CHAPTER 14: GUARDRAIL/BARRIERS

Guardrail Terminals at 6 in. (150 mm) Curb

A potential problem is created when a guardrail end treatment is used where 6 in. (150 mm) curb is inplace. Since a flared terminal is placed with a 4 ft. (1.2 m) flare, a considerable length of guardrail is more than 9 in. (230 mm) behind the face of the curb, thus causing a condition under which an errant vehicle could hit the curb and vault over the guardrail. When a tangent terminal is used, the extruder box is 9 ½ in. (241 mm) closer to the traffic lane than the guardrail. This means then even if the guardrail is set the maximum 9 in. (230 mm) behind the face of the curb, the extruder box will be partially in front of the face of the curb. This results in the possibility of the extruder box being hit by a passing vehicle or, more probable yet, a snow plow.

The problem mentioned above can be eliminated by the following action. When a flared terminal is installed behind 6 in. (150 mm) curb, the curb should be ground down 3 in. (75 mm) to a height of 3 in. (75 mm) beginning at a point 20 ft. (6.1 m) in advance of the guardrail nose and continuing to Post No. 8, a total distance of 58 ft. (17.7 m). When a tangent terminal is placed behind 6 in. (150 mm) curb, the extruder box should be placed a minimum of 9 in. (230 mm) behind the face of the curb. The first 50 ft. (15.2 m) of guardrail needs to be in a straight line angled towards the curb and slightly kinked between Post Nos. 9 and 10. Beyond this point it would be parallel with the curb. The curb should be ground down 3 in. (75 mm) to a height of 3 in. (75 mm) beginning at a point 10 ft. (3 m) in advance of the extruder box and continuing to Post No. 9, a total distance of 60 ft. (18.3 m).

As an alternate to grinding down the curb, it could be removed and replaced with D 424 curb and gutter. On overlay projects, no correction of the curb is necessary if the thickness of the overlay at the curb face is such that no more than 4 in. (100 mm) of curb remains exposed.

When a tangent terminal is used with 4 in. (100 mm) curb or where there is no curb the configuration described above should also be used. However, in the latter case, the 9 in. (230 mm) minimum setback of the extruder box should be measured from a straight line extending forward from the face of the guardrail at Post No. 9.

Impact Attenuator Barrels

Engineering Cost Data and Estimating Unit is responsible for determining reasonable prices for supplemental agreement to construction projects alerted us to the fact that our past practice has been to have a pay item for these barrel attenuators as an assembly, perhaps ten (10) barrels comprising an installation (assembly).

If a second or third installation was required on the project, with a different number of barrels, we could have 2 or 3 pay items. Also, if these installations are used for traffic control, the contract reads that the contractor would replace any units at his expense. This is difficult for a contractor to bid.

We will use impact attenuator barrels, (each). If additional barrels may be needed for replacement, include a quantity for this and subnote the item on the estimate sheet. The cost of

each barrel has been coming out the same, regardless of the amount of sand/salt required. If a paved area is required, it should be allowed for separately. The attenuator should be shown in the plans per past practice, the number of barrels, spacing and weight of sand/salt shown.

Portable Precast Concrete Barrier

PPCB, (Type III), Standard Plate No. 8337 is for temporary usage only. It is not designed to be used for a permanent barrier.

The Type III PPCB is required on many bridge construction sites and their immediate approaches (normally, 36.6 m (120 ft.) adjacent to the bridge end) when the PPCB is designated as the means of protecting the construction site. The Type III barrier will also be required along deep drop-offs immediately adjacent to lanes used to carry traffic. Type III PPCB is required for major maintenance work on bridges, which will take a considerable length of time and if a positive barrier is needed.

Adequate flare (desirably about 1:10) or end protection, such as a crash cushion, to prevent impact with exposed barrier ends must continue to be provided.

Guardrail End treatments

Mn/DOT has requested and received a Public Interest Finding for the specification of w-beam guardrail terminals for use on State Trunk Highways.

