Technical Publications Committee
Meeting Agenda
1:00 PM April 15, 2021
Microsoft TEAMS Meeting
E-mail distribution message includes connection instructions

Call to Order

Roll Call of Attendees

Approval of Minutes of 1-28-2021 Meeting

Unfinished Business

3	DD-251 Temporary Erosion Control	L. Conley-Rinehart (8-6-20)
4	Rescind WVDOH Erosion and Sediment Control Manual	M. Dougherty (8-6-20)
5	DD-666 – Impact Attenuators	T. Whitmore (10-1-20)
6	DD-644 – Asphalt Pavement	V. Allison (2-6-20)
7	DD-812 – Salvage Value of Materials	M. Dougherty (1-28-21)
8	Attachment to DD-706 – PS&E Checklist	M. Dougherty (1-28-21)

Continued on Page 2

New Business

9 DD-204 Guidance for Use of CPM Schedules for Projects Under Design
R.J. Scites (4-15-21)

10 DD-503 Selection of Pipe Materials D. Kirk (4-15-21)

11 DD-621 Intersection Sight Distance M. Dougherty (4-15-21)

12 DD-702 Signing and Sealing Professional Work M. Dougherty (4-15-21)

13 DD-803 Determination of Contract Completion Date
M. Dougherty (4-15-21)

14 Standard Detail for Elliptical Concrete Safety End Sections
A. Gillispie (4-15-21)

15 DD-6?? New Design Directive – Project Categories R.J. Scites (4-15-21)

16 New Standard Detail - Type X Median Barrier J. Hall (4-15-21)

17 Rescind Existing Standard Detail GR17 – Type 10 Median Barrier
J. Hall (4-15-21)

Next Meeting – Thursday June 17, 2021, via Microsoft Teams. Deadline for submissions May 17, 2021.

Adjournment

Publications Committee
Meeting of January 28, 2021
MINUTES

The meeting was called to order at 1:00 PM by Martin Dougherty.

DOH Staff:
Aggy Bundy - DD
Laura Conley-Rinehart – DD
Martin Dougherty – DD
Joe Hall – DD
Steve Boggs – FC
Shawn Smith - FC
Vince Allison – FM
John Cummings - FM
Dan Brayack – FM
Colton Farley - FM
Shawn Jack – FM
Conner Thompson - FM
Ted Whitmore - DT
Bill Murray – OM
Kimberly Hoover-Trent – OM

Others - Industry:
Pat Parsons - CAWV/APAWV
Tony Anders – CAWV
Chad Miller - JF Allen Company
Bryan Leatherman – JF Allen
Ray Seipp – ACPA (Pavement)
Jerry Elkins – HNTB
Stormy Brewster - Marathon Petroleum
Bill Varney – ACEC
Scott Hamm – Kelly Paving
Mark Haverty – Kelly Paving
Kevin McGlumphy – Associated Asphalt
Mark Moyer – Enterprise Lime and Stone
Rick Johnson – WV Paving
Chris Calain - Greer Asphalt
Andrew Cunningham – Bear Construction

Minutes of 10-1-20 Meeting were approved as presented.

Unfinished Business:

1. DD 251- Temporary Erosion Control: This is the third time this Design Directive has come before the Committee for review. Many additional changes have been made in follow-up from the meeting held 10-1-20 and were discussed by Martin. Because of these changes, it was decided to NOT vote on this Design Directive. Continued discussions will be held at the next meeting.

2. Repeal WVDOH Erosion and Sediment Control Manual: No action was taken on this Manual at the present time. This item was put on hold.

3. DD 611 – Additional or Revised Access Pointes to the Interstate System: This is the second time this Design Directive has come before the Committee for review and it is eligible to vote. Joe Hall shared minor verbiage changes. Motion made to accept the revisions and was passed by voting members – 5-0.

4. DD 6-……. – 600 Series, new Design Directive – Regarding Impact Attenuators. This is the second draft; few comments were received, and they were mainly word verbiage versus technical changes. Joe Hall stated he would like Traffic Engineering Division and the Roadway

Departure committee members review this new design directive. It was decided to not vote on this Design Directive and to discuss further at the next meeting.

New Business:

1. DD 644 – Asphalt Pavement: Martin informed everyone that management rescinded the revisions of this DD since the last Pubs meeting. The beginning point for this document is the version approved by committee at the October 1, 2020 meeting. This is the first time this Directive has come before the Committee and it is not eligible to vote. Discussions were made amongst all; the major comment was that there can only be one methodology per project. Changes are not anticipated to take place this year, and it will affect only new projects after it is passed.

2. DD 812 – Salvage Value of Materials: This is the first time this Directive has come before the committee and it is not eligible to vote. FHWA sent comments and Martin shared with all. The current DD does not meet Federal regulations (1996). Some comments: Page 2 – "Method B" – FHWA suggests changing so all Federal Aid projects reimburse the FHWA for the salvage value. This would eliminate any need to segregate inventory. Steve Boggs suggested adding an example not in the DD pertaining to salvage under "Method B". Martin discussed changes. Rick Johnson suggested adding a contact person and instructions to take salvage to other places if a salvage lot were full/cost more/etc. Rick also suggested that the project designer needs to work more with this concern. This last comment is noted in this Directive, next to the last paragraph. Other comments were: Asphalt pavement recycling? What is the intrinsic value of stone? 25% of value of cutting where located when created – where did this come from? 25% reasonable estimate of what value of material is worth? Value of wrap – recycle vs. virgin wrap?

With the intensity of discussion of this DD, Rick Johnson suggested we need to discuss outside the meeting. Martin suggested creating a task force. Volunteers consist of: Rick Johnson, Mark Haverty, Pat Parsons, Vince Allison, Shawn Jack, Steve Boggs. Pat stated he will get other members around the state and give names to Martin. It was decided to continue with discussions at the next Pubs meeting.

3. Attachments to DD 706 – PS&E Checklist: Martin discussed minor revisions were made to this document and it was decided to discuss further at the next meeting.

4. DD 301 – Right of Way Plans: The changes made in this Directive are ministerial in nature; pertaining to the Utilities Unit within the Engineering Division is now relocated to the Right of Way Division. Motion made to accept the revisions and was passed by voting members – 5-0.

Next meeting: Thursday, April 8, 2001, 1:00 pm via TEAMS Meeting due to COVID-19 or if restrictions are lifted, Lower Lever Conference Room, Engineering Division.

Deadline for Submission of Documents: March 8, 2021.

Meeting Adjourned.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 251
TEMPORARY EROSION AND SEDIMENT CONTROL

Draft of April 7, 2021
Supersedes July 1, 2006

Temporary erosion and sediment control measures and NPDES permitting measures shall be incorporated into contract plans on all projects per these guidelines.

GENERAL REQUIREMENTS:

The designer shall prepare, or include provisions in the contract plans for the contractor to prepare, erosion and sediment control plans in accordance with The West Virginia Department of Environmental Protection (DEP) *Erosion and Sediment Control Best Management Practice Manual* (BMP Manual), latest edition. The BMP Manual is available at https://dep.wv.gov/WWE/Programs/stormwater/csw/Pages/ESC_BMP.aspx .

COORDINATION OF PLANS:

The DOH has agreed to maintain close coordination with DEP during the design and construction stages of highway development. This will be accomplished by informing DEP of all future projects in writing as outlined in DD-202. DEP will conduct periodic reviews during plan development and during construction. As shown in Appendix A of DD-202 all coordination letters shall contain the following statements:

- Letters to the DEP:
  "This submission is for your review and comments in relation to significant water quality effects."

- Letters to the DNR:
  "This submission is for your review and comments in relation to fish and wildlife and recreational resources effects."

DESIGN:

The designer will evaluate the land disturbing activities for a particular project to determine what erosion and sediment control features are necessary and appropriate to be included in the project plans.

For projects such as resurfacing and bridge deck overlays, erosion and sediment control features may not be required. However, any activities that have the potential to affect water quality shall be addressed with BMPs and may require a permit.

For all projects with land disturbing activities, individual bid items as per Section 642 of the Specifications will be established. Plan quantities will be developed utilizing criteria set worth in the DEP's BMP Manual and/or any appropriate Design Directive. Sediment basins will be designed and shown on the plans as they may require additional right-of-way.

The designer is directed to review additional design and applicability information contained in the BMP Manual.

PERMIT REQUIREMENTS:

In accordance with the current National Pollutant Discharge Elimination System (NPDES) General Permit all land disturbing activities of 1 acre ~~*(0.4 ha)*~~ and greater are required to be registered with the West Virginia Department of Environmental Protection. Registration under the permit is divided into two types. Those projects involving disturbed areas of 1 to 3 ~~acres *(0.4 to 1.2 ha)*~~ require the submission of a "Minor Construction Application" (MCA) form. A "Large Construction Application" (LCA) form shall be submitted for those projects involving 3 acres ~~*(1.2 ha)*~~ or more of disturbance. One WVDOH method of calculating disturbed area is to utilize the Clearing and Grubbing (C&G) quantity.

General guidelines as to which form to complete and submit are:

1. Any project with less than 1 acre ~~*(0.4 ha)*~~ of C&G activities and an undefined waste site, borrow site, or undefined construction access area will require a Letter of Non-registration (LONR).

2. Any project with 1 to less than 3 acres ~~*(0.4 to 1.2 ha)*~~ of C&G activities will require a completed MCA form.

3. Any project with C&G of 3 acres or more requires a completed LCA form.

4. Most waste sites and many borrow sites are located outside of state R/W. Any project with waste or borrow sites outside of state R/W will be the contractor's responsibility and will not be included in any NPDES Construction Storm Water Permit Registration that includes the DOH as a permittee or co-permittee.

The designer shall complete and submit the appropriate NPDES registration form to the Review Section of the Engineering Division during the final phases of design. The Engineering Division will review the documents for completeness and provide comments to the designer, if needed, and once complete, will submit the permit registration documents to the WVDEP in the name of the WV Division of Highways.

The WVDOH will ~~register~~ obtain conditional approval all design-bid-build projects with any land disturbing activities of 1 acre or greater. For projects built by WVDOH forces the WVDOH will perform the entire permitting process. For Alternative Delivery/Design Build projects NPDES registration, modifications, and fees shall be the Contractor's responsibility. The WVDOH shall not be a NPDES co-applicant/co-permittee for Alternative Delivery/Design Build projects. Projects such as resurfacing, bridge deck overlays, traffic signal installation, guardrail

placement, ditch pulling, etc. may not require an NPDES registration; however, the use of *BMPs* is required to comply with water quality regulations.

All designers are cautioned to pay particular attention to all the necessary requirements and criteria for the sizing of sediment basins. The tentative locations of sediment basins are to be indicated on the Preliminary Field Review plan submission. All sediment basins shall be completely designed and shown on the Final Field Review plan submission. If the DEP makes comments or requests corrections on the permit registration submission, then corrections shall be made promptly and resubmitted for approval.

If the required size of a sediment basin cannot be accomplished, written justification explaining in detail the reasons for not meeting the necessary criteria shall be provided in the NPDES Permit Registration package. *Right-of-way constraints are not justification for downsizing a basin* unless the taking of an occupied dwelling, encroaching on a cultural/natural resource or the disturbance to construct the basin is greater than the area being protected. The designer shall establish right-of-way limits that allow for the full development of a properly designed sediment basin(s).

"Enhanced BMPs" means activity schedules or sediment and erosion controls that are more protective of the environment than those routinely employed to quality for coverage under this permit. Enhanced BMPs are required by the NPDES Construction Storm Water Permit. Stormwater shall go through an Enhanced BMP prior to discharging from the construction site.

The designer is to provide all the necessary bid items and quantities that will allow the Contractor to develop an Erosion and Sediment Control plan for submittal to the DEP.

For a designer, enhanced BMPs include but are not limited to:

a. 100-foot (or greater) vegetative buffer zone
b. Sediment Basin/Pond: forebay, baffles, skimmers*
c. Super Silt Fence
d. 42" High-Tensile/High-Modulus Woven Geotextile Sediment Fence (High Strength Silt Fence)*
e. 18" or larger Compost Filled Filter Socks*
f. Use of WVDEP approved flocculants*
g. Use of erosion control blanket for slopes steeper than 3:1
h. Series of Step pools with stabilized diversion and/or contour ditches.
i. Soil tackifier (asphalt emulsion is not acceptable)
j. Other items that provide additional or enhanced control concerning the potential erosion and sediment discharge

* The Project Manager should go to Approved Project Specific Provisions (PDF) on ProjectWise for the latest special provisions or contact the Specifications Engineer for copies of the latest approved special provisions for skimmers, high strength silt fence, filter socks, and flocculants.

The WVDOH will provide for information purposes only and for possible use in the contractor's Storm Water Pollution Prevention Plan (SWPPP):

a. Estimated start and completion dates for the project.
b. List and name all receiving stream(s).

c. Topo map with the Limit of Disturbance (LOD) and receiving streams identified.
d. Sequence of Construction Activities.
e. Drainage Report, including the following:
   i. Drainage area maps for construction site discharges points. Note: Discharge points are all locations where the project stormwater leaves the site or enters a stream.
   ii. Pre-Construction Drainage Maps include 1 year 24-hour discharge calculations for each discharge point.
   iii. Post Construction Drainage Maps include 1 year 24-hour discharge calculations for each discharge point.
   iv. Ditchline and pipe sizing calculations.
   v. Discharge points and drainage analysis for completed project.
   vi. Permanent Stormwater Management design details.
   vii. For Large Construction Projects (3 Acres or more of earth disturbing activities) with post-construction peak discharge 10% (or more) greater than the pre-construction peak discharges of 5 cubic feet per second or more for the 1-year, 24-hour storm: Post-construction stormwater management BMPs must be implemented to reduce potential location erosion at the discharge point. (Include calculations with permit application) Calculations and justification must be submitted if post-construction stormwater management features are deemed unnecessary.

f. Tier 2 or Tier 3 Stream Protection Designation (as designated by the WVDEP), Stream with an approved sediment-related Total Maximum Daily Load (TMDL)
g. Preliminary Site Plan (Maps) showing Limits of Disturbance in a closed polygon and projected in NAD83 WV State Plane Coordinate System in ArcGIS Shapefile (.shp) or Google Earth (.kmz or .kml).
h. Municipal Separate Storm Sewer Systems requirements (Design Directive 506) if applicable.
i. Soil maps https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Note: As per WVDEP requirements the site maps shall contain a North arrow with sites oriented to the North, with a minimum level of detail of five-foot topographical contour intervals.

Additional guidance and details are located in ProjectWise – WVDOT FILE TRANSFER, ENGINEERING-File Transfer, Consultant Resources, Permitting

QUANTITY ESTIMATION:

The quantities may be estimated using the following guidelines. However, conditions on individual projects may indicate the need to adjust these methods or substitute other methods. The designer is to use good engineering judgement.

Item 642001, Temporary Berms, per linear foot ~~*(meter)*~~ – For estimating purposes, use length of the embankment in profile times 2.5.

Item 642002, Slope Drain, per linear foot ~~*(meter)*~~ – Use the longitudinal embankment length divided by 250 +1, multiplied by the average length of slope from shoulder to toe of the embankment.

[(Embankment Length/250) + 1] x (Average length of the finished slope of the embankment)

This calculation is for one side of the embankment.

Item 642004, Seed Mix, "Type", per pound ~~*(kilogram)*~~ – See current Specifications Tables 642.5.3.1 and 642.5.3.2 for rate of seed per acre ~~*(hectare)*~~ and Subsection 642.5.2, Schedule of Seeding Operations. For estimating purposes, designer may assume the entire project will be seeded twice per construction season.

Item 642005, Mulch, "Type", per ton ~~*(megagram)*~~ – See current specifications for rate of mulch per acre ~~*(hectare)*~~ of area to be seeded and mulched. For estimating purposes, designer may assume the entire project will be mulched twice per construction season. Wood cellulose mulch shall not be used when enhanced BMPs are required.

Item 642006, Fertilizer, per ton ~~*(megagram)*~~ – Fertilizer shall be applied at the rate of 800 lb. per acre ~~*(900 kilogram per hectare)*~~ of area to be seeded and mulched. For estimating purposes, designer may assume the entire project will be fertilized twice per construction season.

Item 642007, Fiber Matting, per square yard ~~(square meter)~~ – Use when contour ditch velocities exceed that allowable as set forth in the Drainage Manual.

Item 642008, Temporary Pipe, per linear foot ~~(meter)~~ – Use to prevent equipment from coming in direct contact with water when crossing an active stream, intermittent stream or ephemeral stream created during heavy rainfall. Appropriately size for the estimated flows.

Item 642009, Contour Ditch, per linear foot ~~(meter)~~ – For estimating purposes, use three times the project length rounded to the nearest 100 feet ~~(30 meters)~~.

Item 642010, Agricultural Limestone, per ton ~~(megagram)~~ – Use 1.5 ton per acre ~~(3.4 megagrams per hectare)~~ to be seeded and mulched unless the pH tests indicate otherwise.

Item 642012, Silt Fence, per linear foot ~~(meter)~~ – Use 2 times the project length.

Item 642015, Super Silt Fence, per linear foot ~~(meter)~~ – Use 2 times the project length.

