Road & Bridge Design Publications

Monthly Update – February 2024

Revisions for the month of **February** are listed and displayed below and will be included in projects submitted for the **June** letting. The special detail index for **January** 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.

Road Design Manual
6.04.12E: Concrete Pavement Patching: Eliminated the pay item "cement" from the list of common pay items applicable to a patching project. (It is no longer intended to be the typical pay item used for patching.)

7.01.06: Guardrail Worksheet: Revised the grading flare rate in advance of the terminal from a fixed rate to a reference to the appropriate standard plan.

Bridge Design Manual
7.02.27 (LRFD): Clarified the use of 2.0% for sidewalk cross slopes to account for inconsistencies in concrete finishing.

12.08.08: Updated Bridge Design Guide reference, AASHTO LRFD reference and deleted the "pending and available shortly" sentence**.**

Bridge Design Guides
Table of Contents: Added Guides 5.22.02, .02A & .02B. New guides for Pier Strut Retrofit for Vehicular Collision Loads.

5.22.02, 02A & 02B: Bridge Design Guide 5.22.02, .02A & .02B have been developed to provide typical designs for struts with specific dimensions and for cases where the length of the strut is less than the critical wall length over which the yield line mechanism occurs (Lc). Generally, following this design guide will result in a strut design that meets the requirements of AASHTO LRFD Section 3.6.5. ***IT IS IMPORTANT TO NOTE THAT THE VERTICAL ADHESIVE ANCHORS IN THE PIER FOOTING MUST BE DESIGNED FOR THE APPLIED TENSION AND SHEAR LOADS AND CONCRETE STRENGTH OF THE EXISTING FOOTING, AND THE DESIGN SHOULD NOT ASSUME THAT THE MINIMUM EMBEDEMENT CALLED FOR IN THE MDOT STANDARD SPECIFICATIONS FOR CONSTRUCTION ARE ADEQUATE.***

For additional information on this topic see the July and November of 2023 Road and Bridge Design Publications.

Michigan Department of Transportation

Road & Bridge Design Publications

Monthly Update – February 2024

6.29.10C & 6.29.17E: Clarified the use of 2.0% for sidewalk cross slopes to account for inconsistencies in concrete finishing.

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.

6.04.12 (revised 2-26-2024)

Concrete Pavement Patching

A. References

See Standard Plan R-44-Series, "Concrete Pavement Repair". Also see Section 6.03.04B, Concrete or Composite (HMA on Concrete) Pavement.

B. General

It is preferable to delay a first-time resurfacing of a concrete pavement as long as possible by patching and joint repair. As the emphasis has shifted from large scale new construction or relocation to improving and expanding the existing trunkline system, and maintaining it, patching and joint repair projects have taken an increasingly larger share of construction dollars.

It is difficult to separate patching from joint repair. Except for construction-induced pavement and base deficiencies, most deterioration of a pavement occurs at the joints, primarily in the transverse joints and, to a lesser extent, in the longitudinal joints and deteriorated transverse cracks.

6.04.12 (continued)

C. Distances Between Concrete Patches

The minimum distance between patches should be 8', according to the ***Standard Specifications for Construction***. If less than 8' between repairs, the entire section of old pavement should be removed and a longer repair constructed. A note should be included in the plans to this effect. Some judgement should be used, however; if the designer frequently finds that the minimum distance between patches criteria is being encountered, it may indicate that the wrong "fix" has been chosen for the project.

Too many patches per mile is objectionable for two reasons:

1. The motorist visually perceives the pavement to be in bad condition and thus may expect a poor ride even though the patches may actually be quite smooth riding.

2. Excessive patching may indicate that the wrong treatment has been selected and that the money spent on patching could have been better utilized if contributed toward a different type of rehabilitation. A study prepared by Gerald T. Luther in February 1989 concluded that, using a life cycle analysis, about 75 patches per lane mile equates in cost to about 4" of HMA resurfacing over a 20-year life span. The HMA project, however, would be ready for total rehabilitation at the end of the 20 years whereas the patched project would still have about seven years of useful life remaining. The Engineering Operations Committee, on March 21, 1989, decided that for design purposes, patches should be limited to a maximum of 60 repairs per lane mile.

6.04.12 (continued)

Concrete Pavement Patching

D. Expansion Space to be Provided

Unless the pavement being repaired is to be HMA overlaid, patches and joint repairs should provide 1" of expansion space in 1000' of pavement. Expansion space is provided by use of Expansion Joint, Erg.

In general, it is preferable to disperse expansion space throughout a project than to concentrate joints at one location. Since most old expansion joints are bound up, providing less than full width relief will only compound the problem. Where the existing joint is an expansion joint, provide a new Erg across all lanes to provide uniform relief. (Do not use an E2 and match the existing joint.) Care must be taken to choose locations where the Expansion Joint, Erg can be placed across all lanes.

E. Patching Pay Items

The more common pay items applicable to a patching project are:

Pavt Repr, Rem	Square Yard
Saw Cut, Intermediate	Foot
Pavt Repr, Noneinf Conc, __ inch	Square Yard
Lane Tie, Epoxy Anchored	Each
Joint, Contraction, Crg	Foot
Joint, Expansion, Erg	Foot
Joint, Expansion, Esc	Foot
Joint, Tied, Trg	Foot
Non-Chloride Accelerator	Gallon

6.04.12E (continued)

The following notes clarify the use of these items:

1. Pavt Repr, Rem

The pay item of Pavt Repr, Rem applies to pavement removals from 4' (the minimum length of a patch) to 100' long. Removals more than 100' long are paid for as Pavt, Rem. Removal of concrete shoulders, curb, curb and gutter, and valley gutter are paid for using the same pay item as used for the adjacent pavement.

It should be noted that Pavt, Rem carries no restriction regarding disturbance of the underlying base, whereas Pavt Repr, Rem does carry a prohibition against disturbing the base, so as to require sawing and lifting methods. Pavement removal for utility cuts, even though unavoidably disturbing the base, should be paid for as "Pavt Repr, Rem.

