Road & Bridge Design Publications

Monthly Update – March 2016

Revisions for the month of **March** are listed and displayed below. New special details will be included in projects submitted for the **June** letting as is stated on the special detail index sheets. E-mail Road related questions on these changes to MDOT-Road-Design-Standards@michigan.gov. E-mail Bridge related questions to MDOT-Bridge-Design-Standards@michigan.gov.

Special Details

21: Guardrail at Intersections: Revised the detail on sheet one to allow the use of MGS Guardrail along the trunkline portion of the roadway.

24: Guardrail Anchored in Back Slope Types 4B, 4T, & 4MGS-8: Added details for MGS guardrail on sheets 2, 4, & 7.

R-28-J: Sidewalk Ramp and Detectable Warning Details: On sheets two and six, the term "curb cut" or "curb & gutter" was revised to "curb opening" and "ramp" was changed to "ramp run". "Turning spaces" were renamed "landings". A landing was eliminated in the Ramp Type C sketch on page three. Also eliminated a note in the note section in regards to providing landings at turning movements.

R-60-J: Guardrail Types A, B, BD, T, TD, MGS-8 & MGS-8D: Corrected typos on sheet three in regards to the depth of the offset block for Type B guardrail (12" to 8"). Revised the offset from shoulder hinge point to edge of shoulder for Type MGS-8 guardrail on sheet seven from 5' and 3' to 5'-8" and 3'-8" to match what is required for MGS guardrail. Restored the notes under "Placement of Guardrail Reflectors" on sheet sixteen, which were inadvertently left out. Removed references & details for MGS-0 & MGS-0D guardrail.

R-61-H: Guardrail Approach Terminal Types 1B & 1T: Removed references to MGS-0 & MGS-0D guardrail.

R-62-H: Guardrail Approach Terminal Types 2B & 2T: Removed references to MGS-0 & MGS-0D guardrail.

R-63-C: Guardrail Approach Terminal, Type 3B & 3T: Added MGS-8 to the guardrail types which connect to the Type 3B terminals and added notes referencing R-60-series for details regarding guardrail layout to connect MGS guardrail to the Type 3T ending. Revised the height of the Type 3B terminals from 27¾" to 28" to reflect the height of Guardrail Type BD.

R-67-G: Guardrail Anchorage, Bridge Details: Removed references to MGS-0 & MGS-0D guardrail.

Road & Bridge Design Publications

Monthly Update – March 2016

R-72-D: W-Beam Backed Guardrail & Guardrail Long Span Installations: Added details for three long span installations over culverts using MGS guardrail. Also, added a long span installation using Type B guardrail.

R-73-F: Guardrail over Low-Fill Box or Slab Culverts: Added details for MGS guardrail on sheets 1, 3, & 6. Also revised the note regarding the depth of the drilled hole when using adhesive anchored bolts or concrete anchors to secure the posts to the culvert.

B-22-E: Bridge Railing, Thrie Beam Retrofit (R4): Removed references to MGS-0 & MGS-0D guardrail.

B-23-F: Bridge Railing, Thrie Beam Retrofit (Open Parapet): Removed references to MGS-0 & MGS-0D guardrail.

Road Design Manual

2.01, 3.01, 3.03, 3.03.01, 3.03.02, 3.08.01, 3.09.02, 3.11.01, Appendix 3A, 7.07, & 12.02: Revised references to AASHTO based on MDOT adoption of the 2011 AASHTO Green Book (A Policy on Geometric Design of Highways and Streets).

5.11: Consent to Grade: Added a paragraph regarding the pursuit of "consent to grade" when permanent easement or fee ROW is not feasible because the adjacent property is subject to section 4(F) of USDOT Act of 1966.

7.01.12: Types of Guardrail Used in Michigan: Removed descriptions of and references to MGS-0 & MGS-0D guardrail.

7.01.15: Guardrail Terminals: Removed references to MGS-0 & MGS-0D guardrail.

7.01.16: Guardrail Attachment to Bridges & Walls: Removed references to MGS-0 & MGS-0D guardrail.

10.02.02, 14.31.01, 14.57: Revised sections to replace references to Form 1775-LAP (linked) with Form 1775 (unlinked).

Bridge Design Manual

2.01.07, 7.02.31 C. (LFD & LRFD), 12.00, 12.02 & Appendix 12.02: Updated reference to "A Policy on Geometric Design of Highways and Streets, 2011, 6th Edition". The 2011 edition is approved for use over the 2004 edition.

Road & Bridge Design Publications

Monthly Update – March 2016

12.07.07: Updated color to Federal Standard 595C.

14.12.02: Form 1775-LAP changed to Form 1775, with link to form removed. Form is sent to project managers and includes mitigation measures for projects.

Updates to MDOT Cell Library, Bridge Auto Draw Program, etc., may be required in tandem with some of this month's updates. Until such updates to automated tools 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.

Index to Special Details

3-21-2016

⑥

SPECIAL DETAIL NUMBER	NUMBER OF SHEETS	TITLE	CURRENT DATE
*21	2	GUARDRAIL AT INTERSECTIONS	3-14-16
*24	8	GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8	3-14-16
99	2	CHAIN LINK FENCE WITH WIRE ROPE	9-22-14
R-1-G	9	DRAINAGE STRUCTURES	7-28-15
*R-28-J	7	SIDEWALK RAMP AND DETECTABLE WARNING DETAILS	3-15-16
R-53-A	22	TEMPORARY CONCRETE BARRIER LIMITED DEFLECTION	8-14-15
*R-60-J	16	GUARDRAIL TYPES A, B, BD, T, TD, MGS-8, & MGS-8D	3-15-16
*R-61-H	19	GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SKT, FLEAT, & X-Lite)	3-15-16
*R-62-H	10	GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-Lite)	3-15-16
*R-63-C	16	GUARDRAIL APPROACH TERMINAL TYPES 3B & 3T	3-15-16
R-66-E	4	GUARDRAIL DEPARTING TERMINAL TYPES B, T, & MGS	1-28-16
*R-67-G	7	GUARDRAIL ANCHORAGE, BRIDGE, DETAILS	3-15-16
*R-72-D	11	W-BEAM BACKED GUARDRAIL & GUARDRAIL LONG SPAN INSTALLATIONS	3-15-16
*R-73-F	6	GUARDRAIL OVER BOX OR SLAB CULVERTS	3-15-16
R-83-C	5	UTILITY TRENCHES	2-8-16
R-126-I	5	PLACEMENT OF TEMPORARY CONCRETE & STEEL BARRIER	8-25-15

*** Denotes New or Revised Special Detail to be included in projects for (beginning with) the June letting.**

Note: Former Standard Plans IV-87, IV-89, IV-90, and IV-91 Series, used for building cast-in-place concrete head walls for elliptical and circular pipe culverts, are now being replaced with plans that detail each specific size. The Municipal Utilities Unit will provide these full sized special details for inclusion in construction plans for MDOT jobs. To assure prompt delivery, requests ***must*** be made in advance.

Former Standard Plans IV-93 and IV-94 series have been replaced with precast concrete box & three-sided culverts as per the 2012 Standard Specifications for Construction.

Index to Bridge Detail Sheets

3-21-2016

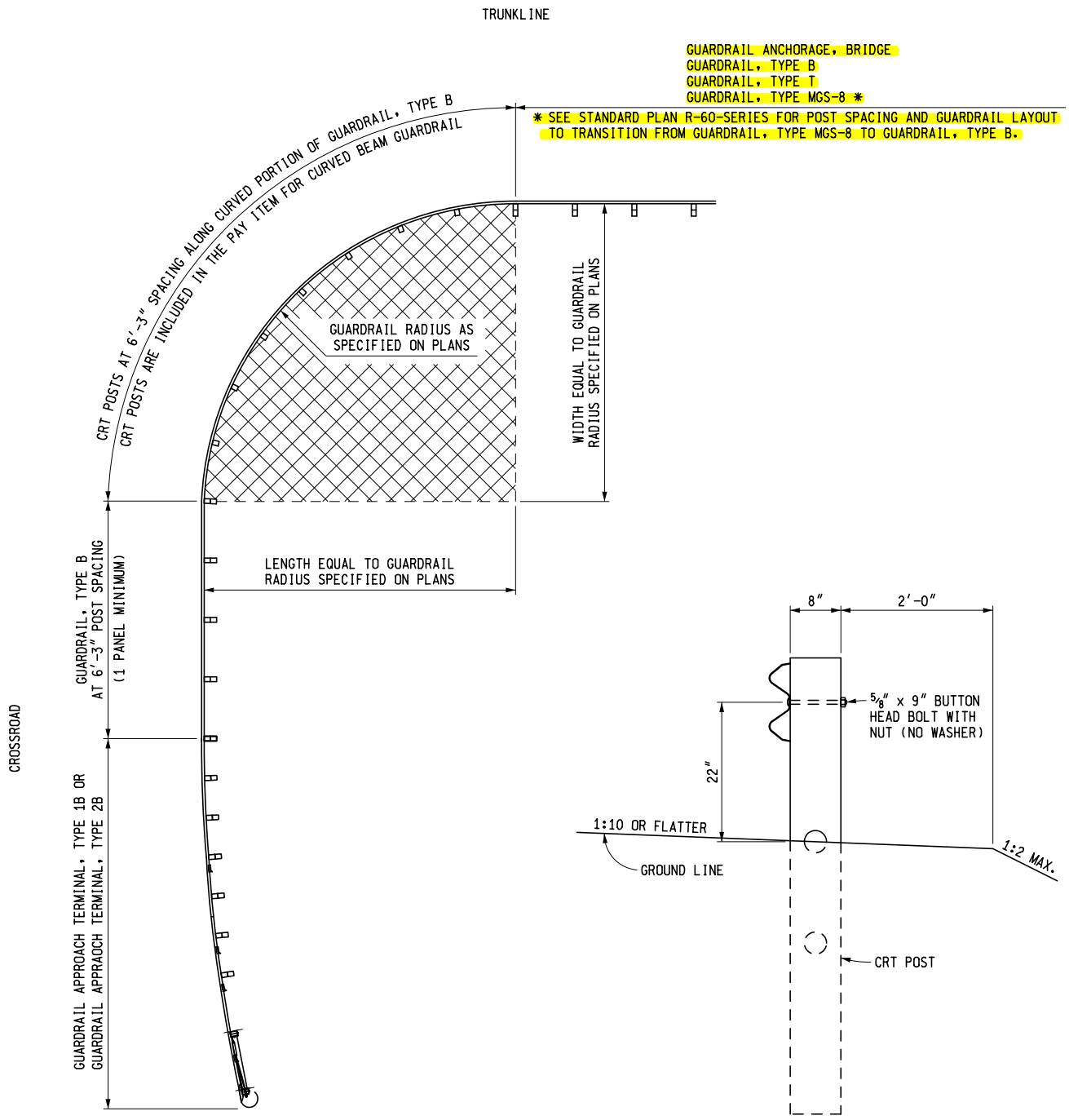
⑦

DETAIL NUMBER	NUMBER OF SHEETS	TITLE	CURRENT DATE
*B-22-E	4	BRIDGE RAILING, THRIE BEAM RETROFIT (R4 TYPE RAILING)	3-15-16
*B-23-F	4	BRIDGE RAILING, THRIE BEAM RETROFIT (OPEN PARAPET RAILING)	3-15-16
B-101-G	2	DRAIN CASTING ASSEMBLEY DETAILS	2-8-16
EJ3AB	1 or 2	EXPANSION JOINT DETAILS	2-10-16
EJ4O	1 or 2	EXPANSION JOINT DETAILS	2-10-16
PC-2G	1	70" PRESTRESSED CONCRETE I-BEAM DETAILS	3-31-06
PC-4E	1	PRESTRESSED CONCRETE 1800 BEAM DETAILS	3-31-06
PC-1L	1	PRESTRESSED CONCRETE I-BEAM DETAILS	7-12-06

*** Denotes New or Revised Special Detail to be included in projects for (beginning with) the June letting.**

Note: Details EJ3AA & EJ4N are interactive, i.e. designers and detailers choose details based upon railing type and angle of crossing. Place all details appropriate for the project, structure specific information, and the Expansion Joint Device quantity on the sheet. The sheet shall then be added to the plans as a normal plan sheet.

Detail PC-1L, PC-2G and PC-4E shall have structure specific information and quantities added to the sheet. The sheet shall then be added to the plans as a normal plan sheet.



PLAN VIEW

TYPICAL SECTION AT CRT POST

NOTE:
FOR DRIVEWAYS, IF R.O.W. ALLOWS, USE DEPARTING END TERMINAL. (SEE STANDARD PLAN R-66-SERIES). IF R.O.W. IS LIMITED SUCH THAT A TYPICAL DEPARTING END TERMINAL CANNOT BE FIT IN, DRILL 8 HOLES IN THE CURVED BEAM GUARDRAIL TO ACCOMODATE AN ANCHOR PLATE AND INSTALL A CABLE ANCHOR SIMILAR TO THAT OF THE DEPARTING END TERMINAL ON STANDARD PLAN R-66-SERIES. THIS WILL BE PAID FOR AS GUARDRAIL, DEPARTING TERMINAL.

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

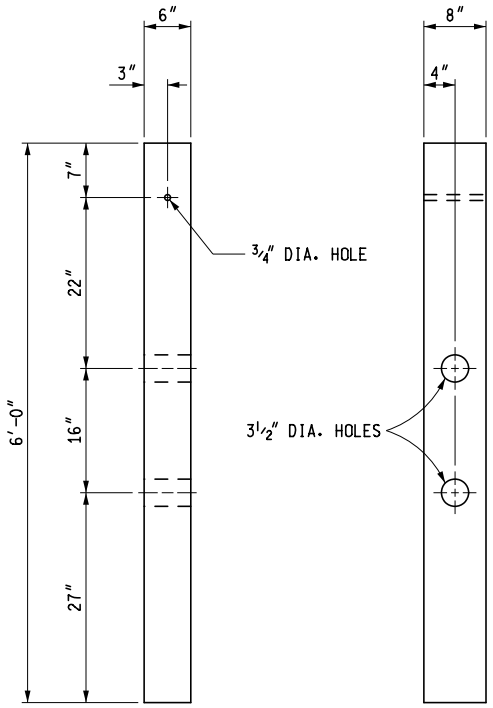
APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT SPECIAL DETAIL

GUARDRAIL AT INTERSECTIONS

F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 21	SHEET 1 OF 2



CONTROLLED RELEASING TERMINAL POST
(CRT)

NOTES:

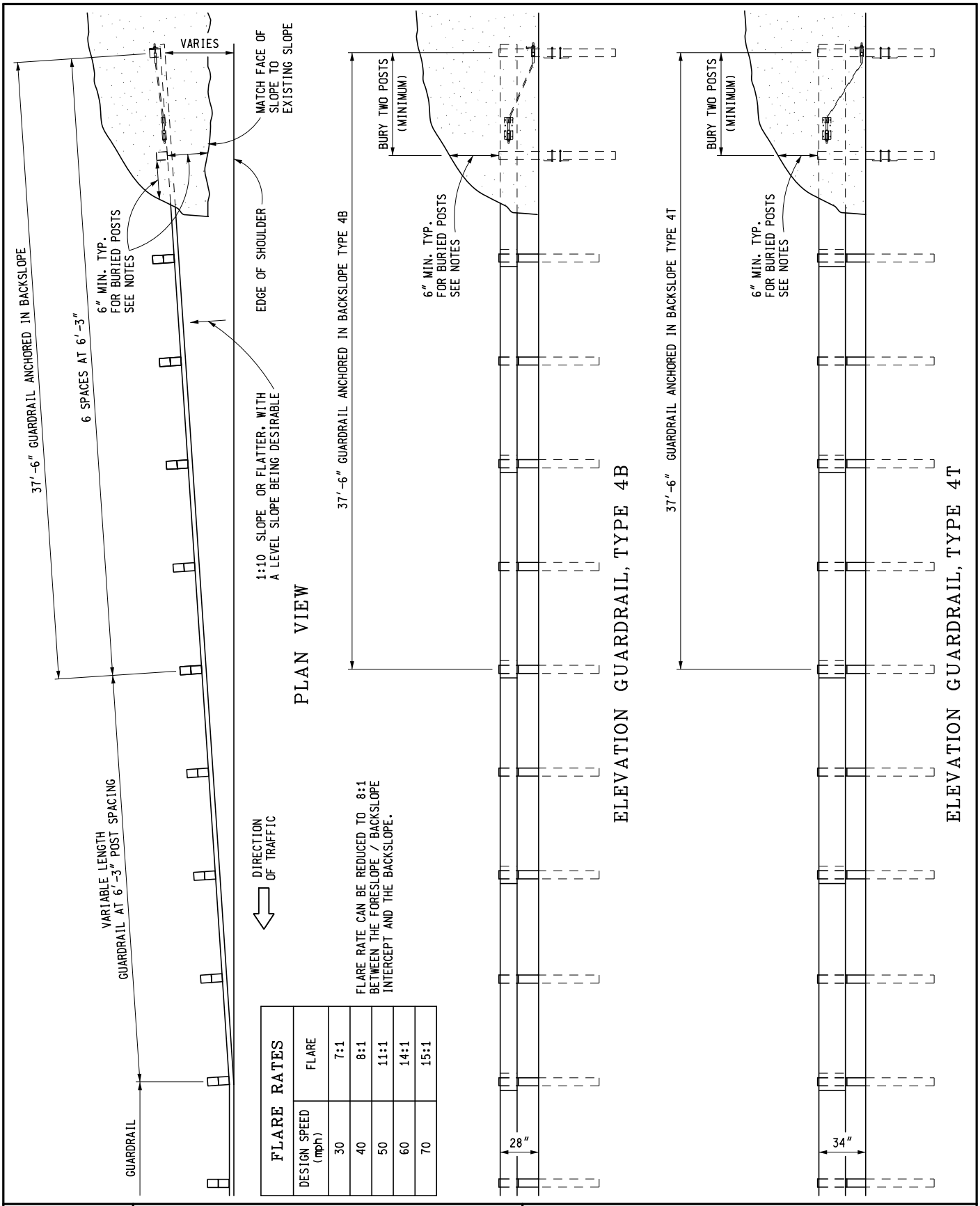
THE SLOPE IN FRONT OF THE INSTALLATION SHOULD NOT EXCEED 1:10 AND EXTEND TO 2′-0″ BEYOND THE GUARDRAIL POST. THE SLOPE BEYOND THIS HINGE LINE SHALL BE 1:2 OR FLATTER.

THE CROSS HATCHED AREA BEHIND THE CURVED GUARDRAIL SHOULD BE KEPT FREE OF FIXED OBJECTS.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT SPECIAL DETAIL

GUARDRAIL AT INTERSECTIONS

F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 21	SHEET 2 OF 2



FLARE RATES	
DESIGN SPEED (mph)	FLARE
30	7:1
40	8:1
50	11:1
60	14:1
70	15:1

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

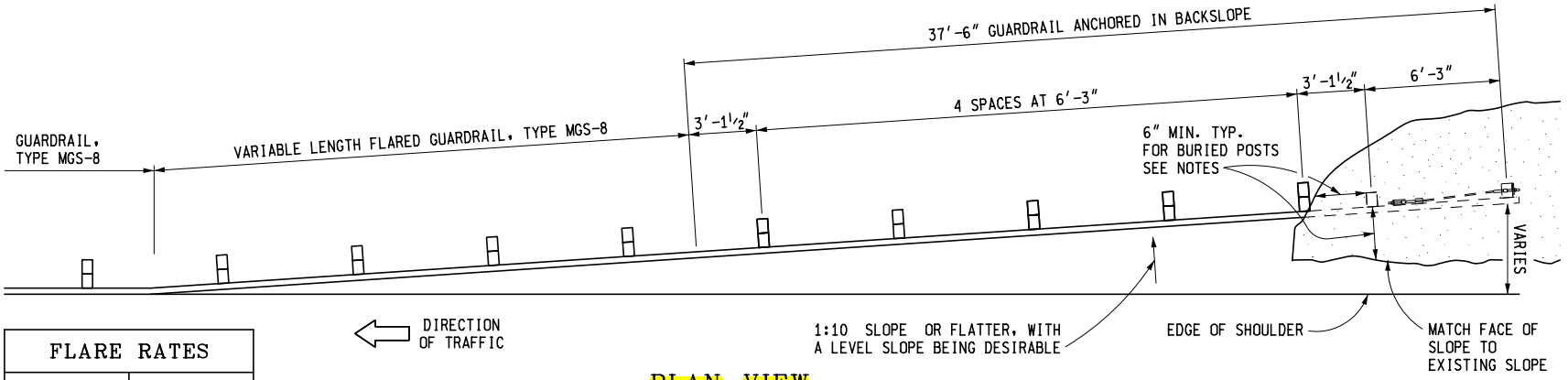
APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT SPECIAL DETAIL FOR

GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8

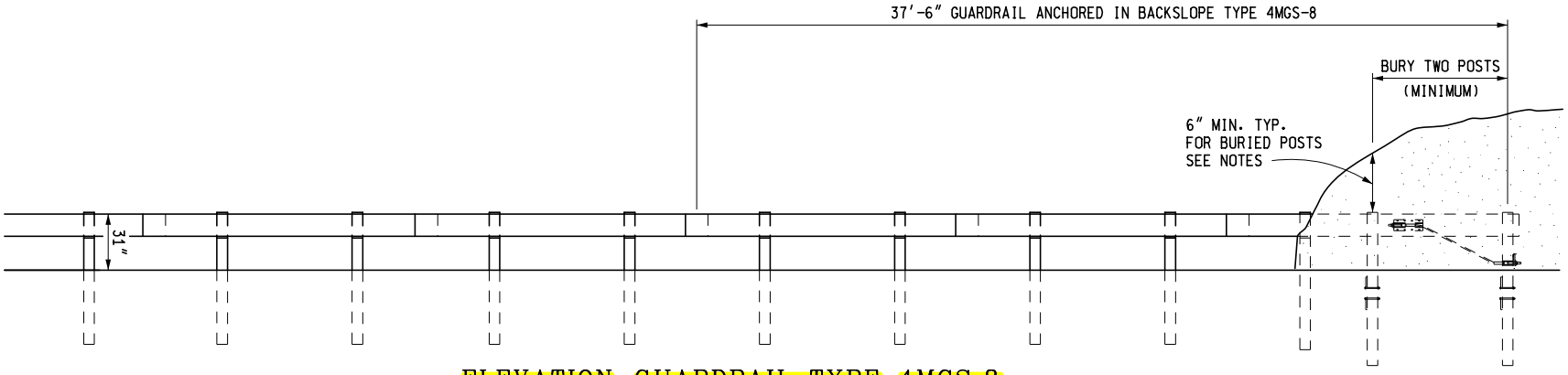
F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 24	SHEET 1 OF 8



PLAN VIEW

FLARE RATES	
DESIGN SPEED (mph)	FLARE
30	7:1
40	8:1
50	11:1
60	14:1
70	15:1

FLARE RATE CAN BE REDUCED TO 8:1 BETWEEN THE FORESLOPE / BACKSLOPE INTERCEPT AND THE BACKSLOPE.



ELEVATION GUARDRAIL, TYPE 4MGS-8

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT SPECIAL DETAIL FOR

GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8

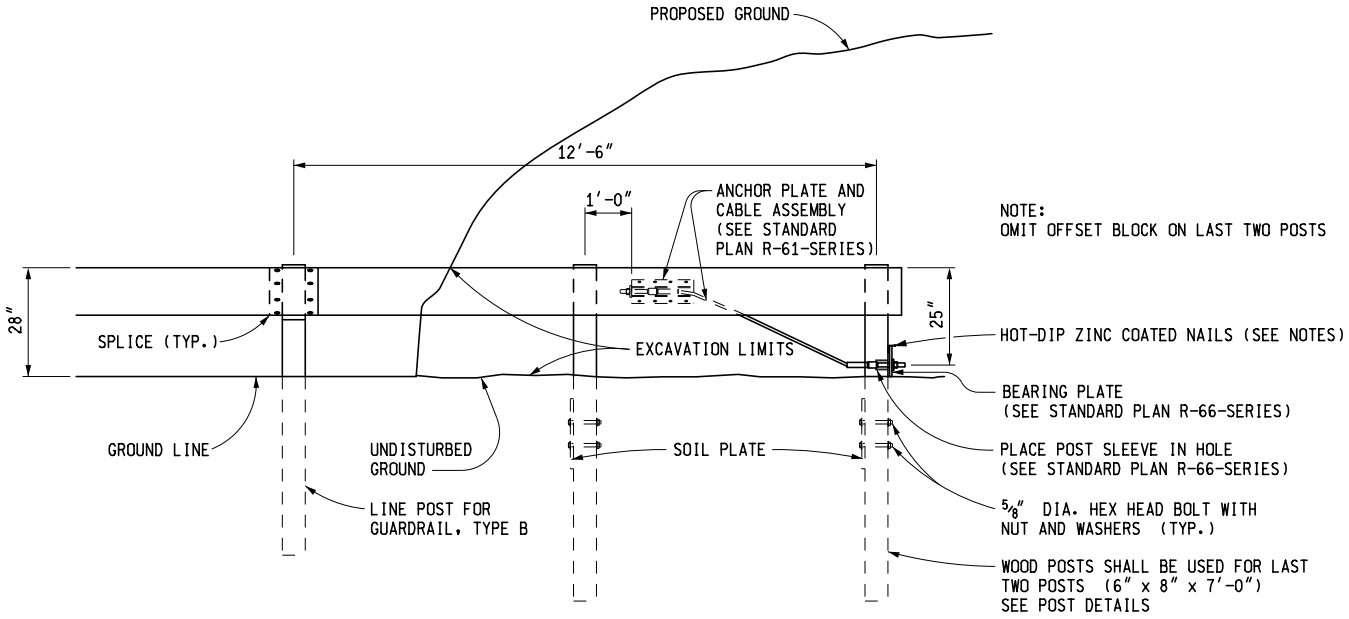
F.H.W.A. APPROVAL

3-14-2016
PLAN DATE

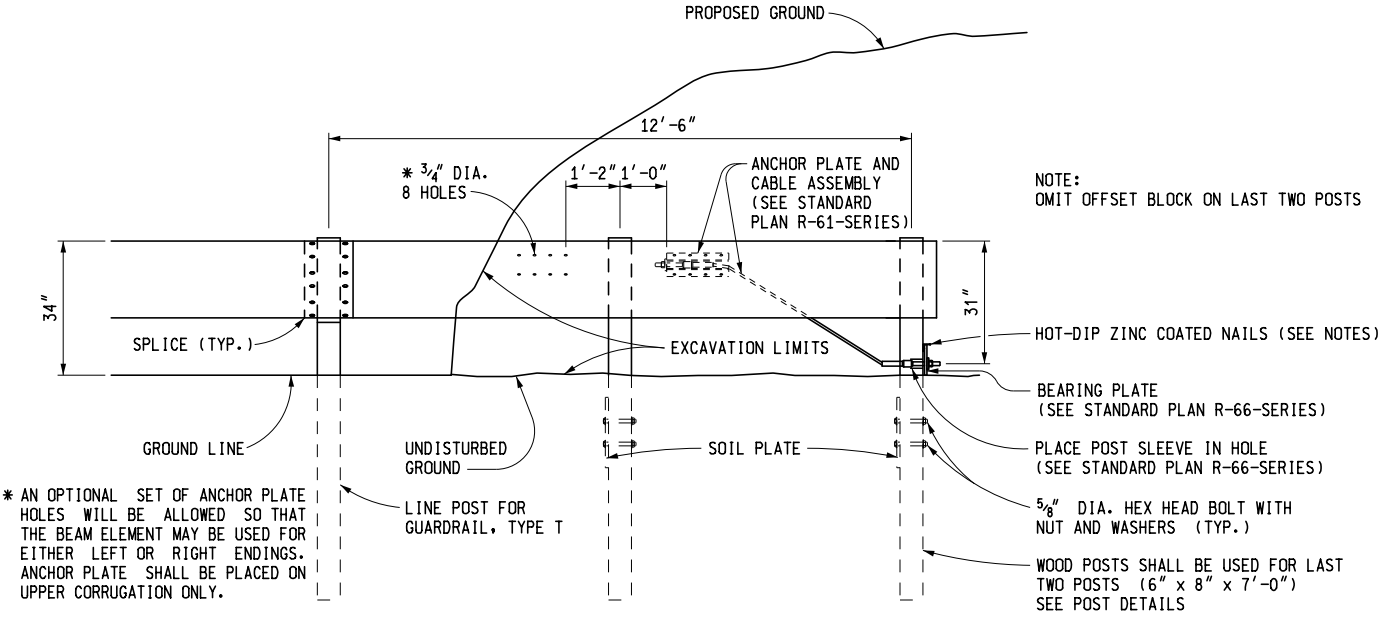
SPECIAL DETAIL 24

SHEET 2 OF 8

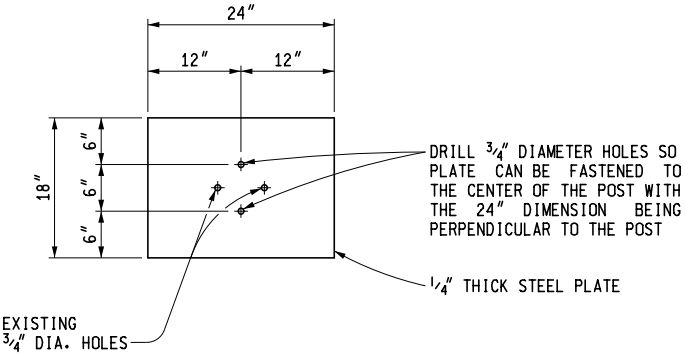
PLAN VIEW



ELEVATION GUARDRAIL, TYPE 4B



ELEVATION GUARDRAIL, TYPE 4T



SOIL PLATE

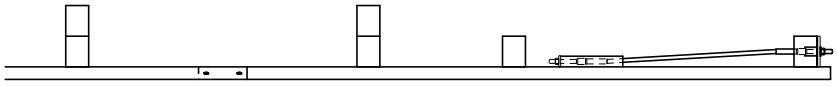
MODIFIED FROM SOIL PLATE SPECIFIED ON STANDARD PLAN R-61-SERIES BY ADDING TWO HOLES

MICHIGAN DEPARTMENT OF TRANSPORTATION

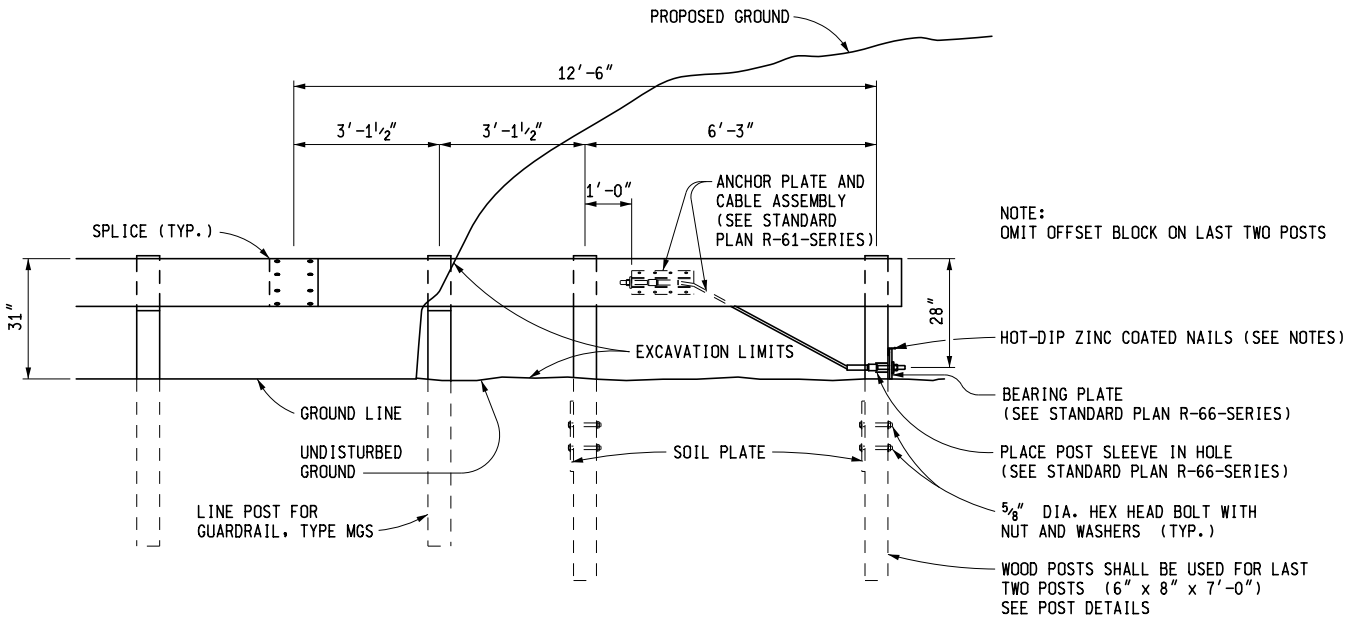
BUREAU OF DEVELOPMENT SPECIAL DETAIL FOR

GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8

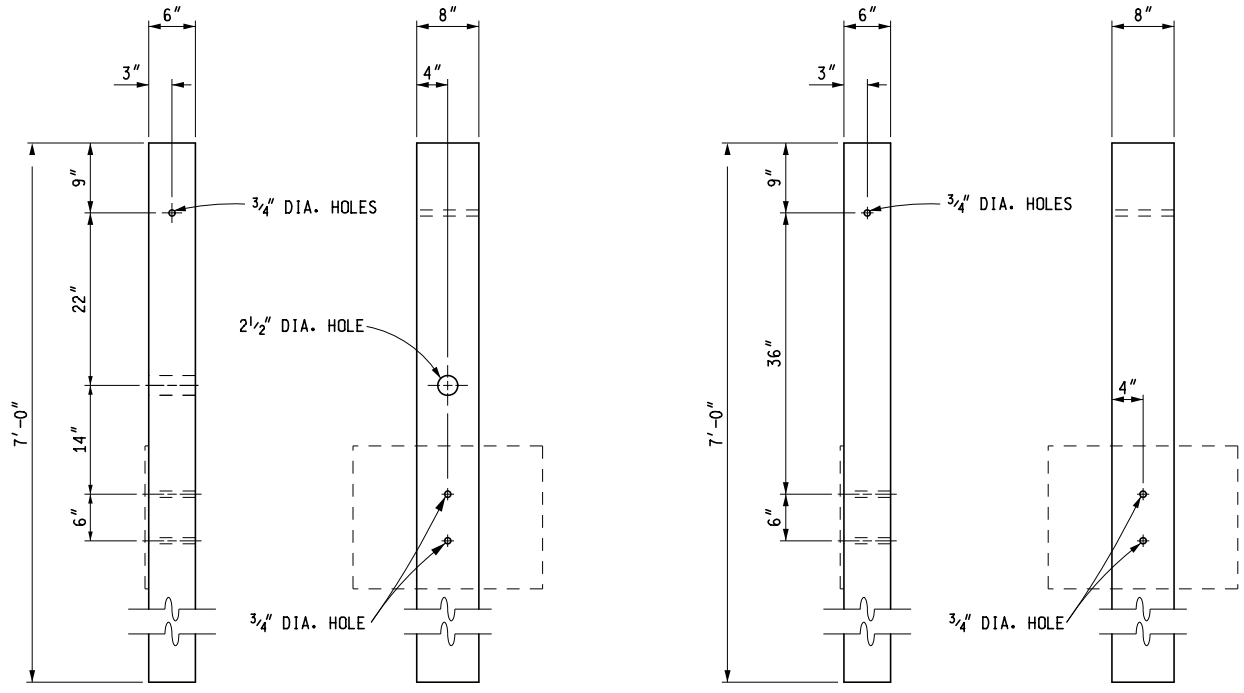
F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 24	SHEET 3 OF 8



PLAN VIEW



ELEVATION GUARDRAIL, TYPE 4MGS-8



POST 1 POST 2

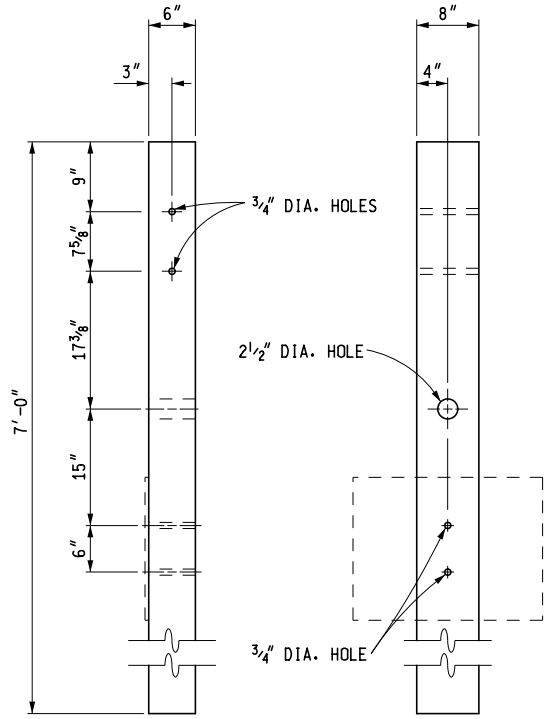
WOOD POST DETAILS

GUARDRAIL ANCHORED IN BACKSLOPE TYPE 4MGS-8

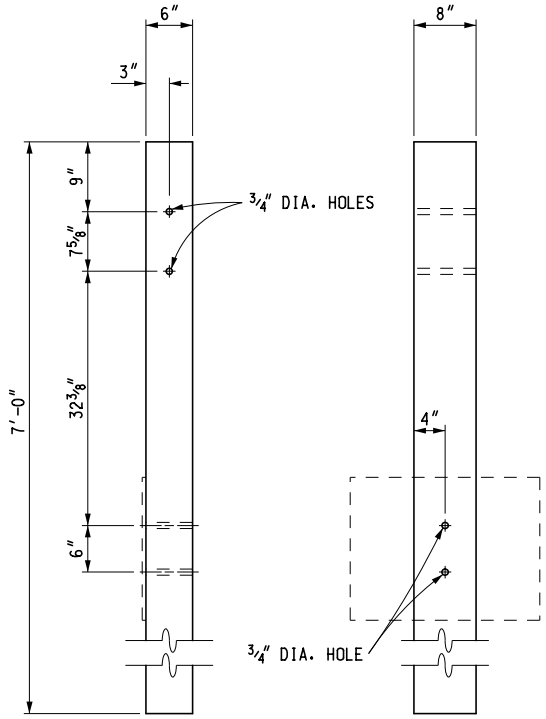
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT SPECIAL DETAIL FOR

GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8

F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 24	SHEET 4 OF 8



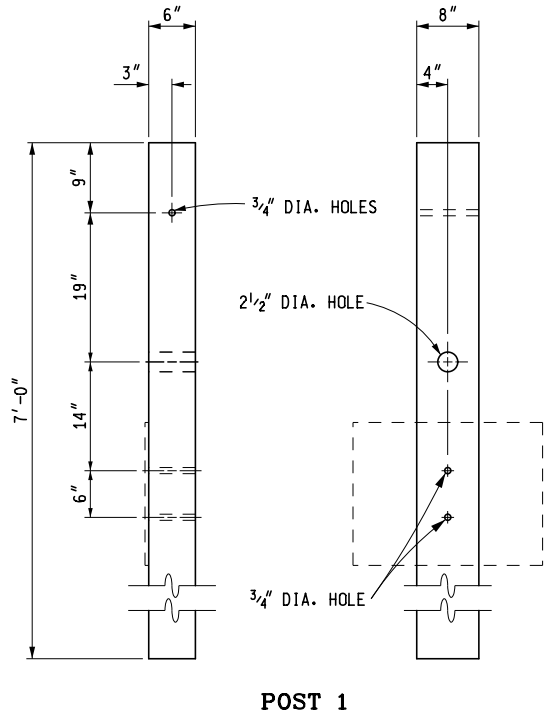
POST 1



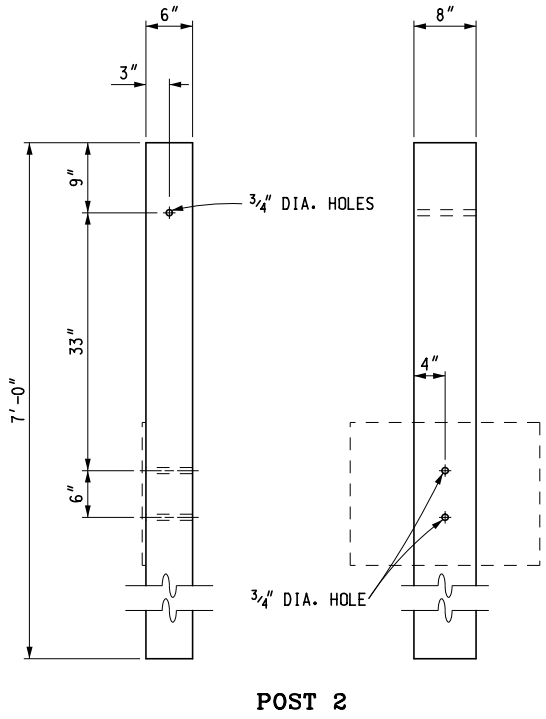
POST 2

WOOD POST DETAILS

GUARDRAIL ANCHORED IN BACKSLOPE TYPE 4T



POST 1



POST 2

WOOD POST DETAILS

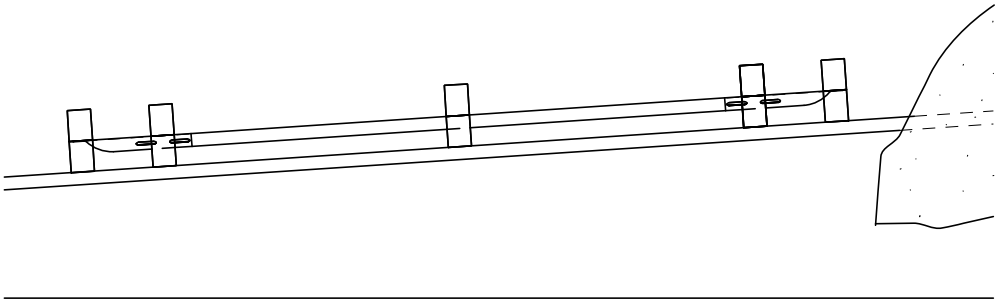
GUARDRAIL ANCHORED IN BACKSLOPE TYPE 4B

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT SPECIAL DETAIL FOR

GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8

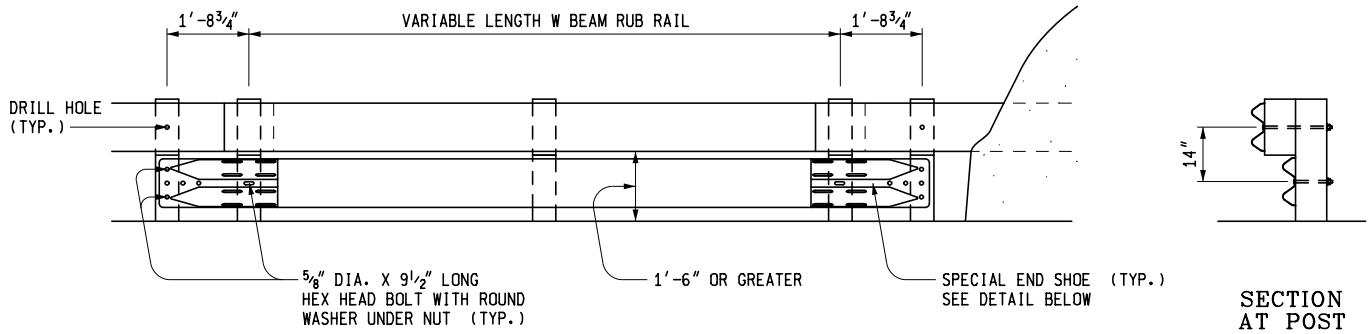
F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 24	SHEET 5 OF 8



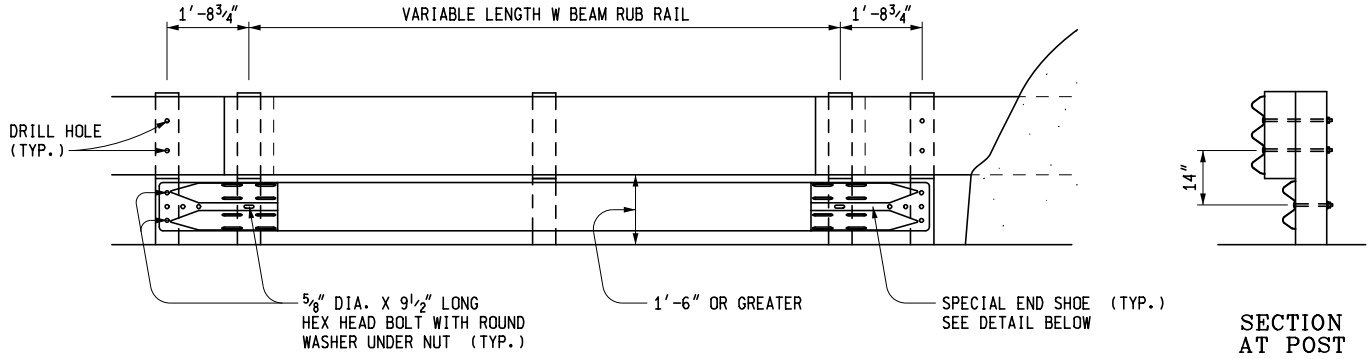
PLAN VIEW
WITH RUB RAIL

NOTE:

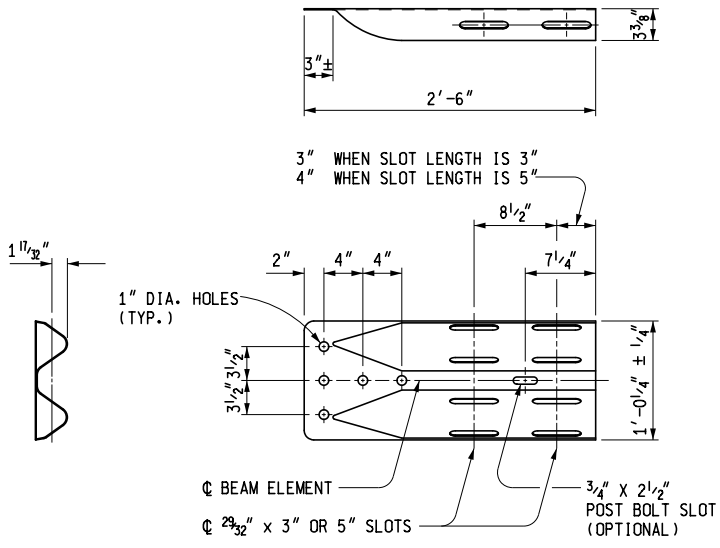
EXTRA POSTS, SPECIAL END SHOES, GUARDRAIL, HARDWARE AND ANY EXTRA WORK ARE INCLUDED IN THE BID ITEM GUARDRAIL ANCHORED IN BACKSLOPE TYPE 4B OR TYPE 4T.



ELEVATION GUARDRAIL, TYPE 4B
WITH RUB RAIL



ELEVATION GUARDRAIL, TYPE 4T
WITH RUB RAIL

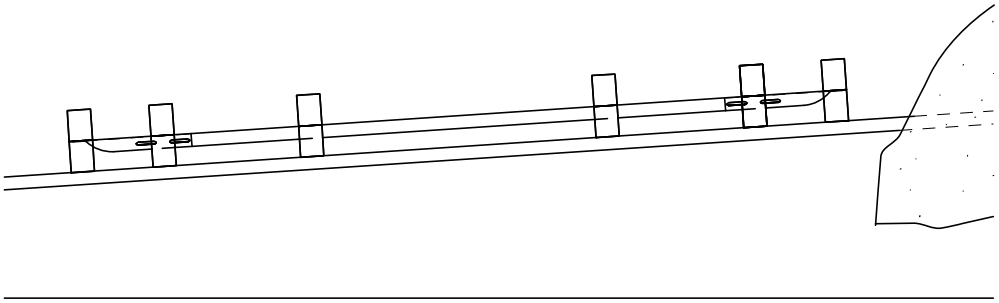


SPECIAL END SHOE
(3″ OR 5″ SLOT LENGTHS)

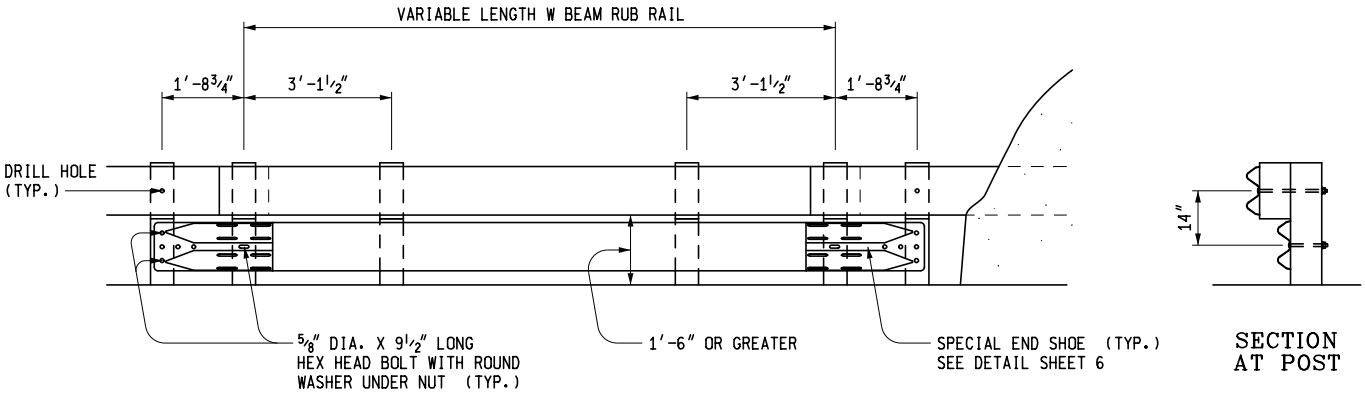
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT SPECIAL DETAIL FOR

GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8

F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 24	SHEET 6 OF 8



PLAN VIEW GUARDRAIL, TYPE 4MGS-8
WITH RUB RAIL



ELEVATION GUARDRAIL, TYPE 4MGS-8
WITH RUB RAIL

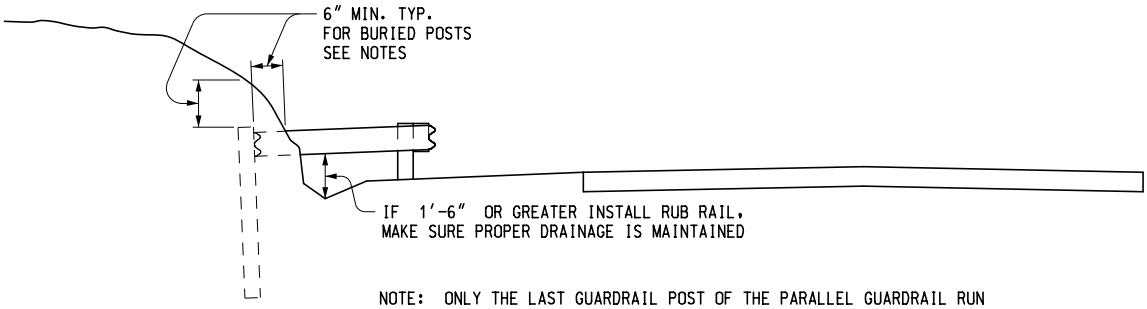
NOTE:

EXTRA POSTS, SPECIAL END SHOES, GUARDRAIL, HARDWARE AND ANY EXTRA WORK ARE INCLUDED IN THE BID ITEM GUARDRAIL ANCHORED IN BACKSLOPE TYPE 4MGS-8

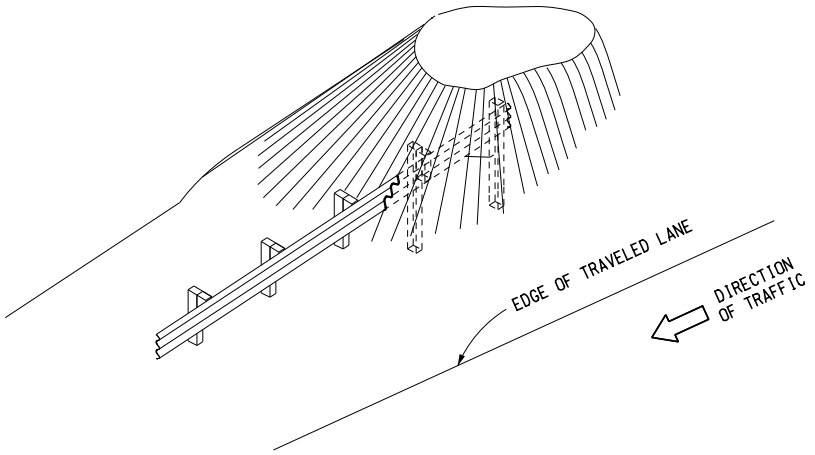
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT SPECIAL DETAIL FOR

GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8

F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 24	SHEET 7 OF 8



NOTE: ONLY THE LAST GUARDRAIL POST OF THE PARALLEL GUARDRAIL RUN AND THE LAST BURIED GUARDRAIL POST ARE SHOWN. (OTHER POSTS ALONG THE FLARED GUARDRAIL RUN ARE NOT SHOWN)



BURIED ENDING SKETCHES

NOTES:

ALL POSTS, OFFSET BLOCKS, BEAM ELEMENTS, AND HARDWARE (INCLUDING BOLTS, NUTS, AND WASHERS) SHALL CONFORM TO THE CURRENT STANDARD SPECIFICATIONS AND TO THE CURRENT STANDARD PLAN R-60-SERIES, WHERE APPLICABLE, EXCEPT AS SPECIFIED ON THIS PLAN.

ALL 1:10 SLOPES SHALL BE GRADED TO CLASS A SLOPE TOLERANCES.

AFTER THE CABLE ASSEMBLY HAS BEEN TIGHTENED, A SECOND NUT SHALL BE INSTALLED SO THAT THE CABLE WILL NOT LOOSEN.

TWO HOT-DIP ZINC COATED NAILS SHALL BE DRIVEN INTO THE WOOD POST AT THE TOP OF THE BEARING PLATE TO KEEP THE BEARING PLATE FROM ROTATING.

WHEN ADDITIONAL POST BOLT SLOTS ARE REQUIRED, THEY SHALL BE DRILLED OR PUNCHED AND REGALVANIZED. BURNING WILL NOT BE ALLOWED.

TERMINAL SHALL BE SET A MINIMUM 6" INTO THE BACKSLOPE AND HAVE 6" OF COVER ON ALL SIDES TO LESSEN THE POSSIBILITY IT WILL BE EXPOSED BY EROSION AND SNAG AN IMPACTING VEHICLE.

THE GUARDRAIL SHALL REMAIN AT A CONSTANT HEIGHT RELATIVE TO THE LOCAL GRADE. A W BEAM RUB RAIL WILL BE REQUIRED IF THE OPENING UNDER THE PRIMARY RAIL IS 1'-6" OR MORE. SEE DETAILS.

MICHIGAN DEPARTMENT OF TRANSPORTATION

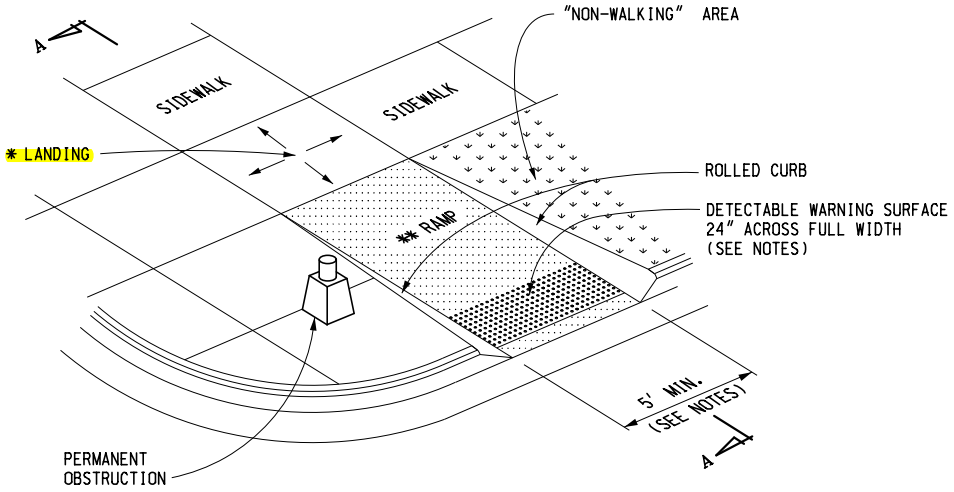
BUREAU OF DEVELOPMENT SPECIAL DETAIL FOR

GUARDRAIL ANCHORED IN BACKSLOPE TYPES 4B, 4T, & 4MGS-8

F.H.W.A. APPROVAL	3-14-2016 PLAN DATE	SPECIAL DETAIL 24	SHEET 8 OF 8

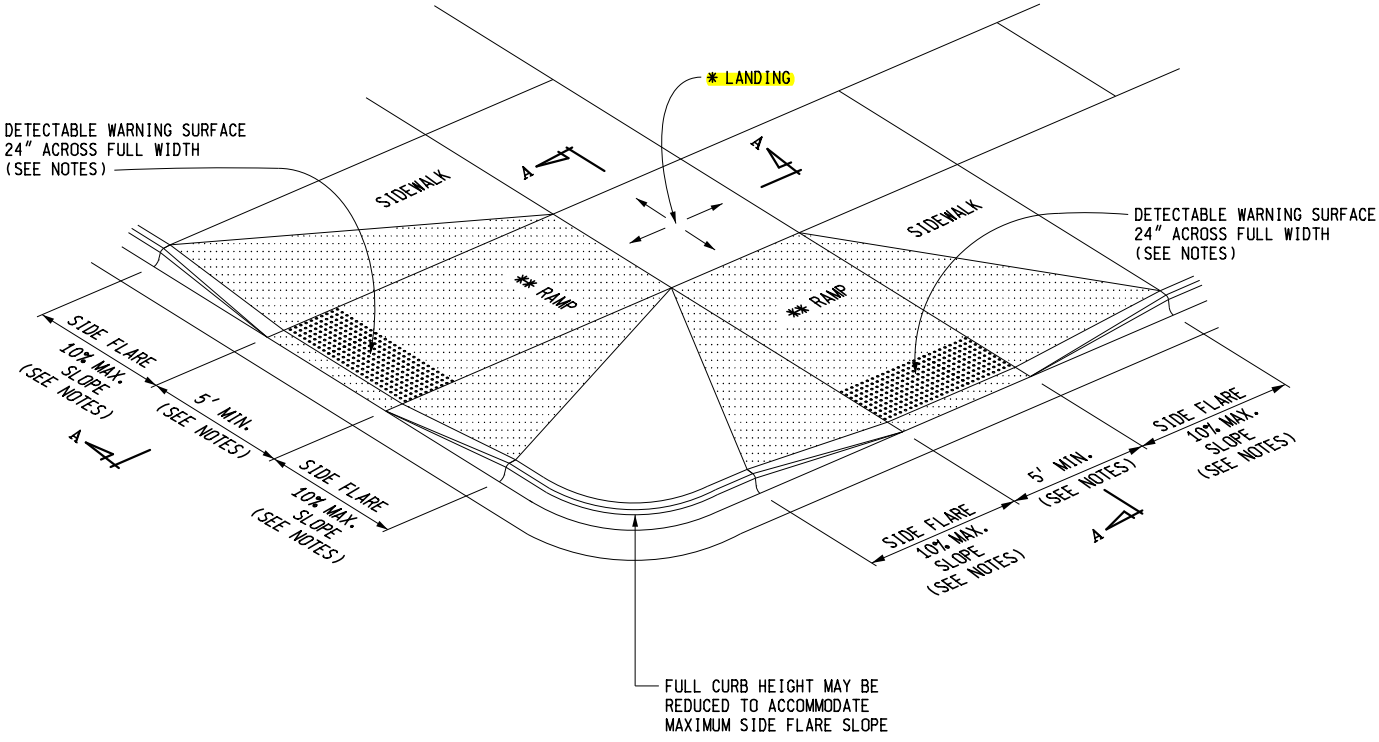
* MAXIMUM LANDING SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. MINIMUM DIMENSIONS 5′ x 5′. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%. RUNNING SLOPE 5% – 7% (8.3% MAXIMUM). SEE NOTES.



SIDEWALK RAMP TYPE R

(ROLLED SIDES)



SIDEWALK RAMP TYPE F

(FLARED SIDES, TWO RAMPS SHOWN)

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

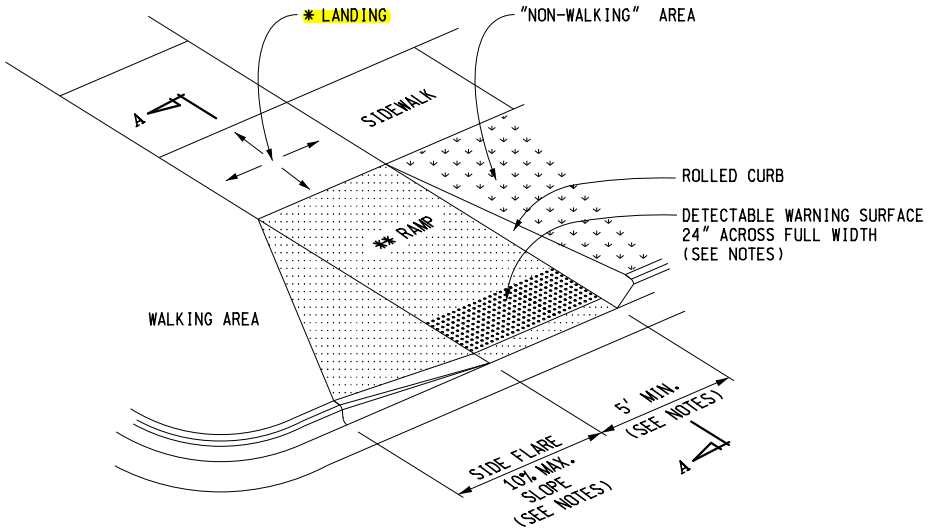
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-28-J	SHEET 1 OF 7

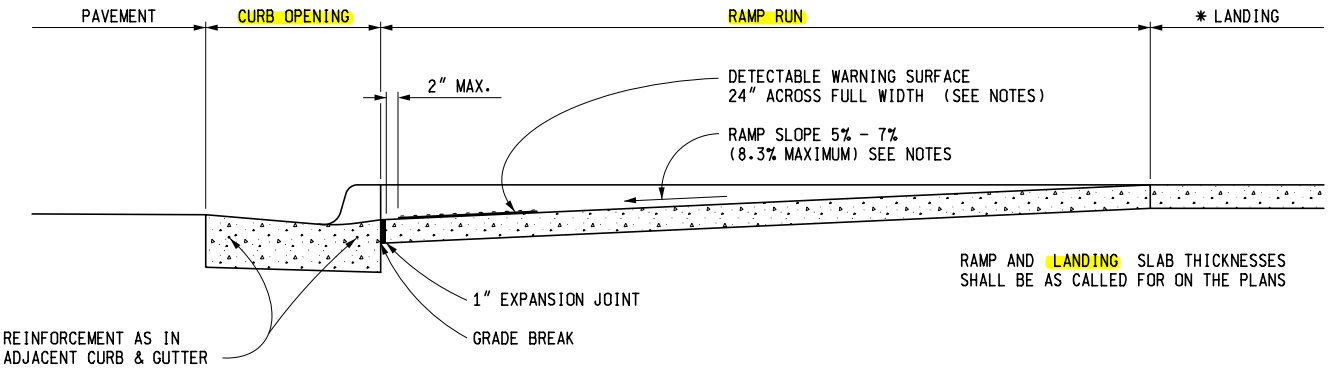
* MAXIMUM LANDING SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. MINIMUM DIMENSIONS 5′ x 5′. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%. RUNNING SLOPE 5% – 7% (8.3% MAXIMUM). SEE NOTES.



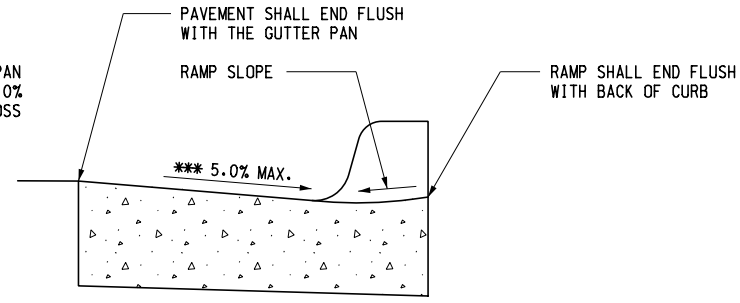
SIDEWALK RAMP TYPE RF

(ROLLED / FLARED SIDES)



SECTION A-A

*** TRANSITION ADJACENT GUTTER PAN CROSS SECTION TO PROVIDE 5.0% MAXIMUM COUNTER SLOPE ACROSS THE RAMP OPENING.



SECTION THROUGH CURB OPENING

(TYPICAL ALL RAMP TYPES)

MICHIGAN DEPARTMENT OF TRANSPORTATION

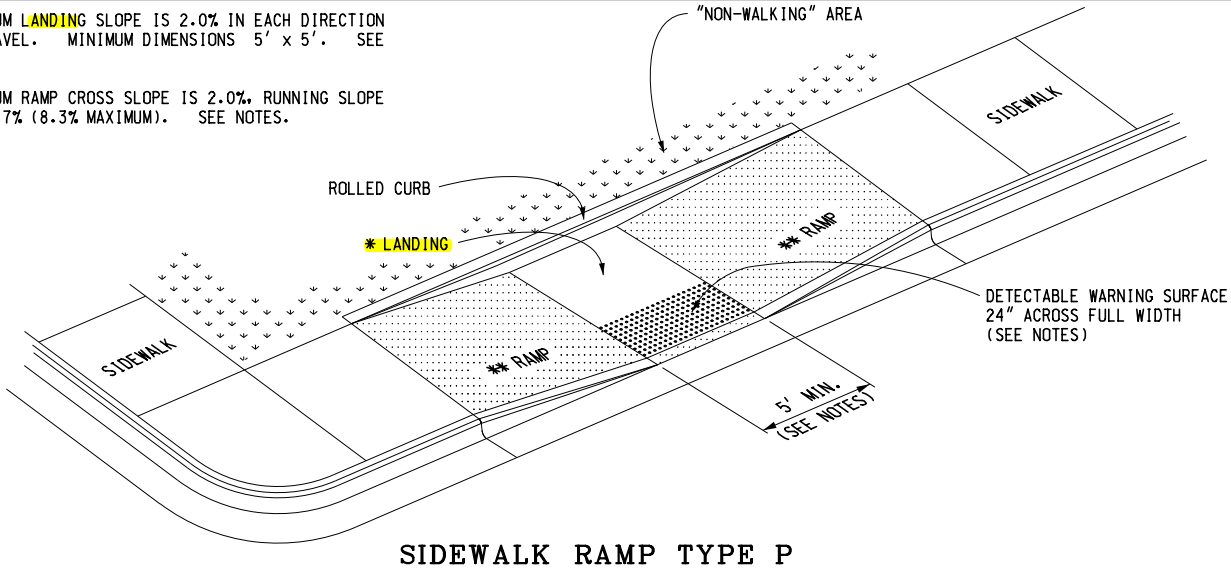
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-28-J	SHEET 2 OF 7

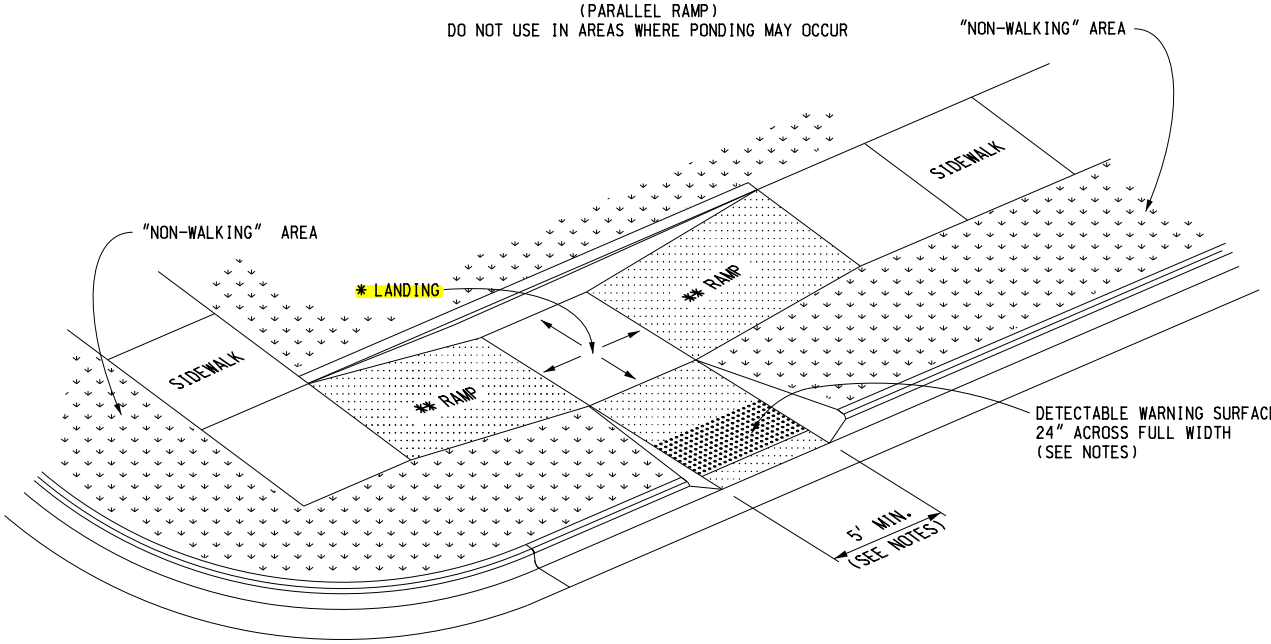
* MAXIMUM LANDING SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. MINIMUM DIMENSIONS 5′ x 5′. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%. RUNNING SLOPE 5% – 7% (8.3% MAXIMUM). SEE NOTES.



SIDEWALK RAMP TYPE P

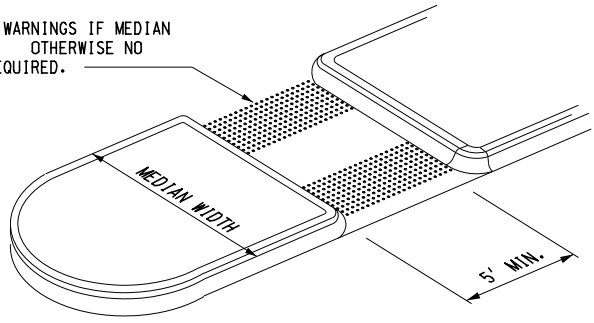
(PARALLEL RAMP)
DO NOT USE IN AREAS WHERE PONDING MAY OCCUR



SIDEWALK RAMP TYPE C

(COMBINATION RAMP)

USE 24" DEEP DETECTABLE WARNINGS IF MEDIAN WIDTH IS AT LEAST 6′-0". OTHERWISE NO DETECTABLE WARNING IS REQUIRED.