Item 642031, Rock Check Dams~~Ditch Checks~~, per each – (Ditch Checks ~~Rock Check Dams~~) See Section 3.05 of the WVDEP's BMP Manual.

Item 642033, Sediment Trap, per cubic yard ~~(cubic meter)~~ - For estimating purposes, use 100 cubic yards ~~(77 cubic meters)~~ of excavation per 1000 feet ~~(300 meters)~~ of project length.

Item 642034, Sediment ~~Dam~~Basin, per cubic yard ~~(cubic meter)~~ – Sediment ~~dams~~ basins are to be site-specific designed as outlined in Chapter 5 of the DEP's Erosion and Sediment Control Best Management Practices Manual and shown on the constructions plans.

Item 642035-001, Riser, per each – A riser is to be used for all sediment ponds with a contributing drainage area of 5 acres ~~(2 hectares)~~ or greater and all sediment ~~dams~~ basins when Enhanced BMPS are not required. The outlet pipe is to be bid as a regular pipe item.

Item 642035-002, Skimmer, per each – A skimmer is to be used for all sediment ponds with a contributing drainage area of 5 acres ~~(2 hectares)~~ or greater and all sediment ~~dams~~ basins when an Enhanced BMP is required. The outlet pipe is to be bid as a regular pipe item.

Item 642036, Sediment Removal, per cubic yard ~~(cubic meter)~~ – For estimating purposes, use 100 cubic yards per 1000 feet of project length or 50% of the total sediment basin (ponds and dams) volume, whichever is greater, per construction season.

Item 642037, Sediment Pond, per cubic yard ~~(cubic meter)~~ – Sediment ponds are to be site-specific designed as outlined in Chapter 3.30 and Chapter 5 of the WVDEP Erosion and Sediment Control BMP Manual 2006 and shown on the constructions plans.

Item 642040, Inlet Protection, per each – One for each existing and proposed inlet.

Any sediment ~~dams~~ basins and ponds left in place for permanent storm water control shall be fenced in accordance with Section 608 of the specifications.

The methods of calculating the quantities for pay items shown above is only a guide. Conditions of individual projects may dictate the need to adjust these methods or substitute other methods.

NPDES PERMIT REQUIREMENTS:

The General "National Pollutant Discharge Elimination System" (NPDES) Permit requires registration of most construction projects. An approved NPDES registration or a memorandum stating that NPDES registration is not required shall be included in all PS&E submissions. Completed example forms are attached to this DD.

On state funded resurfacing projects the following note shall be added to the plans:

"If the contractor chooses to waste the millings and the waste area is between 1 acre and 3 acres, the contractor is responsible for obtaining the NPDES MCA Registration through the DEP which includes a $300.00 registration fee prior to beginning construction. The contractor shall provide the West Virginia Division of Highways a copy of the DEP's acceptance and confirmation of the registration, prior to the start of construction. The DEP will require additional fees based on the length of time required for construction as outlined in the general NPDES permit."

Rescind the WVDOH Erosion and Sediment Control Manual.

Rescinding of the Erosion and Sediment Control Manual is fairly straight forward. After the revised DD-251 is accepted the DOH intends to rescind the E&SC Manual. Since the manual is a large document it was not included in the package. Any interested person may view a copy at

https://transportation.wv.gov/highways/engineering/files/Erosion/Erosion2003.pdf.

This rescission will cause the WVDEP's Erosion and Sediment Control Best Management Practices Manual to become the default manual. The BMP Manual may be viewed here: https://dep.wv.gov/WWE/Programs/stormwater/csw/Documents/E%20and%20S_BMP_2006.pdf .

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 666
IMPACT ATTENUATORS

Draft of April 5, 2021
First Edition

The purpose of this Directive is to establish the Division's guidelines for the use of permanent and temporary ~~Impact Attenuators~~attenuators. The scope of this Directive includes a description and explanation of ~~Impact Attenuators~~attenuators, guidelines as to when ~~Impact Attenuators~~attenuators should be incorporated, ~~Impact Attenuator~~ attenuator type selection and specification, and additional related design considerations.

Sections 4 of this Directive provides the information the Designer needs to properly specify an attenuator for a project. Sections 1 through 3 provide primarily background information. However, it is important that the Designer have an understanding of the information provided in these sections such as how the devices function, how they are categorized, and when their use is warranted.

SECTION 1 - IMPACT ATTENUATOR GENERAL DESCRIPTION

~~Impact Attenuators~~Attenuators are traffic safety devices that prevent errant vehicles from impacting fixed objects. ~~Impact Attenuators~~Attenuators have the ability to shield the object from vehicles approaching from the front and either side. ~~Impact Attenuators~~Attenuators function during front, head-on impacts by gradually decelerating vehicles to a safe stop. During side impacts, ~~Impact Attenuators~~attenuators are designed to either function as a rigid barrier which redirects vehicles away from the a~~A~~ttenuator and object (non-gating), or to capture the vehicle and bring it to a gradual safe stop (gating). Note, most non-gating devices have a "Length-Of-Need" (LON) point some distance downstream from the nose of the device, though in most cases the distance is small relative to the overall device length.~~Most non-gating devices have a "*Length-Of-Need*" (LON) point some distance downstream from the nose of the device, usually this distance is small relative to the overall device length.~~ Regardless, note that these devices should be considered to be completely gating when a side impact occurs upstream of the LON point; that is, it should be assumed that side impacts upstream of the LON point will result in the vehicle passing through and beyond the opposite side of ~~the~~this type attenuator.~~These devices should be considered to be completely gating when a side impact occurs upstream of the LON point. The designer should assume that side impacts upstream of the LON point will result in the vehicle passing through and beyond the opposite side of the device.~~

SECTION 2 – DETERMINATION OF NEED

Although impact with an attenuator may be preferable to impact with a fixed object, the use of an attenuator may actually increase the likelihood of an impact due to its closer proximity to the roadway and in many cases, it's more formidable size in relation to the object that the attenuator shields.~~Like guardrail, Impact Attenuators do not lessen the probability of an impact occurring. They serve to lessen the severity of an impact. The use of an Impact Attenuator may actually increase the likelihood of an impact due to its closer proximity to the roadway and in many cases, its larger size compared to the object that the Impact Attenuator shields~~. ~~Impact~~

~~A~~attenuator is the most practical and/or cost-effective solution. Other options include removing the object, relocating the object to a location where shielding it will not be required as defined in the RDG, making the object itself "crashworthy" as defined by other standards, or shielding the object with another device. ~~Regarding the last option, as an example an~~An attenuator should not be selected to shield the end of a run of single faced guardrail unless unique circumstances require otherwise. ~~For example an Impact Attenuator should not be selected to shield the end of a run of single faced guardrail unless unique circumstances prevent the use of a terminal.~~ Typically, a less costly guardrail Tangent or Flared End Terminal, as appropriate, should be utilized. The most common application for attenuators is to shield the upstream end of concrete or double-faced guardrail median barrier. ~~The most common application for which Impact Attenuators are employed is to shield the upstream end of concrete or double-faced guardrail median barrier.~~ To a lesser extent, ~~Impact Attenuators~~attenuators are frequently placed in the back of interchange exit gore areas, most commonly on elevated roadways where concrete parapets converge at the back of the gore.

~~Regarding fixed objects warranting consideration of an Impact A~~attenuator, ~~the~~The RDG lists typical fixed objects that generally merit shielding when located within the clear zone.

It is ~~recommended~~critical that designers document in the project file their decision-making process leading to the decision to specify the use of an attenuator in lieu of other options.

SECTION 3 – CLASSIFICATION OF IMPACT ATTENUATORS

Attenuators may be classified based on, but not limited to, gating characteristics, impact speed design, maximum width of the object to be shielded, and intended application. ~~There are numerous characteristics of Impact Attenuators that may be used for classification purposes. These characteristics include the gating characteristics of the device, the impact speed that the device is designed for, the maximum width of the object that the device is designed to shield, and the intended application.~~

SECTION 3.1 – SPEED CATEGORIZATION

~~Regarding impact speed categorization, Impact Attenuators~~Attenuators are subject to industry crash testing requirements mandated by the FHWA. Current crash testing requirements are contained in the AASHTO publication *Manual ~~on~~ for Assessing Safety Hardware* (MASH), latest edition. Testing parameters and performance requirements are established within MASH for different Test Levels, which for the scope of this discussion are distinguished from one another by the velocity of the impacting vehicle. For the purposes of ~~Impact Attenuators~~attenuators, the two relevant Test Levels are Test Level 2 (TL-2) and Test Level 3 (TL-3). The TL-2 parameters require an impact speed of 70 Kilometers Per Hour (Km/h), or 43.5 Miles Per Hour (MPH). The TL-3 parameters require an impact speed of 100 Km/h, or 62.1 MPH.

The WVDOH recognizes and refers to these Test Levels for the purpose of specifying ~~Impact Attenuators~~attenuators for particular applications. Designers for the WVDOH shall specify TL-2 ~~Impact Attenuators~~attenuators where the normal posted speed limit in effect at the location of the device is 40 MPH or less. Otherwise, a TL-3 attenuator is to be specified.~~At locations where the normal posted speed limit is 45 MPH or greater, a TL-3 Impact Attenuator is to be specified.~~

When determining the appropriate Test Level device to be used for a temporary work zone application, this is to be based on the normal posted speed limit of the roadway and not the temporary reduced speed limit that will be in effect during construction.

SECTION 3.2 – GATING CHARACTERISTIC CATEGORIZATION

~~Impact Attenuators~~Attenuators may be categorized as gating or non-gating. Non-gating ~~Impact Attenuators~~attenuators are designed to safely decelerate impacting vehicles during front on impacts. Beginning at the nose or a short distance downstream of the nose of the attenuator~~Impact Attenuator~~, they are designed to perform essentially the same as a rigid longitudinal barrier during side impacts by redirecting the vehicle downstream. For front-end impacts, gating ~~Gating Impact Attenuators~~ attenuators perform essentially the same as non-gating ~~Impact Attenuators~~attenuators ~~during front end impacts~~. During side impacts, they are designed to capture and gradually decelerate the vehicle and do not have any ability to redirect vehicles. Gating ~~Impact Attenuators~~attenuators ~~are typically sacrificial, therefore unrepairable.~~

~~An example of a gating Impact A~~attenuator is a sand barrel array~~, which consists of an array of plastic modules filled with different amounts of sand. .The array is arranged with lighter barrels in the front and heavier barrels in the rear so that increasing stopping force can be applied to the vehicle as it travels through the array.~~ One fallacy of sand barrels is their inability to adequately prevent impacts that result in excessive vehicle decelerations when a side impact occurs near the back of the array. ~~One fallacy of sand barrels is their inability to adequately prevent impacts that result in vehicle decelerations and vehicle occupant impact velocities that exceed the MASH limits when a side impact occurs near the back of the array.~~ In some cases, the vehicle may impact only one of the barrels before impacting the fixed object.~~In some cases, the vehicle may impact only one of the heaviest barrels in the array before impacting the fixed object.~~ Due to this and other concerns, gating ~~Impact Attenuators~~attenuators should be avoided if possible and should only be utilized for temporary work zone or emergency applications. This is typically only the case when the object to be shielded is relatively wide. For permanent applications, manufacturers offer non-gating ~~Impact Attenuators~~attenuators that are designed to shield relatively wide objects.

SECTION 3.3 – WIDTH CATEGORIZATION

Non-gating ~~Impact Attenuators~~attenuators are typically manufactured in various models to accommodate a range of maximum object widths, typically ranging from 24-inches to 120-inches. ~~The Impact Attenuators~~Attenuators are not designed to be adjustable in width. Different models of the same ~~Impact A~~attenuator are manufactured with each model designed to shield a set maximum width object. Typically, ~~Impact Attenuators~~attenuators designed to shield objects greater than 36-inches in width are designed such that the sides of the ~~Impact A~~attenuator taper outward from front to rear in order to achieve the design width, and ~~Impact Attenuators~~Attenuators designed to shield objects 36-inches or less in width are designed such that sides of the ~~Impact A~~attenuator do not taper.

In some cases, particular manufacturers do not offer models of an ~~Impact A~~attenuator in design widths greater than the maximum width non-tapered model. Under certain circumstances, a non-tapered model may be acceptably used for shielding an object wider than the model design width. This can be accomplished if the manufacturer offers a rigid, crash-tested, tapered transition system that can be used to transition from the rear of the device to the object. However, in this case the overall installation length will be greater and may not be desirable due to additional reduction of the traversable area across the gore.~~However, in this case the overall installation length will be greater. In order to avoid frequent necessary maintenance this also requires a gore area having a long enough length to provide adequate traversable area for vehicles making a last second exiting maneuver across the gore area.~~

Gating devices such as sand barrels can typically be designed to accommodate any width object by simply adding additional barrels to the array.

SECTION 4 – SELECTION AND SPECIFICATION OF IMPACT ATTENUATORS

The guidance herein reflects the capabilities of the products that are currently available ~~on the market~~ and is subject to modification based on changes to ~~such~~the Approved Products List (APL).~~This Section of the Directive provides designers with guidance on selecting and specifying the appropriate type of Impact Attenuator once a determination has been made that an Impact Attenuator is needed as described in Section 2. Note that this guidance reflects the capabilities of the products that are currently available on the market and the guidance is subject to modification based on changes to the availability of products.~~ Designers are encouraged to review the APL of available products then review properties and correct application of each.

Permanent Impact Attenuators

The bid item to be used for each permanent ~~Impact A~~attenuator installation is to be one of the following:

- 664015-* Impact Attenuating Device, C-1, TL-2, "Design Width in Inches"
- 664016-* Impact Attenuating Device, C-1, TL-2, 36+"
- 664020-* Impact Attenuating Device, C-1, TL-3, "Design Width in Inches"
- 664021-* Impact Attenuating Device, C-1, TL-3, 36+"
- 664025-* Impact Attenuating Device, C-2, TL-3, 24"

The "Design Width in Inches" portion of items 664015 and 664020 are supplemental descriptions to be determined by the designer. These are explained below.

The C-1 and C-2 descriptions in the bid items refer to the device Class Number. The Class Numbers are defined as follows:

- Class 1: Non-Gating Impact Attenuator requiring a concrete pad or bridge deck
- Class 2: Non-Gating Impact Attenuator with driven or drilled support posts not requiring a concrete pad. **Class 2 devices are to only be considered when shielding is required at the end of a run of double faced guardrail.**

~~Class 2 devices are to only be considered when shielding is required at the end of a run of double faced guardrail.~~ Class 2 devices are generally less costly but more sacrificial than Class 1 devices~~, similar to the typical single faced guardrail end treatments,~~ typically ~~requiring~~ require almost complete replacement after a design impact. ~~Class 2 devices are typically less costly but more sacrificial than Class 1 devices, similar to the typical single faced guardrail end treatments, therefore requiring almost complete replacement after certain design impacts.~~ Both classes of devices offer the same level of protection in an impact. However, the design of Class 2 devices gives less consideration to time and monetary cost of repairs. If it is determined that an attenuator may be subject to an elevated increase in impact frequency and/or severity, a Class 1 device should be considered. Designers should use best judgement to make this determination. Factors to consider include, but are not necessarily limited to, proximity of the device to the roadway, horizontal curvature of the roadway, amount of traffic (ADT) along the roadway, and operating speed of the roadway. For example, double faced guardrail is typically used to separate the adjacent ramps at partial cloverleaf interchanges. Although the device will be in close proximity to the roadway, operating speeds will be relatively low. A Class 2 device would typically be acceptable in this

situation. However, along the mainline of an expressway having an operating speed of 65 mph and an ADT of 50,000, Class 1 would be a better choice for a device within the same proximity of the roadway. Limitations on the placement of the device and the increased portion of the front of the device that must be considered gating with Class 2 devices may also be a factor.~~Under certain circumstances, it may be more appropriate to specify the use of a Class 1 device. For example, the likelihood of a vehicle striking an object adjacent to the roadway obviously increases the closer the object is to the roadway, although the exact increase in likelihood is not known. As a source of guidance in making this determination, it is suggested that the designer refer to the Suggested Shy-Line Offset Value Table in the AASHTO Roadside Design Guide. For mainline Interstate and expressway applications, it is suggested that if the distance from the near face of the device to the edge of the traveled way will be less than the applicable value, the designer should consider specifying the placement of a Class 1 device. A Class 2 device may be acceptable with a lesser offset along lower speed and/or ADT road segments such as ramps. This is not intended to be the only criterion in making this determination. If for any other reasons the designer judges that under the circumstances the Impact Attenuator may be subject to an elevated increase in impact frequency, a Class 1 device should be considered.~~

The TL-2 and TL-3 descriptions in the bid items refer to the crash testing Test Level. The Test Levels are ~~defined~~ required as follows:

Design or Operating Speed	Speed Limit*	Test Level
< 43.5 MPH	< 40 MPH	2
> 43.5 MPH	> 40 MPH	3

* - In the absence of design or operating speed data

~~The TL-2 and TL-3 descriptions in the bid items refer to the crash testing Test Level. The Test Levels are defined as follows:~~

- ~~TL-2: To be specified where the normal posted speed limit is 40 MPH or less~~
- ~~TL-3: To be specified when the normal posted speed limit is 45 MPH or greater~~

For the design width portion of the supplemental description, designers should follow the following guidance:

Object Width	Device Width to be Specified	Additional Notes
≤ 24 inches	24	24-inch wide devices are appropriate for existing F-shape and NJ-shape barriers, as well as the Type 10 median barrier shown in the Standard Details, Vol. I.
> 24 inches and ≤ 30 inches	30	30-inch wide devices are appropriate for existing Type VII single slope barriers.
> 30 inches and ≤ 36 inches	36	
> 36 inches	36+	

Typically, manufacturers offer non-tapered models in 24, 30, and 36-inch widths, or can accommodate a 30 and/or 36-inch object using a 24-inch design width model and specially designed transition panels at the rear of the device. There is no uniform set of “standard” design widths for the tapered models designed to accommodate widths greater than 36-inches.

