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REVIEW & INVESTIGATION OF W-BEAM GUARDRAIL TERMINALS WITH CURBS

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16. Abstract

The Roadside Safety Pooled Fund members prioritized the investigation of current practices for installing w-beam guardrail terminals near curbs. Currently, there is little guidance on the effects on the impact performance of w-beam guardrail terminals caused by curbs. Therefore, the Texas A&M Transportation Institute (TTI) was tasked to review previous and on-going research on this topic and then collect information on current state of practice for installing w-beam guardrail terminals near curbs. Consequently, the objective of this project was to compile current literature and practices on w-beam guardrail terminals when located near a curb. This was achieved through a review of previous and on-going research projects and a state survey. The results of the survey were compiled and documented in this report. Appendix A shows the results of the survey in a raw format to provide information on specific design configurations. Appendix B shows the results of the survey in an aggregated format to provide information on current trends in the practice.

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Chapter 1. INTRODUCTION

1.1 PROBLEM STATEMENT

For this project, members of the Roadside Safety Pooled Fund prioritized the investigation of current practices for installing w-beam guardrail terminals near curbs. While high-speed roadways are often designed without curbs, State Departments of Transportion (DOTs) are sometimes required to provide a curb on a high-speed roadway. Currently, there is little guidance on the effects on the impact performance of w-beam guardrail terminals caused by curbs. Therefore, the Texas A&M Transportation Institute (TTI) was tasked to review current literature and research on this topic and then collect information on how the DOTs are currently handing w-beam guardrail terminals when they are installed near curbs.

1.2 WORK PLAN

The TTI research team first reviewed previous and on-going research regarding w-beam guardrail terminals installed near curbs. The TTI research team then developed a survey that investigated current state practices for installing w-beam guardrail terminals near curbs. This survey was distributed to state DOT representatives. The survey was approved by the technical representative of the Roadside Safety Pooled Fund prior to distribution.

The TTI research team compiled the results of the survey and prepared visual documentation of these results. Lastly, the TTI research team prepared a final research report documenting the work completed in this project, including the results of the state survey.

1.3 OBJECTIVE

The objective of this project was to compile current practices on installing w-beam guardrail terminals near curbs.

Chapter 2. LITERATURE REVIEW AND STATE SURVEY

2.1 LITERATURE REVIEW

The research team first reviewed previous and on-going research projects which were relevant to installing w-beam guardrail terminals near curbs. The Midwest Roadside Safety Facility (MwRSF) completed two projects in 2000 and 2001 which evaluated w-beam guardrail systems installed near curbs. In these projects, the researchers identified that no crash testing on w-beam guardrail terminals installed near curbs had been completed at that point in time. They went further to state "all guardrails and guardrail terminals installed over curbs must be crash tested and shown to meet current impact safety standards in order for its use to be continued on federal-aid highways" (*1*,*2*).

In 2017, researchers at MwRSF further investigated w-beam guardrail terminals installed near curbs. The objective of this project was to investigate whether curb placement in advance of guardrail end terminals degrades barrier performance on high-speed roadways. In this project, the researchers sent a survey to the members of the Midwest States Pooled Fund Program to investigate their typical practices regarding w-beam guardrail terminals installed near curbs on high-speed roadways. This survey provided valuable information for researchers to progress in the next tasks of the project, such as common w-beam terminals, curb shapes, etc. (*3*).

MwRSF researchers continued their investigation through computer simulations and evaluated the results to MASH 2009 evaluation criteria. MwRSF used a previously developed Midwest Guardrail System (MGS) finite element analysis (FEA) model that was modified to include a non-proprietary end terminal that was representative of several compression-based end terminal systems. Two variations of the model were used. Option one consisted of a 27 ¾ in. tall guardrail with 8 in. blockouts, and option two consisted of a 31 in. tall rail with 12 in. blockouts. Both variations were 175 ft. long and used the same representative end terminal system (*3*).

Baseline conditions were established by simulating end terminal impacts on both model variations without curbs. NCHRP Report 350 and MASH 2009 small car and pickup truck end terminal tests were simulated, and the results were compared to previous full-scale crash tests to ensure the end terminal model reasonably represented actual systems. Once the end terminal model was reasonably validated, the two model variations were simulated with various curb configurations. The curb configurations consisted of 2-inch., 4-inch, and 6-inch tall vertical and sloped wedge-shaped curbs in combination with 0-inch, 6-inch, and 6-inch. lateral offsets from the front face of the guardrail. The curb heights and shapes are shown in Figure 1 (*3*).

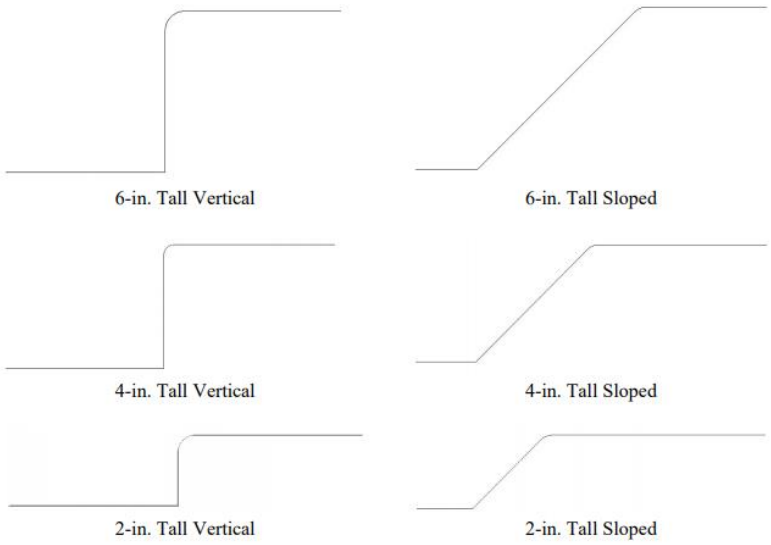


Figure 1. Curb Heights and Shapes used for Guardrail End Terminal Simulation (*3*)

The end terminal model was also evaluated when flared at a 1:25 flare rate with a 2-foot lateral offset. The flared end terminal was evaluated with no curb and with 2-inch., 4-inch, and 6-inch sloped wedge-shaped curbs with a 0-inch lateral offset from the front face of the guardrail (*3*).

Overall the researchers found that the presence of curbs had a greater impact on the small car than the pickup truck. It was found that the pickup truck is minimally affected by the presence of curbs, while the small car was most affected by the 4 in. and 6 in. tall vertical curbs. The taller vertical curbs affected small car vehicle yaw, and sloped curbs had minimal effect on vehicle yaw. The larger, 6-foot. lateral offset between the curb and the face of the guardrail was found to affect vehicle trajectory and interaction with the impact head. The smaller offsets were found to have minimal impacts on vehicle trajectory and interaction with the impact head. End terminal flaring was found to have the most effect on tests with angled impacts (*3*).

Some computer simulation limitations were recognized and recommended for improvement in future simulation efforts. Vehicle models used for simulations conducted with curbs and angled impact trajectories on both flared and tangent end terminal systems were found to have steering and suspension behavior that was unrealistic. A curb traversal study was recommended to calibrate steering and suspension of vehicle models. The use of one specific end terminal model and validation of that model was recommended for future studies. Full-scale crash tests were also recommended to be part of future research efforts (*3*).

MwRSF researchers are currently planning the continuation of this research project, which includes survey, simulation, and full-scale crash testing efforts. The results of the survey will serve as the basis for computer simulation parameters. LS-DYNA computer simulations will be conducted to determine performance of energy-absorbing terminals adjacent to curbs with head-on and angled impacts near end terminals. The simulation effort will also determine critical tests and impact points for full-scale crash testing. The testing effort will be comprised of both a small

car and a pickup truck full-scale crash test. These tests will serve to validate the computer simulation effort and provide guidance for future curb and terminal studies.

2.2 STATE SURVEY

The TTI research team created a state survey which investigated current state practices for installing w-beam guardrail terminals near curbs. The survey was focused on identifying specific curb configurations used when installing w-beam guardrail terminals nearby. The survey was built around a series of core questions that asked respondents about the specific curb details their respective states use for installing w-beam guardrail terminals near curbs. For example, the respondent was asked to provide specific curb types and heights that were used near w-beam guardrail terminals. Additionally, the survey also investigated the prevalence of installing w-beam guardrail terminals near curbs on low-speed roadways vs. on high-speed roadways. Because curbs are installed more frequently on low-speed roadways than on high-speed roadways, researchers initially believed the w-beam guardrail terminals would be installed near curbs more frequently on the low-speed roadways. Additionally, different curb details may be used by designers on low-speed roadways than on high-speed roadways. Therefore, the TTI research team included appropriate questions to ensure the difference between low-speed roadway configurations and high-speed roadway configurations was captured properly in the survey.

The survey was built upon a series of core questions which repeated themselves based upon respondent input. One trigger for this loop mechanism was classifying the adjacent roadway as low-speed, high-speed, or both. If the user selected both low-speed and high-speed adjacent roadways, the respondent was prompted to answer the core questions with respect to low-speed roadways, and the questions were repeated for the high-speed condition. The other trigger for engaging the loop mechanism was the respondent's input of an additional curb configuration to their responses. For example, the user could answer the core questions with respect to a 6-inch sloped curb configuration and then repeat the core question series with respect to an additional 4-inch vertical curb configuration. This allowed readers to review specific curb configuration details in the responses to the survey. The list of all responses to the individual survey questions is listed in Appendix A.

In order to simplify review of the results, the researchers also aggregated the responses into single data sets corresponding to repeated questions. This will allow readers to review the data from a much larger scale and gain an understanding of current trends in practice. For example, a reader may view that 6-inch curbs represented 36% of all low-speed curb configurations submitted to the survey. The list of these aggregated results can be found in Appendix B.

Chapter 3. SUMMARY AND CONCLUSIONS

3.1 SUMMARY

The Roadside Safety Pooled Fund members prioritized the investigation of current practices for installing w-beam guardrail terminals near curbs. Currently, there is little guidance on the effects on the impact performance of w-beam guardrail terminals caused by curbs. Therefore, the Texas A&M Transportation Institute (TTI) was tasked to review previous and on-going research on this topic and then collect information on current state of practice for installing w-beam guardrail terminals near curbs. Consequently, the objective of this project was to compile current literature and practices on w-beam guardrail terminals when located near a curb. This was achieved through a review of previous and on-going research projects and a state survey. The results of the survey were compiled and documented in this report. Appendix A shows the results of the survey in a raw format to provide information on specific design configurations. Appendix B shows the results of the survey in an aggregated format to provide information on current trends in the practice.

3.2 CONCLUSIONS

Appendix A lists the results of the survey in their raw non-aggregated format in order to provide readers information on specific design details. Appendix B lists the aggregated results of the survey to provide readers with current trends in the practice. A few survey results are highlighted below.

When asked if the respondent's state installs w-beam guardrail terminals near curbs on high-speed roadways, low-speed roadways, both, or neither, there was a relatively even split between low-speed roadways or both. Furthermore, the vast majority of the respondents did install w-beam guardrail terminals near curbs despite the lack of formal guidance; only approximately 12% of respondents did not install w-beam guardrail terminals near curbs. Therefore, this is a prevalent situation that state DOTs are encountering. This prevalence combined with the lack of guidance in the industry warrants further research on this topic. Figure 1 below shows the results of this question on prevalence in the survey.

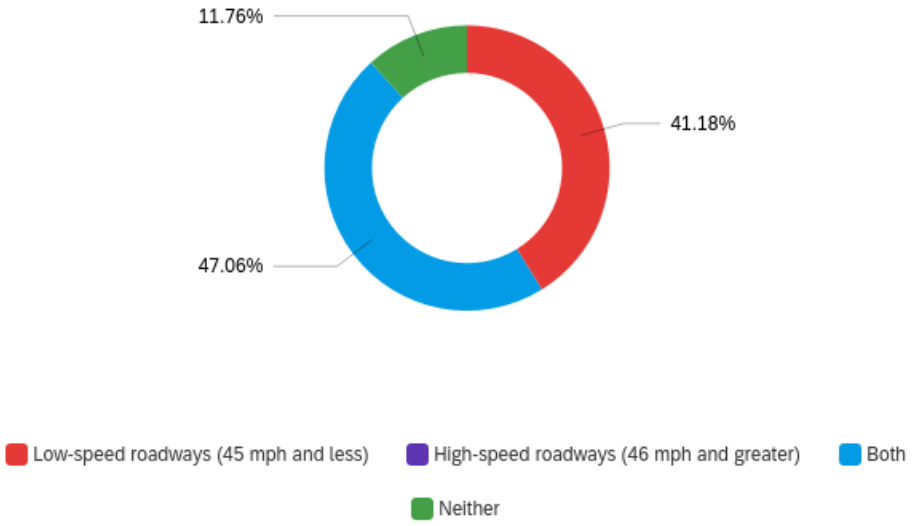


Figure 1. State Usage of W-beam Guardrail Terminals near Curbs by Roadway Speed

This need is further reinforced when states responded to questions regarding their desires for a crashworthy w-beam guardrail terminal with curb applications. Approximately 77% of respondents desired a crashworthy w-beam guardrail terminal with a curb application for low-speed roadways. Furthermore, approximately 61% of respondents desired a crashworthy w-beam guardrail terminal with a curb application for high-speed roadways. Figures 2 and 3 show the results of these questions in the survey.

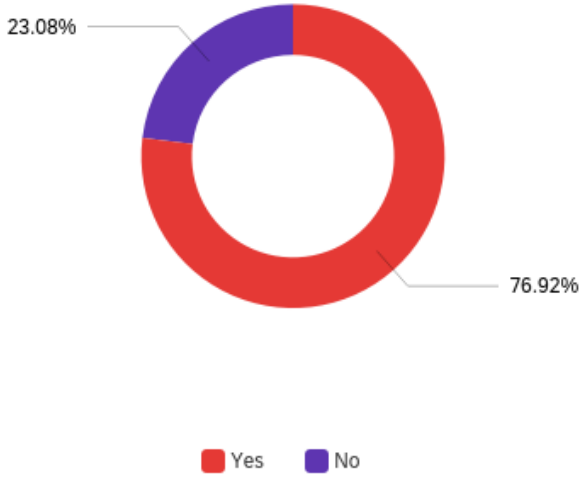


Figure 2. Respondents' Desire of a Crashworthy W-beam Guardrail Terminal near Curbs on Low-speed Roadways

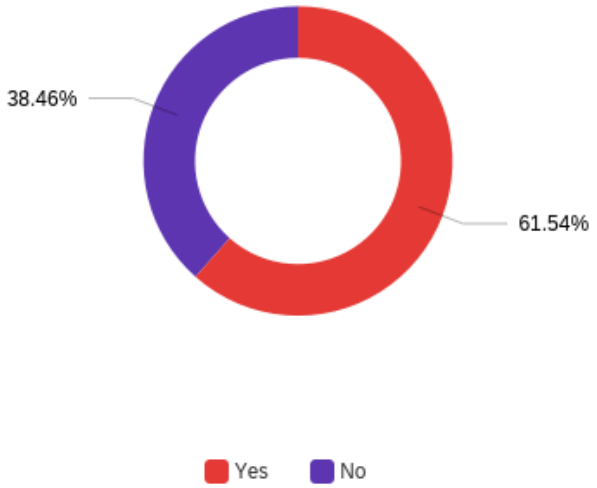
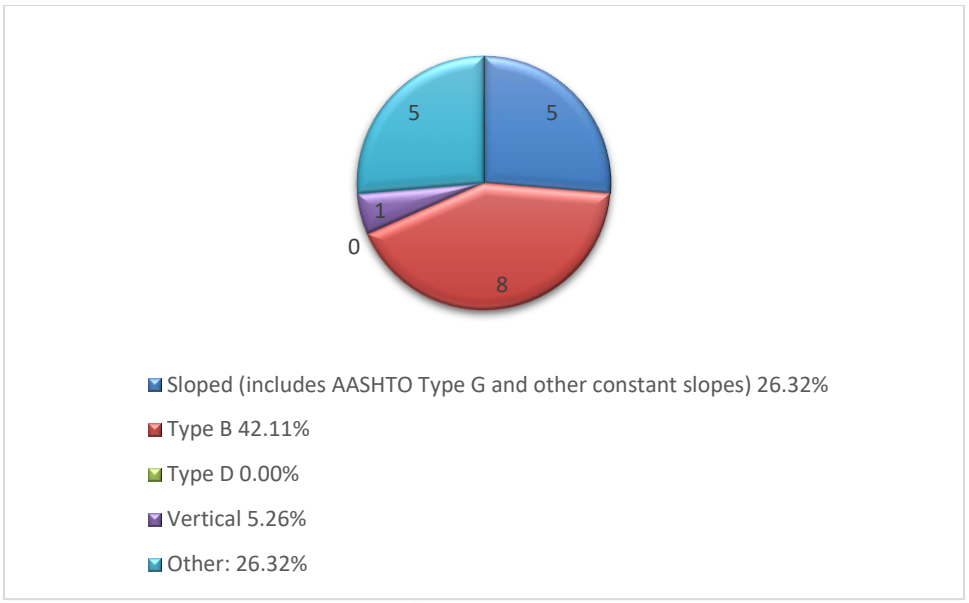
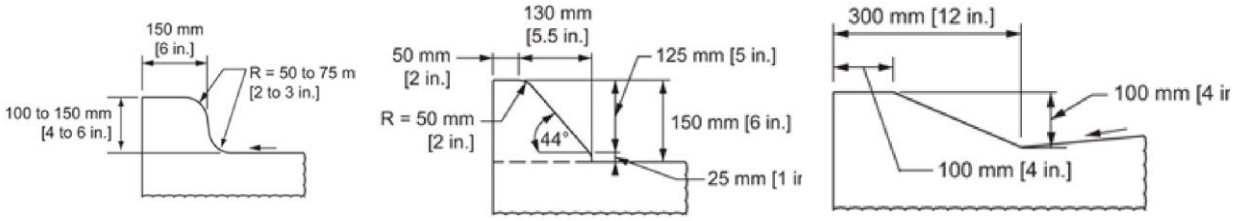


Figure 3. Respondents' Desire of a Crashworthy W-beam Guardrail Terminal near Curbs on High-speed Roadways.

Out of the configurations submitted to this survey regarding low-speed roadways, Type B curbs were used most often, followed by constant sloped curbs. Figure 4 below shows the breakdown of survey responses for curb type on low-speed roadways. While curb type prevalence was clear, the design configurations submitted showed a more even split between curb heights. Curbs with a 6-inch height were most common with approximately 36% of the responses, followed by 4-inch height with 26% of the responses. Figure 5 below shows the breakdown of survey responses for curb height on low-speed roadways.





Type B Type D Type G

Figure 4. Curb Type Prevalence in Submitted Configurations for Low-Speed Roadways

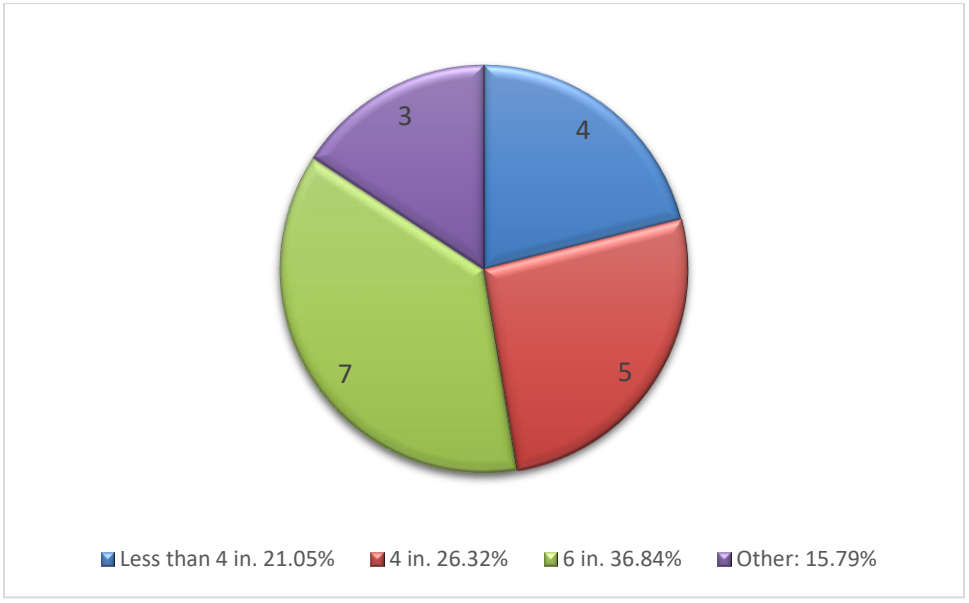


Figure 5. Curb Height Prevalence in Submitted Configurations for Low-Speed Roadways

Out of the configurations submitted to this survey regarding high-speed roadways, constant slope curbs were used most often, followed by Type B curbs. Figure 6 below shows the breakdown of survey responses for curb type on high-speed roadways. Unlike the low-speed case, curb height prevalence was clear in the high-speed case. Curbs with a 4-inch height were most common with 80% of the responses, followed by 6-inch height with 20% of the responses. Figure 7 below shows the breakdown of survey responses for curb height on high-speed roadways.

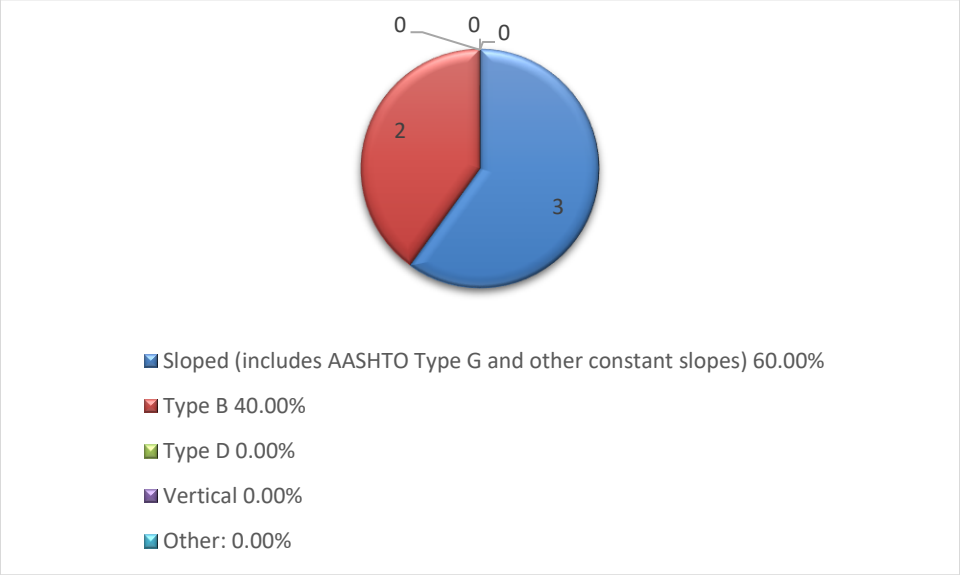


Figure 6. Curb Type Prevalence in Submitted Configurations for High-Speed Roadways

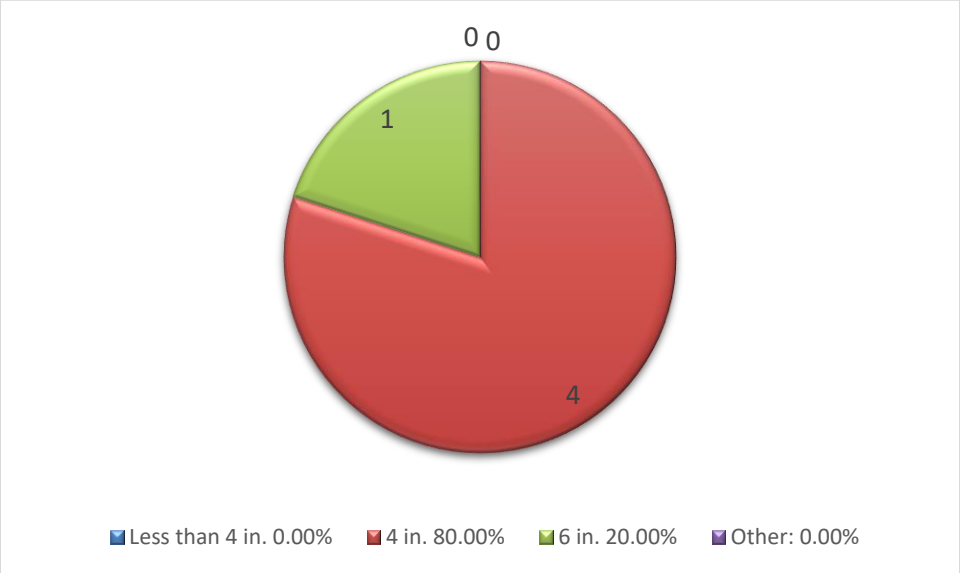


Figure 7. Curb Height Prevalence in Submitted Configurations for High-Speed Roadways

The results of the survey show a need for research and guidance on installing w-beam guardrail terminals near curbs. Therefore, the research team recommends further computer simulation, analysis, and full-scale crash testing in order to provide the state DOTs with appropriate guidance for implementation.

REFERENCES

1. K.A. Polivka, R.K. Faller, D.L. Sicking, J.R. Rohde, J.D. Reid, and J.C. Holloway, "Guardrail and Guardrail Terminals Installed Over Curbs," Research Report TRP-03-83-99, Midwest Roadside Safety Facility, Lincoln, NE, March 2000.

2. K.A. Polivka, R.K. Faller, D.L. Sicking, J.R. Rohde, J.D. Reid, and J.C. Holloway, "Guardrail and Guardrail Terminals Installed Over Curbs- Phase II," Research Report TRP-03-105-00, Midwest Roadside Safety Facility, Lincoln, NE, November 2001.

3. J.D. Schmidt, R.W. Bielenberg, B.D. Schroder, R.K. Faller, and K.A. Lechtenberg, "Safety Investigation and Design Guidance for Curbs Near Energy-Absorbing End Terminals," Research Report TRP-03-358-17, Midwest Roadside Safety Facility, Lincoln, NE, July 2017.

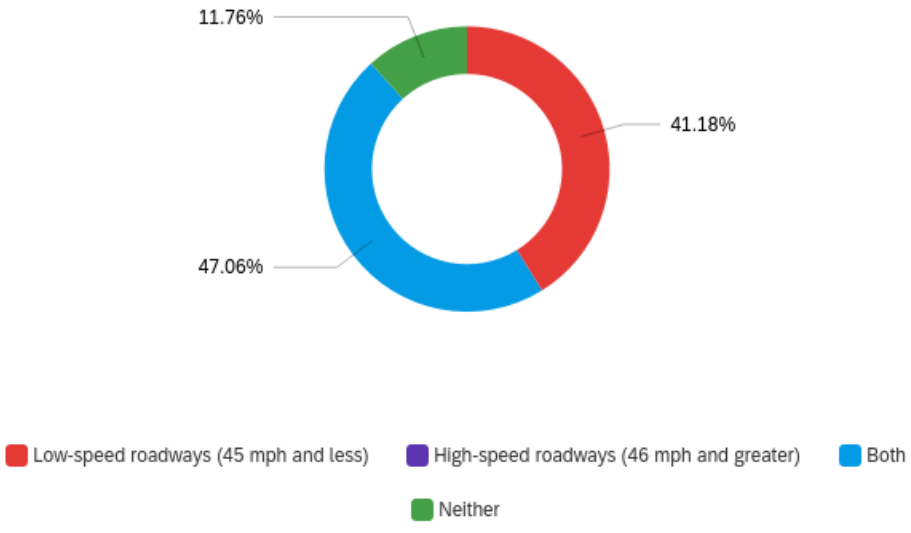
APPENDIX A. STATE SURVEY QUESTIONS AND INDIVIDUAL RESULTS

This Appendix is comprised of the results from the state survey distributed during this project. Individual responses are alphanumerically numbered, so the first respondent to the survey was numbered "R1," the second "R2," and so on. If a question did not receive any responses, the question was noted as "No response provided" in this report. As discussed in Chapter 2, the layout of the survey included a list of several core questions that were repeated depending upon user input. This loop mechanism was engaged when users inputted curb configurations for both low-speed and high-speed roadways or when inputting multiple curb configurations. This Appendix shows the survey questions and responses in their raw format, or in other words, prior to aggregation. This will allow users to identify detailed curb configurations used when w-beam guardrail terminals are installed nearby. For example, users can find which curb height is used with a specific type of curb. Alternatively, Appendix B shows the aggregated list of survey questions and answers, which can provide a larger perspective on general trends and practices.

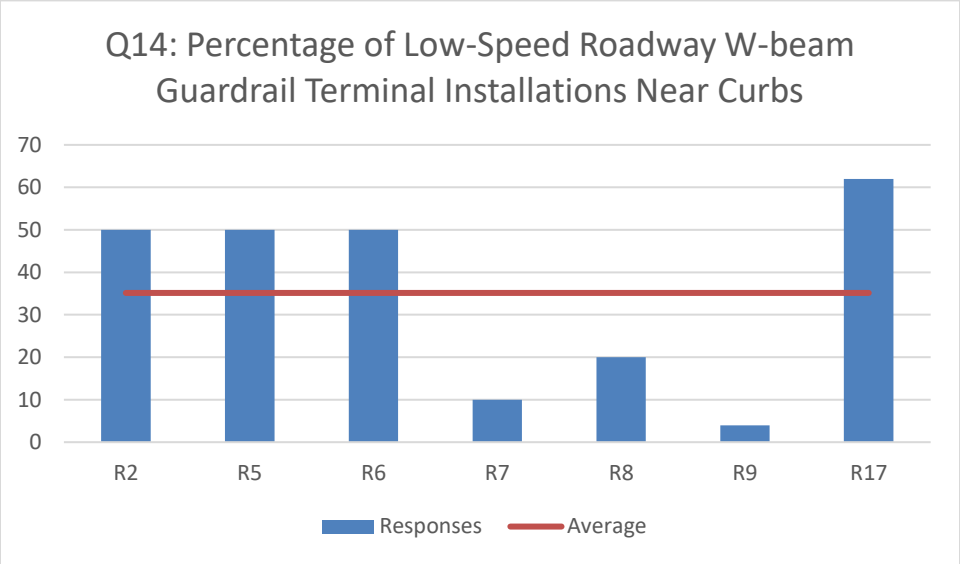
A.1 INTRODUCTORY QUESTIONS

The first section of the survey introduced the topic and investigated basic trends of installing w-beam guardrail terminals near curbs. The following questions were included in this first introductory section.

Q4 - Does your transportation agency install w-beam guardrail terminals in close proximity to curbs on low-speed or high-speed roadways? If your agency does not install w-beam guardrail terminals near curbs, please select neither.



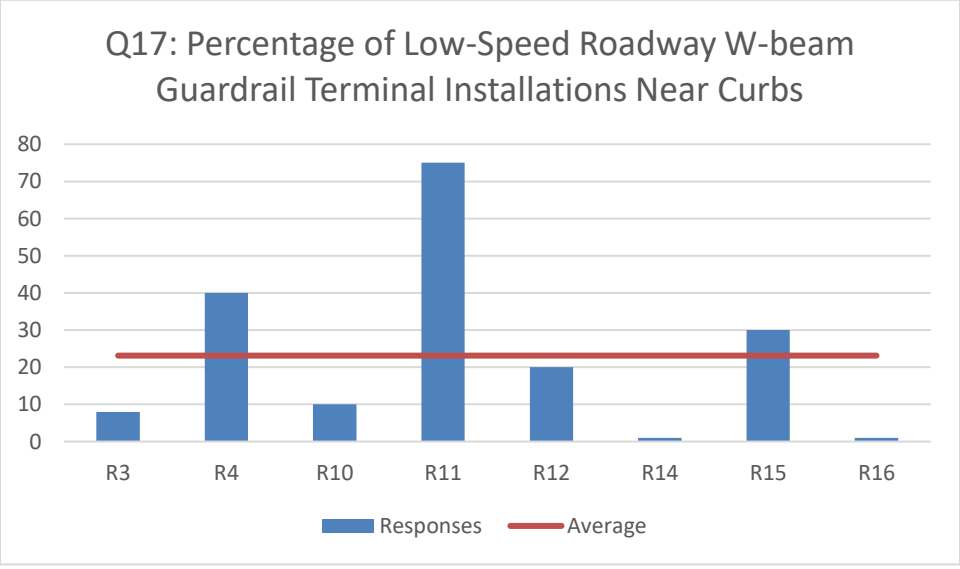
Q14 - What percentage of low-speed roadway w-beam guardrail terminal installations are located near curbs?

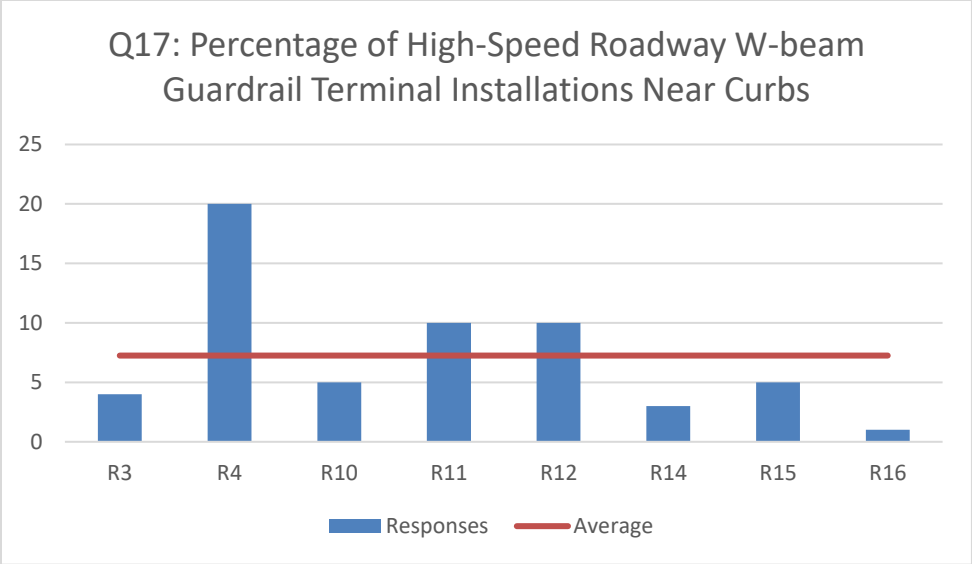


Q16 - What percentage of high-speed roadway w-beam guardrail terminal installations are located near curbs?

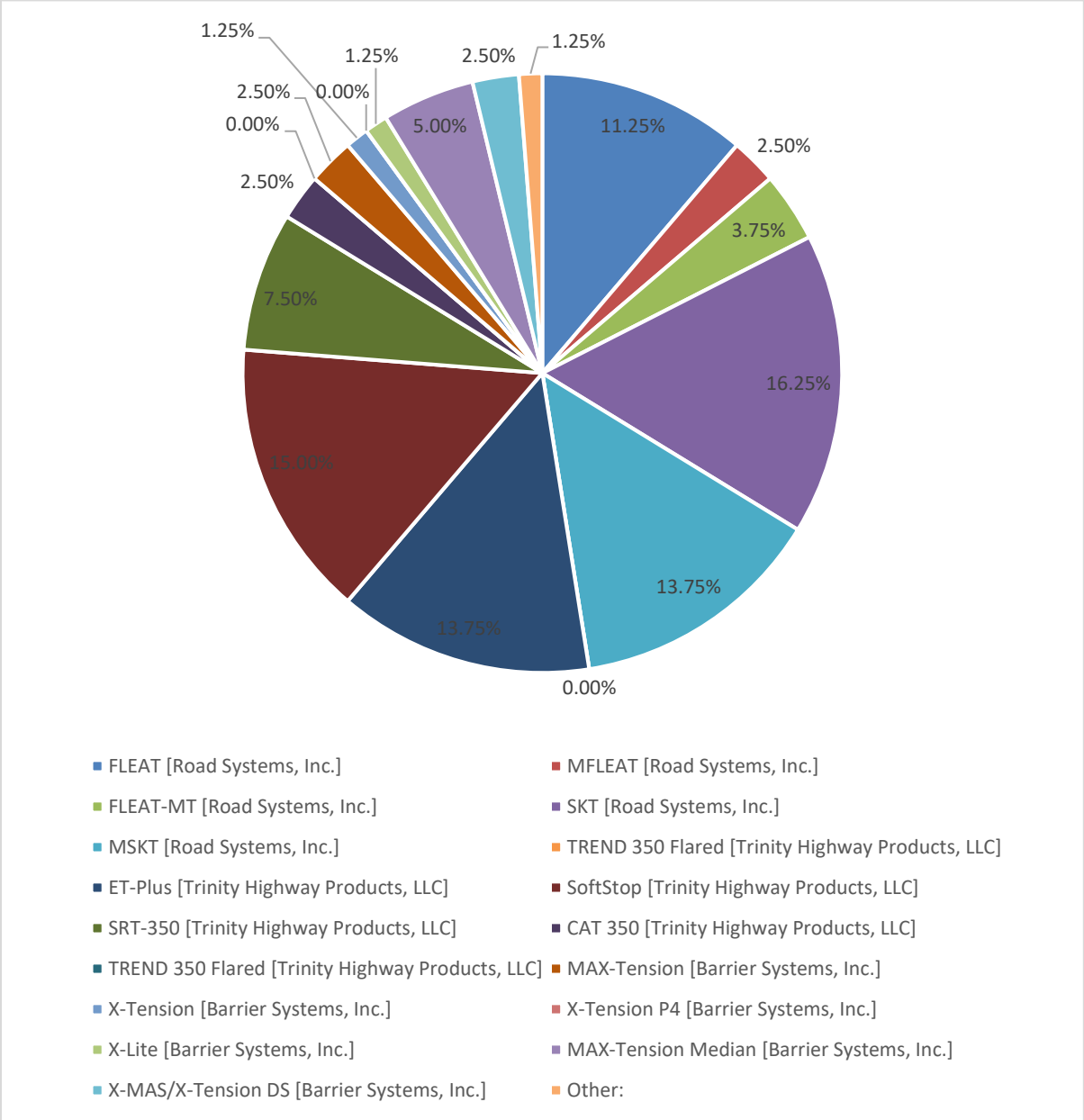
No responses provided.

Q17 - What percentage of w-beam guardrail terminal installations are located near curbs?
(When both low-speed and high-speed roadways are selected in Q4)




Q17: Percentage of High-Speed Roadway W-beam Guardrail Terminal Installations Near Curbs
25
20
15
10
5
0
R3
R4
R10
R11
R12
R14
R15
R16
Responses
Average

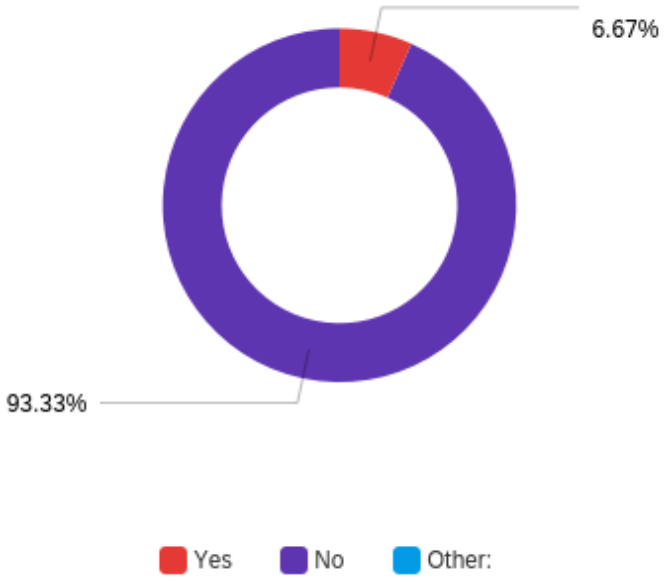
Q312 - Which of the following roadside/median terminals have you installed near curbs in the past or are currently installing? Please select all that apply.



Terminal	Percentage	Count
FLEAT [Road Systems, Inc.]	11.25%	9
MFLEAT [Road Systems, Inc.]	2.50%	2
FLEAT-MT [Road Systems, Inc.]	3.75%	3
SKT [Road Systems, Inc.]	16.25%	13
MSKT [Road Systems, Inc.]	13.75%	11
TREND 350 Flared [Trinity Highway Products, LLC]	0.00%	0
ET-Plus [Trinity Highway Products, LLC]	13.75%	11
SoftStop [Trinity Highway Products, LLC]	15.00%	12
SRT-350 [Trinity Highway Products, LLC]	7.50%	6
CAT 350 [Trinity Highway Products, LLC]	2.50%	2
TREND 350 Flared [Trinity Highway Products, LLC]	0.00%	0
MAX-Tension [Barrier Systems, Inc.]	2.50%	2
X-Tension [Barrier Systems, Inc.]	1.25%	1
X-Tension P4 [Barrier Systems, Inc.]	0.00%	0
X-Lite [Barrier Systems, Inc.]	1.25%	1
MAX-Tension Median [Barrier Systems, Inc.]	5.00%	4
X-MAS/X-Tension DS [Barrier Systems, Inc.]	2.50%	2
Other:	1.25%	1

Other Response: Breakmaster 350

Q7 - Does your agency differentiate between which terminals are installed near curbs and those which are not installed near curbs?

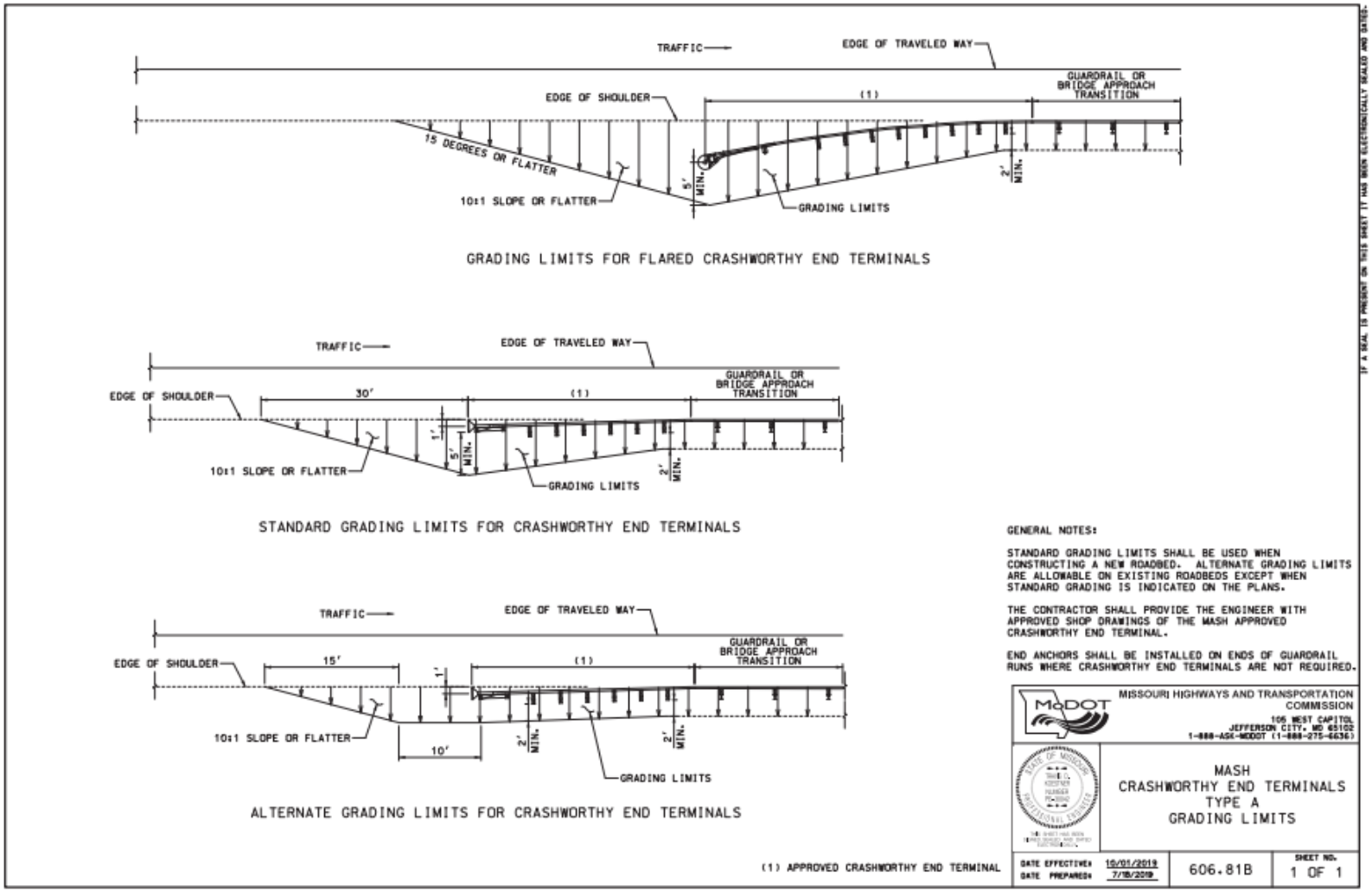


Answer	%	Count
Yes	6.67%	1
No	93.33%	14
Other:	0.00%	0
Total	100%	15

A.2 LOW-SPEED ROADWAY QUESTIONS- REPETITION 1

The second section of this survey investigated specific practices when installing w-beam guardrail terminals near curbs. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. This section was the first iteration of the questions based on a low-speed roadway configuration. The user was directed to this section if he or she selected to input details on low-speed roadway configurations of w-beam guardrail terminals near curbs. The user was also directed to this section if he or she selected to input details on both low-speed and high-speed roadway configurations of w-beam guardrail terminals near curbs. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

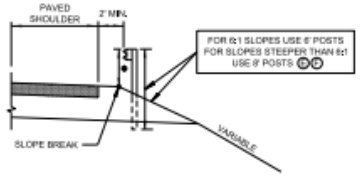
Q18 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.



■ REV. 10-11-12: ADDED NOTE TO DETAIL B. MINOR DRAFTING UPDATE. ADDED TABLE.

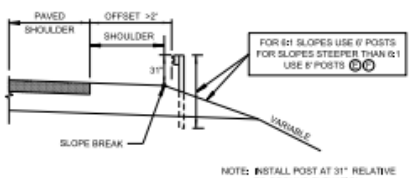
REV. 7-11-13: GENERAL REVISION.

REV. 05-26-15: ADDED GENERAL NOTE (D) AND (E). REVISED TABLE FOR GUARDRAIL POST REDUCTION IN DEFLECTION FOR SINGLE W-BEAM. REVISED DETAILS A THRU E. REMOVED TABLE A. REDRAW SHEET.



● NOTE: INSTALL POST AT 31" RELATIVE TO A LINE EXTENDED FROM THE SHOULDER SLOPE

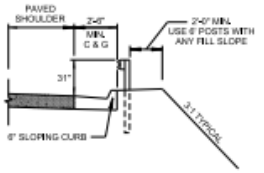
DETAIL A
GUARDRAIL PLACEMENT AT SLOPE BREAK



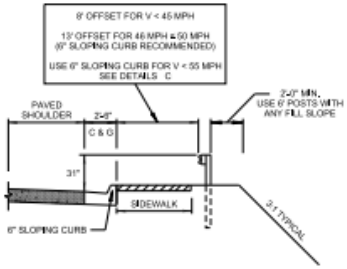
NOTE: INSTALL POST AT 31" RELATIVE TO GROUND ELEVATION

DETAIL B
OFFSET GUARDRAIL PLACEMENT

TYPICAL SECTIONS (NON CURB & GUTTER)



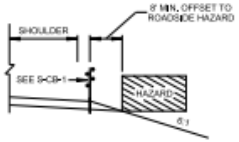
DETAIL C
GUARDRAIL PLACEMENT
ON CURB AND GUTTER SECTION



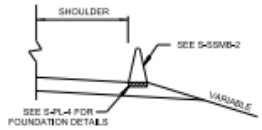
DETAIL D
OFFSET GUARDRAIL PLACEMENT
ON CURB AND GUTTER SECTION

TYPICAL SECTIONS WITH CURB AND GUTTER

USE 6" SLOPING CURB AT LOCATIONS WHERE THE POSTED SPEED IS BETWEEN 45 - 55 M.P.H.
DO NOT USE CURB AND GUTTER AT LOCATIONS WHERE THE POSTED SPEEDS ARE ABOVE 55 M.P.H.



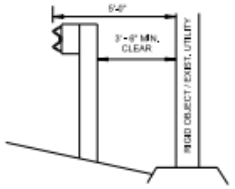
DETAIL E
HIGH TENSION 4 STRAND CABLE BARRIER
(TL-3 OR TL-4)



DETAIL F
FREE STANDING CONCRETE BARRIER RAIL
(TL-3, TL-4 OR TL-5)

ALTERNATE TO W-BEAM GUARDRAIL WHERE HIGHER PERFORMANCE IS NEEDED

NOT TO SCALE



TYPICAL MIN. CLEAR TO A RIGID OBJECT
(SEE TABLE BELOW IF LESS DEFLECTION IS DESIRED)
(REFER TO MWRSF REPORT TRP 03-171-06)

GUARDRAIL POST REDUCTION IN DEFLECTION FOR SINGLE W-BEAM			
POST SPACING	6' - 3"	3' - 1 1/2"	1' - 6 3/4"
DEFLECTION	3' - 6"	3' - 0"	2' - 6"

GENERAL NOTES FOR GUARDRAIL

(A) THIS DRAWING PROVIDES GUIDANCE FOR FACILITIES WITH POSTED SPEED LIMIT EQUAL TO OR GREATER THAN 60 MPH. SOME GUIDANCE FOR FACILITIES WITH POSTED SPEED LIMITS LESS THAN 60 MPH ARE INCLUDED IN THIS DRAWING AND ARE LESS STRINGENT. REFER TO THE STANDARDS AND POLICY OFFICE IN THE ROADWAY DESIGN DIVISION FOR ADDITIONAL GUIDANCE.

(B) IF GUARDRAIL IS IN A CURB AND GUTTER SECTION, IT SHALL BE PLACED SUCH THAT THE GUARDRAIL FACE IS EVEN WITH THE CURB (DETAIL C) OR A MINIMUM OF 8' FROM THE CURB (DETAIL D).

(C) ON 6:1 OR FLATTER SLOPE, GUARDRAIL MAY BE PLACED AT THE SLOPE BREAK.

(D) REFER TO RD11-TS SERIES OF STANDARD DRAWINGS FOR TYPICAL SECTION INFORMATION.

(E) REFER TO TEXAS A & M REPORT NUMBER 405160-20, FOR GUARDRAIL PLACED ON 3:1 SLOPE.

(F) PAY ITEMS:

705-06.01, W BEAM GR (TYPE 2) MASH TL3, L.F. (8' POST)
705-06.02, W BEAM GR (TYPE 2) MASH TL3 (LONG POST), L.F. (8' POST)

■ MINOR REVISION — FHWA APPROVAL NOT REQUIRED

STATE OF TENNESSEE
STANDARD DRAWING
DEPARTMENT OF TRANSPORTATION

SAFETY PLAN
SAFETY HARDWARE
PLACEMENT
ON OUTSIDE EDGE

7-11-13 | S-PL-6

SHEET	CONTENTS
1	General Notes; Index Contents
2	General, TL-3 Guardrail – Installed Plan and Elevation
3	Low-Speed, TL-2 Guardrail – Installed Plan and Elevation
4	W-Beam and Thrie-Beam Panel Details
5	Post and Offset Block Details
6	Guardrail Sections – Heights and Adjacent Slopes
7	End Treatment – Approach Terminal Geometry, Parallel
8	End Treatment – Approach Terminal Geometry, Curbed and Double Faced
9	End Treatment – Trailing Anchorage
10	End Treatment – Component Details
11	End Treatment – Controlled Release Terminal (CRT) System
12	Layout for CRT System – Side Roads and Driveways
13	Approach Transition Connection to Rigid Barrier – General, TL-3
14	Approach Transition Connection to Rigid Barrier – General, TL-3 – Curb Connections
15	Approach Transition Connection to Rigid Barrier – Low-Speed, TL-2
16	Approach Transition Connection to Rigid Barrier – Low-Speed, TL-2 – Curb Connections
17	Approach Transition Connection to Rigid Barrier – Details
18	Approach Transition Connection to Rigid Barrier – Double Faced Guardrail
19	Layout to Rigid Barrier – Approach Ends
20	Layout to Rigid Barrier – Approach Ends with Double Faced Guardrail Layout to Rigid Barrier – Trailing Ends Trailing End Transition Connection to Rigid Barrier
21	Rub Rail Details
22	Pedestrian Safety Treatment – Pipe Rail
23	Modified Mount – Special Steel Post for Concrete Structure Mount; Modified Mount – Encased Post for Shallow Mount; Modified Mount – Frangible Leave-Out for Concrete Surface Mount
24	Barrier Delineators – Post Mounted; Clear Space – Reduced Post Spacing for Hazards; ⅝" Button-Head Bolt System

GENERAL NOTES:

1. INSTALLATION: Construct guardrail in accordance with Specification 536.

   This Index, along with the plans and the manufacturers' drawings on the Approved Products List (APL), is sufficiently detailed for installation of General Guardrail, Low-Speed Guardrail, End Treatment assemblies, and their connecting options shown herein. This precludes requirements for shop drawing submittals unless otherwise specified in the plans.

2. COMPATIBILITY: The General Guardrail in this Index is based on the Midwest Guardrail System (MGS) design, with an approximate height of 31" at the top of the Panel (2'-1" mounting height at vertical ℄ of Panel) and a midspan panel splice as shown on Sheet 2. Guardrail components included on the APL, which are compatible with this Index, may also be identified as 31" or MGS Guardrail.

3. STANDARD COMPONENTS: Standard guardrail components, including posts, panels, and bolt systems, are based on the Task Force 13 Publication: Guide to Roadside Hardware Components (http://tf13.org/Guides/componentGuide/).

4. BUTTON-HEAD BOLTS: Install Button-Head Bolts where indicated using bolts, nuts, and washers as defined on Sheet 24. Place washers under nuts. Do not place washers between bolt heads and panels, except where otherwise shown in this Index.

5. HEX-HEAD BOLTS: Install Hex-Head Bolts where indicated using bolts, nuts, and washers in accordance with material properties of Specification 967. Place washers under nuts.

6. MISCELLANEOUS ASPHALT PAVEMENT: Install Miscellaneous Asphalt Pavement where indicated with a tolerance of ± ½" depth and in accordance with Specification 339.

7. ADJACENT SIDEWALKS & SHARED USE PATHS: When guardrail posts are placed within 4'-0" of a sidewalk or shared use path, use timber posts, or use steel posts only if treated with Pipe Rail as shown on Sheet 22.

   When timber posts are used, one of the following safety treatments is required for the bolt(s) protruding from the back face of the posts:
   a. After tightening the nut, trim the protruding post bolt flush with the nut and galvanize per Specification 562.
   b. Use post bolts 15" in length and countersink the washer and nut between 1" and 1½" deep into the back face of the post.
   c. Use 15" post bolts with sleeve nuts and washers.

   When End Treatment posts are within 4'-0" of a sidewalk or shared use path, steel posts are not permitted within the End Treatment segment. Terminate the Pipe Rail outside of End Treatment segments, as noted per Sheet 22.

8. NESTED W-BEAM: Where called for in the plans, install two W-Beam Panels mounted flush per location, securing all panels with Button-Head Bolts threaded through aligned slots and holes. 2" Button-Head Bolts are permitted for panel splice locations.

9. CONNECTION TO RIGID BARRIER: The connections to Rigid Barrier in this Index only apply to newly constructed bridge Traffic Railing and Concrete Barrier or where the complete Approach Transition Connection to Rigid Barrier shown herein can be installed without conflicting with existing Traffic Railings, structures, or approach slabs.

   For connecting guardrail to existing bridge Traffic Railings, see Indexes 536-002, 521-404, and 521-405.

10. CONNECTION TO EXISTING GUARDRAIL: Where a transition to existing guardrail at 27" height is required, linearly transition the new guardrail height over a distance ranging from 25'-0" to 31'-3". Height transitions must occur outside of End Treatment and Approach Transition segments.

    Provide an immediate transition to the required midspan panel splice using the available panel options on Sheet 4 (9'-4½" or 15'-7½" panel). Alternatively, this transition to midspan panel splice may be achieved by installing a single reduced post spacing of 3'- 1½" within the new guardrail, immediately adjacent to the connection location.

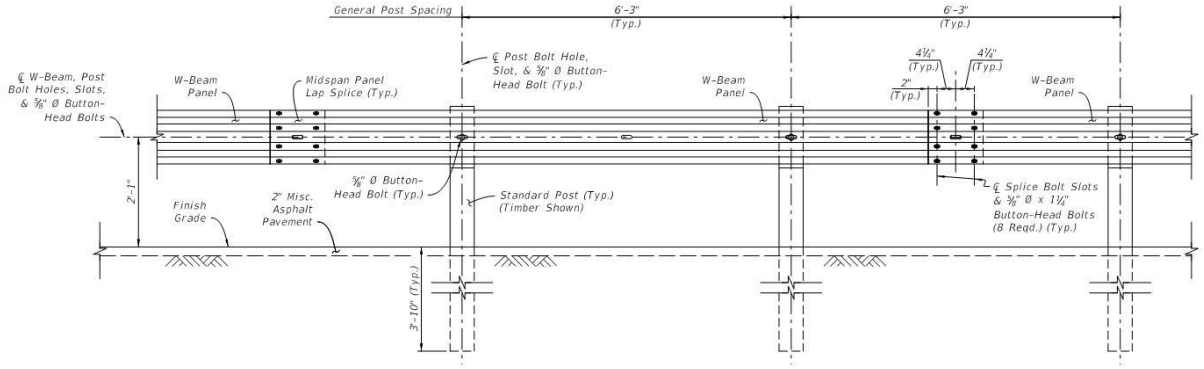
11. PLANS CALLOUTS: Begin/End Station labels are shown throughout this Index as they correspond to the station and offset callouts specified in the plans.

    In the plans, Begin/End Guardrail Station refers to the General TL-3 Guardrail Pay Item, and it may be abbreviated as Begin/End GR. Station. Where the Low-Speed TL-2 Guardrail Pay Item is specifically required, the callout in the plans will then specify Begin/End TL-2 GR. Station.

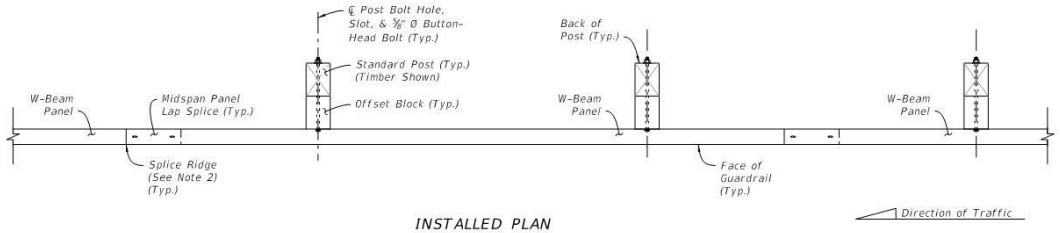
12. QUANTITY MEASUREMENT: Measure guardrail and corresponding components as defined in Specification 536. The Guardrail length is measured along the centerline of installed Panels, between the points labeled Begin/End Guardrail Station shown on the following Index Sheets and defined in the plans (typically measured from the ℄ of the panel's post bolt slots at the approach/trailing ends).

10/29/2019 2:48:03 PM

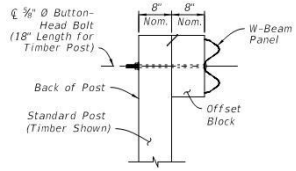
LAST REVISION	REVISION	DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
11/01/19					536-001	1 of 24



GENERAL GUARDRAIL
INSTALLED ELEVATION



INSTALLED PLAN



INSTALLED SECTION

NOTES:

1. GENERAL: Install the General Guardrail configuration where indicated in the plans. This may include tapered segments if called for in the plans.

   Use 12'-6" or longer W-Beam Panels. A single 6'-3" Panel may be used at the end of the run to meet the nominal Begin/End Guardrail Sta. requirements.

   Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the plans, obtain approval from the Engineer prior to installation.

2. MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

   Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.

3. CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.

4. W-BEAM PANEL DETAILS: See Sheet 4.

5. POST & OFFSET BLOCK DETAILS: See Sheet 5.

6. GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.

7. MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 23 for additional post mounting options.

8. DEFINED SEGMENTS: The General Guardrail shown provides the base configuration, including Post Spacing and splice locations, for Defined Segment modifications where indicated in the plans and using the Guardrail Types, Sections, and/or hardware as shown in this Index (e.g. Double Faced W-Beam, Deep Posts at Slope Breaks, Pipe Rail, Rub Rail, or Reduced Post Spacing for Hazards).

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GENERAL, TL-3 GUARDRAIL DETAILS

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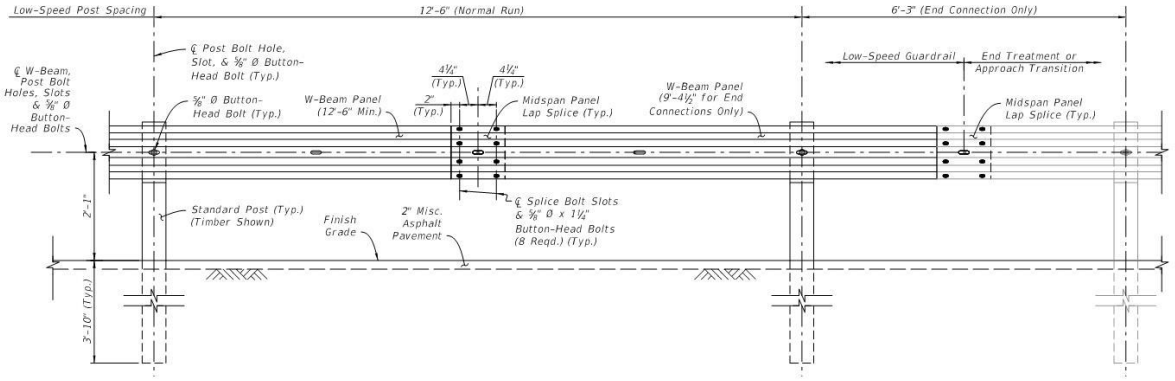
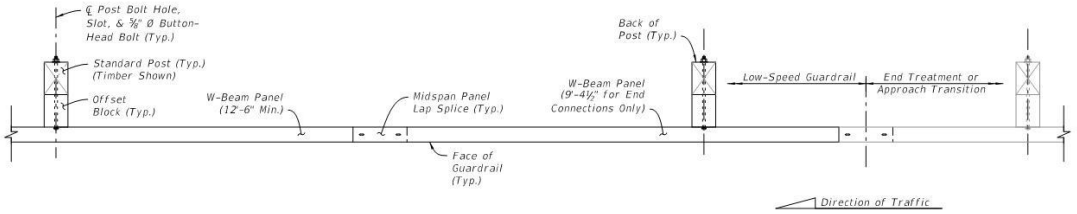
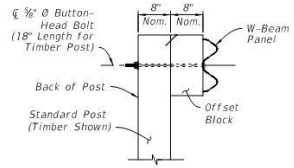


LOW-SPEED GUARDRAIL
INSTALLED ELEVATION



INSTALLED PLAN



INSTALLED SECTION

NOTES:

1. GENERAL: Install the Low-Speed Guardrail configuration where indicated in the plans. Low-Speed Guardrail may include tapered segments if called for in the plans.

   Use 12'-6" or 25'-0" W-Beam Panels for normal spans, and use 9'-4½" Panels for end connections to adjoining segments as shown. A single 6'-3" Panel may be used at the end of the Low-Speed Guardrail run along with a single reduced 6'-3" post spacing to meet the nominal Begin/End Guardrail Sta. required.

   Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the Plans, obtain approval from the Engineer prior to installation.

2. MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

   Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.

3. CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.

4. W-BEAM PANEL DETAILS: See Sheet 4.

5. POST & OFFSET BLOCK DETAILS: See Sheet 5.

6. GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.

7. MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 23 for additional post mounting options.

8. RESTRICTIONS: Low-Speed Guardrail segments are not permitted for use with items including, but not limited to, Double Faced W-Beam, Deep Posts at Slope Breaks, Raised Curb, Pipe Rail, and/or Rub Rail.

LOW-SPEED, TL-2 GUARDRAIL DETAILS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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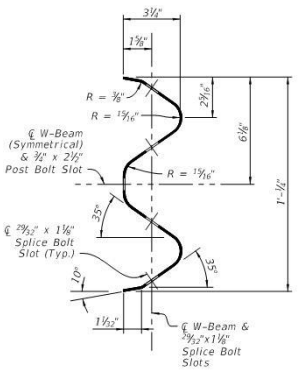
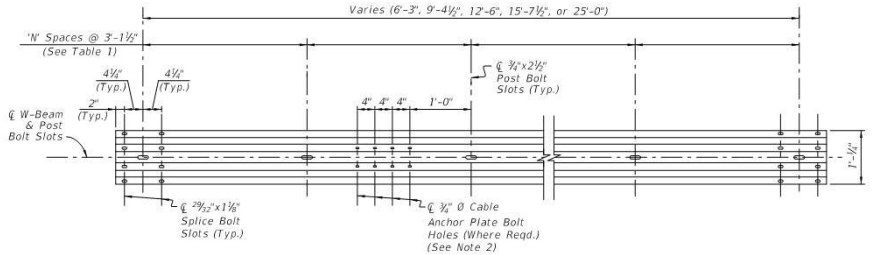


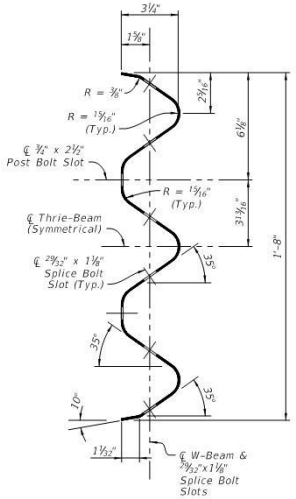
W-BEAM PANEL SECTION



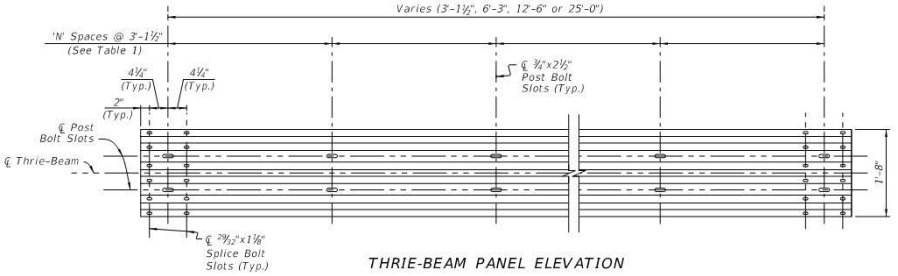
W-BEAM PANEL ELEVATION

PANEL SUMMARY TABLE:

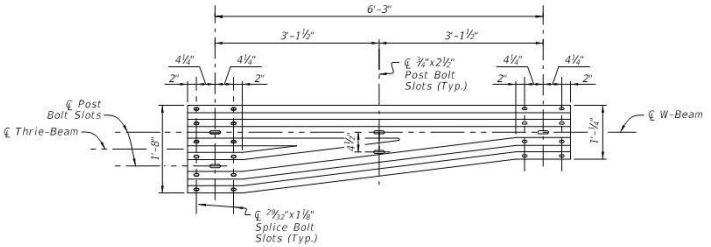
Panel Type	Number of Spaces 'N'	Gauge
6'-3" W-Beam	2	12
9'-4½" W-Beam	3	12
12'-6" W-Beam	4	12
15'-7½" W-Beam	5	12
25'-0" W-Beam	8	12
3'-1½" Thrie-Beam	1	10
6'-3" Thrie-Beam	2	12
12-6" Thrie-Beam	4	12
25-0" Thrie-Beam	8	12
Thrie-Beam Trans.	2	10



THRIE-BEAM PANEL SECTION



THRIE-BEAM PANEL ELEVATION



THRIE-BEAM TRANSITION PANEL ELEVATION
(Reverse Direction Similar by Opposite Hand)

NOTES:

1. MATERIALS:
   Use corrugated steel panels in accordance with Specification 967 and made from either Class A, 12 gauge steel or Class B, 10 gauge steel as specified in the 'Panel Summary Table' above.

2. CABLE ANCHOR PLATE BOLT HOLES:
   Include ¾" Ø Cable Anchor Plate Bolt Holes only where required for installation of the Cable Anchor Plate shown on Sheet 9, 10, & 11.

   29⁄32" x 1⅛" slots may substitute for the ¾" Ø holes shown.

W-BEAM AND THRIE-BEAM PANEL DETAILS

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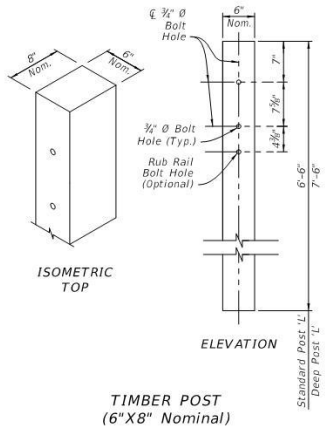
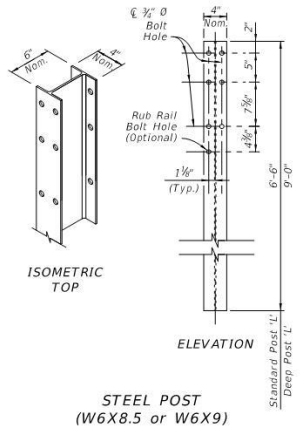
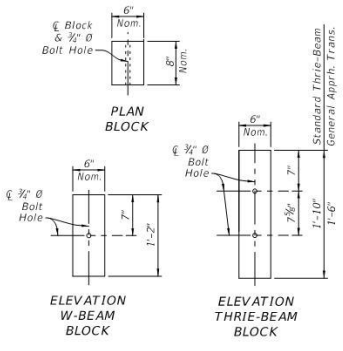


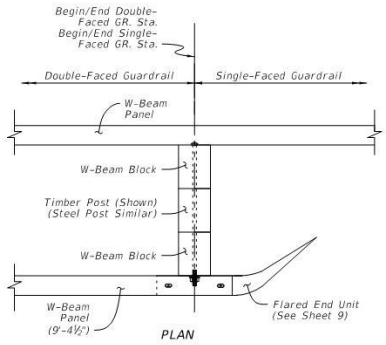
TIMBER POST
(6"X8" Nominal)



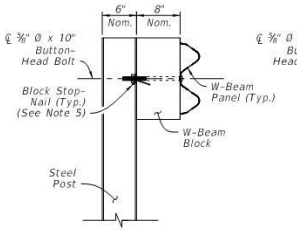
STEEL POST
(W6X8.5 or W6X9)

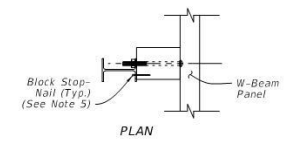


TIMBER OFFSET BLOCK
(6"X8" Nominal)

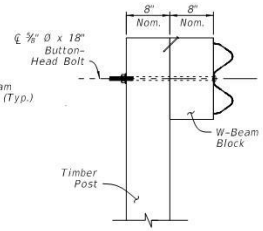


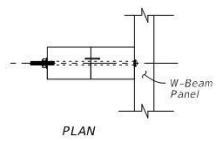
SINGLE-FACED / DOUBLE-FACED
GUARDRAIL CONNECTION



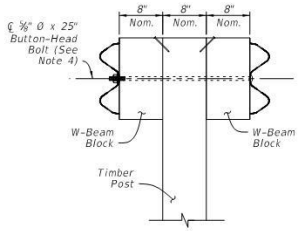


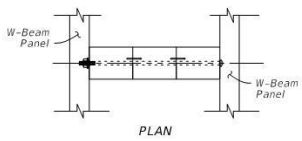
SINGLE-FACED
W-BEAM
STEEL POST



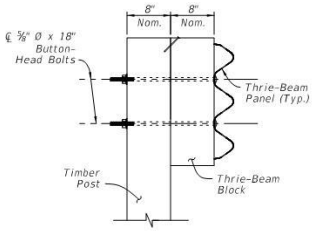


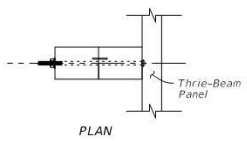
SINGLE-FACED
W-BEAM
TIMBER POST





DOUBLE-FACED W-BEAM
TIMBER POST
(Thrie-Beam Similar)
(Steel Post Similar)





THRIE-BEAM
TIMBER POST
(Steel Post Similar)

NOTES:

1. STANDARD POSTS: Where Standard Posts are called for in this Index, use either a Timber Post or Steel Post at the Length, 'L', shown for Standard Posts. Use a single post material type consistently per each run of guardrail. Only where specified in the Plans, use the Deep Post 'L' for Slope Break Conditions as shown on Sheet 6.
2. OFFSET BLOCKS: For each Panel type, install the corresponding Offset Block type as shown. For General, TL-3 (Single Faced) Approach Transitions only, use the 1'-6" Thrie-Beam Block (See Sheet 13).
3. BOLT HOLES: ¾" Ø Bolt Holes shown in posts within this Index may be substituted with 13/16" Ø Bolt Holes.
4. DOUBLE FACED GUARDRAIL: Orient Post Bolts with the Button-Head located on the side nearest the traffic lane. The bolt's threaded portion is not permitted to extend beyond ⅜" from the face of the tightened nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.
5. BLOCK STOP-NAIL: Drive one nail per Standard Offset Block as shown to prevent Block rotation. Use steel 3½" Type 16d nails with ASTM A153 hot-dip galvanization. For steel posts, drive the nail through the unused flange Bolt Hole and bend the nail so its head contacts the flange.
6. MATERIALS: Use timber and steel posts and offset blocks in accordance with Specification 967. Composite offset blocks may be substituted as approved on the APL. Use a single offset block type consistently per each run of guardrail. Steel offset blocks are only permitted for Modified Thrie Beam.

