-25-2019)
- B. Apply (Concrete Surface Coating) (Silane) to the (entire concrete portion of bridge barrier (including brush block),)(front face and top of concrete bridge barrier) (back face of concrete bridge barrier) (slab fascia,) (sidewalk fascia,) (underside of deck from slab fascia to fascia beam flange,) (exterior face and bottom of bottom flange of fascia beam). (See Special Provision for coating color.) (Use concrete surface coating [AMS-STD-595](#) color number [insert number], [insert color].) * The estimated area of coating is ____ syd. [Include any and all parts that are to be coated. Add sketch to plans for clarity if desired. Use note twice if applying silane and surface coating to differing faces of barriers. *Specify color in note if Frequently Used Special Provision is not used.] (4-19-2021)
- C. Apply low temperature protection of concrete according to Section 706.03 J. of the Standard Specifications for Construction. Low temperature protection of concrete is included in related items of work. (12-5-2005)
- D. Implement measures to prevent debris from falling from the structure. (*If debris falls into the waterway, remove it within 24 hours. Since disturbance of the waterway bottom may be as harmful as the debris itself, the preventive measures must be effective.) Removal of debris is included related items of work. [*Use for bridges over waterways.] (4-19-2021)
- E. Notify each utility company a minimum of three full working days in advance of work impacting that company's conduits or facilities. (8-20-2009)
- F. Do not weld on existing girders (beams) (except as noted).
- G. Remove all accumulated foreign matter from the (bridge deck including (sidewalk)(curbs)(expansion joints)), (tops of abutments (including bearings)), (tops of piers (including bearings)) (lower flanges of (beams)(girders) (within (____) feet of reference line(s) (____)). Stage work such that elements are clean and free of debris after completion of all bridge work. If cleaning of elements is required for access or to safely perform work operations, cleaning may be required before and after other items of work. Included in the bid item "Bridge Cleaning (Structure Identification)". (Payment for cleaning area of steel requiring painting is included in the cleaning and coating pay items.) [Use when requested by Region Bridge Engineer for bridges receiving preventative maintenance or rehabilitation work. Include all parts that are to be cleaned. Include Special Provision for Bridge Cleaning.]

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.09.01 (continued)

Miscellaneous Notes

- H. At the locations shown on the plans, apply Silane to the beam ends for a distance of _____ feet, starting from the beam end at the joint, coating both sides, bottom and end of beam (after completion of any beam repairs). (Do not coat outside and bottom of fascia beams.). [Use on rehabilitation projects with Prestressed I-Beam, Michigan 1800 beam, Bulb-Tee Beams and box beam bridges with expansion joints. Show locations to be coated on the erection diagram or on the existing general plan of structure. If concrete surface coating is being applied to fascia beams, do not apply silane in areas that will receive Concrete Surface Coating. Include Special Provision for Silane Treatment for Bridge Concrete.] (8-29-2022)
- I. The steel density of the existing reinforcement (in the _____) to be protected by galvanic anodes is _____. [This note is to be used with the Frequently Used Special Provision for Embedded Galvanic Anodes, High Performing for Corrosion Control on all rehabilitation projects that include concrete repair. Include separate notes or provide a table to report the steel density for each repair location where existing reinforcement will be exposed (deck, barrier, abutment).] (8-25-2025)

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

8.09.02

Bridge Deck Repair Notes

- A. The volume of "Conc (Bridge Deck Ovly) (Silica Fume Modified)" is based on the overlay and an estimated quantity to replace unsound concrete and to make (crown) (superelevation) (grade) adjustments as determined by the Engineer. (12-5-2005)
- B. Completely remove and replace the (barrier) (sidewalk) (brush block) within the limits of the joint replacement detailed on the plans. The work to remove the existing concrete and reinforcement is included in the bid item "Deck Joint, Rem". (9-23-2024)
- C. Sound concrete before overlaying to determine whether the removal at either side of transverse joints will be adequate. Increase the removal limits as approved by the Engineer. (5-22-2017)
- D. Silica Fume Modified Concrete or Latex Modified Concrete may be selected for the bridge deck overlay concrete. (9-2-2003)
- E. False decking includes the area bounded by (Reference Lines ___ & ___) (edges of shoulders) and outside flange fascias of fascia beams. [Use when limits are not detailed on the plans.] (4-19-2021)
- F. Construct bridge overlay to a cross slope of (2%)(1.5%)(to match existing slope). [Use 2% cross slope unless compelling reasons warrant the use of 1.5% or existing cross slope. See Section [7.02.19 G.](#) for additional information.] (8-20-2009)
- G. Heavy equipment, including concrete trucks and vacuum trucks for removing concrete debris, are not allowed on hydrodemolished surfaces of the deck. (4-19-2021)

8.09.02 (continued)

- H. Do not scarify or hydrodemolish the area(s) designated as link slab(s). [Detail limits on deck plan.] (12-5-2005)
- I. Over active roadbeds, maintain formwork above the bottom of beams. [Use where bridge deck is to be cast over traffic.] (4-19-2021)

8.09.03

Railing Replacement Notes

- A. Removal of existing guardrail is included in the bid item "Guardrail, Type ____". [Applies to projects where the quantity is low or is not included in road plans.]
- B. Do not coat the metal expansion joint except for exposed metal surfaces at the concrete barrier. Shop and/or field coat according to Subsections 716 & 715 of the Standard Specifications. (Included in the bid item "Bridge Joint, Revise Expansion Device".) [Use when revising existing metal expansion joints.]
- C. Remove rail and posts from parapet railing and retain anchor bolts. (Included in the bid item, "Bridge Railing, Thrie Beam Retrofit".) [Use when circumstances such as sight distance or poor condition warrant rail and post removal.] (8-20-2009)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.09.04

Maintenance Painting Notes

- A. This bridge is coated with lead based paint. [Existing bridge was built before 1967, has never been repainted, and has the original paint system (i.e. not uncoated A588 steel).] (8-20-2009)
- B. This bridge is coated with lead based paint. The structural steel has been blast cleaned prior to coating. The additional effort to clean the structural steel will not be paid for separately but will be considered included in the bid items. [Existing bridge was built between 1967 and 1978, has never been repainted, and has the original paint system (i.e. not uncoated A588 steel).] (8-20-2009)
- C. This bridge is coated with a lead based coating system. The structural steel has been blast cleaned prior to coating. The additional effort to clean the structural steel will not be paid for separately but will be considered included in the bid items. [Existing bridge was repainted between 1967 and 1978.] (8-20-2009)
- D. This bridge is coated with a zinc based coating system. The structural steel has been blast cleaned prior to coating. The additional effort to clean the structural steel will not be paid for separately but will be considered included in the bid items. [Existing bridge was built after 1978, or was repainted after 1978. It does not have uncoated A588 steel.] (8-20-2009)
- E. This bridge has uncoated A588 structural steel. The additional effort to clean the structural steel and the additional coating material required due to excessive surface profile will not be paid for separately but will be considered included in the bid items. [Existing bridge has uncoated A588 steel.] (1-23-2012)

8.09.04 (continued)

- F. (*Do not) clean and coat ____ (conduits) (mains). (*See Subsection 715 of the Standard Specifications.) [*Use for Johns Manville Transite (asbestos) ducts or when protective shielding is requested by the utility company.] (8-6-1992)
- G. Remove and replace end diaphragms of spans _____ to permit proper cleaning and coating. Included in the bid item "End Diaphragm, Rem and Replace". See Subsection 715.03 E. of the Standard Specifications. [Use when clearance between end diaphragms and backwall or adjacent diaphragms is 14" or less and the slab above the diaphragms is not to be removed.] (8-6-1992)
- H. When hanger assemblies are not to be replaced, protect the existing paint under the link plates from damage due to blast cleaning by inserting an approved material around the periphery of the link plates. Remove the material prior to coating. (Included in the bid item "Steel Structure, Cleaning, Type 4 (Structure Identification)".) (12-5-2005)
- I. The Engineer will inspect the structural steel parts that have been blast cleaned for evidence of cracks or loss of section due to corrosion of more than 25 percent. The Engineer will report deterioration in writing to the Region Bridge Engineer. [Use on all projects with blast cleaning and coating structural steel.] 2-16-2016)
- J. The estimated area of structural steel to be coated is ____ square feet.
- K. Apply Substructure Horizontal Surface Sealer to the top of Abutment ____ (and __) (and the front face of the independent backwall). Clean accidentally coated vertical surfaces at contractor's expense. [Use when there is a superstructure transverse joint directly above or the unit is adjacent to a pavement.] (12-5-2005)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.09.04 (continued)

Maintenance Painting Notes

- L. Apply Substructure Horizontal Surface Sealer to the top of (all) Pier(s) (___ & ___). Clean accidentally coated vertical surfaces at contractor's expense. [Use only when superstructure transverse joints are directly above the pier.] (12-5-2005)
- M. Remove shear locks by methods approved by Engineer before structure is blast cleaned. (Included in the bid item "Steel Structure, Cleaning, Type 4 (Structure Identification)".) (12-5-2005)
- N. Remove the sign(s) over (description of location) to permit proper cleaning and coating of the fascia beam(s). After the coating has been cured in accordance with Subsection 715.03 D.3. of the Standard Specifications, reinstall sign(s) using new connection hardware. [Use where it has been determined that signs must be removed to allow cleaning and coating of fascia beams.] (12-27-2022)
- O. Apply sealant around the perimeter of bearing plate to concrete contact surfaces after cutting away any protruding portion of lead plate. [Use when superstructure transverse joints are directly above pier or abutment.] (9-18-1998)
- P. Apply sealant around the perimeter of bolted end diaphragm connection plates and angles. [Use when end diaphragms are under an open transverse deck joint.] (9-18-1998)
- Q. Apply sealant around the perimeter of all riveted girder plates and angles. [Use at riveted plate girders.] (9-18-1998)
- R. Apply sealant around the perimeter of all beam ends where encased in the backwalls. (9-18-1998)

8.09.04 (continued)

- S. Apply sealant to the perimeter of all riveted (bolted) girder plate and angle contact surfaces at the outside face of the fascia beams for the entire length and at each girder end, below deck joints, for a total length of 5'-0" [Use at riveted or bolted plate girders on outside of fascia only.] (9-18-1998)
- T. Blast clean and prime faying surfaces prior to erecting (diaphragms) (bent plates). Included in the pay items for cleaning and coating existing structural steel. [Use where project includes field coating and steel members will be added or replaced.] (9-18-1998)
- U. Apply sealant around the perimeter of riveted pin plates and stiffeners. (9-18-1998) (11-26-2012)
- V. Apply sealant around the connection of new structural steel member to existing structural steel member. (8-23-2021)
- W. Use light gray urethane protective coat, [AMS-STD-595](#) color number 16440. [Use with shop or field coating. Check with Roadside Development Unit if other color is desired.] (12-26-2017)
- X. Protect portions of the structure, including superstructure, substructure, slope protection, and highway appurtenances from spatter and overspray of coating material. Included in the bid item "Steel Structure, Coating, Type 4 (Structure Identification)". (12-5-2005)
- Y. The plate surfaces of the main girder splices, and all other bolted connections are considered Slip Critical Connections unless noted otherwise. (4-19-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.09.05



Hanger Assembly Replacement Notes

- A. Clean and coat the area within 3 feet each side of the centerline of the hanger assembly prior to installing the new link plates and pins. Shop coat proposed link plates. (Field coat proposed stiffeners.) (12-5-2005)
- B. Repair the end diaphragm after installation of the new hanger assembly as shown on the plans. [Use if diaphragm repair is required.]

8.09.06 (4-19-2021)

Existing Plan Sheet Notes

- A. Do not work from this sheet. The information shown here is for reference only. No pay items are shown. [Use on existing plan sheets used for information only.] (9-18-1998)
- B. The only items of work to be done from this sheet are identified by the legend box below, labeled with this project's job number. [Use on existing plan sheets used for removal and proposed work. Add the legend box below.] (9-18-1998)

JOB NO. <New Number>	
	Proposed Work
	Denotes Removal Portions

- C. Only the hatched areas, indicating removals, are to be used for bidding purposes. [Use if just removals are shown, with no legend box.] (9-18-1998)
- D. The bridge paint may contain lead. [Use on all projects with existing painted structural steel regardless of work type.] (8-20-2009)

8.09.07 (4-19-2021)

Temporary Support Notes

- A. Contact the Region Soils Engineer at least 48 hours in advance to request a foundation inspection prior to the placement of the temporary support footing (or the "Embankment, Structure, CIP"). (6-24-2024)
- B. Use structural grade timber with a minimum flexural strength of 1,200 psi and a minimum horizontal shear strength of 100 psi.
- C. Do not load temporary supports for a continuous period greater than four weeks. [Use when footing is placed on soil or paved surface.]
- D. Use temporary concrete barrier to protect the temporary support as shown on the plans or as directed by the Engineer. [Use when protection of temporary support is not covered in maintaining traffic.]
- E. Submit alternative design of the temporary support shown to the Engineer according to the Standard Specifications when any plan dimension, detail, or material is changed. Base alternate designs of the temporary support on loads as follows:
 - ____ tons vertical girder load (Dead Load).
 - ____ tons vertical girder load (Live Load).
 - ____ psf allowable soil pressure.(7-25-2022)
- F. The temporary support design does not include the weight of construction equipment. If construction equipment is to be used on the span while the temporary support is in place, submit an alternative design and working drawings to the Engineer in accordance with the Standard Specifications for Construction. The alternative design must include a check of the existing superstructure that accounts for the current condition of bridge members and must include details for any strengthening of the existing structure required to prevent damage from the temporary support loads. (9-26-2022)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

8.10

STEEL REINFORCEMENT (9-1-1988)

- A. Bundle and tag reinforcement according to the location as shown on this sheet.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 9

Chapter has been removed. Relevant information has been relocated to Chapter 1. (11-24-2025)

**MICHIGAN DESIGN MANUAL
BRIDGE DESIGN**

CHAPTER 10

SHOP DRAWING REVIEW

10.00 SHOP DRAWING REVIEW

10.01 TYPES OF SHOP DRAWINGS

10.01.01 Structural Steel

10.01.02 Prestressed Concrete

10.01.03 Bearings

10.01.04 Metal Stay - In - Place Forms (11-26-99)

10.01.05 Expansion Joints

10.01.06 Mechanical Equipment

10.01.07 Electrical Equipment and Circuitry

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10.02 SHOP DRAWING PRODUCTION (3-26-2018)

10.03 SHOP DRAWINGS FOR RAILROAD STRUCTURES

10.03.01 Review Time

10.03.02 Fabricator Submittal (8-20-2009)

10.04 SHOP DRAWINGS FOR CONSULTANT-DESIGNED JOBS (3-26-2018)

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BRIDGE DESIGN

CHAPTER 10

SHOP DRAWING REVIEW

10.00

SHOP DRAWING REVIEW

When reviewing shop drawings, it is not necessary to check the exact dimensions. It is the responsibility of MDOT to ascertain that the fabricator is supplying the items specified, while it is the contractor's responsibility that all items are fabricated to the correct dimensions. See [Subsection 104.02](#) of the Standard Specifications for Construction. Fabricators shall submit all drawings in Adobe Acrobat "PDF" format. (8-20-2009)

10.01

TYPES OF SHOP DRAWINGS

Shop drawings for the following construction items require the review and approval by MDOT prior to authorizing fabrication:

- A. Structural Steel
- B. Prestressed Concrete Beams
- C. Bearings
- D. Metal Stay-In-Place forms (11-26-99)
- E. Expansion Joints (If not pre-approved.)
- F. Mechanical Equipment
- G. Electrical Equipment and Circuitry
- H. Water Mains
- I. Mechanically Stabilized Earth (MSE) Walls (8-20-2009)
- J. Precast Three Sided, Arch or Box Culverts greater than 10 feet in span length (8-20-2009)

10.01.01

Structural Steel

Structural Steel shop drawings shall be reviewed for the items included on the [Structural Steel Shop Drawing Review List](#) (pages 13-15) accessible through the [Structural Fabrication Unit](#) website. This list includes items to be reviewed by MDOT Bridge Design as well as MDOT Structural Fabrication. (3-26-2018)

The Design Engineer shall review and approve structural steel pay weights submitted. Pay weights will be stamped in same manner as for Structural Steel Shop Drawings. (3-26-2018)

10.01.02

Prestressed Concrete

Prestressed Concrete shop drawings shall be reviewed for the items included on the [Structural Precast Concrete Shop Drawing Review List](#) (pages 11-12) accessible through the [Structural Fabrication Unit](#) website. This list includes items to be reviewed by MDOT Bridge Design as well as MDOT Structural Fabrication Unit. (3-26-2018)

10.01.03

Bearings

Elastomeric Bearing shop drawings shall be reviewed for the items included on the [Elastomeric Bearing Shop Drawing Review List](#) (page 10) accessible through the [Structural Fabrication Unit](#) website. This list includes items to be reviewed by MDOT Bridge Design as well as MDOT Structural Fabrication Unit. (3-26-2018)

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10.01.04

Metal Stay-In-Place Forms (11-26-99)

Shop drawings for fabricator designed metal stay-in-place forms shall be reviewed for the following items:

- A. That all criteria listed in section 706.03 D of the Standard Specifications for Construction have been adhered to. (12-5-2005)
- B. Voids are filled or not filled with concrete based upon original design.
- C. Deck depth has not been compromised (increased or decreased) as result of using forms.
- D. All materials are galvanized.
- E. Support angles do not protrude above proposed top of haunch (or top of the beam where there is no proposed haunch) (8-23-2021) (8-20-2009)
- F. Caulk or grout is applied along longitudinal seam between support angles and beam.
- G. Gauge (thickness) of metal deck form. Generally 0.0456"(19 gauge) or 0.0336" (22 gauge) is acceptable.
- H. Welding or mechanically fastening permanent metal deck forms or accessories to structural steel is prohibited. (6-16-2014) (3-26-2018)

10.01.05

Expansion Joints

Shop drawings are not required for proprietary expansion joints installed in bridge decks where the maximum opening is 4", and where standard shop drawings have been pre-approved by MDOT. The Contractor may select any joint that satisfies the design requirements from a number of joints listed on the plans and in the supplemental specifications. Copies of the standard shop drawings of the devices selected are available at the MDOT website or will be provided to the Resident/Delivery Engineer by MDOT Bridge Design. When the maximum opening in the bridge deck is larger than 4", a modular expansion joint is required and shop drawings for these joints shall be handled as the shop drawings for structural steel in Section [10.01.01](#). (3-26-2018)

10.01.06

Mechanical Equipment

Shop drawings for mechanical equipment must be reviewed for general conformance with the design specifications and plan details. The Contractor may submit copies of catalogue cuts, parts lists, operating procedures, etc., for review.

10.01.07

Electrical Equipment and Circuitry

Shop drawings for electrical equipment and circuitry must be reviewed for general conformance with the design specifications and plan details. The Contractor may submit copies of catalogue cuts, parts lists, operating procedures, etc., for review.

10.01.08

Water Mains

Shop drawings for water mains must be reviewed for general conformance with the design specifications and plan details. The drawings shall, as a minimum, show the plan and profile of the water mains, the type and quantity of material, all details for special connectors and fittings, and a listing of all specialty items.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

10.01.09

MSE Walls (8-20-2009)

Shop drawings and design calculations shall be reviewed for general conformance with the design specifications (including Special Provision for MSE Retaining Wall System), plan details and the following items:

- A. Geometry.
- B. Factored bearing pressure versus factored bearing resistance.
- C. Minimum soil reinforcement length(s).
- D. Conformance to the plans and specifications.
- E. Corrosion protection of soil reinforcements.
- F. Coping details.
- G. Aesthetic details.
- H. Load and resistance factors in calculations.
- I. How the MSE wall supplier is dealing with obstructions.
- J. Quantities.
- K. Calculations use correct parameters (such as phi angle, unit weight of soil, surcharges, etc.) specified in specifications.
- L. Calculations supplied for precast panel reinforcement.
- M. Professional Engineer seal from MSE wall designer.

