MASH Implementation
Phase I

Informational Workshop Meeting

August 29, 2017 & September 5, 2017

Leo Fontaine
David Kilpatrick
Sal Aresco
Bill Nicolle

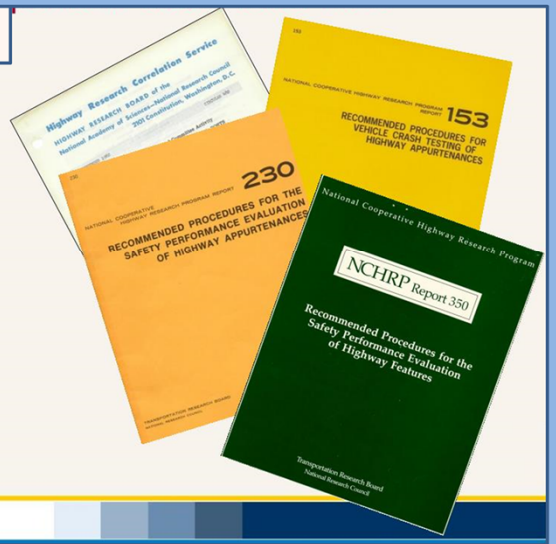
Agenda

1. **What is MASH?**
2. **Why use MASH?**
3. **What hardware is being replaced?**
4. **What is being implemented?**
   a) Highway Standard Drawings (New, Revised, and Eliminated)
   b) Qualified Products List (QPL)
   c) Pay Items
   d) Specifications
5. **What is not changing with implementation of MASH?**
6. **What is coming in the future?**
7. **Department Resources**

What is MASH?

History of Crash Testing

- *Highway Research Correlation Services Circular 482 (1962)*
- *NCHRP Report 153 (1974)*
- *NCHRP Report 230 (1980)*
- *NCHRP Report 350 (1993)*



- MASH abbreviation for "Manual for Assessing Safety Hardware" is the testing and evaluation criteria for the safety performance of highway features and hardware.
- Historical view of Crash Testing
  - 1993 NCHRP Report 350
    - Added Crash test level criteria; Levels 1-3 based on speed: TL- 1 31 mph, TL-2 43 mph, TL-3 62 mph, and TL 4 – 6 added large trucks
  - 2009 MASH updated test vehicles to reflect changes in the American fleet
  - 2016 MASH (second edition of MASH) refined testing for Cable Systems

MASH

Vehicle	Gross Vehicle Weight NCHRP-350 to MASH	Other
Passenger Car	1,800 lbs. to 2,420 lbs.	20 to 25 Degrees
Pickup Truck	4,400 lbs. to 5,000 lbs.	Single to Quad Cab
Single Unit Truck	17,600 lbs. to 22,000 lbs.	50 to 56 mph

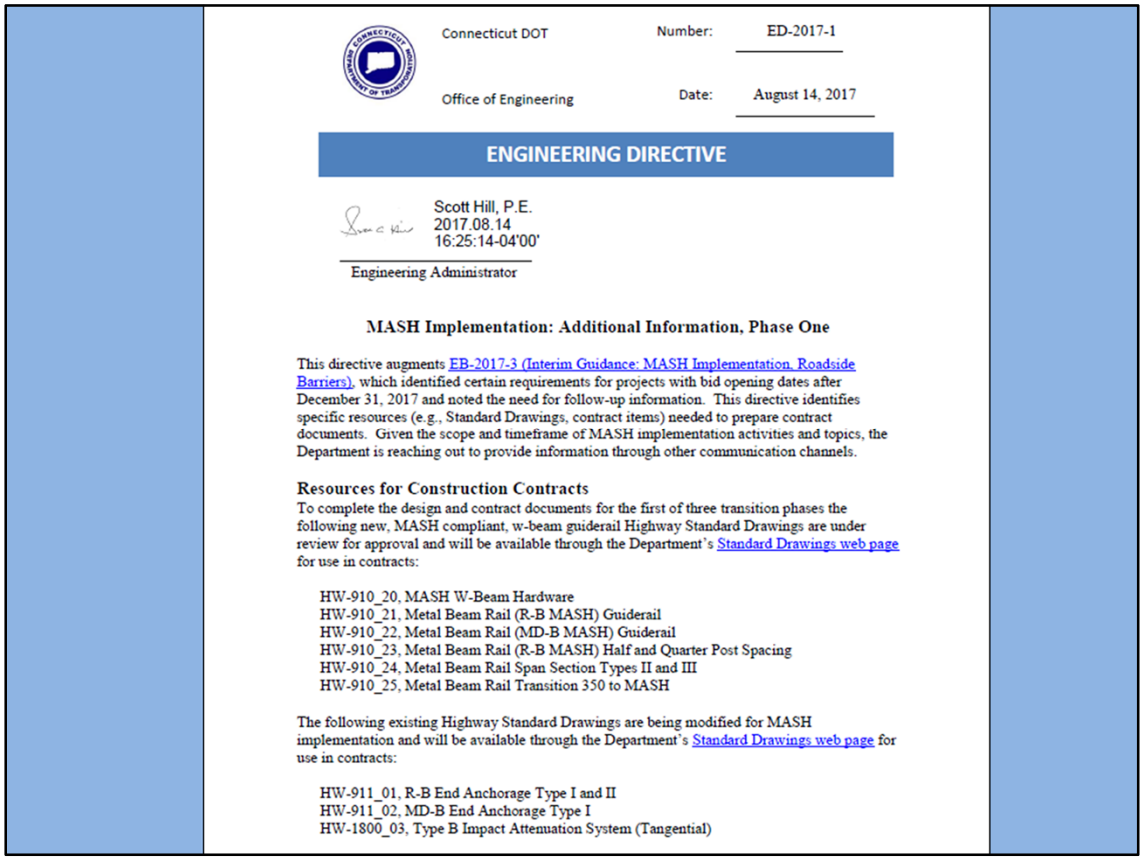
- MASH implemented due to changes in the American vehicle fleet (weight & center of gravity) and refined testing parameters based on more experience in crash testing the extreme limits to better represent real world situations in a controlled environment.

See the Announcements for revisions to the listed items

Why MASH

- **Implementation Agreement**
  - **December 31, 2017**: w-beam barriers and cast-in-place concrete barriers **PHASE 1**
  - **June 30, 2018:** w-beam terminals
  - **December 31, 2018:** cable barriers, cable terminals, and crash cushion
  - **December 31, 2019:** bridge rails, transitions, all other longitudinal barriers (including portable barriers installed permanently), all other terminals, sign supports, all other breakaway hardware and temporary work zone devices (based on manufactured date).

- Jan 2016 AASHTO/FHWA Joint MASH Implementation Agreement was nationally adopted. The AASHTO Standing Committee on Highways with approval of FHWA voted/accepted the implementation of MASH agreement which accomplished four things;
  1) Defined the roles of AASHTO and FHWA;
     - AASHTO Technical Committee on Roadside Safety is responsible for developing and maintaining the evaluation criteria
     - FHWA continue to issue Letters of Eligibility of Hardware for Federal-aid reimbursement
  2) Urged agencies to establish a process for upgrading existing outdated equipment that is not successfully tested to NCHRP Report 350 or later testing criteria
  3) Encouraged states to upgrade hardware when damaged beyond repair with MASH 2016 compliant safety hardware
  4) Established phased in approach of safety hardware based on contract letting dates. One exception is temporary work zone devices are based on manufactured date and normal service life



Connecticut DOT

Office of Engineering

Number: ED-2017-1

Date: August 14, 2017

ENGINEERING DIRECTIVE

Scott Hill, P.E.
2017.08.14
16:25:14-04'00'

Engineering Administrator

MASH Implementation: Additional Information, Phase One

This directive augments EB-2017-3 (Interim Guidance: MASH Implementation. Roadside Barriers), which identified certain requirements for projects with bid opening dates after December 31, 2017 and noted the need for follow-up information. This directive identifies specific resources (e.g., Standard Drawings, contract items) needed to prepare contract documents. Given the scope and timeframe of MASH implementation activities and topics, the Department is reaching out to provide information through other communication channels.

Resources for Construction Contracts

To complete the design and contract documents for the first of three transition phases the following new, MASH compliant, w-beam guiderail Highway Standard Drawings are under review for approval and will be available through the Department's Standard Drawings web page for use in contracts:

HW-910_20, MASH W-Beam Hardware
HW-910_21, Metal Beam Rail (R-B MASH) Guiderail
HW-910_22, Metal Beam Rail (MD-B MASH) Guiderail
HW-910_23, Metal Beam Rail (R-B MASH) Half and Quarter Post Spacing
HW-910_24, Metal Beam Rail Span Section Types II and III
HW-910_25, Metal Beam Rail Transition 350 to MASH

The following existing Highway Standard Drawings are being modified for MASH implementation and will be available through the Department's Standard Drawings web page for use in contracts:

HW-911_01, R-B End Anchorage Type I and II
HW-911_02, MD-B End Anchorage Type I
HW-1800_03, Type B Impact Attenuation System (Tangential)

- Engineering Directive

What Hardware is Being Replaced?

Highway Design Manual

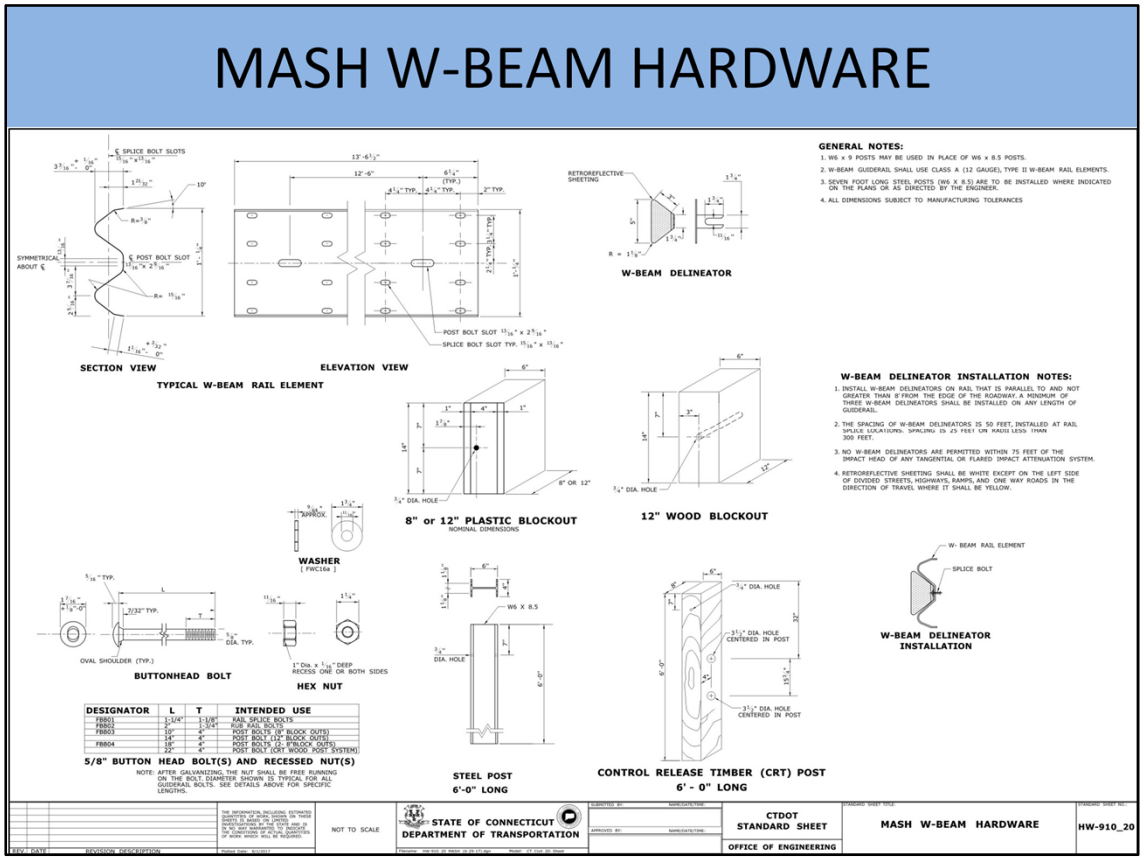
Chapter 13 – Disposition of Existing Rail

All new w-beam rail must meet MASH

- R-B 350
- MD-B 350
- Modified R-I

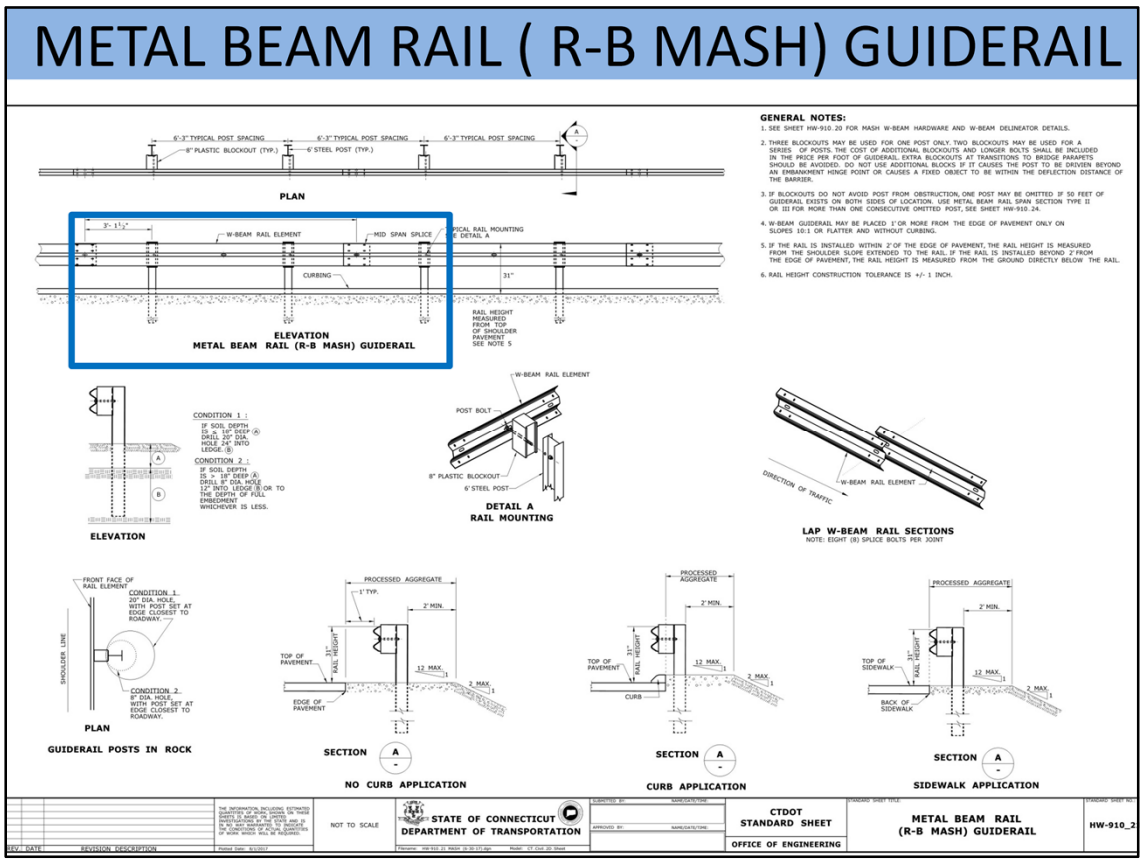
- Highway Design Manual – Chapter 13 section 13-9.03.01 Roadside Barrier