For example ~~purposes~~, if the designer determines that a 24-inch wide, Test Level 3, Class 1 device is required, the bid item number and complete description would be:

664020-* - Impact Attenuating Device, C-1, TL-3, 24

Designers are not responsible for the design of many of the details associated with an ~~Impact~~ Aattenuator installation. This includes specific placement, anchoring, pad design, transitions, etc. These details are to be determined and specified by the device manufacturer and followed by the Contractor. The primary concern of the designer should be to provide a proper template with the design of the roadway, barriers, shoulder, median, and gore areas to ensure that an ~~Impact~~ Aattenuator can be chosen and installed by the Contractor that can be properly installed meeting the requirements of the RDG and the device manufacturer. This also includes producing plans that provide a clear representation of the specific site conditions that exist or that are to be constructed, including all cross slopes and longitudinal ~~slopes~~ grades as well as allowable variances in these slopes so that the device manufacturer can provide the proper site-specific recommendations for the installation. The Additional Design Considerations section of this directive provides additional guidance for designers in this regard.

Temporary Impact Attenuators

The bid item to be used for each temporary ~~Impact A~~attenuator installation is to be one of the following:

- 636060-015 Temporary Impact Attenuating Device, C-1, TL-2
- 636060-020 Temporary Impact Attenuating Device, C-1, TL-3
- 636060-021 Temporary Impact Attenuating Device, C-3, TL-2
- 636060-025 Temporary Impact Attenuating Device, C-3, TL-3

The C-1 and C-2 descriptions in the bid items refer to the device Class Number. The Class Numbers options are defined as follows:

- Class 1: Non-Gating Impact Attenuator.
- Class 3: Gating Impact Attenuator.

The TL-2 and TL-3 descriptions in the bid items refer to the crash testing Test Level. The Test Levels options are defined ~~as follows~~ as follows:

- TL-2: To be specified where the normal posted speed limit is 40 MPH or less
- TL-3: To be specified when the normal posted speed limit is greater than 40 MPH
- ~~The C-1 and C-2 descriptions in the bid items refer to the device Class Number. The Class Numbers options are defined as follows: Class 1: Non-Gating Impact Attenuator.~~
- ~~Class 3: Gating Impact Attenuator.~~

- ~~The TL-2 and TL-3 descriptions in the bid items refer to the crash testing Test Level. The Test Levels options are defined as follows as follows:TL-2: To be specified where the normal posted speed limit is 40 MPH or less~~
- ~~TL-3: To be specified when the normal posted speed limit is 45 MPH or greater~~

The width of the obstacle is not specified as part of the temporary ~~Impact A~~attenuator bid item. Standard Class 1 devices owned and utilized by industry for temporary applications are typically 24-inch design width, and determination of the Class device to be specified should be based on this. Typically, a 24-inch design width Class 1 device will be acceptable with any of the various

temporary longitudinal barriers that a Contractor may choose to utilize. Manufacturers also typically have specialized anchoring options available for temporary Class 1 devices placed on top of base stone, asphalt, or a combination thereof rather than concrete. In cases where a Class 3 device must be specified based on the obstacle width, the Contractor will be responsible for determining the appropriate model and/or manufacturer recommended design of the device based on the required width and specified Test Level.

For example, if the designer determines that a Test Level 2, Class 1 device is required, the bid item number and complete description would be as follows:

636060-015 - Temporary Impact Attenuating Device, C-1, TL-2.

Note, Section 636 of the Specifications also includes bid item 636060-002 - Remove and Reset Attenuator Device. The quantity of each temporary device bid item specified for a project should be equal to the maximum number of devices falling under that bid item to be in place on the project at a given time. The quantity of Item 636060-002 specified for a project should ~~be equal to the sum of the differences between the number of instances that a device falling under each individual bid item will be required to be installed and the installation bid quantity specified~~recognized the availability of a "Temporary Impact Attenuating Device" for the next phase of a project using the Remove and Reset pat item.

SECTION 5 – ADDITIONAL DESIGN CONSIDERATIONS

The typical overall length and length of need (LON) point (see Section 1) for the classes of devices described are pertinent to portions of the items of discussion in this Section. These values can of course vary based on the specific model device utilized. Table 5.1 provides values that the designer may reference for design purposes. Exact lengths for specific models are available in the manufacturers' literature.

		Length (ft)		
Class	Test Level	Non-Tapered (≤ 36-inches)	Tapered (> 36-inches)	LON Point (ft)
1	2	10-15	10-20	0-3
1	3	20-25	20-25	0-3
2	2	n/a	n/a	n/a
2	3	25-40	n/a	15-20
3	2	22		n/a
3	3	40		n/a

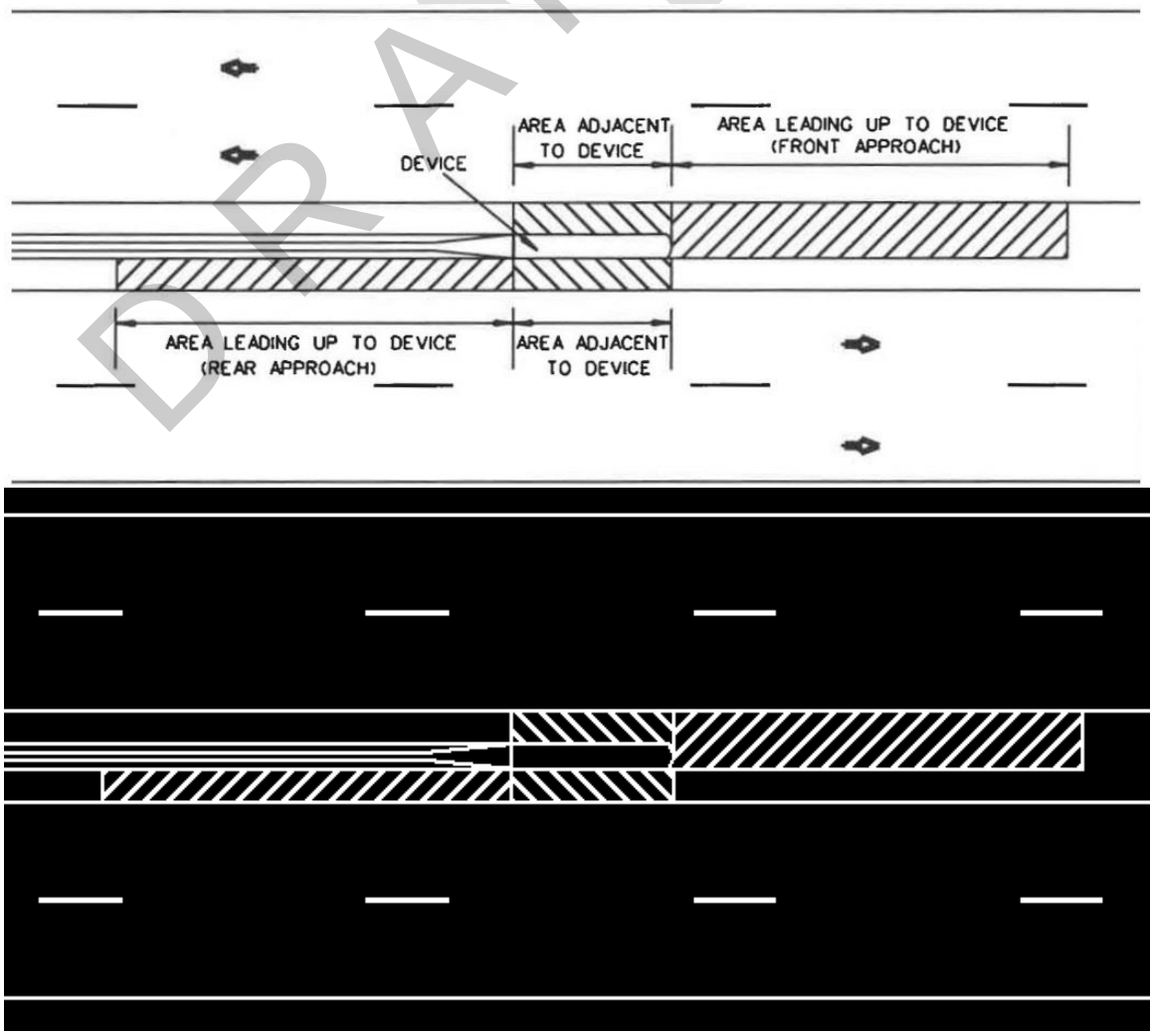
Table 5.1

Designers should take into account that when a Class 1 or 2 device is installed to shield the end of a run of double faced guardrail, a transition is required between the w-shape or thrie beam guardrail and the thrie or quad beams of the ~~Impact A~~attenuator. These transitions are included in the ~~Impact A~~attenuator bid item. It is the responsibility of the Contractor to determine the need and provide the transitions. These transitions may be fairly significant in length based on the specific device used, typically ranging from 5-25 feet for w-beam guardrail and 5-20 feet for thrie beam guardrail.

One suggested way for the designer to deal with the variance in device and transition lengths for different devices would be to specify the station number for the nose of the ~~Impact A~~attenuator for each location and require the Contractor to adjust the station number for the end of the double faced guardrail or concrete barrier based on the nose location, length of device, and length of transition.

Approaches to Impact Attenuators

One of the most important considerations for the area leading up to and adjacent to all ~~Impact A~~attenuator installations is the need for these areas to be nearly uniform in longitudinal and lateral slope.~~grade and cross-slope~~. All crash testing that is conducted by manufacturers is conducted under these conditions. The area leading up to the installation should be considered to begin a minimum of fifty (50) feet in advance of the estimated location of the nose of the device. If the device may be subjected to side impacts by vehicles approaching from the rear, such as when the device is installed in a median, the area leading up to the device should also be considered to begin a minimum of fifty (50) feet in advance of the estimated location of the rear of the device. The area adjacent to the installation should be considered to run all the way along the length of the device and ending at the beginning of the object being shielded. Figure 5.1 shows the areas leading up to and adjacent to an impact attenuator in a bi-directional traffic application.



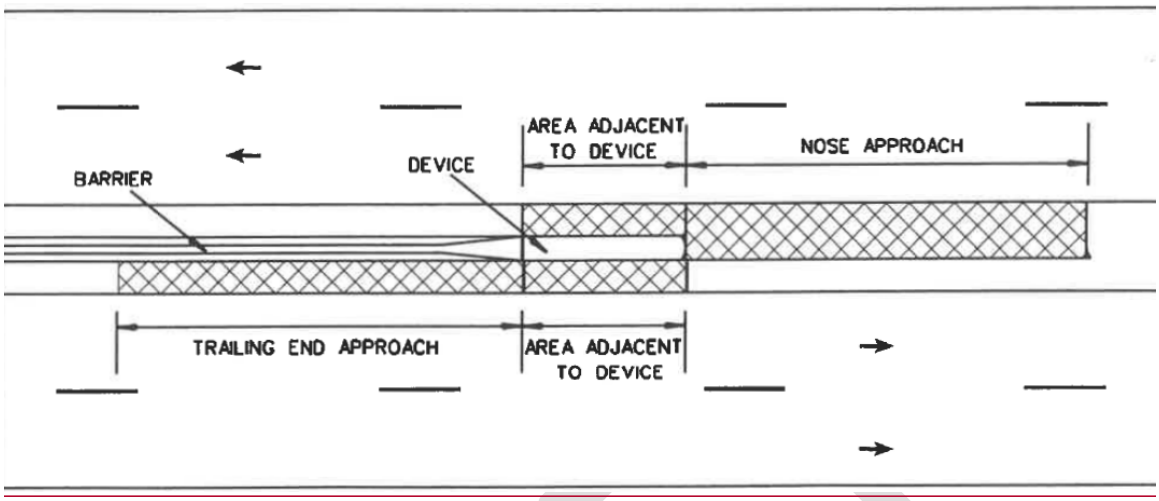


Figure 5.1

If the approach areas are non-uniform~~If the approach areas do not have these characteristics~~, the vehicle may impact the device with its suspension compressed or extended, or with the vehicle yawing, pitching, and/or rolling. In many cases, this may result in ~~Impact A~~attenuator performance being below its crash test performance, or even completely ineffective. The two roadside characteristics that most frequently cause difficulties in achieving a level and uniformly sloped area leading up to and adjacent to the installation are slope and curbs.

Designers should not specify curbs to be built along the area leading up to and adjacent to where an ~~Impact A~~attenuator is to be installed. If curb is necessary, the following guidelines shall be followed:

-

Design or Operating Speed	Speed Limit*	Curb Guidelines
< 45 MPH	≤ 35 MPH	Curb as high as six (6) inches with a mountable face is undesirable but acceptable if the face of the curb will be a minimum of eight (8) feet outside of the near face of the device.
45-50 MPH	40-45 MPH	Curb as high as four (4) inches with a mountable face is undesirable but acceptable if the face of the curb will be a minimum of thirteen (13) feet outside of the near face of the device.
>50 MPH	>45 MPH	No guidelines exist which allow for the use of curb along the area leading up to and adjacent to where an ~~Impact A~~attenuator is to be installed when the traffic speeds at the location are higher than those specified above.

* - In the absence of design or operating speed data

Existing ~~Impact A~~attenuator locations should be reviewed to determine if the presence of a curb is likely to affect the performance of the device if the above guidelines for new construction are not met, and if so, consideration should be given to making appropriate modifications when major roadway rehabilitation is being performed to bring the location into compliance with the above guidance. In general, a curb no higher than four (4) inches should be considered to be acceptable

to be left in place at existing locations. Locations where the design or operating speed is 45 MPH or greater, or if the posted speed limit is 40 MPH or greater in the absence of design or operating speed data, and where the slope of the face of the curb is greater than 1V:3H should be of particular concern.

Once off of the traveled way and shoulder, c~~C~~ross slope in the area leading up to and adjacent to where an ~~Impact A~~attenuator is to be installed should be 1V:10H or flatter in order to avoid deviations of the vehicle bumper height from its normal position after the vehicle leaves the traveled way and paved shoulder. In addition, the cross slope of the area where the ~~Impact A~~attenuator is to be placed should be 1V:11 H or flatter.

Sight Distance

The ~~Impact A~~attenuator devices discussed herein are normally about the same height as the rigid barriers and guardrails that they typically shield. When considering sight distance criteria, designers should take this and the lengths of the devices and transitions into account. Figure 5.2 demonstrates a situation where the designer would take the device length into account when determining placement so that drivers turning left onto the expressway from the intersecting road will be provided the WVDOH and AASHTO Green Book required sight distance.