SIDEWALK RAMP TYPE M

(MEDIAN ISLAND)

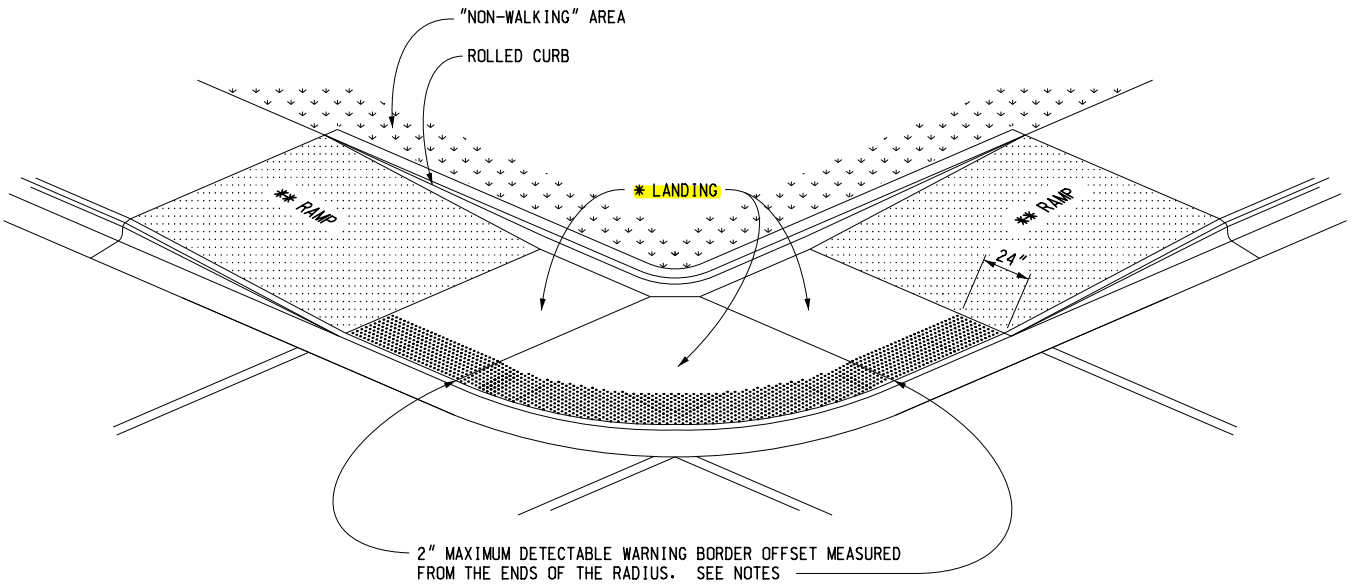
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

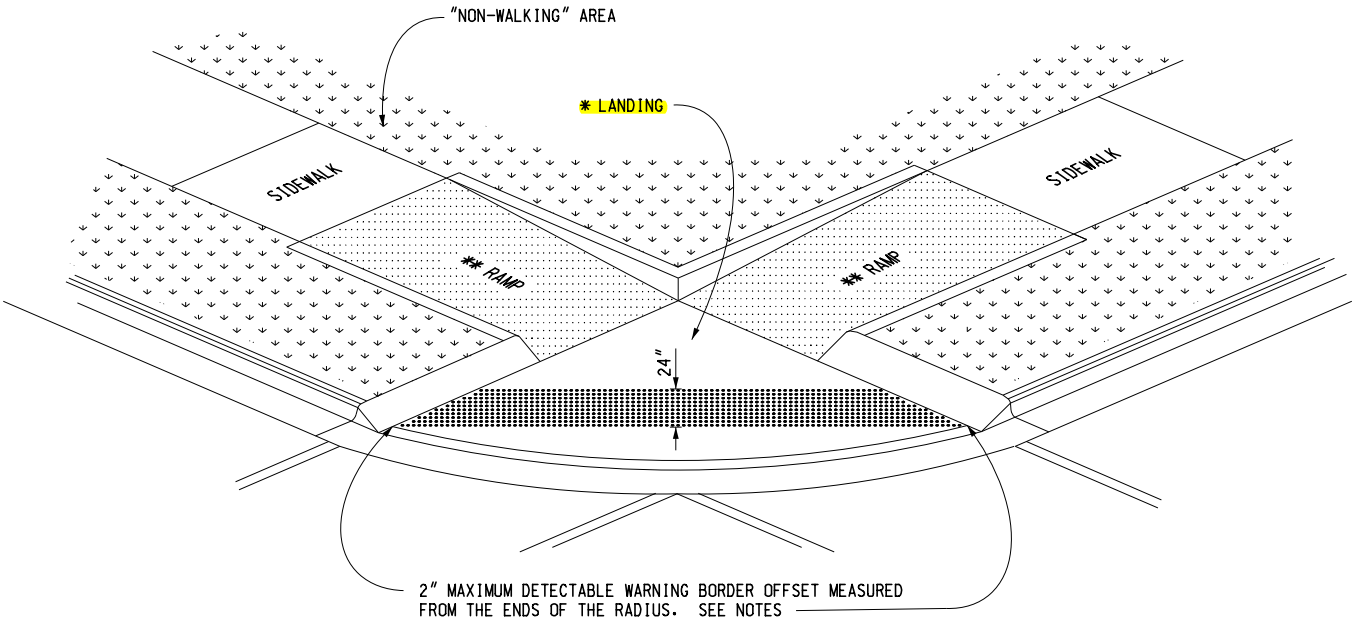
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-28-J	SHEET 3 OF 7

* MAXIMUM LANDING SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. MINIMUM DIMENSIONS 5′ x 5′. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%, RUNNING SLOPE 5% – 7% (8.3% MAXIMUM). SEE NOTES.



(RADIAL DETECTABLE WARNING SHOWN)



(TANGENT DETECTABLE WARNING SHOWN)

SIDEWALK RAMP TYPE D

(DEPRESSED CORNER)

USE ONLY WHEN INDEPENDENT DIRECTIONAL RAMPS CAN NOT BE CONSTRUCTED FOR EACH CROSSING DIRECTION

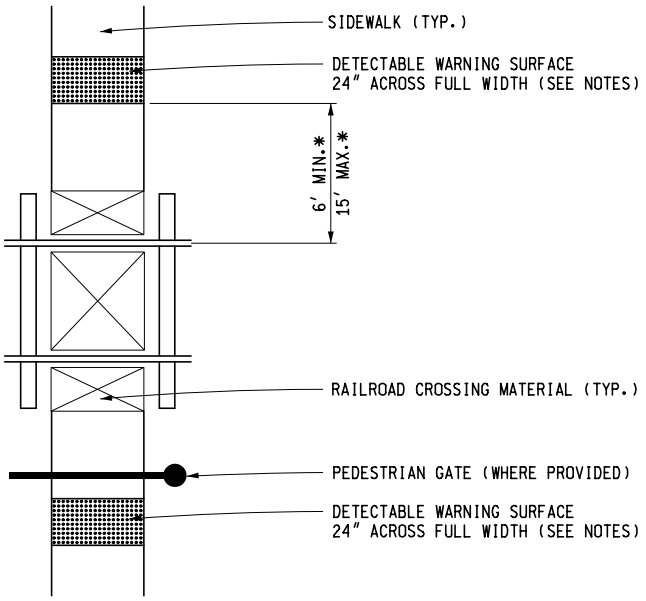
MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

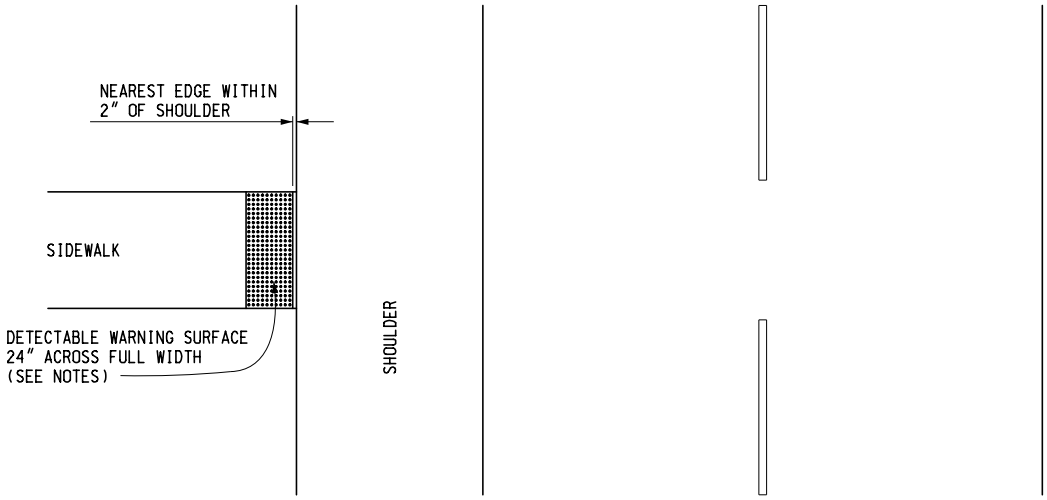
SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-28-J	SHEET 4 OF 7

* THE DETECTABLE WARNING SURFACE SHALL BE LOCATED SO THAT THE EDGE NEAREST THE RAIL CROSSING IS 6′ MINIMUM AND 15′ MAXIMUM FROM THE CENTERLINE OF THE NEAREST RAIL. DO NOT PLACE DETECTABLE WARNING ON RAILROAD CROSSING MATERIAL.



DETECTABLE WARNING AT RAILROAD CROSSING

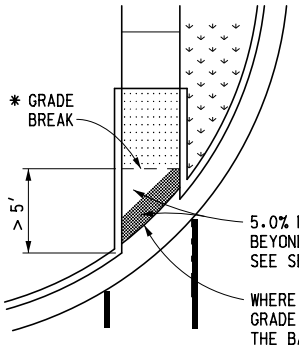


DETECTABLE WARNING AT FLUSH SHOULDER OR ROADWAY

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

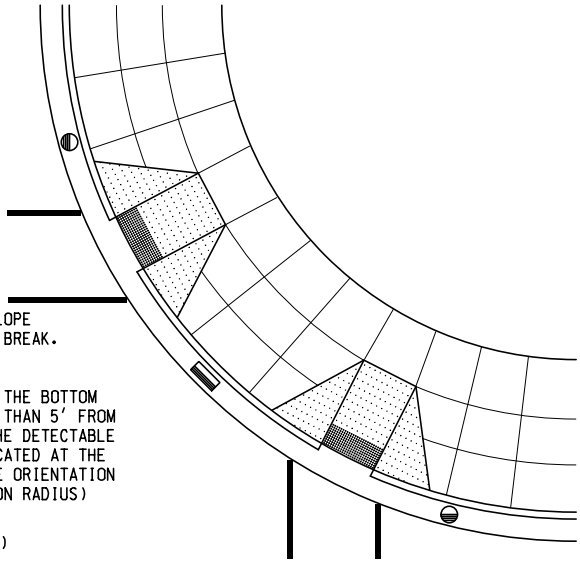
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-28-J	SHEET 5 OF 7



5.0% MAX. RUNNING SLOPE BEYOND BOTTOM GRADE BREAK. SEE SECTION B-B

WHERE EITHER END OF THE BOTTOM GRADE BREAK IS MORE THAN 5' FROM THE BACK OF CURB, THE DETECTABLE WARNING SHALL BE LOCATED AT THE BACK OF CURB. (DOME ORIENTATION IS NOT SIGNIFICANT ON RADIUS)

SIDEWALK RAMP LOCATED IN RADIUS (TYPE R SHOWN)
(GRADE BREAK GREATER THAN 5')

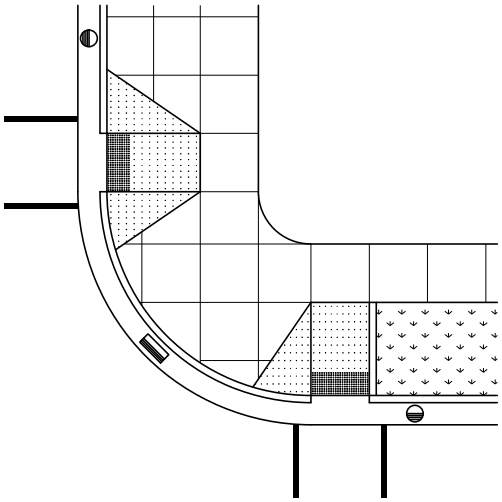


SIDEWALK RAMP PERPENDICULAR TO RADIAL CURB (TYPE F SHOWN)

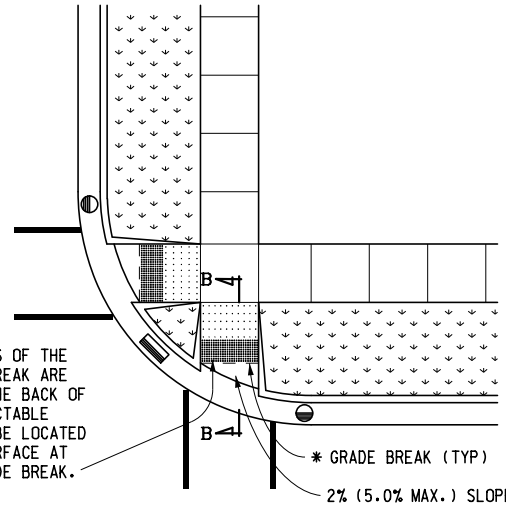
(USE WITH RADIAL CURB WHEN THE CROSSWALK AND SIDEWALK RAMP ARE NOT ALIGNED)

LEGEND

- SLOPED SURFACE
- DETECTABLE WARNING
- "NON-WALKING" AREA
- CROSSWALK MARKING
- PREFERRED LOCATION OF DRAINAGE INLET (TYP.)
- ALTERNATE LOCATION OF DRAINAGE INLET (TYP.)



SIDEWALK RAMP PERPENDICULAR TO TANGENT CURB
(TYPE F AND TYPE RF SHOWN)

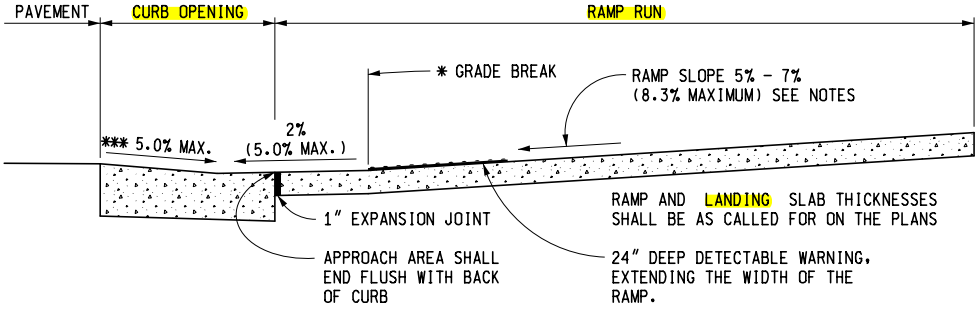


WHERE BOTH ENDS OF THE BOTTOM GRADE BREAK ARE WITHIN 5' OF THE BACK OF CURB, THE DETECTABLE WARNING SHALL BE LOCATED ON THE RAMP SURFACE AT THE BOTTOM GRADE BREAK.

* GRADE BREAK (TYP)

2% (5.0% MAX.) SLOPE BEYOND BOTTOM GRADE BREAK

SIDEWALK RAMP LOCATED IN RADIUS (TYPE R SHOWN)
(GRADE BREAK LESS THAN 5')



* GRADE BREAKS AT THE TOP AND BOTTOM OF CURB RAMPS SHALL BE PERPENDICULAR TO THE DIRECTION OF TRAVEL.

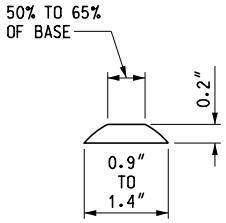
*** TRANSITION ADJACENT GUTTER PAN CROSS SECTION TO PROVIDE 5.0% MAXIMUM COUNTER SLOPE ACROSS THE RAMP OPENING.

SECTION B-B
SIDEWALK RAMP ORIENTATION

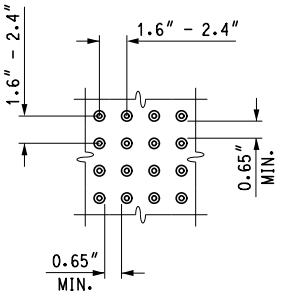
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

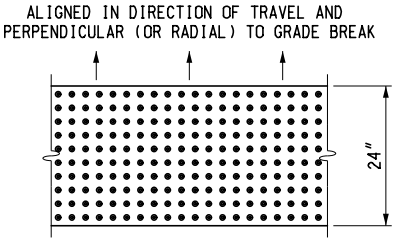
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-28-J	SHEET 6 OF 7



DOME SECTION



DOME SPACING



DOME ALIGNMENT

DETECTABLE WARNING DETAILS

NOTES:

DETAILS SPECIFIED ON THIS PLAN APPLY TO ALL CONSTRUCTION, RECONSTRUCTION, OR ALTERATION OF STREETS, CURBS, OR SIDEWALKS IN THE PUBLIC RIGHT OF WAY.

SIDEWALK RAMPS ARE TO BE LOCATED AS SPECIFIED ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

RAMPS SHALL BE PROVIDED AT ALL CORNERS OF AN INTERSECTION WHERE THERE IS EXISTING OR PROPOSED SIDEWALK AND CURB. RAMPS SHALL ALSO BE PROVIDED AT MARKED AND/OR SIGNALIZED MID-BLOCK CROSSINGS.

SURFACE TEXTURE OF THE RAMP SHALL BE THAT OBTAINED BY A COARSE BROOMING, TRANSVERSE TO THE RUNNING SLOPE.

SIDEWALK SHALL BE RAMPED WHERE THE DRIVEWAY CURB IS EXTENDED ACROSS THE WALK.

CARE SHALL BE TAKEN TO ASSURE A UNIFORM GRADE ON THE RAMP. WHERE CONDITIONS PERMIT, IT IS DESIRABLE THAT THE SLOPE OF THE RAMP BE IN ONLY ONE DIRECTION, PARALLEL TO THE DIRECTION OF TRAVEL.

RAMP WIDTH SHALL BE INCREASED, IF NECESSARY, TO ACCOMMODATE SIDEWALK SNOW REMOVAL EQUIPMENT NORMALLY USED BY THE MUNICIPALITY.

WHEN 5′ MINIMUM WIDTHS ARE NOT FEASIBLE, RAMP WIDTH MAY BE REDUCED TO NOT LESS THAN 4′ AND LANDINGS TO NOT LESS THAN 4′ x 4′.

DETECTABLE WARNING SURFACE COVERAGE IS 24″ MINIMUM IN THE DIRECTION OF RAMP/PATH TRAVEL AND THE FULL WIDTH OF THE RAMP/PATH OPENING EXCLUDING CURBED OR FLARED CURB TRANSITION AREAS. A BORDER OFFSET NOT GREATER THAN 2″ MEASURED ALONG THE EDGES OF THE DETECTABLE WARNING IS ALLOWABLE. FOR RADIAL CURB THE OFFSET IS MEASURED FROM THE ENDS OF THE RADIUS.

FOR NEW ROADWAY CONSTRUCTION, THE RAMP CROSS SLOPE MAY NOT EXCEED 2.0%. FOR ALTERATIONS TO EXISTING ROADWAYS, THE CROSS SLOPE MAY BE TRANSITIONED TO MEET AN EXISTING ROADWAY GRADE. THE CROSS SLOPE TRANSITION SHALL BE APPLIED UNIFORMLY OVER THE FULL LENGTH OF THE RAMP.

THE MAXIMUM RUNNING SLOPE OF 8.3% IS RELATIVE TO A FLAT (0%) REFERENCE. HOWEVER, IT SHALL NOT REQUIRE ANY RAMP OR SERIES OF RAMPS TO EXCEED 15 FEET IN LENGTH.

DRAINAGE STRUCTURES SHOULD NOT BE PLACED IN LINE WITH RAMPS. THE LOCATION OF THE RAMP SHOULD TAKE PRECEDENCE OVER THE LOCATION OF THE DRAINAGE STRUCTURE. WHERE EXISTING DRAINAGE STRUCTURES ARE LOCATED IN THE RAMP PATH OF TRAVEL, USE A MANUFACTURER′S ADA COMPLIANT GRATE. OPENINGS SHALL NOT BE GREATER THAN $\frac{1}{2}$″. ELONGATED OPENINGS SHALL BE PLACED SO THAT THE LONG DIMENSION IS PERPENDICULAR TO THE DOMINANT DIRECTION OF TRAVEL.

TRANSITION THE GUTTER PAN CROSS SECTION SUCH THAT THE COUNTER SLOPE IN THE DIRECTION OF RAMP TRAVEL IS NOT GREATER THAN 5.0%. MAINTAIN THE NORMAL GUTTER PAN CROSS SECTION ACROSS DRAINAGE STRUCTURES.

THE TOP OF THE JOINT FILLER FOR ALL RAMP TYPES SHALL BE FLUSH WITH THE ADJACENT CONCRETE.

CROSSWALK AND STOP LINE MARKINGS, IF USED, SHALL BE SO LOCATED AS TO STOP TRAFFIC SHORT OF RAMP CROSSINGS. SPECIFIC DETAILS FOR MARKING APPLICATIONS ARE GIVEN IN THE "MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES".

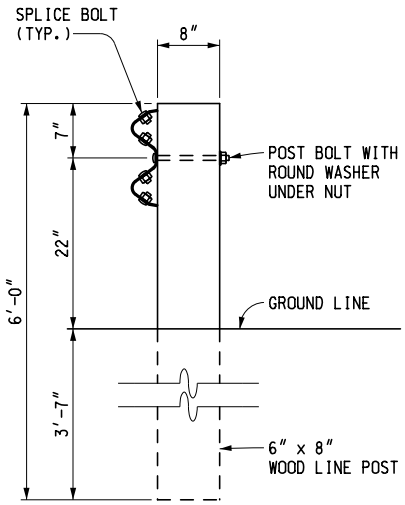
FLARED SIDES WITH A SLOPE OF 10% MAXIMUM, MEASURED ALONG THE ROADSIDE CURB LINE, SHALL BE PROVIDED WHERE AN UNOBSTRUCTED CIRCULATION PATH LATERALLY CROSSES THE SIDEWALK RAMP. FLARED SIDES ARE NOT REQUIRED WHERE THE RAMP IS BORDERED BY LANDSCAPING, UNPAVED SURFACE OR PERMANENT FIXED OBJECTS. WHERE THEY ARE NOT REQUIRED, FLARED SIDES CAN BE CONSIDERED IN ORDER TO AVOID SHARP CURB RETURNS AT RAMP OPENINGS.

DETECTABLE WARNING PLATES MUST BE INSTALLED USING FABRICATED OR FIELD CUT UNITS CAST AND/OR ANCHORED IN THE PAVEMENT TO RESIST SHIFTING OR HEAVING.

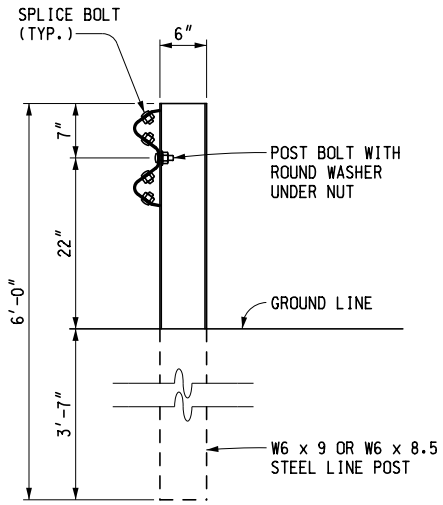
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

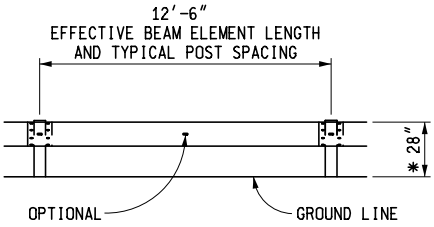
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-28-J	SHEET 7 OF 7



WOOD POST



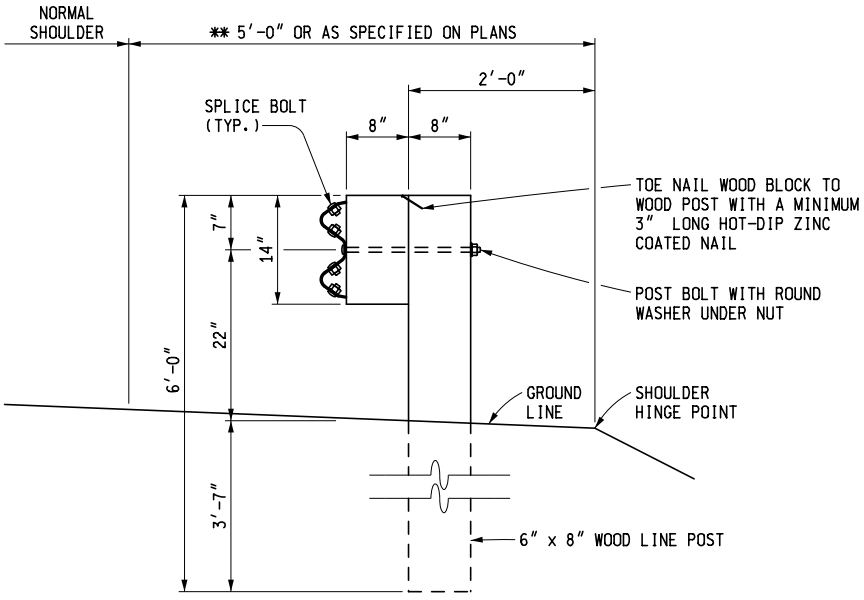
STEEL POST



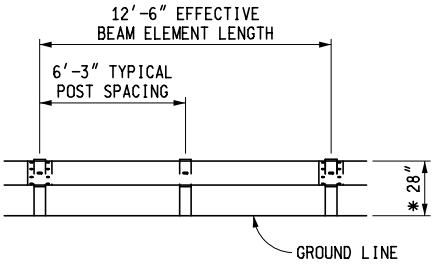
ELEVATION SHOWING POST SPACING

* SEE NOTES FOR GUARDRAIL IN CONJUNCTION WITH CURB

GUARDRAIL, TYPE A



** FOR PAVED SHOULDER WIDTHS OF AT LEAST 12′, USE 3′-0″.



ELEVATION SHOWING POST SPACING

* SEE NOTES FOR GUARDRAIL IN CONJUNCTION WITH CURB

GUARDRAIL, TYPE B
(WOOD POST)

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

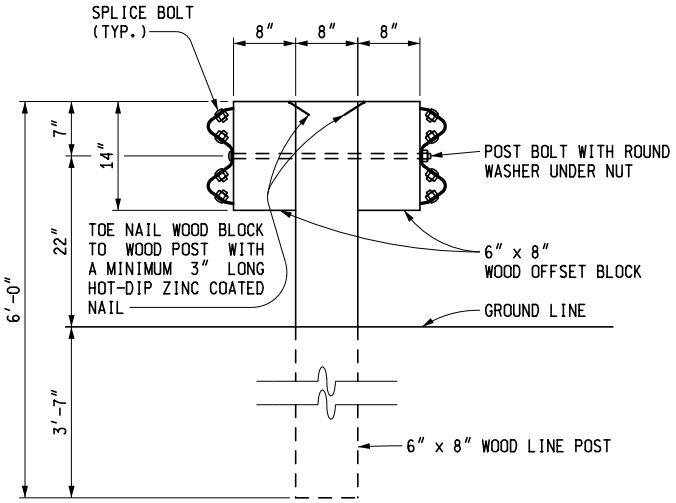
APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

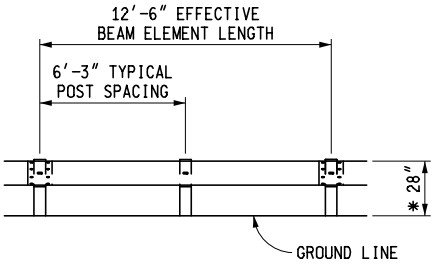
APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 1 OF 16

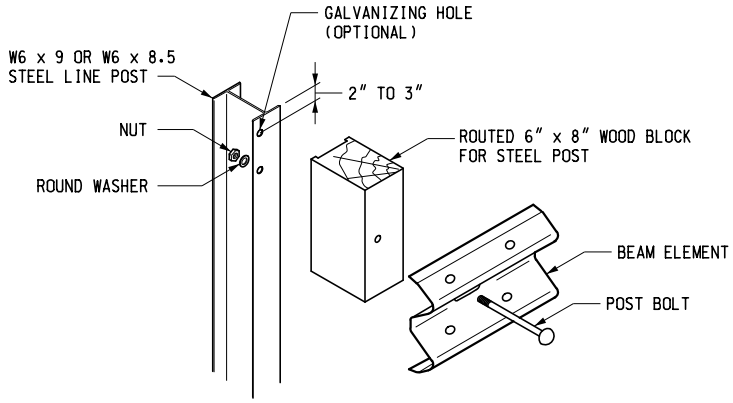


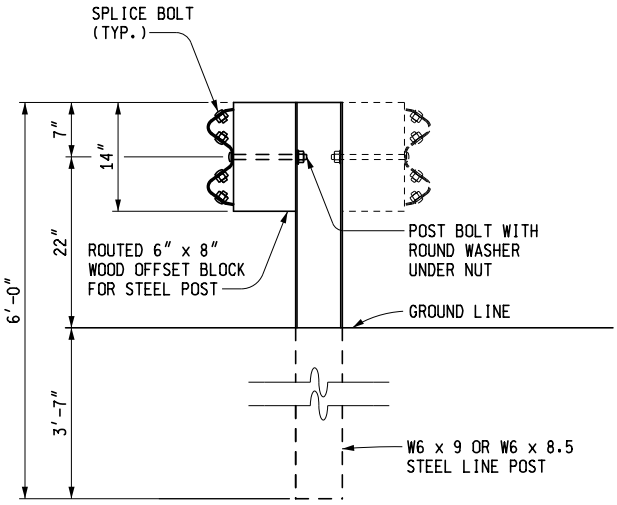


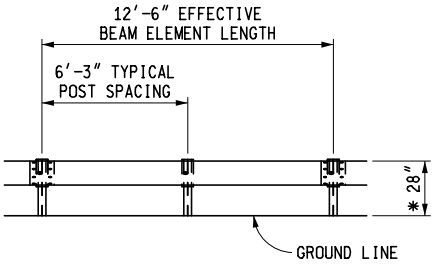
ELEVATION SHOWING POST SPACING

* SEE NOTES FOR GUARDRAIL IN CONJUNCTION WITH CURB

GUARDRAIL, TYPE BD
(WOOD POST)







ELEVATION SHOWING POST SPACING

* SEE NOTES FOR GUARDRAIL IN CONJUNCTION WITH CURB

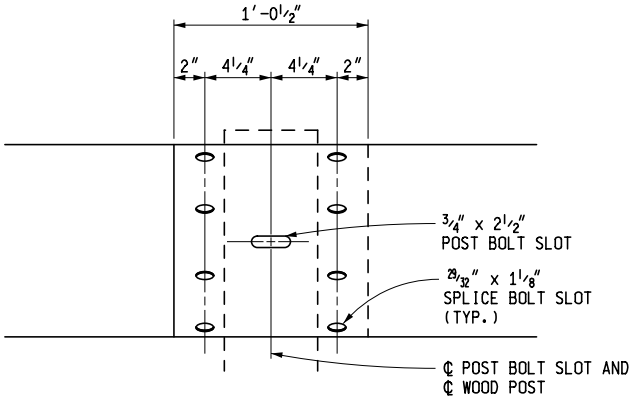
GUARDRAIL, TYPE B (OR BD)
(STEEL POST)

MICHIGAN DEPARTMENT OF TRANSPORTATION

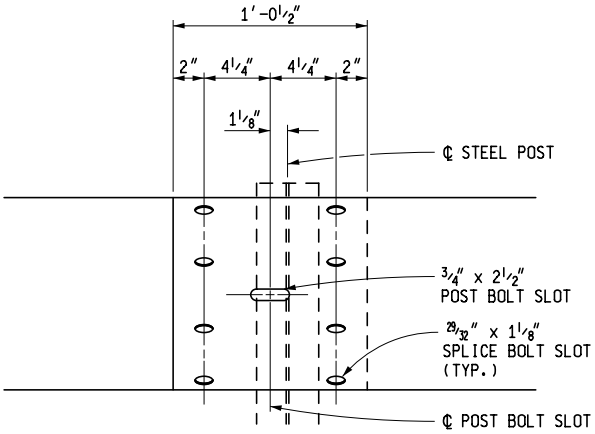
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 2 OF 16

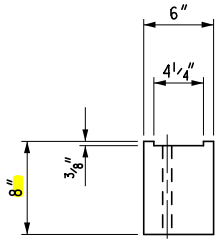


WOOD POST

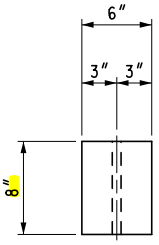


STEEL POST

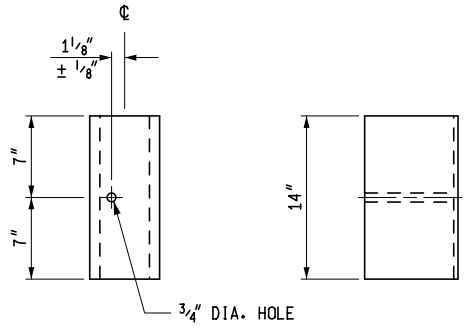
BEAM ELEMENT SPLICE DETAILS



TOP

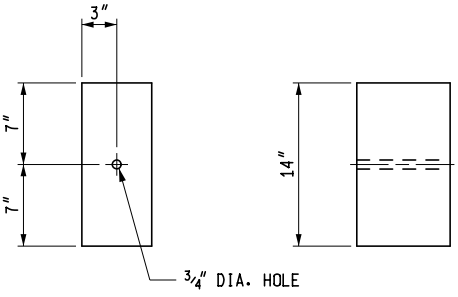


TOP



FRONT SIDE

FOR USE ON STEEL POSTS



FRONT SIDE

FOR USE ON WOOD POSTS

(SEE NOTES ON SHEET 16 OF 16)

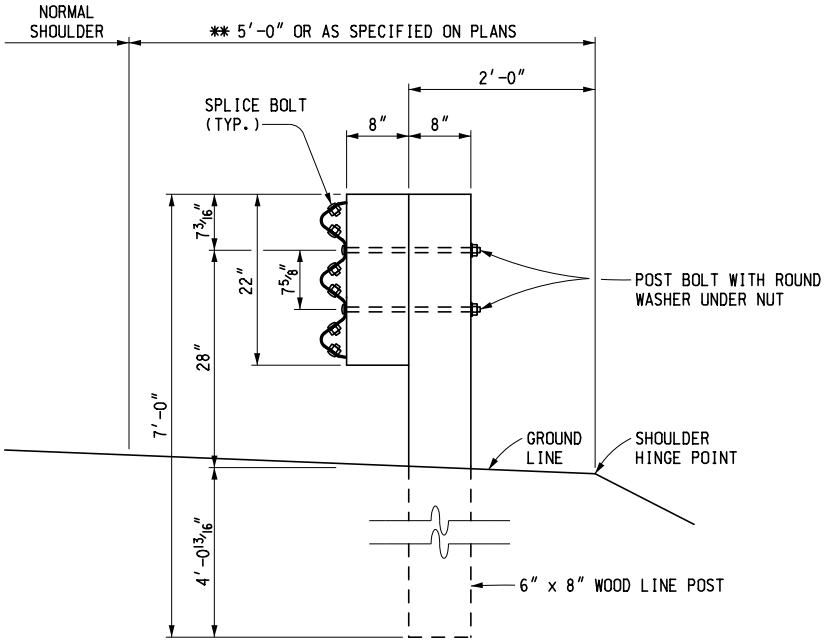
WOOD OFFSET BLOCKS FOR GUARDRAIL, TYPE B AND TYPE BD

MICHIGAN DEPARTMENT OF TRANSPORTATION

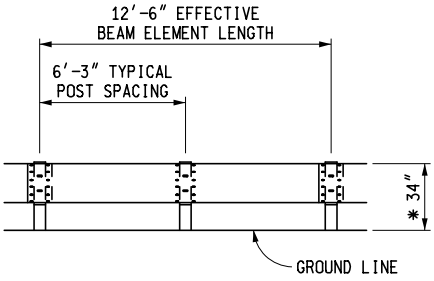
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 3 OF 16



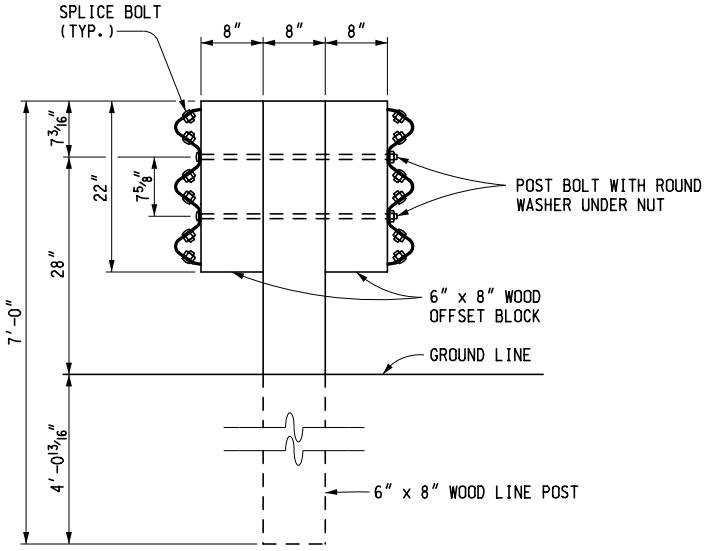
** FOR PAVED SHOULDER WIDTHS OF AT LEAST 12′, USE 3′-0″.

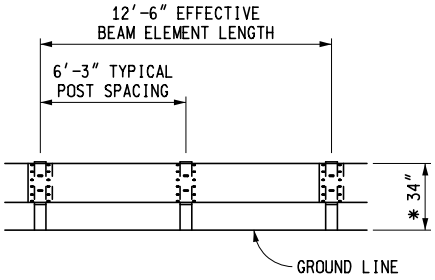


ELEVATION SHOWING POST SPACING

* SEE NOTES FOR GUARDRAIL IN CONJUNCTION WITH CURB

GUARDRAIL, TYPE T
(WOOD POST)





ELEVATION SHOWING POST SPACING

* SEE NOTES FOR GUARDRAIL IN CONJUNCTION WITH CURB

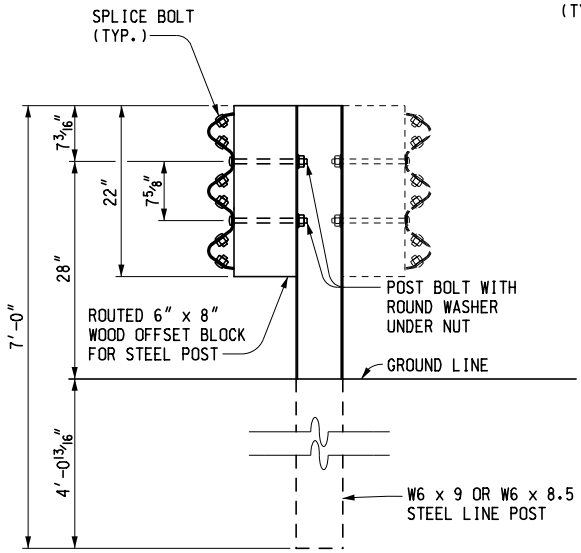
GUARDRAIL, TYPE TD
(WOOD POST)

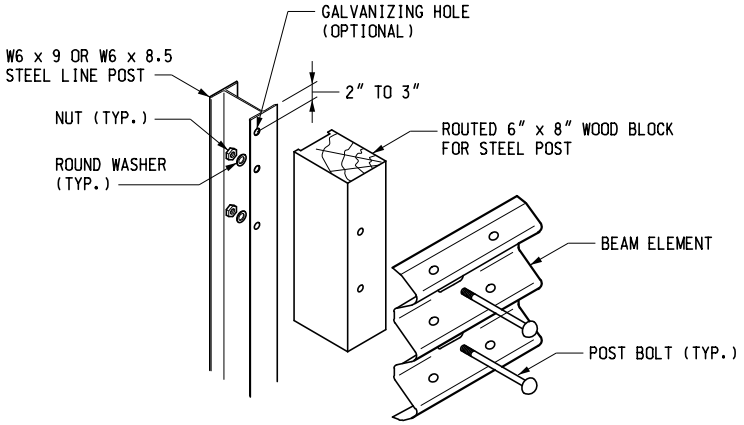
MICHIGAN DEPARTMENT OF TRANSPORTATION

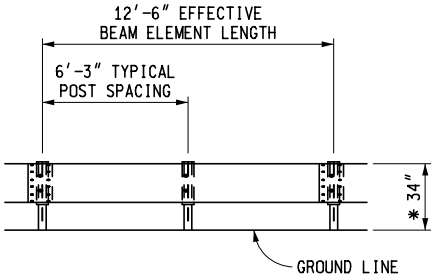
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 4 OF 16



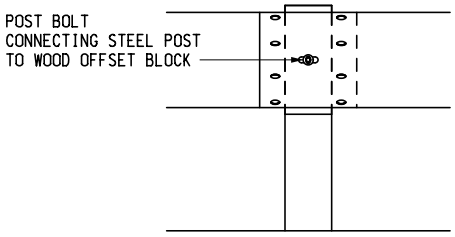




ELEVATION SHOWING POST SPACING

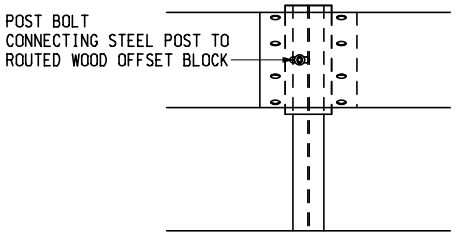
* SEE NOTES FOR GUARDRAIL IN CONJUNCTION WITH CURB

GUARDRAIL, TYPE T OR TD
(STEEL POST)



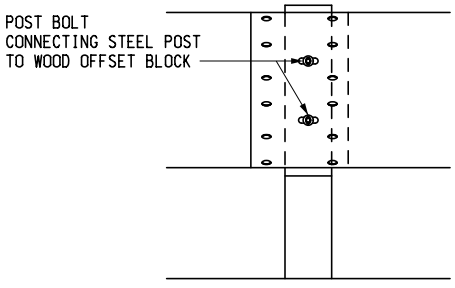
GUARDRAIL, TYPE B

WOOD POST



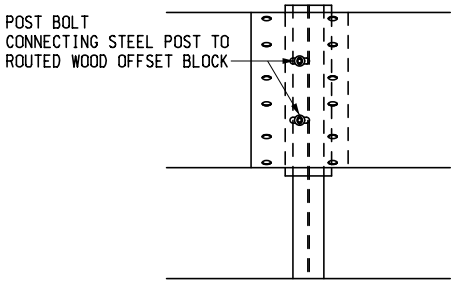
GUARDRAIL, TYPE B

STEEL POST



GUARDRAIL, TYPE T

WOOD POST



GUARDRAIL, TYPE T

STEEL POST

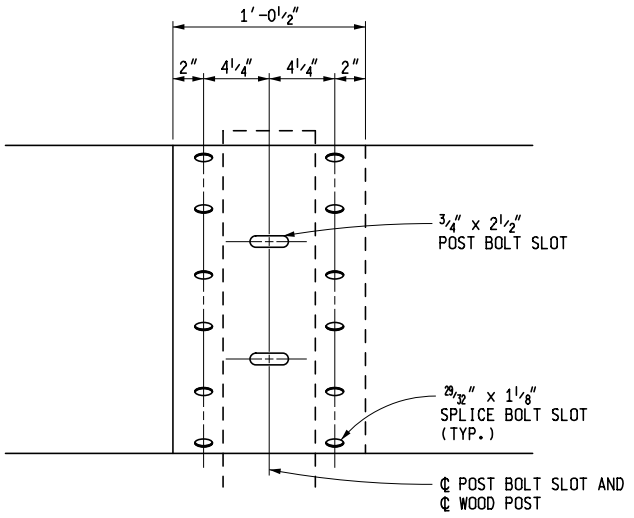
BLOCK AND POST CONNECTION DETAILS

MICHIGAN DEPARTMENT OF TRANSPORTATION

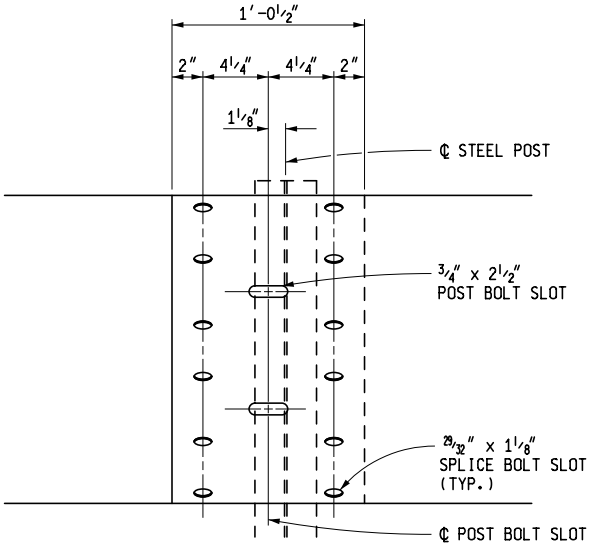
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 5 OF 16

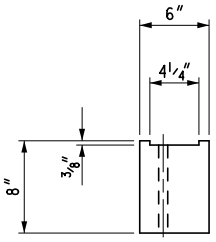


WOOD POST

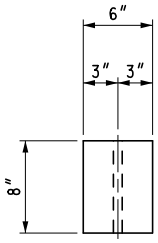


STEEL POST

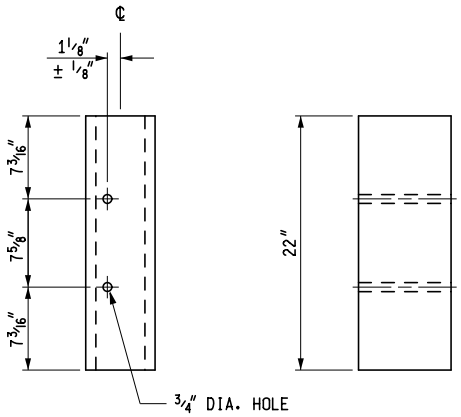
THRIE BEAM ELEMENT SPLICE DETAILS



TOP

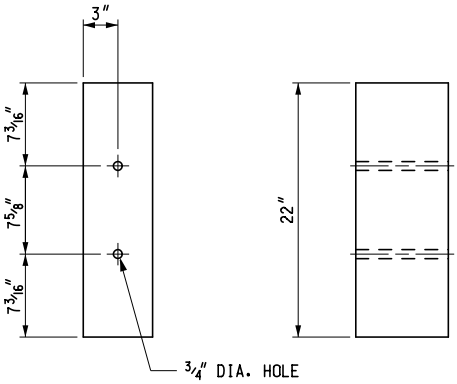


TOP



FRONT SIDE

FOR USE ON STEEL POSTS



FRONT SIDE

FOR USE ON WOOD POSTS

(SEE NOTES ON SHEET 16 OF 16)

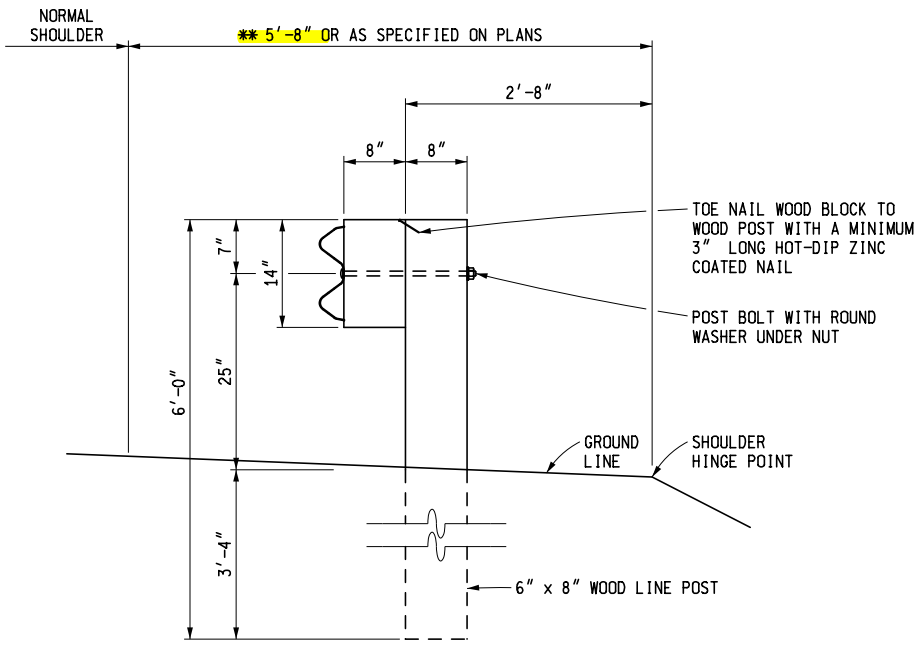
WOOD OFFSET BLOCKS FOR GUARDRAIL, TYPE T AND TYPE TD

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

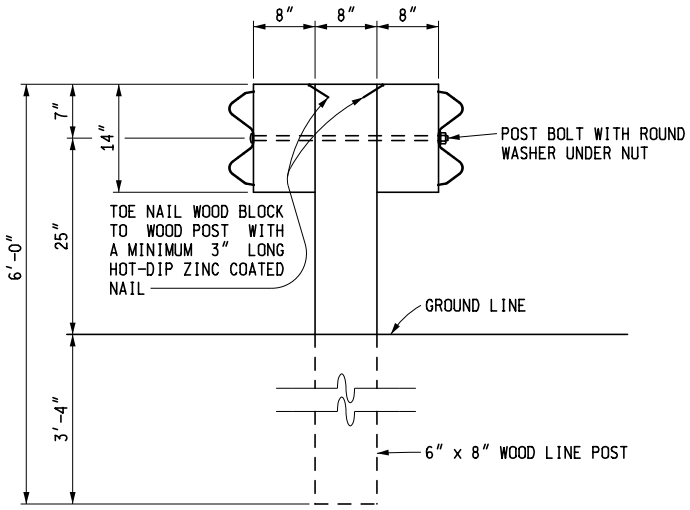
GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 6 OF 16



** FOR PAVED SHOULDER WIDTHS OF AT LEAST 12′, USE 3′-8″.

GUARDRAIL, TYPE MGS-8
(WOOD POST)



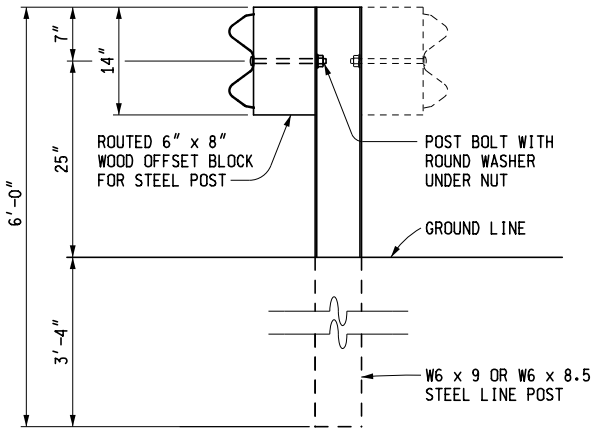
** FOR PAVED SHOULDER WIDTHS OF AT LEAST 12′, USE 3′-0″.

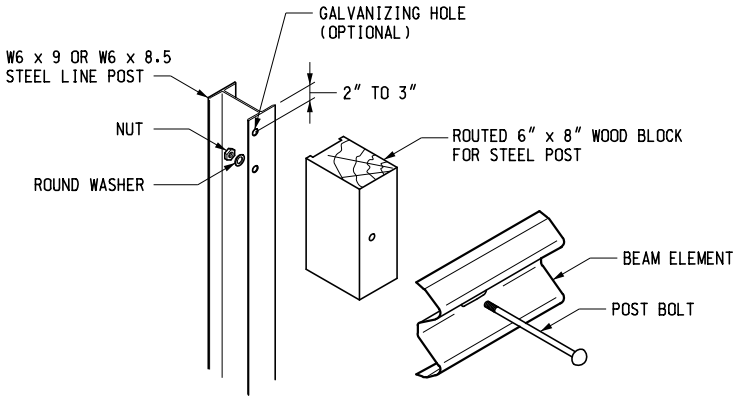
GUARDRAIL, TYPE MGS-8D
(WOOD POST)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 7 OF 16



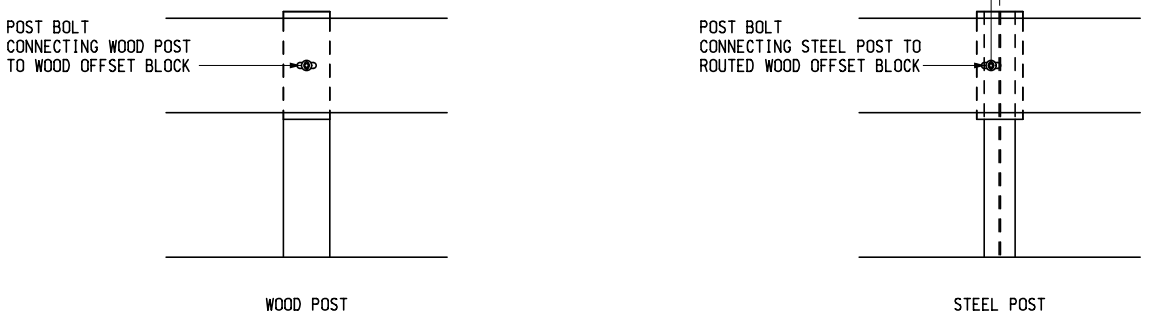


GUARDRAIL, TYPE MGS-8 (OR MGS-8D)
(STEEL POST)

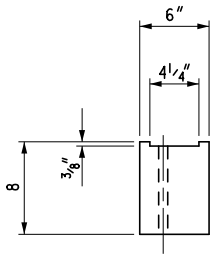
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

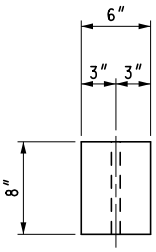
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 8 OF 16



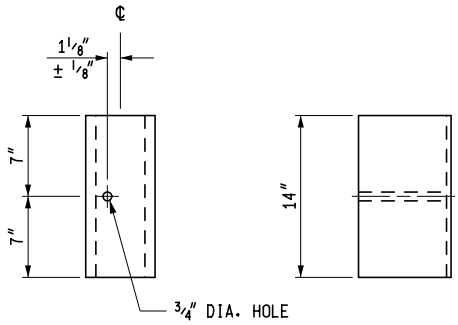
BLOCK AND POST CONNECTION DETAILS



TOP

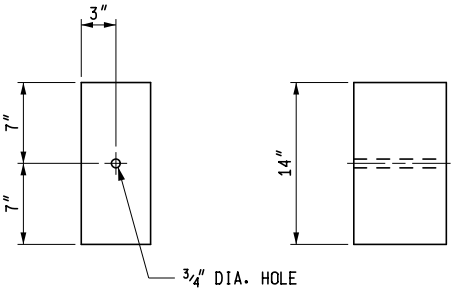


TOP



FRONT SIDE

FOR USE ON STEEL POSTS



FRONT SIDE

FOR USE ON WOOD POSTS

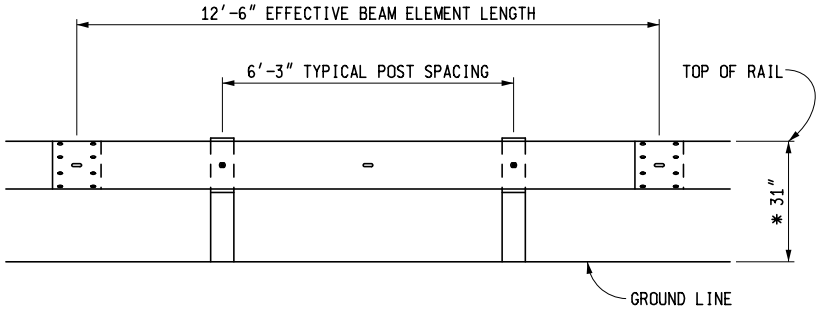
(SEE NOTES ON SHEET 16 OF 16)

WOOD OFFSET BLOCKS FOR GUARDRAIL, TYPE MGS-8 AND TYPE MGS-8D

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

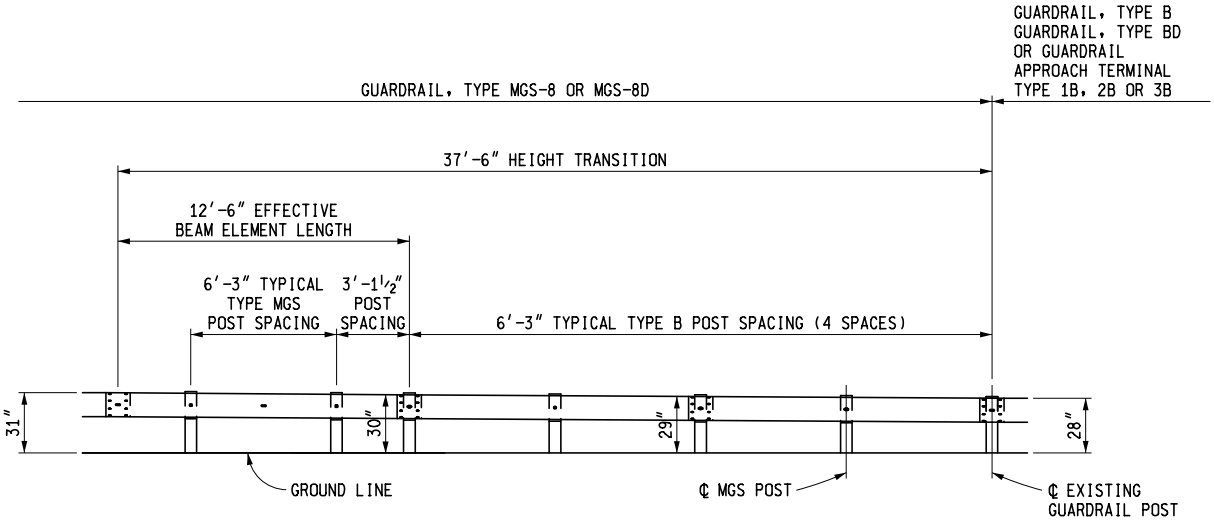
GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 9 OF 16

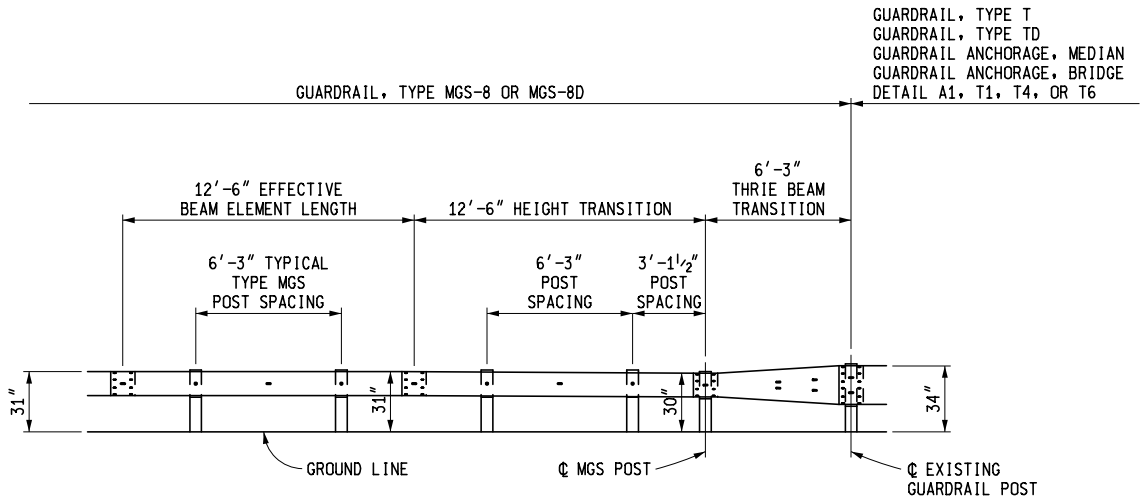


ELEVATION SHOWING POST SPACING FOR
GUARDRAIL, TYPE MGS-8 OR MGS-8D

* SEE NOTES FOR GUARDRAIL IN CONJUNCTION WITH CURB



ELEVATION SHOWING POST SPACING CONNECTING
GUARDRAIL, TYPE MGS-8 OR MGS-8D TO
GUARDRAIL, TYPE B, GUARDRAIL, TYPE BD, OR
GUARDRAIL APPROACH TERMINAL TYPE 1B, 2B, OR 3B

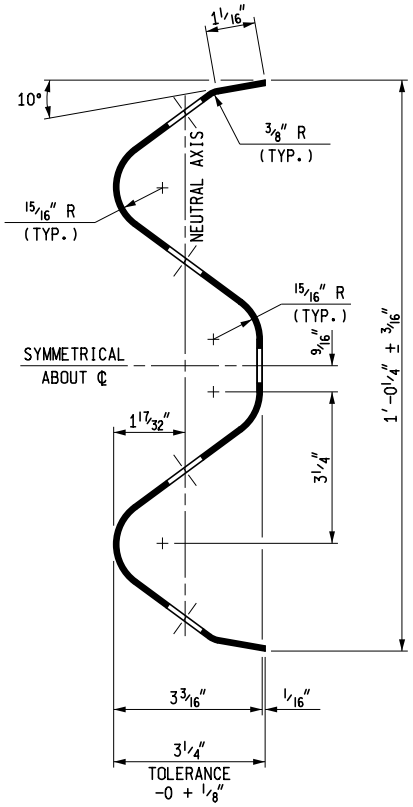


ELEVATION SHOWING POST SPACING CONNECTING
GUARDRAIL, TYPE MGS-8 OR MGS-8D TO
GUARDRAIL, TYPE T, GUARDRAIL, TYPE TD,
GUARDRAIL ANCHORAGE, MEDIAN,
GUARDRAIL ANCHORAGE, BRIDGE DETAIL A1, T1, T4 OR T6

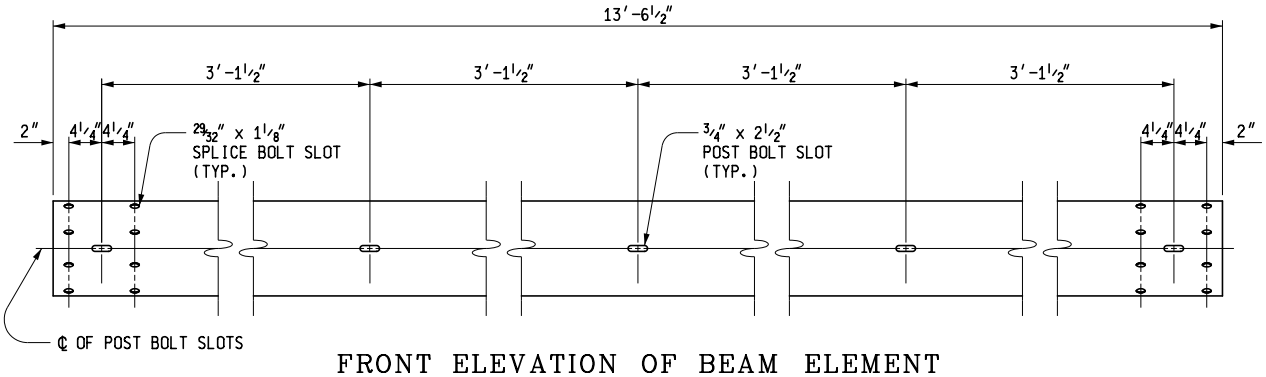
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

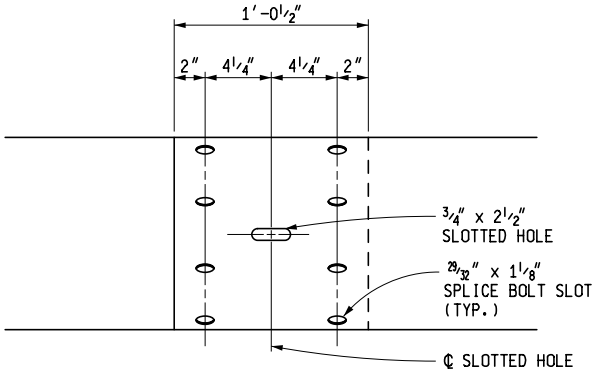
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 10 OF 16



SECTION THROUGH BEAM ELEMENT



FRONT ELEVATION OF BEAM ELEMENT



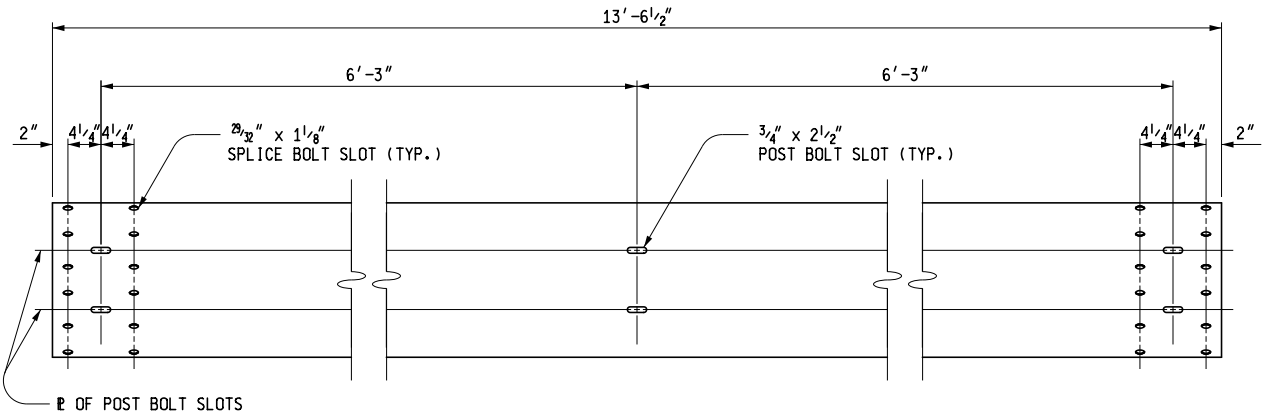
BEAM ELEMENT SPLICE DETAILS

MICHIGAN DEPARTMENT OF TRANSPORTATION

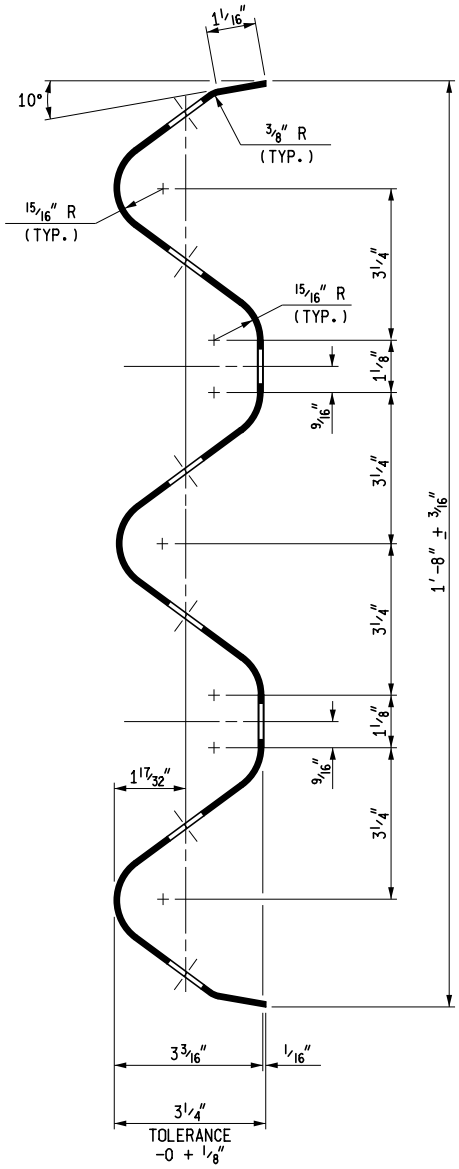
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 11 OF 16



FRONT ELEVATION OF THRIE BEAM ELEMENT



SECTION THROUGH THRIE BEAM ELEMENT

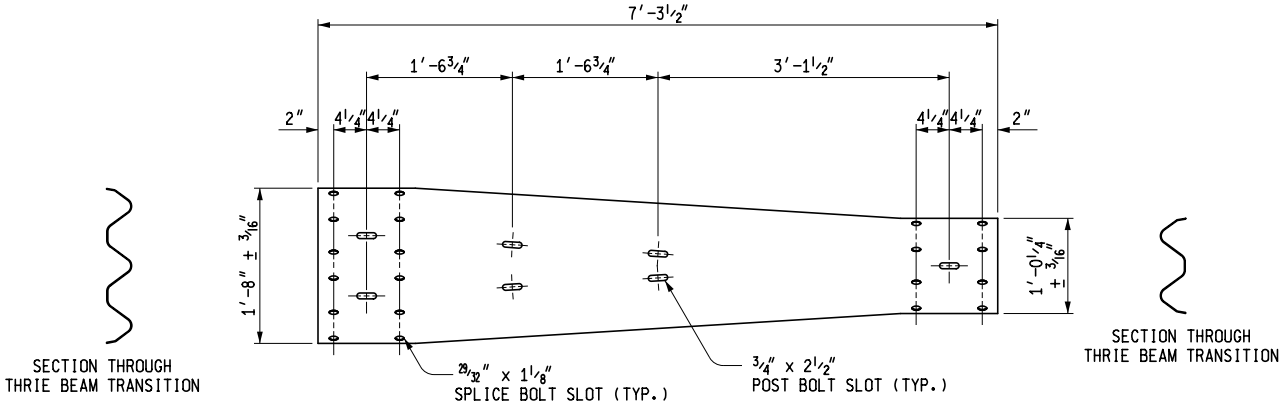
(FOR GUARDRAIL, TYPE T AND TD)

MICHIGAN DEPARTMENT OF TRANSPORTATION

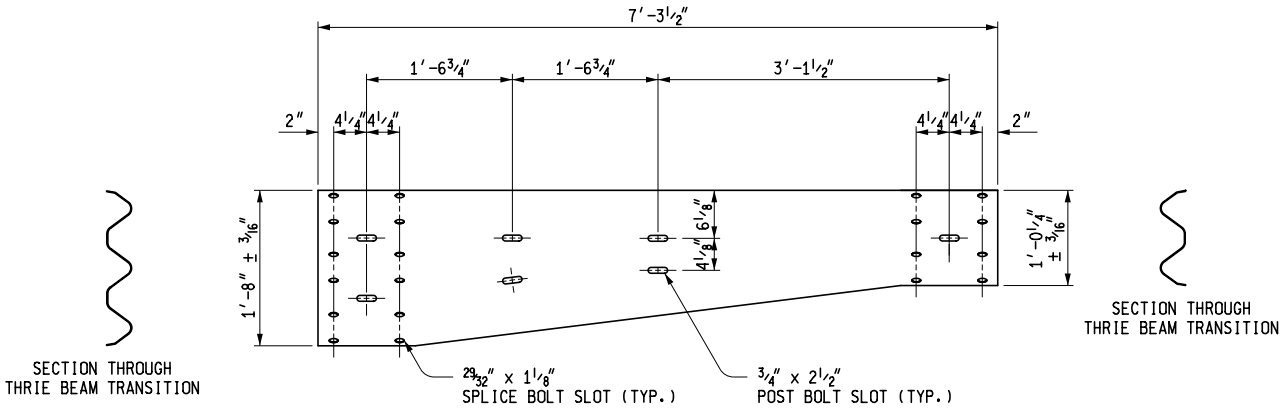
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

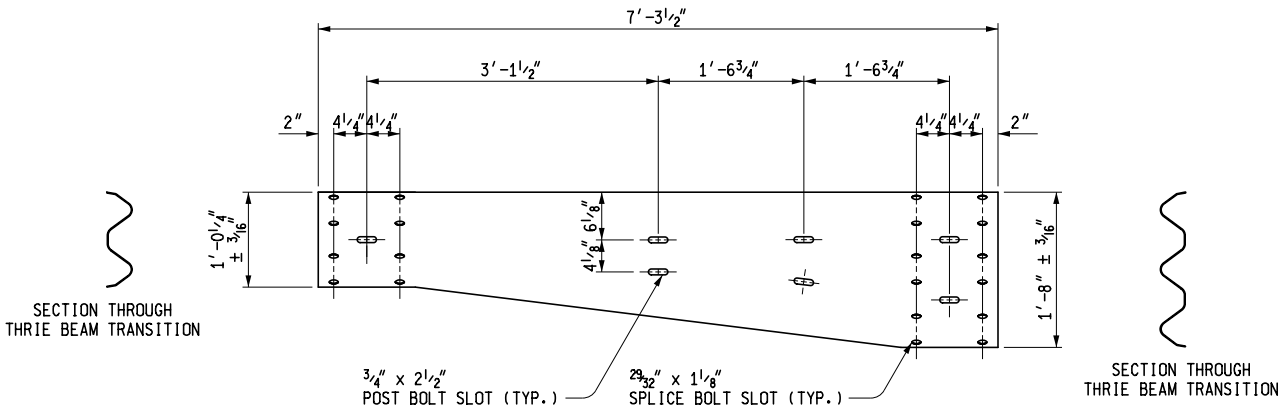
GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 12 OF 16



THRIE BEAM TRANSITION





ASYMMETRICAL THRIE BEAM TRANSITIONS

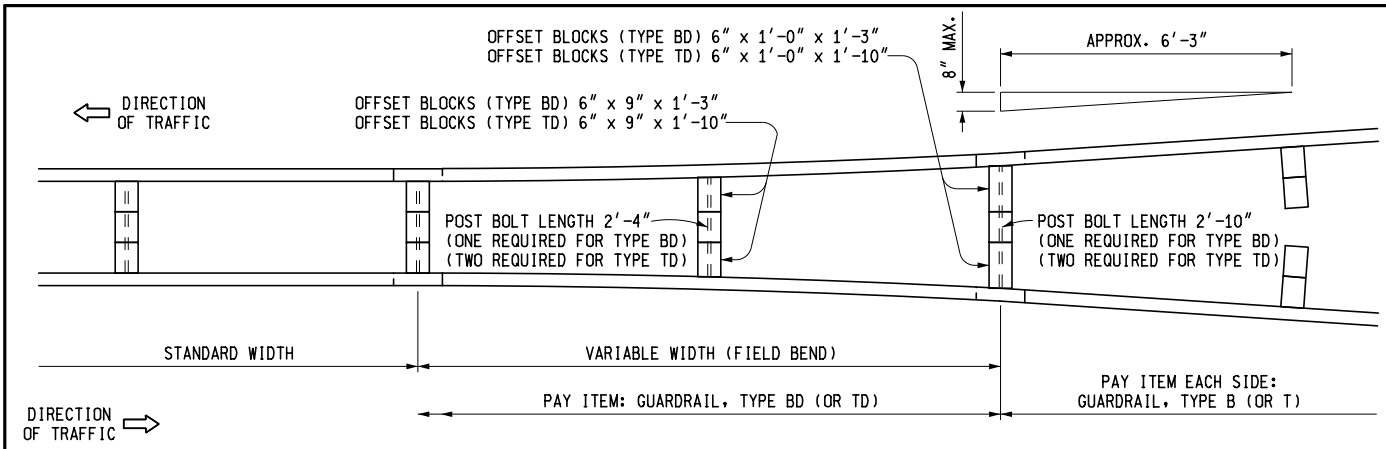
NOTE: ASYMMETRICAL TRANSITION TYPE WILL VARY BY LOCATION DEPENDING ON GUARDRAIL LAYOUT

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 13 OF 16



DETAIL SHOWING TRANSITION FROM GUARDRAIL, TYPE B (OR TYPE T) TO GUARDRAIL, TYPE BD (OR TYPE TD)

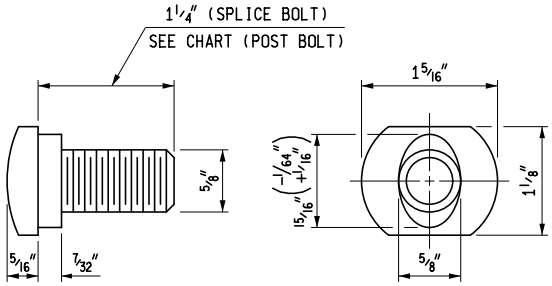
POST BOLTS, SPLICE BOLTS AND WASHERS AT BEAM ELEMENT SPLICE POSTS AND AT INTERMEDIATE POSTS

GUARDRAIL TYPE	POST	OFFSET BLOCK	POST BOLTS NO. REQ'D	POST BOLTS LENGTH	SPLICE BOLTS (1¼" LONG) (NO. REQ'D)		WASHERS (ROUND) (NO. REQ'D)
A	WOOD	N/A	1	9½"	8	NOT NEEDED AT INTERMEDIATE POSTS	1
	STEEL	N/A	1	2"			1
B	WOOD	WOOD	1	18"	8		1
	STEEL	WOOD	1	9½"			1
BD	WOOD	WOOD	1	*26½"	16		———
	STEEL	WOOD	2	9½"			2
T	WOOD	WOOD	2	18"	12		2
	STEEL	WOOD	2	9½"			2
TD	WOOD	WOOD	2	*26½"	24		———
	STEEL	WOOD	4	9½"			4

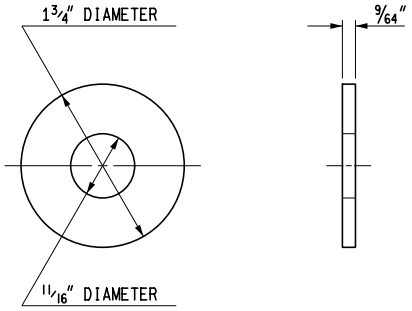
THRIE BEAM TRANSITIONS REQUIRE 20 SPLICE BOLTS EACH (12 ON TYPE T END AND 8 ON TYPE B END).