MASH W-BEAM HARDWARE



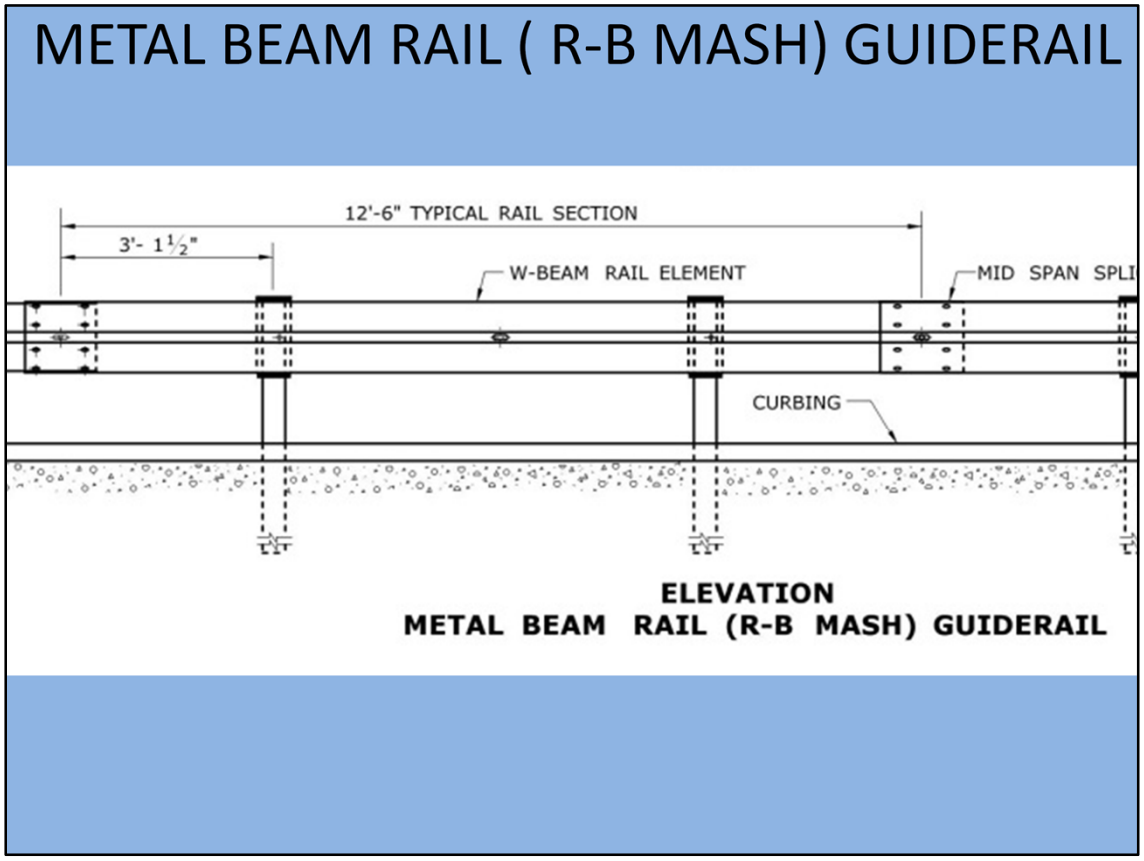
- The same hardware is being used to build MASH guiderail as our current NCHRP-350 tested guiderail, just a different way of assembling them
- Standard sheets have been cleansed of design and/or spec information to reduce duplication of information, example
  - Material specification covers shop bent w-beam. This is no longer covered in the general notes. Designer needs to call out the radii on plans when the rail is to have a radii of 150’ or less
- Material change with MASH – only 12 Gauge used for MASH guiderail – no longer using 10 Gauge as previously noted in the general notes

METAL BEAM RAIL (R-B MASH) GUIDERAIL



- R-B stands for Roadside Barrier

METAL BEAM RAIL (R-B MASH) GUIDERAIL



- For MASH tested guiderail, the w-beam has been raised from 29” to 31” in height and the splice point was shifted to mid-span location. This effectively reduced the concentration of stresses developed upon impact of the system.

- Trial Installation, note W-beam splice is lapped in the direction of traffic from right to left.

METAL BEAM RAIL (R-B MASH) GUIDERAIL

GENERAL NOTES:

1. SEE SHEET HW-910_20 FOR MASH W-BEAM HARDWARE AND W-BEAM DELINEATOR DETAILS.

2. THREE BLOCKOUTS MAY BE USED FOR ONE POST ONLY. TWO BLOCKOUTS MAY BE USED FOR A SERIES OF POSTS. THE COST OF ADDITIONAL BLOCKOUTS AND LONGER BOLTS SHALL BE INCLUDED IN THE PRICE PER FOOT OF GUIDERAIL. EXTRA BLOCKOUTS AT TRANSITIONS TO BRIDGE PARAPETS SHOULD BE AVOIDED. DO NOT USE ADDITIONAL BLOCKS IF IT CAUSES THE POST TO BE DRIVIEN BEYOND AN EMBANKMENT HINGE POINT OR CAUSES A FIXED OBJECT TO BE WITHIN THE DEFLECTION DISTANCE OF THE BARRIER.

3. IF BLOCKOUTS DO NOT AVOID POST FROM OBSTRUCTION, ONE POST MAY BE OMITTED IF 50 FEET OF GUIDERAIL EXISTS ON BOTH SIDES OF LOCATION. USE METAL BEAM RAIL SPAN SECTION TYPE II OR III FOR MORE THAN ONE CONSECUTIVE OMITTED POST, SEE SHEET HW-910_24.

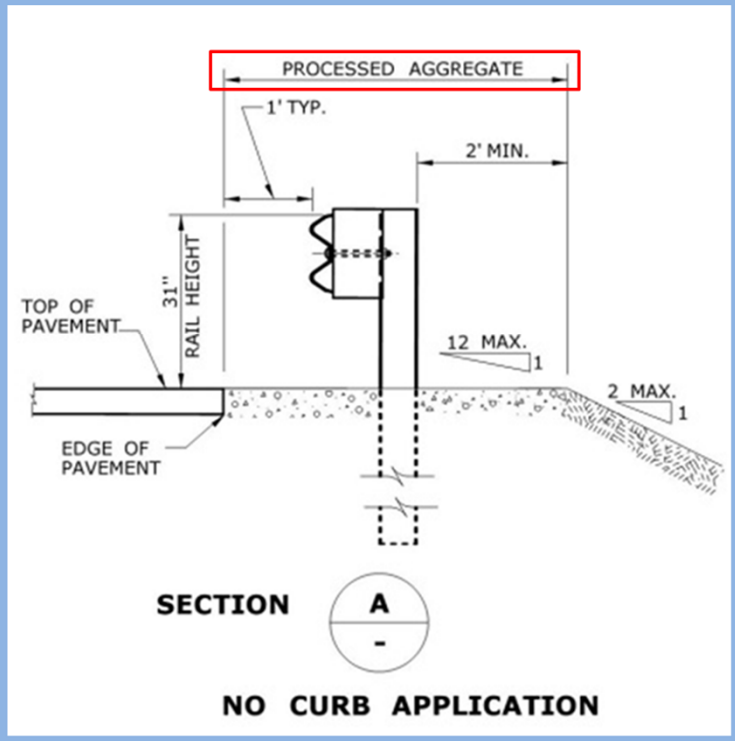
4. W-BEAM GUIDERAIL MAY BE PLACED 1' OR MORE FROM THE EDGE OF PAVEMENT ONLY ON SLOPES 10:1 OR FLATTER AND WITHOUT CURBING.

5. IF THE RAIL IS INSTALLED WITHIN 2' OF THE EDGE OF PAVEMENT, THE RAIL HEIGHT IS MEASURED FROM THE SHOULDER SLOPE EXTENDED TO THE RAIL. IF THE RAIL IS INSTALLED BEYOND 2' FROM THE EDGE OF PAVEMENT, THE RAIL HEIGHT IS MEASURED FROM THE GROUND DIRECTLY BELOW THE RAIL.

6. RAIL HEIGHT CONSTRUCTION TOLERANCE IS +/- 1 INCH.

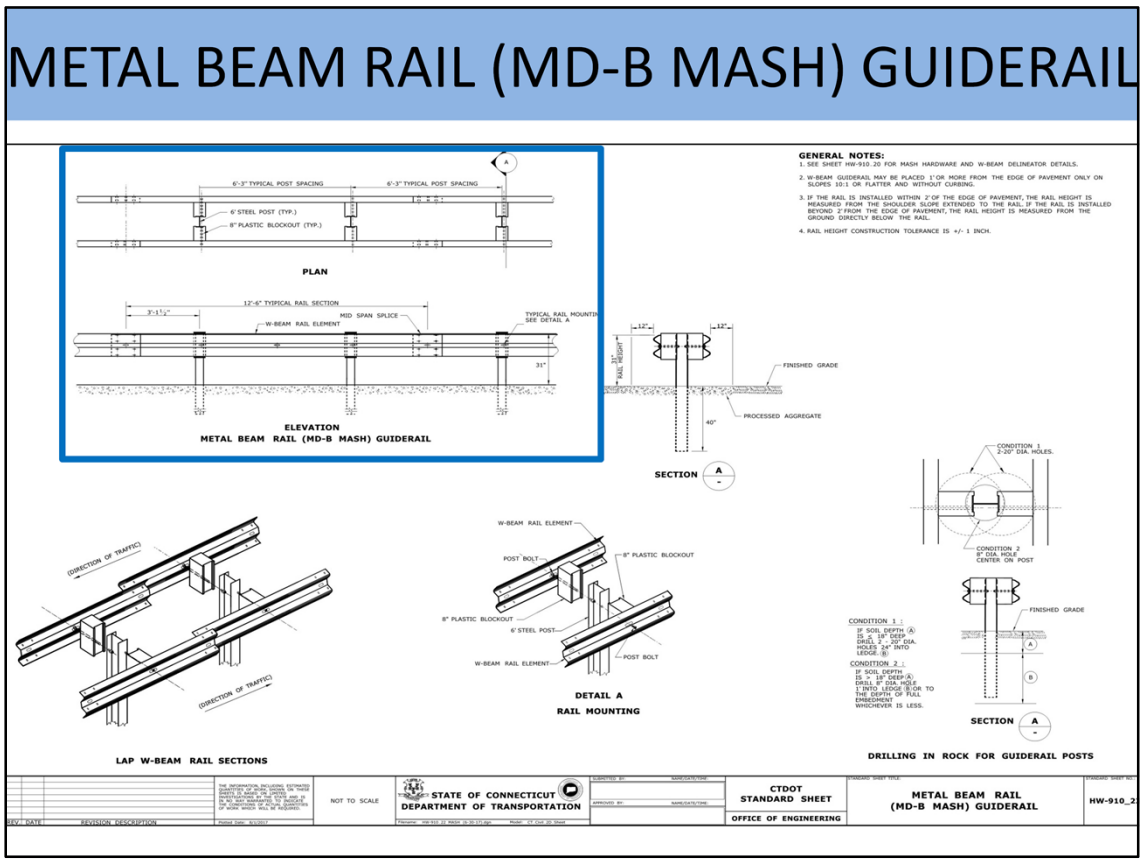
- Permitted to omit a single post. For locations where omitting two or three posts requires CRT posts installed as indicated on Sheet HW-910_24.

