

Project Insights and Best Practices

for

MaineDOT Highway Design

Session 2: November 5, 2018



Purpose

To provide a learning opportunity for designers to share their own project specific and general experiences, and receive clarification and answers to questions related to MaineDOT Policies, Engineering Instructions (EI's), and Design Guidance, with the intent of improving the overall quality and consistency of the Highway Design process, submissions received from consultants and internal MaineDOT Highway design teams.

Process (1 of 5)

- Idea originally raised during a Highway Subcommittee Meeting regarding:
 - potential lack of consistency of design submissions
(including different submissions from the same consultant)
 - passing down/sharing of information with newer staff
 - sharing of information between consultants
- The subcommittee felt this warranted further exploration and took it on as a goal.
- Subcommittee members involved in initial discussions:
 - Tony Grande – VHB
 - Don Ettinger – Gorrill Palmer
 - Dale Mitchell – HNTB
 - Kevin Ducharme – T.Y. LIN

Process (2 of 5)

- Topics Covered were mainly based on the Highway Design Guide:
 1. Pre-Scoping or General Policy Discussion Points
 2. Typical Sections
 3. Alignment (H/V)
 4. Geometric Layout
 5. Drainage
 6. *Cross Sections*
 7. *Guardrail*
 8. *Quantities/Estimating*
 9. *Geotechnical*

Process (3 of 5)

- With this list as the focus, polled our own internal design teams, for:
 - Project-specific experiences worth sharing
 - Design questions or areas where clarification would be helpful
 - Any other topics that may not be listed
- Lists from all four firms were then combined
- Held several meetings, included our experienced designers, shared some project experiences, and vetted through each item on the combined list
- Results were then compressed, and refined for discussion with MaineDOT

Process (4 of 5)

- (3) meetings with MaineDOT, and included our experienced designers
 - September 28, 2017
 - October 20, 2017
 - November 1, 2017
- MaineDOT Highway Program involved in discussions:
 - Brad Foley
 - Steve Bodge
 - Andy MacDonald
 - Atlee Mousseau
 - Shawn Smith
 - Denis Lovely

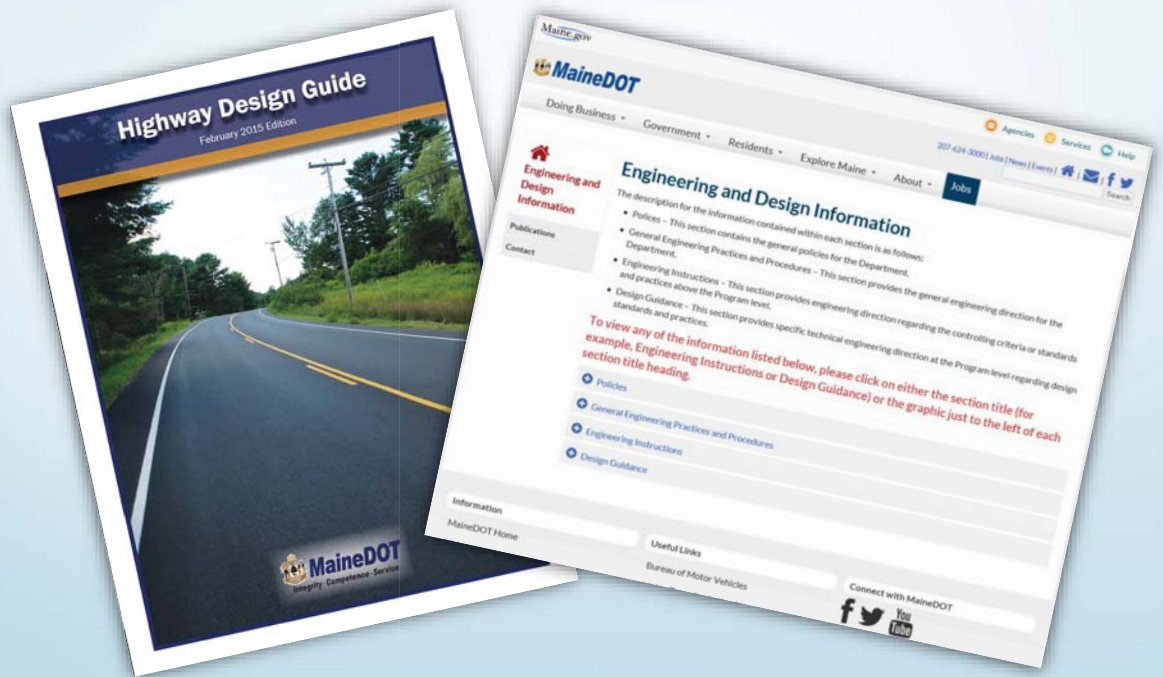
Process (5 of 5)

- Meetings were very interactive, discussions included:
 - project specific examples,
 - policy discussion points
 - general design issues
 - other issues that came about as a result of discussion

Today's Meeting

- Review the results
- Interactive discussion
- Meeting feedback included in final document
- Final document available on MaineDOT Highway webpage.

Presentation of Results



Cross Sections

6. Cross Sections (1 of 11)

- A. Do not show interpretive bedrock surfaces on final cross sections or profiles. Okay to show them through Pre-PS&E for slope development and estimating purposes.**

In the past, bedrock limits were approximated and shown on the profile and cross sections. Since the bedrock can vary significantly between borings and the strength of bedrock is so variable, MaineDOT is no longer showing this information on the final stamped plans.