The Public Interest Finding allows Mn/DOT to specify one of the following w-beam terminals for exclusive use within a specific highway corridor, the plans must state as a note on either the estimate quantities table or the tab sheet:

Tangent Terminal: Shall be either ET-2000 or SKT-350

Flared Terminal: Shall be either SRT-350 or FLEAT-350

Guardrail Replacement

The following information is meant to be tips for designers to better facilitate installation in the field.

The designer should make a site visit for each installation. It might be a good idea to take pictures. The designer should be aware of the design requirements.

During the site visit, particular attention should be paid to the following:

- -existing geometrics, especially entrance slopes (was the original installation done properly?)
- -condition of material around the installation (is there considerable erosion?)
- -will the existing conditions allow installation without grading work?
- -make an estimate of grading materials required to make the installation proper.

(a good field estimate will do, no cross sections are required)
-closely review the affect grading will have on drainage
-will grading require culvert extensions, etc.?
-check for existence of utilities

Include pipe extensions, appurtenances, and treatments in estimate of quantities.

Break down grading quantities to individual pay items, rather than incidental, etc. (some of these applications can result in considerable quantities of grading material)
-this will ensure that bidders are actually including this in their bids.
-it will relieve our project people from paying premium prices for later contract adjustments

Guardrail – Plate Beam Pay Items

The following are pay items to be used in dealing with plate beam guardrail involving wood and steel posts and end treatments. Remember each situation is different and not all pay items may be required or additional items may be needed. Design Specials (first 25' off the ends of bridges) are not covered in this write-up.

1. When removing plate beam guardrail (including posts and end treatment) and will not be reusing the guardrail but replace the existing system with new, use the following items:

   2104.501 Remove Guard Rail – Plate Beam
   2104.509 Remove Anchorage Assembly – Plate Beam (providing there is one inplace)
   2104.509 Remove *specify end treatment* (i.e. twisted end, energy absorbing, etc…)
   2554.501 Traffic Barrier Design B8338 (steel posts)
   2554.501 Traffic Barrier Design B8307 (wood posts)
   2554.521 Anchorage Assembly – Plate Beam (if required)
   2554.523 End Treatment – *specify* (see below)

2. When removing plate beam rail only (posts remain) and will not reuse the rail (this is used if the rail was hit or in poor condition and the District has decided that the wood posts are in good condition and would like to keep the wood post system), use the following items:

   2104.501 Remove Guard Rail
   2104.509 Remove Anchorage Assembly (providing there is one inplace)
   2554.521 Anchorage Assembly – Plate Beam (if required)
   2554.602 Guardrail Post (if required)
   2554.603 Plate Beam Rail

3. When there is a run of plate beam guardrail with wood posts and the rail is in good condition, the District may opt for salvaging the rail and replace the wood posts with steel posts, if this is the case use the following items:

2104.509 Remove Anchorage Assembly (providing there is one inplace)
2104.521 Salvage Guard Rail (add note to estimate: Includes the removal of the wood posts.)
2554.521 Anchorage Assembly- Plate Beam (if required)
2554.603 Install Guard Rail (add note to estimate: Includes the Furnish and Install of steel posts)

END TREATMENTS

4. There are details available on the server both in Metric and English for the following end treatments, which should be placed into the plans. These details are propriety end treatments and should not be modified or signed.
   Tangent Terminal - (ET-2000 and SKT-350)
   Flared Terminal - (SRT-350 and FLEAT-350)

5. Use these pay items:

   2554.523 End Treatment - Tangent Terminal (Include details in plan)
   2554.523 End Treatment - Flared Terminal (Include details in plan)

6. EXCEPTION (**FLARED TERMINAL ONLY**):
   The SRT-350 only comes with wood posts. The FLEAT-350 is the only flared treatment that has steel posts. So, if the District wants to have a flared terminal with steel posts, then the following pay item should be used:

   2554.523 End Treatment - Energy Absorbing Terminal (add note to estimate: Shall be flared and have steel posts.

   If this situation is used alone (no other end treatments) in your plan then **Do NOT** include the detail in plan for a flared terminal. If you are using this item along with the End Treatment – Flared Terminal pay item then the details for the flared terminals should be included in the plan.