METAL BEAM RAIL (R-B MASH) GUIDERAIL



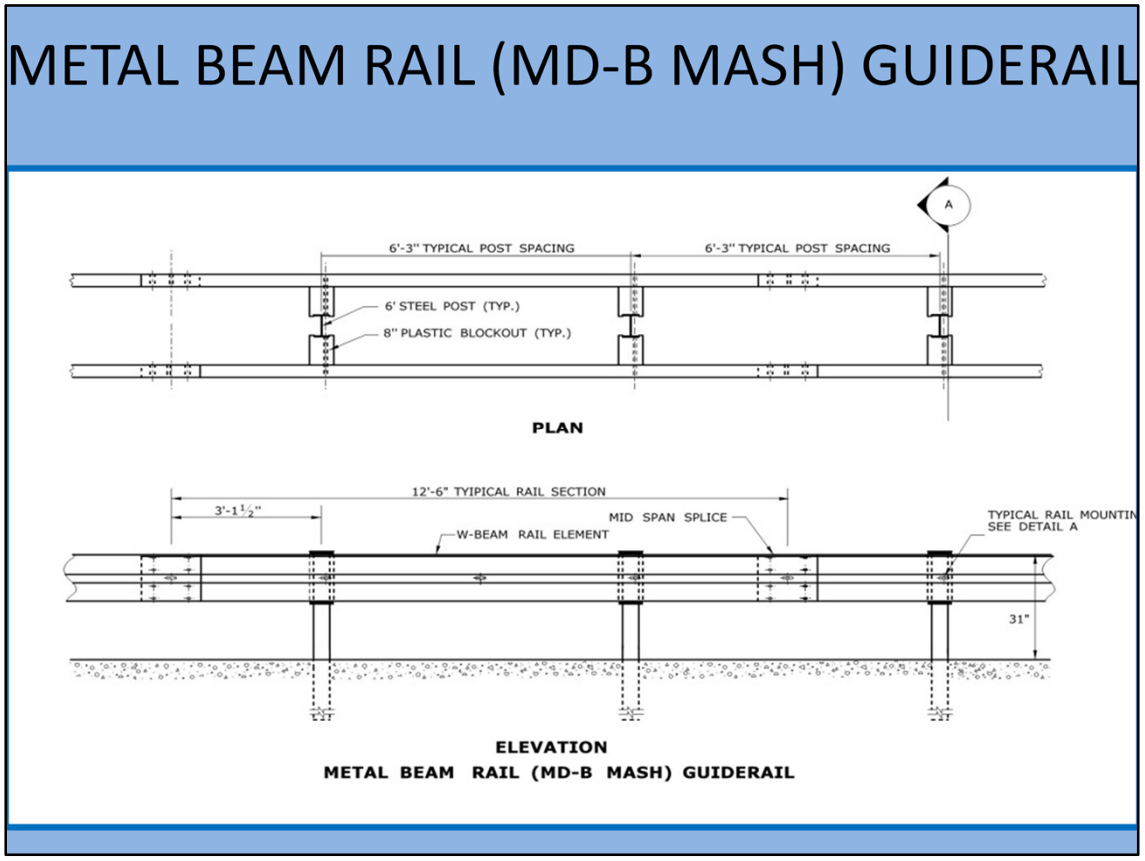
- 6” depth of Processed Aggregate needs to be shown for new construction projects on typical sections
- On upgrade projects, Processed Aggregate will be used to back up existing vertical edges of pavement

METAL BEAM RAIL (MD-B MASH) GUIDERAIL



- Lap w-beam on each side based on the direction of traffic to avoid snags
- Mid-span splices are located at same location for both sides
- Curbing is not recommended if the rail is between 1’ and 10’ from the edge of road
- Processed Aggregate limits extend 1’ past the face of the rail
- MD-B stands for Median Barrier

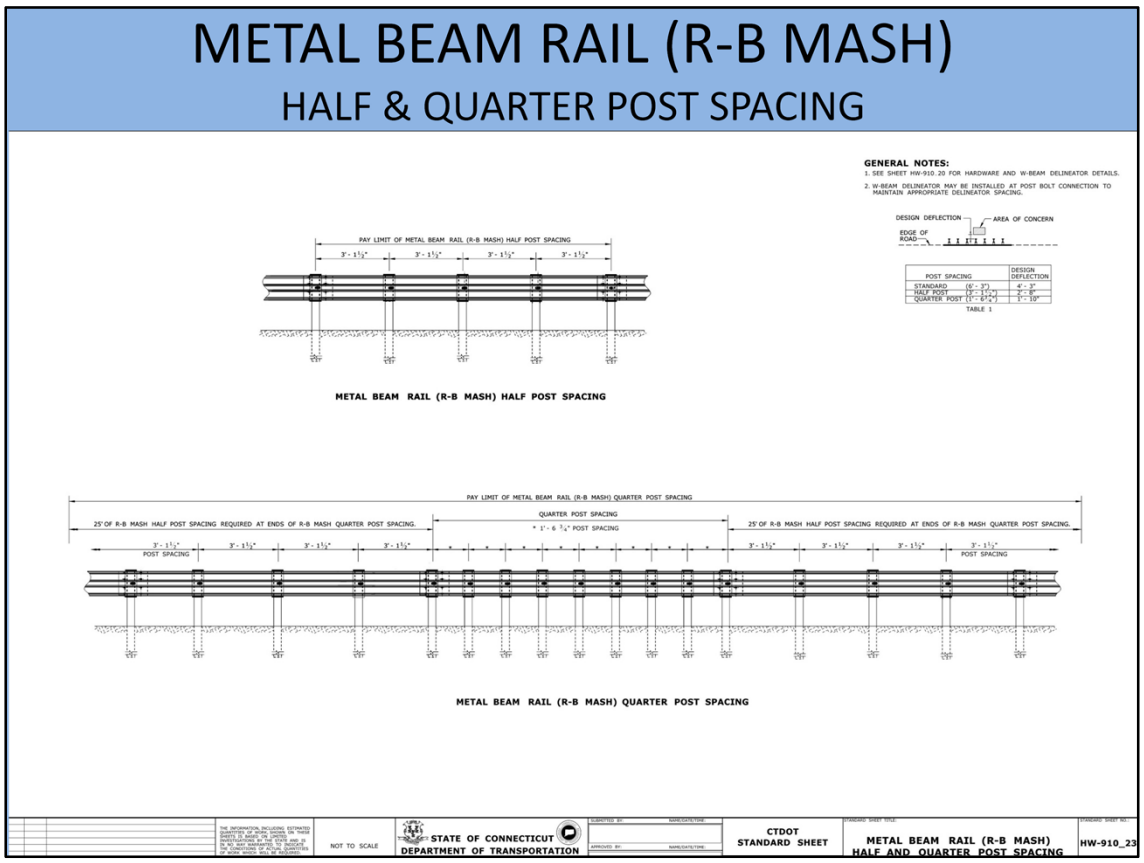
METAL BEAM RAIL (MD-B MASH) GUIDERAIL



- The w-beam has been raised from 29” to 31” in height and the splice point has been shifted to a mid-span location

METAL BEAM RAIL (R-B MASH)

HALF & QUARTER POST SPACING



- Half Post Spacing (Formerly System 5) is shown as one rail length, yet this length can be extended if desired
- Quarter Post Spacing (Formerly System 6) requires 25' of Half Post Spacing on both sides of the Quarter Post Spacing and includes this in the Quarter Post Spacing pay item
- Rub rails are no longer used in conjunction with reduced post spacing

METAL BEAM RAIL (R-B MASH)

HALF & QUARTER POST SPACING

System Name and (Post)	Barrier Type and Category	Post Spacing	Design Deflections[6]
3-cable Guiderail (S3x5.7) weak post	3 - 3/4" Dia. steel cables Flexible System[1]	16'-0"[9] 8'-0"[7,10]	12'-6"[4, 5] 8'-0"[4, 5]
Type R-I Type Modified R-I (S3x5.7) weak post	Steel W-Beam Element Flexible System[2,11]	12'-6" 6'-3" 3'-1½"	8'-0"[4, 5] 6'-0"[5] 4'-6"[5]
Type R-B Type R-B 350 (W6 x 8.5) strong post	Steel W-Beam Element Semi-rigid Systems[2,11]	6'-3" 3'-1½" 1'-6¾"	4'-3"[5] 2'-8"[5] 1'-10"[5]
6" 6" Box Beam (S3x5.7) weak post	Steel 6" x 6" Tube Semi-rigid System[3]	6'-0" 3'-0"[8]	4'-10" 4'-0"
Type MD-I (S3x5.7) weak post	Steel W-Beam Element Flexible Systems[2,11]	12'-6" 6'-3"	6'-0" 4'-0"
Type MD-B Type MD-B 350 (W6 x 8.5) strong post	Steel W-Beam Element Semi-rigid Systems[2,11]	6'-3"	2'-0"
8" x 6" Box Beam (S3x5.7) weak post	Steel 8" x 6" Tube Semi-rigid System[3]	6'-0" 3'-0"[8]	6'-6" 4'-0"
Thrie-beam 350 (W6 x 8.5) strong post	Steel Thrie-beam Element Semi-rigid System	6'-3"	4'-4"[5]
Merritt Parkway Guiderail (W6 x 15) strong post	Rough Sawn Timber Element Semi-rigid System	10'-0" 5'-0" 2'-6"	4'-0"[5] 2'-6"[5] 1'-0"[5]
Merritt Parkway Median Guiderail (W6 x 15) strong post	Rough Sawn Timber Element Semi-rigid System	10'-0"	3'-0"
Safety, Single Slope and Vertical Shapes	Concrete Barriers, Rigid	N/A	0

Notes:

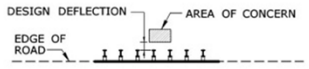
1. *Must be properly tensioned and anchored to limit deflection to values shown.*
2. *Must be properly anchored at both ends to limit deflections to values shown.*
3. *To develop beam strength must be a minimum length of 130 ft.*
4. *To minimize rollover problems, barrier systems with deflections of 8 ft or more should not be used adjacent to slopes steeper than 1:2.*
5. *Measured from back of post.*
6. *Where extra long weak posts are required, the design deflection distance should be multiplied by 1.3.*
7. *Split spacing achieved by use of backup posts bolted to cable.*
8. *Split spacing achieved by use of backup posts driven behind the rail but not fastened to it.*
9. *Recommended min. length on roads with design speeds ≥ 45 mph excluding end anchors is 248'.*
10. *Recommended min. length on roads with design speeds < 45 mph is 156' excluding end anchors using 8' post spacing.*
11. *To develop strength and tension in the rail, a min. length of 62.5' excluding anchors is recommended.*

DESIGN DEFLECTIONS

Figure 13-4D

GENERAL NOTES:

1. SEE SHEET HW-910.20 FOR HARDWARE AND W-BEAM DELINEATOR DETAILS.
2. W-BEAM DELINEATOR MAY BE INSTALLED AT POST BOLT CONNECTION TO MAINTAIN APPROPRIATE DELINEATOR SPACING.



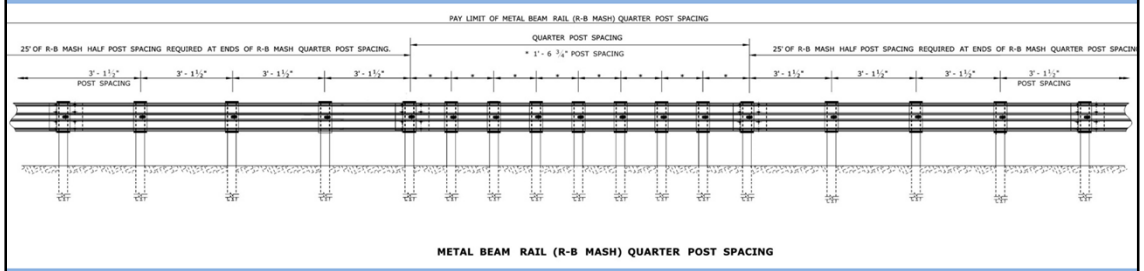
POST SPACING	DESIGN DEFLECTION
STANDARD (6' - 3")	4' - 3"
HALF POST (3' - 1½")	2' - 8"
QUARTER POST (1' - 6¾")	1' - 10"

TABLE 1

- W-beam design deflections can be found in the Highway Design Manual, no change in values with the implementation of MASH.

METAL BEAM RAIL (R-B MASH)

HALF & QUARTER POST SPACING

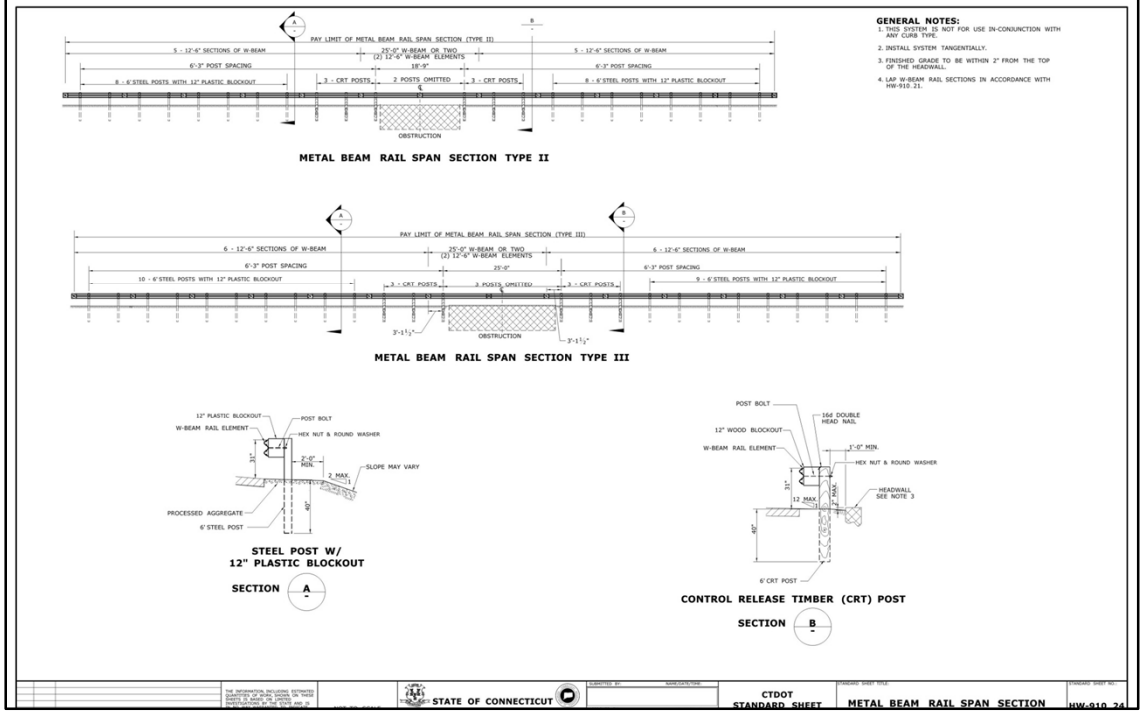


METAL BEAM RAIL (R-B MASH) QUARTER POST SPACING

- Quarter Post Spacing (Formerly System 6) requires 25' of Half Post Spacing on both sides of the Quarter Post Spacing and includes this in the Quarter Post Spacing pay item