If the thickness of the old pavement being removed results in the base being more than 2" low, the contractor will be required to bring it up to proper elevation with aggregate. (Concrete would be permitted but payment will be limited to that for aggregate) If the base is 2" low or less, or is low as a result of the contractor's removal operation, the contractor must fill the deficiency with concrete at his/her expense. Any disturbed base must be recompacted before casting the patch, otherwise settlement will occur.

7.01.05 (revised 4-24-2023)

Basic Concepts for Roadside Control

The following are basic concepts and design options for the use or non-use of roadside barriers. The primary sources of information for roadside control are found in the AASHTO documents listed in Section 7.01.01, "References".

A. A collision with a roadside barrier is considered a crash, because the barrier itself is a roadside obstacle.

B. A roadside barrier may increase the frequency of crashes, therefore a barrier should only be installed if it will reduce the severity of potential crashes.

C. When considering the design options for roadside treatment and the progression of design options basic concepts for roadside control should be as follows.

1. Remove the obstacle or redesign it so it can be safely traversed.

2. Relocate the obstacle to a point where it is less likely to be struck.

3. Reduce impact severity by using an appropriate breakaway or traversable device.

4. Redirect a vehicle by shielding the obstacle with a longitudinal traffic barrier and/or crash cushion.

5. Delineate the obstacle if the above alternatives are not appropriate.

D. Generally, a roadside barrier should be placed as far from the traveled way as conditions will permit. See Section 7.01.30G.

E. Compared to parallel guardrail installations, flared guardrail installations have the advantage of requiring less guardrail to effectively shield a hazard. However, guardrail installations have minimum grading requirements that must be met, and flared guardrail installations may not be economically feasible if extensive earthwork/slope flattening are required.

7.01.05 (continued)

Therefore, the decision to use a flared or parallel guardrail installation should be made on a case-by-case basis taking site-specific conditions into consideration.

F. To uniformly compute the length of need for roadside barriers, a guardrail worksheet has been developed and should be used on both new and upgrading projects. Computation methods used on this worksheet complies with the guidelines described in the ***Roadside Design Guide***. It still remains important that all designers become familiar with the "Guide" to understand the design process. For determining the length of need when non traversable embankments are the only obstacles of concern, see Section 7.01.30.

The worksheet shall be used by all designers, including consulting firms performing work for the Department, to compute guardrail length of needs.

The designer should fill in all data and compute each individual barrier run. This will assure proper compliance to standards and allow each barrier run calculation to be documented and checked for accuracy.

Construction field offices should be sent the completed worksheets for reference during project construction.

The worksheet does not cover all situations which may occur in the field, although it is expected to cover most installations. Any situation not covered by the worksheet shall be similarly documented, along with a sketch providing the details of the guardrail installation.

7.01.06 (revised 2-26-2024)

Guardrail Worksheet

The guardrail worksheet is shown on the following pages.

GUARDRAIL WORKSHEET

(REV. 02-2024)

FOR APPROACH TERMINALS ON R-61-SERIES, R-62-SERIES AND R-63-SERIES

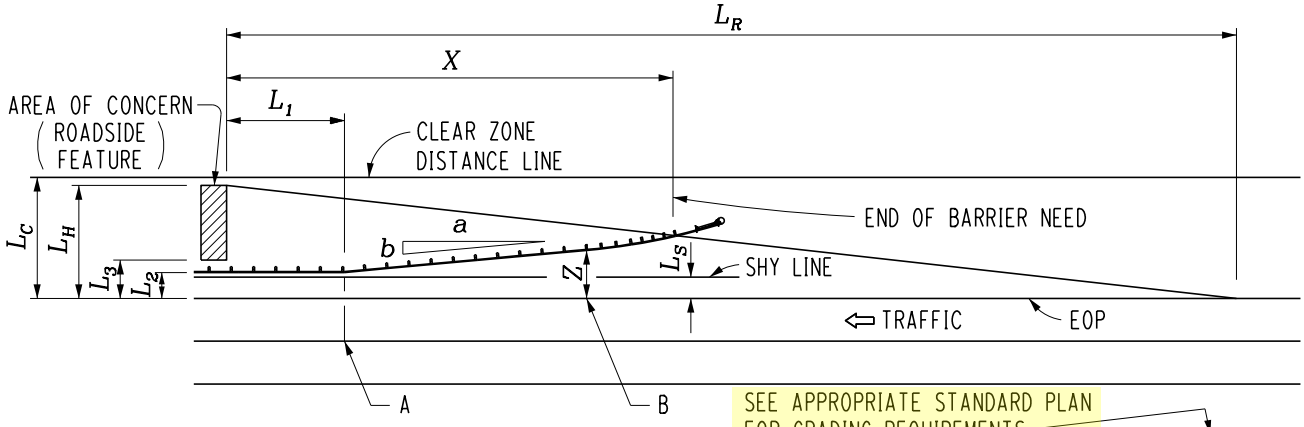
ROUTE _____ CONTROL SECTION _____ JOB # _____

DESIGNED BY _____ DATE _____ CHECKED BY _____ DATE _____

APPROX. STATION OR M.P. _____ DESCRIPTION _____

GUARDRAIL RUN # _____

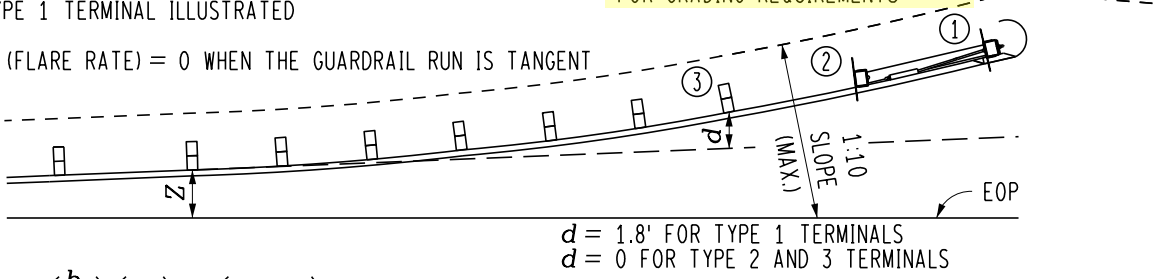
IF STATIONING IS NOT AVAILABLE, LOCATE TO NEAREST FIXED OBJECT



SEE APPROPRIATE STANDARD PLAN FOR GRADING REQUIREMENTS

NOTES: TYPE 1 TERMINAL ILLUSTRATED

$\frac{b}{a}$ (FLARE RATE) = 0 WHEN THE GUARDRAIL RUN IS TANGENT



d = 1.8' FOR TYPE 1 TERMINALS
d = 0 FOR TYPE 2 AND 3 TERMINALS

$$X = \frac{L_H + \left(\frac{b}{a}\right)(L_1) - (L_2 + d)}{\frac{b}{a} + \frac{L_H}{L_R}}$$