10.01.10

Precast Three Sided, Arch & Box Culverts

Shop drawings for precast culverts must be reviewed for general conformance with the design specifications and plan details.
(5-24-2021)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

10.02

SHOP DRAWING PRODUCTION

MDOT's Bridge Design Shop Drawing Review Process has been incorporated into MDOT's E-Construction [Shop Drawing Review Process](#) document accessible through the [Structural Fabrication Unit](#) website. This document details the production, submittal, review and distribution process for shop drawings for all fabricated structural elements. (3-26-2018)

10.03

SHOP DRAWINGS FOR RAILROAD STRUCTURES

When a railroad crosses over a highway, the Railroad must review and approve shop drawings for that structure.

10.03.01

Review Time

At the pre-construction meeting the Contractor must be made aware of the extra time required for review of the shop drawings by the Railroad.

10.03.02

Fabricator Submittal

The fabricator shall submit shop drawings (in PDF format) to MDOT for review. MDOT will forward shop drawings (in PDF format) to the Railroad for review and after approval. (8-20-2009)

10.04

SHOP DRAWINGS FOR CONSULTANT-DESIGNED JOBS

When a structure has been designed by a consultant, shop drawing review will, in general, be a separate part of the Scope of Work defined in the Consultant Agreement. The review of shop drawings and structural steel pay weights shall be as described in sections 10.01-10.03. The consultant shall complete all shop drawing reviews utilizing ProjectWise and following the appropriate workflows whenever possible. (8-20-2009) (3-26-2018)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 11

PLAN REVISIONS

11.01 GENERAL INFORMATION

11.02 PLAN REVISION PREPARATION (11-25-2024)

- 11.02.01 General Procedure and Distribution
- 11.02.02 Plan Revisions Involving Shop Details and Suppliers
- 11.02.03 Plan Revisions Involving Federal-aid Projects
- 11.02.04 Plan Revisions Involving Utilities
- 11.02.05 Plan Revisions Affecting the Load Carrying Capacity of the Structure
(8-20-2009)
- 11.02.06 Plan Revisions Involving Package Contracts

MICHIGAN DESIGN MANUAL

BRIDGE DESIGN

CHAPTER 11

PLAN REVISIONS

11.01

GENERAL INFORMATION (8-20-2009) (11-25-2024)

General information regarding plan revisions can be found in [Road Design Manual Section 14.70](#).

- A. When it is necessary to change the plans of a project, update the CAD (Computer Aided Drafting) files and produce new plan sheets. Prepare a Revision of Plans [Form 0291](#) and/or a Pay Item Changes spreadsheet (if applicable). If the revision is for a log job, then a revision box is created on the 8½" x 11" sheet and the revisions are made in the same manner as for plan sheets described in this chapter.
- B. If the quantity change is of a bid item that is routinely balanced at the completion of construction (e.g., Structural Steel, earthwork) and the change is minor, it does not have to be included on the form, but instead note that the quantity adjustment is included in the final balancing.

11.01 (continued)

- C. When making a plan revision, any change in dimensions or quantities are made by crossing out the figures/details being revised (do not delete), adding the new figure/detail above or adjacent to the old figure/detail and circling the entire revision. Place the revision number adjacent to the circled figures/details. As noted in subsection 11.01 A., update the CAD files without deleting the original details.
- D. The revision block on the plan sheets is to be used only for revisions made after plans are advertised for bidding. Revision numbers are prefixed with the letter B. Example: B-1.

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11.02.01 (continued)

11.02

PLAN REVISION PREPARATION

11.02.01

General Procedure and Distribution (11-25-2024)

A. General Procedure (8-20-2009)

Follow the procedure laid out in [Road Design Manual Section 14.70.01](#), subsections 1. - 5.

B. Distribution

1. MDOT

From ProjectWise, send an email link from PLANREV1.PDF, to all affected "MDOT" staff notifying them that a plan revision is available. List of possible recipients includes:

- a. Construction Files
- b. TSC Construction Engineer
- c. Bridge Design Unit (if structure affected)
- d. Road Design Unit (if grade, alignment or drainage affected)
- e. Bridge Management Unit – Bureau of Bridges and Structures (Load Rating Engineer) (if change affects load capacity of structure)
- f. Structural Fabrication Unit – Bureau of Bridges and Structures (if change affects beams or other structural elements)
- g. Utility Coordination, Permits & Agreements Section of Development Services Division, Bureau of Development (if change in quantities chargeable to a utility company)
- h. Railroad Coordination Unit – Office of Rail

2. Non-MDOT

Distribute copies of Revision of Plans [Form 0291](#), a Pay Item Changes spreadsheet (if applicable) and the revised plan sheets (if required) in "PDF" format, to any "non-MDOT" affected agencies. List of possible recipients includes:

- a. FHWA (Risk Based Project Involvement) (FHWA oversight projects) See [Section 11.02.03](#)
- b. Consultant
- c. City (if participating)
- d. County (if participating)
- e. County Drain Commission
- f. Utility
- g. Steel Reinforcement Fabricator
- h. Fabricator (if structural steel or prestressed concrete is affected)
 - 1) Steel beams or pile bents
 - 2) Tube railing
 - 3) Bearings
 - 4) Expansion joint device
 - 5) Stay in place forms
 - 6) PC beams
 - 7) MSE wall units
 - 8) Culverts
 - 9) Structural steel repairs
 - 10) Pin & hanger assemblies
 - 11) Ornamental fence
 - 12) Other fabricated materials/items not listed

(11-25-2024)

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11.02.02

Plan Revisions Involving Shop Details and Suppliers

Plan revisions involving shop details and suppliers require that revised detail sheets be included with Revision of Plans [Form 0291](#).

11.02.03

Plan Revisions Involving FHWA Oversight Projects (Risk Based Project Involvement (RBPI))

- A. Plan revisions involving **FHWA Oversight** (RBPI) projects are to be reviewed by and discussed with the FHWA before they are distributed.
(8-6-92)
- B. Indicate on Revision of Plans [Form 0291](#) the date of FHWA approval.
(10-22-2012) (5-27-2013)
- C. Exceptions to the above would be plan revision(s) involving dimensions, small changes in quantities, or a similar omission in the plans.

11.02.04

Plan Revisions Involving Utilities

On a plan revision involving a change in quantities chargeable to a utility company, send a ProjectWise email link from PLANREV1.PDF to the Utilities-Permits Section in the Development Services Division.
(8-20-2009) (10-22-2012)

11.02.05

Plan Revisions Affecting the Load Carrying Capacity of the Structure

If the plan revision will affect the load-carrying capacity of the structure, send a ProjectWise email link from PLANREV1.PDF to the Bridge Management Unit (Load Rating Engineer) of the Bureau of Bridges and Structures.
(8-20-2009) (10-22-2012)

11.02.06

Plan Revision on Package Contracts (8-20-2009)

- A. On plan revisions concerning bridges in package contracts, where more than one bridge is involved, it is necessary to identify the structure, sheet number(s) and detail(s) involved on the Revisions of Plans Form.
- B. Prepare separate plan revisions for each structure involved even though the revisions are the same or are distributed at the same time.

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CHAPTER 12

REHABILITATION PROJECTS

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CHAPTER 12

REHABILITATION PROJECTS

12.00

REHABILITATION PROJECTS (9-1-88)

For the purpose of this volume, the following definitions will be used:

Preventive maintenance work is defined as bridge activities that will repair and preserve the bridge. Projects where only this work is done do not have to include geometric enhancements. This is done with the understanding that future rehabilitation or reconstruction projects will contain appropriate safety and geometric enhancements, thus Design Exceptions / Variances are not required for preventive maintenance work. These activities include joint replacement, pin and hanger replacement, complete painting, zone painting, thin polymer overlays, deck patching, asphalt overlay, hot mix asphalt (HMA) cap and scour countermeasures. (9-2-2003) (2-21-2017)

Rehabilitation (3R) is defined as work undertaken to extend the service life of an existing bridge and to enhance highway safety. The intent of this work is to return a bridge to a condition of structural or functional adequacy. This work may include upgrading geometric features such as roadway (bridge) widening (no increase in number of through lanes), flattening curves, or improving sight distance. Examples of this work are shallow and deep concrete overlays, superstructure repairs, railing replacements, extensive substructure repair, and substructure replacement. (8-20-2009)

Reconstruction (4R) involves substantial changes to the existing structure such as bridge deck replacement or greater. See Chapter 7 for reconstruction (including deck replacements) projects requirements. (3-26-2012)

12.00 (continued)

Bridges to remain in place criteria occurs when a bridge carrying road project traffic falls within a road project and no work is planned for the bridge (see AASHTO publication, ***A Policy on Design Standards - Interstate System*** or ***A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition***). If the bridge does not meet the criteria to “remain in place” the Road Designer shall submit any necessary design exceptions or design variances for the bridge. (3-26-2012) (3-21-2016) (8-22-2016) (2-21-2017)

With structure resurfacing, railing upgrading and joint replacement projects the structural adequacy of the superstructure shall be evaluated.

Structures being hydrodemolished, being painted (constructed prior to 1978) or when hazardous material removal are part of the project work need a Michigan Department of Environment, Great Lakes and Energy (MDEGLE) hazardous waste number. If a number exists in [MiBRIDGE](#) (web based structure management application) and begins with anything but “MIG”, “MIE”, “MIH” or “MIT” use this number on project Title Sheet (note [8.02 I.](#)). If number doesn’t exist or begins with “MIG”, “MIE”, “MIH” or “MIT” request a new number from the Bridge Management Section, Bureau of Bridges and Structures data request email, MDOT-Bridge-Data-Request@michigan.gov. See also Section [14.04](#). (8-23-2021) (1-27-2020) (10-28-2024)

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12.01

SCOPE OF REHABILITATION PROJECTS (8-20-2009)

The scope for rehabilitation projects is created by the Region Bridge Engineer using the Bridge Deck Preservation Matrix (Section [12.09.02](#)) and [Steel Bridge Girder Coatings Repair Matrix](#) (Section [12.07](#)). As soon as possible after assignment, the bridge design engineer should schedule a scope verification meeting. At this meeting, the scope of the project will be reviewed. (10-23-2017)

If a project includes 3R and 4R (Chapter 7) work, the applicable standards are governed by the standards that correspond individually to each work type (3R or 4R). Work type overlap within a structure may cause a default to 4R standards within the overlap (entire structure). Identify each work type on the project information sheet to distinguish where 3R guidelines and 4R standards are separately applied.

When other work types are combined with 3R or 4R projects, they are also governed separately and identified as such on the project information sheet.

Projects categorized as CPM (preventive maintenance) projects are governed by guidelines that differ from 3R and 4R Guidelines. When CPM work types are packaged with a 3R or 4R project, the portion of the project that is outside the 3R or 4R work limits is governed by the guidelines that pertain to CPM work type. When describing the work type in the request for Plan Review Meeting, identify the work type separation so that the appropriate requirements are considered within each structure. Work type overlap within a structure may cause a default to 3R or 4R requirements.

Cross road over bridges shall be treated as individual segments regardless of project work type. (8-22-2016)

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12.01 (continued)

SCOPE OF REHABILITATION PROJECTS

In addition to any concerns the designer may have over the project scope, the following design elements must be reviewed to determine conformance with both MDOT's 3R criteria (see Road Design Manual [Chapter 3](#)) and AASHTO standards (see also Section [12.02](#)). For specific controlling geometric design elements, a formal design exception must be submitted and approved when the standards cannot be met. Other specific elements and conditions will require a less formal design variance when standards cannot be met. These elements are listed below with their corresponding level of documentation and/or approval.

The Geometric Design Unit will review plans and identify the need for Design Exceptions (DE) or Design Variances (DV) when standards are not met for specified geometric design elements. See also Section [12.03](#). (8-20-2009) (2-21-2017)

Non-Standard Design Element (NHS and Non-NHS)	Applicability of Design Exception(DE) Design Variance (DV)	
	Design Speed	
	≥ 50 MPH	< 50 MPH
Design Speed < Posted Speed	DE	DE
Lane Width*	DE	DV **
Shoulder Width	DE	DV
Horizontal Curve Radius*	DE	DV
Superelevation Rate*	DE	DV
Superelevation Transition Length*	DV	DV
Maximum Grade*	DE	DV
Stopping Sight Distance (HSO and K-value Horizontal and Vertical)*	DE	DV
Cross Slope	DE	DV
Vertical Clearance	DE	DE
Design Loading Structural Capacity	DE	DE
Ramp Acceleration / Deceleration Lanes Length*	DV	DV

*Values based on design speeds less than posted.

**Lane width reductions from existing conditions on National Networks require the Design Exception process be followed regardless of design speed. See Road Design Manual section [3.08.01 G](#). (11-28-2022)

For more detailed information/definitions of elements, see the [Road Design Manual](#). (2-21-2017)

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12.01.01

Structures Carrying Pedestrian or Other Mode of Transportation (12-16-2019)

Where pedestrian traffic exists across a structure having sidewalks less than 4'-0" wide, an evaluation must be made to determine the hazard involved and to consider practical improvements.

All structures carrying pedestrians need to be evaluated for conformance with the Americans with Disabilities Act (ADA) requirements.

Regardless of project work type, expansion joints located on sidewalks shall be fitted with cover plates to eliminate vertical depressions caused by the joint. Cover plates may be galvanized steel (AASHTO M270, Grade 36) or steel encapsulated in EPDM rubber or neoprene (polychloroprene). Cover plates shall meet all the requirements set forth by ADA. See Section [7.02.27](#) & [12.06.01](#), EJ3 & EJ4 Sheets and Bridge Design Guide [6.28.06](#). Detail cover plates that require a length greater than 11' to be fabricated from two equal length pieces with a joint located at the centerline of the sidewalk or path. Provide a ¼" wide gap at the joint that is parallel to the centerline of the sidewalk or path. (1-23-2023)

Where recommended by the Region Project Development or Bridge Engineer, rehabilitation projects should include pedestrian fencing. In Metro Detroit, all rehabilitation projects, including painting projects, over freeways should include pedestrian fencing.

For limits of the metropolitan area see [Appendix 12.01.01](#). (8-6-92)

For information regarding MDOT fencing policy and design criteria see Section [7.02.29](#) and Section [7.05](#).

Where other modes of transportation (pedestrian, bicycle, multi-use paths, etc.) exist across a structure, an evaluation must be made to consider practical improvements.(12-16-2019)

12.01.02

Historic Bridges

Consideration must be given to preserving structures designated as "historic bridges." The project engineer can find a bridge's historical significance from [MiBRIDGE](#) (web based structure management application) . (5-28-2013) (2-21-2017)

Designers rehabilitating historically designated bridges shall contact the Cultural Resource Coordinator in the Environmental Services Section of the Bureau of Highway Development to determine what measures are practical and justified to preserve the historical value. Where projects are insufficiently scoped for the proposed work, adding significantly to the cost of the project, the designer shall request the Region Project Development Engineer to appropriate the additional funds from their bridge budget.

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12.02

GEOMETRIC CRITERIA

While it is desirable to improve all structures to current design standards, upgrading to this extent may not be considered cost effective where a project is otherwise programmed for only rehabilitation. Criteria for roadway widths and design loading structural capacity have been established in ***A Policy on Design Standards - Interstate System***, 2005, and the 7th Edition of AASHTO's ***Policy on Geometric Design of Highways and Streets*** ("***Green Book***" or "***GB7***"). These criteria are based on the type of roadway carried by the structure and are summarized in [Appendix 12.02](#). Criteria for structures carrying interstate freeways are provided in AASHTO's 2005 edition of ***A Policy On Design Standards - Interstate System***. The policy states: "The standards used for horizontal alignment, vertical alignment, and widths of median, traveled way, and shoulders for resurfacing, restoration and rehabilitation projects may be the AASHTO interstate standards that were in effect at the time of the original construction or inclusion into the interstate system." Non Interstate structures shall adhere to the ***GB7*** design criteria (standards). Therefore, if a bridge on a road project is not altered it is subject to design exceptions or design variances for full new/reconstruction standards. (1-26-2026)

12.02.01

Vertical Clearance (1-26-2026)

For Design Exception Requirements for Vertical Clearance see [Appendix 12.02.01A](#).

For Construction on Existing Roads (3R) freeway projects, if the existing vertical clearance is not reduced and a crash pattern involving high load hits does not exist, the vertical clearance may be retained without a design exception. However, if the vertical clearance is reduced to a value less than the standard (table value in Section [7.01.08](#)), a design exception will be required. The format for the design exception does not require a detailed evaluation but should include the basis for the request and review of the accident history and high load hits for the structures in the immediate vicinity of the structure.

For the remaining Construction on Existing Roads (3R) route classifications (Section [7.01.08](#)), existing vertical clearances greater than or equal to the minimums shown may be retained without a design exception. Vertical clearance reductions that fall below the minimums for new construction require a design exception.

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12.03

DESIGN EXCEPTIONS / DESIGN VARIANCES

The **GB7** classification of a project as defined by Section 3.08 of the Road Design Manual will determine whether a geometric review is required for a bridge project. The **GB7** categorizes projects into three different project types, with the historic 3R/4R classifications following in parentheses:

- New Construction (4R)
- Reconstruction (4R)
- Construction on Existing Roads (3R)

If the project classification calls for a Design Exception/Design Variance, identify it during the Scope Verification Process or at Project Scoping. The table in [Appendix 12.02.01B](#) includes common bridge projects and their associated project types. Submittals of Design Exceptions / Variances on a timely basis are essential to maintain the project schedule and provide an approved design where conditions may inhibit designers from meeting the required design criteria.

Additionally, Urgent Needs and Request for Action projects as defined in Section 8.03, do not require geometrics review for design exceptions / design variances.
(1-26-2026)

Design Exception (DE) - Design Exception requests are submitted on [Form DE26](#) and require approval by the Engineer of Design. With the exception of low speed (< 50 mph) vertical clearance DE's, subsequent FHWA approval is required for DE elements specifically designated for federal approval in the [Risk Based Project Involvement Stewardship and Oversight \(RBPI S&O\)](#) plan.
(12-27-2021)

Along with the justification for not meeting MDOT and/or AASHTO standards the design exception includes a site-specific Highway Safety Manual (HSM) Crash Analysis (if applicable) and the estimated total cost required to attain full standards compliance. If a specific HSM model does not exist for that roadway type, then perform a crash analysis using crash data for the existing conditions.

12.03 (continued)

Utilize the most recent 5 years of crash data available on RoadSoft for the requested Geometric element. The project Crash Analysis or Road Safety Audit (if required) are not applicable for design exceptions. See Road Design Manual Section 14.11 for design exception submittal procedures.

Design Variance (DV) – Design Variances are submitted on [Form DV26](#). The procedures and conditions of design variances are as follows:

- Crash analysis review on the element in question.
- Simple justification for not meeting standards (cost, ROW, environmental, etc.)
- If the DV involves a geometric element affected by a bridge, coordination with the Bridge Design Supervising Engineer is required.
- The DV is signed by the Associate Region Engineer of Development affirming that the DV is appropriate.
- The signed DV in ProjectWise completes the DV process.

During QA review of final plan package, if a DV is needed and not provided, the project will not proceed to letting until a DV is provided. If the DV is provided, then the project proceeds. Verification must be indicated on the Milestone Checklist and the Certification & Acceptance (CA) form.

See Road Design Manual Section 14.11 for additional information on design variances.

When a proposed road rehabilitation project contains a bridge not conforming to minimum standards, and no work is proposed for the bridge, AASHTO “bridges to remain in place” criteria apply to the bridges. See AASHTO publication, ***A Policy on Design Standards-Interstate System***, 2005 or the **GB7**. The road Design Engineer/Project Manager will prepare the design exception / variance request and shall be responsible for submitting any necessary design exceptions or design variances for the bridge. (1-26-2026)

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12.03.01

Requests for Traffic Volumes and Crash Histories

(9-1-88) When requesting traffic volumes and crash histories, the Design Engineer should advise the appropriate Bureau, Division or Section as to when the response is needed to meet the schedule for plan preparation. The request should also identify any other work included within the project limits, e.g., additional bridges, road construction or other mode of transportation. (12-16-2019)

A. Traffic Volumes(Traffic Analysis Request)

Send requests for traffic volumes to the Bureau of Transportation Planning, Project Planning Section using MDOT [Form 1730](#).