METAL BEAM RAIL SPAN SECTION

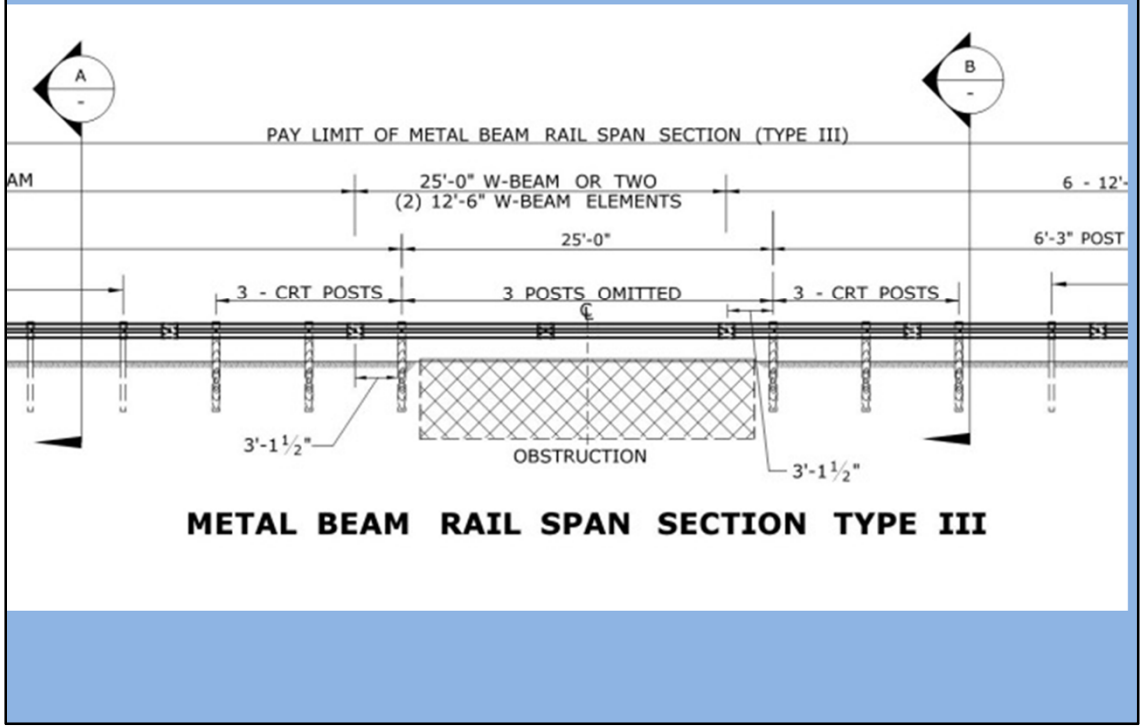
TYPES II AND III



- This sheet will replace the existing posted Standard Drawing HW-910_05 “Metal Beam Rail R-B 350 Span Section Type I, II, & III

METAL BEAM RAIL SPAN SECTION

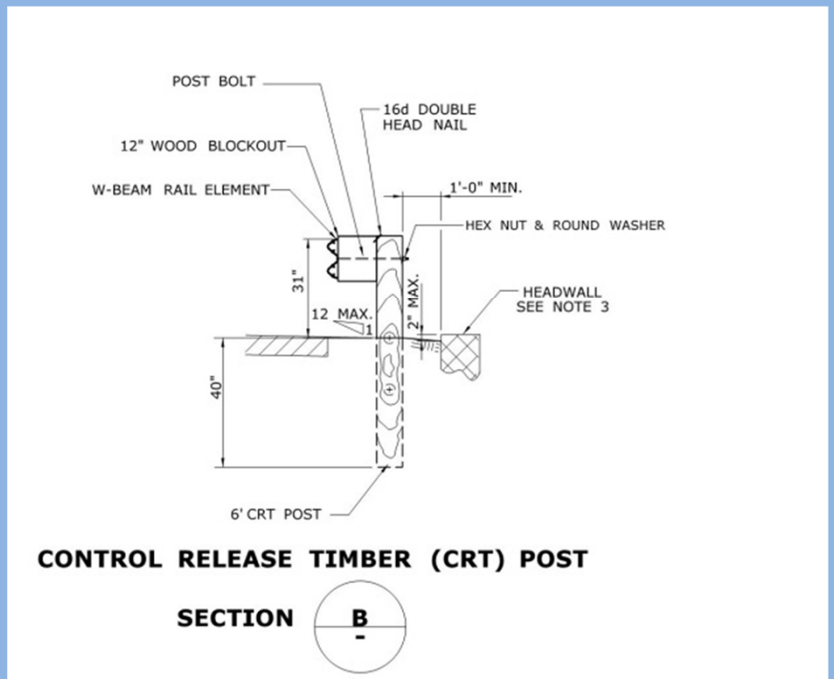
TYPES II AND III



- Major changes:
  - No longer only shown for culverts, system can be utilized for any obstruction preventing post installations
  - Removed diagram for 1 omitted posts since the R-B MASH guiderail system allows for a single post omission
  - This system must be installed tangentially

METAL BEAM RAIL SPAN SECTION

TYPES II AND III

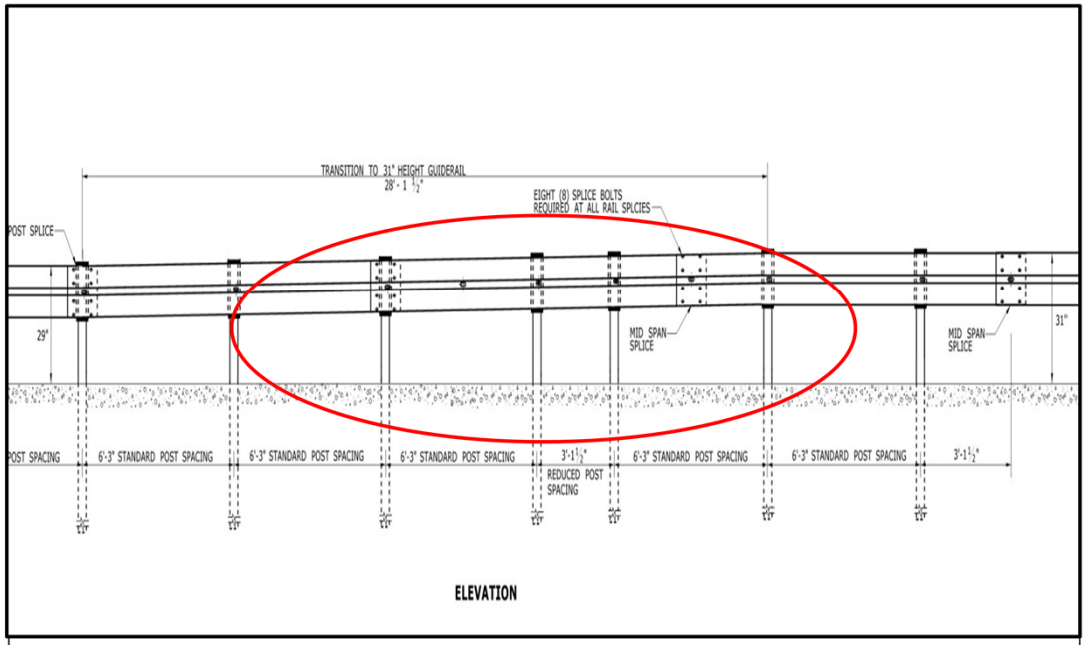


Watch

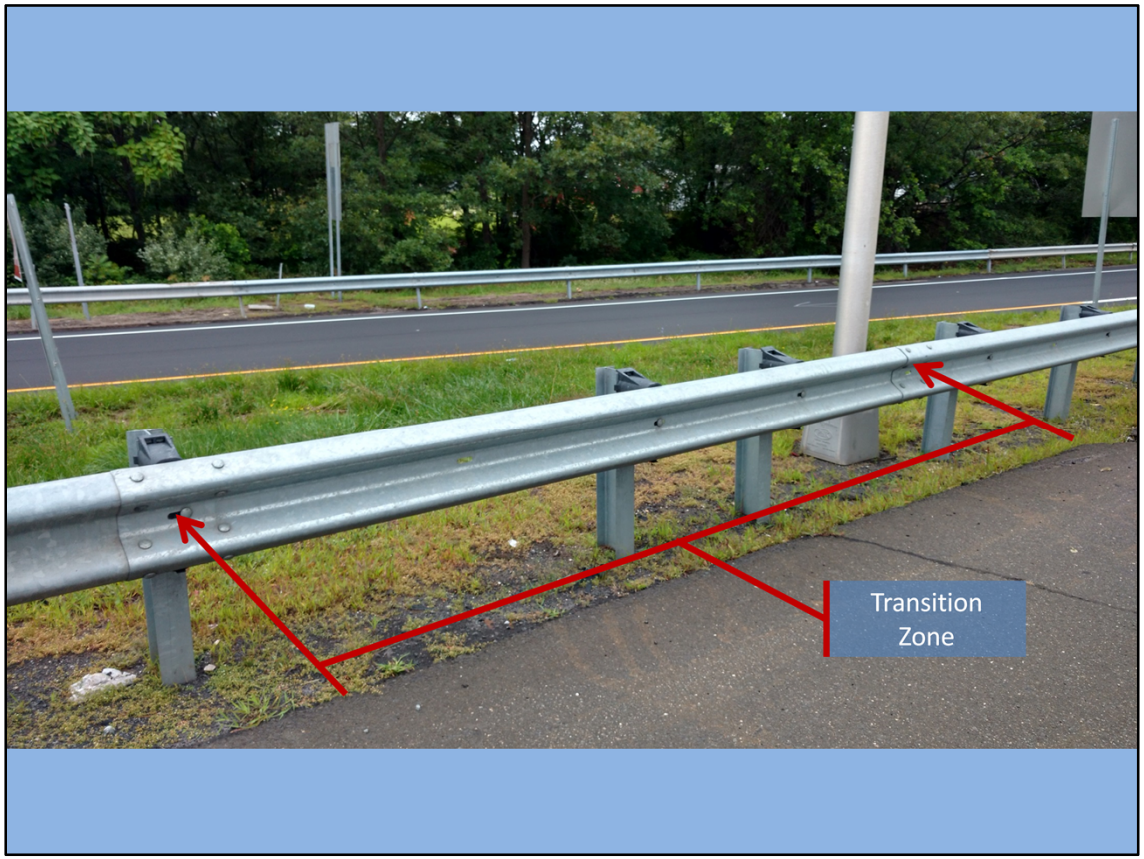
- Headwalls adjacent to this system are limited to a 2 inch MAX reveal because anything higher could obstruct the return flight of the vehicle
- Fencing on top of headwalls with this span section should avoid having any horizontal piping
- MASH tested deflection ranged between 48 and 77 inches
- Link to crash test video: http://mwrsf.unl.edu/researchhub/files/Report109/lsc2aos3.wmv

METAL BEAM RAIL TRANSITION

350 TO MASH

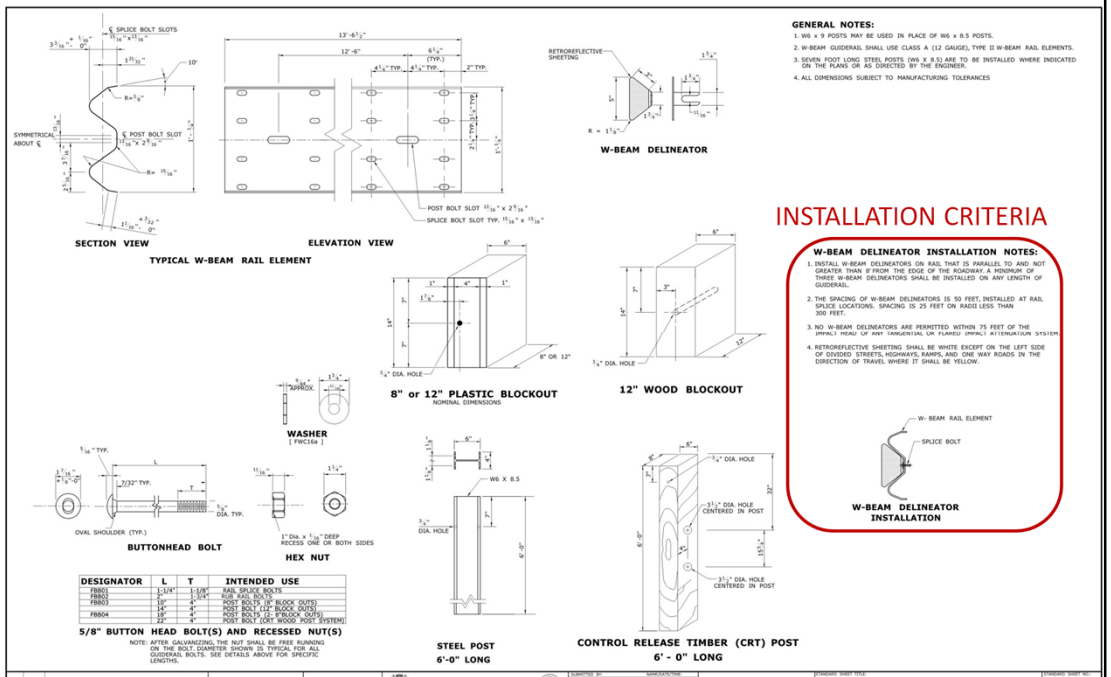


- Transition method is appropriate for both single and double faced guiderail
- The purpose of this transition is to adjust the w-beam rail height and splice location
- Transitions will be paid for under the longitudinal item, a callout should still be provided for a transition



- Trial Installation

MASH W-BEAM HARDWARE

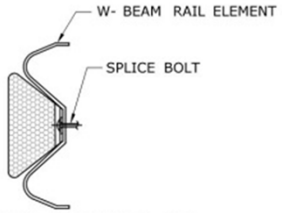


- W-Beam Delineators
  - Physically installed at the mid span splice connections for either R-B MASH or MD-B MASH guiderail, but is allowed at post connections in reduced post spacing sections

W-BEAM DELINEATOR INSTALLATION CRITERIA

W-BEAM DELINEATOR INSTALLATION NOTES:

1. INSTALL W-BEAM DELINEATORS ON RAIL THAT IS PARALLEL TO AND NOT GREATER THAN 8' FROM THE EDGE OF THE ROADWAY. A MINIMUM OF THREE W-BEAM DELINEATORS SHALL BE INSTALLED ON ANY LENGTH OF GUIDERAIL.
2. THE SPACING OF W-BEAM DELINEATORS IS 50 FEET, INSTALLED AT RAIL SPLICE LOCATIONS. SPACING IS 25 FEET ON RADII LESS THAN 300 FEET.
3. NO W-BEAM DELINEATORS ARE PERMITTED WITHIN 75 FEET OF THE IMPACT HEAD OF ANY TANGENTIAL OR FLARED IMPACT ATTENUATION SYSTEM.
4. RETROREFLECTIVE SHEETING SHALL BE WHITE EXCEPT ON THE LEFT SIDE OF DIVIDED STREETS, HIGHWAYS, RAMPS, AND ONE WAY ROADS IN THE DIRECTION OF TRAVEL WHERE IT SHALL BE YELLOW.