$$Z = L_2 + (|S_B - S_A|)\left(\frac{b}{a}\right)$$

LENGTH OF NEED ..... X = _____

RUNOUT LENGTH (7.01.19) ..... L_R = _____

GUARDRAIL TAPER RATE (7.01.29A) ..... $\frac{b}{a}$ = _____

E.O.P. TO FACE OF BARRIER (DESIGNED) ..... L_2 = _____

CLEAR ZONE (7.01.11) ..... L_C = _____

E.O.P. TO ROADSIDE FEATURE (MEASURED) ..... L_3 = _____

EFFECTIVE TURNED OUT DISTANCE OF ANCHORAGE ... d = _____

LATERAL EXTENT OF ROADSIDE FEATURE (MEASURED).. L_H = _____

LATERAL OFFSET AT END OF FLARE ..... Z = _____

NOTE: DISTANCE OF OBJECT FROM BACK OF BARRIER MUST BE GREATER THAN THE MAXIMUM DEFLECTION (7.01.20)

$L_H \leq L_C$

REFER TO STANDARD PLAN R-59-SERIES AND DESIGN MANUAL SECTION 7.01.30 FOR GUARDRAIL AT EMBANKMENTS

DESIGN ADT _____

DESIGN SPEED _____

APPROACH SLOPE _____

L_1 = _____ (RECOMMENDED MINIMUM DISTANCE: 25' OR LENGTH OF GUARDRAIL BRIDGE ANCHORAGE MEASURED FROM BRIDGE RAIL ENDING, WHICHEVER IS GREATER)

L_S = _____ SHY LINE (7.01.18)

STATION AT A (S_A) _____

STATION AT B (S_B) _____

(REV. 02-2024)

PROPOSED TREATMENT

CALCULATIONS OR NOTES

PAY ITEMS

_____ Ft * Guardrail, Type _____ , _____ inch Post

_____ Ea Guardrail Anch, Bridge, Det _____

_____ Ft Bridge Railing, Thrie Beam Retrofit

_____ Ea Guardrail Approach Terminal, Type _____

_____ Ea Guardrail Departing Terminal, Type _____

_____ Ea Guardrail Reflector

_____ Cyd Embankment, LM

* FOR THIS PAY ITEM, THE GUARDRAIL APPROACH TERMINAL, TYPE ____ PORTION OF LENGTH OF NEED (X) MUST BE DEDUCTED

DEDUCTION TABLE							
GUARDRAIL APPROACH TERMINAL TYPE							
1B	1T	2B	2T	2M	3B	3T	3M
25'	31.25'	37.5'	43.75'	34.3'	12.5'	31.25'	21.8'

PAY LENGTHS MUST BE DIVISIBLE BY 12.5'. ROUND TO NEXT HIGHEST RAIL LENGTH, EXCEPT WHEN TYPE MGS-8 OR TYPE MGS-8D GUARDRAIL IS ATTACHED TO A GUARDRAIL FEATURE REQUIRING A HEIGHT TRANSITION (e.g., GUARDRAIL APPROACH TERMINAL TYPES 1B, 2B, OR 3B; A T-SERIES GUARDRAIL BRIDGE ANCHORAGE; etc.)

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.

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)

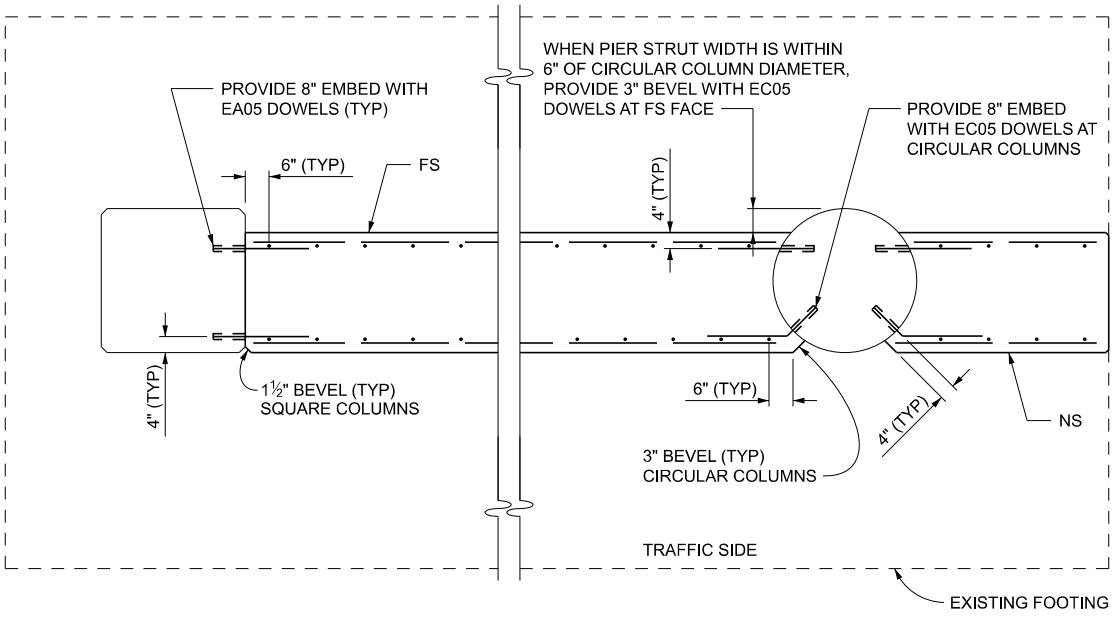
Alternatively, the vehicle collision force can be redirected or absorbed with Type C single face concrete barrier in accordance with Standard Plan R-54-Series. Locate the barrier relative to the face of the pier in accordance with the requirements outlined in Section 3.6.5.1 of the AASHTO LRFD Bridge 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.

