



Design Scene Part 2 – Plan Conventions

Chapter 14 Guardrail and Barriers

4/26/23

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Chapter 14 Guardrail and Barriers

General Guidance

This chapter is intended to assist designers by providing general guidance for guardrail and barrier design and pay items. It supplements the policies and standards which are continuously updated to reflect current design standards. Please contact the Project Design Services or the Design Standards Units for any questions regarding the design of longitudinal barriers, end terminals, crash cushions and related pay items.

For an overview of this topic as well as barrier selection and length of need guidance, please see Section 10-7.0 TRAFFIC BARRIERS in [RDM Ch 10 Traffic Control Devices & Traffic Barriers](#) and for specific guidance with related links see the [Roadside Safety Design](#) website.

Guardrail and Barrier in Construction Plan

- It is helpful to assign a Site Number to each location with guardrail work that can be used as a cross reference between the plan view and the guardrail tabulation.
- Be sure the pay items in guardrail and barrier tabulations match the SEQ bid item description.
- In plan view, differentiate between existing guardrail and proposed guardrail and end treatments.
- Label the station where the guardrail ends and the end treatment begins.

Guardrail Replacement Considerations

Existing guardrail on preservation projects should be evaluated. Upgrade consideration guidance can be found in Tech Memo 17-07-TS-02.

Consider the following if guardrail is being replaced:

- Check if grading is needed for proper installation of guardrail replacement.
- If grading material is needed, estimate the quantity and include a pay item for common embankment rather than making it incidental. Show the grading on plan view sheets and cross sections, if applicable.
- Closely review the effect grading will have on slopes and drainage.
- Check if culvert extensions are needed and include pay items.
- Check for existing utility conflicts.

Existing Guardrail and End Treatment Identification

The following handbook can be used to aid in the determination of existing guardrail and end treatment types: [Roadside Hardware Handbook](#)

Type 31 Guardrail System – Furnish and Install

The Type 31 Guardrail System is a steel post, W-beam guardrail system that has been successfully crash tested per MASH TL-3 criteria and is MnDOT's standard system.

Following are the pay items, standard plans and plates, as applicable:

- 2554.503 TRAFFIC BARRIER DESIGN TYPE 31 by LIN FT; This is steel post W-beam guardrail.
 - Standard Plan 5-297.601 and 5-297.690.

- Standard Plates: 8355, 8360, 8361, 8369.
- 2554.503 TRAFFIC BARRIER DESIGN TRANS TYPE 31 by LIN FT; This is the crash-worthy transition between semi-rigid barrier (guardrail) and a bridge rail (Single Slope, F-shape or J-shape Barrier) or barrier wall (Vertical face). The pay item is used for the 37.5 lin ft or 50 lin ft Approach Guardrail Transition (AGT) to Single Slope, F-shape or J-shape Barrier End Post or to a Vertical End Post.
 - Standard Plan 5-297.694 (Single Slope End Post; pay item is 37.5 lin ft)
 - Standard Plan 5-297.695 (F-shape or J-shape Barrier; pay item is 50 lin ft)
 - Standard Plan 5-297.693 (Vertical End Post; pay item is 37.5 lin ft)
 - Standard Plates: 8350, 8352, 8355, 8356, 8357, 8360, 8361, 8369
- 2554.502 END TREATMENT - TANGENT TERMINAL by EACH; Crash-worthy, approved tangent end treatment meeting MASH criteria. Add note to tab or SEQ: Shall be SOFTSTOP or MSKT
 - Standard Plan 5-297.612
- 2554.502 END TREATMENT - FLARED TERMINAL by EACH; Crash-worthy, approved flared end treatment meeting MASH criteria.
 - Standard Plan 5-297.613
- 2554.502 ANCHORAGE ASSEMBLY - TYPE 31 by EACH; End anchorage on downstream end when a crash-worthy terminal is not needed.
 - Standard Plan 5-297.692
 - Standard Plates: 8365, 8366, 8370

Guardrail Height Transition – Furnish and Install

The 25' vertical height transition section used to connect 28" (B8338 guardrail) and 31" (Type 31 guardrail) is included in the length of Traffic Barrier Type 31. The pay item is:

- 2554.503 TRAFFIC BARRIER DESIGN TYPE 31 by LIN FT; Add a note to the tabulation indicating the pay item includes the 25' height transition.
 - Standard Plan 5-297.601 and 5-297.690.
 - Standard Plates: 8355, 8360, 8361, 8369.