(5-1-2000) (5-28-2013) (02-17-2014)

B. Crash Histories

Send requests for crash histories to the appropriate Region or Lansing Traffic and Safety personnel. (See sample submittal in [Appendix 12.03.01 B.](#)) (9-2-2003)

Where underclearance is the only design exception, however, the concern about crashes is limited to impacts from high loads. This history and the approximate traffic volume are most expeditiously obtained from the Bridge Management Unit of Bureau of Bridges and Structures. (8-6-92) (3-26-2012)

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12.04

STRUCTURE RESURFACING(9-2-2003)

Where the scope of work indicates an overlay, it will be for one of the following types:

- Shallow concrete overlay
- Deep concrete overlay
- Hot mix asphalt (HMA) wearing course

Shallow concrete overlays are either latex or silica fume. Use this option when additional deck work is anticipated in 10 to 15 years.

Deep overlays are silica fume modified mixes or Grade 4500 concrete with slag cement replacement. Use this option where the underside of the deck is sound and additional deck work is not anticipated for 25 to 30 years. See Section 12.04.06 B. (6-28-2021)

Use an HMA wearing course on a waterproofing barrier - where additional deck work is anticipated within 5 to 10 years. (12-5-2005)

With all types of overlays, an existing thrie beam retrofit height of 34" to top of rail shall be maintained. (12-5-2005)

See the Bridge Deck Preservation Matrix (Section [12.09.02](#)) for further clarification.

See section [7.02.19 G](#) when superelevations and parabolic crowns are encountered on an overlay project. (12-5-2005) (3-26-2012)

If feasible overlays should be done to a 2 % cross slope, otherwise a 1.5 % slope is acceptable. A check of the structural adequacy of the superstructure shall be done and composite action of shallow and deep concrete overlays according to AASHTO Bridge Specifications shall also be considered. (8-20-2009)

12.04.01

Origin of Projects

Resurfacing projects usually originate from the bridge maintenance programs of the Region/TSC. They may also originate from a road resurfacing project, since the FHWA requires all structures within the limits of such projects be considered for upgrading if there is a need.

12.04.02

Bridges Within Road Project Limits

(9-2-2003) Concrete decks that are in good condition and that have no existing hot mix asphalt (HMA) overlay will be gapped out of road resurfacing projects. If the deck condition is poor or there is an HMA overlay, they shall be treated as follows:

- A. If the deck is scheduled for a concrete overlay, it shall be included in the project as a concrete overlay.
- B. If the deck is scheduled for replacement within two years, the deck may be overlaid with HMA. Any existing HMA shall be removed.
- C. Gapping out the HMA overlay is not cost effective for very short structures. For these structures, the HMA overlay will be continued across the structure after placing a waterproofing barrier.

12.04.03

Concrete Removal

(5-1-2000) Decks which are to be overlaid with a concrete surfacing mixture will be prepared by scarification followed by two passes of hydrodemolition.

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12.04 (continued)

12.04.04

Hydrodemolishing

Normally, the entire deck surface will be hydrodemolished regardless of the apparent extent of unsound concrete. This will assure removal of any undiscovered delaminations along with the layer of concrete having the highest chloride contamination. Any existing overlays or hot mix asphalt (HMA) patches must be removed, and the deck scarified, before beginning the first pass of hydrodemolishing. Calculate area with limits as reference lines and toes of barriers/curbs. Eliminate area of link slabs if they exist and add note [8.09.02 I](#) to plans. (12-5-2005) (8-23-2021)

Ideally, properly calibrated hydrodemolishing equipment will remove the specified depth of sound concrete and all unsound concrete. From experience, it is known that some unsound concrete will remain after one pass and the need for a second pass can be anticipated. The second pass area shall be estimated at 4% of the first pass. If the deck to be overlaid has an existing latex overlay, the second pass quantity will be estimated at 10% of the first pass. This is due to the greater difficulty in estimating the areas of unsound concrete. (5-1-2000)

Ensure that the structural capacity (design, legal and permit loading) for bridges during hydrodemolishing for rehabilitation/overlay projects will not be decreased. For further information regarding hydrodemolishing of variable depth concrete T-Beam bridges and precautions to take, please see the "[Rehab Guidelines for T-Beam Structures](#)" reference document, located at the Bridge Operations, Bridge Management and Scoping website. (7-17-2017)

12.04.04 (continued)

Structures being hydrodemolished need a Michigan Department of Environment, Great Lakes and Energy (MDEGLE) hazardous waste number. If a number exists in [MiBRIDGE](#) (web-based structure management application) and begins with anything other than "MIG", "MIE", "MIH" or "MIT" use this number on project Title Sheet (note [8.02 I](#)). If number doesn't exist or begins with "MIG", "MIE", "MIH" or "MIT" request a new number from the Bridge Management Section, Bureau of Bridges and Structures data request email, MDOT-Bridge-Data-Request@michigan.gov. See also Section [14.04](#).

(8-23-2021) (1-27-2020) (10-28-2024)

12.04.05

Hand Chipping

When it is necessary to remove unsound concrete by hand chipping, the removal of the concrete will be divided into two categories:

- A. Hand Chipping - Shallow:
Where concrete removal is not required to be deeper than the midpoint of the top reinforcement, the concrete removal shall be bid as "Hand Chipping, Shallow."
- B. Hand Chipping - Deep:
Where concrete removal is required to be below the midpoint of the top reinforcement, the concrete removal shall be bid as "Hand Chipping, Deep."

Where bridge decks require hand chipping, the areas requiring it shall be indicated in a diagram included on the plans. Normally, the Engineer should increase the total area of delaminations shown on the maintenance report by 50 percent to arrive at the plan quantity for hand chipping. However, if spalled or delaminated areas occur in clusters, each cluster should be enclosed in an assumed area to be hand chipped. The total of the assumed areas should be increased by 20 percent to arrive at the plan quantity. (9-1-88)

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12.04 (continued)

12.04.06

Concrete Overlays (5-1-2000)

MDOT uses the following two strategies for concrete overlays (also see Section [12.09.02](#) and the Bridge Deck Preservation Matrix):

A. Shallow Overlays (7-28-2025)

Shallow overlays are a medium term fix. They are designed to last approximately 10 to 15 years.

Remove a minimum of 1½" from the bridge deck. The removal must include scarifying the top surface of the deck a minimum of ¼". The final 1" of removal must be completed using hydrodemolition to achieve the desired surface profile.

Shallow overlays consist of a latex modified or silica fume modified concrete overlay mixture placed a minimum of 2 ¼" in thickness. If the thickness must be less than 2 ¼" contact the BOBS Construction Unit to discuss the appropriate plan details for the project.

B. Deep Overlays (6-28-2021)

Deep overlays are a long term fix. They are designed to last 20 to 30 years depending on the condition of the existing deck.

Deep overlays consist of a concrete overlay made of either silica fume modified concrete or Grade 4500 concrete with slag cement replacement. It is placed on the existing deck after it has been scarified and hydrodemolished.

It is desirable to completely encapsulate the top mat of reinforcing steel in the deep overlay. However, it is difficult to know the precise location of the mat before hydrodemolishing the deck. In addition, the thickness of the existing deck will influence the amount of concrete removed.

12.04.06 B. (continued)

The deep overlay thickness and procedures varies depending on the thickness of the existing bridge deck (excluding any existing overlay).

For decks 7½" or less in thickness, the deck is scarified ¼" and hydrodemolished 2¾" or to ¾" below the top mat of steel, whichever is less. The overlay is a minimum of 3" in thickness. (10-24-2001)

For decks greater than 7½" in thickness, the deck is scarified ¼" and hydrodemolished 3¾" or to ¾" below the top mat of steel, whichever is less. The standard concrete overlay should use silica fume modified concrete with a minimum thickness of 4". (1-20-2015)

Deep overlays for which 2/3 or more of the deck will be greater than 4" in thickness should use a Grade 4500 concrete that replaces 25 to 40 percent of the required cement content with slag cement. These overlays shall not become shallower than 2". Additional chipping at the gutter line (toe of barrier or curb) may be detailed to accommodate this requirement. See the Special Provision for Deep Concrete Bridge Deck Overlays.

12.04.07

Hot Mix Asphalt (HMA) Overlays and Caps (12-5-2005)

In general, an HMA overlay or cap is not a preferred treatment for bridge decks. Where a bridge is scheduled for a deck replacement within two years, an HMA cap is an acceptable means of obtaining rideability.

Where HMA is used for a longer term overlay (five years or more) the designer must incorporate a waterproofing membrane in the design (see the Standard Specifications). Also see Section 12.04.

Where an HMA mix has not been specified as part of a road project, the project manager should consult the Construction Field Services Bituminous Pavement Unit for an acceptable HMA. (3-26-2012)

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12.04 (continued)

12.04.08

Approaches (5-1-2000)

To eliminate approach pavement settlement, a concrete approach section will be used for all concrete overlays. For hot mix asphalt (HMA) deck overlays, a concrete approach is not necessary. (3-26-2012)

The details of the approach slab shall be as specified on Standard Plan R-45-Series except on existing structures where the grade will not be raised; the length of the approach slab shall match the existing approach slab joint.

The transverse limits of the approach section shall extend to the concrete curb and gutter.

12.04.09 (2-22-2021)

Metal Mesh Panels

Bridge deck deterioration and spalling concrete from the underside of bridge has led to the need to protect the roadways below bridges.

A. Considerations

Metal mesh panels should be considered for projects with full depth patching in spans over traffic, and projects with rigid (concrete) overlay projects, regardless of observed condition of deck underside. Panels should be added over the extents of all paved areas, including paved shoulders and sidewalks. For projects that require false decking, include quantities for false decking as usual. False decking will be removed upon completion of rehabilitation work, and metal mesh panels will be installed.

12.04.09 (continued)

B. Limitations and Use Guidance

1. Metal mesh panel length is limited to 6'-6". Larger sizes become too heavy and too awkward for the average personnel to install. Larger sizes have not been impact tested. Longer sizes can be accommodated but require the width of the panel to be reduced from 48" to 24". Also require design checks on tube sizes and revision to Special Provision.
2. Metal mesh panels are not applicable on curved girder structures or superstructures with flared beam spacing.

3. Other Considerations

- a. Variable depth steel girders would require a designed attachment.
- b. Steel beams with full depth diaphragm connections or stiffeners require a modification to the panel.
- c. Concrete T-Beams and spread box beams require a designed connection.

4. Fit and Installation Problems

In general, metal mesh panels are installed by placing one end of the metal mesh panel near the top flange(web fillet) until the other end clears the opposite bottom flange. Then rested on the bottom flanges. Installation is similar on PCI Beams.

- a. Short beams need to be checked for feasibility of installation.
- b. Check bays for utilities that would interfere with installation.
- c. Check clearance between diaphragm and bottom flange.

Use wood false decking when metal mesh panels cannot be used on a project and circumstances warrant protection of roadways, shoulders, or sidewalks.

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12.05

RAILING UPGRADING (11-25-2019)

Bridge railings shall be upgraded where the existing facility is found to be inadequate, either because of crash experience or because it is not a current MDOT approved railing. Upgrading will be scheduled according to the following guidelines:

- A. Railings shall be upgraded at any location where a revised railing can be expected to reduce the severity of crashes.
- B. Railings shall be upgraded at any location within safety upgrading projects.
- C. Railings shall be upgraded when bridge reconstruction of any nature is planned.
- D. Railings shall be upgraded where pedestrian screening is added to a bridge.

The decision to retain, retrofit, or replace existing railing depends on the type and condition of the railing and the curb or sidewalk treatment.

Where replacement is required, the proposed railing must be a current MDOT approved railing. (5-1-2000)

12.05.01

Approved MDOT Railings

(5-1-2000) (11-25-2019) (9-28-2020)

Current MDOT approved railings are:

- A. Bridge Barrier Railing, Type 6 (B-29-Series)
- B. Bridge Barrier Railing, Type 7 (B-28-Series)
- C. Bridge Railing, Aesthetic Parapet Tube (B-25-Series)
- D. Bridge Railing, 2 Tube (B-21-Series)
- E. Bridge Railing, Thrie Beam Retrofit (B-22&23-Series)
- F. Bridge Railing, 4 Tube (9-2-2003) (B-26-Series)
- G. Bridge Railing, 3 Tube With Pickets (B-27-Series)
- H. Bridge Railing, Concrete Block Retrofit (B-50-Series)
- I. Bridge Barrier Railing, Type 6, Replacement * (B-29-Series & [Bridge Design Guides](#))

* **Type 6, Replacement (adhesive anchored) barrier must only be used for non-NHS routes.** Approval to use Type 6, Replacement (adhesive anchored) barriers on NHS routes must be requested from the Chief Structure Design Engineer if the deck overhang cannot be replaced AND the superstructure has appreciable life left (good or fair condition upon completion of the project). Other criteria/circumstances that make replacement of the barrier and necessary portions of the deck not technically feasible may be considered.

Adhesive anchored railings other than Bridge Railing, Conc Block Retrofit and Bridge Barrier Railing, Type 6, Replacement (subject to the specific conditions listed in the footnote above) are not permitted.

(12-28-2020) (10-24-2022)

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12.05.02

Existing Railings and Upgrading Options (11-25-2019) (9-28-2020) (10-24-2022)

Use the following table to determine railing treatment on projects. Table options are minimum railing upgrading criteria and when circumstances warrant the railing shall be replaced rather than retrofitted or retained.

Option		Offset	Posted Speed	R4 Railing (concrete posts)	R5 Railing (metal posts)	Concrete Parapet Railing	Aluminum Railings (2&3 Tube)	R15 Railing (GM Shape), Type 4 & 5
Reconstruction		All	All	Replace				Replace
Rehabilitation ⁽⁶⁾	Guardrail Retrofit	Sidewalk/Brushblock ≤ 2'-6" ⁽¹⁾	All	Retrofit (Std B-22)	Replace	Retrofit ⁽²⁾ (Std B-23)	Replace	Replace or Retain ⁽⁴⁾
		Sidewalk/Brushblock > 2'-6" ⁽¹⁾	≤ 40 mph	Replace or Guardrail ⁽³⁾		Retain		
			> 40 mph	Replace				
	Concrete Block Retrofit, B-50 ⁽⁵⁾	Sidewalk/Brushblock ≤ 1'-6" ⁽¹⁾	All	Remove Railing and Retrofit				
		Sidewalk/Brushblock ≥ 1'-6" ⁽¹⁾	All	Remove or Retain Railing and Retrofit				
	Type 6, Replacement (non-NHS only)	All	All	Remove Railing and Replace ⁽⁶⁾				
Preventive Maintenance		All	All	Retain				Retain

Replace = Replace railing with Standard MDOT approved bridge rail.

Retrofit = Retrofit per Standard Plans B-22, B-23 or B-50 Series.

Retain = Retain existing bridge rail.

Guardrail = Attach thrie beam guardrail directly to concrete posts.

¹ Where sidewalks are required for pedestrian use, they shall provide at least 4'-0" clear distance between the bevel point and the retained, retrofitted or replaced railing. (12-5-2005).

² Normally, handrails should not be removed; however, if they are removed, anchor bolts should be left in place. This treatment is accepted as crash tested for Michigan Thrie Beam Retrofit (Std B-23).

³ Replace railing if circumstances warrant, otherwise attach thrie beam guardrail to railing (concrete posts) with 7/8" diameter bolts. Wood blocks and blockouts shall not be used in guardrail attachment to posts. If approach guardrail is present or being installed, it shall be attached to thrie beam guardrail on bridge; use thrie beam transition and expansion sections as required. If no approach guardrail is present or being installed terminate thrie beam guardrail at end post of railing with thrie beam terminal connector.

⁴ Obsolete Standards R15 A - R15 N, X-17 and B-17 Series & X-20 and B-20 Series. Replace if warranted by the condition of the existing barrier and the crash history, retain otherwise.

⁵ Sidewalk/brushblock height at curb must be ≥ 10".

⁶ Remove sidewalk width as needed for shoulder width.

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12.05.02 (continued)

Existing Railings and Upgrading Options

While a thrie beam retrofit, concrete block retrofit or Type 6, Replacement is an acceptable means of upgrading existing substandard railings, there will be locations where shoulder widths will be less than the minimums recommended for minor bridge deck rehabilitation. In these situations, the project manager shall request a design exception or design variance for shoulder widths. (8-6-92) (11-25-2019) (9-28-2020) (10-24-2022)

12.05.03

Horizontal Curvature

Where a structure is on a horizontal curve with a radius less than or equal to 950 feet, consideration should be given for a special railing system to accommodate sight distance. This may require the complete removal and replacement of the existing railing system.

12.05.04

Revisions to Guardrails

When a bridge railing is replaced with a new railing, approach and trailing guardrails shall be changed to meet current standards. Guardrail having corrosion resistant (rusty steel) beam elements shall be replaced. Where obsolete guardrail extends a considerable distance from the structure, guardrail replacement should be limited to 200'-0" in each quadrant. See Road Design Manual Section [7.01.44](#) for guardrail upgrading on local roads. (8-6-92) (3-26-2012) (6-25-2018)

12.05.05

Repairs to Existing Type 4 or Type 5 Railings

Many situations warrant repairs to portions of an existing bridge railing that is otherwise intended to be retained. The following requirements pertain to situations where deterioration of portions of existing Type 4 or Type 5 railings is such that portions must be removed and replaced.

Generally, the replaced portions of bridge railing may be attached to the existing bridge deck using adhesive anchored reinforcement. Guidance for adhesive anchoring of Type 4 barrier railing can be found in Bridge Design Guide 6.29.09A. These details can be adapted for Type 5 barrier railing repairs.

Do not use adhesive anchored reinforcement to replace portions of bridge railings in the following cases:

- A. The existing deck at the fascia of the bridge is in poor condition.
- B. The railing is being repaired due to damage caused by a vehicle collision.
- C. The existing bridge railing is attached to the bridge deck using adhesive anchored reinforcement.

Exceptions to the cases listed above may be considered based on project specific conditions and must be approved by the Chief Structure Design Engineer.

Projects requiring the replacement of Type 4 or Type 5 railing along a full fascia of the bridge must be replaced with a current MDOT approved railing and follow the requirements of the new railing. (1-27-2025)

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12.06

JOINT REPLACEMENT

Deck joints of various types have proven ineffective and may require replacement on projects where other rehabilitation has been scheduled. Because of their poor performance, joints should be eliminated whenever possible. On painting contracts, leaking joints should be sealed. On overlay projects, even joints in good condition should be replaced to match the new deck grade.

A common treatment for the expansion joints at the abutments of continuous concrete T-Beam bridges built in the 1940s and 1950s was to support the sidewalk on a sliding steel plate over the independent backwall. On projects of this type, plans should call for removal of the plates at the independent backwall and the installation of the new expansion joint from fascia to fascia. Where existing railing is to remain in place, provision should be made for replacement of the end posts. (8-6-92)

Generally, joint replacement should include replacement of the deck from fascia to fascia (including portions of the barriers) to ensure consistent opening for the entire width of the bridge. If sufficient opening exists, and barrier ends and fascias are in good condition, joint replacement may be terminated at the barrier. (3-20-2017)

12.06.01

Expansion Joint Devices

(5-1-2000) Where expansion joints require replacement, the deck concrete should be removed and replaced for the full depth, 1'-6" either side of the joint. (See Bridge Detail EJ3)

Where expansion joint replacement is the only substantial work on the existing deck, and the deck concrete is sound, some proprietary joints can be replaced using the procedure shown on Bridge Detail EJ4. This replacement removes only enough concrete to remove the existing joint and to permit the casting of polymer or elastomeric concrete headers. Shallow depth strip seal anchorages are then embedded in the header material. This allows a fast joint replacement. (5-1-2000)

12.06.01 (continued)

The expansion device shall be replaced with a proprietary expansion joint currently approved by MDOT and having no single opening wider than 4". Where openings greater than 4" are required, a modular expansion joint may be used. (See the Special Provision for Modular Expansion Joints.)

When an expansion joint device is used on a sidewalk it shall be fitted with a cover plate as described and detailed in Section [7.02.27](#), [12.01.01](#), EJ3 and EJ4 Sheets and Bridge Design Guide [6.28.06](#). (1-23-2023)

12.06.02

Felt - Type Joints

Where felt - type joints ("Joint Filler") are to be removed, deck concrete should be removed and replaced for the full depth, 1'-6" either side of the joint. Replacement will be with an expansion joint device, or, where possible, the joint eliminated.

12.06.03

Revisions to Deck Joints (5-1-2000)

When removing curbs or sidewalks from decks, it will be necessary to rehabilitate the existing deck joints.