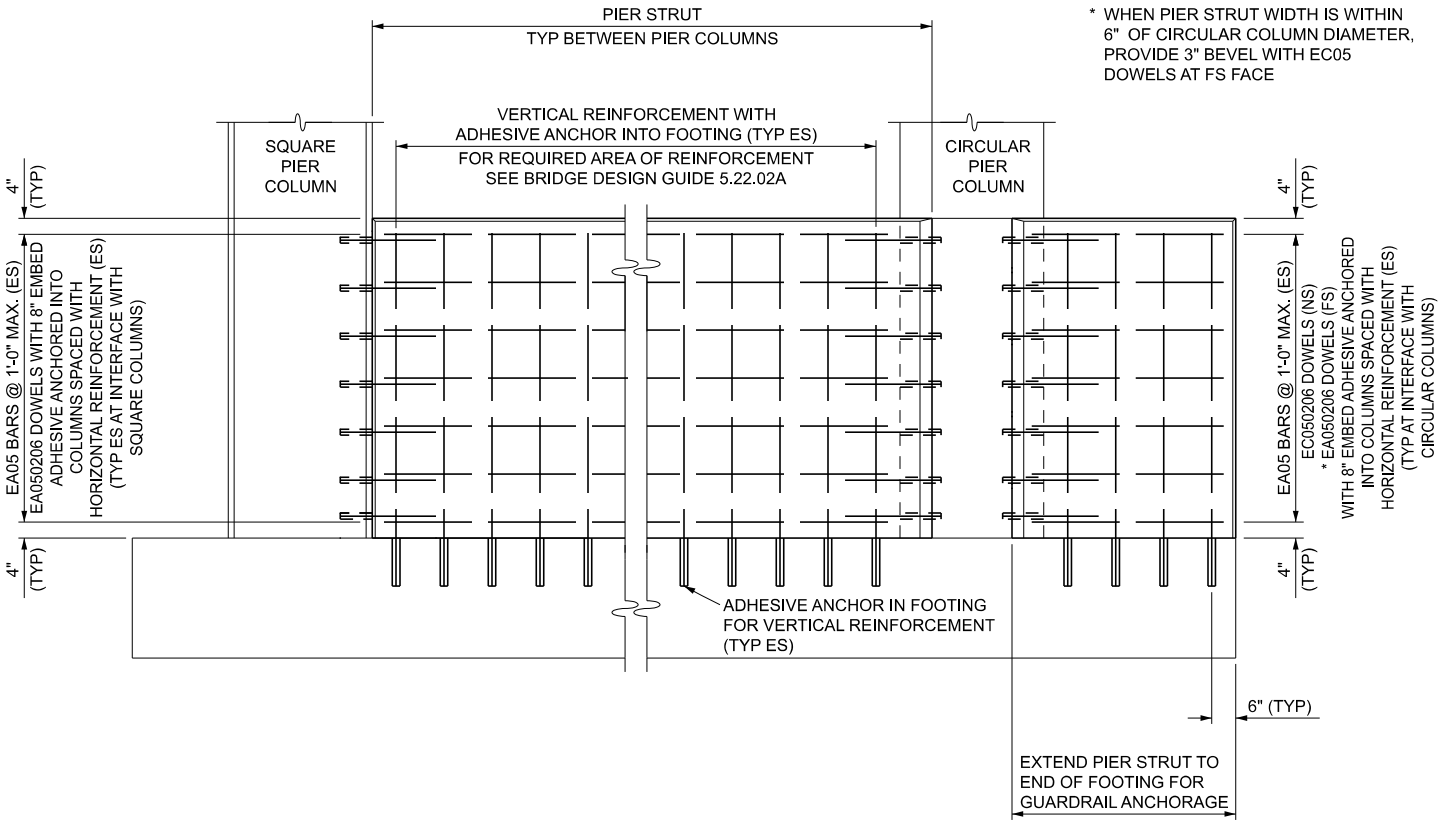
MICHIGAN DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN GUIDES

TABLE OF CONTENTS

DRAWN BY: BLT	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT	ISSUED: 02/26/24
CHECKED BY: VZ	PIER STRUT RETROFIT	SUPERSEDES:
APPROVED BY: KCK		



PIER STRUT PLAN

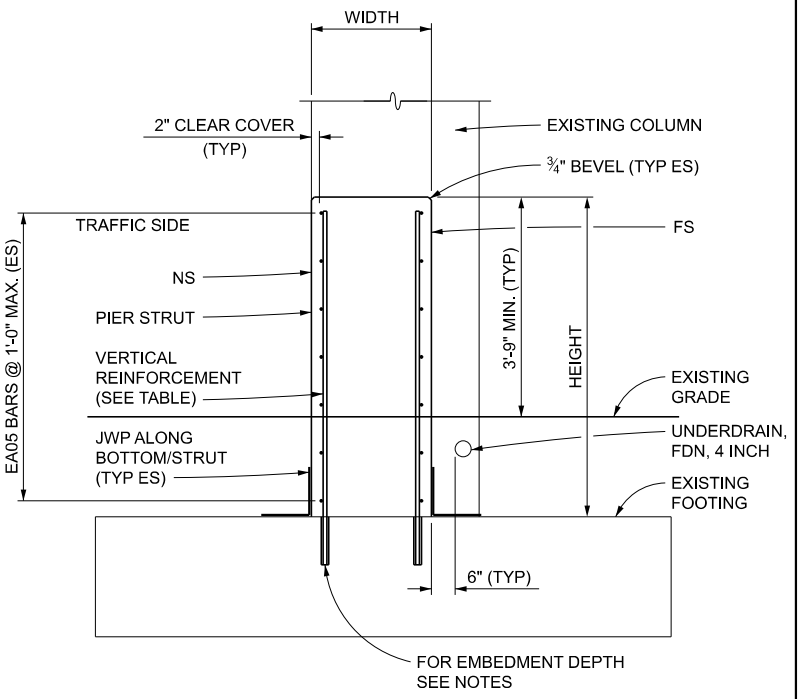


PIER STRUT ELEVATION

PREPARED BY DESIGN DIVISION	5.22.02

DRAWN BY: BLT	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT	ISSUED: 02/26/24
CHECKED BY: VZ	PIER STRUT RETROFIT	SUPERSEDES:
APPROVED BY: KCK		