Bullnose Guardrail – Furnish and Install

Following are the pay items, standard plans and plates, as applicable:

- 2554.503 TRAFFIC BARRIER DESIGN BULLNOSE by LIN FT; The bullnose pay limit is 100 lin ft which is dimensioned on the standard plan.
 - Standard Plan 5-297.611
 - Standard Plates: 8356, 8357, 8358, 8360, 8361, 8362, 8365, 8366, 8369
- 2575.507 MULCH MATERIAL TYPE 9 by CU YD; Include 3" depth of mulch in median as shown on Standard Plan 5-297.611 sheet 6 of 6.

3-Cable Guardrail (Low Tension) – Furnish and Install

This is a flexible weak-post system with either wood or steel posts. For more information regarding its use, see Section 10-7.0 TRAFFIC BARRIERS in [RDM Ch 10 Traffic Control Devices & Traffic Barriers](#).

Following are the pay items, standard plans and plates, as applicable:

- 2554.503 TRAFFIC BARRIER DESIGN 8330 by LIN FT; Wood Post 3-Cable guardrail.
 - Standard Plate: 8330

- 2554.503 TRAFFIC BARRIER DESIGN 8331 by LIN FT; Steel Post 3-Cable guardrail.
 - Standard Plate: 8331
- 2554.502 ANCHORAGE ASSEMBLY – CABLE by EACH; Required at each end.
 - Standard Plate: 8333

High Tension Cable Guardrail – Furnish and Install

This is a flexible system with steel posts that is generally used in the median. See [Longitudinal Barriers \(High Tension Cable\) - Approved/Qualified Products](#). Design guidance can be found in the HTCBB Technical Memorandum No. 15-08-TS-04 [Technical Memoranda](#). This is an expired Memo which is still relevant and contains guidance on minimum and maximum length of installation, lateral placement, overlap, anchors, etc. Future guidance will be published in the Facilities Design Guide.

Following are the pay items, standard plans and plates as applicable:

- 2554.603 TENSION CABLE GUARDRAIL by LIN FT; See above and standard plan for placement and overlap details.
 - Standard Plan 5-297.688
 - Standard Plates: 8342 (Concrete line post foundation) or 8343 (Steel line post foundation)
- 2554.502 ANCHORAGE ASSEMBLY - TENSION CABLE by EACH; Required at each end.

Consider the following or similar Construction Notes for use on HTCBB projects, if not already covered elsewhere within your project:

- All drainage inlets within 200 feet of disturbed soil in the median shall be provided with appropriate inlet protection prior to disturbance. Inlet protection is incidental unless otherwise specified in the contract.
- All material removed and not reused on this project shall become the property of the contractor and be disposed of outside MnDOT Right of Way in accordance with Spec. 2106.
- Salvage and installation of culvert marker posts are incidental.
- Any required grading for HTCBB shall be done before guardrail posts are set.
- Roads shall be kept clean of sediment. Use a street sweeper with pick-up type, non-dust generating power broom as often as necessary to keep roads visibly clean within 24 hours of activity that generates sediment tracking or before opening the affected lane to traffic, whichever comes first. All street sweeping work, including street sweeper, shall be incidental.
- Post foundations shall be flush with the ground line posts shall be placed plumb.
- For all construction activities within designated noxious and invasive weed infested areas as shown in the plan, see special provisions.
- Any required mowing for High Tension Cable Barrier (HTCBB) construction is incidental.

B8338 Guardrail System – Furnish and Install

Following are the pay items, standard plans and plates, as applicable:

- 2554.503 TRAFFIC BARRIER DESIGN B8338 by LIN FT
 - Standard Plan 5-297.601
 - Standard Plates: 8338, 8360
- 2554.503 TRAFFIC BARRIER DESIGN SPECIAL by LIN FT; This is a 25' transition to F-shape or J-shape Barrier. However, the Type 31 Transition which is MnDOT's standard system, should be used in most

cases. See Type 31 Guardrail System above.