POST AND OFFSET BLOCK DETAILS

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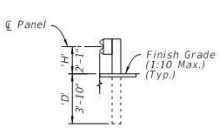
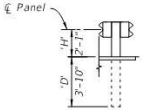
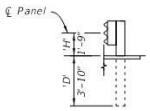


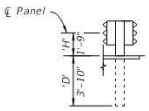
W-BEAM



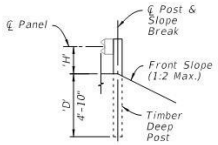
DOUBLE FACED W-BEAM



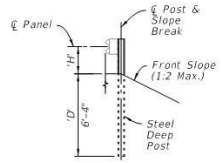
THRIE-BEAM



DOUBLE FACED THRIE-BEAM

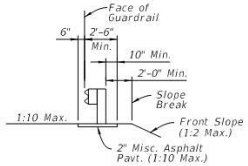


SLOPE BREAK CONDITION TIMBER DEEP POST

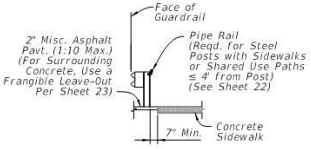


SLOPE BREAK CONDITION STEEL DEEP POST

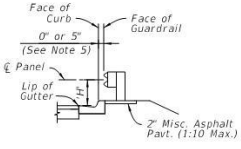
GUARDRAIL TYPES - MOUNTING HEIGHTS & POST DEPTHS



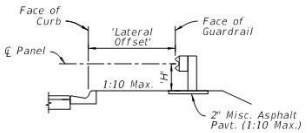
TYPICAL GRADING & PAVT. PLACEMENT DETAIL (See Note 2)



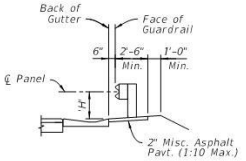
TYPICAL SIDEWALK DETAIL (Work with Other Sections as Reqd.)



ADJACENT TO CURB (Type F Curb Shown)



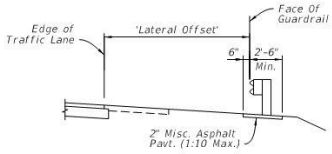
BEHIND CURB (Type F Curb Shown)



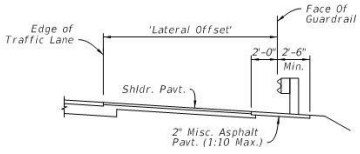
ADJACENT TO SHOULDER GUTTER

GUARDRAIL SECTIONS - TYPICAL

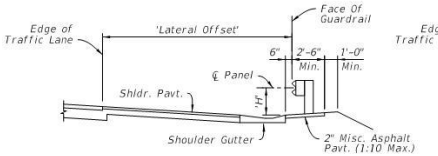
GUARDRAIL SECTIONS - CURB & GUTTER



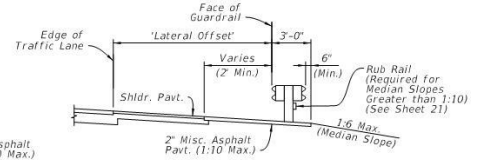
UNPAVED OR PARTIALLY PAVED SHOULDER



FULLY PAVED SHOULDER



SHOULDER GUTTER



DOUBLE FACED GUARDRAIL (Shown In Median)

GUARDRAIL SECTIONS - SHOULDERS

GUARDRAIL HEIGHT SUMMARY TABLE:			
Type:	Min. Depth 'D':	Mounting Height 'H':	Post Length 'L':
W-Beam (Single and Double Faced)	3'-10"	2'-1"	6'-6"
Thrie-Beam (Single and Double Faced)	3'-10"	1'-9"	6'-6"
Timber Deep Post	4'-10"	See Above	7'-6"
Steel Deep Post	6'-4"	See Above	9'-0"

NOTES:

1. GUARDRAIL SECTIONS: Construct Sections as indicated in the plans. The details shown herein depict W-Beam Guardrail, but are applicable to the other defined Guardrail Types placed at the corresponding height, 'H'. Use components per Sheets 4 & 5. Steel and timber post types are interchangeable unless otherwise defined. The 1:10 Max. cross slope shown is the maximum slope permitted for proper guardrail function, but project-specific cross slope requirements are governed per the plans.
2. TYPICAL GRADING & PAVEMENT PLACEMENT DETAIL: Construct features as depicted except where superceded by specific Guardrail Sections or the plans. Place the Slope Break a Minimum of 2' behind the post. For Deep Posts, the slope break may be placed at the ℄ Post with the 2" Miscellaneous Asphalt Pavement omitted.
3. SLOPE BREAK CONDITION: Install Deep Posts only where called for in the plans. Deep Posts are only permitted where post spacing is 6'-3" or less.
4. LATERAL OFFSETS: The Lateral Offsets shown are governed by the station and offset call outs for Face of Guardrail, as shown in the plans.
5. ADJACENT TO CURB: Place the Face of Guardrail consistently offset either flush with the Face of Curb or 5" behind the Face of Curb, as indicated by the plans station and offset callout. For offset changes, transition the Face of Guardrail as shown in the plans.

GUARDRAIL SECTIONS

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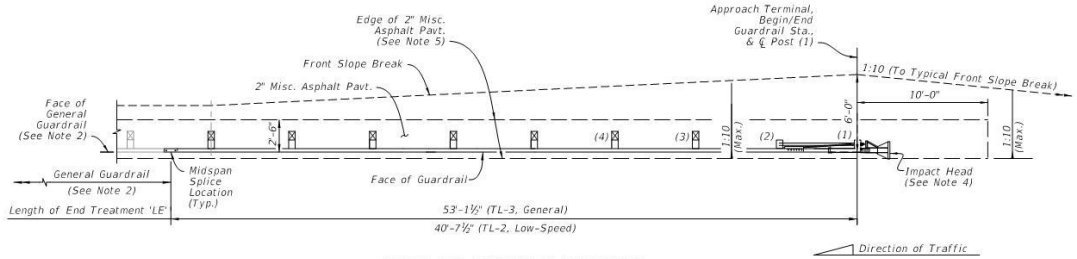


APPROACH TERMINAL ASSEMBLY
'PARALLEL' TYPE - PLAN VIEW

NOTES:

1. INSTALLATION: Locate Approach Terminals where called for in the plans, with the Post (1) ℄ placed at the Begin/End Guardrail Station indicated in the plans.

   The Plan Views shown herein are schematic only, showing basic geometry for Approach Terminals listed on the APL. The predefined Length of End Treatment, 'LE', includes the proprietary portion of various Approach Terminals and provides for more consistent planning of assembly installations across the differing Approach Terminal types. Forward-anchoring style Approach Terminals may vary from the planned lengths shown by up to 3'-0".

   Construct Approach Terminals as shown in the APL and in accordance with the manufacturer's unique drawing details, procedures, and specifications.

   Install posts in accordance with the manufacturer's drawings. The Special Posts on Sheet 23, including Special Steel Posts, Encased Posts, and Frangible Leave-Outs, are not permitted within the Approach Terminal segment unless otherwise called for in the plans.

   Align panel lap splices in accordance with the manufacturer's drawings, regardless of the direction of traffic.

   Install adjacent grading, gutters, and/or curbing as shown herein.

2. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments.

   Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

3. APPROACH TERMINAL TEST LEVEL: Install either a Test Level 3 (TL-3) or Test Level 2 (TL-2) Approach Terminal as specified in the plans. TL-3 Approach Terminals may substitute for TL-2 Approach Terminals unless the substitution is specifically prohibited in the plans. TL-2 Approach Terminals may not substitute for TL-3 installations.

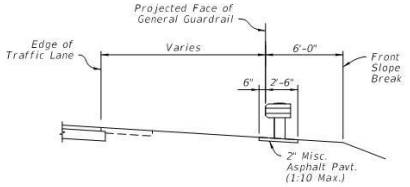
4. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.

5. 2" MISCELLANEOUS ASPHALT PAVEMENT: The Plan View depicts the Unpaved Shoulder condition. For Fully Paved Shoulder and Shoulder Gutter conditions, extend the 2" Misc. Asphalt Pavement as shown in the corresponding 'Section at Post (1)' details below.

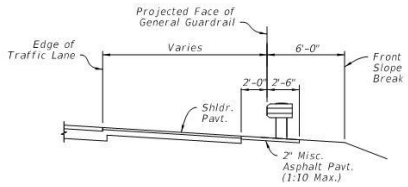
   The 2" Misc. Asphalt Pavement shown upstream of Post (1) may be substituted with a different pavement type where called for in the Plans.

6. CLEAR AREA REQUIREMENT: Do not place any permanent aboveground installations within the areas shown with 1:10 maximum grading. For the finished condition, keep this area free of all aboveground obstructions, including dense vegetation and trees.

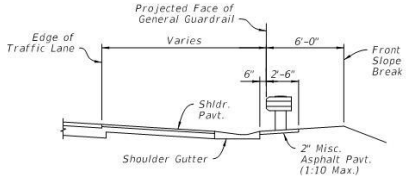
7. 'CURBED' AND 'DOUBLE FACED' GUARDRAIL SEGMENTS: See Sheet 8.



SECTION AT POST (1)
WITH UNPAVED SHOULDER



SECTION AT POST (1)
WITH FULLY PAVED SHOULDER



SECTION AT POST (1)
WITH SHOULDER GUTTER

END TREATMENT -
APPROACH TERMINAL
GEOMETRY - PARALLEL

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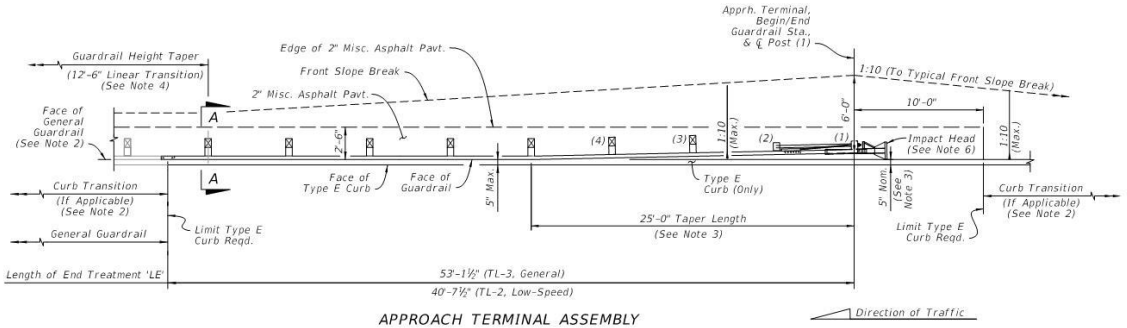
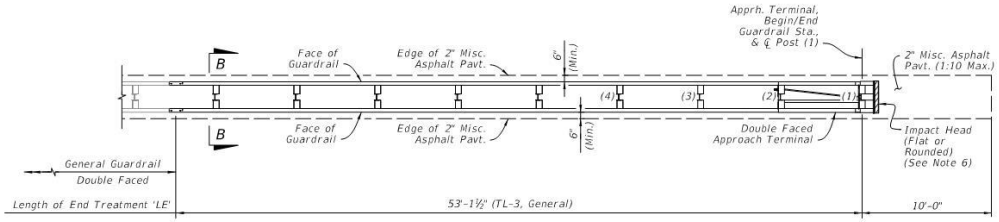
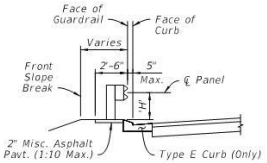


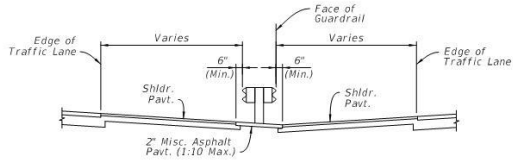
APPROACH TERMINAL ASSEMBLY
'CURBED' SEGMENT - PLAN VIEW



APPROACH TERMINAL ASSEMBLY
'DOUBLE FACED' SEGMENT - PLAN VIEW



'CURBED' SECTION A-A
(Height, 'H', Measured from
Misc. Asphalt Pavt.)



'DOUBLE FACED' SECTION B-B
(1:10 Slope or Flatter Reqd.)

NOTES:

1. GENERAL: See Notes 1 through 3 on Sheet 7.
2. CURBED SEGMENTS: Type E curb is required within the limits shown. When a different curb type is called for outside of the Type E curb limits, transition the curb shape linearly, over a nominal distance ranging 5'-0" to 10'-0".
3. TAPER LENGTH: For Curbed Segments, taper the guardrail away from the roadway where shown to place the inside edge of the Impact Head at 5" behind the face of the curb. Where additional lateral offset is required to fit the Approach Terminal Assembly hardware, such as a soil plate, place the Impact Head as close to the curb as the hardware allows, not to exceed 2'-0" from the face of curb.
4. GUARDRAIL HEIGHT TAPER: For Curbed Segments, the connecting General Guardrail Mounting Height, 'H', is typically measured from the Lip of Gutter (See Sheet 6 Guardrail Sections, 'Adjacent to Curb'), while the End Terminal Assembly 'H' is measured from the Misc. Asphalt Pavt. (See Section A-A). Linearly taper the difference in Mounting Height over a minimum length of 12'-6", starting where indicated herein.
5. DOUBLE FACED SEGMENT: Connect to Double Faced General Guardrail. Use consistent Posts and Offset Block types as specified in the APL drawings over the entire Length of End Treatment, 'LE'. Posts and Offset Blocks in the adjoining General Guardrail segment may be different from those inside of the 'LE'. A change in post type between timber and steel is permitted, immediately outside of the 'LE' segment.

   Maintain the 1:10 maximum grading as shown in Section B-B throughout segment 'LE'. Where required, transition to differing adjacent slopes linearly, over a minimum longitudinal length of 25'-0".
6. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.
7. CLEAR AREA REQUIREMENT: Do not place any permanent aboveground installations within the areas shown with 1:10 maximum grading. For the finished condition, keep this area free of all aboveground obstructions, including dense vegetation and trees.
8. 2" MISCELLANEOUS ASPHALT PAVEMENT: The 2" Misc. Asphalt Pavement shown upstream of Post (1) may be substituted with a different pavement type where called for in the Plans.
9. SINGLE FACED 'PARALLEL' SEGMENTS: See Sheet 7.

END TREATMENT -
APPROACH TERMINAL GEOMETRY
CURBED AND DOUBLE FACED

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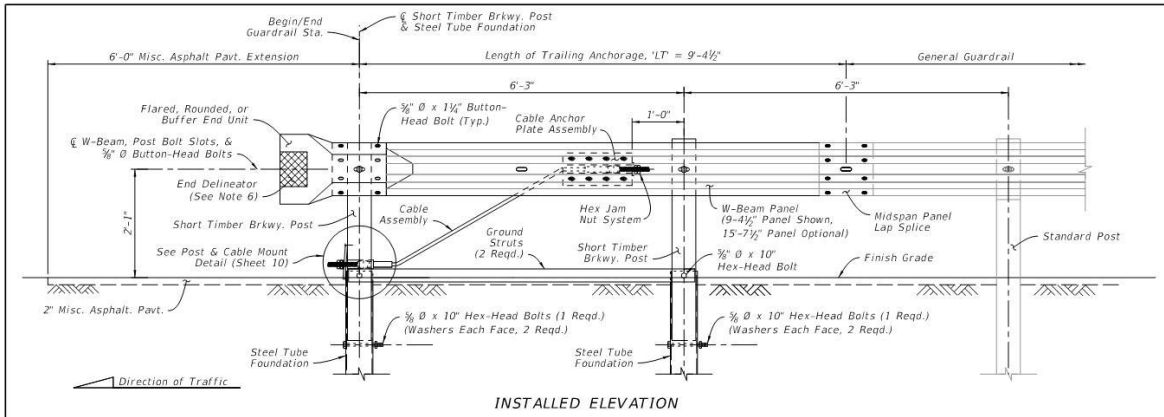
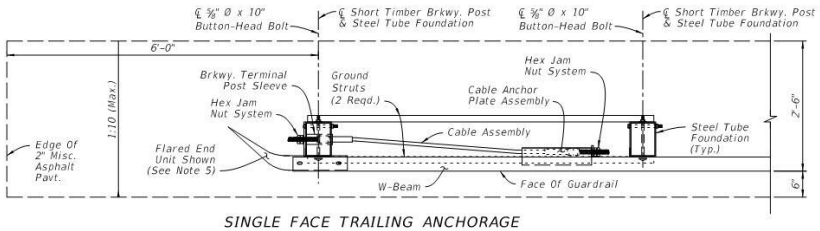
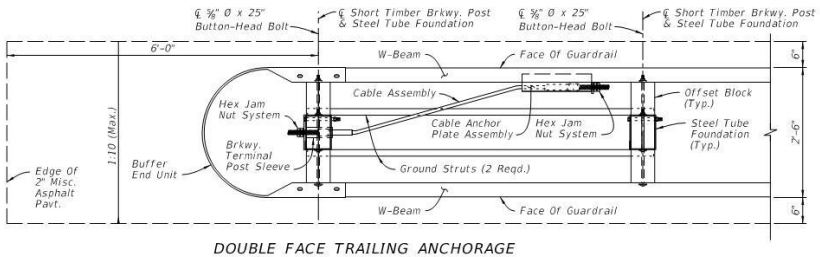


INSTALLED ELEVATION



SINGLE FACE TRAILING ANCHORAGE
INSTALLED PLAN



DOUBLE FACE TRAILING ANCHORAGE
INSTALLED PLAN

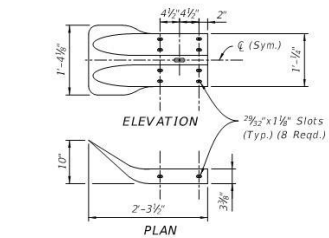
NOTES:

1. COMPONENT DETAILS: For additional component details, See Sheet 10.
2. END UNITS: Use materials for end units as defined in Specifications Section 967. End Units are referred to as "End or Buffer Sections" in AASHTO M180.

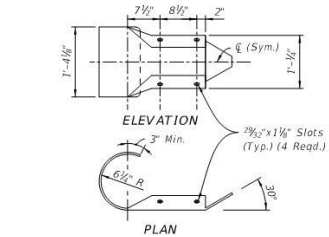
   Lap the Flared End Unit behind the W-Beam; lap the Rounded and Buffered End Units over the face of the W-Beam.
3. FOUNDATIONS: Install Steel Tubes by either of the following methods:

   a. Excavate, backfill, and compact material to provide full passive soil resistance to the surface of the Tube.

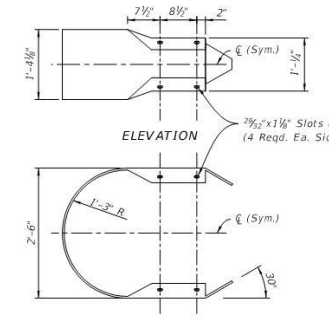
   b. Drive the Tube using a dummy timber post to prevent damage to the Breakaway Post.
4. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.
5. SIDEWALK REQUIREMENTS: When sidewalks are located adjacent to the End Treatment, install a Rounded End Unit (Flared End Unit not permitted for this case).
6. END DELINEATOR: Mount retroreflective sheeting to the approach face of the End Unit in accordance with Specification Sections 536 and 967.



FLARED END UNIT



ROUNDED END UNIT



BUFFER END UNIT

END TREATMENT - TRAILING ANCHORAGE

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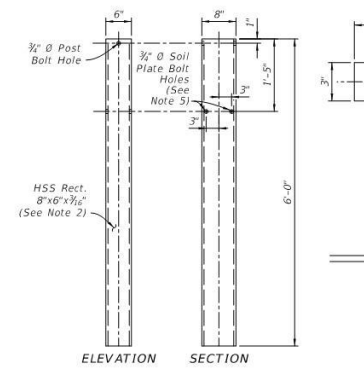
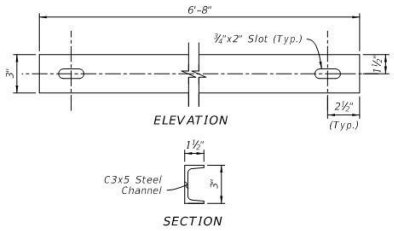
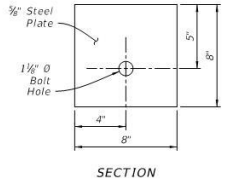


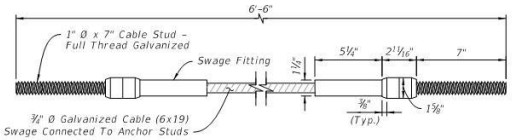
STEEL TUBE FOUNDATION



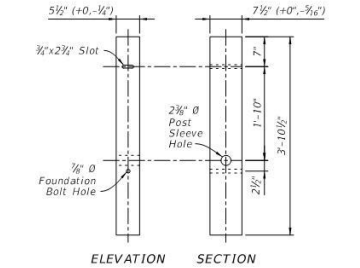
GROUND STRUT



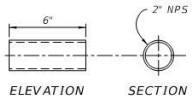
BEARING PLATE



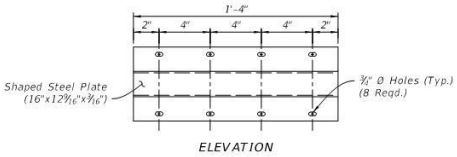
CABLE ASSEMBLY

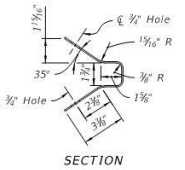


STEEL TUBE FOUNDATION



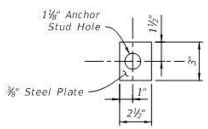
BREAKAWAY TERMINAL POST SLEEVE



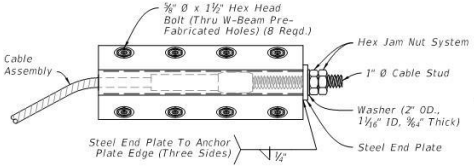


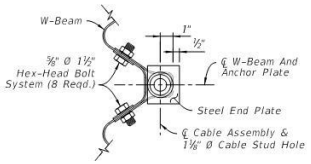
CABLE ANCHOR PLATE

SHORT TIMBER BREAKAWAY POST (6"x8" Nom.)

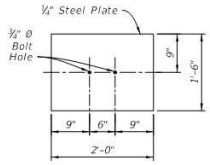


STEEL END PLATE

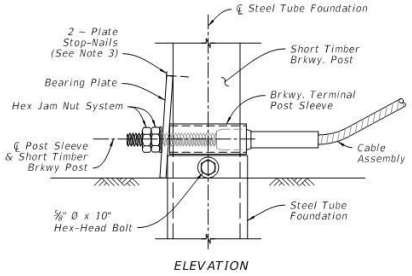




CABLE ANCHOR PLATE ASSEMBLY



SOIL PLATE



POST & CABLE MOUNT ASSEMBLY

NOTES:

1. INSTALLATION: Use components as shown on Sheets 9 & 11.
2. MATERIALS: Use steel plates, channels, and Cable Assemblies in accordance with Specification 967.

   Use Short Timber Breakaway Posts and Steel Tube Foundations in accordance with Specification 536.

   Use Hex Nuts, Hex Jam Nuts, and Washers in accordance with the AASHTO-AGC-ARTBA Guide to Standardized Barrier Hardware with English unit equivalents of components FNX24a and FWC24a, respectively. Two Hex Nuts may be used for the Hex Jam Nut System.
3. PLATE STOP-NAILS: To prevent rotation of the Bearing Plate, drive steel 2½" Type 8d nails with ASTM A153 hot-dip galvanization.
4. CABLE ANCHOR PLATE ASSEMBLY INSTALLATION: Mount to the pre-fabricated Cable Anchor Plate Bolt Holes in the W-Beam Panel, as shown on Sheet 4. These panel holes are only permitted for this Cable Anchor Plate Assembly application.
5. SOIL PLATE BOLT HOLE(S): For Trailing Anchorage installations as shown on Sheet 9, the two bolt holes shown may be substituted with a single bolt hole located at the tube centerline.

END TREATMENT - COMPONENT DETAILS

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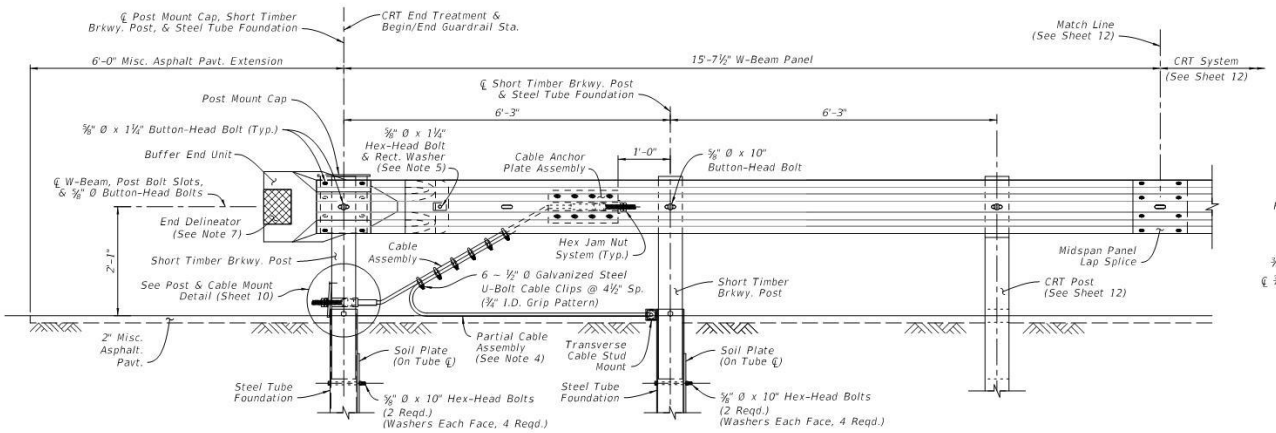
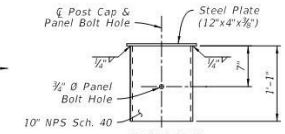
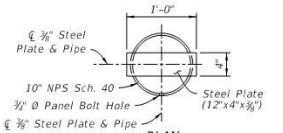


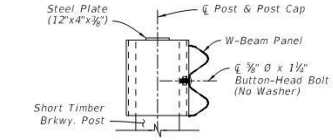
INSTALLED ELEVATION



ELEVATION

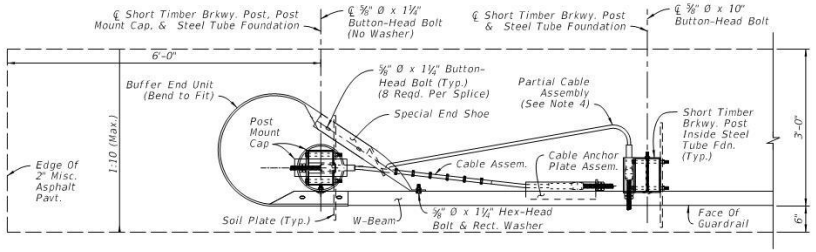


PLAN

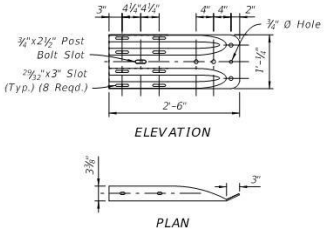


INSTALLED SECTION

POST MOUNT CAP



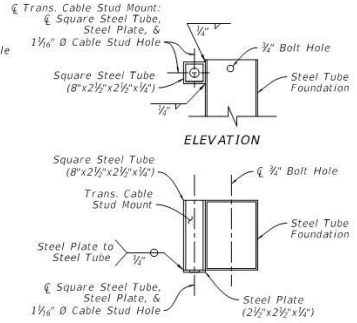
INSTALLED PLAN



ELEVATION

PLAN

SPECIAL END SHOE



PLAN

TRANSVERSE CABLE STUD MOUNT

NOTES:

1. INSTALLATION: Use with CRT Systems as required on Sheet 12.
2. COMPONENT DETAILS: For additional component details, See Sheet 10 & 12. For the Rectangular Washer detail, see Sheet 24.
3. MATERIALS: Use steel End Shoes, Plates, Tubes, and pipes in accordance with Specification 967.
4. PARTIAL CABLE ASSEMBLY: The Partial Cable Assembly is similar to the Cable Assembly defined on Sheet 10, except with a 9'-0" total length and the Swage Fitting and Cable Stud omitted from one end.

   Feed the Cable Stud through the Cable Stud Hole of the Transverse Cable Stud Mount as shown, and secure it with the Hex Jam Nut System as defined on Sheet 10.
5. SPECIAL END SHOE MOUNT: Punch a ¾" Ø hole in the W-Beam Panel as needed to secure the Special End Shoe with the ⅝" Ø Hex-Head Bolt. Galvanize hole per Specification 562.
6. FOUNDATIONS: Install Steel Tubes with attached Soil Plates by either of the following methods:

   a. Excavate, backfill, and compact material to provide full passive soil resistance to all surfaces of the tube and soil plate.

   b. Drive the steel tube and soil plate as a single unit using a dummy timber post to prevent damage to the breakaway post.
7. END DELINEATOR: Mount retroreflective sheeting to the approach face of the Buffer End Unit in accordance with Specifications 536 and 967.

END TREATMENT - CONTROLLED RELEASE TERMINAL (CRT) SYSTEM

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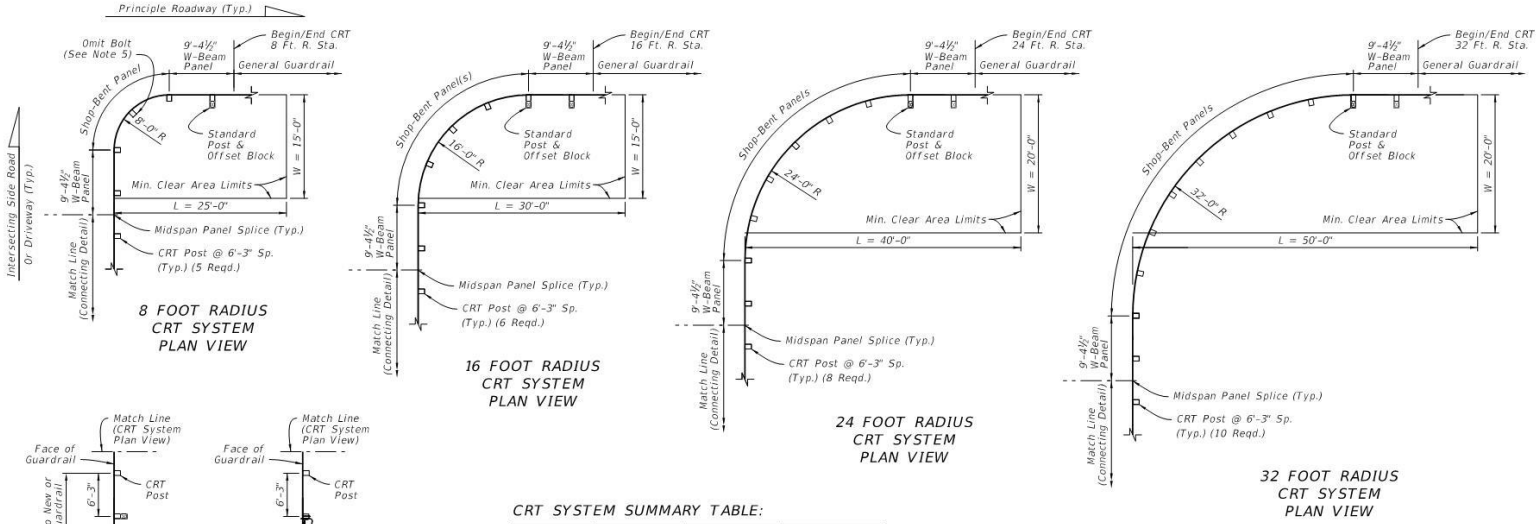
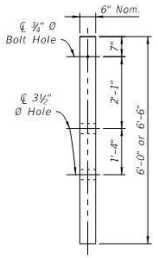


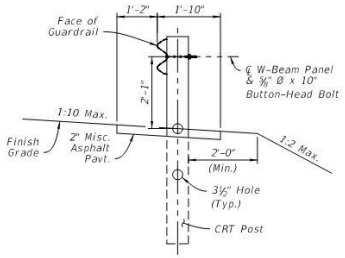
CONNECTING DETAIL

CRT SYSTEM SUMMARY TABLE:

RETURN RADIUS (FT.)	LENGTH OF SHOP-BENT PANEL(S) (FT.)	QUANTITY OF CRT POSTS	AREA CLEAR OF HAZARDS 'L' x 'W' (FT.)
8	12.5	5	25 x 15
16	25.0	6	30 x 15
24	37.5	8	40 x 20
32	50.0	10	50 x 20



CRT POST ELEVATION (6"x8" Nom. Timber)



CRT INSTALLED SECTION

NOTES:

1. INSTALLATION: Construct the specified radius layout and Connecting Detail option as shown in the plans.
2. MIN. CLEAR AREA: Keep the area behind the CRT free of fixed objects and aboveground hazards within the Min. Clear Area limits shown. Maintain a slope not steeper than 1:10 for a minimum 2' behind the posts, and maintain a slope not steeper than 1:2 beyond 2' from the posts.
3. APPROACH GRADING: Maintain grading on the roadway side of the guardrail face at a maximum slope of 1:10.
4. MATERIALS: For CRT Posts, use Timber Post material in accordance with Specification 967. Use steel panels and hardware in accordance with Specification 967.
5. BOLT OMISSION: For the 8 Foot Radius CRT System only, do not place a panel-to-post mount bolt at the center CRT Post (omit the ⅞" Button-Head Bolt only at the location shown).
6. SHOP-BENT PANELS: Install Shop-Bent panel(s) where indicated using 12'-0" or 25'-0" W-Beam Panels. Splice at post locations within the CRT radius using the General configuration of ⅞" Ø Button-Head Bolts (8 reqd. per splice).
7. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

LAYOUT FOR CONTROLLED RELEASE TERMINAL (CRT) SYSTEMS - SIDE ROADS AND DRIVEWAYS

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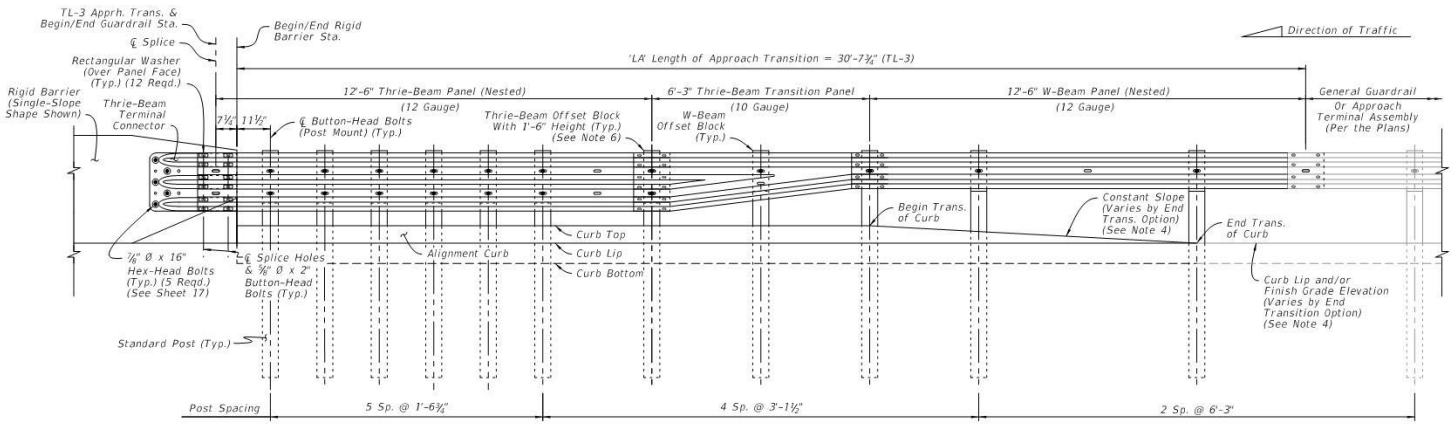
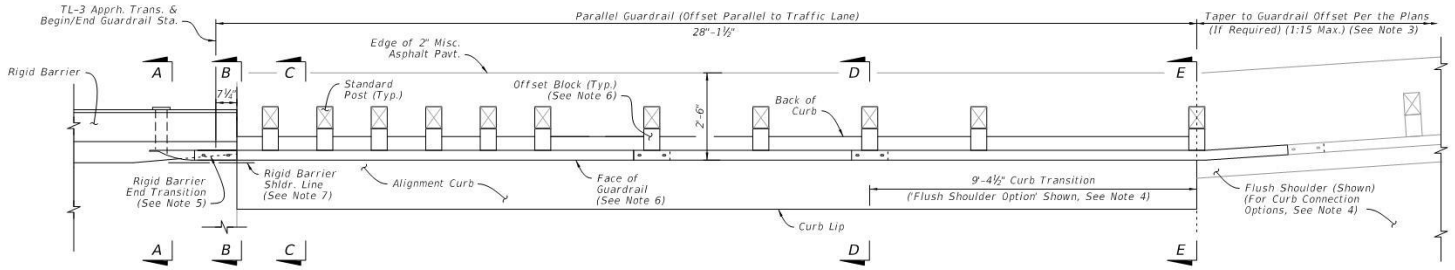


TL-3 APPROACH TRANSITION
INSTALLED ELEVATION



TL-3 APPROACH TRANSITION
INSTALLED PLAN

NOTES:

1. INSTALLATION: Construct the Approach Transition segment where indicated in the plans. For example Layouts showing the Approach Transition's fit among other guardrail segments, see Sheet 19.

   For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.

2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.

3. GUARDRAIL TAPER: The connecting guardrail may require a different lateral offset if shown in the plans. At the location shown herein, taper the guardrail to the connecting guardrail offset. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.

4. END TRANSITION OF CURB OPTIONS: The Plan and Elevation views depict an example Curb Transition to Flush Shoulder from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option shown in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flush Shoulder Option'). See Sheet 14 for additional curb options and Sheet 17 for curb shape details.

5. RIGID BARRIER END TRANSITION: Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.

6. OFFSET BLOCKS: For Thrie-Beam post locations within the Length of Approach Transition segment, use the Timber Offset Blocks with 1'-6" height shown on Sheet 5.

   For the midspan of the Thrie-Beam Transition Panel and for all other W-Beam locations shown herein, use the W-Beam Offset Blocks with 1'-2" height.

7. OFFSET: The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.

8. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

APPROACH TRANSITION CONNECTION
TO RIGID BARRIER - GENERAL, TL-3

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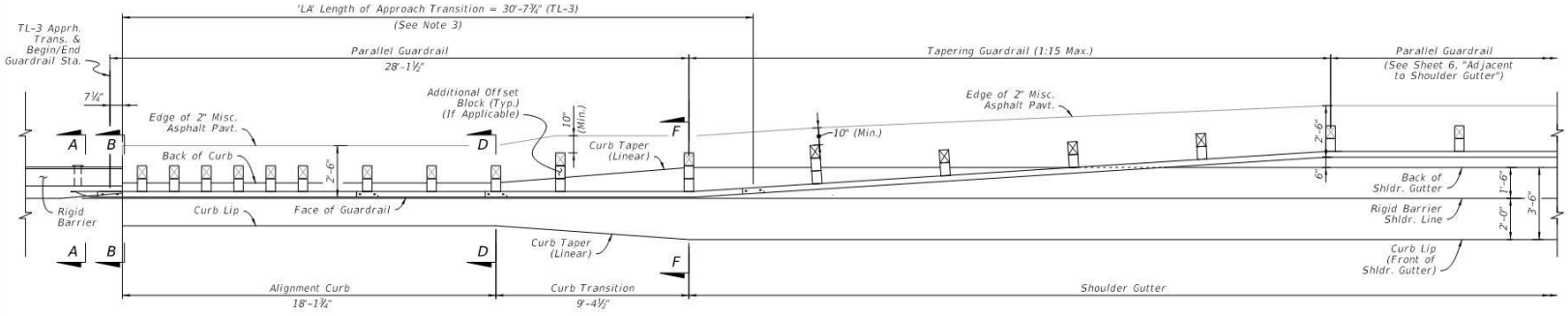
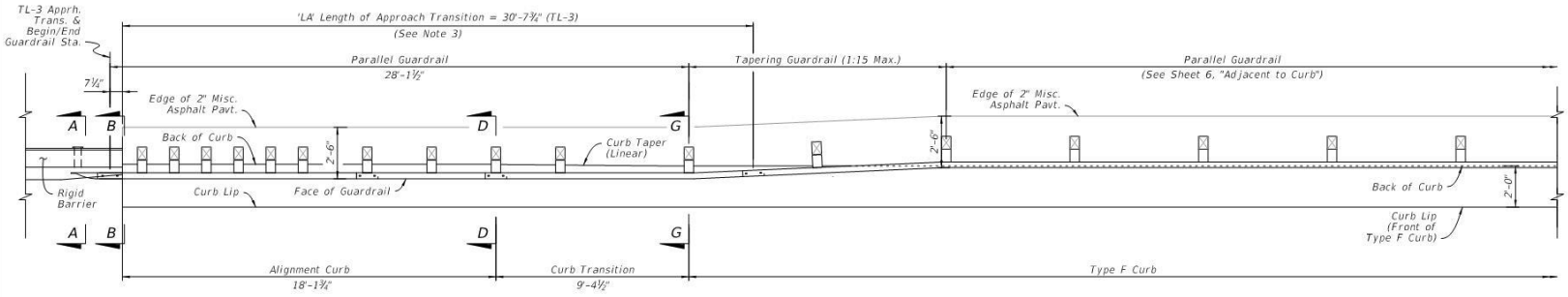
LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
11/01/19						536-001	13 of 24



TL-3 APPROACH TRANSITION
WITH 'SHOULDER GUTTER'
CONNECTION - PLAN VIEW



TL-3 APPROACH TRANSITION
WITH 'TYPE F CURB'
CONNECTION - PLAN VIEW

NOTES:

1. GENERAL: See the applicable notes and details on Sheet 13.
2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
3. ELEVATION VIEW: For post and panel installation details within 'LA', see the elevation view on Sheet 13. The curb details will differ depending on curb option required.

APPROACH TRANSITION CONNECTION
TO RIGID BARRIER - GENERAL, TL-3
CURB CONNECTIONS

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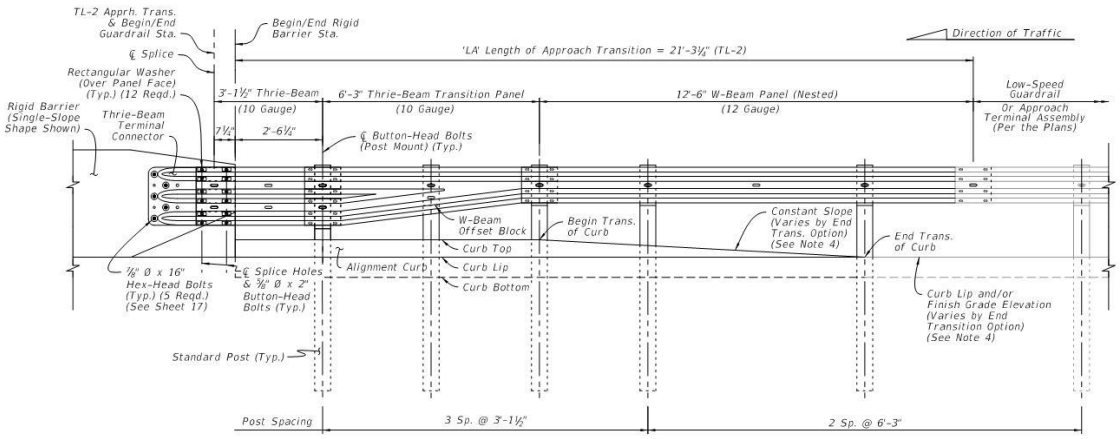
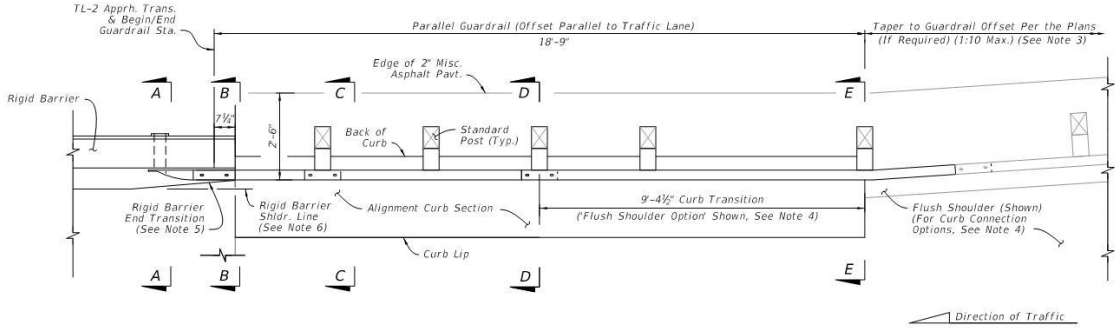
11/01/19						536-001	14 of 24



TL-2 APPROACH TRANSITION INSTALLED ELEVATION



TL-2 APPROACH TRANSITION INSTALLED PLAN

NOTES:

1. *INSTALLATION: Construct the Approach Transition segment where indicated in the plans. For example Layouts showing the Approach Transition's fit among other guardrail segments, see Sheet 19.*

   For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.

2. *SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.*

3. *GUARDRAIL TAPER: The connecting guardrail may require a different lateral offset if shown in the plans. At the location indicated herein, taper the guardrail to the connecting guardrail offset. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.*

4. *END TRANSITION OF CURB OPTIONS: The Plan and Elevation views depict an example Curb Transition to Flush Shoulder from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option shown in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flush Shoulder Option'). See Sheet 16 for additional curb options and Sheet 17 for curb shape details.*

5. *RIGID BARRIER END TRANSITION: Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.*

6. *OFFSET: The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.*

7. *GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.*

APPROACH TRANSITION CONNECTION TO RIGID BARRIER - LOW-SPEED, TL-2

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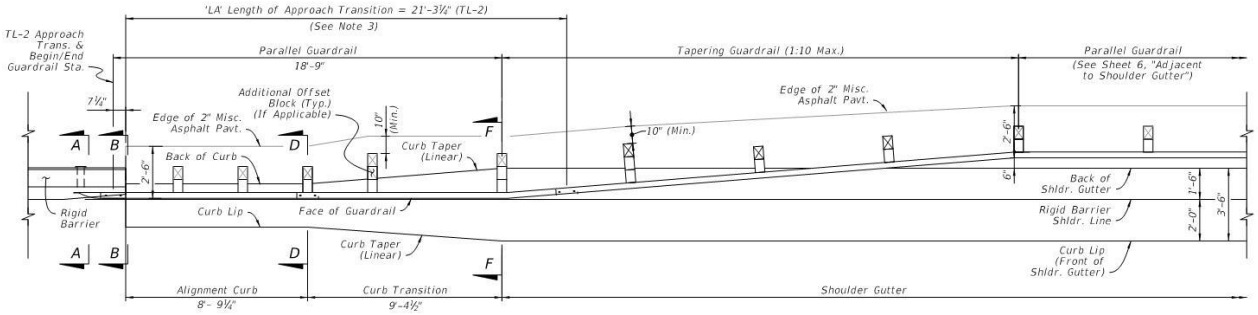
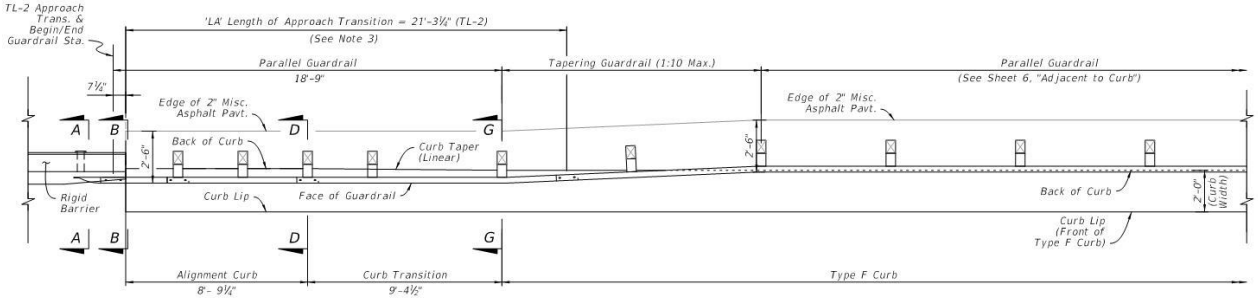
LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
11/01/19						536-001	15 of 24



TL-2 APPROACH TRANSITION WITH 'SHOULDER GUTTER' CONNECTION - PLAN VIEW



TL-2 APPROACH TRANSITION WITH 'TYPE F CURB' CONNECTION - PLAN VIEW

NOTES:

1. GENERAL: See the applicable notes and details on Sheet 15.
2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
3. ELEVATION VIEW: For post and panel installation details within 'LA', see the elevation view on Sheet 15. The curb details will differ depending on curb option required.

APPROACH TRANSITION CONNECTION TO RIGID BARRIER - LOW-SPEED, TL-2 CURB CONNECTIONS

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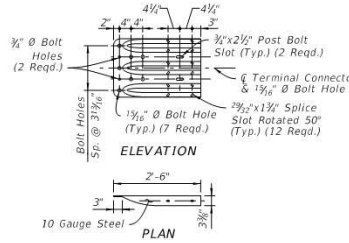
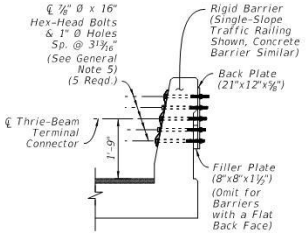
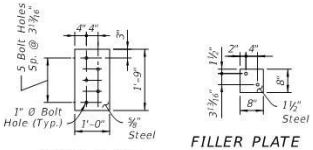
LAST REVISION	REVISION	DESCRIPTION:			INDEX	SHEET
11/01/19			FY 2020-21 STANDARD PLANS	GUARDRAIL	536-001	16 of 24

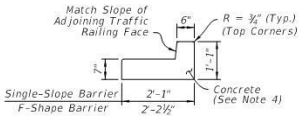


THRIE-BEAM TERMINAL CONNECTOR DETAIL

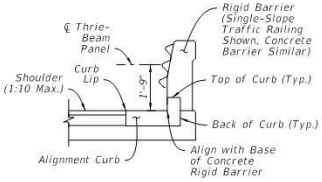


SECTION A-A
RIGID BARRIER TERMINAL CONNECTOR MOUNT

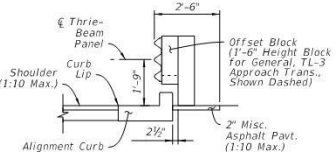




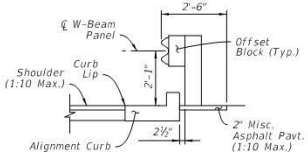
ALIGNMENT CURB SECTION



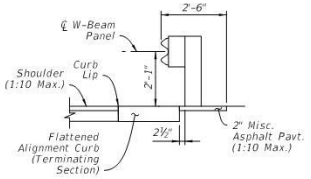
SECTION B-B
BEGIN ALIGNMENT CURB
(Mate to Rigid Barrier)



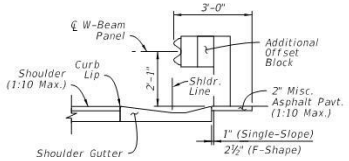
SECTION C-C
ALIGNMENT CURB
(Intermediate)



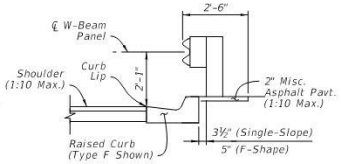
SECTION D-D
BEGIN TRANSITION
(End Alignment Curb)



SECTION E-E
END TRANSITION
FLUSH SHOULDER OPTION

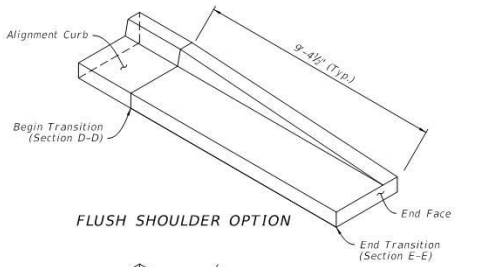


SECTION F-F
END TRANSITION
SHOULDER GUTTER OPTION

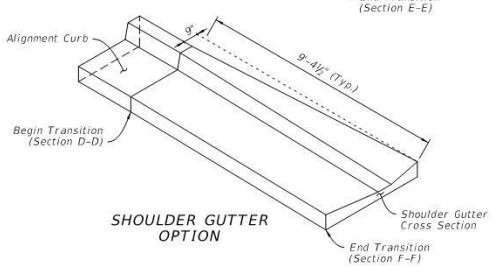


SECTION G-G
END TRANSITION
RAISED CURB OPTION

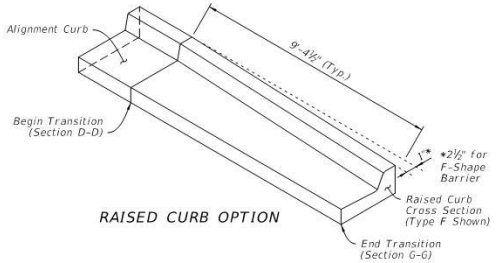
CURB TYPICAL SECTIONS



FLUSH SHOULDER OPTION



SHOULDER GUTTER OPTION



RAISED CURB OPTION

CURB TRANSITION ISOMETRIC VIEWS

NOTES:

1. PLAN AND ELEVATION VIEWS: Work with Sheets 13 thru 16.
2. END TRANSITION OF CURB OPTION: Install one of the three End Transition types shown per Section E-E as indicated by the plans.
3. GRADING BEHIND POSTS: Place Slope Break a Min. 2'-0" behind the post, per Sheet 6.
4. MATERIALS & CONSTRUCTION: Construct the concrete Aligning Curb and Curb transition in accordance with Specification 520. Use steel Plates and Thrie-Beam Terminal Connectors in accordance with Specification 967.

APPROACH TRANSITION CONNECTION - DETAILS

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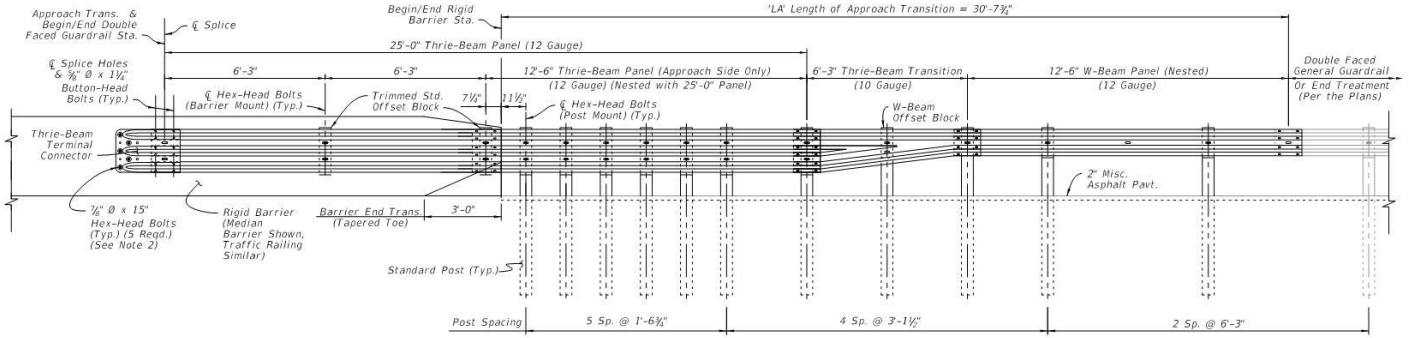
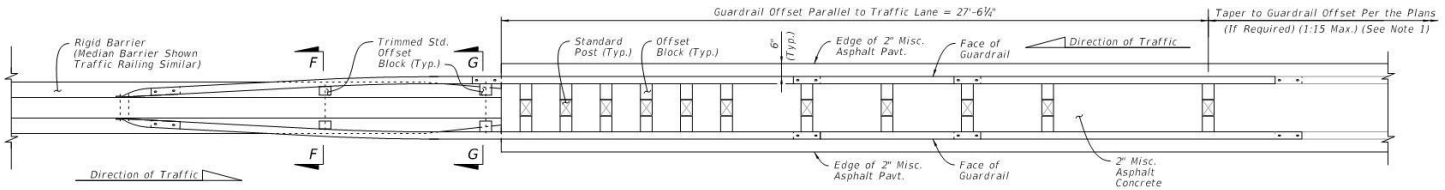


TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED ELEVATION



TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED PLAN

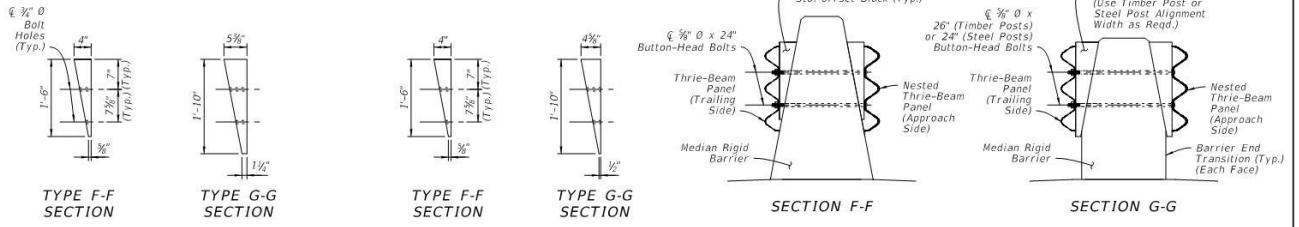
NOTES:

1. INSTALLATION: Construct the Approach Transition segment where indicated in the plans. The required offset of the connecting adjacent guardrail is shown in the plans.

   The Layout given on Sheet 20 provides a basic scheme for connections to adjacent guardrail, where a taper to a differing guardrail offset may be required. If the adjacent guardrail has the same offset as the Approach Transition segment, then no taper is required.

2. THRIE-BEAM TERMINAL CONNECTOR: See Sheet 17 for Details. The installed bolt's threaded portion is not permitted to extend beyond ¾" from the face of the nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.

3. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. End Treatments or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.



APPROACH TRANSITION CONNECTION TO
RIGID BARRIER WITH DOUBLE FACED GUARDRAIL

LAST REVISION 11/01/19	REVISION	DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 18 of 24

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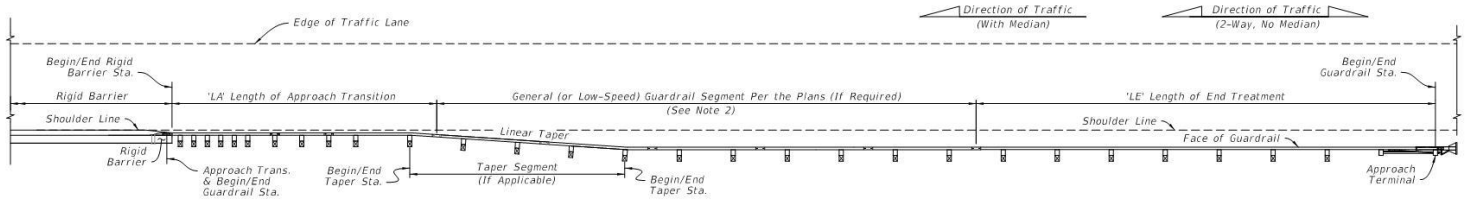
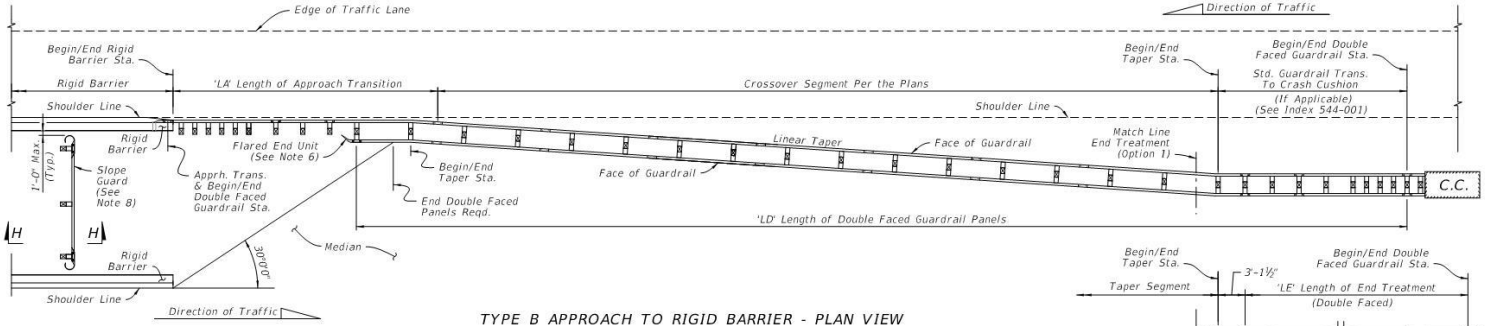
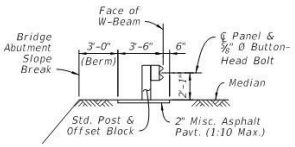


TYPE A APPROACH TO RIGID BARRIER - PLAN VIEW
MEDIAN OR OUTSIDE SHOULDERS
(Mirror Horiz. and/or Vert. for Opposite Direction and/or Side of Road)



TYPE B APPROACH TO RIGID BARRIER - PLAN VIEW
CROSSOVER GUARDRAIL FOR MEDIAN SHOULDERS ONLY
DUAL BRIDGE APPROACH CONFIGURATION
(Mirror Horiz. and Vert. for Opposite Direction)



SECTION H-H
BRIDGE ABUTMENT SLOPE GUARD
(Between Bridges)

NOTES:

1. *INSTALLATION: The Plan Views shown are schematic only, showing example geometry for connecting guardrail segments including taper locations and Double Faced Guardrail requirements as applicable. Work this Sheet with the plans, where stationing and offsets for Begin/End Guardrail, Begin/End Rigid Barrier, and Begin/End Taper are specified. For existing bridge layouts, see Index 536-002, 521-404, and 521-405.*

2. *GENERAL (OR LOW-SPEED) GUARDRAIL SEGMENT: Construct this segment if shown in the plans. For the case where this segment's offset differs from the Approach Transition offset, linearly taper the guardrail between the Begin/End Taper Stations and offsets as specified in the plans.*

   For the shortest length case of a direct connection between the End Treatment and the Approach Transition, this segment may be omitted as shown in the plans.

3. *LENGTH OF APPROACH TRANSITION 'LA': Install the applicable Approach Transition as shown per Sheets 13 thru 16, where called for in the plans.*

4. *LENGTH OF END TREATMENT 'LE': Install the Approach Terminal End Treatment as shown per Sheet 7 or 8, where called for in the plans. Use the corresponding APL drawings for construction details.*

5. *CROSSOVER GUARDRAIL (FOR TYPE B APPROACH): Install the Crossover Segment tapering linearly from the Begin Taper Sta. and offset to the End Taper Sta. and offset as specified in the plans.*

6. *LENGTH OF DOUBLE FACED GUARDRAIL PANELS, 'LD' (FOR TYPE B APPROACH): Terminate the Double Faced Guardrail panels as shown (based upon the 30° line measured from the hazard on the opposite side of the median). Extend the panel segment longer than the dimension 'LD' as needed for the Panel's end Bolt Slot to align with a post Bolt hole.*

   Install a Flared End Unit where shown, as defined on Sheet 9.

7. *END TREATMENT OPTIONS (FOR TYPE B & C APPROACH): For Double Faced applications, use either a Double Faced Approach Terminal Assembly per Sheet 8 or a Crash Cushion per Index 544-001. For either Option, meet the 1:10 adjacent grading requirements for Approach Terminals as shown on Sheet 8.*

8. *SLOPE GUARD: Where indicated in the plans, install a Guardrail segment between bridge approaches and offset from the bridge abutment's Slope Break as shown. Install posts at the end bolt slots of the panel system. Use post spacing of either 3'-1½" or 6'-3", as needed to correctly fit system between barriers. The system may also be lengthened to fit by installing two Rounded End Units as defined on Sheet 9.*

LAYOUT TO RIGID BARRIER - APPROACH ENDS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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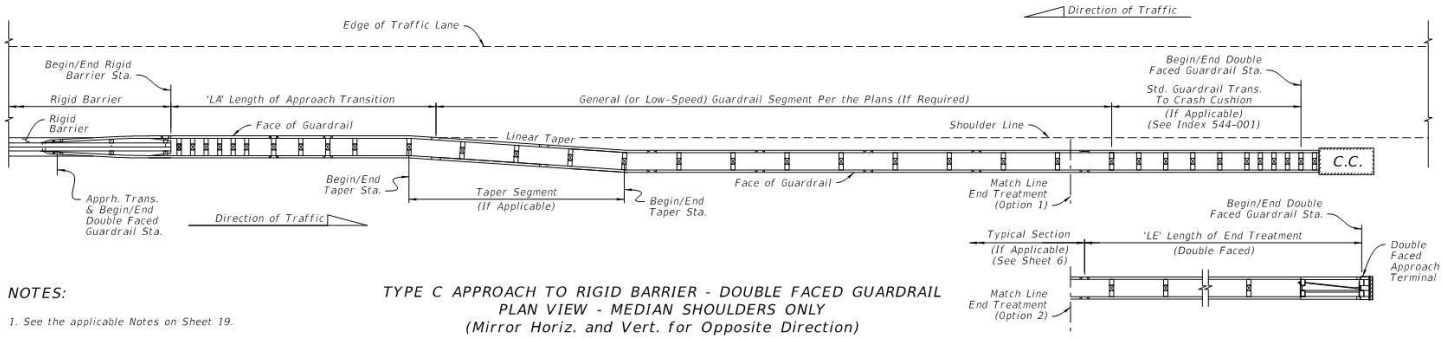
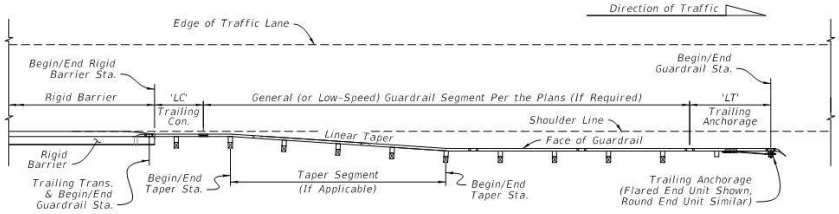


NOTES:

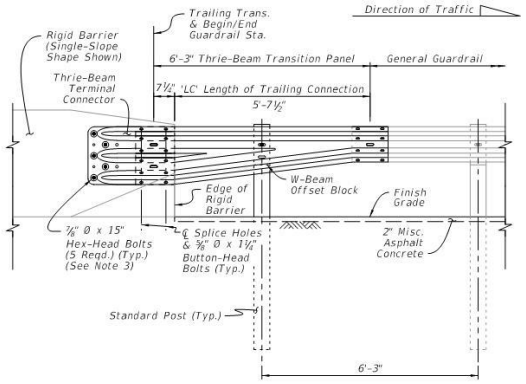
1. See the applicable Notes on Sheet 19.

TYPE C APPROACH TO RIGID BARRIER - DOUBLE FACED GUARDRAIL
PLAN VIEW - MEDIAN SHOULDERS ONLY
(Mirror Horiz. and Vert. for Opposite Direction)

LAYOUT TO RIGID BARRIER - APPROACH ENDS WITH DOUBLE FACED GUARDRAIL



TYPE D TRAILING CONNECTION FROM RIGID BARRIER
PLAN VIEW - MEDIAN OR OUTSIDE SHOULDER
(Mirror Horiz. and/or Vert. for Opposite Direction and/or Side of Road)



TRAILING END TRANSITION CONNECTION
TO RIGID BARRIER - INSTALLED ELEVATION

NOTES:

1. See the applicable Notes on Sheet 19.
2. LENGTH OF TRAILING ANCHORAGE, 'LT': Install the Trailing Anchorage as shown on Sheet 9, where called for in the plans.
3. THRIE-BEAM TERMINAL CONNECTOR: Install connector and bolts as shown on Sheet 17.
4. RIGID BARRIER SINGLE SLOPE END FACE: See Concrete Barrier Wall, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-423, for details.

LAYOUT TO RIGID BARRIER - TRAILING ENDS

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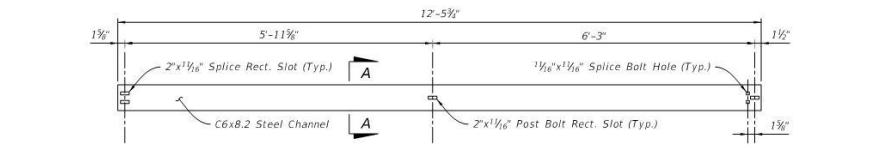
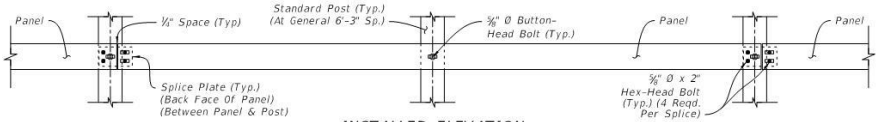
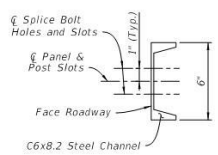
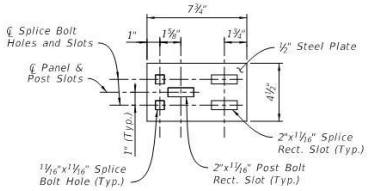
LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
11/01/19						536-001	20 of 24





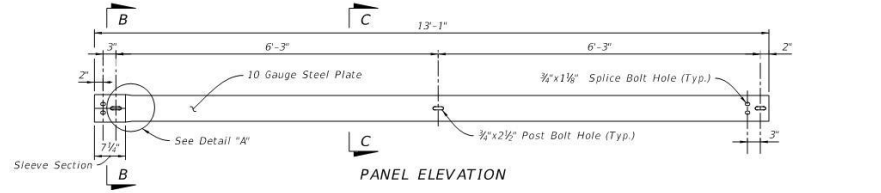


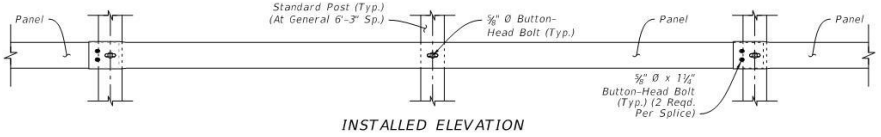
SECTION A-A
(Panel Typical)

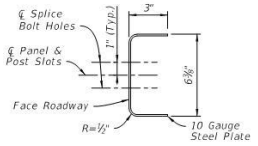


SPLICE PLATE
ELEVATION

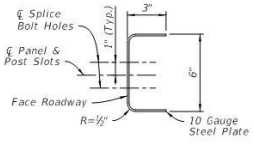
CHANNEL SECTION RUB RAIL



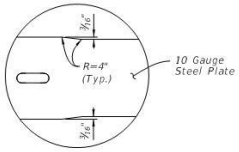




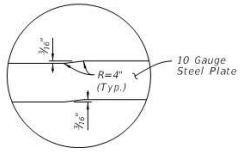
SECTION B-B
(Panel Sleeve End)



SECTION C-C
(Panel Typical)

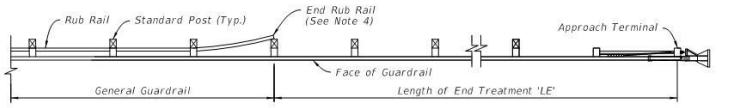


DETAIL "A"
(Sleeve Transition Elevation)



DETAIL "B"
(Sleeve Transition Plan)

BENT-PLATE PANEL RUB RAIL



RUB RAIL TERMINATION - SCHEMATIC PLAN VIEW

NOTES:

1. GENERAL: Install Rub Rail where called for in the plans. Position as shown on Sheet 6 unless otherwise shown in the plans. Install the backs of Rub Rail panels flush against Standard Posts. Either of the Channel Section or Bent-Plate Panel Rub Rail options may be used (consistent type per project). Where Double Sided Rub Rail is called for, thread the Button-Head Bolt through the Post Bolt Hole(s) and the panels on either side, and tighten the nut against the face of the panel farthest from adjacent traffic lanes. Trim the bolt's threaded portion in accordance with Note 4 on Sheet 5.
2. MOUNTING HEIGHT: Mount to the Standard Post's Rub Rail Bolt Hole as defined on Sheet 5.
3. MATERIALS: Use steel components in accordance with Specification 967.
4. END RUB RAIL: For Single Sided Rub Rail, terminate the run of Rub Rail by bending the panel behind the post and securing in place (as shown). For Double Sided Rub Rail, terminate the runs of Rub Rail on their respective front face of the post and secure with the typical Button-Head bolt.

