Road & Bridge Design Publications

Monthly Update – July 2023

Revisions for the month of **July** are listed and displayed below and will be included in projects submitted for the **November** letting. The special detail index from **April** will remain in effect.

E-mail road related questions to MDOT-Road-Design-Standards@michigan.gov.
E-mail bridge related questions to MDOT-Bridge-Design-Standards@michigan.gov.

Bridge Design Manual
7.01.04 K., 7.03.03 B.1., 7.03.03 B.4., 7.03.03 C. & D., 7.03.10 A.2. & 12.08.08: AASHTO LRFD Section 3.6.5.1 states that abutments and piers located within the clear zone shall be investigated for vehicle collisions. MDOT has developed a policy for new construction and rehabilitation projects meeting these requirements on both trunkline and Local Agency projects. This policy was approved at the June 22, 2023, Engineering Operations Committee (EOC) meeting.

7.03 & 7.05.06 A.: Removed reference to clear zone Guide 6.06.05, information is in Road Design Manual Chapter 7.

Bridge Design Guides
Table of Contents: Deleted Guides 6.06.05 & 6.06.05A. The information is presented in section 7.01.11 C. & D. of Road Design Manual.

5.22.01: This is related to the protection of abutments and piers for vehicular collisions as specified above in the Bridge Manual. An informative note to designers and detailers that reinforcement show as minimum (or maximum) is to be designed for spacing and or size. This is true for this guide and all Bridge Design Guides. See the Preface to the Guides.

6.60.11 & 6.60.11A: Redefined location of transverse EA 06 bars and updated dimensions for EW bars within diaphragm.

Road Design Manual
7.01.74: Protection of Existing Piers in the Clear Zone: New section added. This is related to the protection of abutments and piers for vehicular collisions as specified above in the Bridge Manual.

Updates to the MDOT Cell Library, Sample Plans, and other automated tools may be required in tandem with some of this month's updates. Until such updates can be made, it is the designer's/detailer's responsibility to manually incorporate any necessary revisions to notes and plan details to reflect these revisions.

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".

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)

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.

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.

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.

7.01.04 (continued)

Design Loading

K. Vehicle Collision Force

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.

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.

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)

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)

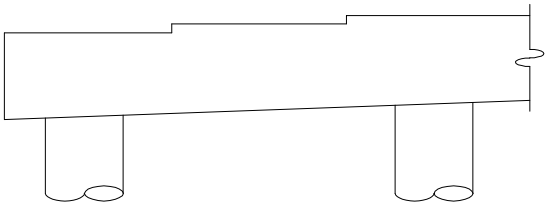
1. Size

   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:

   a. Avoid splicing reinforcement at points of maximum stress. Where this is not practical, stagger the splices.

   b. Calculate the clear distance between contact lap splices assuming the bars are placed in a horizontal plane unless otherwise noted on the plans.

   c. Use temporary supports during staged construction to shore cantilevered pier caps exceeding five feet in length.

   d. 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)

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'. (5-6-1999)

   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.

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)

MICHIGAN DESIGN MANUAL
BRIDGE DESIGN

CHAPTER 12 REHABILITATION PROJECTS (continued)

12.08 MISCELLANEOUS REHABILITATION

12.08.01 Field Inspections

12.08.02 Concrete Repair - General (10-24-2001)

12.08.03 Substructure Repairs

12.08.04 Repair of Overhead Concrete Surfaces

12.08.05 Expansion Anchored Bolts

12.08.06 Deck Patching (5-1-2000)

12.08.07 Temporary Support Systems (8-6-92)

12.08.08 Protection of Existing Piers in the Clear Zone (7-24-2023)

12.08.09 Rocker Realignment (7-25-2022)

12.09 BRIDGE DECK REPAIR STRATEGY (8-6-92) (3-26-2012)

12.09.01 Deck Restoration

12.09.02 Bridge Deck Preservation Matrix (10-24-2001)

Appendix 12.01.01 Detroit Metropolitan Area (8-6-92)

Appendix 12.02 Clear Roadway Widths and Design Loading Structural Capacity (9-1-88) (2-21-2017)

Appendix 12.02.01 Design Exception Requirements - Vertical Clearance (5-1-2000)

Appendix 12.03.01 B. Sample request for Accident Analysis and Safety Review (5-1-2000)

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.