- Standard Plans 5-297.603, 5-297.605, 5-297.607 and 5-297.618 (depending on rail type)
- Standard Plates: 8318, 8338, 8356, 8360
- This transition can be followed by 28" guardrail (B8338) or a 25' vertical transition from 28" to 31" height guardrail (See Standard Plan 5-297.601).
- END TREATMENTS; Use of the NCHRP 350 end treatments for B8338 guardrail (28") such as the SKT-350, ET-PLUS, SRT-350, and FLEAT-350 are no longer permissible. It is recommended to transition the 28" height to 31" height guardrail (See Standard Plan 5-297.601) and use a Type 31 MASH compliant end terminal. If there is a case where it is necessary to connect a terminal to 28" guardrail, the MSKT end treatment can be used. It is a MASH terminal designed for 31" guardrail but can be used with 28" guardrail. However, when it is installed at 28" it's no longer a MASH-compliant terminal. A note should be added to the guardrail tabulation at each applicable location stating that the MSKT is connecting to a 28" guardrail system and shall be constructed accordingly.
 - Standard Plan 5-297.612 – cross out Softstop and certify standard plan sheet.
- 2554.502 ANCHORAGE ASSEMBLY – PLATE BEAM by EACH; End anchorage used when a crash-worthy end terminal is not needed.
 - Standard Plate: 8338

Short Radius Guardrail – Furnish and Install

This design is needed when wrapping guardrail around an entrance, driveway or side road. Following is the pay item and plate:

- 2554.503 TRAFFIC BARRIER DESIGN B8307 by the LIN FT; This is a wood post guardrail system. Include the Short Radius Design Detail SHORTRG which can be found under Design Details on the MnDOT Standard Plans website. The detail indicates the pay limit length depending upon the radius. A minimum of 12.5 feet of standard rail (B8338) is required beyond the radius before a 25' vertical transition section from 28" to 31" height guardrail followed by Type 31 guardrail. See Standard Plan 5-297.601 for height transition.
 - Standard Plate: 8307

Type 31 Guardrail System – Remove or Salvage and Install

The following pay items should be used, as applicable, for removal:

- 2104.503 REMOVE GUARDRAIL - TYPE 31 by LIN FT (Note if removal includes AGT)
- 2104.502 REMOVE ENERGY ABSORBING TERMINAL by EACH (Note type e.g. SOFTSTOP, MSKT)
- 2104.502 REMOVE ANCHORAGE ASSEMBLY - TYPE 31 by EACH

The following pay items should be used, as applicable, for salvage and install:

- 2104.503 SALVAGE GUARDRAIL - TYPE 31 by LIN FT
- 2554.503 INSTALL TRAFFIC BARRIER DESIGN TYPE 31 by LIN FT
- 2104.502 SALVAGE ENERGY ABSORBING TERMINAL by EACH (Note type e.g. SOFTSTOP, MSKT)
- 2554.602 INSTALL ENERGY ABSORBING TERMINAL by EACH (Note type e.g. SOFTSTOP, MSKT)
- 2104.502 SALVAGE ANCHORAGE ASSEMBLY - TYPE 31 by EACH
- 2554.602 INSTALL ANCHOR ASSEMBLY - TYPE 31 by EACH

3-Cable Guardrail (Low Tension) – Remove or Salvage and Install

The following pay items should be used, as applicable, to remove or salvage a 3-Cable system or to salvage 3-cable guardrail and replace the wood posts with steel posts:

- 2104.503 REMOVE CABLE GUARDRAIL by LIN FT
- 2104.503 SALVAGE GUARDRAIL – CABLE by LIN FT (If replacing wood posts with steel posts, add note to SEQ or tab: Includes the removal of the wood posts).
- 2554.603 INSTALL 3-CABLE GUARDRAIL by LIN FT (If replacing wood posts with steel posts, add note to SEQ or tab: Includes the Furnish and Install of steel posts).
- 2554.503 INSTALL TRAFFIC BARRIER DESIGN 8330 by LIN FT (Use when salvaging and installing the wood post system)
- 2554.503 INSTALL TRAFFIC BARRIER DESIGN 8331 by LIN FT (Use when salvaging and installing the steel post system)
- 2104.502 REMOVE ANCHORAGE ASSEMBLY-CABLE by EACH
- 2104.502 SALVAGE ANCHORAGE ASSEMBLY-CABLE by EACH
- 2554.602 INSTALL ANCHOR ASSEMBLY-3 CABLE by EACH

High-Tension Cable Guardrail – Remove or Salvage and Install

This is a flexible system with steel posts that is generally used in the median. Design guidance can be found in the HTC B Technical Memorandum No. 15-08-TS-04.