* EXCEPT AS SPECIFIED ON DETAIL SHOWING TRANSITION FROM GUARDRAIL, TYPE B (OR TYPE T) TO GUARDRAIL, TYPE BD (OR TYPE TD). POST BOLTS SHALL NOT EXTEND MORE THAN ½" BEYOND NUT.

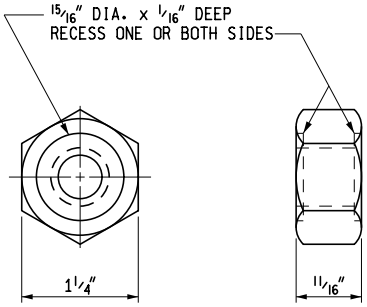
MINIMUM POST BOLT THREAD LENGTH	
BOLT LENGTH	MINIMUM THREAD LENGTH
9½"	1¾"
18"	2½"
26½"	3"



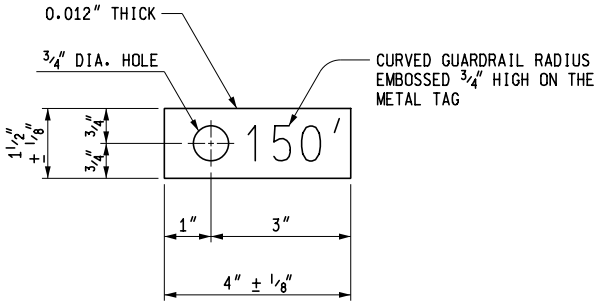
SPLICE BOLT AND POST BOLT



ROUND WASHER



NUT



METAL TAG

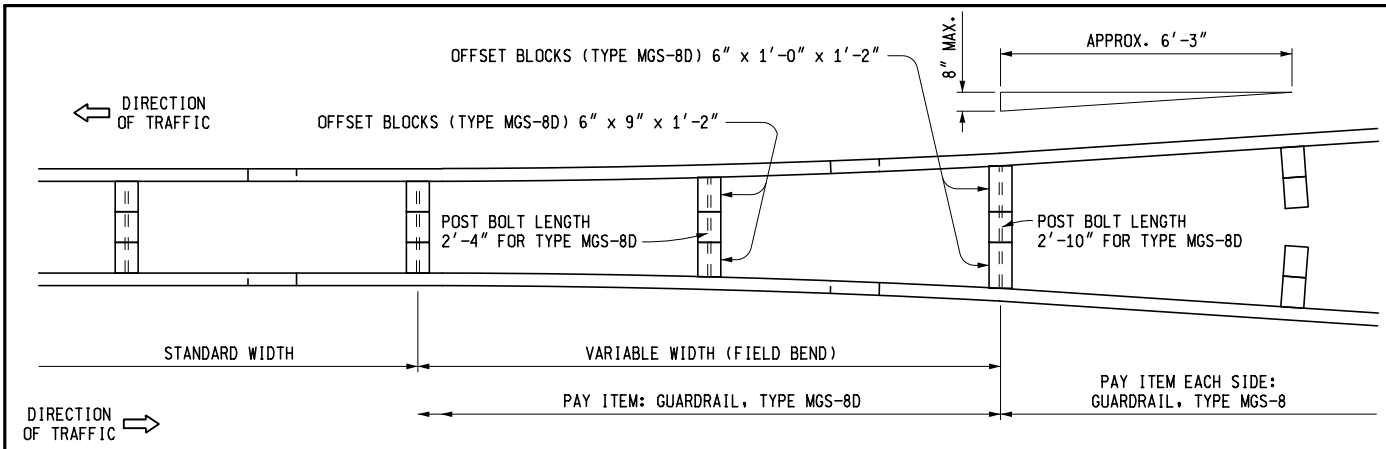
FOR CURVED GUARDRAIL WITH RADIUS OF 150' OR LESS

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 14 OF 16



DETAIL SHOWING TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL, TYPE MGS-8D

POST BOLTS, SPLICE BOLTS AND WASHERS AT BEAM ELEMENT SPLICE POSTS AND AT INTERMEDIATE POSTS

GUARDRAIL TYPE	POST	OFFSET BLOCK	POST BOLTS		SPLICE BOLTS	WASHERS
			NO. REQ'D	LENGTH	(1 1/4" LONG) (NO. REQ'D)	(ROUND) (NO. REQ'D)
MGS-8	WOOD	WOOD	1	18"	8	1
	STEEL	WOOD	1	9 1/2"		1
MGS-8D	WOOD	WOOD	1	*26 1/2"	16	———
	STEEL	WOOD	2	9 1/2"		2

THRIE BEAM TRANSITIONS REQUIRE 20 SPLICE BOLTS EACH (12 ON TYPE T END AND 8 ON TYPE MGS END).

* EXCEPT AS SPECIFIED ON DETAIL SHOWING TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL, TYPE MGS-8D POST BOLTS SHALL NOT EXTEND MORE THAN 1/2" BEYOND NUT.

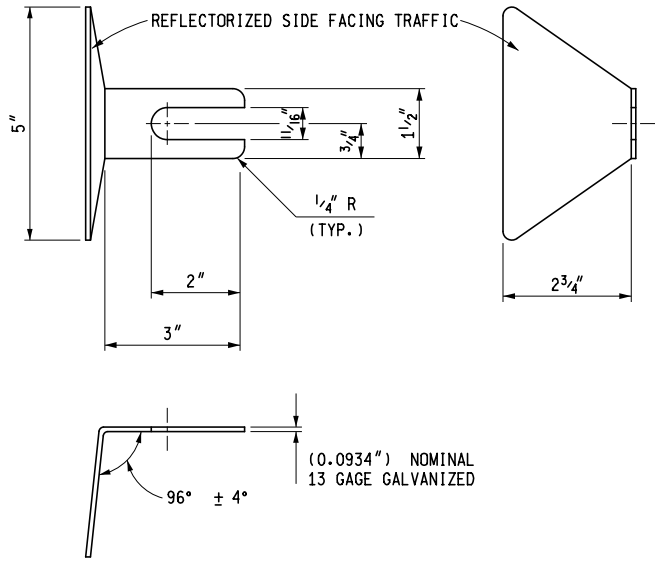
MINIMUM POST BOLT THREAD LENGTH

BOLT LENGTH	MINIMUM THREAD LENGTH
9 1/2"	1 3/4"
18"	2 1/2"
26 1/2"	3"

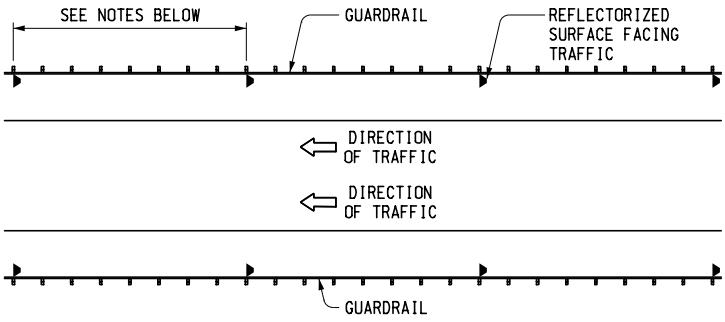
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

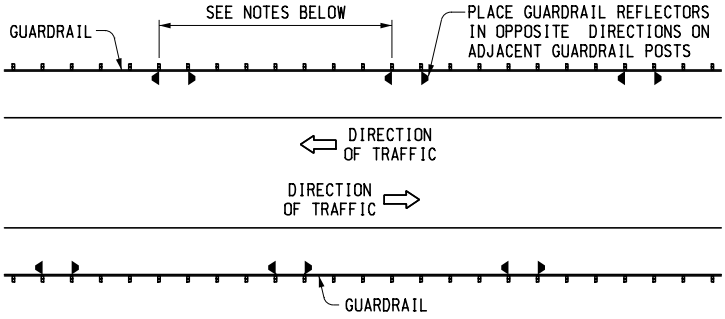
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 15 OF 16



GUARDRAIL REFLECTOR



ONE-WAY TRAFFIC

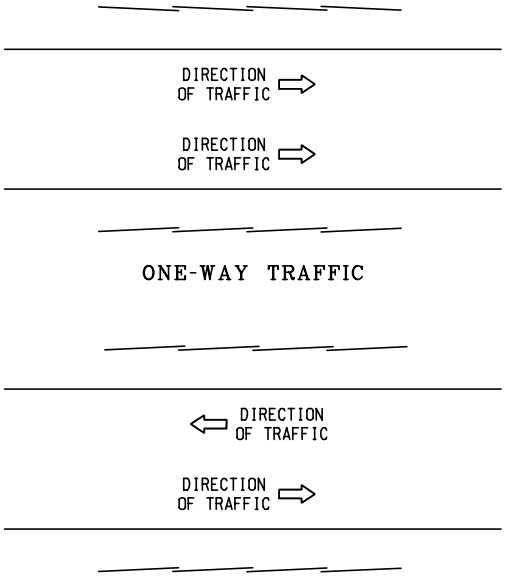


TWO-WAY TRAFFIC

PLACEMENT OF GUARDRAIL REFLECTORS

NOTES GOVERNING THE USE OF GUARDRAIL REFLECTORS

1. GUARDRAIL REFLECTORS SHALL BE USED ON ALL STANDARD GUARDRAIL RUNS, REGARDLESS OF ROADWAY LIGHTING.
2. GUARDRAIL REFLECTORS ARE TO BE SPACED AT THE FOLLOWING INTERVALS:
   a) 50'-0" ON TANGENT SECTIONS AND CURVES WITH A RADIUS OF 1150' OR MORE.
   b) 25'-0" ON CURVES WITH A RADIUS LESS THAN 1150'.
3. FOR GUARDRAIL REFLECTOR PLACEMENT ON APPROACH TERMINALS, SEE THE APPROPRIATE GUARDRAIL APPROACH TERMINAL STANDARD PLAN.
4. A GUARDRAIL REFLECTOR IS TO BE PLACED ON THE SECOND POST FROM THE GUARDRAIL DEPARTING TERMINAL.
5. ON GUARDRAIL, TYPE T AND TYPE TD GUARDRAIL REFLECTORS ARE TO BE PLACED ON THE UPPER POST BOLT.
6. GUARDRAIL REFLECTORS SHALL MATCH COLOR OF EDGE LINE.



TWO-WAY TRAFFIC

DIRECTION OF RAIL LAP

NOTES:

DETAILS SPECIFIED ON THIS STANDARD ARE ACCORDING TO THE AASHTO-AGC-ARTBA JOINT COMMITTEE, TASK FORCE 13 PUBLICATION TITLED "A GUIDE TO STANDARDIZED HIGHWAY BARRIER HARDWARE."

BEAM ELEMENTS SHALL BE SHOP BENT TO PLAN RADIUS FOR CURVE RADII 150' OR LESS. A TAG IDENTIFYING THE CURVATURE OF THE SHOP BENT SECTION WILL BE REQUIRED FOR EACH CURVED ELEMENT.

SEE STANDARD PLAN R-61-SERIES, R-62-SERIES OR R-63-SERIES FOR GUARDRAIL APPROACH TERMINALS, STANDARD PLAN R-66-SERIES FOR GUARDRAIL DEPARTING TERMINALS AND STANDARD PLAN R-67-SERIES FOR GUARDRAIL ANCHORAGE, BRIDGE.

WHEN THE PLANS SPECIFY GUARDRAIL (TYPE B OR T) TO BE PLACED ON THE SHOULDER HINGE POINT, RATHER THAN AS SPECIFIED ON THIS PLAN, 8'-0" POSTS SHALL BE PROVIDED, WITH THE ADDITIONAL LENGTH EMBEDDED FOR ADDED STABILITY. (NOT NECESSARY WHEN THE SLOPE IS REASONABLY LEVEL BEYOND THE SHOULDER HINGE POINT, AS DETERMINED BY THE ENGINEER.)

WHEN THE PLANS SPECIFY GUARDRAIL TYPE MGS-8 TO BE PLACED ON THE SHOULDER HINGE POINT, RATHER THAN AS SPECIFIED ON THIS PLAN, 9'-0" POSTS SHALL BE PROVIDED, WITH THE ADDITIONAL LENGTH EMBEDDED FOR ADDED STABILITY. (NOT NECESSARY WHEN THE SLOPE IS REASONABLY LEVEL BEYOND THE SHOULDER HINGE POINT, AS DETERMINED BY THE ENGINEER.)

WOOD POSTS WITH 1/2" BEVELS AT THE TOP MAY BE USED IN LIEU OF WOOD POSTS WITHOUT BEVELS SPECIFIED. THE LENGTH, WIDTH AND DEPTH OF THE POST SHALL BE AS SPECIFIED ON THIS STANDARD AND THE POST BOLT HOLES SHALL BE LOCATED TO ENSURE PROPER RAIL HEIGHT.

WOOD OFFSET BLOCKS WITH 1/2" BEVELS AT THE TOP AND BOTTOM OR A 1" BEVELED TOP MAY BE USED IN LIEU OF WOOD BLOCKS WITHOUT BEVELS SPECIFIED. THE LENGTH (FRONT AND BACK FACE), WIDTH AND DEPTH OF THE BLOCK SHALL BE AS SPECIFIED ON THIS STANDARD AND THE POST BOLT HOLES SHALL BE LOCATED TO ENSURE PROPER RAIL HEIGHT AND COMPATIBILITY WITH POST HOLES.

WHEN THE FACE OF GUARDRAIL IS PLACED FLUSH WITH FACE OF CURB, THE RAIL HEIGHT SHOULD BE MEASURED FROM THE FRONT EDGE OF THE GUTTER PAN, WHICH IS THE POINT ON THE GUTTER PAN THAT IS CLOSEST TO THE EDGE OF THE TRAVELED LANE. WHEN THE FACE OF THE GUARDRAIL PANEL IS LOCATED BEHIND THE CURB THE RAIL HEIGHT SHOULD BE MEASURED FROM THE GROUND JUST IN FRONT OF THE GUARDRAIL.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL, TYPES A, B, BD, T, TD, MGS-8, & MGS-8D

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-60-J	SHEET 16 OF 16

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

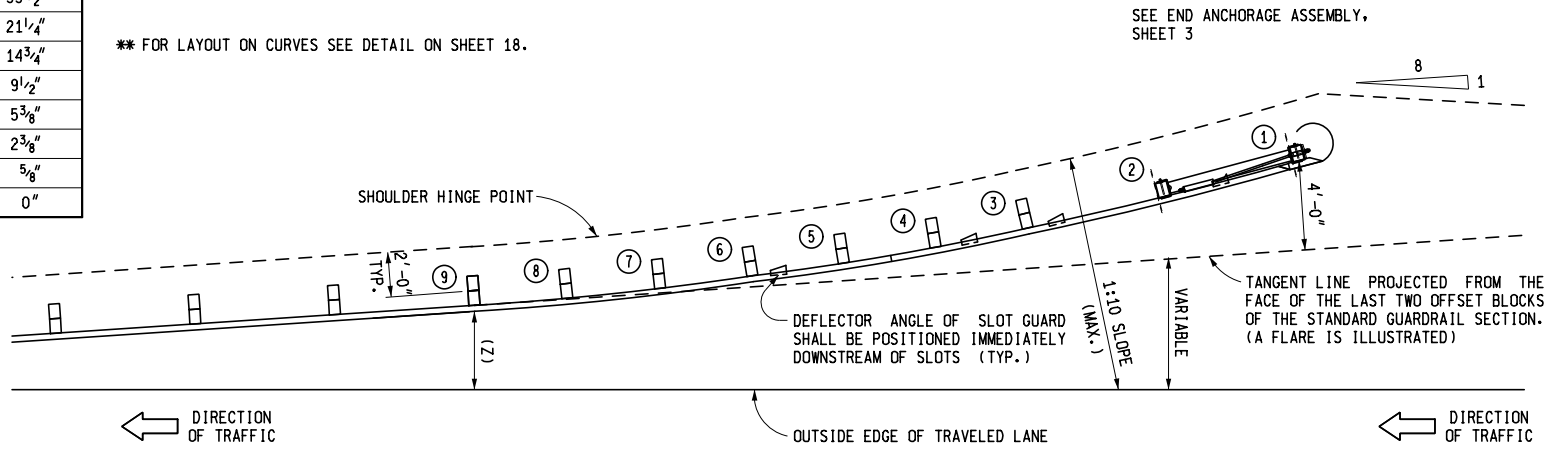
OPTION 1

(DETAILED ON SHEETS 1 THROUGH 6, 11 AND 12)

POST	** POST OFFSET DISTANCE	
1	4.0′	48″
2	2.8′	33 1/2″
3	1.8′	21 1/4″
4	1.2′	14 3/4″
5	0.8′	9 1/2″
6	0.45′	5 3/8″
7	0.2′	2 3/8″
8	0.05′	5/8″
9	0′	0″

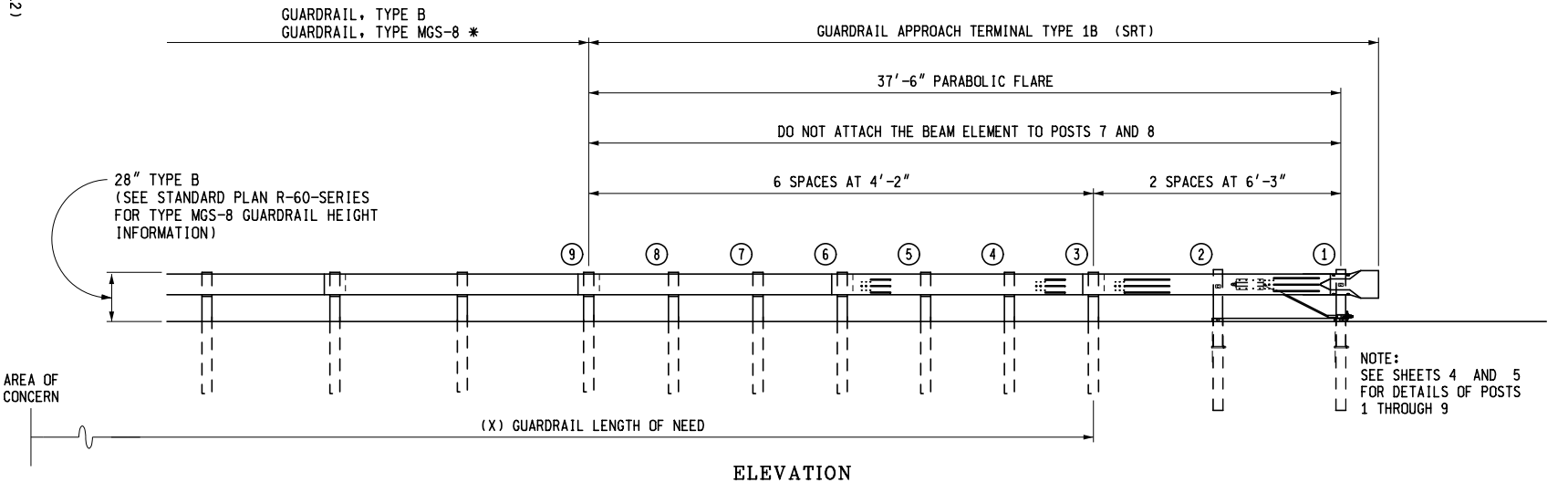
THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE WOOD OFFSET BLOCKS, EXCEPT FOR THE FIRST AND SECOND POSTS WHICH ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE POST. OFFSET POINTS ARE TO BE LOCATED BY CHORD MEASUREMENTS AT THE BACK OF THE RAIL EQUAL TO THE NOMINAL POST SPACINGS SPECIFIED. POSTS ARE TO BE SET APPROXIMATELY TANGENT TO THE BEAM ELEMENT AT EACH POST LOCATION.

** FOR LAYOUT ON CURVES SEE DETAIL ON SHEET 18.



PLAN VIEW

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL APPROACH TERMINAL TYPE 1B



ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 1B
"SRT"

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

APPROVED BY: _____ ENGINEER OF DELIVERY

APPROVED BY: _____ ENGINEER OF DEVELOPMENT

DEPARTMENT DIRECTOR
Kirk T. Steudle

F.H.W.A. APPROVAL

3-15-2016
PLAN DATE

R-61-H

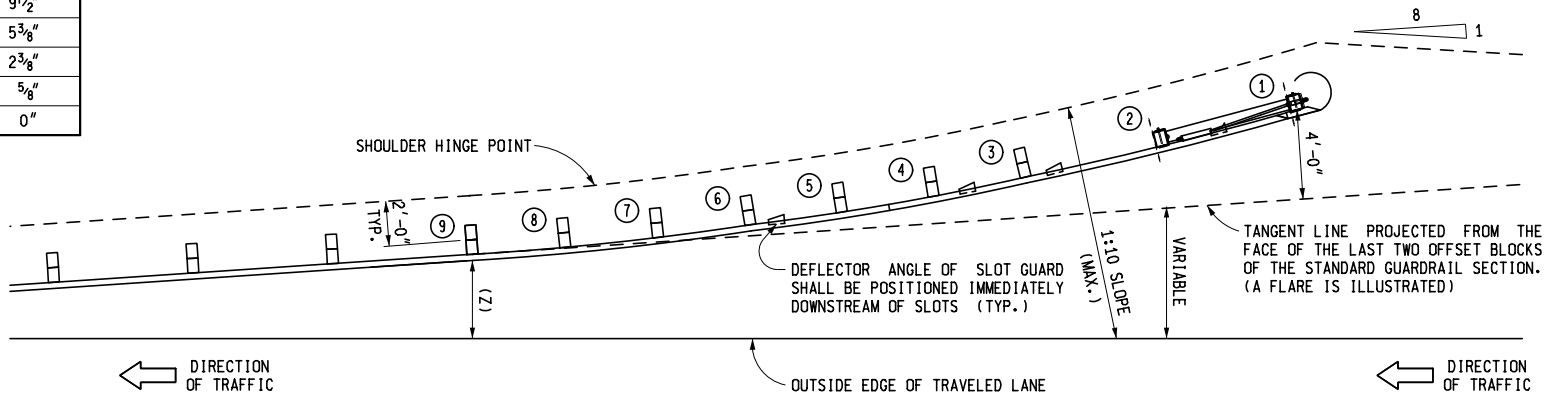
SHEET 1 OF 19

POST	** POST OFFSET DISTANCE	
1	4.0′	48″
2	2.8′	33 1/2″
3	1.8′	21 1/4″
4	1.2′	14 3/4″
5	0.8′	9 1/2″
6	0.45′	5 3/8″
7	0.2′	2 3/8″
8	0.05′	5/8″
9	0′	0″

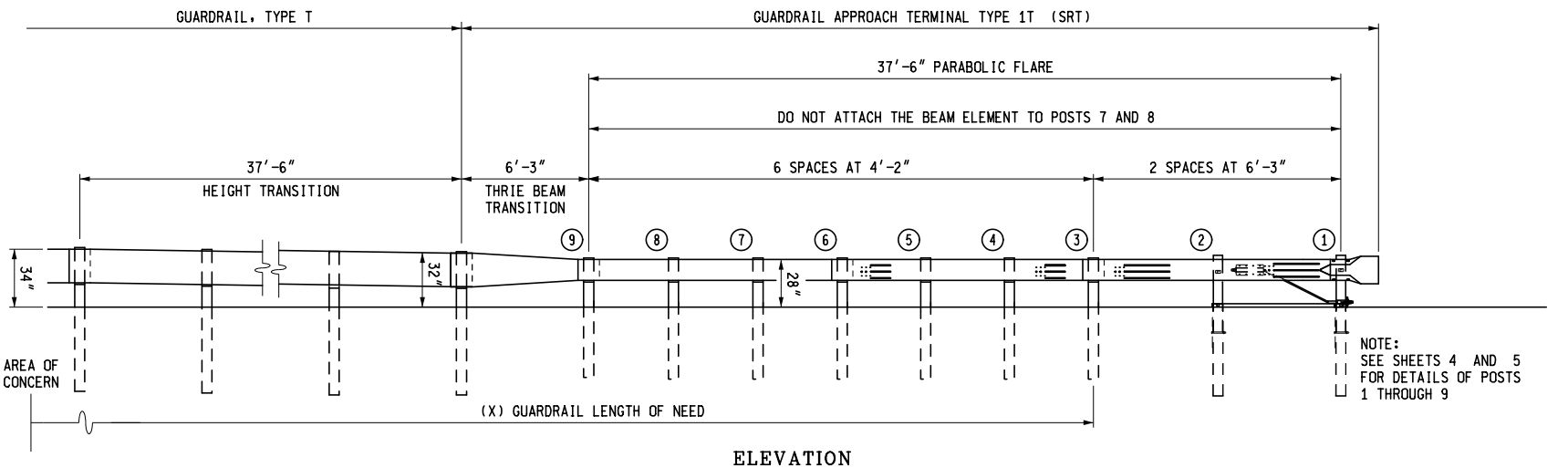
THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE WOOD OFFSET BLOCKS, EXCEPT FOR THE FIRST AND SECOND POSTS WHICH ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE POST. OFFSET POINTS ARE TO BE LOCATED BY CHORD MEASUREMENTS AT THE BACK OF THE RAIL EQUAL TO THE NOMINAL POST SPACINGS SPECIFIED. POSTS ARE TO BE SET APPROXIMATELY TANGENT TO THE BEAM ELEMENT AT EACH POST LOCATION.

** FOR LAYOUT ON CURVES SEE DETAIL ON SHEET 18.

SEE END ANCHORAGE ASSEMBLY, SHEET 3



PLAN VIEW



ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 1T "SRT"

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

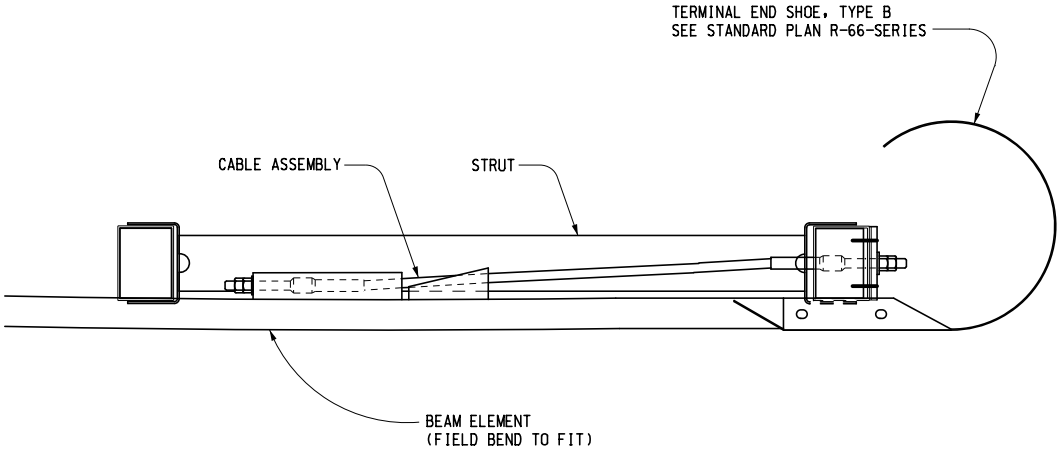
GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL

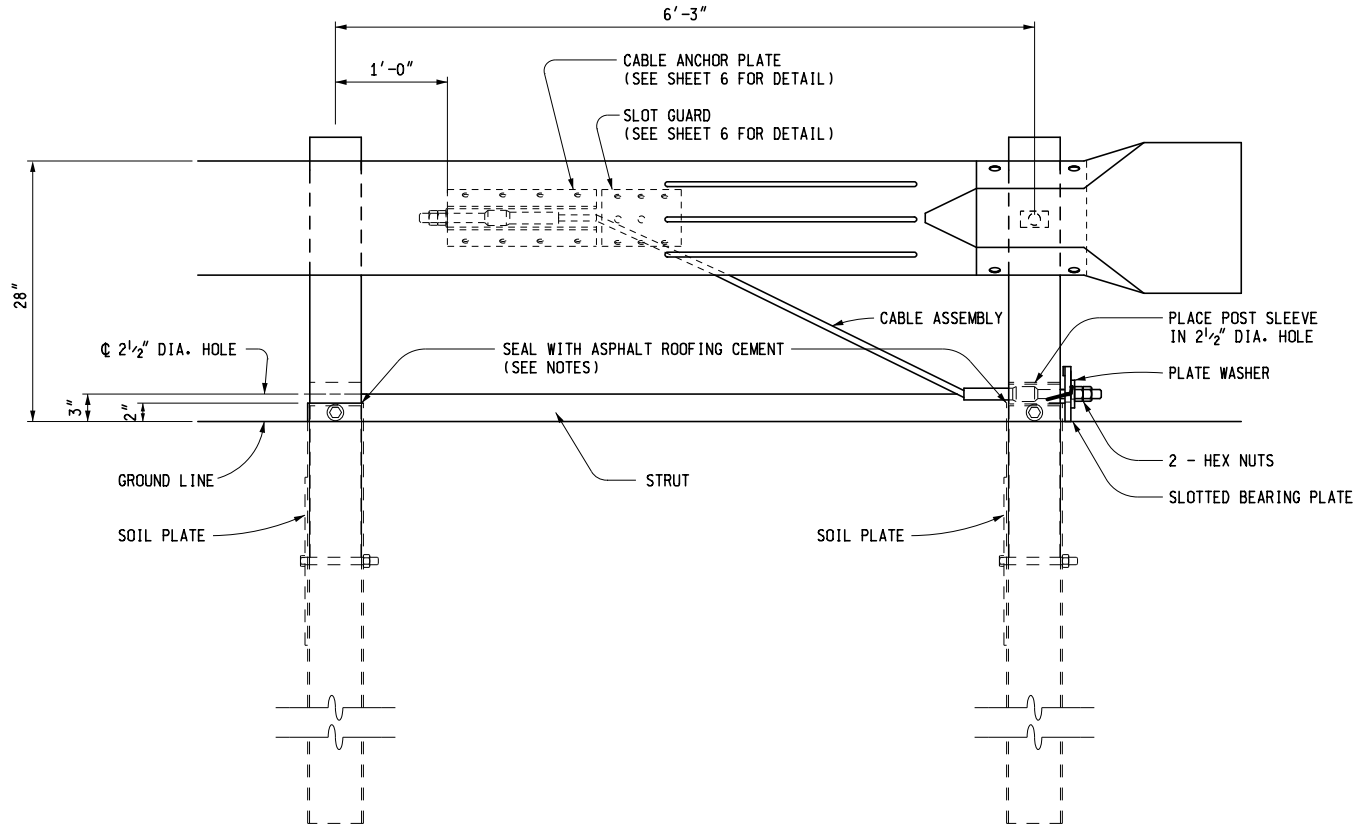
3-15-2016
PLAN DATE

R-61-H

SHEET 2 OF 19



PLAN VIEW



ELEVATION

END ANCHORAGE ASSEMBLY

(SRT)

NOTES:

DETAILS ON THIS SHEET ONLY APPLY TO "SRT".

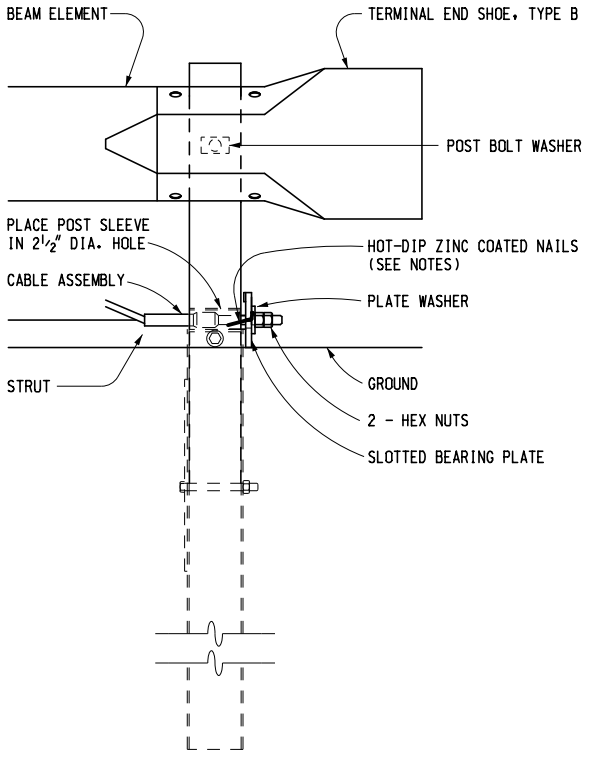
AFTER THE CABLE ASSEMBLY HAS BEEN TIGHTENED, A SECOND NUT SHALL BE INSTALLED ON EACH END OF THE CABLE SO THAT THE CABLE WILL NOT LOOSEN.

ASPHALT ROOFING CEMENT SHALL BE USED TO SEAL THE PERIMETER AREA BETWEEN THE STEEL SLEEVE (SOIL TUBE) AND THE WOOD BREAKAWAY POST.

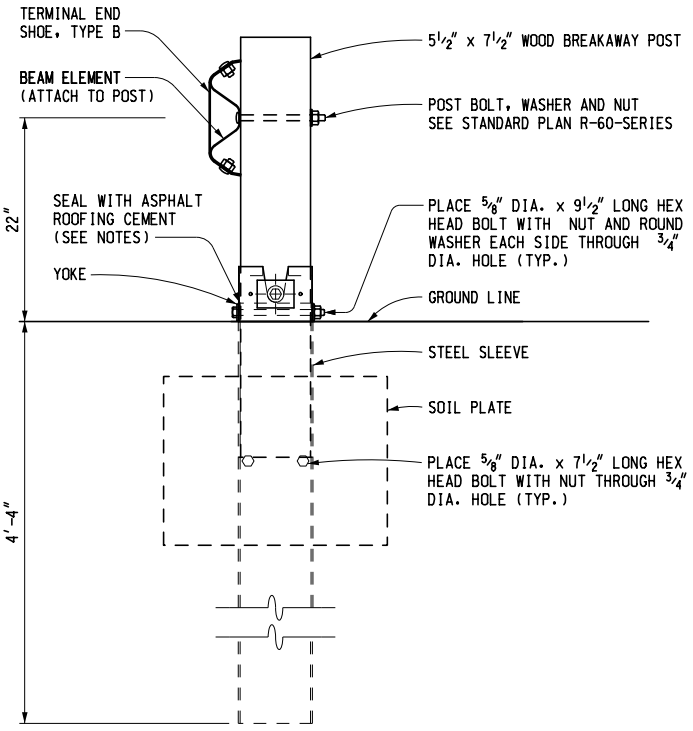
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 3 OF 19

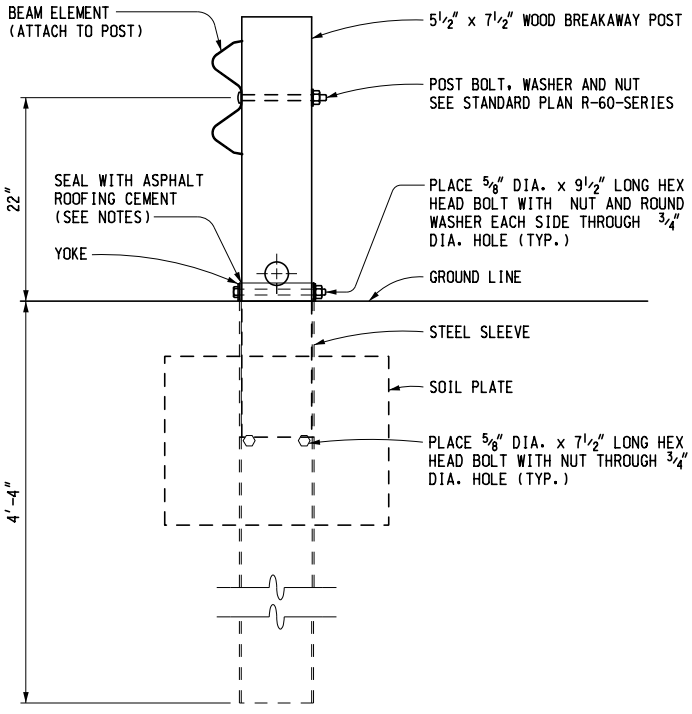


ELEVATION



SIDE

POST 1 DETAIL
(SRT)



POST 2 DETAIL
(SRT)

NOTES:

DETAILS ON THIS SHEET ONLY APPLY TO "SRT".

TWO HOT-DIP ZINC COATED NAILS SHALL BE DRIVEN INTO THE WOOD POST THROUGH THE HOLES IN THE SLOTTED BEARING PLATE ON POST 1 OF THE "SRT" TO KEEP THE PLATE FROM ROTATING.

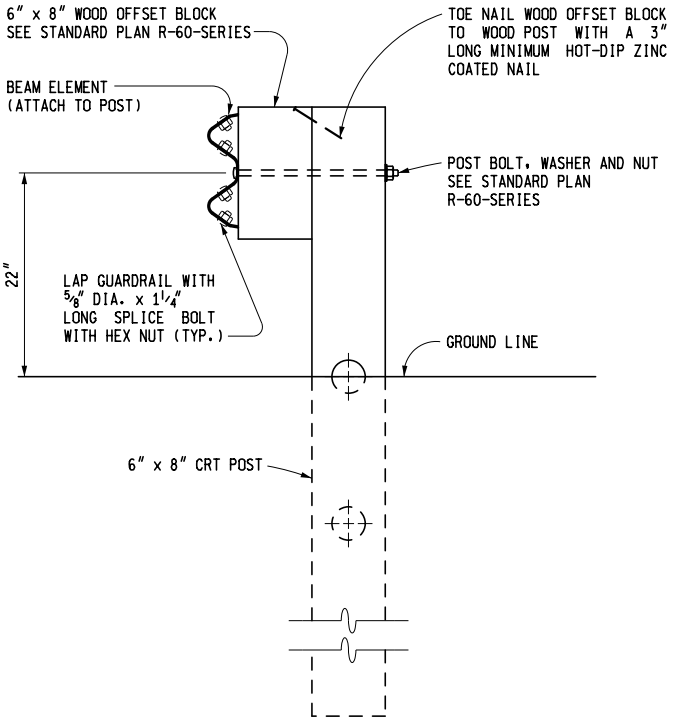
AFTER THE CABLE ASSEMBLY HAS BEEN TIGHTENED, A SECOND NUT SHALL BE INSTALLED ON EACH END OF THE CABLE SO THAT THE CABLE WILL NOT LOOSEN.

ASPHALT ROOFING CEMENT SHALL BE USED TO SEAL THE PERIMETER AREA BETWEEN THE STEEL SLEEVE (SOIL TUBE) AND THE WOOD BREAKAWAY POST.

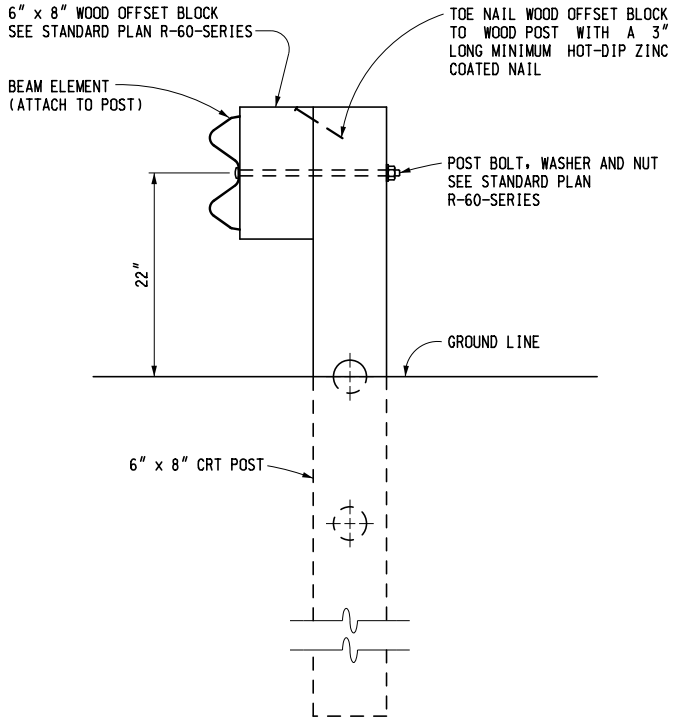
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

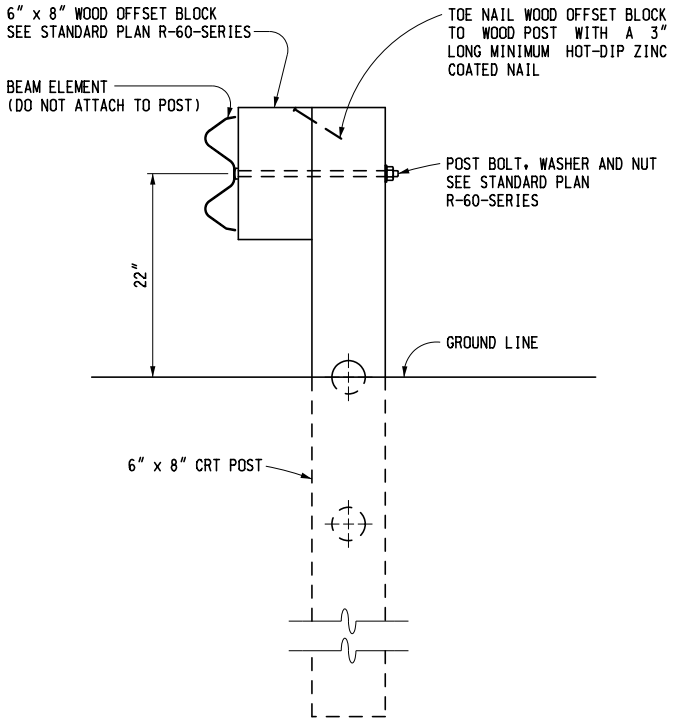
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 4 OF 19



POST 3 AND 6 DETAIL
(SRT)



POST 4 AND 5 DETAIL
(SRT)



POST 7 AND 8 DETAIL
(SRT)

NOTE: POST 9 IS A STANDARD LINE POST

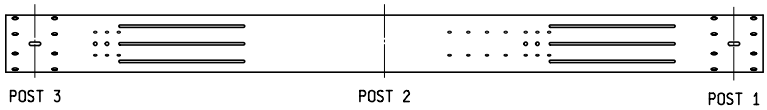
NOTE:

DETAILS ON THIS SHEET ONLY APPLY TO "SRT".

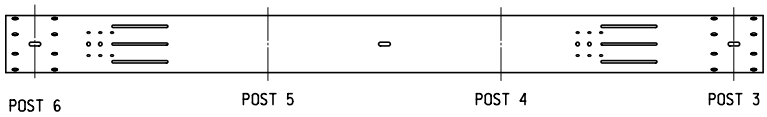
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

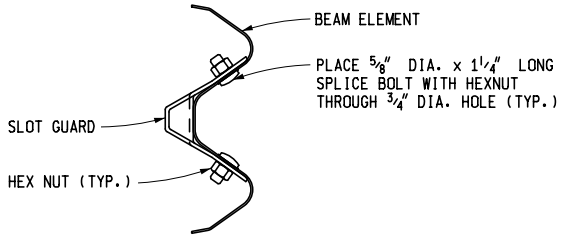
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 5 OF 19



SLOTTED RAIL BEAM ELEMENT
(POST 1 THROUGH 3)

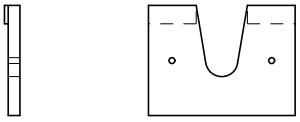


SLOTTED RAIL BEAM ELEMENT
(POST 3 THROUGH 6)



ASSEMBLY DETAIL

SLOT GUARD DETAILS



SLOTTED BEARING PLATE

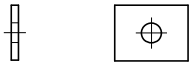
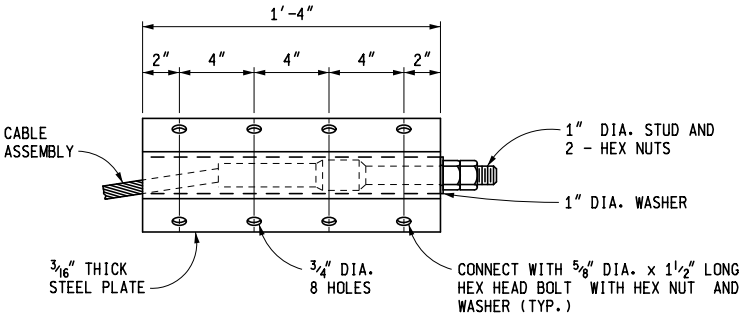
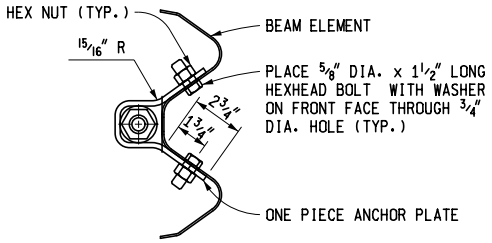


PLATE WASHER

NOTE: ALL "SRT" ITEMS ILLUSTRATED WITHOUT DIMENSIONS SHALL BE ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.





CABLE ANCHOR PLATE DETAILS
(SRT)

NOTES:

DETAILS ON THIS SHEET ONLY APPLY TO "SRT".

AFTER THE CABLE ASSEMBLY HAS BEEN TIGHTENED, A SECOND NUT SHALL BE INSTALLED ON EACH END OF THE CABLE SO THAT THE CABLE WILL NOT LOOSEN.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 6 OF 19

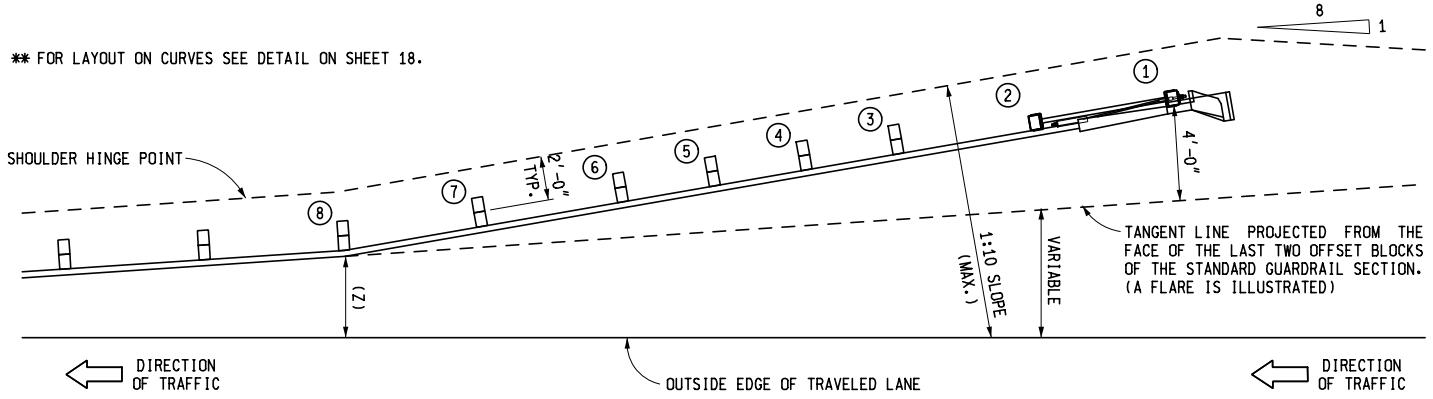
POST	** POST OFFSET DISTANCE	
1	4.0′	48″
2	3.33′	40″
3	2.67′	32″
4	2.22′	$26\frac{11}{16}$″
5	1.77′	$21\frac{5}{16}$″
6	1.33′	16″
7	0.67′	8″
8	0′	0″

THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE WOOD OFFSET BLOCKS, EXCEPT FOR THE FIRST AND SECOND POSTS WHICH ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE POST. OFFSET POINTS ARE TO BE LOCATED BY CHORD MEASUREMENTS AT THE BACK OF THE RAIL EQUAL TO THE NOMINAL POST SPACINGS SPECIFIED. POSTS ARE TO BE SET APPROXIMATELY TANGENT TO THE BEAM ELEMENT AT EACH POST LOCATION.

** FOR LAYOUT ON CURVES SEE DETAIL ON SHEET 18.

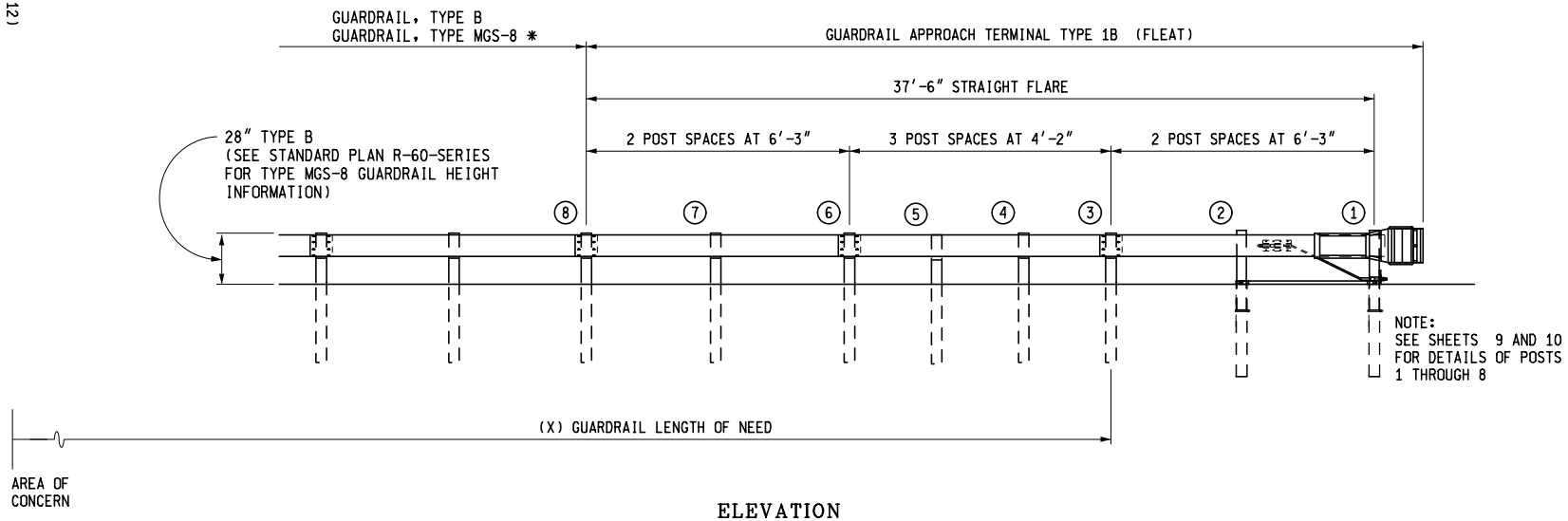
OPTION 2

(DETAILED ON SHEETS 7 THROUGH 12)



PLAN VIEW

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL APPROACH TERMINAL TYPE 1B



ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 1B "FLEAT"

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL

3-15-2016
PLAN DATE

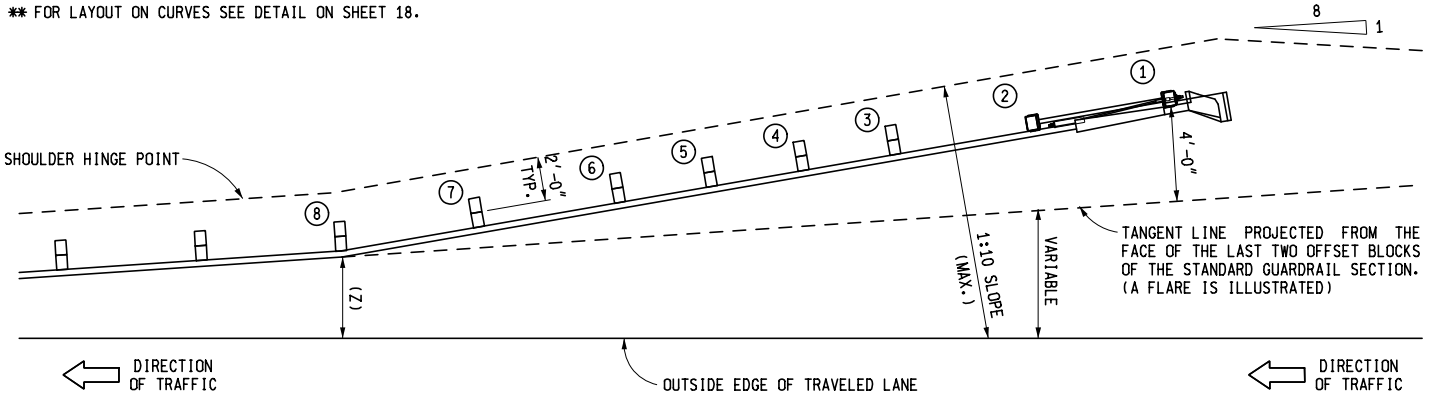
R-61-H

SHEET 7 OF 19

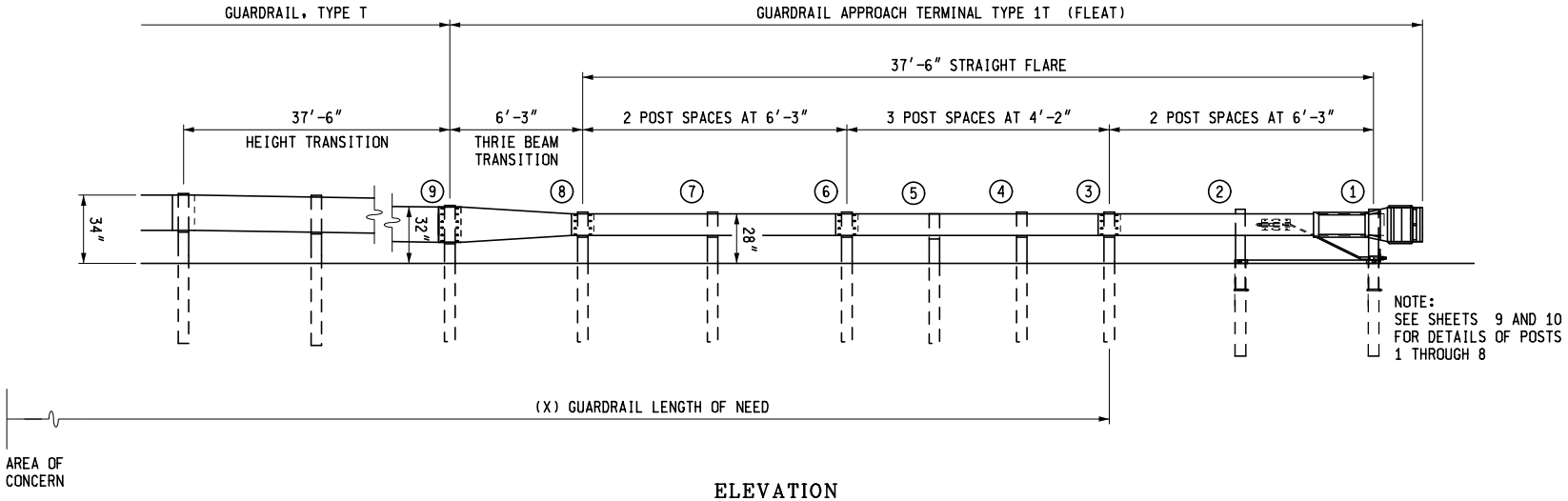
POST	** POST OFFSET DISTANCE	
1	4.0′	48″
2	3.33′	40″
3	2.67′	32″
4	2.22′	$26\frac{11}{16}$″
5	1.77′	$21\frac{5}{16}$″
6	1.33′	16″
7	0.67′	8″
8	0′	0″

THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE WOOD OFFSET BLOCKS, EXCEPT FOR THE FIRST AND SECOND POSTS WHICH ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE POST. OFFSET POINTS ARE TO BE LOCATED BY CHORD MEASUREMENTS AT THE BACK OF THE RAIL EQUAL TO THE NOMINAL POST SPACINGS SPECIFIED. POSTS ARE TO BE SET APPROXIMATELY TANGENT TO THE BEAM ELEMENT AT EACH POST LOCATION.

** FOR LAYOUT ON CURVES SEE DETAIL ON SHEET 18.



PLAN VIEW



ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 1T "FLEAT"

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

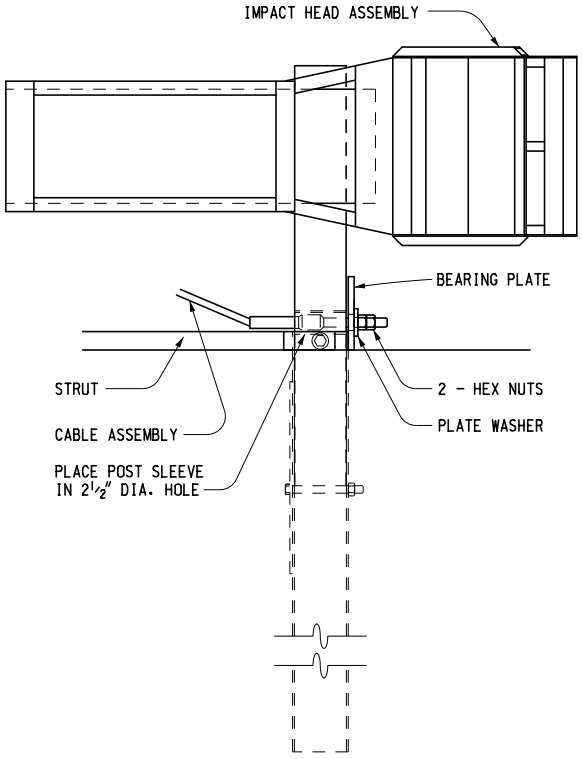
GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL

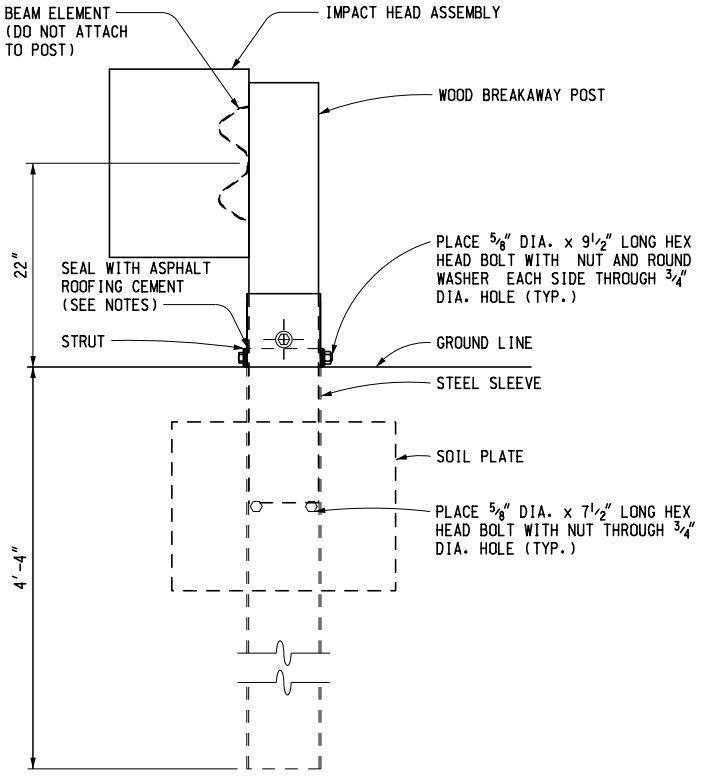
3-15-2016
PLAN DATE

R-61-H

SHEET 8 OF 19



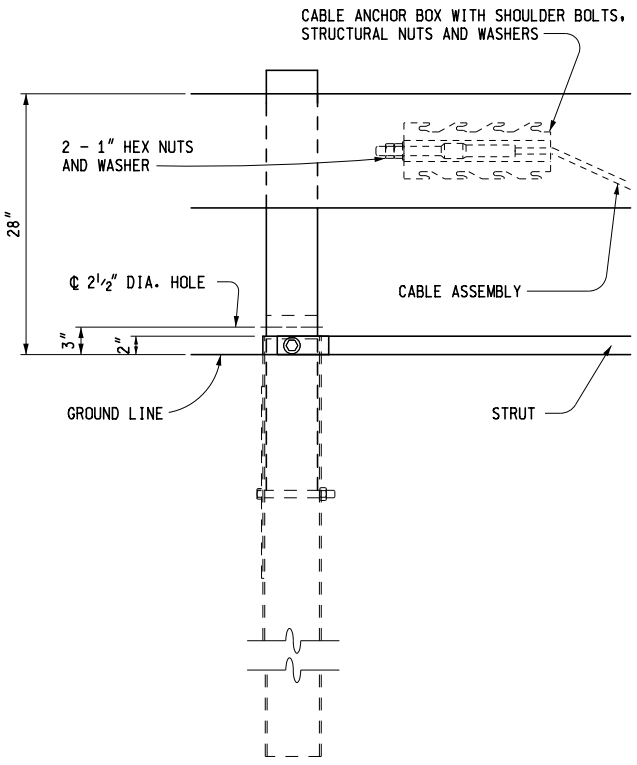
ELEVATION



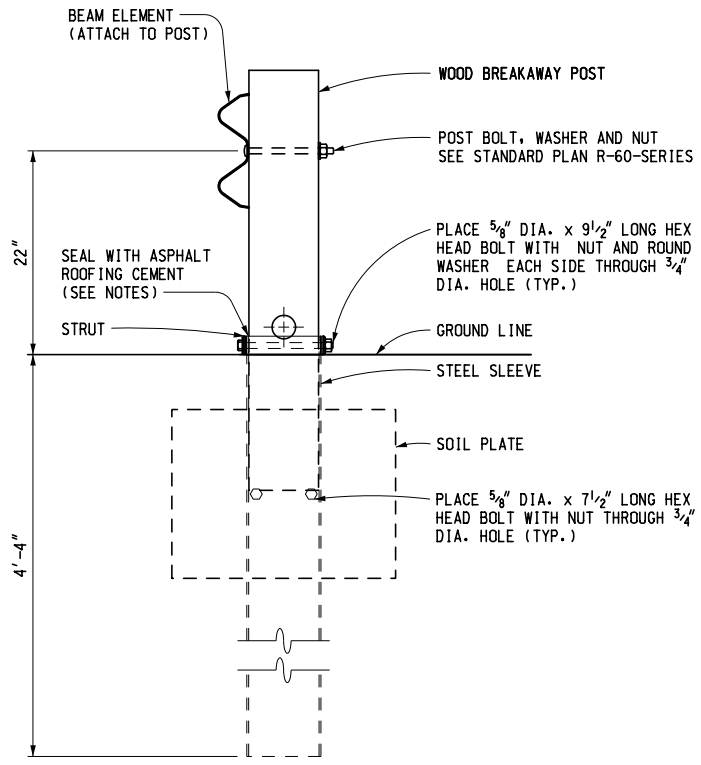
SIDE

POST 1 DETAIL

(FLEAT)



ELEVATION



SIDE

POST 2 DETAIL

(FLEAT)

NOTES:

DETAILS ON THIS SHEET ONLY APPLY TO "FLEAT".

AFTER THE CABLE ASSEMBLY HAS BEEN TIGHTENED, A SECOND NUT SHALL BE INSTALLED ON EACH END OF THE CABLE SO THAT THE CABLE WILL NOT LOOSEN.

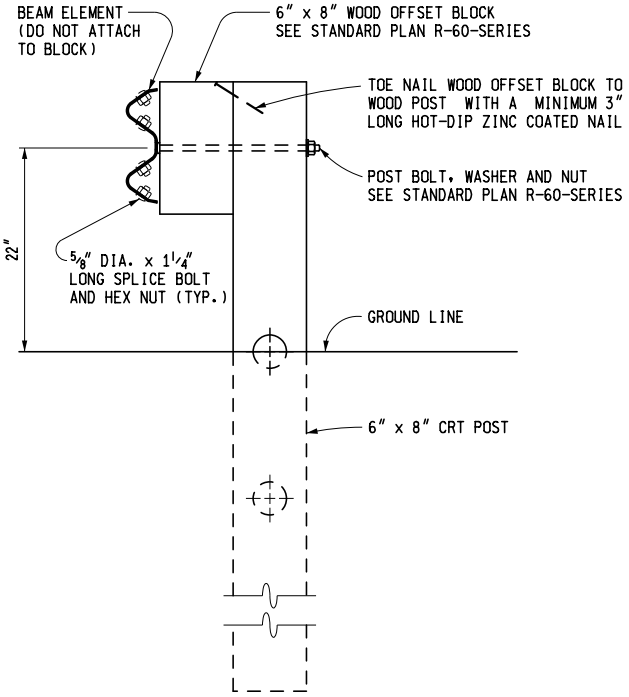
ASPHALT ROOFING CEMENT SHALL BE USED TO SEAL THE PERIMETER AREA BETWEEN THE STEEL SLEEVE (SOIL TUBE) AND THE WOOD BREAKAWAY POST.

MICHIGAN DEPARTMENT OF TRANSPORTATION

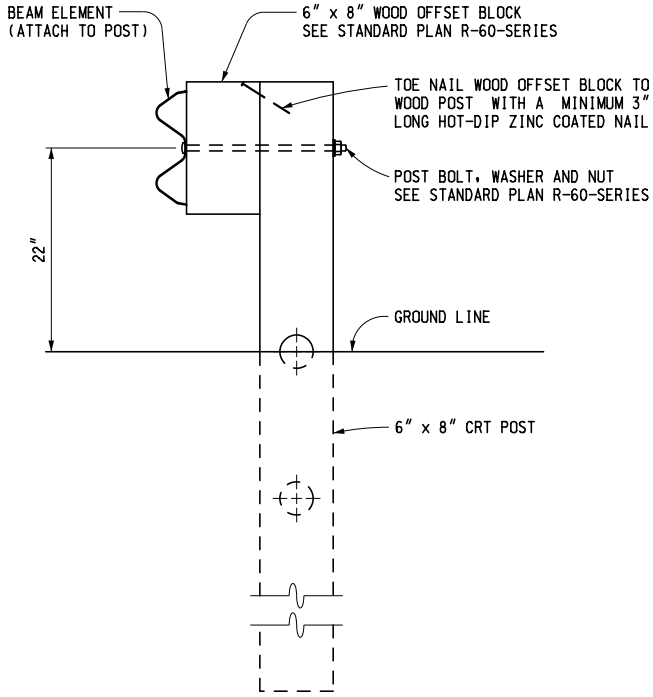
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 9 OF 19

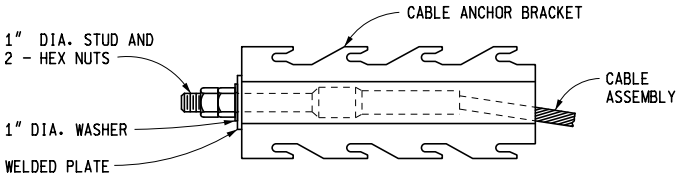


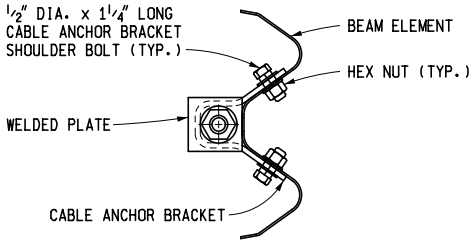
POST 3 DETAIL
(FLEAT)



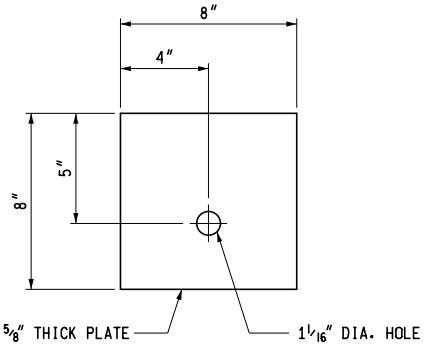
POST 4 THROUGH 7 DETAIL
(FLEAT)

NOTE: POST 8 IS A STANDARD LINE POST

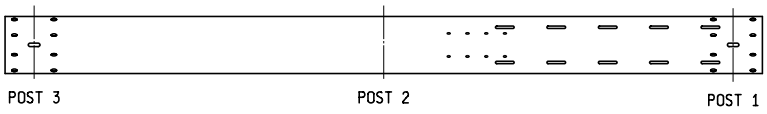




CABLE ANCHOR BRACKET DETAIL
(FLEAT)



BEARING PLATE
(FLEAT)



W-BEAM GUARDRAIL END SECTION
(POST 1 THROUGH 3)

NOTE: ALL "FLEAT" ITEMS ILLUSTRATED WITHOUT DIMENSIONS SHALL BE ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

NOTES:

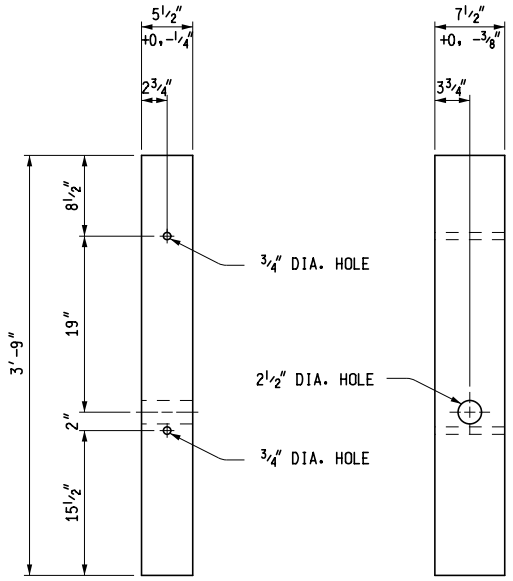
DETAILS ON THIS SHEET ONLY APPLY TO "FLEAT".

AFTER THE CABLE ASSEMBLY HAS BEEN TIGHTENED, A SECOND NUT SHALL BE INSTALLED ON EACH END OF THE CABLE SO THAT THE CABLE WILL NOT LOOSEN.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

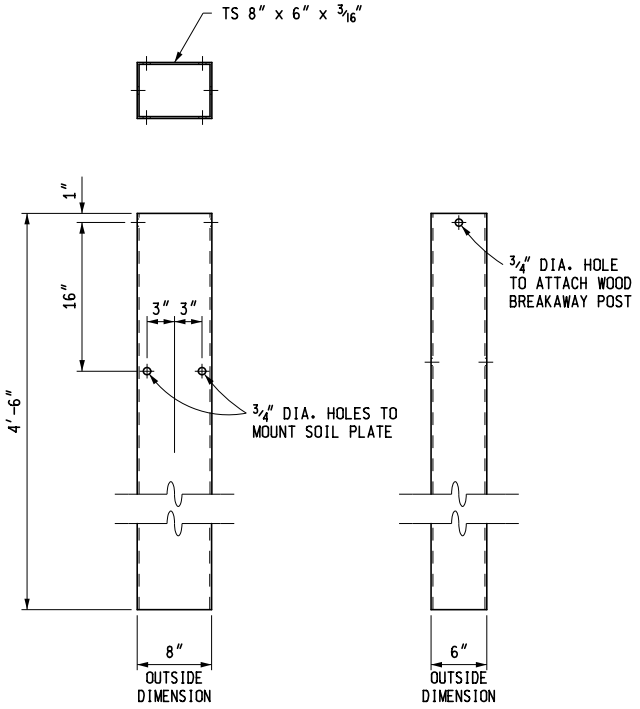
GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 10 OF 19

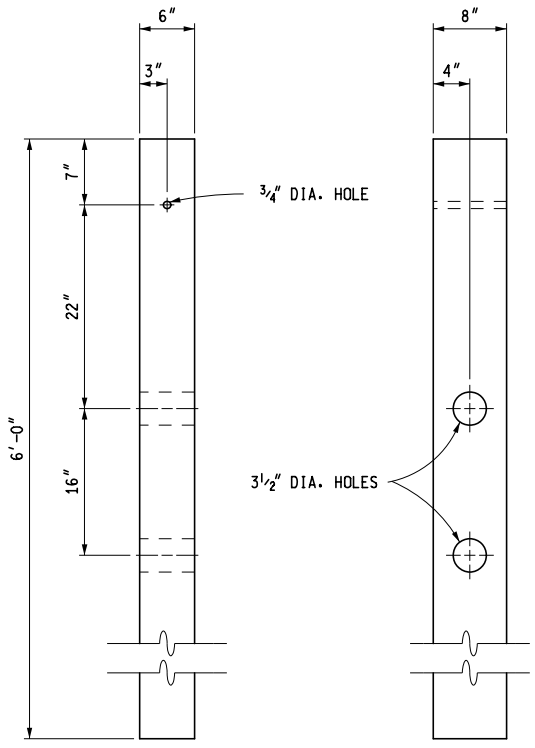


WOOD BREAKAWAY POST

POSTS 1 AND 2 "SRT" AND "FLEAT"

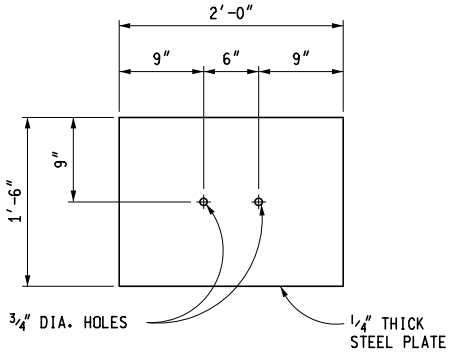


STEEL SLEEVE



CRT POST

POSTS 3 THROUGH 9 "SRT"
POSTS 3 THROUGH 7 "FLEAT"



SOIL PLATE

POST SLEEVE

(FOR POST 1)

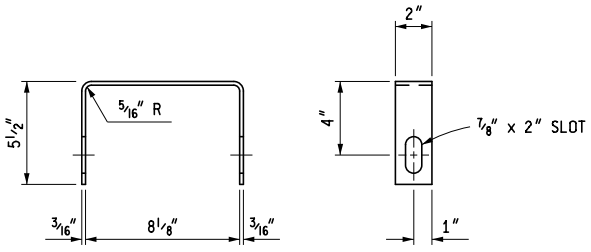
NOTE:

DETAILS ON THIS SHEET ONLY APPLY TO "SRT" AND "FLEAT".