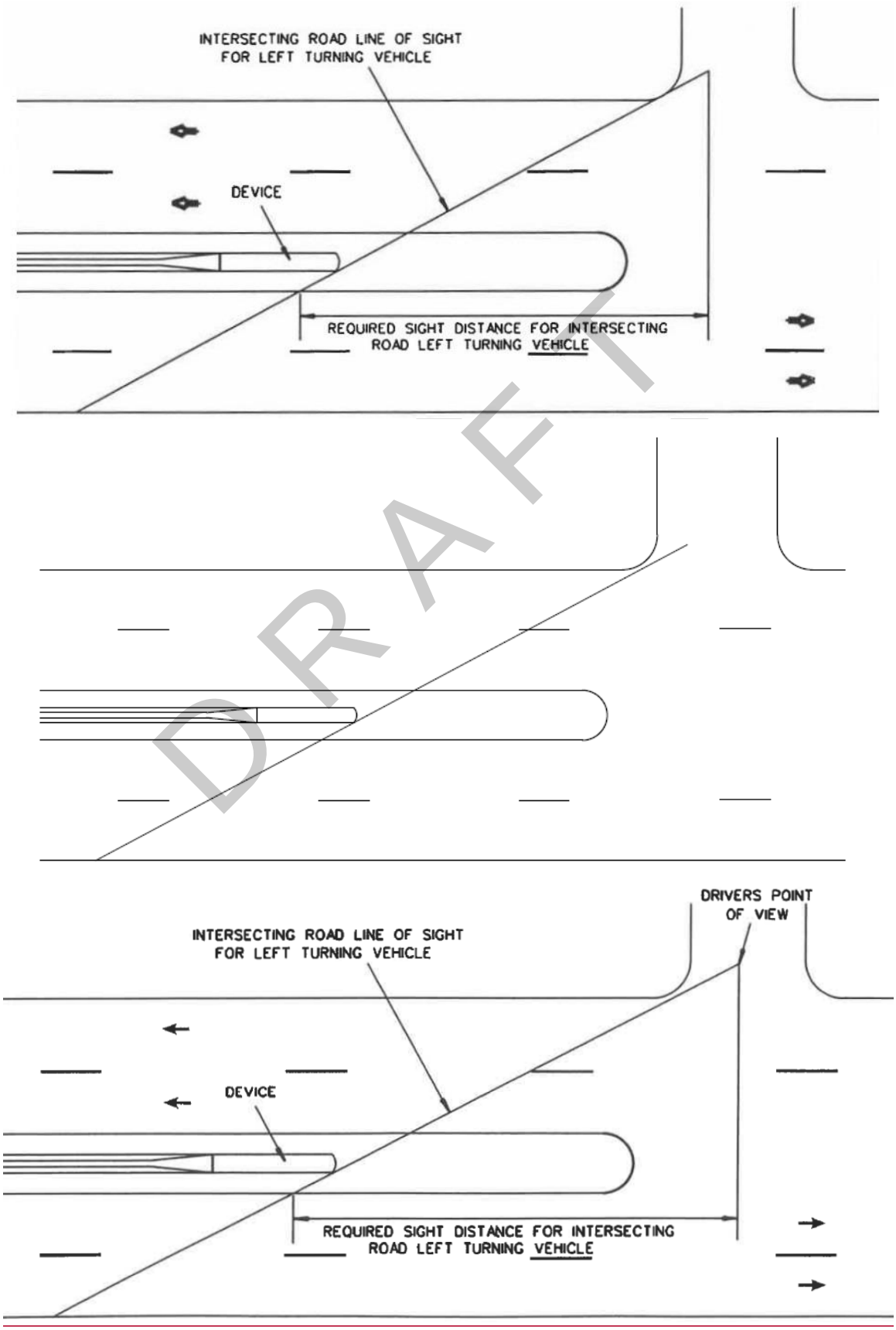

INTERSECTING ROAD LINE OF SIGHT
FOR LEFT TURNING VEHICLE
DEVICE
REQUIRED SIGHT DISTANCE FOR INTERSECTING
ROAD LEFT TURNING VEHICLE
DRIVERS POINT
OF VIEW
INTERSECTING ROAD LINE OF SIGHT
FOR LEFT TURNING VEHICLE
DEVICE
REQUIRED SIGHT DISTANCE FOR INTERSECTING
ROAD LEFT TURNING VEHICLE

Figure 5.2

Impact Attenuator Accommodating Transitions

In most cases, ~~Impact Attenuators~~attenuators are used at the beginning of a run of another type of barrier. This may be a concrete median barrier, double faced guardrail, or at the beginning of two diverging runs of concrete parapet or guardrail in the rear of a gore area. Designers should design the beginning of these barriers so that the ~~Impact A~~attenuator can be easily and properly transitioned to the barrier. The preference of the WVDOH is that these designs be such that a 24-inch wide Class 1 or 2 device, as appropriate, can be connected directly to the transition. This avoids the need for additional device manufacturer proprietary transitions or wider tapered devices.

If the ~~Impact A~~attenuator is to be used to shield the beginning of a double faced guardrail section, whether it is at the beginning of a long run of double faced guardrail or it is at the rear of a gore area where the faces of the guardrail diverge away from one another, the double faced guardrail should be terminated at an appropriate point and the ~~Impact A~~attenuator manufacturer provided transitions will be used to transition from the ~~Impact A~~attenuator to the double faced guardrail w-beam or thrie beam. This would be used when the recovery area is insufficient and cannot be corrected. As an example, for a gore area with guardrail adjacent to the ramp and mainline and it is determined that an attenuator is necessary in lieu of separate guardrail end terminals spaced adequately apart, it is necessary that the two guardrail faces run parallel to one another for a short distance and that the end view of the barrier appear as is shown on Standard Details Book Volume I Sheet GR3 with the beams being at the same elevation.~~At the rear of a gore area where the faces of guardrail diverge away from one another, it is necessary that the two guardrail faces run parallel to one another for a short distance and that the end view of the barrier appear as is shown on Standard Details Book Volume I Sheet GR3, with the beams being at the same elevation.~~ It is recommended that the two guardrail faces run parallel to one another for a minimum distance equal to the length of a standard section of guardrail, 12’-6”. Figure 5.3 below shows an example drawing of this.

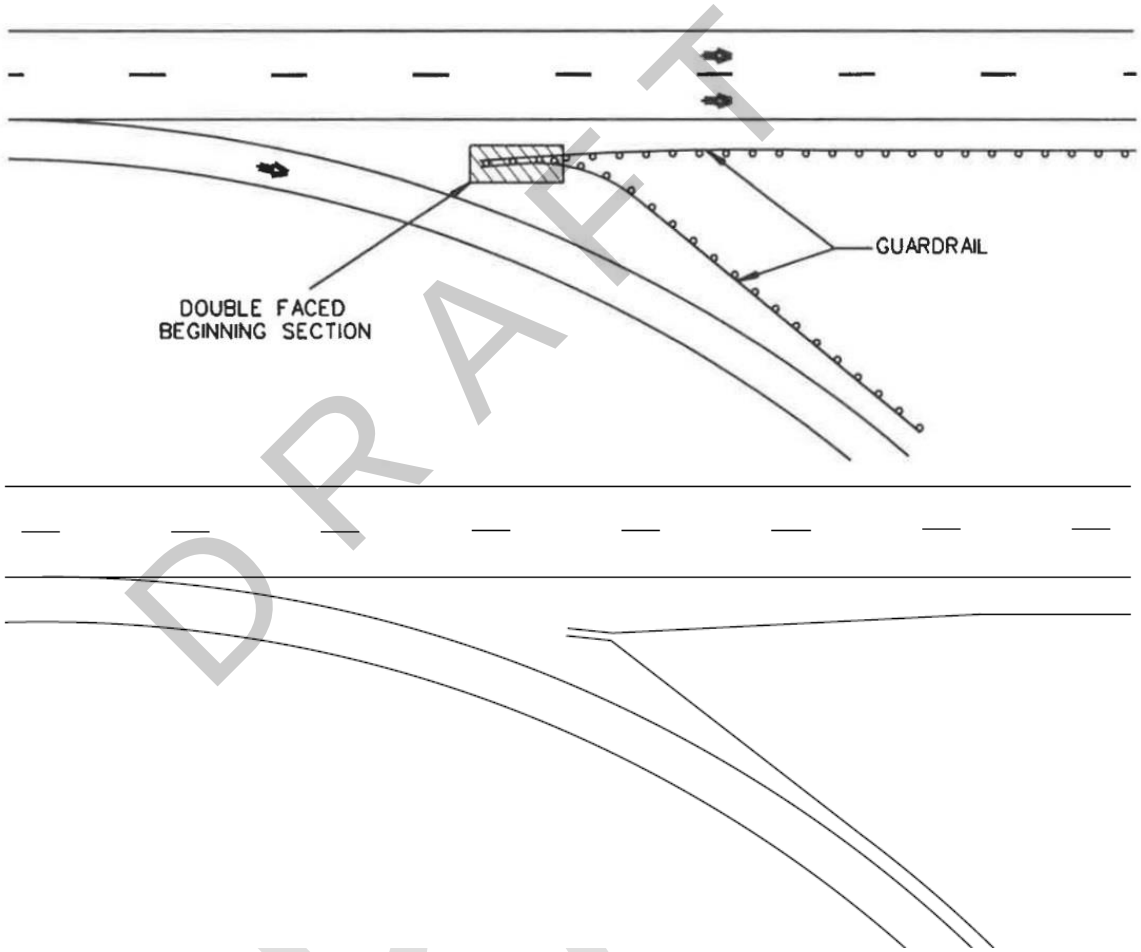


Figure 5.3

If the ~~Impact A~~attenuator is used to shield the end of a concrete median or shoulder barrier, a transition should be included as part of the construction of the start of the barrier. More specifically, the barrier should begin as a twenty-four (24) inch wide by thirty-two (32) inch tall by thirty (30) inch long block, and should be transitioned to the barrier shape over a length of five-feet three-inches (5'-3") beyond the rear of the block. In addition, a six (6) inch chamfer should be incorporated on the left and right sides of the front face of the block to prevent wheel snagging. Figure 5.4 shows an isometric representation of the concrete block and an example transition from the block to a single slope barrier shape.

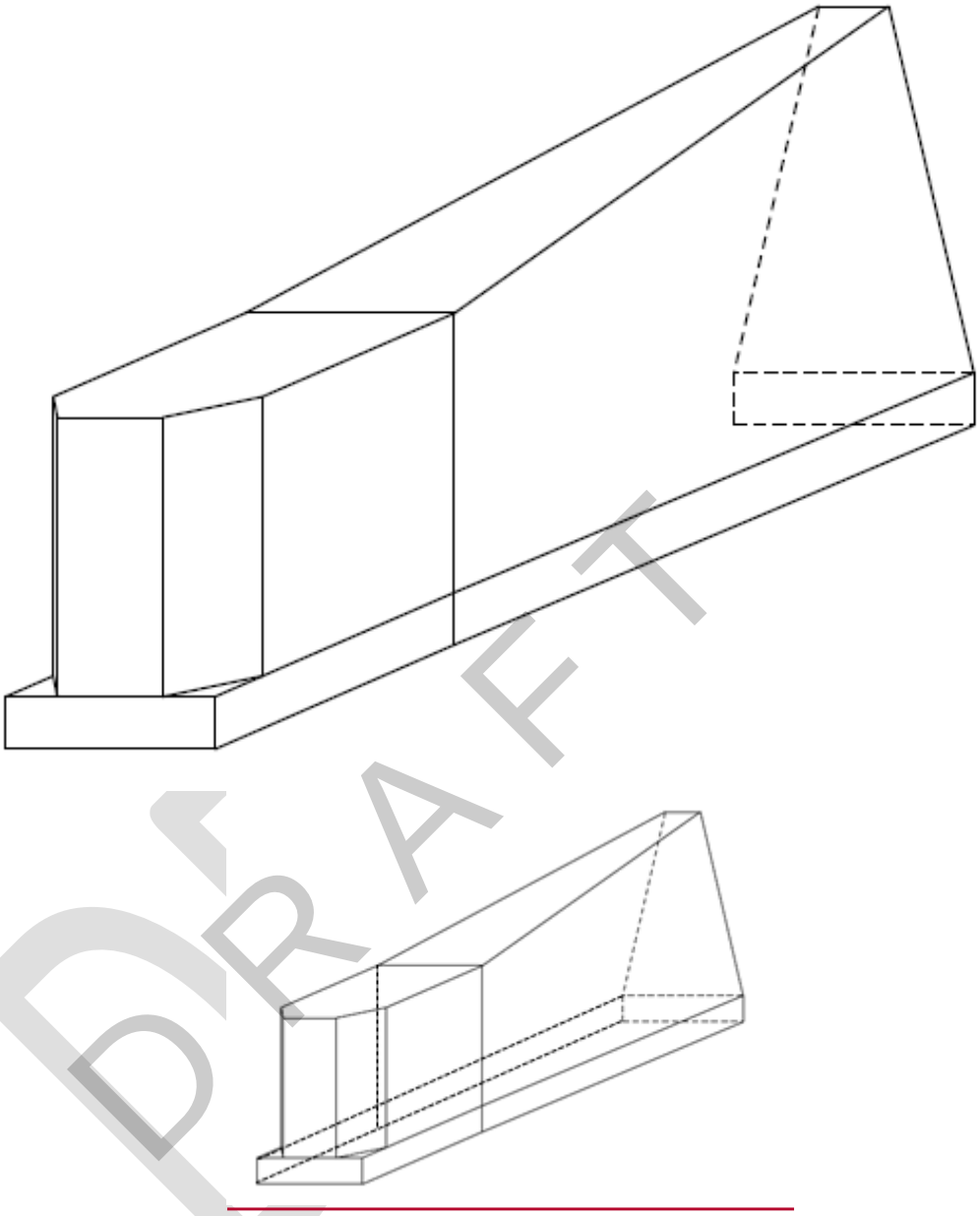


Figure 5.4

~~In many cases~~Typically on elevated structures, parapet walls are initiated on either side of the gore area near the rear. The barriers should be initiated with the same twenty-four (24) inch wide by thirty-two (32) inch tall by thirty (30) inch long block described previously, and each barrier should be transitioned to the parapet shape over a length of five-foot three-inches (5'-3") as the parapets diverge from one another. Figures 5.5 and 5.6 below show example isometric and plan view drawings of this concept.

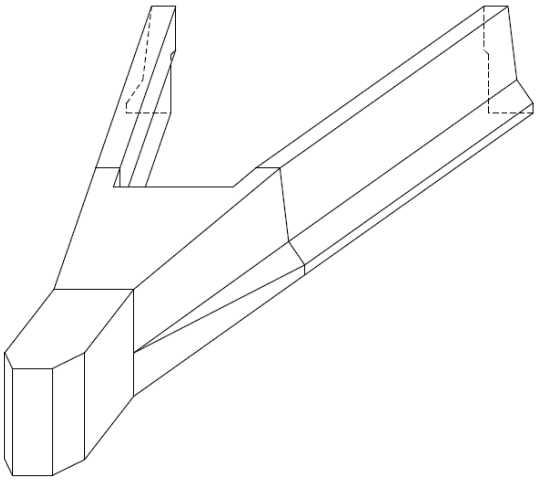


Figure 5.5

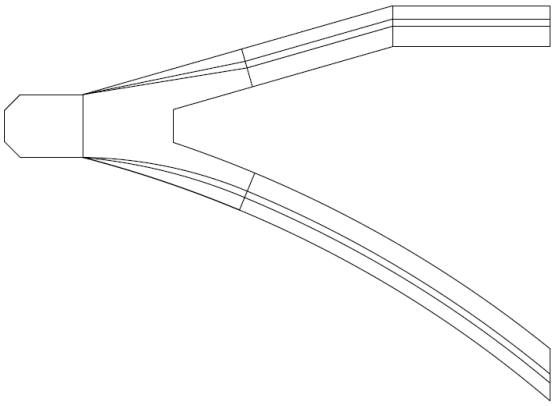


Figure 5.6

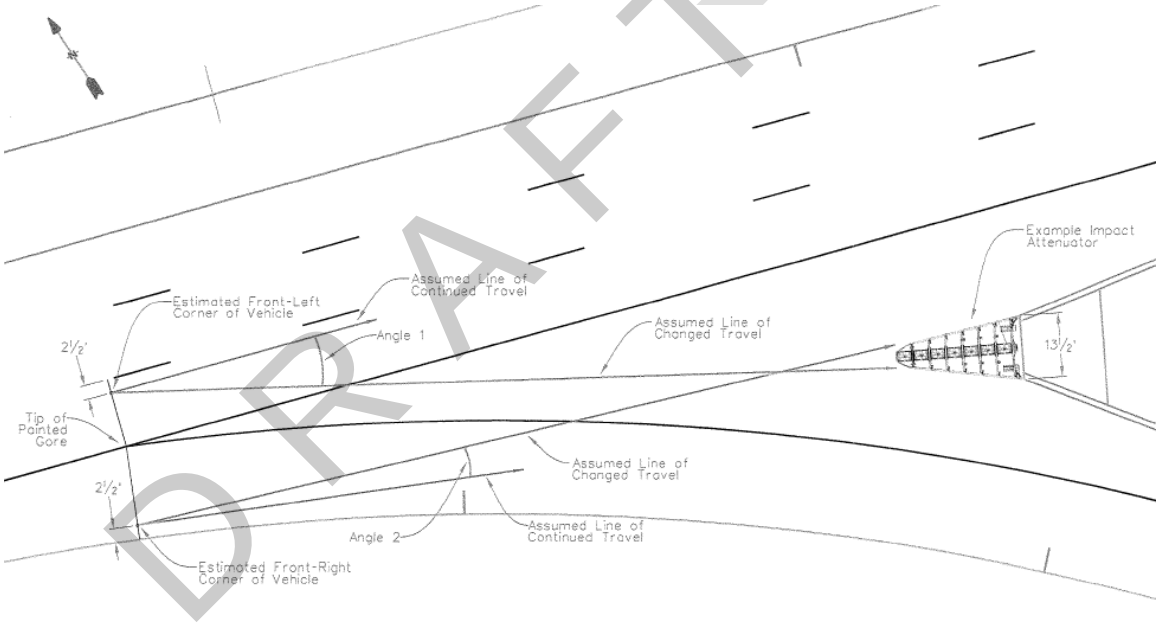
Maintenance Considerations

Maintenance personnel and Contractors must access attenuators to perform inspections and repairs when the devices are damaged, ideally with minimal required traffic control such as lane closures, and minimal exposure of personnel to surrounding traffic hazards~~Designers should take into consideration the need for maintenance personnel and Contractors to access Impact Attenuators to perform inspections and repairs when the devices are damaged, ideally with minimal required traffic control such as lane closures, and minimal exposure of personnel to surrounding traffic hazards.~~ This should be taken into account when designing medians, shoulders, and gore areas. Designs that lessen the likelihood of impacts should also be implemented as much as possible. Generally, this is achieved by creating as much distance between the device and traffic as reasonably possible.