- A. Metal Expansion Joints. Where it is necessary to extend an existing metal floor joint or an expansion joint device after removal of the curbs, the plans shall include a bid item for "Bridge Joint, Revise Expansion Device".
- B. Felt -Type Joints. Where it is necessary to extend a felt-type joint, either an expansion or a construction joint, after removal of the curb, the plans shall include a bid item for "Bridge Joint, Revise Compression Seal".

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12.07

PAINTING

Projects for painting structural steel are requested by the Region/TSC. These projects may either be for the repainting of previously coated steel or the initial painting of A588 steel. For additional information, see Subsection [7.02.17](#). The [Steel Bridge Girder Coatings Repair Matrix](#) also provides guidance on paint defects and recommended repairs. (10-23-2017)

12.07.01

Blast Cleaning

- A. In addition to the normal precautions required during blast cleaning of existing steel, provisions must be made to properly confine and dispose of abrasive material and residue. These provisions are required whether the entire structure is to be cleaned or only isolated portions. (8-6-92)
- B. (8-6-92) Some telephone ducts installed under bridges in the past have been Johns Manville Transite ducts, made in part of asbestos. These will have to be encased to prevent release of the asbestos into the atmosphere during blast cleaning for painting.

The bridge inspectors will identify ducts marked "Johns Manville" or "Transite" and record this information on their reports. If the telephone ducts are inaccessible and the material cannot be identified, this will be noted. We will then make the determination during a site visit. (5-1-2000)

These ducts and others not requiring painting should be encased in a protective shielding to prevent damage due to blast cleaning (see Note [8.09.04 C.](#)).

12.07.02

Substructure Protection

To prevent deterioration, coat (seal) the top surface of all substructure units under superstructure transverse joints. For coating options (materials) see Subsection [7.03.11](#). (12-27-2022)

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12.07.03

Pins and Hangers (1-24-2022)

The pin and hanger assemblies of cantilever bridges are particularly susceptible to corrosion, and their replacement may have to be included in painting contracts. Region scoping engineers will designate which assemblies will have to be replaced. See [Chapter 7](#) for details.

Where steel beams of adjacent spans are in contact or insufficient expansion length is available between beam ends, consider addressing the closure and the cause of the closure.

If the webs are buckling at closed pin and hanger assemblies, the closure should be addressed.

There are several options to address the closure. Feasibility of various options is dependent on the proposed scope of work. The decision should also be based on the maintenance report and/or observations made during field reviews.

Often, pressure from approaching concrete pavements cause the superstructure to shorten and should be addressed by adding pavement relief joints.

The following repair methodology/criteria is relevant only for redundant structures:

If two pin and hanger assemblies exist between fixed bearings, the closed pin and hanger assembly can be fixed by adding a bolted stay plate and removing the stay plate at the opposing assembly. Substructures should be analyzed for additional loads, where applicable.

If the deck is being replaced, beams may be pulled back to their original location, restoring the opening between beam ends. Other work to the superstructure may be necessary.

12.07.03 (continued)

If necessary, beam ends can be trimmed. To determine the feasibility of trimming, the capacity of the beam must be evaluated for the proposed edge distance between the pin holes and the cut surfaces. If pack rust exists between pin plates of built-up members, employ mechanical means of beam cutting.

If beams are in contact, and cutting or other methods stated above cannot be implemented to relieve the pressure and/or restore the opening between beam ends, an analysis should be performed to ensure that the beams can be left in contact until a project with sufficient scope to address the issue can be constructed.

The assessment and repair of non-redundant (fracture critical) structures should be handled on a case by case basis. It may not be prudent to leave girder ends in contact until a project with sufficient scope can be constructed since web buckling of a single member could have a larger impact on the overall performance of the superstructure.

Generally, the design of new pin and hanger assemblies result in dimensions that are different than those of the existing assemblies. The designer must ensure that the proposed pin and hanger assemblies do not conflict with existing elements and will fit within the confines of the existing superstructure while still meeting all applicable design requirements. (2-21-2023)

New pins shall be stainless steel and used in conjunction with nylon washers and non-metallic bushings. New pin plates/link plates shall use an allowable bearing stress of $0.8 F_y$. Non-redundant structures shall use a reduced allowable bearing stress of $0.4 F_y$. (12-5-2005)

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12.07.04

End Diaphragms

On field inspections of structures scheduled for painting, the designer should consider accessibility behind end diaphragms for cleaning and painting. If the end diaphragms are within 1'-2" of an abutment backwall (or if the end diaphragms at a pier are too close) and the slab above the diaphragms is not to be removed, the diaphragms shall be removed to permit proper cleaning and coating.

Plans shall include an acceptable system for shoring the slab while the diaphragm is not in place. It should be noted that the contractor may use an alternate shoring system subject to the engineer's approval.

Where end diaphragms must be removed for cleaning and painting, place note [8.09.04 G.](#) on the plans and detail work according to Subsection 715.03 E. of the Standard Specifications. (8-23-2021) (12-27-2022)

12.07.05

Cleaning and Coating Exposed Steel

(8-6-92) Where structural steel has been exposed by the removal of deck concrete, it shall be cleaned and coated. Cleaning and Coating shall be according to the Standard Specifications for Construction or Special Provisions.

Construction sequencing (painting after casting deck) of deck replacement projects with steel beams requires the use of the pay item, "Top Flanges and Beam Ends, Clean and Coat", even if the project requires total beam painting. (8-20-2009)

12.07.06

Performance Warranties for Bridge Painting (5-1-2000)

Whenever possible, performance warranties shall be required on bridge painting contracts. On non-National Highway System bridges (NHS) the Design units shall include the performance specification in the contract. A trunkline project can be considered non-NHS, even though it may have NHS funding, if the facility carried is non-NHS.

If the facility carried is NHS traffic, the performance warrantee specification may still be applicable. The Design units shall contact the Construction Field Services Coatings Specialist, at the preliminary plan stage, to determine whether the bridge can be added to Special Experimental Projects list for warranty painting. (3-26-2012)

12.07.07

Paint Color (5-1-2000)

The standard color for MDOT bridges is Light Gray. The [AMS-STD-595](#) number for this color is 16440. Previously, the MDOT standard color was Light Blue - number 15488. Other colors may be recommended by the Region. (3-21-2016) (10-23-2017) (12-26-2017)

12.07.08

MDEGLE Hazardous Waste Number (8-23-2021) (10-28-2024)

All structures scheduled for painting (constructed prior to 1978) need a Michigan Department of Environment, Great Lakes and Energy (MDEGLE) hazardous waste number. If a number exists in [MiBRIDGE](#) (web based structure management application) and begins with anything but "MIG", "MIE", "MIH" or "MIT" use this number on project Title Sheet (note [8.02 I.](#)). If number doesn't exist or begins with "MIG", "MIE", "MIH" or "MIT" request a new number from the Bridge Management Section, Bureau of Bridges and Structures data request email, MDOT-Bridge-Data-Request@michigan.gov. See also Section [14.04](#).

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12.07.09

A588 Steel Beams (9-2-2003)

The following rehabilitation situations exist for A588 beams:

1. Little or no section loss ($< 20\%$), painting is not required.
2. Significant section loss ($\geq 20\%$), the entire structure is painted. This includes projects with beam end repairs.
3. Pin and hanger projects where beams are otherwise in good condition ($< 20\%$ section loss), beams are zone painted (with the outside of the fascia beams top coated brown in the zone area).

12.07.10

Partial Painting

Where structural steel cleaning and coating involves only partial sections of beams or diaphragms the entire perimeter of the beams or diaphragms, less any portions encased in concrete, shall be cleaned and coated. Cleaning and Coating shall be according to the Standard Specifications for Construction or Special Provisions. (3-26-2012)

When temporary stiffeners are required, use the remaining life of the existing coating system to determine the appropriate cleaning and coating items to include. Generally, if a project to clean and coat the existing structural steel is not planned for 5 years or more, specify that the perimeter of the temporary stiffener be sealed using the Beam Plate, Seal Perimeter pay item and call for the cleaning and coating of the existing structural steel located within at least 3 feet of the temporary stiffener. If a project to clean and coat the existing structural steel is planned within the next 5 years, it is recommended to not include the sealing of the perimeter of the temporary stiffener or the cleaning and coating of the existing structural steel outside of the limits of the faying surface. In both cases, the treatment of the faying surfaces of the temporary stiffener and the existing structural steel and the coating of the temporary stiffener shall be according to the Standard Specifications for Construction or Special Provisions. (8-29-2022)

12.07.11

Existing Bridge Sign Connections (12-27-2022)

For rehabilitation projects that do not include replacement of bridge mounted sign connections, the Bridge Engineer must visually inspect existing connections for evidence of beam overstress or distortion. If signs of overstress or distortion are observed, analyze the existing beam and include the installation of any measures needed to strengthen the existing beam/girder in the bridge rehabilitation project. (2-24-2025)

Where existing bridge sign connections are attached to the bridge or where existing signs prevent proper cleaning and coating of the structural steel, they shall be removed to permit proper cleaning and coating. Contact the MDOT Signing Unit to determine if the existing signs and existing bridge sign connections should be replaced or salvaged and reinstalled.

After the existing structural steel has been cleaned and coated the signs will be installed. New and salvaged bridge sign connections shall be installed in accordance with the requirements of the [MDOT Sign Support Standard Plans](#). The work to remove, salvage, and install the bridge sign connections and signs shall not be considered incidental to the work to clean and coat the structural steel. Include the appropriate pay items to cover the work as outlined in Subsection 810 of the MDOT Standard Specifications for Construction. If existing bridge sign connections are to be salvaged and reinstalled, include the Special Provision for Bridge Sign Connection, Type __, Salvage, Erect in the Contract documents.

Where existing bridge sign connections or signs must be removed for cleaning and coating, add note [8.09.04 N.](#) to the contract plans.

See [Sign Design, Placement, and Application Guidelines](#) for additional guidance.

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12.08

MISCELLANEOUS REHABILITATION

Some miscellaneous rehabilitation is significant and is programmed for the specific purpose. More frequently, miscellaneous work is an adjunct to other work. As such, its nature and cost should be determined as early as possible so that the primary project programming can be adjusted.

Include saw cut depth dimensions when removing portions of abutments, piers and columns on the plans. (8-20-2009)

12.08.01

Field Inspections

The Plan Review Meeting with a field inspection should be conducted on all rehabilitation projects. This inspection should be made within six months of the contract letting to most accurately determine the extent of deterioration. If a project is postponed, it may be necessary to conduct a second inspection. (5-27-2020)

12.08.02

Concrete Repair - General (9-22-2025)

Embedded Galvanic Anodes for Concrete Repairs

Galvanic anodes consist of a cementitious shell encapsulating a zinc electrolyte. The embedded galvanic anodes serve to provide localized corrosion protection to existing steel reinforcement through the principles of electrochemistry. Often, when new concrete is placed adjacent to old concrete, corrosion in the old concrete is accelerated. This is the result of a difference in the electrolytic potential between the new and old concrete. By introducing zinc to the system through galvanic anodes, a new galvanic cell is created which results in the accelerated deterioration of the anodes rather than the existing reinforcement. This protection is directly related to the amount of zinc contained in the anodes as the protection lasts only until the anodes have fully oxidized.

12.08.02 (continued)

The embedded anodes have a life expectancy of 15 to 20 years, which is dependent on anode spacing, environmental exposure, zinc content, and the amount of existing steel reinforcement in the structure element being repaired. Galvanic anodes must be specified with an adequate amount of zinc content per foot along the perimeter of concrete patches or along the interface between new/existing concrete to reach the desired service life.

Use galvanic anodes with uncoated and epoxy coated reinforcement. Embedded anodes must be tied to uncoated steel reinforcement for proper function. Where galvanic anode is connected to coated rebar the coating must be removed to ensure electrical connection between anode tie wire and reinforcing steel.

Use embedded galvanic anodes whenever existing reinforcement will be encased in both new concrete and existing concrete after the proposed work is completed. Suggested uses are as follows:

1. Bridge deck widening.
2. Deck joint replacement.
3. Substructure repairs.
4. Deck repairs, where greater than ten years patch service life is required.
5. Substructure widening.
6. Concrete superstructure repair and patching.
7. Concrete bridge railing repairs and/or replacements.

For items 1 thru 7, placement of anodes will follow the Frequently Used Special Provision for Embedded Galvanic Anodes, High Performing for Corrosion Control. Include Special Provision in proposal for all rehabilitation projects including concrete repair. The steel density of each bridge element being repaired utilizing galvanic anodes must be reported in the project plans. (9-22-2025)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

12.08.03

Substructure Repairs

A. Patching

This work generally includes the sealing of cracks and patching of spalled areas.

Designers should be aware that the cost of extensive substructure patching may be more than the cost of removal and replacement of a portion of the unit. Where removal of substructure portions is feasible it should be considered. A prime example of this is removing a portion of a pier cap on a project that includes superstructure replacement. (5-1-2000)

1. Removal of concrete shall be paid for as "Hand Chipping, Other Than Deck" and includes all areas excluding the top surface of the deck and sidewalk; i.e. all substructure units, the underside of the deck, and the barriers and fascias.
2. Patching mixtures include latex modified (LM) concrete as one of the choices. Since its bonding characteristics are superior to the others, LM concrete overlay mixtures (Table 1006-2 in the Standard Specifications) should be used for substructure repair where latex is relatively available. In the North and Superior Regions, this mixture should be used only where the project already includes LM concrete for a deck overlay. Otherwise, repairs should be made with a structure patching mixture from Table 1006-1. (5-24-2021)
3. When substructure units are patched, the entire surface of the substructure unit shall be coated with "Penetrating Water Repellent Treatment" to prevent further deterioration. As an alternative, where aesthetics are important, an elastomeric concrete sealer may be used. See Section 7.03.11. (5-1-2000)

B. Column Wrapping (10-24-2001) (07-30-2012)

This work consists of repairing concrete pier columns by wrapping them with a fiber reinforced polymer (FRP) wrap (see the Special Provision for Column Wrapping with Fiber Reinforced Polymer (FRP) sheets and the Michigan Department of Transportation's (MDOT) [Research Report No. RC 1386](#), ***Repair of Corrosion-Damaged Columns using FRP Wraps*** for detailed information.)

Column wrapping should be considered as an alternate to the traditional chip, patch, and seal repair method for both square and round columns when only slight to moderate deterioration exists in the columns. Some concrete surface preparation is required prior to wrapping the column, but only to the extent necessary to obtain a flat surface. Blast cleaning, rounding corners, and patching spalls are all that is needed for the concrete surface preparation. Crack epoxy injection and concrete chipping behind steel reinforcement is not necessary. Criteria for using column wrapping in Capital Scheduled Maintenance (CSM) and Capital Preventive Maintenance (CPM) projects are as follows:

1. Column size

No restrictions on column height. No restrictions on round column diameter. Width of rectangular columns must be limited to 3' because the wrap is not as effective in confining the mid point of the side compared with a round column.

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12.08.03 B. (continued)

Substructure Repairs

2. Filler walls

The presence of filler walls adjacent to a column prevents wrapping that portion of the column. Replacement of the adjoining portion of the filler wall decreases the cost effectiveness of the column wrapping. Filler wall replacement in conjunction with column wrapping is cost effective when the cost to replace the filler wall is small compared with the cost of column wrapping and needs to be considered on a case by case basis. Deteriorated filler walls would be cause for replacement, which would then enable column wrapping.

3. Column deterioration

In general, column wrapping is cost effective when the deteriorated areas are between 5% and 15% of the column area. When column deterioration exceeds 5% to 10% of the column area, column wrapping has a lower life cycle cost than the traditional chip, patch, and seal repair method. For practical considerations, column wrapping should not be used when the deterioration exceeds 15% of the column area because there is a concern that the deterioration has progressed too far for the wrapping to be effective. Deterioration in this case is considered to be delaminated areas, spalled areas, and incipient corner spalls. Corner cracks without delamination should not be considered deterioration for this case.

The life cycle cost for the column wrapping and traditional chip, patch, and seal repair methods used the following service lives; 10 to 15 years for patching, 3 to 5 years of sealing, and 30 years for column wrapping. Interest rates of 3% and 4% were used for the present value calculation.

12.08.04

Repair of Overhead Concrete Surfaces

Experience has shown we cannot patch overhead spalls that are deeper than 1". Any spalls on the underside of the deck that are deeper will have to be repaired by full depth patching. Where we do patch the shallow spalls, we should call for an overhead patching material from the qualified products list. (5-1-2000)

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12.08.05

Expansion Anchored Bolts (5-1-2000)

In addition to field testing, we will ensure sound anchorage by reducing allowable design loads. The values to be used will vary with the application as show below:

PULLOUT VALUES OF EXPANSION ANCHORED BOLTS IN POUNDS						
Application	Approx. Safety Factor	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{5}{8}$ "	$\frac{3}{4}$ "	$\frac{7}{8}$ "
Noncritical Design Loads (Including noncritical, static or shock loads)	4	875	1,620	2,565	3,775	5,240
Vibratory Loads (e.g., Sign Supports)	12	290	540	855	1,260	1,755

Design details should always call for two or more anchors for redundancy.

For additional information on other types of concrete anchors see Section [7.06.02](#).

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12.08.06

Deck Patching (5-1-2000)

Delaminated portions of the deck that show signs of imminent spalling are to be hand chipped. These areas and those that have already spalled are to be repaired with a latex-modified concrete mixture.

In the Upper Peninsula and areas of the Lower Peninsula where the cost of latex-modified concrete is high, bridges with traffic volumes less than 4000 ADT are to have decks repaired by applying a latex bonding slurry to the chipped areas followed by patching with a Concrete patching mixture.

See Section [12.04.09](#) for the use of metal mesh panels with deck patching.

12.08.07

Temporary Support Systems

(8-6-92) Plans for rehabilitation may require details of a construction scheme as described in Section [7.01.10](#). Without this concurrence, the contractor may attempt a procedure which would jeopardize the integrity of the structure during his/her operations.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

12.08.08

Protection of Existing Piers in the Clear Zone (7-24-2023)

The piers of existing bridges located within the clear zone as defined in Section 7.01.11 of the MDOT Road Design Manual shall be retrofitted to account for the vehicle collision force (see section 7.01.04 K.) as part of any project that includes the 3R or 4R work on the bridge or along the roadway under the bridge if one of the following conditions are true:

1. The pier has columns with a minimum width of less than 3'-0".
2. The pier does not have load path redundancy. This includes, but is not limited to:
 - a. The pier has two columns or fewer.
 - b. The superstructure beams are supported directly on the columns with no cap adjoining columns.
3. The pier has columns with a minimum width or diameter of 3'-0" or greater and the face of the pier is located 12' or less from the edge of the lane (traveled way) of the roadway.

If an existing pier is located within the clear zone and meets one of the conditions listed above design and detail a strut between the existing columns based on the guidelines included in MDOT Bridge Design Guides 5.20.02, .02A & .02B. The guidance included in the MDOT Bridge Design Guides have been developed based on the requirements in Section 3.6.5.1 and A13.3.1 of the AASHTO LRFD Bridge Design Specifications. (2-26-2024)

12.08.08 (continued)

Check the existing pier foundation to verify the additional dead load from the pier strut can be supported without exceeding the allowable bearing capacity or pile capacity. Complete this check according to AASHTO LRFD where practicable. In cases where AASHTO LRFD cannot be used, the design method shall be approved by the MDOT Chief Structure Design Engineer. (11-27-2023)

Because of the short duration over which they would be applied, the forces used to design the pier strut do not need to be transferred to the pier footing or to the deep foundation supporting the existing pier. Neither the forces used to design the pier strut, nor the AASHTO LRFD vehicle collision force need to be applied to the existing pier columns. (11-27-2023)

Alternatively, the vehicle collision force can be redirected or absorbed with Type C single face concrete barrier in accordance with Standard Plan R-54-Series. Locate the barrier relative to the face of the pier in accordance with the requirements outlined in Section 3.6.5.1 of the AASHTO LRFD Bridge Design Specifications. Provide appropriate barrier end treatments in accordance with the MDOT Road Design Manual.