It is still okay to develop the design based on this information, but bedrock lines will be removed for the PS&E submittal. There is recent MaineDOT discussion regarding not showing bedrock lines on any submittals. Coordinate your work with MaineDOT.

6. Cross Sections (2 of 11)

- A. Do not show interpretive bedrock surfaces on final cross sections or profiles. Okay to show them through Pre-PS&E for slope development and estimating purposes.**

General Note - Geotechnical information furnished or referred to in the Bid Documents is for the use of the Bidders. No assurance is given that the information or interpretations will be representative of the actual subsurface conditions throughout the construction site. MaineDOT will not be responsible for any interpretations or conclusion drawn from the geotechnical information. The Boring Logs provided in the Bid Documents (if any) present factual and interpretive subsurface information collected at discrete locations. Data provided may not be representative of the subsurface conditions between boring locations.

6. Cross Sections (3 of 11)

- A. Do not show interpretive bedrock surfaces on final cross sections or profiles. Okay to show them through Pre-PS&E for slope development and estimating purposes.

Boring symbols will still be shown on plans and cross sections.

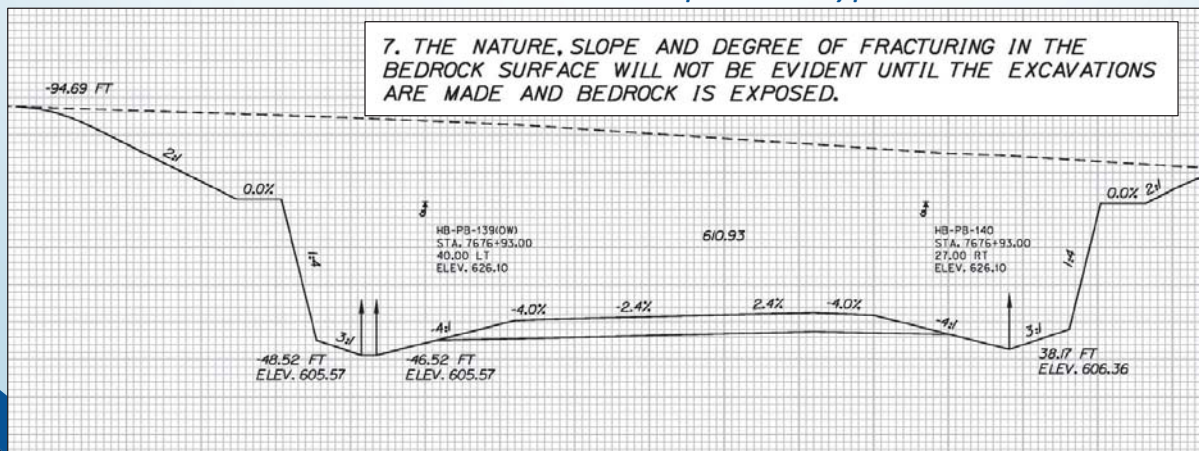
Coordinate with MaineDOT on limits of right of way takings in bedrock areas (2:1 vs. 1:4 bedrock slope).

MaineDOT is looking to collect more subsurface data in the future (GPR data).

6. Cross Sections (4 of 11)

- A. Do not show interpretive bedrock surfaces on final cross sections or profiles. Okay to show them through Pre-PS&E for slope development and estimating purposes.

Sample XS & typical section note



6. Cross Sections (5 of 11)

B. Benching, don't show on cross sections, just add label?

General Note - existing inslopes in proposed fill areas shall be benched by excavating steps of sufficient width to permit placing and compacting the fill material along with the material removed.

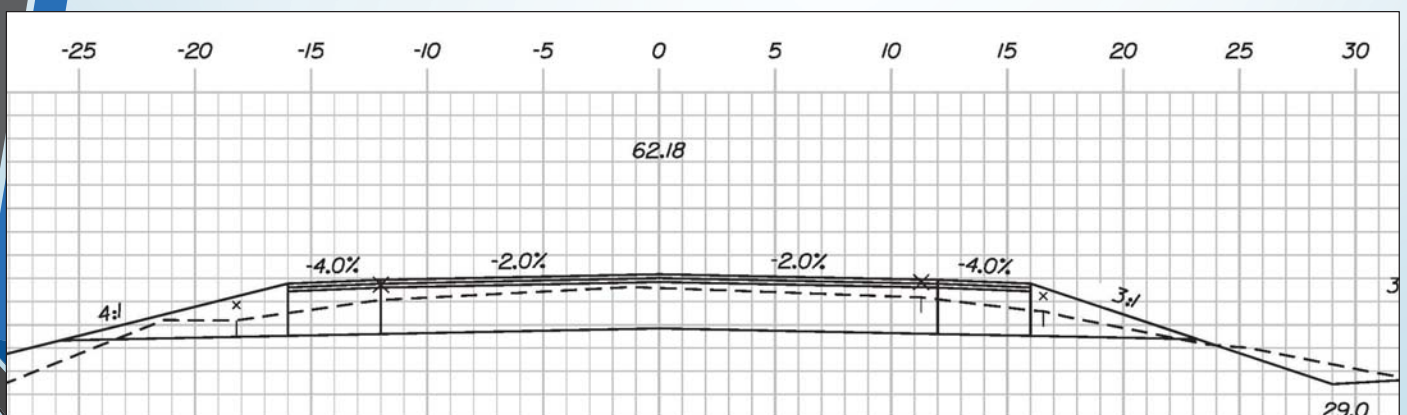
Similar language in MaineDOT Repair Spec, Section 203.09

Benching is no longer shown on the cross sections. Benching everywhere but not showing anywhere.