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 the MDOT Bridge Design Guides. The guidance included in the MDOT Bridge Design Guides have been developed based on the requirements in Section 3.6.5.1 of the AASHTO LRFD Bridge Design Specifications. (**This is pending and will be available shortly.**)

12.08.08 (continued)

Protection of Existing Piers in the Clear Zone (7-24-2023)

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.

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.

12.08.08 (continued)

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.

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.

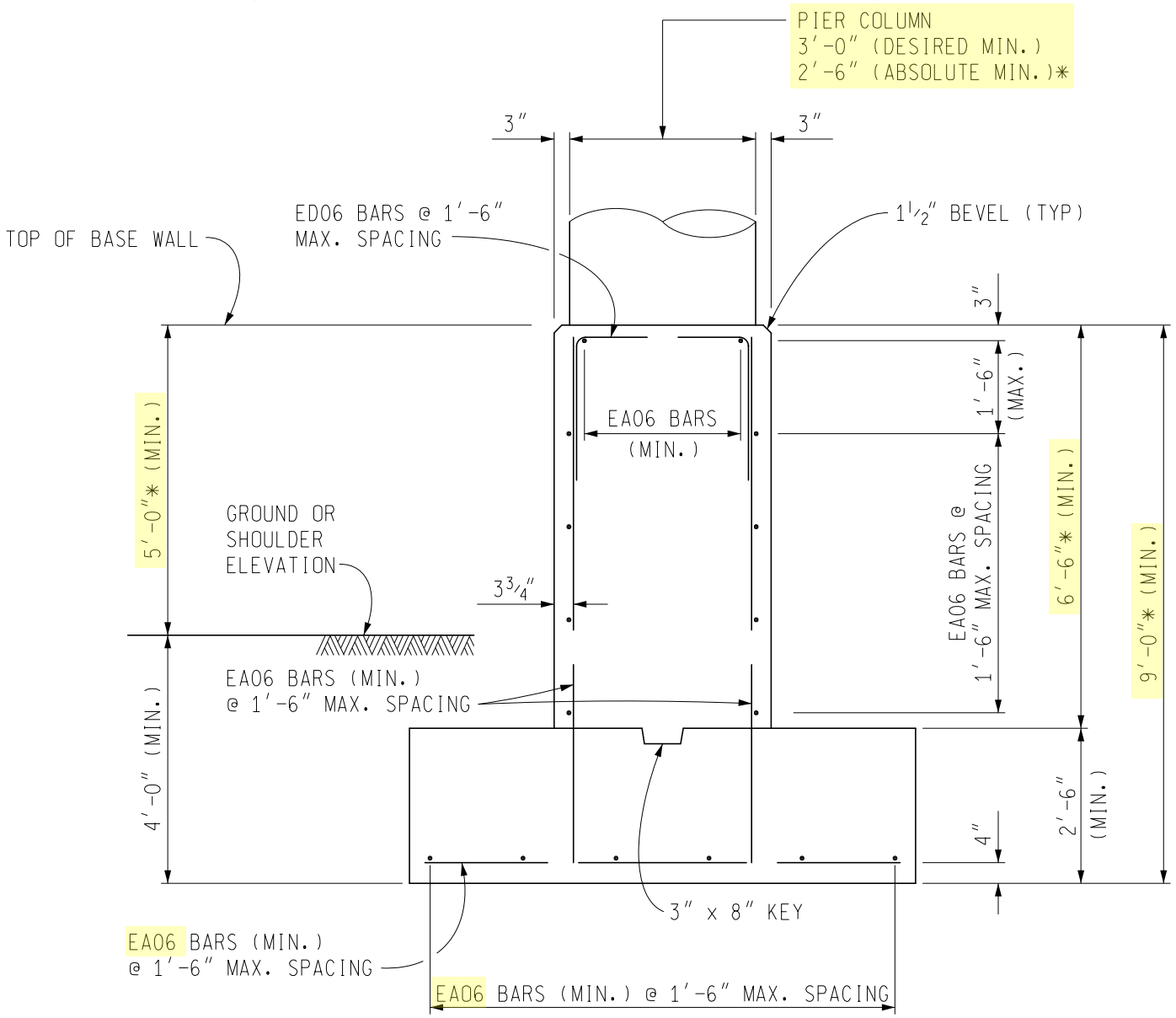
Bridges spanning over railroad right-of-way shall meet the requirements outlined in the AREMA Manual for Railway Engineering or local railroad company guidelines.