PIER STRUT RETROFIT REINFORCED CONCRETE DESIGN			
HEIGHT (FT)	WIDTH (FT)	VERTICAL REINFORCEMENT (IN^2/FT)	APPLIED TENSION LOAD (KIP/FT)
5.0	1.5	1.11	60
6.0	2.0	0.90	52
7.0	2.0	1.11	61
8.0	2.5	0.94	54
9.0	2.5	1.11	61
10.0	3.0	0.95	56
11.0	3.0	1.05	61
12.0	3.0	1.18	67



PIER STRUT SECTION

NOTES:

NS DENOTES NEAR SIDE, FS DENOTES FAR SIDE, AND ES DENOTES EACH SIDE.

DETAILS INCLUDED IN THIS GUIDE MAY BE USED TO RETROFIT EXISTING BRIDGE PIERS THAT MEET ONE OF THE CONDITIONS OUTLINED IN BRIDGE DESIGN MANUAL SECTION 12.08.08.

INFORMATION PROVIDED IN THE TABLE APPLIES WHEN THE LENGTH OF THE PIER STRUT IS LESS THAN THE CRITICAL WALL LENGTH OVER WHICH THE YIELD LINE MECHANISM OCCURS (Lc). IF THE LENGTH OF THE PIER STRUT EXCEEDS Lc, DESIGN THE REINFORCEMENT IN ACCORDANCE WITH AASHTO LRFD SECTION A13.3.1. FOR DEFINITIONS OF YIELD LINE MECHANISM AND Lc SEE AASHTO LRFD A13.3.1.

AT MEDIAN PIERS, PLACE VERTICAL REINFORCEMENT, SPECIFIED IN THE TABLE, IN BOTH FACES OF THE PIER STRUT. THE WIDTH OF THE STRUT AT MEDIAN PIERS SHOULD MATCH THE WIDTH/DIAMETER OF THE EXISTING PIER COLUMNS.

VERTICAL ADHESIVE ANCHORS IN THE PIER FOOTING MUST BE DESIGNED FOR THE APPLIED TENSION (SEE TABLE) AND SHEAR LOADS USING THE DESIGN STRENGTH OF THE CONCRETE IN THE PIER FOOTING AND ASSUMING A CRACKED SECTION. THE ADHESIVE SYSTEM AND MINIMUM EMBEDMENT DEPTH OF THE VERTICAL REINFORCING ANCHORED INTO THE FOOTING IS REQUIRED TO MEET THE PROVISIONS OF BRIDGE DESIGN MANUAL SECTION 7.06.02.B.

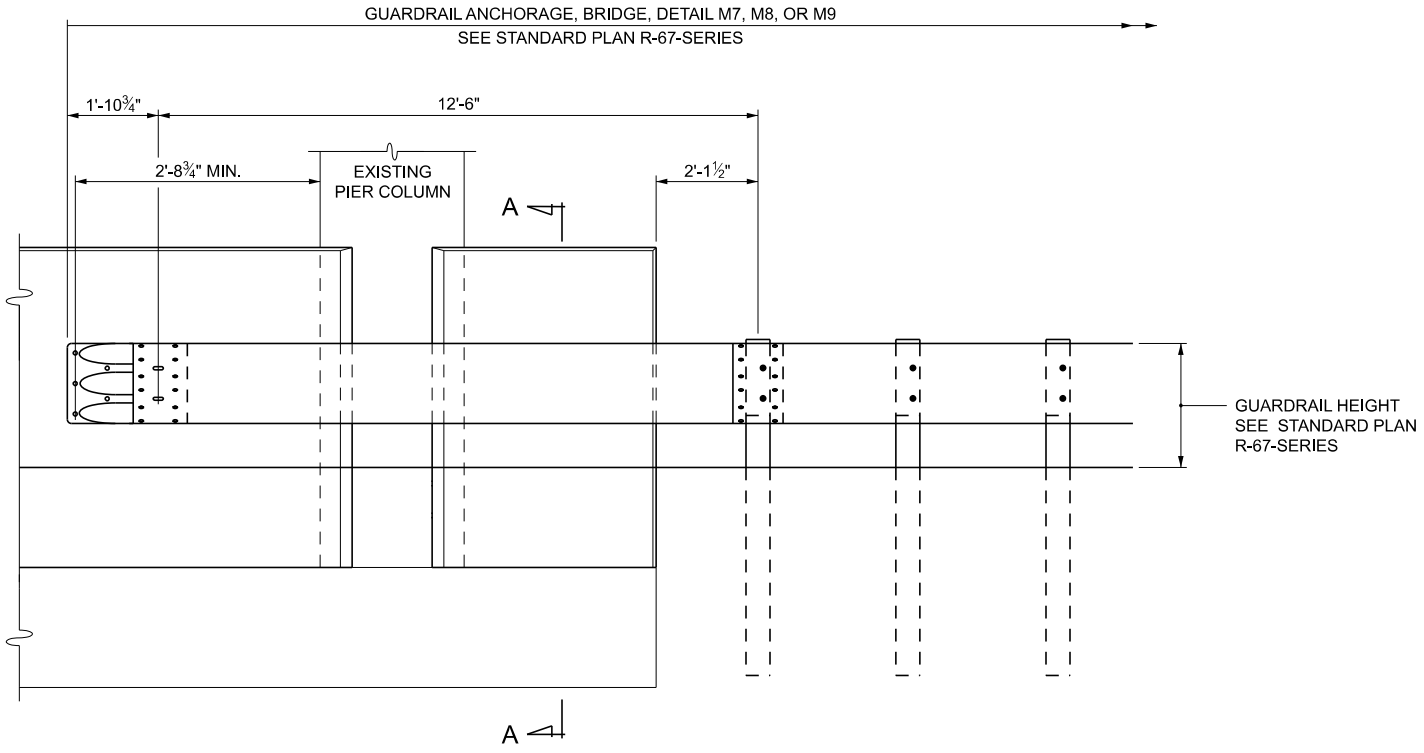
PIER STRUTS WITH HEIGHTS AND WIDTHS OTHER THAN THOSE LISTED IN THE PIER STRUT RETROFIT REINFORCED CONCRETE DESIGN TABLE SHALL BE DESIGNED IN ACCORDANCE WITH AASHTO LRFD SECTION 3.6.5.