RUB RAIL DETAILS

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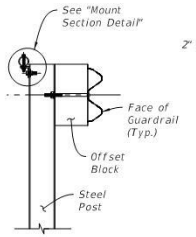
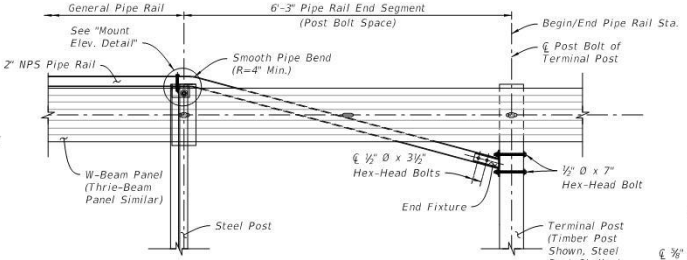
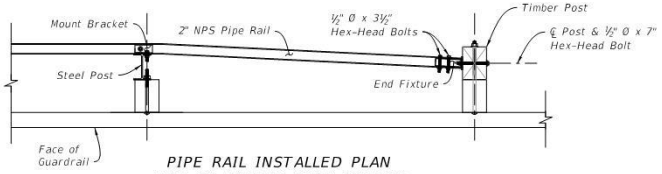


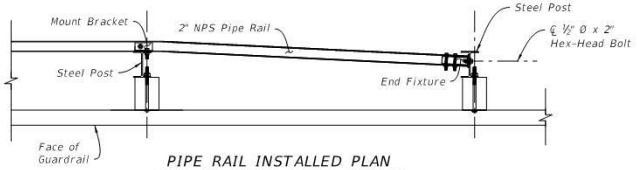
GENERAL PIPE RAIL SECTION



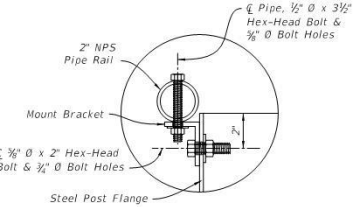
PIPE RAIL INSTALLED ELEVATION
(End Segment Shown)



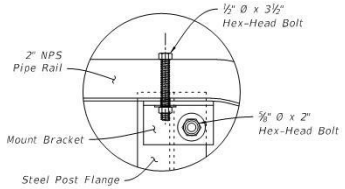
PIPE RAIL INSTALLED PLAN
END AT TIMBER POST OPTION



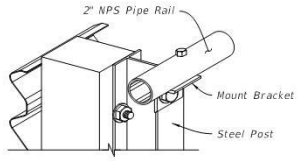
PIPE RAIL INSTALLED PLAN
END AT STEEL POST OPTION



MOUNT SECTION DETAIL



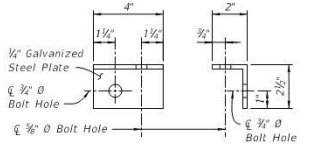
MOUNT ELEVATION DETAIL
(Back View - Mirrored)



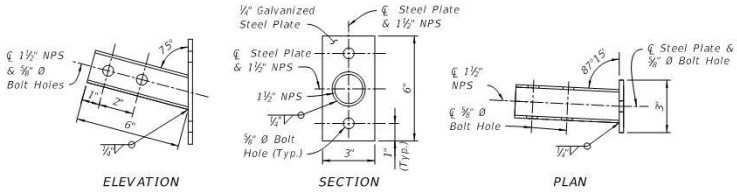
MOUNT ISOMETRIC
CUT-AWAY

NOTES:

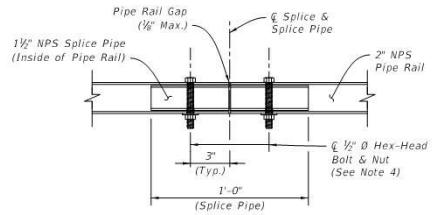
1. GENERAL: Install General Pipe Rail where indicated in the plans or when existing sidewalks or shared use paths are located less than 4'-0" from the back of Steel Posts as shown on Sheet 6.
2. PIPE RAIL END SEGMENTS: Place End Segments on both ends of General Pipe Rail runs, with End Fixtures mounted to Terminal Posts located outside of Approach Terminal Assembly ('LE'), Trailing Anchorage Assembly ('LT'), and Approach Transition ('LA') segments.
3. MATERIALS: Use steel brackets, fixtures, and pipes in accordance with Specification 967.
4. RAIL SPLICES: Install Rail Splices to join pieces of 2" NPS Pipe Rail into a continuous system. Place splices as needed, at a spacing of 18'-0" or greater. Orient the head of bolt on the top of the pipe.



MOUNT BRACKET DETAIL



END FIXTURE DETAIL



RAIL SPLICE DETAIL

PEDESTRIAN SAFETY TREATMENT - PIPE RAIL

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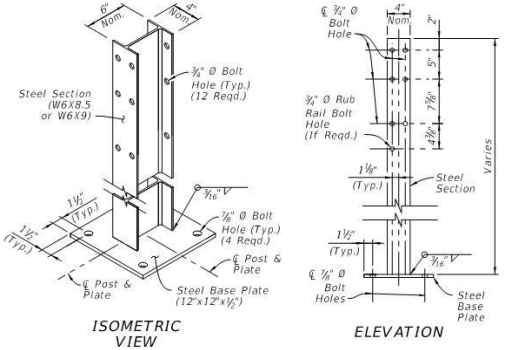
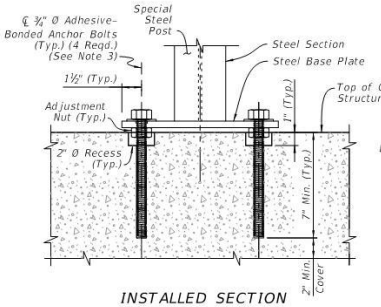
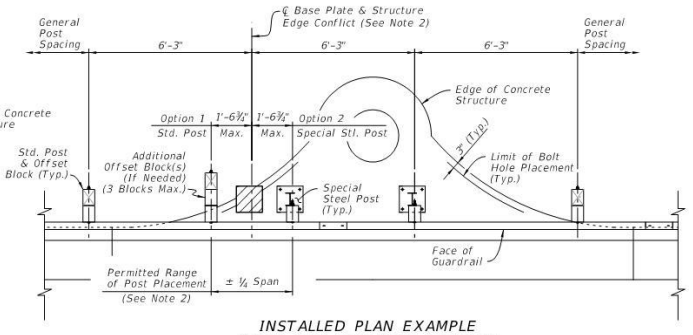


ISOMETRIC VIEW

ELEVATION



INSTALLED SECTION (Option 2, Special Post)



INSTALLED PLAN EXAMPLE (Curb Inlet Top Type 2 Shown)

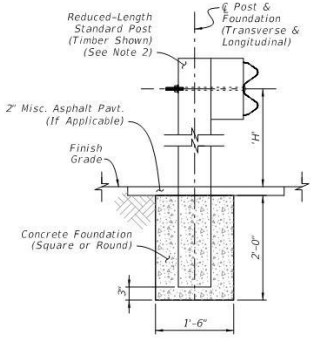
SPECIAL STEEL POST

STRUCTURE MOUNTING

NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) located atop culverts, inlets, pier footings, or similar concrete structures, a Special Steel Post may be substituted for a Standard Post. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
2. EDGE CONFLICT: When a required post location causes an Edge Conflict with the structure, where the Steel Base Plate is not located entirely on the structure at least 3" from the Edge of Concrete, the longitudinal post location may be altered by up to 1'-6¾" (Quarter Span) from the original required spacing location to prevent the Edge Conflict. With the post location adjusted, use a Std. Post mounted in soil (Option 1) or a Special Steel Post with its Base Plate mounted entirely on the structure (Option 2). Maintain the original required spacing locations upstream and downstream of the structure.
3. BASE PLATE MOUNT: Install Special Steel Posts as shown using steel Adhesive-Bonded Anchor Bolts in accordance with Specification 536. Use ¾" Hex-Head Bolts for structures less than 9" deep as defined in the Specification.
4. PANEL MOUNT TO ADJUSTED POST: Punch additional ¾"x2½" Post Bolt Slot(s) in the W-Beam or Thrie-Beam Panel only where needed to mount the panel to a post in an adjusted location. Meet the Panel Post Bolt Slots requirements of Specification 536.
5. MATERIALS: Use steel base plates in accordance with Specification 536.

SPECIAL STEEL POST FOR CONCRETE STRUCTURE MOUNT

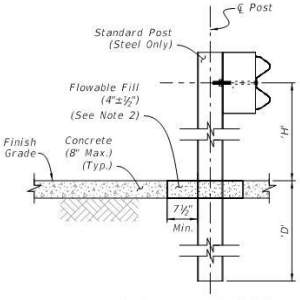


INSTALLED SECTION

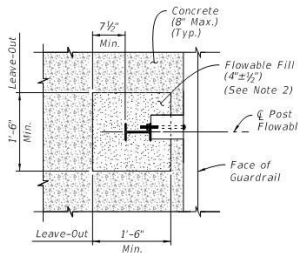
NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) conflicting with underground utilities or other underground obstructions, an Encased Post may be used where a 2'-0" depth will avoid the conflict. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
2. REDUCED-LENGTH STANDARD POST: Use a Standard Post with reduced Length such that the Panel Height 'H' is maintained while the post bottom terminates 3" from the bottom of the Concrete Foundation. Typically, the Post Length 'L' is 4'-7" for W-Beam Guardrail.
3. FOUNDATION: Use non-reinforced Class NS Concrete material in accordance with Specification 347. After casting the concrete, ensure the surrounding soil material is completely backfilled and tamped to provide full passive resistance.
4. LIMIT: Encased Posts are not permitted for more than 3 consecutive posts.

ENCASED POST FOR SHALLOW MOUNT



INSTALLED SECTION



INSTALLED PLAN

NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) placed within a concrete surface (typically a sidewalk), use a Frangible Leave-Out around the post base as shown. Install where shown in the plans and/or as-needed, in accordance with Specification 536.

   Use Standard steel posts. Timber posts are not permitted for frangible leave-outs.

   For the required 1'-6" x 1'-6" Leave-Out, smoothly cut the existing concrete surface or form-up the square shape when an application has new surrounding concrete.

   Ensure Flowable Fill surface is smooth and even with the adjacent concrete surface.
2. MATERIALS: Use Non-Excavatable Flowable Fill in accordance with Specification 121, not to exceed 150 psi.

FRANGIBLE LEAVE-OUT FOR CONCRETE SURFACE MOUNT

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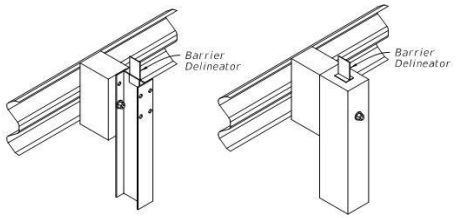
NOTES:

1. INSTALLATION: Install Barrier Delineators as shown in accordance with the plans, with Specifications 536 and 705, and with the manufacturer's design as approved on the APL.
2. MATERIALS: Use materials of the size and type defined for Barrier Delineators in Specification 993.
3. COLOR: Use either white or yellow retroreflective sheeting to match the color of the nearest lane's edgeline.
4. MOUNT LOCATIONS: Mount Barrier Delineators atop posts as shown, starting with Post (3) of Approach Terminals and incrementally increasing spacing towards the downstream direction. Install the Barrier Delineators at the following spacing:

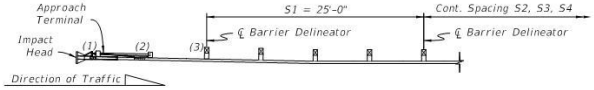
   S1 = 25' x 1 Space
   S2 = 50' x 1 Space
   S3 = 75' x 1 Space
   S4 = 100' x for the Remaining Run

   Additionally, place a Barrier Delineator on Post (2) of the Trailing Anchorage or on the post nearest the Rigid Barrier.
5. MEDIAN GUARDRAIL: Install retroreflective sheeting on both sides of the barrier delineator for Guardrail on medians.



STEEL POSTS TIMBER POSTS

MOUNT LOCATION - ISOMETRIC VIEWS



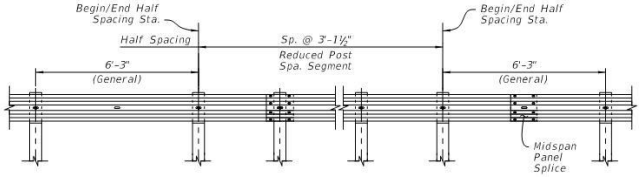
MOUNT LOCATION - PLAN VIEW

BARRIER DELINEATORS

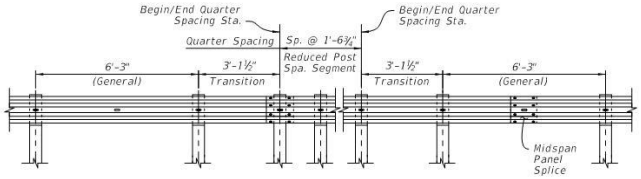
NOTES:

1. INSTALLATION: Work these details with the plans, where Stationing for Begin/End Half Spacing and Begin/End Quarter Spacing are indicated if required.

   Where the Begin/End Stations indicated in the plans do not correspond exactly to post locations in construction, extend the Reduced Post Spacing segment to the nearest post(s) before the Begin Station and/or after the End Station called for.
2. PANEL SPLICES: Midspan Panel Splices are not required in Transition and Reduced Post Spacing segments, however they are required for General segments. To place midspan splices in General segments, use one Non-General panel length (9'-4½" or 15'-7½") or add an additional Transition spaced post where required.
3. LOW-SPEED GUARDRAIL: For Reduced Post Spacing with Low-Speed Guardrail (12'-6" post spacing), the Reduced Spacing pattern requires a 6'-3" space between the 12'-6" and 3'-1½" spaces.
4. PANEL POST BOLT SLOTS: For Quarter Spacing configurations, punch additional ¾"x2½" Post Bolt Slots in the panels only where required for mounting and in accordance with Specification 536.

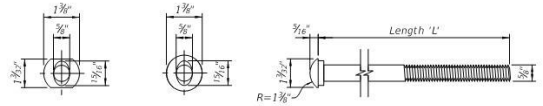


DETAIL 'S' - HALF SPACING ELEVATION
(AS REQD. PER THE PLANS)



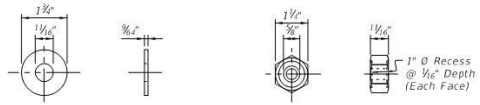
DETAIL 'S' - QUARTER SPACING ELEVATION
(AS REQD. PER THE PLANS)

REDUCED POST SPACING FOR HAZARDS



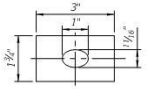
ELEVATION OPTION 1 ELEVATION OPTION 2 PROFILE (Option 1 Shown)

BUTTON-HEAD BOLT



ELEVATION PROFILE ELEVATION PROFILE

WASHER HEX-NUT



ELEVATION PROFILE

RECTANGULAR WASHER
(For CRT & Terminal Connectors Where Shown - Install Over Panel Face)

BUTTON-HEAD BOLT LENGTHS:

Application(s):	Length 'L':	Min. Thread Length:
Panel Splice	1½"	Full Length
Steel Post Mount – Single Faced Guardrail	10"	4"
Timber Post Mount – Single Faced Guardrail	18"	4"
Steel or Timber Post Mount – Double Faced Guardrail	25"	4"

NOTES:

1. Use nuts, bolts, and washers in accordance with Specification 967.
2. For Steel Posts with Double Faced Guardrail, the single 25" Length bolt (one bolt thru both post flanges) may be replaced with two 10" Length bolts (one bolt per post flange).
3. Use bolts listed in Table 2 in corresponding locations shown in this Index.

⅝" BUTTON-HEAD BOLT SYSTEM

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Maine DOT Response:

6. ROADSIDE DESIGN
Practices and Procedures

6-1 ROADSIDE CLEAR ZONES

See EI C2 – Clear Zone, Design Guidance – Clear Zone Relative to Right of Way and Chapter 3 Roadside Topography and Drainage Features of *the AASHTO Roadside Design Guide.*

6-2 ROADSIDE BARRIER WARRANTS

6-2.01 Embankments

See Design Guidance – Sideslopes and Backslopes

6-2.02 Roadside Obstacles

See Section 5.2.2 Roadside Obstacles in the *AASHTO Roadside Design Guide*.

6-3 ROADSIDE BARRIER TYPES

See the MaineDOT Guardrail and Guardrail Terminal Policy and Section 5.4 Structural and Safety Characteristics of Roadside Barriers in the *AASHTO Roadside Design Guide*.

6-4 ROADSIDE BARRIER LAYOUT

6-4.01 Length of Need

See Design Guidance – Barrier Layout - Length of Need

6-4.02 Lateral Placement

The following will apply to the lateral placement of a roadside barrier:

1. ***Relative to Shoulder.*** In restricted locations, it is acceptable to place the barrier at the normal shoulder edge, but only if the following conditions can be met: Guardrail should not be placed closer than 4 feet from the edge of travel lane or 16 feet from the centerline. The greater distance will control. The 16 feet minimum is critical to accommodate snowplow widths without excessive encroachment on the opposing lane.

2. ***Deflection Distance.*** The dynamic deflection of the barrier cannot be violated. Double-nesting the rails or decreasing the post spacing to 3 feet 1.5 inches will decrease the

deflection distance by 50%. Either method must extend at least 25 feet in advance of and beyond the trailing end of the obstacle being shielded.

3. ***Relative to Embankments.*** A minimum of 3 feet should be provided between the face of the barrier and the break in a fill embankment. When minimal impacts are an issue, a 2 foot space may be used, but 8 foot guardrail posts are required.

4. ***Bridge Approaches.*** Short runs of barrier at less than the desirable lateral offset are acceptable at bridges where the bridge width is narrower than the normal face-of-barrier-to-face-of-barrier width.

5. ***Shy Line Offset.*** See Section 5.6.1 Barrier Offset in the *AASHTO Roadside Design Guide*.

6. ***Flare Rate***. See Section 5.6.3 Flare Rate in the *AASHTO Roadside Design Guide.*

6-4.03 Barrier Gap

Barrier gaps of less than 200 feet should be connected, unless the gap is needed for access (e.g., driveways, maintenance operations).

6-4.04 Placement on Slopes

Roadside barriers should not be placed on roadside slopes steeper than 10:1. This also applies to the area approaching the beginning of the barrier installation.

6-4.05 Placement Behind Curbs

Barrier/Curb Orientation

The face of the barrier should be flush with the face of the curb (i.e., at the gutter line). The height of the barrier is measured from the pavement surface. Curb height shall not exceed 4 inches.

Sidewalks

See Section 5.6.2.1 Curbs in the *AASHTO Roadside Design Guide.*

Sidewalks and Bridge Rails

See Section 5.6.2.1 Curbs in the *AASHTO Roadside Design Guide.*

Guardrail Terminal/Curb Orientation

Guardrail terminals should not be placed behind curb. Where there is no alternative, curb height should be reduced to 2 inches approximately 50 feet in advance of the terminal. For flared terminals, the 2 inch height should be carried an additional 37 feet beyond the upstream end. For

tangent terminals, the 2 inch height should be carried 12 feet beyond the upstream end and the terminal should be offset 1 foot to keep the impact head behind the face of curb.

6-4.06 Rub Rail

See Section 5.6.2 Terrain Effects in the *AASHTO Roadside Design Guide*.

A rub rail should be considered where a potential snagging problem may exist.

6-4.07 Guardrail Terminals

See the MaineDOT Guardrail and Guardrail Terminal Policy and Design Guidance – Guardrail Height Adjustment Considerations.

6-5 MEDIAN BARRIERS

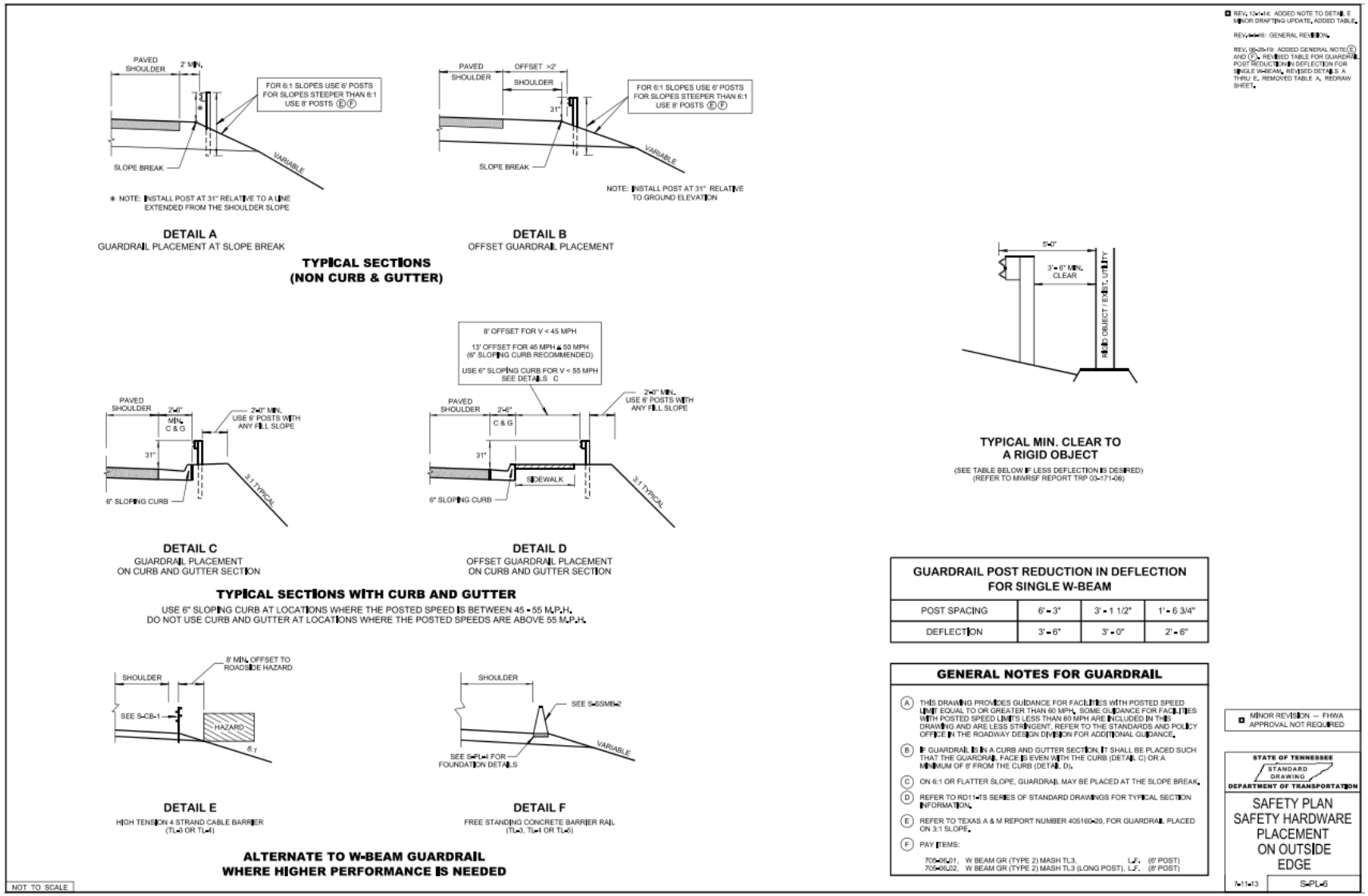
See Chapter 6 Median Barriers in the *AASHTO Roadside Design Guide.*

6-6 IMPACT ATTENUATORS

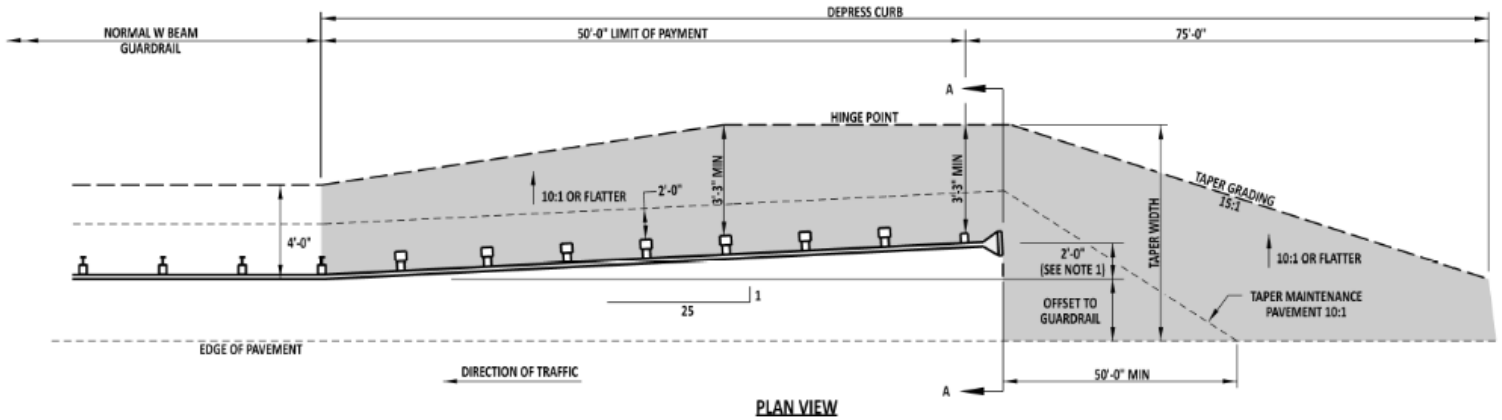
See Section 8.4 Crash Cushion Design Concepts and 9.3 Crash Cushions (for work zones) in the *AASHTO Roadside Design Guide*. Also see Design Guidance – Crash Cushions.

Other Response: If curb is necessary for drainage, we use a maximum 2" height.

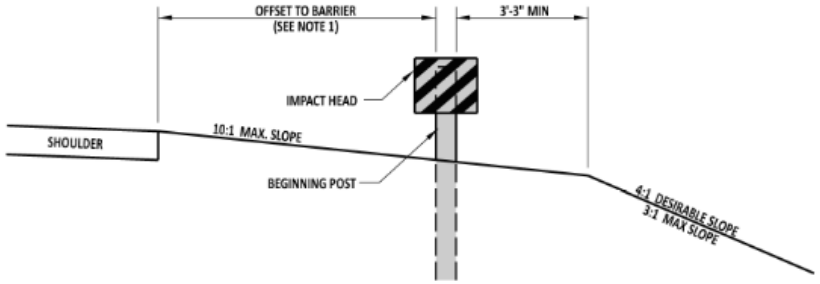
Q17 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.



SCALE : NTS



PLAN VIEW



SECTION A-A

= NO OBSTRUCTIONS IN SHADED AREA

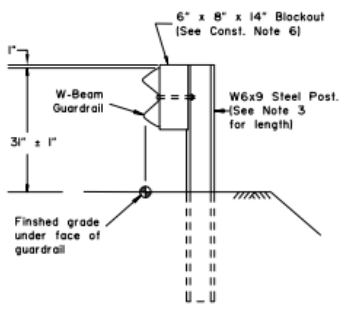
NOTES:

1). FLARE THE END TREATMENT AT 25:1 BEGINNING 50'-0" FROM THE END OF THE IMPACT HEAD, UNLESS THE CONSTRUCTION PLANS OR SPECIFICATIONS SPECIFY A SMALLER FLARE.
2). THIS DETAIL WAS SOLELY CREATED TO SHOW THE GRADING REQUIRED FOR THIS TYPE OF ATTENUATOR AND IS APPLICABLE REGARDLESS OF THE HEIGHT OF THE GUARDRAIL SYSTEM.
3). THE GUARDRAIL END TREATMENT ATTENUATOR SHALL BE INSTALLED AS PER THE MANUFACTURER'S AND THE DEPARTMENT OF TRANSPORTATION'S SPECIFICATIONS.
4). IF CURB IS PRESENT, DEPRESS THE CURB TO A MAXIMUM HEIGHT OF 2" WITHIN THE LIMITS OF THE END TREATMENT AND THROUGHOUT THE LENGTH OF THE TAPER GRADING.

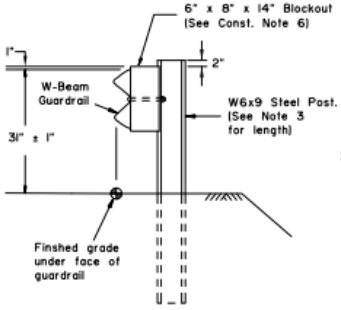
DELAWARE DEPARTMENT OF TRANSPORTATION	GRADING FOR GUARDRAIL END TREATMENT ATTENUATOR, TYPE 1		APPROVED SIGNATURE ON FILE (CHIEF ENGINEER) 1/04/2019 (DATE)
	STANDARD NO. B-2 (2018)	SHT. 1 OF 3	RECOMMENDED SIGNATURE ON FILE (DESIGN ENGINEER) 12/20/2018 (DATE)

Respondent – Picture 1(Mountable Curb)

Respondent- Picture 2(Barrier Curb)

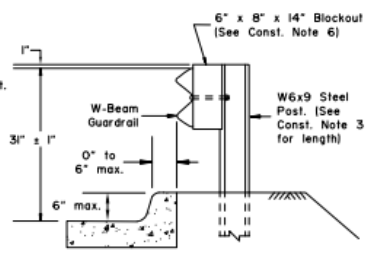


TYPE I POST INSTALLATION

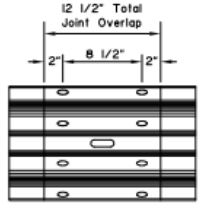


TYPE II POST INSTALLATION

(Facilitates raising rail for future overlays.)

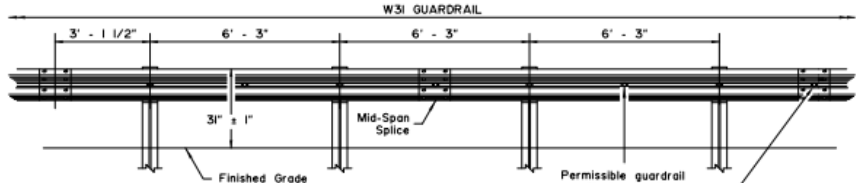


TYPE III POST INSTALLATION

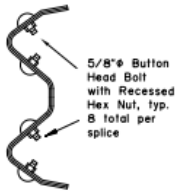


SPLICE DETAIL

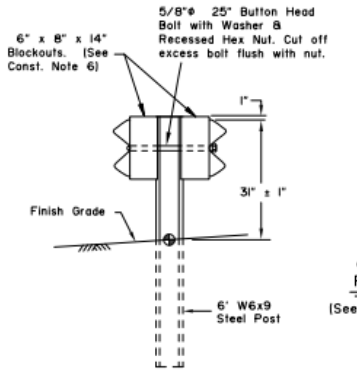
(At mid span between posts only. Bolts not shown for clarity)



TYPICAL ELEVATION



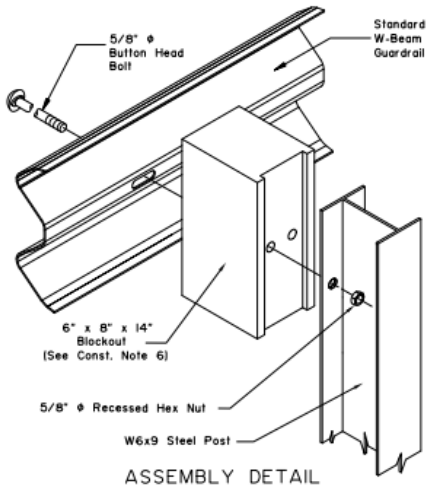
SPLICE CROSS-SECTION



TYPE IV DOUBLE SIDED INSTALLATION

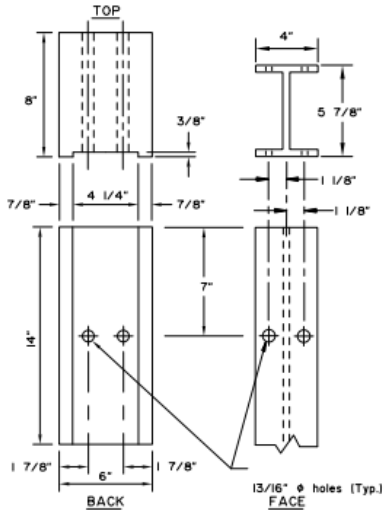
GUARDRAIL REFLECTOR

(See Const. Note 5)



ASSEMBLY DETAIL

(Type I post shown)



6" x 8" BLOCKOUT

W6x9 STEEL POST

CONSTRUCTION NOTES:

1. Provide hardware compliant with the Task Force 13 (TF13) Guide to Standardized Roadside Safety Hardware.
2. See Standard Plan G-00 for hardware details not shown on this drawing.
3. See Standard Plan G-10 for post lengths corresponding to different combinations of slope and behind-post embankment width.
4. Typical post spacing is 6'-3" center to center.
5. Attach guardrail reflector to guardrail using a 5/8" button head bolt with 5/8" recessed head hex nut and steel washer at location shown in the Typical Elevation. Install reflectors every 25' on tangents and every 12.5' on curves starting 100' before the P.C. and ending 100' after the P.T.
6. Use wood or synthetic blockouts designed, tested, and passed per MASH for use with steel posts. Either bolt hole on the blockout may be used for attachment.
7. Use a 25 linear foot transition to match differing height of existing or new rail elements and end treatments - see Standard Plan G-11.
8. W6x8.5 steel post may be substituted for W6x9 steel post.
9. Install flexible delineators on guardrail posts when called for in the contract. See Standard Plan G-00 for guardrail flexible delineator details.

DESIGN NOTES:

1. No fixed objects allowed within 36" of the back side of guardrail post.
2. This barrier is acceptable under MASH Tests 3-10 and 3-11.

State of Alaska DOT&PF
ALASKA STANDARD PLAN

STEEL POST W31 GUARDRAIL

Adopted as an Alaska Standard Plan by: Carolyn Morehouse

Carolyn Morehouse, P.E.
Chief Engineer

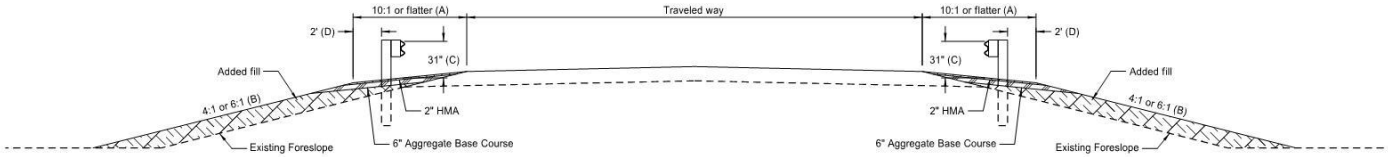
Adoption Date: 05/15/2019

Last Code and Stds. Review By: LRG Date: 5/15/2019

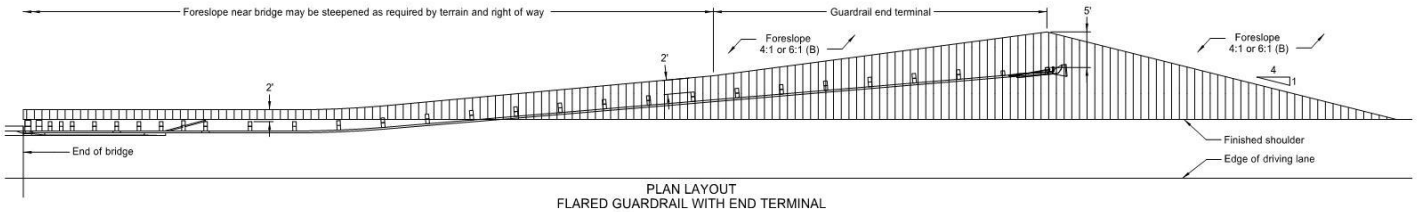
Next Code and Standards Review date: 5/15/2029

D-764-48

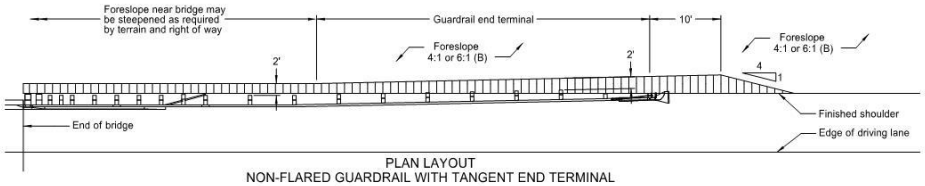
TYPICAL GRADING AT BRIDGE ENDS WITH MGS W-BEAM GUARDRAIL



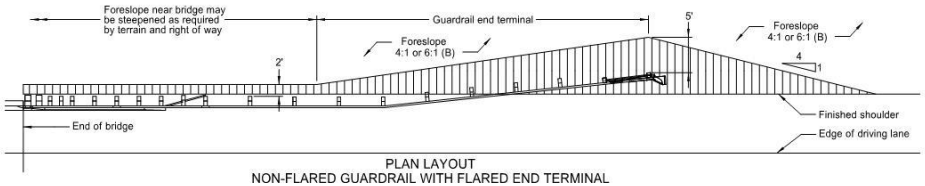
TYPICAL SECTION



PLAN LAYOUT
FLARED GUARDRAIL WITH END TERMINAL



PLAN LAYOUT
NON-FLARED GUARDRAIL WITH TANGENT END TERMINAL



PLAN LAYOUT
NON-FLARED GUARDRAIL WITH FLARED END TERMINAL

NOTES:

(A) Slope flatter than 10:1 may be required to provide proper guardrail height.

(B) Where normal foreslope is 4:1 the added fill shall be 4:1. Where normal foreslope is 6:1 the added fill shall be 6:1.

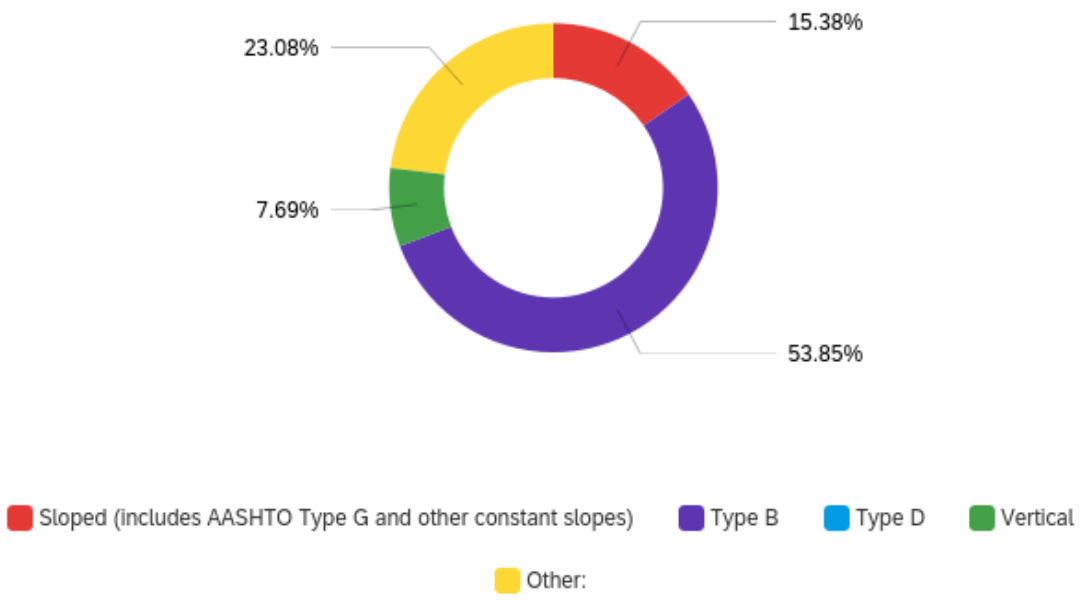
(C) Measured from top of guardrail to top of surfacing at front face of guardrail.

(D) Dimension at end terminals may vary per Plan Layouts shown on this sheet.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
7-14-17	
REVISIONS	
DATE	CHANGE

This document was originally issued and sealed by Roger Weigel, Registration Number PE- 2930, on 7/14/17 and the original document is stored at the North Dakota Department of Transportation

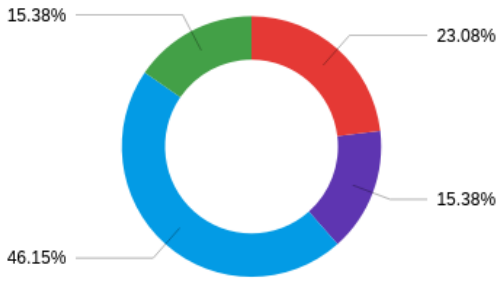
Q26 - What curb shape does your agency use at sites with w-beam guardrail terminals?



Answer	%	Count
Sloped (includes AASHTO Type G and other constant slopes)	15.38%	2
Type B	53.85%	7
Type D	0.00%	0
Vertical	7.69%	1
Other:	23.08%	3
Total	100%	13

Respondent	Response
R2	Both Type B and Vertical but with a max 2" height.
R3	Sloped
R4	Type B
R5	Type B
R6	Current State_X Type E but historically a AASHTO Type B
R7	Vertical
R8	Type B
R9	Type B
R10	Type B
R12	Type B
R14	Sloped
R15	Type B
R17	3" height

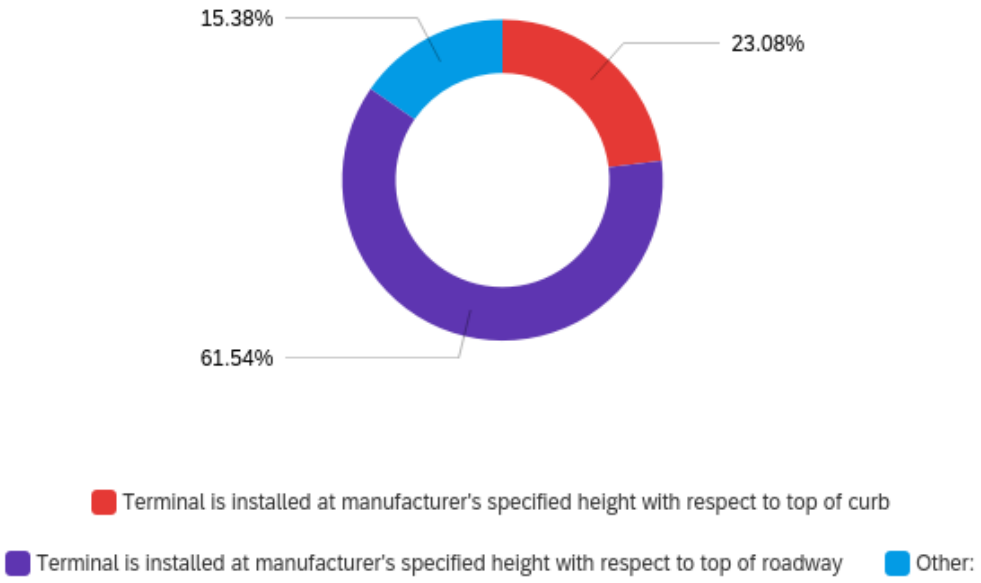
Q27 - What is the curb height when w-beam guardrail terminals are installed nearby?



Answer	%	Count
Less than 4 in.	23.08%	3
4 in.	15.38%	2
6 in.	46.15%	6
Other:	15.38%	2
Total	100%	13

Respondent	Response
R2	2"
R3	4 in.
R4	6 in.
R5	6 in.
R6	Currently 4", but many installations have 6"
R7	Less than 4 in.
R8	6 in.
R9	6 in.
R10	6 in.
R12	4 in.
R14	Less than 4 in.
R15	6 in.
R17	Less than 4 in.

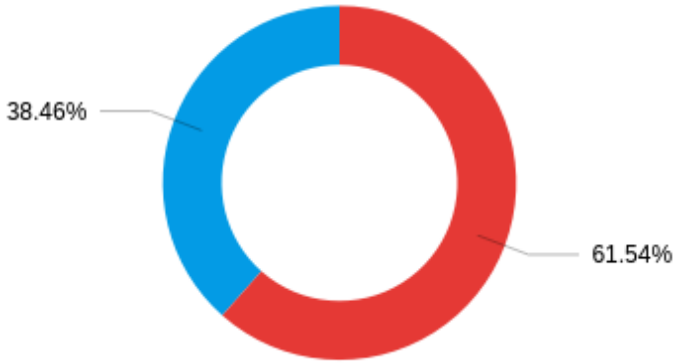
Q8 - How does your agency accommodate the height of the curb?



Answer	%	Count
Terminal is installed at manufacturer's specified height with respect to top of curb	23.08%	3
Terminal is installed at manufacturer's specified height with respect to top of roadway	61.54%	8
Other:	15.38%	2
Total	100%	13

Respondent	Response
R2	Terminal is installed at manufacturer's specified height with respect to top of curb
R3	Terminal is installed at manufacturer's specified height with respect to top of roadway
R4	Terminal is installed at manufacturer's specified height with respect to top of roadway
R5	Terminal is installed at manufacturer's specified height with respect to top of roadway
R6	Terminal is installed at manufacturer's specified height with respect to top of curb
R7	Terminal is installed at manufacturer's specified height with respect to top of roadway
R8	Terminal is installed at manufacturer's specified height with respect to top of roadway
R9	Terminal is installed at manufacturer's specified height with respect to top of roadway
R10	Terminal is installed at manufacturer's specified height with respect to top of roadway
R12	With respect to the gutter line.
R14	Terminal is installed at manufacturer's specified height with respect to top of roadway
R15	Terminal is installed at manufacturer's specified height with respect to top of curb
R17	Referenced state design sheet included above

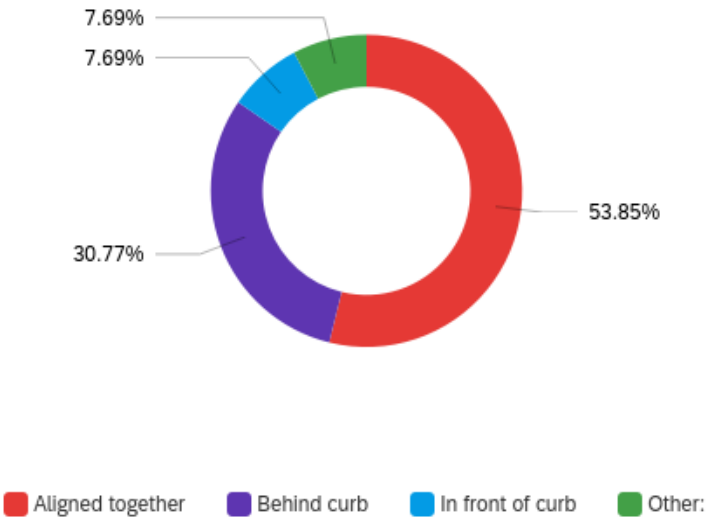
Q9 - What kind of w-beam guardrail terminals do you install on curbs?



Answer	%	Count
Tangent	61.54%	8
Flared	0.00%	0
Both	38.46%	5
Other:	0.00%	0
Total	100%	13

Respondent	Response
R2	Tangent
R3	Both
R4	Both
R5	Tangent
R6	Tangent
R7	Both
R8	Tangent
R9	Tangent
R10	Tangent
R12	Both
R14	Tangent
R15	Tangent
R17	Both

Q10 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?



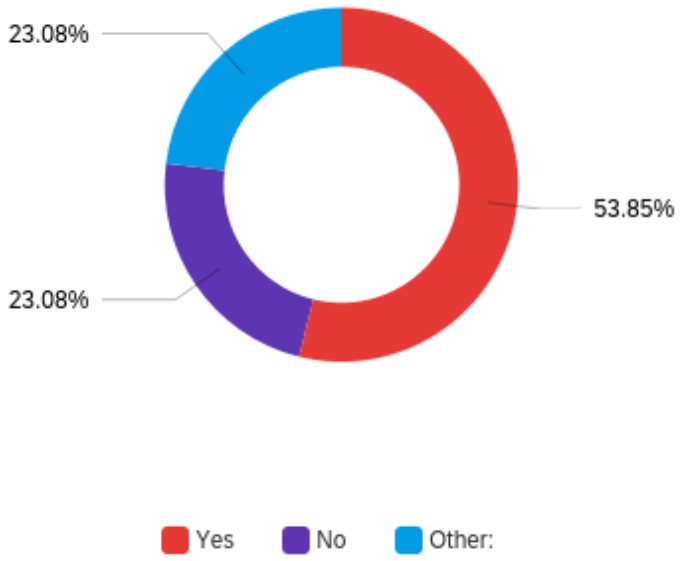
Answer	%	Count
Aligned together	53.85%	7
Behind curb	30.77%	4
In front of curb	7.69%	1
Other:	7.69%	1
Total	100%	13

Respondent	Response
R2	Behind curb
R3	Aligned together
R4	Aligned together
R5	Behind curb
R6	Behind, but typically still in very close proximity (i.e., enough to allow for installation of hardware)
R7	Aligned together
R8	Aligned together
R9	Aligned together
R10	Behind curb
R12	Aligned together
R14	In front of curb
R15	Aligned together
R17	Behind curb

Q11 - What is the offset between the face of rail and face of curb?

Respondent	Response
R2	Typically face of guardrail matches face of rail so the end treatment follows that alignment.
R5	1 foot
R10	6"
R14	6 ft
R17	It is variable

Q12 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?



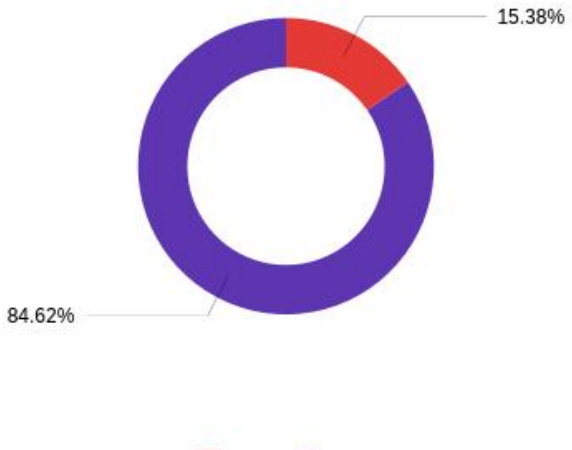
Answer	%	Count
Yes	53.85%	7
No	23.08%	3
Other:	23.08%	3
Total	100%	13

Respondent	Response
R2	won't that defeat the purpose of a 50' tangent length for the impact head?
R3	Yes
R4	Yes and no. It depends on site conditions, prevailing speeds, etc.
R6	Yes
R7	Yes
R8	No
R9	Yes
R10	No
R12	Yes
R14	No
R15	Yes
R17	It is inline with the taper of the end terminal

Q13 - What is the offset between the w-beam guardrail terminal head and face of rail?

Respondent	Response
R3	One foot
R5	1 foot
R6	6" typ.
R7	2-4 feet
R9	24" max offset
R12	1-2 feet
R15	Enough to get the head completely outside of the shoulder or travel lane.

Q313 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.



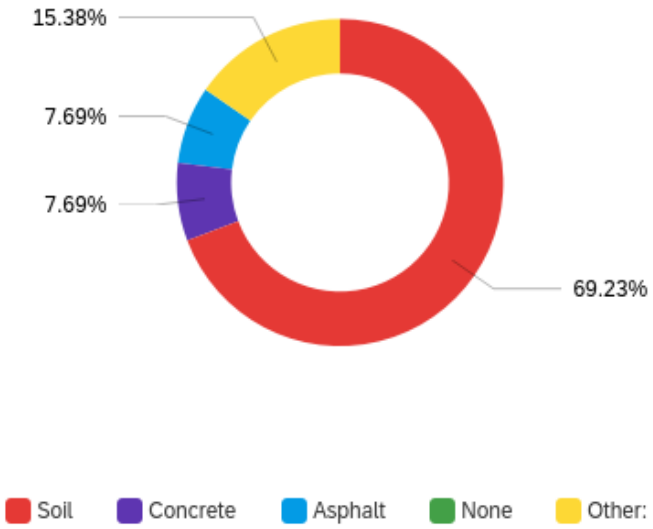
Answer	%	Count
Yes	15.38%	2
No	84.62%	11
Total	100%	13

Respondent	Response
R2	No
R3	No
R4	No
R5	No
R6	No
R7	No
R8	No
R9	Yes
R10	Yes
R12	No
R14	No
R15	No
R17	No

Q314 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

Respondent	Response
R9	24" max offset
R10	6" min.

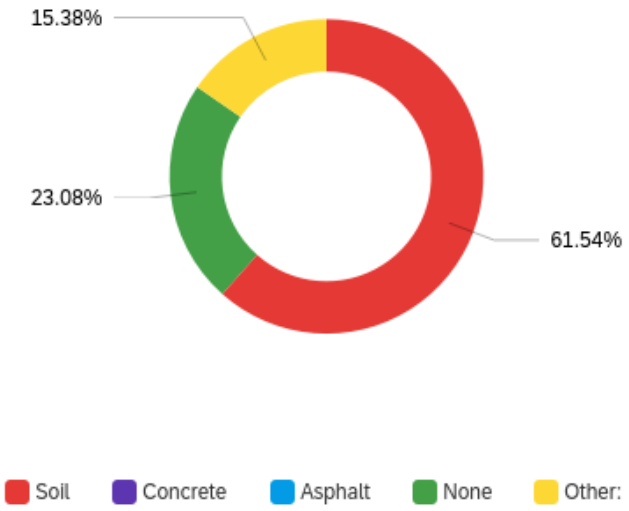
Q22 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.



Answer	%	Count
Soil	69.23%	9
Concrete	7.69%	1
Asphalt	7.69%	1
None	0.00%	0
Other:	15.38%	2
Total	100%	13

Respondent	Response
R2	Asphalt
R3	Concrete
R4	Soil
R5	Soil
R6	Soil
R7	Soil
R8	Soil
R9	Soil
R10	Soil
R12	Soil
R14	Typically AB
R15	Soil
R17	Soil, base, asphalt

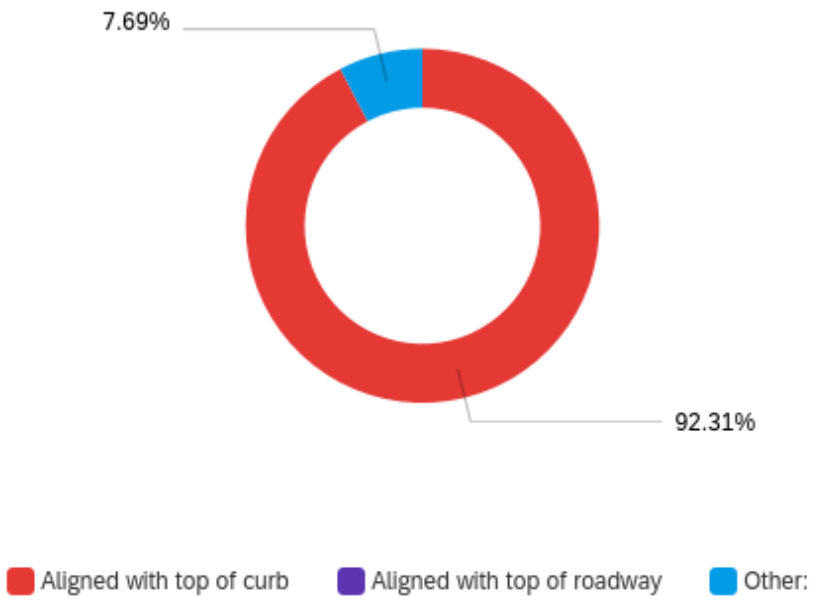
Q69 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.



Answer	%	Count
Soil	61.54%	8
Concrete	0.00%	0
Asphalt	0.00%	0
None	23.08%	3
Other:	15.38%	2
Total	100%	13

Respondent	Response
R2	Soil
R3	Soil
R4	Soil
R5	Soil
R6	Soil
R7	Gravel
R8	Soil
R9	None
R10	Soil
R12	Soil
R14	None
R15	None
R17	Soil, base, asphalt

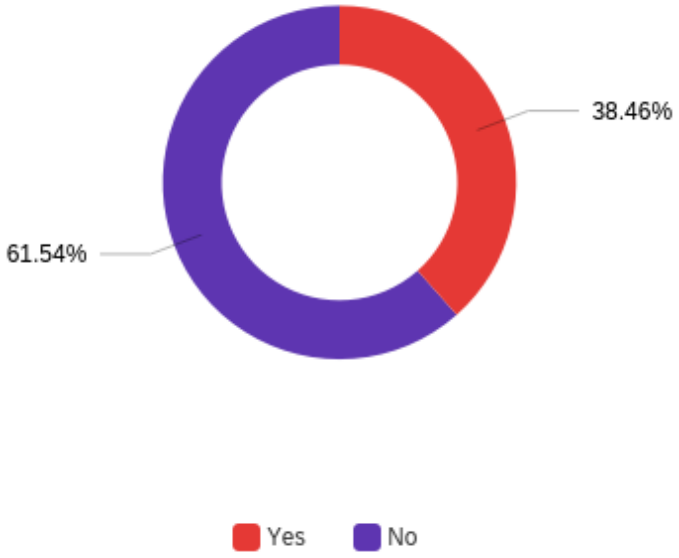
Q23 - What is the height of the top level of backfill material?



Answer	%	Count
Aligned with top of curb	92.31%	12
Aligned with top of roadway	0.00%	0
Other:	7.69%	1
Total	100%	13

Respondent	Response
R2	Aligned with top of curb
R3	Aligned with top of curb
R4	Aligned with top of curb
R5	Aligned with top of curb
R6	Aligned with top of curb
R7	Aligned with top of curb
R8	Aligned with top of curb
R9	Aligned with top of curb
R10	Aligned with top of curb
R12	Aligned with top of curb
R14	Aligned with top of curb
R15	Aligned with top of curb
R17	It isn't clear

Q75 - Does your agency use another curb configuration for installing w-beam guardrail terminals near curbs (only considering low-speed applications)? For example, a variation in curb height or curb type?



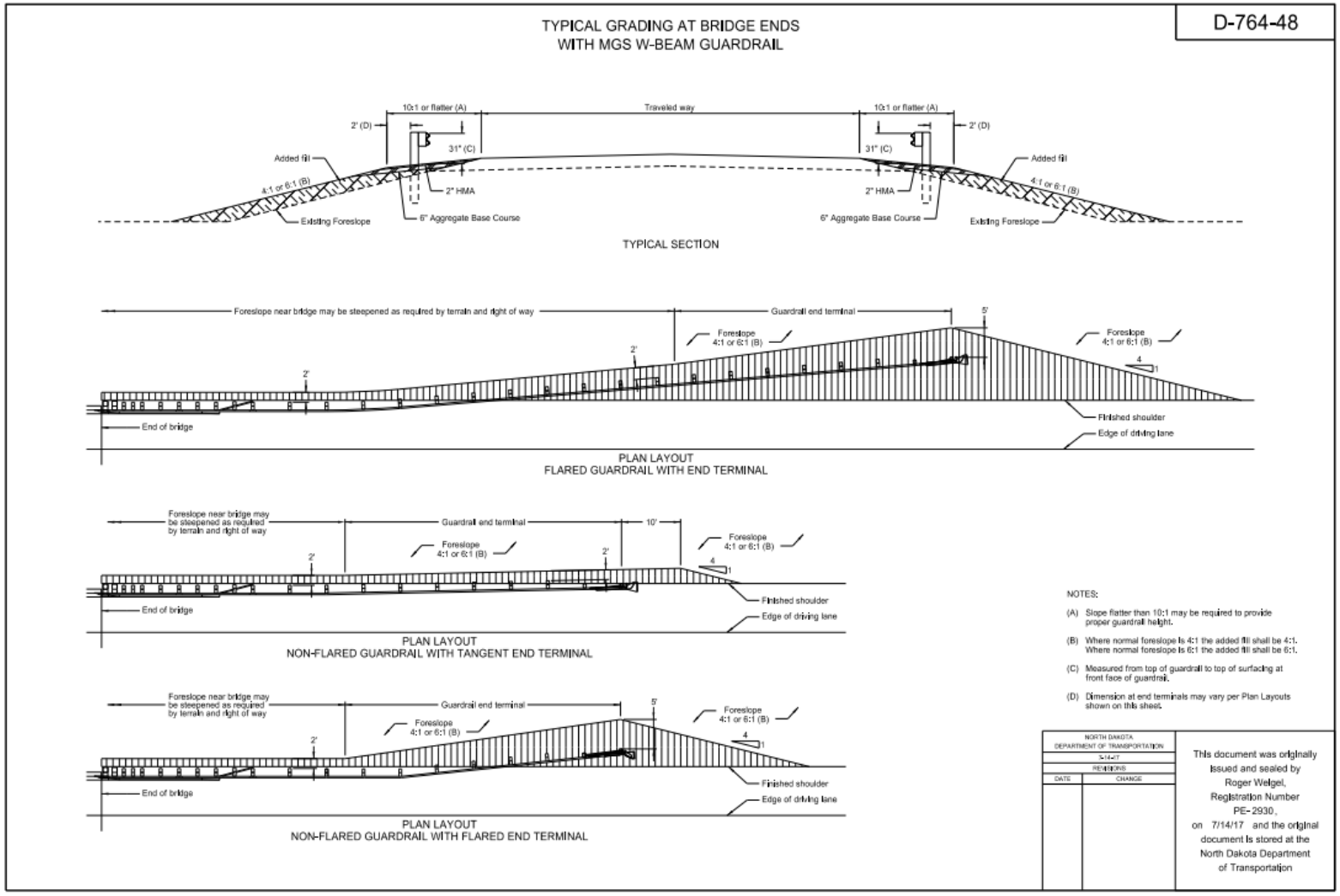
Answer	%	Count
Yes	38.46%	5
No	61.54%	8
Total	100%	13

Respondent	Response
R2	No
R3	No
R4	Yes
R5	No
R6	Yes
R7	No
R8	No
R9	No
R10	No
R11	
R12	No
R13	
R14	Yes
R15	Yes
R16	
R17	Yes

A.3 LOW-SPEED ROADWAY QUESTIONS- REPETITION 2

The third section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on low-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on low-speed roadways in the previous section. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q79 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.



SHEET	CONTENTS
1	General Notes; Index Contents
2	General, TL-3 Guardrail – Installed Plan and Elevation
3	Low-Speed, TL-2 Guardrail – Installed Plan and Elevation
4	W-Beam and Thrie-Beam Panel Details
5	Post and Offset Block Details
6	Guardrail Sections – Heights and Adjacent Slopes
7	End Treatment – Approach Terminal Geometry, Parallel
8	End Treatment – Approach Terminal Geometry, Curbed and Double Faced
9	End Treatment – Trailing Anchorage
10	End Treatment – Component Details
11	End Treatment – Controlled Release Terminal (CRT) System
12	Layout for CRT System – Side Roads and Driveways
13	Approach Transition Connection to Rigid Barrier – General, TL-3
14	Approach Transition Connection to Rigid Barrier – General, TL-3 – Curb Connections
15	Approach Transition Connection to Rigid Barrier – Low-Speed, TL-2
16	Approach Transition Connection to Rigid Barrier – Low-Speed, TL-2 – Curb Connections
17	Approach Transition Connection to Rigid Barrier – Details
18	Approach Transition Connection to Rigid Barrier – Double Faced Guardrail
19	Layout to Rigid Barrier – Approach Ends
20	Layout to Rigid Barrier – Approach Ends with Double Faced Guardrail Layout to Rigid Barrier – Trailing Ends Trailing End Transition Connection to Rigid Barrier
21	Rub Rail Details
22	Pedestrian Safety Treatment – Pipe Rail
23	Modified Mount – Special Steel Post for Concrete Structure Mount; Modified Mount – Encased Post for Shallow Mount; Modified Mount – Frangible Leave-Out for Concrete Surface Mount
24	Barrier Delineators – Post Mounted; Clear Space – Reduced Post Spacing for Hazards; ⅝" Button-Head Bolt System

GENERAL NOTES:

1. INSTALLATION: Construct guardrail in accordance with Specification 536.

   This Index, along with the plans and the manufacturers' drawings on the Approved Products List (APL), is sufficiently detailed for installation of General Guardrail, Low-Speed Guardrail, End Treatment assemblies, and their connecting options shown herein. This precludes requirements for shop drawing submittals unless otherwise specified in the plans.

2. COMPATIBILITY: The General Guardrail in this Index is based on the Midwest Guardrail System (MGS) design, with an approximate height of 31" at the top of the Panel (2'-1" mounting height at vertical ℄ of Panel) and a midspan panel splice as shown on Sheet 2. Guardrail components included on the APL, which are compatible with this Index, may also be identified as 31" or MGS Guardrail.

3. STANDARD COMPONENTS: Standard guardrail components, including posts, panels, and bolt systems, are based on the Task Force 13 Publication: Guide to Roadside Hardware Components (http://tf13.org/Guides/componentGuide/).

4. BUTTON-HEAD BOLTS: Install Button-Head Bolts where indicated using bolts, nuts, and washers as defined on Sheet 24. Place washers under nuts. Do not place washers between bolt heads and panels, except where otherwise shown in this Index.

5. HEX-HEAD BOLTS: Install Hex-Head Bolts where indicated using bolts, nuts, and washers in accordance with material properties of Specification 967. Place washers under nuts.

6. MISCELLANEOUS ASPHALT PAVEMENT: Install Miscellaneous Asphalt Pavement where indicated with a tolerance of ± ½" depth and in accordance with Specification 339.

7. ADJACENT SIDEWALKS & SHARED USE PATHS: When guardrail posts are placed within 4'-0" of a sidewalk or shared use path, use timber posts, or use steel posts only if treated with Pipe Rail as shown on Sheet 22.

   When timber posts are used, one of the following safety treatments is required for the bolt(s) protruding from the back face of the posts:
   a. After tightening the nut, trim the protruding post bolt flush with the nut and galvanize per Specification 562.
   b. Use post bolts 15" in length and countersink the washer and nut between 1" and 1½" deep into the back face of the post.
   c. Use 15" post bolts with sleeve nuts and washers.

   When End Treatment posts are within 4'-0" of a sidewalk or shared use path, steel posts are not permitted within the End Treatment segment. Terminate the Pipe Rail outside of End Treatment segments, as noted per Sheet 22.

8. NESTED W-BEAM: Where called for in the plans, install two W-Beam Panels mounted flush per location, securing all panels with Button-Head Bolts threaded through aligned slots and holes. 2" Button-Head Bolts are permitted for panel splice locations.

9. CONNECTION TO RIGID BARRIER: The connections to Rigid Barrier in this Index only apply to newly constructed bridge Traffic Railing and Concrete Barrier or where the complete Approach Transition Connection to Rigid Barrier shown herein can be installed without conflicting with existing Traffic Railings, structures, or approach slabs.

   For connecting guardrail to existing bridge Traffic Railings, see Indexes 536-002, 521-404, and 521-405.

10. CONNECTION TO EXISTING GUARDRAIL: Where a transition to existing guardrail at 27" height is required, linearly transition the new guardrail height over a distance ranging from 25'-0" to 31'-3". Height transitions must occur outside of End Treatment and Approach Transition segments.

    Provide an immediate transition to the required midspan panel splice using the available panel options on Sheet 4 (9'-4½" or 15'-7½" panel). Alternatively, this transition to midspan panel splice may be achieved by installing a single reduced post spacing of 3'- 1½" within the new guardrail, immediately adjacent to the connection location.

11. PLANS CALLOUTS: Begin/End Station labels are shown throughout this Index as they correspond to the station and offset callouts specified in the plans.

    In the plans, Begin/End Guardrail Station refers to the General TL-3 Guardrail Pay Item, and it may be abbreviated as Begin/End GR. Station. Where the Low-Speed TL-2 Guardrail Pay Item is specifically required, the callout in the plans will then specify Begin/End TL-2 GR. Station.

12. QUANTITY MEASUREMENT: Measure guardrail and corresponding components as defined in Specification 536. The Guardrail length is measured along the centerline of installed Panels, between the points labeled Begin/End Guardrail Station shown on the following Index Sheets and defined in the plans (typically measured from the ℄ of the panel's post bolt slots at the approach/trailing ends).

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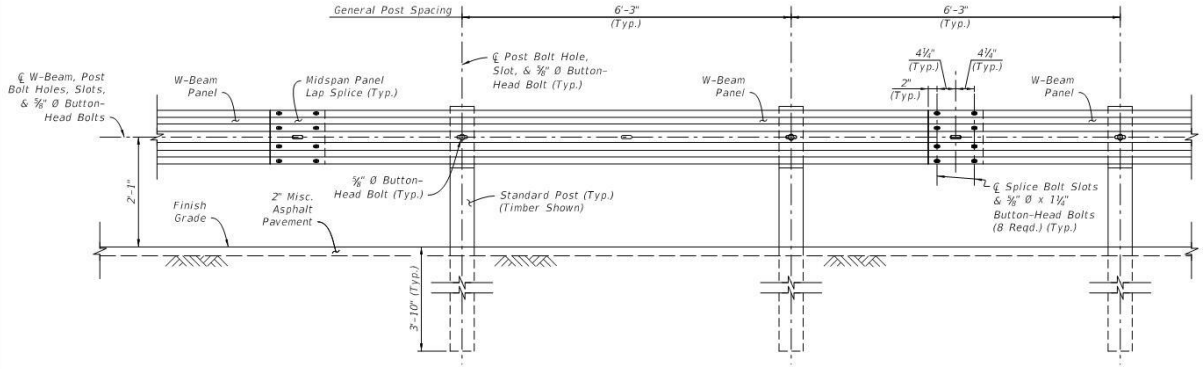
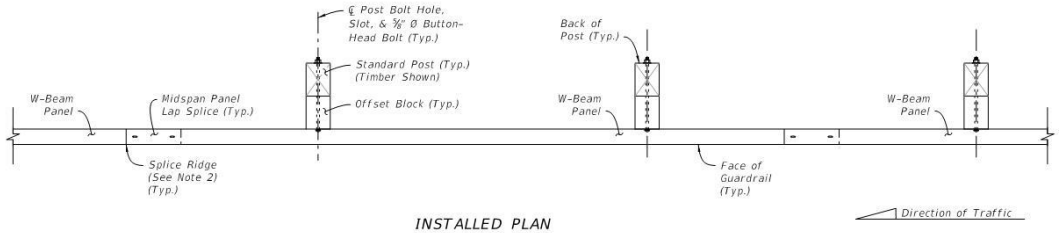
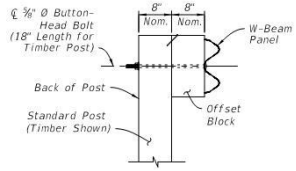


GENERAL GUARDRAIL
INSTALLED ELEVATION



INSTALLED PLAN



INSTALLED SECTION

NOTES:

1. GENERAL: Install the General Guardrail configuration where indicated in the plans. This may include tapered segments if called for in the plans.

   Use 12'-6" or longer W-Beam Panels. A single 6'-3" Panel may be used at the end of the run to meet the nominal Begin/End Guardrail Sta. requirements.

   Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the plans, obtain approval from the Engineer prior to installation.

2. MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

   Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.

3. CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.

4. W-BEAM PANEL DETAILS: See Sheet 4.

5. POST & OFFSET BLOCK DETAILS: See Sheet 5.

6. GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.

7. MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 23 for additional post mounting options.

8. DEFINED SEGMENTS: The General Guardrail shown provides the base configuration, including Post Spacing and splice locations, for Defined Segment modifications where indicated in the plans and using the Guardrail Types, Sections, and/or hardware as shown in this Index (e.g. Double Faced W-Beam, Deep Posts at Slope Breaks, Pipe Rail, Rub Rail, or Reduced Post Spacing for Hazards).

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GENERAL, TL-3 GUARDRAIL DETAILS

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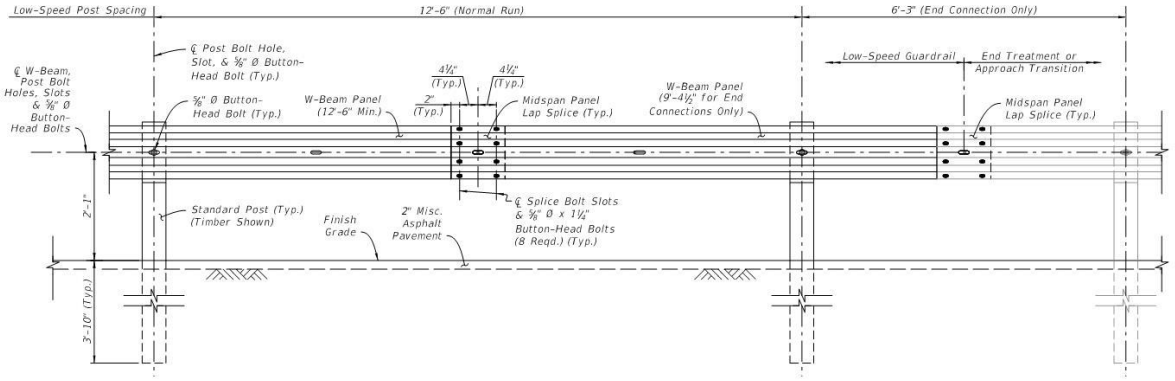
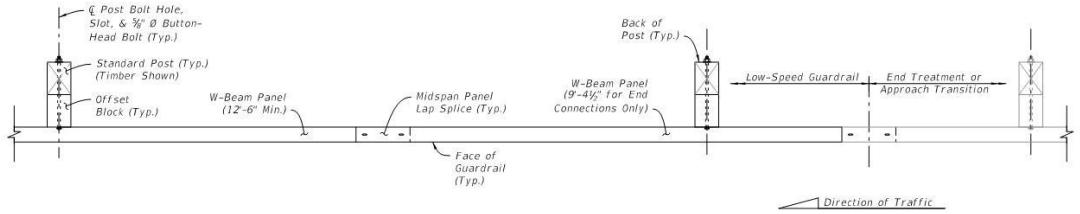
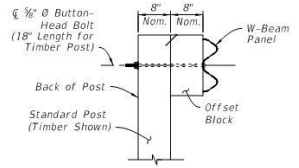


LOW-SPEED GUARDRAIL
INSTALLED ELEVATION



INSTALLED PLAN



INSTALLED SECTION

NOTES:

1. GENERAL: Install the Low-Speed Guardrail configuration where indicated in the plans. Low-Speed Guardrail may include tapered segments if called for in the plans.

   Use 12'-6" or 25'-0" W-Beam Panels for normal spans, and use 9'-4½" Panels for end connections to adjoining segments as shown. A single 6'-3" Panel may be used at the end of the Low-Speed Guardrail run along with a single reduced 6'-3" post spacing to meet the nominal Begin/End Guardrail Sta. required.

   Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the Plans, obtain approval from the Engineer prior to installation.

2. MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

   Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.

3. CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.

4. W-BEAM PANEL DETAILS: See Sheet 4.

5. POST & OFFSET BLOCK DETAILS: See Sheet 5.

6. GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.

7. MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 23 for additional post mounting options.

8. RESTRICTIONS: Low-Speed Guardrail segments are not permitted for use with items including, but not limited to, Double Faced W-Beam, Deep Posts at Slope Breaks, Raised Curb, Pipe Rail, and/or Rub Rail.

LOW-SPEED, TL-2 GUARDRAIL DETAILS

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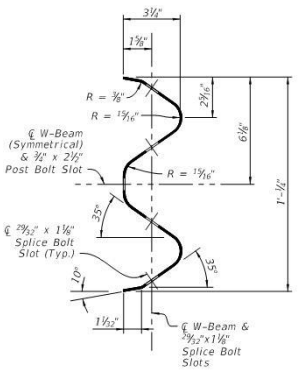
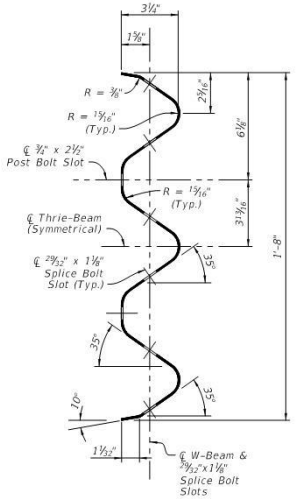
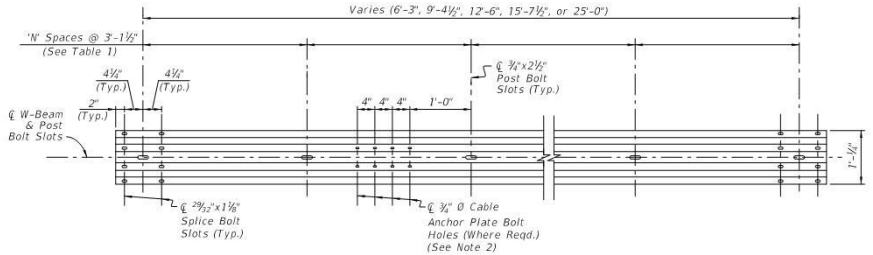


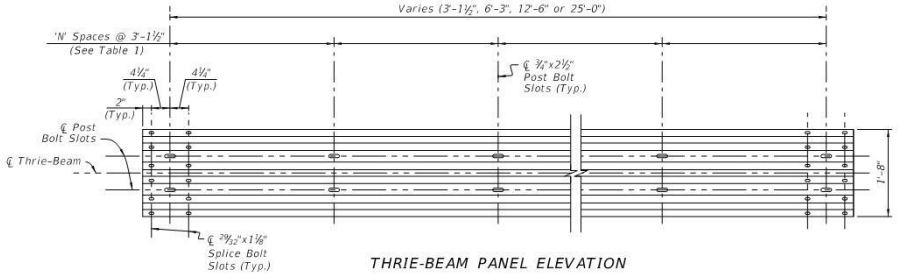
W-BEAM PANEL SECTION



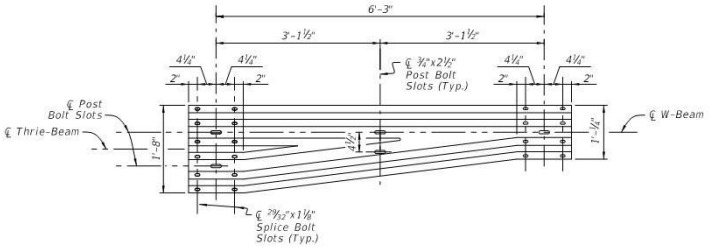
THRIE-BEAM PANEL SECTION



W-BEAM PANEL ELEVATION



THRIE-BEAM PANEL ELEVATION



THRIE-BEAM TRANSITION PANEL ELEVATION
(Reverse Direction Similar by Opposite Hand)

PANEL SUMMARY TABLE:

Panel Type	Number of Spaces 'N'	Gauge
6'-3" W-Beam	2	12
9'-4½" W-Beam	3	12
12'-6" W-Beam	4	12
15'-7½" W-Beam	5	12
25'-0" W-Beam	8	12
3'-1½" Thrie-Beam	1	10
6'-3" Thrie-Beam	2	12
12-6" Thrie-Beam	4	12
25-0" Thrie-Beam	8	12
Thrie-Beam Trans.	2	10

NOTES:

1. MATERIALS:
   Use corrugated steel panels in accordance with Specification 967 and made from either Class A, 12 gauge steel or Class B, 10 gauge steel as specified in the 'Panel Summary Table' above.

2. CABLE ANCHOR PLATE BOLT HOLES:
   Include ¾" Ø Cable Anchor Plate Bolt Holes only where required for installation of the Cable Anchor Plate shown on Sheet 9, 10, & 11.

   29⁄32" x 1⅛" slots may substitute for the ¾" Ø holes shown.

W-BEAM AND THRIE-BEAM PANEL DETAILS

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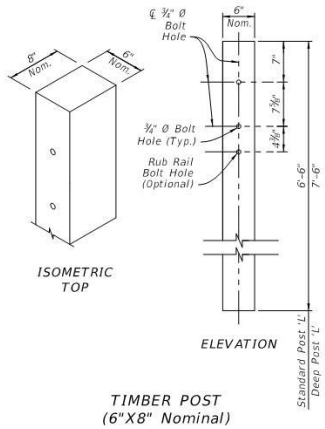
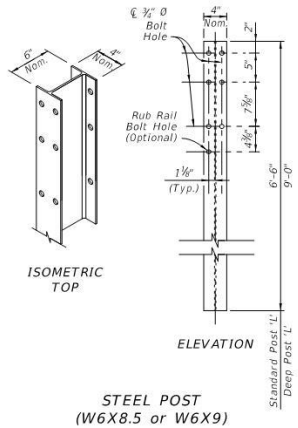
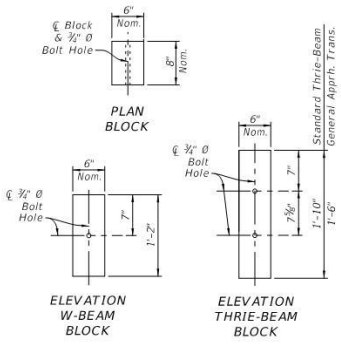


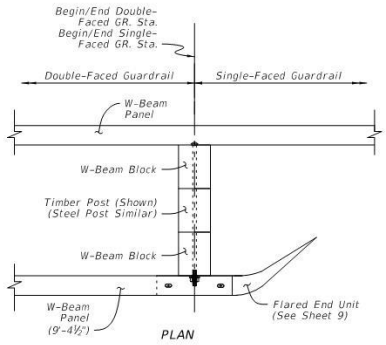
TIMBER POST
(6"X8" Nominal)



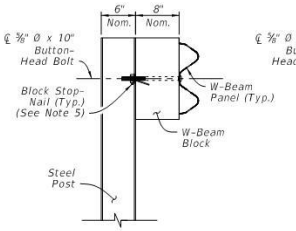
STEEL POST
(W6X8.5 or W6X9)

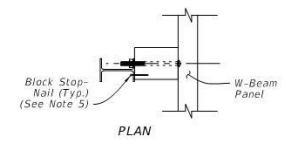


TIMBER OFFSET BLOCK
(6"X8" Nominal)

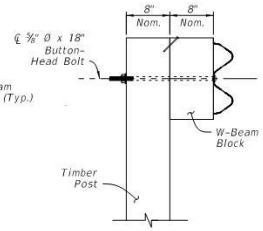


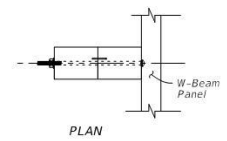
SINGLE-FACED / DOUBLE-FACED
GUARDRAIL CONNECTION



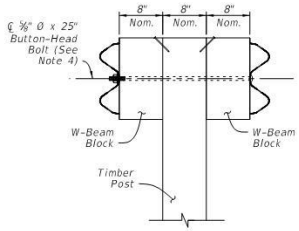


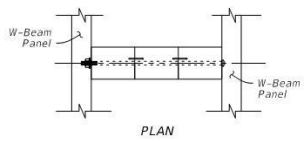
SINGLE-FACED
W-BEAM
STEEL POST



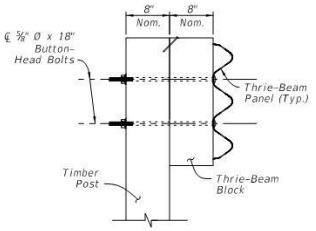


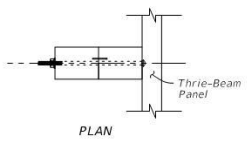
SINGLE-FACED
W-BEAM
TIMBER POST





DOUBLE-FACED W-BEAM
TIMBER POST
(Thrie-Beam Similar)
(Steel Post Similar)





THRIE-BEAM
TIMBER POST
(Steel Post Similar)

NOTES:

1. STANDARD POSTS: Where Standard Posts are called for in this Index, use either a Timber Post or Steel Post at the Length, 'L', shown for Standard Posts. Use a single post material type consistently per each run of guardrail. Only where specified in the Plans, use the Deep Post 'L' for Slope Break Conditions as shown on Sheet 6.
2. OFFSET BLOCKS: For each Panel type, install the corresponding Offset Block type as shown. For General, TL-3 (Single Faced) Approach Transitions only, use the 1'-6" Thrie-Beam Block (See Sheet 13).
3. BOLT HOLES: ¾" Ø Bolt Holes shown in posts within this Index may be substituted with 13/16" Ø Bolt Holes.
4. DOUBLE FACED GUARDRAIL: Orient Post Bolts with the Button-Head located on the side nearest the traffic lane. The bolt's threaded portion is not permitted to extend beyond ⅜" from the face of the tightened nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.
5. BLOCK STOP-NAIL: Drive one nail per Standard Offset Block as shown to prevent Block rotation. Use steel 3½" Type 16d nails with ASTM A153 hot-dip galvanization. For steel posts, drive the nail through the unused flange Bolt Hole and bend the nail so its head contacts the flange.
6. MATERIALS: Use timber and steel posts and offset blocks in accordance with Specification 967. Composite offset blocks may be substituted as approved on the APL. Use a single offset block type consistently per each run of guardrail. Steel offset blocks are only permitted for Modified Thrie Beam.

POST AND OFFSET BLOCK DETAILS

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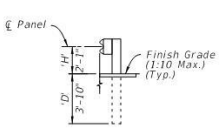
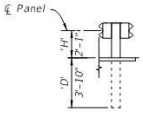
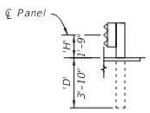


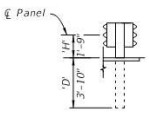
W-BEAM



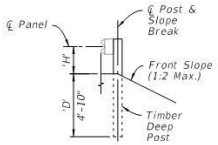
DOUBLE FACED W-BEAM



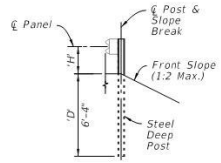
THRIE-BEAM



DOUBLE FACED THRIE-BEAM

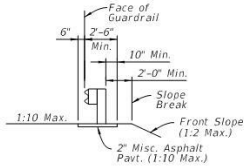


SLOPE BREAK CONDITION TIMBER DEEP POST

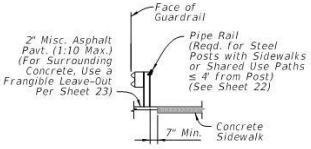


SLOPE BREAK CONDITION STEEL DEEP POST

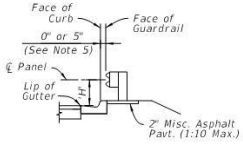
GUARDRAIL TYPES - MOUNTING HEIGHTS & POST DEPTHS



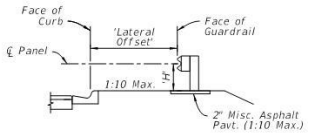
TYPICAL GRADING & PAVT. PLACEMENT DETAIL (See Note 2)



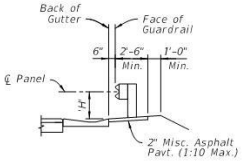
TYPICAL SIDEWALK DETAIL (Work with Other Sections as Reqd.)



ADJACENT TO CURB (Type F Curb Shown)



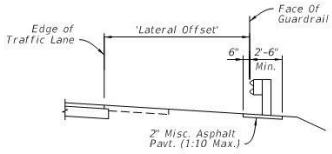
BEHIND CURB (Type F Curb Shown)



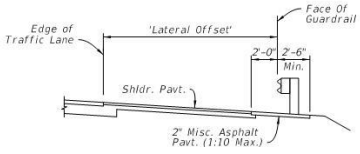
ADJACENT TO SHOULDER GUTTER

GUARDRAIL SECTIONS - TYPICAL

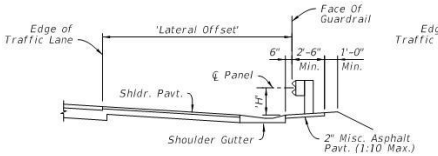
GUARDRAIL SECTIONS - CURB & GUTTER



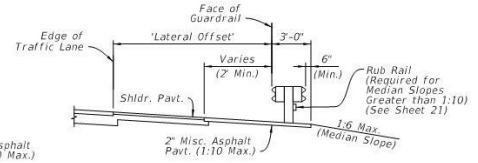
UNPAVED OR PARTIALLY PAVED SHOULDER



FULLY PAVED SHOULDER



SHOULDER GUTTER



DOUBLE FACED GUARDRAIL (Shown In Median)

GUARDRAIL SECTIONS - SHOULDERS

GUARDRAIL HEIGHT SUMMARY TABLE:			
Type:	Min. Depth 'D':	Mounting Height 'H':	Post Length 'L':
W-Beam (Single and Double Faced)	3'-10"	2'-1"	6'-6"
Thrie-Beam (Single and Double Faced)	3'-10"	1'-9"	6'-6"
Timber Deep Post	4'-10"	See Above	7'-6"
Steel Deep Post	6'-4"	See Above	9'-0"

NOTES:

1. GUARDRAIL SECTIONS: Construct Sections as indicated in the plans. The details shown herein depict W-Beam Guardrail, but are applicable to the other defined Guardrail Types placed at the corresponding height, 'H'. Use components per Sheets 4 & 5. Steel and timber post types are interchangeable unless otherwise defined. The 1:10 Max. cross slope shown is the maximum slope permitted for proper guardrail function, but project-specific cross slope requirements are governed per the plans.
2. TYPICAL GRADING & PAVEMENT PLACEMENT DETAIL: Construct features as depicted except where superceded by specific Guardrail Sections or the plans. Place the Slope Break a Minimum of 2' behind the post. For Deep Posts, the slope break may be placed at the ℄ Post with the 2" Miscellaneous Asphalt Pavement omitted.
3. SLOPE BREAK CONDITION: Install Deep Posts only where called for in the plans. Deep Posts are only permitted where post spacing is 6'-3" or less.
4. LATERAL OFFSETS: The Lateral Offsets shown are governed by the station and offset call outs for Face of Guardrail, as shown in the plans.
5. ADJACENT TO CURB: Place the Face of Guardrail consistently offset either flush with the Face of Curb or 5" behind the Face of Curb, as indicated by the plans station and offset callout. For offset changes, transition the Face of Guardrail as shown in the plans.

GUARDRAIL SECTIONS

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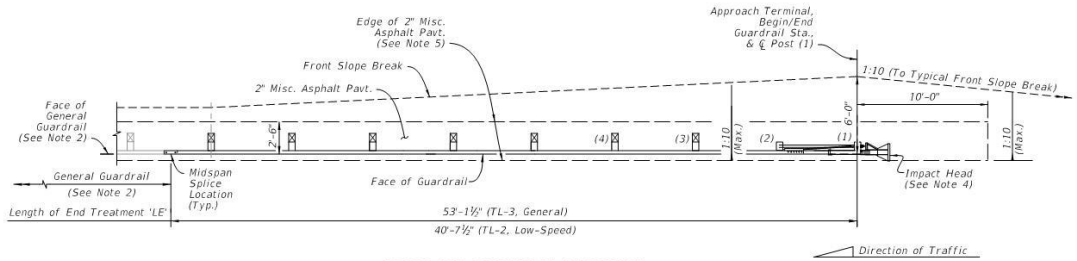


APPROACH TERMINAL ASSEMBLY
'PARALLEL' TYPE - PLAN VIEW

NOTES:

1. INSTALLATION: Locate Approach Terminals where called for in the plans, with the Post (1) ℄ placed at the Begin/End Guardrail Station indicated in the plans.

   The Plan Views shown herein are schematic only, showing basic geometry for Approach Terminals listed on the APL. The predefined Length of End Treatment, 'LE', includes the proprietary portion of various Approach Terminals and provides for more consistent planning of assembly installations across the differing Approach Terminal types. Forward-anchoring style Approach Terminals may vary from the planned lengths shown by up to 3'-0".

   Construct Approach Terminals as shown in the APL and in accordance with the manufacturer's unique drawing details, procedures, and specifications.

   Install posts in accordance with the manufacturer's drawings. The Special Posts on Sheet 23, including Special Steel Posts, Encased Posts, and Frangible Leave-Outs, are not permitted within the Approach Terminal segment unless otherwise called for in the plans.

   Align panel lap splices in accordance with the manufacturer's drawings, regardless of the direction of traffic.

   Install adjacent grading, gutters, and/or curbing as shown herein.

2. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments.

   Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

3. APPROACH TERMINAL TEST LEVEL: Install either a Test Level 3 (TL-3) or Test Level 2 (TL-2) Approach Terminal as specified in the plans. TL-3 Approach Terminals may substitute for TL-2 Approach Terminals unless the substitution is specifically prohibited in the plans. TL-2 Approach Terminals may not substitute for TL-3 installations.

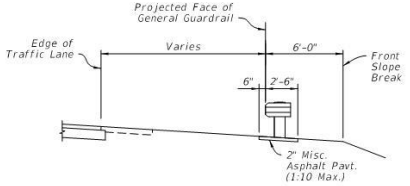
4. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.

5. 2" MISCELLANEOUS ASPHALT PAVEMENT: The Plan View depicts the Unpaved Shoulder condition. For Fully Paved Shoulder and Shoulder Gutter conditions, extend the 2" Misc. Asphalt Pavement as shown in the corresponding 'Section at Post (1)' details below.

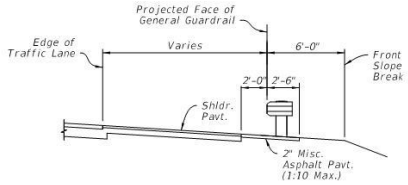
   The 2" Misc. Asphalt Pavement shown upstream of Post (1) may be substituted with a different pavement type where called for in the Plans.

6. CLEAR AREA REQUIREMENT: Do not place any permanent aboveground installations within the areas shown with 1:10 maximum grading. For the finished condition, keep this area free of all aboveground obstructions, including dense vegetation and trees.

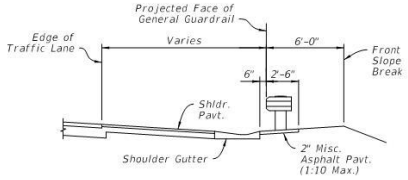
7. 'CURBED' AND 'DOUBLE FACED' GUARDRAIL SEGMENTS: See Sheet 8.



SECTION AT POST (1)
WITH UNPAVED SHOULDER



SECTION AT POST (1)
WITH FULLY PAVED SHOULDER



SECTION AT POST (1)
WITH SHOULDER GUTTER

END TREATMENT -
APPROACH TERMINAL
GEOMETRY - PARALLEL

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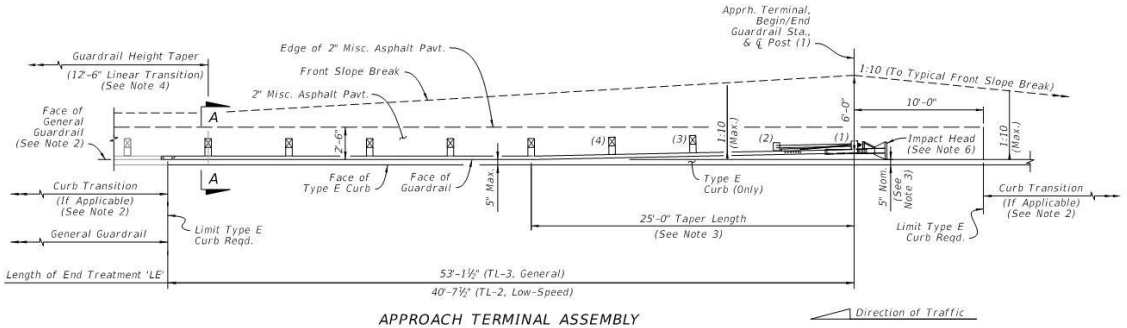
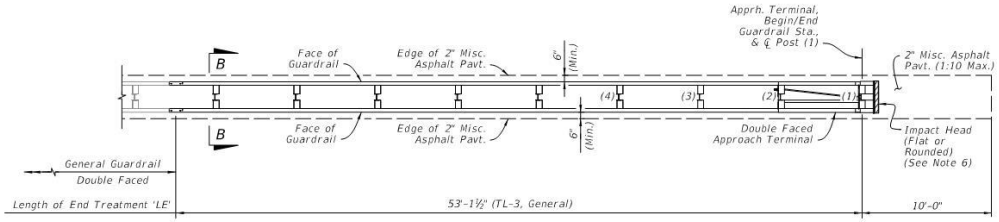
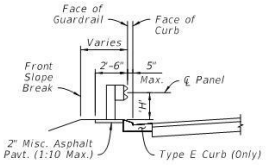


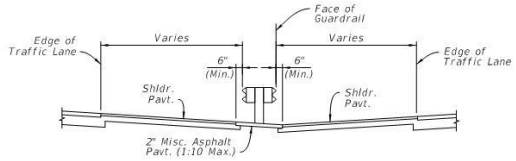
APPROACH TERMINAL ASSEMBLY
'CURBED' SEGMENT - PLAN VIEW



APPROACH TERMINAL ASSEMBLY
'DOUBLE FACED' SEGMENT - PLAN VIEW



'CURBED' SECTION A-A
(Height, 'H', Measured from
Misc. Asphalt Pavt.)



'DOUBLE FACED' SECTION B-B
(1:10 Slope or Flatter Reqd.)

NOTES:

1. GENERAL: See Notes 1 through 3 on Sheet 7.
2. CURBED SEGMENTS: Type E curb is required within the limits shown. When a different curb type is called for outside of the Type E curb limits, transition the curb shape linearly, over a nominal distance ranging 5'-0" to 10'-0".
3. TAPER LENGTH: For Curbed Segments, taper the guardrail away from the roadway where shown to place the inside edge of the Impact Head at 5" behind the face of the curb. Where additional lateral offset is required to fit the Approach Terminal Assembly hardware, such as a soil plate, place the Impact Head as close to the curb as the hardware allows, not to exceed 2'-0" from the face of curb.
4. GUARDRAIL HEIGHT TAPER: For Curbed Segments, the connecting General Guardrail Mounting Height, 'H', is typically measured from the Lip of Gutter (See Sheet 6 Guardrail Sections, 'Adjacent to Curb'), while the End Terminal Assembly 'H' is measured from the Misc. Asphalt Pavt. (See Section A-A). Linearly taper the difference in Mounting Height over a minimum length of 12'-6", starting where indicated herein.
5. DOUBLE FACED SEGMENT: Connect to Double Faced General Guardrail. Use consistent Posts and Offset Block types as specified in the APL drawings over the entire Length of End Treatment, 'LE'. Posts and Offset Blocks in the adjoining General Guardrail segment may be different from those inside of the 'LE'. A change in post type between timber and steel is permitted, immediately outside of the 'LE' segment.

   Maintain the 1:10 maximum grading as shown in Section B-B throughout segment 'LE'. Where required, transition to differing adjacent slopes linearly, over a minimum longitudinal length of 25'-0".
6. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.
7. CLEAR AREA REQUIREMENT: Do not place any permanent aboveground installations within the areas shown with 1:10 maximum grading. For the finished condition, keep this area free of all aboveground obstructions, including dense vegetation and trees.
8. 2" MISCELLANEOUS ASPHALT PAVEMENT: The 2" Misc. Asphalt Pavement shown upstream of Post (1) may be substituted with a different pavement type where called for in the Plans.
9. SINGLE FACED 'PARALLEL' SEGMENTS: See Sheet 7.

END TREATMENT -
APPROACH TERMINAL GEOMETRY
CURBED AND DOUBLE FACED

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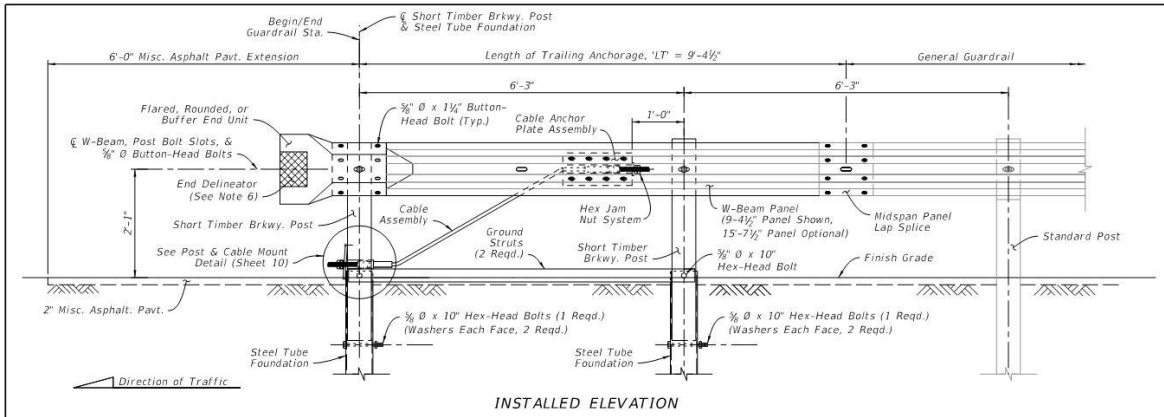
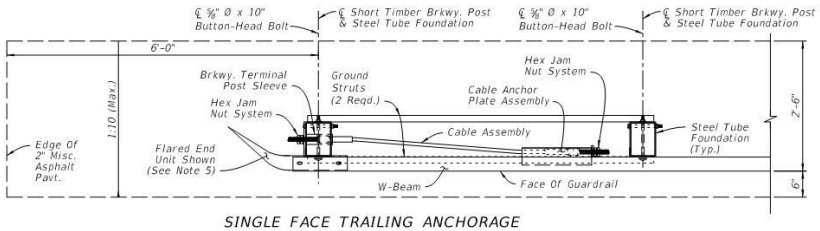
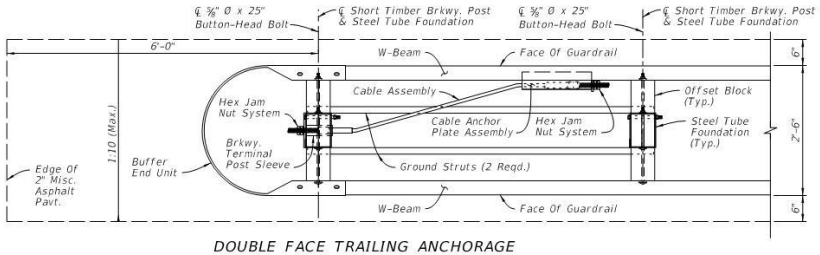


INSTALLED ELEVATION



SINGLE FACE TRAILING ANCHORAGE
INSTALLED PLAN



DOUBLE FACE TRAILING ANCHORAGE
INSTALLED PLAN

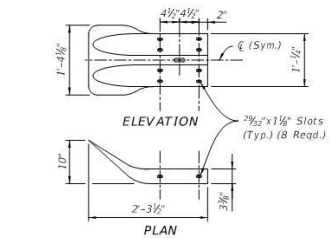
NOTES:

1. COMPONENT DETAILS: For additional component details, See Sheet 10.
2. END UNITS: Use materials for end units as defined in Specifications Section 967. End Units are referred to as "End or Buffer Sections" in AASHTO M180.

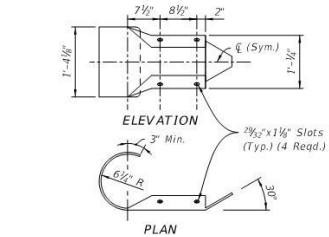
   Lap the Flared End Unit behind the W-Beam; lap the Rounded and Buffered End Units over the face of the W-Beam.
3. FOUNDATIONS: Install Steel Tubes by either of the following methods:

   a. Excavate, backfill, and compact material to provide full passive soil resistance to the surface of the Tube.

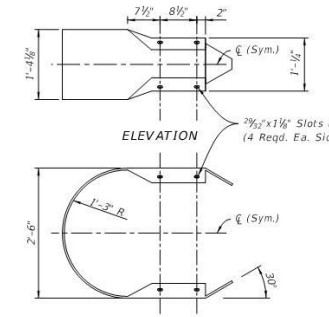
   b. Drive the Tube using a dummy timber post to prevent damage to the Breakaway Post.
4. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.
5. SIDEWALK REQUIREMENTS: When sidewalks are located adjacent to the End Treatment, install a Rounded End Unit (Flared End Unit not permitted for this case).
6. END DELINEATOR: Mount retroreflective sheeting to the approach face of the End Unit in accordance with Specification Sections 536 and 967.



FLARED END UNIT



ROUNDED END UNIT



BUFFER END UNIT

END TREATMENT - TRAILING ANCHORAGE

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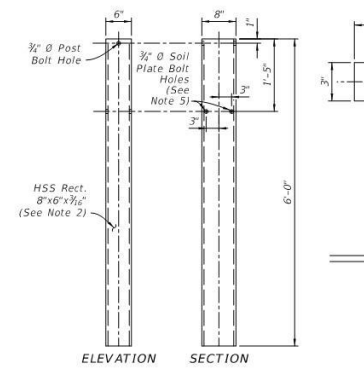
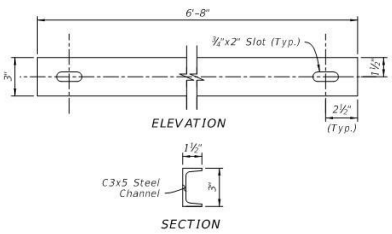
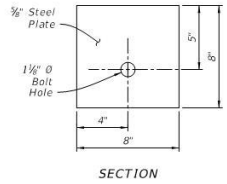


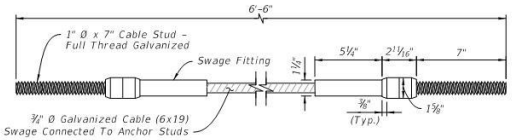
STEEL TUBE FOUNDATION



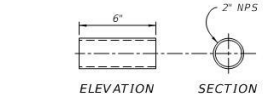
GROUND STRUT



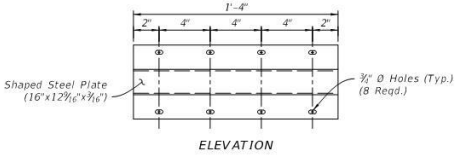
BEARING PLATE

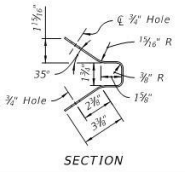


CABLE ASSEMBLY

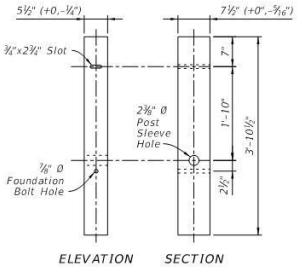


BREAKAWAY TERMINAL POST SLEEVE

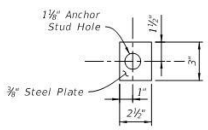




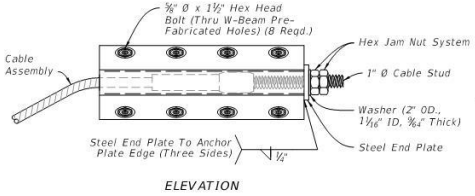
CABLE ANCHOR PLATE

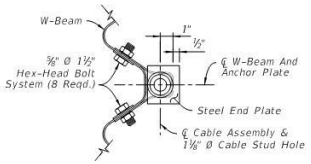


SHORT TIMBER BREAKAWAY POST (6"x8" Nom.)

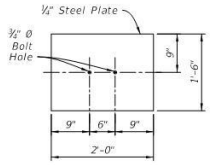


STEEL END PLATE

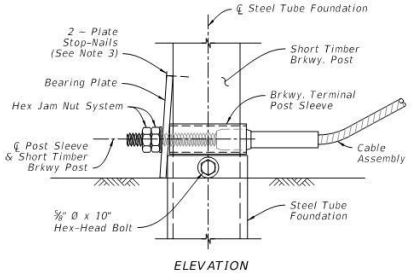




CABLE ANCHOR PLATE ASSEMBLY



SOIL PLATE



POST & CABLE MOUNT ASSEMBLY

NOTES:

1. INSTALLATION: Use components as shown on Sheets 9 & 11.
2. MATERIALS: Use steel plates, channels, and Cable Assemblies in accordance with Specification 967.

   Use Short Timber Breakaway Posts and Steel Tube Foundations in accordance with Specification 536.

   Use Hex Nuts, Hex Jam Nuts, and Washers in accordance with the AASHTO-AGC-ARTBA Guide to Standardized Barrier Hardware with English unit equivalents of components FNX24a and FWC24a, respectively. Two Hex Nuts may be used for the Hex Jam Nut System.
3. PLATE STOP-NAILS: To prevent rotation of the Bearing Plate, drive steel 2½" Type 8d nails with ASTM A153 hot-dip galvanization.
4. CABLE ANCHOR PLATE ASSEMBLY INSTALLATION: Mount to the pre-fabricated Cable Anchor Plate Bolt Holes in the W-Beam Panel, as shown on Sheet 4. These panel holes are only permitted for this Cable Anchor Plate Assembly application.
5. SOIL PLATE BOLT HOLE(S): For Trailing Anchorage installations as shown on Sheet 9, the two bolt holes shown may be substituted with a single bolt hole located at the tube centerline.

END TREATMENT - COMPONENT DETAILS

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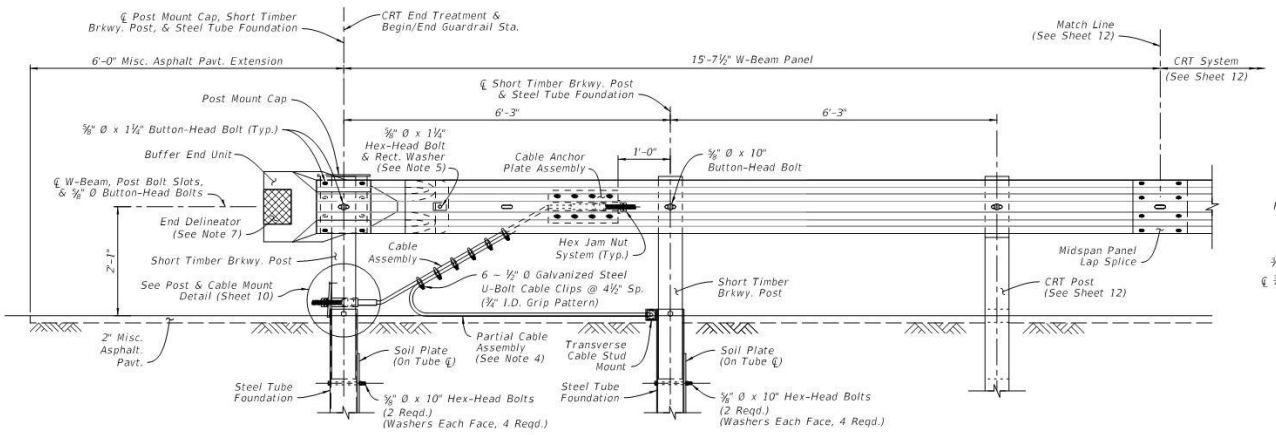
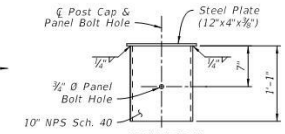
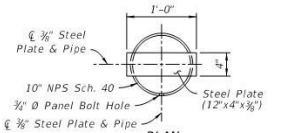


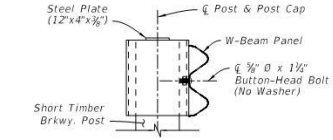
INSTALLED ELEVATION



ELEVATION

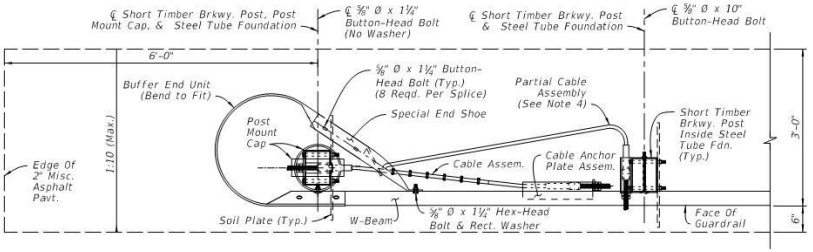


PLAN



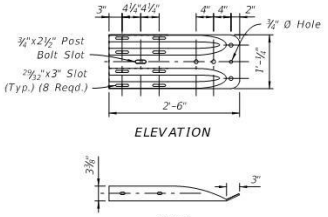
INSTALLED SECTION

POST MOUNT CAP



INSTALLED PLAN

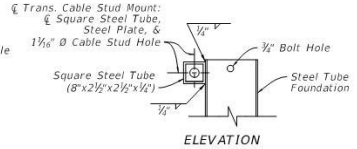
CRT END TREATMENT ASSEMBLY



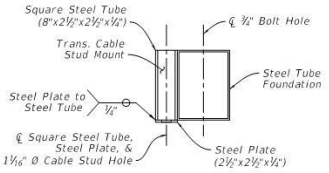
ELEVATION

PLAN

SPECIAL END SHOE



ELEVATION



PLAN

TRANSVERSE CABLE STUD MOUNT

NOTES:

1. INSTALLATION: Use with CRT Systems as required on Sheet 12.
2. COMPONENT DETAILS: For additional component details, See Sheet 10 & 12. For the Rectangular Washer detail, see Sheet 24.
3. MATERIALS: Use steel End Shoes, Plates, Tubes, and pipes in accordance with Specification 967.
4. PARTIAL CABLE ASSEMBLY: The Partial Cable Assembly is similar to the Cable Assembly defined on Sheet 10, except with a 9'-0" total length and the Swage Fitting and Cable Stud omitted from one end.

   Feed the Cable Stud through the Cable Stud Hole of the Transverse Cable Stud Mount as shown, and secure it with the Hex Jam Nut System as defined on Sheet 10.
5. SPECIAL END SHOE MOUNT: Punch a ¾" Ø hole in the W-Beam Panel as needed to secure the Special End Shoe with the ⅜" Ø Hex-Head Bolt. Galvanize hole per Specification 562.
6. FOUNDATIONS: Install Steel Tubes with attached Soil Plates by either of the following methods:

   a. Excavate, backfill, and compact material to provide full passive soil resistance to all surfaces of the tube and soil plate.

   b. Drive the steel tube and soil plate as a single unit using a dummy timber post to prevent damage to the breakaway post.
7. END DELINEATOR: Mount retroreflective sheeting to the approach face of the Buffer End Unit in accordance with Specifications 536 and 967.

END TREATMENT - CONTROLLED RELEASE TERMINAL (CRT) SYSTEM

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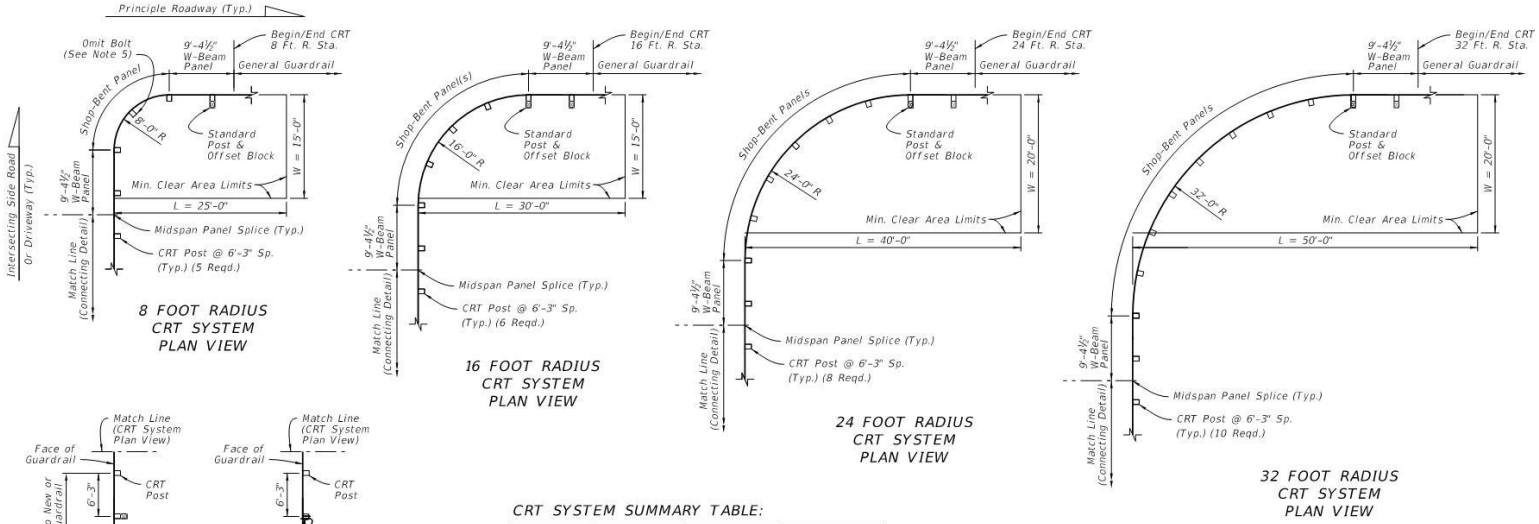
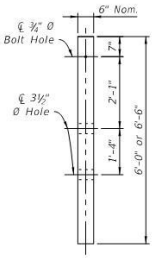


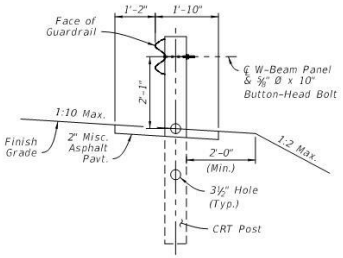
CONNECTING DETAIL

CRT SYSTEM SUMMARY TABLE:

RETURN RADIUS (FT.)	LENGTH OF SHOP-BENT PANEL(S) (FT.)	QUANTITY OF CRT POSTS	AREA CLEAR OF HAZARDS 'L' x 'W' (FT.)
8	12.5	5	25 x 15
16	25.0	6	30 x 15
24	37.5	8	40 x 20
32	50.0	10	50 x 20



CRT POST ELEVATION (6"x8" Nom. Timber)



CRT INSTALLED SECTION

NOTES:

1. INSTALLATION: Construct the specified radius layout and Connecting Detail option as shown in the plans.
2. MIN. CLEAR AREA: Keep the area behind the CRT free of fixed objects and aboveground hazards within the Min. Clear Area limits shown. Maintain a slope not steeper than 1:10 for a minimum 2' behind the posts, and maintain a slope not steeper than 1:2 beyond 2' from the posts.
3. APPROACH GRADING: Maintain grading on the roadway side of the guardrail face at a maximum slope of 1:10.
4. MATERIALS: For CRT Posts, use Timber Post material in accordance with Specification 967. Use steel panels and hardware in accordance with Specification 967.
5. BOLT OMISSION: For the 8 Foot Radius CRT System only, do not place a panel-to-post mount bolt at the center CRT Post (omit the ⅞" Button-Head Bolt only at the location shown).
6. SHOP-BENT PANELS: Install Shop-Bent panel(s) where indicated using 12'-0" or 25'-0" W-Beam Panels. Splice at post locations within the CRT radius using the General configuration of ⅞" Ø Button-Head Bolts (8 reqd. per splice).
7. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

LAYOUT FOR CONTROLLED RELEASE TERMINAL (CRT) SYSTEMS - SIDE ROADS AND DRIVEWAYS

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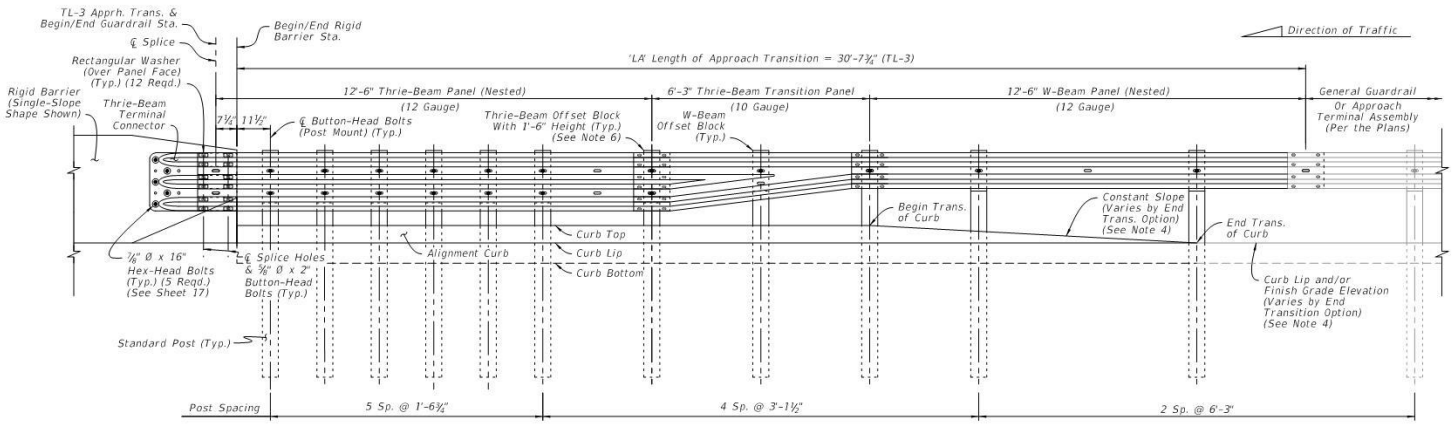
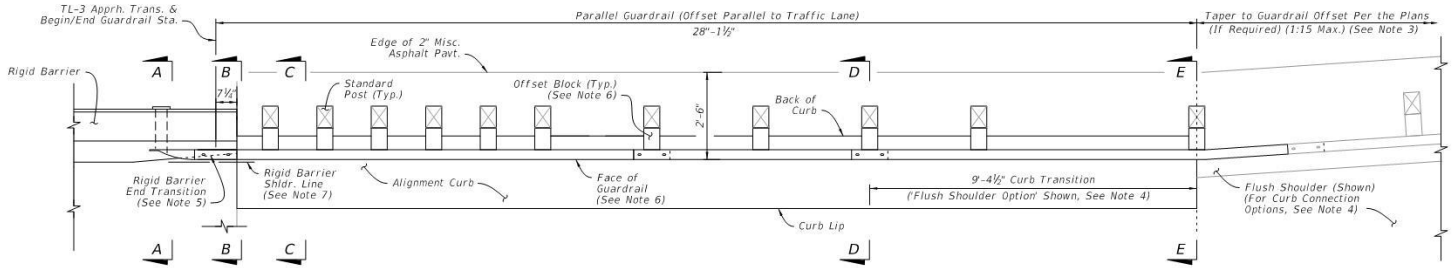
LAST REVISION	REVISION	DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
11/01/19					536-001	12 of 24



TL-3 APPROACH TRANSITION INSTALLED ELEVATION



TL-3 APPROACH TRANSITION INSTALLED PLAN

NOTES:

1. *INSTALLATION: Construct the Approach Transition segment where indicated in the plans. For example Layouts showing the Approach Transition's fit among other guardrail segments, see Sheet 19.*

   For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.

2. *SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.*

3. *GUARDRAIL TAPER: The connecting guardrail may require a different lateral offset if shown in the plans. At the location shown herein, taper the guardrail to the connecting guardrail offset. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.*

4. *END TRANSITION OF CURB OPTIONS: The Plan and Elevation views depict an example Curb Transition to Flush Shoulder from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option shown in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flush Shoulder Option'). See Sheet 14 for additional curb options and Sheet 17 for curb shape details.*

5. *RIGID BARRIER END TRANSITION: Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.*

6. *OFFSET BLOCKS: For Thrie-Beam post locations within the Length of Approach Transition segment, use the Timber Offset Blocks with 1'-6" height shown on Sheet 5.*

   For the midspan of the Thrie-Beam Transition Panel and for all other W-Beam locations shown herein, use the W-Beam Offset Blocks with 1'-2" height.

7. *OFFSET: The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.*

8. *GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.*

APPROACH TRANSITION CONNECTION TO RIGID BARRIER - GENERAL, TL-3

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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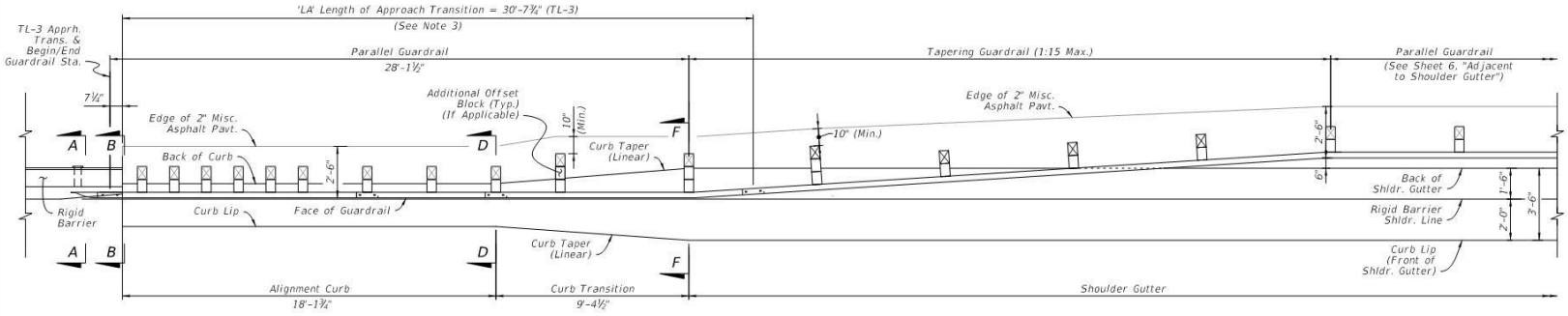
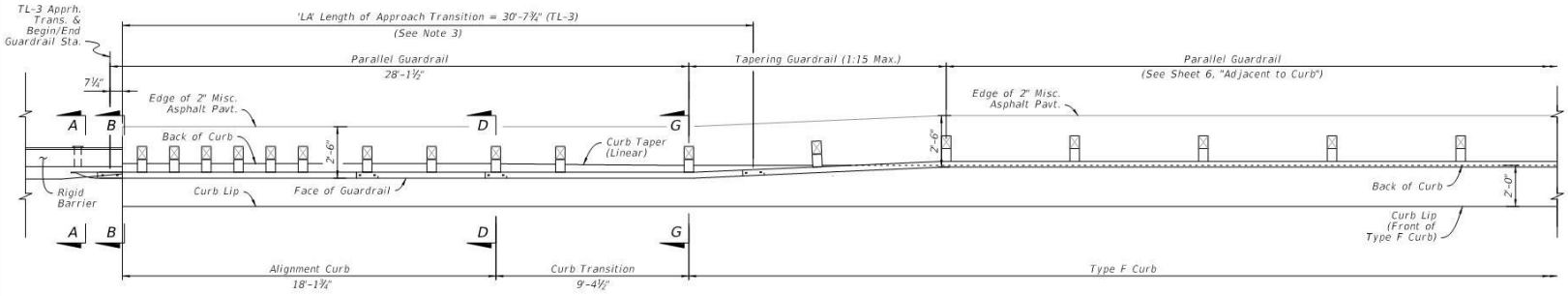


TL-3 APPROACH TRANSITION
WITH 'SHOULDER GUTTER'
CONNECTION - PLAN VIEW



TL-3 APPROACH TRANSITION
WITH 'TYPE F CURB'
CONNECTION - PLAN VIEW

NOTES:

1. GENERAL: See the applicable notes and details on Sheet 13.
2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
3. ELEVATION VIEW: For post and panel installation details within 'LA', see the elevation view on Sheet 13. The curb details will differ depending on curb option required.

APPROACH TRANSITION CONNECTION
TO RIGID BARRIER - GENERAL, TL-3
CURB CONNECTIONS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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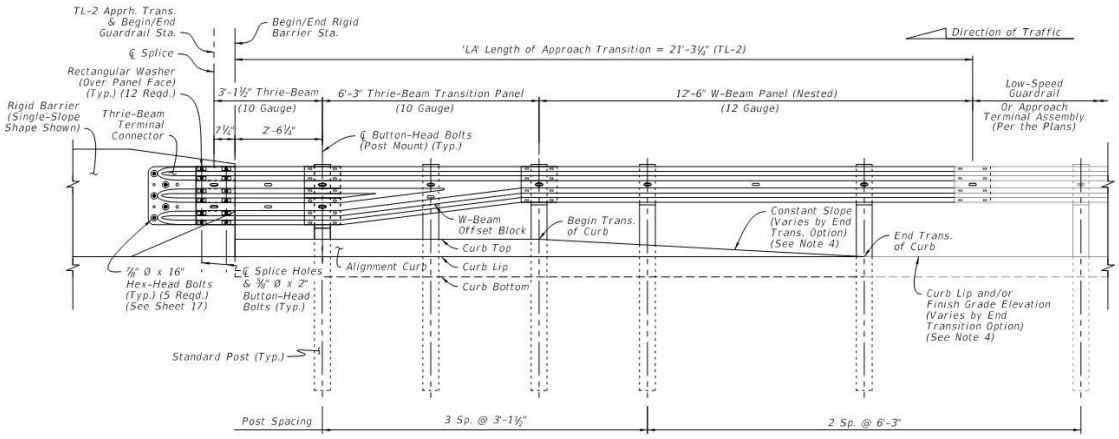
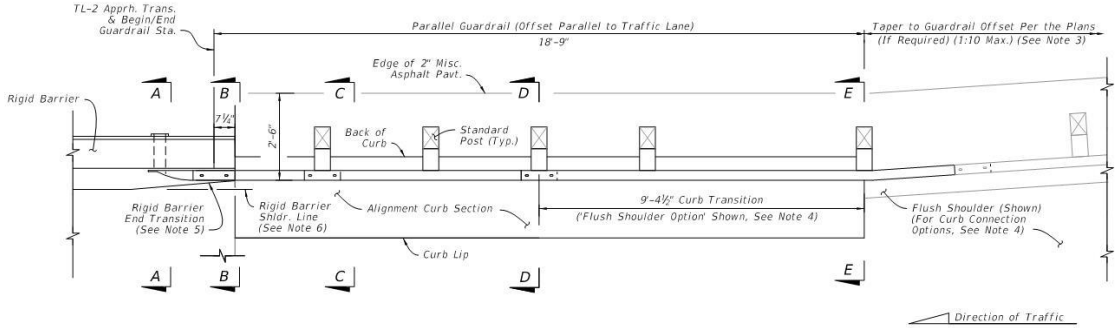


TL-2 APPROACH TRANSITION
INSTALLED ELEVATION



TL-2 APPROACH TRANSITION
INSTALLED PLAN

NOTES:

1. *INSTALLATION: Construct the Approach Transition segment where indicated in the plans. For example Layouts showing the Approach Transition's fit among other guardrail segments, see Sheet 19.*

   For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.

2. *SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.*

3. *GUARDRAIL TAPER: The connecting guardrail may require a different lateral offset if shown in the plans. At the location indicated herein, taper the guardrail to the connecting guardrail offset. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.*

4. *END TRANSITION OF CURB OPTIONS: The Plan and Elevation views depict an example Curb Transition to Flush Shoulder from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option shown in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flush Shoulder Option'). See Sheet 16 for additional curb options and Sheet 17 for curb shape details.*

5. *RIGID BARRIER END TRANSITION: Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.*

6. *OFFSET: The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.*

7. *GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.*

APPROACH TRANSITION CONNECTION
TO RIGID BARRIER - LOW-SPEED, TL-2

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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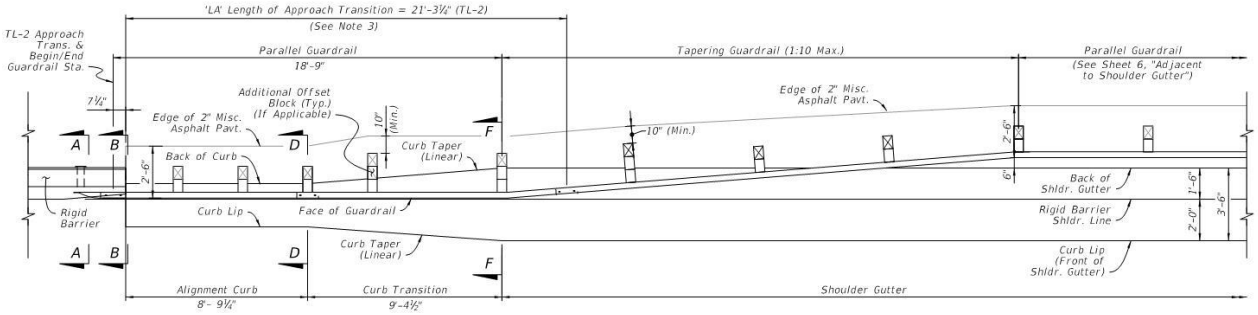
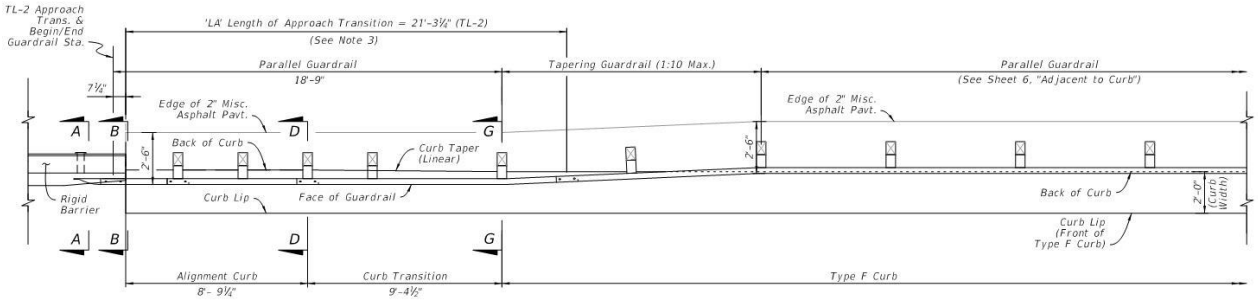


TL-2 APPROACH TRANSITION WITH 'SHOULDER GUTTER' CONNECTION - PLAN VIEW



TL-2 APPROACH TRANSITION WITH 'TYPE F CURB' CONNECTION - PLAN VIEW

NOTES:

1. GENERAL: See the applicable notes and details on Sheet 15.
2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
3. ELEVATION VIEW: For post and panel installation details within 'LA', see the elevation view on Sheet 15. The curb details will differ depending on curb option required.

APPROACH TRANSITION CONNECTION TO RIGID BARRIER - LOW-SPEED, TL-2 CURB CONNECTIONS

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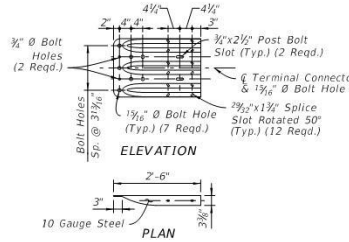
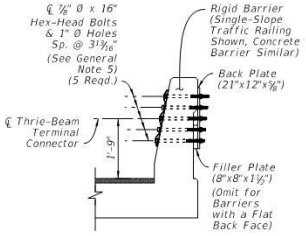
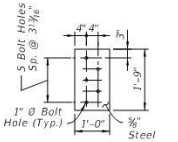


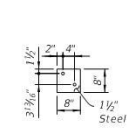
THRIE-BEAM TERMINAL CONNECTOR DETAIL



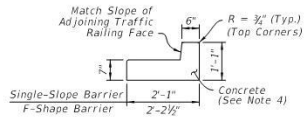
SECTION A-A
RIGID BARRIER TERMINAL CONNECTOR MOUNT



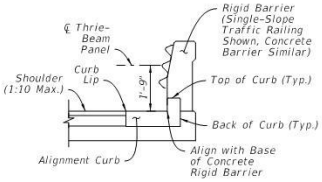
BACK PLATE



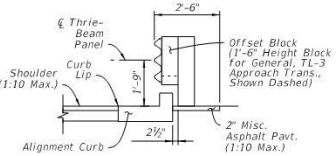
FILLER PLATE



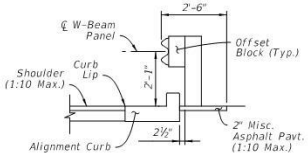
ALIGNMENT CURB SECTION



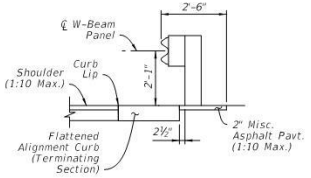
SECTION B-B
BEGIN ALIGNMENT CURB
(Mate to Rigid Barrier)



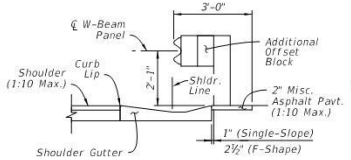
SECTION C-C
ALIGNMENT CURB
(Intermediate)



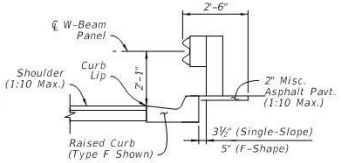
SECTION D-D
BEGIN TRANSITION
(End Alignment Curb)



SECTION E-E
END TRANSITION
FLUSH SHOULDER OPTION

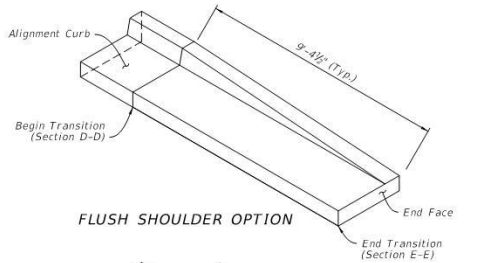


SECTION F-F
END TRANSITION
SHOULDER GUTTER OPTION

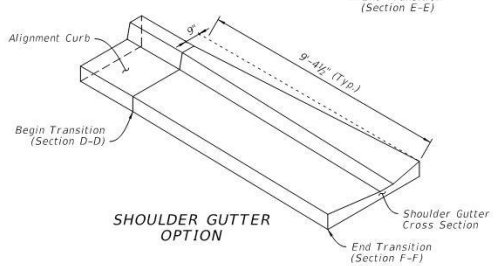


SECTION G-G
END TRANSITION
RAISED CURB OPTION

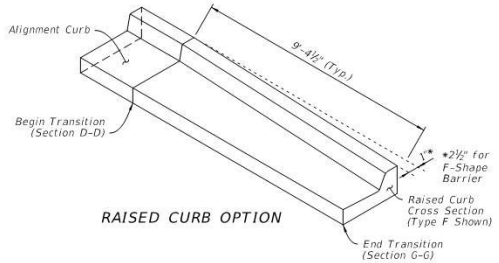
CURB TYPICAL SECTIONS



FLUSH SHOULDER OPTION



SHOULDER GUTTER OPTION



RAISED CURB OPTION

CURB TRANSITION ISOMETRIC VIEWS

NOTES:

1. PLAN AND ELEVATION VIEWS: Work with Sheets 13 thru 16.
2. END TRANSITION OF CURB OPTION: Install one of the three End Transition types shown per Section E-E as indicated by the plans.
3. GRADING BEHIND POSTS: Place Slope Break a Min. 2'-0" behind the post, per Sheet 6.
4. MATERIALS & CONSTRUCTION: Construct the concrete Aligning Curb and Curb transition in accordance with Specification 520. Use steel Plates and Thrie-Beam Terminal Connectors in accordance with Specification 967.

APPROACH TRANSITION CONNECTION - DETAILS

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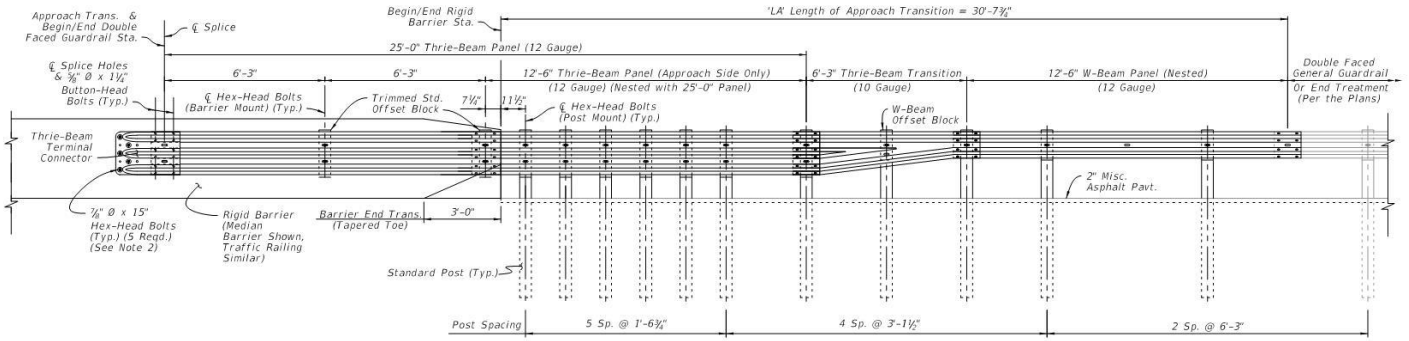
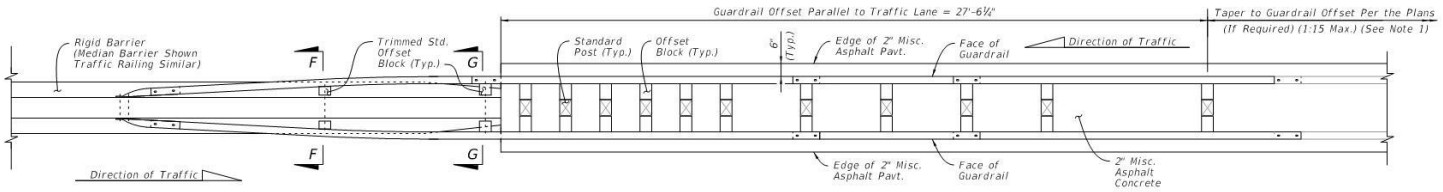


TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED ELEVATION



TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED PLAN

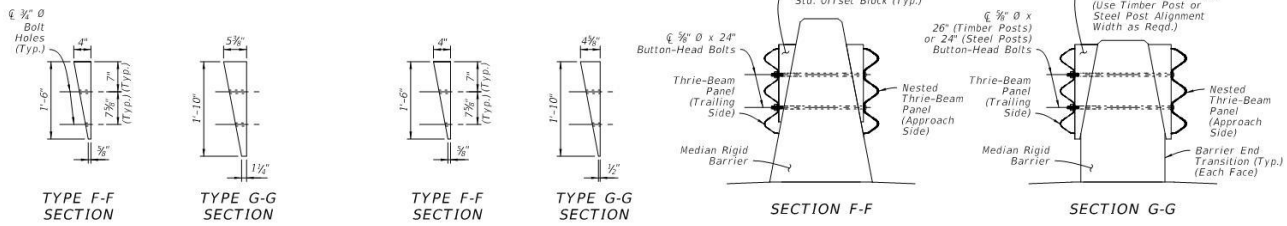
NOTES:

1. INSTALLATION: Construct the Approach Transition segment where indicated in the plans. The required offset of the connecting adjacent guardrail is shown in the plans.

   The Layout given on Sheet 20 provides a basic scheme for connections to adjacent guardrail, where a taper to a differing guardrail offset may be required. If the adjacent guardrail has the same offset as the Approach Transition segment, then no taper is required.

2. THRIE-BEAM TERMINAL CONNECTOR: See Sheet 17 for Details. The installed bolt's threaded portion is not permitted to extend beyond ¾" from the face of the nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.

3. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. End Treatments or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.