If the existing pier foundation is not capable of supporting the additional dead load from a pier strut or if the pile supports for a Type C single face concrete barrier conflict with the existing pier footing the existing pier can be protected with a Type B single face concrete barrier placed directly in front of the pier columns in accordance with R-54-Series. Use this option only if the barrier can be installed without the need for a design exception/design variance for shoulder width. Provide appropriate barrier end treatments (R-55, 67, etc.-Series) in accordance with the MDOT Road Design Manual.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

12.08.08 (continued)

Protection of Existing Piers in the Clear Zone (7-24-2023)

As an alternative to retrofitting the existing pier, the Bridge Engineer can demonstrate through calculations that the existing pier has sufficient capacity to resist the vehicle collision force or that the superstructure will not collapse with one column missing as outlined in Section 3.6.5.1 of the AASHTO LRFD Bridge Design Specifications.

Where existing piers are to be widened, design the widened portions of the pier to account for the vehicle collision force as outlined in Section 7.01.04.K. Account for the vehicle collision force at the portion of the existing pier to remain in place as outlined in the preceding paragraphs. If the existing portion of the pier is being protected with single face concrete barrier extend the concrete barrier to protect the proposed portion of the pier as well.

If site or project specific conditions make it unfeasible to retrofit the existing structure to account for the vehicle collision force, and calculations demonstrate that the existing pier does not have sufficient capacity to resist the vehicle collision force a request to waive these requirements must be submitted to the Chief Structure Design Engineer for approval. The request must include a detailed justification for waiving the requirements, and once approved must be included in the project file.

Where filler walls have previously been constructed between the columns of a pier and the column width or diameter is less than 3'-0" remove the filler walls in their entirety. Retrofit the existing pier to account for the vehicle collision force following the preference for existing piers to remain in place summarized above.

12.08.08 (continued)

Where filler walls have previously been constructed between the columns of a pier and the column width or diameter is 3'-0" or greater the existing filler wall may remain in place. If the height of the filler wall is less than 42 inches above the ground adjacent to the pier, increase the filler wall height to extend a minimum of 42" above the ground adjacent to the pier.

A Local Agency has the discretion to define their policy for accounting for the AASHTO LRFD vehicle collision force in the design of bridges within their inventory in accordance with Section 3.6.5 of AASHTO LRFD. In the absence of published guidance from a Local Agency the applicability of the AASHTO LRFD vehicle collision force shall be determined using the same criteria that is used for classifying bridges under MDOT jurisdiction.

Bridges spanning over railroad right-of-way shall meet the requirements outlined in the AREMA Manual for Railway Engineering or local railroad company guidelines.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

12.08.09

Rocker Realignment (7-25-2022)

The realignment of expansion rocker bearings should be considered as part of rehabilitation projects if the offset of the bearing has reached an unacceptable threshold. If expansion rocker bearings with excessive offset are left unaddressed there is an increased risk that the continued movement of the bearing could result in the rocker falling over and the beam being unsupported. The final decision to realign expansion rocker bearings will be made by the Bridge Design Engineer after a review of all available bridge inspection and bridge scoping reports, and a review of all the conditions that exist at a particular bridge.

Generally, realignment of expansion rocker bearings should be considered if at least one of the following conditions have been observed:

- A. The vertical line of the reaction falls outside of the middle half of the bearing surface for a majority of the expansion rocker bearings along a line of bearings. The vertical line of the reaction is to be taken as passing through the radius point of the bearing surface as is shown in the figure below. Maximum rocker offsets and rotations for various expansion rocker bearings are given in the table on following page.

The bearing dimensions used to make the assessment should be the dimensions shown on the as-built plans for the bridge.

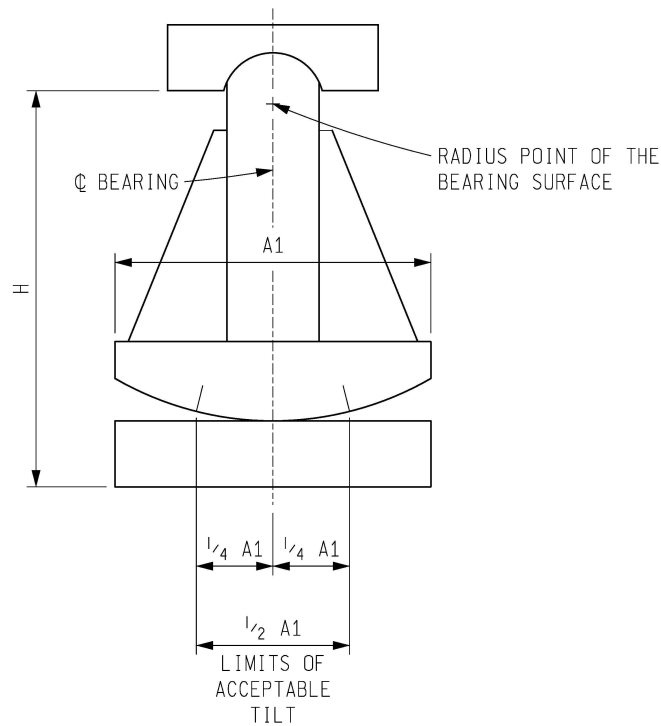
If the offset was measured at a time of the year with either extremely high or low temperatures (over 100° F or below 0° F) it is recommended that the offset be checked again when ambient temperatures are more moderate to confirm that offset of the expansion rocker bearing is outside of the limits described above.

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12.08.09 (continued)

"H" Dimension* (in)	Rocker Bearing Plate Width "A1" (in)	Max. Rocker Offset (in)	Max. Rocker Rotation (degrees)
8 ½"	6"	1 ½"	10
8 ½"	7"	1 ¾"	12
8 ½"	8"	2"	14
12 ½"	9"	2 ¼"	10
12 ½"	10"	2 ½"	12
12 ½"	11"	2 ¾"	13
12 ½"	12"	3"	14
12 ½"	13"	3 ¼"	15
12 ½"	14"	3 ½"	16
12 ½"	15"	3 ¾"	18

*Note: The "H" dimension is the vertical distance between the sole plate and the masonry plate. See the figure below.



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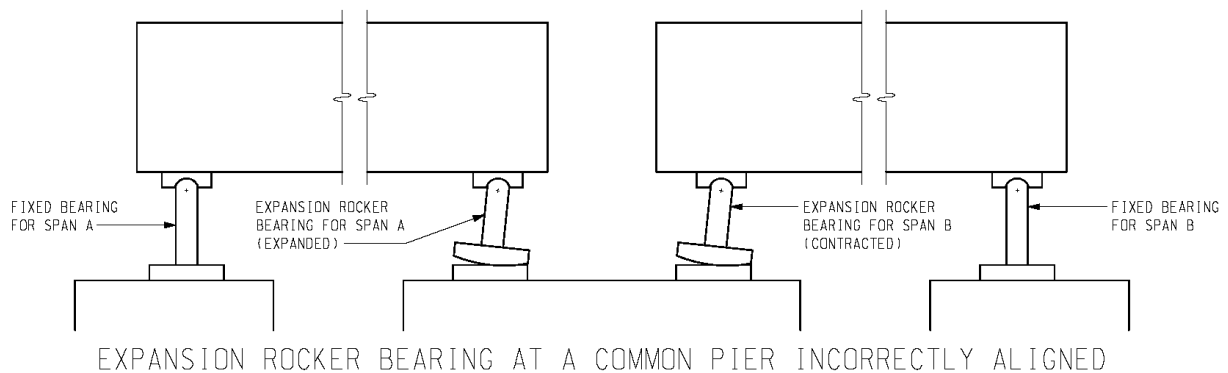
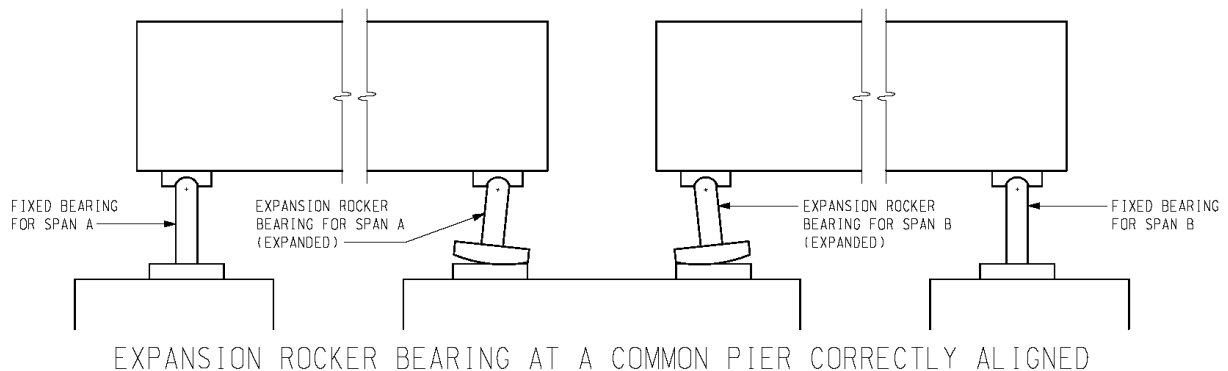
BRIDGE DESIGN

12.08.09 (continued)

Rocker Realignment

B. If the vertical line of the reaction falls within the middle half of the bearing surface for a majority of the expansion rocker bearings along a line of bearing but the offset deviates from the calculated rocker offset for the temperature the alignment was checked at by more than $\frac{3}{4}$ " realignment of the expansion rocker bearings should be considered.

C. When a substructure element supports two lines of expansion rocker bearings with an expansion joint in the bridge deck above the pier the bearings should be tilted in opposite directions, with both lines of bearings expanded/contracted relative to the fixed bearing for each span. If the bearing lines are tilted in the same direction the line tilted in the wrong direction should be realigned. This is illustrated in the figure below.



MICHIGAN DESIGN MANUAL BRIDGE DESIGN

12.08.09 (continued)

Rocker Realignment

- D. If there is more than 1,000 feet of concrete pavement adjacent to the bridge and pressure relief joints have not been installed the proposed scope of work should include the installation of pressure relief joints, a structural approach slab, or approach pavement according to MDOT Standard Plan R-45-Series. If pressure relief joints have previously been installed but have closed up the proposed scope of work should include recutting the pressure relief joints, installing a structural approach slab, or installing approach pavement according to MDOT Standard Plan R-45-Series.

- E. The Bridge Design Engineer may consider other measures to address the excessive tilt of expansion rocker bearings when the scope of work includes a deck replacement. This may include but is not limited to returning the entire superstructure to its proper location based on the temperature at the time the work is being performed. Measures like this are desirable because not only do they adjust the bearing alignment to minimize the risk of further movement resulting in an unsupported beam, but it also helps to ensure the proper gap between beams ends at piers and/or pin and hanger assemblies is restored.

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12.09

BRIDGE DECK REPAIR STRATEGY (3-26-2012)

12.09.01

Deck Restoration

Restoration of deteriorated decks includes everything from crack sealing to complete replacement. The alternative selected will be influenced by the factors listed in the Bridge Deck Preservation Matrix (Section 12.09.02) and by judgment. The Construction Engineer should be consulted in most cases as he/she is aware of current costs, equipment, and contractor capability.

At locations where traffic volumes are high, the maintenance of traffic may influence the selection of the restoration treatment.

The Region Project Development Engineer will consider future work in the area. This may influence the repair strategy. It should be recognized that several years will elapse between the inspection/scoping and the work of rehabilitation. Allowance for additional deterioration during this period should be made when selecting an appropriate rehabilitation measure. (5-1-2000)

12.09.02

Bridge Deck Preservation Matrix (5-1-2000)

The Bridge Deck Preservation Matrix ([Uncoated Black Bar](#) or [Epoxy Coated Rebar](#)), gives recommended repair methods for various deck conditions. The repair strategies are based on National Bridge Inventory ratings provided from bridge inspection and scoping documents.

In general, the condition of the underside of the deck is of primary concern. Deck with sound undersides can be rehabilitated to a nearly "new" condition. The repair strategies for these structures will vary from patching and crack sealing for decks with good top surfaces, to deep overlays for decks with poor top surfaces.

Decks with undersides in poor conditions are either replaced, or repaired with a shorter term "fix." This fix varies from a shallow concrete overlay to a hot mix asphalt (HMA) cap. (9-2-2003)

DETROIT METROPOLITAN AREA



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Appendix 12.02
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CLEAR ROADWAY WIDTHS AND DESIGN LOADING FOR BRIDGES BEING REHABILITATED (3-26-2012)			
Type of Roadway		Minimum Clear Roadway Width	Minimum Design Loading
Non-Interstate Freeway		A, B	HS-20
Interstate Freeway		A, B	HS-20
Arterial (Non-Freeway Trunkline)	Rural	C	HS-20
	Urban	D	HS-20
Collector (Non-Trunkline)	Rural	Exhibit 6-7.	H 15
	Urban	Exhibit 6-5., E	H 15
Local (Non-Trunkline)	Rural	Exhibit 5-7.	ADT \leq 50:H 10 ADT>50:H 15
	Urban	Exhibit 5-5., E	

- (A) As constructed.
- (B) Consideration should be given to carrying the full shoulders of the approach roadway across the structure if it is cost effective to do so.
- (C) The minimum clear roadway should accommodate the traveled way plus 2'-0" on each side.
(12-5-2005)
- (D) The minimum clear width on the bridge shall be the same as the curb-to-curb width of the street.
- (E) The minimum clear roadway shall be the traveled way plus 1'-0" to each curb face. However, consideration should be given to providing the same width as the curb-to-curb approach width if it is cost effective to do so.

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Appendix 12.02
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The tables shown in this appendix are derived from A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition, published by AASHTO and do not include clearances for bridge rail offset. See the [Bridge Design Guides](#) for MDOT offset criteria. (3-26-2012) (7-20-2015) (3-21-2016)

Exhibit 6-7. STRUCTURAL CAPACITIES AND MINIMUM ROADWAY WIDTHS FOR BRIDGES BEING REHABILITATED CARRYING RURAL COLLECTOR ROADS		
Design Traffic Volume(veh/day)	Design Loading Structural Capacity	Minimum Clear Roadway Width (ft) ^(a)
Under 400	H 15	22
400 to 1500	H 15	22
1500 to 2000	H 15	24
over 2000	H 15	28
<p>(a) Clear width between curbs or railings, whichever is the lesser, shall be equal to or greater than the approach traveled way width, wherever practical.</p> <p>The values in Exhibit 6-7. do not apply to structures with a total length greater than 100 ft. These structures should be analyzed individually by taking into consideration the clear width provided, safety, traffic volumes, remaining life of the structure, design speed, and other pertinent factors.</p>		

Exhibit 6-5. MINIMUM WIDTH OF TRAVELED WAY FOR COLLECTOR ROADS				
Design Speed(mph)	Design Traffic Volumes (veh/day)			
	Under 400	400-1500	1500 -2000	over 2000
	Width of Traveled Way (ft)			
	20 ^(a)	20	22	24
20-30	20 ^(a)	22	22	24
35-40	20	22	22	24
45-50	22	22	24	24
55-60	22	22	24	24
<p>(a) A 18 ft minimum width may be used for roadways with design volumes under 250 veh/day.</p> <p>On roadways to be reconstructed, a 22 ft traveled way may be retained where the alignment and safety records are satisfactory.</p>				

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BRIDGE DESIGN

Appendix 12.02
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Exhibit 5-7. MINIMUM STRUCTURAL CAPACITIES AND MINIMUM CLEAR ROADWAY WIDTHS FOR BRIDGES BEING REHABILITATED CARRYING RURAL LOCAL ROADS		
Design Traffic Volume(veh/day)	Design Loading Structural Capacity	Minimum Clear Roadway Width (ft) ^{(a) (b)}
0-50	H 10	20 ^(c)
51-250	H 15	20
250-1500	H 15	22
1500-2000	H 15	24
over 2000	H 15	28
<p>(a) Clear width between curbs or railings, whichever is the lesser.</p> <p>(b) Minimum clear widths that are 2 ft narrower may be less than the approach traveled way width.</p> <p>(c) For one-lane bridges use 18 ft.</p> <p>The values in Exhibit 5-7. do not apply to structures with total length greater than 100 ft. These structures should be analyzed individually, taking into consideration the clear width provided, traffic volumes, remaining life of the structure, pedestrian volumes, snow storage, design speed, crash record, and other pertinent factors.</p>		

Exhibit 5-5. MINIMUM WIDTH OF TRAVELED WAY FOR LOCAL ROADS				
Design Speed(mph)	Design Traffic Volumes (veh/day)			
	Under 400	400-1500	1500 -2000	over 2000
	Width of Traveled Way (ft)			
	18	20	20	22
15	18	20	20	22
20-40	18	20	22	24
45-50	20	22	22	24
55-60	22	22	24	24
Where the width of traveled way is shown as 24 ft, the width may remain 22 ft m on reconstructed bridges where alignment and safety records are satisfactory.				

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Design Exception Requirements - Vertical Clearance (8-20-2009) (1-14-2013)

Design Exceptions are needed where proposed vertical clearance does not meet the minimum clearance requirements provided in Section [7.01.08](#)

Type of Project	Design Exception Required	Coordination with SDDCTEA Required	MDOT approval required by Engineer of Design Programs	FHWA Approval Required
New and 4R reconstruction work on Interstate greater than \$1,000,000	Yes	Yes	Yes	Yes
New and 4R reconstruction work on Interstate less than \$1,000,000	Yes	Yes	Yes	No
New and 4R reconstruction work on Non Interstate Freeways greater than \$1,000,000	Yes	No	Yes	Yes
New and 4R reconstruction work on Non Interstate Freeways less than \$1,000,000	Yes	No	Yes	No
New and 4R reconstruction work on NHS Routes other than Freeways greater than \$1,000,000	Yes	No	Yes	Yes
New and 4R reconstruction work on NHS Routes other than Freeways less than \$1,000,000	Yes	No	Yes	No
New and 4R Reconstruction on Non-NHS Routes	Yes	No	Yes	No
3R Work on Interstate System	Yes	Yes	Yes	Only if negotiated oversight is assigned to FHWA on NHS projects > \$5 million.
3R Work on Non Interstate Freeways	Yes	No	Yes	
3R Work on Non-Freeway Routes	Yes	No	Yes	
Preventative Maintenance Work	No	No	No	No

SDDCTEA - Surface Deployment and Distribution Command Transportation Engineering Agency

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PROJECTS REQUIRING DESIGN EXCEPTION/DESIGN VARIANCE

Major Project Scope of Work	AASHTO Green Book (7 th Edition) Project Classification	DE/DV Required
New Bridge	New Construction	Yes
Bridge Replacement	Reconstruction	Yes
Complete Superstructure Replacement	Reconstruction	Yes
Partial Superstructure Replacement without Additional Lanes	Construction on Existing Roadway	Yes
Partial Superstructure Replacement with Additional Lanes	Reconstruction	Yes
Bridge Widening to Accommodate Additional Lanes	Reconstruction	Yes
Deck Replacement with Bridge Widening to Accommodate Additional Lanes	Reconstruction	Yes
Bridge Widening without Additional Lanes	Construction on Existing Roadway	Yes
Deck Replacement without Additional Lanes	Construction on Existing Roadway	Yes
Partial Substructure Replacement (can include the complete removal of an entire substructure element but not the replacement of all the substructure elements)	Construction on Existing Roadway	Yes
Barrier Replacement ¹	Construction on Existing Roadway	Yes
Deep Overlay ²	Preventive Maintenance	No
Shallow Overlay ²	Preventive Maintenance	No
Epoxy Overlay	Preventive Maintenance	No
Deck Patching	Preventive Maintenance	No
Healer/Sealer	Preventive Maintenance	No
Sealing Cracks in the Bridge Deck	Preventive Maintenance	No
Installing Cathodic Protection on the Bridge Deck	Preventive Maintenance	No
Joint Replacement or Joint Resealing	Preventive Maintenance	No
Elimination of an Existing Joint on the Bridge	Preventive Maintenance	No
Cleaning Joints	Preventive Maintenance	No
Repair or Replacement of Deck Drains	Preventive Maintenance	No
Cleaning or Flushing Deck Drains	Preventive Maintenance	No
Replacing Bridge Approach Slabs	Preventive Maintenance	No
Barrier Patching or Repair	Preventive Maintenance	No
Sealing Cracks in Barrier	Preventive Maintenance	No
Silane Treatment of Concrete	Preventive Maintenance	No
Structural Steel Repairs	Preventive Maintenance	No
Fatigue Crack Mitigation	Preventive Maintenance	No

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PROJECTS REQUIRING DESIGN EXCEPTION/DESIGN VARIANCE

Major Project Scope of Work	AASHTO Green Book (7th Edition) Project Classification	DE/DV Required
Retrofitting Non-Redundant Steel Tension Members (formerly known as Fracture Critical Members)	Preventive Maintenance	No
Cleaning and Coating Structural Steel	Preventive Maintenance	No
Pin and Hanger Replacement	Preventive Maintenance	No
Bearing Realignment or Replacement	Preventive Maintenance	No
Heat Straightening of Existing Steel Superstructure	Preventive Maintenance	No
Concrete Beam Repairs or Overcasting	Preventive Maintenance	No
Coating/Sealing Concrete Beams	Preventive Maintenance	No
Repair or Maintenance of Moveable Bridge Machinery	Preventive Maintenance	No
Repair or Maintenance of Movable Bridge Electrical Components	Preventive Maintenance	No
Cleaning or Washing of the Bridge	Preventive Maintenance	No
Substructure Patching	Preventive Maintenance	No
Coating/Sealing Substructure Concrete	Preventive Maintenance	No
Installing Cathodic Protection on the Substructure	Preventive Maintenance	No
Foundation Pile Preservation (Jackets/Wraps/Cathodic Protection)	Preventive Maintenance	No
Channel Clearing or Debris Removal in the Channel	Preventive Maintenance	No
Installing Scour Countermeasures	Preventive Maintenance	No
Request for Action Project	Preventive Maintenance	No
Urgent Need Project	Preventive Maintenance	No

¹ Barrier replacement projects involve the removal and replacement of the barrier along the full length of the bridge. Removal and replacement of a portion of the bridge barrier are considered barrier repair. The guidance included in Section 12.05.05 of the Bridge Design Manual must be considered when deciding between a barrier replacement project and a barrier repair project. Appropriate judgement must also be used to ensure that limits of a barrier replacement do not leave a short section of the existing bridge railing that will warrant a barrier replacement project in the future.