PLACE ½" JOINT FILLER BETWEEN PIER COLUMNS OR STRUTS AND SLOPE PAVING OR HEADER. FOR SLOPE PAVING DETAILS AT THE INTERFACE WITH PIER COLUMNS OR STRUTS, SEE STANDARD PLAN B-102-SERIES.

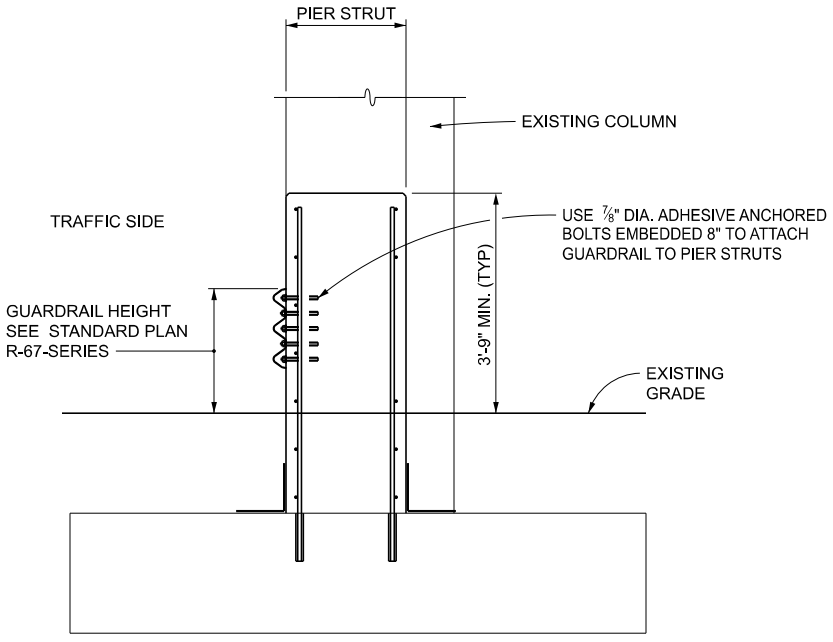
INCLUDE PAY ITEMS FOR UNDERDRAIN OUTLET AND UNDERDRAIN OUTLET ENDINGS. FOR UNDERDRAIN AND OUTLET ENDING DETAILS SEE STANDARD PLAN R-80-SERIES.

PREPARED BY DESIGN DIVISION	5.22.02A

DRAWN BY: BLT	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT	ISSUED: 02/26/24
CHECKED BY: VZ	PIER STRUT RETROFIT	SUPERSEDES:
APPROVED BY: KCK		



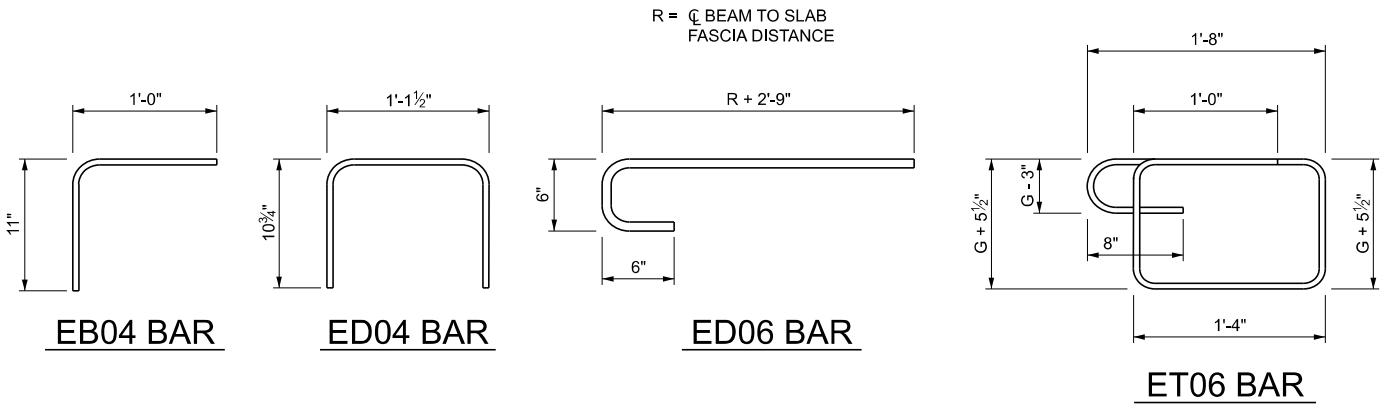
PIER STRUT ELEVATION
(SEE STANDARD PLAN R-67-SERIES FOR GUARDRAIL ATTACHMENT DETAILS)