CONTENTS

SECTION 5 - SUBSTRUCTURE (cont)

SECTION 6 - SUPERSTRUCTURE

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: KCK	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT BASE WALL DETAILS FOR PIER ADJACENT TO ROADWAY	ISSUED: 07/24/23 SUPERSEDES: 02/14/11



* THE WIDTH OF THE PIER COLUMN SHOULD BE 3′-0″ MINIMUM WHENEVER PRACTICAL. INCREASE THE MINIMUM HEIGHT OF THE BASE WALL ABOVE THE ADJACENT GROUND OR SHOULDER TO 5′-3″ IF THE WIDTH OF THE PIER COLUMN IS LESS THAN 3′-0″. COLUMNS WITH A WIDTH LESS THAN 3′-0″ ARE MORE SUSCEPTIBLE TO FAILURE WHEN STRUCK, AND THE ADDITIONAL HEIGHT OF THE BASE WALL ENSURES THE COLUMN IS PROTECTED AFTER FUTURE OVERLAYS OF THE ROADWAY ADJACENT TO THE PIER.

SECTION OF BASE WALL

NOTES:

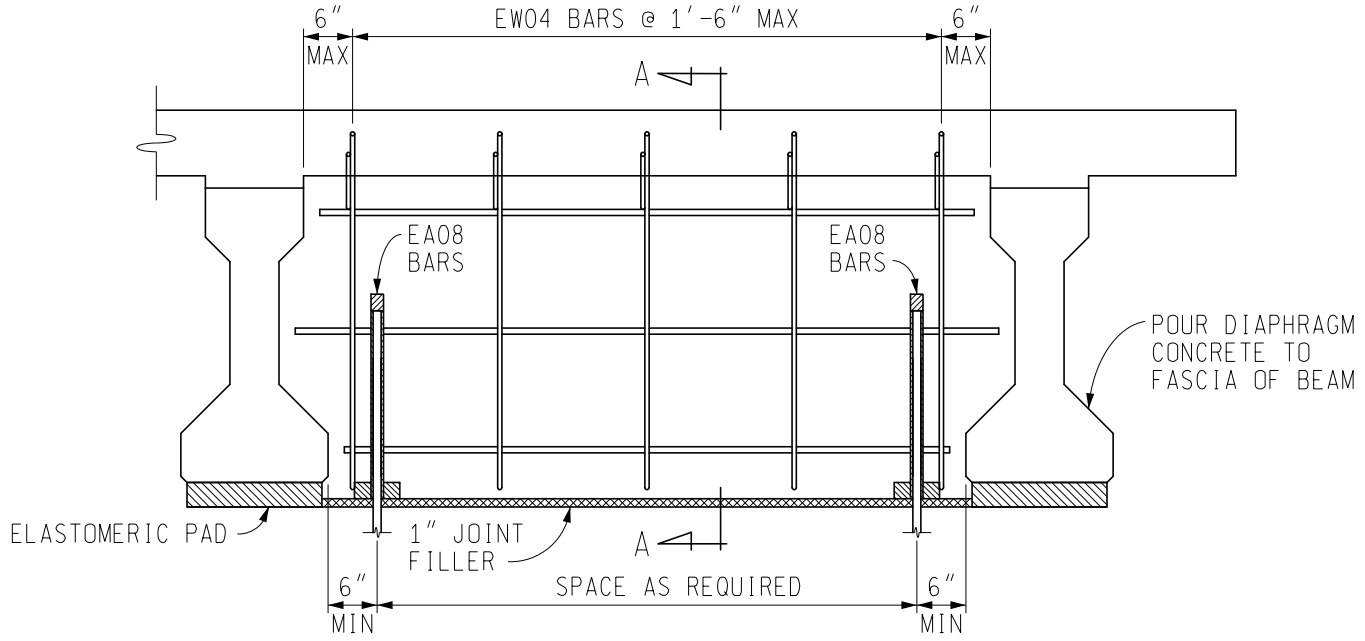
EXTEND BASE WALL TO END OF FOOTING WHEN GUARDRAIL ATTACHMENT IS ANTICIPATED.

FOR ADDITIONAL REQUIREMENTS SEE BRIDGE MANUAL CHAPTER 7.