Typically, maintenance personnel are required to reset Class 1 devices by pulling on the front of the device using chains and a pickup truck. In gore areas, ideally the gore area should be designed such that the gore maintains a width of twelve (12) feet for a minimum distance of about twenty-five (25) feet in front of where the nose of the device will be expected to be. ~~Ideally~~Preferably, the

gore area should also ideally be designed such that a pickup truck can be placed alongside the device while not encroaching into the roadway with additional room to spare. Therefore, distances of approximately ten (10) feet minimum should be maintained in these areas. These needs should also be taken into consideration as applicable, and accommodated within reason, in the design of ~~Impact A~~attenuator installations in medians and along shoulders.

Another factor to consider for gore areas is the amount of traversable recovery area provided between the front of the gore and the device for vehicles making erratic maneuvers across the front of the gore area to avoid missing an exit. A reliable metric that can be used for quantifying and comparing this is demonstrated directly below in Figure 5.7.



Notes:

The two (2) Assumed Lines of Changed Travel each bypass the nose of the Impact Attenuator with each having an offset of 1' from the centerline of the attenuator as shown.

The Assumed Line of Continued Travel 1 is tangent to the mainline right edge line at the Tip of Painted Gore.

The Assumed Line of Continued Travel 2 is tangent to the ramp right edge line at the Tip of Painted Gore.

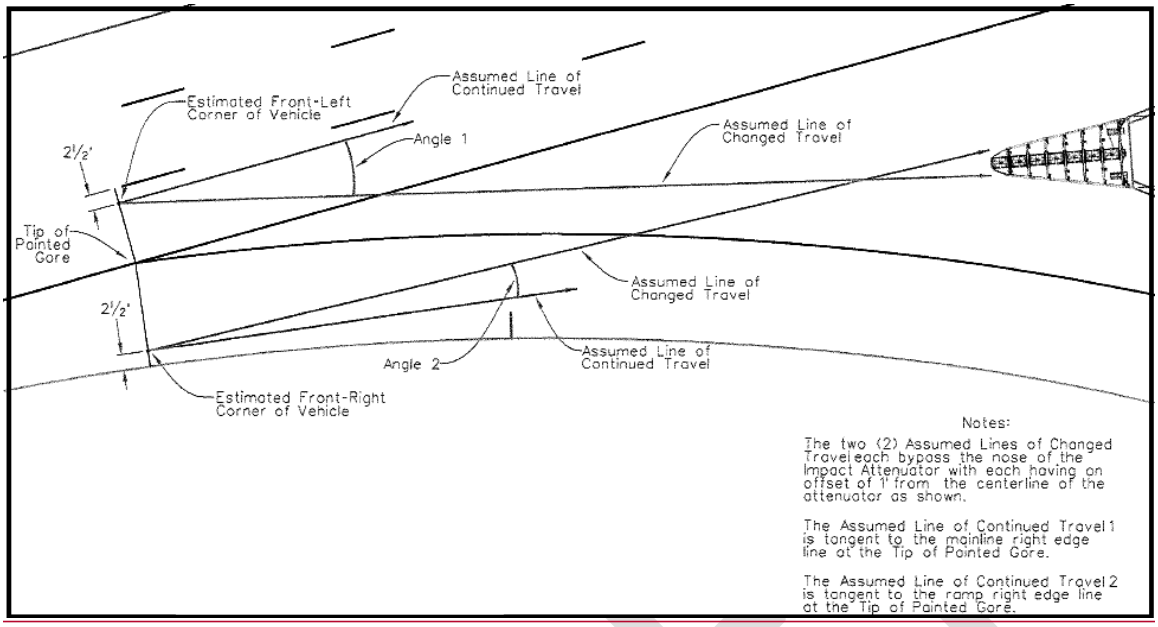


Figure 5.7

After estimating the approximate location of the nose of the attenuator~~After making a calculated estimate of the approximate location of the front of the nose of the Impact Attenuator~~, if the gore area can be designed such that Angles 1 and 2 are minimized this will provide maximal recovery area and lessen the likelihood of impacts. Based on past experience with various ~~Impact A~~attenuator installations, the ideal scenario would be to have Angles 1 and 2 both less than 10 degrees. The next best scenario would be to have no more than one of these angles greater than 10 but less than 15 degrees. Angles greater than 15 degrees will cause difficulty for vehicles to cut across the gore area and avoid an impact with the device. Of course, in most cases one of these angles will be more critical than the other based on the configuration. Typically, this would be Angle 1. The designer should also take this into consideration in their design.

APPENDIX A – CONTRACTOR DEVICE SUBSTITUTION REQUIREMENTS

As described in Section 664.2 of the Specifications, the Contractor may at their option elect to utilize a 36-inch wide or less non-tapered Class 1 device in lieu of a 36-inch + wide tapered device in order to shield gore area objects greater than 36-inches in width. This shall not have a significant effect on the amount of recovery and maintenance area provided in the front of the gore area. ~~However, this shall not have a significant effect on the amount of recovery area provided for vehicles making erratic maneuvers across the front of the gore area to avoid missing an exit.~~

Refer to Section 5, the subsection on Maintenance Considerations, and Figure 5.7. If the Contractor elects to propose substituting a non-tapered device for a tapered device as described above, the following shall be included with the Contractor's shop drawing submittal:

- Project plan sheet showing the gore area and object to be shielded with a scaled drawing of the tapered device selected by the Contractor imposed onto the drawing. Angle 1 and Angle 2 shall be measured and labeled on the drawing. The drawing shall also show the distance in front of the nose of the device for which the gore area width is at least 12-feet.
- Identical project plan sheet with a scaled drawing of the non-tapered device and manufacturer recommended rigid transition imposed onto the drawing. Angle 1 and Angle

2 shall be measured and labeled on the drawing. The drawing shall also show the distance in front of the nose of the device for which the gore area width is at least 12-feet.

The plan sheets shall demonstrate that Angle 1 on the drawing showing the non-tapered device will conform with the following:

- < 10 degrees if Angle 1 on the drawing showing the tapered device is < 10 degrees
- < 15 degrees if Angle 1 on the drawing showing the tapered device is < 15 degrees

The same criteria shall apply to Angle 2.

In regard to the distance in front of the nose of the device for which the gore area width is at least 12-feet, this distance on the drawing showing the non-tapered device shall be 25-feet or more if this distance is 25-feet or more on the drawing showing the tapered device.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 644
ASPHALT PAVEMENT

Draft of March 22, 2020
Supersedes February 23, 2017

This Design Directive (DD) provides guidance on selecting asphalt pavement mix design methods and types of asphalt pavement. It also provides descriptions of situations that require polymer-modified asphalts, and methods for calculating quantities and types of materials that are to be used.

TYPES OF ASPHALT MIX DESIGNS

MARSHALL ASPHALT MIX DESIGN - Bruce Marshall developed the "Marshall" method of asphalt mix design in the late 1930's for the Mississippi Highway Department. This method has been used by the WVDOT in the past and was the standard mix design method for many years. Only use asphalt mixtures utilizing the Marshall mix design methodology in the following applications~~Asphalt mixtures utilizing the Marshall mix design methodology can only be used in the following applications~~:

1. Purchase Orders (POs), both pickup and laydown.
2. Non-NHS county routes with less than 3000 ADT that are either two-lane, two-way or single-lane, one way.

Note that while Marshall mixtures are exclusive to these applications, Superpave may also be used if the designer chooses to do so. Superpave shall be used in all other scenarios. Projects shall use only one mix design methodology.

SUPERPAVE ASPHALT MIX DESIGN - "Superpave" stands for Superior Performing Asphalt Pavements. It represents an improved system for specifying the components of asphalt concrete, asphalt mixture design and analysis, and asphalt pavement performance prediction. The Strategic Highway Research Program (SHRP) developed the Superpave asphalt pavement mix design method in the early 1990's. Superpave is now the standard mix design method for asphalt pavements.

SPECIFICATION SELECTION CRITERIA

There are three specifications available when identifying the asphalt requirement for projects. Specifications Sections 401, 402 and 410 shall be used based on project criteria. Sections 401 and 402 are the Specifications that have been used historically for project plan development. Section 410, "Percent Within Limits", is a specification for use when there is a need for performance related results. This Specification uses mathematical models to quantify relationships between quality characteristics and product performance. These characteristics include mat density, asphalt content, bond strength and others, with samples taken directly from the roadway.

Section 410 (PWL) of the Specification shall be used on the following project types:

1. New Construction where the mainline is asphalt pavement.
2. Overlay projects on existing multilane divided highways.
3. Overlay projects on any National Highway System (NHS) routes, as found on the Divisions website using the latest version of the "Annual Roadway Inventory Statistics"
4. Projects on other highways where approved by the Deputy State Highway Engineer for Development or Operations.

Additionally, a project must meet the following specific requirements for the use of Section 410:

1. Projects exceeds 5,000 tons in any asphalt layer
2. The overall width of asphalt equals or exceeds 20 feet in width
3. Project paving is continuous for a minimum of 1500 feet
4. Posted speeds equal to or greater than 35 mph

The Specifications in Section 401 and 402 of the Specification shall be used for all other projects.

DETERMINATION OF EQUIVALENT SINGLE AXLE LOAD (ESAL)

The "ESAL Calculator" program shall be used to calculate the 20-year projected design ESALs for all projects unless one of the following applies.

1. The "ESAL Calculator" program produces a value exceeding 10,000,000.
2. When a traffic study has been performed. (i.e. When traffic movements or traffic counts are provided by the Traffic Modeling and Analysis Unit of the Planning Division.)
3. On roadway realignment projects that exceed 1000 feet of relocated roadway.
4. When there is an expected development in the area that may change or alter the nature or character of the expected traffic. (i.e. Shopping centers, schools, etc.)
5. The project is on the CRTS (Coal and Resource Transportation System).

The ESAL Calculator program can be obtained from the West Virginia Department of Transportation's Engineering Publications and Manuals website at http://www.transportation.wv.gov/highways/engineering/Pages/Manuals.aspx, then under the "Paving" heading choose "ESAL Calculator".

When the ESAL Calculator program cannot be used to calculate the ESALs, then the ESALs or the percentage of traffic in each of the 13 classes shall be obtained from the Traffic Monitoring Unit of the Strategic Performance Management Division. The Traffic Monitoring Unit can be emailed at TMATrafficMonitoring@wv.gov. The designer is cautioned that the development of appropriate data to establish accurate ESAL estimates should be requested prior to the Design Study Office Review (if there is one) or prior to the Preliminary Field Review (if there was not a design study.)

SURFACE PREPARATIONS

Milling is used to remove surface distresses, create a better bond for an overlay, restore cross slope, and maintain vertical geometric properties, such as bridge clearance, guardrail height, and grade with gutter area. Milling shall be the preferred method of correcting deviations to the road surface prior to resurfacing.

When milling is specified by the contract, the thickness of milling specified by the Designer shall be at least ¼" into the layer just below the layer(s) being removed. The intent is to mill off entire layers, and not leave any partial layers.

Milling of Asphalt Pavement Surfaces, Section 415 of the Specifications, contains three types of milling: Standard Milling, Fine Milling, and Micromilling. These are differentiated primarily by the carbide tooth spacing, typically 15, 8, and 5 mm respectively, resulting in finer textured surfaces. These milling types specify the final surface texture prior to any overlay. The following describes the conditions in which the designer should use each type of milling:

> **Standard Milling -** Used as the default milling of asphalt pavement. It is intended to be used when the Division plans to remove existing asphalt pavement to correct deviations less than 1 inch, without a high level of profile and slope control.
>
> **Fine Milling -** Used when the Division intends to overlay the milled surface with a 2 inch or less asphalt course. It shall also be used when the contract contains pay items from Section 410 of the Specifications, *Asphalt Base and Wearing Courses, Percent Within Limits (PWL)*. It is intended be used when control of the profile and slope of the milled surface is important. Fine milling shall only be used if there is a minimum of 5,000 SY of fine milling.
>
> **Micro Milling -** Used for smoothness correction, skid correction, bump and/or grade corrections on existing or newly paved surfaces. This milling is typically less than an inch. It is not intended to be used when additional asphalt will be placed on the milled surface.

If fine milling is needed and multiple milling passes are necessary, standard milling shall be used to cut down to one inch above the final prepared surface. The designer shall document in the plans the estimated thickness of each type of milling.

ASPHALT MATERIAL (TACK COAT)

Asphalt Material (Tack Coat) (Section 408) shall be specified for placement on all existing pavement prior to placing asphalt pavement. If the designer can anticipate phased construction where part of the base or intermediate course will be open to traffic prior to final lift placement additional Asphalt Material should be included.

SCRATCH

Scratch Course is normally used in rehabilitation or resurfacing projects that do not contain a milling item. Scratch should be used to correct rutting and other deviations up to about one inch

when the milling operation will cause an unnecessary disruption to the traveling public. If milling is performed on the project, Scratch Course shall not be used.

Scratch Course can be placed over the entire project or to the limits established by the designer. If the Scratch Course is not to be placed over the full width of the project, it shall be specified full lane width increments. Although Scratch Course can be placed over the entire project, it is not a constant thickness layer. The term "Scratch Course" comes from the method of placement of this item. The paving equipment is set to drag on or “scratch” the high areas of the existing pavement, only depositing material in the low areas; thereby creating a smooth surface on which to place the next layer of asphalt pavement.

Scratch course may be specified as a 9.5 mm or a 4.75 mm mix.

Scratch Course shall be shown on the plan typical sections as a line without a thickness or application rate. Scratch Course is not included in the structural design of the pavement.

Scratch Course shall not be used on new construction.

PATCH AND LEVEL

Patching and Leveling is to be placed at various locations throughout the project to remove irregularities in the existing pavement, such as dips, or to raise the outside edge of the existing pavement to provide a uniform template prior to placing a base or wearing course. Patching and Leveling shall not be specified as a continuous layer or course to be placed over the full width and length of the project.

Patching and Leveling shall be used only in resurfacing or rehabilitation projects, not in the construction of new pavements. It shall be specified when the deviations in the existing pavement are 1 inch or greater in depth.

Patching and Leveling shall be shown on the plan typical sections as a layer with thickness specified as "variable - 2" maximum lift thickness. No application rate shall be shown. Patching and Leveling thickness is not included in the structural design of the pavement.

PERFORMANCE GRADED (PG) BINDER TYPE SELECTION

Binder Selection will be based on the design ESAL estimate for all projects.

Binder	**ESALs**
PG64S-22	<20 million
PG64H-22	20 million – 30 million
PG64E-22 (Polymer Modified Binder)	See below

While rare, for colder areas of the state, a lower binder grade of PG 58S-28 may be appropriate. If unsure, the designer can contact the Asphalt Group of Materials Control, Soils, and Testing Division at DOHasphalt@wv.gov.

When using anything other than PG64S-22, the binder grade shall be provided on both the general notes sheet and the typical section sheet(s) showing the pavement details.
PG 64S-22 binder may be used in asphalt placed below the top two lifts in any pavement section. Scratch course and patching and leveling are not identified as lifts.

POLYMER MODIFIED ASPHALTS (PMA) OR NON STANDARD GRADE
The binder PG 64E-22, which is a polymer-modified binder, is required to be used in the following cases:

1. For the surface lift on roadways facilitating access to industrial parks, warehouses, production facilities, etc.
2. High Performance Thin Overlay (HPTO) asphalt pavement in accordance with Special Provision 496. Since PG 64E-22 is required by the Special Provision a plan note is not required.

A binder grade associated with a higher ESAL count may be used at the discretion of the responsible engineer on projects where the pavement exhibits severe rutting or shoving problems due to heavy traffic conditions, such as:

1. Intersections with very heavy truck traffic
2. Truck climbing lanes and ramps

PMAs have shown great success as being a long-term solution to severe rutting problems. Due to the additional cost of a PMA, it shouldn't be used on any project without first repairing base failures and removing excessively rutted pavement. PMA shall generally be used only in the skid surface mix (preferably a 12.5 mm mix) but may also be used in the underlying courses depending on the severity of the traffic conditions. Always use the preferred thickness from the Superpave asphalt pavement recommended lift thickness tables as a minimum thickness when using PMA. Any mix design to be used as a scratch course shall not be specified to use PMA.

PMA Pavement quantities shall be used in increments of 400 tons due to minimum requirements necessary for ordering of material.

PG 64S-22 binder should be used in asphalt placed below the top two lifts in any pavement section. Scratch course and patching and leveling are not identified as lifts.

PAVEMENT STRUCTURE

BOTTOM COURSES
When developing the overall pavement thickness, it is recommended the designer use 25 mm mix as the bottom lifts.

INTERMEDIATE COURSES
On new construction or multi-lift projects a 19mm mixture shall be utilized below the surface

course to promote smoothness in the final pavement.

SURFACE COURSES
The wearing course is a single lift constant thickness to be placed over the entire pavement surface. The wearing course is the riding surface on which traffic travels. A 4.75 mm, 9.5mm, or 12.5mm mixture is the mix type to be used as the surface course. PMA can also be used if traffic warrants.

A skid mix shall be used as the surface course on projects with a current ADT of 3000 or more vehicles per day. On projects meeting this ADT criteria, the wearing course shall be a skid resistant mix in accordance with Section 402 of the Specifications. Only 9.5mm and 12.5mm mixtures shall be specified as a skid resistant mix.