7. When removing or salvaging an existing guardrail end treatment (you know what it is) then use ….
   2104.509 Remove Energy Absorbing Terminal
   2104.509 Remove Breakaway Cable Terminal
   2104.509 Remove Slotted Rail Terminal
   2104.509 Remove Eccentric Loader BCT
   2104.523 Salvage Energy Absorbing Terminal
   2104. 523 Salvage Breakaway Cable Terminal
   2104. 523 Salvage Slotted Rail Terminal
   2104. 523 Salvage Eccentric Loader BCT
   2554.602 Install Energy Absorbing Terminal
   2104. 602 Install Breakaway Cable Terminal
   2104. 602 Install Slotted Rail Terminal
   2104. 602 Install Eccentric Loader BCT

And add a note of what they are.

If, however it is an instance where the contractor will be salvaging a guardrail end treatment as a result of staging cross traffic. Then use…
2104.523 Salvage Tangent Terminal *
2104.523 Salvage Flared Terminal *
2554.602 Install Tangent Terminal *
2554.602Install Flared Terminal *

*Note as 4 above.

8. If anyone ever has any questions regarding guardrail, end treatments and/or pay items included in your plan, please contact the Design Support Engineer or the Standards Engineer prior to completing your plan. It is much easier having a plan come in with the correct information than try to correct it later.