THE MINIMUM LENGTH OF THE BASE WALL MUST BE 10′-0″.

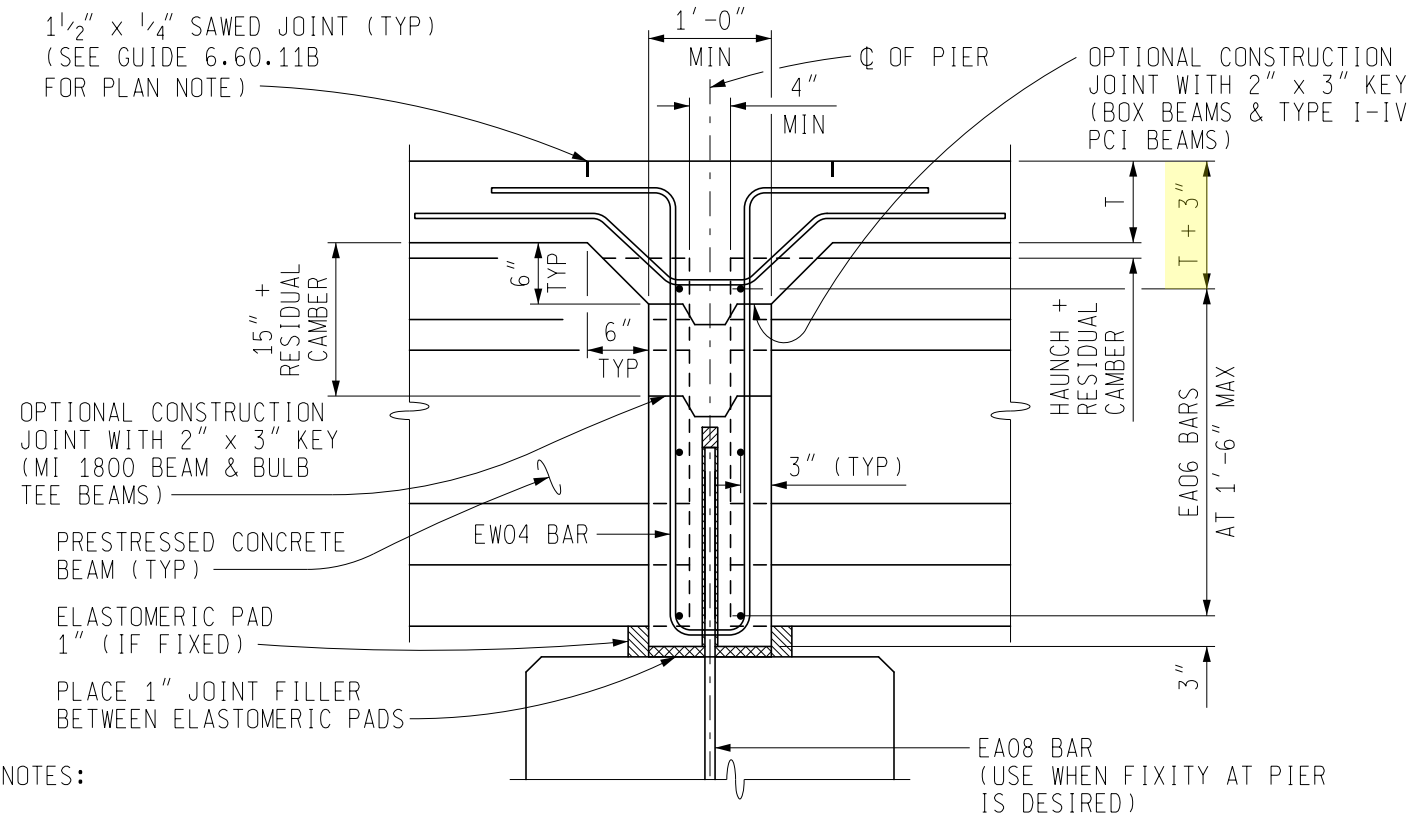
REINFORCEMENT SHOWN IS THE MINIMUM REINFORCEMENT. INCREASE THE SIZE AND/OR SPACING OF THE REINFORCEMENT WHEN THE DESIGN OF THE BASE WALL OR FOOTING REQUIRES IT.