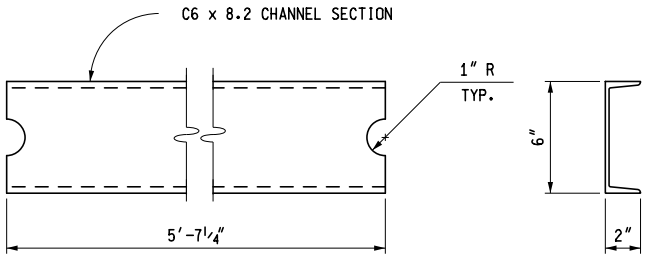
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

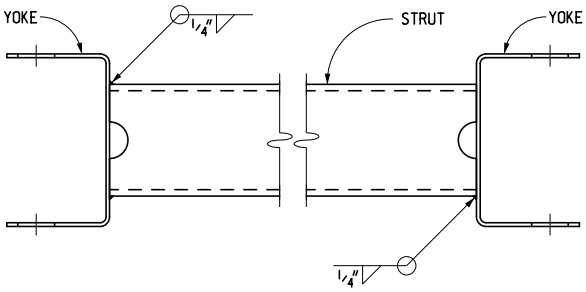
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 11 OF 19



YOKE DETAIL

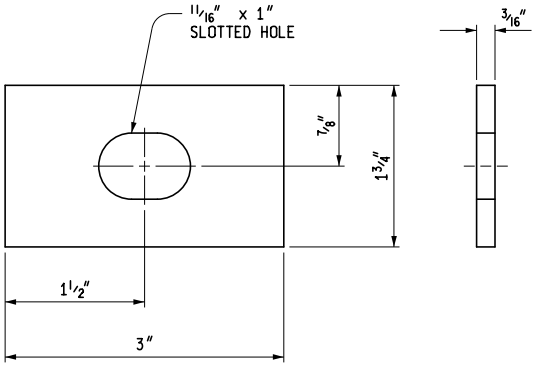


STRUT DETAIL

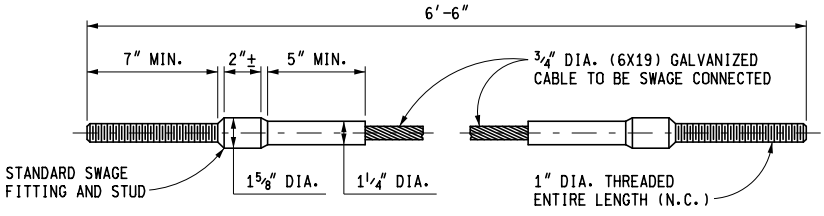


ASSEMBLY DETAIL

STRUT AND YOKE ASSEMBLY



POST BOLT WASHER
(POST 1 ONLY)



CABLE ASSEMBLY

NOTE:

DETAILS ON THIS SHEET ONLY APPLY TO "SRT" AND "FLEAT".

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

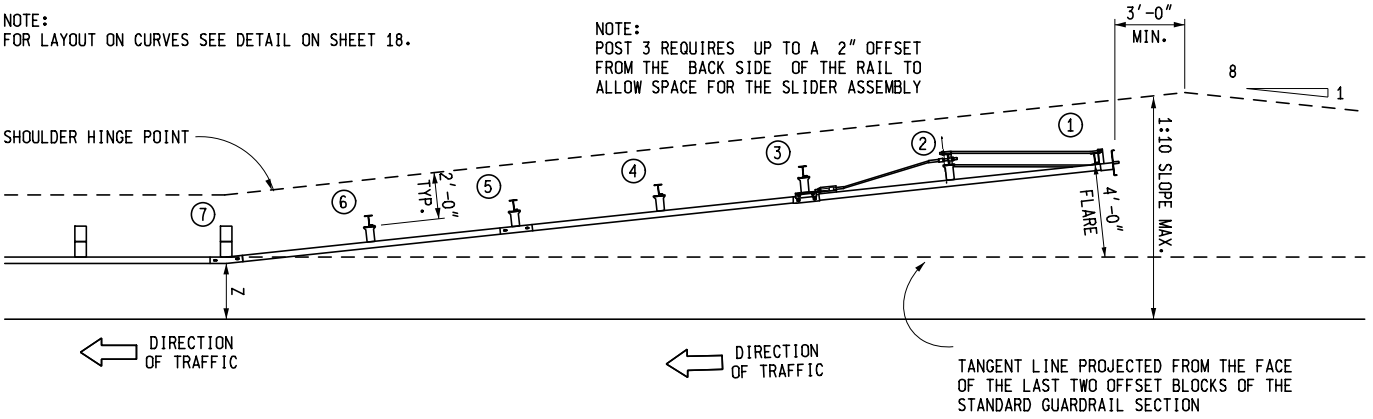
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 12 OF 19

TRAILING END

APPROACH END

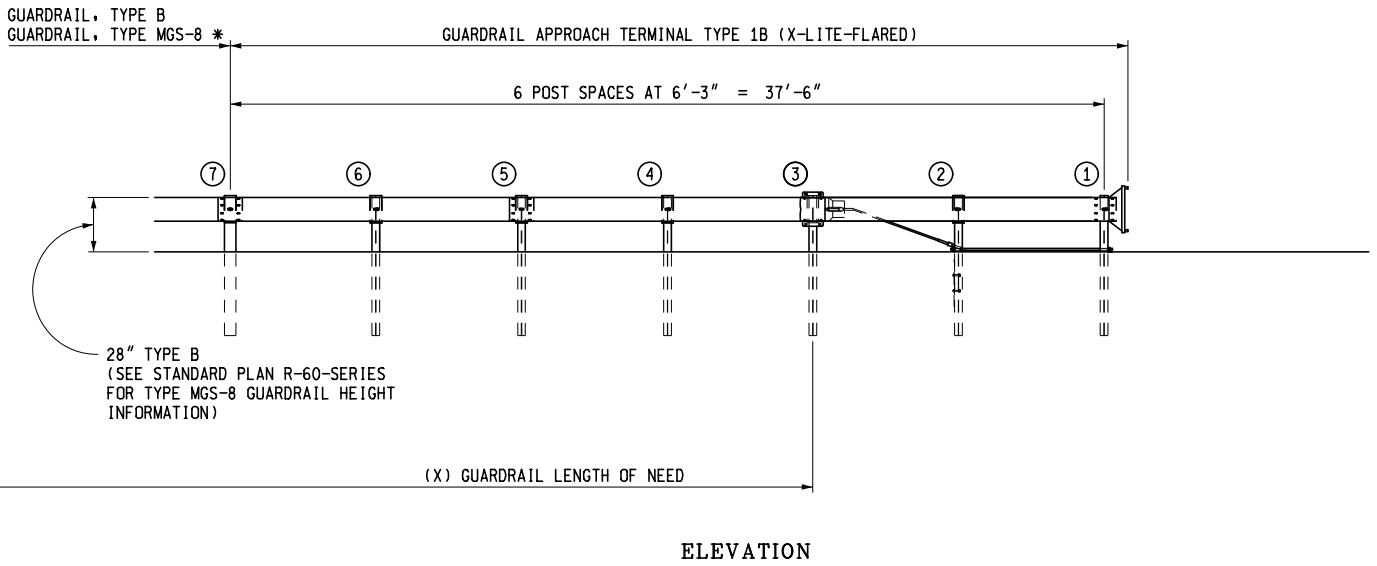
NOTE:
FOR LAYOUT ON CURVES SEE DETAIL ON SHEET 18.

NOTE:
POST 3 REQUIRES UP TO A 2" OFFSET FROM THE BACK SIDE OF THE RAIL TO ALLOW SPACE FOR THE SLIDER ASSEMBLY



PLAN VIEW

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL APPROACH TERMINAL TYPE 1B



ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 1B "X-LITE-FLARED"

OPTION 3

(DETAILED ON SHEETS 13 THROUGH 17)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

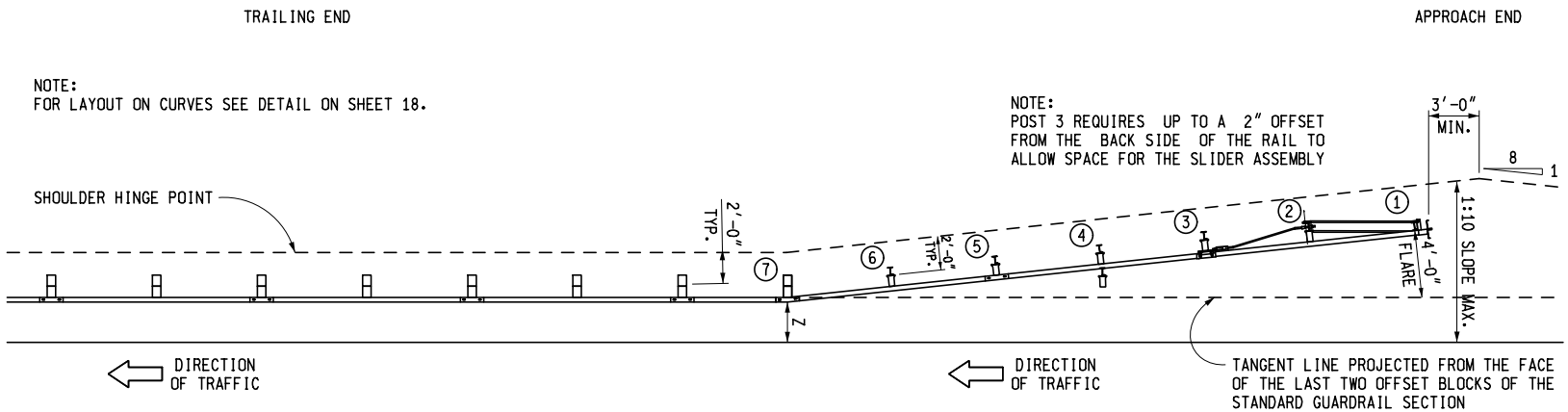
GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL

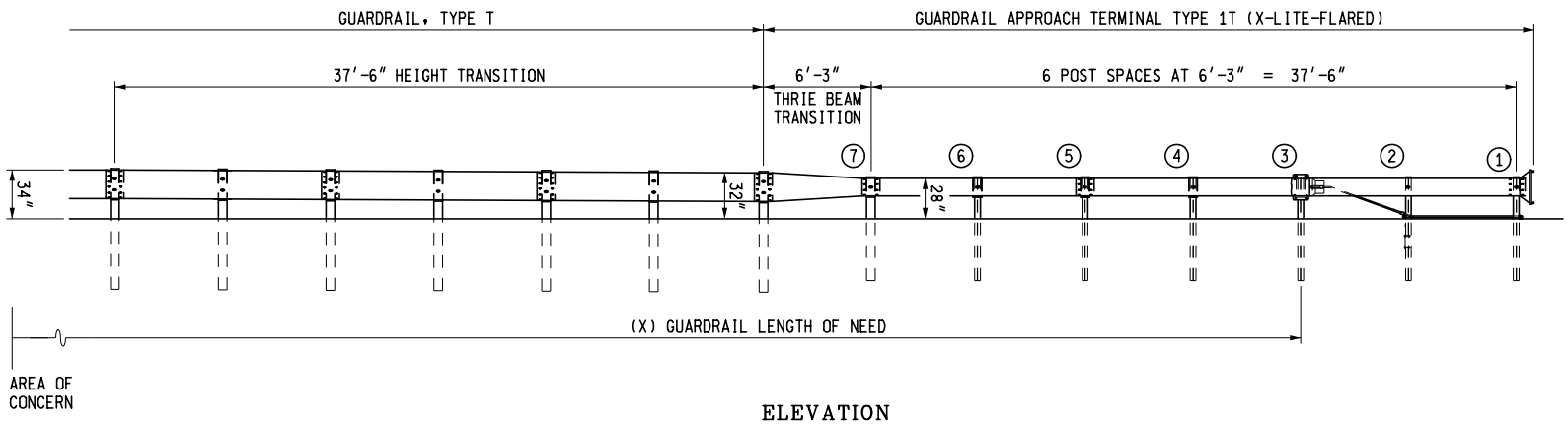
3-15-2016
PLAN DATE

R-61-H

SHEET
13 OF 19



PLAN VIEW



ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 1T "X-LITE-FLARED"

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

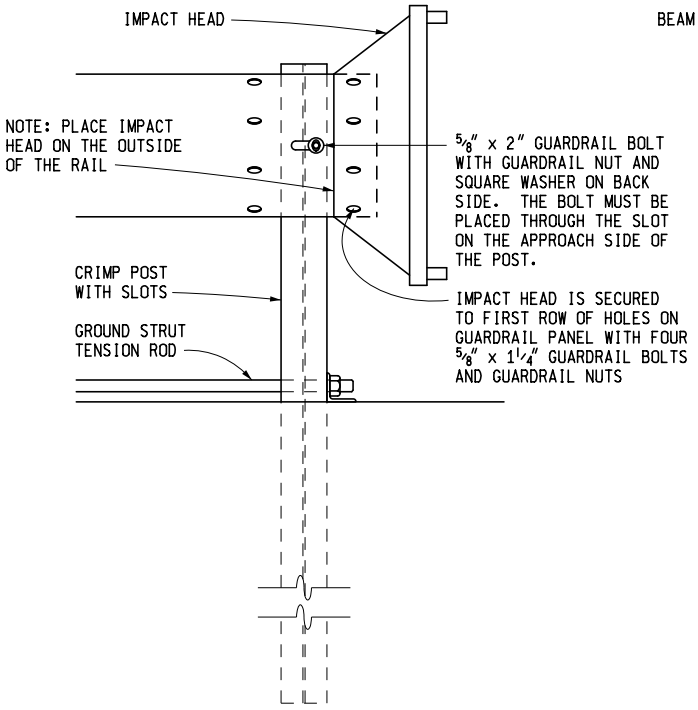
GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

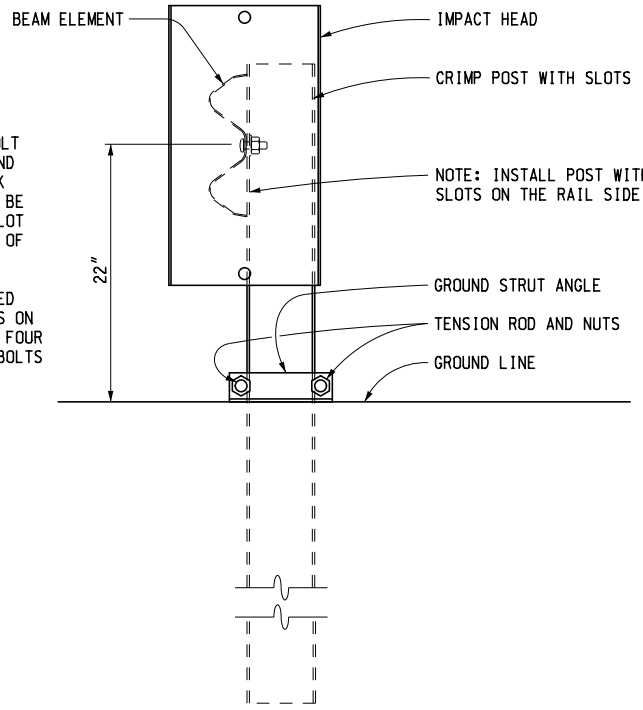
F.H.W.A. APPROVAL

3-15-2016
PLAN DATE

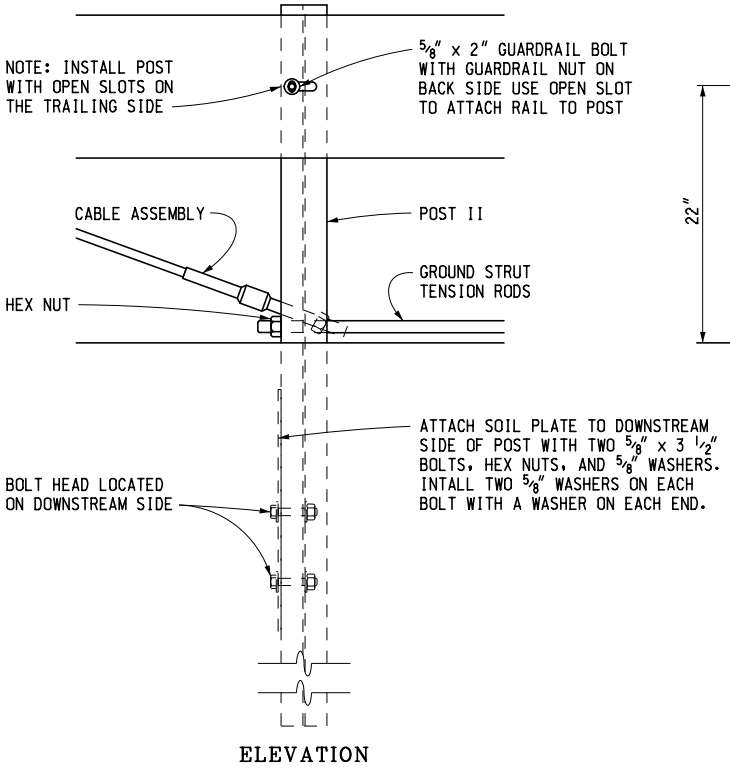
R-61-H

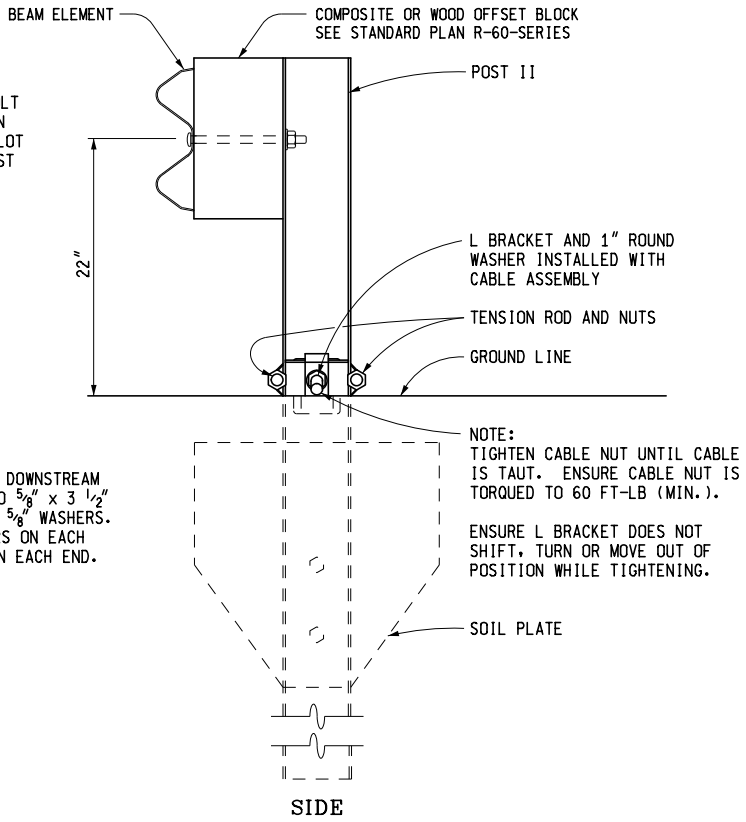
SHEET 14 OF 19





POST 1 DETAIL





POST 2 DETAIL

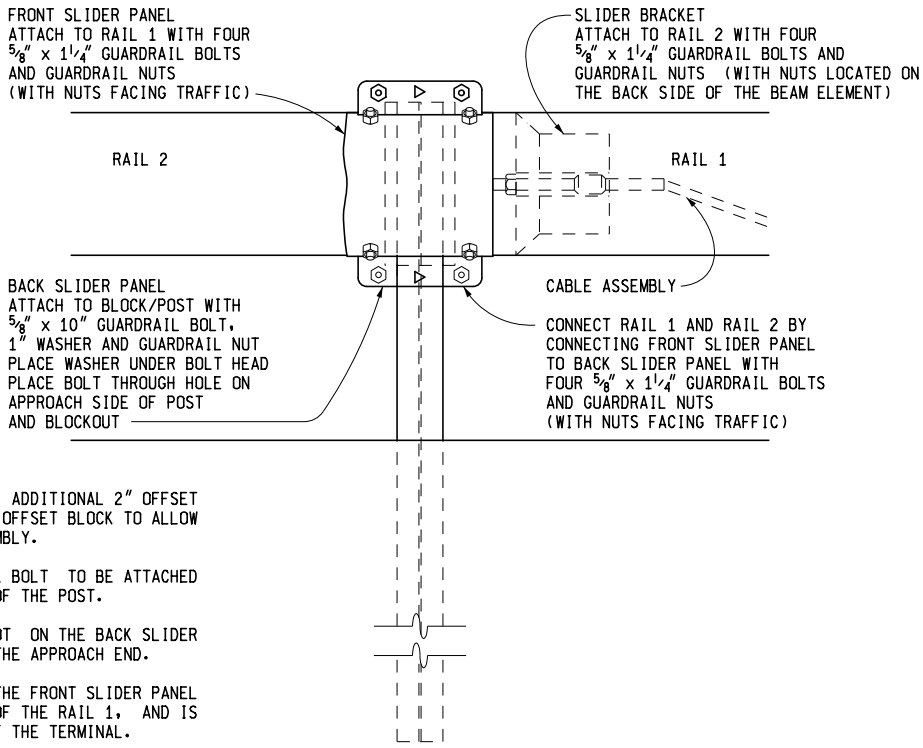
NOTE:

DETAILS ON THIS SHEET ONLY APPLY TO "X-LITE-FLARED".

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 15 OF 19



NOTES:

POST 3 REQUIRES UP TO AN ADDITIONAL 2" OFFSET BETWEEN THE RAIL AND THE OFFSET BLOCK TO ALLOW SPACE FOR THE SLIDER ASSEMBLY.

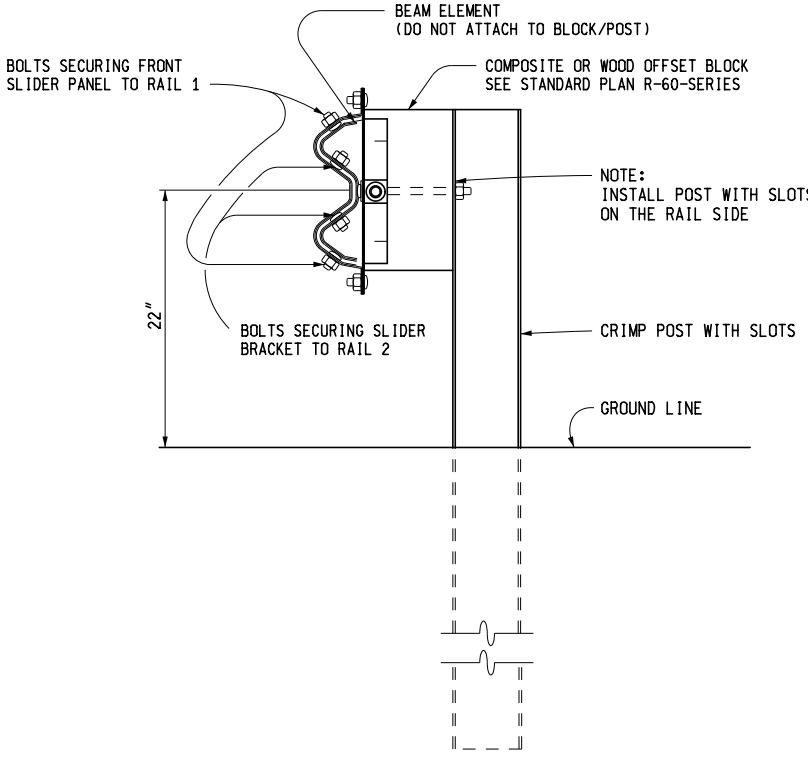
POST 3 REQUIRES GUARDRAIL BOLT TO BE ATTACHED TO SLOT ON TRAILING SIDE OF THE POST.

ENSURE OPEN END OF THE SLOT ON THE BACK SLIDER PANEL IS POINTING TOWARD THE APPROACH END.

ENSURE ANGLED PORTION OF THE FRONT SLIDER PANEL EXTENDS BEYOND THE END OF THE RAIL 1, AND IS FACING THE TRAILING END OF THE TERMINAL.

ARROWS ON FRONT AND BACK SLIDER PANELS NEED TO POINT TOWARD THE APPROACH END OF THE TERMINAL.

ELEVATION



SIDE

POST 3 DETAIL

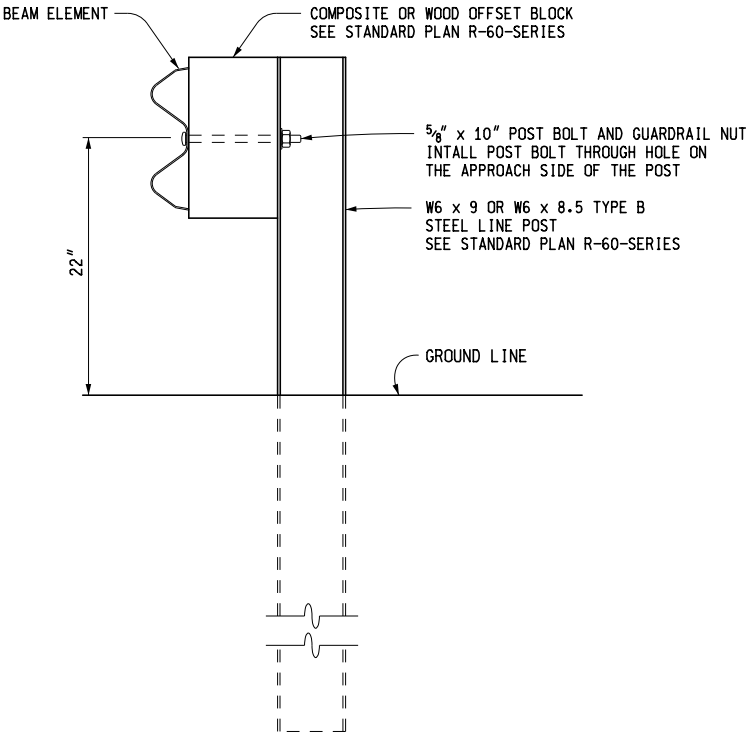
NOTE:

DETAILS ON THIS SHEET ONLY APPLY TO "X-LITE-FLARED".

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

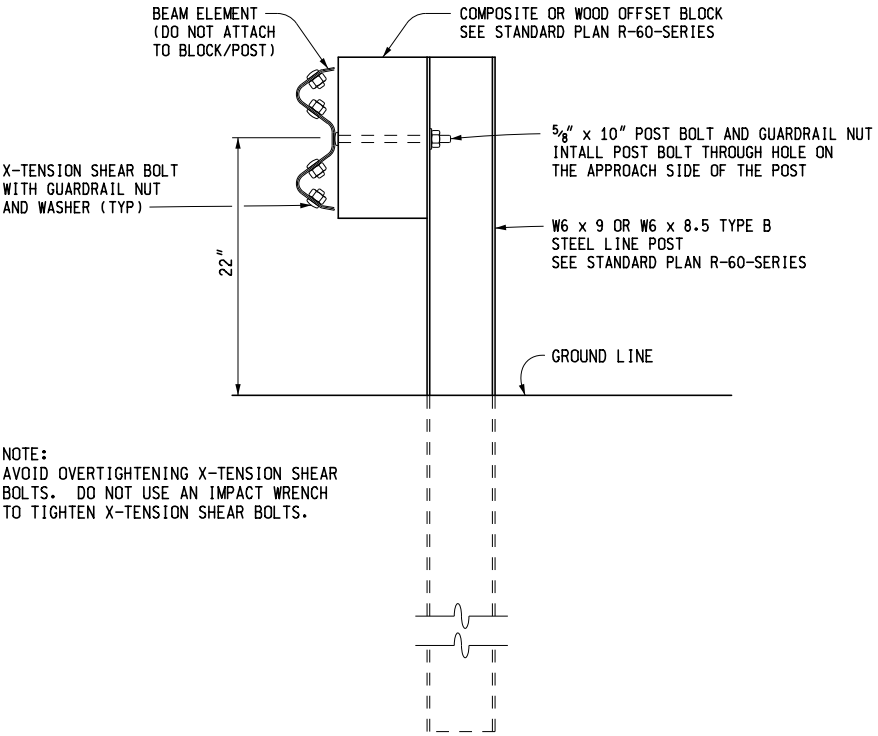
GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 16 OF 19



POST 4 AND 6 DETAIL

NOTE:
OVERLAP BEAM ELEMENTS WITH ELEMENTS
ON THE APPROACH END OVER ELEMENTS
ON THE TRAILING END.



NOTE:
AVOID OVERTIGHTENING X-TENSION SHEAR
BOLTS. DO NOT USE AN IMPACT WRENCH
TO TIGHTEN X-TENSION SHEAR BOLTS.

POST 5

NOTE:
POST 7 IS A STANDARD LINE POST.

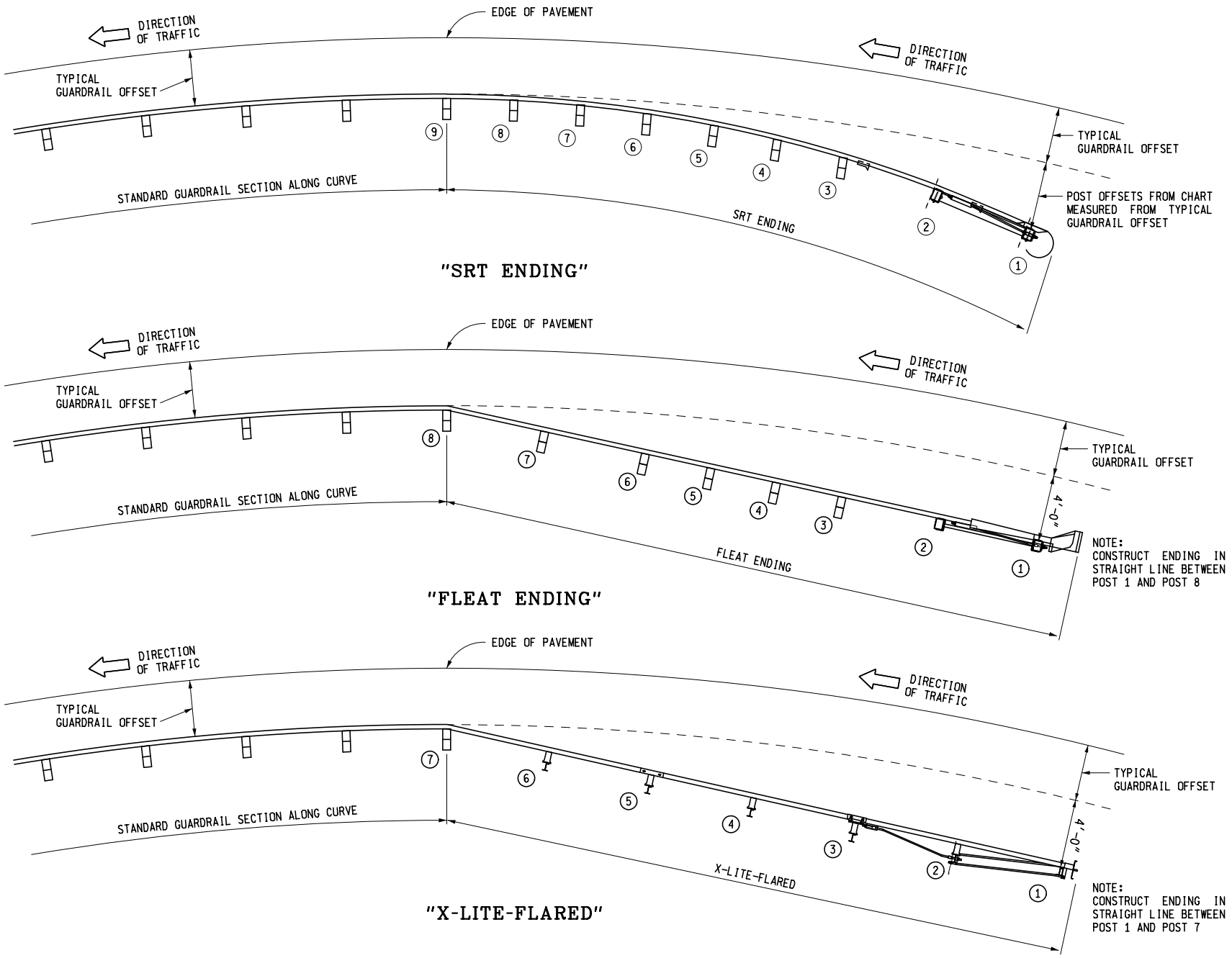
NOTE:

DETAILS ON THIS SHEET ONLY APPLY TO "X-LITE-FLARED".

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 17 OF 19



MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 18 OF 19

NOTES:

ALL POSTS, OFFSET BLOCKS, BEAM ELEMENTS, AND HARDWARE (INCLUDING BOLTS, NUTS, AND WASHERS) SHALL CONFORM TO THE CURRENT STANDARD SPECIFICATIONS AND TO THE CURRENT STANDARD PLAN R-60-SERIES, WHERE APPLICABLE, EXCEPT AS SPECIFIED ON THIS STANDARD.

ALL 1:10 SLOPES SHALL BE GRADED TO CLASS A SLOPE TOLERANCES.

GUARDRAIL REFLECTORS ARE NOT TO BE USED ON THE GUARDRAIL APPROACH TERMINAL. PLACE REFLECTORS BEGINNING ON STANDARD RUN OF GUARDRAIL.

USE REFLECTIVE SHEETING ACCORDING TO THE FOLLOWING TRAFFIC CONDITIONS:
(NOTE: ALTERNATE 3" BLACK AND 3" YELLOW STRIPES ON A 45° ANGLE)

TRAFFIC PASSING ON THE LEFT SIDE

TRAFFIC PASSING ON BOTH SIDES

TRAFFIC PASSING ON THE RIGHT SIDE

ON THE "SRT", THE CURVED PORTION OF THE TERMINAL END SHOE FACING TRAFFIC (HALF CIRCLE) SHALL BE COMPLETELY COVERED WITH HIGH INTENSITY ADHESIVE REFLECTIVE SHEETING.

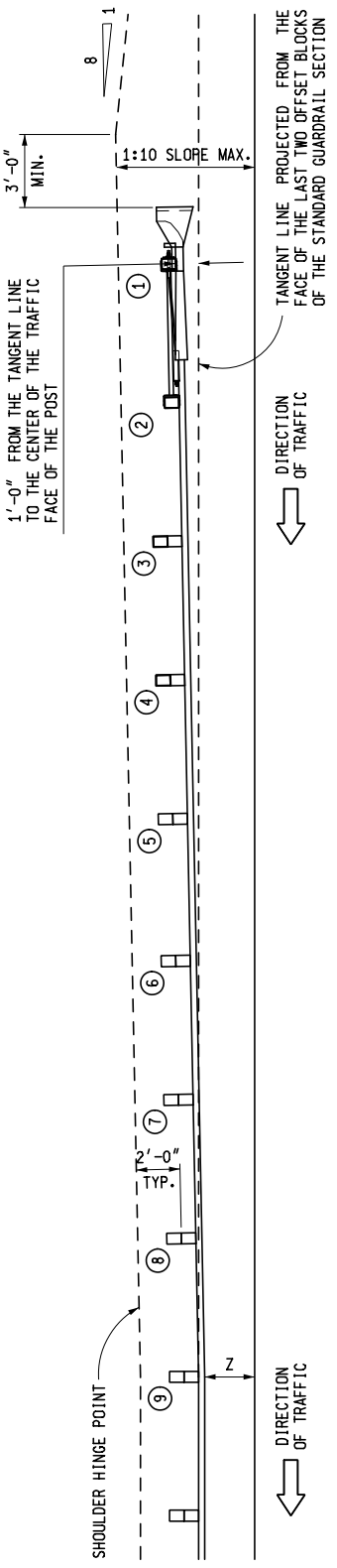
ON THE "FLEAT" AND "X-LITE-FLARED", THE PORTION OF THE IMPACT HEAD ASSEMBLY FACING TRAFFIC SHALL BE COMPLETELY COVERED WITH HIGH INTENSITY ADHESIVE REFLECTIVE SHEETING.

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

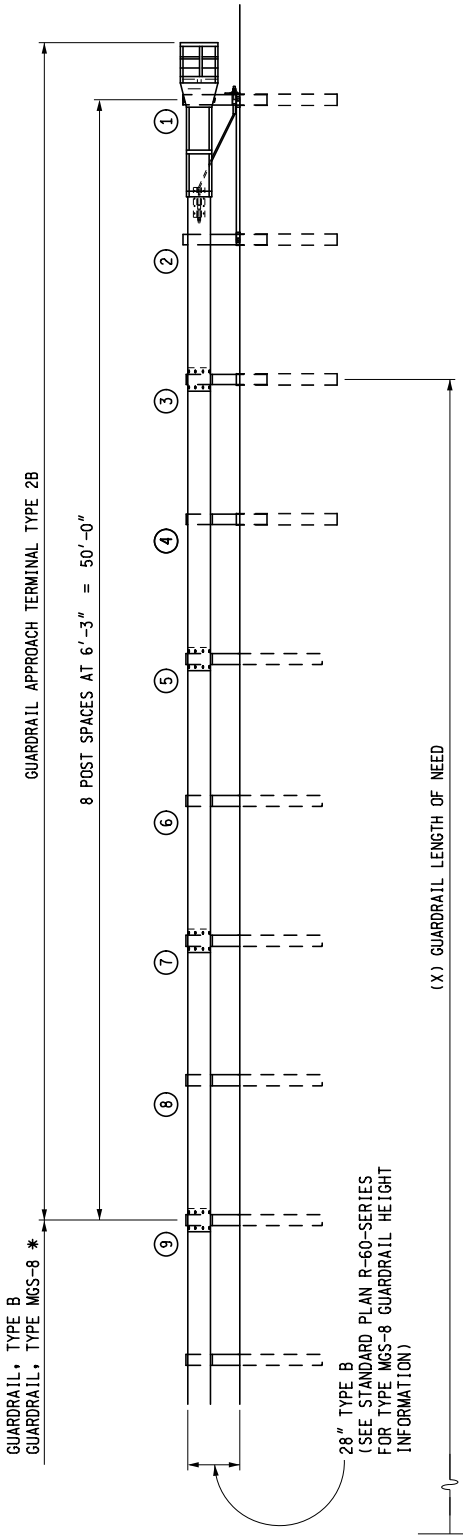
GUARDRAIL APPROACH TERMINAL TYPES 1B & 1T (SRT, FLEAT & X-LITE-FLARED)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-61-H	SHEET 19 OF 19



PLAN VIEW

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL APPROACH TERMINAL TYPE 2B



ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 2B "SKT"

OPTION 1

(DETAILED ON SHEETS 1 THROUGH 4)

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

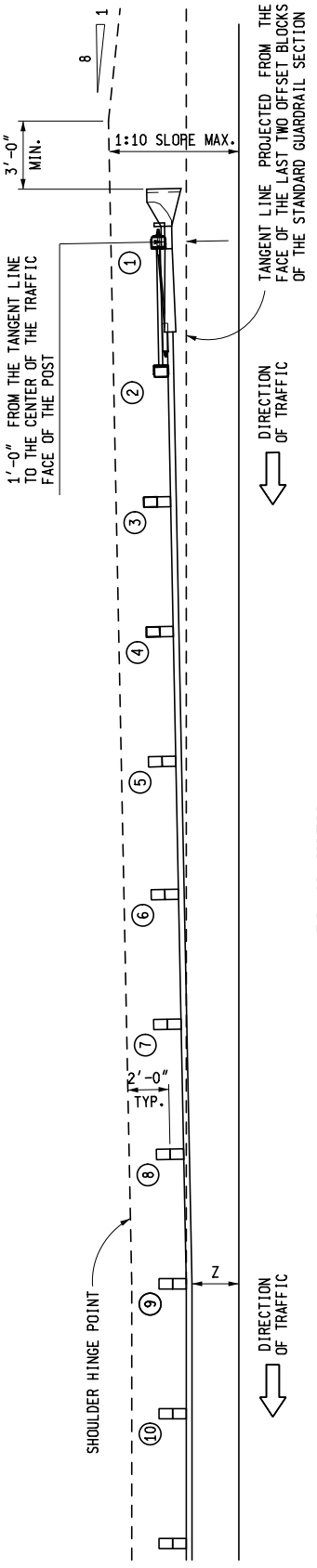
APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____
DIRECTOR, BUREAU OF HIGHWAY DEVELOPMENT

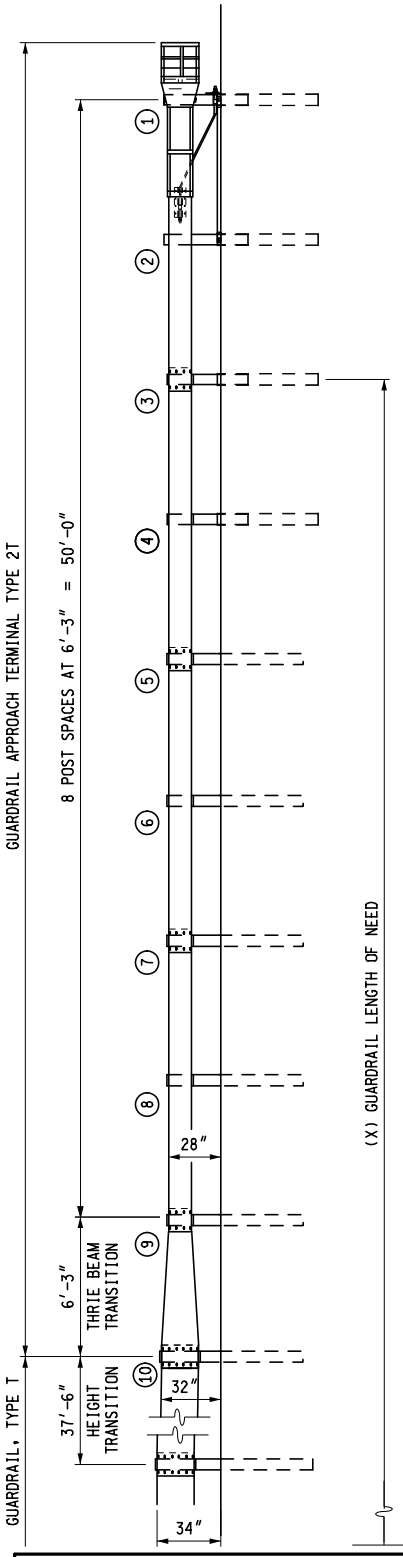
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 1 OF 10



PLAN VIEW



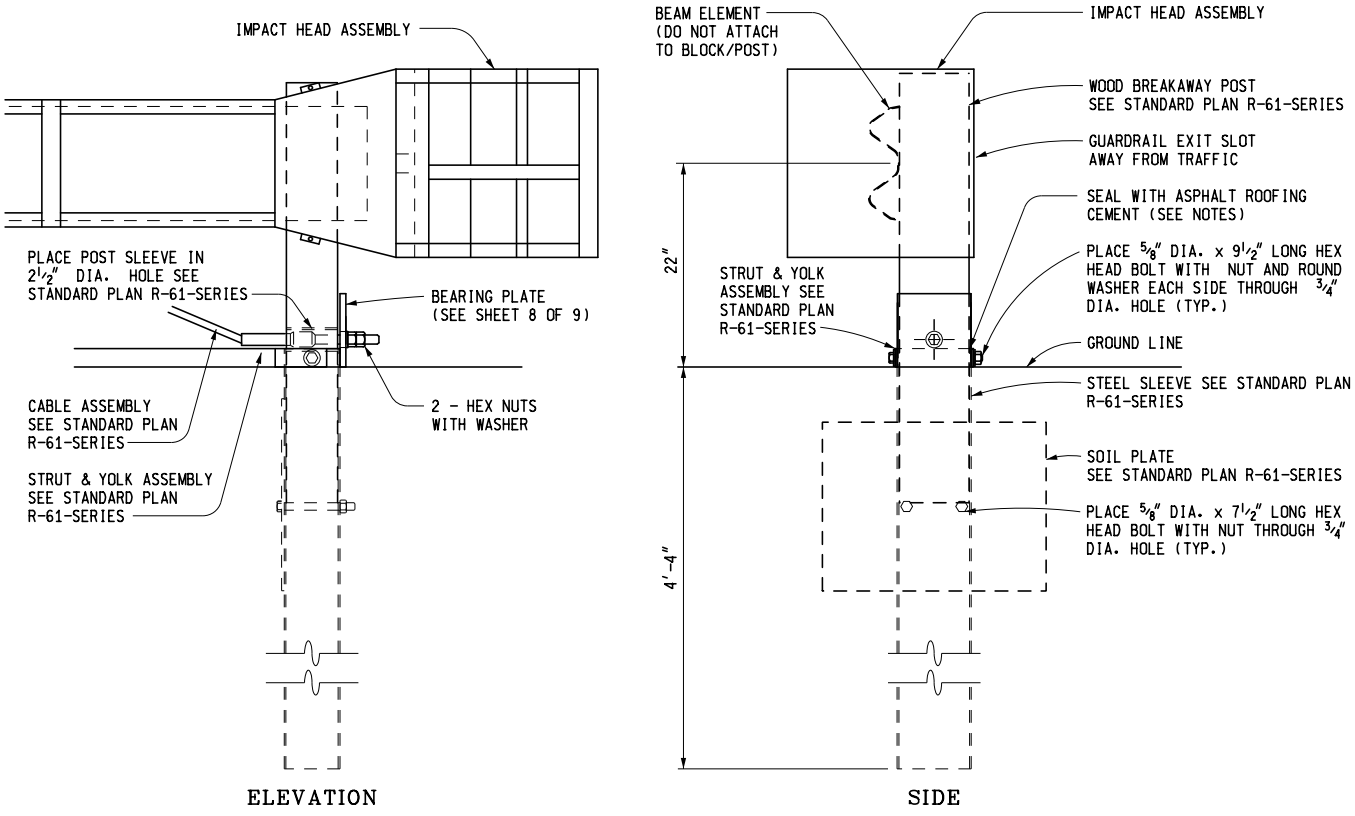
ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 2T "SKT"

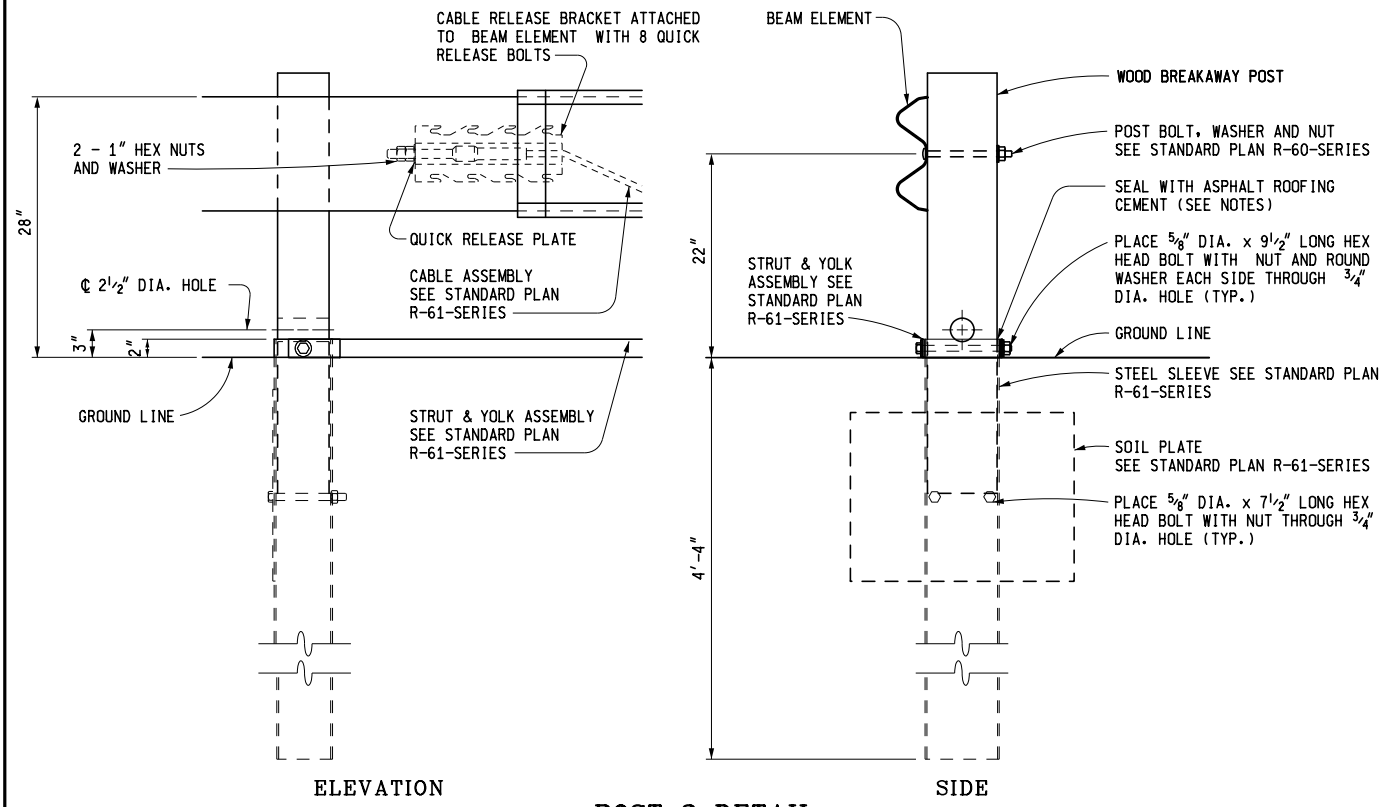
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 2 OF 10



POST 1 DETAIL



POST 2 DETAIL

NOTE:

THE BREAKAWAY CABLE ASSEMBLY MUST BE TAUT. A LOCKING DEVICE (VICE GRIPS OR CHANNEL LOCK PLIERS) SHOULD BE USED TO PREVENT THE CABLE FROM TWISTING WHEN TIGHTENING THE NUTS.

AFTER THE CABLE ASSEMBLY HAS BEEN TIGHTENED, A SECOND NUT SHALL BE INSTALLED ON EACH END OF THE CABLE SO THAT THE CABLE WILL NOT LOOSEN.

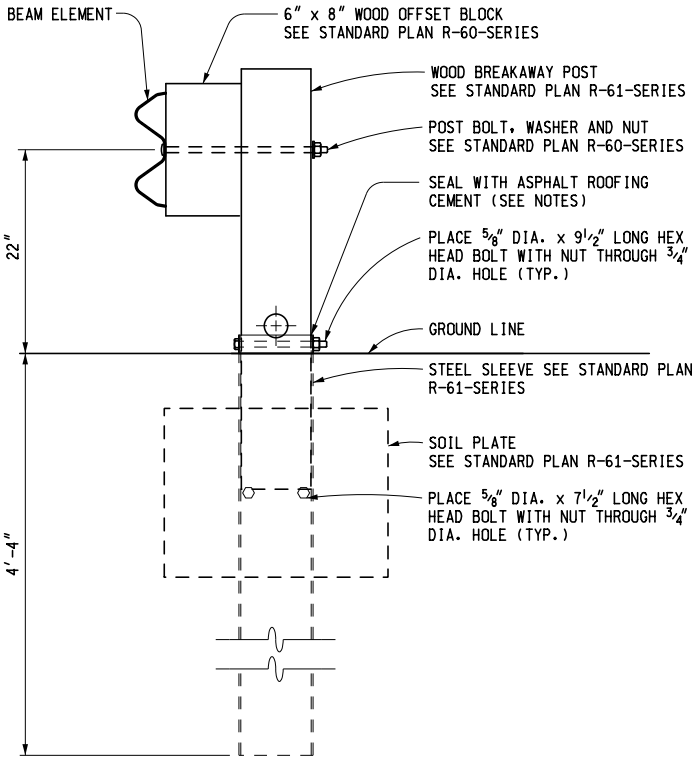
ASPHALT ROOFING CEMENT SHALL BE USED TO SEAL THE PERIMETER AREA BETWEEN THE STEEL SLEEVE (SOIL TUBE) AND THE WOOD BREAKAWAY POST.

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

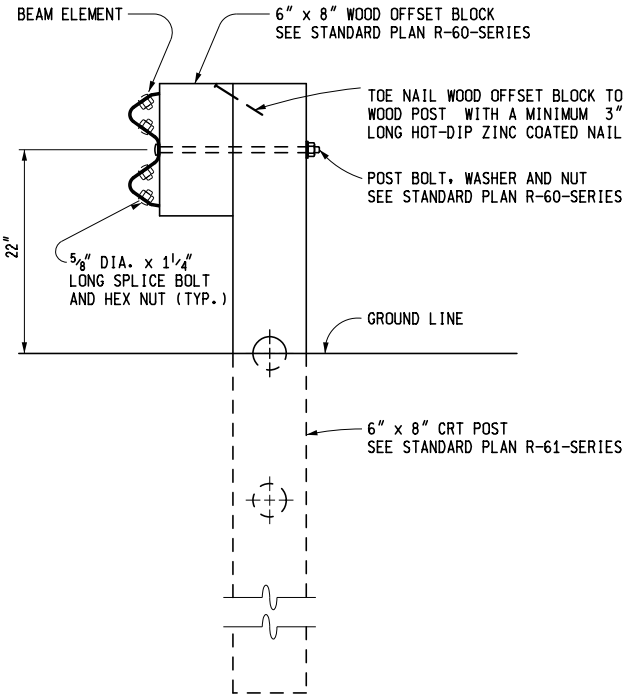
GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 3 OF 10

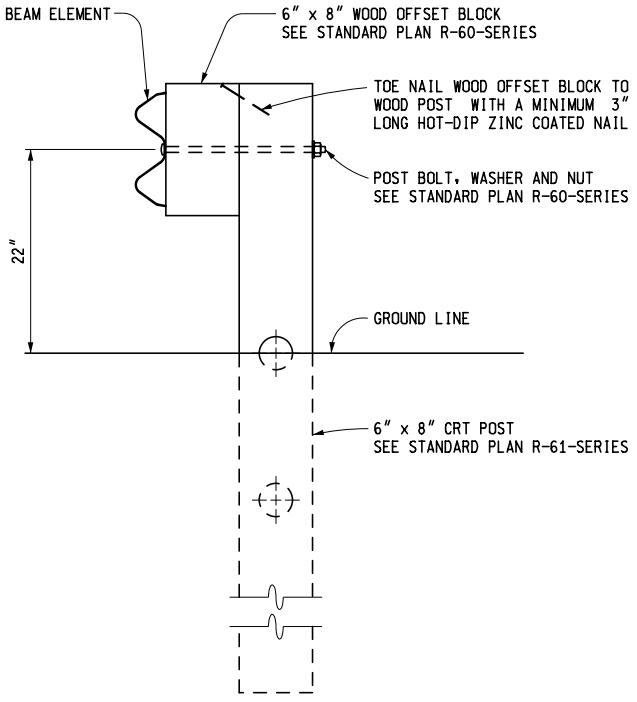


POST 3 AND 4 DETAIL

NOTE: BEAM ELEMENTS ARE SPLICED TOGETHER AT POST 3

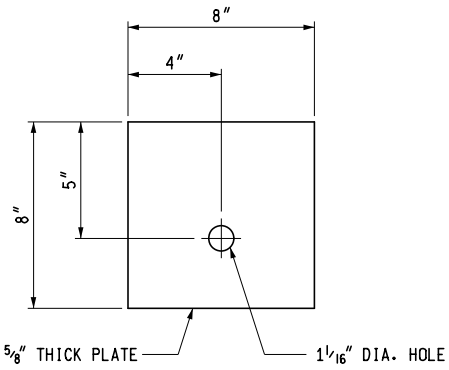


POST 5 AND 7 DETAIL



POST 6 AND 8 DETAIL

NOTE: POST 9 IS A STANDARD LINE POST.



BEARING PLATE

NOTE:

ASPHALT ROOFING CEMENT SHALL BE USED TO SEAL THE PERIMETER AREA BETWEEN THE STEEL SLEEVE (SOIL TUBE) AND THE WOOD BREAKAWAY POST.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 4 OF 10

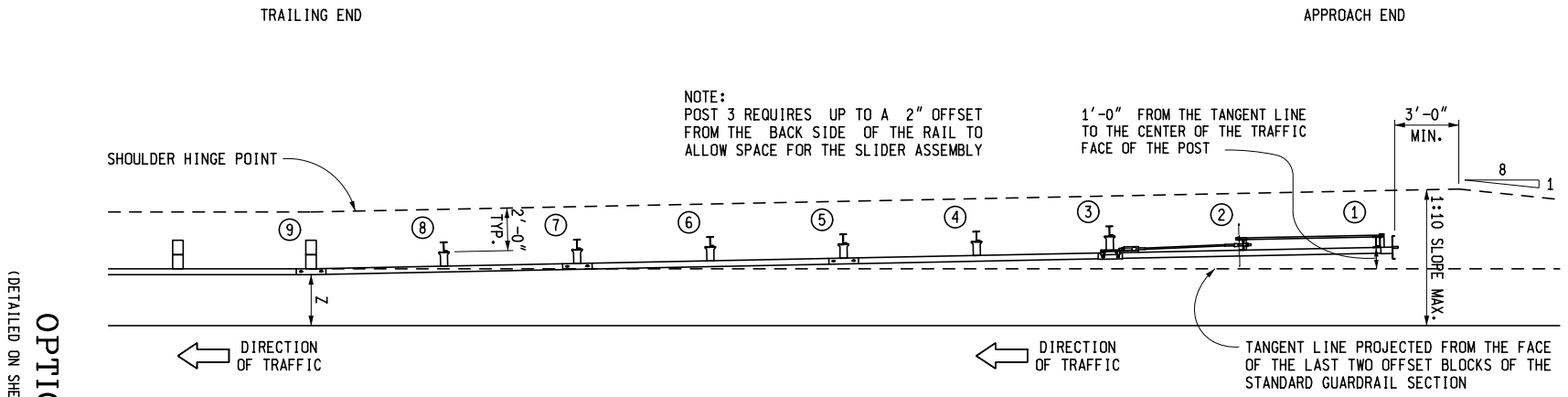
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 5 OF 10

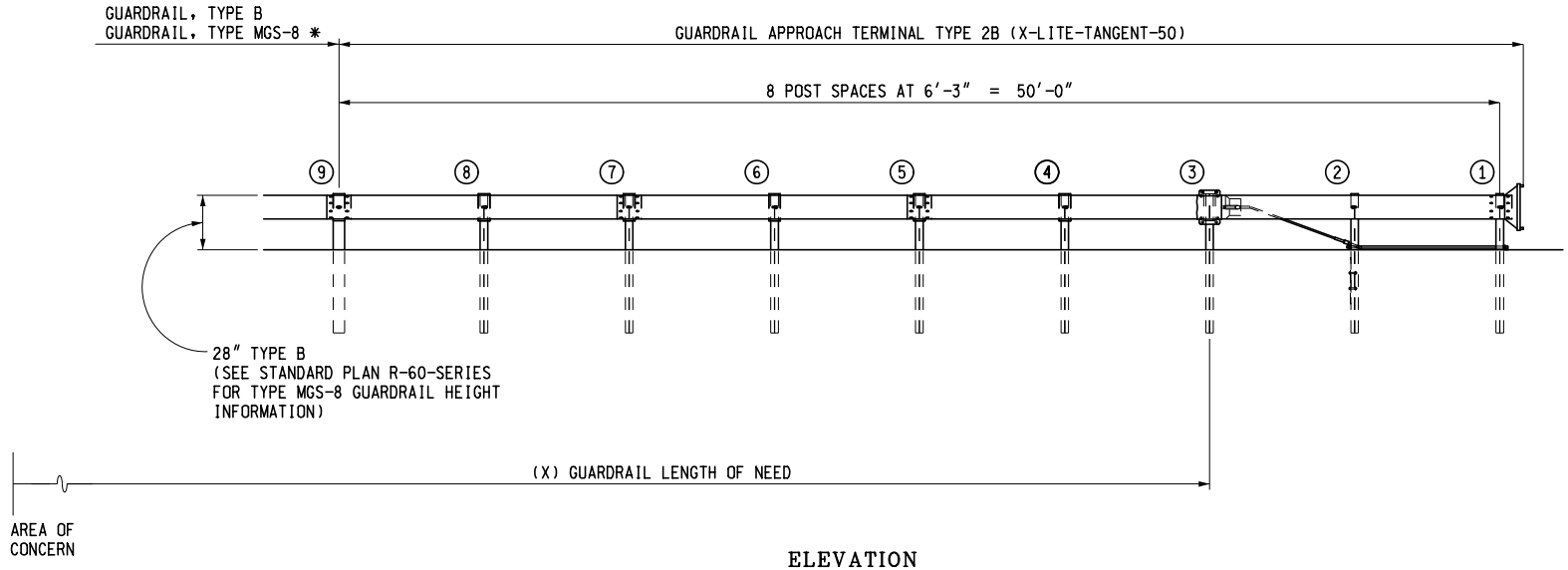
OPTION 2

(DETAILED ON SHEETS 5 THROUGH 9)



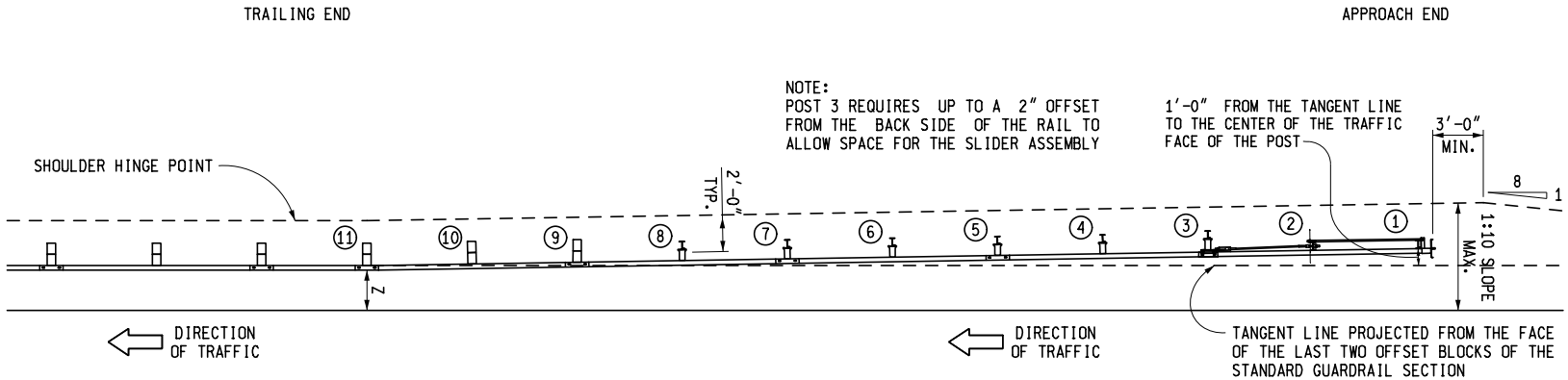
PLAN VIEW

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL APPROACH TERMINAL TYPE 2B

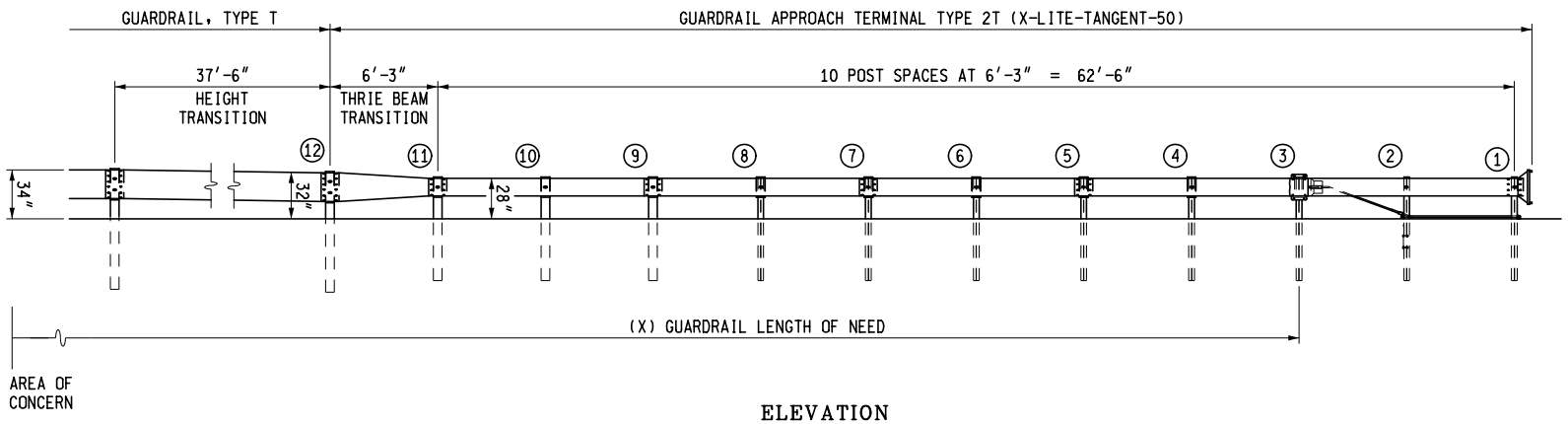


ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 2B "X-LITE-TANGENT-50"



PLAN VIEW



ELEVATION

GUARDRAIL APPROACH TERMINAL TYPE 2T "X-LITE-TANGENT-50"

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

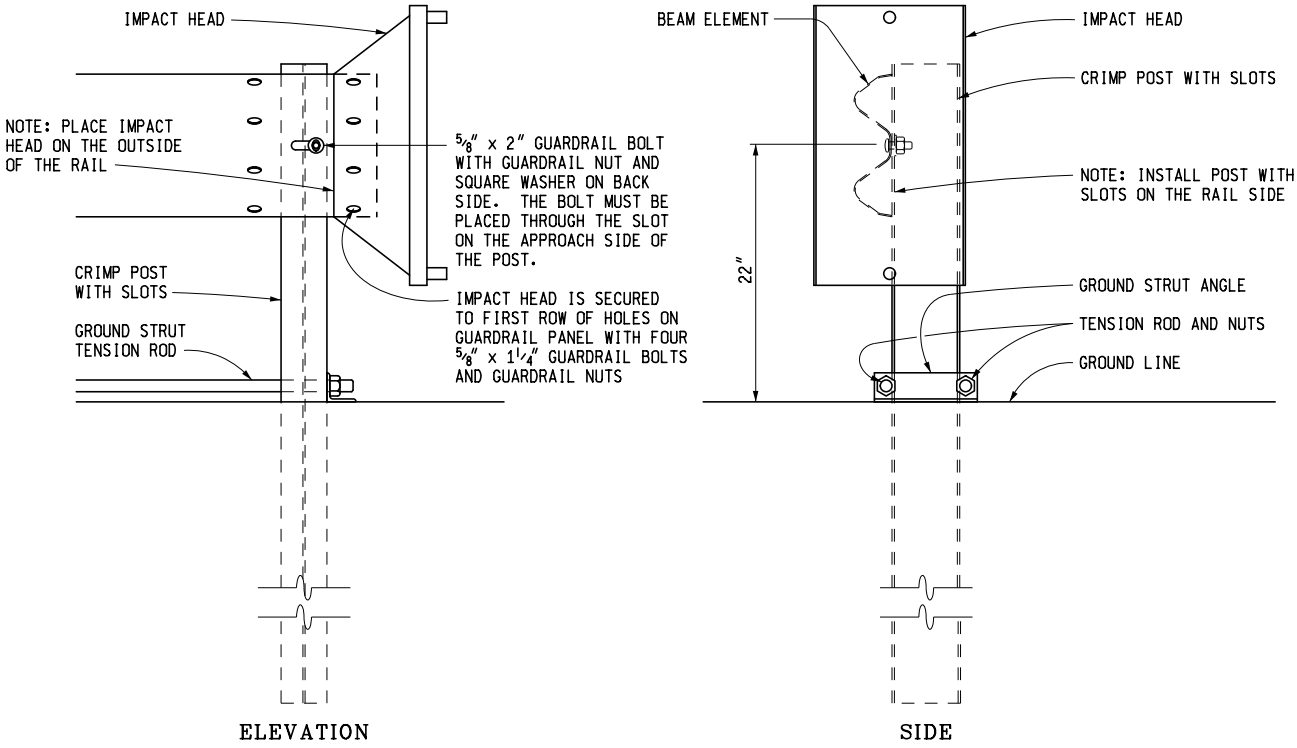
GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL

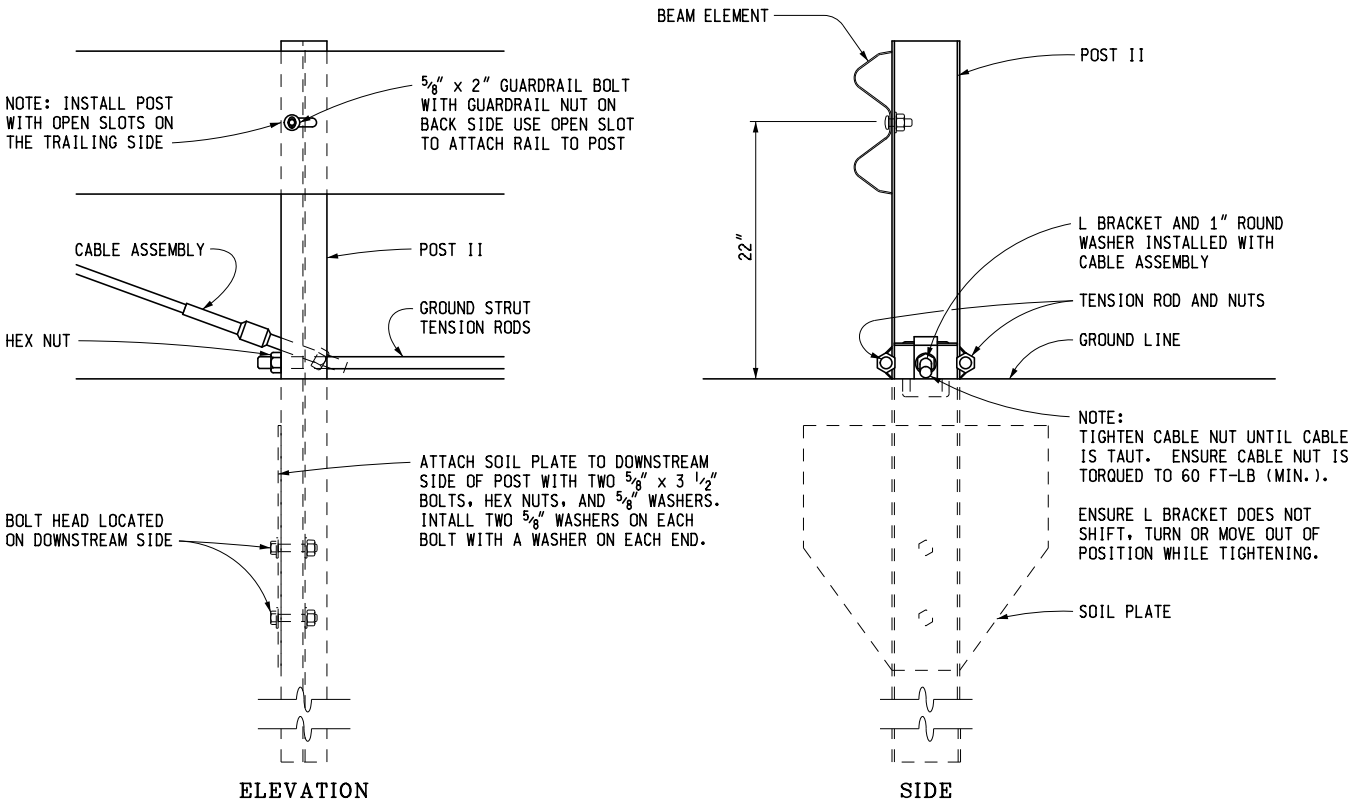
3-15-2016
PLAN DATE

R-62-H

SHEET 6 OF 10



POST 1 DETAIL



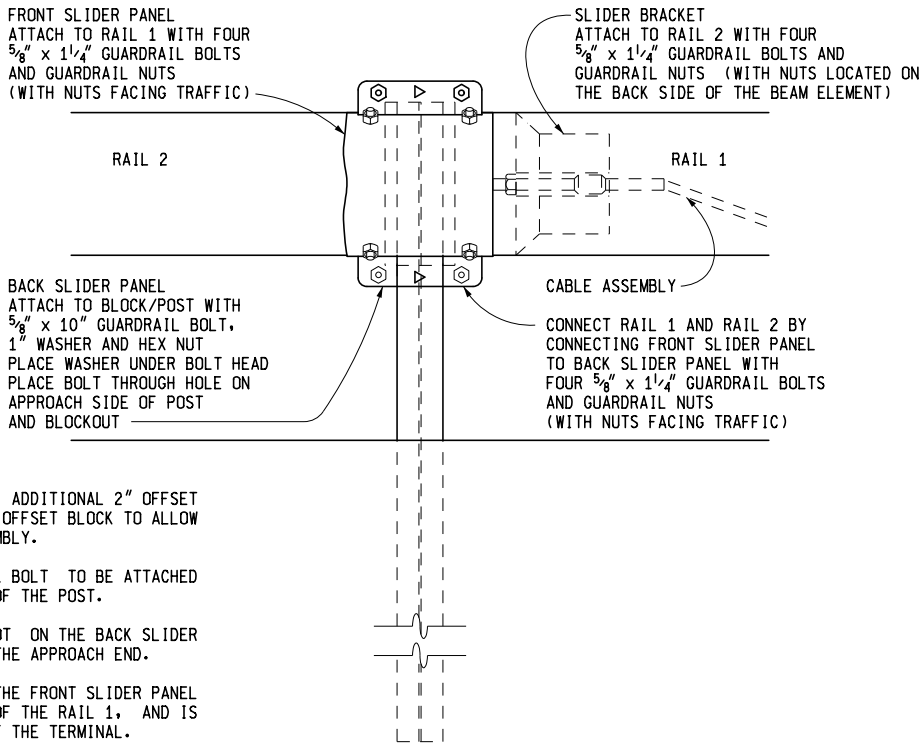
POST 2 DETAIL

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 7 OF 10



NOTES:

POST 3 REQUIRES UP TO AN ADDITIONAL 2" OFFSET BETWEEN THE RAIL AND THE OFFSET BLOCK TO ALLOW SPACE FOR THE SLIDER ASSEMBLY.