The following pay items should be used, as applicable, for remove or salvage and install of a High-Tension Cable system:

- 2104.503 REMOVE TENSION CABLE GUARDRAIL by LIN FT
- 2104.503 SALVAGE TENSION CABLE GUARDRAIL by LIN FT
- 2554.603 INSTALL TENSION CABLE GUARDRAIL by LIN FT
- 2104.502 REMOVE ANCHORAGE ASSEMBLY-TENSION CABLE by EACH; When High-Tension Cable Guardrail Anchors need to be relocated, the existing anchors should be removed, and new anchors constructed. The anchors cannot be salvaged and installed.

B8338 Guardrail System – Remove or Salvage and Install

B8338 guardrail end terminals, anchor assemblies and design specials may be salvaged for parts (check with your maintenance shop) but they should not be installed on MnDOT projects. The following pay items should be used, as applicable, for removal:

- 2104.503 REMOVE GUARDRAIL – PLATE BEAM by LIN FT (Note if removal includes Design Special)
- 2104.502 REMOVE ENERGY ABSORBING TERMINAL by EACH (Note type e.g. ET-2000, SKT-350, etc)
- 2104.502 REMOVE SLOTTED RAIL TERMINAL by EACH
- 2104.502 REMOVE ECCENTRIC LOADER BCT by EACH
- 2104.502 REMOVE TWISTED END TREATMENT by EACH (Note if includes removal of anchorage blocks)
- 2104.502 REMOVE ANCHORAGE ASSEMBLY – PLATE BEAM by EACH

The following pay items should be used, as applicable, for salvage and install:

- 2104.503 SALVAGE GUARDRAIL – PLATE BEAM by LIN FT

- 2554.503 INSTALL TRAFFIC BARRIER DESIGN B8338 by LIN FT

Remove and Replace Posts Only on Plate Beam Guardrail

The following pay items should be used for the replacement of existing wood posts with steel posts and the rail is in good enough condition to be salvaged and installed.

- 2104.502 REMOVE ANCHORAGE ASSEMBLY – PLATE BEAM by EACH; If there is an existing wood post anchor, the entire anchorage assembly should be replaced.
- 2104.503 SALVAGE GUARDRAIL by LIN FT (Add note: Includes the removal of the wood posts)
- 2554.502 ANCHORAGE ASSEMBLY – PLATE BEAM by EACH (If replacing)
- 2554.603 INSTALL GUARDRAIL by LIN FT (Add note: Includes the Furnish and Install of steel posts)

Remove and Replace Rail Only on Plate Beam Guardrail

The following pay items should be used for the replacement of plate beam rail (e.g. rail has been hit or in poor condition), but the posts are in good condition and will be left as is.

- 2104.502 REMOVE ANCHORAGE ASSEMBLY by EACH; If the rail on anchorage is in poor condition, the entire anchorage assembly should be replaced.
- 2104.502 REMOVE GUARDRAIL POST by EACH (If needed to replace specific posts)
- 2104.503 REMOVE GUARDRAIL by LIN FT (Add note: Remove rail only) Or
- 2104.503 REMOVE PLATE BEAM RAIL by LIN FT
- 2554.502 ANCHORAGE ASSEMBLY – PLATE BEAM by EACH (If replacing)
- 2554.602 GUARDRAIL POST by EACH (If replacing specific posts.)
- 2554.603 PLATE BEAM RAIL by LIN FT

Guardrail Connection to Stand-Alone Single Slope Barrier

A connection detail must be designed and included in the plan when attaching Type 31 Guardrail to Concrete Median Barrier Single Slope that is not part of a bridge railing or retaining wall. This barrier is typically on a moment slab. The connection detail should include the guardrail connection plate detail, single slope barrier transition and reinforcement bars.