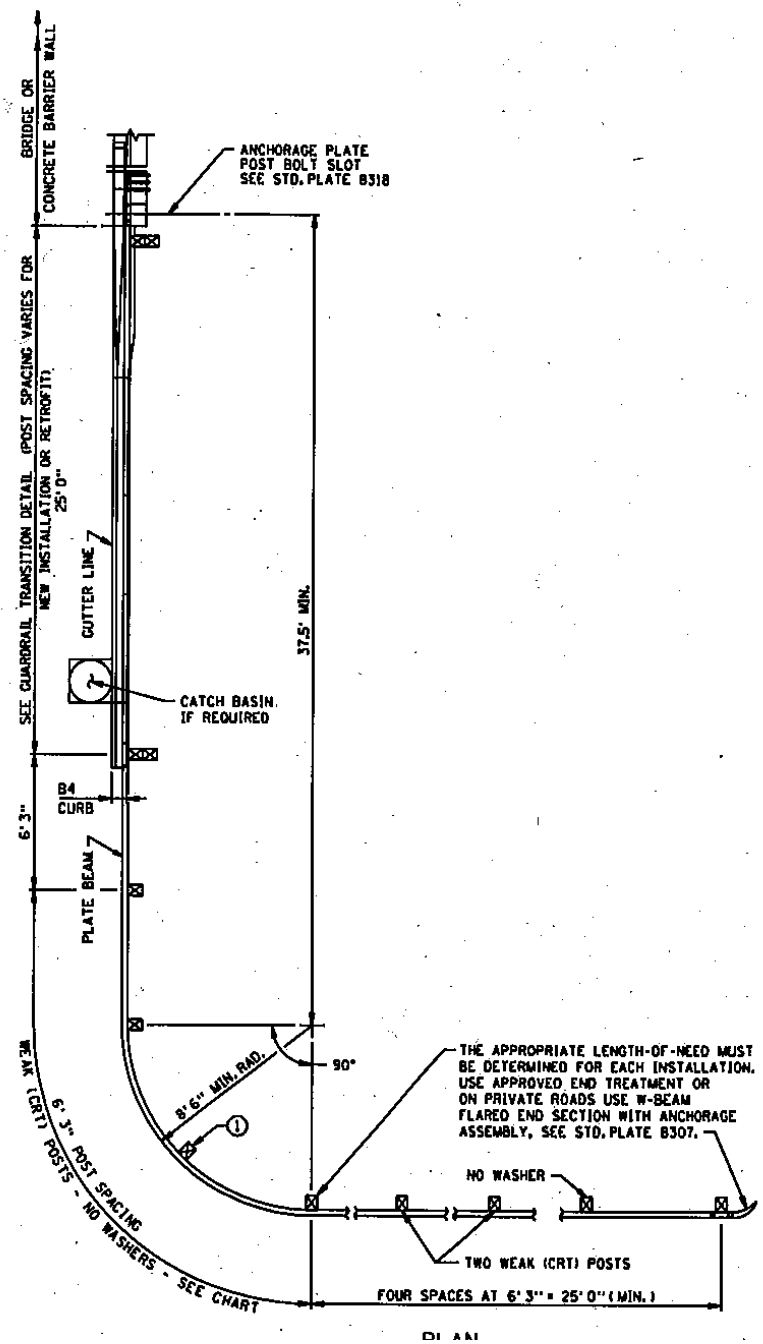
Short Radius Guardrail

Whenever the guardrail includes a short radius around an entrance, driveway, or side road it will require a special short radius detail.

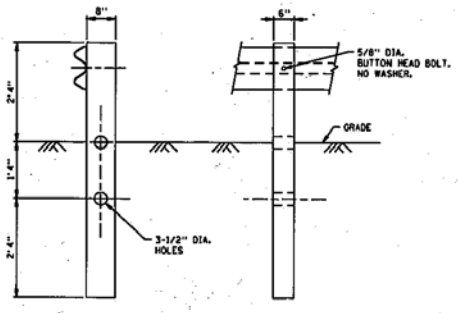
This is considered an unapproved standard detail and shows the use of wood posts. This would require the use of item 2554.501 TRAFFIC BARRIER DESIGN A8307 or 2554.501 TRAFFIC BARRIER DESIGN B8307 by the LIN FT.

The detail can be found on ProjectWise at

OTS\DesignStandards\DesignDetails\Development\shortrg_dd.dgn or can be seen below…



PLAN



CONTROLLED RELEASING TERMINAL WEAK (CRT) POST

NUMBER OF WEAK (CRT) POSTS AND GUARDRAIL RADIUS

NO. OF POSTS	APPROXIMATE RADIUS
4	8'-6" (1)
5	12'-0"
6	16'-0"
7	20'-0"
8	24'-0"
9	28'-0"