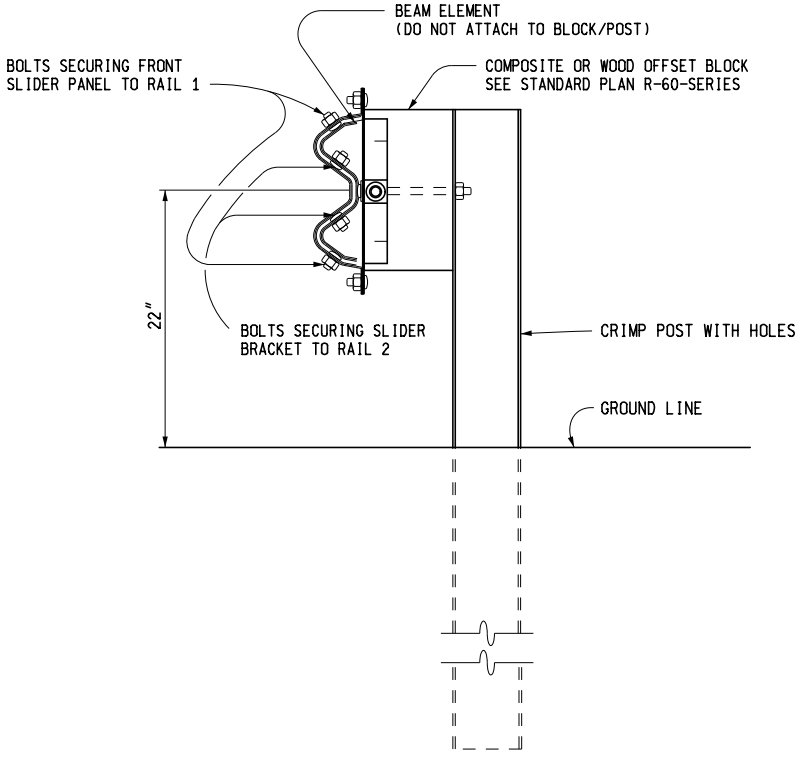
POST 3 REQUIRES GUARDRAIL BOLT TO BE ATTACHED TO HOLE ON APPROACH SIDE OF THE POST.

ENSURE OPEN END OF THE SLOT ON THE BACK SLIDER PANEL IS POINTING TOWARD THE APPROACH END.

ENSURE ANGLED PORTION OF THE FRONT SLIDER PANEL EXTENDS BEYOND THE END OF THE RAIL 1, AND IS FACING THE TRAILING END OF THE TERMINAL.

ARROWS ON FRONT AND BACK SLIDER PANELS NEED TO POINT TOWARD THE APPROACH END OF THE TERMINAL.

ELEVATION



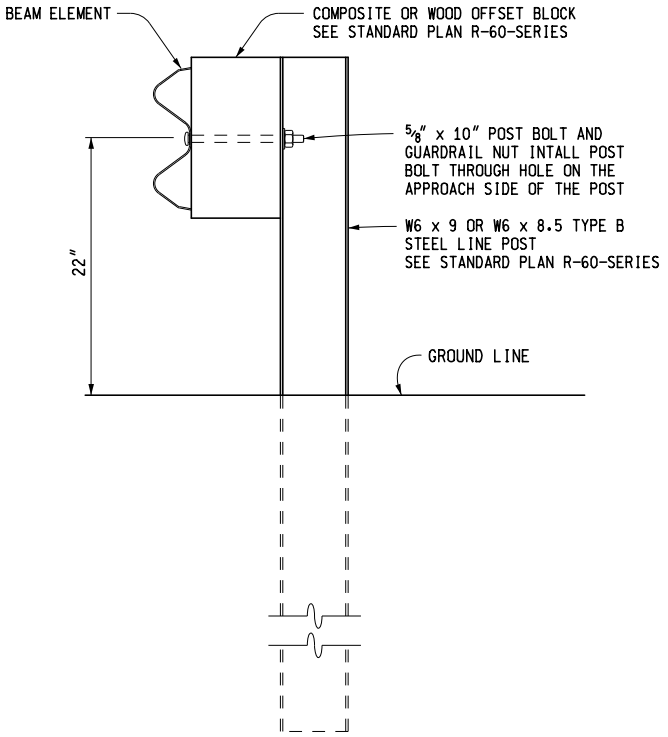
SIDE

POST 3 DETAIL

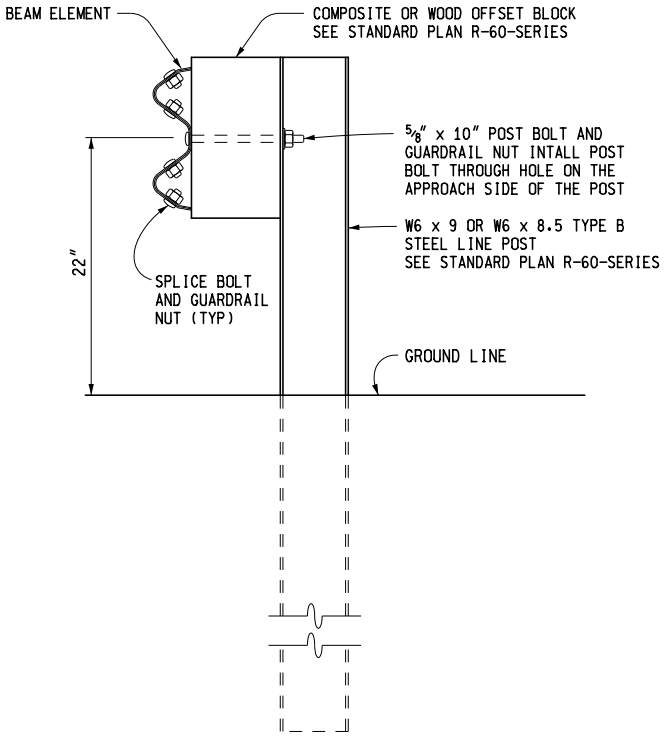
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

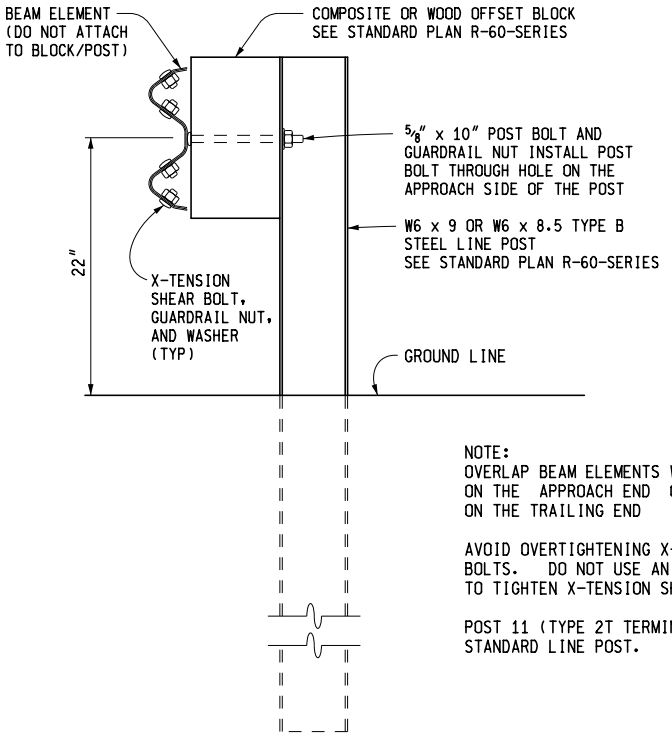
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 8 OF 10



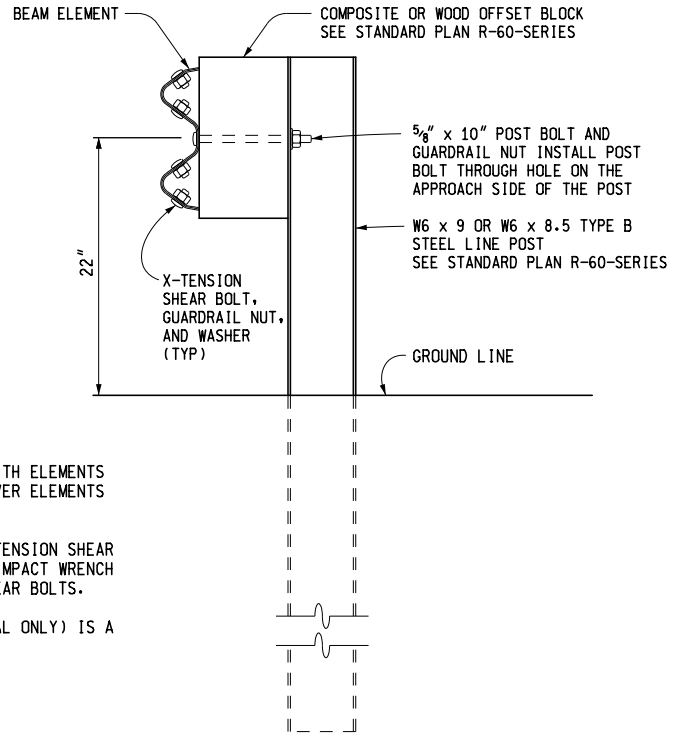
POST 4, 6, AND 8 DETAIL
POST 10 DETAIL (TYPE 2T TERMINAL ONLY)



POST 9 DETAIL



POST 5 DETAIL



POST 7 DETAIL

NOTE:
OVERLAP BEAM ELEMENTS WITH ELEMENTS ON THE APPROACH END OVER ELEMENTS ON THE TRAILING END

AVOID OVERTIGHTENING X-TENSION SHEAR BOLTS. DO NOT USE AN IMPACT WRENCH TO TIGHTEN X-TENSION SHEAR BOLTS.

POST 11 (TYPE 2T TERMINAL ONLY) IS A STANDARD LINE POST.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 9 OF 10

NOTES:

ALL POSTS, OFFSET BLOCKS, BEAM ELEMENTS, AND HARDWARE (INCLUDING BOLTS, NUTS, AND WASHERS) SHALL CONFORM TO THE CURRENT STANDARD SPECIFICATIONS AND TO THE CURRENT STANDARD PLAN R-60-SERIES, WHERE APPLICABLE, EXCEPT AS SPECIFIED ON THIS STANDARD.

ALL 1:10 SLOPES SHALL BE GRADED TO CLASS A SLOPE TOLERANCES.

WHEN SITE CONDITIONS WARRANT AND WITH THE APPROVAL OF THE ENGINEER, GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T CAN BE INSTALLED STRAIGHT (WITHOUT THE 1'-0" OFFSET FROM THE TANGENT LINE TO THE TRAFFIC FACE OF POST 1).

GUARDRAIL REFLECTORS ARE NOT TO BE USED ON THE GUARDRAIL APPROACH TERMINAL. PLACE REFLECTORS BEGINNING ON STANDARD RUN OF GUARDRAIL.

USE REFLECTIVE SHEETING ACCORDING TO THE FOLLOWING TRAFFIC CONDITIONS: (NOTE: ALTERNATE 3" BLACK AND 3" YELLOW STRIPES ON A 45° ANGLE)

TRAFFIC PASSING ON THE LEFT SIDE

TRAFFIC PASSING ON BOTH SIDES

TRAFFIC PASSING ON THE RIGHT SIDE

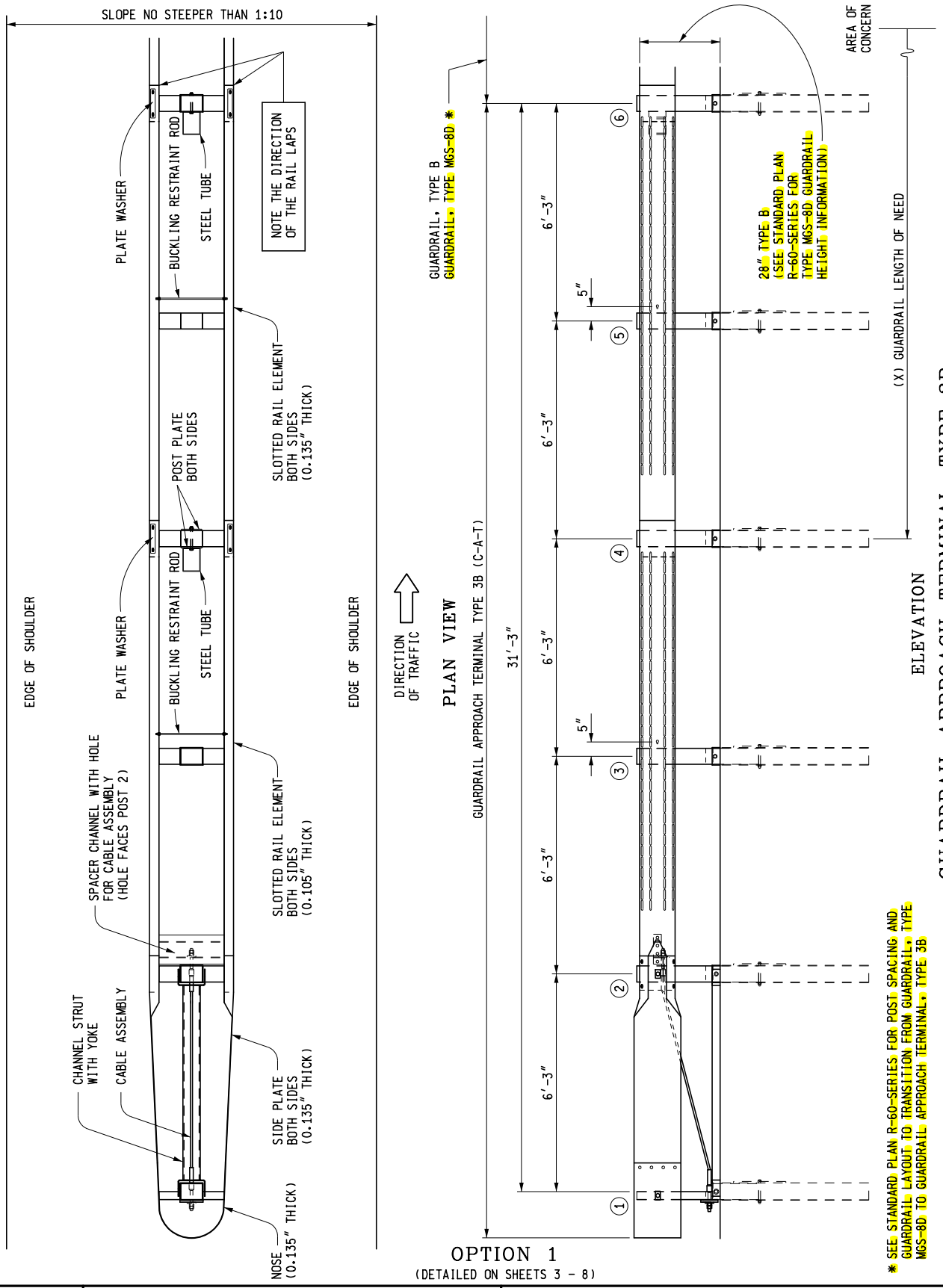
THE PORTION OF THE IMPACT HEAD ASSEMBLY FACING TRAFFIC SHALL BE COMPLETELY COVERED WITH HIGH INTENSITY ADHESIVE REFLECTIVE SHEETING.

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL TYPES 2B & 2T (SKT & X-LITE-TANGENT-50)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-62-H	SHEET 10 OF 10



GUARDRAIL APPROACH TERMINAL, TYPE 3B "C-A-T"

OPTION 1
(DETAILED ON SHEETS 3 - 8)

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

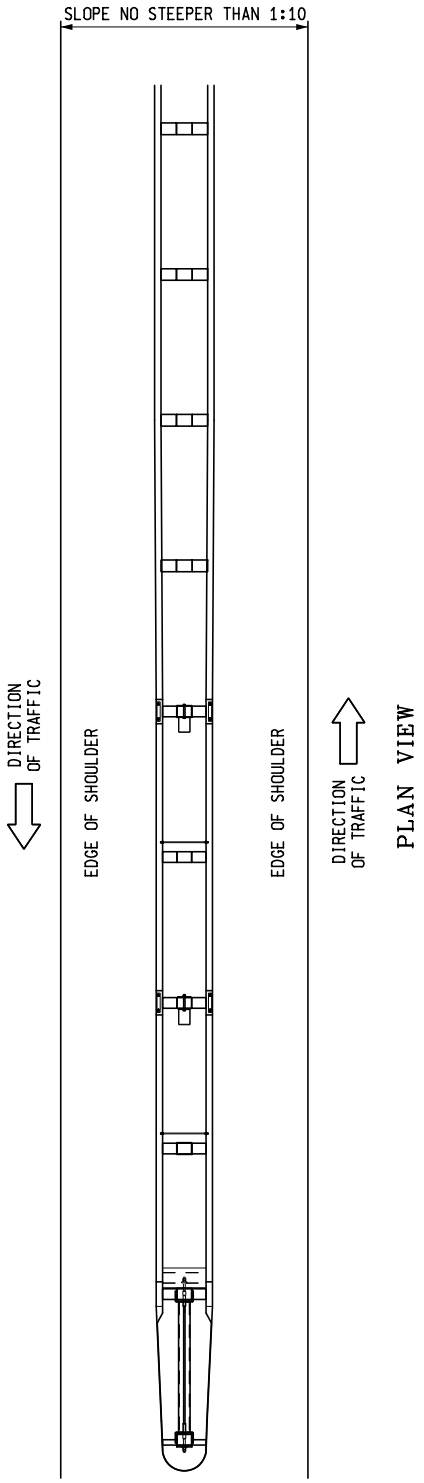
APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

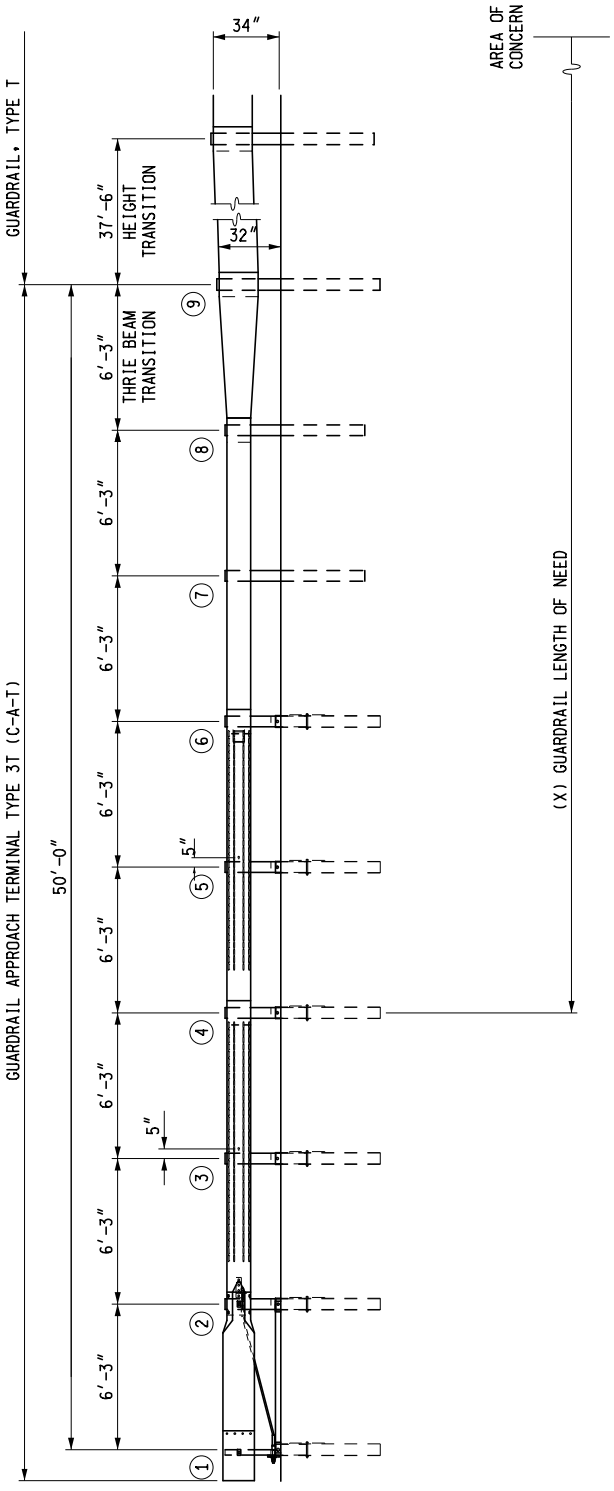
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 1 OF 16



PLAN VIEW



ELEVATION

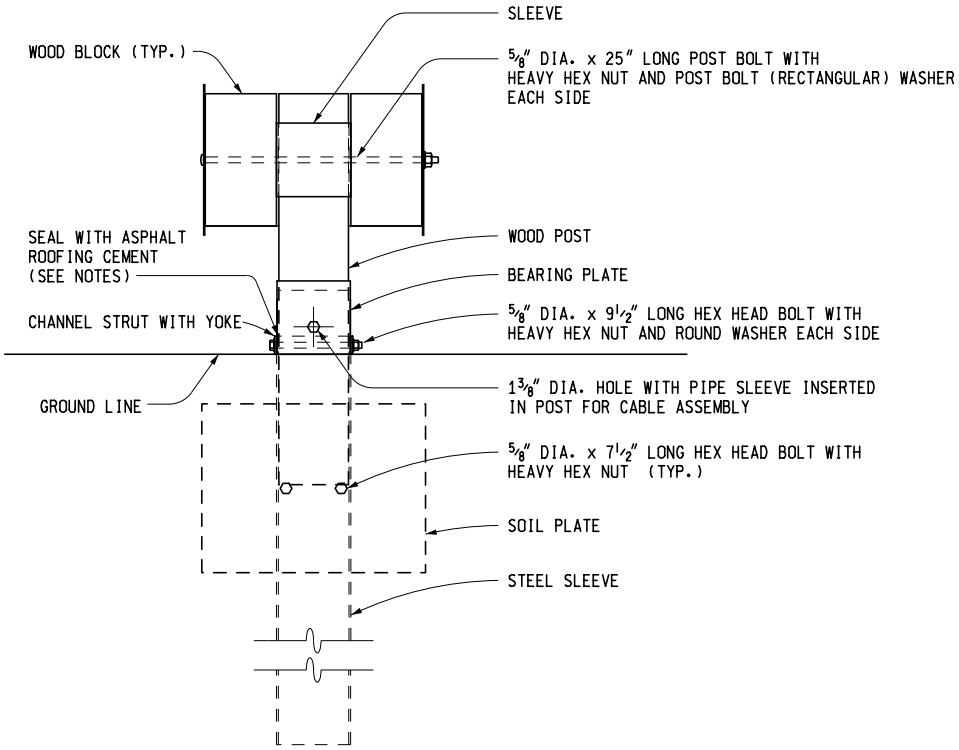
GUARDRAIL APPROACH TERMINAL, TYPE 3T
"C-A-T"

OPTION 1
(DETAILED ON SHEETS 3 - 8)

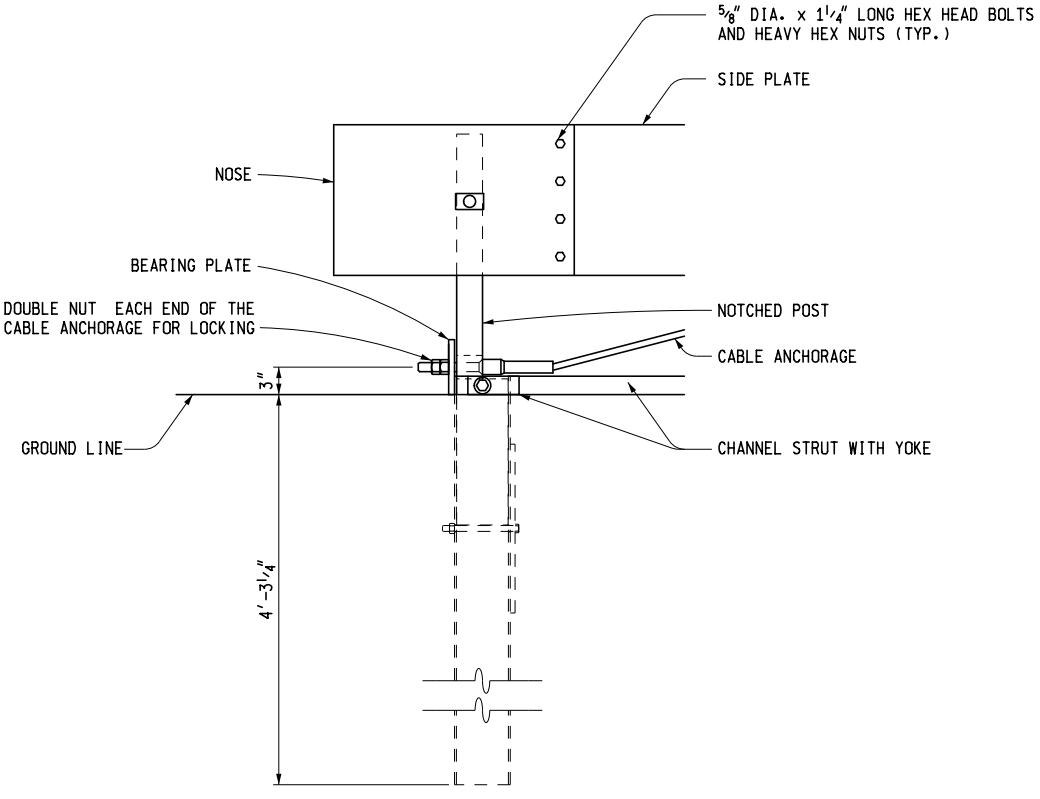
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 2 OF 16



SIDE



ELEVATION

POST 1 DETAILS

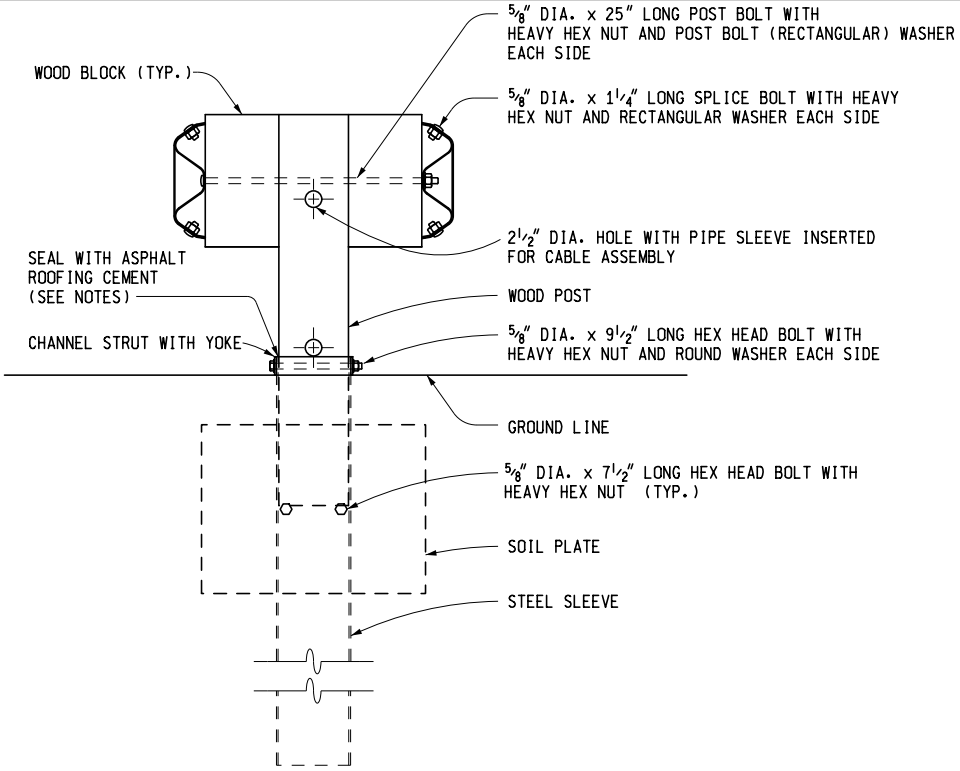
(C-A-T)

MICHIGAN DEPARTMENT OF TRANSPORTATION

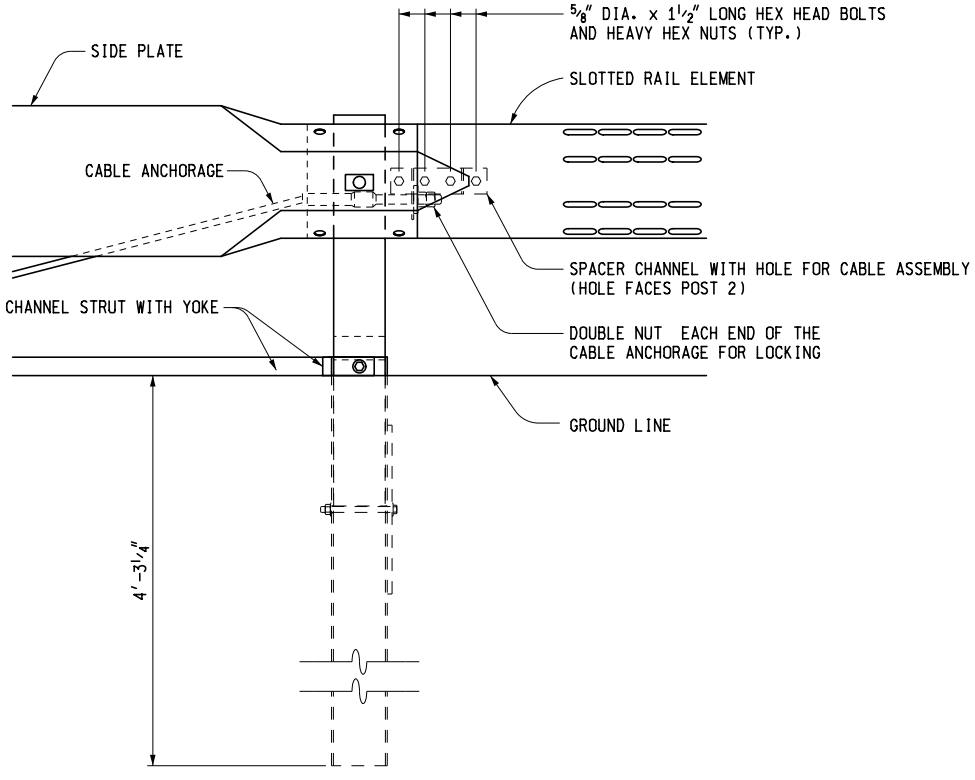
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 3 OF 16



SIDE



ELEVATION

POST 2 DETAILS

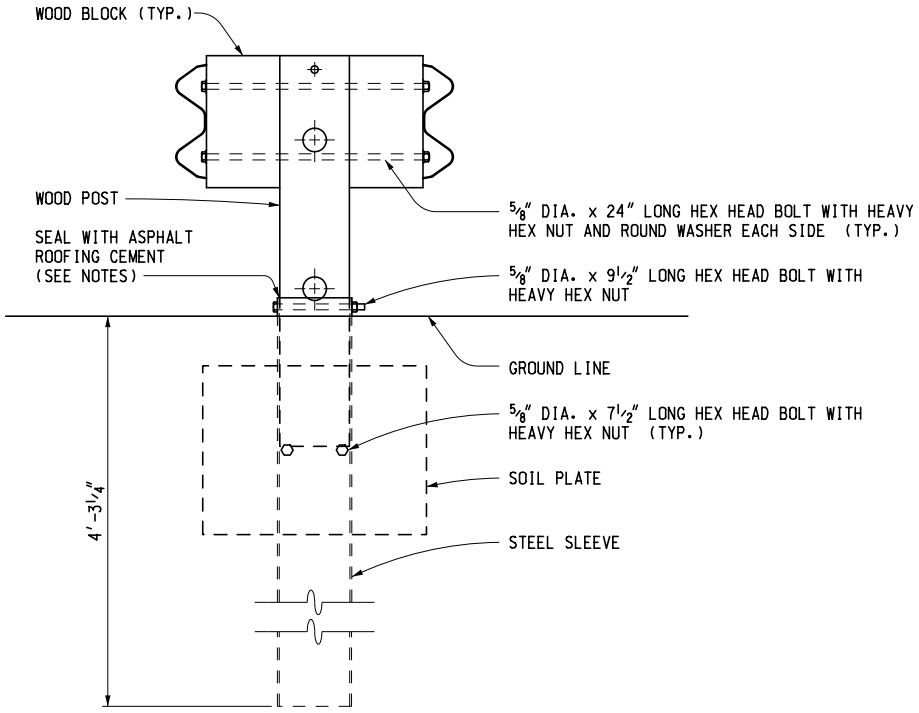
(C-A-T)

MICHIGAN DEPARTMENT OF TRANSPORTATION

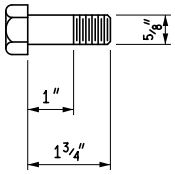
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 4 OF 16

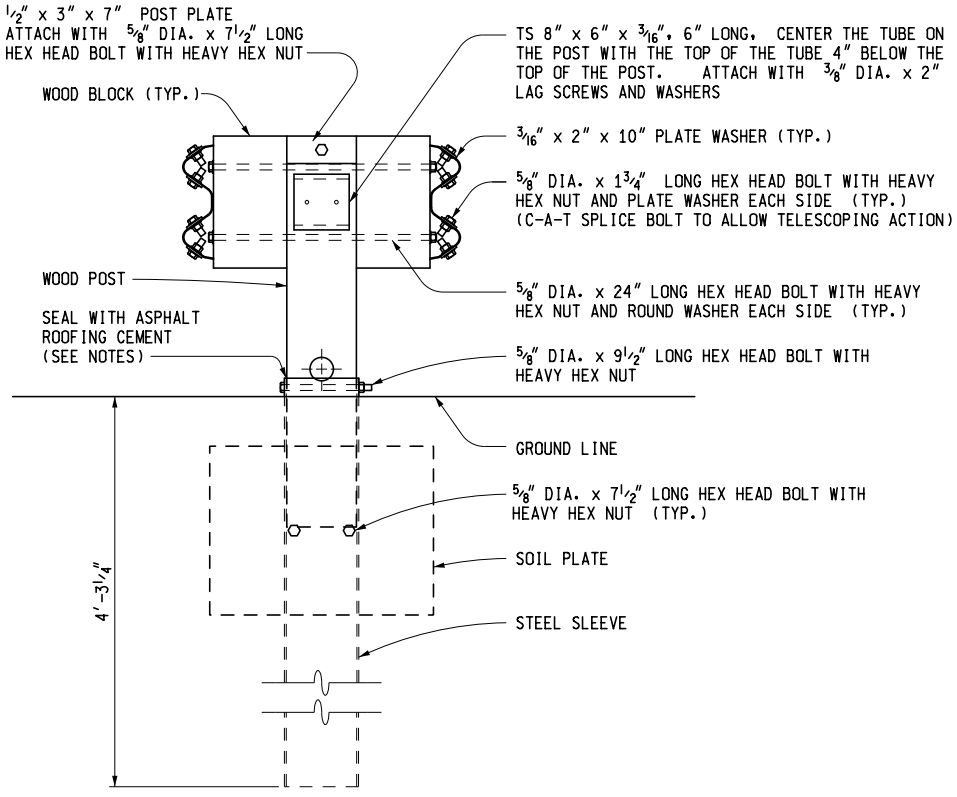


POST 3 AND 5 DETAIL
(C-A-T)



C-A-T SPLICE BOLT

C-A-T SPLICE BOLTS REQUIRED TO ALLOW TELESCOPING ACTION

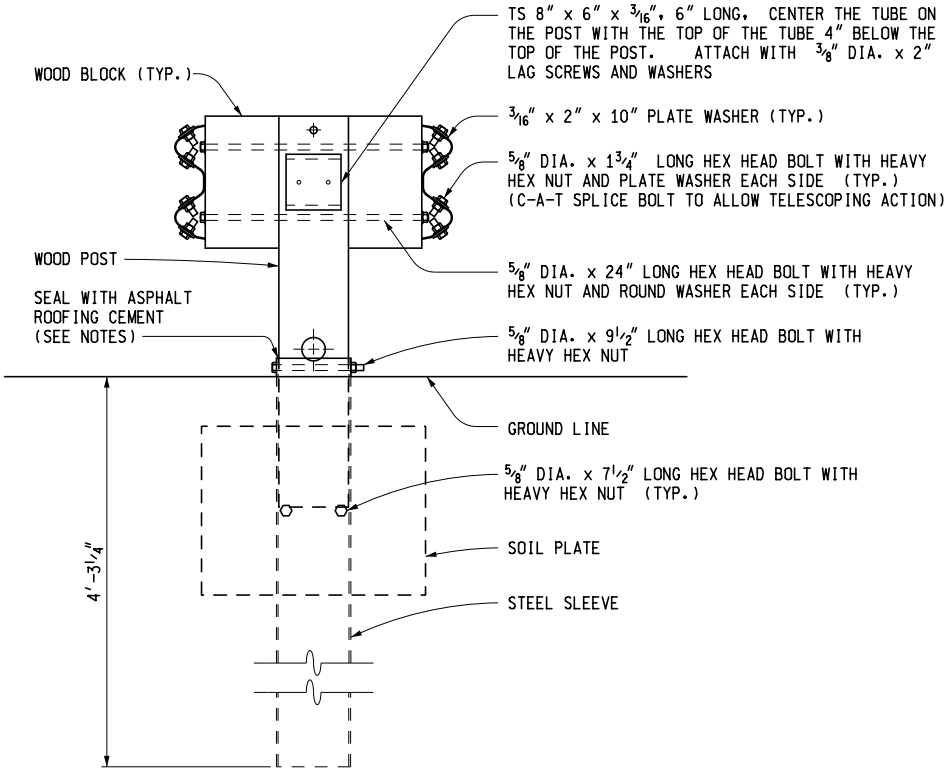


POST 4 DETAIL
(C-A-T)

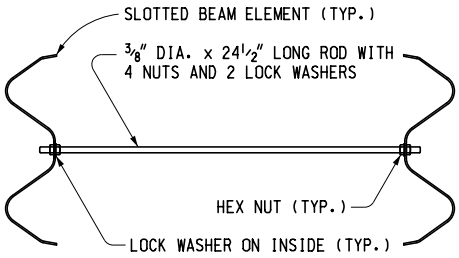
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 5 OF 16



POST 6 DETAIL
(C-A-T)

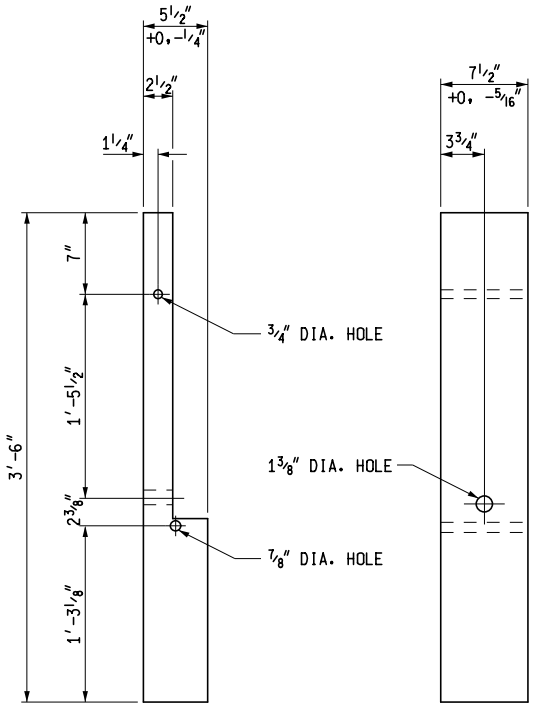


BUCKLING RESTRAINT ROD DETAIL
(C-A-T)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

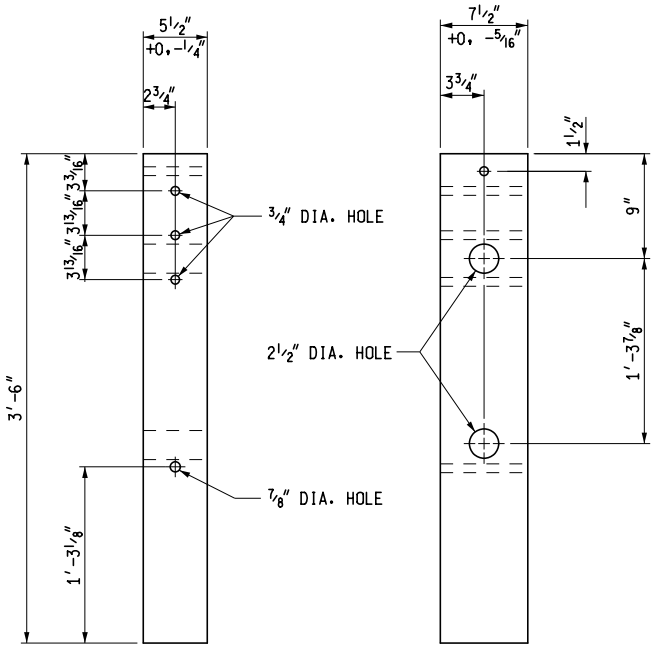
GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 6 OF 16



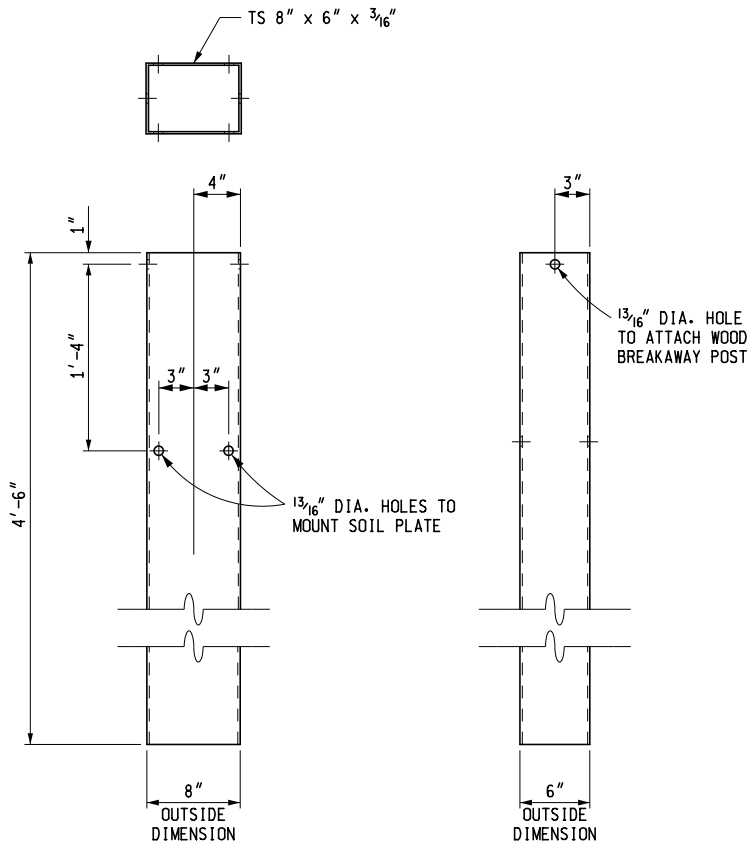
WOOD BREAKAWAY POST

(C-A-T POST 1)



WOOD BREAKAWAY POST

(C-A-T POST 2 - 6)



STEEL SLEEVE

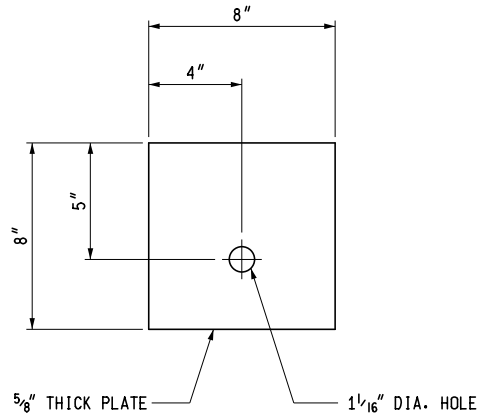
(C-A-T)

MICHIGAN DEPARTMENT OF TRANSPORTATION

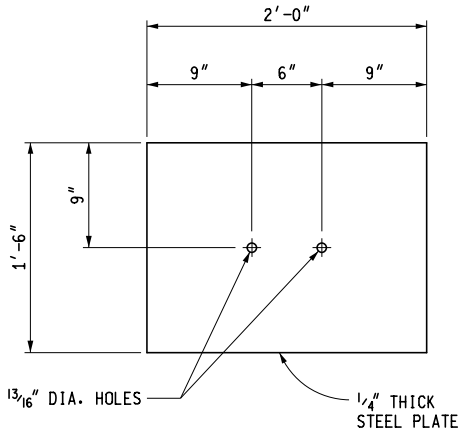
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

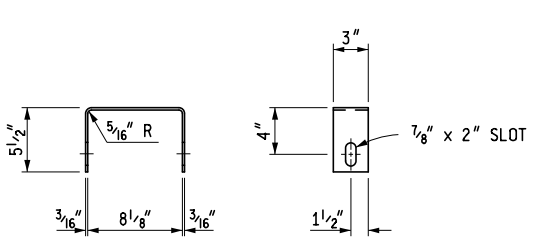
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 7 OF 16

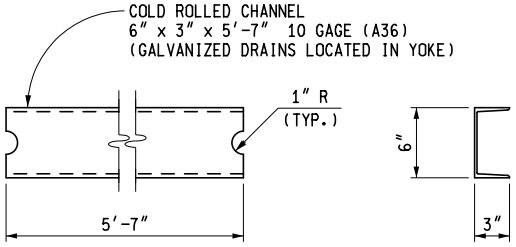


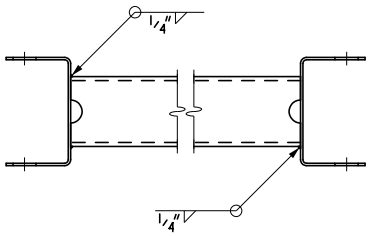
BEARING PLATE
(C-A-T)



SOIL PLATE
(C-A-T)

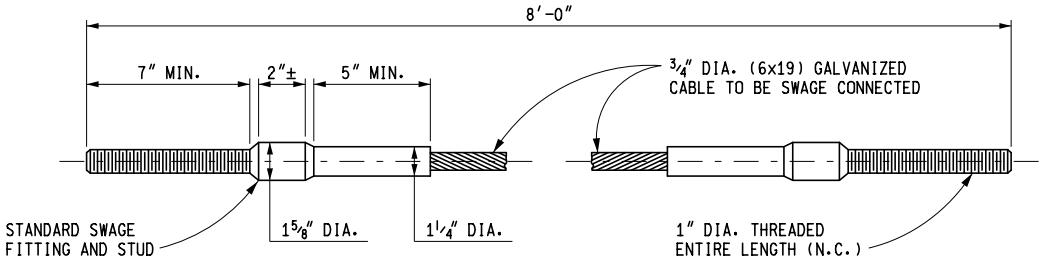






ASSEMBLY DETAIL

STRUT DETAILS
(C-A-T)

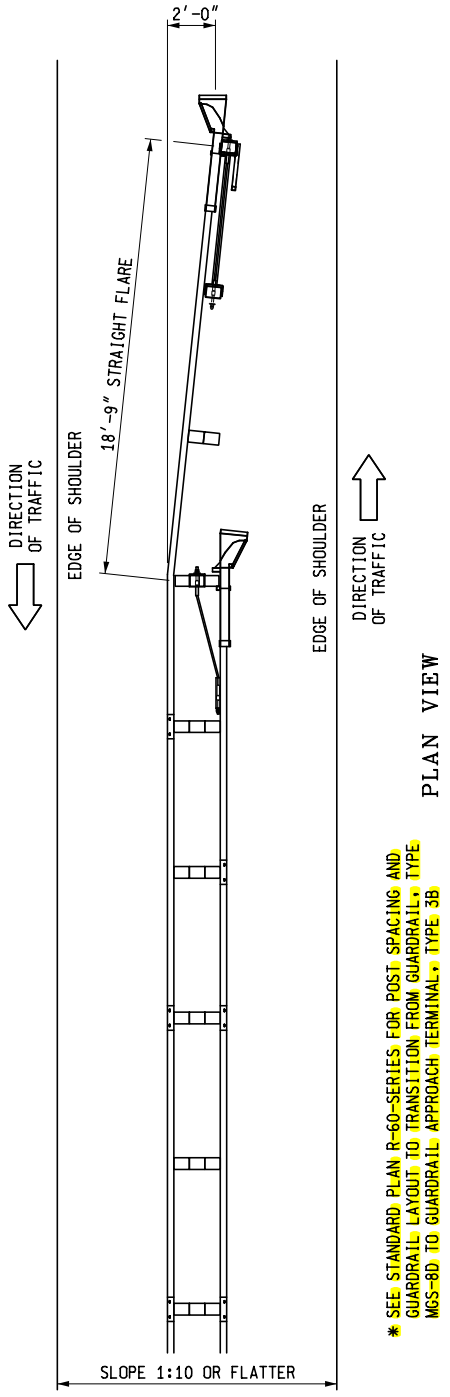


CABLE ASSEMBLY
(C-A-T)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

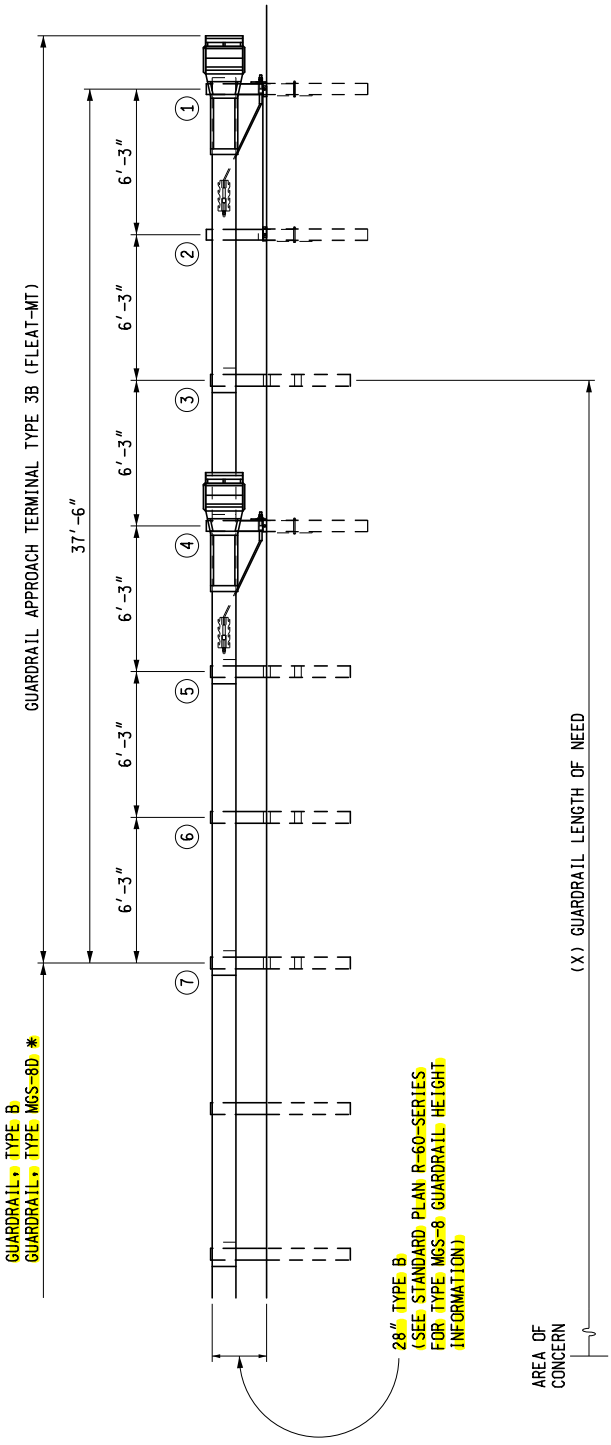
GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 8 OF 16



PLAN VIEW

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8D TO GUARDRAIL APPROACH TERMINAL, TYPE 3B



ELEVATION

GUARDRAIL APPROACH TERMINAL, TYPE 3B "FLEAT - MT"

OPTION 2

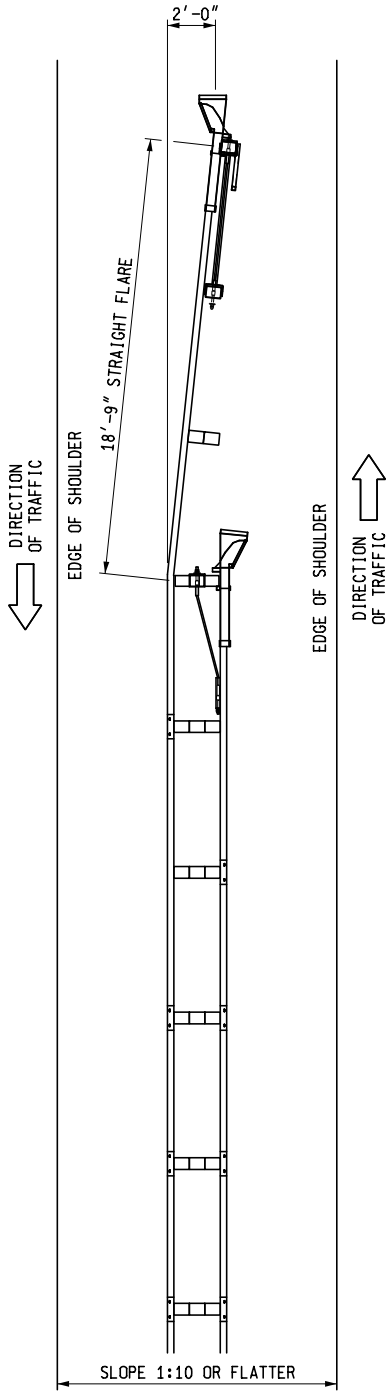
(DETAILED ON SHEETS 11 - 15)

MICHIGAN DEPARTMENT OF TRANSPORTATION

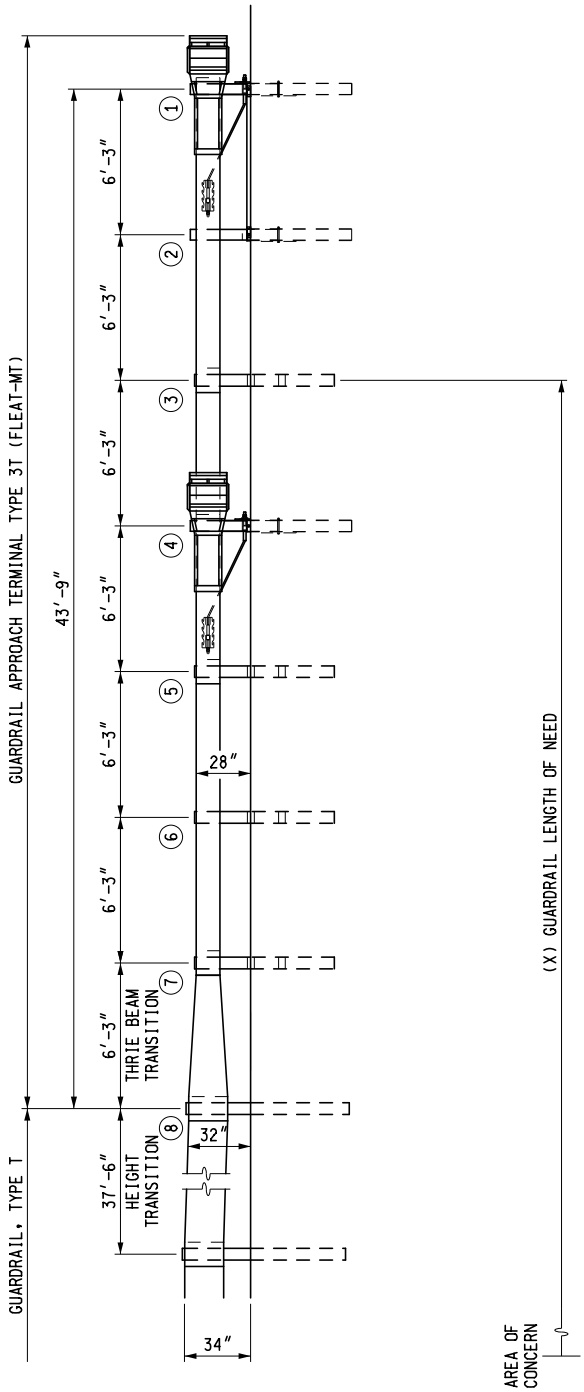
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 9 OF 16



PLAN VIEW



ELEVATION

GUARDRAIL APPROACH TERMINAL, TYPE 3T
"FLEAT - MT"

OPTION 2

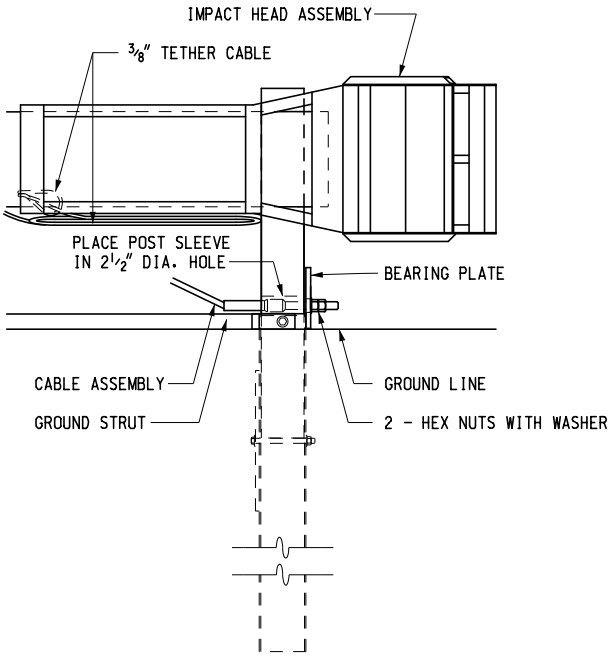
(DETAILED ON SHEETS 11 - 15)

MICHIGAN DEPARTMENT OF TRANSPORTATION

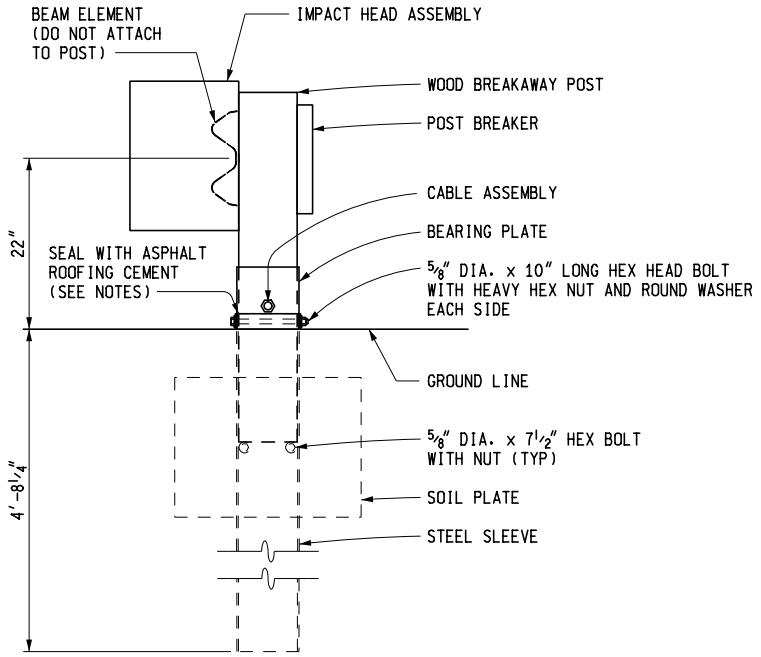
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 10 OF 16



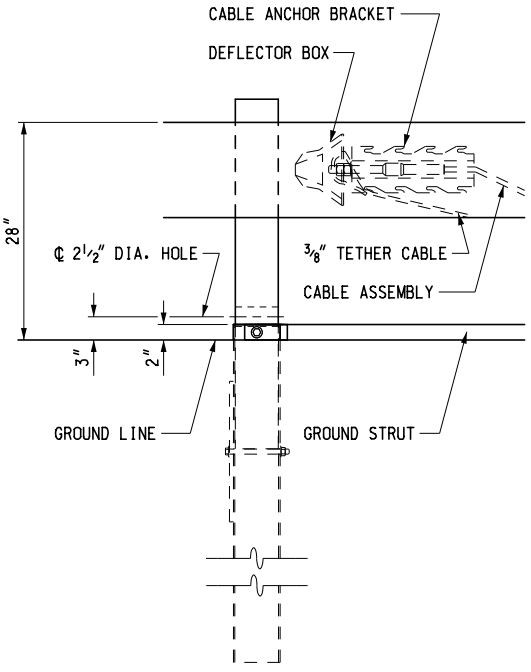
ELEVATION



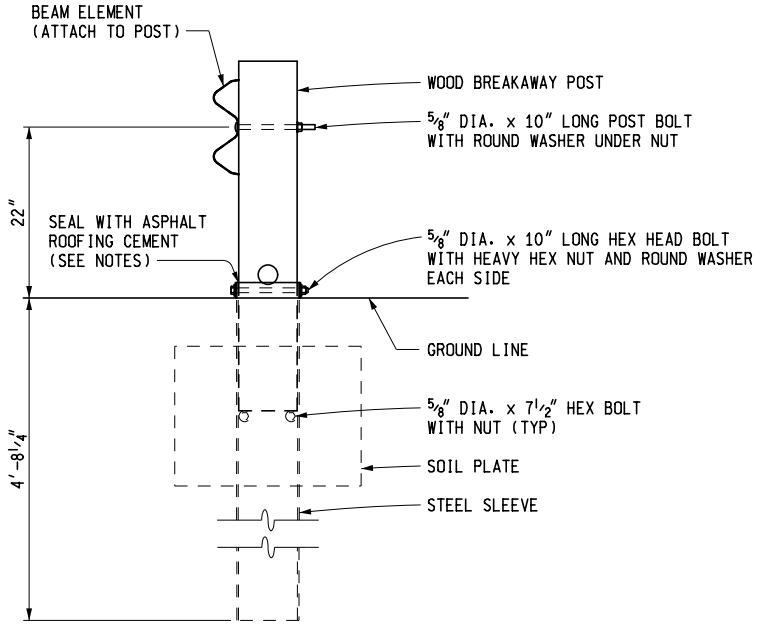
SIDE

POST 1 DETAIL

(FLEAT-MT)



ELEVATION



SIDE

POST 2 DETAIL

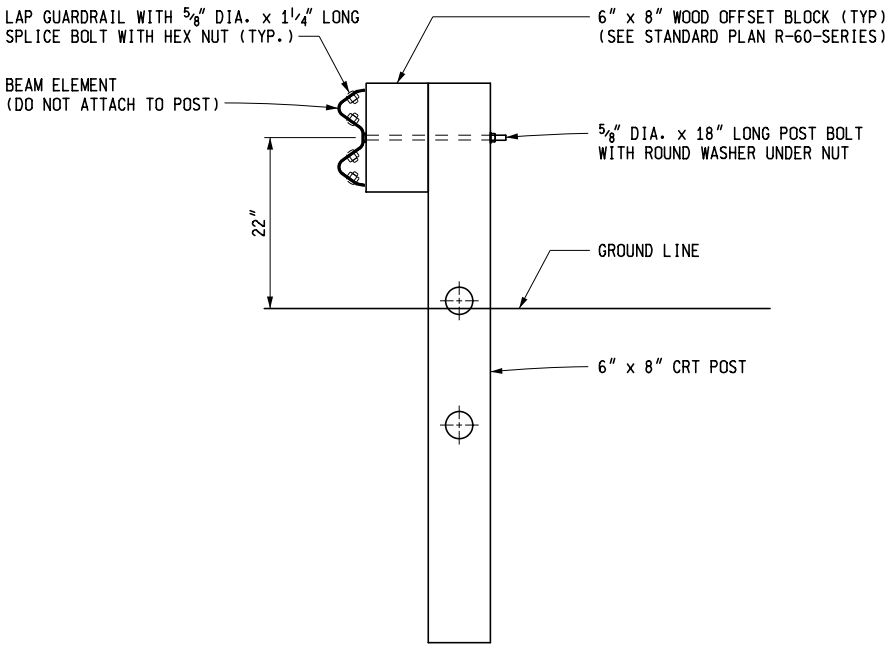
(FLEAT-MT)

MICHIGAN DEPARTMENT OF TRANSPORTATION

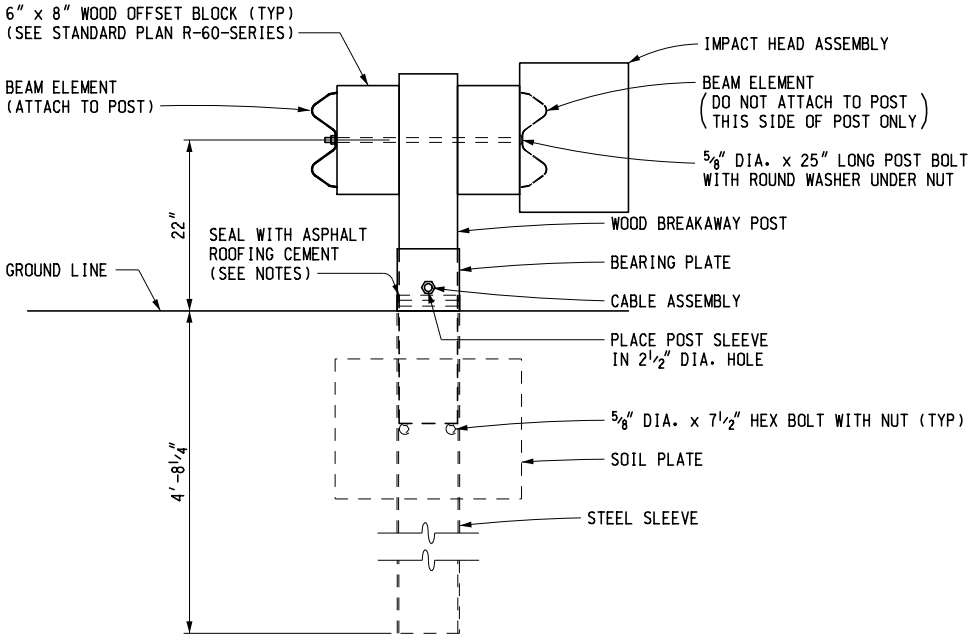
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 11 OF 16



POST 3 DETAIL
(FLEAT-MT)

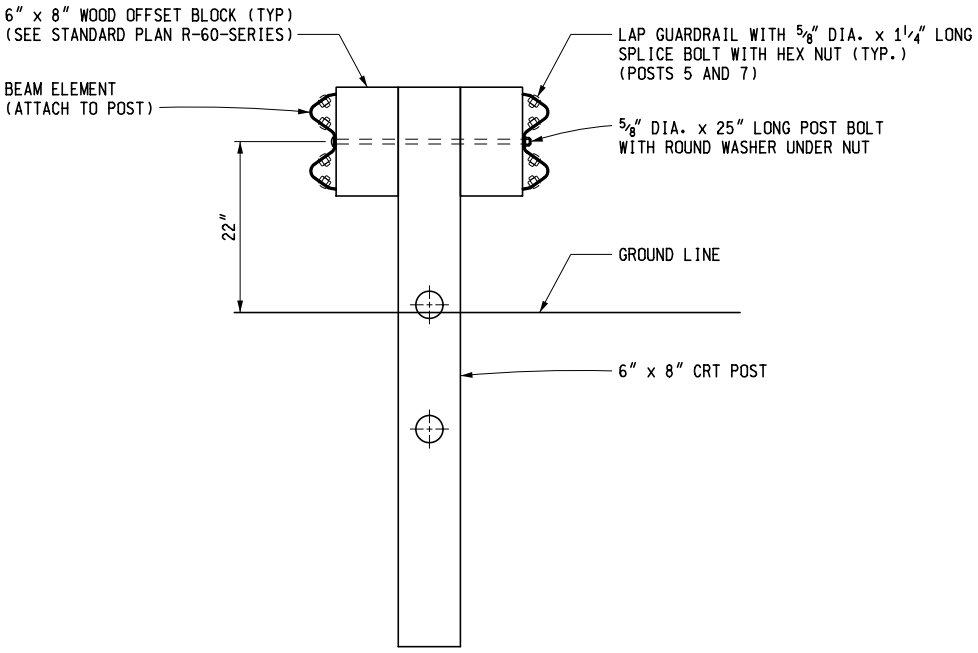


POST 4 DETAIL
(FLEAT-MT)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

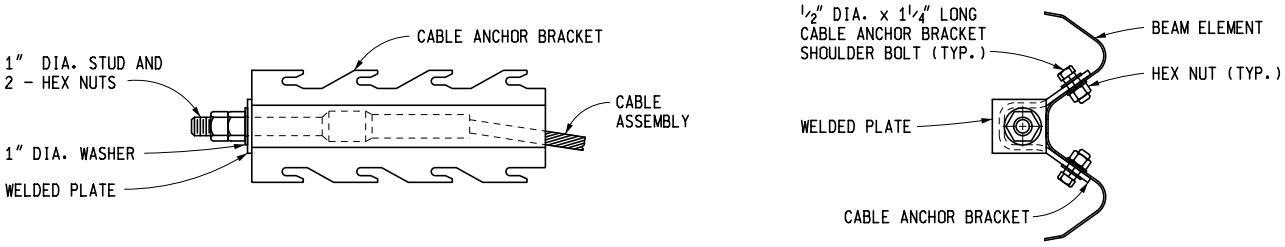
GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 12 OF 16



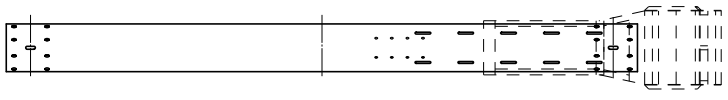
POST 5, 6 AND 7 DETAIL

(FLEAT-MT)
NOTE: POST 8 IS A STANDARD LINE POST



CABLE ANCHOR BRACKET DETAIL

(FLEAT-MT)



W-BEAM GUARDRAIL END SECTION

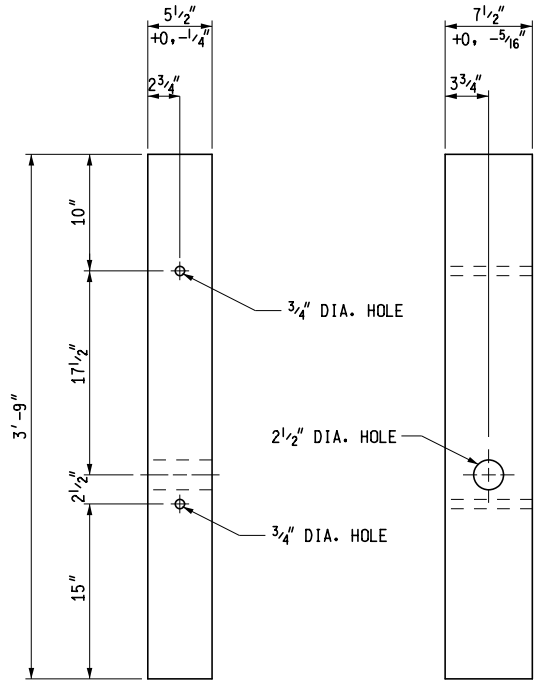
(USE WITH IMPACT HEAD ASSEMBLY)

NOTE: ALL (FLEAT-MT) ITEMS ILLUSTRATED WITHOUT DIMENSIONS SHALL BE ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

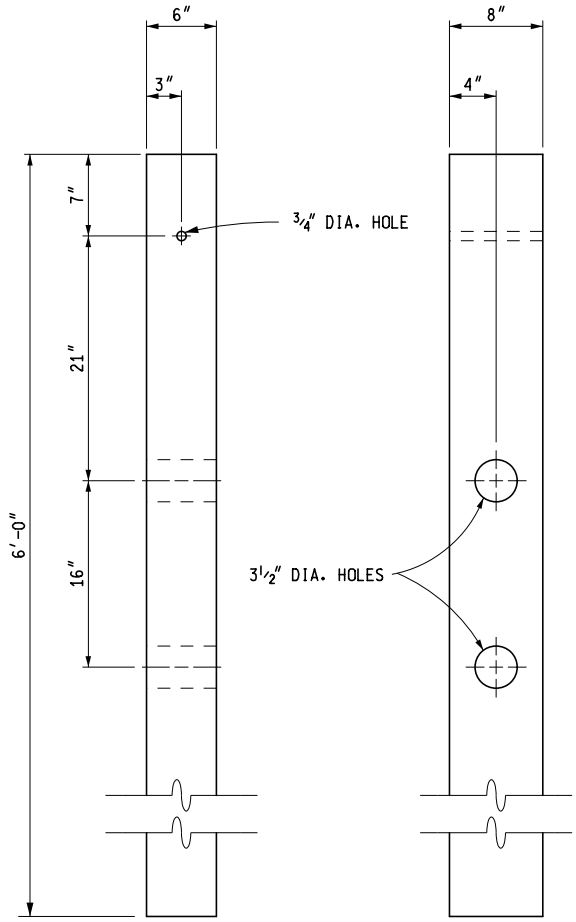
GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 13 OF 16



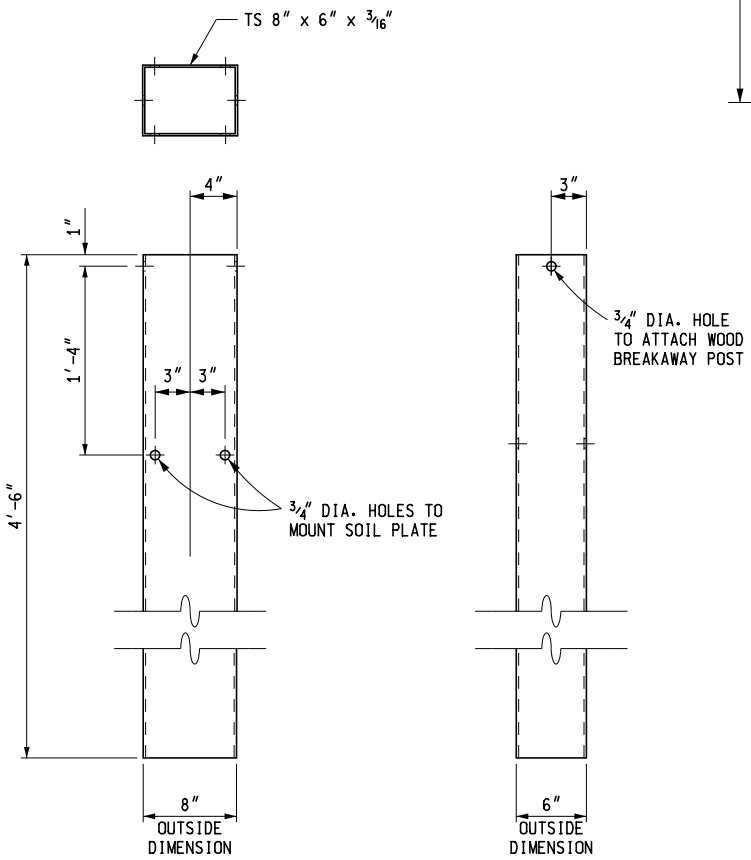
WOOD BREAKAWAY POST

(FLEAT-MT POST 1, 2, & 4)



CRT POST

(FLEAT-MT POST 3, 5, 6, & 7)



STEEL SLEEVE

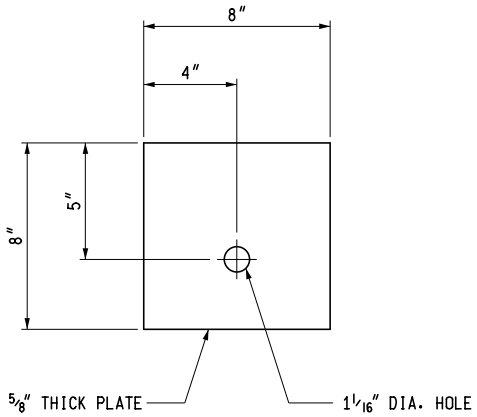
(FLEAT-MT)

MICHIGAN DEPARTMENT OF TRANSPORTATION

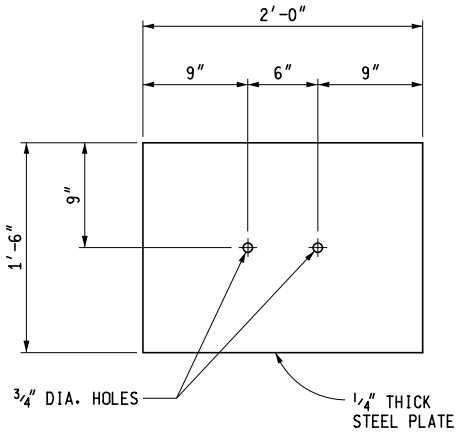
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

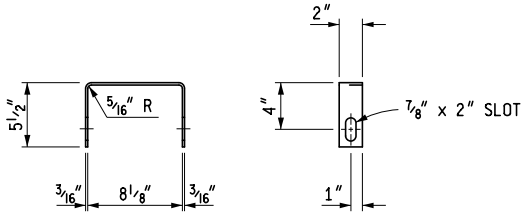
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 14 OF 16

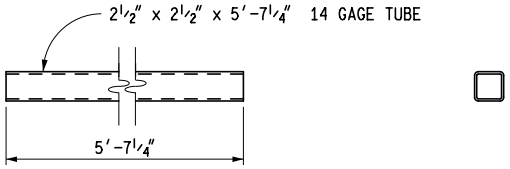


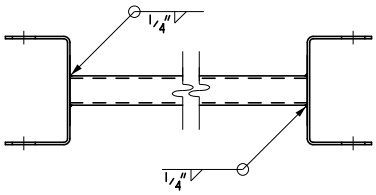
BEARING PLATE
(FLEAT-MT)



SOIL PLATE
(FLEAT-MT)

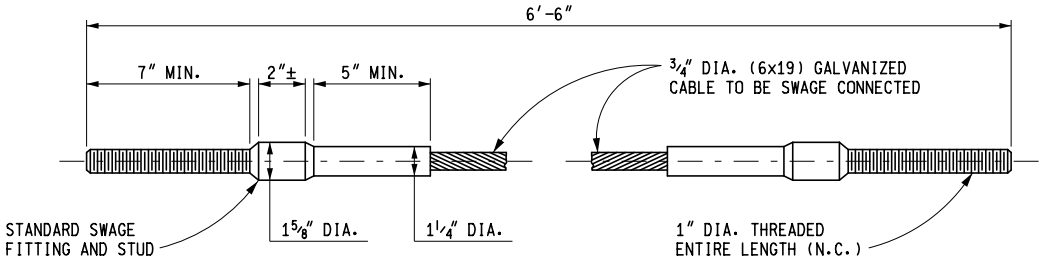






ASSEMBLY DETAIL

STRUT DETAILS
(FLEAT-MT)



CABLE ASSEMBLY
(FLEAT-MT)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 15 OF 16

NOTES:

ALL POSTS, OFFSET BLOCKS, BEAM ELEMENTS, AND HARDWARE (INCLUDING BOLTS, NUTS, AND WASHERS) SHALL CONFORM TO THE CURRENT STANDARD SPECIFICATIONS AND TO THE CURRENT STANDARD PLAN R-60-SERIES, WHERE APPLICABLE, EXCEPT AS SPECIFIED ON THIS STANDARD.