APPROACH TRANSITION CONNECTION TO
RIGID BARRIER WITH DOUBLE FACED GUARDRAIL

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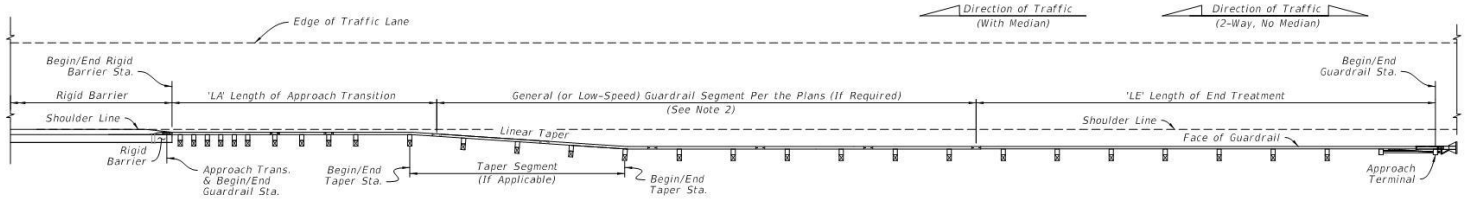
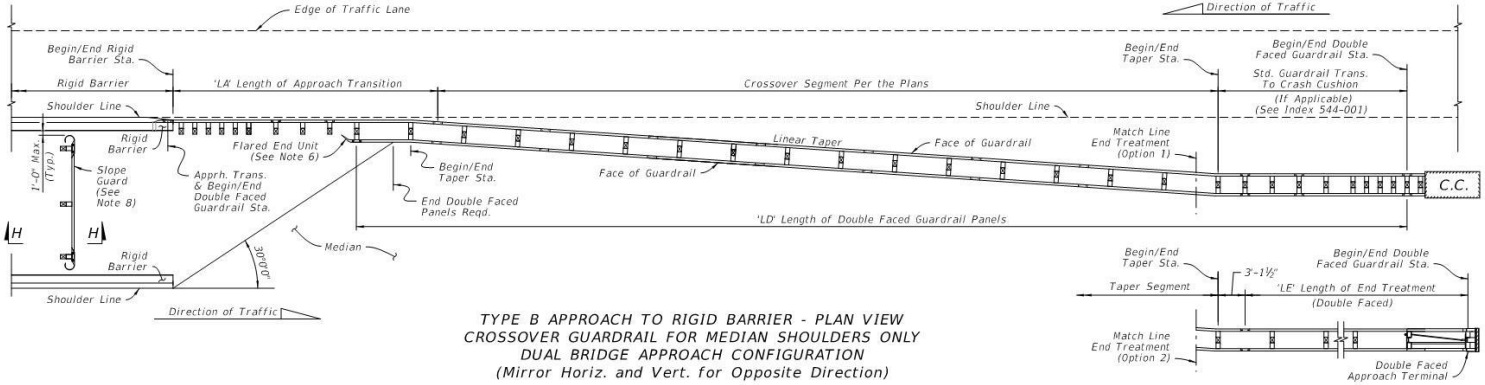
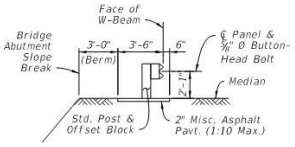


TYPE A APPROACH TO RIGID BARRIER - PLAN VIEW
MEDIAN OR OUTSIDE SHOULDERS
(Mirror Horiz. and/or Vert. for Opposite Direction and/or Side of Road)



TYPE B APPROACH TO RIGID BARRIER - PLAN VIEW
CROSSOVER GUARDRAIL FOR MEDIAN SHOULDERS ONLY
DUAL BRIDGE APPROACH CONFIGURATION
(Mirror Horiz. and Vert. for Opposite Direction)



SECTION H-H
BRIDGE ABUTMENT
SLOPE GUARD
(Between Bridges)

NOTES:

1. *INSTALLATION: The Plan Views shown are schematic only, showing example geometry for connecting guardrail segments including taper locations and Double Faced Guardrail requirements as applicable. Work this Sheet with the plans, where stationing and offsets for Begin/End Guardrail, Begin/End Rigid Barrier, and Begin/End Taper are specified. For existing bridge layouts, see Index 536-002, 521-404, and 521-405.*

2. *GENERAL (OR LOW-SPEED) GUARDRAIL SEGMENT: Construct this segment if shown in the plans. For the case where this segment's offset differs from the Approach Transition offset, linearly taper the guardrail between the Begin/End Taper Stations and offsets as specified in the plans.*

   For the shortest length case of a direct connection between the End Treatment and the Approach Transition, this segment may be omitted as shown in the plans.

3. *LENGTH OF APPROACH TRANSITION 'LA': Install the applicable Approach Transition as shown per Sheets 13 thru 16, where called for in the plans.*

4. *LENGTH OF END TREATMENT 'LE': Install the Approach Terminal End Treatment as shown per Sheet 7 or 8, where called for in the plans. Use the corresponding APL drawings for construction details.*

5. *CROSSOVER GUARDRAIL (FOR TYPE B APPROACH): Install the Crossover Segment tapering linearly from the Begin Taper Sta. and offset to the End Taper Sta. and offset as specified in the plans.*

6. *LENGTH OF DOUBLE FACED GUARDRAIL PANELS, 'LD' (FOR TYPE B APPROACH): Terminate the Double Faced Guardrail panels as shown (based upon the 30° line measured from the hazard on the opposite side of the median). Extend the panel segment longer than the dimension 'LD' as needed for the Panel's end Bolt Slot to align with a post Bolt hole.*

   Install a Flared End Unit where shown, as defined on Sheet 9.

7. *END TREATMENT OPTIONS (FOR TYPE B & C APPROACH): For Double Faced applications, use either a Double Faced Approach Terminal Assembly per Sheet 8 or a Crash Cushion per Index 544-001. For either Option, meet the 1:10 adjacent grading requirements for Approach Terminals as shown on Sheet 8.*

8. *SLOPE GUARD: Where indicated in the plans, install a Guardrail segment between bridge approaches and offset from the bridge abutment's Slope Break as shown. Install posts at the end bolt slots of the panel system. Use post spacing of either 3'-1½" or 6'-3", as needed to correctly fit system between barriers. The system may also be lengthened to fit by installing two Rounded End Units as defined on Sheet 9.*

LAYOUT TO RIGID BARRIER - APPROACH ENDS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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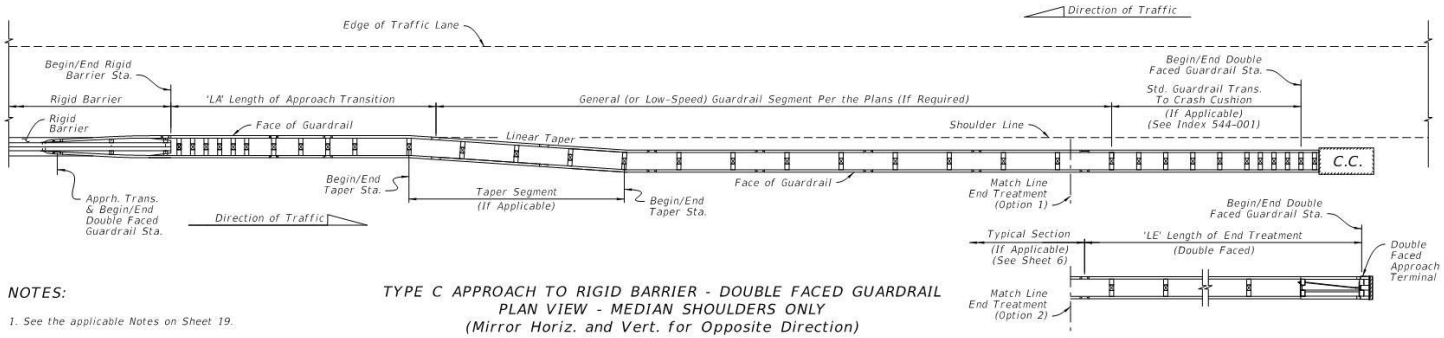
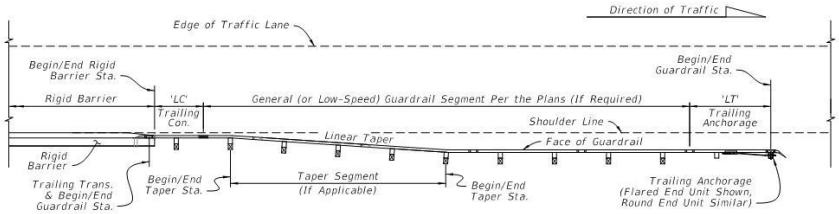


NOTES:

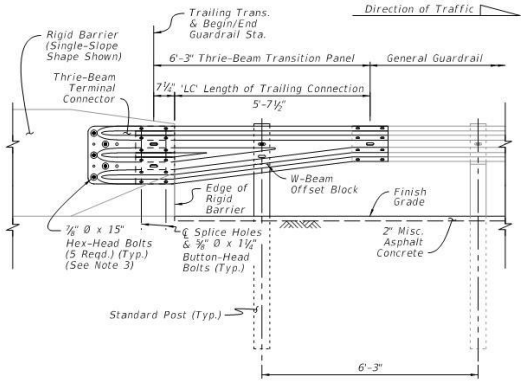
1. See the applicable Notes on Sheet 19.

TYPE C APPROACH TO RIGID BARRIER - DOUBLE FACED GUARDRAIL
PLAN VIEW - MEDIAN SHOULDERS ONLY
(Mirror Horiz. and Vert. for Opposite Direction)

LAYOUT TO RIGID BARRIER - APPROACH ENDS WITH DOUBLE FACED GUARDRAIL



TYPE D TRAILING CONNECTION FROM RIGID BARRIER
PLAN VIEW - MEDIAN OR OUTSIDE SHOULDER
(Mirror Horiz. and/or Vert. for Opposite Direction and/or Side of Road)



TRAILING END TRANSITION CONNECTION
TO RIGID BARRIER - INSTALLED ELEVATION

NOTES:

1. See the applicable Notes on Sheet 19.
2. LENGTH OF TRAILING ANCHORAGE, 'LT': Install the Trailing Anchorage as shown on Sheet 9, where called for in the plans.
3. THRIE-BEAM TERMINAL CONNECTOR: Install connector and bolts as shown on Sheet 17.
4. RIGID BARRIER SINGLE SLOPE END FACE: See Concrete Barrier Wall, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-423, for details.

LAYOUT TO RIGID BARRIER - TRAILING ENDS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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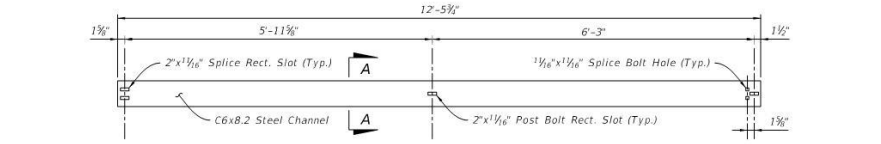
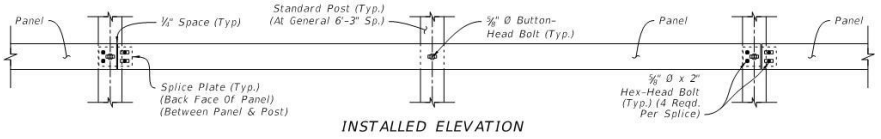
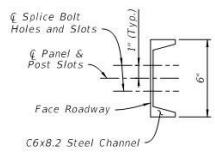
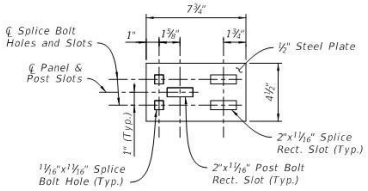




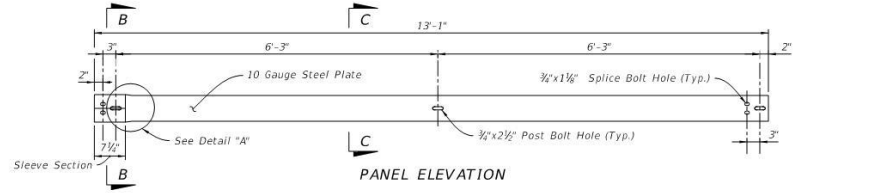


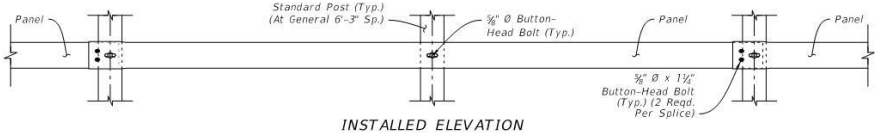
SECTION A-A
(Panel Typical)

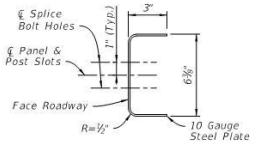


SPLICE PLATE
ELEVATION

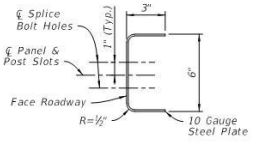
CHANNEL SECTION RUB RAIL



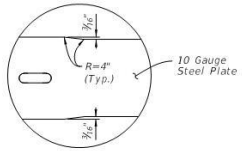




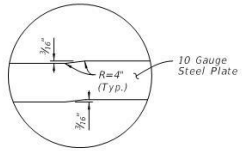
SECTION B-B
(Panel Sleeve End)



SECTION C-C
(Panel Typical)

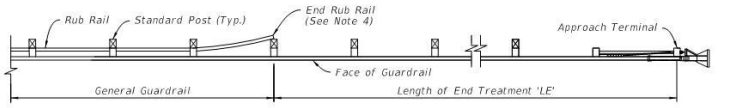


DETAIL "A"
(Sleeve Transition Elevation)



DETAIL "B"
(Sleeve Transition Plan)

BENT-PLATE PANEL RUB RAIL



RUB RAIL TERMINATION - SCHEMATIC PLAN VIEW

NOTES:

1. GENERAL: Install Rub Rail where called for in the plans. Position as shown on Sheet 6 unless otherwise shown in the plans. Install the backs of Rub Rail panels flush against Standard Posts. Either of the Channel Section or Bent-Plate Panel Rub Rail options may be used (consistent type per project). Where Double Sided Rub Rail is called for, thread the Button-Head Bolt through the Post Bolt Hole(s) and the panels on either side, and tighten the nut against the face of the panel farthest from adjacent traffic lanes. Trim the bolt's threaded portion in accordance with Note 4 on Sheet 5.
2. MOUNTING HEIGHT: Mount to the Standard Post's Rub Rail Bolt Hole as defined on Sheet 5.
3. MATERIALS: Use steel components in accordance with Specification 967.
4. END RUB RAIL: For Single Sided Rub Rail, terminate the run of Rub Rail by bending the panel behind the post and securing in place (as shown). For Double Sided Rub Rail, terminate the runs of Rub Rail on their respective front face of the post and secure with the typical Button-Head bolt.

RUB RAIL DETAILS

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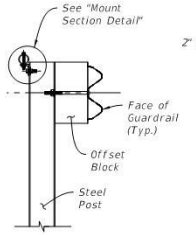
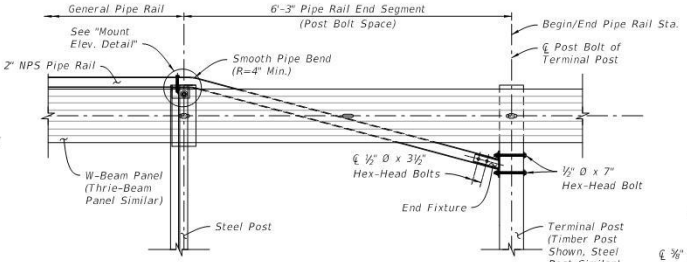
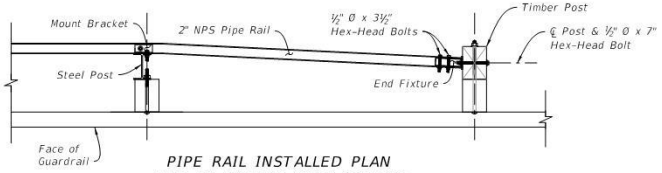


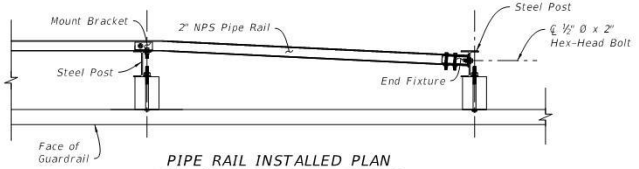
GENERAL PIPE RAIL SECTION



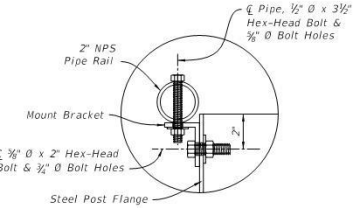
PIPE RAIL INSTALLED ELEVATION
(End Segment Shown)



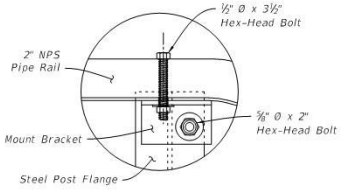
PIPE RAIL INSTALLED PLAN
END AT TIMBER POST OPTION



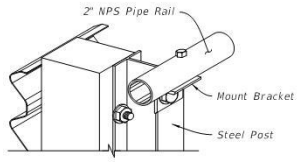
PIPE RAIL INSTALLED PLAN
END AT STEEL POST OPTION



MOUNT SECTION DETAIL



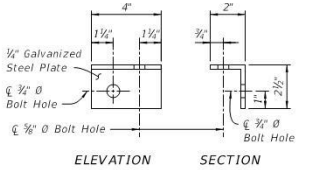
MOUNT ELEVATION DETAIL
(Back View - Mirrored)



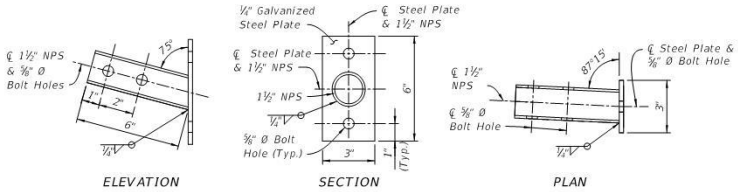
MOUNT ISOMETRIC
CUT-AWAY

NOTES:

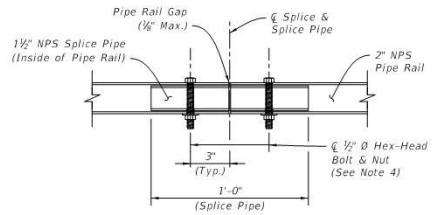
1. GENERAL: Install General Pipe Rail where indicated in the plans or when existing sidewalks or shared use paths are located less than 4'-0" from the back of Steel Posts as shown on Sheet 6.
2. PIPE RAIL END SEGMENTS: Place End Segments on both ends of General Pipe Rail runs, with End Fixtures mounted to Terminal Posts located outside of Approach Terminal Assembly ('LE'), Trailing Anchorage Assembly ('LT'), and Approach Transition ('LA') segments.
3. MATERIALS: Use steel brackets, fixtures, and pipes in accordance with Specification 967.
4. RAIL SPLICES: Install Rail Splices to join pieces of 2" NPS Pipe Rail into a continuous system. Place splices as needed, at a spacing of 18'-0" or greater. Orient the head of bolt on the top of the pipe.



MOUNT BRACKET DETAIL



END FIXTURE DETAIL



RAIL SPLICE DETAIL

PEDESTRIAN SAFETY TREATMENT - PIPE RAIL

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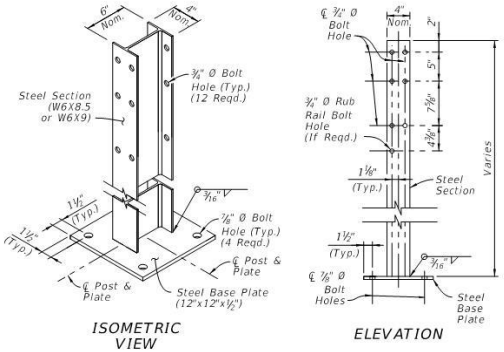
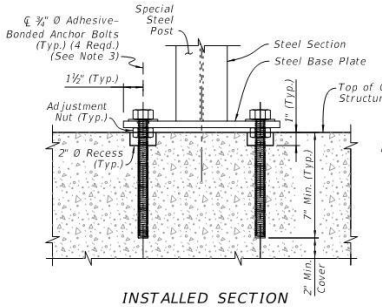
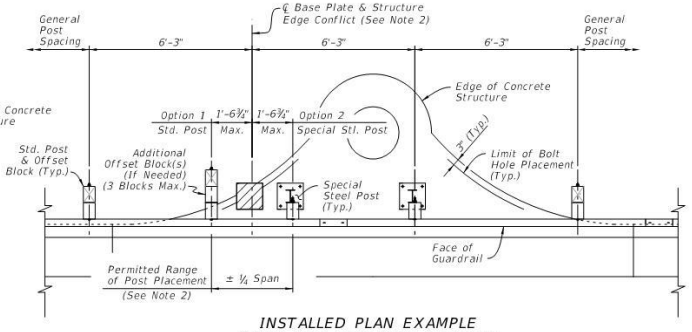


ISOMETRIC VIEW

ELEVATION



INSTALLED SECTION (Option 2, Special Post)



INSTALLED PLAN EXAMPLE (Curb Inlet Top Type 2 Shown)

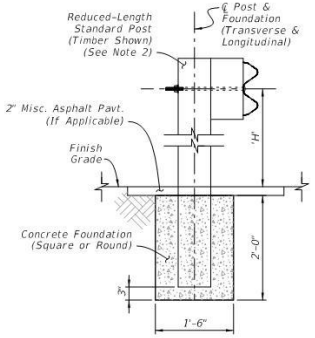
SPECIAL STEEL POST

STRUCTURE MOUNTING

NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) located atop culverts, inlets, pier footings, or similar concrete structures, a Special Steel Post may be substituted for a Standard Post. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
2. EDGE CONFLICT: When a required post location causes an Edge Conflict with the structure, where the Steel Base Plate is not located entirely on the structure at least 3" from the Edge of Concrete, the longitudinal post location may be altered by up to 1'-6¾" (Quarter Span) from the original required spacing location to prevent the Edge Conflict. With the post location adjusted, use a Std. Post mounted in soil (Option 1) or a Special Steel Post with its Base Plate mounted entirely on the structure (Option 2). Maintain the original required spacing locations upstream and downstream of the structure.
3. BASE PLATE MOUNT: Install Special Steel Posts as shown using steel Adhesive-Bonded Anchor Bolts in accordance with Specification 536. Use ¾" Hex-Head Bolts for structures less than 9" deep as defined in the Specification.
4. PANEL MOUNT TO ADJUSTED POST: Punch additional ⅞"x2½" Post Bolt Slot(s) in the W-Beam or Thrie-Beam Panel only where needed to mount the panel to a post in an adjusted location. Meet the Panel Post Bolt Slots requirements of Specification 536.
5. MATERIALS: Use steel base plates in accordance with Specification 536.

SPECIAL STEEL POST FOR CONCRETE STRUCTURE MOUNT

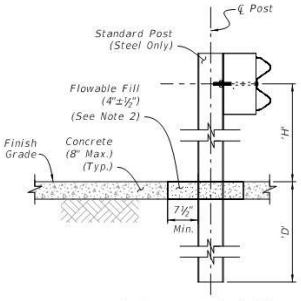


INSTALLED SECTION

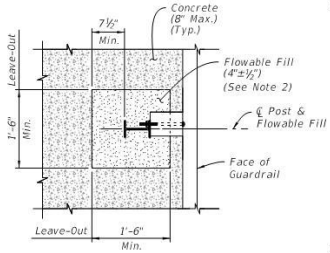
NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) conflicting with underground utilities or other underground obstructions, an Encased Post may be used where a 2'-0" depth will avoid the conflict. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
2. REDUCED-LENGTH STANDARD POST: Use a Standard Post with reduced Length such that the Panel Height 'H' is maintained while the post bottom terminates 3" from the bottom of the Concrete Foundation. Typically, the Post Length 'L' is 4'-7" for W-Beam Guardrail.
3. FOUNDATION: Use non-reinforced Class NS Concrete material in accordance with Specification 347. After casting the concrete, ensure the surrounding soil material is completely backfilled and tamped to provide full passive resistance.
4. LIMIT: Encased Posts are not permitted for more than 3 consecutive posts.

ENCASED POST FOR SHALLOW MOUNT



INSTALLED SECTION



INSTALLED PLAN

NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) placed within a concrete surface (typically a sidewalk), use a Frangible Leave-Out around the post base as shown. Install where shown in the plans and/or as-needed, in accordance with Specification 536.

   Use Standard steel posts. Timber posts are not permitted for frangible leave-outs.

   For the required 1'-6" x 1'-6" Leave-Out, smoothly cut the existing concrete surface or form-up the square shape when an application has new surrounding concrete.

   Ensure Flowable Fill surface is smooth and even with the adjacent concrete surface.
2. MATERIALS: Use Non-Excavatable Flowable Fill in accordance with Specification 121, not to exceed 150 psi.

FRANGIBLE LEAVE-OUT FOR CONCRETE SURFACE MOUNT

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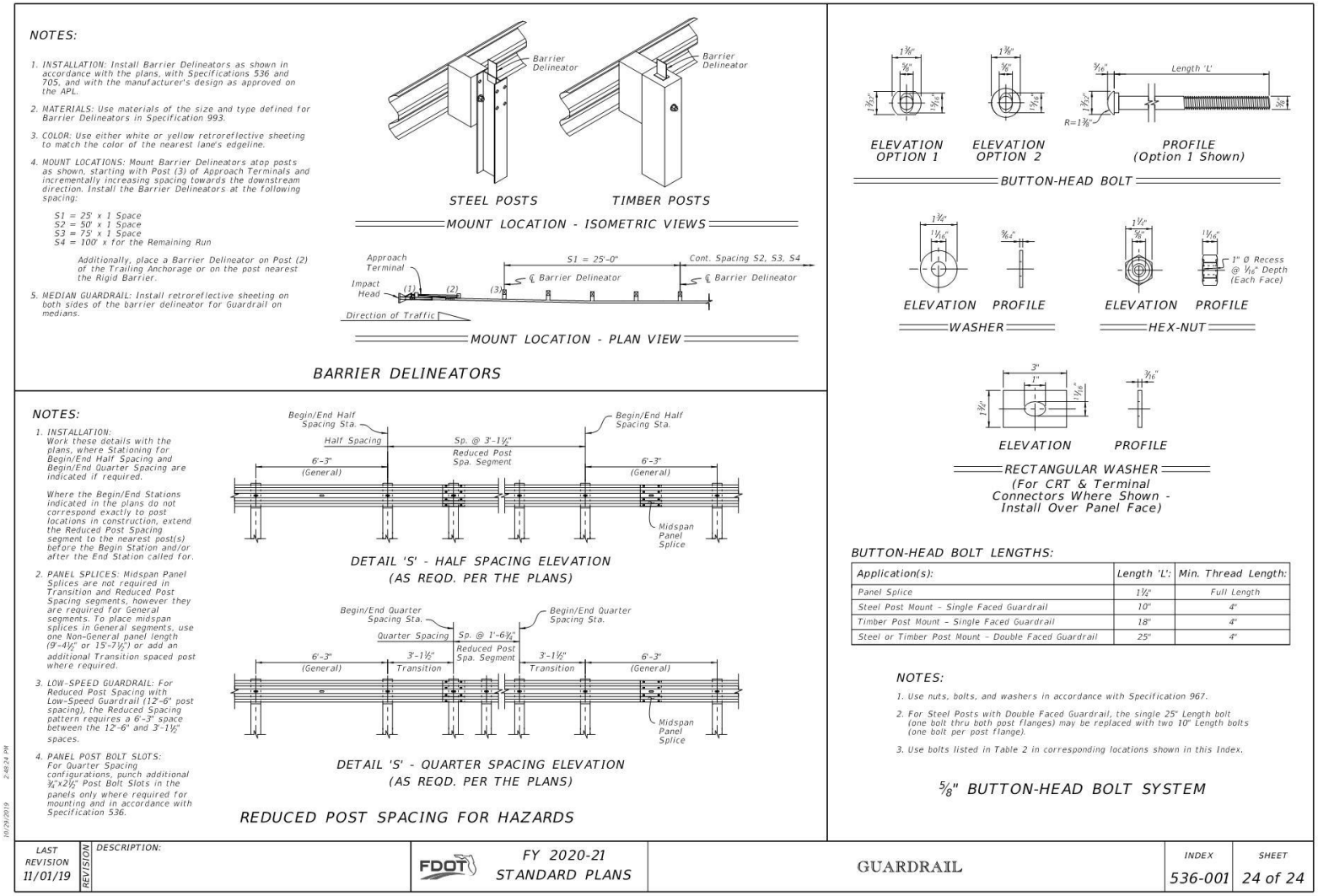
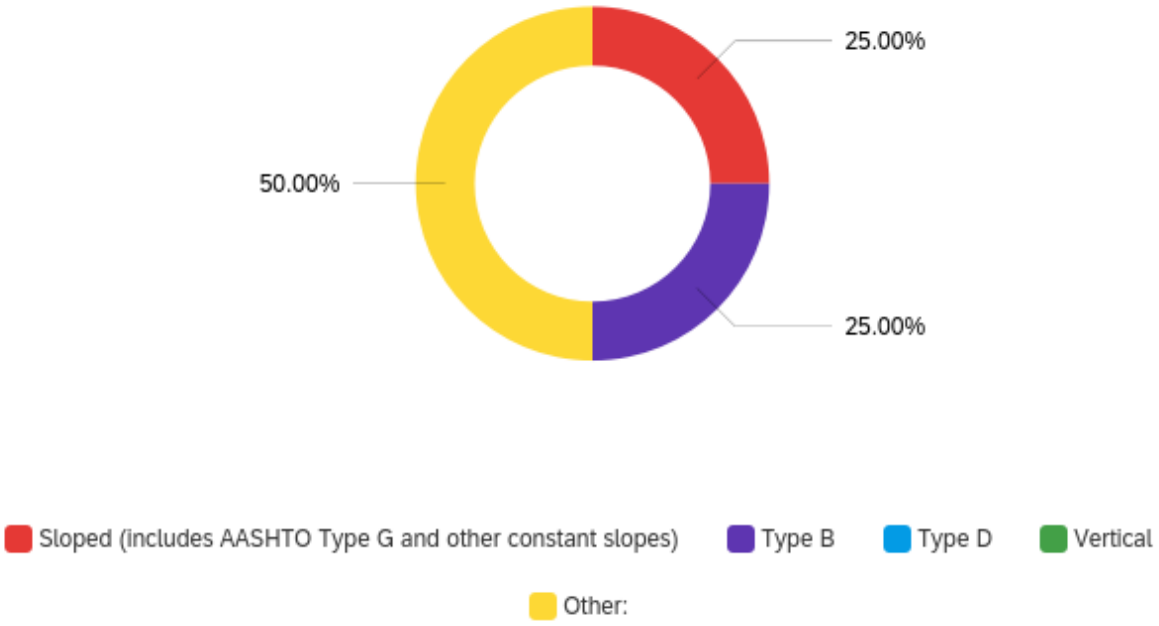


Q80 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No responses provided.

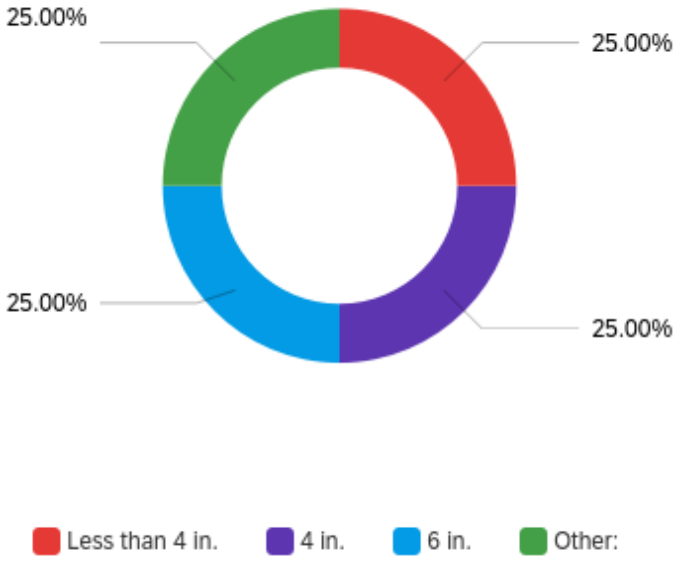
Q83 - What curb shape does your agency use at sites with w-beam guardrail terminals?



Answer	%	Count
Sloped (includes AASHTO Type G and other constant slopes)	25.00%	1
Type B	25.00%	1
Type D	0.00%	0
Vertical	0.00%	0
Other:	50.00%	2
Total	100%	4

Respondent	Response
R4	Sloped (includes AASHTO Type G and other constant slopes)
R6	See previous answer
R15	Type B
R17	3"

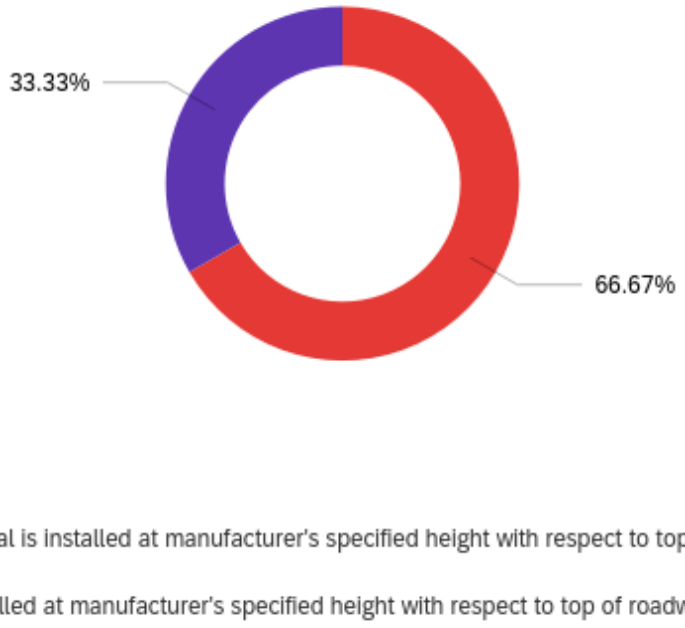
Q84 - What is the curb height when w-beam guardrail terminals are installed nearby?



Answer	%	Count
Less than 4 in.	25.00%	1
4 in.	25.00%	1
6 in.	25.00%	1
Other:	25.00%	1
Total	100%	4

Respondent	Response
R4	4 in.
R6	See previous answer
R15	6 in.
R17	Less than 4 in.

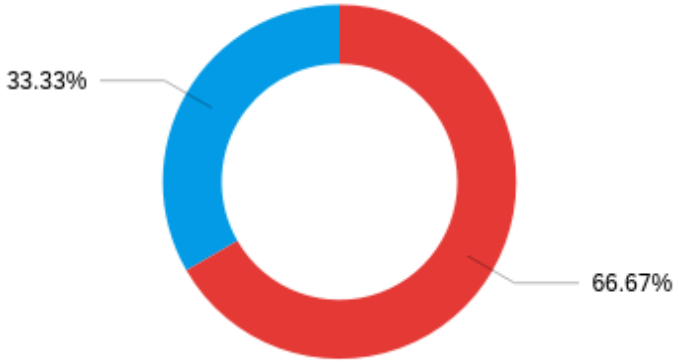
Q85 - How does your agency accommodate the height of the curb?



Answer	%	Count
Terminal is installed at manufacturer's specified height with respect to top of curb	66.67%	2
Terminal is installed at manufacturer's specified height with respect to top of roadway	33.33%	1
Other:	0.00%	0
Total	100%	3

Respondent	Response
R4	Terminal is installed at manufacturer's specified height with respect to top of roadway
R6	Terminal is installed at manufacturer's specified height with respect to top of curb
R15	Terminal is installed at manufacturer's specified height with respect to top of curb

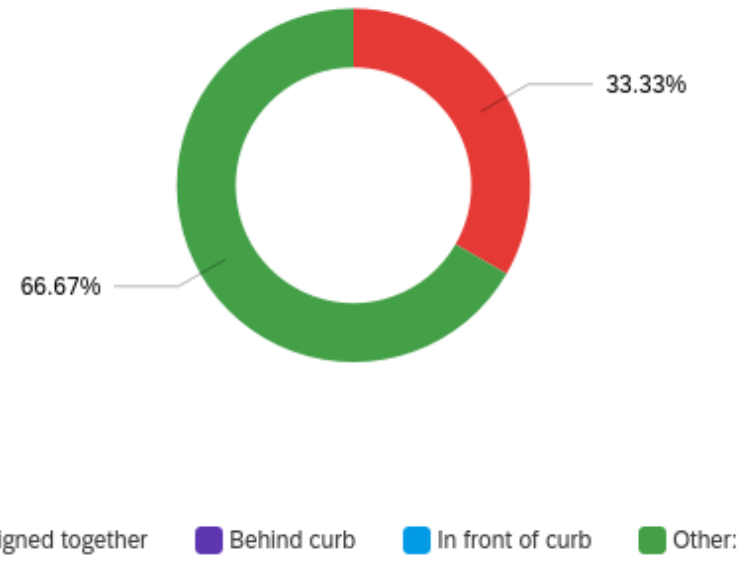
Q86 - What kind of w-beam guardrail terminals do you install on curbs?



Answer	%	Count
Tangent	66.67%	2
Flared	0.00%	0
Both	33.33%	1
Other:	0.00%	0
Total	100%	3

Respondent	Response
R4	Both
R6	Tangent
R15	Tangent

Q87 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?



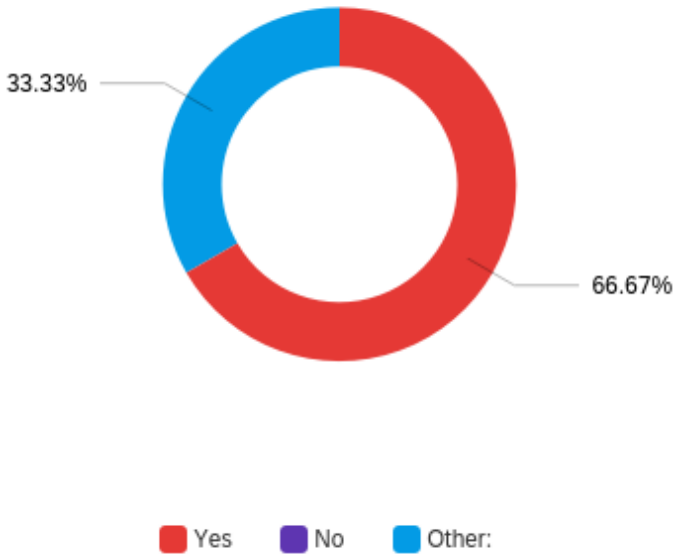
Answer	%	Count
Aligned together	33.33%	1
Behind curb	0.00%	0
In front of curb	0.00%	0
Other:	66.67%	2
Total	100%	3

Respondent	Response
R4	It depends on site conditions, prevailing speeds, etc.
R6	See previous answer
R15	Aligned together

Q88 - What is the offset between the face of rail and face of curb?

No response provided.

Q89 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?



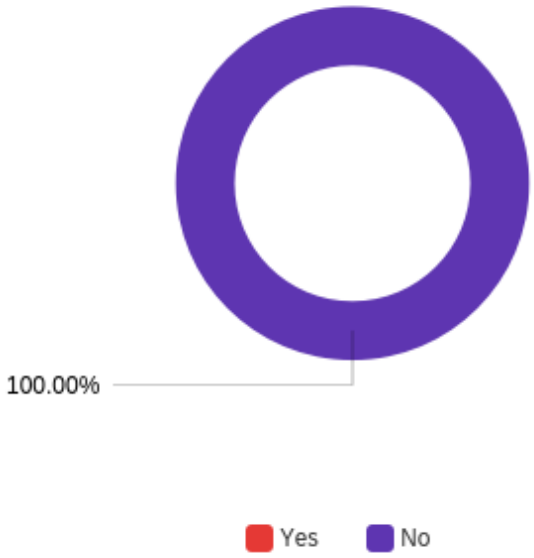
Answer	%	Count
Yes	66.67%	2
No	0.00%	0
Other:	33.33%	1
Total	100%	3

Respondent	Response
R4	It varies depending on site conditions, prevailing speeds, etc.
R6	Yes
R15	Yes

Q90 - What is the offset between the w-beam guardrail terminal head and face of rail?

Respondent	Response
R6	See previous answer
R15	Enough so that the head is clear of the shoulder or travel lane.

Q315 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.



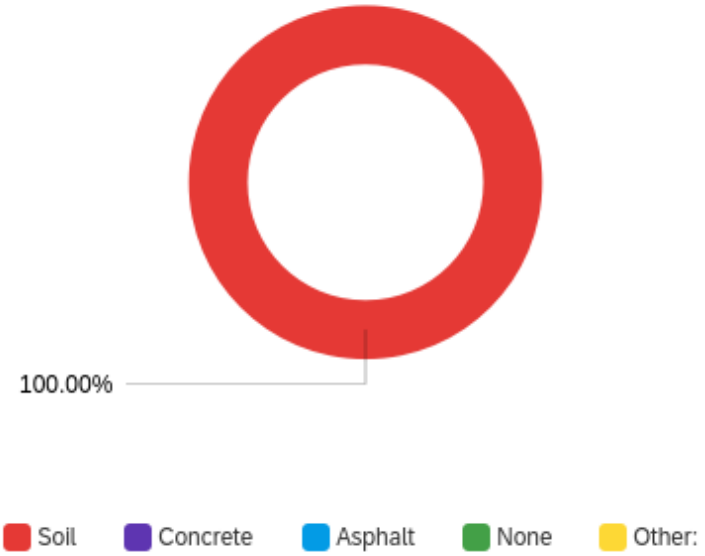
Answer	%	Count
Yes	0.00%	0
No	100.00%	3
Total	100%	3

Respondent	Response
R4	No
R6	No
R15	No

Q330 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

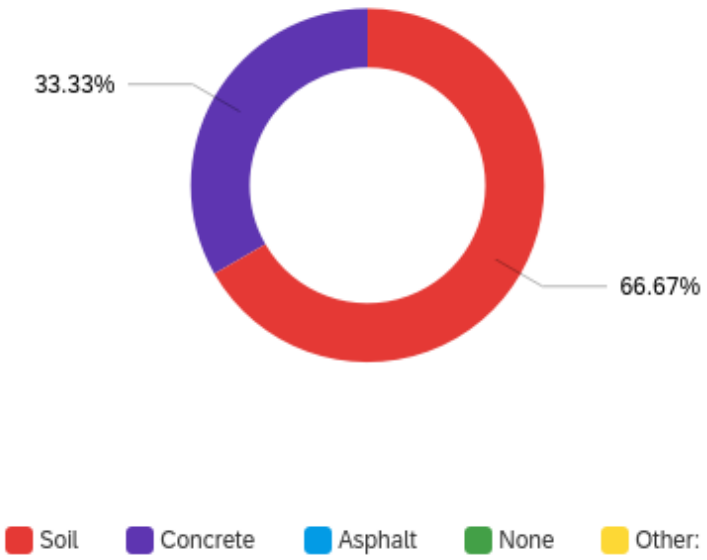
Q91 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.



Answer	%	Count
Soil	100.00%	3
Concrete	0.00%	0
Asphalt	0.00%	0
None	0.00%	0
Other:	0.00%	0
Total	100%	3

Respondent	Response
R4	Soil
R6	Soil
R15	Soil

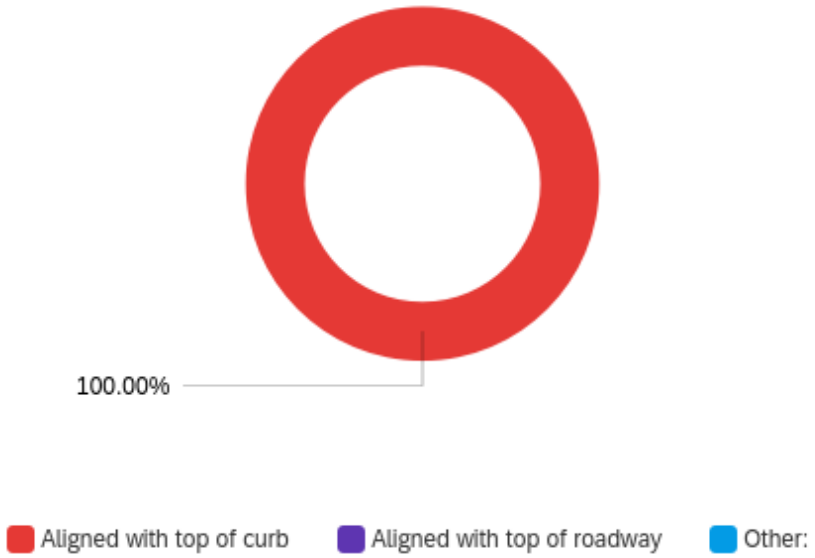
Q92 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.



Answer	%	Count
Soil	66.67%	2
Concrete	33.33%	1
Asphalt	0.00%	0
None	0.00%	0
Other:	0.00%	0
Total	100%	3

Respondent	Response
R4	Soil
R6	Soil
R15	Concrete

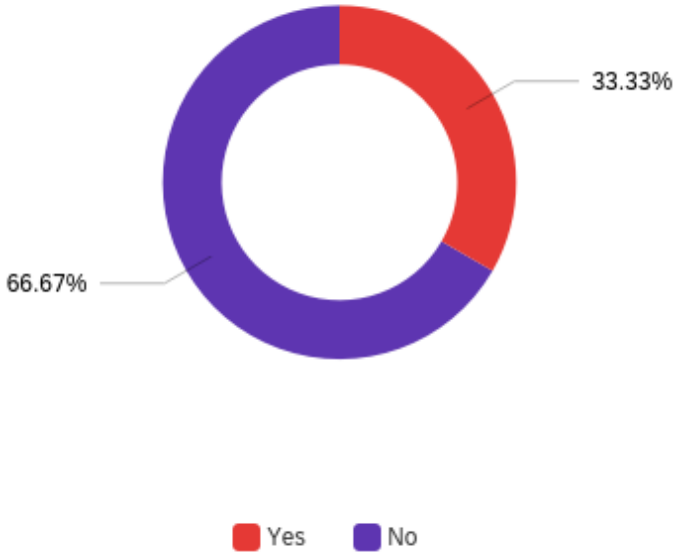
Q93 - What is the height of the top level of backfill material?



Answer	%	Count
Aligned with top of curb	100.00%	3
Aligned with top of roadway	0.00%	0
Other:	0.00%	0
Total	100%	3

Respondent	Response
R4	Aligned with top of curb
R6	Aligned with top of curb
R15	Aligned with top of curb

Q96 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering low-speed applications)?



Answer	%	Count
Yes	33.33%	1
No	66.67%	2
Total	100%	3

Respondent	Response
R4	No
R6	No
R15	Yes

A.4 LOW-SPEED ROADWAY QUESTIONS- REPETITION 3

The fourth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on low-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on low-speed roadways in the previous section. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q98 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q99- Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q102 - What curb shape does your agency use at sites with w-beam guardrail terminals?

Respondent	Response
R15	Sloped (includes AASHTO Type G and other constant slopes)

Q103 - What is the curb height when w-beam guardrail terminals are installed nearby?

Respondent	Response
R15	4 in.

Q104 - How does your agency accommodate the height of the curb?

Respondent	Response
R15	Terminal is installed at manufacturer's specified height with respect to top of curb

Q105 - What kind of w-beam guardrail terminals do you install on curbs?

Respondent	Response
R15	Tangent

Q106 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

Respondent	Response
R15	Aligned together

Q107 - What is the offset between the face of rail and face of curb?

No response provided.

Q108 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

Respondent	Response
R15	Yes

Q109 - What is the offset between the w-beam guardrail terminal head and face of rail?

Respondent	Response
R15	Enough so that the head is clear of the roadway

Q317 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

Respondent	Response
R15	No

Q331 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q110 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

Respondent	Response
R15	Soil

Q111 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

Respondent	Response
R15	None

Q112 - What is the height of the top level of backfill material?

Respondent	Response
R15	Aligned with top of curb

Q115 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering low-speed applications)?

Respondent	Response
R15	Yes

A.5 LOW-SPEED ROADWAY QUESTIONS- REPETITION 4

The fifth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on low-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on low-speed roadways in the previous section. At the end of this section, the user was directed to the conclusion questions.

Q117 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q118 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q121 - What curb shape does your agency use at sites with w-beam guardrail terminals?

Respondent	Response
R15	Sloped (includes AASHTO Type G and other constant slopes)

Q122 - What is the curb height when w-beam guardrail terminals are installed nearby?

Respondent	Response
R15	4 in.

Q123 - How does your agency accommodate the height of the curb?

Respondent	Response
R15	Terminal is installed at manufacturer's specified height with respect to top of curb

Q124 - What kind of w-beam guardrail terminals do you install on curbs?

Respondent	Response
R15	Tangent

Q125 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

Respondent	Response
R15	Aligned together

Q126 - What is the offset between the face of rail and face of curb?

No response provided

Q127 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

Respondent	Response
R15	Yes

Q128 - What is the offset between the w-beam guardrail terminal head and face of rail?

Respondent	Response
R15	Enough so that the head is clear of the roadway.

Q318 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

Respondent	Response
R15	No

Q332 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q129 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

Respondent	Response
R15	Concrete

Q130 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

Respondent	Response
R15	Soil

Q131 - What is the height of the top level of backfill material?

Respondent	Response
R15	Aligned with top of curb

Q134 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering low-speed applications)?

Respondent	Response
R15	No

Q136 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q137 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q140 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q141 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q142 - How does your agency accommodate the height of the curb?

No response provided.

Q143 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q144 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q145 - What is the offset between the face of rail and face of curb?

No response provided.

Q146 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q147 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q319 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q333 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q148 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q149 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

Q150 - What is the height of the top level of backfill material?

No response provided.

A.6 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 1

The sixth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. This section was the first iteration of the questions based on a high-speed roadway configuration. The user was directed to this section if he or she selected to only input details on high-speed roadway configurations of w-beam guardrail terminals near curbs. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q32 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q33 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q67 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q37 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q38 - How does your agency accommodate height of the curb?

No response provided.

Q39 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q40 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q41 - What is the offset between the face of rail and face of curb?

No response provided.

Q42 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q43 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q320 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q334 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q44 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q71 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

Q45 - What is the height of top level of backfill material?

No response provided.

Q76 - Does your agency have another design for installing w-beam guardrail terminals near curbs?

No response provided.

A.7 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 2

The seventh section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on high-speed roadways in the previous section. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q155 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q156 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q159 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q160 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q161 - How does your agency accommodate height of the curb?

No response provided.

Q162 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q163 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q164 - What is the offset between the face of rail and face of curb?

No response provided.

Q165 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q166 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q321 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q335 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q167 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q168 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

Q169 - What is the height of top level of backfill material?

No response provided.

Q172 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering high-speed applications)?

No response provided.

A.8 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 3

The eighth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on high-speed roadways in the previous section. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q174 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q175 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q178 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q179 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q180 - How does your agency accommodate the height of the curb?

No response provided.

Q181 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q182 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q183 - What is the offset between the face of rail and face of curb?

No response provided.

Q184 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q185 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q322 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q336 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q186 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q187 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

Q188 - What is the height of top level of backfill material?

No response provided.

Q191 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering high-speed applications)?

No response provided.

A.9 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 4

The ninth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on high-speed roadways in the previous section. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q193 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q194 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q197 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q198 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q199 - How does your agency accommodate the height of the curb?

No response provided.

Q200 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q201 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q202 - What is the offset between the face of rail and face of curb?

No response provided.

Q203 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q204 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q323 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q337 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q205 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q206 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

Q207 - What is the height of top level of backfill material?

No response provided.

Q210 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering high-speed applications)?

No response provided.

A.10 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 5

The tenth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on high-speed roadways in the previous section. At the end of this section, the user was directed to the conclusion questions.

Q212 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q213 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q216 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q217 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q218 - How does your agency accommodate the height of the curb?

No response provided.

Q219 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q220 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q221 - What is the offset between the face of rail and face of curb?

No response provided.

Q222 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q223 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q324 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q338 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q224 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q225 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

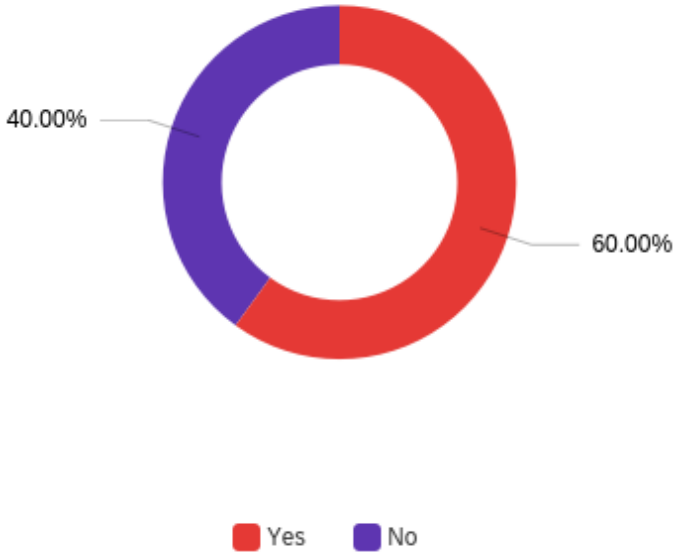
Q226 - What is the height of top level of backfill material?

No response provided.

A.11 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 1 (SUBSEQUENT TO LOW-SPEED ROADWAY CONDITIONS)

The eleventh section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on both low-speed and high-speed roadway configurations of w-beam guardrail terminals near curbs. The user answered the questions regarding w-beam guardrail terminals near curbs on low-speed roadways in earlier sections and was then directed here to answer questions regarding high-speed roadway configurations. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q66 - Are all of your answers to the questions regarding high-speed roadways the same as what you entered for low-speed roadways?

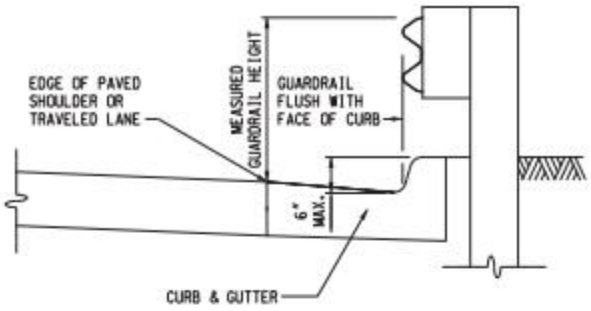


Answer	%	Count
Yes	60.00%	3
No	40.00%	2
Total	100%	5

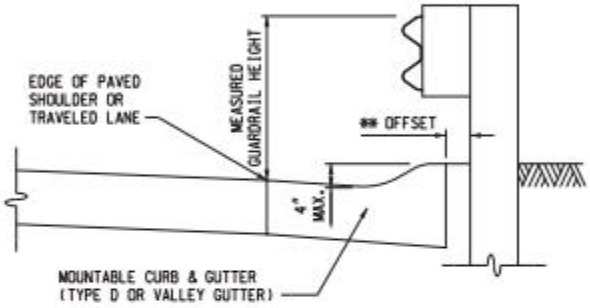
Respondent	Response
R3	Yes
R4	No
R10	Yes
R12	Yes
R15	No

Q50 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

Michigan DOT Response:

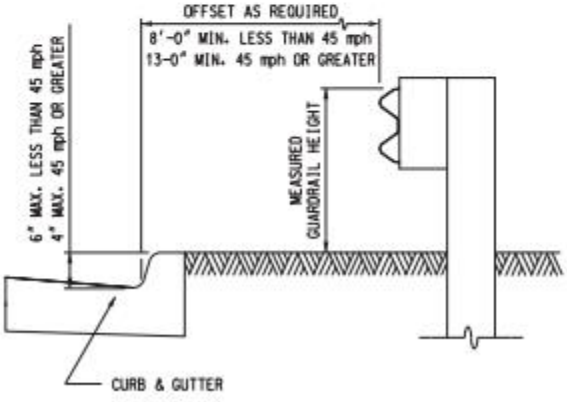


GUARDRAIL WHEN CURB IS ADJACENT TO
EDGE OF PAVED SHOULDER OR TRAVELED LANE
(DESIGN SPEED 50 mph OR LESS)



** 2" WHEN CURB IS PLACED NEXT TO SHOULDER
10" WHEN CURB IS PLACED NEXT TO TRAVELED LANE

GUARDRAIL WHEN CURB IS ADJACENT TO
EDGE OF PAVED SHOULDER OR TRAVELED LANE
(DESIGN SPEED GREATER THAN 50 mph)

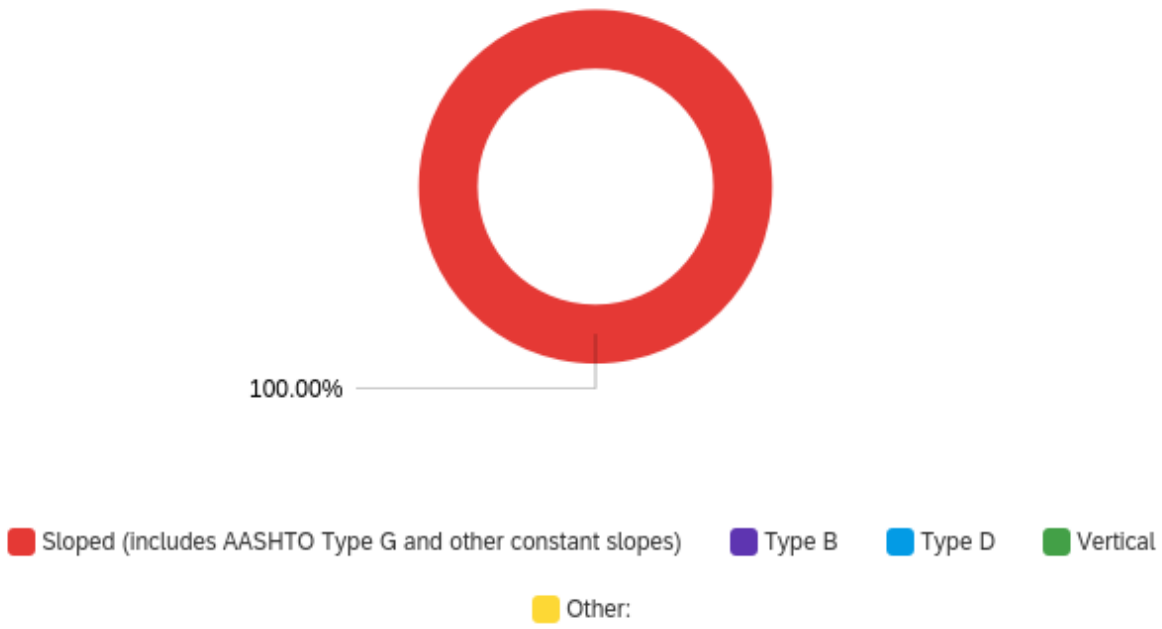


GUARDRAIL - CURB OFFSET
WHEN GUARDRAIL IS PLACED AWAY FROM CURB

Q51 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

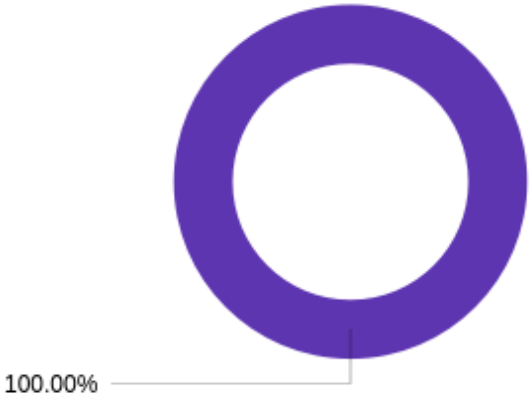
Q68 - What curb shape does your agency use at sites with w-beam guardrail terminals?



Answer	%	Count
Sloped (includes AASHTO Type G and other constant slopes)	100.00%	2
Type B	0.00%	0
Type D	0.00%	0
Vertical	0.00%	0
Other:	0.00%	0
Total	100%	2

Respondent	Response
R4	Sloped (includes AASHTO Type G and other constant slopes)
R15	Sloped (includes AASHTO Type G and other constant slopes)

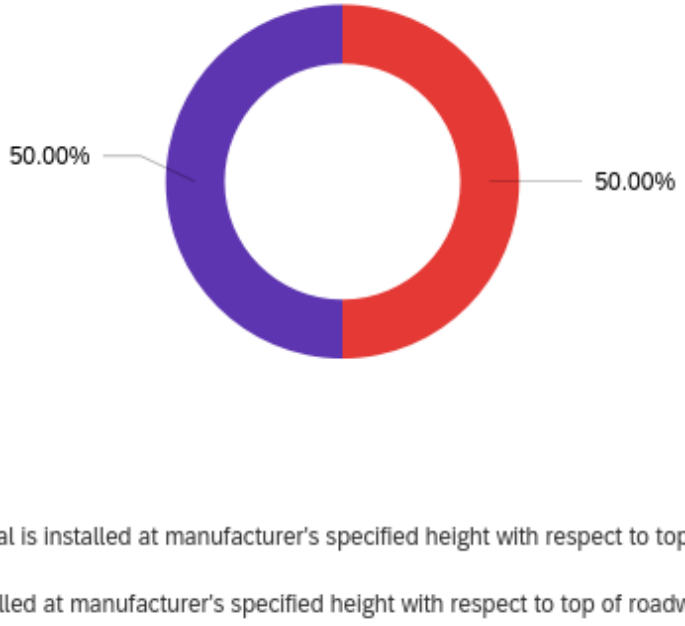
Q55 - What is the curb height when w-beam guardrail terminals are installed nearby?



Answer	%	Count
Less than 4 in.	0.00%	0
4 in.	100.00%	2
6 in.	0.00%	0
Other:	0.00%	0
Total	100%	2

Respondent	Response
R4	4 in.
R15	4 in.

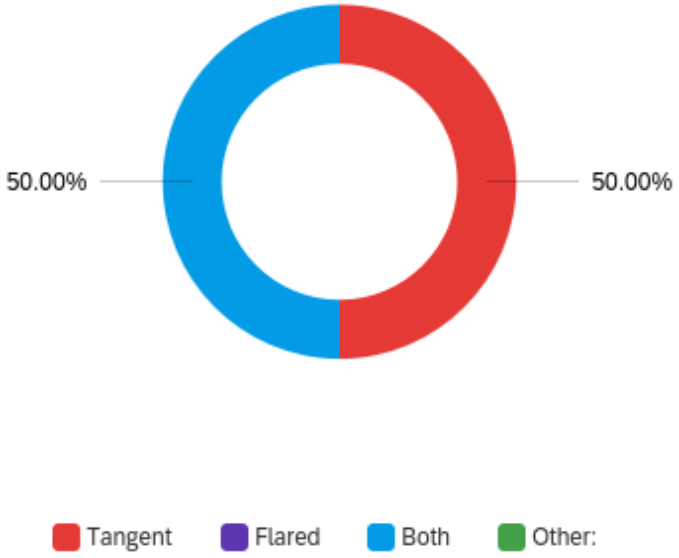
Q56 - How does your agency accommodate the height of the curb?



Answer	%	Count
Terminal is installed at manufacturer's specified height with respect to top of curb	50.00%	1
Terminal is installed at manufacturer's specified height with respect to top of roadway	50.00%	1
Other:	0.00%	0
Total	100%	2

Respondent	Response
R4	Terminal is installed at manufacturer's specified height with respect to top of roadway
R15	Terminal is installed at manufacturer's specified height with respect to top of curb

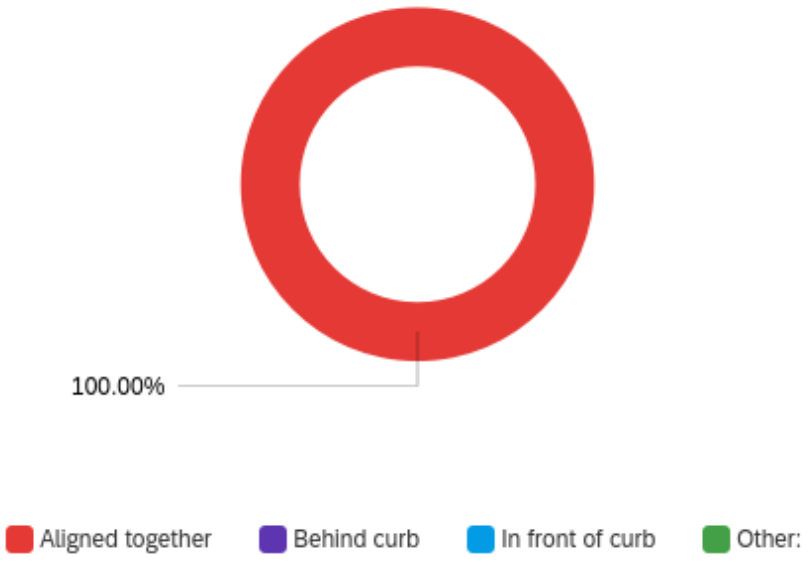
Q57 - What kind of w-beam guardrail terminals do you install on curbs?



Answer	%	Count
Tangent	50.00%	1
Flared	0.00%	0
Both	50.00%	1
Other:	0.00%	0
Total	100%	2

Respondent	Response
R4	Both
R15	Tangent

Q58 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?



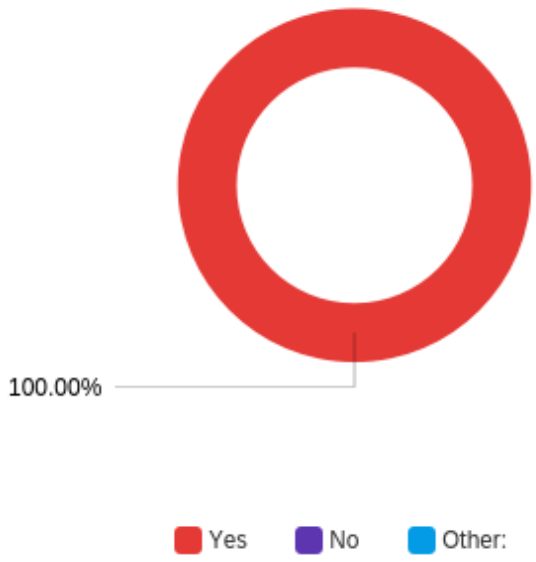
Answer	%	Count
Aligned together	100.00%	2
Behind curb	0.00%	0
In front of curb	0.00%	0
Other:	0.00%	0
Total	100%	2

Respondent	Response
R4	Aligned together
R15	Aligned together

Q59 - What is the offset between the face of rail and face of curb?

No response provided.

Q60 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?



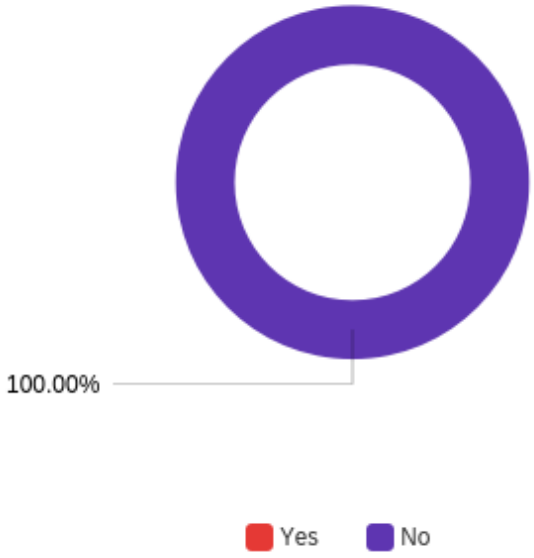
Answer	%	Count
Yes	100.00%	2
No	0.00%	0
Other:	0.00%	0
Total	100%	2

Respondent	Response
R4	Yes
R15	Yes

Q61 - What is the offset between the w-beam guardrail terminal head and face of rail?

Respondent	Response
R4	Typically 1 foot
R15	Enough so that the head is clear of the roadway.

Q325 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.



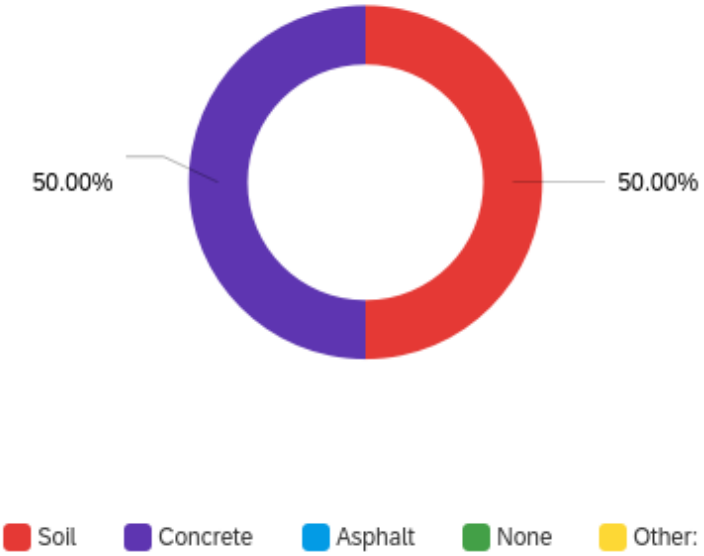
Answer	%	Count
Yes	0.00%	0
No	100.00%	2
Total	100%	2

Respondent	Response
R4	No
R15	No

Q339 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

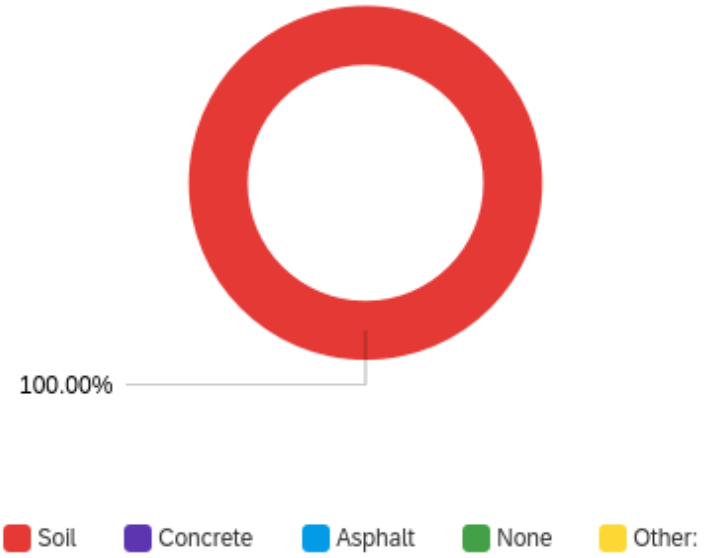
Q62 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.



Answer	%	Count
Soil	50.00%	1
Concrete	50.00%	1
Asphalt	0.00%	0
None	0.00%	0
Other:	0.00%	0
Total	100%	2

Respondent	Response
R4	Soil
R15	Concrete

Q72 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.



Answer	%	Count
Soil	100.00%	2
Concrete	0.00%	0
Asphalt	0.00%	0
None	0.00%	0
Other:	0.00%	0
Total	100%	2

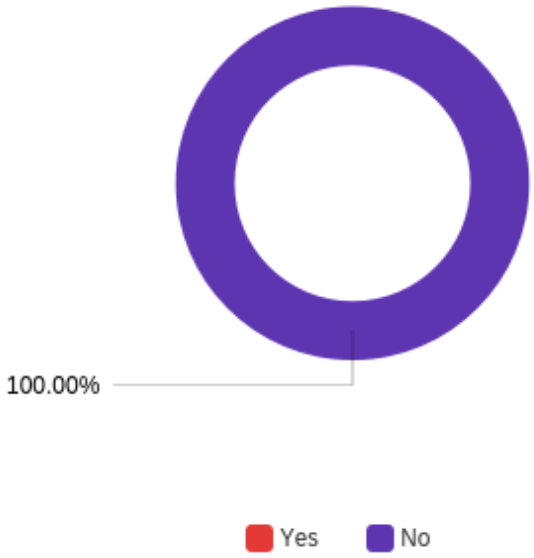
Respondent	Response
R4	Soil
R15	Soil

Q63 - What is the height of top level of backfill material?

Answer	%	Count
Aligned with top of curb	100.00%	2
Aligned with top of roadway	0.00%	0
Other:	0.00%	0
Total	100%	2

Respondent	Response
R4	Aligned with top of curb
R15	Aligned with top of curb

Q306 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering high-speed applications)?



Answer	%	Count
Yes	0.00%	0
No	100.00%	2
Total	100%	2

Respondent	Response
R4	No
R15	No

A.12 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 2 (SUBSEQUENT TO LOW-SPEED ROADWAY CONDITIONS)

The twelfth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on high-speed roadways in the previous section. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q232 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q233 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q236 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q237 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q238 - How does your agency accommodate the height of the curb?

No response provided.

Q239 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q240 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q241 - What is the offset between the face of rail and face of curb?

No response provided.

Q242 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q243 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q326 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q340 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q244 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q245 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

Q246 - What is the height of the top level of backfill material?

No response provided.

Q307 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering high-speed applications)?

No response provided.