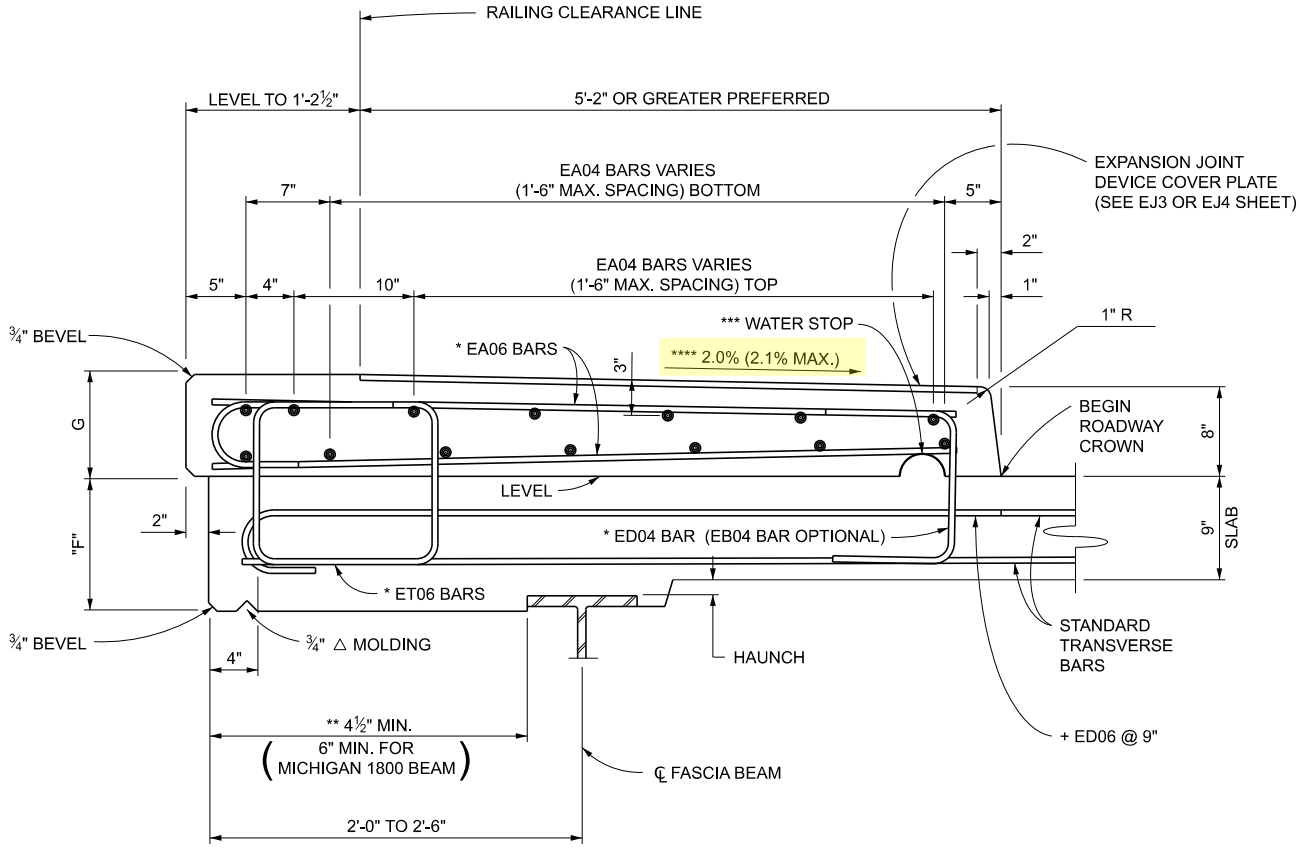
SECTION A-A

PREPARED BY DESIGN DIVISION	5.22.02B

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: KCK	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT BRIDGE RAILING, AESTHETIC PARAPET TUBE SIDEWALK SECTION	ISSUED: 02/26/24 SUPERSEDES: 11/27/23



EB04 BAR ED04 BAR ED06 BAR ET06 BAR



NOTES:

"F" CONSTANT EQUALS SLAB THICKNESS PLUS HAUNCH PLUS THICKEST FASCIA BEAM FLANGE PLUS ½" PLUS AMOUNT OF FASCIA BEAM DROP REQUIRED TO MAINTAIN SLAB THICKNESS AT CURB LINE.

IF "F" BECOMES GREATER THAN 12" USE A HAUNCH DETAIL ON THE FASCIA SIDE OF THE BEAM SIMILAR TO THE HAUNCH DETAIL ON THE INTERIOR SIDE. ADDITIONAL REINFORCEMENT MAY BE REQUIRED IN THE AREA OVER THE BEAM FLANGE IF THE HAUNCH BECOMES EXCESSIVE.

+ THE DETAILED REINFORCEMENT IN THE SLAB (ED06 BARS) IS THE MINIMUM FOR THE RAILING. THE DESIGN OF THE SLAB OVERHANG MAY REQUIRE ADDITIONAL REINFORCEMENT (OR INCREASING THE REINFORCEMENT AREA (DIAMETER) SHOWN). ALL TOP TRANSVERSE BRIDGE SLAB REINFORCEMENT IS HOOKED SIMILAR TO THE ED06 BAR DETAILED ON THIS SHEET. BARS WITH PREFIX "E" ARE TO BE EPOXY COATED.

* SPACE WITH ALTERNATE TRANSVERSE SLAB BARS (1'-6" MAX.). EB04 BAR MAY BE ADHESIVE ANCHORED INTO 6" DEEP HOLE INSTEAD OF ED04 BAR. PLACE ADDITIONAL ET06 BAR 6" EACH SIDE OF ℄ RAILING POST.