ALL 1:10 SLOPES SHALL BE GRADED TO CLASS A SLOPE TOLERANCES.

FOR DETAILS OF GUARDRAIL PLACEMENT, SEE STANDARD PLAN R-56-SERIES, AND R-59-SERIES.

AFTER THE CABLE ASSEMBLY HAS BEEN TIGHTENED, A SECOND NUT SHALL BE INSTALLED SO THAT THE CABLE WILL NOT LOOSEN.

HARDWARE BETWEEN POST 1 AND POST 6 (OPTION 1) ARE PROPRIETARY ITEMS OF THE C-A-T AND MUST BE PURCHASED FROM AN AUTHORIZED DISTRIBUTER.

HARDWARE BETWEEN POST 1 AND POST 7 (OPTION 2) ARE PROPRIETARY ITEMS OF THE FLEAT-MT AND MUST BE PURCHASED FROM AN AUTHORIZED DISTRIBUTER.

GUARDRAIL REFLECTORS ARE NOT TO BE USED ON THE "C-A-T" OR "FLEAT-MT". PLACE RELECTORS BEGINNING ON STANDARD RUN OF GUARDRAIL.

USE REFLECTIVE SHEETING ACCORDING TO THE FOLLOWING TRAFFIC CONDITIONS: (NOTE: ALTERNATE 3" BLACK AND 3" YELLOW STRIPES ON A 45° ANGLE)

TRAFFIC PASSING ON THE LEFT SIDE

TRAFFIC PASSING ON BOTH SIDES

TRAFFIC PASSING ON THE RIGHT SIDE

ON THE "C-A-T", THE CURVED PORTION OF THE NOSE FACING TRAFFIC SHALL BE COMPLETELY COVERED WITH HIGH INTENSITY ADHESIVE REFLECTIVE SHEETING.

ON THE "FLEAT-MT", THE PORTION OF THE IMPACT HEAD ASSEMBLIES FACING TRAFFIC SHALL BE COMPLETELY COVERED WITH HIGH INTENSITY ADHESIVE REFLECTIVE SHEETING.

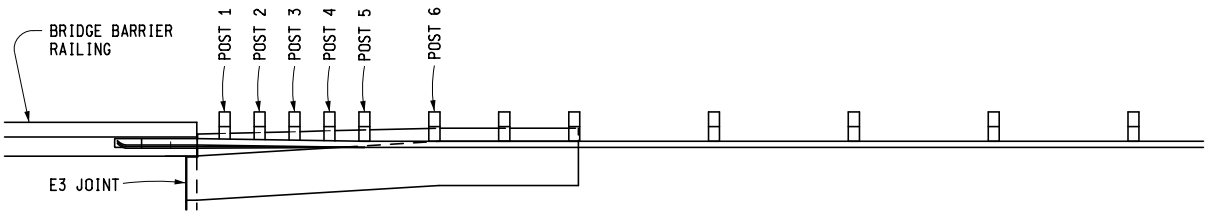
ASPHALT ROOFING CEMENT SHALL BE USED TO SEAL THE PERIMETER AREA BETWEEN THE STEEL SLEEVE (SOIL TUBE) AND THE WOOD BREAKAWAY POST.

MICHIGAN DEPARTMENT OF TRANSPORTATION

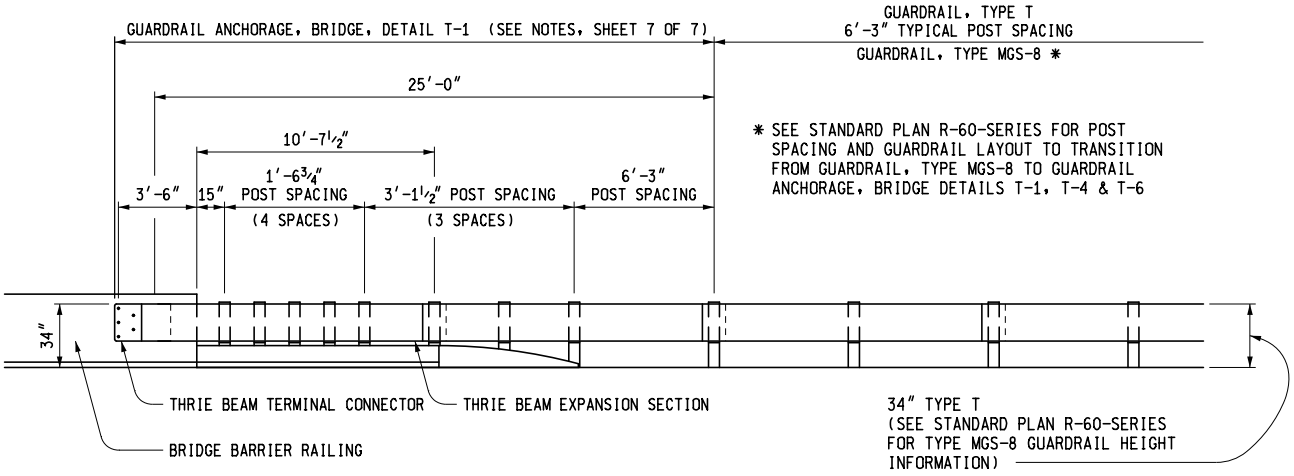
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL APPROACH TERMINAL, TYPE 3B & 3T

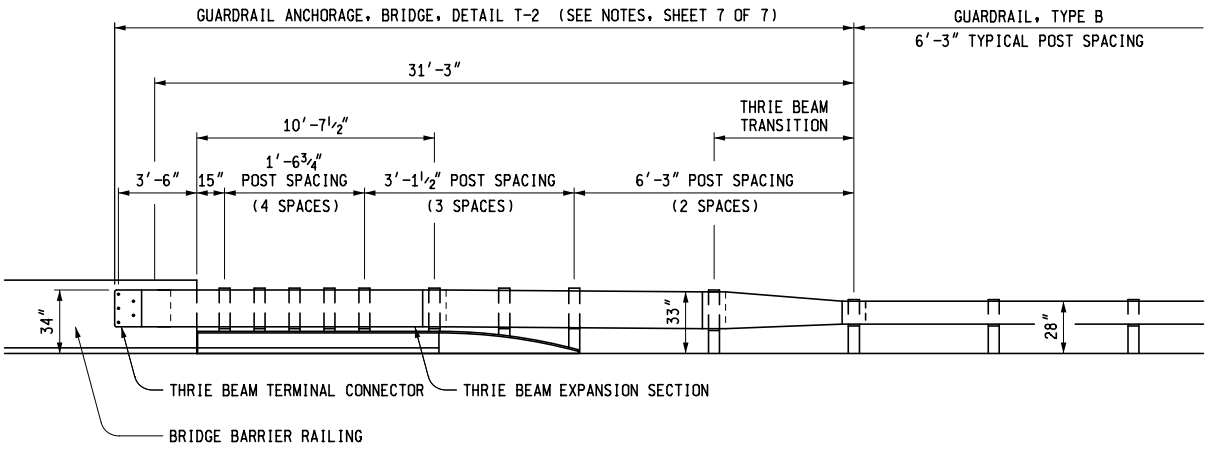
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-63-C	SHEET 16 OF 16



PLAN VIEW



ELEVATION VIEW
(TO BE USED WITH GUARDRAIL, TYPE T & TYPE MGS-8)



ELEVATION VIEW
(TO BE USED WITH GUARDRAIL, TYPE B)

DETAILS FOR CONNECTING GUARDRAIL TO BRIDGE BARRIER RAILINGS, TYPE 4, 2-TUBE, 4-TUBE, OR AESTHETIC PARAPET TUBE

(WITHOUT EXPANSION AT BACKWALL)

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: _____

CHECKED BY: _____

DEPARTMENT DIRECTOR
Kirk T. Steudle

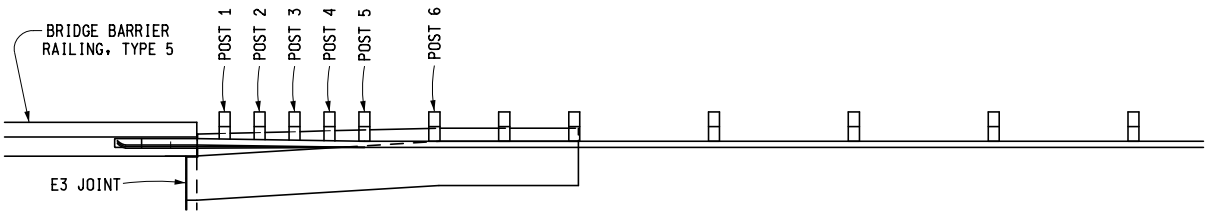
APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

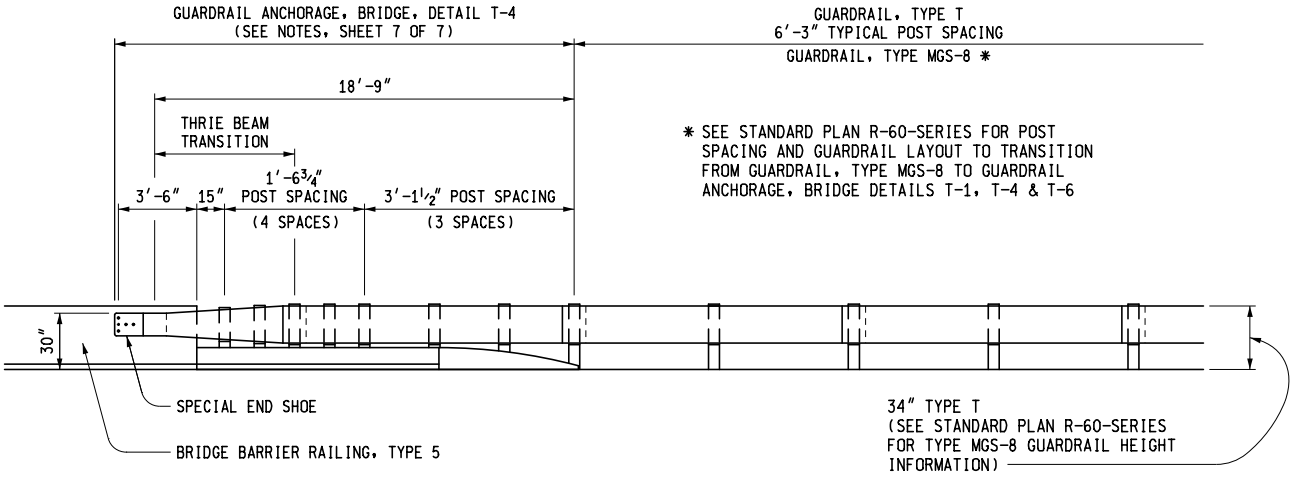
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL ANCHORAGE, BRIDGE, DETAILS

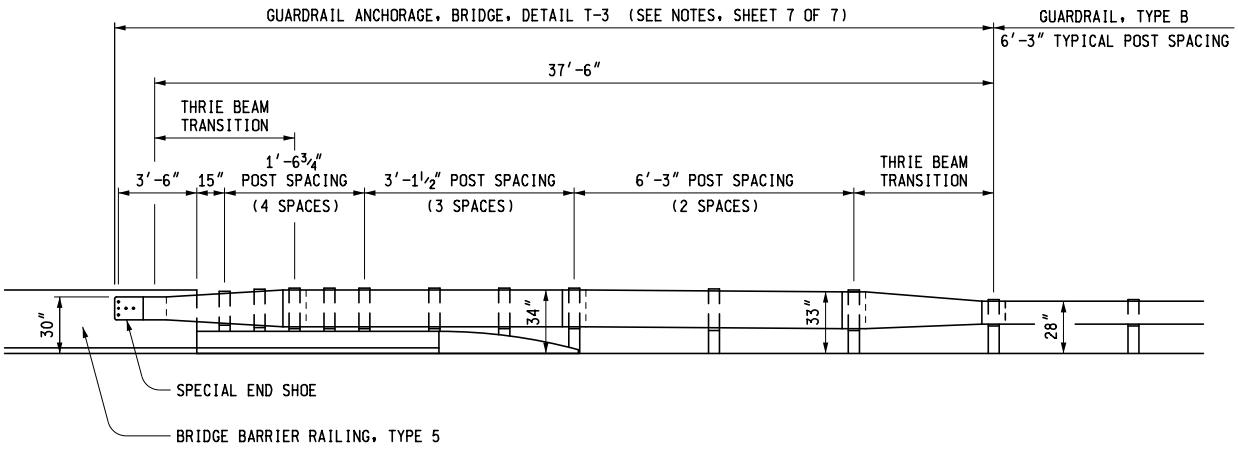
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-67-G	SHEET 1 OF 7



PLAN VIEW



ELEVATION VIEW
(TO BE USED WITH GUARDRAIL, TYPE T & TYPE MGS-8)



ELEVATION VIEW
(TO BE USED WITH GUARDRAIL, TYPE B)

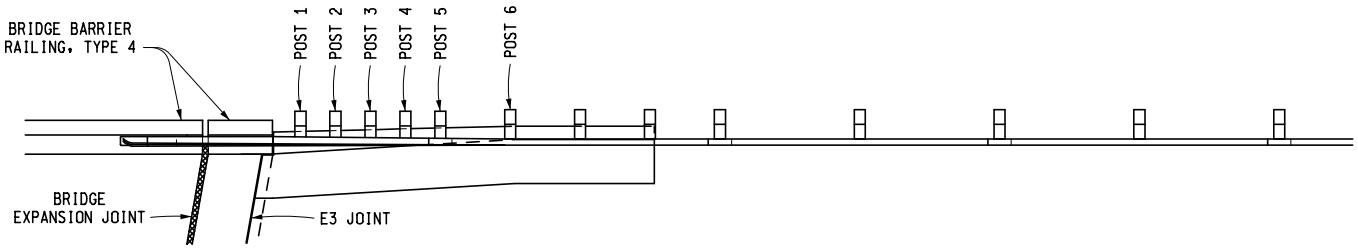
DETAILS FOR CONNECTING GUARDRAIL TO BRIDGE BARRIER RAILINGS, TYPE 5

(WITHOUT EXPANSION AT BACKWALL)

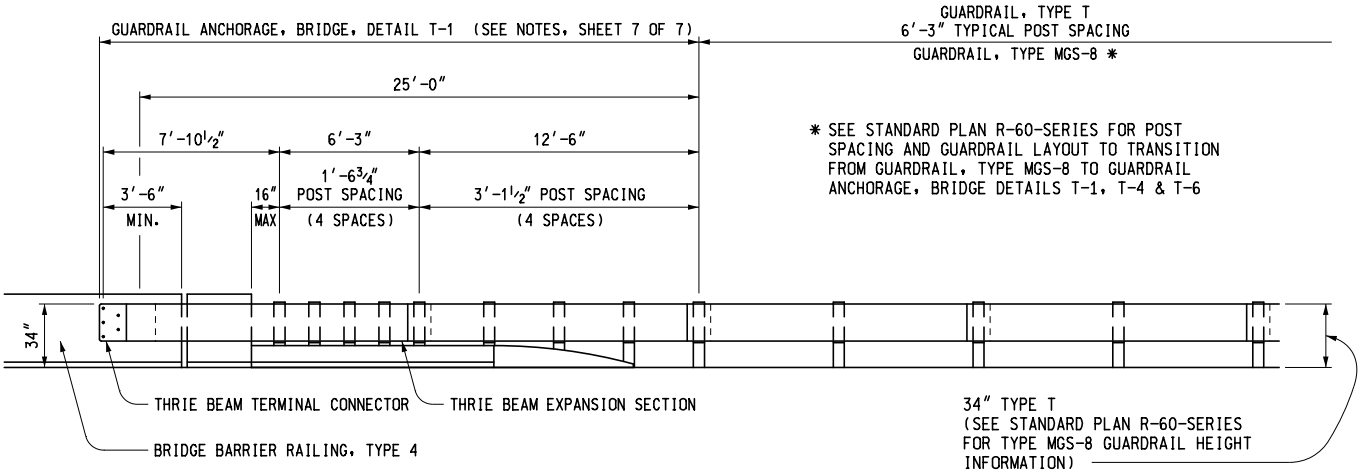
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL ANCHORAGE, BRIDGE, DETAILS

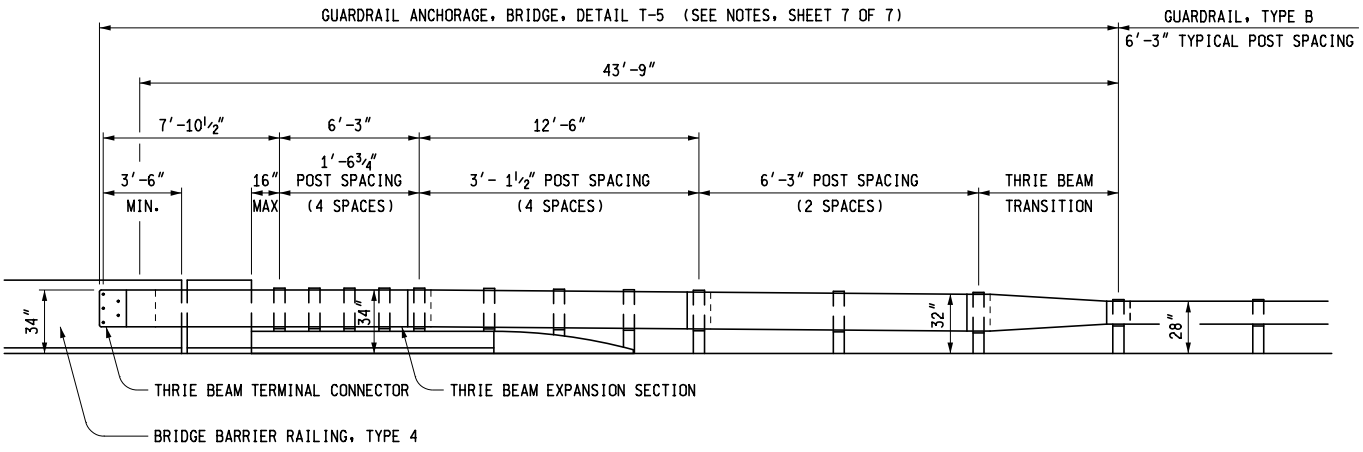
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-67-G	SHEET 2 OF 7



PLAN VIEW



ELEVATION VIEW
(TO BE USED WITH GUARDRAIL, TYPE T & TYPE MGS-8)



ELEVATION VIEW
(TO BE USED WITH GUARDRAIL, TYPE B)

DETAILS FOR CONNECTING GUARDRAIL TO BRIDGE BARRIER RAILINGS, TYPE 4, 2-TUBE, 4-TUBE, OR AESTHETIC PARAPET TUBE

(WITH EXPANSION AT BACKWALL)

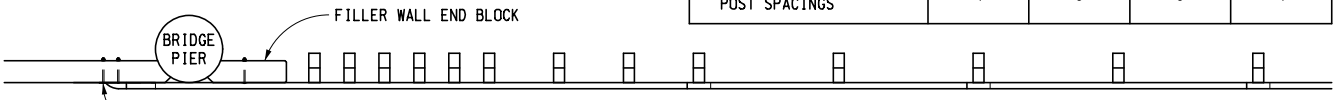
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL ANCHORAGE, BRIDGE, DETAILS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-67-G	SHEET 3 OF 7

NOTE: FILLER WALL END BLOCK MAY BE OMITTED WHEN FIRST ANCHORAGE POST CAN BE INSTALLED FULL DEPTH 1′-3″ FROM BRIDGE PIER.

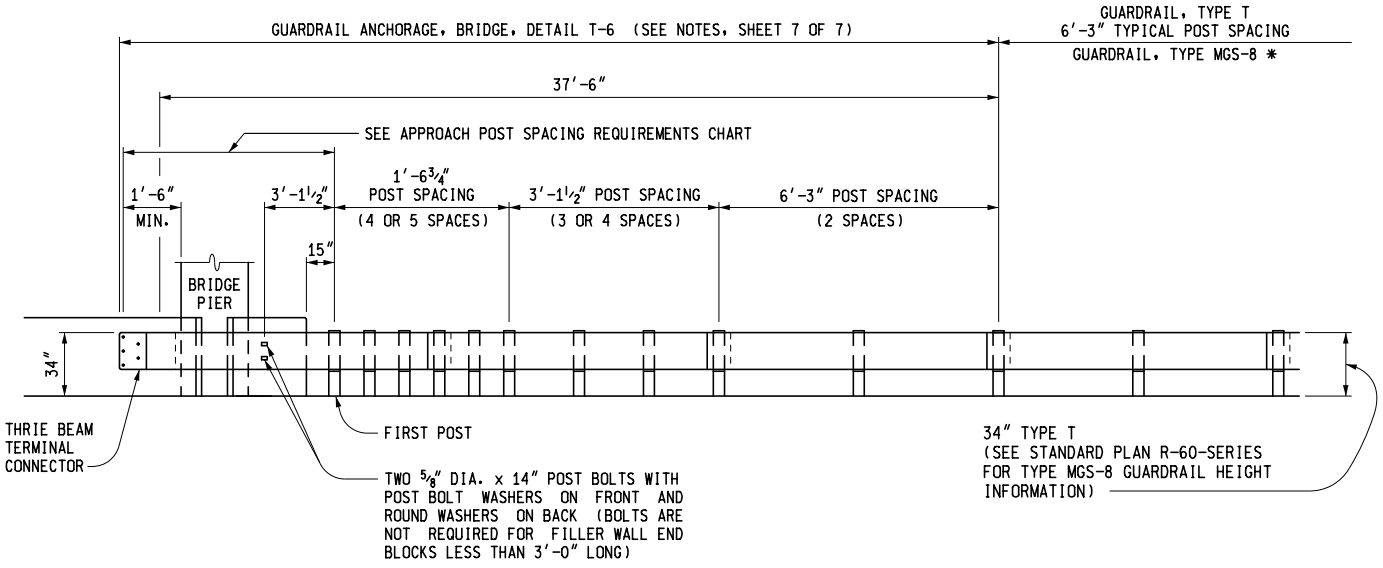
APPROACH POST SPACING REQUIREMENTS				
DISTANCE FROM ANCHOR BOLTS TO FIRST POST	7′-11¾″	9′-6½″	11′-1¼″	12′-8″
NUMBER OF 1′-6¾″ POST SPACINGS	4	5	4	5
NUMBER OF 3′-1½″ POST SPACINGS	4	3	3	4



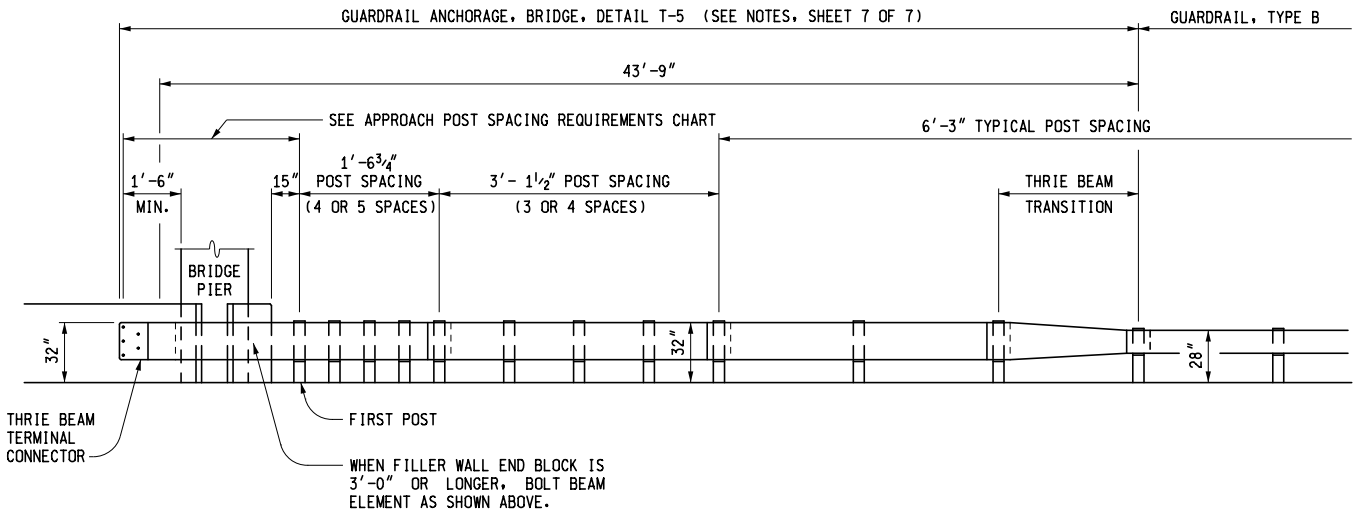
INSTALL BOLTS THROUGH FILLER WALL (SEE CHART FOR BOLT REQUIREMENTS FOR CONNECTING GUARDRAIL TO BRIDGE RAILINGS AND FILLER WALLS, SHEET 5 OF 7)

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL ANCHORAGE, BRIDGE DETAILS T-1, T-4 & T-6

PLAN VIEW



ELEVATION VIEW
(TO BE USED WITH GUARDRAIL, TYPE T & TYPE MGS-8)



ELEVATION VIEW
(TO BE USED WITH GUARDRAIL, TYPE B)

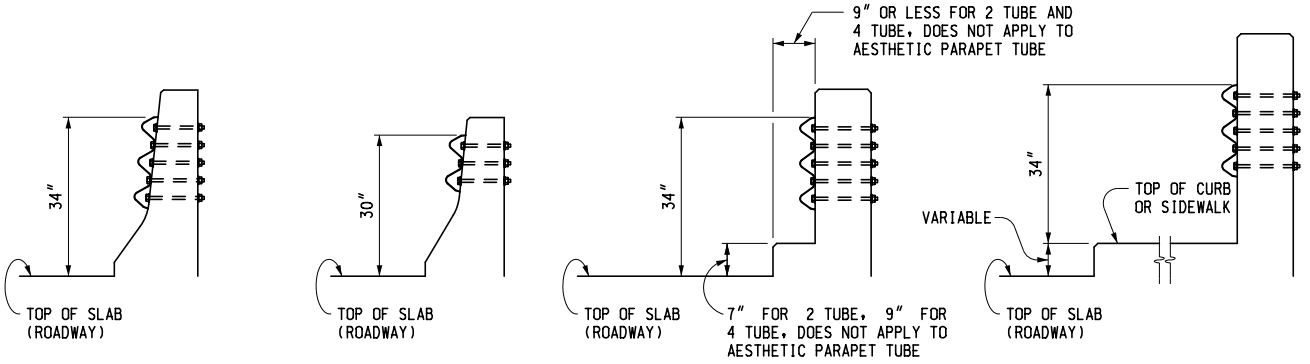
DETAILS FOR CONNECTING GUARDRAIL TO FILLER WALLS

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL ANCHORAGE, BRIDGE, DETAILS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-67-G	SHEET 4 OF 7

HIGH STRENGTH $\frac{7}{8}$" DIA. HEX HEAD BOLT AND NUTS SHALL BE USED TO CONNECT GUARDRAIL TO BRIDGE RAILINGS WITH ROUND WASHERS ON FRONT AND SQUARE WASHERS ON BACK. (SEE CHART BELOW FOR LENGTHS AND NUMBER REQUIRED.) WASHER DETAILS ARE SHOWN ON SHEET 6 OF 7.



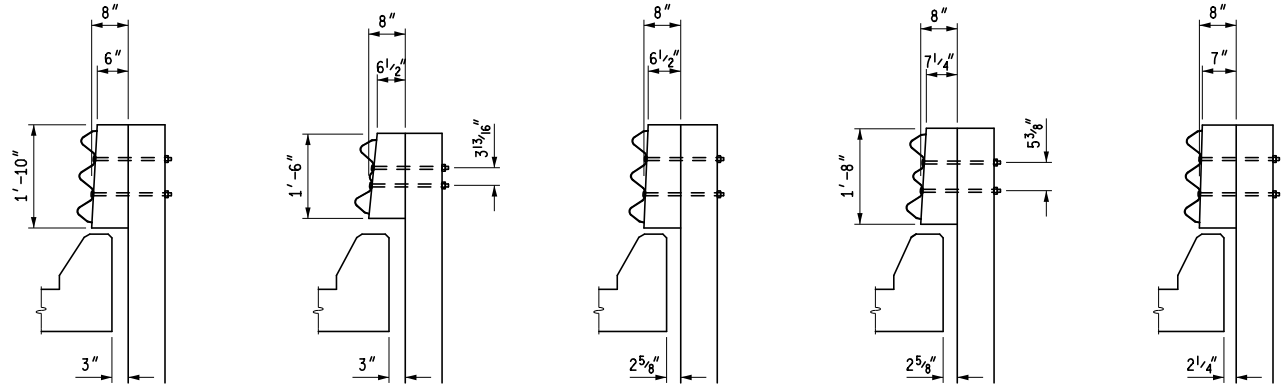
BRIDGE BARRIER RAILING TYPE 4

BRIDGE BARRIER RAILING TYPE 5

BRIDGE RAILING, 2 TUBE, 4 TUBE, OR AESTHETIC PARAPET TUBE
(WITHOUT SIDEWALK OR BRUSH BLOCK)

BRIDGE RAILING, 4 TUBE OR AESTHETIC PARAPET TUBE
(WITH SIDEWALK)

SECTIONS AT BRIDGE RAILINGS



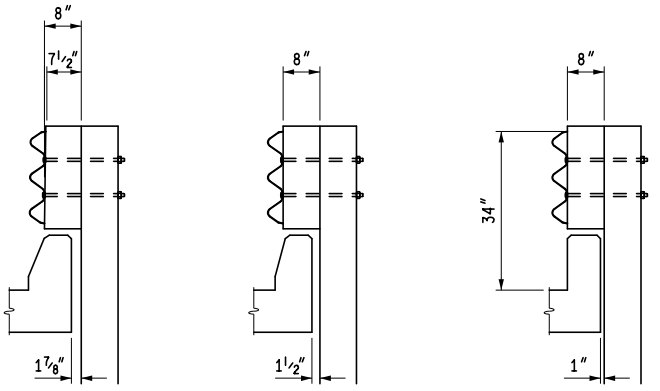
POST 1 FOR BRIDGE BARRIER RAILING, TYPE 4

POST 1 FOR BRIDGE BARRIER RAILING, TYPE 5

POST 2 FOR BRIDGE BARRIER RAILING, TYPE 4

POST 2 FOR BRIDGE BARRIER RAILING, TYPE 5

POST 3



POST 4

POST 5

POST 6

BOLT REQUIREMENTS FOR CONNECTING GUARDRAIL TO BRIDGE RAILINGS & FILLER WALLS			
BRIDGE RAILING	BOLT LENGTH	MINIMUM THREAD LENGTH	NUMBER REQUIRED
TYPE 4	12 1/2"	4"	5
TYPE 5	11 1/2"	4"	4
2 TUBE	WALL THICKNESS + 2"	2"	5
4 TUBE	WALL THICKNESS + 2"	2"	5
AESTHETIC PARAPET	WALL THICKNESS + 2"	2"	5
** FILLER WALL	WALL THICKNESS + 2"	2"	5
SHORTER BOLT LENGTHS MAY BE USED PROVIDED THE BOLT EXTENDS 1/4" BEYOND THE NUT WHEN TIGHTENED.			

** THE USE OF $\frac{7}{8}$" DIA. ADHESIVE ANCHORED BOLTS EMBEDDED 8" TO ATTACH GUARDRAIL TO FILLER WALLS WILL BE ALLOWED, INSTEAD OF BOLTING THROUGH THE FILLER WALL, IN THE FOLLOWING LOCATIONS:

1. AT OR NEAR THE JOINT LINE WHEN A FILLER WALL IS A DIFFERENT THICKNESS THAN THE FILLER WALL EXTENSION.
2. IN EXISTING FILLER WALLS THICKER THAN 1'-6".
3. WHEN CONDITIONS PROHIBIT THE USE OF BOLTS.

GUARDRAIL POST SECTIONS FOR GUARDRAIL ANCHORAGE, BRIDGE

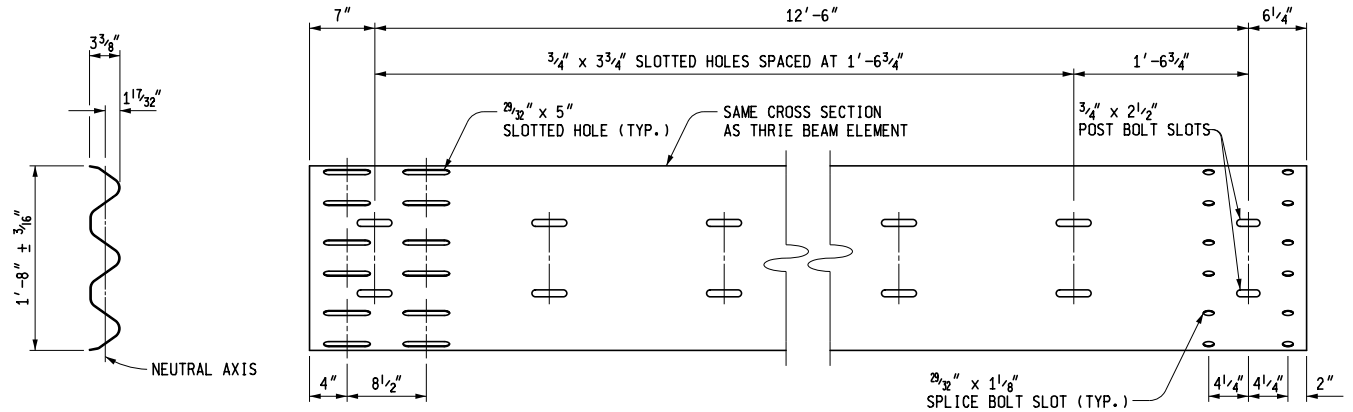
NOTE: ADHESIVE ANCHORS SHALL BE SELECTED FROM THE QUALIFIED PRODUCTS LIST OF THE MATERIALS SAMPLING GUIDE.

NOTE:
POST AND BLOCK SECTIONS FOR THE 2 TUBE, 4 TUBE, AND AESTHETIC PARAPET TUBE BRIDGE RAILINGS SHALL BE THE SAME AS THAT SHOWN ON POST 6. POST SPACING SHALL BE AS SHOWN IN ELEVATION VIEWS.

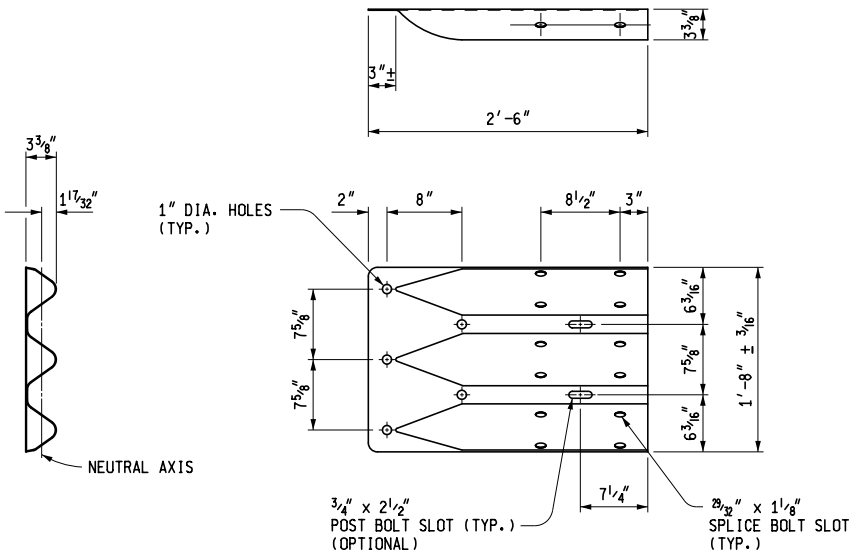
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL ANCHORAGE, BRIDGE, DETAILS

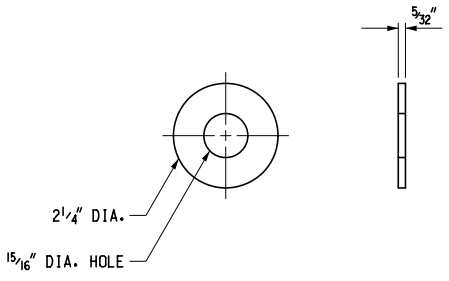
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-67-G	SHEET 5 OF 7



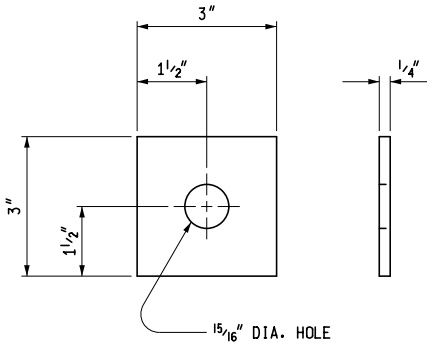
THRIE BEAM EXPANSION SECTION



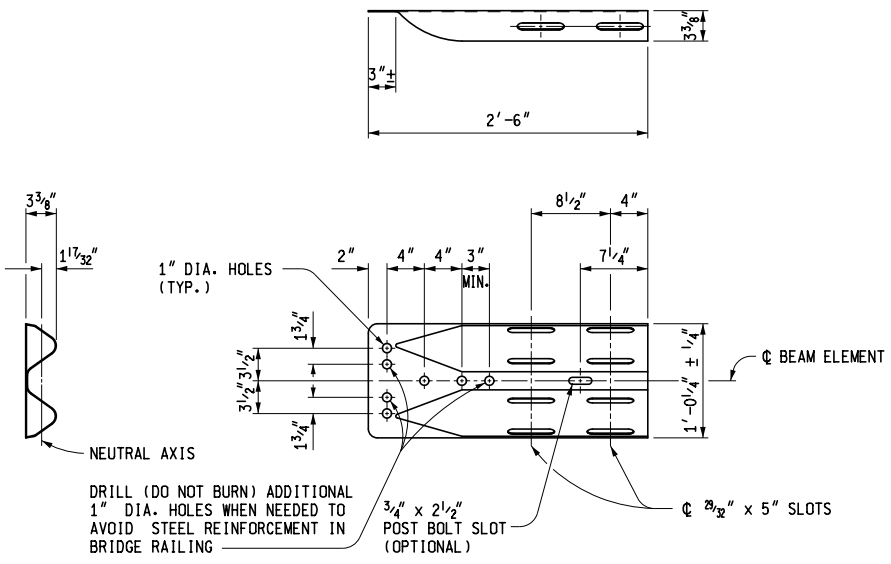
THRIE BEAM TERMINAL CONNECTOR



ROUND WASHER FOR 7/8" DIA. BOLTS



SQUARE WASHER FOR 7/8" DIA. BOLTS



SPECIAL END SHOE

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL ANCHORAGE, BRIDGE, DETAILS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-67-G	SHEET 6 OF 7

NOTES:

ALL POSTS, OFFSET BLOCKS, BEAM ELEMENTS, REFLECTORS, AND HARDWARE, (INCLUDING BOLTS, NUTS, AND WASHERS) SHALL CONFORM TO THE CURRENT STANDARD SPECIFICATIONS AND TO THE CURRENT STANDARD PLAN R-60-SERIES, WHERE APPLICABLE, EXCEPT AS SPECIFIED ON THIS STANDARD.

ALL POSTS USED TO CONSTRUCT GUARDRAIL ANCHORAGE, BRIDGE SHALL BE 7'-0" LONG.

THE THRIE BEAM TERMINAL CONNECTOR AND SPECIAL END SHOE SHALL BE THE SAME MATERIAL AS ADJACENT RUN OF GUARDRAIL, EXCEPT THAT THEY SHALL NOT BE LIGHTER THAN 10 GAGE (0.138").

SECTIONS OF THE THRIE BEAM ELEMENT REQUIRED TO BE TWISTED FOR USE IN ANCHORAGE SHALL BE FIELD BENT.

GUARDRAIL BEAM ELEMENTS SHALL BE LAPPED IN THE DIRECTION OF TRAFFIC, EXCEPT FOR THE THRIE BEAM TERMINAL CONNECTOR WHICH MAY BE LAPPED IN EITHER DIRECTION.

STANDARD SPLICE BOLTS SHALL BE USED WHEN SPLICING THE THRIE BEAM TERMINAL CONNECTOR TO THE THRIE BEAM EXPANSION SECTION AND WHEN SPLICING THE SPECIAL END SHOE TO THE TRANSITION SECTION. THE SPLICE BOLT NUT SHALL BE INSTALLED FINGER-TIGHT AND SHALL FULLY ENGAGE THE SPLICE BOLT WITH A MINIMUM OF ONE THREAD EXTENDING BEYOND THE NUT. THIS SHALL BE FOLLOWED UP BY UPSETTING THE FIRST THREAD ON THE OUTSIDE OF THE NUT WITH A CENTER PUNCH OR COLD CHISEL, SO THAT IT WILL NOT LOOSEN.

SEE THE CURRENT STANDARD PLAN R-32-SERIES FOR APPROACH CURB AND GUTTER AND DOWNSPOUT HEADER.

GUARDRAIL ANCHORAGE, BRIDGE, DETAILS T-1, T-2, T-5, AND T-6 REQUIRE THAT THE THRIE BEAM TERMINAL CONNECTOR BE ATTACHED TO THE $\frac{29}{32}$" x 5" LONG SLOTTED HOLES IN THE THRIE BEAM EXPANSION SECTION.

SEE APPROPRIATE PLANS TO DETERMINE WHETHER GUARDRAIL ANCHORAGE, BRIDGE SPANS A BRIDGE EXPANSION JOINT.

SEE THE CURRENT STANDARD PLAN R-55-SERIES FOR FILLER WALLS AND FILLER WALL END BLOCK.

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL ANCHORAGE, BRIDGE, DETAILS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-67-G	SHEET 7 OF 7

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL APPROACH TERMINAL, TYPE 1B OR GUARDRAIL APPROACH TERMINAL, TYPE 2B.

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

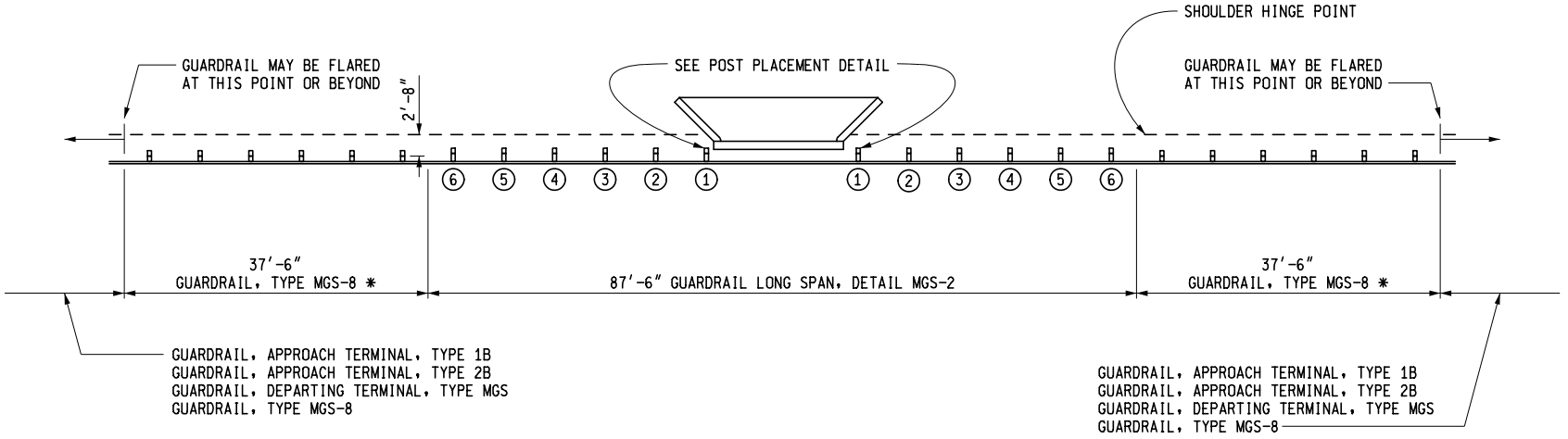
APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

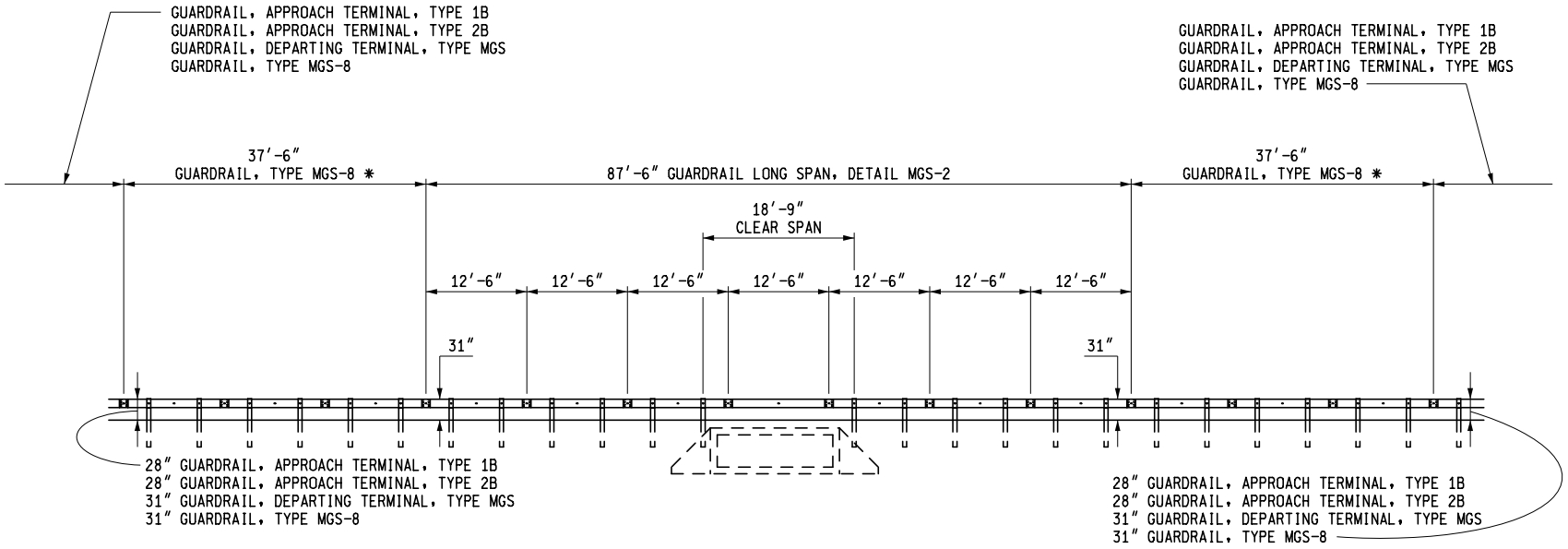
W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 1 OF 11

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL APPROACH TERMINAL, TYPE 1B OR GUARDRAIL APPROACH TERMINAL, TYPE 2B.



PLAN



ELEVATION

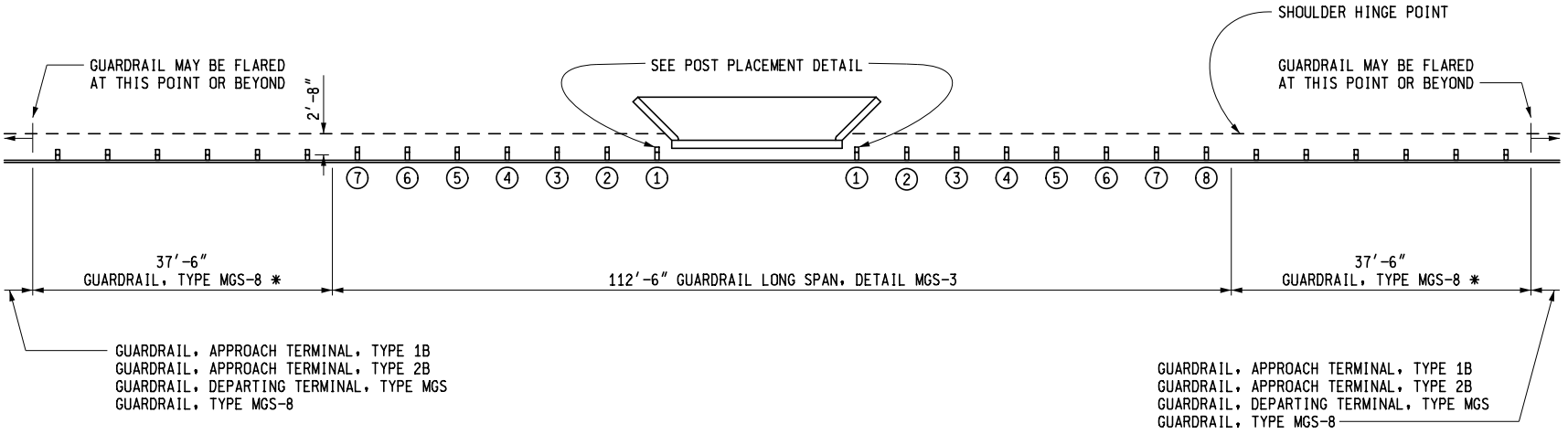
GUARDRAIL LONG SPAN, DETAIL MGS-2

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

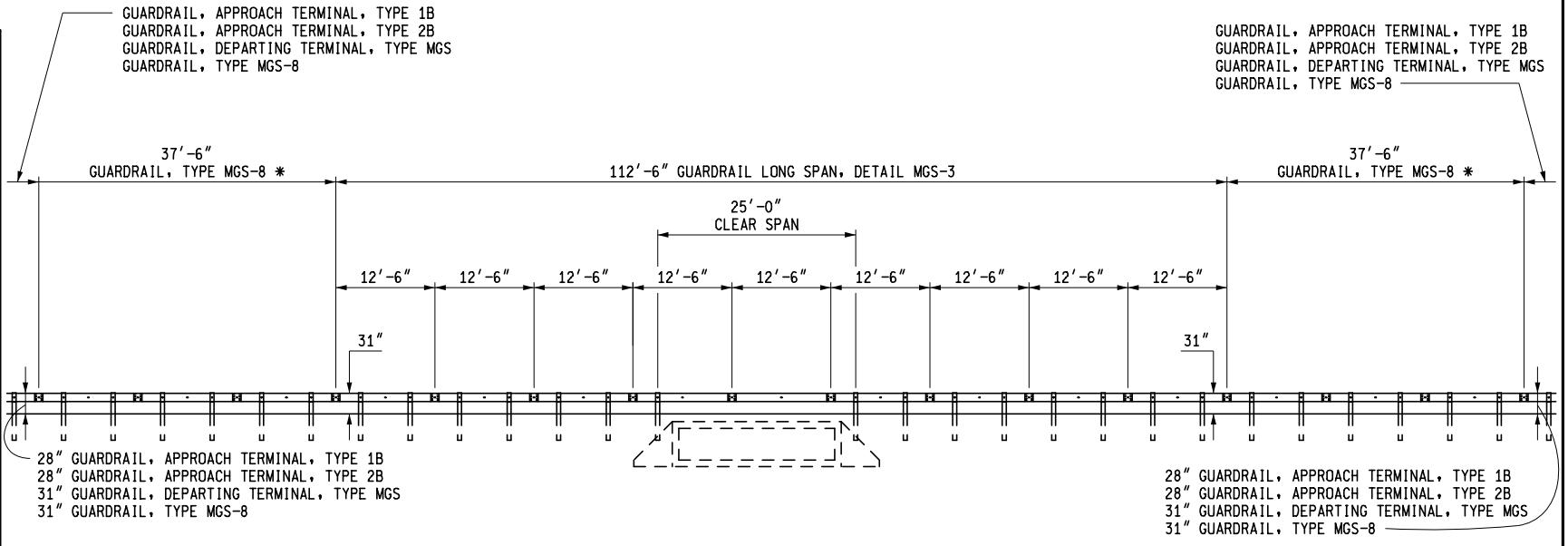
W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 2 OF 11

* SEE STANDARD PLAN R-60-SERIES FOR POST SPACING AND GUARDRAIL LAYOUT TO TRANSITION FROM GUARDRAIL, TYPE MGS-8 TO GUARDRAIL APPROACH TERMINAL, TYPE 1B OR GUARDRAIL APPROACH TERMINAL, TYPE 2B.



PLAN



ELEVATION

GUARDRAIL LONG SPAN, DETAIL MGS-3

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

F.H.W.A. APPROVAL

3-15-2016
PLAN DATE

R-72-D

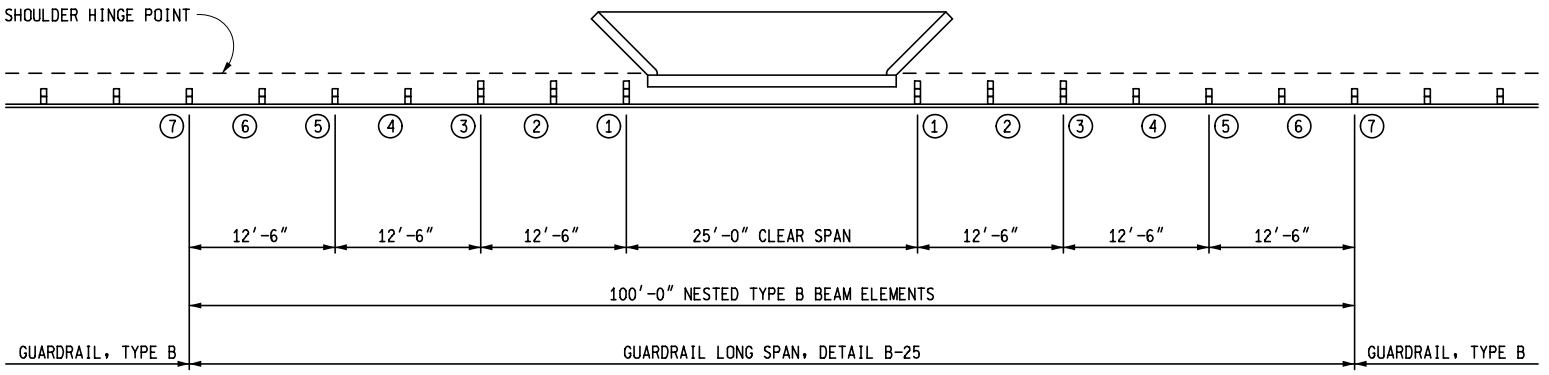
SHEET
3 OF 11

NOTES:

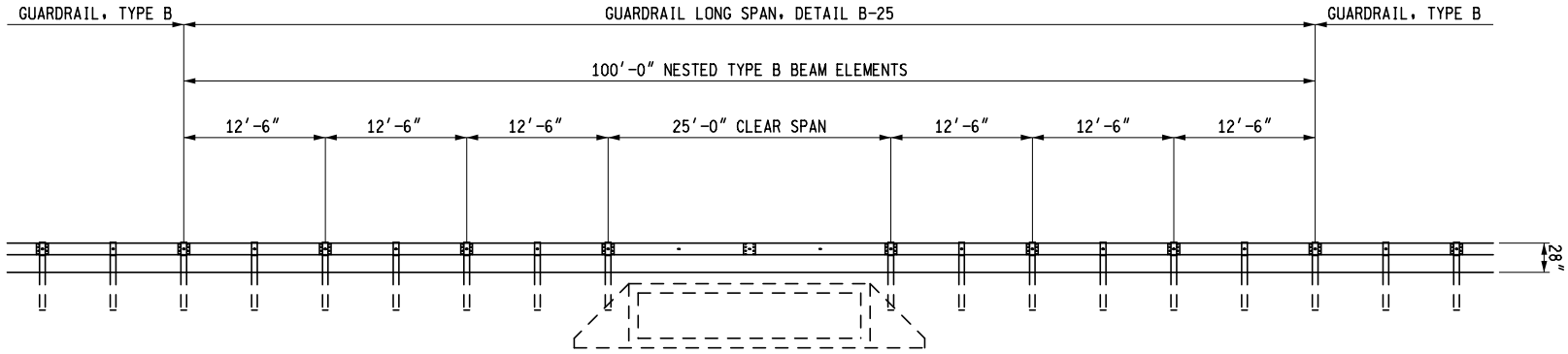
POSTS 1, 2, AND 3 ARE CRT POSTS WITH TWO STANDARD WOOD OFFSET BLOCKS ATTACHED TO THE POST. SEE SHEET 10 FOR CRT POST DETAIL.

POSTS 4, 5, 6, AND 7 ARE STANDARD STEEL OR WOOD TYPE B POSTS WITH OFFSET BLOCK. SEE STANDARD PLAN R-60-SERIES.

INSTALL A MINIMUM OF 12'-6" OF TYPE B GUARDRAIL BETWEEN POST 7 AND GUARDRAIL TERMINAL.