Excavation for benching to receive embankments will not be paid for directly. Is considered incidental to other contract items.

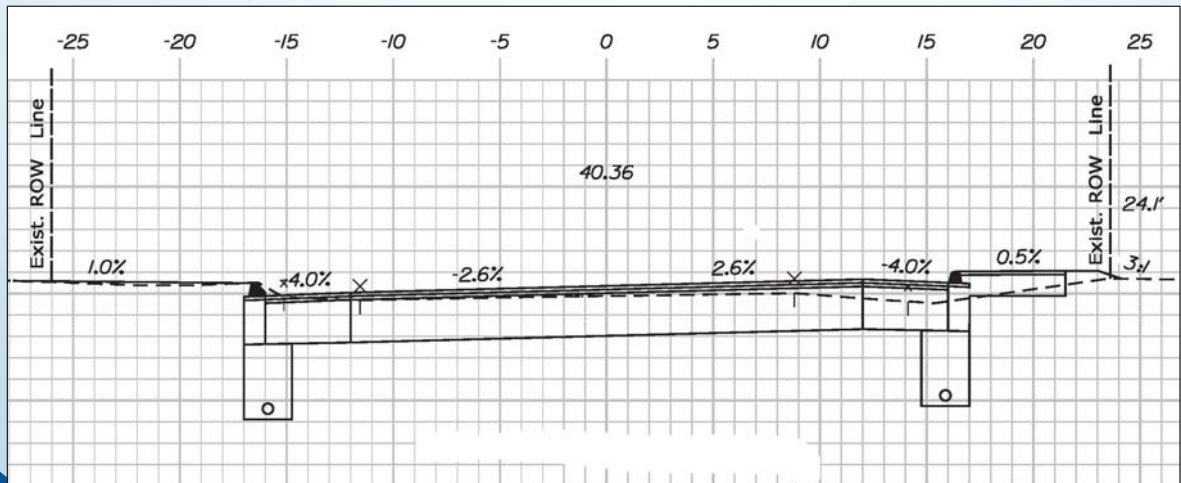
6. Cross Sections (6 of 11)

C. Labeling of cross slopes, positive (+) sloping above CL/BL vs. minus (-) sloping below CL/BL



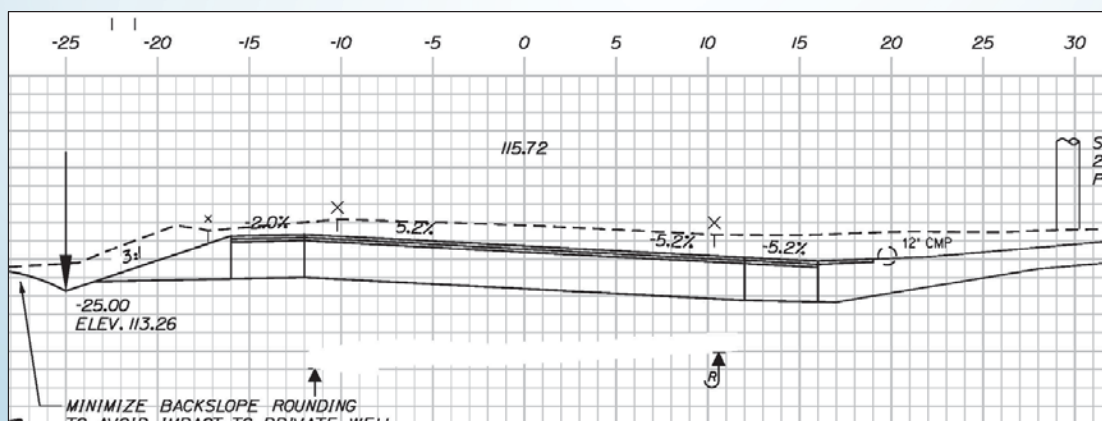
6. Cross Sections (7 of 11)

- C. Labeling of cross slopes, positive (+) sloping above CL/BL vs. minus (-) sloping below CL/BL



6. Cross Sections (8 of 11)

- C. Labeling of cross slopes, positive (+) sloping above CL/BL vs. minus (-) sloping below CL/BL



6. Cross Sections (9 of 11)

D. Stone Ditch Protection @ 6% grade or steeper

Chapter 14 of HDG discusses uses for stone ditch protection, riprap and erosion control blanket in roadside ditch areas (to be removed).

Stone Ditch Protection – use in roadside ditches with slopes 6% or steeper. Depth = 12". Width = 6' min.