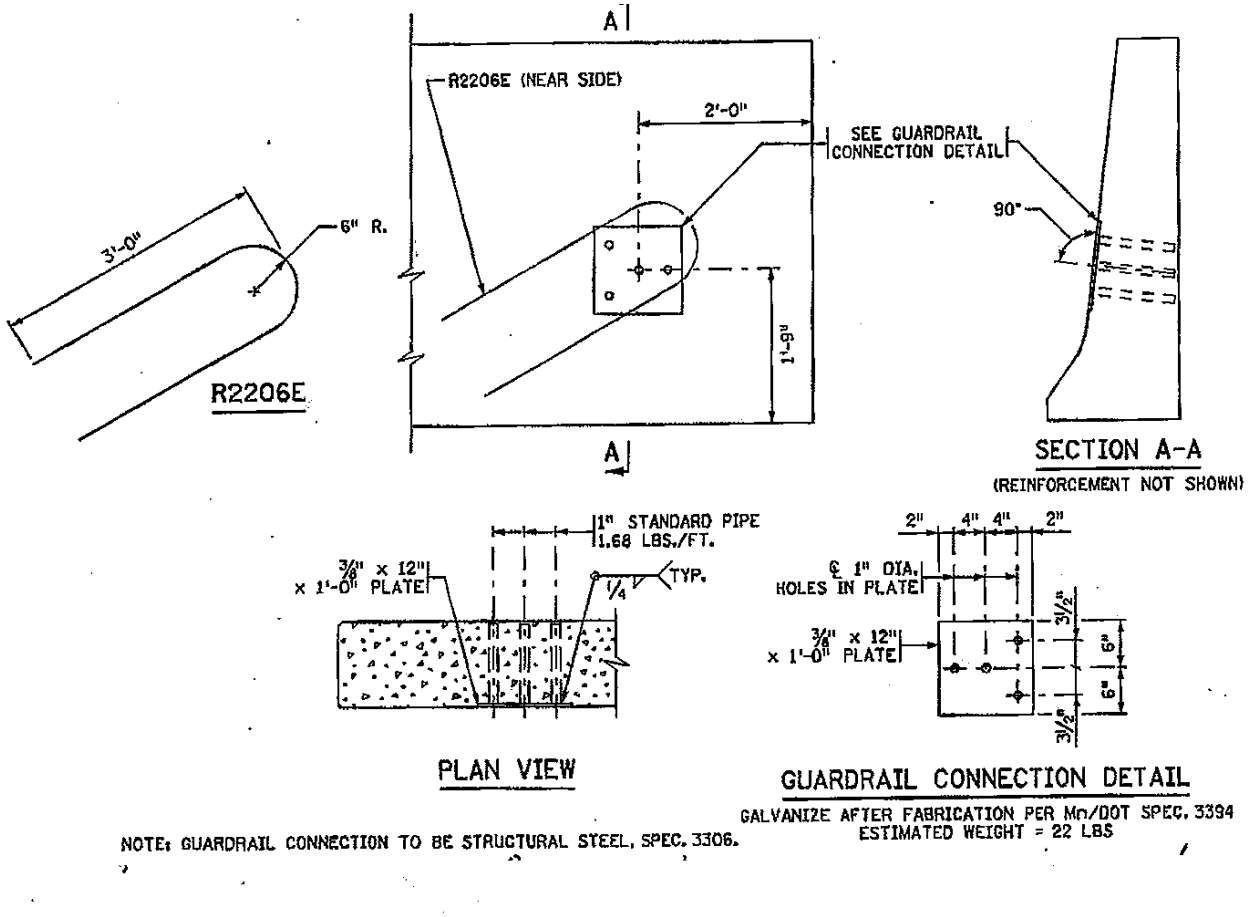
(1) NO BOLT ON CENTER POST.

NOTE: SEE SPEC. 2554.

NOT NCHRP 350 APPROVED

Guardrail Attachment to Barrier

When attaching guardrail to concrete barrier you need to take into account the connection to the barrier. The detail below is an example of one such detail you would need to add to the plan….



Concrete End Post

The One-Line Bridge Rail End Post as shown on Standard Plan .609 & .619 has 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.

Designers will need to work with the Bridge Office to develop specific end post details and reinforcing on a "case-by-case" basis for all new projects that require use of these standard plan sheets. The Office of Project Management and Technical Support is working on a proposal to get a new "stand alone" end post crash tested in accordance with current crash test requirements.

Impact Attenuators

In order to avoid external conflicts and maintain consistency within MnDOT, we will be changing how we call out temporary and permanent impact attenuators on our traffic control plans.

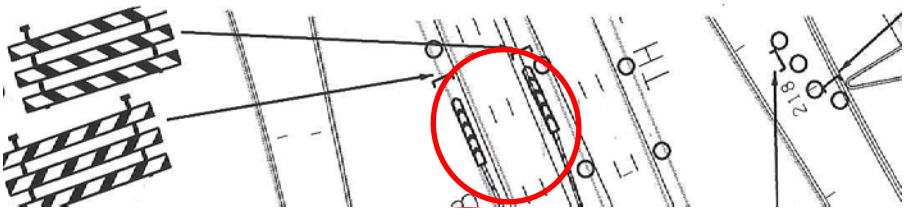
We will be specifying whether they are TL3's or TL2's (test level's) instead of posted speed limits.

All Temporary Impact Attenuators that are to be placed on roads with the speeds of 50 mph or greater will now be TL3 and those that are 45 mph or less shall be TL2.
These will be noted on our Pay Item Tabulation sheets like we have been doing. If the project requires both TL3 and TL2 attenuation, then they should be labeled on the plan sheets for clarification.