PLAN



ELEVATION

GUARDRAIL LONG SPAN, DETAIL B-25

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

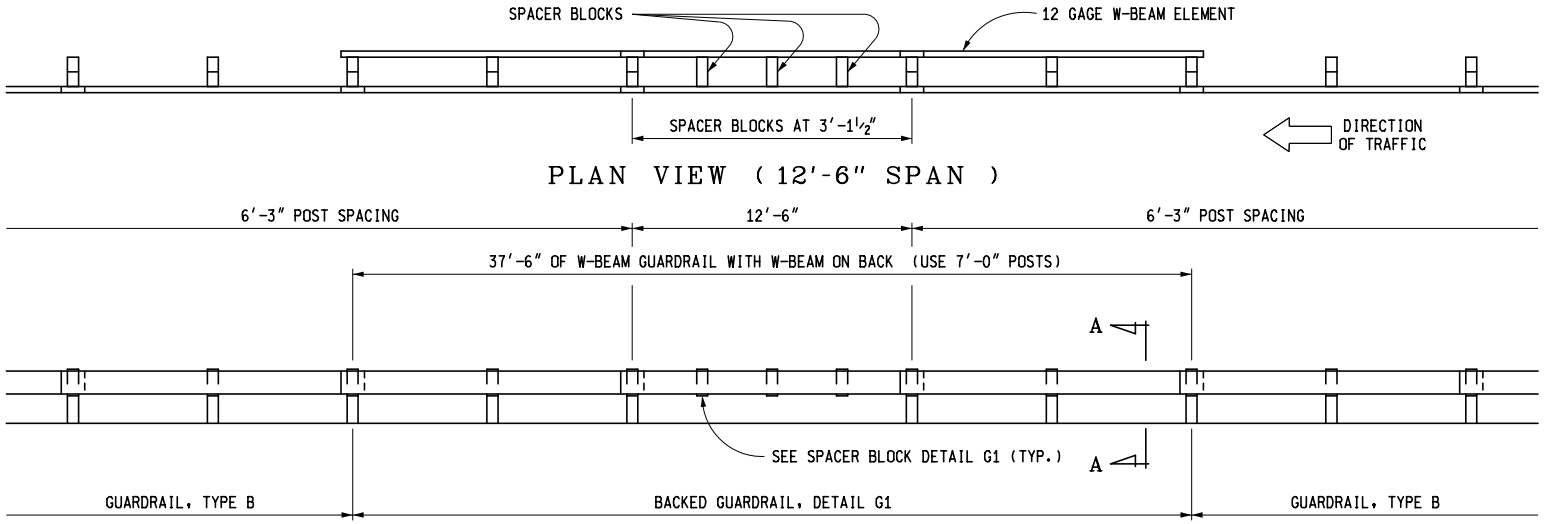
W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

F.H.W.A. APPROVAL

3-15-2016
PLAN DATE

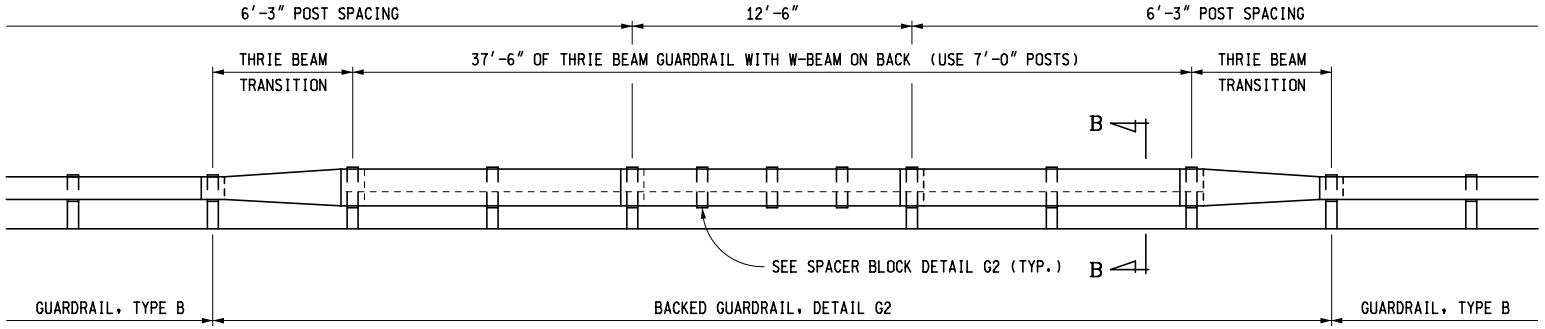
R-72-D

SHEET
4 OF 11



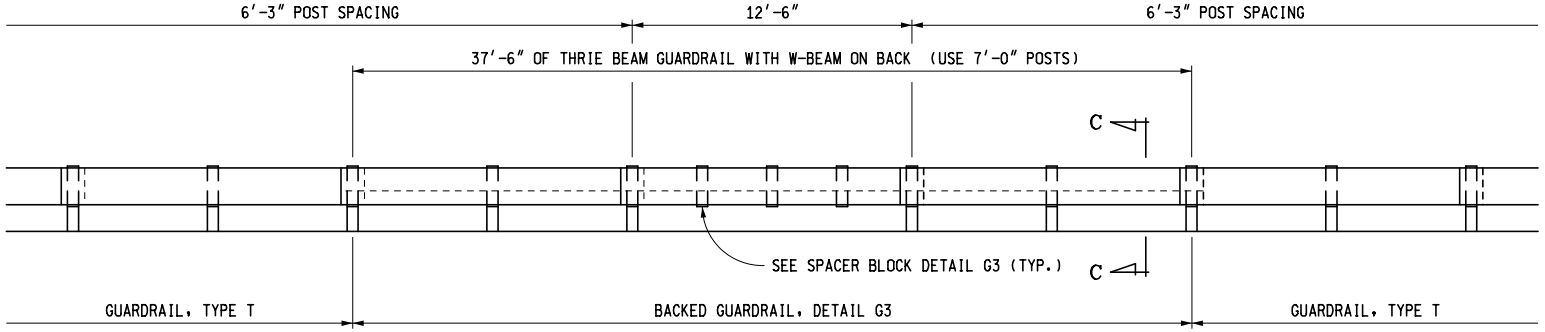
PLAN VIEW (12'-6" SPAN)

W-BEAM BACKED GUARDRAIL, TYPE B (12'-6" SPAN)



W-BEAM BACKED GUARDRAIL, TYPE T (12'-6" SPAN)

(USE AT DEEP THROATED DOWNSPOUT HEADERS)



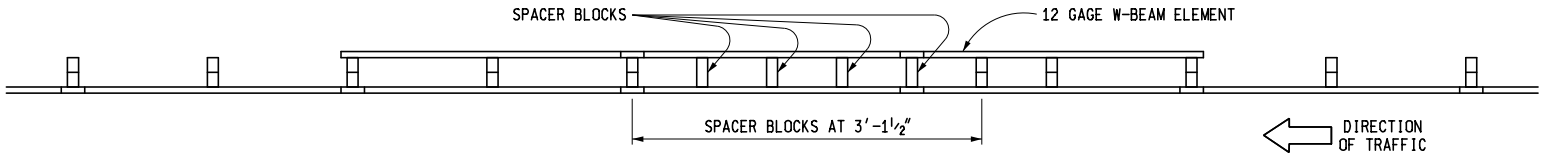
W-BEAM BACKED GUARDRAIL, TYPE T (12'-6" SPAN)

MICHIGAN DEPARTMENT OF TRANSPORTATION

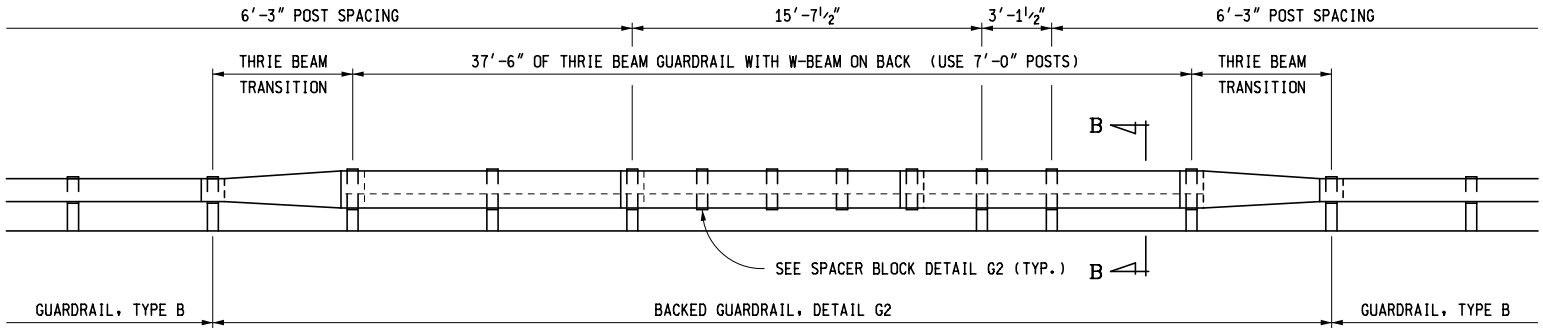
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

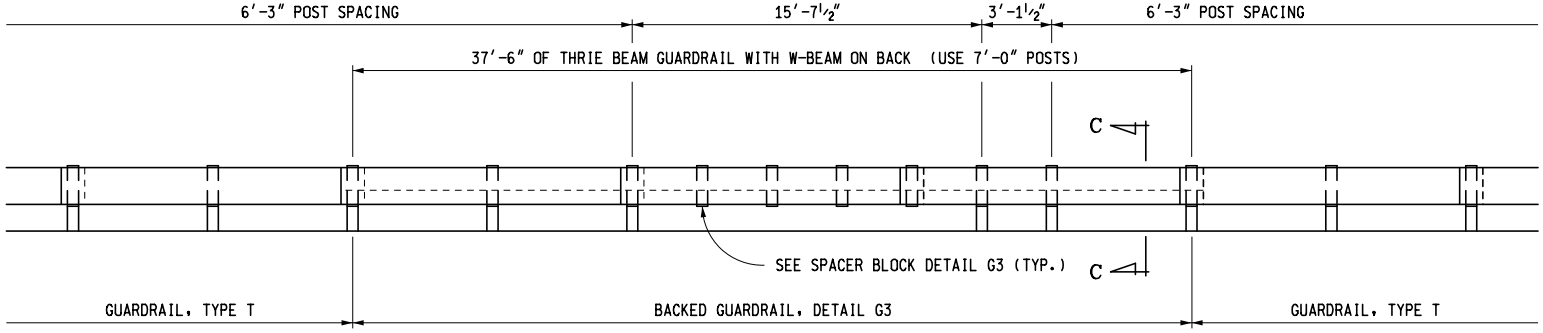
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 5 OF 11



PLAN VIEW (15′-7½″ SPAN)



W-BEAM BACKED GUARDRAIL, TYPE T (15′-7½″ SPAN)

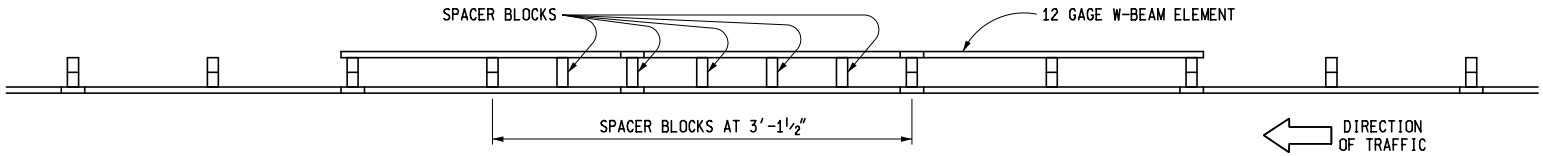


W-BEAM BACKED GUARDRAIL, TYPE T (15′-7½″ SPAN)

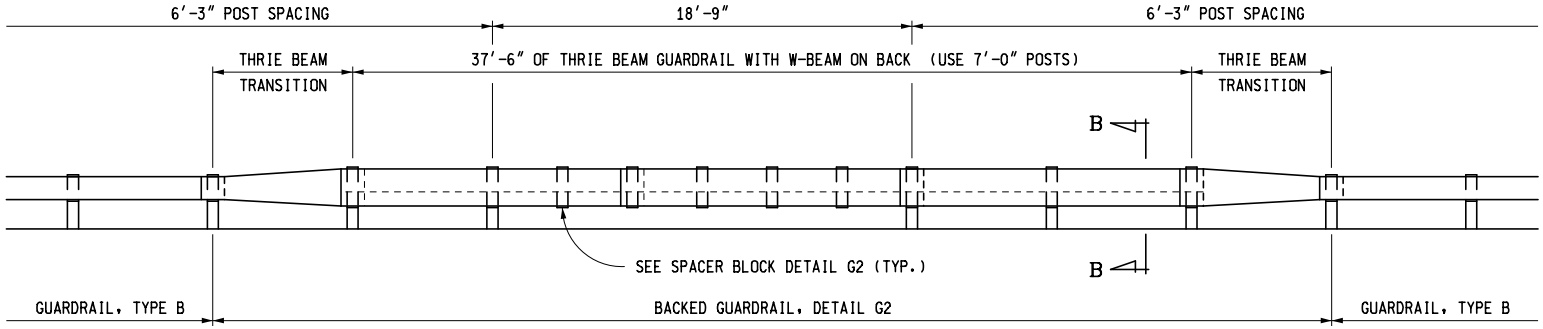
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

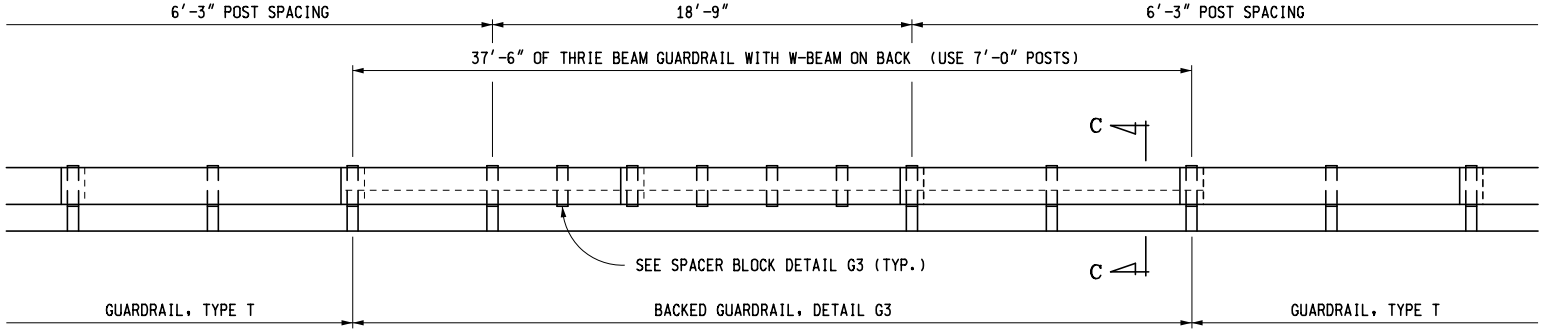
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 6 OF 11



PLAN VIEW (18′-9″ SPAN)



W-BEAM BACKED GUARDRAIL, TYPE T (18′-9″ SPAN)

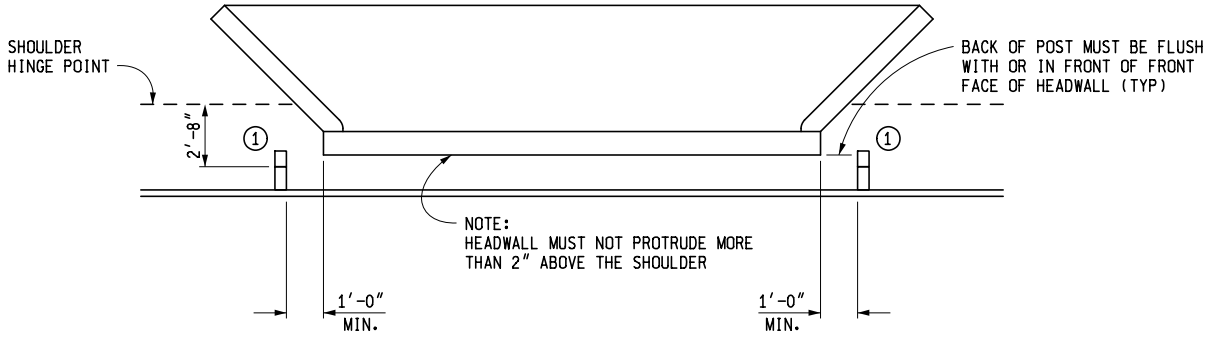


W-BEAM BACKED GUARDRAIL, TYPE T (18′-9″ SPAN)

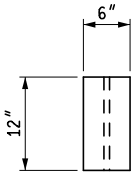
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

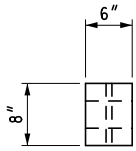
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 7 OF 11



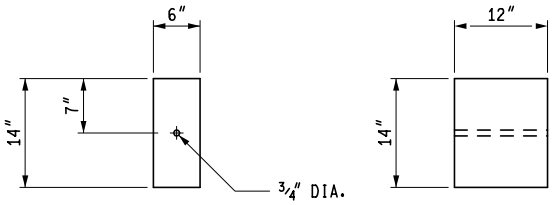
POST PLACEMENT DETAIL



TOP



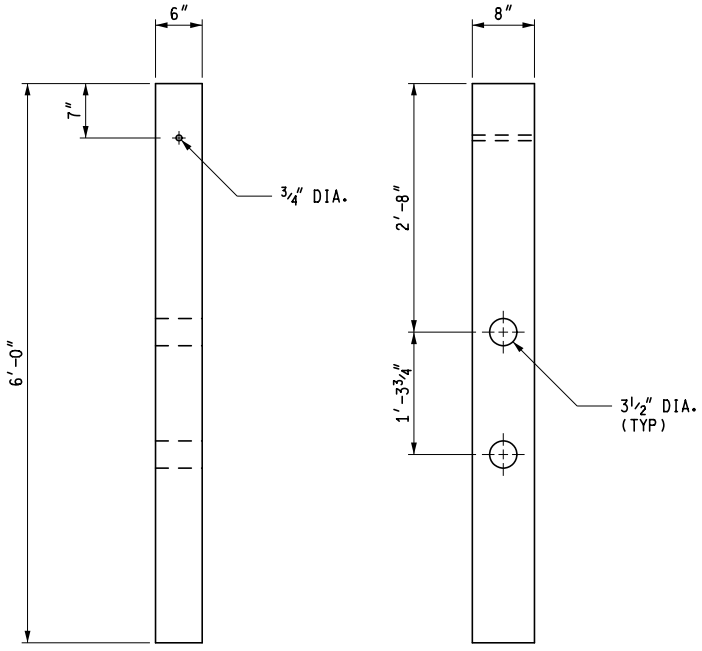
PLAN



FRONT SIDE

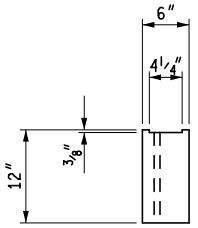
MGS 12" OFFSET BLOCK

FOR USE ON WOOD POSTS

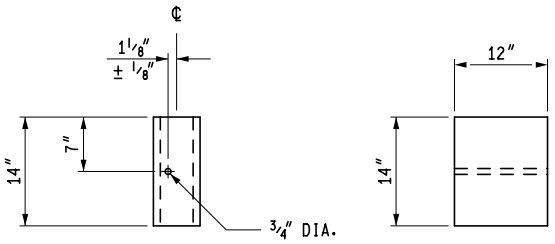


FRONT SIDE

MGS-CRT POST



TOP



FRONT SIDE

MGS 12" OFFSET BLOCK

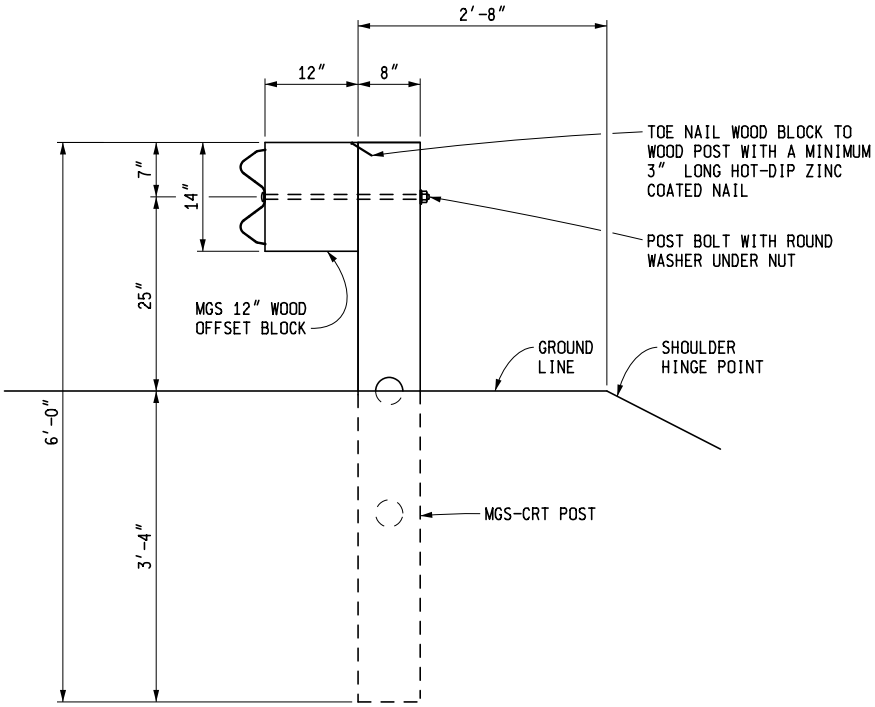
FOR USE ON STEEL POSTS

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

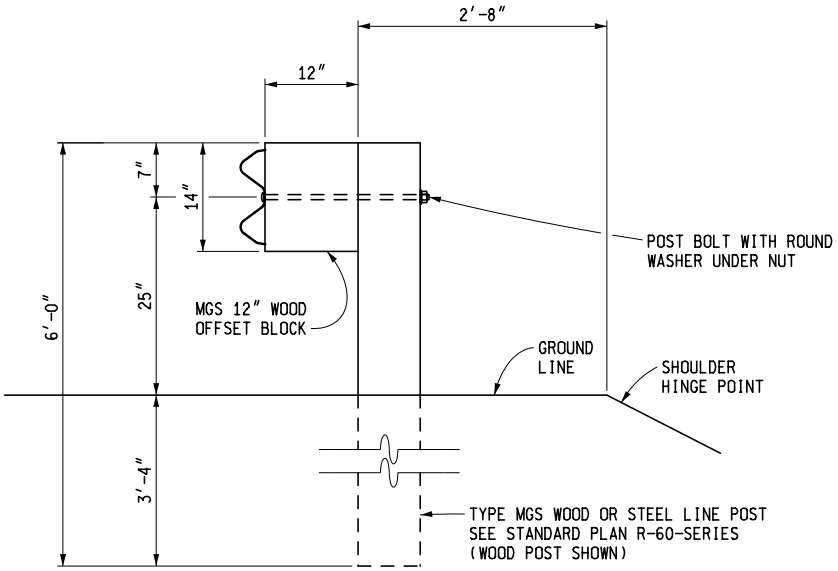
W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 8 OF 11



POST 1 THROUGH 3 DETAIL

GUARDRAIL LONG SPAN DETAILS MGS-1, MGS-2, & MGS-3



POST 4 THROUGH 6 DETAIL

GUARDRAIL LONG SPAN DETAILS MGS-1 & MGS-2

POST 4 THROUGH 8 DETAIL

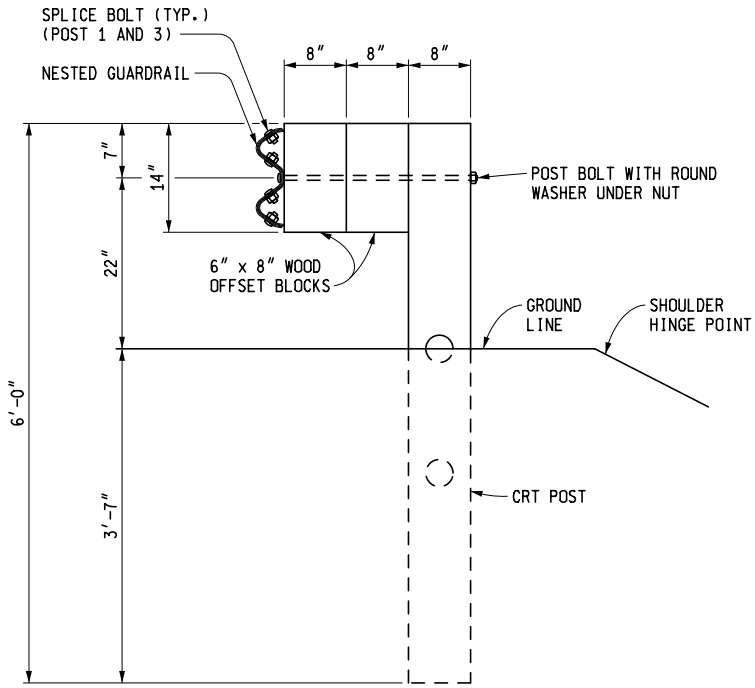
GUARDRAIL LONG SPAN DETAIL MGS-3

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

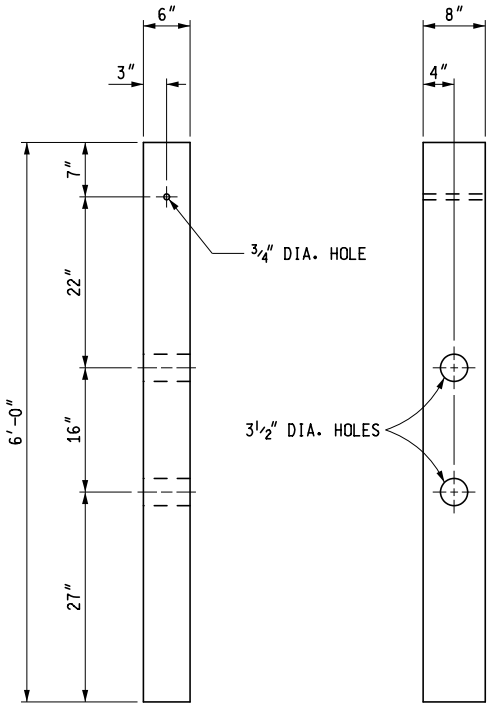
W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 9 OF 11

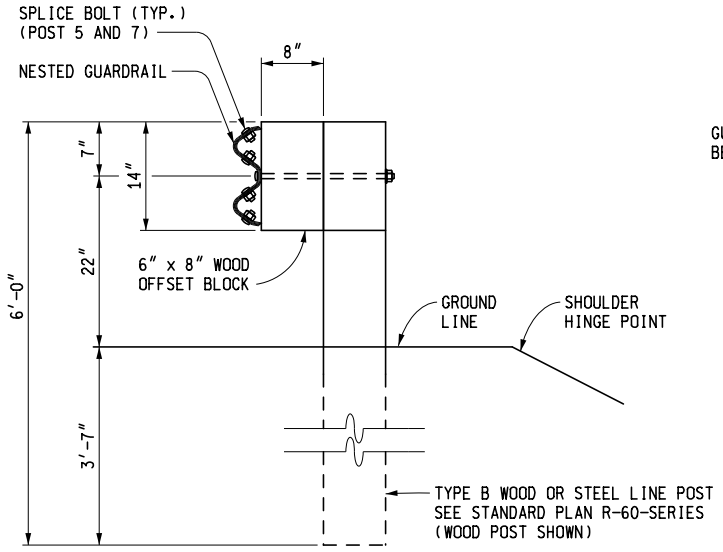


POST 1 THROUGH 3 DETAIL

GUARDRAIL LONG SPAN DETAIL B-25

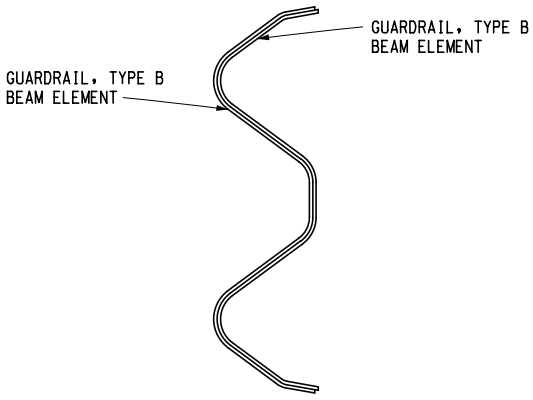


CONTROLLED RELEASING
TERMINAL POST
(CRT)



POST 4 THROUGH 7 DETAIL

GUARDRAIL LONG SPAN DETAIL B-25



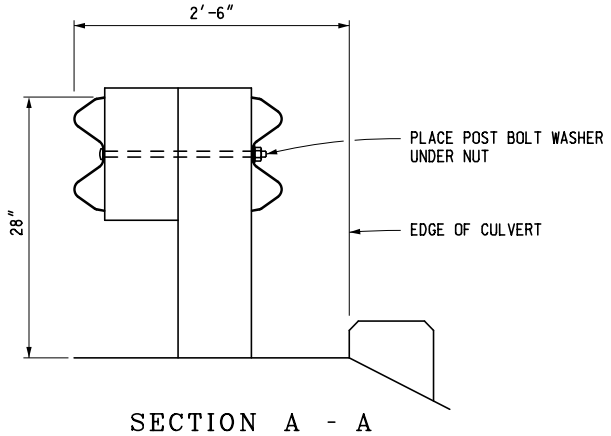
NESTED GUARDRAIL
DETAIL

MICHIGAN DEPARTMENT OF TRANSPORTATION

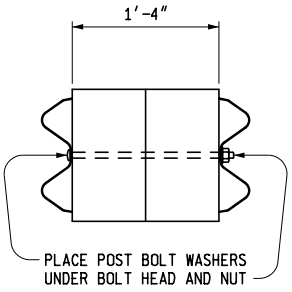
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

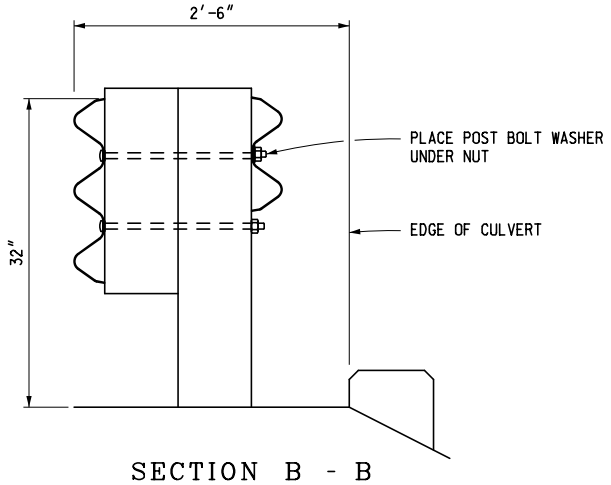
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 10 OF 11



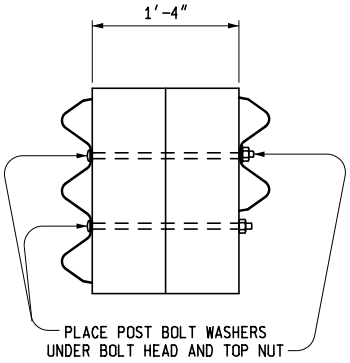
SECTION A - A



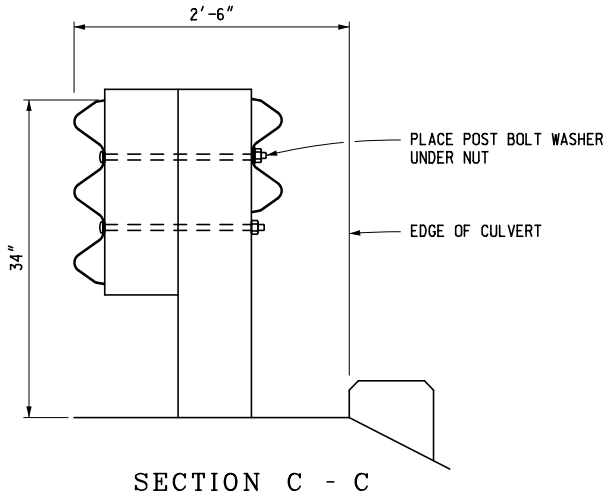
SPACER BLOCK DETAIL G1



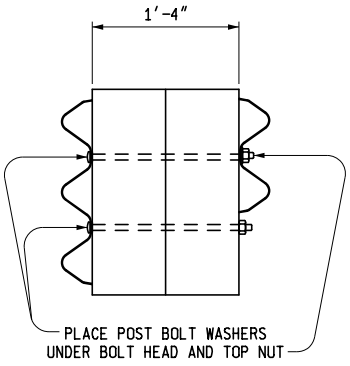
SECTION B - B



SPACER BLOCK DETAIL G2



SECTION C - C



SPACER BLOCK DETAIL G3

NOTES:

ALL POSTS, OFFSET BLOCKS, BEAM ELEMENTS, AND HARDWARE (INCLUDING BOLTS, NUTS, AND WASHERS) SHALL BE ACCORDING TO THE CURRENT STANDARD SPECIFICATIONS AND THE CURRENT STANDARD PLAN R-60-SERIES, WHERE APPLICABLE, EXCEPT WHERE NOTED ON THIS STANDARD.

THE GUARDRAIL MODIFICATIONS DETAILED ON THIS STANDARD SHOULD ONLY BE USED WHERE 6′-3″ POST SPACING AND POST EMBEDMENT CANNOT BE MET. WHEN THE SPANNING DISTANCE BETWEEN POSTS IS 15′-7½″, THE 3′-1½″ POST SPACING SHOULD BE PLACED ON THE APPROACH END.

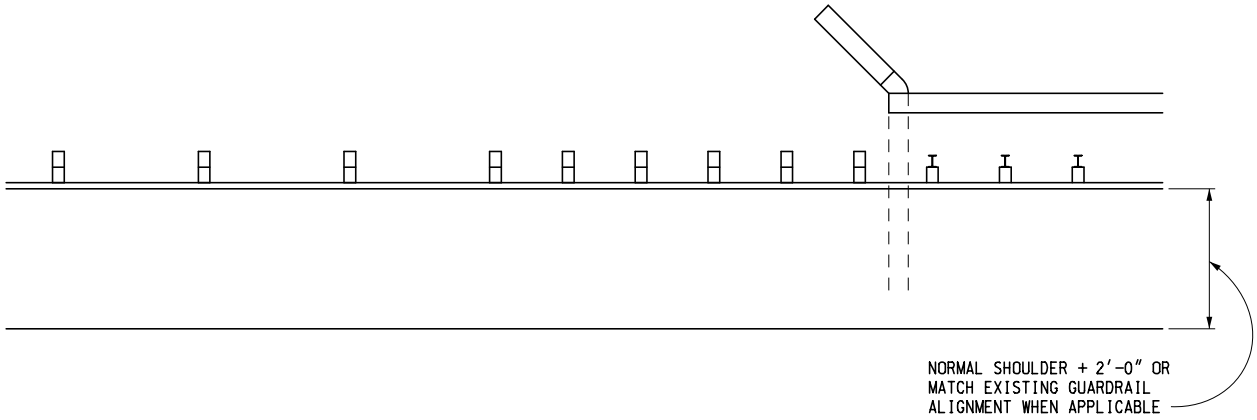
IF USE OF THIS DESIGN WOULD INTERFERE WITH THE POST SPACING WITHIN A GUARDRAIL BRIDGE ANCHORAGE AS SPECIFIED ON STANDARD PLAN R-67-SERIES, OTHER OPTIONS SHOULD BE INVESTIGATED AND USED.

MICHIGAN DEPARTMENT OF TRANSPORTATION

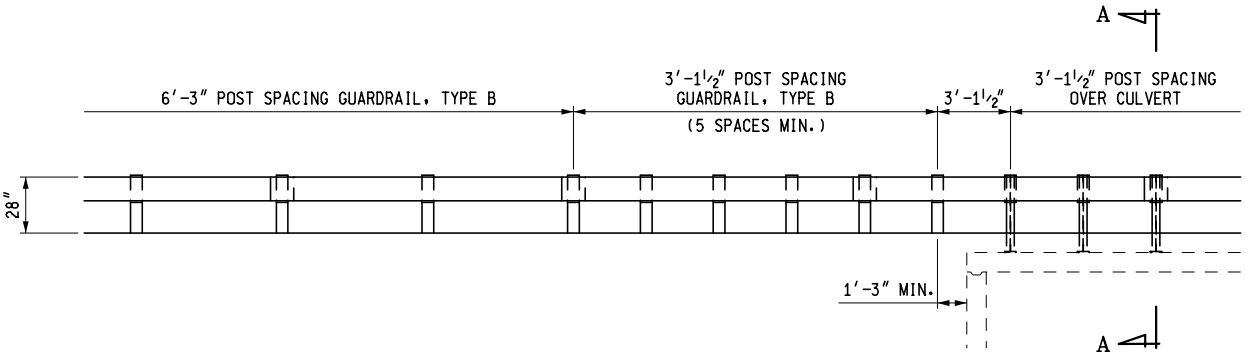
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

W-BEAM BACKED GUARDRAIL AND GUARDRAIL LONG SPAN INSTALLATIONS

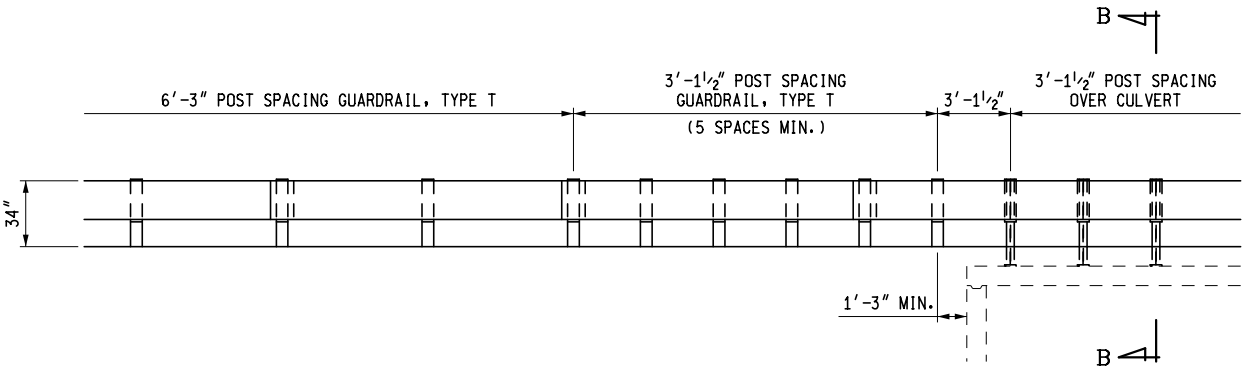
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-72-D	SHEET 11 OF 11



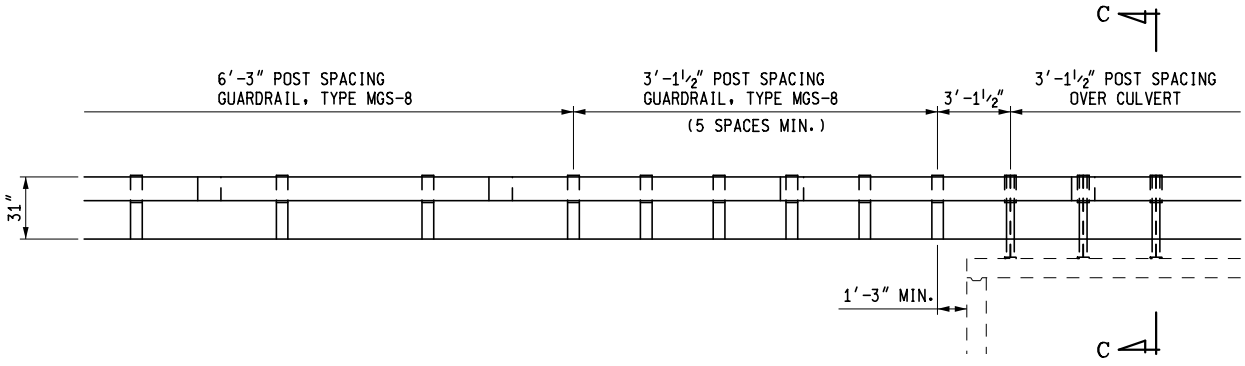
PLAN VIEW



ELEVATION SHOWING GUARDRAIL, TYPE B



ELEVATION SHOWING GUARDRAIL, TYPE T



ELEVATION SHOWING GUARDRAIL, TYPE MGS-8

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

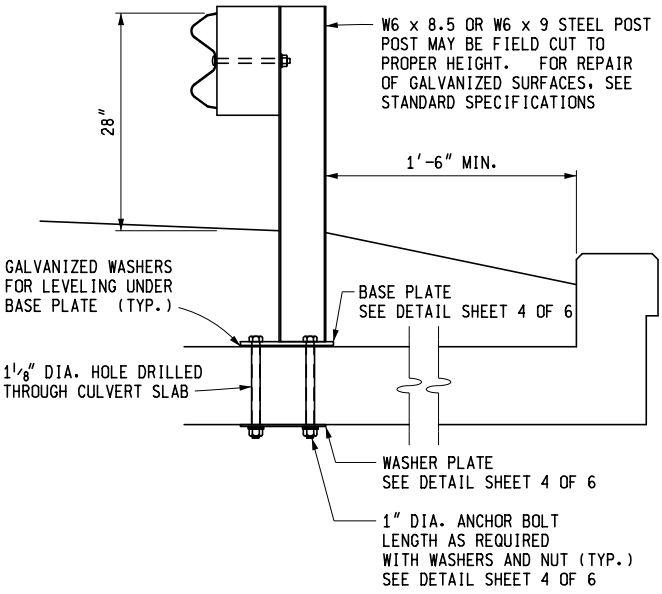
APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

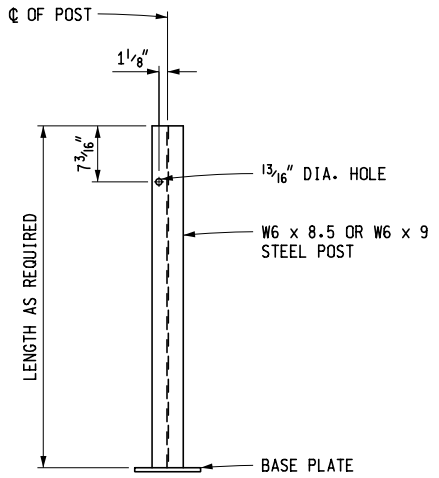
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL OVER BOX OR SLAB CULVERTS

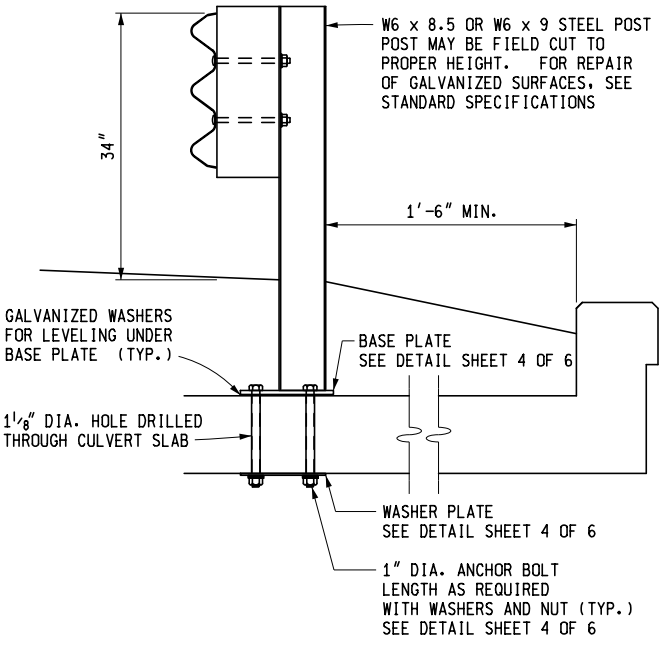
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-73-F	SHEET 1 OF 6



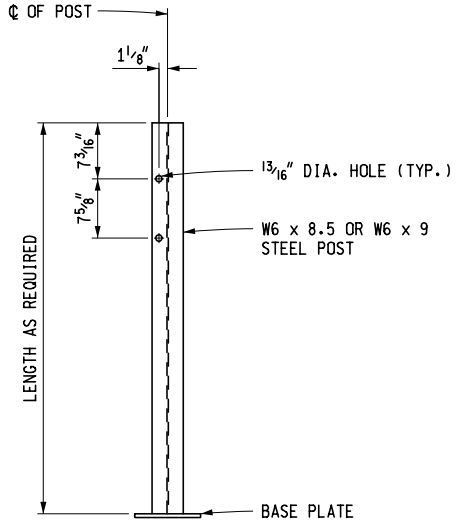
SECTION A - A



STEEL POST DETAIL FOR
GUARDRAIL, TYPE B



SECTION B - B



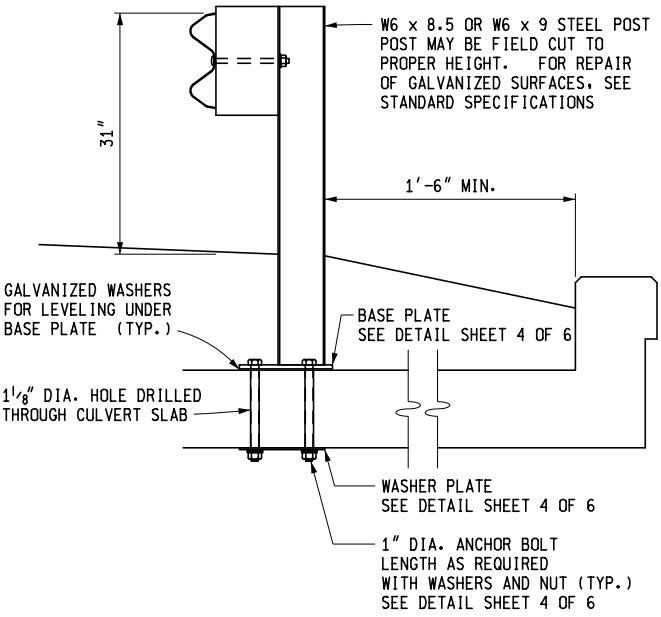
STEEL POST DETAIL FOR
GUARDRAIL, TYPE T

PREFERRED CONSTRUCTION METHOD

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

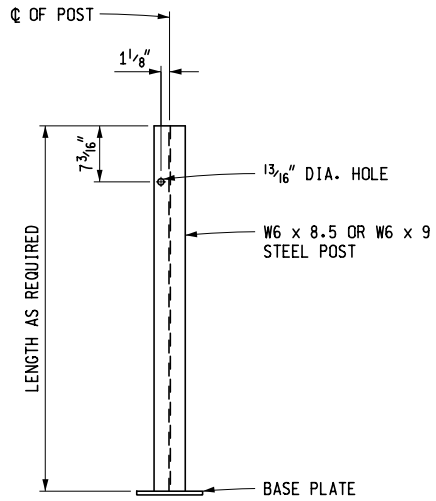
GUARDRAIL OVER BOX OR SLAB CULVERTS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-73-F	SHEET 2 OF 6



SECTION C - C

GUARDRAIL, TYPE MGS-8



STEEL POST DETAIL FOR GUARDRAIL, TYPE MGS-8

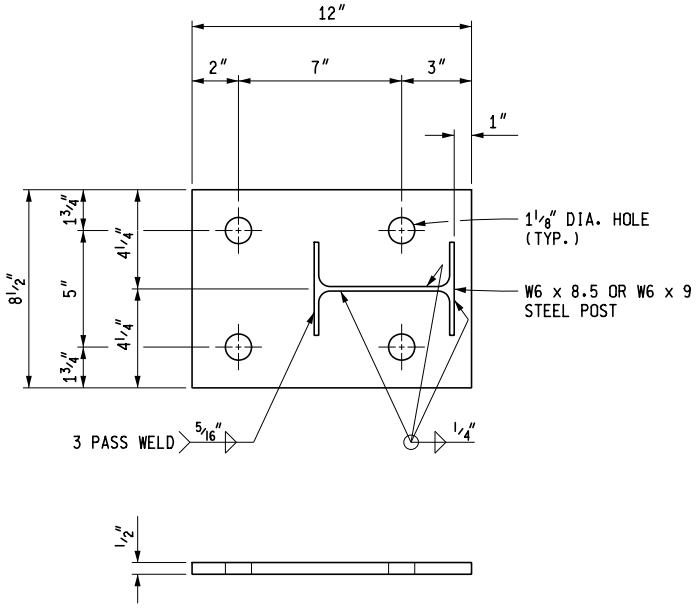
PREFERRED CONSTRUCTION METHOD

MICHIGAN DEPARTMENT OF TRANSPORTATION

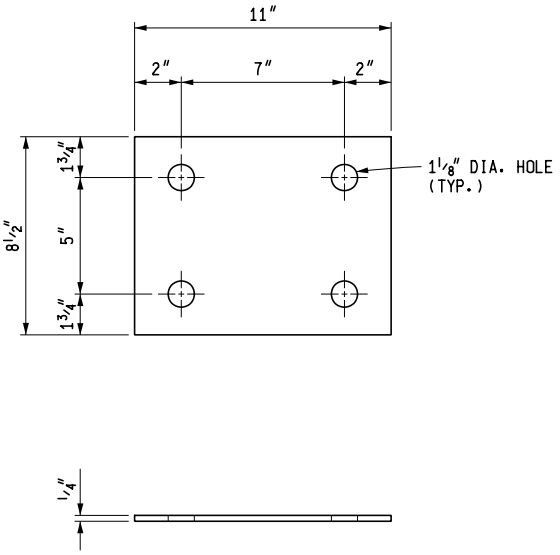
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL OVER BOX OR SLAB CULVERTS

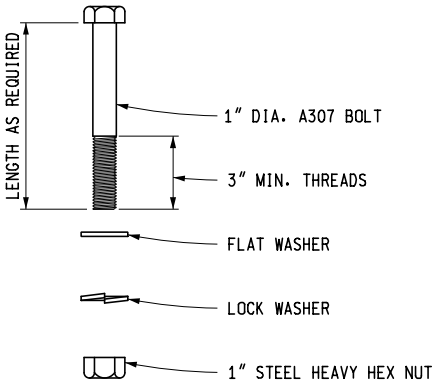
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-73-F	SHEET 3 OF 6



BASE PLATE DETAIL



WASHER PLATE DETAIL



ANCHOR BOLT DETAIL

NOTES:

GUARDRAIL SHALL BE CONSTRUCTED AND PAID FOR ACCORDING TO THE CURRENT STANDARD PLAN R-60-SERIES AND THE CURRENT STANDARD SPECIFICATIONS. IN ADDITION, POSTS ANCHORED TO THE CULVERT SLAB WILL BE PAID FOR AS "GUARDRAIL POST, CULV", WHICH INCLUDES ALL LABOR AND MATERIALS REQUIRED TO CONSTRUCT THE POST AS DETAILED ON THIS PLAN.

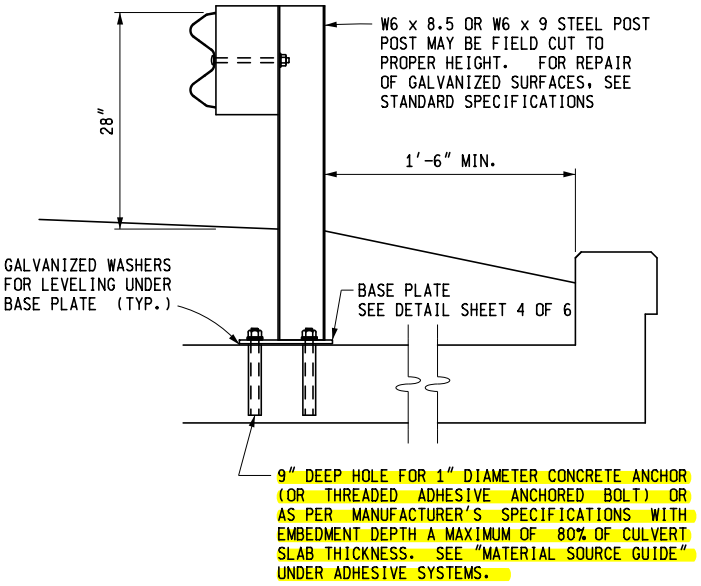
ALL MATERIALS FOR GUARDRAIL POST, CULVERT SHALL MEET THE CURRENT STANDARD SPECIFICATIONS FOR BRIDGE RAILINGS.

ALL WORK AND MATERIALS SHALL BE ACCORDING TO THE CURRENT STANDARD SPECIFICATIONS.

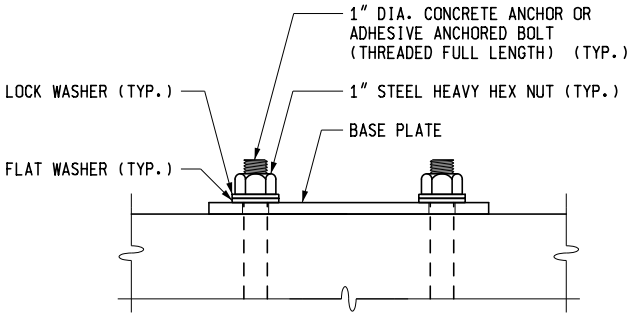
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL OVER BOX OR SLAB CULVERTS

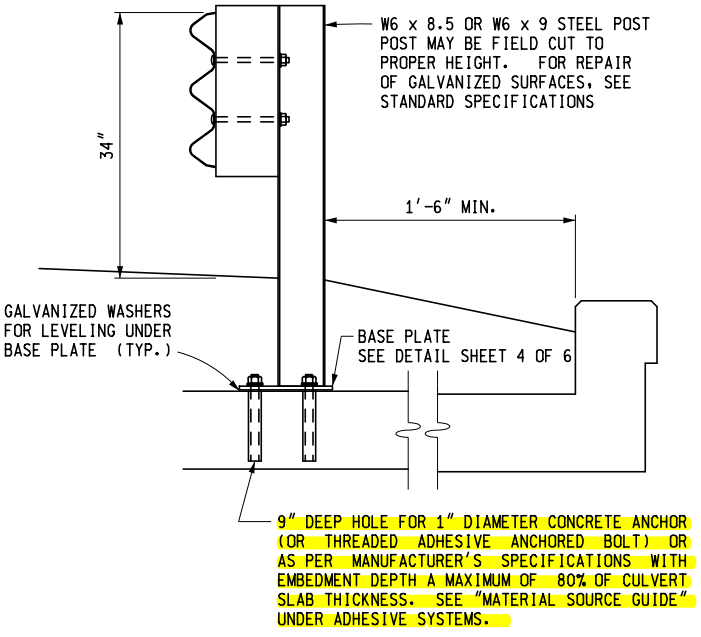
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-73-F	SHEET 4 OF 6



SECTION A - A



ANCHOR DETAIL



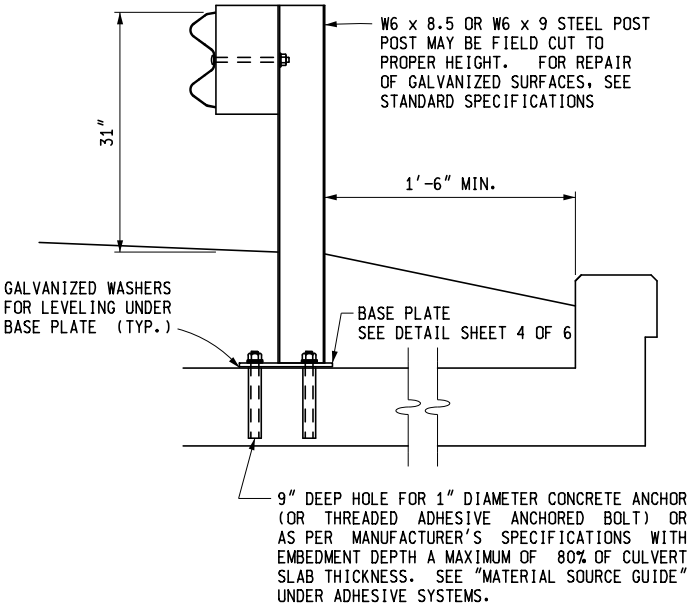
SECTION B - B

ALTERNATE CONSTRUCTION METHOD

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

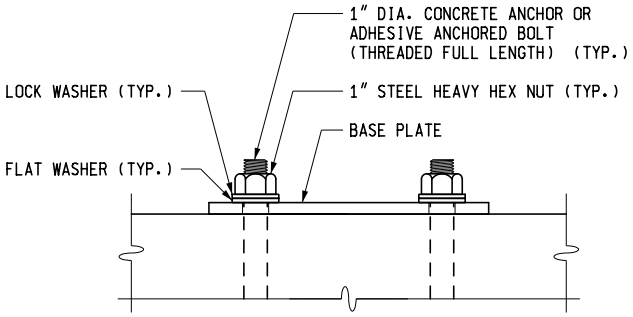
GUARDRAIL OVER BOX OR SLAB CULVERTS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-73-F	SHEET 5 OF 6



SECTION C - C

GUARDRAIL, TYPE MGS-8



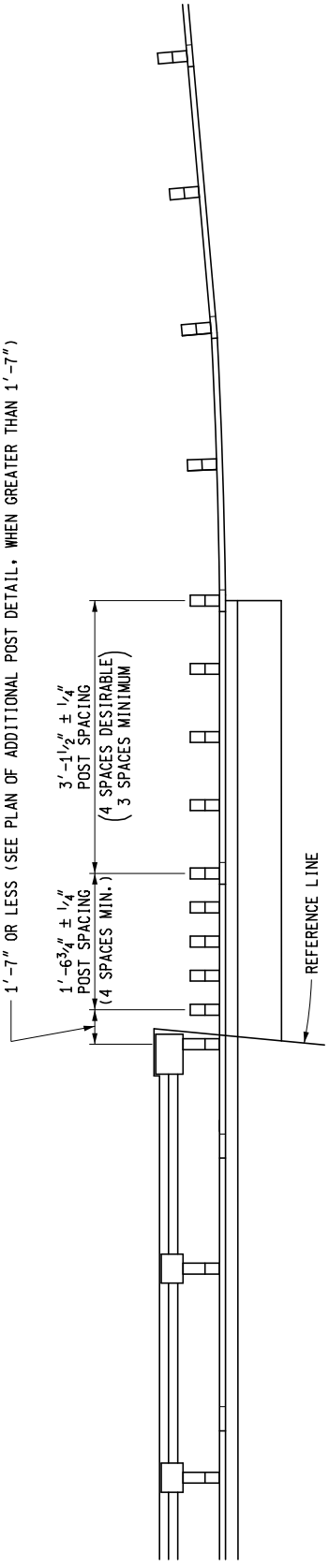
ANCHOR DETAIL

ALTERNATE CONSTRUCTION METHOD

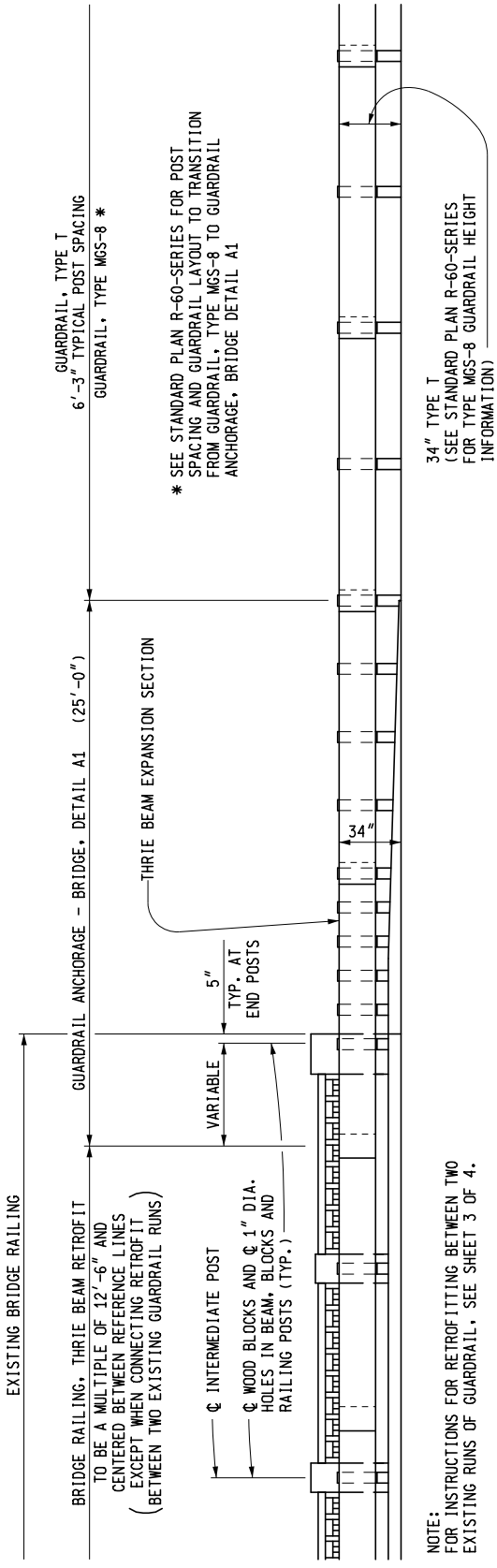
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

GUARDRAIL OVER BOX OR SLAB CULVERTS

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	R-73-F	SHEET 6 OF 6



PLAN



ELEVATION

BRIDGE RAILING, THRIE BEAM RETROFIT AND APPROACH GUARDRAIL

(FOR USE WITH BEAM GUARDRAIL, TYPE T, TYPE MGS-0, & MGS-8)

MDOT Michigan Department of Transportation

PREPARED BY DESIGN DIVISION

DRAWN BY: _____

CHECKED BY: _____

DEPARTMENT DIRECTOR
Kirk T. Steudle

APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

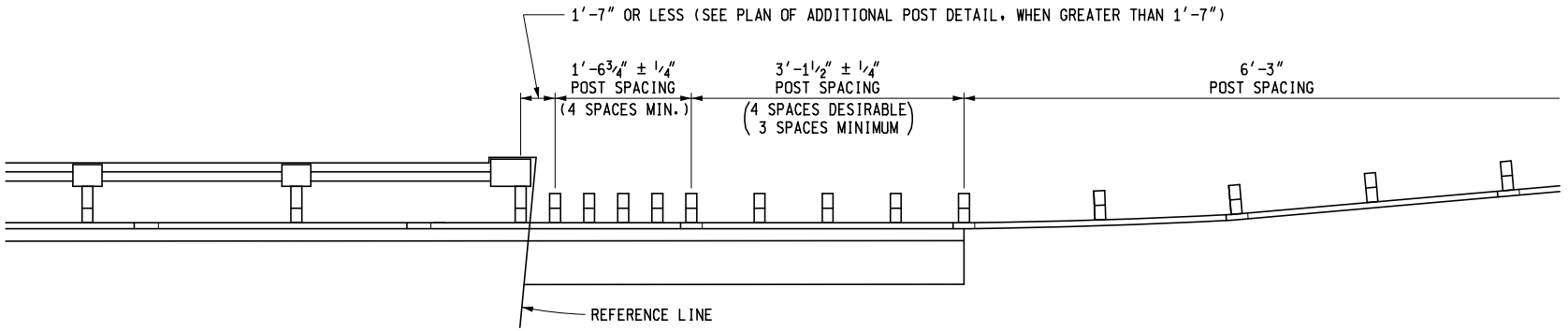
APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

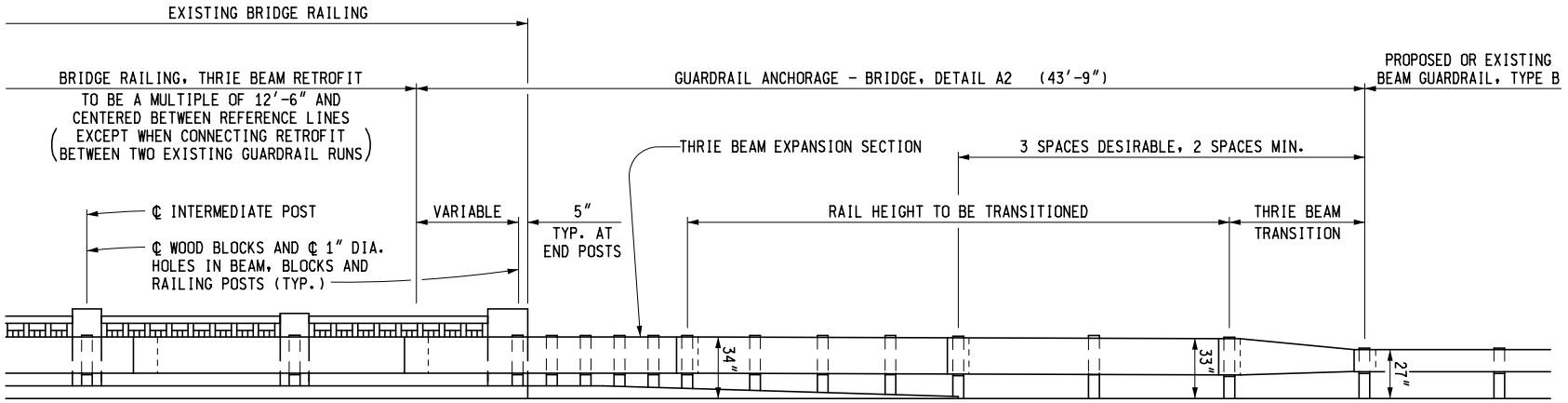
BRIDGE RAILING, THRIE BEAM RETROFIT

(R4 TYPE BRIDGE RAILING)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	B-22-E	SHEET 1 OF 4



PLAN



NOTE:
FOR INSTRUCTIONS FOR RETROFITTING BETWEEN TWO EXISTING RUNS OF GUARDRAIL, SEE SHEET 3 OF 4.

ELEVATION

BRIDGE RAILING, THRIE BEAM RETROFIT AND APPROACH GUARDRAIL

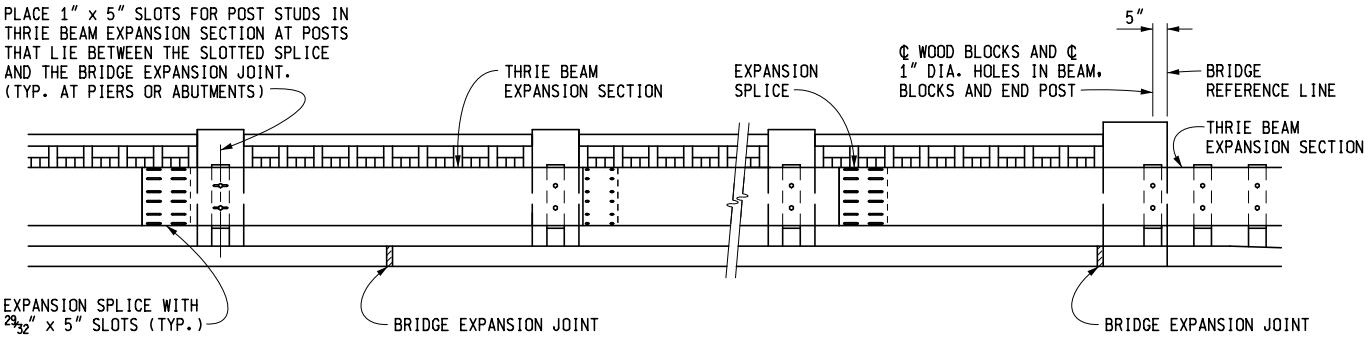
(FOR USE WITH BEAM GUARDRAIL, TYPE B)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

BRIDGE RAILING, THRIE BEAM RETROFIT

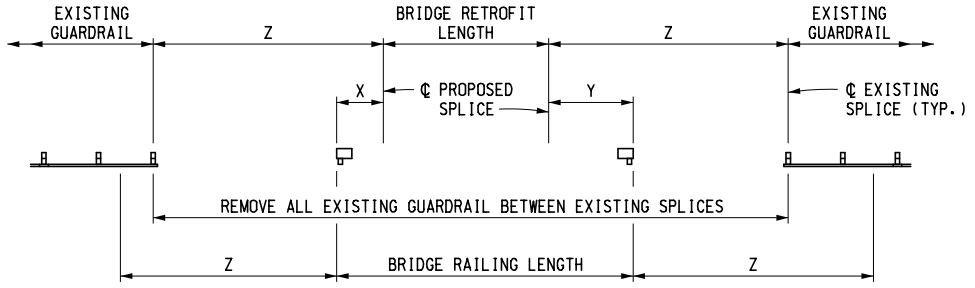
(R4 TYPE BRIDGE RAILING)

F.H.W.A. APPROVAL	PLAN DATE		SHEET
	3-15-2016	B-22-E	2 OF 4



AT PIER AT ABUTMENT

ELEVATION SHOWING THRIE BEAM RETROFIT OVER BRIDGE EXPANSION JOINTS

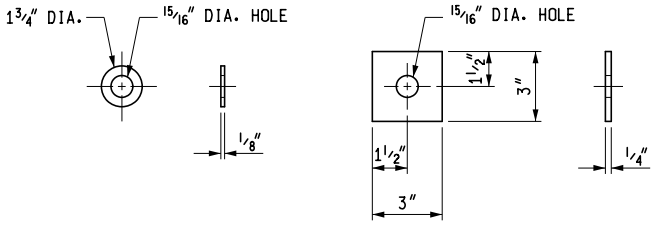


Z = 25'-0" WHEN CONNECTING TO BEAM GUARDRAIL, TYPE T OR TYPE MGS-8. USE GUARDRAIL ANCHORAGE, BRIDGE, DETAIL A1
OR
Z = 43'-9" WHEN CONNECTING TO BEAM GUARDRAIL, TYPE B. USE GUARDRAIL ANCHORAGE, BRIDGE, DETAIL A2.

SKETCH FOR RETROFITTING BETWEEN TWO EXISTING RUNS OF GUARDRAIL

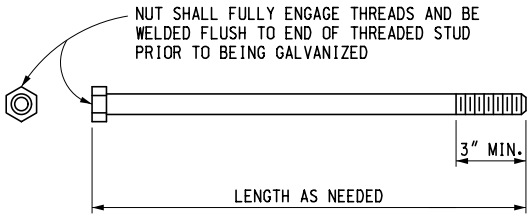
INSTRUCTIONS FOR LAYING OUT RETROFIT
BETWEEN TWO EXISTING RUNS OF GUARDRAIL

1. MEASURE THE APPROPRIATE "Z" DISTANCE FROM ONE END OF THE BRIDGE RAILING AND LOCATE THE FIRST EXISTING SPLICE BACK TOWARD THE BRIDGE.
2. FROM THIS SPLICE, MEASURE THE SAME "Z" DISTANCE BACK TOWARD THE BRIDGE TO OBTAIN THE "X" DIMENSION. THIS DIMENSION WILL VARY FROM 0 TO 12'-6".
3. REPEAT STEPS 1 AND 2, FROM OPPOSITE END OF THE BRIDGE TO OBTAIN "Y" DIMENSION.
4. SUBTRACT THE SUM OF "X" + "Y" FROM BRIDGE RAILING LENGTH. THIS WILL BE THE BRIDGE RETROFIT LENGTH.
5. DIVIDE THE BRIDGE RETROFIT LENGTH BY 12'-6" TO OBTAIN THE NUMBER OF BEAM ELEMENTS PLUS A REMAINDER. THE REMAINDER WILL BE THE LENGTH OF A SHORTENED ELEMENT.
6. WHEN THE REMAINDER IS LESS THAN 2'-6", ADD 12'-6" TO THE REMAINDER AND DIVIDE BY TWO. THE BRIDGE RETROFIT WILL CONTAIN TWO SHORTENED BEAM ELEMENTS WITH ONE LESS 12'-6" BEAM ELEMENT THAN CALCULATED IN STEP 5.



ROUND WASHER SQUARE WASHER

WASHERS USED WITH 7/8" DIA. STUDS



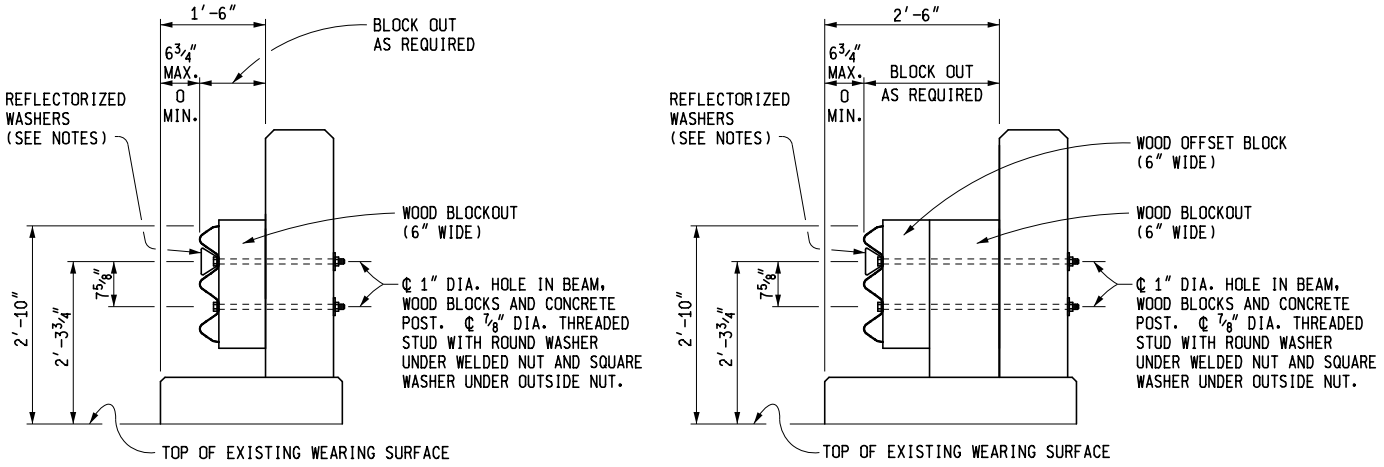
7/8" DIA. THREADED STUD

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

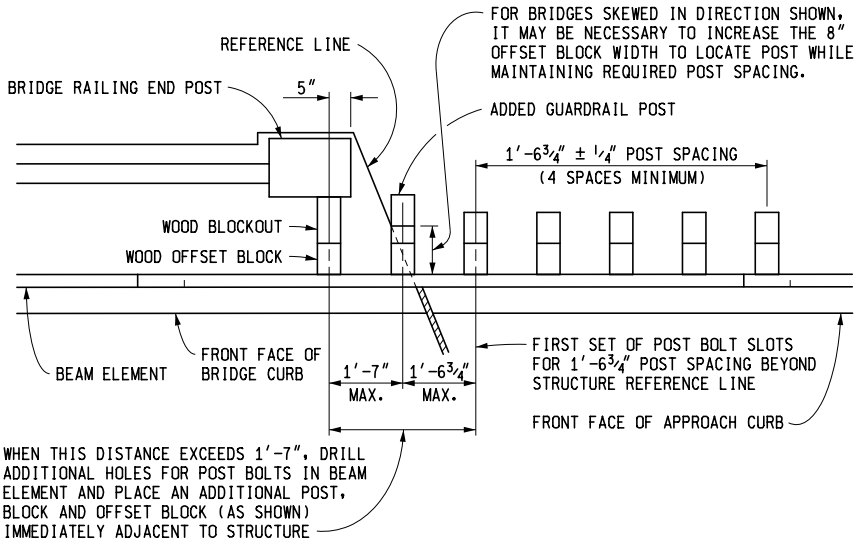
BRIDGE RAILING, THRIE BEAM RETROFIT

(R4 TYPE BRIDGE RAILING)

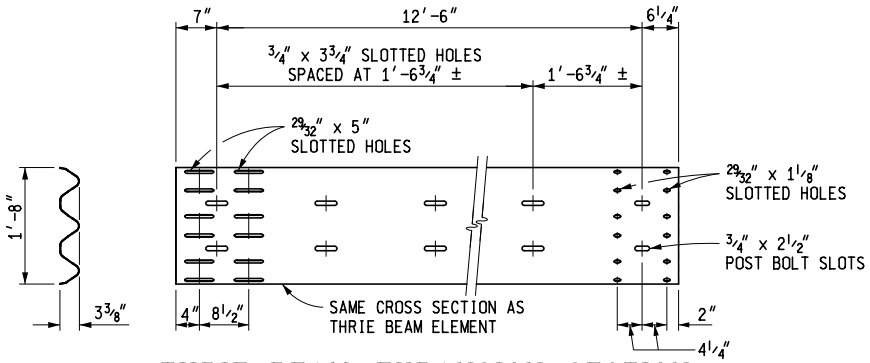
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	B-22-E	SHEET 3 OF 4



SECTIONS THRU R4 RAILING

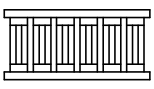


PLAN OF ADDITIONAL POST DETAIL



THRIE BEAM EXPANSION SECTION

NOTE:



R4 TYPE BRIDGE RAILINGS CAN BE IDENTIFIED AS HAVING CONCRETE POSTS AND REMOVABLE METAL PANELS WITH GRIDS OF THIS PATTERN.

NOTES:

THIS STANDARD IS INTENDED FOR USE IN UPGRADING OF EXISTING R4 TYPE BRIDGE RAILINGS AND APPROACH GUARDRAIL.

BRIDGE RAILING, THRIE BEAM RETROFIT AND GUARDRAIL ANCHORAGES SHALL CONFORM TO THE CURRENT STANDARD PLAN R-60-SERIES, WHERE APPLICABLE, EXCEPT AS SHOWN ON THIS PLAN.

ALL WORK AND MATERIAL SHALL BE IN ACCORDANCE WITH SECTIONS 807 & 908 OF THE STANDARD SPECIFICATIONS.

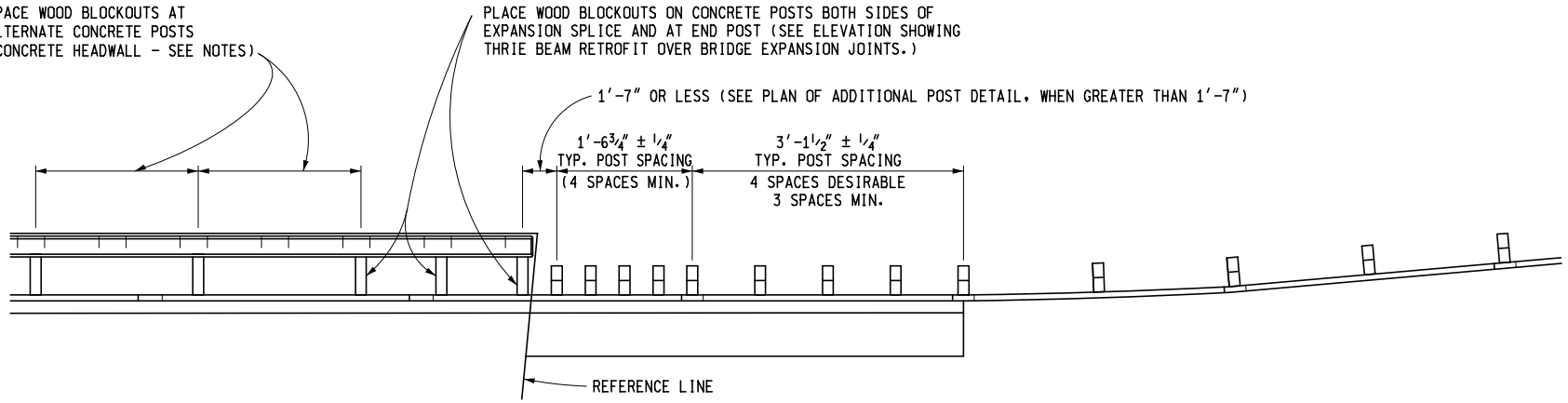
REFLECTORIZED WASHERS SHALL BE SPACED AT 25′-0″ INTERVALS AT BEAM ELEMENT SPLICES. THEY SHALL BE ATTACHED AT UPPER POST BOLT SLOTS WITH STANDARD SPLICE BOLTS.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

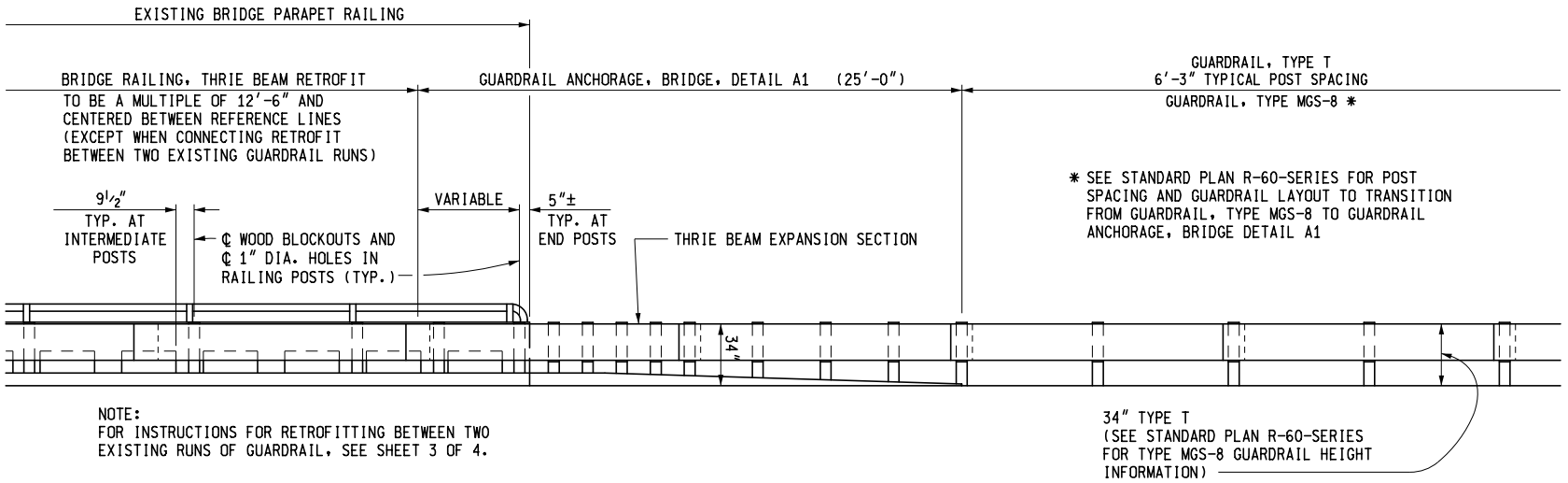
BRIDGE RAILING, THRIE BEAM RETROFIT

(R4 TYPE BRIDGE RAILING)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	B-22-E	SHEET 4 OF 4



PLAN



ELEVATION

BRIDGE RAILING, THRIE BEAM RETROFIT AND APPROACH GUARDRAIL
(FOR USE WITH BEAM GUARDRAIL, TYPE T, TYPE MGS-0, & TYPE MGS-8)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

BRIDGE RAILING, THRIE BEAM RETROFIT

(OPEN PARAPET TYPE BRIDGE RAILING)

DEPARTMENT DIRECTOR
Kirk T. Steudle

APPROVED BY: _____ DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____ DIRECTOR, BUREAU OF DEVELOPMENT

F.H.W.A. APPROVAL

3-15-2016
PLAN DATE

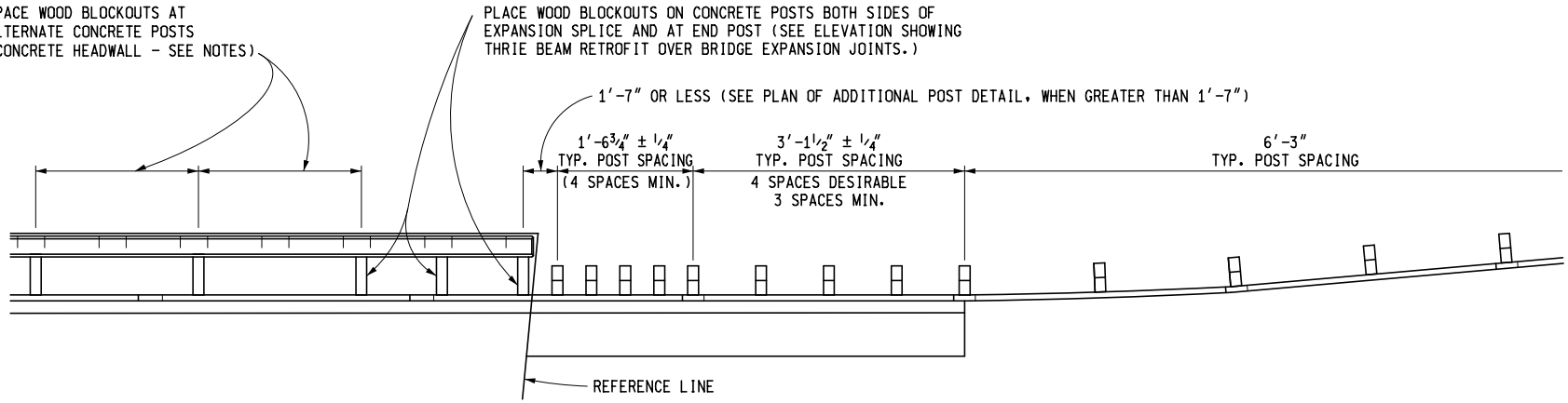
B-23-F

SHEET 1 OF 4

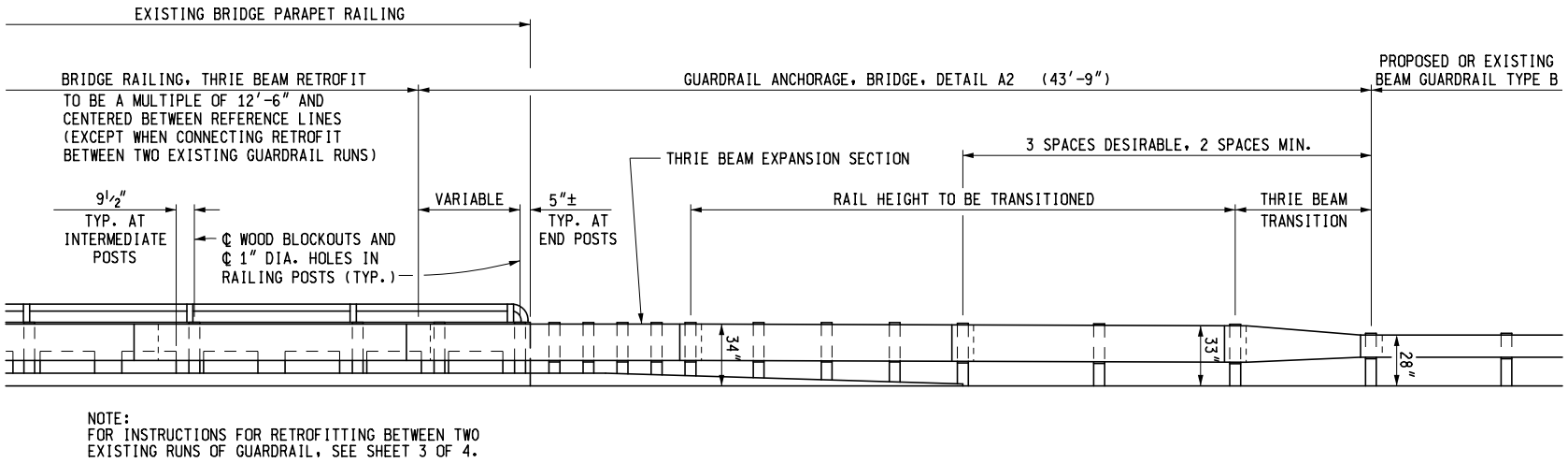
PREPARED BY DESIGN DIVISION

DRAWN BY: ____

CHECKED BY: ____



PLAN



NOTE:
FOR INSTRUCTIONS FOR RETROFITTING BETWEEN TWO
EXISTING RUNS OF GUARDRAIL, SEE SHEET 3 OF 4.