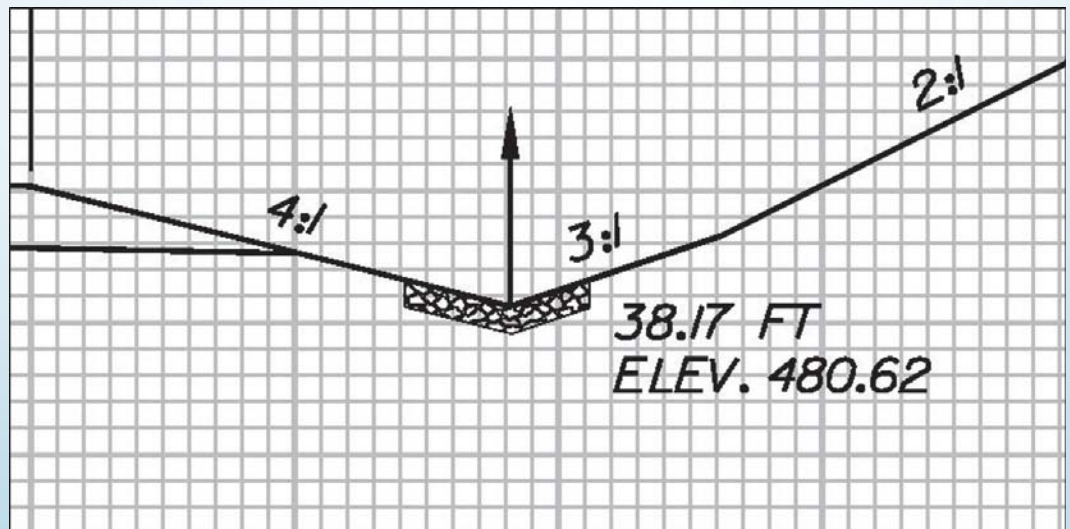
Riprap – use in roadside ditches with slopes 6% or steeper with substantial flows (high velocities). Depth = 18". Width = 6' min.

Erosion Control Blanket – use in roadside ditches with slopes less than 6%. Width = 6' min.

6. Cross Sections (10 of 11)

D. Stone Ditch Protection @ 6% grade or steeper

Provide 1.0' min. depth of protected ditch (example below provides 7' SDP width)



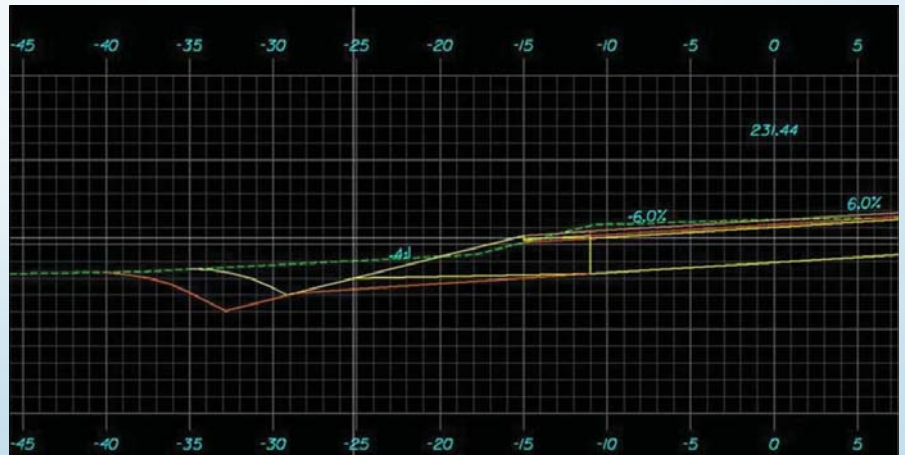
6. Cross Sections (11 of 11)

E. Subgrade Design for the Low-Side of Superelevated Curves

In the past, break the shoulder subgrade at the edge of travelway at 2% subgrade slope to the side-slope intercept (yellow lines).

New practice, continue the shoulder subgrade slope at the same slope as travelway subgrade slope (orange lines).

Maintain 1.0' min. ditch depth below side-slope intercept



Guardrail / Terminals / End Treatments

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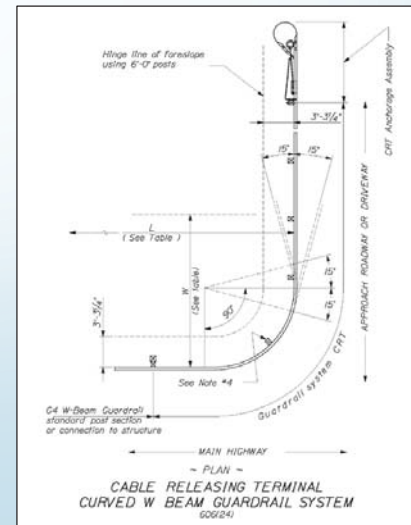
7. Guardrail / Terminals / End Treatments (1 of 21)

A. Use of CRT

Cable Releasing Terminal –

Not using CRT's as it is difficult to install per the manufacturers requirements.

Doesn't seem practical in most cases.



7. Guardrail / Terminals / End Treatments (2 of 21)

B. End Treatments – Tangential vs. Flared ends

GR & GR Terminal Policy – provides information relating to new and existing GR and GR Terminals for new construction, reconstruction, rehabilitation and restoration work (MASH & NCHRP 350).

Flared terminals are preferred over tangent terminals. Install with 4' offset.

Tangent terminals are allowed. Recommend 2' offset on leading and trailing ends to reduce plow damage/nuisance hits.

7. Guardrail / Terminals / End Treatments (5 of 21)

B. End Treatments – Tangential vs. Flared ends

Grading requirements in advance of GR terminals.

Curbing limitations under GR and in advance of GR terminals.