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: KCK	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT PIER DIAPHRAGMS FOR PRESTRESSED CONCRETE BEAMS CONTINUOUS FOR LIVE LOAD	ISSUED: 07/24/23 SUPERSEDES: 06/26/23



PIER DIAPHRAGM ELEVATION

PCI BEAMS SHOWN. SPREAD BOX BEAMS, MICHIGAN 1800 BEAMS, AND BULB TEE BEAMS ARE SIMILAR.



SECTION A-A

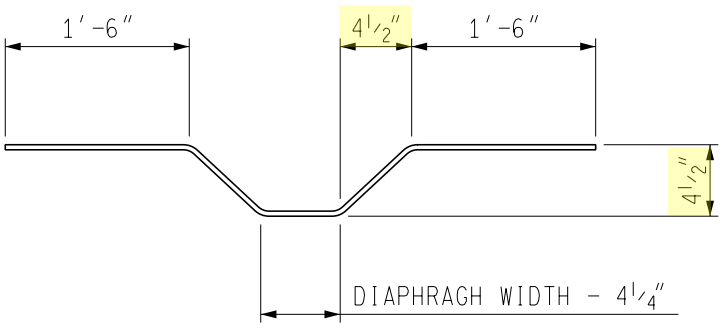
NOTES:

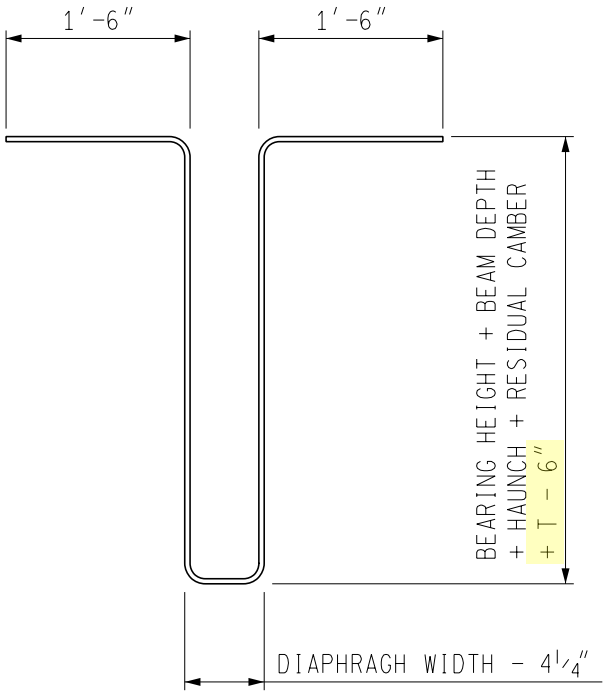
RESIDUAL CAMBER IS DEFINED AS THE ESTIMATED REMAINING CAMBER IN PRESTRESSED CONCRETE BEAMS AFTER ANY DEFLECTION FROM THE DEAD LOAD OF STRUCTURAL COMPONENTS, NON-STRUCTURAL ATTACHMENTS, WEARING SURFACES AND UTILITIES HAVE BEEN ACCOUNTED FOR.

PRESTRESSED CONCRETE BEAMS SHALL BE DESIGNED AS SIMPLE SPAN BEAMS FOR DEAD LOAD AND LIVE LOAD. THE BRIDGE SLAB SHALL BE DESIGNED CONTINUOUS FOR LIVE LOAD OVER PIERS.

PREPARED BY DESIGN DIVISION	6.60.11

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: KCK	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT PIER DIAPHRAGMS FOR PRESTRESSED CONCRETE BEAMS CONTINUOUS FOR LIVE LOAD	ISSUED: 07/24/23 SUPERSEDES: 06/26/23





EW04 BARS

PREPARED BY DESIGN DIVISION	6.60.11A

CHAPTER 7 APPURTENANCES INDEX (continued)

7.01.74 (added 7-24-2023)

Protection of Existing Piers in the Clear Zone

The piers of existing bridges located within the clear zone as defined in Section 7.01.11 shall be retrofitted to account for the vehicle collision force 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:

- The pier has columns with a minimum width of less than 3'-0".
- The pier does not have load path redundancy. This includes, but is not limited to:
  - The pier has two columns or fewer.
  - The superstructure beams are supported directly on the columns with no cap adjoining columns.
- 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.

Contact the Region Bridge Engineer or the Chief Structure Design Engineer if one of the conditions listed above exist within the limits of the 3R or 4R road project.