A.13 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 3 (SUBSEQUENT TO LOW-SPEED ROADWAY CONDITIONS)

The thirteenth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on high-speed roadways in the previous section. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q251 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q252 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q255 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q256 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q257 - How does your agency accommodate the height of the curb?

No response provided.

Q258 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q259 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q260 - What is the offset between the face of rail and face of curb?

No response provided.

Q261 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q262 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q327 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q341 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q263 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q264 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

Q265 - What is the height of the top level of backfill material?

No response provided.

Q308 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering high-speed applications)?

No response provided.

A.14 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 4 (SUBSEQUENT TO LOW-SPEED ROADWAY CONDITIONS)

The fourteenth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on high-speed roadways in the previous section. At the end of this section, the user was prompted to repeat the questions if he or she had another design configuration to input or to proceed to the conclusion questions.

Q289 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q290 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q293 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q294 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q295 - How does your agency accommodate the height of the curb?

No response provided.

Q296 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q297 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q298 - What is the offset between the face of rail and face of curb?

No response provided.

Q299 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q300 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q328 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q342 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q301 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q302 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

Q303 - What is the height of the top level of backfill material?

No response provided.

Q309 - Does your agency have another design for installing w-beam guardrail terminals near curbs (only considering high-speed applications)?

No response provided.

A.15 HIGH-SPEED ROADWAY QUESTIONS- REPETITION 5 (SUBSEQUENT TO LOW-SPEED ROADWAY CONDITIONS)

The fifteenth section of the survey investigated specific practices when installing w-beam guardrail terminals near curbs on high-speed roadways. As discussed in Chapter 2, the questions included in this section were considered the core questions that were repeated for different roadway or curb configurations. The user was directed to this section if he or she selected to input details on an additional design configuration regarding w-beam guardrail terminals near curbs on high-speed roadways in the previous section. At the end of this section, the user was directed to the conclusion questions.

Q270 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q271 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

No response provided.

Q274 - What curb shape does your agency use at sites with w-beam guardrail terminals?

No response provided.

Q275 - What is the curb height when w-beam guardrail terminals are installed nearby?

No response provided.

Q276 - How does your agency accommodate the height of the curb?

No response provided.

Q277 - What kind of w-beam guardrail terminals do you install on curbs?

No response provided.

Q278 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?

No response provided.

Q279 - What is the offset between the face of rail and face of curb?

No response provided.

Q280 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?

No response provided.

Q281 - What is the offset between the w-beam guardrail terminal head and face of rail?

No response provided.

Q329 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.

No response provided.

Q343 - What was the offset between the back of curb and the head of the w-beam guardrail terminal?

No response provided.

Q282 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.

No response provided.

Q283 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.

No response provided.

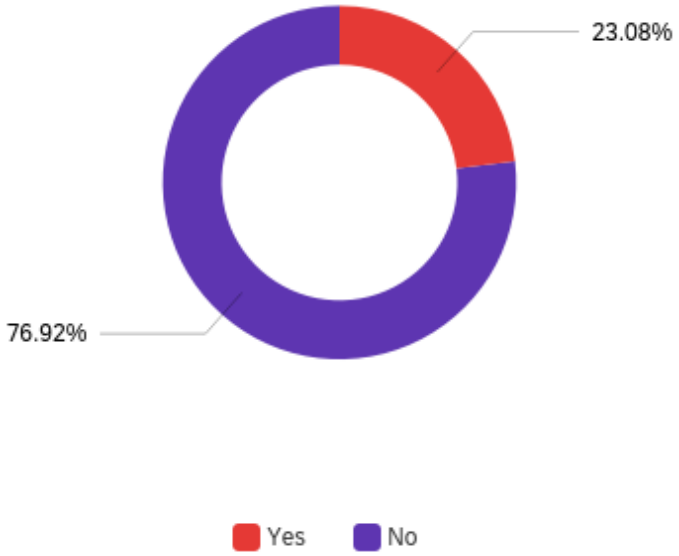
Q284 - What is the height of the top level of backfill material?

No response provided.

A.16 CONCLUDING QUESTIONS

The last section of the survey asked several questions that focused on broad trends in state design practices and identifying new research needs. The following questions were included in this last concluding section.

Q344 - Do you differ your configuration for curbs near w-beam guardrail terminals when they are used with an approach terminal vs a trailing end/downstream terminal?



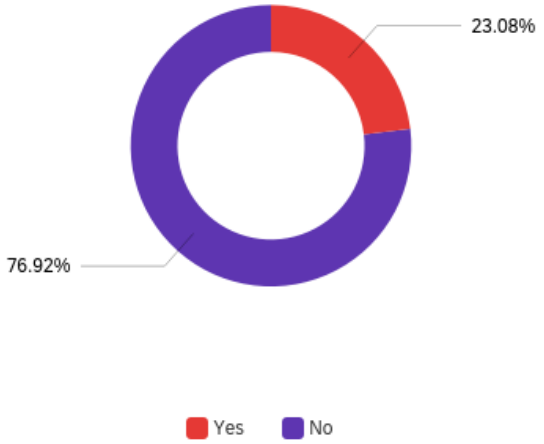
Answer	%	Count
Yes	23.08%	3
No	76.92%	10
Total	100%	13

Respondent	Response
R1	Yes
R2	Yes
R3	No
R4	No
R5	No
R6	No
R7	No
R8	No
R9	Yes
R10	No
R12	No
R13	No
R15	No

Q345 - Please describe the differences.

Respondent	Response
R1	Use roll away curb instead.
R2	2" height for the approach (likely to be struck) Typical curb height on downstream end if it is outside of the clearzone.
R9	Downstream terminals may be more likely to flair away from the face of curb. It still is project dependent, so difficult to make a blanket statement.

Q29 - Has your agency received any guidance from w-beam guardrail terminal manufacturers with regards to installing their product near curbs?



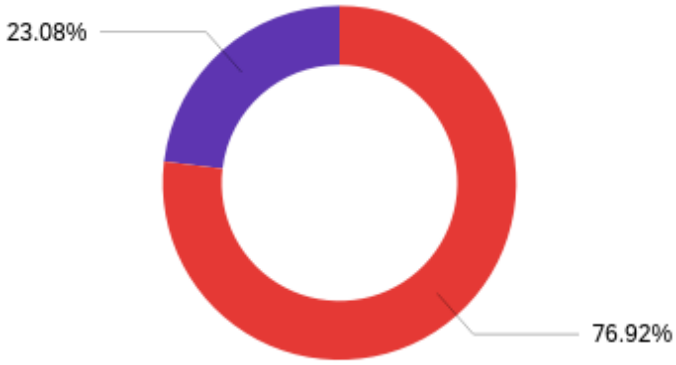
Answer	%	Count
Yes	23.08%	3
No	76.92%	10
Total	100%	13

Respondent	Response
R1	No
R2	No
R3	No
R4	No
R5	Yes
R6	Yes
R7	No
R8	No
R9	No
R10	No
R12	Yes
R13	No
R15	No

Q30 - Please provide that guidance, if possible.

Respondent	Response
R6	Install as crash tested...
R12	SoftStop Installation Manual

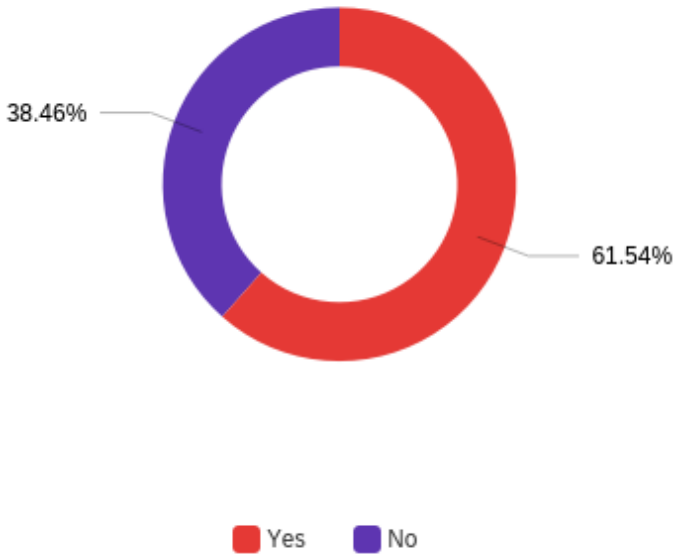
Q19 - Do you have a desire for a crashworthy w-beam guardrail terminal for low-speed roadway applications near curbs?



Answer	%	Count
Yes	76.92%	10
No	23.08%	3
Total	100%	13

Respondent	Response
R1	Yes
R2	Yes
R3	No
R4	Yes
R5	Yes
R6	Yes
R7	Yes
R8	Yes
R9	No
R10	Yes
R12	Yes
R13	No
R15	Yes

Q20 - Do you have a desire for a crashworthy w-beam guardrail terminal for high-speed roadway applications near curbs?



Answer	%	Count
Yes	61.54%	8
No	38.46%	5
Total	100%	13

Respondent	Response
R1	Yes
R2	Yes
R3	No
R4	Yes
R5	Yes
R6	No
R7	No
R8	Yes
R9	No
R10	Yes
R12	Yes
R13	No
R15	Yes

Q21 - Thank you for participating in this survey. If you have any additional comments, please use the text box below.

Response: Louisiana does not have any policy or guidance related to guard rail end terminals installed near curbs and there is little official guidance available from AASHTO or FHWA on this subject. However, our needs require that we install end terminals behind curbs while trying to follow the manufacturer's original recommendations as best we can. This usually results in installing a tangent end aligned with the face of the curb with the head offset enough to stay clear of the roadway. The end terminal is also installed with respect to the top of the curb so that the ground strut is clear and not buried. This results in the end terminal being slightly higher than the rest of the rail. Again, given the site conditions along curbed roadways and the lack of any guidance, we feel this type of installation is the best of the available alternatives.

Response: MoDOT is currently reviewing policy changes to terminate curbs prior to CET's.

Response: Current best practices would be helpful until a tested system is available!

Response: Please refer to Section 7.01.34 of the Michigan Road Design Manual (MiRDM) for MDOT's guidelines pertaining to guardrail in conjunction in curb. Please note that MDOT does not have specific guidelines for guardrail terminals. Currently, the guidelines from 7.01.34 - MiRDM apply to all guardrail installations, including guardrail terminals. https://mdotjboss.state.mi.us/stdplan/englishroadmanual.htm

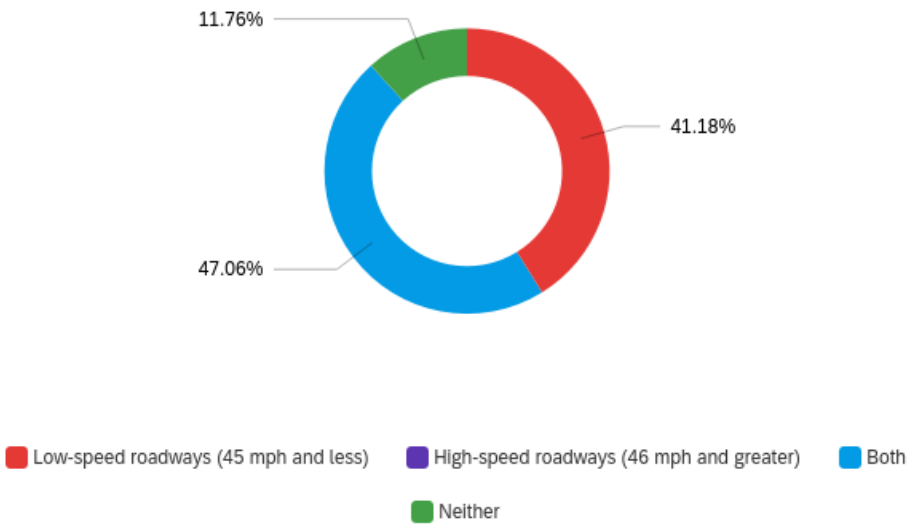
APPENDIX B. STATE SURVEY QUESTIONS AND AGGREGATED RESULTS

The results presented in this section of the report represent the aggregated responses collected from the survey. If a question did not receive any responses, the question was noted as "No response provided" in this report. As discussed in Chapter 2, the layout of the survey included a list of several core questions that were repeated depending upon user input. This loop mechanism was engaged when users inputted curb configurations for both low-speed and high-speed roadways or when inputting multiple curb configurations. Because of this loop mechanism, the TTI research team aggregated the results of the survey to provide readers a perspective on the trends in current design practice regarding w-beam guardrail terminals installed near curbs. This Appendix lists these aggregated results in the following sections.

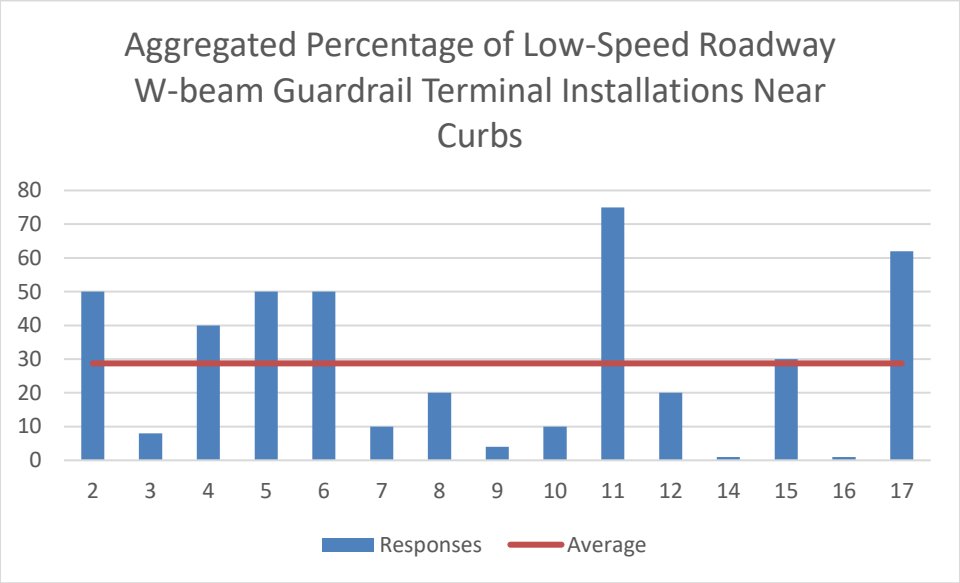
B.1 AGGREGATED INTRODUCTORY RESULTS

This first section of this Appendix shows the aggregated results from the introductory section in the survey.

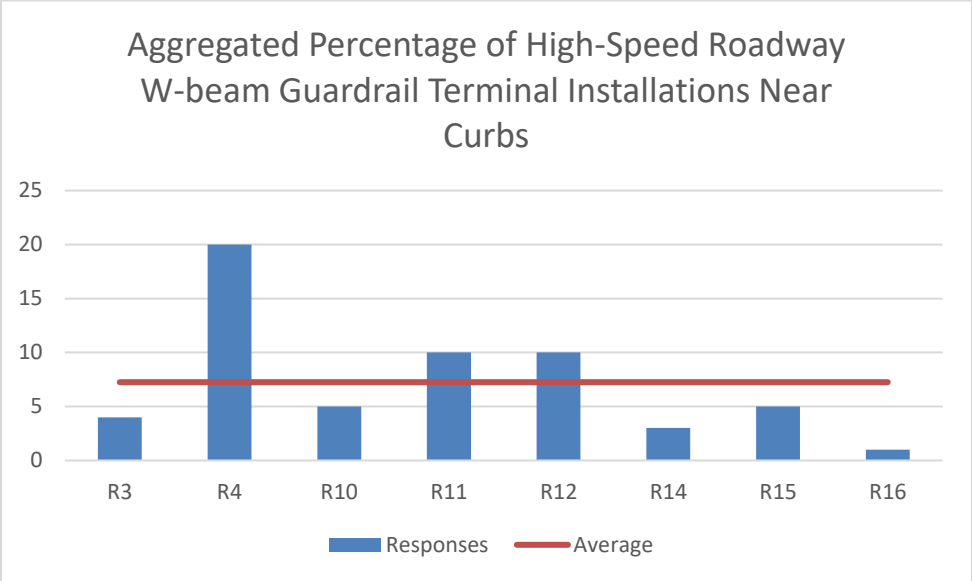
Q4 - Does your transportation agency install w-beam guardrail terminals in close proximity to curbs on low-speed or high-speed roadways? If your agency does not install w-beam guardrail terminals near curbs, please select neither.



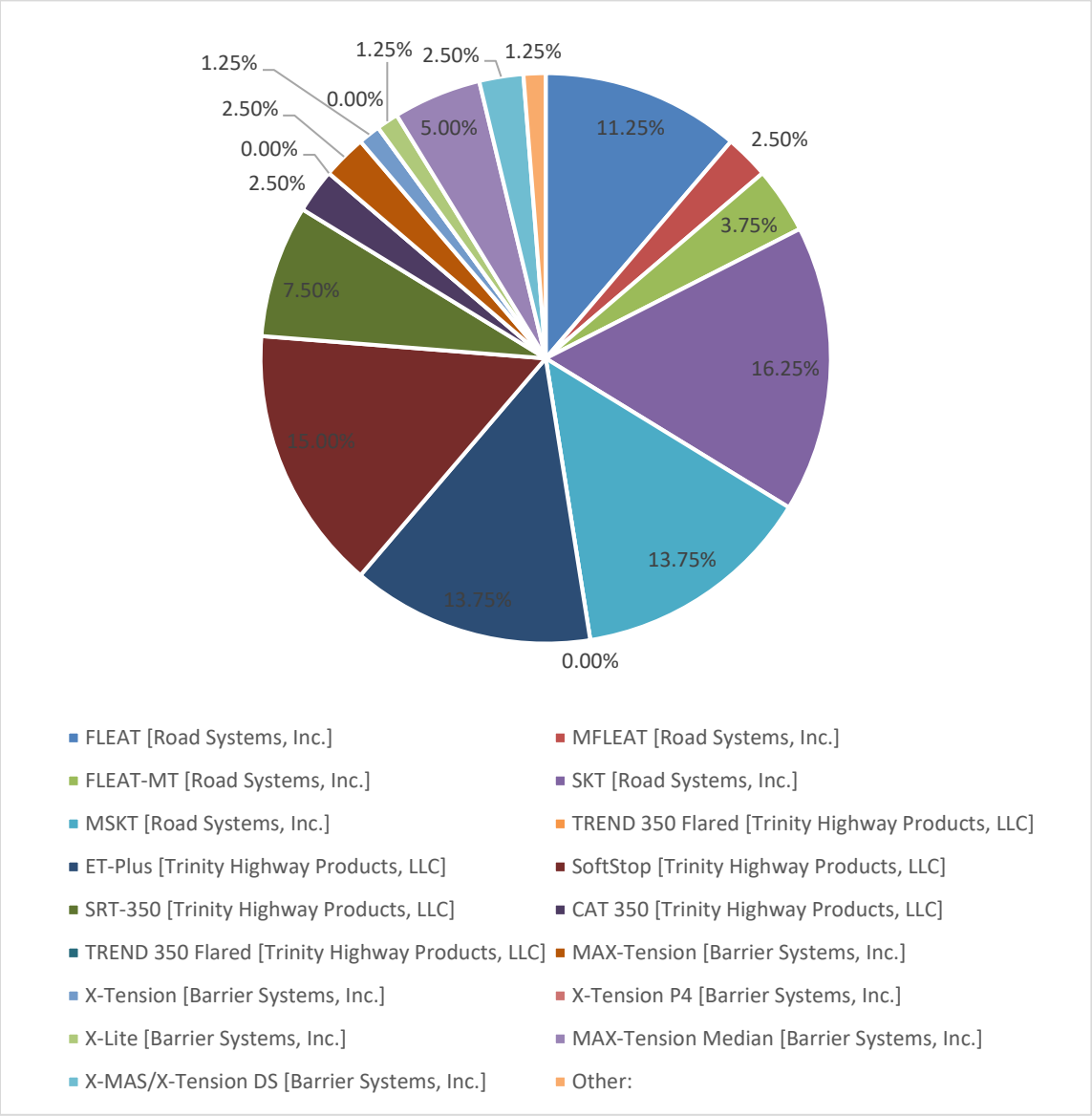
Q14 & Q17 - What percentage of low-speed roadway w-beam guardrail terminal installations are located near curbs?



Q16 & Q17 What percentage of high-speed roadway w-beam guardrail terminal installations are located near curbs?



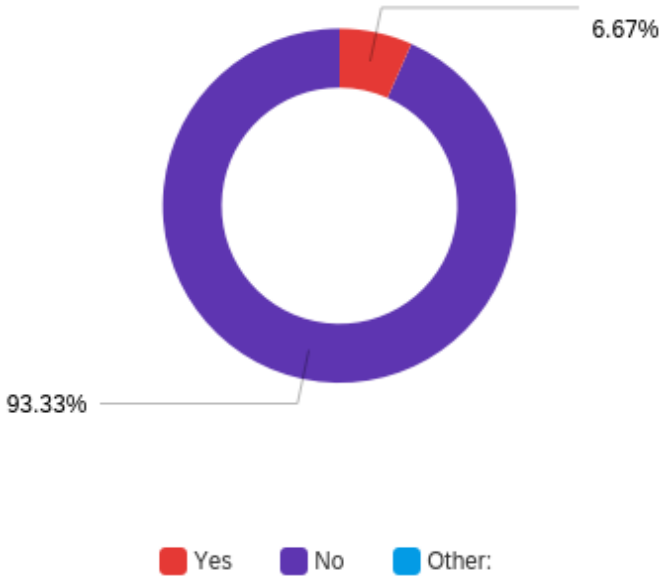
Q312 - Which of the following roadside/median terminals have you installed near curbs in the past or are currently installing? Please select all that apply.



Terminal	Percentage	Count
FLEAT [Road Systems, Inc.]	11.25%	9
MFLEAT [Road Systems, Inc.]	2.50%	2
FLEAT-MT [Road Systems, Inc.]	3.75%	3
SKT [Road Systems, Inc.]	16.25%	13
MSKT [Road Systems, Inc.]	13.75%	11
TREND 350 Flared [Trinity Highway Products, LLC]	0.00%	0
ET-Plus [Trinity Highway Products, LLC]	13.75%	11
SoftStop [Trinity Highway Products, LLC]	15.00%	12
SRT-350 [Trinity Highway Products, LLC]	7.50%	6
CAT 350 [Trinity Highway Products, LLC]	2.50%	2
TREND 350 Flared [Trinity Highway Products, LLC]	0.00%	0
MAX-Tension [Barrier Systems, Inc.]	2.50%	2
X-Tension [Barrier Systems, Inc.]	1.25%	1
X-Tension P4 [Barrier Systems, Inc.]	0.00%	0
X-Lite [Barrier Systems, Inc.]	1.25%	1
MAX-Tension Median [Barrier Systems, Inc.]	5.00%	4
X-MAS/X-Tension DS [Barrier Systems, Inc.]	2.50%	2
Other:	1.25%	1

Other Response: Breakmaster 350

Q7 - Does your agency differentiate between which terminals are installed near curbs and those which are not installed near curbs?

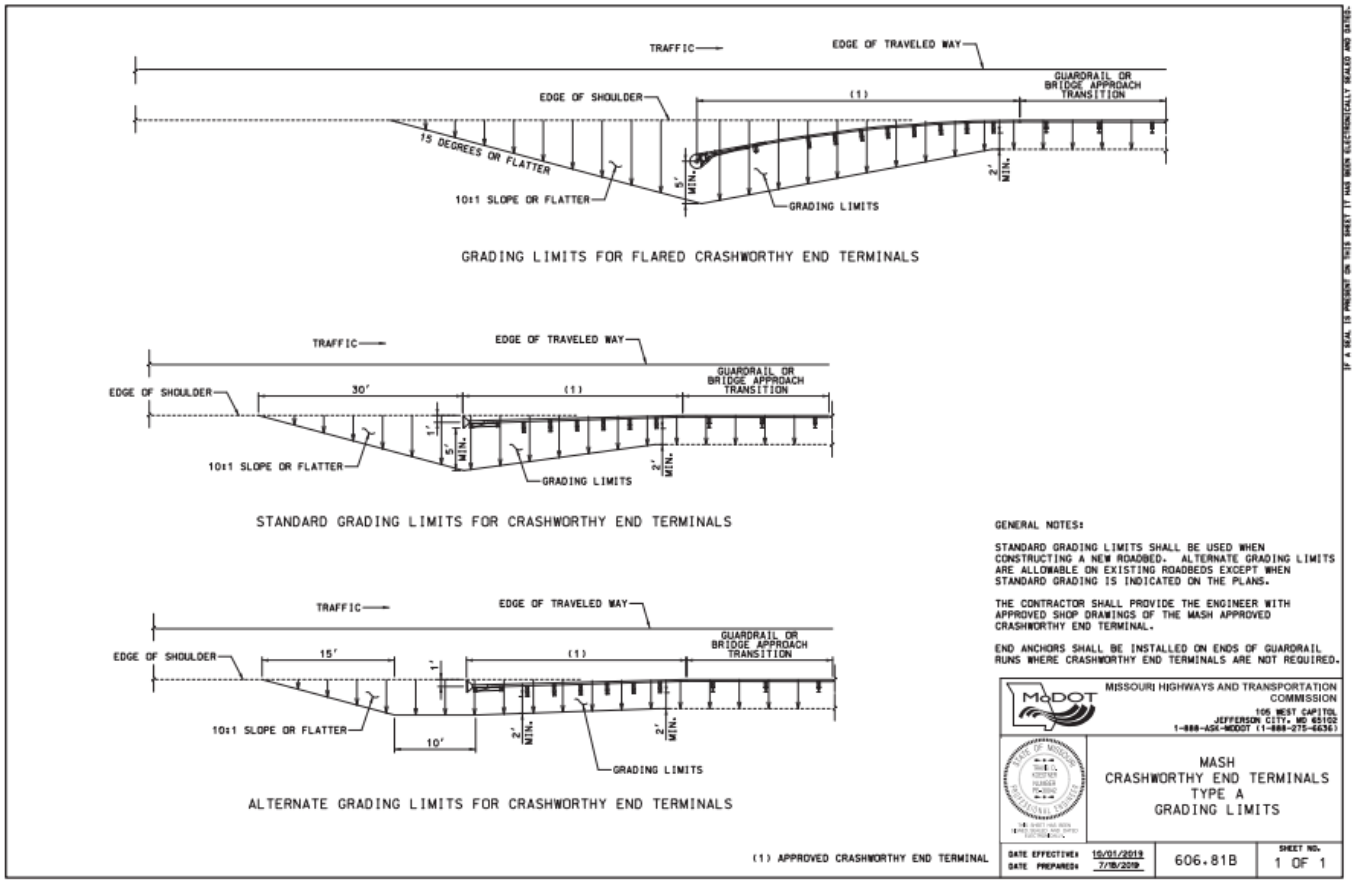


Answer	%	Count
Yes	6.67%	1
No	93.33%	14
Other:	0.00%	0
Total	100%	15

B.2 AGGREGATED LOW-SPEED ROADWAY RESULTS

This section of the Appendix shows the aggregated results of the survey questions regarding low-speed roadways.

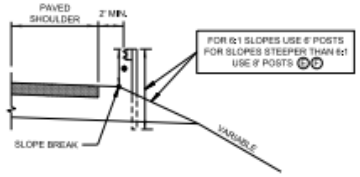
Q18, Q79 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.



REV. 10-11-12: ADDED NOTE TO DETAIL B. MINOR DRAFTING UPDATE. ADDED TABLE.

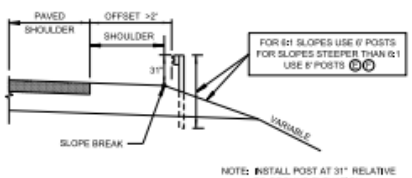
REV. 4-4-16: GENERAL REVISION.

REV. 05-26-19: ADDED GENERAL NOTE (G) AND (H). REVISED TABLE FOR GUARDRAIL POST REDUCTION IN DEFLECTION FOR SINGLE W-BEAM. REVISED DETAILS A THRU E. REDRAWN TABLE A. REDRAW SHEET.



● NOTE: INSTALL POST AT 31" RELATIVE TO A LINE EXTENDED FROM THE SHOULDER SLOPE

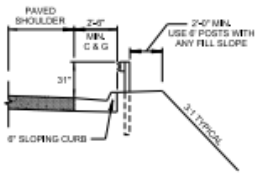
DETAIL A
GUARDRAIL PLACEMENT AT SLOPE BREAK



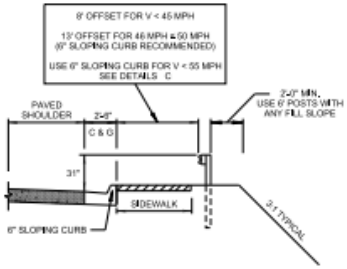
NOTE: INSTALL POST AT 31" RELATIVE TO GROUND ELEVATION

DETAIL B
OFFSET GUARDRAIL PLACEMENT

TYPICAL SECTIONS (NON CURB & GUTTER)



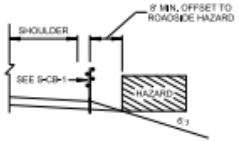
DETAIL C
GUARDRAIL PLACEMENT
ON CURB AND GUTTER SECTION



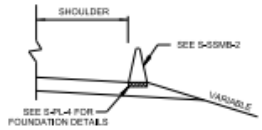
DETAIL D
OFFSET GUARDRAIL PLACEMENT
ON CURB AND GUTTER SECTION

TYPICAL SECTIONS WITH CURB AND GUTTER

USE 6" SLOPING CURB AT LOCATIONS WHERE THE POSTED SPEED IS BETWEEN 45 - 55 M.P.H.
DO NOT USE CURB AND GUTTER AT LOCATIONS WHERE THE POSTED SPEEDS ARE ABOVE 55 M.P.H.



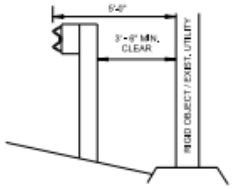
DETAIL E
HIGH TENSION 4 STRAND CABLE BARRIER
(TL-3 OR TL-4)



DETAIL F
FREE STANDING CONCRETE BARRIER RAIL
(TL-3, TL-4 OR TL-5)

ALTERNATE TO W-BEAM GUARDRAIL WHERE HIGHER PERFORMANCE IS NEEDED

NOT TO SCALE



TYPICAL MIN. CLEAR TO A RIGID OBJECT
(SEE TABLE BELOW IF LESS DEFLECTION IS DESIRED)
(REFER TO MWRSF REPORT TRP 03-171-06)

GUARDRAIL POST REDUCTION IN DEFLECTION FOR SINGLE W-BEAM			
POST SPACING	6' - 3"	3' - 1 1/2"	1' - 6 3/4"
DEFLECTION	3' - 6"	3' - 0"	2' - 6"

GENERAL NOTES FOR GUARDRAIL

(A) THIS DRAWING PROVIDES GUIDANCE FOR FACILITIES WITH POSTED SPEED LIMIT EQUAL TO OR GREATER THAN 60 MPH. SOME GUIDANCE FOR FACILITIES WITH POSTED SPEED LIMITS LESS THAN 60 MPH ARE INCLUDED IN THIS DRAWING AND ARE LESS STRINGENT. REFER TO THE STANDARDS AND POLICY OFFICE IN THE ROADWAY DESIGN DIVISION FOR ADDITIONAL GUIDANCE.

(B) IF GUARDRAIL IS IN A CURB AND GUTTER SECTION, IT SHALL BE PLACED SUCH THAT THE GUARDRAIL FACE IS EVEN WITH THE CURB (DETAIL C) OR A MINIMUM OF 5' FROM THE CURB (DETAIL D).

(C) ON 6:1 OR FLATTER SLOPE, GUARDRAIL MAY BE PLACED AT THE SLOPE BREAK.

(D) REFER TO RD11-TS SERIES OF STANDARD DRAWINGS FOR TYPICAL SECTION INFORMATION.

(E) REFER TO TEXAS A & M REPORT NUMBER 405190-20, FOR GUARDRAIL PLACED ON 3:1 SLOPE.

(F) PAY ITEMS:

705-06.01, W BEAM GR (TYPE 2) MASH TL3, L.F. (8' POST)
705-06.02, W BEAM GR (TYPE 2) MASH TL3 (LONG POST), L.F. (8' POST)

■ MINOR REVISION — FHWA APPROVAL NOT REQUIRED

STATE OF TENNESSEE
STANDARD DRAWING
DEPARTMENT OF TRANSPORTATION

SAFETY PLAN
SAFETY HARDWARE
PLACEMENT
ON OUTSIDE EDGE

7-11-13 | S-PL-6

SHEET	CONTENTS
1	General Notes; Index Contents
2	General, TL-3 Guardrail – Installed Plan and Elevation
3	Low-Speed, TL-2 Guardrail – Installed Plan and Elevation
4	W-Beam and Thrie-Beam Panel Details
5	Post and Offset Block Details
6	Guardrail Sections – Heights and Adjacent Slopes
7	End Treatment – Approach Terminal Geometry, Parallel
8	End Treatment – Approach Terminal Geometry, Curbed and Double Faced
9	End Treatment – Trailing Anchorage
10	End Treatment – Component Details
11	End Treatment – Controlled Release Terminal (CRT) System
12	Layout for CRT System – Side Roads and Driveways
13	Approach Transition Connection to Rigid Barrier – General, TL-3
14	Approach Transition Connection to Rigid Barrier – General, TL-3 – Curb Connections
15	Approach Transition Connection to Rigid Barrier – Low-Speed, TL-2
16	Approach Transition Connection to Rigid Barrier – Low-Speed, TL-2 – Curb Connections
17	Approach Transition Connection to Rigid Barrier – Details
18	Approach Transition Connection to Rigid Barrier – Double Faced Guardrail
19	Layout to Rigid Barrier – Approach Ends
20	Layout to Rigid Barrier – Approach Ends with Double Faced Guardrail Layout to Rigid Barrier – Trailing Ends Trailing End Transition Connection to Rigid Barrier
21	Rub Rail Details
22	Pedestrian Safety Treatment – Pipe Rail
23	Modified Mount – Special Steel Post for Concrete Structure Mount; Modified Mount – Encased Post for Shallow Mount; Modified Mount – Frangible Leave-Out for Concrete Surface Mount
24	Barrier Delineators – Post Mounted; Clear Space – Reduced Post Spacing for Hazards; ⅝" Button-Head Bolt System

GENERAL NOTES:

1. INSTALLATION: Construct guardrail in accordance with Specification 536.

   This Index, along with the plans and the manufacturers' drawings on the Approved Products List (APL), is sufficiently detailed for installation of General Guardrail, Low-Speed Guardrail, End Treatment assemblies, and their connecting options shown herein. This precludes requirements for shop drawing submittals unless otherwise specified in the plans.

2. COMPATIBILITY: The General Guardrail in this Index is based on the Midwest Guardrail System (MGS) design, with an approximate height of 31" at the top of the Panel (2'-1" mounting height at vertical ℄ of Panel) and a midspan panel splice as shown on Sheet 2. Guardrail components included on the APL, which are compatible with this Index, may also be identified as 31" or MGS Guardrail.

3. STANDARD COMPONENTS: Standard guardrail components, including posts, panels, and bolt systems, are based on the Task Force 13 Publication: Guide to Roadside Hardware Components (http://tf13.org/Guides/componentGuide/).

4. BUTTON-HEAD BOLTS: Install Button-Head Bolts where indicated using bolts, nuts, and washers as defined on Sheet 24. Place washers under nuts. Do not place washers between bolt heads and panels, except where otherwise shown in this Index.

5. HEX-HEAD BOLTS: Install Hex-Head Bolts where indicated using bolts, nuts, and washers in accordance with material properties of Specification 967. Place washers under nuts.

6. MISCELLANEOUS ASPHALT PAVEMENT: Install Miscellaneous Asphalt Pavement where indicated with a tolerance of ± ½" depth and in accordance with Specification 339.

7. ADJACENT SIDEWALKS & SHARED USE PATHS: When guardrail posts are placed within 4'-0" of a sidewalk or shared use path, use timber posts, or use steel posts only if treated with Pipe Rail as shown on Sheet 22.

   When timber posts are used, one of the following safety treatments is required for the bolt(s) protruding from the back face of the posts:
   a. After tightening the nut, trim the protruding post bolt flush with the nut and galvanize per Specification 562.
   b. Use post bolts 15" in length and countersink the washer and nut between 1" and 1½" deep into the back face of the post.
   c. Use 15" post bolts with sleeve nuts and washers.

   When End Treatment posts are within 4'-0" of a sidewalk or shared use path, steel posts are not permitted within the End Treatment segment. Terminate the Pipe Rail outside of End Treatment segments, as noted per Sheet 22.

8. NESTED W-BEAM: Where called for in the plans, install two W-Beam Panels mounted flush per location, securing all panels with Button-Head Bolts threaded through aligned slots and holes. 2" Button-Head Bolts are permitted for panel splice locations.

9. CONNECTION TO RIGID BARRIER: The connections to Rigid Barrier in this Index only apply to newly constructed bridge Traffic Railing and Concrete Barrier or where the complete Approach Transition Connection to Rigid Barrier shown herein can be installed without conflicting with existing Traffic Railings, structures, or approach slabs.

   For connecting guardrail to existing bridge Traffic Railings, see Indexes 536-002, 521-404, and 521-405.

10. CONNECTION TO EXISTING GUARDRAIL: Where a transition to existing guardrail at 27" height is required, linearly transition the new guardrail height over a distance ranging from 25'-0" to 31'-3". Height transitions must occur outside of End Treatment and Approach Transition segments.

    Provide an immediate transition to the required midspan panel splice using the available panel options on Sheet 4 (9'-4½" or 15'-7½" panel). Alternatively, this transition to midspan panel splice may be achieved by installing a single reduced post spacing of 3'- 1½" within the new guardrail, immediately adjacent to the connection location.

11. PLANS CALLOUTS: Begin/End Station labels are shown throughout this Index as they correspond to the station and offset callouts specified in the plans.

    In the plans, Begin/End Guardrail Station refers to the General TL-3 Guardrail Pay Item, and it may be abbreviated as Begin/End GR. Station. Where the Low-Speed TL-2 Guardrail Pay Item is specifically required, the callout in the plans will then specify Begin/End TL-2 GR. Station.

12. QUANTITY MEASUREMENT: Measure guardrail and corresponding components as defined in Specification 536. The Guardrail length is measured along the centerline of installed Panels, between the points labeled Begin/End Guardrail Station shown on the following Index Sheets and defined in the plans (typically measured from the ℄ of the panel's post bolt slots at the approach/trailing ends).

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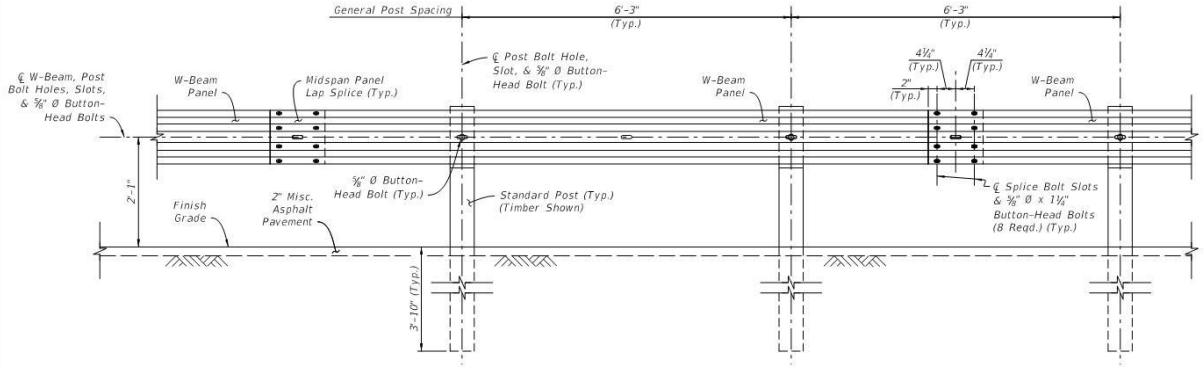
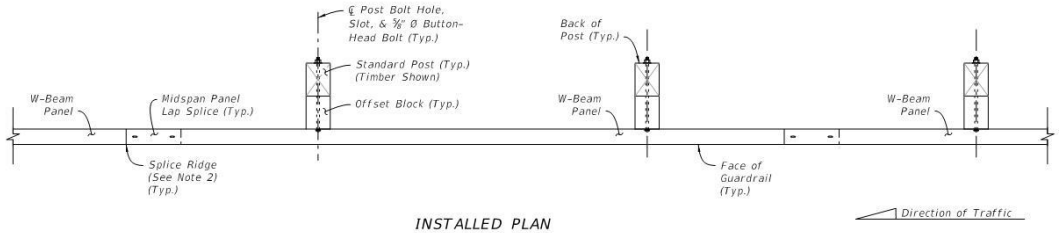
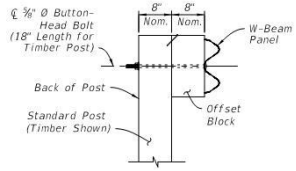
LAST REVISION	REVISION	DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
11/01/19					536-001	1 of 24



GENERAL GUARDRAIL
INSTALLED ELEVATION



INSTALLED PLAN



INSTALLED SECTION

NOTES:

1. GENERAL: Install the General Guardrail configuration where indicated in the plans. This may include tapered segments if called for in the plans.

   Use 12'-6" or longer W-Beam Panels. A single 6'-3" Panel may be used at the end of the run to meet the nominal Begin/End Guardrail Sta. requirements.

   Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the plans, obtain approval from the Engineer prior to installation.

2. MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

   Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.

3. CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.

4. W-BEAM PANEL DETAILS: See Sheet 4.

5. POST & OFFSET BLOCK DETAILS: See Sheet 5.

6. GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.

7. MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 23 for additional post mounting options.

8. DEFINED SEGMENTS: The General Guardrail shown provides the base configuration, including Post Spacing and splice locations, for Defined Segment modifications where indicated in the plans and using the Guardrail Types, Sections, and/or hardware as shown in this Index (e.g. Double Faced W-Beam, Deep Posts at Slope Breaks, Pipe Rail, Rub Rail, or Reduced Post Spacing for Hazards).

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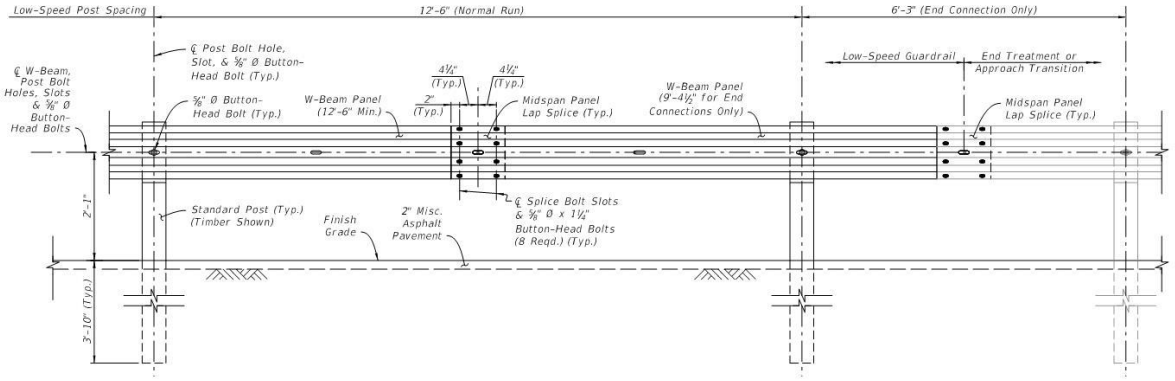
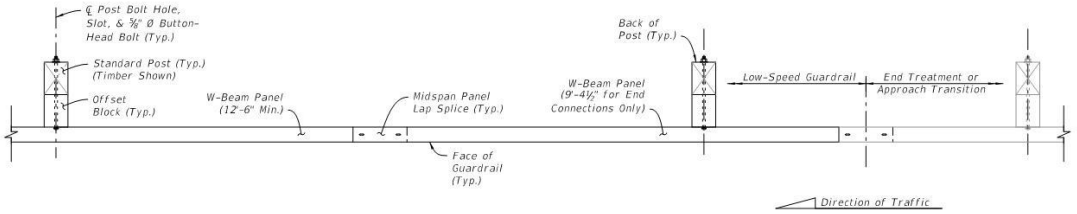
GENERAL, TL-3 GUARDRAIL DETAILS

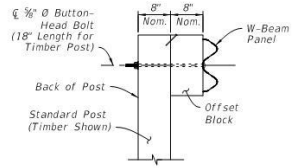
LAST REVISION 11/01/19	REVISION DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 2 of 24



LOW-SPEED GUARDRAIL
INSTALLED ELEVATION



INSTALLED PLAN



INSTALLED SECTION

NOTES:

1. GENERAL: Install the Low-Speed Guardrail configuration where indicated in the plans. Low-Speed Guardrail may include tapered segments if called for in the plans.

   Use 12'-6" or 25'-0" W-Beam Panels for normal spans, and use 9'-4½" Panels for end connections to adjoining segments as shown. A single 6'-3" Panel may be used at the end of the Low-Speed Guardrail run along with a single reduced 6'-3" post spacing to meet the nominal Begin/End Guardrail Sta. required.

   Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the Plans, obtain approval from the Engineer prior to installation.

2. MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

   Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.

3. CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.

4. W-BEAM PANEL DETAILS: See Sheet 4.

5. POST & OFFSET BLOCK DETAILS: See Sheet 5.

6. GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.

7. MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 23 for additional post mounting options.

8. RESTRICTIONS: Low-Speed Guardrail segments are not permitted for use with items including, but not limited to, Double Faced W-Beam, Deep Posts at Slope Breaks, Raised Curb, Pipe Rail, and/or Rub Rail.

LOW-SPEED, TL-2 GUARDRAIL DETAILS

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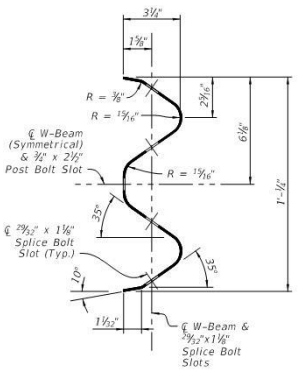
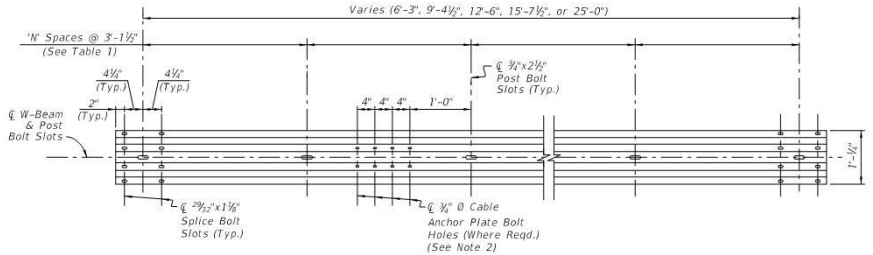
LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
11/01/19						536-001	3 of 24



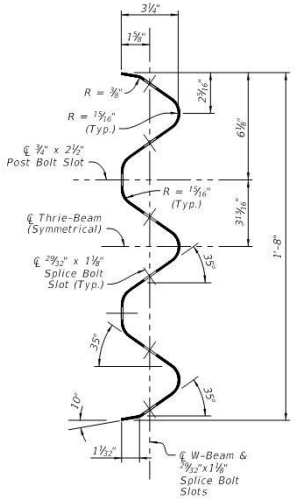
W-BEAM PANEL SECTION



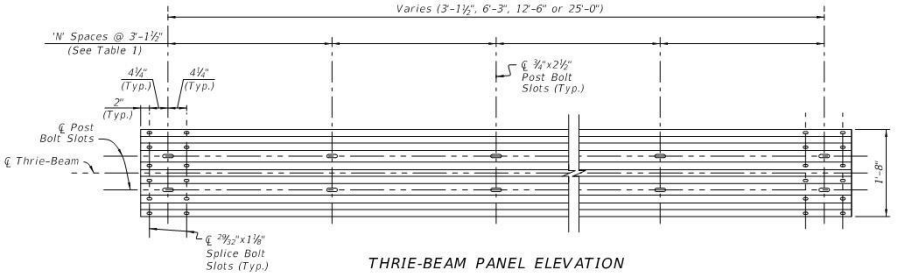
W-BEAM PANEL ELEVATION

PANEL SUMMARY TABLE:

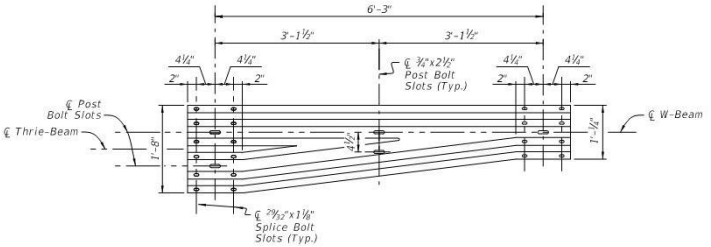
Panel Type	Number of Spaces 'N'	Gauge
6'-3" W-Beam	2	12
9'-4½" W-Beam	3	12
12'-6" W-Beam	4	12
15'-7½" W-Beam	5	12
25'-0" W-Beam	8	12
3'-1½" Thrie-Beam	1	10
6'-3" Thrie-Beam	2	12
12-6" Thrie-Beam	4	12
25-0" Thrie-Beam	8	12
Thrie-Beam Trans.	2	10



THRIE-BEAM PANEL SECTION



THRIE-BEAM PANEL ELEVATION



THRIE-BEAM TRANSITION PANEL ELEVATION
(Reverse Direction Similar by Opposite Hand)

NOTES:

1. MATERIALS:
   Use corrugated steel panels in accordance with Specification 967 and made from either Class A, 12 gauge steel or Class B, 10 gauge steel as specified in the 'Panel Summary Table' above.

2. CABLE ANCHOR PLATE BOLT HOLES:
   Include ¾" Ø Cable Anchor Plate Bolt Holes only where required for installation of the Cable Anchor Plate shown on Sheet 9, 10, & 11.

   29⁄32" x 1⅛" slots may substitute for the ¾" Ø holes shown.

W-BEAM AND THRIE-BEAM PANEL DETAILS

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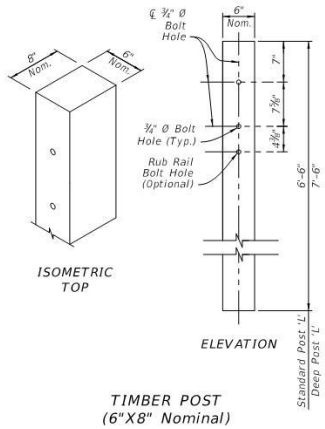
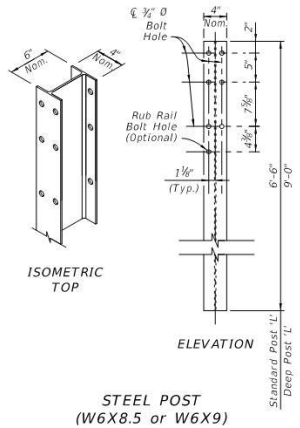
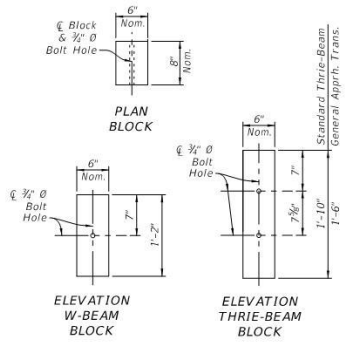
LAST REVISION 11/01/19	REVISION	DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 4 of 24



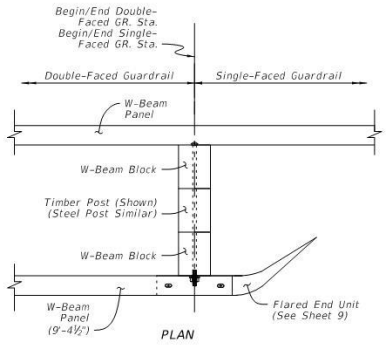
TIMBER POST
(6"X8" Nominal)



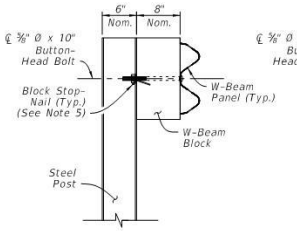
STEEL POST
(W6X8.5 or W6X9)

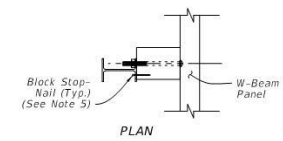


TIMBER OFFSET BLOCK
(6"X8" Nominal)

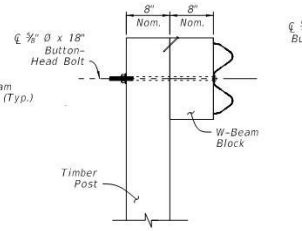


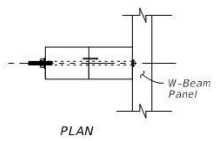
SINGLE-FACED / DOUBLE-FACED
GUARDRAIL CONNECTION



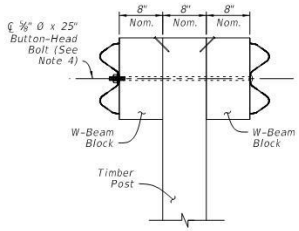


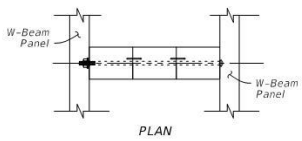
SINGLE-FACED
W-BEAM
STEEL POST



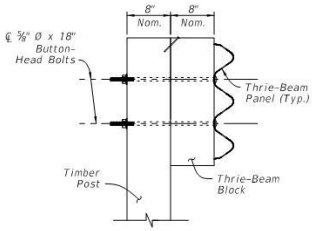


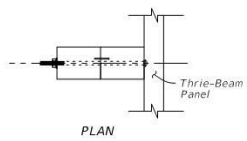
SINGLE-FACED
W-BEAM
TIMBER POST





DOUBLE-FACED W-BEAM
TIMBER POST
(Thrie-Beam Similar)
(Steel Post Similar)





THRIE-BEAM
TIMBER POST
(Steel Post Similar)

NOTES:

1. STANDARD POSTS: Where Standard Posts are called for in this Index, use either a Timber Post or Steel Post at the Length, 'L', shown for Standard Posts. Use a single post material type consistently per each run of guardrail. Only where specified in the Plans, use the Deep Post 'L' for Slope Break Conditions as shown on Sheet 6.
2. OFFSET BLOCKS: For each Panel type, install the corresponding Offset Block type as shown. For General, TL-3 (Single Faced) Approach Transitions only, use the 1'-6" Thrie-Beam Block (See Sheet 13).
3. BOLT HOLES: ¾" Ø Bolt Holes shown in posts within this Index may be substituted with 13/16" Ø Bolt Holes.
4. DOUBLE FACED GUARDRAIL: Orient Post Bolts with the Button-Head located on the side nearest the traffic lane. The bolt's threaded portion is not permitted to extend beyond ⅜" from the face of the tightened nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.
5. BLOCK STOP-NAIL: Drive one nail per Standard Offset Block as shown to prevent Block rotation. Use steel 3½" Type 16d nails with ASTM A153 hot-dip galvanization. For steel posts, drive the nail through the unused flange Bolt Hole and bend the nail so its head contacts the flange.
6. MATERIALS: Use timber and steel posts and offset blocks in accordance with Specification 967. Composite offset blocks may be substituted as approved on the APL. Use a single offset block type consistently per each run of guardrail. Steel offset blocks are only permitted for Modified Thrie Beam.

POST AND OFFSET BLOCK DETAILS

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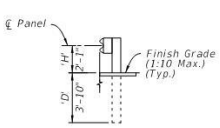
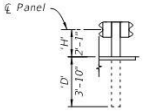
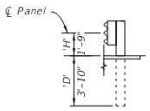


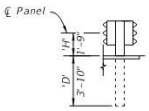
W-BEAM



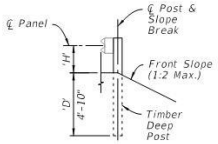
DOUBLE FACED W-BEAM



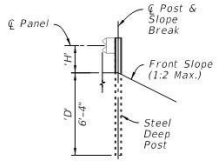
THRIE-BEAM



DOUBLE FACED THRIE-BEAM

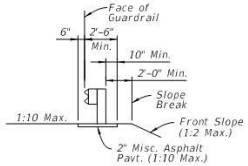


SLOPE BREAK CONDITION TIMBER DEEP POST

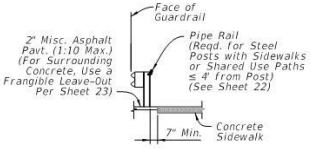


SLOPE BREAK CONDITION STEEL DEEP POST

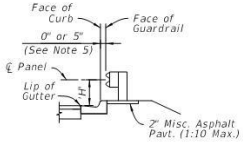
GUARDRAIL TYPES - MOUNTING HEIGHTS & POST DEPTHS



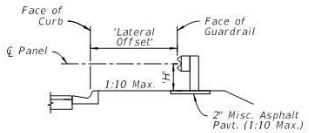
TYPICAL GRADING & PAVT. PLACEMENT DETAIL (See Note 2)



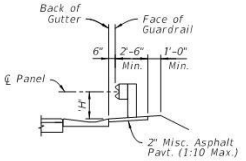
TYPICAL SIDEWALK DETAIL (Work with Other Sections as Reqd.)



ADJACENT TO CURB (Type F Curb Shown)



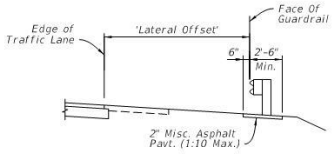
BEHIND CURB (Type F Curb Shown)



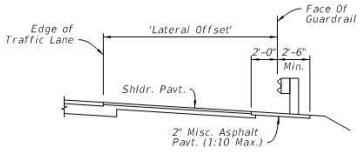
ADJACENT TO SHOULDER GUTTER

GUARDRAIL SECTIONS - TYPICAL

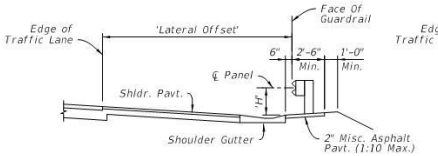
GUARDRAIL SECTIONS - CURB & GUTTER



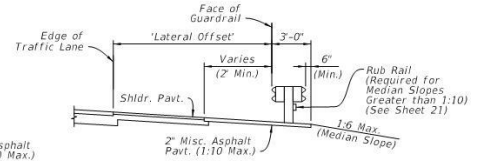
UNPAVED OR PARTIALLY PAVED SHOULDER



FULLY PAVED SHOULDER



SHOULDER GUTTER



DOUBLE FACED GUARDRAIL (Shown In Median)

GUARDRAIL SECTIONS - SHOULDERS

GUARDRAIL HEIGHT SUMMARY TABLE:			
Type:	Min. Depth 'D':	Mounting Height 'H':	Post Length 'L':
W-Beam (Single and Double Faced)	3'-10"	2'-1"	6'-6"
Thrie-Beam (Single and Double Faced)	3'-10"	1'-9"	6'-6"
Timber Deep Post	4'-10"	See Above	7'-6"
Steel Deep Post	6'-4"	See Above	9'-0"

NOTES:

1. GUARDRAIL SECTIONS: Construct Sections as indicated in the plans. The details shown herein depict W-Beam Guardrail, but are applicable to the other defined Guardrail Types placed at the corresponding height, 'H'. Use components per Sheets 4 & 5. Steel and timber post types are interchangeable unless otherwise defined. The 1:10 Max. cross slope shown is the maximum slope permitted for proper guardrail function, but project-specific cross slope requirements are governed per the plans.
2. TYPICAL GRADING & PAVEMENT PLACEMENT DETAIL: Construct features as depicted except where superceded by specific Guardrail Sections or the plans. Place the Slope Break a Minimum of 2' behind the post. For Deep Posts, the slope break may be placed at the ℄ Post with the 2" Miscellaneous Asphalt Pavement omitted.
3. SLOPE BREAK CONDITION: Install Deep Posts only where called for in the plans. Deep Posts are only permitted where post spacing is 6'-3" or less.
4. LATERAL OFFSETS: The Lateral Offsets shown are governed by the station and offset call outs for Face of Guardrail, as shown in the plans.
5. ADJACENT TO CURB: Place the Face of Guardrail consistently offset either flush with the Face of Curb or 5" behind the Face of Curb, as indicated by the plans station and offset callout. For offset changes, transition the Face of Guardrail as shown in the plans.

GUARDRAIL SECTIONS

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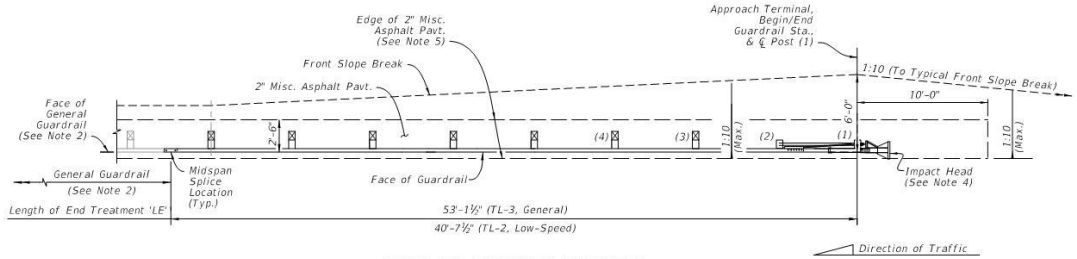


APPROACH TERMINAL ASSEMBLY
'PARALLEL' TYPE - PLAN VIEW

NOTES:

1. INSTALLATION: Locate Approach Terminals where called for in the plans, with the Post (1) ℄ placed at the Begin/End Guardrail Station indicated in the plans.

   The Plan Views shown herein are schematic only, showing basic geometry for Approach Terminals listed on the APL. The predefined Length of End Treatment, 'LE', includes the proprietary portion of various Approach Terminals and provides for more consistent planning of assembly installations across the differing Approach Terminal types. Forward-anchoring style Approach Terminals may vary from the planned lengths shown by up to 3'-0".

   Construct Approach Terminals as shown in the APL and in accordance with the manufacturer's unique drawing details, procedures, and specifications.

   Install posts in accordance with the manufacturer's drawings. The Special Posts on Sheet 23, including Special Steel Posts, Encased Posts, and Frangible Leave-Outs, are not permitted within the Approach Terminal segment unless otherwise called for in the plans.

   Align panel lap splices in accordance with the manufacturer's drawings, regardless of the direction of traffic.

   Install adjacent grading, gutters, and/or curbing as shown herein.

2. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments.

   Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

3. APPROACH TERMINAL TEST LEVEL: Install either a Test Level 3 (TL-3) or Test Level 2 (TL-2) Approach Terminal as specified in the plans. TL-3 Approach Terminals may substitute for TL-2 Approach Terminals unless the substitution is specifically prohibited in the plans. TL-2 Approach Terminals may not substitute for TL-3 installations.

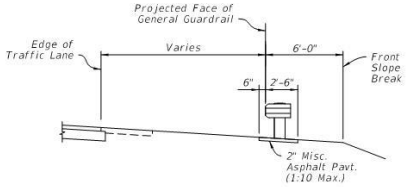
4. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.

5. 2" MISCELLANEOUS ASPHALT PAVEMENT: The Plan View depicts the Unpaved Shoulder condition. For Fully Paved Shoulder and Shoulder Gutter conditions, extend the 2" Misc. Asphalt Pavement as shown in the corresponding 'Section at Post (1)' details below.

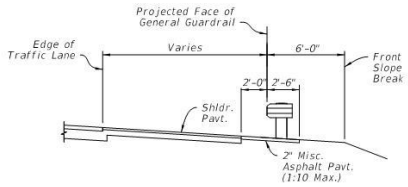
   The 2" Misc. Asphalt Pavement shown upstream of Post (1) may be substituted with a different pavement type where called for in the Plans.

6. CLEAR AREA REQUIREMENT: Do not place any permanent aboveground installations within the areas shown with 1:10 maximum grading. For the finished condition, keep this area free of all aboveground obstructions, including dense vegetation and trees.

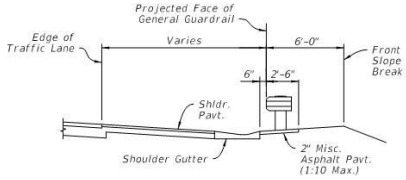
7. 'CURBED' AND 'DOUBLE FACED' GUARDRAIL SEGMENTS: See Sheet 8.



SECTION AT POST (1)
WITH UNPAVED SHOULDER



SECTION AT POST (1)
WITH FULLY PAVED SHOULDER



SECTION AT POST (1)
WITH SHOULDER GUTTER

END TREATMENT -
APPROACH TERMINAL
GEOMETRY - PARALLEL

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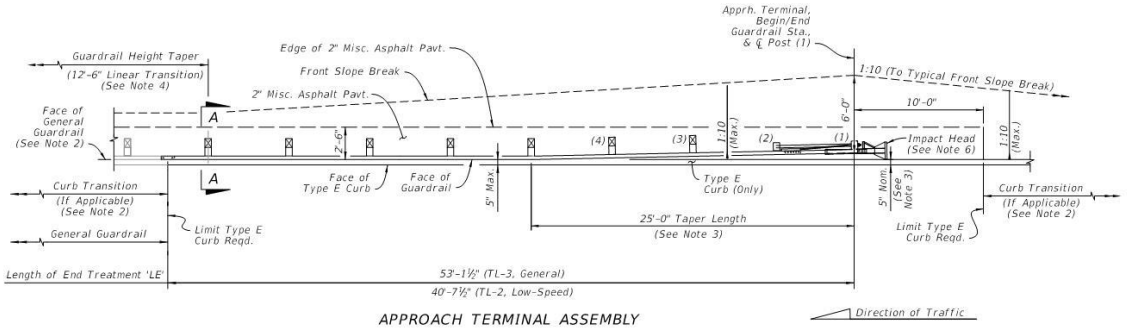
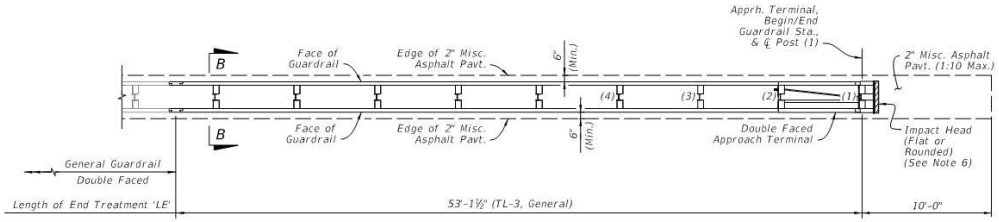
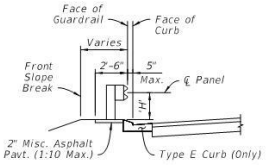


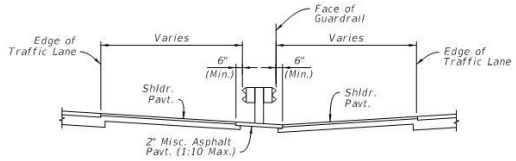
APPROACH TERMINAL ASSEMBLY
'CURBED' SEGMENT - PLAN VIEW



APPROACH TERMINAL ASSEMBLY
'DOUBLE FACED' SEGMENT - PLAN VIEW



'CURBED' SECTION A-A
(Height, 'H', Measured from
Misc. Asphalt Pavt.)



'DOUBLE FACED' SECTION B-B
(1:10 Slope or Flatter Reqd.)

NOTES:

1. GENERAL: See Notes 1 through 3 on Sheet 7.
2. CURBED SEGMENTS: Type E curb is required within the limits shown. When a different curb type is called for outside of the Type E curb limits, transition the curb shape linearly, over a nominal distance ranging 5'-0" to 10'-0".
3. TAPER LENGTH: For Curbed Segments, taper the guardrail away from the roadway where shown to place the inside edge of the Impact Head at 5" behind the face of the curb. Where additional lateral offset is required to fit the Approach Terminal Assembly hardware, such as a soil plate, place the Impact Head as close to the curb as the hardware allows, not to exceed 2'-0" from the face of curb.
4. GUARDRAIL HEIGHT TAPER: For Curbed Segments, the connecting General Guardrail Mounting Height, 'H', is typically measured from the Lip of Gutter (See Sheet 6 Guardrail Sections, 'Adjacent to Curb'), while the End Terminal Assembly 'H' is measured from the Misc. Asphalt Pavt. (See Section A-A). Linearly taper the difference in Mounting Height over a minimum length of 12'-6", starting where indicated herein.
5. DOUBLE FACED SEGMENT: Connect to Double Faced General Guardrail. Use consistent Posts and Offset Block types as specified in the APL drawings over the entire Length of End Treatment, 'LE'. Posts and Offset Blocks in the adjoining General Guardrail segment may be different from those inside of the 'LE'. A change in post type between timber and steel is permitted, immediately outside of the 'LE' segment.

   Maintain the 1:10 maximum grading as shown in Section B-B throughout segment 'LE'. Where required, transition to differing adjacent slopes linearly, over a minimum longitudinal length of 25'-0".
6. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.
7. CLEAR AREA REQUIREMENT: Do not place any permanent aboveground installations within the areas shown with 1:10 maximum grading. For the finished condition, keep this area free of all aboveground obstructions, including dense vegetation and trees.
8. 2" MISCELLANEOUS ASPHALT PAVEMENT: The 2" Misc. Asphalt Pavement shown upstream of Post (1) may be substituted with a different pavement type where called for in the Plans.
9. SINGLE FACED 'PARALLEL' SEGMENTS: See Sheet 7.

END TREATMENT -
APPROACH TERMINAL GEOMETRY
CURBED AND DOUBLE FACED

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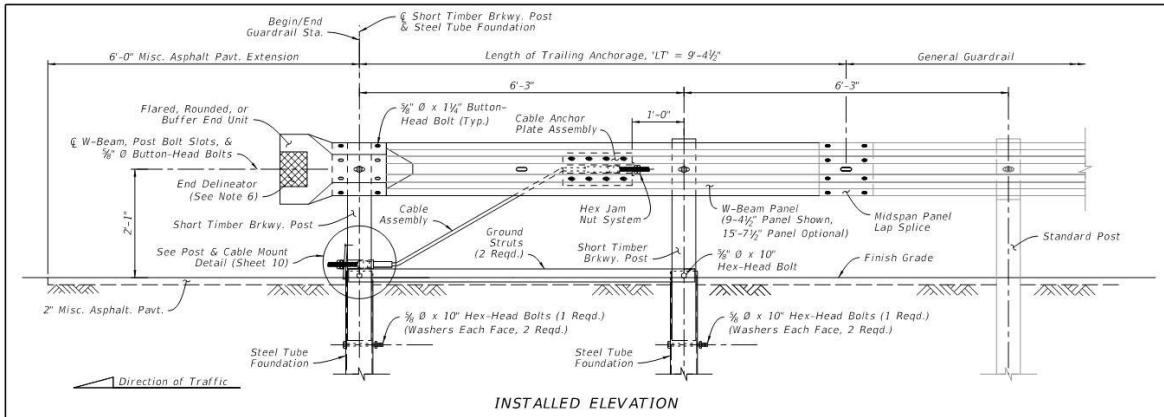
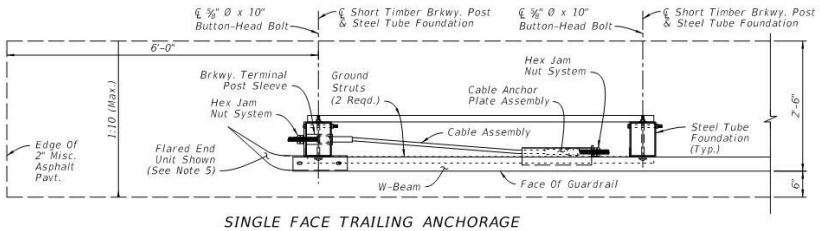
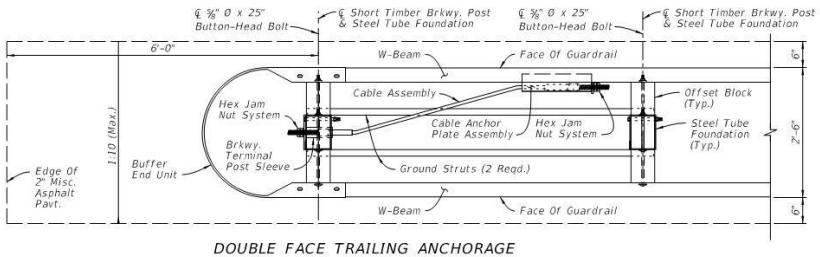


INSTALLED ELEVATION



SINGLE FACE TRAILING ANCHORAGE
INSTALLED PLAN



DOUBLE FACE TRAILING ANCHORAGE
INSTALLED PLAN

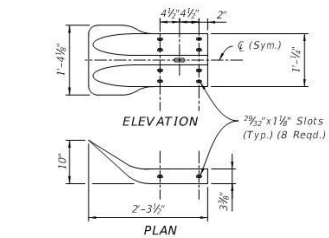
NOTES:

1. COMPONENT DETAILS: For additional component details, See Sheet 10.
2. END UNITS: Use materials for end units as defined in Specifications Section 967. End Units are referred to as "End or Buffer Sections" in AASHTO M180.