- 4" curb height under GR
- No curb or 1.5" curb height at GR terminals (RDG)

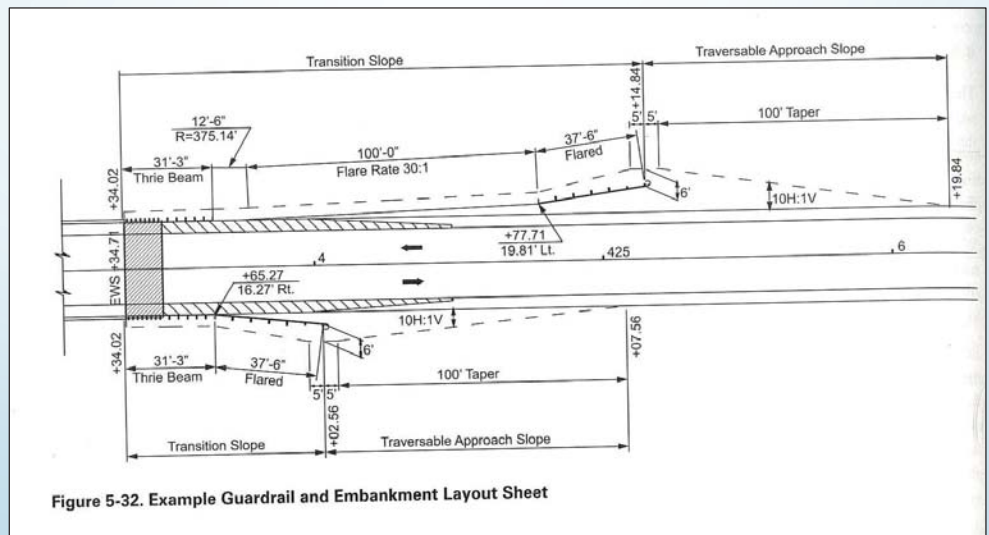
Discussed in manufacturers literature and RDG.

7. Guardrail / Terminals / End Treatments (6 of 21)

B. End Treatments – Tangential vs. Flared ends

Grading requirements in advance of GR terminals (RDG)

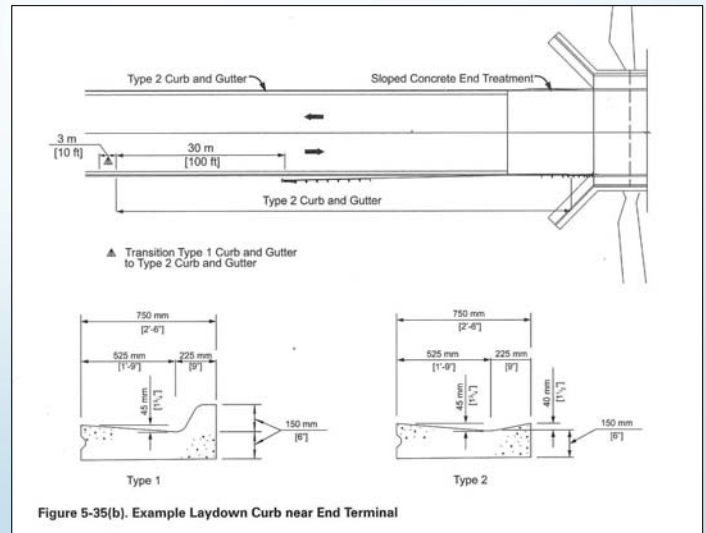
See manufacturers literature.



7. Guardrail / Terminals / End Treatments (7 of 21)

B. End Treatments – Tangential vs. Flared ends

Curbing limitations under GR and in advance of GR terminals.



7. Guardrail / Terminals / End Treatments (8 of 21)

B. End Treatments – Low Volume ends

*Low Volume Ends -
See GR and GR Terminal Policy.*

*Existing low volume ends are okay on Priority 4 roadways with
AADT less than 1,000.*

Not allowed on new projects.

7. Guardrail / Terminals / End Treatments (9 of 21)

B. End Treatments – Driveway / Side Road Termination

Driveway Termination -

Consider running standard GR radius beyond LON. Might eliminate need for crashworthy end treatment.

Only use anchoring at end of driveway if extreme hazard

Assess on case by case basis.

Side Roads -

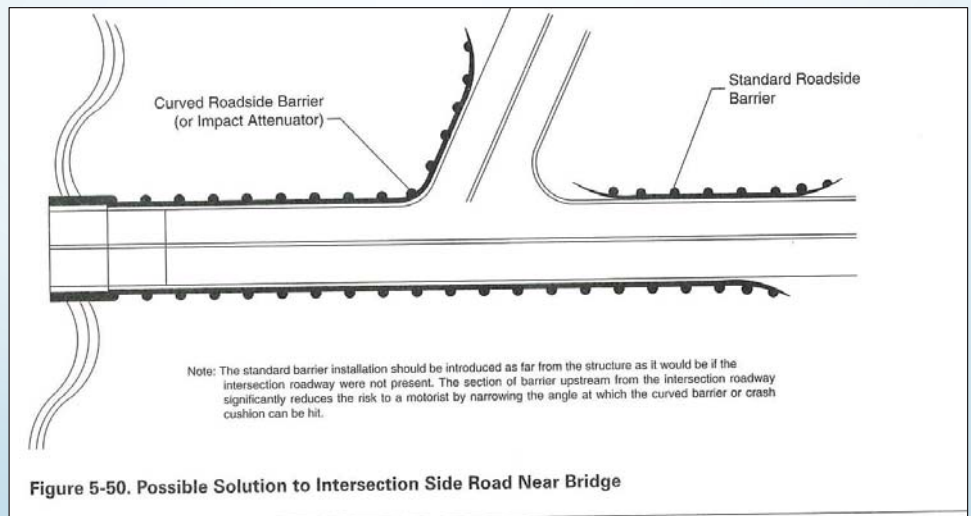
Follow higher roadway priority when designing GR.