² A safety review must be completed as part of projects where the major project scope of work includes either a deep overlay or a shallow overlay. Examine the existing cross slope or superelevation and follow the guidance in Section 3.08.01 of the Road Design Manual to determine whether a Design Exception/Design Variance Request must be prepared and submitted.



OFFICE MEMORANDUM

DATE: *[Enter Date]*

TO: *[Enter name and title of Region or Lansing Traffic and Safety personnel]*

FROM: *[Enter requestor name and title]*

SUBJECT: Accident Analysis and Safety Review

Location: _____

Control Section: _____ Job Number: _____ Finance Code: _____

Begin Milepoint _____ End Milepoint _____

Schedule Plan Completion Date _____

Clear Description of Project Scope (Attach PCS if available):

This is a ____ Improve/Expand, ____ Preserve, ____ Preservation project.

Particular items special attention should be given to:

Design Exceptions / Variances to be requested from FHWA/MDOT include: _____

Completed analysis needed on or before: _____

For questions pertaining to this project, please contact _____ at _____
or me at _____.

cc:

[Requestor Signature]
[Enter requestor name]

**MICHIGAN DESIGN MANUAL
BRIDGE DESIGN**

CHAPTER 13

RAILROAD CROSSINGS

13.00 RAILROAD CROSSINGS

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13.02 AGREEMENT PREPARATION

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13.02.03 Force Accounts

13.02.04 Easements

13.02.05 Final Agreement

13.03 SPECIAL PROVISIONS

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13.04.02 Drainage

13.04.03 Railroad Cross-Section

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13.04.05 Temporary Steel Sheet Piling

13.04.06 Railroad-Owned Materials

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13.05 PLAN DISTRIBUTION

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CHAPTER 13

RAILROAD CROSSINGS

13.00

RAILROAD CROSSINGS

While there is an occasional at-grade railroad crossing on a freeway, it can be assumed that a structure will be built to separate the rail traffic from the highway traffic. For a discussion of at-grade railroad crossings, refer to [Chapter 12](#) of the Road Design Manual. Grade separations will be discussed in this chapter.

For grade separations on a free access road, the Economic Analysis Unit, Program Planning Division, Bureau of Transportation Planning will calculate the cost/benefit ratio based on a given time period (usually 50 years). The cost/benefit ratio must equal at least 1.0 for the grade separation to be economically justified.

13.01

IDENTIFICATION OF GRADE SEPARATIONS

When a railroad is carried over the highway, the structure identification will be by X (i.e., X09 of 82022); and when a highway is carried over the railroad, the identification will be by R (i.e., R01 of 63041).

13.02

AGREEMENT PREPARATION

All work performed on either existing or new grade separations is subject to approval by the Railroad that has jurisdiction over the tracks. An agreement, if required, covering the work is prepared by the Governmental and Railroad Coordination Unit of the Design Division.

13.02.01

Railroad Contacts

The Railroad Grade Separations Engineer of the Railroad Coordination Unit – Office of Rail will contact the Railroad when the programming letter for the project is issued. They will request the Railroad to submit an estimate for preliminary engineering. This estimate includes the cost of reviewing agreements, special provisions, preliminary and final plans, preparation of force account plans and estimates, and cost of attendance at meetings. After a letter of agreement or other arrangements for preliminary engineering has been made and FHWA approval has been received, the Railroad is authorized to start preliminary engineering work. No plans should be sent to the Railroad until after the Railroad is authorized to start preliminary engineering.

It is important to note that Railroads require anywhere from eight months to one and a half years (or longer, depending on project complexity and the particular Railroad) after receipt of preliminary plans to complete their reviews, prepare force account estimates, and sign the agreement. As Railroad agreements are needed before advertising, letting, and awarding a project, sufficient time must be allowed for the Railroad to complete its process. (1-14-2000)

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

13.02.02

Agreement Plans

The agreement with the Railroad contains exhibits showing the general features of the proposed work. The Design Engineer-Bridge shall prepare appropriate plan sheets. Normally the General Plan of Site and General Plan of Structure will suffice but special details such as runarounds, drainage plans, and right-of-way must be included. These exhibits (generally in Adobe "PDF" format) shall be submitted to the Railroad Grade Separations Engineer. (8-20-2009)

13.02.03

Force Accounts

The Railroad Grade Separations Engineer of the Railroad Coordination Unit – Office of Rail will request the Railroad to submit an estimate of the Force Account work to be performed by the Railroad. This Force Account work will normally be paid through a separate job number initiated by the Railroad Grade Separations Engineer; however there may be some projects for which the cost of the Force Account work will be included in the estimated cost of the bridge project number. The Railroad Grade Separations Engineer will notify the Design Engineer - Bridge if the Force Account work is to be included in the bridge project job number. (1-14-2000)

13.02.04

Easements

The Railroad Grade Separations Engineer will indicate on the General Plan of Site sheet the desired highway easement across Railroad right of way for highway purposes. He/she will obtain Railroad approval and then forward the Railroad approved easement plan to the Design Engineer - Bridge for transmittal to the Real Estate Division as part of the final right-of-way requirements.

The Real Estate Division will prepare all legal documents of easement granted by the Railroad to MDOT.

13.02.05

Final Agreement

The Final Agreement, if required, will be processed through the Railroad Coordination Unit – Office of Rail in the normal manner. Final approval of the agreement by the Railroad, and MDOT, will give the Railroad the right to approve the plans as prepared by MDOT. Before a project may be advertised, let, and awarded, MDOT must have obtained the Railroad's approval of the plans and Final Agreement. (1-14-2000)

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13.03

SPECIAL PROVISIONS

Plans for railroad grade separations require Special Provisions for work on Railroad Property. The information to be included will be obtained by the Railroad Grade Separations Engineer from the Railroad.

The Railroad Grade Separations Engineer will prepare Special Provisions and forward them to the Railroad for review and approval. Special Provisions may cover such items as temporary roads, railroad runarounds, flagging, and utility relocation. After receiving Railroad approval, he/she will forward the special provisions to the Design Engineer - Bridge for inclusion in the proposal.

The pay item, "Railroad Inspection and Flagging," is included in the Special Provisions. The Design Engineer - Bridge will estimate a pre-established, budgeted dollar amount for this pay item which will appear in the bid document so that all bidders use the same dollar amount. Railroad flagging can be assumed to be required any and all times the contractor is working on, above, or below Railroad property. Assume 8 hours straight time and anything beyond 8 hours (including nights/weekends) is figured as double time. Contact the Railroad Grade Separations Engineer for the current daily dollar amount to use in estimating the flagging. (1-14-2000)

Information regarding the speed and frequency of Railroad movements at the proposed project will be forwarded by the Railroad Grade Separations Engineer to the Design Engineer - Bridge for inclusion in the Proposal as a "Notice to Bidders."

The "Progress Clause", included in the Proposal, shall place a time limit restriction on the contractor to complete work on Railroad property. This will ensure a timely completion of work on the Railroad and alleviate the need for flagging regardless of total project completion time. (8-20-2009)

13.04

PLAN PREPARATION

Plans for Railroad Grade Separations must show several items that are specifically required for Railroad plans. Special attention must be given to drainage, Railroad cross-section, underclearance, side clearance and temporary steel sheet piling. MDOT may be required to provide details and calculations to the Railroad to facilitate the approval of the plans. (1-14-2000)

13.04.01

Design Criteria

Structures carrying the Railroad over the highway shall be designed according to the current American Railway Engineering and Maintenance of Way Association (AREMA) specifications, and the contract plans shall so note. In addition, any structures influencing the track or its support (such as retaining walls and culverts) shall satisfy AREMA specifications. Some Railroads may have design requirements supplemental to AREMA specifications. The Railroad Grade Separations Engineer should be contacted on all jobs involving Railroads and shall inform designers of these requirements. (1-14-2000)

13.04.02

Drainage

Adequate provisions must be made to handle existing track drainage and meet with the Railroad's approval.

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13.04.03

Railroad Cross-Section

A cross section with a horizontal distance of 20'-0", measured at right angles from the centerline of track at the top of rails, to the face of the embankment slope, may be approved. The 20'-0" distance may be increased at individual structure locations as appropriated to provide for drainage if justified by a hydraulic analysis or to allow adequate room to accommodate special conditions, such as where heavy and drifting snow is a problem. The railroad must demonstrate that this is its normal practice to address these special conditions in the manner proposed. (1-14-2000)

Where required by the Railroad, side clearance shall be provided for off-track maintenance equipment. The Railroad Grade Separations Engineer will determine from the Railroad the extent and location of this clearance.

Federal funds are eligible to participate in costs to provide space for more tracks than are in place when the Railroad establishes to the satisfaction of MDOT and the FHWA that it has a definite demand and plans for installation of the additional tracks within a reasonable time.

13.04.04

Underclearance

In general, a vertical underclearance of 23'-0" is required for highway grade separations over Railroads when constructing a new bridge or removing the existing superstructure. For preventative maintenance, rehabilitation and deck replacement projects the existing railroad vertical underclearance does not need to be increased unless requested by the Railroad. (8-20-2009)

13.04.05

Temporary Steel Sheet Piling

Except where required for jacking pits, approval of temporary sheeting and bracing details must be obtained from the Railroad prior to letting of the contract. Details are to be prepared by the Design Engineer-Bridge, submitted to the Railroad for approval, and shown on the contract plans. Details of sheeting for jacking pits are normally to be submitted by the contractor to the Railroad for approval.

13.04.06

Railroad-Owned Materials

When the plans call for removal of Railroad-owned materials (rails, ties, and hardware), the proposed disposition of these materials must be noted on the plans so that the contractor will not assume that the salvaged material will become his/her property. The Railroad may wish to salvage these materials for future use.

13.04.07

Hazard Cost

The Estimating Engineer-Bridge will calculate the percentage of the construction cost representing a hazard to train operations. The hazard cost includes the cost of the portion of superstructure over, and the substructure units adjacent to the tracks, and will be calculated to the nearest one (1) percent.

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13.04.08

Temporary Runaround

In constructing Railroad bridges over highways, a temporary runaround for the Railroad will be required. The details of this by-pass will be provided by the Railroad through the Railroad Grade Separations Engineer and will be included in the project plans. In general, the contractor will be responsible for all earthwork up to the subgrade. The Railroad will place the ballast and tracks, with the cost of this work borne by MDOT.

13.04.09

Crash Walls

Faces of piers or pier columns located closer than 25'-0" from the centerline of the nearest track shall be protected by a crash wall according to AREMA Specifications.

13.05

PLAN DISTRIBUTION

Distribution of plans for review and approval varies with the Railroads and must be according to Section [3.02.04](#) and [3.03.02](#) in this manual. Distribution procedures for specific Railroads can be obtained through the Railroad Grade Separations Engineer.

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CHAPTER 14

PERMIT APPLICATIONS AND ENVIRONMENTAL ISSUES

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CHAPTER 14

PERMIT APPLICATIONS AND ENVIRONMENTAL ISSUES

14.00

PERMIT APPLICATION AND ENVIRONMENTAL ISSUES

Work performed by MDOT and other public agencies is subject to existing law and is regulated by state or federal agencies. Permits may be required as listed in administrative rules promulgated by agencies involved in the administration of appropriate statutes. The Design Unit preparing the plans is responsible for obtaining the required permits through the Environmental Services Section of the Bureau of Highway Development and insuring that the permits are included in the contract proposal. A copy of the permit shall be sent to the Region/TSC Delivery Engineer with a cover letter under the signature of the Engineer of Design.

Permit application should be made approximately three to six months prior to the plan completion date of the project to initiate the process. In the event of an urgent job, the Design Engineer should request that the application be given special attention.
(8-20-99)

14.00 (continued)

MDEGLE permits involve several Parts of the Michigan Natural Resources and Environmental Protection Act, ACT 451, Public Acts of 1994 as amended. Pertinent Parts are addressed in sections 14.01 - 14.03 and 14.07 - 14.09. A copy of ACT 451 and its Parts is located at the MDEGLE web site, under the [Laws and Rules](#) section.
(8-20-2009) (2-17-2014) (6-24-2019)

Federal permits issued by the U.S. Army Corps of Engineers, under the Clean Water Act and the Rivers and Harbors Act of 1899, and Coast Guard permits and are addressed in sections 14.05 - 14.06. U.S. Army Corps of Engineers Permit information is located at their website under the [Regulatory Programs and Permits](#) section. The US Army Corps of Engineers regulates watercourses near the Great Lakes and on navigable waters. Work in navigable waters of the US may also require approval from the US Coast Guard. The Federal Aviation Administration (FAA) regulates navigable airspace and permit requirements are addressed in section 14.14.
(8-20-99) (2-17-2014) (2016)

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14.01

PART 301 of ACT 451

This Part refers to the "Inland Lakes and Streams Act". A permit must be obtained from the Michigan Department of Environment, Great lakes and Energy (MDEGLE) for the crossing of an inland lake or stream by either a bridge or culvert or the fill and excavation of an inland lake or stream below the ordinary high water mark. (2-17-2014) (6-24-2019)

14.01.01

Definitions

An "inland lake" is a natural or artificial lake, pond or impoundment with a surface area of 5 acres or more. A "stream" is a waterway, which may or may not be serving as a county or inter county drain, which has definite banks, a bed and visible evidence of a continued flow or continued occurrence of water. Included are the St. Mary's, St. Clair and Detroit Rivers. Any work in an inland lake or stream below the Ordinary High Water Mark (OHWM) requires state and/or federal permits and must be documented during the environmental classification process. In some instances, work within 500 feet of an inland lake and stream is also regulated. Many inland lakes and streams have special regulatory concerns that must be addressed before a permit will be issued. In some locations, approval of the US Army Corps of Engineers or the US Coast Guard may also be required. Project types that often require an Inland Lakes and Streams permit include culvert replacements, culvert extensions, bridge replacements, pier repairs, riprap placement, stream relocation and other drainage work. (8-20-99)

14.01.02

Exemptions

The Environmental Services Section of the Bureau of Highway Development will notify the Design Engineer of any exemptions that apply to specific projects.

14.01.03

Applications

The Design Engineer will complete a Bridge and Culvert Data Form and forward it along with necessary attachments to the Environmental Services Section of the Bureau of Highway Development. The Environmental Services Section will complete Form PR2731, Application for Permit, sign and transmit it to MDEGLE. For a sample Bridge and Culvert Data Form see MDOT [Form 4200](#). (8-20-99) (2-17-14) (6-24-2019)

14.01.04

Attached Materials (8-20-99)

For attachment requirements see section [14.11](#).

14.02

PART 325 of ACT 451

This Part is known as the "Great Lakes Submerged Lands Act". The act requires a permit from MDEGLE for excavating, filling or in any manner altering or modifying the Great Lakes bottomland or waters, including the bays and harbors. (2-17-2014) (6-24-2019)

14.02.01

Applications

The application procedure for permits under PART 325 of ACT 451 is identical to the procedure under PART 301 of ACT 451.

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14.03

PART 31 of ACT 451

This Part refers to Water Resources Protection/ Floodplain Authority/ Stormwater Control and requires the establishment of the waterway opening size so as not to cause a harmful interference on adjacent riparian property owners that may be impacted by the project. (8-20-99)

14.03.01

MDEGLE Review

The act requires MDEGLE to review and/or permit all flood plain related projects. (2-17-2014) (6-24-2019)

14.03.02

Exemptions

Permits under this act are not required for the following types of projects:

- A. A watershed, the total drainage area of which measured from the downstream limits of the project site, is less than 2 square miles
- B. Those projects which are clearly beyond the flood plain limits.

The Environmental Services Section of the Bureau of Highway Development will notify the Design Engineer of any exemptions that apply to specific projects. (8-20-99)

14.03.03

Applications

When a permit is required, the application procedure is the same as the procedure for application under PART 301 of ACT 451.

14.03.04

Coordination

A preliminary review of the waterway crossing shall be coordinated with the Design Engineer - Hydraulics/Hydrology and the Transportation Review Unit of the Land and Water Management Division of the Department of Environmental Quality. All correspondences and findings/results will be provided to the Bridge Design Unit, Hydraulics/Hydrology Unit and the Environmental Services Section. (8-20-99)

14.04

PART 111 of ACT 451 (8-20-2009)

This Part refers to Hazardous Waste Management and requires the establishment of Regulated Waste Activity Identification Numbers (U.S. EPA Identification Number). MDEGLE has been authorized to issue these numbers. MDEGLE, Waste and Hazardous Materials Division publication **Notification of Regulated Waste Activity, EQP5150** (replaces U.S. EPA Form 8700-12) contains instructions and an application form. A copy of the application form is also located at the MDEGLE website under the [Waste section](#). (2-17-2014) (6-24-2019)

14.04.01

Applications

For MDOT projects these numbers are requested from MDEGLE/WMD by the Bridge Management Unit of the Design Division. The application form shall be sent to the Bridge Management Unit for their submission to MDEGLE/WMD. Generally, MDOT requests are for, but not limited to, painting projects. See section [8.02](#) for note regarding Regulated Waste Activity Numbers. (2-17-2014) (6-24-2019)

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14.05

U. S. ARMY CORPS OF ENGINEERS PERMITS (8-20-99)

The U.S. Army Corps of Engineers has been regulating the nation's waters since 1890. Their regulatory authority is based primarily on Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act.

Section 404 of the Clean Water Act requires approval prior to discharging dredged or fill material into the waters of the United States and is administered by the U.S. Army Corps of Engineers. Any permits required under this act are referred to as "Section 404 permits".

Section 10 of the Rivers and Harbors Act of 1899 requires approval prior to the accomplishment of any work in or over navigable waters of the United States, or which affects the course, location, condition or capacity of such waters. For a listing of Navigable Waters, see [Appendix 14.05](#). List to be updated as required.

14.05.01

Definition

Road and bridge construction activities that require a permit are activities that occur below the plane of ordinary high water in any stream or body of water and in wetlands adjacent to these above waters. The Corps of Engineers defines adjacent to be a distance of approximately 2'-0". Ordinary high water is defined as the line between upland and bottomland and is the line below which the presence and action of the water is so common or recurrent that the character of the land is marked distinctly from the upland by the configuration of the surface of the soil and the vegetation.

14.05.02

Jurisdiction

The State of Michigan is under the jurisdiction of the Detroit District Office of the U.S. Army Corps of Engineers, Regulatory Branch.