** APPLIES TO CURVED BRIDGES ONLY.

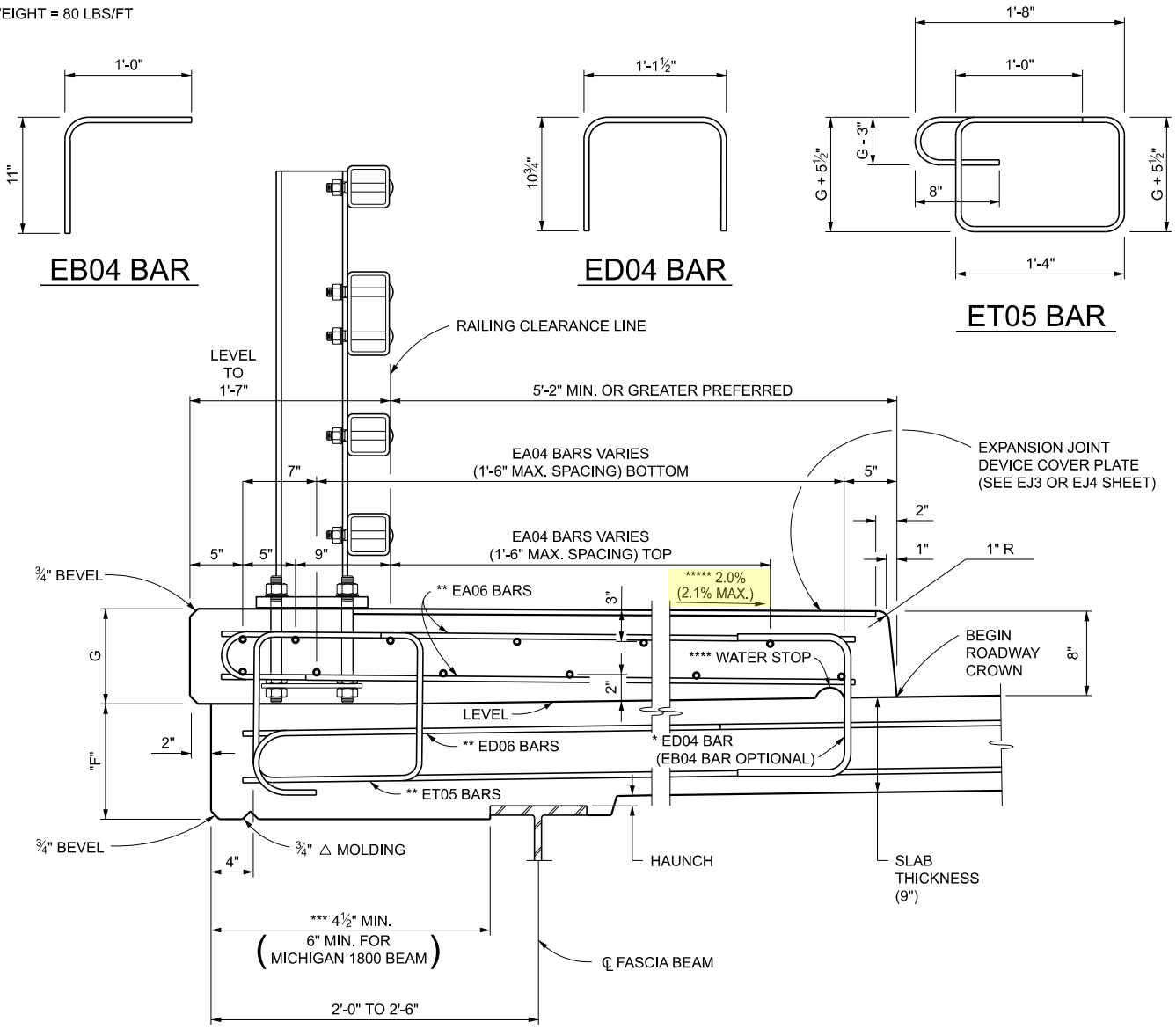
*** 2" HIGH x 4" LONG (±). FORMING NOT REQUIRED.

**** USE A TARGET CROSS SLOPE (2.0%) LESS THAN THE MAXIMUM TO ACCOUNT FOR INCONSISTENCIES IN CONCRETE FINISHING.

PREPARED BY DESIGN DIVISION	6.29.10C

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: KCK	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT BRIDGE RAILING, 4 TUBE - SIDEWALK SECTION PEDESTRIAN RAILING OPTION	ISSUED: 02/26/24 SUPERSEDES: 11/27/23

WEIGHT = 80 LBS/FT



NOTES:

"F" CONSTANT EQUALS SLAB THICKNESS PLUS HAUNCH PLUS THICKEST FASCIA BEAM FLANGE PLUS ½" PLUS AMOUNT OF FASCIA BEAM DROP REQUIRED TO MAINTAIN SLAB THICKNESS AT CURB LINE.

IF "F" BECOMES GREATER THAN 12" USE A HAUNCH DETAIL ON THE FASCIA SIDE OF THE BEAM SIMILAR TO THE HAUNCH DETAIL ON THE INTERIOR SIDE. ADDITIONAL REINFORCEMENT MAY BE REQUIRED IN THE AREA OVER THE BEAM FLANGE IF THE HAUNCH BECOMES EXCESSIVE.

THE DETAILED REINFORCEMENT IN THE SLAB (ED06 BARS) IS THE MINIMUM FOR THE RAILING. THE DESIGN OF THE SLAB OVERHANG MAY REQUIRE ADDITIONAL REINFORCEMENT (OR INCREASING THE REINFORCEMENT AREA (DIAMETER) SHOWN). BARS WITH PREFIX "E" ARE TO BE EPOXY COATED.

* EB04 BAR MAY BE ADHESIVE ANCHORED INTO 6" DEEP HOLE INSTEAD OF ED04 BAR. SPACE WITH ALTERNATE TRANSVERSE SLAB BARS (1'-6" MAX.).

** AT EACH POST PLACE 7 - ET05 BARS SPACED AT 6", ED06 BARS (SEE GUIDE 6.29.17) AND EAO6 BARS WITH ALTERNATE ET05 BARS. PLACE ET05 BARS, ED06 BARS AND EA06 BARS AT 12" MAXIMUM IN REMAINING AREAS.

*** APPLIES TO CURVED BRIDGES ONLY.

**** 2" HIGH x 4" LONG (±). FORMING NOT REQUIRED.

***** USE A TARGET CROSS SLOPE (2.0%) LESS THAN THE MAXIMUM TO ACCOUNT FOR INCONSISTENCIES IN CONCRETE FINISHING.

PREPARED BY DESIGN DIVISION	6.29.17E