W-BEAM DELINEATOR INSTALLATION

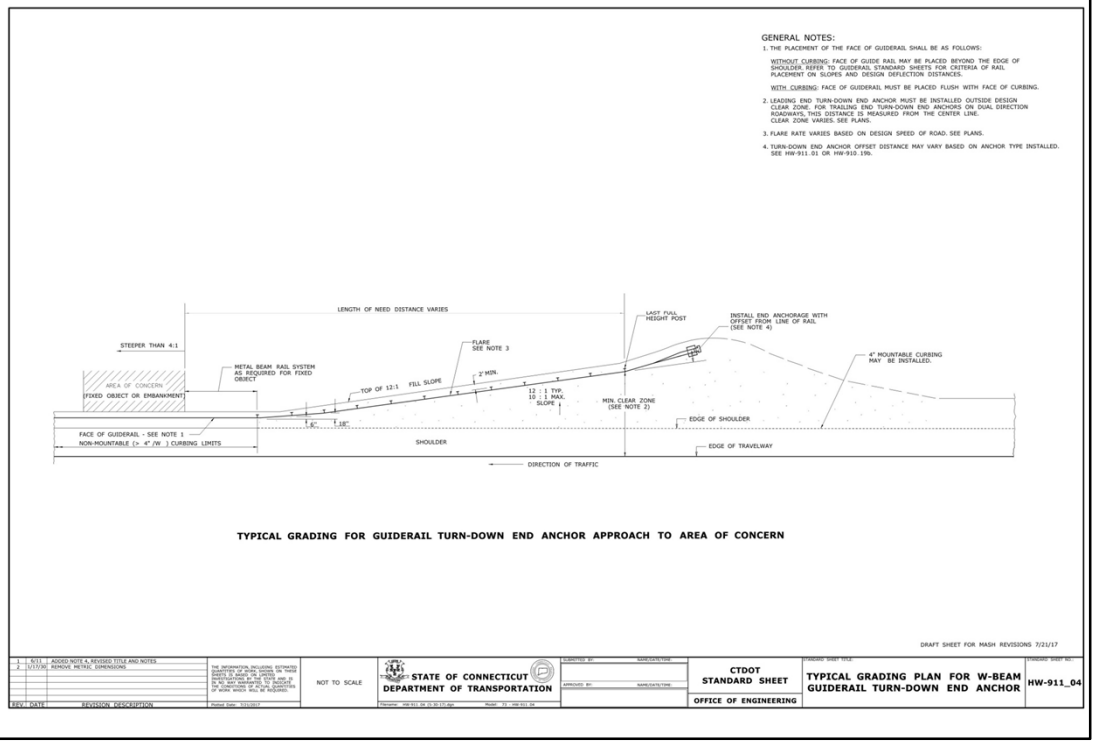
- Delineators not to be installed within 75 feet of any w-beam terminal impact head.
- Installation location criteria included in notes

Revised Specifications

- 9.10 Supplemental
- M.10.02 (Owned Special Provision)
  - Paragraph No. 9 – Plastic Blockouts
- Impact Attenuator (Tangential)
- Impact Attenuator (Flared)
- Impact Attenuator (Median/Gore)

- Form 817 Section 9.10 pay item descriptions revised to no longer include the “350” terminology
  - Revisions are included in the July 2017 Supplement
- New owned special provision for Form 817 Section M.10.02 to require MASH compliant plastic blockouts
- Revised owned special provisions for Type B Impact Attenuation Systems
  - Streamlined, eliminating redundant information that was already addressed in the QPL and elsewhere
  - Requires the installation of either an NCHRP 350 system or a MASH system depending on the type of longitudinal barrier installed

ELIMINATING FROM STANDARDS



GENERAL NOTES:

1. THE PLACEMENT OF THE FACE OF GUIDERAIL SHALL BE AS FOLLOWS:

   WITHOUT CURBING: FACE OF GUIDE RAIL MAY BE PLACED BEYOND THE EDGE OF SHOULDER. REFER TO GUIDERAIL STANDARD SHEETS FOR CRITERIA OF RAIL PLACEMENT ON SLOPES AND DESIGN DEFLECTION DISTANCES.

   WITH CURBING: FACE OF GUIDERAIL MUST BE PLACED FLUSH WITH FACE OF CURBING.

2. LEADING END TURN-DOWN END ANCHOR MUST BE INSTALLED OUTSIDE DESIGN CLEAR ZONE. FOR TRAILING END TURN-DOWN END ANCHORS ON DUAL DIRECTION ROADWAYS, THIS DISTANCE IS MEASURED FROM THE CENTER LINE. CLEAR ZONE VARIES. SEE PLANS.

3. FLARE RATE VARIES BASED ON DESIGN SPEED OF ROAD. SEE PLANS.

4. TURN-DOWN END ANCHOR OFFSET DISTANCE MAY VARY BASED ON ANCHOR TYPE INSTALLED. SEE HW-911.01 OR HW-910.19b.

TYPICAL GRADING FOR GUIDERAIL TURN-DOWN END ANCHOR APPROACH TO AREA OF CONCERN

DRAFT SHEET FOR MASH REVISIONS 7/21/17

REV.	DATE	REVISION DESCRIPTION
1	6/11	ADDED NOTE 4, REVISED TITLE AND NOTES
2	1/17/20	REMOVE METRIC DIMENSIONS

THE INFORMATION INCLUDING ESTIMATED QUANTITIES SHOWN ON THESE SHEETS IS ADAPTED FOR USE ON THIS PROJECT BUT IS IN NO WAY WARRANTED TO INDICATE THE ACTUAL QUANTITIES OF VARIOUS KINDS OF WORK WHICH WILL BE REQUIRED.

Posted Date: 7/21/2017

NOT TO SCALE

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: HW-911.04 (7-20-17).dgn Model: 71 - HW-911.04

SUBMITTED BY: NAME/DATE/TYPE

APPROVED BY: NAME/DATE/TYPE

CTDOT STANDARD SHEET

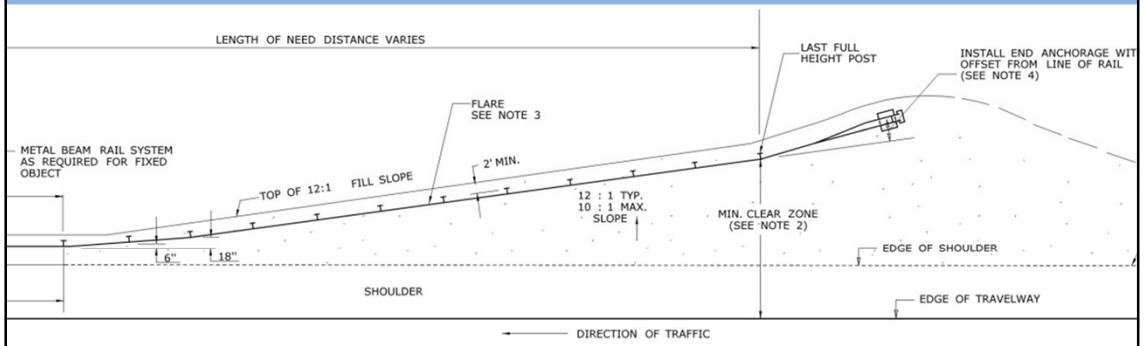
OFFICE OF ENGINEERING

STANDARD SHEET TITLE: TYPICAL GRADING PLAN FOR W-BEAM GUIDERAIL TURN-DOWN END ANCHOR

STANDARD SHEET NO.: HW-911_04

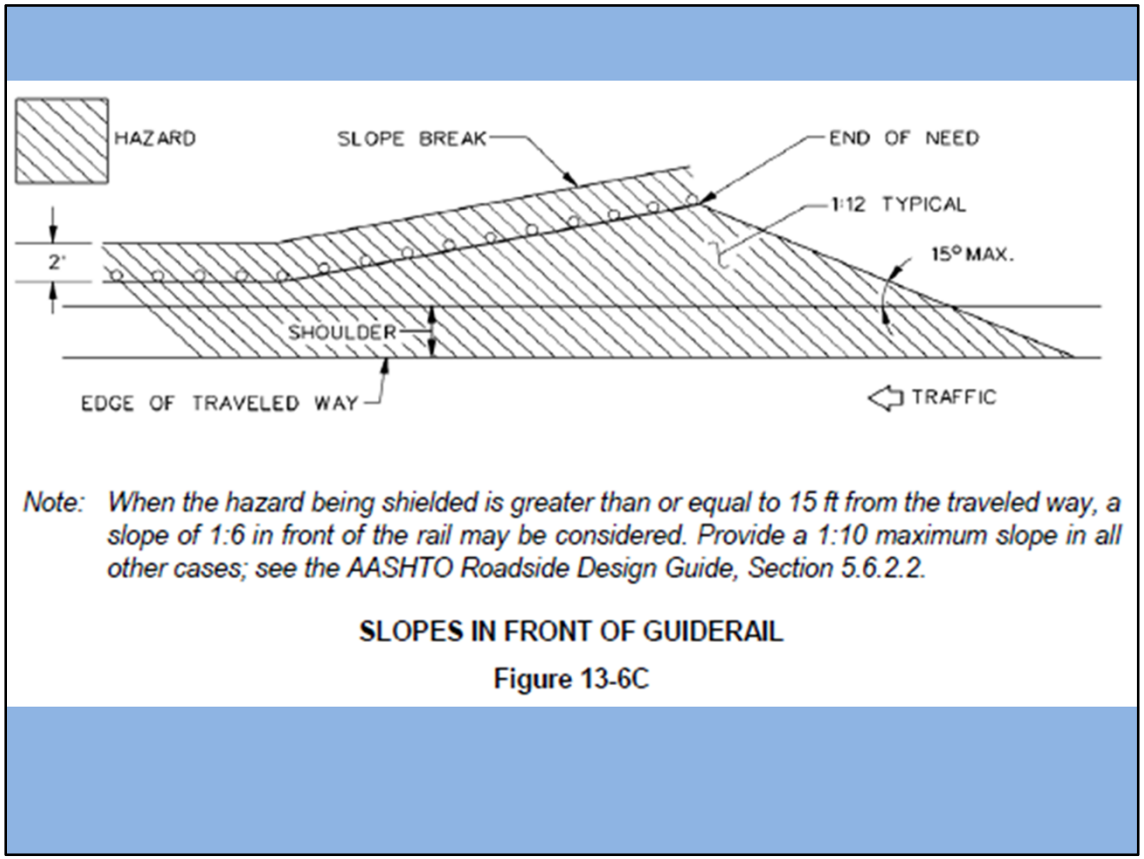
- Typical grading for turn-down end anchor standard drawing is being removed

ELIMINATING FROM STANDARDS



TYPICAL GRADING FOR GUIDERAIL TURN-DOWN END ANCHOR APPROACH TO AREA OF CONCERN

- Highway design manual indicates anchors to be installed outside the Clear Zone
  - The entire anchor system should be installed outside of the clear zone, including the post closest to the anchor
  - A dimension should be provided on plan sheets from either the edge of road or edge of travel to the post closest to the end anchor
- It is desirable to not install curbing in the sections where the rail is flared
  - If curbing is included in a project, strive to introduce the curbing after the rail has become parallel to the edge of road
- Plan sheets and Cross sections should include site specific grading information

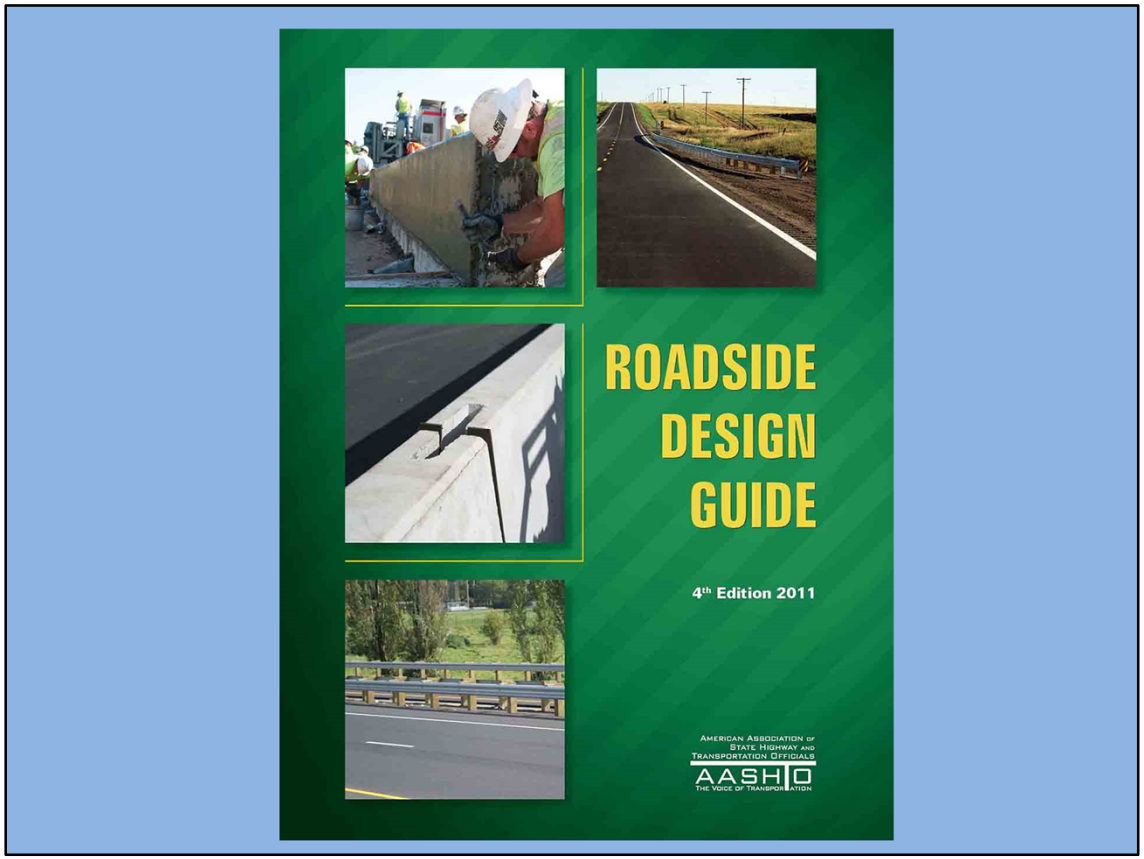


Note: When the hazard being shielded is greater than or equal to 15 ft from the traveled way, a slope of 1:6 in front of the rail may be considered. Provide a 1:10 maximum slope in all other cases; see the AASHTO Roadside Design Guide, Section 5.6.2.2.