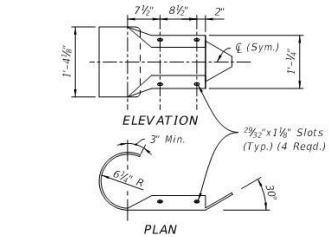
   Lap the Flared End Unit behind the W-Beam; lap the Rounded and Buffered End Units over the face of the W-Beam.
3. FOUNDATIONS: Install Steel Tubes by either of the following methods:

   a. Excavate, backfill, and compact material to provide full passive soil resistance to the surface of the Tube.

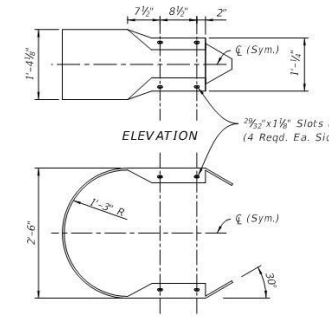
   b. Drive the Tube using a dummy timber post to prevent damage to the Breakaway Post.
4. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.
5. SIDEWALK REQUIREMENTS: When sidewalks are located adjacent to the End Treatment, install a Rounded End Unit (Flared End Unit not permitted for this case).
6. END DELINEATOR: Mount retroreflective sheeting to the approach face of the End Unit in accordance with Specification Sections 536 and 967.



FLARED END UNIT



ROUNDED END UNIT



BUFFER END UNIT

END TREATMENT - TRAILING ANCHORAGE

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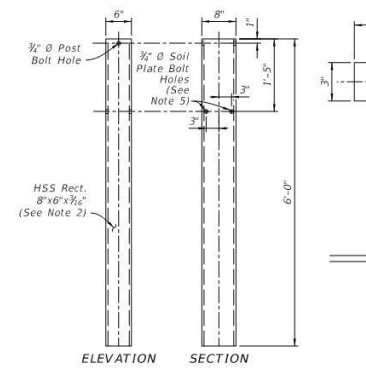
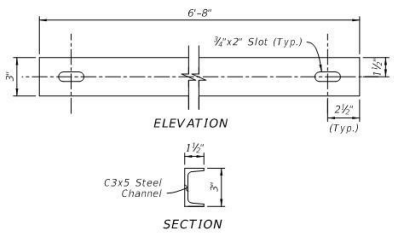
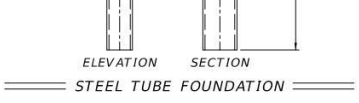


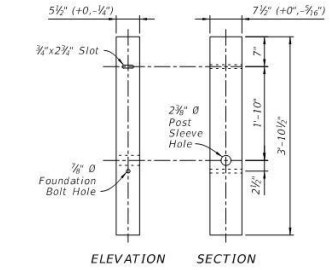
STEEL TUBE FOUNDATION



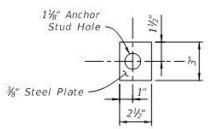
GROUND STRUT



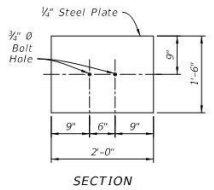
BREAKAWAY TERMINAL POST SLEEVE



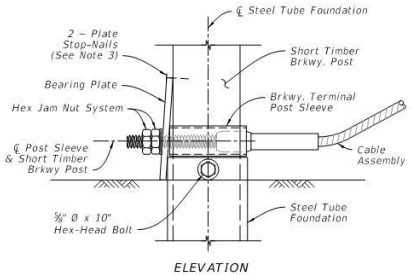
SHORT TIMBER BREAKAWAY POST (6"x8" Nom.)



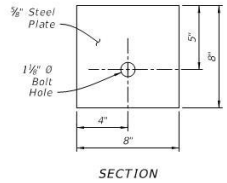
STEEL END PLATE



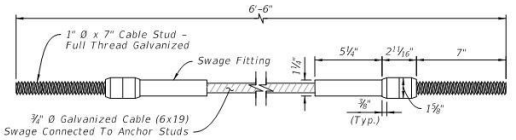
SOIL PLATE



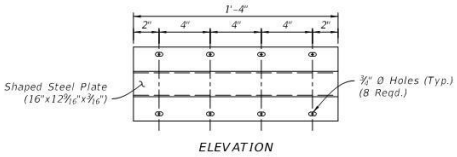
POST & CABLE MOUNT ASSEMBLY

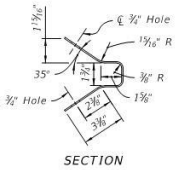


BEARING PLATE

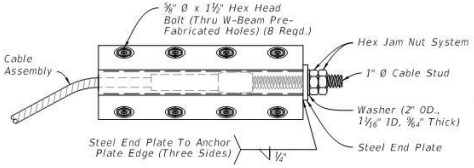


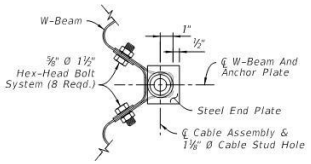
CABLE ASSEMBLY





CABLE ANCHOR PLATE





CABLE ANCHOR PLATE ASSEMBLY

NOTES:

1. *INSTALLATION:* Use components as shown on Sheets 9 & 11.
2. *MATERIALS:* Use steel plates, channels, and Cable Assemblies in accordance with Specification 967.

   Use Short Timber Breakaway Posts and Steel Tube Foundations in accordance with Specification 536.

   Use Hex Nuts, Hex Jam Nuts, and Washers in accordance with the AASHTO-AGC-ARTBA Guide to Standardized Barrier Hardware with English unit equivalents of components FNX24a and FWC24a, respectively. Two Hex Nuts may be used for the Hex Jam Nut System.
3. *PLATE STOP-NAILS:* To prevent rotation of the Bearing Plate, drive steel 2½" Type 8d nails with ASTM A153 hot-dip galvanization.
4. *CABLE ANCHOR PLATE ASSEMBLY INSTALLATION:* Mount to the pre-fabricated Cable Anchor Plate Bolt Holes in the W-Beam Panel, as shown on Sheet 4. These panel holes are only permitted for this Cable Anchor Plate Assembly application.
5. *SOIL PLATE BOLT HOLE(S):* For Trailing Anchorage installations as shown on Sheet 9, the two bolt holes shown may be substituted with a single bolt hole located at the tube centerline.

END TREATMENT - COMPONENT DETAILS

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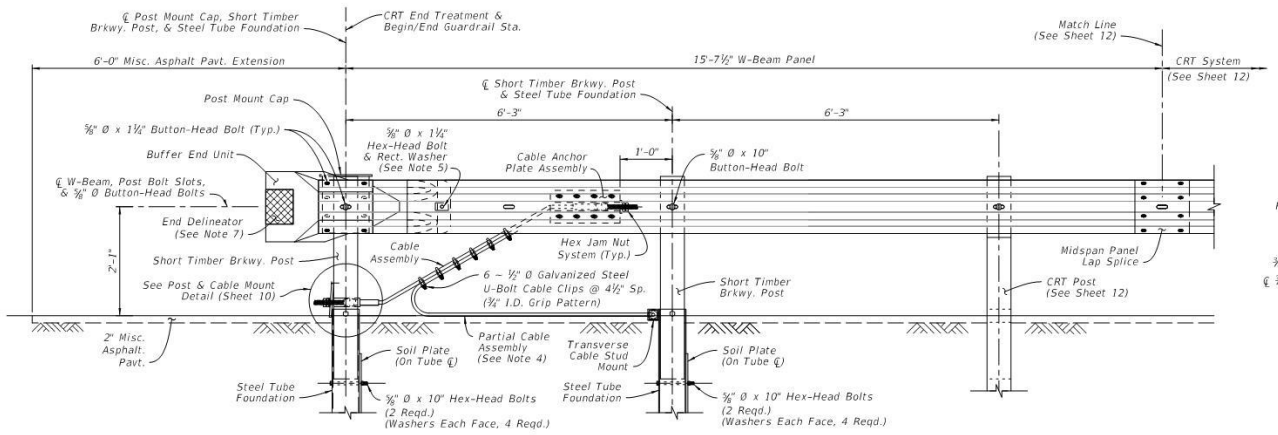

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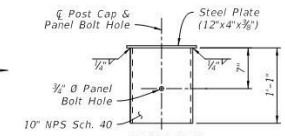
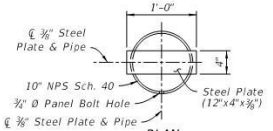
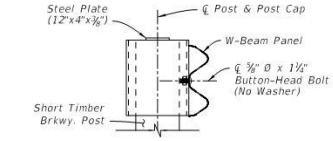


ELEVATION

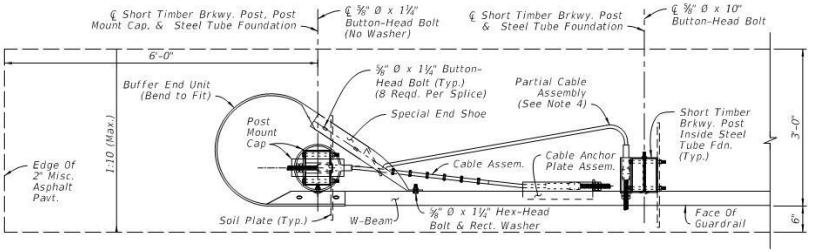


PLAN



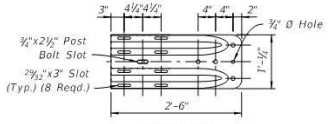
INSTALLED SECTION

POST MOUNT CAP

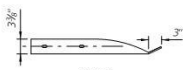


INSTALLED PLAN

CRT END TREATMENT ASSEMBLY

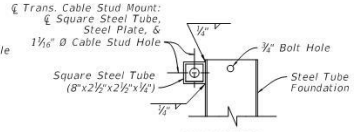


ELEVATION

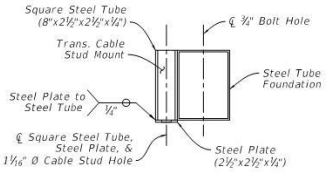


PLAN

SPECIAL END SHOE



ELEVATION



PLAN

TRANSVERSE CABLE STUD MOUNT

NOTES:

1. INSTALLATION: Use with CRT Systems as required on Sheet 12.
2. COMPONENT DETAILS: For additional component details, See Sheet 10 & 12. For the Rectangular Washer detail, see Sheet 24.
3. MATERIALS: Use steel End Shoes, Plates, Tubes, and pipes in accordance with Specification 967.
4. PARTIAL CABLE ASSEMBLY: The Partial Cable Assembly is similar to the Cable Assembly defined on Sheet 10, except with a 9'-0" total length and the Swage Fitting and Cable Stud omitted from one end.

   Feed the Cable Stud through the Cable Stud Hole of the Transverse Cable Stud Mount as shown, and secure it with the Hex Jam Nut System as defined on Sheet 10.
5. SPECIAL END SHOE MOUNT: Punch a ¾" Ø hole in the W-Beam Panel as needed to secure the Special End Shoe with the ⅜" Ø Hex-Head Bolt. Galvanize hole per Specification 562.
6. FOUNDATIONS: Install Steel Tubes with attached Soil Plates by either of the following methods:

   a. Excavate, backfill, and compact material to provide full passive soil resistance to all surfaces of the tube and soil plate.

   b. Drive the steel tube and soil plate as a single unit using a dummy timber post to prevent damage to the breakaway post.
7. END DELINEATOR: Mount retroreflective sheeting to the approach face of the Buffer End Unit in accordance with Specifications 536 and 967.

END TREATMENT - CONTROLLED RELEASE TERMINAL (CRT) SYSTEM

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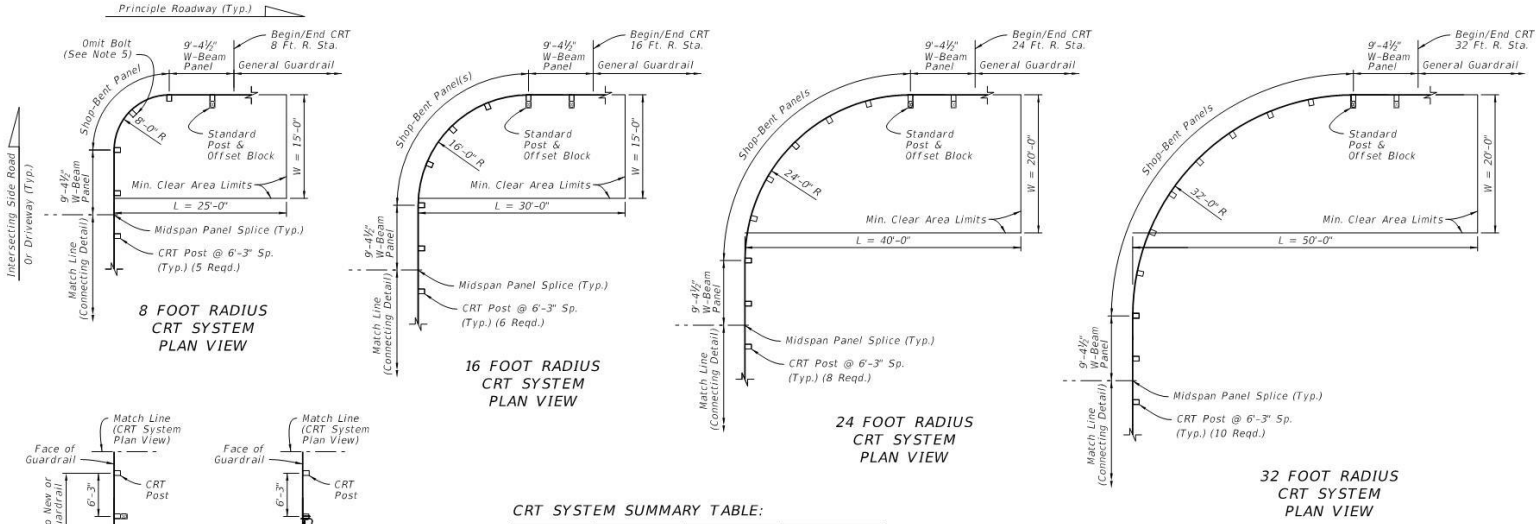
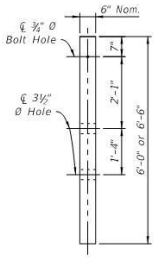


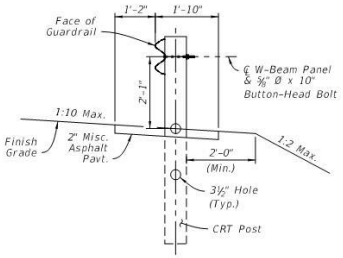
CONNECTING DETAIL

CRT SYSTEM SUMMARY TABLE:

RETURN RADIUS (FT.)	LENGTH OF SHOP-BENT PANEL(S) (FT.)	QUANTITY OF CRT POSTS	AREA CLEAR OF HAZARDS 'L' x 'W' (FT.)
8	12.5	5	25 x 15
16	25.0	6	30 x 15
24	37.5	8	40 x 20
32	50.0	10	50 x 20



CRT POST ELEVATION (6"x8" Nom. Timber)



CRT INSTALLED SECTION

NOTES:

1. INSTALLATION: Construct the specified radius layout and Connecting Detail option as shown in the plans.
2. MIN. CLEAR AREA: Keep the area behind the CRT free of fixed objects and aboveground hazards within the Min. Clear Area limits shown. Maintain a slope not steeper than 1:10 for a minimum 2' behind the posts, and maintain a slope not steeper than 1:2 beyond 2' from the posts.
3. APPROACH GRADING: Maintain grading on the roadway side of the guardrail face at a maximum slope of 1:10.
4. MATERIALS: For CRT Posts, use Timber Post material in accordance with Specification 967. Use steel panels and hardware in accordance with Specification 967.
5. BOLT OMISSION: For the 8 Foot Radius CRT System only, do not place a panel-to-post mount bolt at the center CRT Post (omit the ⅞" Button-Head Bolt only at the location shown).
6. SHOP-BENT PANELS: Install Shop-Bent panel(s) where indicated using 12'-0" or 25'-0" W-Beam Panels. Splice at post locations within the CRT radius using the General configuration of ⅞" Ø Button-Head Bolts (8 reqd. per splice).
7. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

LAYOUT FOR CONTROLLED RELEASE TERMINAL (CRT) SYSTEMS - SIDE ROADS AND DRIVEWAYS

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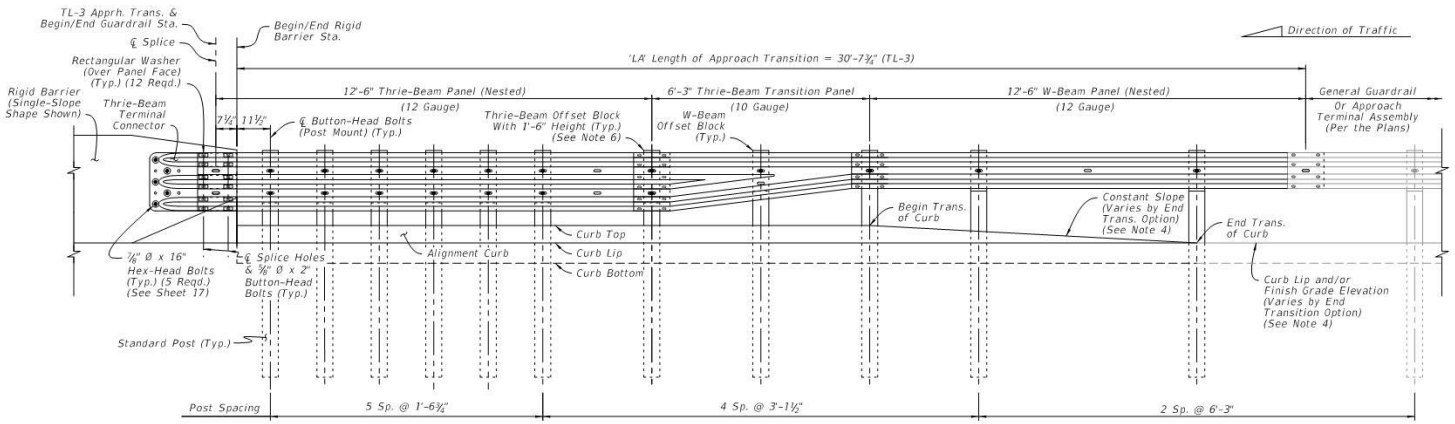
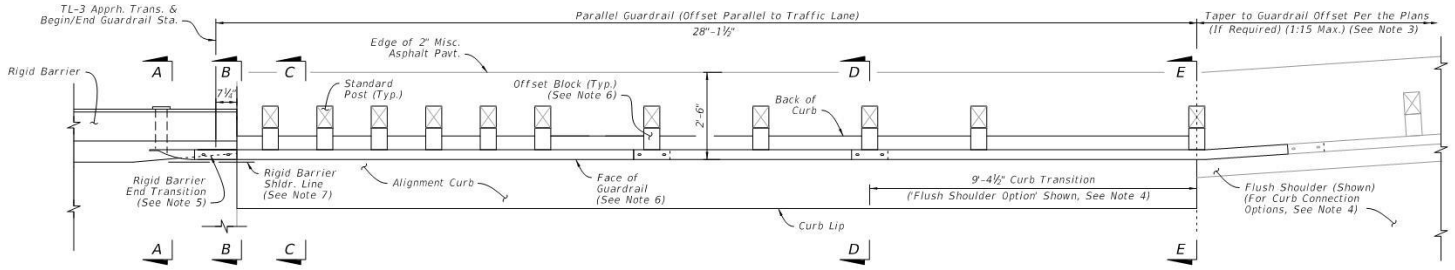


TL-3 APPROACH TRANSITION INSTALLED ELEVATION



TL-3 APPROACH TRANSITION INSTALLED PLAN

Direction of Traffic

NOTES:

1. *INSTALLATION:* Construct the Approach Transition segment where indicated in the plans. For example Layouts showing the Approach Transition's fit among other guardrail segments, see Sheet 19.

   For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.

2. *SECTION VIEWS & DETAILS:* For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.

3. *GUARDRAIL TAPER:* The connecting guardrail may require a different lateral offset if shown in the plans. At the location shown herein, taper the guardrail to the connecting guardrail offset. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.

4. *END TRANSITION OF CURB OPTIONS:* The Plan and Elevation views depict an example Curb Transition to Flush Shoulder from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option shown in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flush Shoulder Option'). See Sheet 14 for additional curb options and Sheet 17 for curb shape details.

5. *RIGID BARRIER END TRANSITION:* Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.

6. *OFFSET BLOCKS:* For Thrie-Beam post locations within the Length of Approach Transition segment, use the Timber Offset Blocks with 1'-6" height shown on Sheet 5.

   For the midspan of the Thrie-Beam Transition Panel and for all other W-Beam locations shown herein, use the W-Beam Offset Blocks with 1'-2" height.

7. *OFFSET:* The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.

8. *GENERAL GUARDRAIL:* General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

APPROACH TRANSITION CONNECTION TO RIGID BARRIER - GENERAL, TL-3

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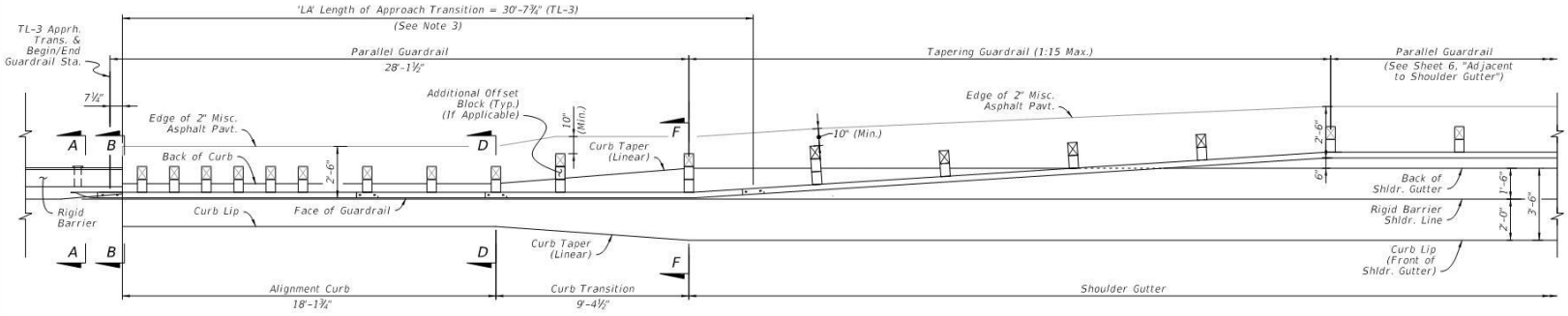
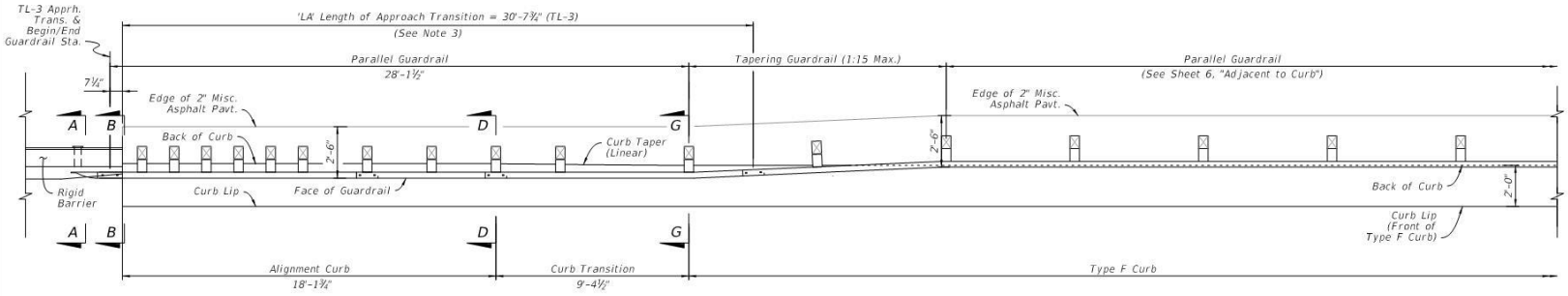


TL-3 APPROACH TRANSITION WITH 'SHOULDER GUTTER' CONNECTION - PLAN VIEW



TL-3 APPROACH TRANSITION WITH 'TYPE F CURB' CONNECTION - PLAN VIEW

NOTES:

1. GENERAL: See the applicable notes and details on Sheet 13.
2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
3. ELEVATION VIEW: For post and panel installation details within 'LA', see the elevation view on Sheet 13. The curb details will differ depending on curb option required.

APPROACH TRANSITION CONNECTION TO RIGID BARRIER - GENERAL, TL-3 CURB CONNECTIONS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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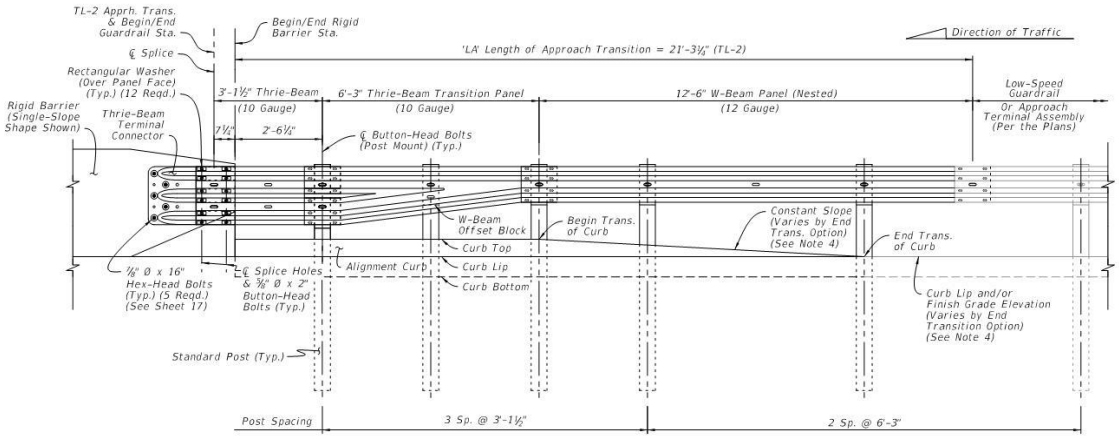
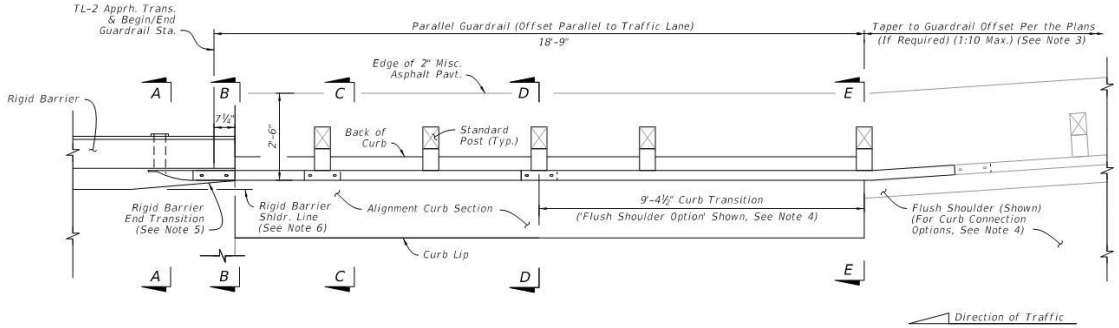


TL-2 APPROACH TRANSITION
INSTALLED ELEVATION



TL-2 APPROACH TRANSITION
INSTALLED PLAN

NOTES:

1. *INSTALLATION: Construct the Approach Transition segment where indicated in the plans. For example Layouts showing the Approach Transition's fit among other guardrail segments, see Sheet 19.*

   For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.

2. *SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.*

3. *GUARDRAIL TAPER: The connecting guardrail may require a different lateral offset if shown in the plans. At the location indicated herein, taper the guardrail to the connecting guardrail offset. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.*

4. *END TRANSITION OF CURB OPTIONS: The Plan and Elevation views depict an example Curb Transition to Flush Shoulder from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option shown in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flush Shoulder Option'). See Sheet 16 for additional curb options and Sheet 17 for curb shape details.*

5. *RIGID BARRIER END TRANSITION: Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.*

6. *OFFSET: The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.*

7. *GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.*

APPROACH TRANSITION CONNECTION
TO RIGID BARRIER - LOW-SPEED, TL-2

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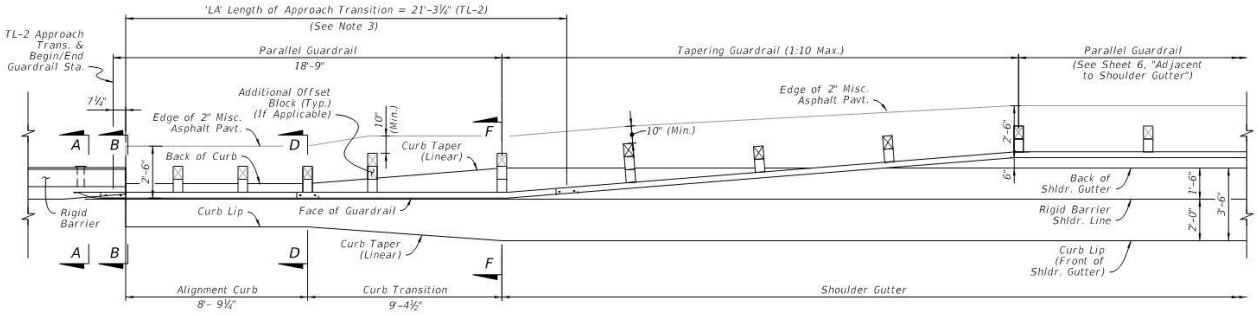
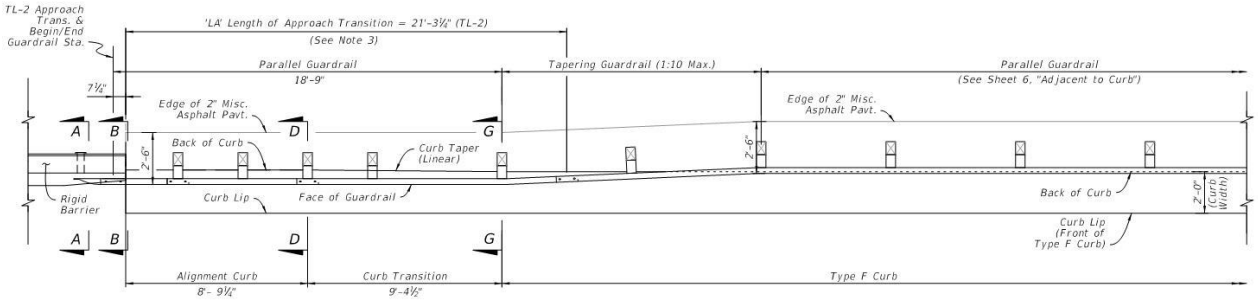


TL-2 APPROACH TRANSITION WITH 'SHOULDER GUTTER' CONNECTION - PLAN VIEW



TL-2 APPROACH TRANSITION WITH 'TYPE F CURB' CONNECTION - PLAN VIEW

NOTES:

1. GENERAL: See the applicable notes and details on Sheet 15.
2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
3. ELEVATION VIEW: For post and panel installation details within 'LA', see the elevation view on Sheet 15. The curb details will differ depending on curb option required.

APPROACH TRANSITION CONNECTION TO RIGID BARRIER - LOW-SPEED, TL-2 CURB CONNECTIONS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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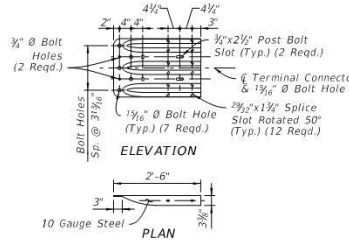
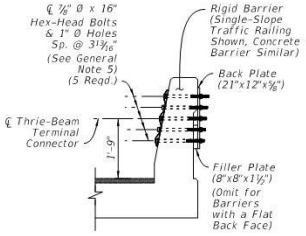
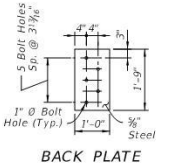


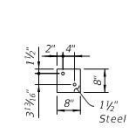
THRIE-BEAM TERMINAL CONNECTOR DETAIL



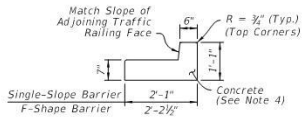
SECTION A-A
RIGID BARRIER TERMINAL CONNECTOR MOUNT



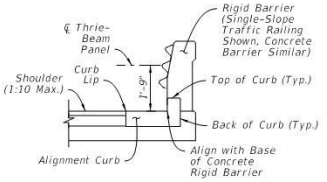
BACK PLATE



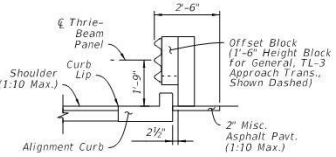
FILLER PLATE



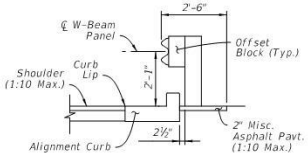
ALIGNMENT CURB SECTION



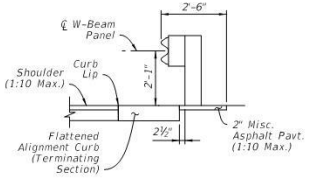
SECTION B-B
BEGIN ALIGNMENT CURB
(Mate to Rigid Barrier)



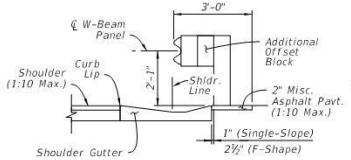
SECTION C-C
ALIGNMENT CURB
(Intermediate)



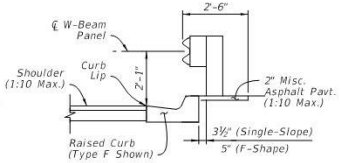
SECTION D-D
BEGIN TRANSITION
(End Alignment Curb)



SECTION E-E
END TRANSITION
FLUSH SHOULDER OPTION

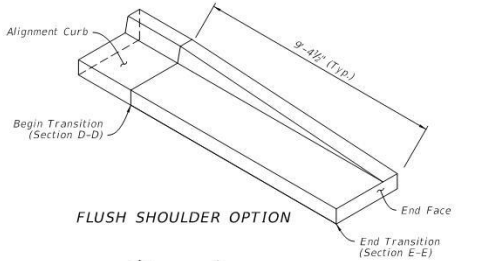


SECTION F-F
END TRANSITION
SHOULDER GUTTER OPTION

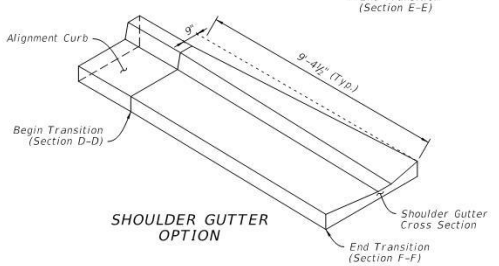


SECTION G-G
END TRANSITION
RAISED CURB OPTION

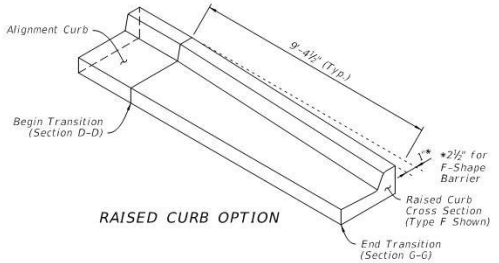
CURB TYPICAL SECTIONS



FLUSH SHOULDER OPTION



SHOULDER GUTTER OPTION



RAISED CURB OPTION

CURB TRANSITION ISOMETRIC VIEWS

NOTES:

1. PLAN AND ELEVATION VIEWS: Work with Sheets 13 thru 16.
2. END TRANSITION OF CURB OPTION: Install one of the three End Transition types shown per Section E-E as indicated by the plans.
3. GRADING BEHIND POSTS: Place Slope Break a Min. 2'-0" behind the post, per Sheet 6.
4. MATERIALS & CONSTRUCTION: Construct the concrete Aligning Curb and Curb transition in accordance with Specification 520. Use steel Plates and Thrie-Beam Terminal Connectors in accordance with Specification 967.

APPROACH TRANSITION CONNECTION - DETAILS

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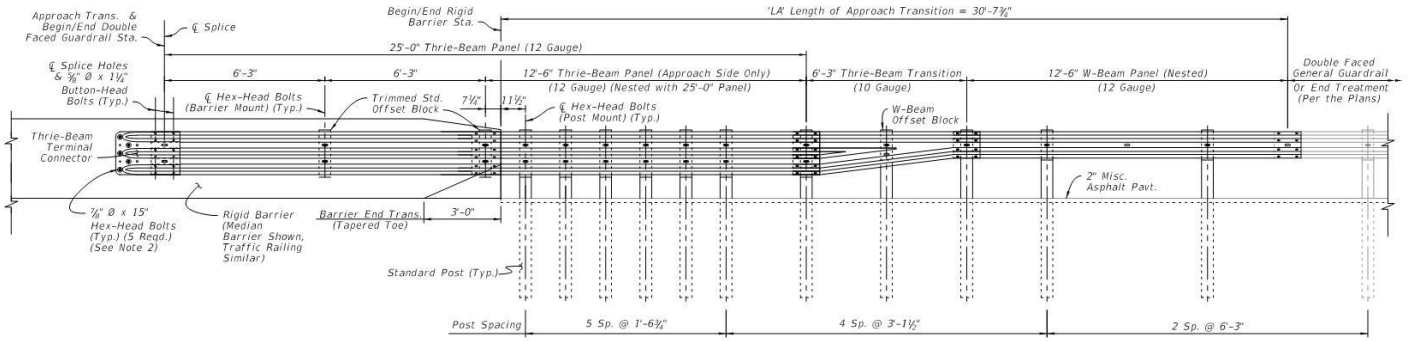
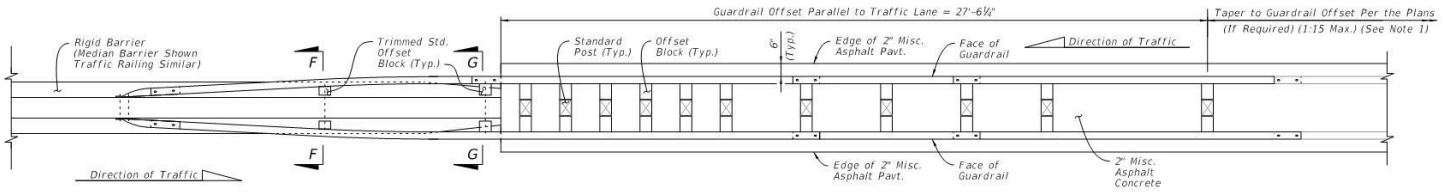


TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED ELEVATION



TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED PLAN

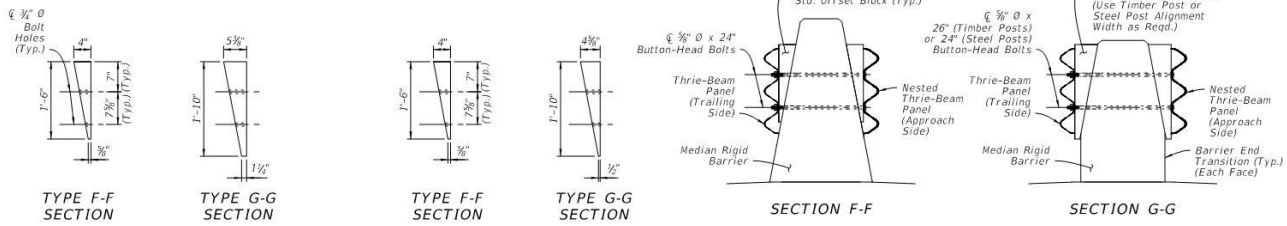
NOTES:

1. INSTALLATION: Construct the Approach Transition segment where indicated in the plans. The required offset of the connecting adjacent guardrail is shown in the plans.

   The Layout given on Sheet 20 provides a basic scheme for connections to adjacent guardrail, where a taper to a differing guardrail offset may be required. If the adjacent guardrail has the same offset as the Approach Transition segment, then no taper is required.

2. THRIE-BEAM TERMINAL CONNECTOR: See Sheet 17 for Details. The installed bolt's threaded portion is not permitted to extend beyond ¾" from the face of the nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.

3. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. End Treatments or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.



APPROACH TRANSITION CONNECTION TO
RIGID BARRIER WITH DOUBLE FACED GUARDRAIL

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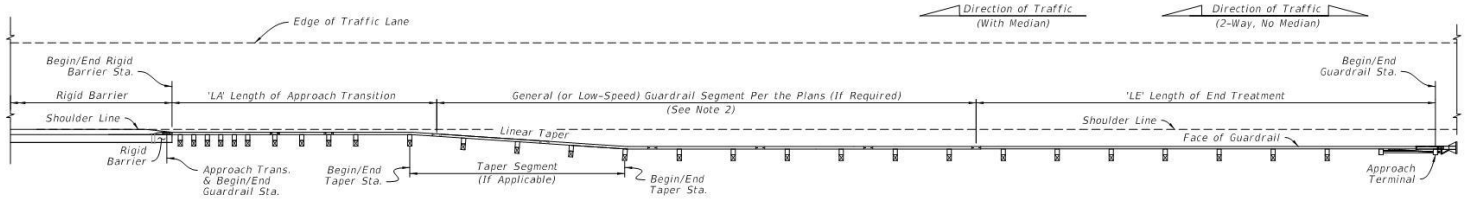
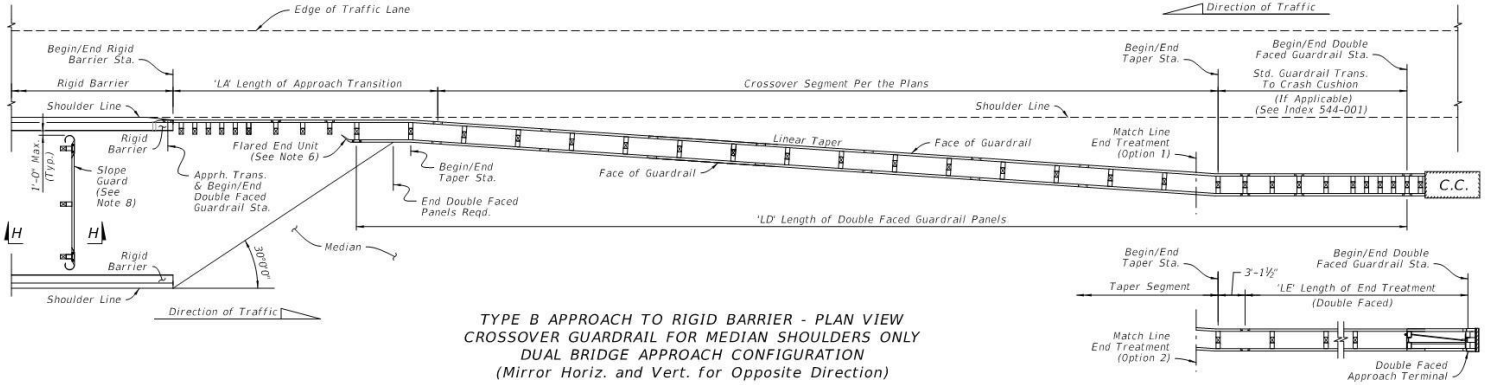
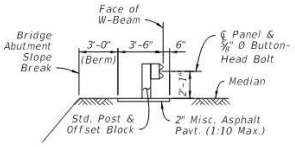
LAST REVISION 11/01/19	REVISION DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 18 of 24



TYPE A APPROACH TO RIGID BARRIER - PLAN VIEW
MEDIAN OR OUTSIDE SHOULDERS
(Mirror Horiz. and/or Vert. for Opposite Direction and/or Side of Road)



TYPE B APPROACH TO RIGID BARRIER - PLAN VIEW
CROSSOVER GUARDRAIL FOR MEDIAN SHOULDERS ONLY
DUAL BRIDGE APPROACH CONFIGURATION
(Mirror Horiz. and Vert. for Opposite Direction)



SECTION H-H
BRIDGE ABUTMENT
SLOPE GUARD
(Between Bridges)

NOTES:

1. *INSTALLATION: The Plan Views shown are schematic only, showing example geometry for connecting guardrail segments including taper locations and Double Faced Guardrail requirements as applicable. Work this Sheet with the plans, where stationing and offsets for Begin/End Guardrail, Begin/End Rigid Barrier, and Begin/End Taper are specified. For existing bridge layouts, see Index 536-002, 521-404, and 521-405.*
2. *GENERAL (OR LOW-SPEED) GUARDRAIL SEGMENT: Construct this segment if shown in the plans. For the case where this segment's offset differs from the Approach Transition offset, linearly taper the guardrail between the Begin/End Taper Stations and offsets as specified in the plans.*

   For the shortest length case of a direct connection between the End Treatment and the Approach Transition, this segment may be omitted as shown in the plans.
3. *LENGTH OF APPROACH TRANSITION 'LA': Install the applicable Approach Transition as shown per Sheets 13 thru 16, where called for in the plans.*
4. *LENGTH OF END TREATMENT 'LE': Install the Approach Terminal End Treatment as shown per Sheet 7 or 8, where called for in the plans. Use the corresponding APL drawings for construction details.*
5. *CROSSOVER GUARDRAIL (FOR TYPE B APPROACH): Install the Crossover Segment tapering linearly from the Begin Taper Sta. and offset to the End Taper Sta. and offset as specified in the plans.*
6. *LENGTH OF DOUBLE FACED GUARDRAIL PANELS, 'LD' (FOR TYPE B APPROACH): Terminate the Double Faced Guardrail panels as shown (based upon the 30° line measured from the hazard on the opposite side of the median). Extend the panel segment longer than the dimension 'LD' as needed for the Panel's end Bolt Slot to align with a post Bolt hole.*

   Install a Flared End Unit where shown, as defined on Sheet 9.
7. *END TREATMENT OPTIONS (FOR TYPE B & C APPROACH): For Double Faced applications, use either a Double Faced Approach Terminal Assembly per Sheet 8 or a Crash Cushion per Index 544-001. For either Option, meet the 1:10 adjacent grading requirements for Approach Terminals as shown on Sheet 8.*
8. *SLOPE GUARD: Where indicated in the plans, install a Guardrail segment between bridge approaches and offset from the bridge abutment's Slope Break as shown. Install posts at the end bolt slots of the panel system. Use post spacing of either 3'-1½" or 6'-3", as needed to correctly fit system between barriers. The system may also be lengthened to fit by installing two Rounded End Units as defined on Sheet 9.*

LAYOUT TO RIGID BARRIER - APPROACH ENDS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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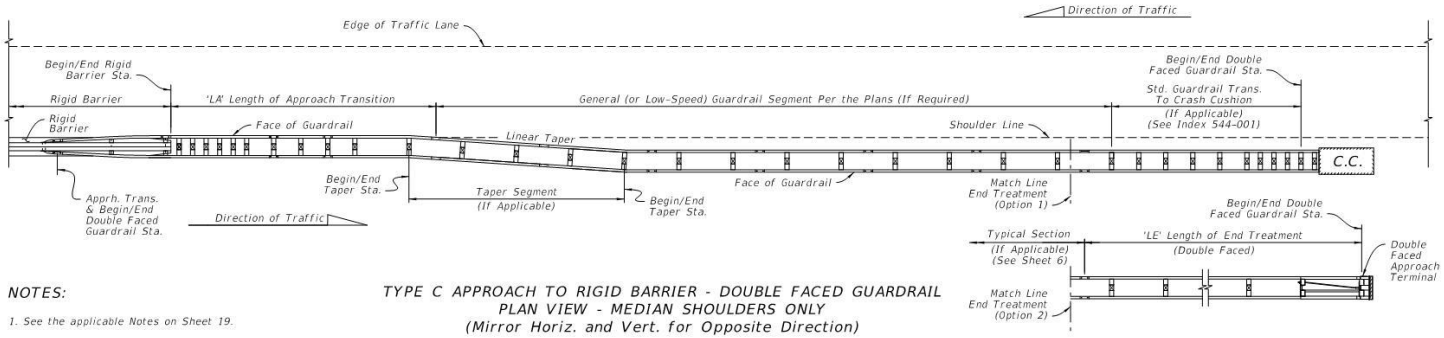
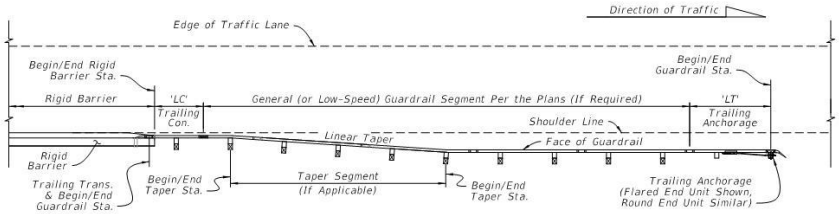


NOTES:

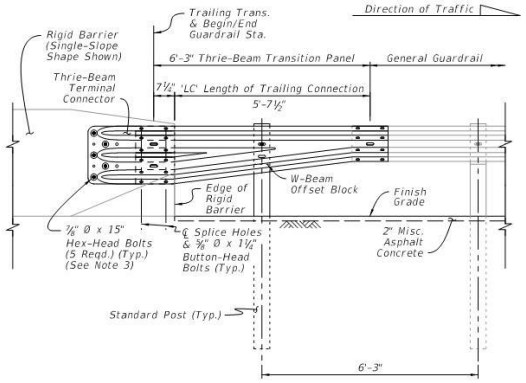
1. See the applicable Notes on Sheet 19.

TYPE C APPROACH TO RIGID BARRIER - DOUBLE FACED GUARDRAIL
PLAN VIEW - MEDIAN SHOULDERS ONLY
(Mirror Horiz. and Vert. for Opposite Direction)

LAYOUT TO RIGID BARRIER - APPROACH ENDS WITH DOUBLE FACED GUARDRAIL



TYPE D TRAILING CONNECTION FROM RIGID BARRIER
PLAN VIEW - MEDIAN OR OUTSIDE SHOULDER
(Mirror Horiz. and/or Vert. for Opposite Direction and/or Side of Road)



TRAILING END TRANSITION CONNECTION
TO RIGID BARRIER - INSTALLED ELEVATION

NOTES:

1. See the applicable Notes on Sheet 19.
2. LENGTH OF TRAILING ANCHORAGE, 'LT': Install the Trailing Anchorage as shown on Sheet 9, where called for in the plans.
3. THRIE-BEAM TERMINAL CONNECTOR: Install connector and bolts as shown on Sheet 17.
4. RIGID BARRIER SINGLE SLOPE END FACE: See Concrete Barrier Wall, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-423, for details.

LAYOUT TO RIGID BARRIER - TRAILING ENDS

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LAST REVISION	REVISION	DESCRIPTION:	FDOT FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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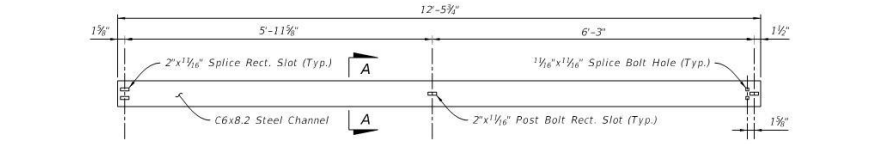
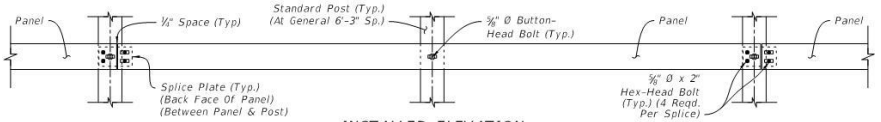
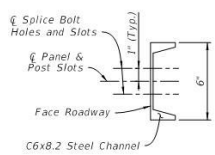
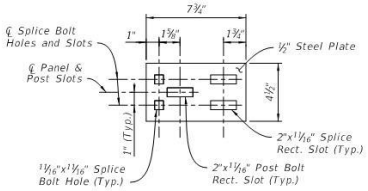




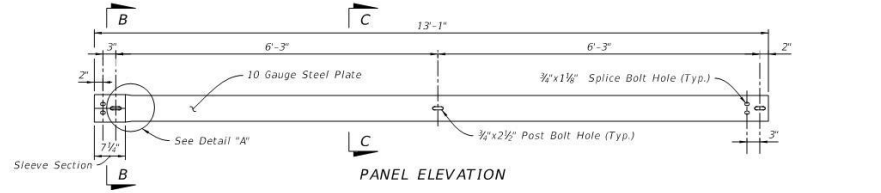


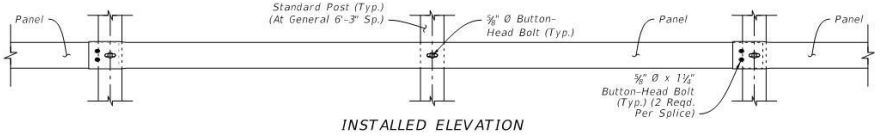
SECTION A-A
(Panel Typical)

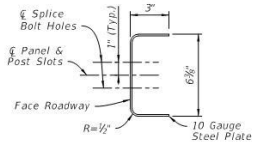


SPLICE PLATE
ELEVATION

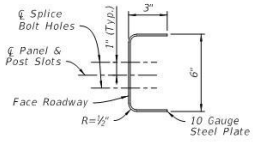
CHANNEL SECTION RUB RAIL



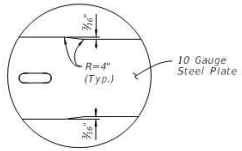




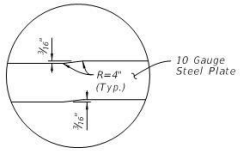
SECTION B-B
(Panel Sleeve End)



SECTION C-C
(Panel Typical)

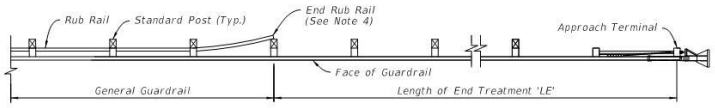


DETAIL "A"
(Sleeve Transition Elevation)



DETAIL "B"
(Sleeve Transition Plan)

BENT-PLATE PANEL RUB RAIL



RUB RAIL TERMINATION - SCHEMATIC PLAN VIEW

Direction of Traffic

NOTES:

1. GENERAL: Install Rub Rail where called for in the plans. Position as shown on Sheet 6 unless otherwise shown in the plans. Install the backs of Rub Rail panels flush against Standard Posts. Either of the Channel Section or Bent-Plate Panel Rub Rail options may be used (consistent type per project). Where Double Sided Rub Rail is called for, thread the Button-Head Bolt through the Post Bolt Hole(s) and the panels on either side, and tighten the nut against the face of the panel farthest from adjacent traffic lanes. Trim the bolt's threaded portion in accordance with Note 4 on Sheet 5.
2. MOUNTING HEIGHT: Mount to the Standard Post's Rub Rail Bolt Hole as defined on Sheet 5.
3. MATERIALS: Use steel components in accordance with Specification 967.
4. END RUB RAIL: For Single Sided Rub Rail, terminate the run of Rub Rail by bending the panel behind the post and securing in place (as shown). For Double Sided Rub Rail, terminate the runs of Rub Rail on their respective front face of the post and secure with the typical Button-Head bolt.

RUB RAIL DETAILS

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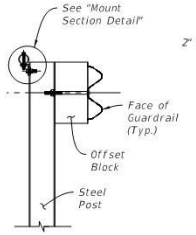
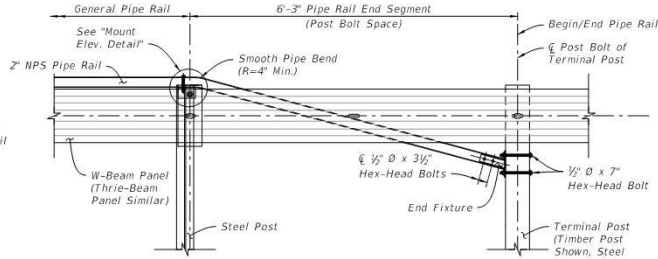
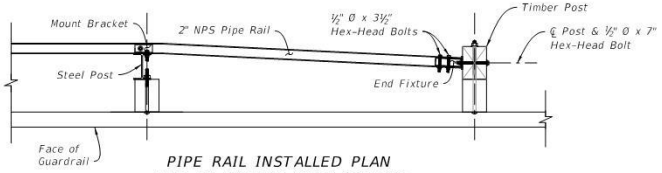


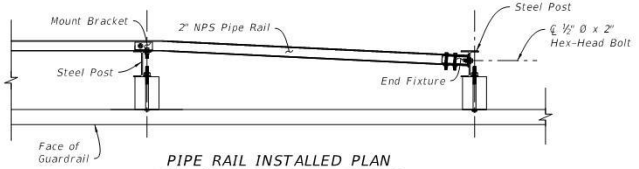
GENERAL PIPE RAIL SECTION



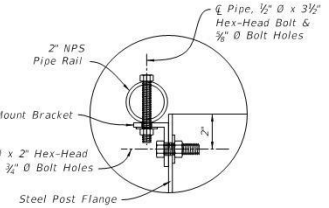
PIPE RAIL INSTALLED ELEVATION
(End Segment Shown)



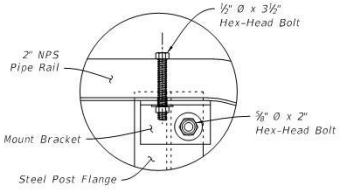
PIPE RAIL INSTALLED PLAN
END AT TIMBER POST OPTION



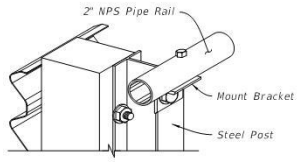
PIPE RAIL INSTALLED PLAN
END AT STEEL POST OPTION



MOUNT SECTION DETAIL



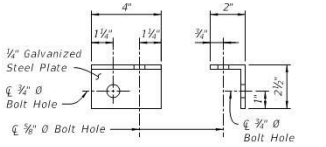
MOUNT ELEVATION DETAIL
(Back View - Mirrored)



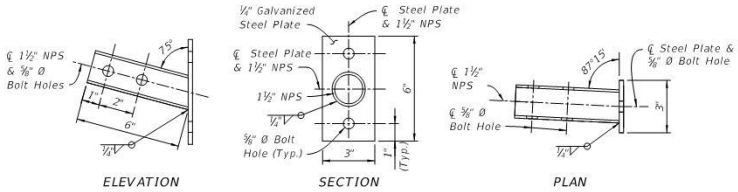
MOUNT ISOMETRIC
CUT-AWAY

NOTES:

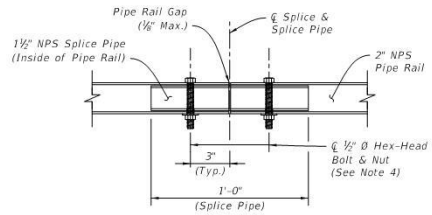
1. GENERAL: Install General Pipe Rail where indicated in the plans or when existing sidewalks or shared use paths are located less than 4'-0" from the back of Steel Posts as shown on Sheet 6.
2. PIPE RAIL END SEGMENTS: Place End Segments on both ends of General Pipe Rail runs, with End Fixtures mounted to Terminal Posts located outside of Approach Terminal Assembly ('LE'), Trailing Anchorage Assembly ('LT'), and Approach Transition ('LA') segments.
3. MATERIALS: Use steel brackets, fixtures, and pipes in accordance with Specification 967.
4. RAIL SPLICES: Install Rail Splices to join pieces of 2" NPS Pipe Rail into a continuous system. Place splices as needed, at a spacing of 18'-0" or greater. Orient the head of bolt on the top of the pipe.



MOUNT BRACKET DETAIL



END FIXTURE DETAIL



RAIL SPLICE DETAIL

PEDESTRIAN SAFETY TREATMENT - PIPE RAIL

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LAST REVISION	REVISION	DESCRIPTION:	FDOT	FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
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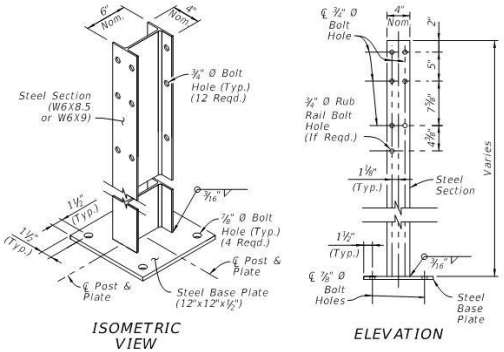
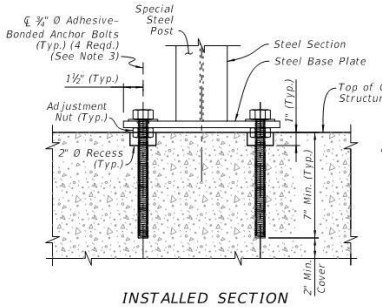
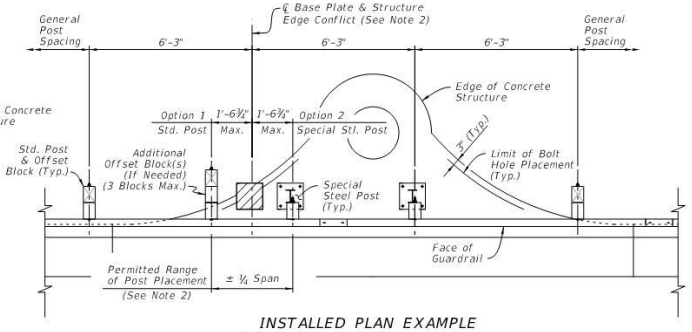


ISOMETRIC VIEW

ELEVATION



INSTALLED SECTION (Option 2, Special Post)



INSTALLED PLAN EXAMPLE (Curb Inlet Top Type 2 Shown)

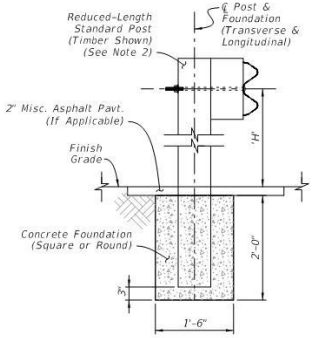
SPECIAL STEEL POST

STRUCTURE MOUNTING

NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) located atop culverts, inlets, pier footings, or similar concrete structures, a Special Steel Post may be substituted for a Standard Post. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
2. EDGE CONFLICT: When a required post location causes an Edge Conflict with the structure, where the Steel Base Plate is not located entirely on the structure at least 3" from the Edge of Concrete, the longitudinal post location may be altered by up to 1'-6¾" (Quarter Span) from the original required spacing location to prevent the Edge Conflict. With the post location adjusted, use a Std. Post mounted in soil (Option 1) or a Special Steel Post with its Base Plate mounted entirely on the structure (Option 2). Maintain the original required spacing locations upstream and downstream of the structure.
3. BASE PLATE MOUNT: Install Special Steel Posts as shown using steel Adhesive-Bonded Anchor Bolts in accordance with Specification 536. Use ¾" Hex-Head Bolts for structures less than 9" deep as defined in the Specification.
4. PANEL MOUNT TO ADJUSTED POST: Punch additional ⅞"x2½" Post Bolt Slot(s) in the W-Beam or Thrie-Beam Panel only where needed to mount the panel to a post in an adjusted location. Meet the Panel Post Bolt Slots requirements of Specification 536.
5. MATERIALS: Use steel base plates in accordance with Specification 536.

SPECIAL STEEL POST FOR CONCRETE STRUCTURE MOUNT

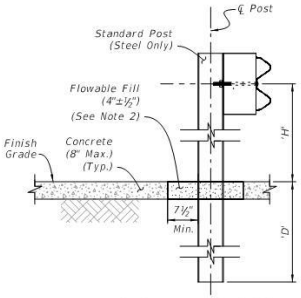


INSTALLED SECTION

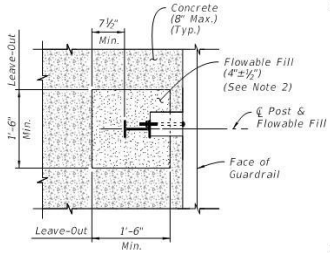
NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) conflicting with underground utilities or other underground obstructions, an Encased Post may be used where a 2'-0" depth will avoid the conflict. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
2. REDUCED-LENGTH STANDARD POST: Use a Standard Post with reduced Length such that the Panel Height 'H' is maintained while the post bottom terminates 3" from the bottom of the Concrete Foundation. Typically, the Post Length 'L' is 4'-7" for W-Beam Guardrail.
3. FOUNDATION: Use non-reinforced Class NS Concrete material in accordance with Specification 347. After casting the concrete, ensure the surrounding soil material is completely backfilled and tamped to provide full passive resistance.
4. LIMIT: Encased Posts are not permitted for more than 3 consecutive posts.

ENCASED POST FOR SHALLOW MOUNT



INSTALLED SECTION



INSTALLED PLAN

NOTES:

1. INSTALLATION: When the construction of Guardrail at the required post spacing results in post(s) placed within a concrete surface (typically a sidewalk), use a Frangible Leave-Out around the post base as shown. Install where shown in the plans and/or as-needed, in accordance with Specification 536.

   Use Standard steel posts. Timber posts are not permitted for frangible leave-outs.

   For the required 1'-6" x 1'-6" Leave-Out, smoothly cut the existing concrete surface or form-up the square shape when an application has new surrounding concrete.

   Ensure Flowable Fill surface is smooth and even with the adjacent concrete surface.
2. MATERIALS: Use Non-Excavatable Flowable Fill in accordance with Specification 121, not to exceed 150 psi.

FRANGIBLE LEAVE-OUT FOR CONCRETE SURFACE MOUNT

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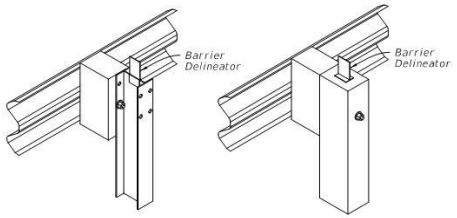
NOTES:

1. INSTALLATION: Install Barrier Delineators as shown in accordance with the plans, with Specifications 536 and 705, and with the manufacturer's design as approved on the APL.
2. MATERIALS: Use materials of the size and type defined for Barrier Delineators in Specification 993.
3. COLOR: Use either white or yellow retroreflective sheeting to match the color of the nearest lane's edgeline.
4. MOUNT LOCATIONS: Mount Barrier Delineators atop posts as shown, starting with Post (3) of Approach Terminals and incrementally increasing spacing towards the downstream direction. Install the Barrier Delineators at the following spacing:

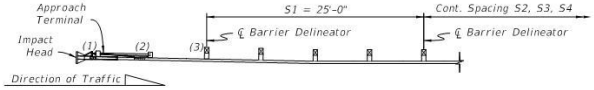
   S1 = 25' x 1 Space
   S2 = 50' x 1 Space
   S3 = 75' x 1 Space
   S4 = 100' x for the Remaining Run

   Additionally, place a Barrier Delineator on Post (2) of the Trailing Anchorage or on the post nearest the Rigid Barrier.
5. MEDIAN GUARDRAIL: Install retroreflective sheeting on both sides of the barrier delineator for Guardrail on medians.



STEEL POSTS TIMBER POSTS

MOUNT LOCATION - ISOMETRIC VIEWS



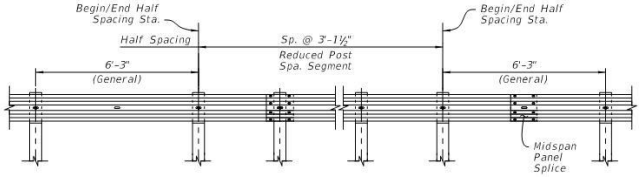
MOUNT LOCATION - PLAN VIEW

BARRIER DELINEATORS

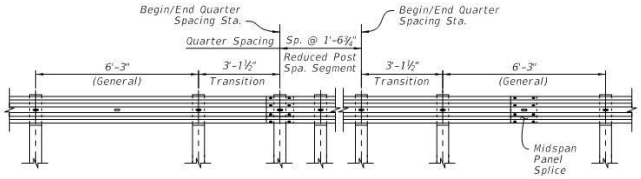
NOTES:

1. INSTALLATION: Work these details with the plans, where Stationing for Begin/End Half Spacing and Begin/End Quarter Spacing are indicated if required.

   Where the Begin/End Stations indicated in the plans do not correspond exactly to post locations in construction, extend the Reduced Post Spacing segment to the nearest post(s) before the Begin Station and/or after the End Station called for.
2. PANEL SPLICES: Midspan Panel Splices are not required in Transition and Reduced Post Spacing segments, however they are required for General segments. To place midspan splices in General segments, use one Non-General panel length (9'-4½" or 15'-7½") or add an additional Transition spaced post where required.
3. LOW-SPEED GUARDRAIL: For Reduced Post Spacing with Low-Speed Guardrail (12'-6" post spacing), the Reduced Spacing pattern requires a 6'-3" space between the 12'-6" and 3'-1½" spaces.
4. PANEL POST BOLT SLOTS: For Quarter Spacing configurations, punch additional ¾"x2½" Post Bolt Slots in the panels only where required for mounting and in accordance with Specification 536.

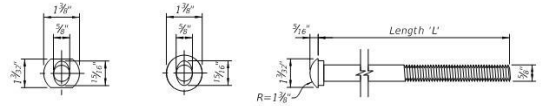


DETAIL 'S' - HALF SPACING ELEVATION
(AS REQD. PER THE PLANS)



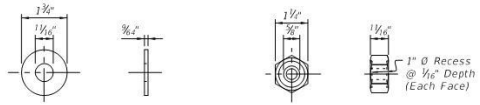
DETAIL 'S' - QUARTER SPACING ELEVATION
(AS REQD. PER THE PLANS)

REDUCED POST SPACING FOR HAZARDS



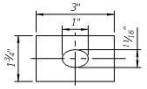
ELEVATION OPTION 1 ELEVATION OPTION 2 PROFILE (Option 1 Shown)

BUTTON-HEAD BOLT



ELEVATION PROFILE ELEVATION PROFILE

WASHER HEX-NUT



ELEVATION PROFILE

RECTANGULAR WASHER
(For CRT & Terminal Connectors Where Shown - Install Over Panel Face)

BUTTON-HEAD BOLT LENGTHS:

Application(s):	Length 'L':	Min. Thread Length:
Panel Splice	1½"	Full Length
Steel Post Mount – Single Faced Guardrail	10"	4"
Timber Post Mount – Single Faced Guardrail	18"	4"
Steel or Timber Post Mount – Double Faced Guardrail	25"	4"

NOTES:

1. Use nuts, bolts, and washers in accordance with Specification 967.
2. For Steel Posts with Double Faced Guardrail, the single 25" Length bolt (one bolt thru both post flanges) may be replaced with two 10" Length bolts (one bolt per post flange).
3. Use bolts listed in Table 2 in corresponding locations shown in this Index.