A 4.75 mm mix shall only be used for pavement preservation applications or as a surface course over an intermediate course in multi-lift applications. High performance thin overlays may be used for pavement preservation on roads with ADT greater than 3000 VPD.

MIX TYPE RECOMMENDATIONS

The following table provides a list of Mix Type recommendations for the designer to use when preparing pavement lift thicknesses for the typical section. Pavement designs provide an overall thickness of asphalt pavement and the designer is generally left to make the decision on bottom, intermediate, and surface course thickness. The designer should use recommendations found in the Pavement Structure section, as well as minimum and maximum thicknesses from the table.

Recommended Lift Thickness For Superpave Asphalt Pavement			
Mix Type (mm)	**Minimum (inches)**	**Maximum (inches)**	**Preferred** Note 1 **(inches)**
4.75	5/8	1.0	5/8
9.5	1.5	2.0	1.5
12.5	1.5	2.5	2.0
19	2.25	3.5	2.5
25	3.0	4.0	3.5

Note 1: Minimum Thickness with Polymer Modified Binders

MIX TYPE RECOMMENDATIONS WHEN USING MARSHALL MIX DESIGN

Marshall Base Courses

General: It is recommended that in multi-lift pavements when Type 1 Base Course is used, the top lift of base course be a Type 2 to improve the smoothness of the finished pavement. This would eliminate the use of a Scratch Course prior to placing the final

wearing or skid course.

a. Type 1 Base Course shall be specified when the total base course thickness for new construction is greater than 3.25 inches. On resurfacing projects, Type 1 Base Course shall not be specified where temporary traffic control requirements prohibit an edge drop-off of 3 inches.
b. Type 2 Base Course shall be specified when the total base course thickness is less than or equal to 3.25 inches.

Recommended Lift Thickness (inches) for Marshall Base Courses			
Mix Type	**Minimum**	**Maximum**	**Preferred**
2	2.0	3.0	2.0
1	3.25	5.0	4.0

B. Marshall Wearing Courses

General: The wearing course is a single lift constant thickness course to be placed over the entire pavement surface. The wearing course is the riding surface on which traffic travels. Type 4 Wearing Course is intended for use in heavy truck traffic situations.

Recommended Lift Thickness (inches) for Marshall Wearing Courses			
Mix Type	**Minimum**	**Maximum**	**Preferred**
3	0.5	0.75	5/8
1	1.0*	1.5*	1.0*
4	2.0	2.0	2.0

* 1½ inch thickness on resurfacing projects where the Wearing Course is the only asphalt pavement material being placed exclusive of Patching & Leveling and Scratch Courses.

PLAN REQUIREMENT

Projects will show the 20-year projected design ESALs on both the general notes sheet and the typical section sheet(s) showing the pavement details. This includes new construction, reconstruction, AND resurfacing projects (including ALL bridge replacement projects regardless of the length of pavement placed). The design ESALs shall be shown for the mainline and all other affected roadways where more than 500 feet of pavement is being placed.

The aggregate used in asphalt mixtures can be either primarily stone and gravel, or slag. The aggregate used is up to the contractor, and typically depends on what the contractor has readily

available that also meets mix requirements. Mixes with the two aggregate types have different densities; as such, estimated weight quantities will be different for mixes with each aggregate type. Alternates for these two shall be listed in the plans, and the contractor will bid appropriately.

The following is an example of how to list alternate asphalt pavement items in plans:

BB1 401001-042 SUPERPAVE HMA BASE CRSE, SG, TY 25, TN (Pavement Repair)
BB2 401001-043 SUPERPAVE HMA BASE CRSE, S, TY 25, TN (Pavement Repair)

PLAN REQUIREMENTS WHEN USING MARSHALL MIX DESIGN

In addition to the requirements listed above, projects using Marshall asphalt pavement, including District-designed projects, will designate the use of "Medium Marshall Mix Design" or "Heavy Marshall Mix Design" as well as the design ESALs on both the general notes sheet and the typical section sheet(s) showing the pavement details. The designer should note that the terms "Medium" and "Heavy" refer to Equivalent Single Axle Loads (ESALs), and not to the quality of the asphalt pavement. After determining the ESALs, the mix design type shall be determined from the following criteria.

Medium Marshall Mix Design - This design is intended for use on local service roads or rural resurfacing projects with a 20-year projected design ESALs of less than 3,000,000.

Heavy Marshall Mix Design - This design is intended for use on new construction projects and on projects with a 20-year projected design ESALs of equal to or greater than 3,000,000.

QUANTITY ESTIMATING

ASPHALT PAVEMENT - The quantity for asphalt pavement shall be estimated at 1.98 ton/cy for stone and gravel mixes, 1.89 ton/cy for slag mixes and 2.10 ton/cy for steel slag mixes**.**

PATCHING AND LEVELING - The quantity for Patching and Leveling Course shall be estimated by multiplying the nominal depth of the irregularity to be repaired plus ¾ inch by the irregularity's surface area. Then the conversion rates of 1.98 ton/cy for stone and gravel mixes, 1.89 ton/cy for slag mixes and 2.10 ton/cy for steel slag mixes will be utilized.

SCRATCH COURSE - The quantity for Scratch Course shall be estimated at a thickness of one-half inch (0.028 ton/sy) for the entire area to be covered with Scratch Course. If the Specification allows, Scratch Course may alternatively be estimated by the square yard. Scratch Course shall not be used if there is Milling on the project, or if there are more than two lifts of asphalt being placed.

ASPHALT MATERIAL (TACK COAT) - The quantity for Asphalt Material (Tack Coat) shall be estimated using the undiluted rates as indicated in Table 408.11 in the Specifications. No application rate will be shown on the typical sections.

SMOOTHNESS – If a project meets the requirements of Section 720.6 of the Specifications,

smoothness testing shall be requested by the designer through the Request Form available at MCS&T's Tool Box at https://transportation.wv.gov/highways/mcst/Pages/tbox.aspx. If the test results are available, the results shall be included the PS&E submittal. If not available, then the request for testing shall be included in the PS&E submittal. If the results arrive before letting, then the results shall be included in an amendment. If too late for an amendment, then the results shall be provided to the District Construction Engineer.

SPECIAL SITUATIONS

GENERAL

The Specifications have been written to account for the majority of the situations that would occur during construction. However, there are always special situations that require the designers' attention.

Specification requirements shall only be altered after careful consideration and when, in the opinion of the designer, there is no practical way for the work to be performed in accordance with the Specifications and a project specific special provision shall be developed as outlined in DD-105.

COMPACTION

The specification density requirement in the of the Specifications shall not be modified when asphalt pavement is placed at normal paving widths. It is possible that asphalt pavement will be placed in certain areas of the project where densities of this magnitude cannot be obtained. These areas usually have an irregular shape, which will not allow the proper use of compaction equipment. Listed below is a situation where the density specification may be modified by plan note and the plan note to be used.

Situation	Plan Note
Concrete pavement repair Note3	Compaction testing shall be in accordance with the Lot-by-Lot method and the rollerpass method shall not be used for acceptance testing for compaction. The engineer may reduce the target density requirement if the contractor has made every reasonable effort at obtaining the required density.

Note3: If the proper density is not obtained during placement, traffic will continue to compact the asphalt pavement in the pavement repair area, causing additional settlement. This will be very noticeable because the surrounding overlay will be placed on the existing concrete pavement, which is rigid and will not settle.

When overlaying Portland Cement Concrete Pavement (PCCP) the concrete is sometimes in need of repair. Whether this is an initial overlay or a subsequent overlay, the designer shall examine the extent of the needed PCCP repairs and evaluate whether to repair with Patch and Level, to perform proper concrete pavement repairs, or to remove the PCCP through rubblization or another process prior to the asphalt overlay. The use of Patch and Level is restricted to those projects with a few shallow repairs when the cost of mobilization for concrete repairs is high. PCCP removal

should be considered only when the existing pavement is extremely distressed. In addition to compaction, consideration shall be given to smoothness, temporary traffic control, and long term impacts to the traveling public.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 812
SALVAGE VALUE OF MATERIALS

Draft of January 4, 2021
Supersedes February 6, 1996

On all projects containing Federal Highway Administration (FHWA) funds which include removal of existing materials that have a salvage value, for example, structural steel, guardrail, milled asphalt pavement cuttings, etc., the designer is responsible for determining the final disposition of the salvaged material. In most cases the Specifications make salvage material the responsibility of the Contractor. The designer should be familiar with Subsections 104.6, 201.9, 203.3, 415.2.4, 607.5, and 660.5, among others, of the Specifications.

Definitions (adapted from FHWA):

Salvage Value - Value of an investment at the end of the analysis period. The two fundamental components associated with salvage value are residual value and serviceable life.

Residual Value - The net value from recycling the material.

Serviceable Life - The remaining life in a material. For example, a 10-year design pavement rehabilitation milled up at year 7 will still have 3 years of serviceable life remaining. The value of the serviceable life at year 7 could be calculated as a percent of design life remaining at the end of the analysis period (3 of 10 years or 30 percent) multiplied by the cost of the rehabilitation at the time of the rehabilitation's construction.

Workflow to Determine and Document Salvage Value:

Salvageable material shall be dealt with by one of the following methods:

Method A - Salvaged Material to Become the Property of the Contractor - By this method, the Division of Highways and FHWA would receive proper credit for the salvaged material in the form of lower unit bid prices for the various items of work contained in the contract.

No special action is required in the plans or proposal as this method is addressed in Section 104.6 and various other sections of the Specifications.

Method B - Salvaged Material to Become the Property of the Division of Highways - If this method is chosen, the designer must do the following: ~~Will the salvaged material be used on future FHWA-funded projects? If so, a statement certifying this fact shall be included in the electronic PS&E submittal package and proceed to Number 3. If not, continue with Number 1.~~

1. The serviceable life of miscellaneous metal products (i.e. guardrail components, right of way fence, etc.) shall be considered to be 20 years. Designer/project manager shall determine the serviceable life of bridges, signal equipment, and other specialty items by contacting the appropriate Central Office Division. This information shall be used to determine the salvage value of the material in question.

2. For Asphalt Pavement, the salvage value shall be calculated based on the most recent lowest State Contract Order pickup price from the applicable SCO bids for wearing course. The low bid price shall be multiplied by 25% to represent the intrinsic value of the materials in the asphalt mix. Since a contractor is limited to 25% recycled content in a mix, the product of the previous calculation shall again be multiplied by 25% to arrive at the Salvage Value. The quantity in tons shall be estimated by calculating the number of cubic yards of material to be milled and multiplying by the unit weight of asphalt pavement, 1.98 ton/cy.

   Sample Calculation: Assume lowest pickup price of wearing course is $64/ton, two-miles of milling, 24-feet wide, and 1.5-inches deep.
   Salvage Value of cuttings is $64/ton x 0.25 x 0.25=$4/ton.
   Volume of cuttings is (2 mi x 1760 yd/mi) x (24 ft ÷3 ft/yd) x (1.5 in ÷ 36 in/yd) = 1173.3 cy.

   Total Salvage Value is 1173.3 cy x 1.98 ton/cy x $4/ton = $9292.54. Round to 3 significant digits, say $9290.

   Enter the $9290 in the memo in step two.

3. Designer shall include a memo stating the salvage value in the electronic PS&E submittal package. Designer shall follow the file naming convention detailed in the document Procedure for Electronic Submission of Documents for PSE. By Federal Regulation, if the salvage value for each salvaged item exceeds $5,000, the amount of the salvaged item must be credited to the Federal share. Contract Administration Division will forward the memo to Programming Division to make the appropriate credit.

4. Designer shall place a note in the plans clearly identifying the items to be salvaged. The note shall also identify the location of the Division of Highways facility where the salvaged items are to be delivered or where the salvaged items will be stockpiled for pick up by the Division of Highways. The location for delivery or pick up must be coordinated with the District.

The District must be made fully aware of the salvage material and quantity so that sufficient personnel may be assigned to handle and inventory the material.

The designer shall carefully consider all costs, e.g. hauling, stockpiling, storing, associated with the salvage of an existing material to ensure that these costs do not exceed the value of the salvaged material. These costs must be accounted for, whether direct costs or costs included in the contract.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PS&E DOCUMENTATION CHECKLIST

Revised March 23, 2021

State Project Number: _____

Federal Project Number: _____

Project Name: _____

County: _____

Project Manager: _____ PS&E Submitted By: _____

Telephone Number: _____ Telephone Number: _____

Email: _____ Email: _____

Signature Applicable Section Head (Central Office or District): _____

Type of Funding with Percentage: FHWA: _____ State: _____

Engineering Phase Authorization Number: _____

Is project on the latest approved STIP? _____ Yes _____ No

Geotechnical Report Required? _____ Yes _____ No

MATERIAL TO BE FURNISHED TO CONTRACT ADMINISTRATION DIVISION'S PS&E SECTION (Note: All material is to be submitted in PDF format		
All Projects	**BY**	**DATE**
1. One set of Plans in PDF format.		
2. One copy of the detailed estimate, in PDF format, to be signed by the Responsible Charge Engineer or Project Manager, and Estimate Preparer - for review by FHWA, Contract Administration Div., & Civil Rights Compliance Div.		
3. One copy of the Project Specific Special Provisions, in PDF format.		
4. One set of working day calculations		
5. One copy of the executed project agreement, if applicable, in PDF format.		
6. All applicable Permits, in PDF format.		
7. Completed Design Exception Report in PDF format (if applicable and not previously submitted)		
8. Completed Americans With Disabilities Act Exceptions Justification Report (if applicable, in PDF format).		
9. Federal Aid Resurfacing 'Operational and Safety Review' Checklist approved by FHWA PRIOR to PS&E for all Interstate and APD Highways		
10. Completed PS&E Checklist in PDF format.		

PLANS	BY	DATE
1. Title Sheet signed by all parties.		
2. Design Exceptions shown on Title Sheet.		
3. Revised Standard Drawings Used are listed on General Notes Sheet.		
4. Necessary Special Detail Sheets included in Plans or listed.		
5. Summary of Quantities in plans agrees with Proposal Quantities.		
6. Summary of Quantities has been carried from Plan Tables, including the Bridge Quantity table.		
7. Design Designation is current and agrees with Program Information.		
8. General Notes Sheet is in Plans; the notes have been reviewed and are applicable to the project.		
9. The proper Standard Detail Books are shown in the Standard Details General Note.		
10. Bench Marks and Survey Reference Points are shown on the Plans.		
11. The length of the project is shown on the Title Sheet, (separated into bridge and roadway, and total length).		
12. Typical Sections are shown for every roadway and situation encountered in the project.		
13. Typical Sections agree with pavement design.		
14. Current specifications called for.		
15. Grading Quantities as per DD-705.		
16. Line, grade, typical section, and waterway opening included for a temporary bridge.		
17. North Arrow shown on Plan Sheets.		
18. Bar Scale shown.		

MAINTENANCE OF TRAFFIC	BY	DATE
1. Temporary Traffic Control Plan included.		
2. Temporary Traffic Control Plan has been approved by Traffic Engineering.		

RIGHT OF WAY	BY	DATE
1. Right of way shown on the Construction Plans agrees with the Right-Of-Way Plans.		
2. Right of Way Plans submitted to the Right of Way Division (DR), requesting Right of Way Certificate, Staus of Utilities Certificate, and Hazardous Waste Certificate. If Right of Way is not required, a memo to DR stating no Right of Way is required along with a copy of the Title Sheet.		
3. Right of Way Certification received.		
4. Status of Utilities Certification received.		
5. Hazardous Waste Certification received.		

UTILITIES	BY	DATE
1. Encountered utilities are shown on the Title Sheet.		
2. All utility relocations and other dispositions are shown on the Plans.		
3. Division of Health and owner(s) have approved water and/or sewer lines to be relocated by the project.		

LIST OF UTILITIES TO BE RELOCATED	RELOCATIONS SHOWN ON PLANS (Yes or No, Date if Yes)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

ESTIMATES	BY	DATE
1. Quantities are the same as in the Summary of Quantities Table in the Plans.		
2. On Job Training item and quantity included in accordance with DD-814 for Non 3R projects with a cost estimate over $2,000,000 and contract time greater than 12 months.		
3. Appropriate Type Codes from the AASHTOWare Project Estimation/Preconstruction software are shown.		
4. The length of the project agrees with the length shown on the Title Sheet.		

PROPOSAL	BY	DATE
1. Schedule of Prices agrees with plans and the Engineer's Estimate.		
2. Final Working Day calculations in accordance with DD-803.		
3. List of Project-Specific Special Provisions is included (See below). See DD-820 for guidance.		
4. If applicable, one set of the I/D Special Provision and backup data in PDF format.		
5. Salvage Value memo, if applicable, and proper plan note in accordance with DD-812.		

PROJECT-SPECIFIC SPECIAL PROVISIONS TO BE INCLUDED IN THE PROPOSAL

NO.	NAME	SPECIAL PROVISION APPROVAL DATE

ENVIRONMENTAL	REQUIRED? Y	REQUIRED? N	BY	DATE
1. Categorical Exclusion.				
2. Environmental Asessment (FONSI).				
3. Final EIS/Record of Decision.				
4. Reevaluation (for Final EIS only).				
5. Section 4(f).				
6. *Section 106 (Cultural Resources) clear.				
7. *Endangered Species (plant or animal) clear.				
8. Wetlands clear.				
9. Hazardous Waste clear.				
10. ** Construction noise restrictions (10:00pm to 6:00am).				
11. Farmland impacts.				
12. Floodplain impacts.				
13. Residential or business relocation impacts.				