Crashworthy end treatment will be required.

7. Guardrail / Terminals / End Treatments (10 of 21)

B. End Treatments – Driveway Termination

Example:



7. Guardrail / Terminals / End Treatments (11 of 21)

B. End Treatments – use of Anchored vs. Unanchored (non-crashworthy).

Anchored ends typically used on trailing end of one-way roadways or on interstate systems. Anchored ends can be used on two-way roadways if the anchored end is protected from impacts.

Unanchored ends requires the GR length to be extended at least 50' beyond hazard or 8 additional GR anchor bolts, in order to provide GR strength at hazard location.

Generally speaking, two-way roadways will have crashworthy end treatments on leading and trailing ends.

7. Guardrail / Terminals / End Treatments (12 of 21)

C. Mid-way Splice/MASH compliance

*See GR and GR Terminal Policy –
Either NCHRP 350 or MASH compliance*

New Construction/Reconstruction – MASH Compliant

Rehabilitation – Existing NCHRP 350 can remain, be adjusted or repaired, however any new or replacement GR shall be MASH compliant.

Resurfacing – Existing GR in good condition can remain.

7. Guardrail / Terminals / End Treatments (13 of 21)

C. Mid-way Splice/MASH compliance

Mid-Way Splice GR System –

Being used on all Highway Program projects moving forward.

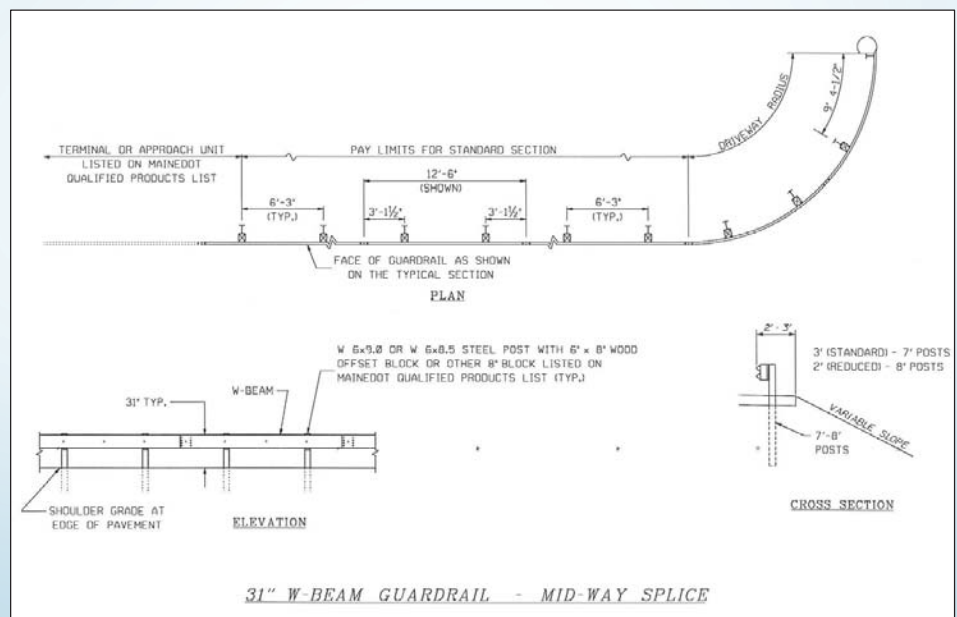
GR height = 31"

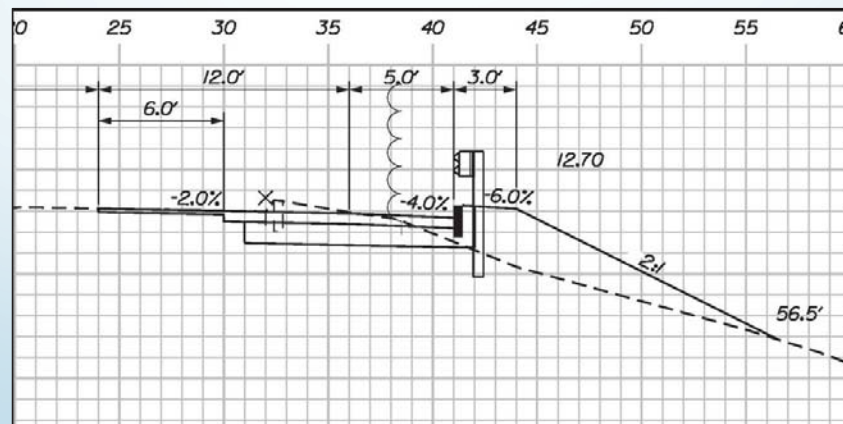
Coordinate with your Project Manager

7. Guardrail / Terminals / End Treatments (14 of 21)

C. Mid-way Splice/MASH compliance

Be aware of pay limits





7. Guardrail / Terminals / End Treatments (17 of 21)

D. Pave under GR? With curbing? (Difference between Bridge vs. Highway Program)

In areas of GR and curbing and sidewalk, the GR panel/berm does not need to be paved if placed behind the sidewalk.