14.05.03

Types of Permits

There are two types of Permits: General and Individual. The permits are divided into the following categories:

Individual Permits:

- Standard Permit
- Letter of Permission (LOP)

General Permits

- Nationwide Permit (issued Feb. 11, 1997)
- Regional Permit

It is Federal Policy, established by Executive Order 11990, that no excavated material is to be placed in wetlands regardless of size or jurisdiction. (The General Permit requires that all excavated material will be deposited at an upland site so that no runoff containing contaminated/suspended material will be allowed into any waterbody or wetland.) If the requirements of the General Permit cannot be met, an Individual Permit is required.(8-20-99)

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14.05.04

Scope of Work (8-20-99)

The following types of work require a permit:

Section 404 of the Clean Water Act

- Depositing of fill or dredged material in waters of the U.S. or adjacent wetlands.
- Site development fill for residential, commercial, or recreational developments.
- Construction of revetments, groins, breakwaters, levees, dams, dikes, and weirs.
- Placement of riprap and road fills.

Section 10 of the Rivers and Harbors Act of 1899

- Construction of piers, wharves, bulkheads, dolphins, marinas, ramps, float intake structures, and cable or pipeline crossings.
- Dredging and excavation.

14.05.05

Special Conditions for Permits (8-20-99)

Special conditions are often included in the permit. The permit should be carefully read by the Design Engineer, Resident Engineer, and Contractor.

14.05.06

Application (8-20-99)

When a U. S. Army Corps of Engineers Permit is required, the application procedure shall follow the format of PART 301 of ACT 451. The Environmental Services Section of the Bureau of Highway Development. will submit permit requests to U. S. Army Corps of Engineers and coordinate the process.

14.05.07

Attached Materials (8-20-99)

For attachment requirements see section [14.11](#).

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14.06

COAST GUARD PERMITS

Construction or modification of a bridge or to dredge in the navigable waters as described in 14.05, will require a Coast Guard Permit, providing that the dredged material is disposed of in a upland site. Michigan, along with the Great Lakes, is part of the Ninth District located in Cleveland, Ohio. They can be contacted at:

Ninth Coast Guard District
1240 East 9th Street
Cleveland, OH 44199-2060
Phone: (216) 902-6118 or
(216) 902-6117

or: <http://www.uscg.mil/d9/>

(2-17-2014)

14.06.01

Applications

Applications for U. S. Coast Guard permits shall be submitted and coordinated by the Environmental Services Section of the Bureau of Highway Development. (8-20-99)

14.06.02

Exemptions

Repairs to a bridge which do not alter the clearances, type of structure, or any integral part of the substructure or superstructure or navigation conditions, but which consists only in the replacement of worn or obsolete parts, may, if the bridge is a legally approved structure, be made as routine maintenance without approval of the U.S. Coast Guard.

The Environmental Services Section will notify the Design Engineer of any exemptions that apply to specific projects. (8-20-99)

14.07

PART 305 of ACT 451

This Part deals with the development, by Michigan Department of Natural Resources, of a Natural River System and designation of Natural Rivers in Michigan. Some rivers are designated as Federally Designated Wild and Scenic Rivers. This designation greatly restricts the number of structures and type of construction allowed in the designated area. (8-20-99)

14.07.01

Trunkline Crossings

When a project is proposed involving trunkline crossings of a natural or a wild and scenic river, the work should be coordinated with FHWA and MDEGLE. The Environmental Services Section will act as liaison between MDOT, MDEGLE and FHWA. A listing of trunkline crossings is appended as [Appendix 14.07.01](#). Appendix to be updated as required. (8-20-99) (2-17-2014) (6-24-2019)

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14.08

PART 91 of ACT 451 (8-20-99)

This Part deals with "Soil Erosion and Sedimentation Control". "Soil erosion" is the wearing away of land by the action of wind, water, gravity, or a combination of wind, water, or gravity. "Sediments" are solid particulate matter, mineral or organic, that have been deposited in water, are in suspension in water, are being transported, or have been removed from their site of origin by the processes of soil erosion. Construction activities in or near a floodplain, lake, river or stream will require a permit and plans of the proposed actions and plans to control or prevent loss of sediments and other polluting materials. This is specifically called a Notice of Coverage for National Pollutant Discharge Elimination System (NPDES) and deals with storm water discharges from construction activity. A Soil Erosion and Sedimentation Control (SESC) Permit from the proper SESC local agency (county enforcing agency or local enforcing agency) is required before submitting this Notice of Coverage. For additional information see Road Design Manual Section [10.04.04](#) and Standard Plan R-96-Series. (5-1-2000)

14.08.01

Applications

The application procedure for permits under PART 91 of ACT 451 is identical to the procedure under PART 301 of ACT 451. In addition the Soil Erosion and Sedimentation Control staff of the Environmental Services Section of the Bureau of Highway Development. shall be contacted.

14.09

PART 303 of ACT 451 (8-20-99)

This Part deals with "Wetlands Protection". "Wetlands" are land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh. When wetlands are required to be filled or are otherwise affected by a project, it is necessary that the damages be mitigated in some fashion.

14.09.01

Applications

The application procedure for permits under PART 303 of ACT 451 is identical to the procedure under PART 301 of ACT 451.

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14.10

PERMIT MODIFICATIONS AND EXTENSIONS (8-20-99)

14.10.01

Changes Affecting Environmental Clearance and Required Permits

As the design of a particular roadway improvement is developed, it is sometimes necessary, for a variety of reasons, to change the original scope of the project. These changes in scope will often affect the conditions under which the environmental clearance and required permit applications for the project were originally approved. Care should be taken whenever the original project scope is modified to ensure the environmental clearance is still valid and to make sure that new permit applications or modifications to existing permits are acquired if necessary. It is advisable to discuss the proposed revisions with the Environmental Section first.

Some items that require review/discussion with the Environmental Section to determine if environmental clearance and permits are affected are listed below.

Changes in Bridge Items

1. Widening bridges, piers, and abutments
2. Culvert extensions, size changes, or new replacements
3. Construction access pads or roads in watercourses, lakes, or wetlands
4. Additional ROW or Grading Permits than originally scoped

Other Factors

1. Guardrail upgrading, including elimination and slope flattening
2. Ditch cleanouts
3. Any grading operations added to the project outside existing shoulders
4. Relocating drains or streams

14.10.01 (continued)

If these, or any other items which are suspected to impact the existing environmental clearance and permit situation arise, the Designer should contact the Environmental Section staff person who is responsible for the project.

14.10.02

Permit Extensions

MDEGLE have agreed to allow MDOT to alter the permit date on permits that have expired prior to letting of a project, if the scope of the project has not been modified.
(2-17-2014) (6-24-2019)

An application to renew the permit is required. MDOT must receive the new permit date prior to changing the date on the permit. Permit date changes will be applied for by the Environmental Section. (8-20-99)

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14.11

ATTACHMENTS for ENVIRONMENTAL SECTION

See MDOT [Form 4200](#); from MDOT web site (2-17-2014)

The Environmental Section shall inform the Design Unit of the permit requirements of the project. Along with **four (4)** sets of ½ sized plans (11" x 17") to be distributed to the resource agencies, the following information will typically need to be provided on letter sized (8½" x 11") paper:

- A. Project Location Map: include county, township, range and section numbers.
- B. A brief description of the project and the reason the work is necessary.
- C. The expected project letting and construction dates.
- D. For wetland impacts, the following will be required:
 - 1. Wetland limits, by station, for each take as well as type such as forested, scrub shrub, or emergent wetlands. This information will be provided by the Environmental Section and should be clearly marked on each plan sheet.
 - 2. The square footage of each take, i.e. 10' x 200', and total acreage take for entire project.
 - 3. Volume of fill in wetlands in cubic yards.
 - 4. Amount of fill per lineal foot in cubic yards for projects impacting less than 2 acres of wetland and less than .25 acre per wetland complex.
- E. For new culverts, culvert replacements and/or culvert extensions, the following information will be required:
 - 1. A completed Bridge and Culvert Data Form (for new culverts or culvert extensions on streams with a drainage area of greater than 2 square miles).

14.11 (continued)

- 2. Cross section view of culvert (may use one typical if there are several of similar nature on project). Cross section should show type, length, diameter, and stationing. Elevations should be shown on new culverts, or when replacing culverts out-of-kind on regulated streams and/or county drains.
- 3. Plan view of culvert stating distance to nearest cross road or reference mark to aid the MDEGLE in locating the culvert during a field inspection. (2-17-2014) (6-24-2019)
- 4. Amount of fill and/or excavation below ordinary high water mark on streams or drains in cubic yards.
- 5. List of riparian owners with names and addresses immediately adjacent to permitted activity for new and/or replacement culverts, extensions greater than 24 feet, or waterway openings greater than 25 square feet.
- F. For bridge repair or new construction over a watercourse, the following information will be required:
 - 1. Cross section view of the bridge abutments, piers, and stream with elevations.
 - 2. Plan view of bridge.
 - 3. A completed Bridge and Culvert Data Form for new bridges, or if altering the original substructure of the existing bridge. See MDOT [Form 4200](#); from MDOT web site (2-17-2014)
 - 4. Earth excavation and fill quantities in cubic yards below the ordinary high water mark of the watercourse.
 - 5. Volume of riprap in square or cubic yards being placed below the ordinary high water mark of the watercourse.
 - 6. A list of riparian owners with their names and addresses from all four quadrants adjoining the watercourse/bridge intersection.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

14.12

ENVIRONMENTAL POLICY (8-20-99)

The National Environmental Policy Act (NEPA) requires an examination and consideration of the potential impacts of a transportation project upon sensitive resources. These resources include, but are not limited to, streams, lakes, floodplains, wetlands, endangered species, historic and archeological sites, parklands, air quality, wildlife habitat, fisheries, etc. It is the policy of the Federal Highway Administration that this examination be completed as part of the NEPA process, that evidence of compliance with the process be contained in appropriate documentation, and that public involvement must be an essential part of the process.

For additional information regarding MDOT environmental issues see the Road Design Manual [Chapter 10](#).

14.12.01

General

Every project that utilizes federal funding must be analyzed for environmental impacts and environmental clearance obtained before the funding is released. The depth of analysis of a project is determined by the severity of its impact upon the environment, not the size of the project. It is possible to have a small project which has such severe impacts that extensive analysis is required. Conversely, it is possible to have a very large project which has very little impact and which requires relatively little analysis. In general, of course, large and complex projects often require more analysis than small, simple projects, but it should be kept in mind that this is a coincidental connection, not a procedural one.

The purposes of the analysis are, basically, to determine what the adverse effects of the project are, whether the positive benefits of the project outweigh the negative effects, to attempt to avoid the negative effects, and to attempt to mitigate those negative effects which can't be avoided. This approach recognizes that the project itself will become a part of the environment. It must therefore be integrated into the existing environment rather than imposed upon it.

The Bridge Design Engineer shall notify the Region/TSC Resource Specialist and the Environmental Section of Environmental Services Section of the Bureau of Highway Development if they identify or encounter any potentially contaminated sites in the design process. See Road Design Manual [Chapter 10](#) and [Chapter 14](#) for more detailed process. See also PPMS Task # 2810 & 2820. (8-20-2009) (2-17-2014)

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14.12.02

Documents / Definitions

There are three levels of analysis: Categorical Exclusion (CE), Environmental Assessment (EA), and Environmental Impact Statement (EIS).

A. Categorical Exclusion

Most projects are cleared through the Categorical Exclusion (CE) process. This process consists of a cursory examination of the proposed scope of work by specialists in the Environmental Section of the Environmental Services Section of the Bureau of Highway Development. If there are no apparent “significant” long term negative environmental impacts, “substantial” controversy on environmental grounds, or significant impacts upon public parks, recreation areas, refuges, or other natural and cultural resources, the project receives an environmental clearance to proceed. Documentation of compliance with the NEPA process is coordinated by the Region’s Environmental Clearance Coordinator (ECC). The ECC will provide the Environmental Classification/Certification, which will often include mitigation measures such as limitations on areas where work can occur, or compensation such as replacement trees in order to avoid or minimize environmental impacts. These mitigation measures must be incorporated into the design of the project.
(3-23-2026)

14.12.02 (continued)

B. Environmental Assessment

When it is uncertain whether or not a project may have a “significant” impact upon the environment, an Environmental Assessment (EA) is prepared. The purpose of the EA is to conduct a more in-depth analysis of the project and to determine either that there is a “Finding of No Significant Impact” (FONSI) or that there is significant impact. If it is determined that there is significant impact, an Environmental Impact Statement will be required.

C. Environmental Impact Statement

When it is obvious that a significant impact upon the environment will result from a project, or when an Environmental Assessment determines that a significant impact will result, an Environmental Impact Statement (EIS) must be prepared. The main purpose of the EIS is to ensure that all considerations and deliberations required by NEPA are carried out and that the decision making process is documented.

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14.13

PROJECT ENVIRONMENTAL CLASSIFICATION (8-20-99)

Every MDOT project is reviewed and it is assigned an environmental classification. The classifications are: Class I (Environmental Impact Statement), Class II (Categorical Exclusion) and Class III (Environmental Assessment). The Majority of projects receive a Categorical Exclusion classification.

14.13.01

General

Projects are classified according to the significance of the impact(s) that they will have upon the environment. The level of analysis of a project increases as the significance of its impacts increases. Those projects in which there are no perceived impacts are classified as Class II (Categorical Exclusions). Those projects in which there is uncertainty as to whether significant impacts will occur receive a Class III (Environmental Assessment) classification. Projects in which it is known or strongly suspected that significant impacts will occur receive the Class I (Environmental Impact Statement) classification.

14.13.02

Environmental Impact Statement

A. Draft Environmental Impact Statement (DEIS)

A DEIS containing a description of project, a discussion of alternative to the construction of the project (including “no build”), an analysis of the impacts that the project and the alternatives would have upon the human and natural environment is developed. The DEIS is then circulated to the appropriate federal and state regulatory agencies and made available for public review. A public hearing on the DEIS is held and public comments recorded. Agency and public comments are incorporated into the DEIS and it is sent to the FHWA for review and approval.

At this stage of analysis, no decisions are made. It is a fact and opinion finding stage.

B. Final Environmental Impact Statement (FEIS)

The FEIS includes discussion of the “recommended alternative” and presents justification for its selection. It also responds to comments gathered from the DEIS and the Public Hearing, and incorporates any corrections to the DEIS. Mitigation and / or enhancement measures intended to reduce or correct any adverse impacts of the recommended alternative are described. Any major unresolved issues will also be incorporated.

The FEIS is then given a final distribution to the public and agencies. A Record of Decision (ROD) is issued by FHWA. After issuance of the ROD, which constitutes environmental clearance and design approval, the project can proceed to the final design, right-of-way acquisition and construction stages.

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

14.13.03

Environmental Assessment (EA)

A. Significance of Impacts

When the significance of the impacts of a project are not clearly established, an EA is prepared. It generally describes the project, discusses the purpose of and need for the project, the alternatives to the project, the impacts of the project and their mitigation, comments and coordination with appropriate agencies, and any other evaluations that may be necessary.

B. Finding of No Significant Impact (FONSI)

The EA process has one of two results. If no impacts are determined to be significant a document known as a FONSI is issued. It states the findings and the basis for the findings and references the EA. If, however, significant impacts are determined to be probable, the Environmental Impact Statement process is initiated for the project.

14.13.04

Categorical Exclusion (CE)

All MDOT projects receive at least a cursory analysis for environmental impacts. If no significant impacts are known or anticipated, the project receives a Categorical Exclusion classification. If, subsequent to this designation, significant impacts are found to be possible or probable, the project is reclassified as either an EA or an EIS.

14.13.05

Asbestos Survey

A full structure asbestos survey is required to be on file for all concrete elements of a bridge that are to undergo construction. The Bridge Design Unit is to review the bridge file in MiBRIDGE for existing surveys at the start of a project. If there is not an existing survey, or existing surveys do not include a concrete element that is to undergo construction or demolition as part of the project, the Bridge Design Unit must submit a request for a survey as early as possible with the Environmental Services Section of the Bureau of Highway Development. New requests to include all concrete elements and other elements that may contain asbestos such as conduits, railing leveling pads, etc. that have not been previously surveyed. To submit a request, the Design Engineer must complete an Asbestos Testing Request form and send to the Statewide Asbestos Contract Manager within the Environmental Services Section. Contact the Environmental Services Section for the appropriate form.

Include the Region Bridge Engineer and other MDOT Region/TSC staff in the request to coordinate sampling, Maintenance of Traffic (MOT), and site access.

Submit completed Asbestos Surveys to the Statewide Asbestos Contract Manager. Project Managers must also include Asbestos Survey results in project Reference Information Documents (RID) and Supporting Documents in ProjectWise to coincide with the project Environmental Classification/Certification.

For consultant-designed projects, the MDOT Project Manager/Consultant Coordinator is responsible for ensuring an asbestos survey is on file or completed as needed.

(11-24-2025)

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14.14

AVIATION, AERONAUTICS & AIRPORT PERMITS (6-23-2025)

14.14.01

Federal Aviation Administration Temporary and Permanent Obstruction Notice Requirements (CFR Title 14 Part 77.9)

The Federal Aviation Administration (FAA) regulations that ensure safe, efficient use, and preservation of navigable airspace are found in Title 14 of the Code of Federal Regulations (14 CFR). Since 1958 these rules have typically been referred to as Federal Aviation Regulations but have recently been identified as the respective CFR Title 14. Subchapter E of Title 14 "Aeronautics and Space", includes Parts 71, 73 and 77 pertaining to "Airspace". CFR Title 14 Part 77 addresses the requirements for filing a Notice associated with alteration due to bridge construction activities.

14.14.01 (continued)

Construction activities that require notice to the FAA requesting an obstruction evaluation will depend on a number of factors including, but not limited to, the height of any permanent and temporary elements, the proximity of the project to an airport, the proximity of the project to airport navigational equipment and use of equipment that emit frequencies. Criteria for determining the need to request an evaluation notice to the FAA is found at **CFR Title 14 Part 77.9** and includes the following:

1. ANY construction or alteration of permanent structures or temporary construction equipment that exceeds 200' or more above ground level (AGL) regardless of proximity of an airport.
2. ANY construction or alteration of permanent structures or temporary construction equipment in the vicinity of an airport that intrudes into a conical zone of airspace surrounding the airport. The size and slope of this zone is dependent on longest runway lengths for each airport and is described in the CFR.
3. The FAA may request ANY construction or alteration of permanent structures or temporary construction equipment to file notice and have subsequent obstruction evaluation conducted.

Permanent bridge construction activities that may require Notice to the FAA, and an obstruction evaluation, include those designs utilizing large pylons, piers, arches, or other structural elements that are above ground level.

Temporary bridge construction activities which will typically involve airspace analysis are those utilizing cranes. Such bridge activities include, but are not limited to, pile driving operations, sheeting installation, beam and structure erection, prefabricated element erection, and cofferdam construction.

FAA determinations are valid for 18 months and typically one 18 month extension (requested 30 days prior to expiration) will be allowed.

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14.14.02

Michigan Tall Structure Permit Requirements

Permanent structures that meet the FAA notice criteria described in section 14.14.01 are subject to the requirements of the Michigan Tall Structures Act ([Act 259 of 1959](#)) and will require coordination with the [MDOT's Office of Aeronautics](#) to obtain a [Michigan Tall Structure Permit](#). To initiate this process and to assure expeditious processing, Notice to the FAA should be filed first, then application for a Michigan Tall Structure Permit should be requested by providing the assigned FAA aeronautical study number(s) to the Office of Aeronautics. The FAA's obstruction evaluation and MDOT's Office of Aeronautics aeronautical study will be done concurrently. Inquiries or request for assistance by MDOT's Office of Aeronautics may be sent via e-mail to MDOT_Tall_Structures@Michigan.gov; please include your FAA Aeronautical study number if available.

Michigan Tall Structure permits are valid for 12 months and are extendable to correspond (match) with FAA permits.

14.14.03

Michigan Local Airport Zoning Permit Requirements

Many publicly owned airports will have local airport zoning regulations administered by the airport or local municipality. These regulations are under the authority of the Michigan Airport Zoning Act, [Act 23 of 1950](#). Airport Zoning regulations are applicable to both permanent and temporary structures and equipment. The heights at which permits are required are different than that of the FAA's Part 77 Notice Criteria and the Michigan Tall Structures Act. **To determine if a separate airport zoning permit is required for temporary equipment or permanent structures, the airport manager or MDOT's Office of Aeronautics should be contacted for assistance.** The Airport Zoning Permit process will also be a concurrent with the FAA obstruction evaluation and the Office of Aeronautics airspace study, but only if separate application is made to the local airport zoning administrator simultaneously. The requirement to obtain a local airport zoning permit is usually very similar to that of the FAA Notice requirements.