⅝" BUTTON-HEAD BOLT SYSTEM

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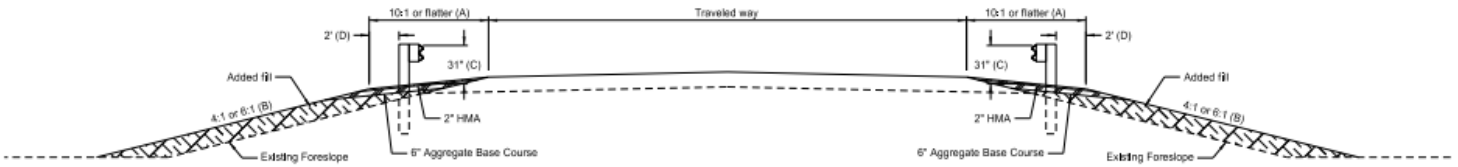
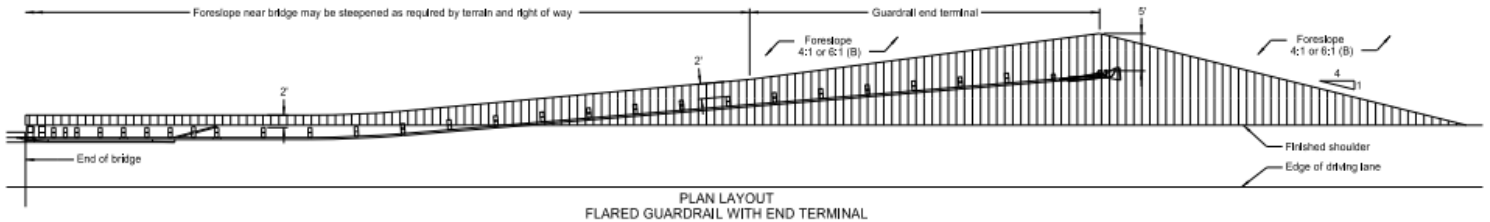
D-764-48

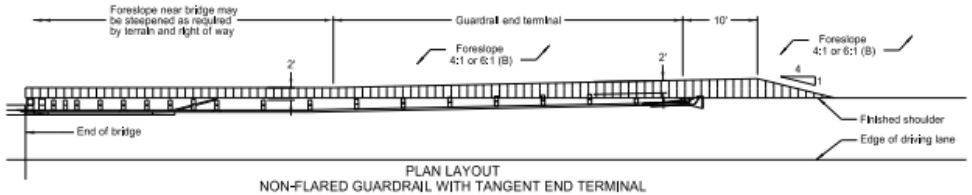
TYPICAL GRADING AT BRIDGE ENDS WITH MGS W-BEAM GUARDRAIL



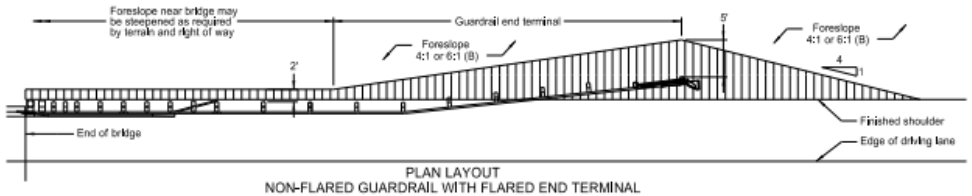
TYPICAL SECTION



PLAN LAYOUT
FLARED GUARDRAIL WITH END TERMINAL



PLAN LAYOUT
NON-FLARED GUARDRAIL WITH TANGENT END TERMINAL



PLAN LAYOUT
NON-FLARED GUARDRAIL WITH FLARED END TERMINAL

NOTES:

(A) Slope flatter than 10:1 may be required to provide proper guardrail height.

(B) Where normal foreslope is 4:1 the added fill shall be 4:1. Where normal foreslope is 6:1 the added fill shall be 6:1.

(C) Measured from top of guardrail to top of surfacing at front face of guardrail.

(D) Dimension at end terminals may vary per Plan Layouts shown on this sheet.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
5-14-17	
REVISIONS	
DATE	CHANGE

This document was originally issued and sealed by Roger Welgel, Registration Number PE-2930, on 7/14/17 and the original document is stored at the North Dakota Department of Transportation

Maine DOT Response:

6. ROADSIDE DESIGN
Practices and Procedures

6-1 ROADSIDE CLEAR ZONES

See EI C2 – Clear Zone, Design Guidance – Clear Zone Relative to Right of Way and Chapter 3 Roadside Topography and Drainage Features of *the AASHTO Roadside Design Guide.*

6-2 ROADSIDE BARRIER WARRANTS

6-2.01 Embankments

See Design Guidance – Sideslopes and Backslopes

6-2.02 Roadside Obstacles

See Section 5.2.2 Roadside Obstacles in the *AASHTO Roadside Design Guide*.

6-3 ROADSIDE BARRIER TYPES

See the MaineDOT Guardrail and Guardrail Terminal Policy and Section 5.4 Structural and Safety Characteristics of Roadside Barriers in the *AASHTO Roadside Design Guide*.

6-4 ROADSIDE BARRIER LAYOUT

6-4.01 Length of Need

See Design Guidance – Barrier Layout - Length of Need

6-4.02 Lateral Placement

The following will apply to the lateral placement of a roadside barrier:

1. ***Relative to Shoulder.*** In restricted locations, it is acceptable to place the barrier at the normal shoulder edge, but only if the following conditions can be met: Guardrail should not be placed closer than 4 feet from the edge of travel lane or 16 feet from the centerline. The greater distance will control. The 16 feet minimum is critical to accommodate snowplow widths without excessive encroachment on the opposing lane.

2. ***Deflection Distance.*** The dynamic deflection of the barrier cannot be violated. Double-nesting the rails or decreasing the post spacing to 3 feet 1.5 inches will decrease the

deflection distance by 50%. Either method must extend at least 25 feet in advance of and beyond the trailing end of the obstacle being shielded.

3. ***Relative to Embankments.*** A minimum of 3 feet should be provided between the face of the barrier and the break in a fill embankment. When minimal impacts are an issue, a 2 foot space may be used, but 8 foot guardrail posts are required.

4. ***Bridge Approaches.*** Short runs of barrier at less than the desirable lateral offset are acceptable at bridges where the bridge width is narrower than the normal face-of-barrier-to-face-of-barrier width.

5. ***Shy Line Offset.*** See Section 5.6.1 Barrier Offset in the *AASHTO Roadside Design Guide*.

6. ***Flare Rate***. See Section 5.6.3 Flare Rate in the *AASHTO Roadside Design Guide.*

6-4.03 Barrier Gap

Barrier gaps of less than 200 feet should be connected, unless the gap is needed for access (e.g., driveways, maintenance operations).

6-4.04 Placement on Slopes

Roadside barriers should not be placed on roadside slopes steeper than 10:1. This also applies to the area approaching the beginning of the barrier installation.

6-4.05 Placement Behind Curbs

Barrier/Curb Orientation

The face of the barrier should be flush with the face of the curb (i.e., at the gutter line). The height of the barrier is measured from the pavement surface. Curb height shall not exceed 4 inches.

Sidewalks

See Section 5.6.2.1 Curbs in the *AASHTO Roadside Design Guide.*

Sidewalks and Bridge Rails

See Section 5.6.2.1 Curbs in the *AASHTO Roadside Design Guide.*

Guardrail Terminal/Curb Orientation

Guardrail terminals should not be placed behind curb. Where there is no alternative, curb height should be reduced to 2 inches approximately 50 feet in advance of the terminal. For flared terminals, the 2 inch height should be carried an additional 37 feet beyond the upstream end. For

tangent terminals, the 2 inch height should be carried 12 feet beyond the upstream end and the terminal should be offset 1 foot to keep the impact head behind the face of curb.

6-4.06 Rub Rail

See Section 5.6.2 Terrain Effects in the *AASHTO Roadside Design Guide*.

A rub rail should be considered where a potential snagging problem may exist.

6-4.07 Guardrail Terminals

See the MaineDOT Guardrail and Guardrail Terminal Policy and Design Guidance – Guardrail Height Adjustment Considerations.

6-5 MEDIAN BARRIERS

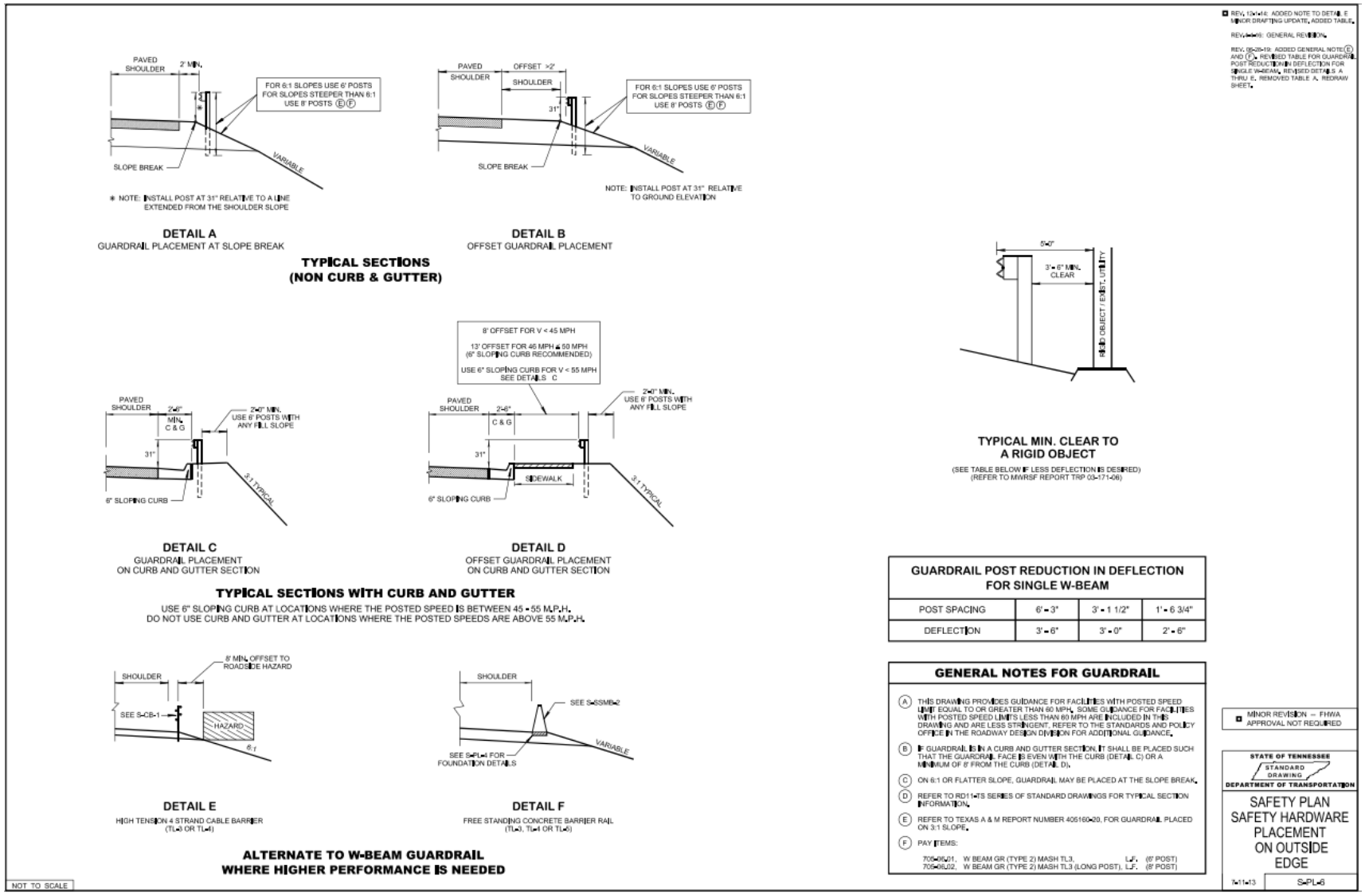
See Chapter 6 Median Barriers in the *AASHTO Roadside Design Guide.*

6-6 IMPACT ATTENUATORS

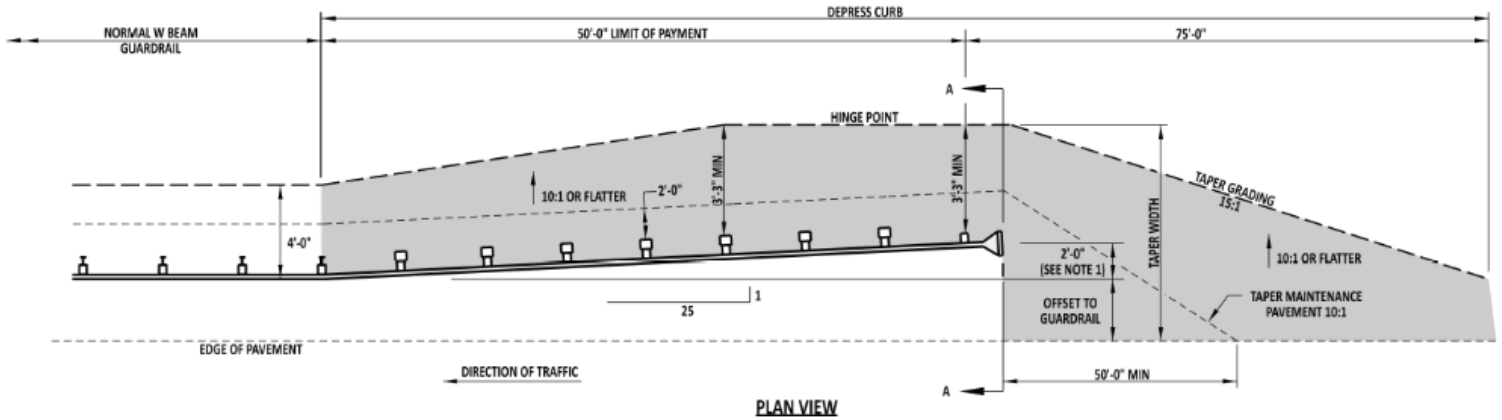
See Section 8.4 Crash Cushion Design Concepts and 9.3 Crash Cushions (for work zones) in the *AASHTO Roadside Design Guide*. Also see Design Guidance – Crash Cushions.

Other Response: If curb is necessary for drainage, we use a maximum 2" height.

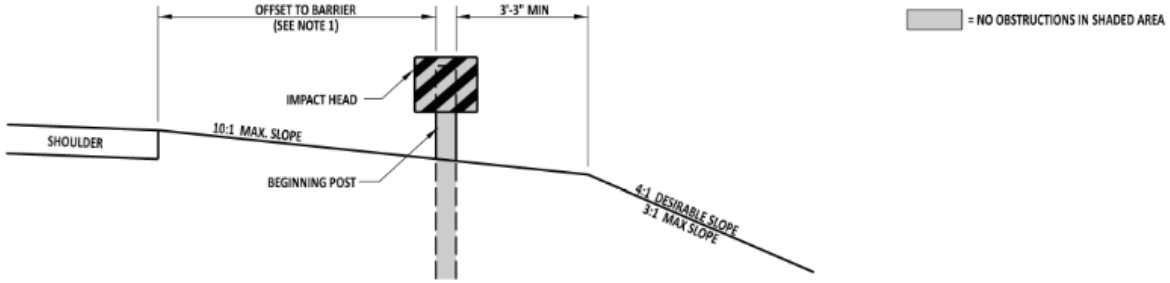
Q17 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.



SCALE : NTS



PLAN VIEW



SECTION A-A

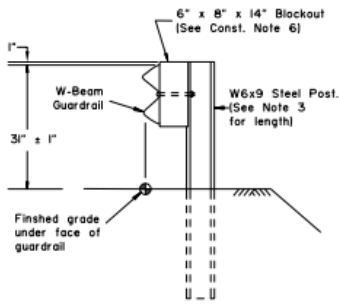
NOTES:

1). FLARE THE END TREATMENT AT 25:1 BEGINNING 50'-0" FROM THE END OF THE IMPACT HEAD, UNLESS THE CONSTRUCTION PLANS OR SPECIFICATIONS SPECIFY A SMALLER FLARE.
2). THIS DETAIL WAS SOLELY CREATED TO SHOW THE GRADING REQUIRED FOR THIS TYPE OF ATTENUATOR AND IS APPLICABLE REGARDLESS OF THE HEIGHT OF THE GUARDRAIL SYSTEM.
3). THE GUARDRAIL END TREATMENT ATTENUATOR SHALL BE INSTALLED AS PER THE MANUFACTURER'S AND THE DEPARTMENT OF TRANSPORTATION'S SPECIFICATIONS.
4). IF CURB IS PRESENT, DEPRESS THE CURB TO A MAXIMUM HEIGHT OF 2" WITHIN THE LIMITS OF THE END TREATMENT AND THROUGHOUT THE LENGTH OF THE TAPER GRADING.

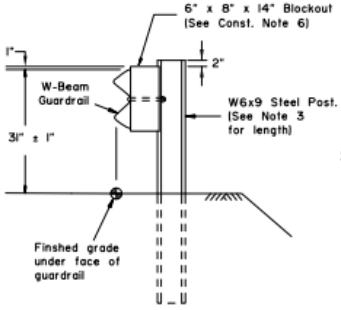
DELAWARE DEPARTMENT OF TRANSPORTATION	GRADING FOR GUARDRAIL END TREATMENT ATTENUATOR, TYPE 1		APPROVED SIGNATURE ON FILE (CHIEF ENGINEER) 1/04/2019 (DATE)
	STANDARD NO. B-2 (2018)	SHT. 1 OF 3	RECOMMENDED SIGNATURE ON FILE (DESIGN ENGINEER) 12/20/2018 (DATE)

Respondent – Picture 1(Mountable Curb)

Respondent- Picture 2(Barrier Curb)

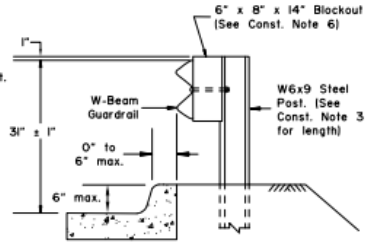


TYPE I POST INSTALLATION

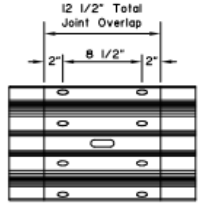


TYPE II POST INSTALLATION

(Facilitates raising rail for future overlays.)

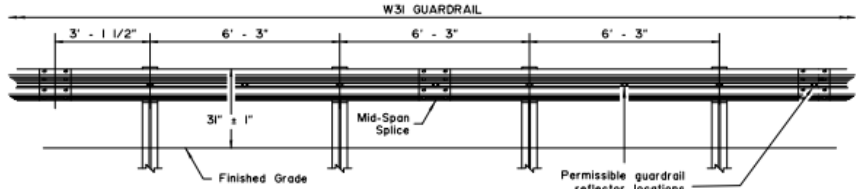


TYPE III POST INSTALLATION

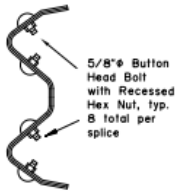


SPLICE DETAIL

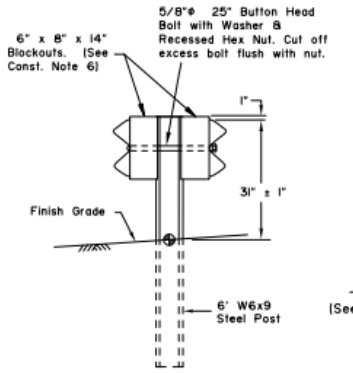
(At mid span between posts only. Bolts not shown for clarity)



TYPICAL ELEVATION



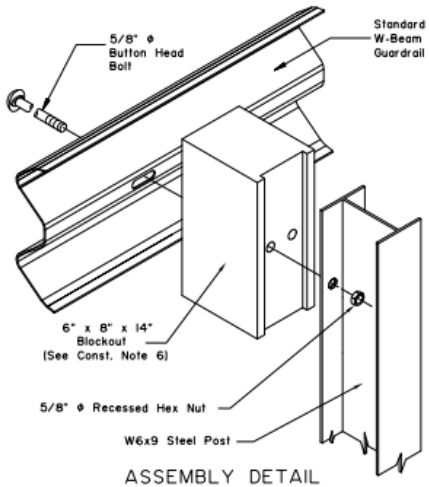
SPLICE CROSS-SECTION



TYPE IV DOUBLE SIDED INSTALLATION

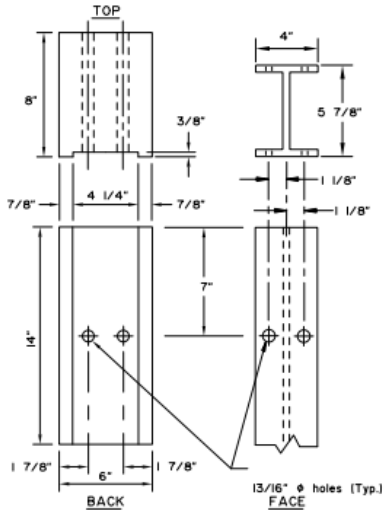
GUARDRAIL REFLECTOR

(See Const. Note 5)



ASSEMBLY DETAIL

(Type I post shown)



6" x 8" BLOCKOUT

W6x9 STEEL POST

CONSTRUCTION NOTES:

1. Provide hardware compliant with the Task Force 13 (TF13) Guide to Standardized Roadside Safety Hardware.
2. See Standard Plan G-00 for hardware details not shown on this drawing.
3. See Standard Plan G-10 for post lengths corresponding to different combinations of slope and behind-post embankment width.
4. Typical post spacing is 6'-3" center to center.
5. Attach guardrail reflector to guardrail using a 5/8" button head bolt with 5/8" recessed head hex nut and steel washer at location shown in the Typical Elevation. Install reflectors every 25' on tangents and every 12.5' on curves starting 100' before the P.C. and ending 100' after the P.T.
6. Use wood or synthetic blockouts designed, tested, and passed per MASH for use with steel posts. Either bolt hole on the blockout may be used for attachment.
7. Use a 25 linear foot transition to match differing height of existing or new rail elements and end treatments - see Standard Plan G-11.
8. W6x8.5 steel post may be substituted for W6x9 steel post.
9. Install flexible delineators on guardrail posts when called for in the contract. See Standard Plan G-00 for guardrail flexible delineator details.

DESIGN NOTES:

1. No fixed objects allowed within 36" of the back side of guardrail post.
2. This barrier is acceptable under MASH Tests 3-10 and 3-11.

State of Alaska DOT&PF
ALASKA STANDARD PLAN

STEEL POST W31 GUARDRAIL

Adopted as an Alaska Standard Plan by: Carolyn Morehouse

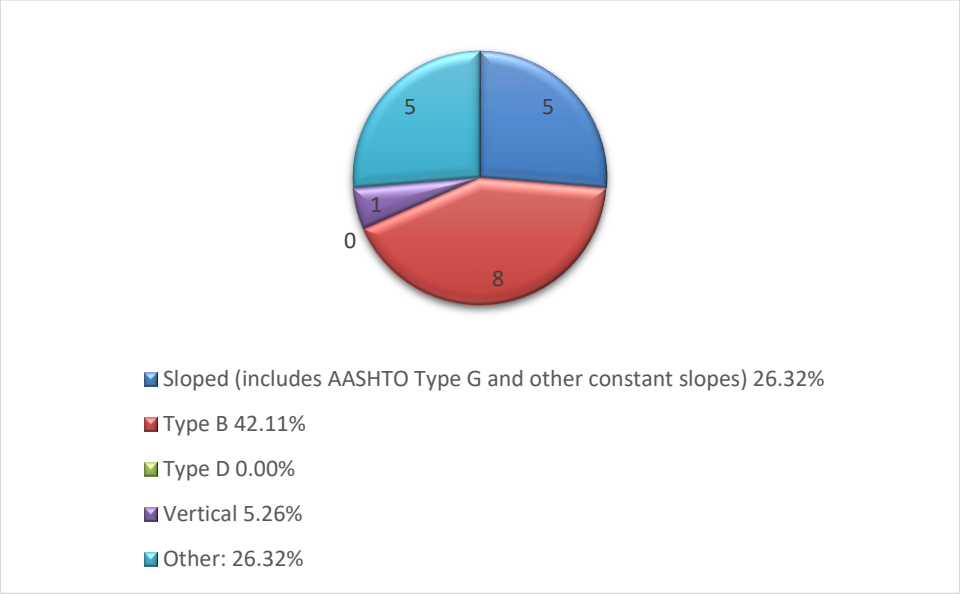
Carolyn Morehouse, P.E.
Chief Engineer

Adoption Date: 05/15/2019

Last Code and Stds. Review By: LRG Date: 5/15/2019

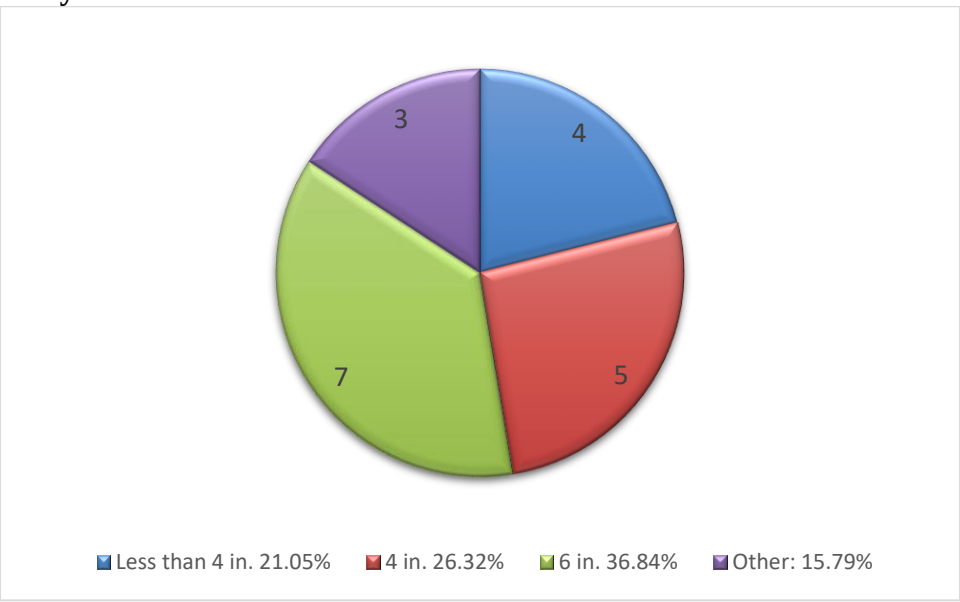
Next Code and Standards Review date: 5/15/2029

Q26, Q83, Q102, Q121 - What curb shape does your agency use at sites with w-beam guardrail terminals?



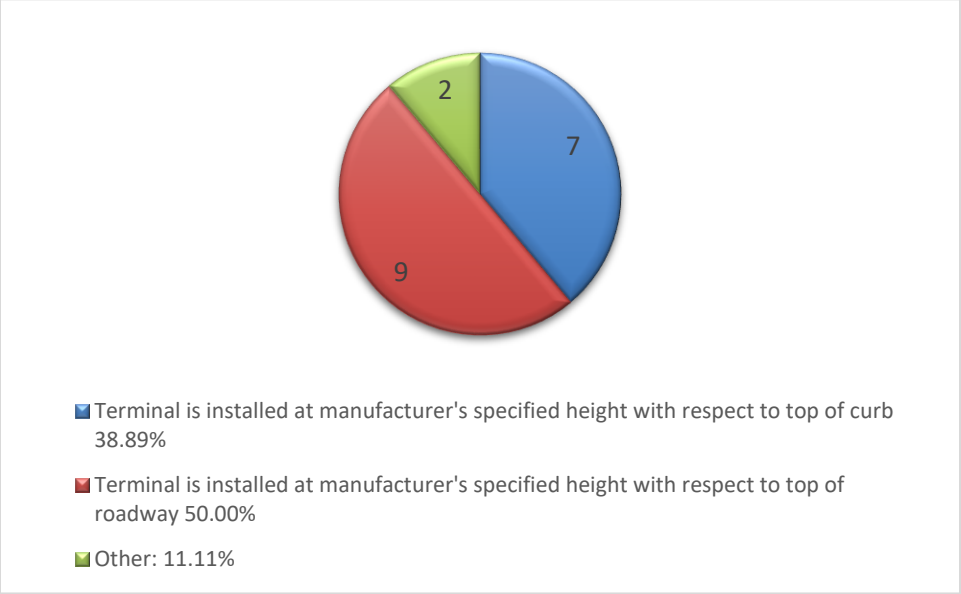
Answer	%	Count
Sloped (includes AASHTO Type G and other constant slopes)	26.32%	5
Type B	42.11%	8
Type D	0.00%	0
Vertical	5.26%	1
Other:	26.32%	5
Total	100.00%	19

Q27, Q84, Q103, Q122 - What is the curb height when w-beam guardrail terminals are installed nearby?



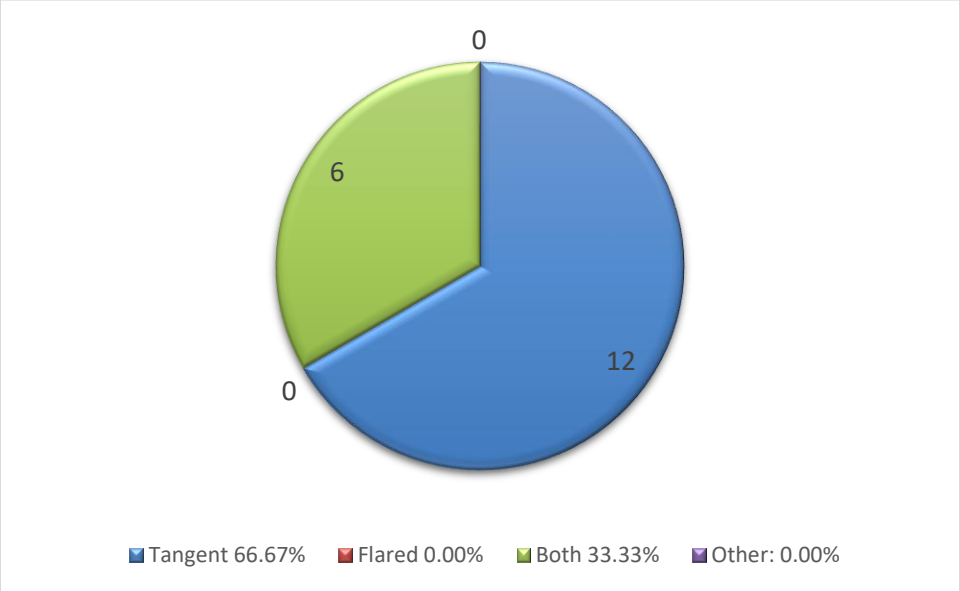
Answer	%	Count
Less than 4 in.	21.05%	4
4 in.	26.32%	5
6 in.	36.84%	7
Other:	15.79%	3
Total	100%	19

Q8, Q85, Q104, Q123 - How does your agency accommodate the height of the curb?



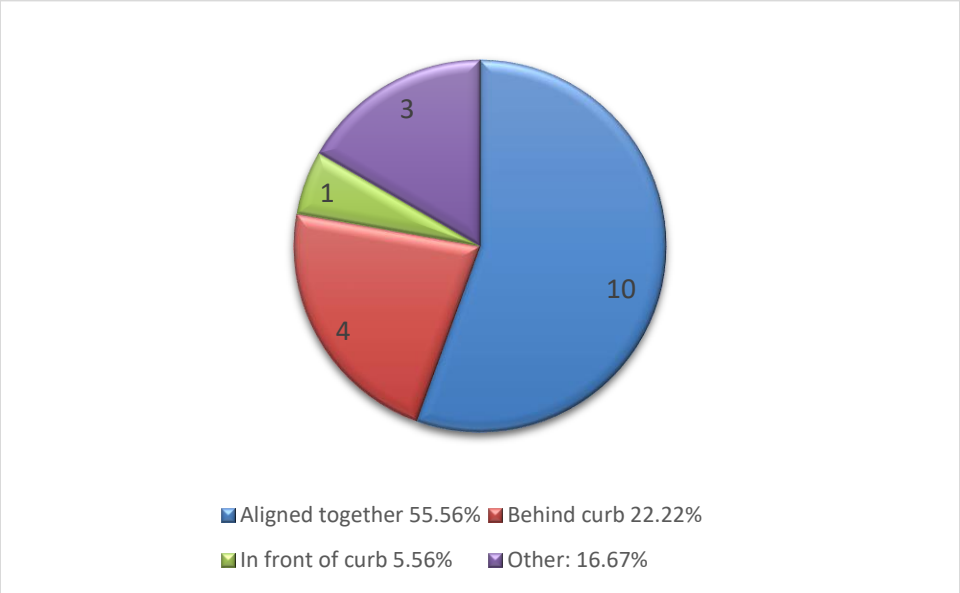
Answer	%	Count
Terminal is installed at manufacturer's specified height with respect to top of curb	38.89%	7
Terminal is installed at manufacturer's specified height with respect to top of roadway	50.00%	9
Other:	11.11%	2
Total	100%	18

Q9, Q86, Q105, Q124 - What kind of w-beam guardrail terminals do you install on curbs?



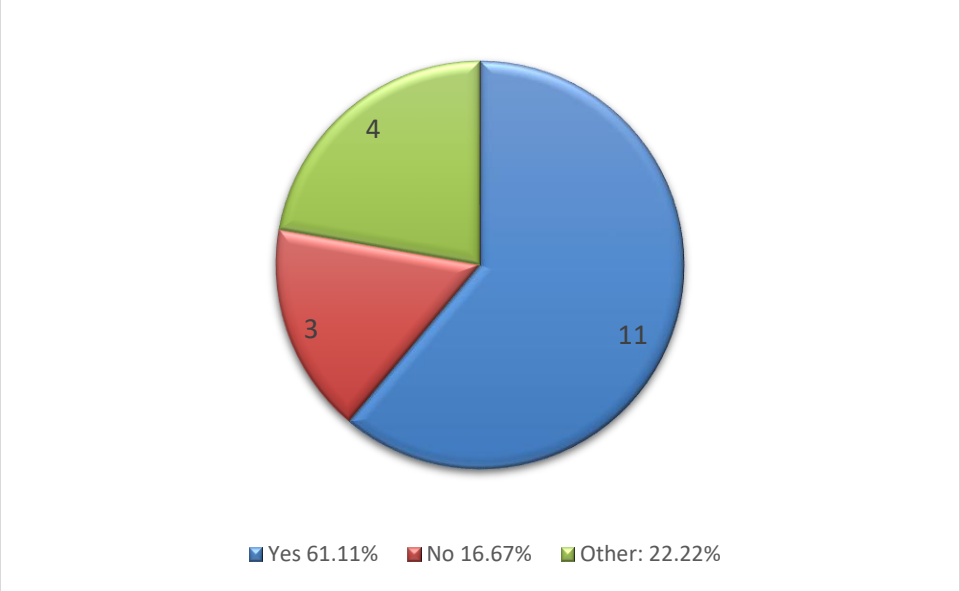
Answer	%	Count
Tangent	66.67%	12
Flared	0.00%	0
Both	33.33%	6
Other:	0.00%	0
Total	100%	18

Q10, Q87, Q106, Q125 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?



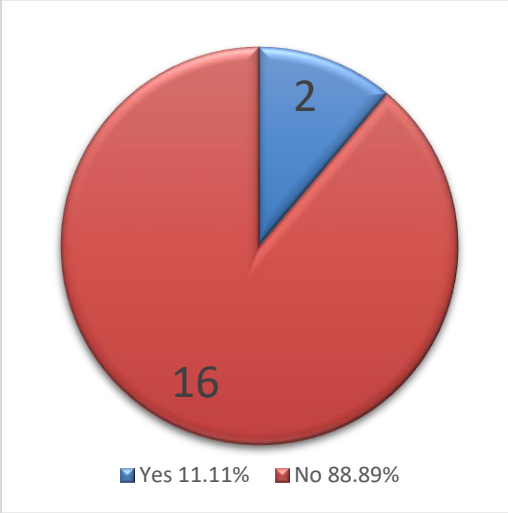
Answer	%	Count
Aligned together	55.56%	10
Behind curb	22.22%	4
In front of curb	5.56%	1
Other:	16.67%	3
Total	100%	18

Q12, Q89, Q108, Q127 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?



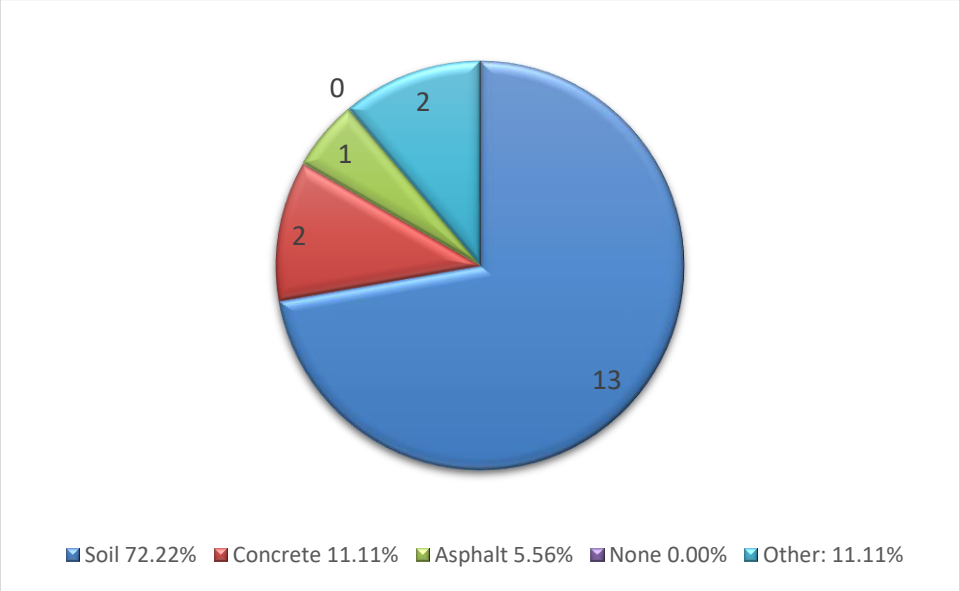
Answer	%	Count
Yes	61.11%	11
No	16.67%	3
Other:	22.22%	4
Total	100%	18

Q313, Q315, Q317, Q318 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.



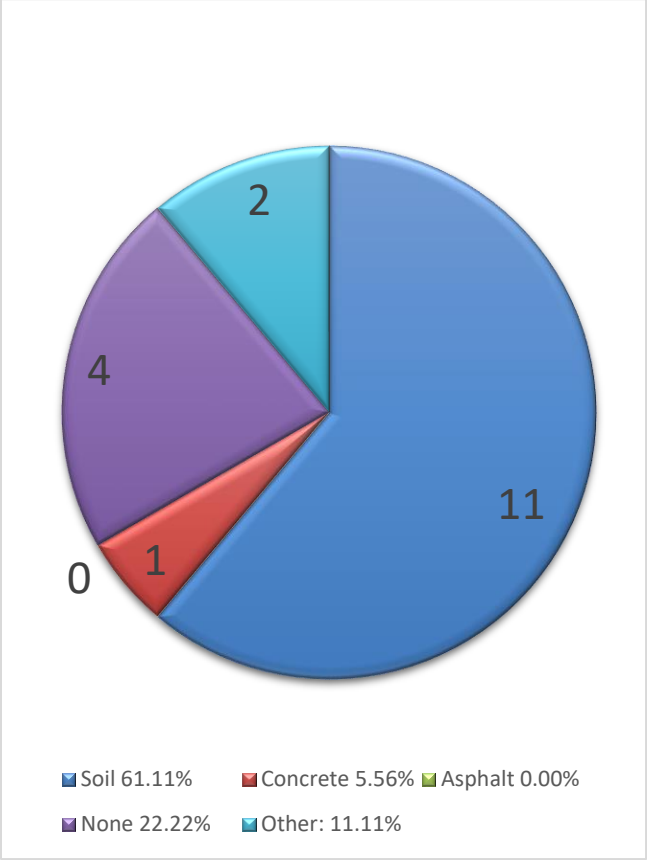
Answer	%	Count
Yes	11.11%	2
No	88.89%	16
Total	100%	18

Q22, Q91, Q110, Q129 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.



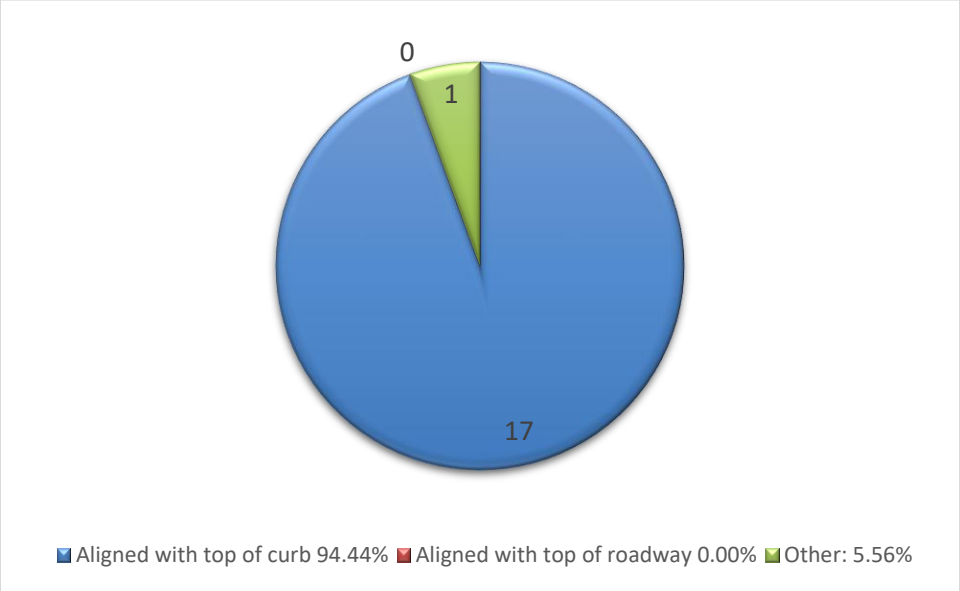
Answer	%	Count
Soil	72.22%	13
Concrete	11.11%	2
Asphalt	5.56%	1
None	0.00%	0
Other:	11.11%	2
Total	100%	18

Q69, Q92, Q111, Q130 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.



Answer	%	Count
Soil	61.11%	11
Concrete	5.56%	1
Asphalt	0.00%	0
None	22.22%	4
Other:	11.11%	2
Total	100%	18

Q23, Q93, Q112, Q131 - What is the height of the top level of backfill material?

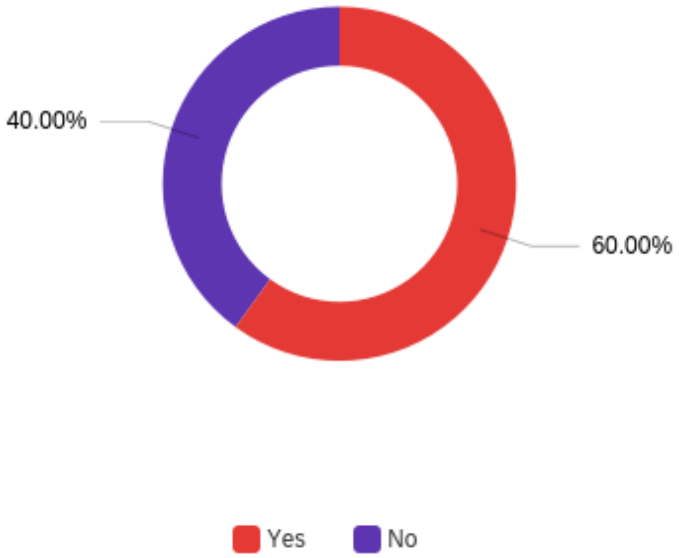


Answer	%	Count
Aligned with top of curb	94.44%	17
Aligned with top of roadway	0.00%	0
Other:	5.56%	1
Total	100%	18

B.3 AGGREGATED HIGH-SPEED ROADWAY RESULTS

This section of the Appendix shows the aggregated results of the survey questions regarding high-speed roadways. These results were compiled from respondents who selected to input design configurations regarding high-speed roadways or both low-speed and high-speed roadways. This section also included the responses derived from selecting that their state's design configuration for high-speed roadways was the same as their design for low-speed roadways.

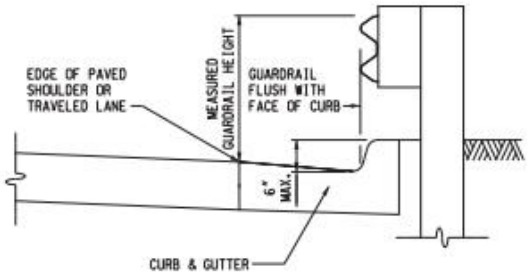
Q66 - Are all of your answers to the questions regarding high-speed roadways the same as what you entered for low-speed roadways?



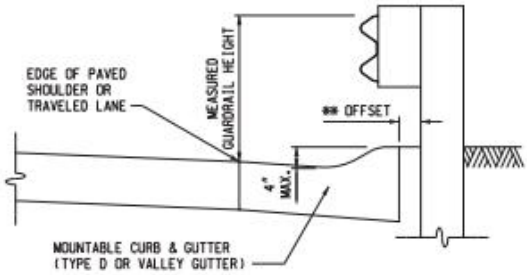
Answer	%	Count
Yes	60.00%	3
No	40.00%	2
Total	100%	5

Q50 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include a link in this question or upload a file in the next question. If you have multiple files to upload, please upload a zipped folder.

Michigan DOT Response:

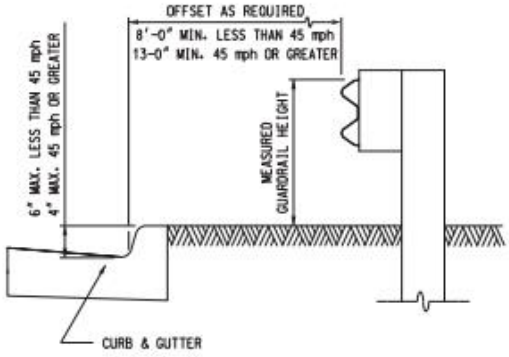


GUARDRAIL WHEN CURB IS ADJACENT TO
EDGE OF PAVED SHOULDER OR TRAVELED LANE
(DESIGN SPEED 50 mph OR LESS)



** 2" WHEN CURB IS PLACED NEXT TO SHOULDER
10" WHEN CURB IS PLACED NEXT TO TRAVELED LANE

GUARDRAIL WHEN CURB IS ADJACENT TO
EDGE OF PAVED SHOULDER OR TRAVELED LANE
(DESIGN SPEED GREATER THAN 50 mph)

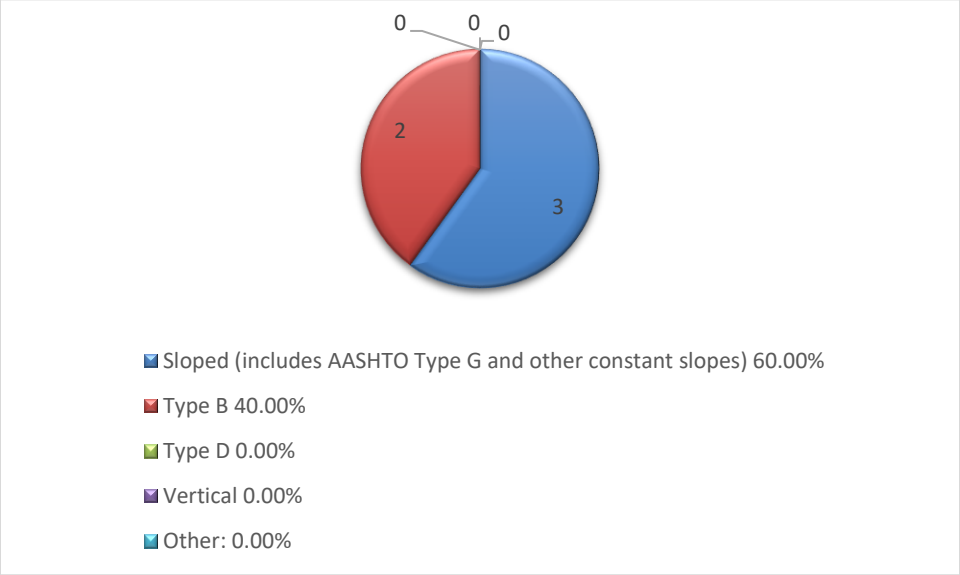


GUARDRAIL - CURB OFFSET
WHEN GUARDRAIL IS PLACED AWAY FROM CURB

Q51 - Please provide drawings, documentation, policies, or photos of w-beam guardrail terminal installations near curb. You may include upload a file in this question. If you have multiple files to upload, please upload a zipped folder.

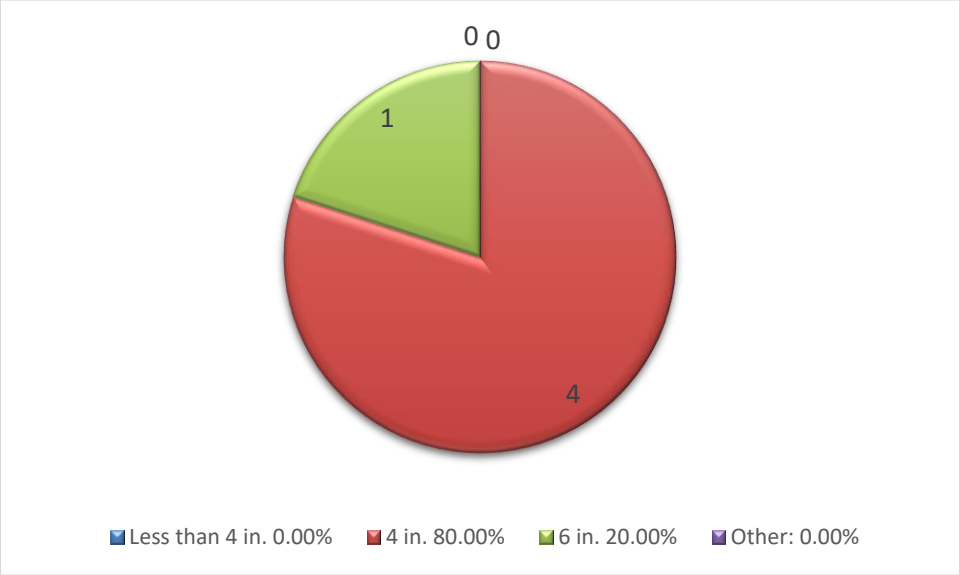
No response provided.

Q68 & Q26- What curb shape does your agency use at sites with w-beam guardrail terminals?



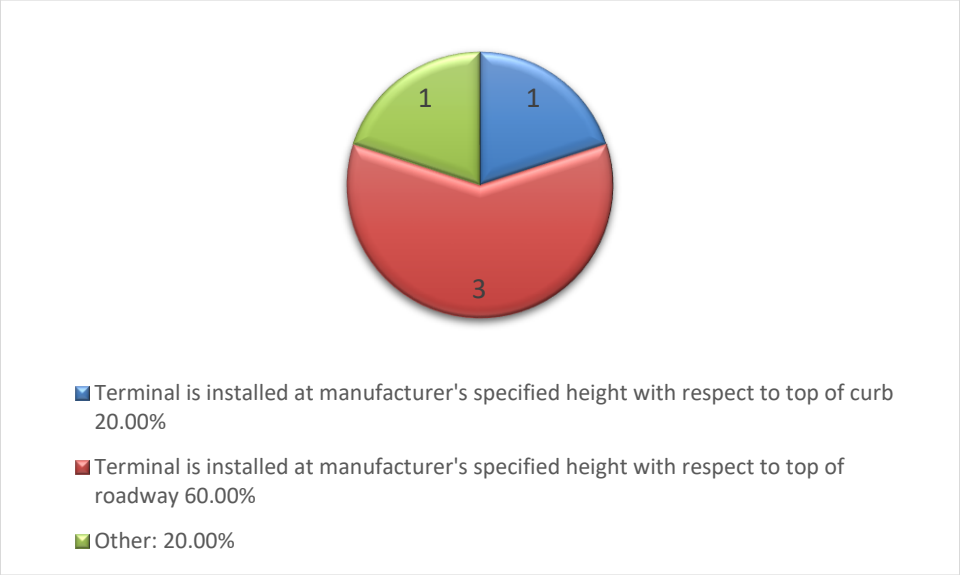
Answer	%	Count
Sloped (includes AASHTO Type G and other constant slopes)	60.00%	3
Type B	40.00%	2
Type D	0.00%	0
Vertical	0.00%	0
Other:	0.00%	0
Total	100%	5

Q55 - What is the curb height when w-beam guardrail terminals are installed nearby?



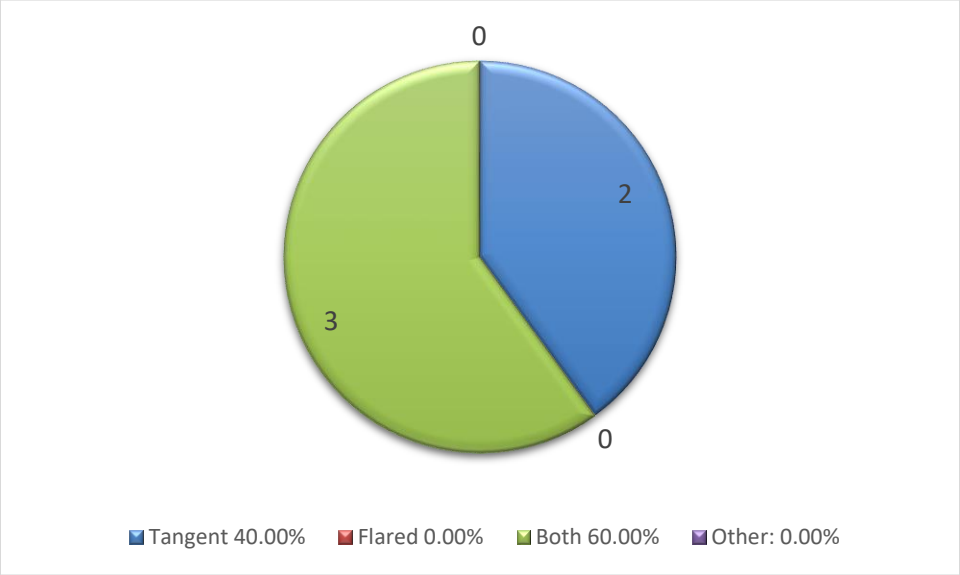
Answer	%	Count
Less than 4 in.	0.00%	0
4 in.	80.00%	4
6 in.	20.00%	1
Other:	0.00%	0
Total	100%	5

Q56 - How does your agency accommodate the height of the curb?



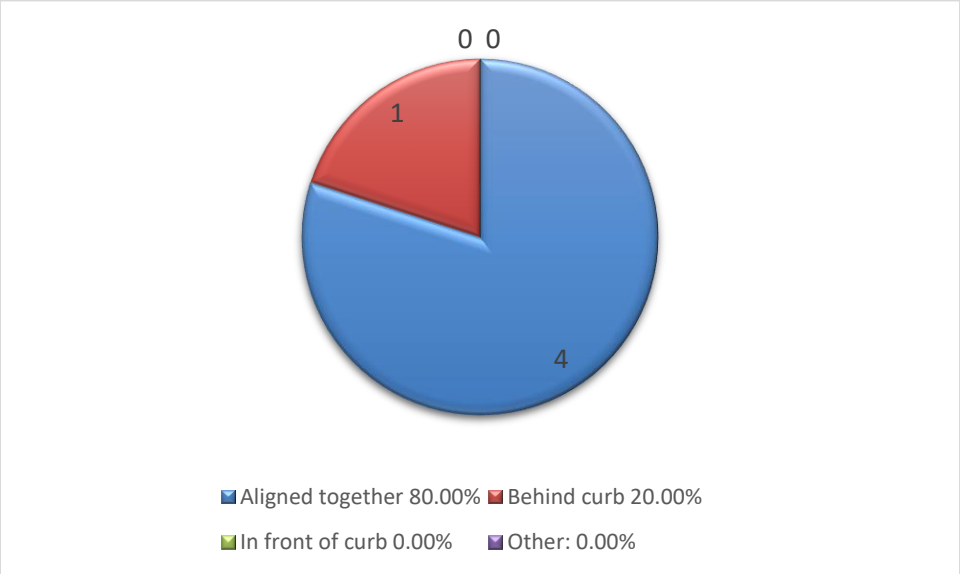
Answer	%	Count
Terminal is installed at manufacturer's specified height with respect to top of curb	20.00%	1
Terminal is installed at manufacturer's specified height with respect to top of roadway	60.00%	3
Other:	20.00%	1
Total	100%	2

Q57 - What kind of w-beam guardrail terminals do you install on curbs?



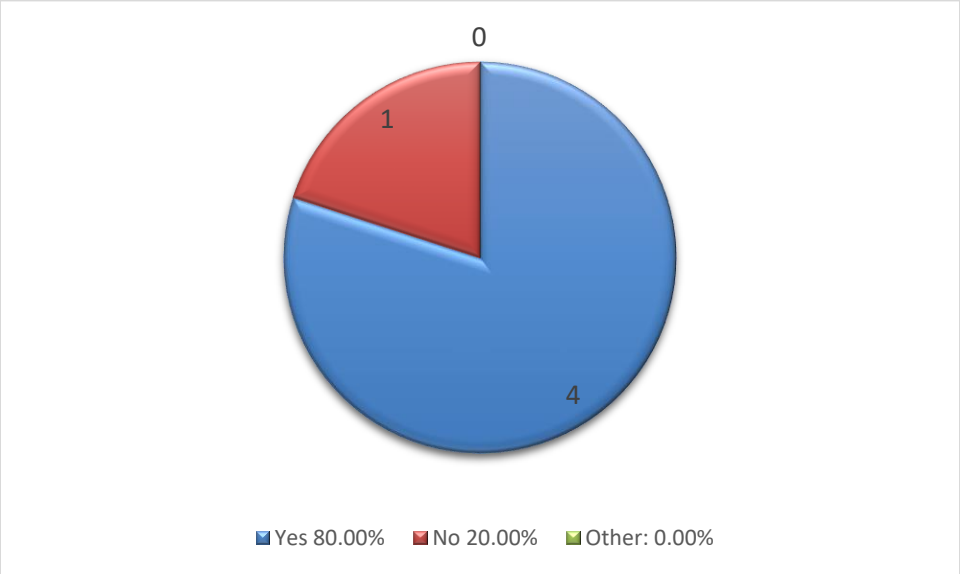
Answer	%	Count
Tangent	40.00%	2
Flared	0.00%	0
Both	60.00%	3
Other:	0.00%	0
Total	100%	5

Q58 - At sites where w-beam guardrail terminals are installed near curbs, what is the alignment of the face of guardrail in relation to the face of curb?



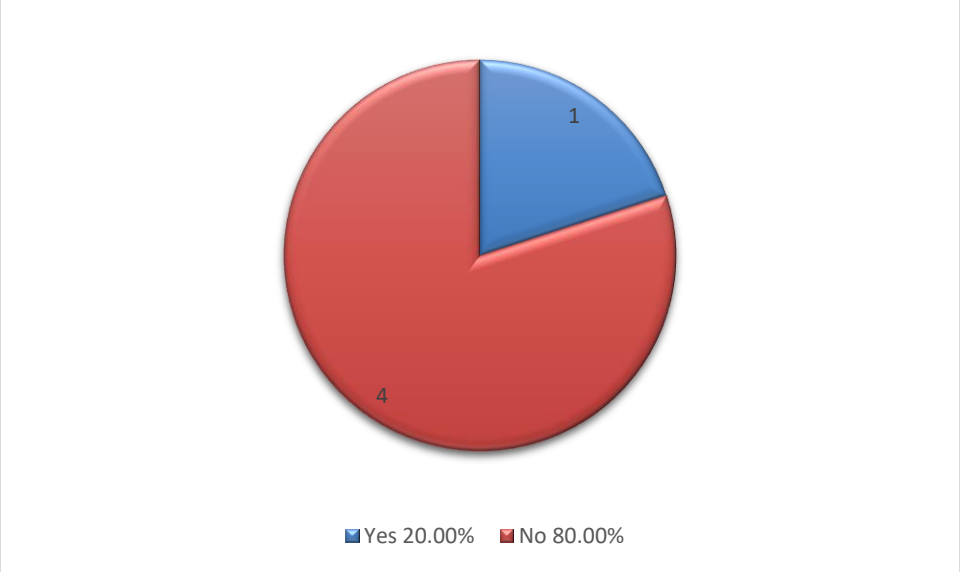
Answer	%	Count
Aligned together	80.00%	4
Behind curb	20.00%	1
In front of curb	0.00%	0
Other:	0.00%	0
Total	100%	5

Q60 - At sites where w-beam guardrail terminals are installed near curbs, do you offset your w-beam guardrail terminal head from alignment with the rail?



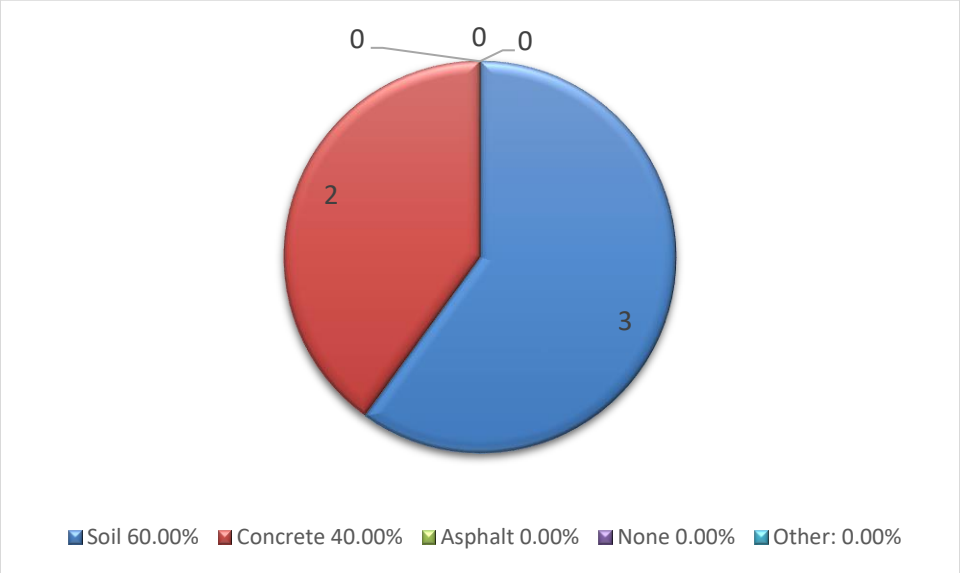
Answer	%	Count
Yes	80.00%	4
No	20.00%	1
Other:	0.00%	0
Total	100.00%	5

Q325 - Is the curb perpendicular to the w-beam guardrail installation? For example, at an intersection.



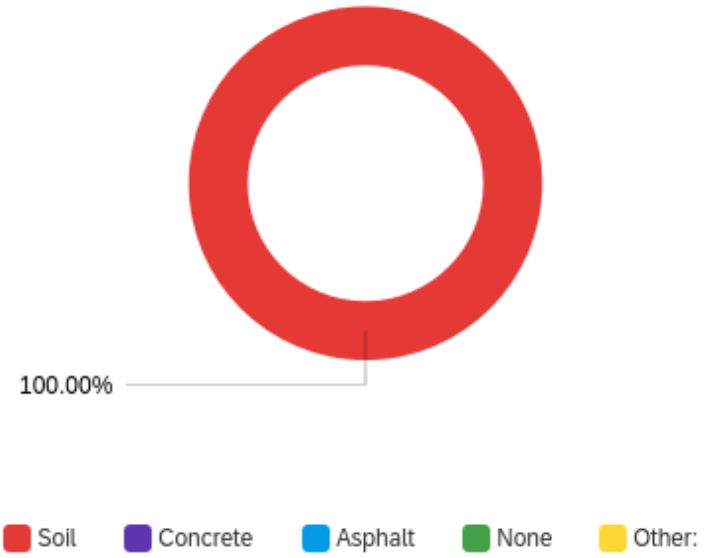
Answer	%	Count
Yes	20.00%	1
No	80.00%	4
Total	100%	5

Q62 - What backfill material is used behind the curb? This is concerning the top level of backfill material. If you use multiple levels of backfill material (concrete over soil, for example), please select the lower level in the next question.



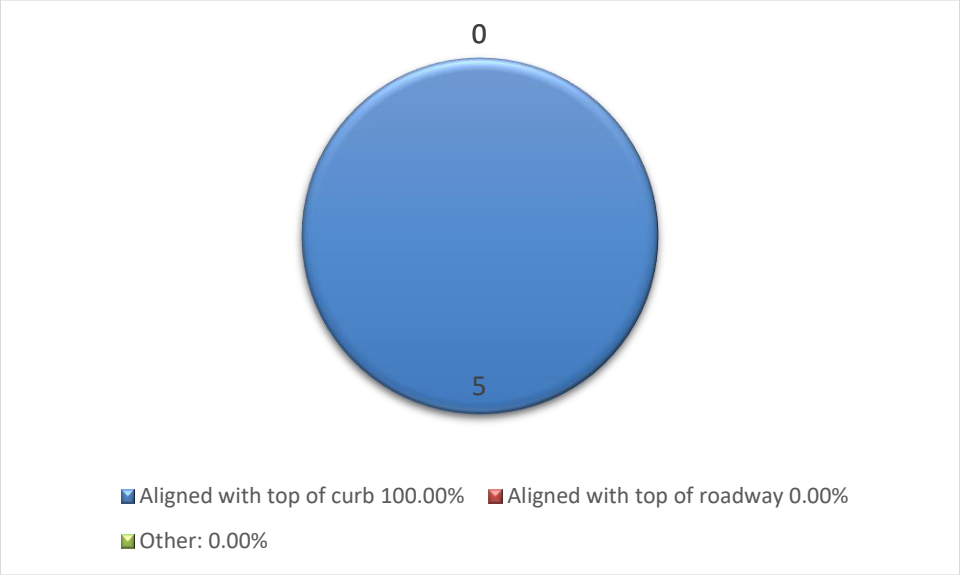
Answer	%	Count
Soil	60.00%	3
Concrete	40.00%	2
Asphalt	0.00%	0
None	0.00%	0
Other:	0.00%	0
Total	100%	5

Q72 - What backfill material is used behind the curb? This is concerning the bottom level of backfill material. If you only have one layer, please choose that material in the previous question and select "None" in this question.



Answer	%	Count
Soil	100.00%	5
Concrete	0.00%	0
Asphalt	0.00%	0
None	0.00%	0
Other:	0.00%	0
Total	100%	5

Q63 - What is the height of top level of backfill material?

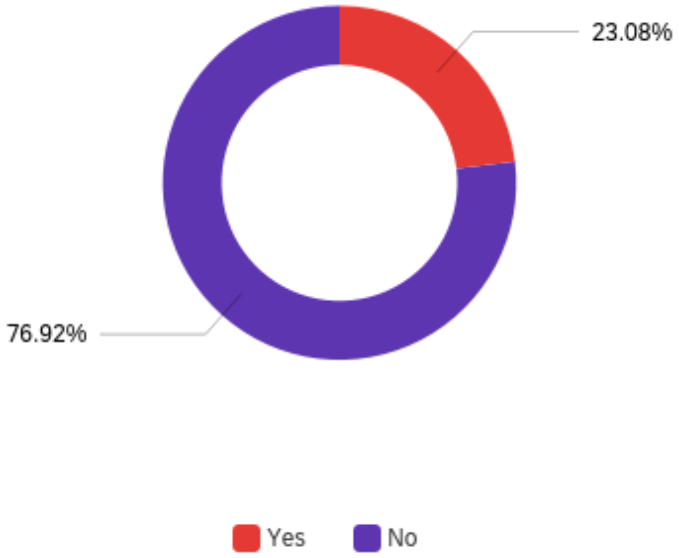


Answer	%	Count
Aligned with top of curb	100.00%	5
Aligned with top of roadway	0.00%	0
Other:	0.00%	0
Total	100%	5

B.4 AGGREGATED CONCLUSION QUESTIONS

This last section of Appendix B shows the aggregated results from the concluding section in the survey.

Q344 - Do you differ your configuration for curbs near w-beam guardrail terminals when they are used with an approach terminal vs a trailing end/downstream terminal?

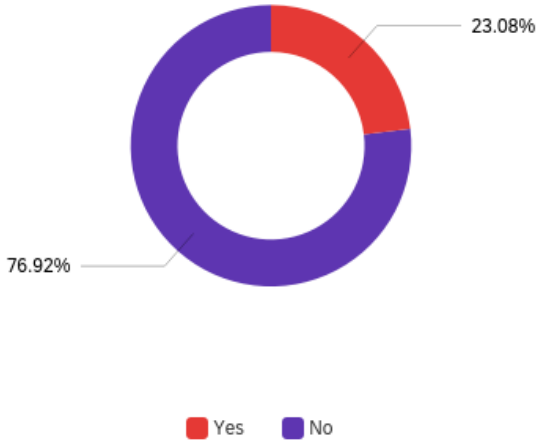


Answer	%	Count
Yes	23.08%	3
No	76.92%	10
Total	100%	13

Q345 - Please describe the differences.

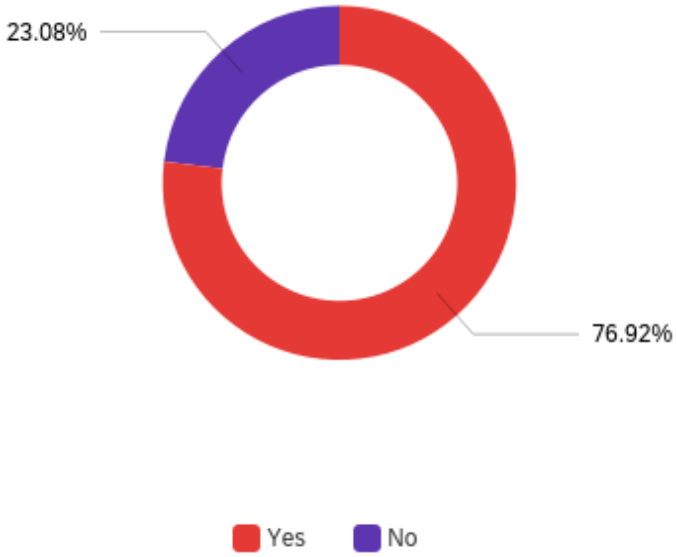
Respondent	Response
R1	Use roll away curb instead.
R2	2" height for the approach (likely to be struck) Typical curb height on downstream end if it is outside of the clearzone.
R9	Downstream terminals may be more likely to flair away from the face of curb. It still is project dependent, so difficult to make a blanket statement.

Q29 - Has your agency received any guidance from w-beam guardrail terminal manufacturers with regards to installing their product near curbs?



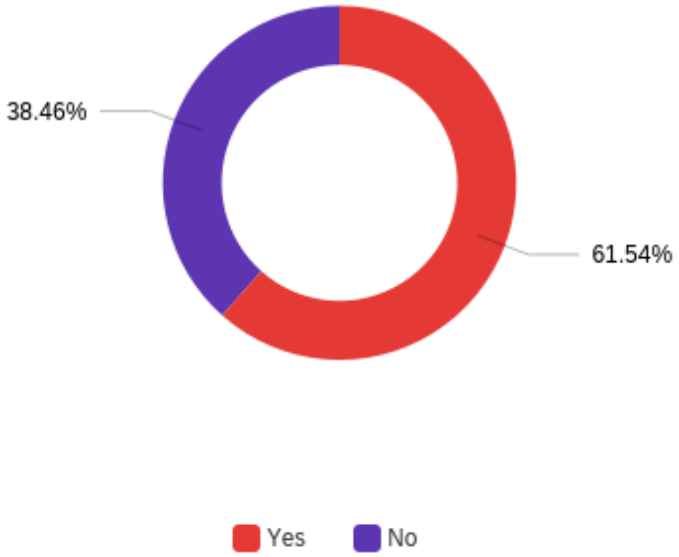
Answer	%	Count
Yes	23.08%	3
No	76.92%	10
Total	100%	13

Q19 - Do you have a desire for a crashworthy w-beam guardrail terminal for low-speed roadway applications near curbs?



Answer	%	Count
Yes	76.92%	10
No	23.08%	3
Total	100%	13

Q20 - Do you have a desire for a crashworthy w-beam guardrail terminal for high-speed roadway applications near curbs?



Answer	%	Count
Yes	61.54%	8
No	38.46%	5
Total	100%	13

Q21 - Thank you for participating in this survey. If you have any additional comments, please use the text box below.

Response: Louisiana does not have any policy or guidance related to guard rail end terminals installed near curbs and there is little official guidance available from AASHTO or FHWA on this subject. However, our needs require that we install end terminals behind curbs while trying to follow the manufacturer's original recommendations as best we can. This usually results in installing a tangent end aligned with the face of the curb with the head offset enough to stay clear of the roadway. The end terminal is also installed with respect to the top of the curb so that the ground strut is clear and not buried. This results in the end terminal being slightly higher than the rest of the rail. Again, given the site conditions along curbed roadways and the lack of any guidance, we feel this type of installation is the best of the available alternatives.

Response: MoDOT is currently reviewing policy changes to terminate curbs prior to CET's.

Response: Current best practices would be helpful until a tested system is available!

Response: Please refer to Section 7.01.34 of the Michigan Road Design Manual (MiRDM) for MDOT's guidelines pertaining to guardrail in conjunction in curb. Please note that MDOT does not have specific guidelines for guardrail terminals. Currently, the guidelines from 7.01.34 - MiRDM apply to all guardrail installations, including guardrail terminals. https://mdotjboss.state.mi.us/stdplan/englishroadmanual.htm