If GR is placed at face of curb in front of the sidewalk, GR panel/berm shall be paved. Discuss with Project Manager.

7. Guardrail / Terminals / End Treatments (18 of 21)

E. Superelevation low side with GR and curb?

Old Practice (HDG) – curbing should be placed under GR on the low side when super elevation is occurring.

New Practice – curbing is not always required under GR on the low side of super elevation. Consider factors such as superelevation rate, profile grade, embankment height, existing conditions, amount of runoff.

If curb is provided, consider both a curb break with a riprap downspout at the low point or a catch basin and drainage pipe outlet (no curb break).

7. Guardrail / Terminals / End Treatments (19 of 21)

F. GR at back of SW; thrie beam rail with rub rail

Old Practice (HDG) – Place GR at face of curb. If GR is placed at back of sidewalk, see below:

- *Provide 6' minimum GR offset from face of curb (less than 45 mph).*
- *If GR is closer than 6' from face of curb, provide thrie rail or rub rail.*

7. Guardrail / Terminals / End Treatments (20 of 21)

F. GR at back of SW; thrie beam rail with rub rail

*Old Practice
(HDG)*

Design Speed (mph)	Recommended Distance Behind Face of Curb ⁷ for Placement of Barrier	
	<i>Desirable</i>	<i>Acceptable</i>
< 45		≥ 6 ft.
≥ 45	Barrier will be flush with face of curb at gutter line.	> 11 ft.

- Notes:**
1. These criteria apply to both sloping and vertical curbs.
 2. Where barrier will be placed closer to curb than recommended distance, a thrie beam or rub rail should be used.

BARRIER PLACEMENT BEHIND CURBS

Table 10-6

7. Guardrail / Terminals / End Treatments (21 of 21)

F. GR at back of SW; thrie beam rail with rub rail

New Practice –

- *No rub rail or thrie rail needed.*
- *Continue to provide W-beam GR behind sidewalk regardless of the curb offset.*
- *If GR is placed at face of curb with sidewalk, consider a double-sided rail. Challenges with end treatments exist for this scenario.*

Quantities / Estimating

(Guidance currently being updated by MaineDOT)

[illegible]

8. Quantities/ Estimating (1 of 13)

- A. Can Consultants receive MaineDOT Average Unit Price list, similar to what MaineDOT uses internally?**

Average unit price information is no longer provided to consultants.

8. Quantities/ Estimating (2 of 13)

- B. Can we establish appropriate contingencies at each submission level for consistency?**

Contingency Rules of thumb:

- *Provide 20-25% contingency at HVAC.*
- *Provide 10-15% contingency at PDR.*
- *Provide 5-10% contingency at PIC.*
- *Provide 0% contingency at PSE.*

Contingency can and should vary per cost estimate and per project due to project and site variables.

Be realistic with your cost estimate, whether or not the project is funded for construction.

8. Quantities/ Estimating (3 of 13)

C. Box Culverts – single item vs. fully itemized; what is preferred method?

Provide fully itemized cost estimate on box culvert projects.

Do not provide one lump sum item for the project.

Consider special detour LS pay item in estimate (510.10).

Consider temporary structural support LS pay item in estimate (524.30).

MaineDOT developing Special Provision for large culvert construction (all-inclusive, staged construction)

8. Quantities/ Estimating (4 of 13)

D. Tree Removals – less than 12” (no pay) but still labeled to remove; 12” or greater (pay)

201.23 Removing Single Tree Top Only - Each

Trees less than 1-foot in diameter will not be considered as trees under this item. Trees in clearing areas will be paid for as clearing.

8. Quantities/ Estimating (5 of 13)

E. Use of Dirty Borrow vs. Loam? 2" vs. 4"

Provide 4" loam in lawn and urban areas.

Provide 2" loam in all other areas.

Provide dirty borrow instead of loam in rural non-residential areas, on a project specific basis.

Earthwork summary – should account for loam volumes. DOT will be providing additional guidance on this.

8. Quantities/ Estimating (6 of 13)

F. Seeding Method – Type 3 no longer used

Use seeding method #1 for lawns

Use seeding method #2 everywhere else.

Seeding Method #3 NO LONGER USED

8. Quantities/ Estimating (7 of 13)

G. Benching not included in common excavation

General Note - existing inslopes in proposed fill areas shall be benched by excavating steps of sufficient width to permit placing and compacting the fill material along with the material removed.

Similar language in MaineDOT Repair Spec, Section 203.09

Benching is no longer shown on the cross sections. Benching everywhere but not showing anywhere.

Excavation for benching to receive embankments will not be paid for directly. Is considered incidental to other contract items.

8. Quantities/ Estimating (8 of 13)

H. Maintenance of Traffic Control Devices – CD or LS

Use Calendar Day for most projects.

Lump sum may be used on very simple projects (not commonly used).

Coordinate with Project Manager.

8. Quantities/ Estimating (9 of 13)

I. Flagger Hours – Guidance on estimating

This item is often estimated too low.

Review anticipated construction duration (how long). Review number of work zones (how many flaggers). Review construction activities where flaggers are needed. Estimate length of need.

Review TAMING results.

Flagger Hours: Proper consideration of breaker flagger hours (SP 652); could increase flagger hours by up to 20%.