Thrie Beam Guardrail Connection for Portable Precast Concrete Barrier (PPCB)

Pay item 2554.602 GUARDRAIL TRANSITION CONNECTION by EACH is used for 12'6" thrie beam guardrail connection for PPCB to anchored PPCB or permanent barrier as shown on Standard Plan 5-297.680.

Guardrail Anchorage Plate for Traffic Barrier Design B8338

Pay item 2554.602 T-BARRIER BRIDGE CONN DES 8318 by EACH should be included in the tab and SEQ when connecting B8338 guardrail on the downstream end of a bridge that does not require a Design Special transition. The anchorage plate is also used in Traffic Barrier Design Specials, but is included in that pay item and doesn't need to be paid for separately. Standard plate 8318 applies.

Guardrail – Long Posts

Please note on the tabulation when a run of guardrail requires posts that are longer than the standard 6-foot length. Note station to station and the required post length. Contractors have requested this as it may affect unit prices. Include Standard Plate 8360.

Guardrail – Post Seat

This is used when the guardrail post cannot go as deep as typically required such as over culverts. This is paid for as 2554.602 GUARDRAIL POST SEAT by EACH. Include the following detail in plan [Guardrail Post Anchorage](#).

Guardrail – Omit Posts

With Type 31 guardrail, omitting a single guardrail post is allowed once every 50' without additional measures taken. Type 31 and B8338 guardrail allow for longer gaps of omitted posts with additional measures. For more information see [Guardrail FAQs](#).

Guardrail – Working Width & Deflection Distance

Working width is the distance between the barrier face before impact and the maximum lateral position of any major part of the system or vehicle during or after impact. This area should be free of any hazards or fixed objects. See [Guardrail FAQ's](#) for more information and [Working Width.pdf](#) showing how this is measured.

Deflection distance is the distance between the barrier face before impact and the barrier face after impact.

Guardrail – Stiffened

See Standard Plan 5-297.601 for details.

Guardrail – Rubrail

Rubrails are used when the distance between the top of curb or paved surface and bottom of plate beam rail is too great. Payment for rubrails is included in the Traffic Barrier Design Transition Type 31 and Design Special pay items and they are detailed in the standard plans. They are not paid for separately.

Concrete End Post (Bridge)

The One-Line Bridge Rail End Post as shown on Standard Plan 5-297.609 and 5-297.619 have been modified to remove specific structural and reinforcing details regarding the end post. The primary intent of these standards is to show the guardrail transition and connection to flat-faced structures.

Designers should work with the Bridge Office to develop specific end post details and reinforcing on a case-by-case basis for all projects that require a new end post. The Office of Project Management and Technical Support is working with the Midwest Roadside Safety Facility (State Pooled Fund) to design and test a new stand-alone end post in accordance with current crash test requirements (MASH).

Impact Attenuators

Temporary impact attenuators used for traffic control applications are paid as 2563.615 TEMPORARY IMPACT ATTENUATOR by ASSEMBLY. The test level (TL) should be noted on the tabulation. If a project requires both TL3 and TL2 attenuation, they should be labeled on the plan sheets for clarification. All Temporary Impact Attenuators that are placed on roads with speeds of 50 mph or greater shall be TL3 and those on roads with speeds 45 mph or lower shall be TL2.

Impact Attenuators/Crash Cushions that are used for permanent applications are paid as 2554.615 IMPACT ATTENUATOR by ASSEMBLY. See the Approved/Qualified Products list for the crash cushions that are acceptable for use: [Crash Cushions - Approved/Qualified Products - MnDOT](#)

The specific product name should be noted in the tabulation along with items that are included such as the concrete pad. For questions regarding crash cushions, contact the Design Standards Unit.

Portable Precast Concrete Barrier (PPCB)

PPCB Type F, Standard Plate 8337 is for temporary use to provide separation between traffic and work areas. It is primarily used for protecting vehicles from severe hazards, e.g., drop-offs, embankments, and fixed objects, protecting workers from errant vehicles, and to separate opposing directions of traffic in certain temporary traffic control applications.

See the Temporary Barrier Guidance Manual 2018 located on the Traffic Engineering Work Zones - Temporary Traffic Control Manuals and Guidelines website for specific guidance and applications.