SLOPES IN FRONT OF GUIDERAIL

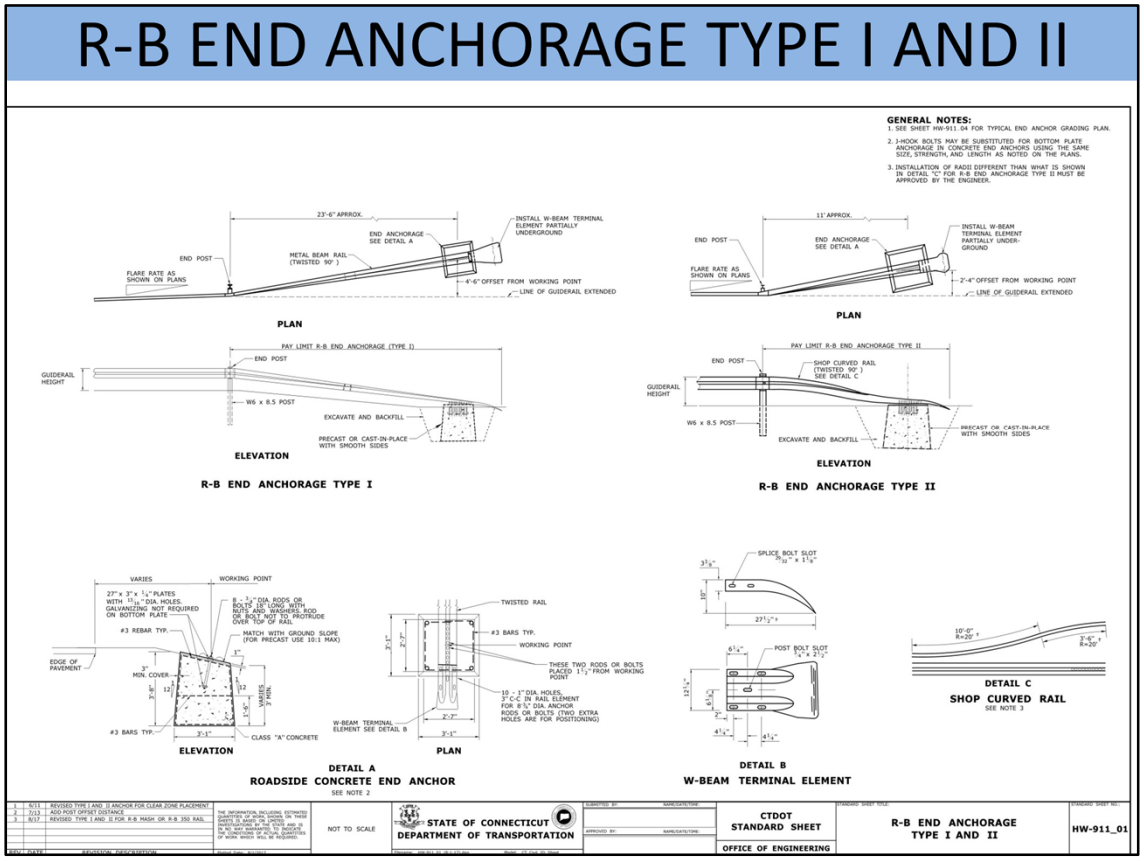
Figure 13-6C

- Highway Design Manual Figure 13-6C should be referenced for guidance on grading for turn-down end anchors



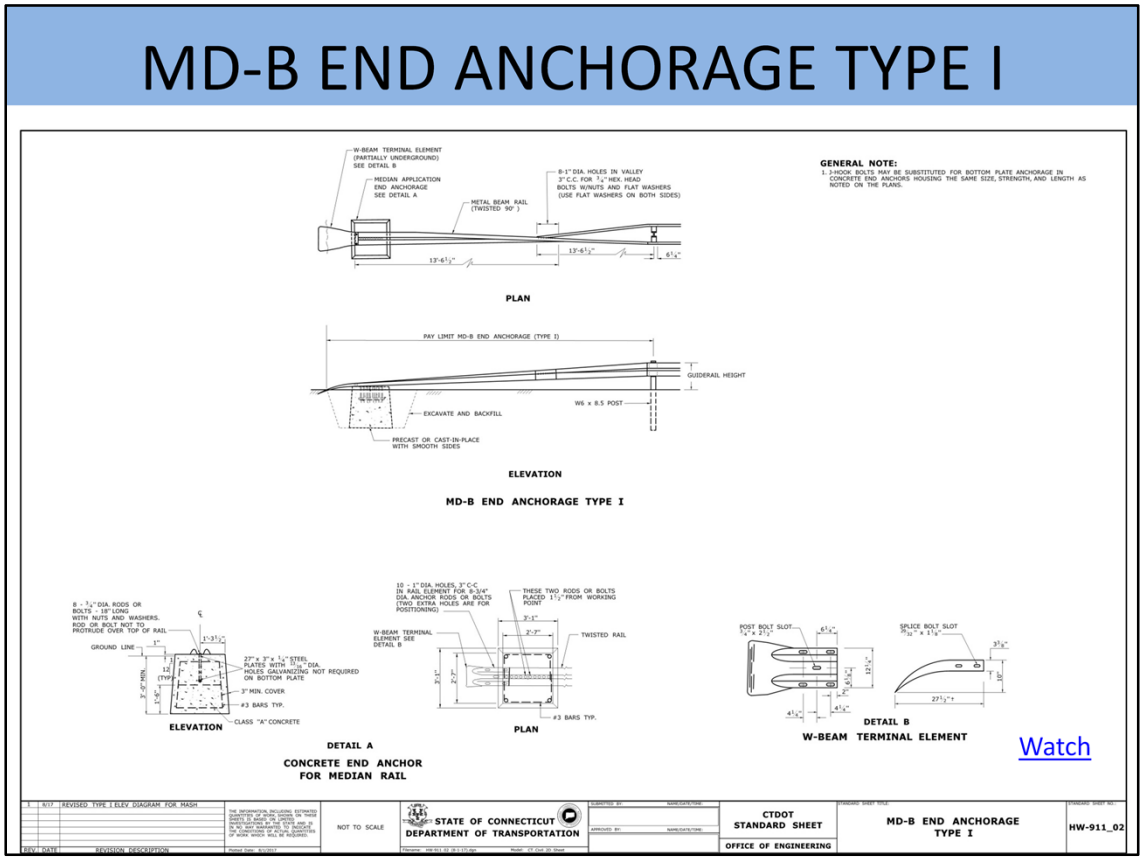
- Any information not available in the Highway Design Manual shall be referenced from the Roadside Design Guide

R-B END ANCHORAGE TYPE I AND II



- 29” Rail height removed
    - These are typical roadside barrier anchors that can be installed at either 29” or 31” rail height
- Entire anchor system should be installed outside of the clear zone in leading end conditions
- Design information for type of end anchor based on Design Speed has been removed
    - 45 mph or greater = Type I
    - Less than 45 mph = Type II
    - Plan sheets should specify whether a Type I or Type II end anchor is to be installed

MD-B END ANCHORAGE TYPE I



Watch

- 29” Rail height removed
    - These are typical median barrier anchors that can be installed at either 29” or 31” rail height
- Entire anchor system should be installed outside of the clear zone
- Link to video of vehicle crashing into turn-down end anchor: https://www.youtube.com/watch?v=EQ6CPIM1ZCs

QUALIFIED PRODUCT LIST
(QPL)

Impact Attenuation Systems - Continued:

SPECIFICATION: CTDOT Special Provision Item # 1803064A & 1803071A

PREAPPROVAL CRITERIA: Crash Tested in accordance with "National Cooperative Highway Research (NCHRP) Report 350 – Recommended Procedures for the Safety Performance Evaluation of Highway Features" Test Level 3 criteria; ***or***, Crash tested in accordance with "AASHTO Manual for Assessing Safety Hardware (MASH)" Test Level 3 criteria.

Comments: For all attenuators, see the ConnDOT Highway Design Manual for guidance.

Type B Impact Attenuation Systems (Tangential)			
System	**Manufacturer/ Supplier**	**Compatible Barrier System**	**Crash Test Specification**
SoftStop	Trinity Products	RB-350, RB-MASH	MASH
MSKT-SP	Road Systems, Inc.	RB-350, RB-MASH	MASH
MAX-Tension	Barrier Systems by Lindsay	RB-350, RB-MASH	MASH
BEAT	Road Systems, Inc.	6" Box Beam	NCHRP-350
WY-BET	Trinity Products	6" Box Beam	NCHRP-350

- QPL means Qualified Products List, it provides:
  - Specification requirements
  - Crash testing criteria
  - Location to be installed (Tangential, Flared, Median/Gore, Non-Gating, Non-Gating High Incident)
  - Manufacturer/Supplier
  - Compatible Barrier Systems
- The QPL is a living document that gets updated as hardware becomes available