* - These items must be clear in order to obtain the USACOE's 404 Permit.
** - If yes, then indicate on the General Notes sheet.

PERMITS APPROVED (If Required)	REQUIRED? Y	REQUIRED? N	BY	DATE
1. Corps of Engineers' 404 Permit				
2. Bureau of Public Health				
3. Coast Guard				
4. *NPDES permit				
5. Flood Plain Coordination Letter				

* Required if project will have more than 1 (one) acre (0.42 hectares) of land disturbing activities. The project's Clearing and Grubbing area may be used for this determination.

REVIEW HISTORY

REVIEW	BY	DATE	COMMENTS RECEIVED (DATE)				COMMENTS ADDRESSED (DATE)			
			DC	DIST.	FHWA		DC	DIST.	FHWA	
Preliminary Field										
Final Field										
Final Office										

Copies of all written comments and written responses shall be included in the PS&E Package.
District-designed projects shall be submitted to the Engineering Division with a cover memorandum stating that the project plans have been reviewed by the District Construction and Maintenance Sections and all comments have been resolved. This memorandum shall be signed by the Assistant District Engineer - Construction, Assistant District Engineer - Maintenance, and the District Engineer.

AMOUNT TO BE USED FOR ENGINEERING AND CONTINGENCIES IN COST ESTIMATING	
Federal-Aid Projects	
Projects greater than $5 million	9% + 4% = 13%
Projects less than $5 million	
Bridge Construction	15% + 4% = 19%
Roadway Construction	9% + 4% = 13%
Resurfacing (3R and 4R)	9% + 4% = 13%
Other types of projects	15% + 4% = 19%
ER Projects	
FEMA Projects	
Signing Projects	
Lighting Projects	
Guardrail Projects	
Traffic Signal Projects	
APL Projects	
Piling Projects	
State-Funded Projects	
Bridge and Roadway Construction	9% + 4% = 13%
Resurfacing	6% + 4% = 10%
NOTE: The First % is for Construction Engineering. The Second % is for Contingencies.	

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
DESIGN DIRECTIVE

DD-204
GUIDANCE FOR USE OF PROJECT SCHEDULES FOR PROJECTS UNDER DESIGN

Draft of March 24, 2021
Supersedes May 1, 2014

This Design Directive provides guidance and instruction, along with sample Project Schedule templates, on how to prepare and submit project schedules for projects under development. These project schedules will be used by project managers, as outlined herein.

10. General

10.1 Introduction: Project schedules are to be submitted by project managers for projects with multidisciplinary involvement, outside resource agency coordination, or have highly technical or complex issues, this includes preliminary study projects. The project schedule shall outline all the required project tasks and the submission dates at project milestones. Design completion dates for projects are established by the schedule and are utilized for tracking project authorization and determining program delivery.

Projects that have few tasks or do not have parallel dependencies that need a critical path identified may not need to use these scheduling procedures. Projects such as contract resurfacing, minor slide repair or emergency projects require few participants and need minor resource documentation. Program milestones will be tracked in the Hub. The Hub is the replacement software for the legacy Project Tracking System.

Network diagrams have historically been used by the Division of Highways for tracking project milestones. Network diagrams identify multiple paths of parallel activities. Those paths are reviewed, and a critical path is identified. The critical path is a list of tasks or activities that drive the project's schedule. No tasks on the critical path can be late and allow the project to remain on schedule. This type of schedule management is referred to as Critical Path Method (CPM) and provides a point of emphasis for managing all tasks. The use of CPM is documented in many manuals and reports and should be referred to for detailed information on scheduling.

Example templates of previously used CPMs are included at the end of the DD and provide visual examples of node to node scheduling. These should be referenced and generally followed to ensure disciplines develop at a rate such that design alterations or new data can be managed and incorporated reasonably and without undue undermining of design efforts.

Bar charts, also called Gantt charts, will be used to graphically display a project's schedule. Microsoft Project is available and can be integrated with the Hub to update programmatic milestones. Schedules should document all necessary milestones including review time by Division of Highways staff.

20. Project Schedules

20.1 Initial Schedule: When it is determined a schedule will be required, an initial review should be developed either prior to programming or shortly after. The schedule should identify all mandatory tasks and define risk based working days. Tasks that involve high probability of risk include major NEPA actions, core drilling operations, right of way acquisition, utility relocations and individual permits.

20.2 Project Schedule: The Project Schedule should be updated within a relatively short time before actual project development starts or when previous studies or program rescheduling have identified refinements to project milestones. The integration with the Hub allows for the schedule adjustments to be uploaded and for automated requests for programmatic milestone revisions.

20.3 Project Schedule Revision: Revisions to schedules should reflect current expectations and provide realistic delivery schedules. Reasons for schedule delays shall be documented and reported to development responsibility management. The revision documentation will be used for evaluation of both DOH staff and Consultant staff.

30. Preparation of the Project Schedules

30.1 General: Project Schedules will be completed on WVDOH provided software. Schedules will be based on working days, not calendar days. Working time or duration shall be entered in days as the unit. The project manager will be responsible for managing leading activities or predecessors. Immediate supervisors will provide guidance and approve working times and schedules in the original Project Schedule. Templates have been created for standard projects and can be managed out of the Hub.

30.2 Scheduling Software: WVDOH will provide software to designated staff who will be responsible for managing schedules. The software will be installed on computers. The software is an industry standard platform and files may be provided to consultants or other firms doing work for the WVDOH. WVDOH will not be responsible for providing software to firms doing work or provide guarantees of compatibility of data files. Compatible templates have been created and can be managed from the Hub.

30.1.3 Schedule Creation: Schedule templates can be downloaded from the Hub. The templates provide many standardized tasks that have been identified historically as major milestones of project development.

There are specific project milestone tasks identified in the standard schedule which must not be modified. These tasks tie directly to Hub critical dates for maintaining programmatic schedules. The milestones are in blue with a "post-it note" icon in the indicator column in the software. These tasks for a 300 series project are:

- CP START – "LINE AND GRADE APPROVAL PROCESS"
- RW START – "AUTHORIZE ROW PHASE"
- CP COMPLETE – "UPDATE FINAL PLANS FOR PSE SUBMISSION"
- CP/RW – "PREPARE AND SUBMIT RW CERTIFICATE"
- PSE – "PSE DOCUMENTS ASSEMBLED AND SUBMIT TO CA"
- ADVERTISE – "PROJECT ADVERTISED FOR LETTING"
- LETTING – "LETTING DATE"
- AWARD – "AWARD OF PROJECT"

Design study or 200 series project templates also have key milestones identified in blue that cannot be changed.

30.4 Project Scheduling: Scheduling of working time should be based on the amount of time it should take to accomplish the tasks. Resources, or workforce, should be allocated appropriately to meet the scheduled time of the tasks.

Task scheduling is based on many factors. The Division has historically leaned on the institutional knowledge base of existing employees to develop schedules. Staff use the scope of the project, technical needs of the design and risks associated with dealing with outside influences to predict working times.

Some tasks may not be used based on the scope of the project and can be zeroed out. If tasks are deleted, it is the responsibility of the project manager to manage predecessors. If tasks not identified in the standard schedule templates are critical, they may be added but the project manager is responsible for updating any predecessors and assuring that links are correct.

When revising standard template schedules the project managers shall make it a practice to review the following:

a) Make no changes to programmatic milestones identified in 30.1.3.
b) Use "auto scheduled" as the task mode. This will update the schedule for future tasks.
c) Use multiple predecessor tasks when critical activities need to occur prior to task completion. An example of multiple critical predecessors is prior to right of way authorization, environmental documents and acquisition and utility estimates need completed.
d) Internal review times need scheduled prior to major submittals.
e) Schedules should be reviewed and concurred by all those responsible for various actions of a project. Different disciplines have more knowledge of resource allocations under their control.

f) Schedules should follow formal policies when identified. Don't "crash" schedules for working times outside of the project manager's ability to allocate resources.
g) Present a realistic schedule based on internal and external resource allocation and risks.

It is important that project managers identify as many risks as possible, hidden time consumers and review times when developing schedules. The timelines should provide a realistic and anticipated flow of project development. Project managers should attempt to control schedules from the earliest stage as possible. Project managers should use design study information to develop the Initial Schedule and once design is initiated update the Project Schedule as resources for design are identified.

Training on project management is available online from AASHTO TC3 program. This service is available free of charge to employees of participating transportation agencies. Staff must set up an account using their state email address. Upon completion of the course, staff will earn continuing educations units (CEUs). To access the courses, go to AASHTO's Store, https://store.transportation.org, and search for the following training:

- Critical Path Method (CPM) Scheduling
- Critical Path (CPM) Schedule Management

Training for the use of the scheduling software, MS Project, is available from many online sources. MS Project can be used for many complex project management operations, but the intent of this direction is only to provide simplistic task identification, node to node actions and assign workdays. Project managers will also be able to add tasks, modify predecessors and alter view layouts. It is suggested that the task mode be set to "auto schedule" to enable automatic updates of start and finish dates, and predecessor changes.

30.5 Schedule Integration with Hub: Schedules will now be integrated, downloaded, and uploaded to the Hub. It is the responsibility of the project manager to assure that schedules are kept up to date on the Hub. MS Project files may be temporarily stored on user's computer, but the official Schedule will be the file stored on the Hub.

30.6 Schedule Storage and Archiving: For recordkeeping, the project's final schedule and any revisions shall be saved in the project's ProjectWise folder. During final evaluation of on time delivery of the project documents, schedule revisions and justifications should be reviewed to determine any issues that need documented for ongoing or future projects.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 503
SELECTION OF PIPE MATERIALS

Draft of February 22, 2020
Supersedes April 4, 2018

This design directive is to provide guidance on the selection of appropriate pipe materials in terms of service life, hydraulic efficiency, and structural capacity. The design process includes consideration of the factors shown in Section 1 through Section 5 below. Life cycle cost and safety shall take priority over initial cost. Small Corrugated metal pipe and pipe-arches may only be used for low volume roads with shallow cover heights. Galvanized structural plate pipe or pipe-arches installed with concrete paved inverts may only be used with the approval of the Director of the Engineering Division and the State Highway Engineer.

SECTION 1: ROADWAY CLASSIFICATION

The following table summarizes acceptable conduit materials based on the design classification, fill height, and service life requirement of the roadway that the pipe is to be placed under. Design classification is site specific rather than project specific and refers to the roadway that is directly over or supported by fill over the culvert. WVDOH items numbers are listed in parenthesis.

Table 503-1
Allowable Pipe Materials

DESIGN CRITERIA	ALLOWABLE CONDUIT MATERIALS
Highways with an ADT ≥ ~~3000~~ 12,000 or Height of cover ≥ 10 ft. 75 year design life	• Cast in Place or Precast Reinforced Concrete Box (604070) • Cast in Place (620003) or Precast Reinforced Concrete Arch (620001) • Reinforced Concrete Pipe (604037) and Elliptical Reinforced Concrete Pipe (604041) • High Density Polyethylene Pipe (solid wall (604056), profile wall (604050), or steel-reinforced (604051), installed in Type F trench • Polyvinyl Chloride Pipe (profile wall), installed in type F trench (604052) • Polypropylene Pipe (604045), ~~installed in (~~type F trench required for fill >10 feet)
Highways with an ADT < ~~3000~~ 12,000 and Height of Cover < 10 ft. 40 year design life	All of the above • High Density Polyethylene Pipe (solid wall (604056), profile wall (604050), or steel-reinforced (604051) • Polyvinyl Chloride Pipe (profile wall) (604052) • Polypropylene Pipe (profile wall) (604045)
Highways with an ADT <400 and Height of Cover < 5 ft. 20 year design life	All of the above • Aluminized Steel, Type 2 Corrugated Metal Pipe, up to 24" (604076) • Aluminized Steel, Type 2 Corrugated Metal Pipe-Arch up to 128" x 83" (604077) • Aluminum Structural Plate Box Culvert (604074)

Unless otherwise specified, all pipes shall be installed in accordance with Standard Specification 604.

SECTION 2: HYDRAULICS

Hydraulic design of culverts is addressed in the WVDOH Drainage Manual.

SECTION 3: STRUCTURE

Refer to DD-502 for maximum cover and minimum cover for all pipes. The maximum values in DD-502 are conservative. The designer may exceed the limits set in DD-502 if the pipe is designed in accordance with AASHTO LRFD Section 12, *BURIED STRUCTURES AND TUNNEL LINERS*.

SECTION 4: CORROSION

Plastic pipe materials are acceptable in most environmental conditions without soil and water testing.

Concrete pipe will require soil and water testing for resistivity and sulfate concentration. A resistivity of less than 1,000 ohm-cm is an indication of the presence of chlorides. Sulfate content data are required for the use of concrete pipe.

Sulfate concentration is also a durability concern for concrete. Type II cement is designed to resist sulfate attack. Therefore, Type II cement shall be used for precast concrete pipe. Reducing the water/cement ratio reduces permeability and is the single most important factor in increasing concrete resistance to sulfate attack. Increasing the cement content also improves sulfate resistance. Precast concrete pipe and box culverts are typically produced using 658 pounds (7 bags) of cement per cubic yard of concrete with a water cement ratio of 0.44 or less. Only a minor adjustment in the water cement ratio is required to meet the severe Sulfate condition. For very severe conditions the water cement ratio shall be reduced to 0.35. The following table illustrates the actions required for a given sulfate concentration. Cement content and water/cement ratio shall be included in the plans when severe and very severe sulfate conditions are encountered.

Table 503-2
Sulfate Concentration For
Reinforced Concrete Pipe

Conditions			**Requirements**		
Relative Degree of Sulfate Attack	% Water-Soluble Sulfate in Soil Samples	PPM Sulfate in Water Samples	Cement Content (bags/cy)	Cement Content (lbs/cy)	Maximum Water/ Cement Ratio
Negligible	0.00 - <0.10	0 – <150	5	470	0.53
Positive	0.10 - <0.20	150 - <1,500	5	470	0.53
Severe	0.20 - 2.00	1,500 - 10,000	5.5	517	0.4
Very Severe	>2.00	>10,000	7	658	0.35

Metal pipes and structures are allowed as stated in Table 503-1. The pH of the water and soil must be between 5 and 9.

SECTION 5: ABRASION

The designer shall assess the abrasion potential for proposed culvert installations. Consider the slope of the stream and the size of the stream bed material. Determine the size of the streambed material in accordance with DD-409. Calculate the velocity of the flow in the channel upstream of the proposed culvert and in the proposed culvert to determine if the abrasive material in the streambed could be transported at a sufficient velocity to cause damage to

the invert of the conduit. A 2-year storm (Q_2) shall be used to determine the velocity for abrasion potential. When flow velocities are greater than 25 feet per second, 6000 psi concrete and abrasion resistant aggregate are required.

There is a potential for higher than normal abrasion during construction due to runoff from disturbed areas that have not yet been vegetated or paved. For new construction projects, sediment traps shall be placed upstream of culverts to prevent large sediment from entering the culvert.

Three sided structures do not require invert protection, however, the potential for scour at the footings shall be addressed and documented. It may be less expensive to provide a concrete slab below the streambed between the footings instead of extending the footings to rock.

The following chart is to be used to select the appropriate invert protection for culverts. Use the velocity of the 2-year storm flow in the pipe or in the channel upstream of the pipe, whichever is greater.

Table 503-3
Invert Protection Chart
For Abrasive Flows

CULVERT MATERIAL	2-Year (Q_2) Storm Design Velocity			
	0 to 5 ft/sec	5 to 10 ft/sec	10 to 25 ft/sec	Greater than 25 ft/sec
Aluminized Steel Type 2	None	None	Concrete Paved invert	Concrete Paved invert
Aluminum Alloy	None	None	Add one gage	Add two gages
Plastic (PVC or HDPE or PP)	None	None	None	None
Reinforced Concrete Pipe	None	None	Aggregate with LA Abrasion loss of less than 30%	6000 psi concrete Aggregate with LA Abrasion loss of less than 30%

SECTION 6: ALTERNATE MATERIALS

When using this directive, more than one material may be found to satisfy the project requirements. The designer should include economical designs that meet the requirements stated above. Allowable alternates should be listed in the pipe quantity table included in the plans.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 621
INTERSECTION SIGHT DISTANCE

March 19, 2021
Supersedes May 16, 2012

In order to assure that proper sight distances are provided at all ramp terminals and major intersections, a minimum sight distance and/or sight triangles shall be determined according to the different type of traffic control~~;~~ found ~~on page 9-32~~ in Section 9 of the ~~2011~~ 2018 AASHTO publication, *"A Policy on Geometric Design of Highways and Streets"*, or latest edition, as follows:

Case A – Intersections with no control
Case B – Intersections with stop control on the minor road
Case B1 – Left turn from the minor road
Case B2 – Right turn from the minor road
Case B3 – Crossing maneuver from the minor road
Case C – Intersections with yield control on the minor road
Case C1 – Crossing Maneuver from the minor road
Case C2 – Left or right turn from the minor road
Case D – Intersections with traffic signal control
Case E – Intersections with all-way stop control
Case F – Left turns from the major road
Case G – Roundabouts

The character of the traffic service on the intersecting road shall be considered, and a higher type design vehicle shall be used if deemed appropriate.