ELEVATION

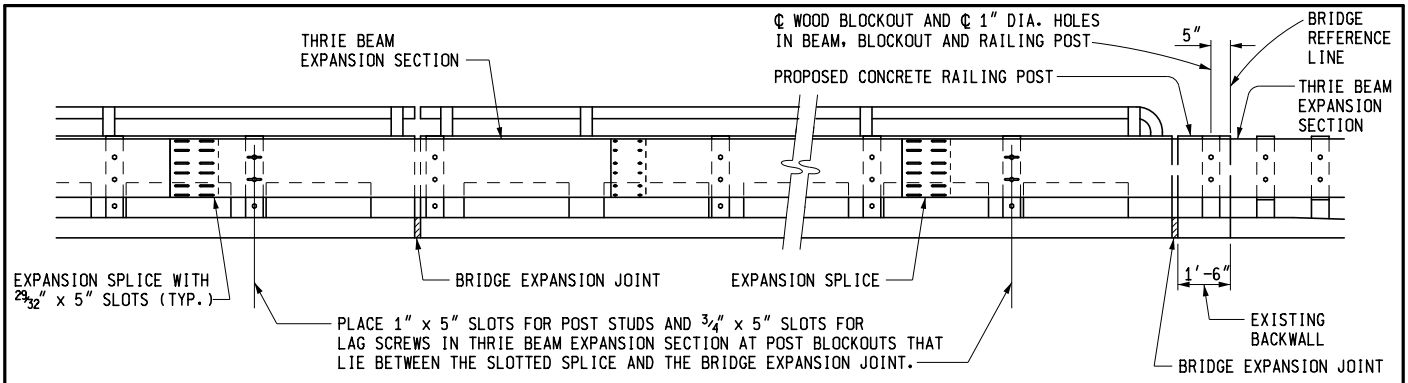
BRIDGE RAILING, THRIE BEAM RETROFIT AND APPROACH GUARDRAIL
(FOR USE WITH GUARDRAIL, TYPE B)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

BRIDGE RAILING, THRIE BEAM RETROFIT

(OPEN PARAPET TYPE BRIDGE RAILING)

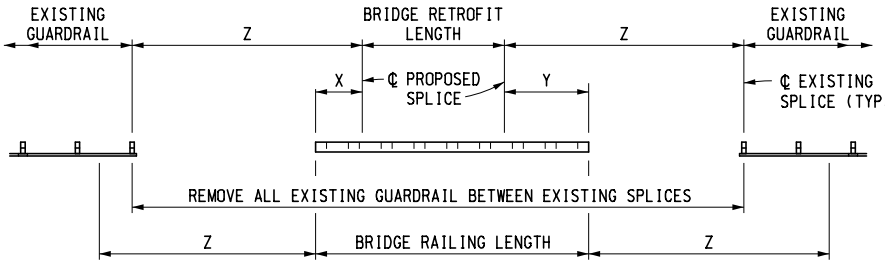
F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	B-23-F	SHEET 2 OF 4



AT PIER OR ABUTMENT WITH RETURN WINGWALLS

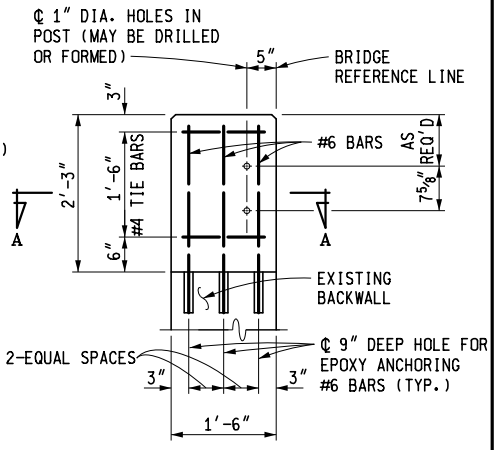
AT ABUTMENT WITH SLOPEWALLS

ELEVATION SHOWING THRIE BEAM RETROFIT OVER BRIDGE EXPANSION JOINTS



Z = 25'-0" WHEN CONNECTING TO BEAM GUARDRAIL TYPE T AND TYPE MGS-8.
USE GUARDRAIL ANCHORAGE, BRIDGE, DETAIL A1
OR
Z = 43'-9" WHEN CONNECTING TO BEAM GUARDRAIL TYPE B.
USE GUARDRAIL ANCHORAGE, BRIDGE, DETAIL A2.

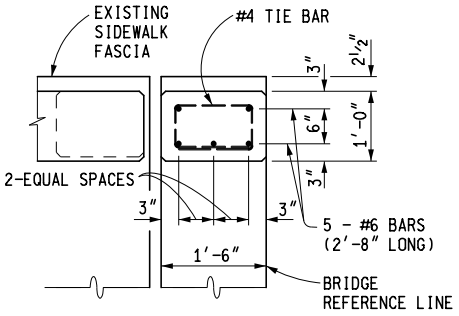
SKETCH FOR RETROFITTING BETWEEN TWO EXISTING RUNS OF GUARDRAIL



ELEVATION

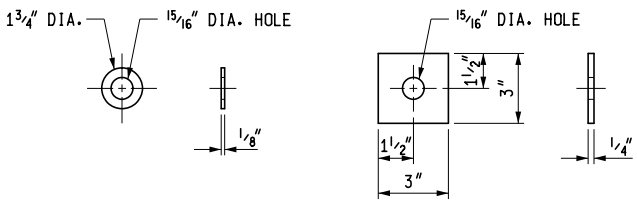
INSTRUCTIONS FOR LAYING OUT RETROFIT
BETWEEN TWO EXISTING RUNS OF GUARDRAIL

1. MEASURE THE APPROPRIATE "Z" DISTANCE FROM ONE END OF THE BRIDGE RAILING AND LOCATE THE FIRST EXISTING SPLICE BACK TOWARD THE BRIDGE.
2. FROM THIS SPLICE, MEASURE THE SAME "Z" DISTANCE BACK TOWARD THE BRIDGE TO OBTAIN THE "X" DIMENSION. THIS DIMENSION WILL VARY FROM 0 TO 12'-6".
3. REPEAT STEPS 1 AND 2, FROM OPPOSITE END OF THE BRIDGE TO OBTAIN "Y" DIMENSION.
4. SUBTRACT THE SUM OF "X" + "Y" FROM BRIDGE RAILING LENGTH. THIS WILL BE THE BRIDGE RETROFIT LENGTH.
5. DIVIDE THE BRIDGE RETROFIT LENGTH BY 12'-6" TO OBTAIN THE NUMBER OF BEAM ELEMENTS PLUS A REMAINDER. THE REMAINDER WILL BE THE LENGTH OF A SHORTENED ELEMENT.
6. WHEN THE REMAINDER IS LESS THAN 2'-6", ADD 12'-6" TO THE REMAINDER AND DIVIDE BY TWO. THE BRIDGE RETROFIT WILL CONTAIN TWO SHORTENED BEAM ELEMENTS WITH ONE LESS 12'-6" BEAM ELEMENT THAN CALCULATED IN STEP 5.



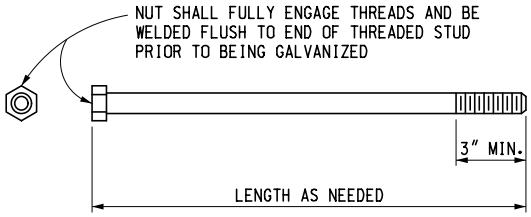
SECTION A - A

CONCRETE RAILING POST DETAIL



ROUND WASHER SQUARE WASHER

WASHERS USED WITH 7/8" DIA. STUDS



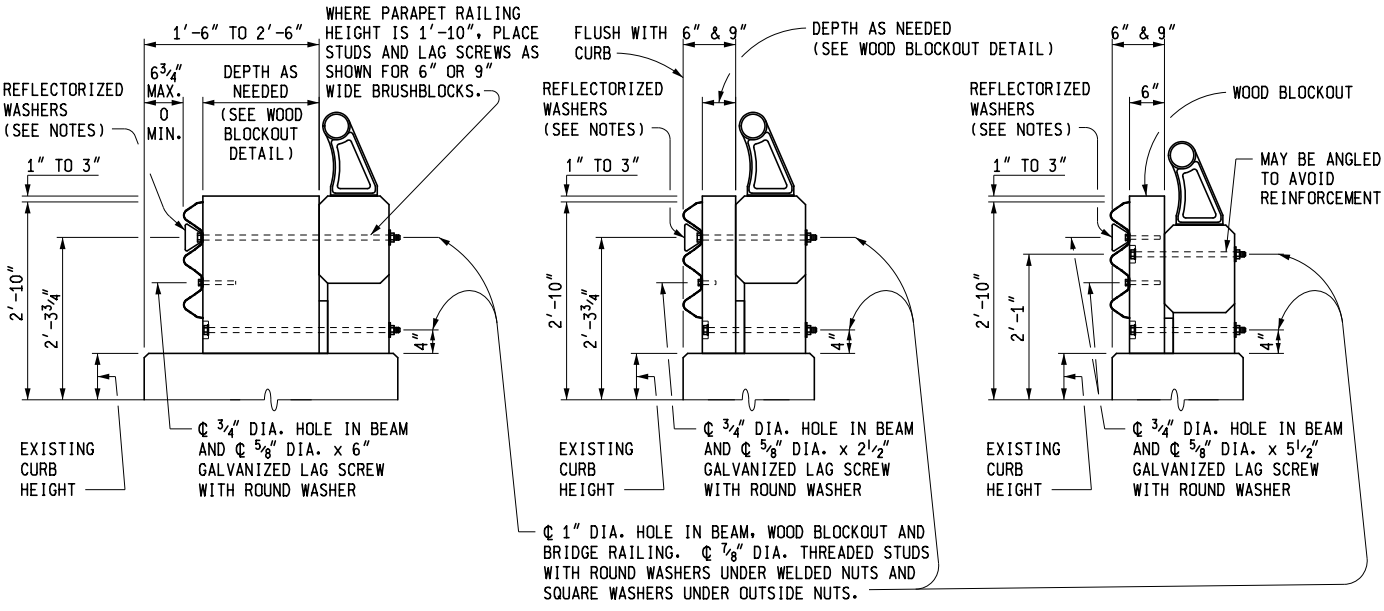
7/8" DIA. THREADED STUD

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF DEVELOPMENT STANDARD PLAN FOR

BRIDGE RAILING, THRIE BEAM RETROFIT

(OPEN PARAPET TYPE BRIDGE RAILING)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	B-23-F	SHEET 3 OF 4

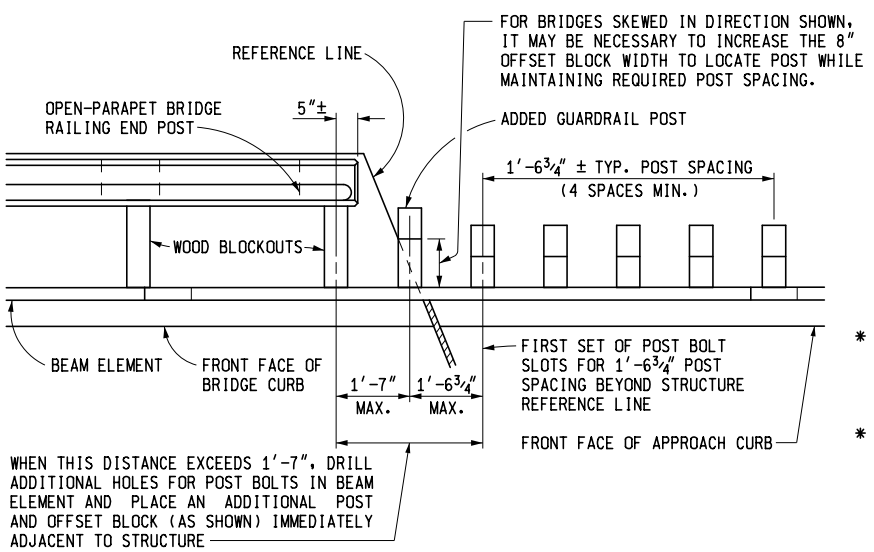


2'-3" HIGH PARAPET RAILING BEHIND 1'-6" TO 2'-6" WIDE BRUSHBLOCK

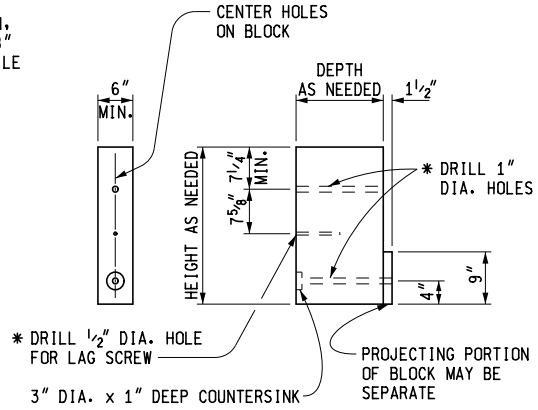
2'-3" HIGH PARAPET RAILING BEHIND 6" OR 9" WIDE BRUSHBLOCK

1'-10" HIGH PARAPET RAILING BEHIND 6" OR 9" WIDE BRUSHBLOCK

SECTIONS THRU PARAPET RAILING



PLAN OF ADDITIONAL POST DETAIL



* NOTE: HOLE LOCATIONS SHOWN ARE FOR 2'-3" HIGH PARAPET RAILING. WHERE REQUIRED, SEE SECTION THRU 1'-10" HIGH PARAPET RAILING

FRONT SIDE

WOOD BLOCKOUT DETAIL

WOOD BLOCKOUTS MAY BE MADE FROM A COMBINATION OF SEPARATE BLOCKS

NOTES:

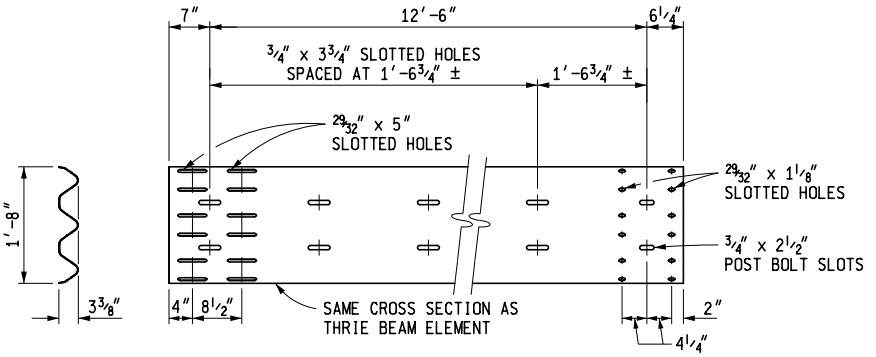
THIS STANDARD IS INTENDED FOR USE IN UPGRADING OF EXISTING OPEN-PARAPET TYPE BRIDGE RAILINGS AND APPROACH GUARDRAIL.

BRIDGE RAILING, THRIE BEAM RETROFIT AND GUARDRAIL ANCHORAGES SHALL CONFORM TO THE CURRENT STANDARD PLAN R-60 SERIES, WHERE APPLICABLE, EXCEPT AS SHOWN ON THIS PLAN.

ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WTH SECTIONS 807 & 908 OF THE STANDARD SPECIFICATIONS.

REFLECTORIZED WASHERS SHALL BE SPACED AT 25'-0" INTERVALS AT BEAM ELEMENT SPLICES. THEY SHALL BE ATTACHED AT UPPER POST BOLT SLOTS WITH STANDARD SPLICE BOLTS.

FOR PRECAST THREE SIDED OR ARCH CULVERTS SPACE BLOCKOUTS FOR THRIE BEAM GUARDRAIL AT A DISTANCE OF 10'-7¾" OR LESS CENTER TO CENTER. PLACE FIRST AND LAST BLOCK ON HEADWALL AS DETAILED ON THIS STANDARD.



THRIE BEAM EXPANSION SECTION

MICHIGAN DEPARTMENT OF TRANSPORTATION

BUREAU OF DEVELOPMENT STANDARD PLAN FOR

BRIDGE RAILING, THRIE BEAM RETROFIT

(OPEN PARAPET TYPE BRIDGE RAILING)

F.H.W.A. APPROVAL	3-15-2016 PLAN DATE	B-23-F	SHEET 4 OF 4

CHAPTER 2

GRADES & EARTHWORK

2.01 (revised 3-21-2016)

REFERENCES

A. ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition

B. ***Roadside Design Guide***, AASHTO, Current Edition

C. Standard Plan R-96-Series, Soil Erosion & Sedimentation Control Measures

D. Standard Plan R-100-Series, Seeding and Tree Planting

E. Standard Plan R-103-Series, Treatment of Peat Marshes

F. Standard Plan R-105-Series, Grading Cross-Sections

G. Standard Plan R-107-Series, Superelevation and Pavement Crowns

H. Guidelines for Plan Preparation

I. ***Field Manual of Soil Engineering (Fifth Edition)***, Michigan Department of State Highways, Current Edition

2.02 (revised 11-28-2011)

VERTICAL ALIGNMENT - GENERAL

Vertical alignment establishes the profile gradeline of a proposed road construction project. The grade can be over virgin land as in the case of a relocation project or along an existing roadway, as in the case of a resurfacing project. In either case and in most proposed construction projects, a gradeline should be established.

Obviously a gradeline must always be established for new construction or relocation projects. Most reconstruction and rehabilitation projects will require new gradelines if improvements for sight distance, superelevation, and drainage are included. A simple resurfacing project can usually be constructed without establishing a new vertical alignment.

Establishing the vertical alignment is based on many factors, including terrain, existing conditions, soils, drainage, coordination with the horizontal alignment, location of bridges, culverts, crossroads, design speed, earthwork balance, etc. The Designer must work with other Divisions, mainly Construction Field Services Division and Traffic and Safety to provide the best possible vertical alignment. The final product should be safe, functional, aesthetically pleasing, and economical.

CHAPTER 3

ALIGNMENT AND GEOMETRICS

3.01 (revised 3-21-2016)

REFERENCES

A. ***A Policy on Design Standards - Interstate System***, AASHTO, 2005

B. ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition

C. ***Highway Capacity Manual***, 2000, published by Transportation Research Board, National Research Council.

D. MDOT Geometric Design Guides

E. ***Michigan Manual of Uniform Traffic Control Devices***, current edition, by the Michigan Department of Transportation

F. ***Roadside Design Guide***, AASHTO, 2006

G. Standard Plan R-107-Series, Superelevation and Pavement Crowns

H. MDOT Sight Distance Guidelines

3.02 (revised 8-17-2009)

DEFINITION OF TERMS

Acceleration Lane - An auxiliary lane, including tapers, for the acceleration of vehicles entering another roadway.

Arterial Road – A roadway which provides a high speed, high volume, network for travel between major points.

Auxiliary Lane – Portion of the roadway adjoining the traveled way for speed change, turning, storage for turning, weaving, truck climbing, passing and other purposes supplementary to through-traffic movement.

Average Daily Traffic (ADT) - The average 24 hour traffic volume, based on a yearly total.

Broken Back Curve - Two curves in the same direction joined by a short tangent distance.

Compound Curve - Two connecting horizontal curves in the same direction having different radii.

Collector Road – Roadway linking a Local Road to an Arterial Road, usually serving moderate traffic volumes.

Crash Analysis - A site specific safety review of crash data performed to identify whether or not a specific geometric design element has either caused, or contributed, to a pattern or concentration of crashes at the location in question. The analysis is a critical component used in determining the appropriate application of geometric design criteria and in the evaluation of design exception approval requests.

3.03 (revised 3-21-2016)

ALIGNMENT-GENERAL

The geometric design of a roadway consists of horizontal alignment, vertical alignment, and a combination of the two. A properly designed alignment (horizontal and vertical) leads to the safe and efficient movement of traffic.

A. Horizontal Alignment

Horizontal alignment is a major factor in determining safety, driving comfort, and capacity of a highway.

Some important factors to consider when designing for horizontal alignment:

1. Passing sight distance on two-lane, two-way roadways should be maximized.

2. Curves should be as flat as physical conditions permit. Abrupt changes in alignment introduce the element of surprise to the driver and should be avoided.

3. Broken back curves should be avoided because they are unsightly and drivers do not expect succeeding curves to be in the same direction.

4. If possible, the minimum distance between reverse curves should be the sum of the superelevation transitions, outside the curves, plus the crown runout lengths. The crown runout can be eliminated in some situations. See the Geometrics Unit (Design Division) for additional guidance. When it isn't possible to obtain the desired distance between reverse curves, up to 40% of the transition may be placed in the curves.

3.03 (continued)

B. Vertical Alignment

Vertical alignment establishes the profile grade of a proposed road construction project. The grade can be over virgin land as in the case of a relocation project or along an existing roadway, as in the case of a resurfacing project. In either case and in most proposed construction projects, a profile grade should be established.

Obviously a profile grade must always be established for new construction or relocation projects. Most reconstruction and rehabilitation projects will require new profile grades if improvements for sight distance, superelevation, and drainage are included. A simple resurfacing project can usually be constructed without establishing a new vertical alignment.

Establishing the vertical alignment is based on many factors, including terrain, existing conditions, soils, drainage, coordination with the horizontal alignment, location of bridges, culverts, crossroads, design speed, earthwork balance, etc. The Designer must work with available resources such as the Geometrics Unit of the Design Division to provide the best possible vertical alignment. The final product should be safe, functional, aesthetically pleasing, and economical.

3.03 (continued)

ALIGNMENT-GENERAL

C. Combined

Horizontal and vertical alignments are permanent design elements. It is extremely difficult and costly to correct alignment deficiencies after the highway is constructed.

A proper combination of horizontal and vertical alignment is obtained by engineering study using the following general controls.

1. Vertical curvature superimposed on horizontal curvature, generally results in a more pleasing appearance. Successive changes in profile not in combination with horizontal curvature may result in a series of humps visible to the driver for some distance.

2. Sharp horizontal curvature should not be introduced at or near the top of a pronounced crest vertical curve. This condition may make it difficult for the driver to perceive the horizontal change in alignment. This can be avoided if the horizontal curvature leads the vertical curvature, i.e., the horizontal curve is made longer than the vertical curve.

3. Sharp horizontal curvature should not be introduced at or near the low point of a pronounced sag vertical curve. Because the road ahead would appear to be fore-shortened, a relatively "flat" horizontal curve should be used to avoid this undesirable phenomenon.

4. Horizontal curvature and profile should be made as flat as possible at intersections where sight distance along both roads or streets is important.

See Chapter 3 of ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition for elements of design.

3.03.01 (revised 3-21-2016)

Horizontal Alignment - Design Controls

A. Minimum Radius

The minimum radius is a limiting value of curvature for a given design speed and is determined from the maximum rate of superelevation and the maximum side friction factor. The minimum radius of curvature should be avoided wherever practical. Attempt to use flatter curves, saving the minimum radius for the most critical conditions. The minimum radius (R_{min}) is shown in the Standard Plan R-107-Series superelevation tabulation at the bottom of each column for each design speed. Values for R_{min} are also tabulated for the straight line superelevation table in Section 3.04.03.

B. Minimum Curve Lengths

Curves should be sufficiently long for small deflection angles to avoid the appearance of a kink.

Curves on rural free access trunklines should be at least 500 feet long for a central angle of 5° and the minimum length should be increased 100 feet for each 1° decrease in the central angle. The minimum should be approximately 15 times the design speed with a desirable length of at least 30 times the design speed. For example a design speed of 60 mph multiplied by 15 gives a minimum curve length of 900’.

3.03.01 (continued)

Horizontal Alignment - Design Controls

C. Compound Curves

Compound curves should be used with caution. Although compound curves give flexibility to fitting the highway to the terrain and other controls, designers should avoid them whenever possible. When curves with considerably different radii are located too close together, the alignment will not have a pleasing appearance. On one-way roads such as ramps, the difference in radii of compound curves is not so important if the second curve is flatter than the first. On compound curves for open highways, the ratio of the flatter radius to the sharper radius should not exceed 1.5 to 1. On ramps the ratio of the flatter radius to the sharper radius may be increased to a 2 to 1 ratio.

D. Sight Distances

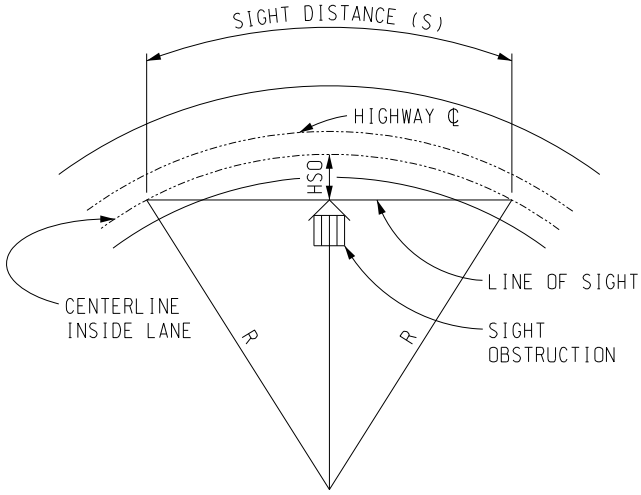
Both stopping sight distance and passing sight distance must be considered for two-way roadways. On one-way roadways only stopping sight distance is required. The designer must be aware that both horizontal and vertical alignments need to be considered when designing for sight distance.

From Table 3-1 of ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition stopping sight distance can be determined from design speed.

Design Speed	Stopping Sight Distance (Design)
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

3.03.01 (continued)

For general use in the design of a horizontal curve, the sight line is a chord of the curve and the stopping sight distance is measured along centerline of the inside lane around the curve



COMPONENTS FOR DETERMINING HORIZONTAL SIGHT DISTANCE

Knowing the stopping sight distance (SSD) and the radius of curve (R) the horizontal sightline offset (HSO) can be calculated from:

$$HSO = R\left(1 - \cos\frac{28.65SSD}{R}\right)$$

or to verify that SSD is met for a given HSO:

$$SSD = \frac{R\cos^{-1}\left(1 - \frac{HSO}{R}\right)}{28.65}$$

(R, SSD, HSO measured in feet)

These equations are exact only when the vehicle and sight obstruction are within the limits of a circular curve.

3.03.01 (continued)

Horizontal Alignment - Design Controls

When determining sight distances, use ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition. The MDOT Sight Distance Guidelines also provide detailed information on sight distance calculation.

The four types of sight distances given are stopping, passing, decision, and intersection.

1. Stopping Sight Distance is defined as the sight distance available on a roadway that is sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

2. Passing Sight Distance is defined as the length needed to complete a passing maneuver as described in ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition.

3. Decision Sight Distance is the distance required for a driver to detect an unexpected or otherwise difficult-to-perceive information source or condition in a roadway environment that may be visually cluttered, recognize the situation or its potential threat, select an appropriate speed and path, and initiate and complete the required maneuver safely and effectively.

3.03.01 (continued)

4. Intersection Sight Distance is the distance that allows drivers sufficient view from a minor road to safely cross or turn on a major road.

   Generally 7.5 seconds of entering sight distance is used for passenger vehicles stopped on a minor road grade of 3% or less to turn left onto a two-lane roadway. An additional 0.5 seconds is added for each additional lane

   Adjustments for other varying conditions that may increase or decrease the time gap are provided in ***A Policy on Geometric Design of Highways and Streets*****,** AASHTO, 2011 6th Edition .

   The designer is cautioned that the element of Clear vision for at-grade intersections is very important, for safety reasons, particularly on high speed trunklines.

3.03.02 (revised 3-21-2016)

Vertical Alignment – Design Controls

Vertical curves are in the shape of a parabola. The basic equation for determining the minimum vertical curve length is:

$$L = KA$$

WHERE:

L = length of vertical curve, feet
K = horizontal distance to produce 1% change in gradient, feet
A = Algebraic difference between the two tangent grades, percent

(Refer to ***A Policy of Geometric Design for Roads and Streets,*** AASHTO, 2011 6th Edition for additional Vertical Curve Formulas). Also refer to the MDOT Sight Distance Guidelines for more detailed information on sight distance calculation.

3.03.02 (continued)

A. Minimum / Maximum Grades

See the "Grade" section of Appendix 3A, the Geometric Design Elements table.

B. Minimum Vertical Curve Lengths

Minimum length (in feet) of a vertical curve should be three times the design speed in mph.

3.03.02 (continued)

Vertical Alignment – Design Controls

C. Stopping Sight Distance

Stopping Sight Distance (SSD) is the principal control of the design of both crest and sag vertical curves. ***A Policy on Geometric Design of Highways and Streets,*** AASHTO 2011 6th Edition gives values for K and lengths of vertical curves for various operational conditions. Values based on reduced design speeds may be used on non-freeway 3R projects. Minimum design guidelines for non-freeway 3R projects are presented in Section 3.09.02. The design speed used for a ramp vertical alignment should meet or exceed the design speed used for the ramp horizontal alignment. See MDOT Sight Distance Guidelines for more detailed information on sight distance calculation.

D. Drainage

Minimum grades correlate with adequate drainage. A desirable minimum grade is typically 0.5%, but grades of 0.3% may be used for paved roadways. On curbed roadways, when it is necessary to use grades that are flatter than 0.3%, provide enclosed drainage with compensating decreased inlet spacing. In addition, close attention to inlet spacing is critical for sag and crest vertical curves when the K value (rate of grade change) is greater than 167.

Uncurbed roads with ditch drainage can have a level longitudinal grade if the crown adequately drains the pavement. Independent ditches should be used when the grade is less than 0.3%. However, efforts to achieve minimum roadway grades of 0.5% would be of great benefit in the event that future curb and gutter or concrete barrier may be installed.

3.03.02 (continued)

E. Other Considerations

Comfort criteria is sometimes a consideration for sag vertical curves. The equation for length of curve for comfort is:

$$L = \frac{AV^2}{46.5}$$

WHERE:

L = length of vertical curve, feet
A = algebraic difference of tangent grades, percent
V = design speed, mph

Passing sight distance must be considered on two way roadways. Passing sight distance is the distance required for a motorist to safely perform a passing maneuver as described in AASHTO.

Intersection Sight Distance is the distance that allows drivers sufficient view from a minor road to safely cross or turn on a major road. See Section 3.03.01.D4.

F. Computations

The following pages show mathematical details used in the design of vertical curves. This section includes definitions, formulas, and examples.

3.08

3R, 4R AND OTHER PROJECTS

3.08.01 (revised 3-21-2016)

General

A. (3R) Resurfacing Restoration and Rehabilitation

This work is defined in 23 CFR (Code of Federal Regulations) as "*work undertaken to extend the service life of an existing highway and enhance highway safety. This includes placement of additional surface material and/or other work necessary to return an existing roadway, including shoulders, bridges, the roadside and appurtenances to a condition of structural or functional adequacy. This work may include upgrading of geometric features, such as widening, flattening curves or improving sight distances*." Examples of this type of work include:

1. Resurfacing, milling or profiling, concrete overlays and inlays (without removing subbase).

2. Lane and/or shoulder widening (no increase in number of through lanes).

3. Roadway base correction.

4. Minor alignment improvements.

5. Roadside safety improvements.

6. Signing, pavement marking and traffic signals.

7. Intersection and railroad crossing upgrades.

8. Pavement joint repair.

9. Crush and shape and resurfacing.

10. Rubblize and resurface.

3.08.01A (continued)

11. Intermittent grade modifications (used to correct deficiencies in the vertical alignment by changing the paving profile for short distances) that leave the existing pavement in service for more than 50% of the total project length.

12. Passing relief lanes.

See Chapter 12 of the Bridge Design Manual for examples of “bridge” 3R work.

B. (4R) New Construction/ Reconstruction

Projects that are mainly comprised of the following types of work are not considered 3R.

1. Complete removal and replacement of pavement (including subbase).

2. Major alignment improvements.

3. Adding lanes for through traffic.

4. New roadways and /or bridges.

5. Complete bridge deck or superstructure replacement.

6. Intermittent grade modifications (used to correct deficiencies in the vertical alignment by changing the paving profile for short distances) that leave the existing pavement in service for less than 50% of the total project length.

The above lists are not all inclusive, but are intended to give typical examples of 3R and 4R work.

3.08.01E (continued)

General

When a bridge falls within a road project and no work is planned 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 ***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 be responsible for submitting any necessary design exceptions for the bridge.

F. Safety Review / Crash Analysis

A safety review is required for all 3R and 4R projects. The Project Manager should contact the TSC Traffic Engineer during scoping, so that a safety review can be performed throughout the project limits. On corridor projects only one analysis that includes roadways and bridges is required. This review should consist of an analysis of available crash data to determine where safety enhancements are warranted. Safety reviews more than 3 years old shall be updated to verify the original safety review.

A site specific crash analysis is required as justification for any design exception. It is also required in determining appropriate 3R design criteria according to Section 3.09.02A and 3.09.02B. Site specific crash analyses more than 3 years old shall be updated to verify the original crash analysis.

3.09

NON-FREEWAY RESURFACING, RESTORATION AND REHABILITATION (3R) MINIMUM DESIGN GUIDELINES

3.09.01 (revised 1-6-99)

General

The intent of the 3R guidelines is to extend the useful life of existing roadways and enhance safety while incurring minimal aesthetic and environmental disturbance and economic burden. Often, design guidelines used for new and major reconstruction are not cost effective on 3R projects. Where economically and physically practical, design guidelines should be according to AASHTO requirements to insure the greatest traffic service. The ultimate goal is to improve operating conditions and provide highways that are reasonably safe and fit for travel.

3R guidelines are divided into three categories that are addressed in subsequent sections of this chapter. These are NHS, Non-NHS and 3R Safety Considerations. They apply strictly to non-freeway applications. Guidelines for freeway 3R and 4R type work are addressed separately in Section 3.11.

3.09.02 (revised 3-21-2016)

3R Minimum Guidelines

Minimum guidelines for controlling design elements shall be according to the following:

3.09.02 (continued)

A. Non-Freeway, NHS

<table>
<tr><th>Geometric Elements</th><th colspan="4">Non-Freeway, NHS 3R Minimum Guidelines</th></tr>
<tr><td>Design Speed
(see Section 3.06)</td><td colspan="4">Posted Speed + 5 mph</td></tr>
<tr><td rowspan="5">Shoulder Width

NOTE: Minimum shoulder widths apply for posted speeds greater than 45 mph. Restrictions such as right of way and roadside context sensitivity issues may preclude the use of minimum shoulders within city, village or township limits with posted speeds of 45 mph and less.</td><td colspan="2">Current ADT
Two-Way</td><td>Inside
Shoulder</td><td>Outside
Shoulder</td></tr>
<tr><td rowspan="4">Two Lane
(and three lane when the center lane is a left turn lane)</td><td><750</td><td rowspan="4"></td><td>3'-0" Gravel</td></tr>
<tr><td>750 - 5000</td><td>6'-0" (3'-0" Paved)</td></tr>
<tr><td>>5000 - 10,000</td><td>8'-0" (3'-0" Paved)</td></tr>
<tr><td>>10,000</td><td>8'-0" (7'-0" Paved)</td></tr>
<tr><td>Multi-Lane
Undivided</td><td>≤ 10,000
> 10,000</td><td></td><td>6'-0" (3'-0" Paved)
8'-0" (3'-0" Paved)</td></tr>
<tr><td>Multi-Lane
Divided</td><td>≤ 10,000
> 10,000</td><td>3'-0" Paved
3'-0" Paved</td><td>6'-0" (3'-0" Paved)
8'-0" (3'-0" Paved)</td></tr>
<tr><td rowspan="3">Lane Width</td><td>ADT</td><td colspan="3">Lane Width</td></tr>
<tr><td>≤750

>750</td><td colspan="3">10'-0"

11'-0"

10'-0" lanes may be considered in urban areas for multi-lane un-divided (regardless of ADT) and multi-lane divided (ADT < 10,000).

12'-0" lanes are desirable on the Priority Commercial Network (PCN).

12'-0" lanes are required on the National Network (also known as the National Truck Network). Design exceptions to maintain existing narrower lanes generally receive favorable consideration but a high burden of justification is placed on requests to reduce lane widths to less than 12'-0".</td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td rowspan="3">Bridge Width, Structural Capacity & Horizontal Clearances</td><td colspan="2">Rural</td><td colspan="2">Urban</td></tr>
<tr><td colspan="2">Traveled way width plus 2'-0" each side.

Minimum Design Loading HS20.</td><td colspan="2">Curb to curb approach width.

Minimum Design Loading HS20.</td></tr>
<tr><td colspan="4">(See Bridge Design Manual Appendix 12.02 for other trunkline classifications)</td></tr>
<tr><td>Horizontal / Vertical Alignment and Stopping Sight Distance</td><td colspan="4">Existing alignment and stopping sight distance may be retained if the design speed of the existing curve is not more than 15 mph below the project design speed and there is no crash concentration. Otherwise standards for new construction apply. See 2011 6th Edition AASHTO Green Book or MDOT Sight Distance Guidelines.</td></tr>
<tr><td>Grade</td><td colspan="4">Review crash data. Existing grade may be retained without crash concentration.</td></tr>
<tr><td>Cross Slopes</td><td colspan="4">Traveled way 1.5% - 2%, Shoulder see Section 6.05.05</td></tr>
<tr><td>Superelevation</td><td colspan="4">Standard Plan R-107-Series or reduced maximum (6%) Straight Line Superelevation Chart using the project design speed.</td></tr>
<tr><td>Vertical Clearance</td><td colspan="4">See Section 3.12.</td></tr>
</table>

3.09.02 (continued)

B. Non-Freeway, Non-NHS

<table>
<tr><th>Geometric Elements</th><th colspan="3">Non-Freeway, Non-NHS 3R Minimum Guidelines</th></tr>
<tr><td>Design Speed</td><td colspan="3">Posted Speed Minimum</td></tr>
<tr><td rowspan="4">Shoulder Width

NOTE: Minimum shoulder widths apply for posted speeds greater than 45 mph. Restrictions such as right of way and roadside context sensitivity issues may preclude the use of minimum shoulders within city, village or township limits with posted speeds of 45 mph and less.</td><td>Current ADT
Two-Way</td><td colspan="2">Inside and Outside Shoulder Width</td></tr>
<tr><td>≤750</td><td colspan="2">2'-0" (Gravel)</td></tr>
<tr><td>750 - 2000</td><td colspan="2">3'-0" (Paved)</td></tr>
<tr><td>> 2000</td><td colspan="2">6'-0" (3'-0" Paved)</td></tr>
<tr><td rowspan="3">Lane Width</td><td>ADT</td><td colspan="2">Lane Width</td></tr>
<tr><td>≤750

>750</td><td colspan="2">10'-0"

11'-0"

10'-0" lanes may be considered in urban areas for multi-lane un-divided (regardless of ADT) and multi-lane divided (ADT < 10,000).

12'-0" lanes are desirable on the Priority Commercial Network (PCN) and the National Network (also known as the National Truck Network). Existing narrower lanes may be retained without design exceptions. Reduction of existing lane widths on the National Network to less than 12-0" require a design exception request having a high burden of justification.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="5">Bridge Width, Structural Capacity & Horizontal Clearances

(Existing Bridges to remain in place)</td><td rowspan="2">Multi-Lane
(Divided &
Undivided)</td><td>Inside
(Divided)</td><td>Outside
(Both sides for un-divided)</td></tr>
<tr><td>3'-0" Paved</td><td>6'-0" (3'-0" Paved)</td></tr>
<tr><td>ADT
(Design Year)</td><td>Minimum
Design
Loading</td><td>Usable Width</td></tr>
<tr><td>0 - 750</td><td>H15</td><td>Width of traveled way.</td></tr>
<tr><td>751 - 1500</td><td>HS15</td><td>Width of traveled way.</td></tr>
<tr><td>1501 - 2000</td><td>HS15</td><td>Width of traveled way plus 1' each side.</td></tr>
<tr><td>> 2000</td><td>HS15</td><td>Width of traveled way plus 2' each side.</td></tr>
<tr><td>Horizontal / Vertical Alignment and Stopping Sight Distance</td><td colspan="3">Existing alignment and stopping sight distance may be retained if the design speed of the existing curve is not more than 15 mph (horizontal alignment) or 20 mph (vertical alignment) below the project design speed and there is no crash concentration. Otherwise standards for new construction apply. See 2011 6th Edition AASHTO Green Book or MDOT Sight Distance Guidelines.</td></tr>
<tr><td>Grade</td><td colspan="3">Review crash data. Existing grade may be retained without crash concentration.</td></tr>
<tr><td>Cross Slopes</td><td colspan="3">Traveled way 1.5% - 2%, Shoulder see Section 6.05.05</td></tr>
<tr><td>Superelevation</td><td colspan="3">Standard Plan R-107-Series or reduced maximum (6%) Straight Line Superelevation Chart using the project design speed.</td></tr>
<tr><td>Vertical Clearance</td><td colspan="3">See Section 3.12.</td></tr>
</table>

3.11 (revised 2006)

FREEWAY RESURFACING, RESTORATION, REHABILITATION AND RECONSTRUCTION / NEW CONSTRUCTION (3R/4R) DESIGN CRITERIA

3.11.01 (revised 3-21-2016)

General

The 3R/4R program applies to freeways, which are defined as divided arterial highways with grade separated intersections and full control of access. Design criteria for Interstate freeways are established in the AASHTO publication, ***A Policy on Design Standards-Interstate System,*** 2005. Design criteria for non interstate freeways are established in the AASHTO publication ***A Policy on Geometric Design of Highways and Streets,*** 2011 6th Edition.

Current freeway standards are shown in Appendix 3A. The standards used for design speed, horizontal alignment, vertical alignment, and widths of median, traveled way and shoulders for freeway 3R projects may be the standards that were approved at the time of original construction or reconstruction, whichever is most recent. See Section 3.08.01C for information on combined 3R and 4R work.

3R/4R freeway projects should be reviewed to determine need for safety improvements such as: alignment modifications, superelevation modifications, sight distance improvements, lengthening ramps, widening shoulders, flattening slopes, increasing underclearances, upgrading guardrail and bridge railings, shielding of obstacles, and removing or relocating obstacles to provide a traversable roadside. (Also see Section 3.08.01F.)

3.11.02 (revised 11-28-2011)

Freeway 3R/4R Checklist

A. Section Deleted

B. Geometrics and Signing

The Project Manager should also contact the Geometrics Unit in the Design Division and the Region Traffic and Safety Engineer to identify desirable enhancements prior to refining the project cost estimate. The Design Division – Traffic Sign Unit should be consulted to identify and coordinate plan preparation for sign upgrading needs.

C. Section Deleted

D. Design Exceptions

Design Exceptions are required whenever the design criteria given in Section 3.11.01 cannot be met for controlling design elements (See Section 3.08.01E.)

Appendix 3A
GEOMETRIC DESIGN ELEMENTS
New Construction / Reconstruction

Grade

Freeway

Type of Terrain	50	55	60	65	70	75
Level	4	4	3	3	3	3
Rolling	5	5	4	4	4	4

Grades 1% steeper may be provided in urban areas. Curbed roadway 0.3% min, 0.5% desirable minimum

Non Freeway (Arterial)

Type of Terrain	Urban							Rural				
	30	35	40	45	50	55	60	40	45	50	55	60
Level	8	7	7	6	6	5	5	5	5	4	4	3
Rolling	9	8	8	7	7	6	6	6	6	5	5	4

Curbed roadway 0.3% min, 0.5% desirable minimum

Collector Roads

Type of Terrain	Urban									Rural								
	20	25	30	35	40	45	50	55	60	20	25	30	35	40	45	50	55	60
Level	9	9	9	9	9	8	7	7	6	7	7	7	7	7	7	6	6	5
Rolling	12	12	11	10	10	9	8	8	7	10	10	9	9	8	8	7	7	6

Curbed roadway 0.3% min, 0.5% desirable minimum

Stopping Sight Distance

Follow 2011 6th Edition of AASHTO "A Policy on Geometric Design of Highways and Streets" (AKA AASHTO Green Book). The MDOT Sight Distance Guidelines also provide detailed information on sight distance calculation.

Cross Slope

Traveled way cross slope = 2.0%, Paved shoulder cross slope = 4.0% (Also see Section 6.05.05)

Superelevation

AASHTO Method 5 "Curvilinear Relation" is used for new construction/reconstruction. Maximum rate of 7%. (See Standard Plan R-107-Series.)

AASHTO Method 1 "Straight Line Relation" is allowed when Method 5 is not feasible. Maximum rate of 6%. (See Section 3.04.03)

The above methods also apply to urban freeways and urban ramps, except the maximum rate is 5% for 60 mph design speed.

Vertical Clearance

	NHS	Non NHS
Freeway	16'-0"	14'-6"
Non Freeway (Arterial)	16'-0"	14'-6"
Collectors & "Special Routes"	14'-6" (1 ft. greater than Michigan legal vehicle height.)	14'-6"

For pedestrian bridges provide 1 ft. additional clearance over non-freeway and 17 ft. minimum under clearance over freeways. A vertical clearance of 23'-0" is required for grade separations over railroads. *(See Bridge Design Manual 7.01.08 and Bridge Design Guides 5.24.03-04.)*

Horizontal Clearance / Bridge Width

See definition of terms in this chapter. Also, see Bridge Design Guides, Section 6

5.10 (revised 9-17-2012)

R.O.W. AT RAILROAD CROSSINGS

When determining the clear vision R.O.W. requirements of an at-grade trunkline crossing with a railroad, a plan sheet of the area in question should be submitted by the Design Engineer to the Railroad Coordination Unit – Office of Rail. This should be done as early as possible, so that the needed R.O.W. may be shown on the preliminary and final R.O.W. plans. ***See Section 5.24, Figure 5.24.03.***

5.11 (revised 3-21-2016)

CONSENT TO GRADE

In cases where minor grading extends a short distance beyond the existing R.O.W., a consent to grade may be required. When it is anticipated that more than 500 cyd of earth excavation is to be removed from a grading consent area, the R.O.W. plans should show the location and estimated quantities. Drainage structures, culverts, and ditches should not be placed within areas with a grading consent, but require fee R.O.W. or easements. Consents to Grade shall be dimensioned from the proposed or existing R.O.W. lines. ***See Section 5.24, Figure 5.24.04.***

When the adjacent property is subject to Section 4(f) of the U. S. Department of Transportation Act of 1966, permanent easement or fee R.O.W. is usually not feasible. Consent to construct sidewalk should be pursued under these conditions.

5.12

POTENTIALLY CONTAMINATED SITES

The identification of potentially contaminated sites is important on all projects, whether proposed R.O.W. is required or the project will be built within existing R.O.W. The Design Engineer should refer to the procedure outlined in Chapter 14.

5.13

TEMPORARY FENCE

It may be necessary to provide temporary fencing in stock grazing land where extra R.O.W. for grading and disposal of muck is required. A miscellaneous quantity of woven wire fence (for temporary fencing) should be shown on the note sheet.

5.14

PRESERVING R.O.W. LOCATION

Knowledge of the physical location of the R.O.W. is important to the Department when future improvements or expansions are planned. It is immediately important to owners of remainder properties abutting our fee ownership. Unless monuments are placed to mark the original alignment on which the R.O.W. was purchased, confusion may result over the location of the R.O.W. In urban trunklines and rural expressway projects, where use of alignment monuments by surveyors would be so dangerous as to be impractical, the R.O.W. lines are monumented. In both cases, state law requires that all Government Corners used in the design survey or affected by construction activities be preserved and a record filed with the Register of Deeds.

7.01.12 (revised 3-21-2016)

Types of Guardrail Used in Michigan

There are seven standard types of steel beam guardrail in addition to cable barrier found on Michigan highways. The term "Current Use" means "currently proposed for use", not necessarily what may be found existing in the field.

A. Type A (Standard Plan R-60-Series)

Description: W-beam attached directly to posts, Terminal End Shoes on ends. 12'-6" post spacing, 28" height to top of rail.

Current Use:
1. Cul-de-sacs
2. Limited to locations not exposed to through traffic.

B. Type B (Standard Plan R-60-Series)

Description: W-beam guardrail, 8" offset blocks. 6'-3" post spacing, 28" height to top of rail.

Current Use:
1. Basic type for all free access trunklines.
2. On local roads when part of a state trunkline project.

C. Type BD (Standard Plan R-60-Series)

Description: Type B with W-beam on both sides of the post, 8" offset blocks.

Current Use:
1. Limited use in medians on free access highways when median barrier is recommended.

7.01.12 (continued)

D. Type T (Standard Plan R-60-Series)

Description: Offset thrie beam rail, 8" offset blocks, 6'-3" post spacing, 34" height to top of rail.

Current Use:
1. Standard guardrail for new freeway construction (including ramps).
2. Updating existing freeways and ramps when the entire run of guardrail is being removed and replaced.

E. Type TD (Standard Plan R-60-Series)

Description: Similar to Type T except beam elements and offset blocks are installed on both sides of the post.

Current Use:
1. In freeway medians over 30' wide when median barrier is recommended. Used to update existing freeway medians when there is a significant length of guardrail being replaced or where none was constructed initially, but barrier is now recommended.

F. Type MGS-8
(Standard Plan R-60-Series)

Description: W-beam guardrail meeting MASH criteria, 8" offset blocks, standard 6'-3" post spacing, and 31" height to top of rail. Beam element splices occur between standard 6'-3" post spaces.

Current Use:
1. Standard MASH-compliant guardrail for all freeways (including ramps) and free access roadways. After December 31, 2017, it is anticipated that Type MGS guardrail systems will be required for new guardrail installations on all freeways (including ramps) and free access roadways.

7.01.12 (continued)

Types of Guardrail used in Michigan

G. Type MGS-8D
(Standard Plan R-60-Series)

Description: Type MGS-8 with W-beam guardrail and 8" offset blocks on both sides of the post.

Current Use:

1. In all roadway medians, freeway and free access, when median guardrail is recommended and a MASH-compliant guardrail system is desired. After December 31, 2017, it is anticipated that Type MGS guardrail systems will be required for new guardrail installations on all freeways (including ramps) and free access roadways.

7.01.12 (continued)

H. Cable Barrier (See Section 7.01.55C)

Description: Three or four steel cables mounted on steel posts, anchored and tensioned.

Current Use:

1. Medians where crash history indicates cross median crashes and rigid barrier is not warranted.

2. Special situations where up to 90 degree impacts can be expected and larger deflections can be tolerated.

7.01.14 (continued)

Guardrail Surface Finish

C. Corrosion-Resistant Guardrail Replacement Policy

The Engineering Operations Committee, meeting on January 20, 1989, decided that all existing corrosion resistant, or "rusty steel", guardrail encountered on proposed Interstate resurfacing or reconstruction projects should be removed and replaced as part of the project. On projects involving bridges only, the nominal provisions of the approach guardrail anchorage shall be replaced if the rail elements are rusty steel. Where guardrail at the bridge approaches is part of a more extensive installation, the decision to replace will be made on the merits of the specific project. See Section 7.01.44 for upgrading local roads.

7.01.15 (revised 3-21-2016)

Guardrail Terminals

The following guardrail terminal details are in current use for new construction and where specified for updating:

A. Guardrail Approach Terminal, Type 1B (Standard Plan R-61-Series)

Current Use:
1. On approach end of Guardrail, Type B, and Type MGS-8, on one-way roadways.
2. On both ends of Guardrail, Type B, and Type MGS-8, on two-way roadways.

B. Guardrail Approach Terminal, Type 1T (Standard Plan R-61-Series)

Current Use:
1. On approach end of Guardrail, Type T, on one-way roadways.
2. On both ends of Guardrail, Type T, on two-way roadways.

7.01.15 (continued)

C. Guardrail Approach Terminal, Type 2B (Standard Plan R-62-Series)

Current Use:
1. Same as Type 1B when grading limits prohibit proper offset for Type 1B.

D. Guardrail Approach Terminal, Type 2T (Standard Plan R-62-Series)

Current Use:
1. Same as Type 1T when grading limits prohibit proper offset for Type for 1T.

E. Guardrail Departing Terminal, Type B (Standard Plan R-66-Series)

Current Use:
1. Departing end of Guardrail, Type B, on one-way roadways.
2. Departing end of Guardrail, Type B, on two-way roadways when located outside the clear zone.

F. Guardrail Departing Terminal, Type T (Standard Plan R-66-Series)

Current Use:
1. Departing end of Guardrail, Type T, on one-way roadways.
2. Departing end of Guardrail, Type T, on two-way roadways when located outside the clear zone.

G. Guardrail Departing Terminal, Type MGS (Standard Plan R-66-Series)

Current Use:
1. Departing end of Guardrail, Type MGS-8, on one-way roadways.
2. Departing end of Guardrail, Type MGS-8, on two-way roadways when located outside the clear zone.

7.01.16 (revised 3-21-2016)

Guardrail Attachment to Bridges and Walls

The following guardrail anchorage details are in current use for new construction and where specified for upgrading and are detailed on Standard Plans R-67-Series, B-22-Series, B-23-Series:

A. Guardrail Anchorage, Bridge, Detail T-1 (Standard Plan R-67-Series)

Current Use: (Two uses detailed)
1. Use when connecting Guardrail, Type T, or Type MGS-8 to Bridge Barrier Railing, Type 4, 2-Tube, 4-Tube, or aesthetic parapet tube without expansion at backwall.
2. Use when connecting Guardrail, Type T, or Type MGS-8 to Bridge Barrier Railing, Type 4, 2-Tube, 4-Tube, or aesthetic parapet tube with expansion at backwall.

B. Guardrail Anchorage, Bridge, Detail T-2 (Standard Plan R-67-Series)

Current Use:
1. Use when connecting Guardrail, Type B to Bridge Barrier Railing, Type 4, 2-Tube, 4-Tube, or aesthetic parapet tube without expansion at backwall.

C. Guardrail Anchorage, Bridge, Detail T-3 (Standard Plan R-67-Series)

Current Use:
1. Use when connecting Guardrail, Type B to Bridge Barrier Railing, Type 5 without expansion at backwall.

D. Guardrail Anchorage, Bridge, Detail T-4 (Standard Plan R-67-Series)

Current Use:
1. Use when connecting Guardrail, Type T, or Type MGS-8 to Bridge Barrier Railing, Type 5 without expansion at backwall.

7.01.16 (continued)

E. Guardrail Anchorage, Bridge, Detail T-5 (Standard Plan R-67-Series)

Current Use: (Two uses detailed)
1. Use when connecting Guardrail, Type B to Bridge Barrier Railing, Type 4, 2-Tube, 4-Tube, or aesthetic parapet tube with expansion at backwall.
2. Use when connecting Guardrail, Type B to Fillerwalls.

F. Guardrail Anchorage, Bridge, Detail T-6 (Standard Plan R-67-Series)

Current Use:
1. Use when connecting Guardrail, Type T, or Type MGS-8 to Fillerwalls.

G. Guardrail Anchorage, Bridge, Detail A-1 (Standard Plans B-22-Series and B-23-Series)

Current Use:
1. Use when connecting Guardrail, Type T, or Type MGS-8 to Bridge Railing, Thrie Beam Retrofit.

H. Guardrail Anchorage, Bridge, Detail A-2 (Standard Plans B-22-Series and B-23-Series)

Current Use:
1. Use when connecting Guardrail, Type B to Bridge Railing, Thrie Beam Retrofit.

I. Need for Additional Expansion

The Guardrail Anchorage, Bridge details on Standard Plan R-67-Series will accommodate thermal deck movement up to about 4". If the expected thermal deck movement will exceed 4", the Road designer should consult with the Bridge designer to decide the method for providing the additional expansion required in the guardrail.

7.07

NOISE BARRIERS

7.07.01 (revised 3-21-2016)

References

A. 23 CFR 772, ***Procedures for Abatement of Highway Traffic Noise and Construction Noise***, FHWA, October 1997

B. ***An Inventory of Traffic Noise Levels Along Limited Access Freeways in Michigan***, Revision of Research Report R-1013A, (formerly) Materials and Technology Division, July 1981.

C. ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition, pages 4-41 to 4-47.

D. ***MDOT Noise Barrier Policy*** (guidelines for highway noise barriers), January 1978 and January 1982

7.07.02 (revised 12-22-2011)

General

The concept of traffic noise attenuation became an integral part of highway planning and design in 1976 when FHWA first issued ***Procedures for Abatement of Highway Traffic Noise and Construction Noise*** (currently 23 CFR 772). This regulation established two types of noise mitigation projects, which are continued to the present.

7.07.02 (continued)

Type I projects are for new highway construction, reconstruction of an existing highway, or the addition of one or more lanes to an existing highway. Guidelines for noise levels for residential, commercial, and special sites are listed in 23 CFR 772. If highway noise levels exceed the specified levels, on a regular basis, then noise mitigation must be considered. The warrants for noise barriers or other noise attenuation devices must include an economic cost-benefit analysis.

Type II projects are proposed Federal or Federal-aid projects for noise abatement on an existing highway, with no other concurrent reconstruction or lane addition being considered. This is a voluntary program and states wanting to participate must meet certain requirements. In order to be eligible for federal participation the Department had to establish a "Noise Barrier Policy", prepare an inventory of sites where highway noise levels exceed FHWA noise guidelines, and establish a priority system for treatment of the identified sites.

Noise attenuation is confined almost entirely to freeways, although there are one or two locations in the state where an earth mound sound barrier has been constructed along a free access route. Generally, the distance between access points, i.e., necessitating an opening in a barrier, are so close on a free access road that a barrier would not be practical.

Responsibilities for noise barrier investigation, evaluation, and design are generally divided as shown in the following chart:

Technical investigation and analysis	Instrumentation and Data Systems Unit, Construction Field Services Division
Environmental Impact Statement	Bureau of Planning, Transportation Planning Services Division
Choice of noise barrier type, general details of design	Roadside Development Design Unit, Design Division
Noise barrier structural analysis	Bridge Design Special Assignment Unit, Design Division
Noise barrier design details	Road Design Unit, Region/TSC

10.02.02 (revised 3-21-2016)

Documents / Definitions

There are three levels of analysis: categorical exclusion, environmental assessment, and environmental impact statement.

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 Project Planning Division. If there are no apparent "significant" long term negative environmental impacts, "substantial" controversy on environmental grounds, or significant impacts upon public parks, recreation areas, or refuges, the project receives an environmental clearance to proceed. Environmental Study for Project Classification (MDOT only Form 1775), with any necessary attachments, serves as the documentation of compliance with the NEPA process. Environmental Study for Project Classification (MDOT only Form 1775) 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.

10.02.02 (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 insure that all considerations and deliberations required by NEPA are carried out and that the decision making process is documented.

12.02

LOCAL ROADS AND STREETS

12.02.01 (revised 3-21-2016)

References

A. Geometric Design Guide GEO-640 Series, "Turned-in Roadways"

B. Geometric Design Guide GEO-650 Series, "Flares and Intersection Details"

C. "Act 51, P.A. of 1951, As Amended, a Part of Michigan Highway Law"

D. ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition

E. Standard Plan R-30-Series, "Concrete Curb and Concrete Curb & Gutter"

12.02.02 (revised 12-15-97)

General

The design of local roads and streets, as with service roads (Section 12.01) and turnbacks (Section 12.03), should be compatible with the design standards of the local agency having jurisdiction. While some counties and cities have design standards equal to trunkline standards, others do not. Usually, a county's primary road standards will be higher than its secondary road standards. The agency's standards can be determined by direct contact or by checking with the Local Agencies Unit.

The Local Agencies Unit maintains up-to-date maps of all counties, cities, and villages. In addition, it has individual maps showing all roads certified by the local agency as part of the basis for Michigan Transportation Fund distribution. The city and village maps are authoritative for determining corporate limits.

12.02.02 (continued)

Whenever a portion of a local road must be reconstructed as part of a trunkline project, the Department does not assume temporary jurisdiction. It is therefore unnecessary to return jurisdiction on completion of the construction. (An exception is when a local road may be taken over as a temporary trunkline where freeway construction ends.)

12.02.03 (revised 12-15-97)

Intersection Approaches

Where a trunkline resurfacing project and a local road intersect, the Region/TSC Traffic and Safety Engineer will designate an Approach Treatment Detail I, II, or III, from Geometric Design Guide GEO-650 Series.

Approach Treatment Detail I is a "minimum" treatment. It is intended for use only when it is requested by the Region/TSC (therefore it should not be set up initially on preliminary plans). It is applicable at an unimproved gravel road or a limited use sand trail. The paved apron is widened to one paver-width and is intended to reduce the incidence of gravel and sand tracking and washing onto the trunkline pavement.

The Approach Treatment Detail II is a "minimum paved approach" and uses limited arcs without curb and gutter. Approach Treatment Detail II is intended for improved, maintained local roads where it is felt that Approach Treatment Detail III is not warranted. It should be noted that the 30' radius is designed for the wheel path of a single unit commercial vehicle. It fits a turning school bus if the bus encroaches beyond the crossroad centerline.

14.30 (revised 2-18-2010)

PRELIMINARY CONSTRUCTABILITY REVIEW
(PPMS Task Description 3565)

Constructability is taken into account during the scoping and early plan development process (and in conjunction with the Early Project Scoping Constructability Checklist). After the Job Concept Statement has been created in MPINS, the Project Manager/Concept Author should consult with the Region/TSC Delivery 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 and Region/TSC Traffic and Safety Engineer may be required throughout this task. In both instances the review and incorporation of any comments must occur prior to Preliminary Plan Development.

14.31 (revised 3-26-2012)

ENVIRONMENTAL REVIEW AND CLEARANCE

Environmental review and clearance is a two step process: Environmental Classification (PPMS Task 3150) and Environmental Certification (PPMS Task 3155).

14.31.01 (revised 3-21-2016)

Environmental Classification
(PPMS Task 3150)

Environmental Classification is required by the National Environmental Policy Act (NEPA). All projects must be reviewed for potential environmental impacts and classified according to the significance of those impacts. Class I Actions are those projects with significant environmental impacts and require the preparation of an Environmental Impact Statement (EIS). Class II Actions have minor or no environmental impacts and require Categorical Exclusion (CE) documentation (Form 1775). Class III Actions are projects where the significance of the impacts is not known and require the preparation of an Environmental Assessment (EA).

Most projects are classified as CEs. However, environmental review is still required to identify non-significant environmental impacts, and establish measures to mitigate those impacts. Measures to mitigate can include avoidance, design changes, protective measures, or replacement. Establishing mitigation measures can be complex and require coordination with state, federal and local resource agencies. Often, mitigation measures can be developed through collaboration between the Project Manager (PM) and MDOT Environmental Staff.

14.31.01 (continued)

Environmental Classification

The Environmental Clearance Coordinator (ECC) will contact the PM about one year prior to the Base Plan Date (BPD), or upon notification of project programming (Form 2604) for projects of short development duration. The ECC will request information about the scope and location of the project. This information can include the extent of grading and filling, right of way requirements, detour information, etc., and is critical in assessing project environmental impacts. The project description, location, and other pertinent project information are put on the Environmental Classification (Form 1775). MDOT Environmental Staff may contact the PM for more details about the project in order to assess impacts.

Once impacts are assessed, collaboration occurs between the PM and MDOT Environmental Staff, to develop mitigation measures. The goal of collaboration is to develop measures that both allow the project to accomplish its transportation goal and minimize impacts to the environment. Once impacts are identified and mitigation measures established the project can be classified as a CE. The PM will be notified and the Environmental Classification (Form 1775) and supporting documentation will be stored in ProjectWise under the Project Job Number. Classification is also recorded in the MAP database (MPINS/MFOS/REMIS). Classification is scheduled to occur on or before the completion of Base Plan Review (PPMS Task 3380).

The Form 1775 filled out by the ECC will have highlighted mitigation measures in bold text to signify that those measures are to be transmitted directly to the TSC Construction Engineer for the project.

It will be the responsibility of the Project Manager and the ECC to ensure that all mitigation measures whether or not highlighted in bold on the Form 1775 are incorporated into the project plans and proposal.

14.31.01 (continued)

Prior to completions of the NEPA review process, preliminary engineering and other activities and analyses must not materially affect the objective consideration of alternatives in the NEPA review process. FHWA defines Preliminary Design as activities that define the general project location and design concepts. It includes, but is not limited to, preliminary engineering and other activities and analyses, such as environmental assessments, topographic surveys, metes and bounds surveys, geotechnical investigations, hydrologic analysis, hydraulic analysis, utility engineering, traffic studies, financial plans, revenue estimate, hazardous materials assessments, general estimates of the types and quantities of materials, and other work needed to establish parameters for the final design.

If the information required for classification requires engineering work or environmental coordination extending beyond the BPD, the PM must receive approval from the ECC to continue work limited to the following tasks:

14.31.01 (continued)

Environmental Classification

The Bureau of Development Environmental Manager will report to FHWA each quarter of the fiscal year the number of projects that have allowed any of the tasks noted above to be performed before the environmental classification.

Final design or right of way acquisition cannot proceed prior to classification. FHWA defines final design as any design activities following preliminary design and expressly includes the preparation of final construction plans and detailed specifications for the performance of construction work.

Between base plans and quality assurance review, environmental mitigation measures are to be fully developed and detailed in the plan package.

Development of the materials necessary to convey the environmental mitigation measures within the Form 1775 will include but not be limited to:

- Project specific Plan Notes
- Notice to Bidders
- Unique Special Provisions

Design staff must take into account that individual pay items needing modification to meet the requirements of environmental mitigation measures require the inclusion of an appropriate unique or frequently used Special Provision to ensure proper construction.

14.31.01 (continued)

Design staff will prepare a memo to be transmitted to the Construction Engineer for their use at the Pre-Construction meeting. The memo should highlight the specific environmental mitigation measures in the plans and proposal and include construction specific instructions related to environmental mitigation highlighted with bold text in the Form 1775.

The Construction Engineer will be responsible for ensuring that the contractor is made aware of all environmental mitigation measures and the consequences of not meeting them.

14.31.02 (new section 3-26-2012)

Environmental Certification
(PPMS Task 3155)

Environmental Certification is the final step in the Environmental Review and Clearance Process. This task takes place during Project Plan Quality Assurance Review (PPMS Task 3865). During Certification, plans and other documents are reviewed to ensure that all areas of concern are avoided, all mitigation measures are in place, and all commitments adhered to. This review is conducted by the ECC and documented (Form 2002).

If all mitigation measures are in place and all commitments adhered to, the project will be certified. The PM will be notified and Environmental Certification Form (Form 2002) and supporting documentation will be stored in ProjectWise under the Project Job Number. Certification is also recorded in the MAP database (MPINS/MFOS/REMIS).

14.57 (revised 3-21-2016)

CERTIFICATION ACCEPTANCE

As part of the stewardship agreement with the FHWA, MDOT developed a procedure involving a system of checks/reviews to verify all requirements of the agreement are met. The Department also made the decision to use the majority of the process (completion of the Certification Acceptance form) on all projects (Federal and M funded), including those classified FHWA Oversight. The verification is accomplished by completing the Certification Acceptance form. The form includes reviews (with confirmation by signature or initials) by several divisions and sections within the Bureau of Highways. Once the form is completed it is included in the proposal folder that is submitted to the Specifications and Estimates Unit. The required signatures (or initials) are listed below:

- Bridge Design Unit (if applicable)
- Project Manager / Design Engineer / Consultants
- Quality Assurance Engineer
- Specifications and Estimates Engineer
- Utility Coordination and Permits
- Governmental Coordination and Engineering
- Drainage Engineer (if applicable)
- Force Account Work (if applicable)
- Geometric Design Engineer
- Traffic Signs and Delineation
- Traffic Signals
- Region/TSC Traffic and Safety
- Resident/Delivery Engineer
- FHWA Area Engineer

14.57 (continued)

The following documentation should be attached to the certification acceptance form prior to submittal to the Specifications and Estimate Unit.

- Environmental Classification (Form 1775)
- Mitigation measures required in the environmental document (EIS, FONSI)
- Permits
- Copies of Scope Verification and The Plan Review Meeting minutes.
- Design Exceptions
- Waiver-Planting Wildflower Expenditures
- Pavement Selection Review Committee Approval Letter.

The Project Manager must send a copy of the **completed** Certification Acceptance form to the FHWA Area Engineer on all FHWA Oversight projects prior to submitting the final plan/proposal submittal to the Specifications and Estimates Unit.

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 shall 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 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 for the bridge.
(10-22-2012) (3-21-2016)

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).

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

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.

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).

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)

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

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 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)

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 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 for the bridge.
(3-26-2012) (3-21-2016)

With structure resurfacing, railing upgrading and joint replacement projects the structural adequacy of the superstructure shall be evaluated.

12.02

GEOMETRIC CRITERIA

(9-1-88) 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 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 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 ***A Policy on Geometric Design of Highways and Streets***, ***2011, 6th Edition*** design criteria (standards). Therefore, if a bridge on a road project is not altered it is subject to design exceptions for full new/reconstruction standards. (8-20-2009) (3-21-2016)

12.02.01

Vertical Clearance (5-1-2000)

For Design Exception Requirements for Vertical Clearance see Appendix 12.02.01.

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

(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.

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.

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

(a) A 18 ft minimum width may be used for roadways with design volumes under 250 veh/day.

On roadways to be reconstructed, a 22 ft traveled way may be retained where the alignment and safety records are satisfactory.

12.07.04

End Diaphragms

(8-6-92) 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, note 8.09.04 I should be placed on the plans and the Special Provision for Removal and Replacement of End Diaphragms should be included in the contract proposal. (8-20-2009)

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 Gray. The Federal Standard 595C number for this color is 16440. Previously, the MDOT standard color was Light Blue - number 15488. Other Federal Standard colors may be recommended by the Region. (3-21-2016)

12.07.08

MDEQ Hazardous Waste Number
(5-1-2000) (3-26-2012)

All structures scheduled for painting need a Michigan Department of Environmental Quality (MDEQ) hazardous waste number (MIR number). These numbers are supplied by the Bridge Management Section of Design Division. See also Section 14.04.

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. Environmental Study for Project Classification (MDOT only form 1775), with any necessary attachments, serves as the documentation of compliance with the NEPA process. Environmental Study for Project Classification (MDOT only form 1775), 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.
(2-17-2014)(3-21-2016)

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 insure that all considerations and deliberations required by NEPA are carried out and that the decision making process is documented.