- Crash results of SoftStop Trial Installation

Each W-Beam Terminal has different size / shape Impact Head

TR-1205_01 Attenuator Sign #

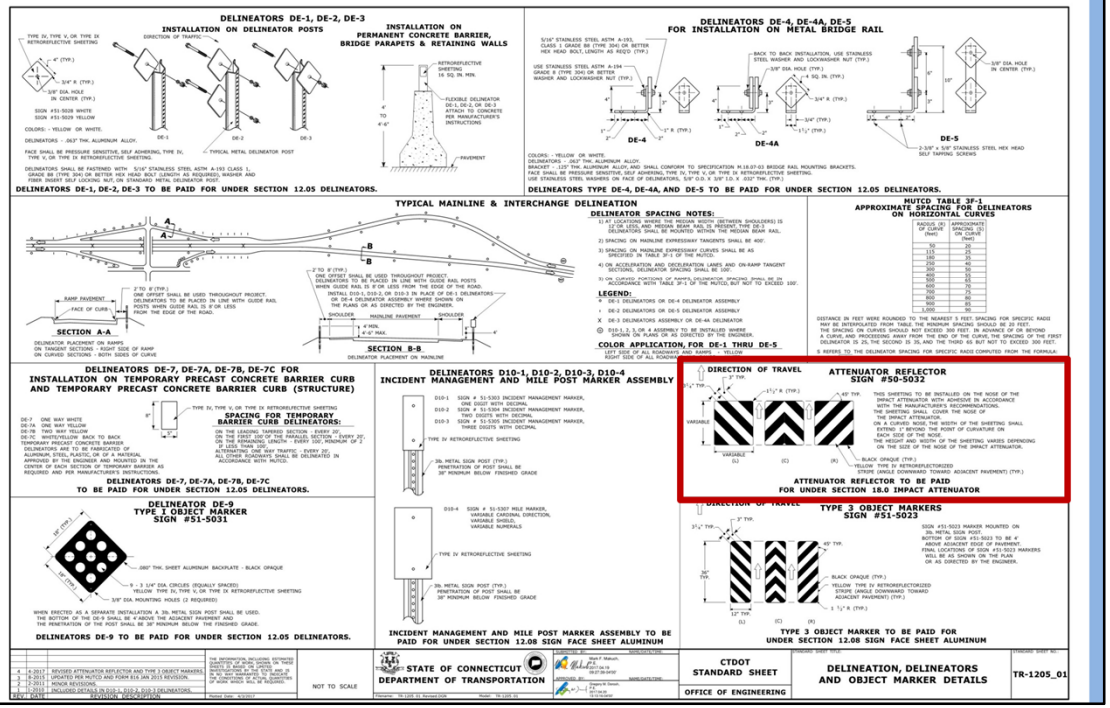
SOFTSTOP

MSKT

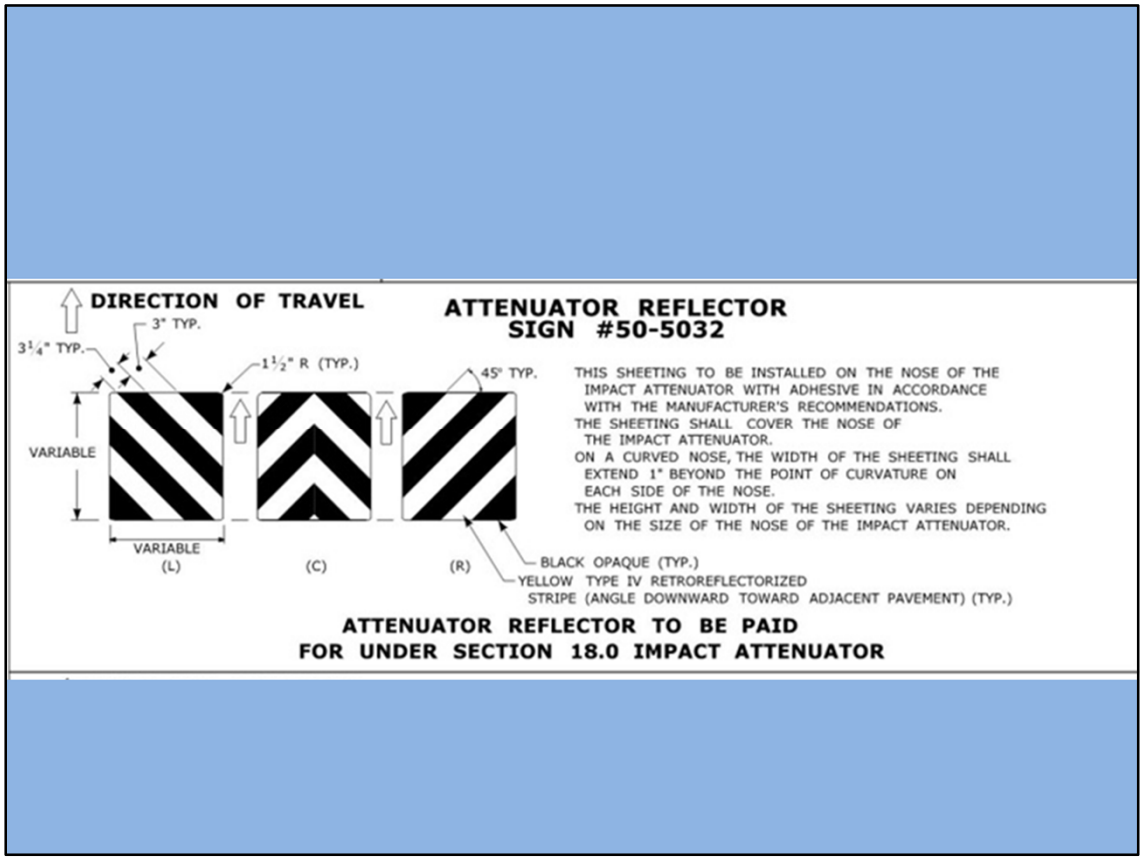
MAX-TENSION

- Impact heads come in different shapes and sizes

TR-1205_01 DELINEATION, DELINEATORS AND OBJECT MAKER DETAILS

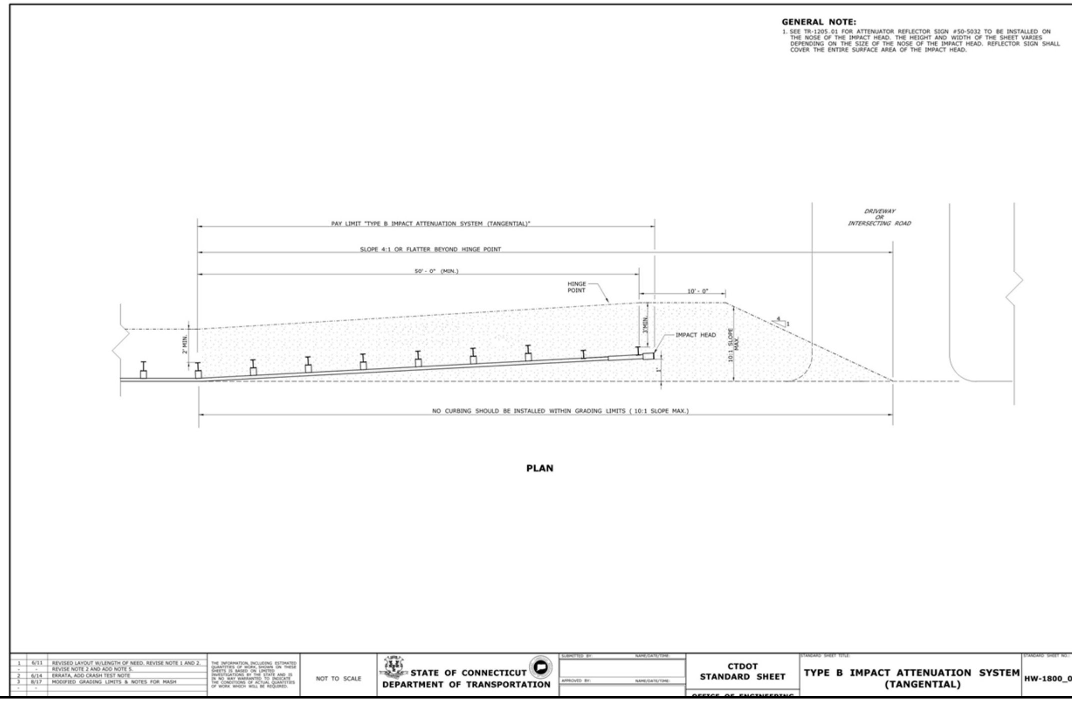


- Traffic standard sheet TR-1205_01 provides reflector guidance for impact heads



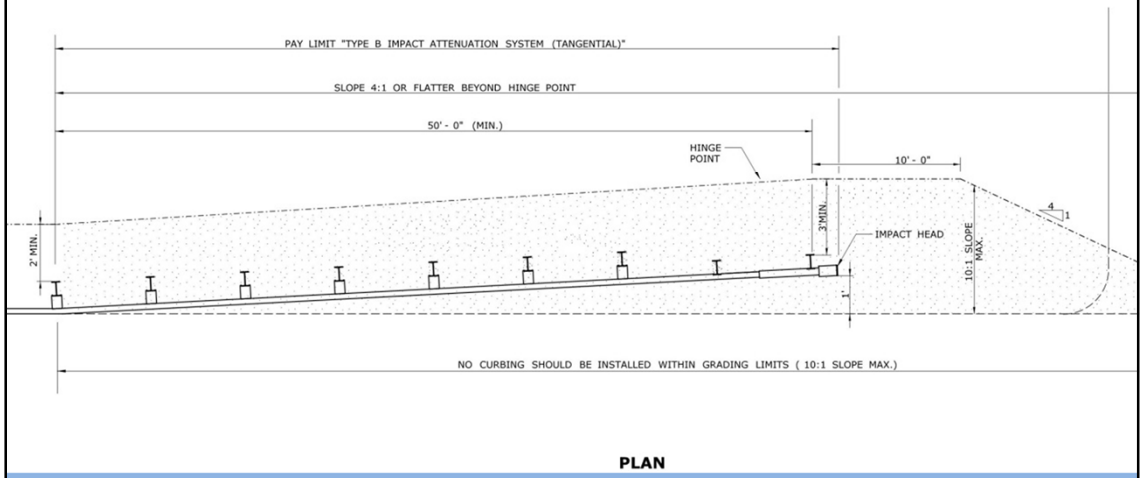
- Attenuator Reflector sign #50-5032

TYPE B IMPACT ATTENUATION SYSTEM
(TANGENTIAL)


GENERAL NOTE:
1. SEE TR-1205.01 FOR ATTENUATOR REFLECTOR SIGN #50-5032 TO BE INSTALLED ON THE NOSE OF THE IMPACT HEAD. THE HEIGHT AND WIDTH OF THE SHEET VARIES DEPENDING ON THE SIZE OF THE NOSE OF THE IMPACT HEAD. REFLECTOR SIGN SHALL COVER THE ENTIRE SURFACE AREA OF THE IMPACT HEAD.
DRIVEWAY OR INTERSECTING ROAD
PAY LIMIT "TYPE B IMPACT ATTENUATION SYSTEM (TANGENTIAL)"
SLOPE 4:1 OR FLATTER BEYOND HINGE POINT
50' - 0" (MIN.)
HINGE POINT
10' - 0"
2' MIN.
3' MIN.
IMPACT HEAD
10:1 SLOPE MAX.
NO CURBING SHOULD BE INSTALLED WITHIN GRADING LIMITS (10:1 SLOPE MAX.)
PLAN
1 6/11 REVISED LAYOUT W/LENGTH OF NEED. REVISE NOTE 1 AND 2.
REVISE NOTE 2 AND ADD NOTE 5.
2 6/14 ERRATA, ADD CRASH TEST NOTE
3 8/17 MODIFIED GRADING LIMITS & NOTES FOR MASH
NOT TO SCALE
STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
CTDOT
STANDARD SHEET
TYPE B IMPACT ATTENUATION SYSTEM
(TANGENTIAL)
HW-1800_03

- Revised standard sheet for tangentially installed systems

TYPE B IMPACT ATTENUATION SYSTEM
(TANGENTIAL)



PLAN

- Grading was changed to better match the Roadside Design Guide
- Clarified limits of curbing in front of Impact attenuator

Equivalent 350 Item No.	MASH ITEMS	
	Item No.	Description
0910170	0910300	Metal Beam Rail (R-B MASH)
0910171	0910310	Metal Beam Rail (MD-B MASH)
0910184	0910322	Metal Beam Rail Span Section Type II
0910185	0910323	Metal Beam Rail Span Section Type III
0910172	0910301	Metal Beam Rail (R-B MASH Half Post Spacing)
0910169	0910302	Metal Beam Rail (R-B MASH Quarter Post Spacing)
0910168	0910351	Convert Metal Beam Rail (R-B 350) to (R-B MASH)
	0910352	Convert Metal Beam Rail (R-B 350 SYSTEM 5) to (R-B MASH)
	0910353	Convert Metal Beam Rail (R-B 350 SYSTEM 5) to (R-B MASH Half Post Spacing)
	0910354	Convert Metal Beam Rail (R-B 350 SYSTEM 5A) to (R-B MASH)
	0910355	Convert Metal Beam Rail (R-B 350 SYSTEM 5A) to (R-B MASH Half Post Spacing)
	0910356	Convert Metal Beam Rail (R-B 350 SYSTEM 6) to (R-B MASH)
	0910357	Convert Metal Beam Rail (R-B 350 SYSTEM 6) to (R-B MASH Quarter Post Spacing)
0910167	0910358	Convert Metal Beam Rail (MD-B 350) to (MD-B MASH)
0912605	0912900	Reset Metal Beam Rail (R-B MASH)
0912614	0912901	Reset Metal Beam Rail (MD-B MASH)

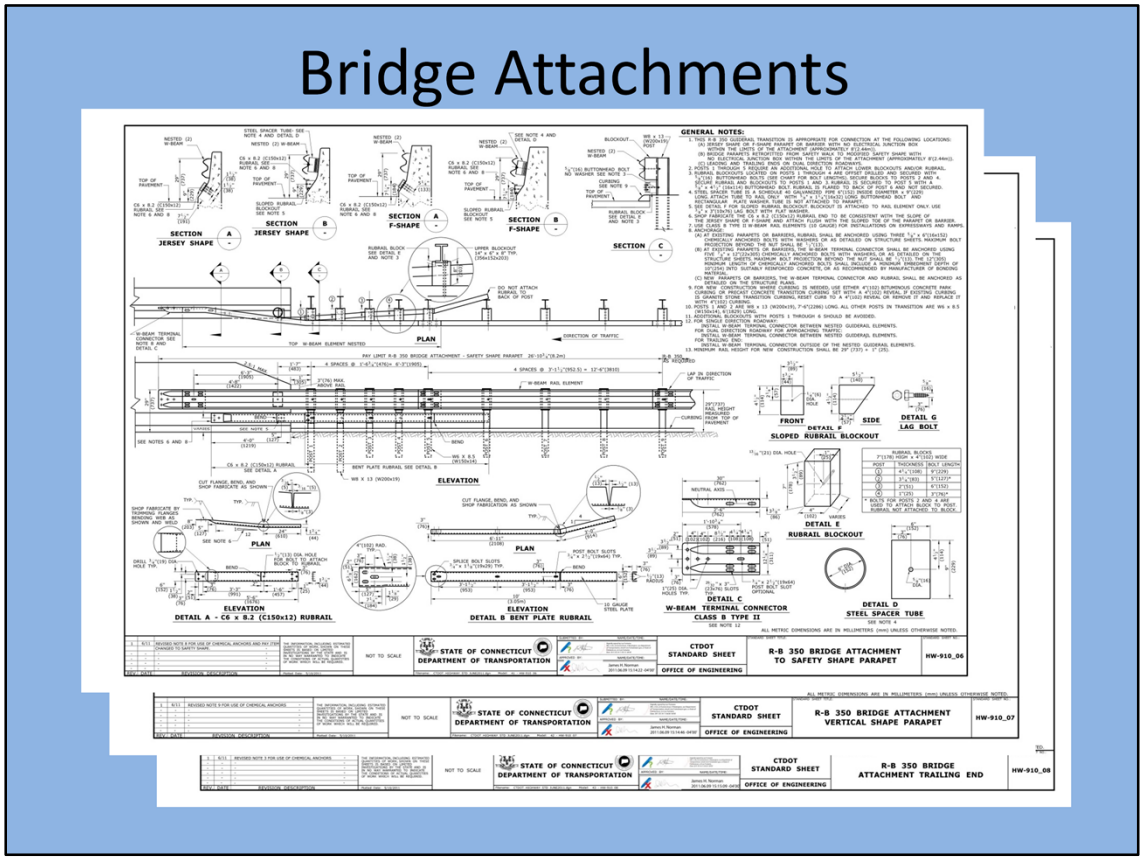
- New pay items for MASH compliant guiderail
  - Table of Equivalent NCHRP 350 Item numbers to assist in estimating

What is NOT Changing in Phase 1

- Bridge Attachments
- Curved Guiderail Treatment
- Anchor in Earth Cut Slope & in Rock Cut
- Crash Cushions
- Pre-Cast Concrete Barrier

- Bridge Attachments are remaining unchanged in the Phase I Implementation of MASH