Examples: Same test level for all…

	PAY ITEM TABULATION		TC
	PAY ITEM	UNIT	TOTAL
	PORTABLE PRECAST CONCRETE BARRIER DESIGN 8337	LIN FT	400
	PORTABLE PRECAST CONCRETE BARRIER DESIGN 8337-ANCHORED	LIN FT	792
(1)	IMPACT ATTENUATOR	ASSEMBLY	4
	TRAFFIC CONTROL	LUMP SUM	1
(2)	MEDIAN BARRIER DELINEATOR	EACH	40
	PORTABLE CHANGEABLE MESSAGE SIGN	UNIT DAY	14
(3)	REMOVABLE PREFORM PAVEMENT MARKING TAPE	LIN FT	5798
	REMOVABLE PREFORMED PLASTIC MASK (BLACK)	LIN FT	3470

(1) TL3 ASSEMBLIES
(2) 20 WHITE,20 YELLOW- ALL ONE WAY
(3) 3052' 4" SOLID LINE WHITE, 840' 4" BROKEN LINE WHITE, 1906' SOLID LINE YELLOW

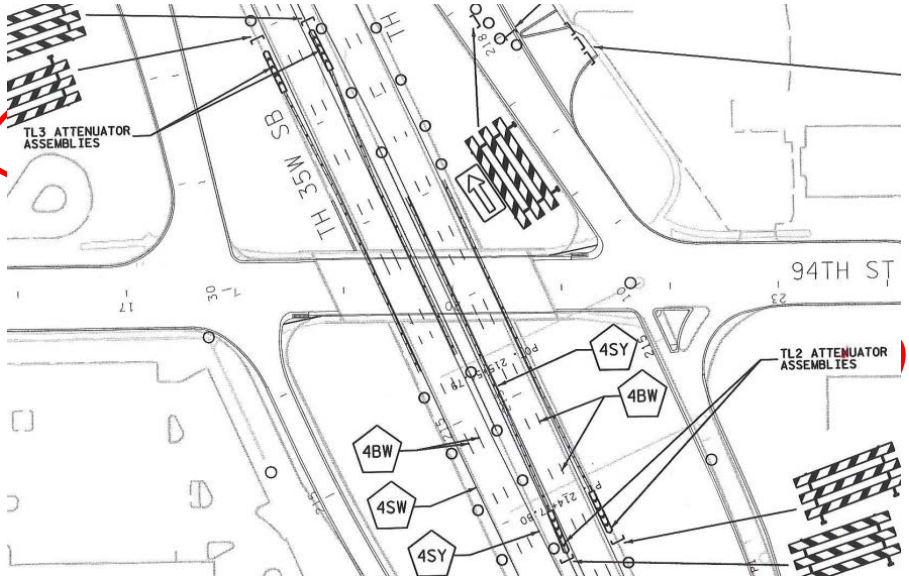


No need to label attenuators

Example: Different test levels…

	PAY ITEM TABULATION		TC
	PAY ITEM	UNIT	TOTAL
	PORTABLE PRECAST CONCRETE BARRIER DESIGN 8337	LIN FT	400
	PORTABLE PRECAST CONCRETE BARRIER DESIGN 8337-ANCHORED	LIN FT	792
(1)	IMPACT ATTENUATOR	ASSEMBLY	4
	TRAFFIC CONTROL	LUMP SUM	1
(2)	MEDIAN BARRIER DELINEATOR	EACH	40
	PORTABLE CHANGEABLE MESSAGE SIGN	UNIT DAY	14
(3)	REMOVABLE PREFORM PAVEMENT MARKING TAPE	LIN FT	5798
	REMOVABLE PREFORMED PLASTIC MASK (BLACK)	LIN FT	3470

(1) 2-TL2, 2-TL3 ASSEMBLIES
(2) 20 WHITE,20 YELLOW- ALL ONE WAY
(3) 3052' 4" SOLID LINE WHITE, 840' 4" BROKEN LINE WHITE, 1906' SOLID LINE YELLOW



Need to label all attenuators as to what level they are.