14.14.04

Jurisdiction

The FAA regulations referenced above are pursuant to Title XIV of the Code of Federal Regulations, Part 77. MDOT's Office of Aeronautics has been delegated certain authorities by the Michigan Aeronautics Commission to administer the Michigan Aeronautics Code ([Act 327 of 1945](#)), Tall Structure Act ([Act 259 of 1959](#)) and the Airport Zoning Act ([Act 23 of 1950](#)).

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

14.14.05

FAA Coordination and Procedures for Filing Notice

MDOT will file a Notice of Proposed Construction or Alteration with the FAA to obtain determination during the design phase for any project that meets the requirements outlined in Section 14.14.01 or as noted below. The Notice of Proposed Construction or Alteration must be submitted to the FAA a minimum of 45 days prior to construction start date. FAA Form 7460-1 (see [FAA OE/AAA Forms](#) site) must be completed for projects requiring a Notice.

The 45-day advance notice requirement is waived if immediate construction or alteration is required due to an emergency. Notification must be made to the FAA through any expeditious means and followed-up with completion of FAA Form 7460-1 within 5-days of initial notification.

The [FAA Obstruction Evaluation/Airport Airspace Analysis](#) website provides access to a “[Pre-Screening Tool](#)” (formerly called the “Notice Criteria Tool”) to assist in identifying the need for filing a Notice of Proposed Construction or Alteration for projects with permanent improvements or temporary material or equipment with a height of less than 200’ AGL. Note that this tool is used only to verify the need to File Notice with FAA. None of the information entered on the website is transmitted to the FAA.

14.14.05 (continued)

A. Pre-Screening Tool

Use of the Pre-Screening Tool requires input of project latitude, longitude, site elevation, structure height and structure type. Structure height will determine compliance with the 200’ AGL requirement. Latitude and longitude in combination with structure height and site elevation will determine project location in relation to any nearby airports, and overall height Above Mean Sea Level (AMSL) with respect to the protected surfaces surrounding the airport that represents flight paths. For structures under 30 feet in elevation, select Structure Type “crane”.

Latitude and longitude of location are required, and they shall be reported in latitude and longitude projection to the closest 100th of a second and in NAD 83 datum (1983 North American Datum). The Pre-Screening Tool includes an interactive map to assist with the retrieval of location coordinates. For a Bridge Structure Type, at least two point locations representing the structure are required.

Enter the site elevation in NAV 88 datum. The elevation should be the highest ground elevation on the project site that a crane is likely to be placed.

If a structure height (or crane height) is unknown, input a structure height of 200’, which will assure that the 200’ AGL requirement is satisfied.

Click the SUBMIT button to display the “Results” report of what action should be taken. Additional guidance can be found in the OE/AAA Public User Manual - link located in the [‘OE3A Library’](#).

For projects that include multiple structures, the Pre-Screening Tool should be evaluated for each structure.

If 200’ structure height causes the need to File Notice, consideration shall be given to limiting the structure height to a lesser height to avoid the need for filing a Notice of Proposed Construction or Alteration for projects. Consult with Bridge Field Services, Operations Field Services Division to determine a reasonable structure height for the project. Construction equipment less than 25’ high does not require a need to file or permit.

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14.14.05

FAA Coordination and Procedures for Filing Notice (continued)

B. Filing Notice

If the need to “File Notice” to the FAA exists, the Project Manager must register on the website and will be the representative/proponent on behalf of MDOT or the contractor. File each structure separately if more than one structure exists within a project. Any correspondence or requests from FAA must be addressed immediately upon receipt to ensure timely processing of the request.

The FAA Notice will require the overall height of the structure to be reported as the overall “Above Mean Sea Level” AMSL (ground AMSL + structure height “Above Ground Level” (AGL)) as determined for the Pre-Screening Tool. If temporary work areas are required to facilitate the construction of a project these should also be included in the notice.

Separate notice will be required for temporary construction equipment that exceeds the heights of the permanent structure and as required in the explanation above.

MDOT’s Office of Aeronautics can assist with the Notice to the FAA, a Michigan Tall Structure Permit and local Airport Zoning Permits (if required) as described above.

14.14.05 (continued)

C. Contract Documents

A copy of all FAA determination letters and permits (Michigan Tall Structure and local or municipal airport zoning) must be included in the Contract Documents for the project.

A special provision for FAA Notification for Structure Work must be included in all projects.

Include note 8.02 P. when a permit has been obtained for a project. Include note 8.02 Q. when the project has been evaluated for a particular structure height and no Notices or permits are required.

Contractors electing to construct the project outside of the parameters of the permit or criteria considered shall bear responsibility for obtaining a new permit.

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SECTION 10/RIVER AND HARBORS ACT 1899
JURISDICTION

NAVIGABLE WATERS OF THE UNITED STATES IN U.S. ARMY
ENGINEER DISTRICT, DETROIT
FEBRUARY, 1978

In administration of the laws enacted by Congress for the protection and preservation of the navigable waters of the United States, MDOT exercises jurisdiction over the waterways listed below, from their mouths to the head of navigation as follows:

NAME OF WATERWAY	HEAD OF NAVIGATION
Au Gres River	Undetermined
Au Sable River	Dam 7 miles above mouth
Bad River	Upper City limits of St. Charles
Belle River	2800 ft above northern limits of Marine City
Betsie River	Head of Betsie Lake, Frankfort - 1.3 miles from Lake Michigan
Black River (St. Clair Co.)	Beach Road 7 miles above mouth
Black River (Ottawa Co.)	Head of Black Lake at Holland, 5.75 miles from Lake Michigan
Black River (Van Buren Co.)	Michigan Central R.R. Bridge, S. Haven, 2.5 miles above mouth
Burt Lake	Navigable throughout
Carp River (Leelanau Co.)	Leland, dam 400 ft above mouth
Cedar River	0.3 miles above mouth
Charlotte River	County Road bridge 0.33 miles above mouth
Cheboygan River	Navigable throughout
Clinton River	Gratiot Ave. Hwy. Bridge, Mt. Clemens
Crooked Lake	Navigable throughout
Crooked River	Navigable throughout
Detroit River	Navigable throughout
Ecorse River	Highway Bridge 400 ft above mouth
Galien River	Whittaker St. Bridge, 0.25 miles above mouth

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NAME OF WATERWAY	HEAD OF NAVIGATION
Grand River	Grand Rapids, 40 miles above mouth Fulton Street Bridge
Green Bay	In its entirety
Huron River	State highway bridge at Flat Rock
Indian River Inc. Inland Route	Navigable throughout Upper end of Crooked Lake, Conway
Kalamazoo River	Allegan, about 38 miles above mouth
Kawkawlin River	Michigan Central R.R. Bridge at Kawkawlin, about 4 miles above mouth
Keweenaw Waterway	Navigable throughout including Portage Lake, Torch Lake, and Torch Canal
Lake Betsie	Navigable throughout
Lake Charlevoix	Navigable throughout
Lake Erie	Navigable throughout
Lake Huron	Navigable throughout
Lake Macatawa	Navigable throughout
Lake Michigan	Navigable throughout
Lake St. Clair	Navigable throughout
Lake Superior	Navigable throughout
La Plaisance Creek	La Plaisance Road Bridge
Leelanau River	Dam 400 ft above mouth
Little Bay De Noc	In its entirety
Little Lake	Navigable throughout
Manistee Lake	Navigable throughout
Manistee River	Including Manistee Lake, 5.6 miles from Lake Michigan
Manistique River	Upper end of lumber slips at Manistique, 0.75 miles above mouth
Menominee River	From its mouth upstream about 1.86 miles to but not including the Interstate Highway bridge (U.S. 41)
Mona Lake	Navigable throughout

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NAME OF WATERWAY	HEAD OF NAVIGATION
Mullett Lake	Navigable throughout
Muskegon Lake	Navigable throughout
Muskegon River	M-37 Highway Bridge, 39.25 miles above mouth (33 miles from head of Muskegon Lake)
Ottawa River	Detroit & Toledo Shore Line Br. about 3 miles
Paw Paw River	Paw Paw Ave., Benton Harbor, 2 miles above mouth
Pentwater Lake	Head of Lake, 2.25 miles from Lake Michigan
Pere Marquette Lake	Navigable throughout
Pere Marquette River	Head of Pere Marquette Lake, 3 miles from Lake Michigan
Pigeon River	Upper village limits of Caseville
Pine River (Arenac Co.)	M-25 Bridge, 0.5 miles above mouth
Pine River (St. Clair Co.)	Detroit Port Huron R.R. Bridge, 3 miles above mouth
Pine River (Charlevoix Co.)	Upper end of both arms, Charlevoix Lake, Michigan 15 miles above mouth
Pinnebog River	Junction with creek, 0.5 miles above mouth
Portage Lake	Navigable throughout
Raisin River	M.C.R.R. Br. at Monroe, 2.5 miles above mouth
Rouge River	M.C.R.R. Br. at Dearborn (Junction Bridge)
Saginaw River	Navigable throughout
St. Clair River	Navigable throughout
St. Joseph River	Berrien Springs, 24.5 miles above mouth
St. Mary's River	Navigable throughout
Sebewaing River	Pere Marquette R.R. Br., 0.5 miles above mouth
Shiawassee River	Junction with Bad River

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NAME OF WATERWAY	HEAD OF NAVIGATION
Spring Lake	Navigable throughout
Tahquamenon River	Lower Falls, about 16 miles above mouth
Thunder Bay River	Dam near upper city limits of Alpena
Tittabawassee River	Dam in Midland
Waiska River	D.S.S. & A.R.R Br., 0.75 miles above mouth
White Lake	Navigable throughout
White River	Head of White Lake, 6.8 miles from Lake Michigan

It should be understood that this merely represents the views of MDOT since jurisdiction of the United States can be conclusively determined only through judicial proceedings.

LAKE SUPERIOR BASIN

LAKE SUPERIOR Westernmost of the Great Lakes bounded by the States of Minnesota, Wisconsin, and Michigan and by the Canadian province of Ontario.

LIMITS OF NAVIGABILITY - within the limits of the United States, navigable throughout.

Keweenaw Waterway crosses Keweenaw Peninsula, Houghton County, Michigan from Keweenaw Bay on the south to the open waters of Lake Superior on the north.

LIMITS OF NAVIGABILITY - waterway including Torch Lake and Torch Canal navigable throughout.

Sturgeon River rises in south central Baraga County, Michigan and flows westerly and northerly through Baraga and Houghton Counties into Pike Bay, a part of Portage Lake which is a segment of the Keweenaw Waterway.

LIMITS OF NAVIGABILITY - navigability from its mouth upstream to mile 50.

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TRUNKLINE CROSSINGS OF MICHIGAN'S NATURAL RIVERS

<u>Control Section</u>	<u>Structure Number</u>	<u>Trunkline</u>	<u>Watercourse</u>
<u>RIFLE RIVER</u>			
Ogemaw County			
65022	BO1	M-55	Rifle River
65051	BO1	M-33	Rifle River
65051	Culvert	M-33	Eddy Creek
65052	BO1	M-33	Klackung Creek
65052	Culvert	M-33	Wilkins Creek
<u>LOWER KALAMAZOO RIVER</u>			
Allegan County			
03021	BO1	M-89	Kalamazoo River
03021	BO2	M-89	Kalamazoo River
03021	Culvert	M-89	Sand River
03072	BO2	M-40	Rabbit River
03072	Culvert	M-40	Bear Creek
<u>BOARDMAN RIVER</u>			
Grand Traverse County			
28021	Culvert	M-113	Swainstone Creek
28021	Culvert	M-113	Jackson Creek
28021	Culvert	M-113	Bancroft Creek
28051	Culvert	M-37	Beitner Creek
Kalkaska County			
40011	CO1	US-131	S. Br. Boardman River
40011	Culvert	US-131	Taylor Creek
40011	Culvert	US-131	Crofton Creek
40011	Culvert	US-131	Failing Creek
<u>ROGUE RIVER</u> (8-6-92)			
Kent County			
41121	BO2	M-46	Rogue River
41121	BO3	M-46	Duke Creek
41132	BO1	US-131	Rogue River
41132	BO2	US-131	Rogue River

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<u>Control Section</u>	<u>Structure Number</u>	<u>Trunkline</u>	<u>Watercourse</u>
<u>PERE MARQUETTE RIVER</u> (Federal and State Designated Wild and Scenic River)			
Lake County			
43011	BO1	M-37	Pere Marquette River
43011	BO2	M-37	Baldwin River
43022	BO1	US-10	Baldwin River
43022	BO2	US-10	Sandborn Creek
Mason County			
53022	BO1	US-10	Waldon Creek
53031	BO2	US-31	Pere Marquette River
53031	BO3	US-31	Pere Marquette River
Newago County			
62032	Culvert	M-37	Cedar Creek
<u>PINE RIVER</u> (2005)			
Wexford County			
830111	BO1	M-37	Pine River
Osceola County & Lake County			
None			
<u>PIGEON RIVER</u>			
Cheboygan County			
16022	BO1	M-68	Pigeon River
<u>FLAT RIVER</u>			
Ionia County			
35081	XO1	M-44	Flat River
Kent County			
41091	BO2	M-91	Flat River
41091	BO3	M-91	Flat River
Montcalm County			
59022	BO1	M-57	Flat River
59022	BO2	M-57	Dickerson Creek
59031	BO1	M-91	Wabasis Creek
59032	BO1	M-91	Flat River
59032	BO2	M-91	Flat River
59044	BO1	M-46	Flat River

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<u>Control Section</u>	<u>Structure Number</u>	<u>Trunkline</u>	<u>Watercourse</u>
<u>JORDAN RIVER</u>			
Antrim County 05051	Culvert	M-66	Green River
Charlevoix County 15051	BO1	M-32	Jordan River
<u>HURON RIVER</u>			
Livingston County 47013	BO1	US-23	Huron River
47041	BO1	M-36	Huron River
<u>WHITE RIVER</u>			
Muskegon County 61073	BO1	US-31 BR	White River
61075	BO5	US-31	White River
Newaygo County 62012	Culvert	M-20	White River
62012	Culvert	M-20	White River
62014	Culvert	M-20	White River
62031	BO2	M-37	White River
Oceana County 64022	BO2	M-20	White River
64022	Culvert	M-20	White River
64022	CO1	M-20	Knutson Creek
<u>BETSIE RIVER</u>			
Benzie County 10011	BO1	M-22	Betsie River
10031	BO1	US-31	Betsie River
10042	BO1	M-115	Betsie River
10042	Culvert	M-115	Dair Creek
Manistee County 51041	BO1	M-115	Betsie River

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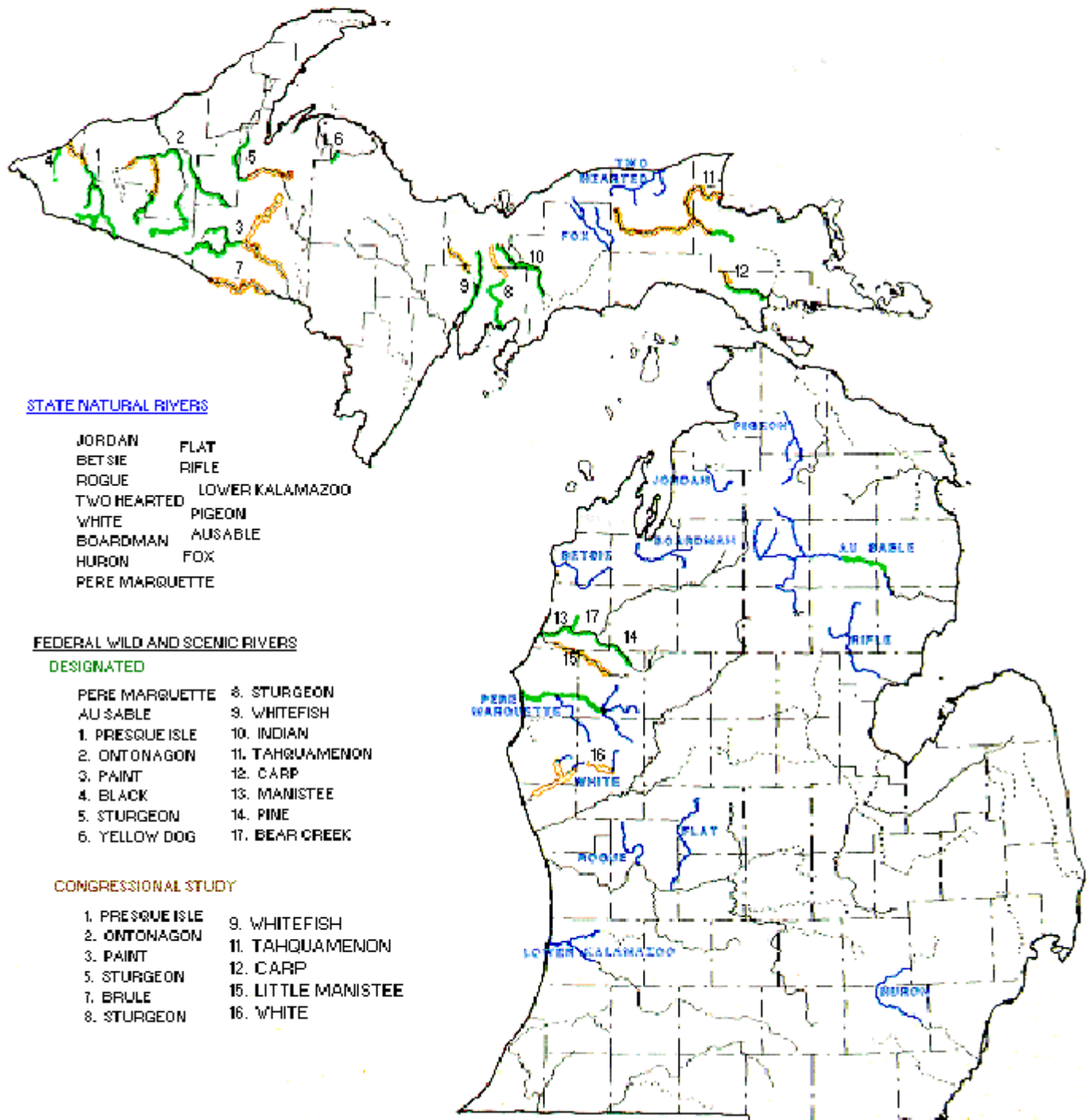
<u>Control Section</u>	<u>Structure Number</u>	<u>Trunkline</u>	<u>Watercourse</u>
<u>FOX RIVER</u> (8-6-92)			
Schoolcraft County			
75052	BO1	M-77	E. Branch Fox River
75061	BO7	M-28	Fox River
<u>TWO HEARTED RIVER</u> (2005)			
Luce County			
None			
<u>AU SABLE RIVER</u> (Federally Designated Wild and Scenic River) (8-6-92)			
Crawford County			
20012	BO1	I-75 BR	Au Sable River
20015	BO1	I-75	Au Sable River
20015	BO2	I-75	Au Sable River
20015	BO3	I-75	E. Br. Au Sable River
20015	BO4	I-75	E. Br. Au Sable River
20021	BO2	M-72/93	Au Sable River
20022	BO1	M-72	S. Br. Au Sable River
Oscoda County			
68012	BO1	M-33/72	Au Sable River
68041	BO1	M-72	W. Branch Big Creek
68041	BO2	M-72	E. Branch Big Creek
Roscommon County			
72041	BO1	M-18/144	S. Br. Au Sable River
<u>UPPER MANISTEE RIVER</u> (2005)			
Crawford County			
20021	B01	M-72	Upper Manistee River
Kalkaska County			
40022	C02	M-72	Upper Manistee River
40022	C03	M-72	Black Creek
40031	B01	M-66	Upper Manistee River
Antrim, Missaukee & Otsego County			
None			

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MICHIGAN'S NATURAL AND WILD & SCENIC RIVERS



MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 15

Chapter has been removed. Relevant information has been relocated to Chapter 1. (11-24-2025)