Bridge Attachments



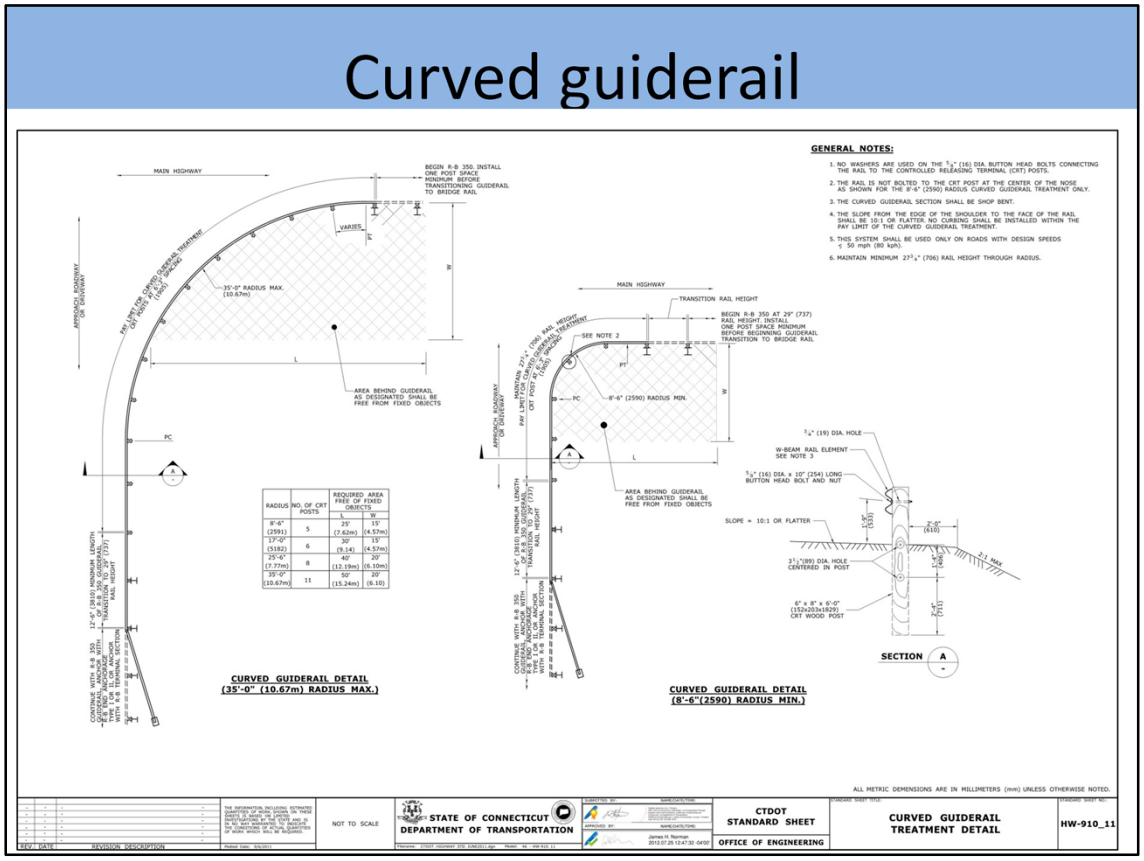
- All current NCHRP 350 bridge attachments continued to be used
- If you are designing a new run of MASH Guiderail connecting into a bridge, install NCHRP 350 bridge attachment along with Transition guiderail (HW-910_25)
- If you are installing R-B MASH Guiderail and an NCHRP 350 Bridge attachment, both hardware standard drawings will need to be included in the contract since the MASH hardware sheet does not have the W8x13 Post
- New Bridge attachments will be coming for the last deadline (End of 2019)

What is not Changing in Phase 1

- Bridge Attachments
- Curved Guiderail Treatment
- Anchor in Earth Cut Slope & in Rock Cut
- Crash Cushions
- Pre-Cast Concrete Barrier

- The Curved Guiderail System is remaining unchanged in the Phase I Implementation of MASH

Curved guiderail



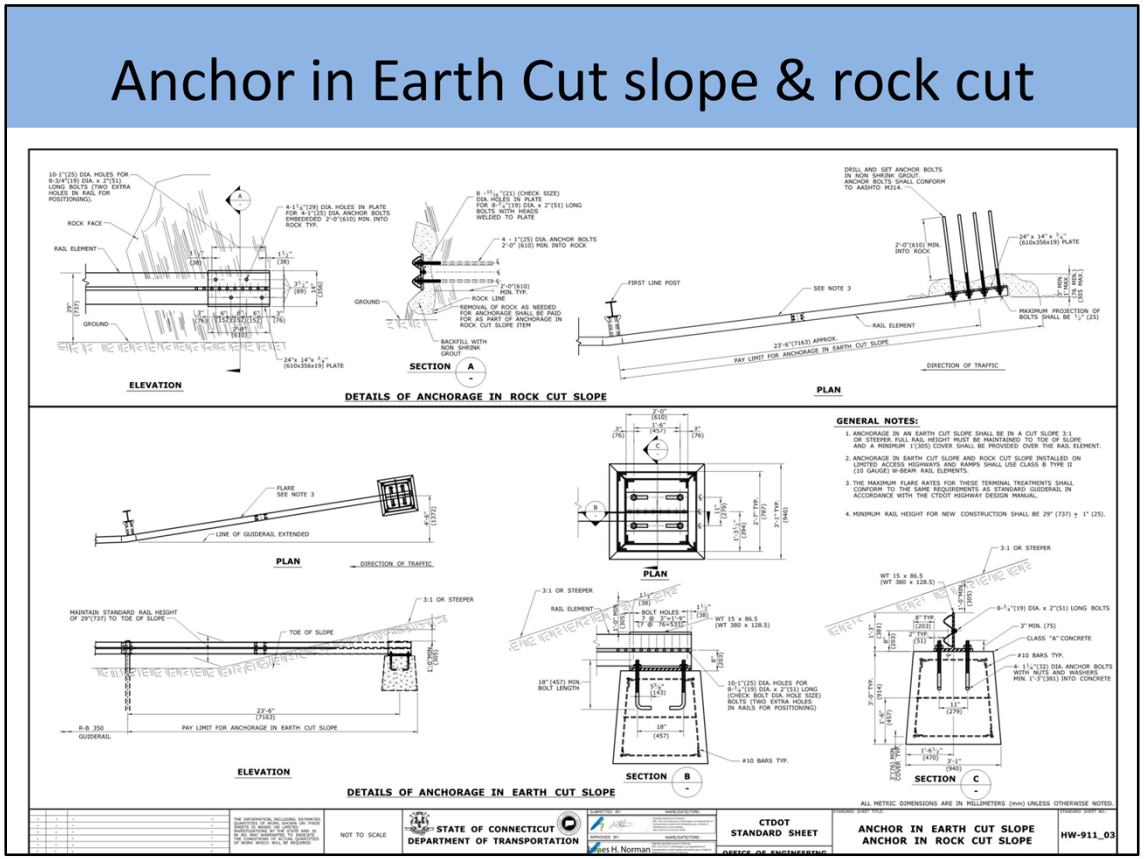
- If you are designing a new run of MASH Guiderail connecting to a curved guiderail treatment, be sure to include transition guiderail (HW-910_25)
- R-B 350 is allowed to be installed if transition length is not available such as at short lengths of rail with bridge attachments and curved guiderail

What is not Changing in Phase 1

- Bridge Attachments
- Curved Guiderail Treatment
- Anchor in Earth Cut Slope & in Rock Cut
- Crash Cushions
- Pre-Cast Concrete Barrier

- The Earth Slope and Rock Slope anchors are remaining unchanged in the Phase I Implementation of MASH

Anchor in Earth Cut slope & rock cut



- These anchors are specific to their height and are not to be confused with the turn-down end anchor
- If you are designing a new run of MASH Guiderail connecting to an Earth Slope or Rock Slope anchor, be sure to include transition guiderail (HW-910_25)

What is not Changing in Phase 1

- Bridge Attachments
- Curved Guiderail Treatment
- Anchor in Earth Cut Slope & in Rock Cut
- Crash Cushions
- Pre-Cast Concrete Barrier

- Crash Cushions are remaining unchanged in the Phase I Implementation of MASH

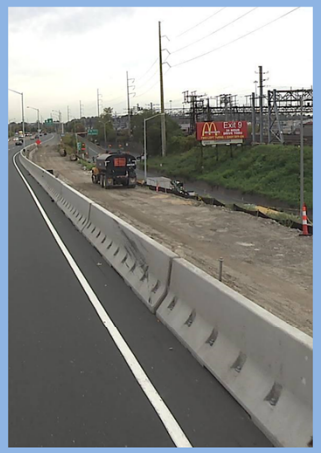
- Crash Cushions are impact attenuators that are attached to or placed in front of rigid concrete barriers or rigid fixed objects
- Crash Cushions will be included in the Phase II implementation for the end of 2018

What is not Changing in Phase 1

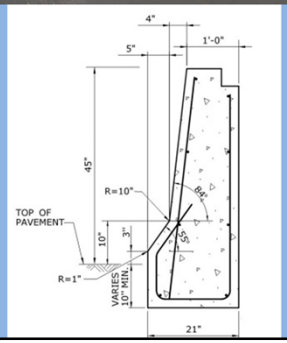
- Bridge Attachments
- Curved Guiderail Treatment
- Anchor in Earth Cut Slope & in Rock Cut
- W-Beam Terminal End (Median Application)
- Crash Cushions
- Pre-cast Concrete Barrier

- Pre-cast Concrete Barriers are remaining unchanged in the Phase I Implementation of MASH

Pre-Cast Concrete Longitudinal Barrier

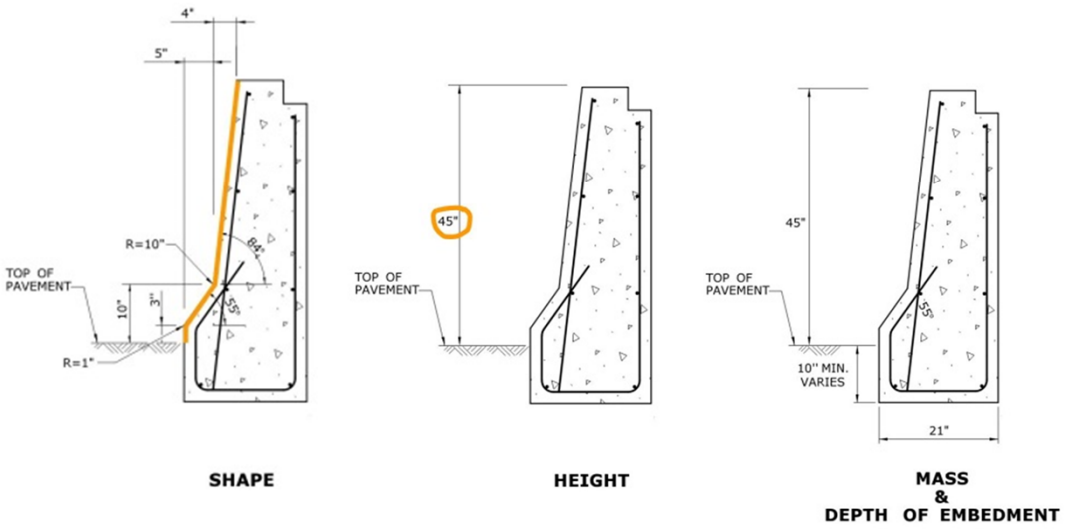


December 31, 2019



- Temporary Pre-cast Concrete Barrier for work zones will be changed with last implementation at the end of 2019
- The current F-shape Concrete barrier design appears to be similar to what's being MASH tested

Pre-Cast Concrete Longitudinal Barrier

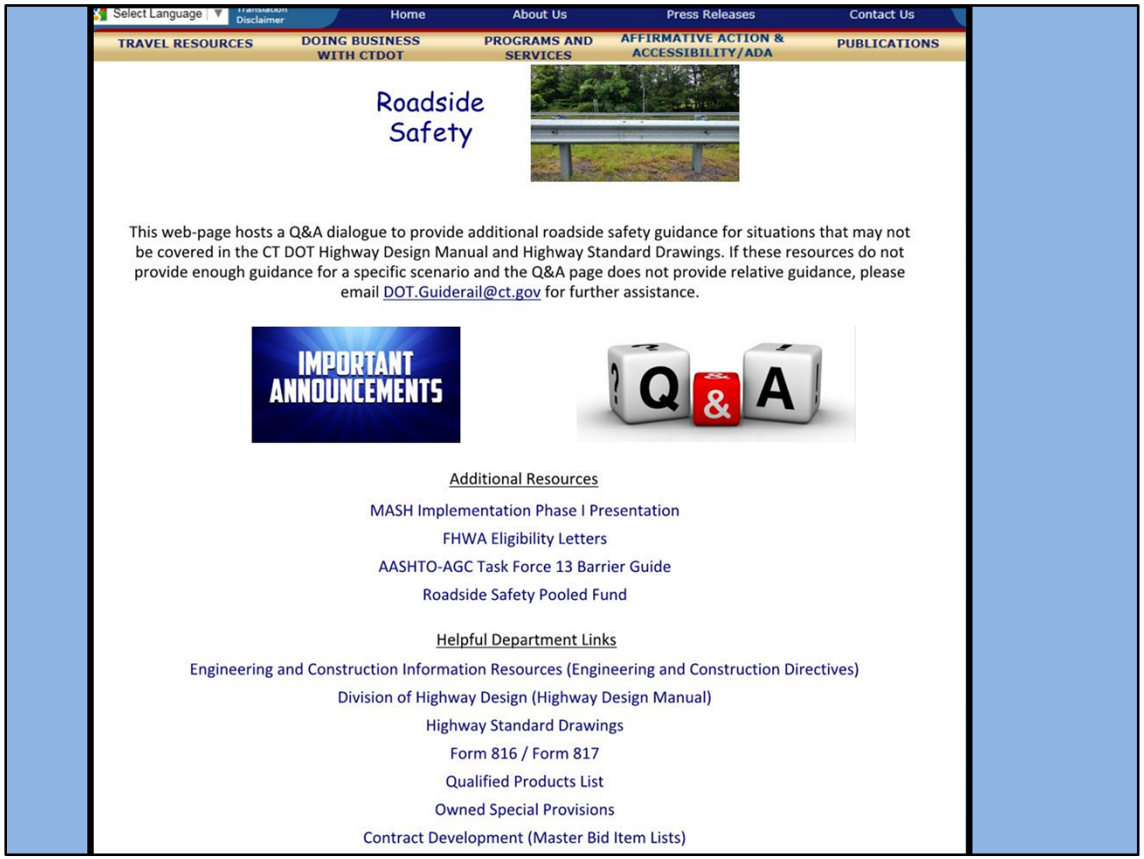


- F-shape or 9.1 degree single slope effectively limits potential rollovers
- 45” is higher than what is currently being tested for MASH test level 4 concrete barrier
- Required depth of embedment is currently being researched
- For now we will continue to use our 45” high F-Shape concrete barrier until more information becomes available

What is coming in the future

- Qualified Products list (QPL) Updates
- Additional W-Beam End Terminals
- Downstream anchor
- Anchor in Earth Cut Slope & in Rock Cuts
- Phases 2 and 3
- Highway Design Manual Revisions

- The QPL is a living document that will be updated as items become approved
- Additional terminals to come
    - Manufacturers are testing Flared and Median applications
- Downstream anchor to come
    - MASH tested Downstream anchor will be coming soon for trailing end anchoring within the clear zone
- Anchor in Earth Slope & Rock Slope
    - MASH testing is currently being performed, changes may come in the future. Continue using current standard with transition.
- Phases 2 and 3 will be coming to stay on target with federal requirements for federal-aid reimbursement



- Informational Roadside Safety website (http://www.ct.gov/dot/cwp/view.asp?a=4109&Q=595306)
  - Contains Department and outside resources
  - Q&A Dialogue
  - Important announcements
  - Email address to send in questions