8. Quantities/ Estimating (10 of 13)

J. Use of Police Officers? Signalized intersections?

Use of police officers is required for some construction activities on Interstate projects.

Police Officers are required to direct traffic at a signalized intersection, unless the signal system is turned off.

8. Quantities/ Estimating (11 of 13)

K. Temporary Signals – When to use? What type?

Use of temporary signals is considered on a project case by case basis.

May be required at existing signalized intersections.

May be required for maintenance of traffic through a work zone when a long duration single lane operation (MOT) is needed (> one day).

Examples – Culvert installations, retaining wall installations, utility installations, road realignments, major profile changes, special detours.

A temporary traffic signal system is required for all drives within a work zone using single lane approaches.

8. Quantities/ Estimating (12 of 13)

L. Paving around field basin, when to use, when not to?

Old Practice (general notes) – provide paved apron around all field basins.

New Practice – not required unless erosion is a concern. General note has been removed. Loam and seed around field basins is acceptable.

8. Quantities/ Estimating (13 of 13)

M. Green Acrylic for Paved Islands – proper item?

Same pay item.

658.20 – Acrylic Latex Finish, Green.

New specification and color being used.

Geotechnical

[illegible]

9. Geotechnical (1 of 6)

A. Plans – Show exploration locations with appropriate symbols on plans

Turn on GEOPLAN.dgn to show exploration locations on plan views.

No geotechnical information is shown on the profiles.

Coordinate with MaineDOT Geotechnical Team member (Kate Maguire).

9. Geotechnical (2 of 6)

B. Updated CADD legends from MaineDOT reflecting latest symbology

Geotech symbols added recently.

PLAN LEGEND			
Town, County, State	_____	Catch Basins	Existing Proposed
Property Lines	-----	Manholes	Existing Proposed
R/W Lines-Existing	-----	Proposed Underdrain	-----
R/W Lines-Proposed	-----	Proposed Ditch	-----
Culvert-Existing	-----	Existing Ditch	-----
Culvert Proposed	-----	Utility Poles	Existing Proposed
Curbing	Existing Proposed	Fire Hydrants	Existing Proposed
Type 1	-----	Existing Water Line	-----
Type 3	-----	Existing San. Sewer	-----
Type 5	-----	Existing San. Sewer Manhole	-----
Outline of Bodies of Water	-----	Guardrail-Existing	-----
Exposed Bedrock	-----	Guardrail-Proposed	-----
Buildings	-----	Guardrail-Cable, Other	-----
Trees	Conifer Deciduous	Centerline-Existing	-----
Tree Line	-----	Centerline-Proposed	-----
Clearing Limit Line	-----	Travelway-Existing	-----
Railroad	-----	Travelway-Proposed	-----
Boring	HB-XXX-###	Probe	P-#, #X
Pavement Core	PC-#	#, # = Depth	
Test Pit	TP-XXX-###	X = W (Weathered Rock)	
		R (Refusal)	
		NR (No Refusal)	

9. Geotechnical (3 of 6)

C. Stone Ditch Protection vs. Riprap?

Typically, stone ditch protection is sufficient on ditch slopes that are 6% or greater.

Stone ditch protection is 12" deep.

In high velocity areas (major drainage flows or long steep grades), riprap should be considered instead of stone ditch protection.

Riprap is required on slopes steeper than 2:1.

Geotechnical analysis is required to determine depth of riprap.

2 ft. of riprap is typically required for stability on slopes steeper than 2:1. Actual required thickness will be determined by Geotech.

9. Geotechnical (4 of 6)

D. Stone sizing

For typical situations, plain riprap is acceptable.

In areas along rivers, possibly along lake edges and near bridge abutments, heavy riprap may be required.

Use heavy riprap where scour and ice impact are likely.

Thickness of riprap on over-steepened slopes (steeper than 2:1) will be determined by Geotech.

9. Geotechnical (5 of 6)

E. Geotechnical sheets, what to include? *Depends on the project...*

If geotechnical explorations were completed for the project, the following sheets may be included in the plan set.

- 1. Boring Location Plan*
- 2. Boring Logs*
- 3. Interpretive Subsurface Profile (NOTE: This is the only place interpretation can be shown.)*
- 4. Boring Location Plan with Foundation Design Recommendations for lighting, signs, and signals, if there are any on the project.*

The Geotechnical Sheets will be prepared and stamped by MaineDOT Geotech or by their Geotechnical Consultant.

[Details of symbols and labels for Geotech information on cross sections are included in a MicroStation Cell library called GOETECH.XSECT.cel]

9. Geotechnical (6 of 6)

F. Over-Steepened Slopes (steeper than 2:1)

Any slopes steeper than 2:1 will require a geotechnical evaluation by MaineDOT.

All slopes steeper than 2:1 require riprap.

Thickness of riprap will be determined by Geotech.

1:1 slopes are not permitted unless reinforced, and designed by Geotech.

Reinforced slope design will require a Details Sheet included in the plan set.

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Next Steps

Next Steps

- Document input/feedback received during these sessions.
- Update the list of topics
- Include additional questions/clarifications
- Confirm answers with MaineDOT
- Provide updated document to all GCA consultants and make available on MaineDOT Highway Design web page.

Questions



*Send any additional questions or comments to:
Tony Grande at agrande@vhb.com (207) 889-3115*