Sight triangle layouts are to become part of the project's permanent file. For intersections near bridges the designer must account for the bridge parapet and approach guardrail. If necessary to achieve sight distances, shoulders, guardrail, or bridge parapet shall be flared as necessary.

If it is necessary to provide a lesser sight distance, an explanation shall be ~~furnished~~ provided by the designer, approved by the responsible charge engineer, and archived with the project documents.

MAINLINE	CROSSROAD		
	ARTERIAL	COLLECTOR	LOCAL ROAD
Arterial	WB-50	SU	SU
Collector		SU	SU
Local Road			P

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 702
SIGNING AND SEALING OF PROFESSIONAL WORK, TITLE SHEET SIGNATURE BLOCK

Draft of February 18, 2021
Supersedes October 1, 2020

The intent of this directive to establish the Division of Highways (Division) procedures regarding signing and sealing engineering documents. Any person signing and sealing engineering work shall be a registered professional engineer in the State of West Virginia and fully knowledgeable of the publications noted below.

The designer and the responsible charge engineer are both referred to the West Virginia State Board of Registration for Professional Engineers publications "*WV Engineering Law Booklet* – April 2020;" *"WV Engineering Law (State Code – Chapter 30, article 13)* – As of March 2015;" *WV Engineering Law (State Rules – title 17, Series 1 – Examination, Licensure and Practice)* – As of April 2020;" and *"WV Engineering Law (State Rules – Title 7, Series 2 – Administrative Hearing Procedures)* – As of July 2004." These publications are available at https://wvpebd.org/West-Virginia-Engineering-Law/West-Virginia-Engineering-Law .

Engineering work for and by the Division will adhere to these laws and legislative rules regarding the practice of engineering and the signing and sealing of documents.

Responsible Charge

In State Code §30-13-3(g) responsible charge is defined as:

> *"Responsible charge" means direct control and personal supervision of engineering work.*

Division Directors or District Engineer/Managers, when those individuals are a West Virginia Registered Professional Engineer, or their W. Va. Registered P.E. designee, shall be the responsible charge engineer for work performed in their division/district. In the event a Division Director or District Engineer/Manager is not a West Virginia Registered Professional Engineer, then the duty shall fall to the next lower ranking person who is a West Virginia Registered Professional Engineer in the Section/Unit/Group where the engineering work is occurring. Consultants shall sign and seal professional engineering work submitted to the Division.

As standard practice, the person(s) who will have responsible charge of the engineering work shall be identified in the early stages of the project. In the event the person(s) having responsible charge cannot sign and seal their work, such work may be sealed by another professional, but only after a thorough review of the work to verify that the work has been accomplished to the same extent that would have been exercised if the work had been done

under the direct control and personal supervision of the professional affixing the seal.

Documents

Generally, the final original document shall be signed and sealed. Contract plans shall be signed and sealed at the PS&E submission.

State Code §30-13-16 states the following about the types of documents that require signature and signing:

> *Whenever presented to a client or any public or governmental agency, the seal, signature and date shall be placed on all specifications, reports, drawings, plans, design information and calculations in accordance with rules promulgated by the board. The seal and signature shall be used by registrants only when the work being stamped was under the registrant's complete direction and control.*

Engineering work that has been produced over long periods by the Division, with no clear person(s) having responsible charge will not require signing and sealing. Examples include, but are not limited to, The Standard Specifications Roads and Bridges and supplements thereto and the Standard Details Volumes I thru III. Revisions to these documents will require signing and sealing.

Revisions

A revision of engineering work after documents have been signed and sealed is addressed in §7-1-7.3.c of the Legislative Rule:

> *Revisions shall be numbered, dated, initialed, and sealed by the registrant responsible for the revision.*

Revisions to engineering work during the construction phase shall be signed and sealed when the revisions change the design or impact previous engineering work or calculations. The engineer in responsible charge of the revisions shall sign and seal the changes. That person shall have direct control and personal supervision of the work and be responsible for engineering decisions regarding the change(s).

Value Engineering Change Proposals (VECP) and Practical Design Change Proposals (PDCP) are revisions to the plans. Such engineering revisions performed by the contractor or the contractor's agent require signing and sealing by the engineer responsible for the proposal.

It is highly recommended that the initial engineer in responsible charge be consulted for any significant change in scope. Not doing so places additional risk on the registrant signing and sealing revisions.

Right of Way Plans

Right of Way Plans are considered an engineering representation of the existing, proposed, or acquired right of way, depending on the submission. Right of Way plans prepared by or for the Division shall be sealed by the engineer in responsible charge of the RW-3 or RW-4 submission, as appropriate.

Title Sheet Signature Block

The attached title sheet signature blocks shall be used for all right of way plans and construction plans regardless if the construction is performed under contract or Division of Highways' Forces. The professional engineer signature and seal block on the consultant title sheets will be applied by the consultant.

All signatures, as per the attachments, will be by Division of Highways' personnel.

Occasionally there may be exceptions which will be handled on a project-by-project basis when approved by the appropriate Deputy State Highway Engineer.

Attachments

CENTRAL OFFICE and DISTRICT PROJECTS (INTERNAL DESIGN)
FULL-SIZE CONSTRUCTION and R/W TITLE SHEET

SIGNED: _____
RESPONSIBLE CHARGE ENGINEER

DATE: _____

RECOMMENDED: _____
PROJECT ENGINEER

RECOMMENDED FOR APPROVAL: _____
STATE HIGHWAY ENGINEER

APPROVED: _____
COMMISSIONER OF HIGHWAYS

I HEREBY CERTIFY THAT THIS IS A CORRECT COPY OF THE PLANS OF PROJECT_____

_____
EXECUTIVE SECRETARY

_____ DAY OF _____, 20_____

CENTRAL OFFICE and DISTRICT PROJECTS (CONSULTANT DESIGN)
FULL-SIZE CONSTRUCTION and R/W TITLE SHEETS

RECOMMENDED: _____
PROJECT MANAGER

RECOMMENDED FOR APPROVAL: _____
STATE HIGHWAY ENGINEER

APPROVED: _____
COMMISSIONER OF HIGHWAYS

I HEREBY CERTIFY THAT THIS IS A CORRECT COPY OF THE PLANS OF PROJECT_____.

_____
EXECUTIVE SECRETARY

_____ DAY OF _____, 20_____

CENTRAL OFFICE and DISTRICT PROJECTS (INTERNAL DESIGN)
8 1/2" X 11" TITLE SHEETS

WV DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN OF PROPOSED IMPROVEMENTS OF
STATE HIGHWAY

PROJECT NAME: _____ STATE PROJECT NO.: _____

FEDERAL PROJECT NO.: _____ COUNTY: _____

LENGTH (mi): _____ COORDINATES: x = _____*DEG.*____*MIN.* y =____*DEG.*____*MIN.*

BEGIN TERMINI: _____ END TERMINI: _____

TYPE OF IMPROVEMENT: _____ EXISTING ADT: _____

"TRAFFIC CONTROL FOR STREETS AND HIGHWAY CONSTRUCTION AND MAINTENANCE OPERATIONS DATED _____ SHALL APPLY TO THIS PROJECT."

SIGNED: _____
RESPONSIBLE CHARGE ENGINEER

DATE: _____

RECOMMENDED: _____
PROJECT ENGINEER

RECOMMENDED FOR APPROVAL: _____
STATE HIGHWAY ENGINEER

APPROVED: _____
COMMISSIONER OF HIGHWAYS

I HEREBY CERTIFY THAT THIS IS A CORRECT COPY OF THE PLANS OF PROJECT_____.

_____
EXECUTIVE SECRETARY

____ DAY OF _____, 20_____

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 803
DETERMINATION OF CONTRACT COMPLETION DATE

Draft of April 5, 2021
Supersedes September 18, 2013

The purpose of this Directive is for the Designer to estimate a time for the Contractor to complete the project consistent with historical records of contractor performance on similar work. This procedure is to be used for all projects unless otherwise directed.

A. General Considerations

The Division shall establish a contract time duration on each construction contract in order to determine the project's contract completion date. Several factors must be considered when establishing contract duration, such as:

- ~~Provide a time for the contractor to complete the project consistent with historical records of Contractor performance on similar work~~.
- Coordination with other government agencies
- Emergency conditions.
- Minimize annoyances in residential areas.
- Minimize traffic disruption and delay in high traffic areas.
- Coordination with other activities and other projects to be performed in the same work area.
- Political sensitivity and public awareness.
- Coordination with adjoining projects to provide usable roadway sections.

Many of these factors can conflict with others and not all of them will have the same importance for each project.

The contract duration time as shown on a bar chart for Estimating Contract Time shall be established when the project is submitted for PS&E. If there are quantity changes or other revisions during the PS&E review, the contract duration may be revised. The bar chart ~~as~~ developed by the designer shall be submitted as part of the ~~pre-PS&E plan review~~ PS&E submission to the Contract Administration Division. If the project has FHWA full oversight, the chart shall be included in the Pre-PS&E submission to both the FHWA and

Contract Administration.

Contract Administration Division's ~~PS&E unit~~Contract Development Section will establish the ~~contract completion date~~project's contract completion date using the contract duration time by adding additional time based on considerations such as what the review process will be, status of utilities, right-of-way acquisition, authorization of funds, length of advertising period, bid review period, award, scheduling of preconstruction conference, and a conversion of the working day contract duration to a calendar time period that accounts for holidays, weekends, unsuitable weather conditions and anticipated winter shutdown time.

Some projects will be selected by Division's management for special handling by inclusion of either Incentive/Disincentive and/or other special concepts. When this occurs, the designer in cooperation with Division's management shall adjust production rates and other factors to reflect these special conditions. DD-708 contains guidelines for project selection and development of the Incentive/Disincentive Special Provisions.

Restrictive hours on contractor's operations may be necessary when considering various factors, such as high traffic volumes in lane closure situations and noise abatement in residential areas.

Specification limits as they relate to seasonal limitations must be observed when calculating contract time periods.

As part of this procedure for determining contract completion dates, the Division has established "Guidelines for Production Rates and Chart for Contract Duration." This document contains a set of production rates for many of the activities that occur in highway/bridge construction projects. Production rates for all possible activities are not included nor are all production rates used in each construction job. The production rates may have to be supplemented with information from other sources and should be tempered with good engineering judgement and past experience with similar work. The "Guidelines for Production Rates and Charts for Contract Duration" is divided into series of production rates for various categories. It also includes the Chart for Estimating Contract Time. The Engineering Division will update the "Guidelines..." as needed~~, but will at least do a complete update on a three-year cycle. Additionally, the Contract Administration Division will select appropriate projects every year on which the approved Project Primavera CPM Schedule will be utilized to keep detailed records on the various operations and compare those to the rates used to develop the contract time.~~

B. Steps for Establishing Contract Duration

In using this procedure, the designers in the respective design units will do Steps 1 through 6. This includes projects being done by Consultants who will submit the Chart for Estimating Contract Time to the Review Section of the applicable controlling Development Division. The designer in the controlling Division will perform Steps 7 and 8, and the applicable ~~PS&E unit~~Contract Development Section will perform Step 9.

Establishing a project's duration will be accomplished with the following steps:

1. Review the project plans and specifications. Analyze and determine special factors that are controls affecting completion or phasing of the work. If the project has more than one phase, determine what work can be done in each of the phases.

2. List the required activities for each phase. These are listed on the chart for Estimate of Contract Time. This list does not need to be exhaustive but does need to include all controlling items of work activities on the critical path.

3. List each quantity of the unit of work that will be used as a basis for estimating the duration of that activity, e.g. for storm sewers this would be the number of linear feet of pipe, etc.

   Each Division supplying a component of the project shall furnish a separate chart to the controlling Division for that component. This shall be integrated onto a chart for the project with only the major phases being shown or just simply shown as a single line activity with its appropriate duration.

   When multiple projects are combined into one contract for bidding purposes, the working day calculations for each project shall be integrated into a single chart which shall reflect the total number of working days necessary to complete ~~both~~ all projects.

   On a project with more than one phase use only that quantity associated with that phase. If the list of pay items shows, for instance, 10,000 cubic yards of excavation for a project, that has two phases, that have approximately the same amount on each phase, put 5,000 cubic yards as the unit of work for excavation in Phase 1 ~~and 5,000 cubic yards as the unit of work for excavation in Phase 1~~ and 5,000 cubic yards as the unit of work for excavation in Phase 2. Extreme accuracy is not required. It is only necessary that the parts of activities sum to the whole, but a percent or two of error on any phase will not affect the results.

4. Use the production rates to convert the units of work into work days. Do this for each activity in each phase.

5. Drawing the Bar Chart for Estimating Contract Time.

   a. Select a scale to draw the bar chart, i.e. if the project is about 200 days and fits on one form, make each block 10 days. More than one page may be used for long projects. Succeeding pages may be for later time periods.

   b. Put the first activity bar on the bar chart, beginning at day 1 and extending the line for the duration of that activity.

   c. Determine how many days after the beginning activity has started until the

second can start. Use that contract day as the starting date of the second activity and extend the bar for the duration of the second activity.

For each succeeding activity, the designer must decide if its start is dependent or partially dependent on a preceding activity. If so, then the beginning of the activity is placed to reflect this dependence.

d. Repeat until all activities are completed on the chart. Use more than one form sheet if necessary.

6. On each form used, complete the federal and state project number, county name, preparation date for the chart, the name and phone number of the person who established the contract duration, and the contract time in working days.

7. The chart shall be included in PS&E and Pre-PS&E submittals. The chart and any supplemental schedules, such as traffic and structures tasks, shall be maintained in the project file.~~This chart is now sent along with the pre-PS&E plans to the Contract Administration Division and/or Assistant District Engineer for Construction for review. This is generally done at the final office review (See DD-202). If the project does not have a final office review, the chart along with the pre-PS&E plans must be submitted to Contract Administration Division and/or ADEC by the project manager prior to submission to the Contract Administration Division's PS&E Unit.~~

8. Direction on how to handle PS&E and Pre-PSE and when the chart is to be reviewed are handled in DD-202 and 706 . ~~The "Chart for Estimating Contract Time" shall be submitted by the designer to Contract Administration Division's PS&E unit and also will be maintained in the project file. The "Chart" maintained in the project file shall have attached all backup charts that were developed for various phases, such as individual bridges, and submissions from other design units, such as Traffic Engineering and Structures.~~

9. Contract Administration Division's ~~PS&E unit~~Contract Development Section will use the "Chart" which is in working days and convert it to a calendar period in order to establish ~~a~~ the project's contract completion date. Factors to be considered by the ~~PS&E unit~~Contract Development Section include the following along with other applicable provisions:

a. Conversion from working days to calendar days will be made by use of the Scheduling Conversion Matrix~~ which is updated every year by the PS&E unit~~. There are two matrices which can be used. One is based on a five-day work week and the other is based on a six-day work week. These matrices exclude the major holidays of Memorial Day, Independence Day, Labor Day, and the Thanksgiving Thursday/Friday holiday. The five-day matrix shall be used for most projects. The six-day matrix can be used when it is advantageous to the Division of Highways to accelerate the completion of the project.

b. Winter shut down due to seasonal limitations will be addressed if the contract duration requires the work to occur during two or more construction seasons. The matrix does not include any working days for the period of December 1st to March 31st.

c. Status of utility report from the Right of Way Division will be checked to determine if any time adjustments are needed before the project is advertised or the Contractor will be able to start work. Also a determination should be made for coordination with utilities for any concurrent utility relocation work required.

d. A time factor will be added to the date the PS&E package is projected to start through the Division's management approval process and, if appropriate, review and approval by the Federal Highway Administration. This time factor should reflect items such as:

1) Authorization of funds - state and/or federal.
2) Review time.
3) ~~Printing plans.~~
4) Advertising period.
5) Bid review period.
6) Award time.
7) Scheduling preconstruction conference.
8) Start of work after notice to proceed.

e. Certain projects shall have seasonal completion dates that will provide the Contractor time flexibility in scheduling the actual work to reflect that a single Contractor may have several projects to complete. Projects with seasonal completion dates shall include a special provision that will limit the on-site time to minimize the disruption to traffic by specifying the number of allowed calendar days. If the number of allowed calendar days is exceeded, then contract liquidated damages or some other specified monetary amount shall be assessed. Projects with seasonal completion dates will generally have a construction cost of less than $500,000 and be of the following types:

1) Resurfacing.
2) Guardrail.
3) Bridge Deck Overlays.
4) Pavement Markings.

The seasonal completion date for projects advertised in the early part of the year will generally be October 31st for resurfacing and November 15th for other project types, but the seasonal dates may vary based on particular conditions, such as the District locality or the current specifications related

to weather and temperature limitations. For projects advertised late in the year where completion of the work is not critical to that construction season, the seasonal completion date shall be established as June 30th of the next year. If the Contractor undertakes the project work during winter shutdown, the above mentioned special provision shall include restrictions as to the on-site time that would disrupt traffic.

f. With all of the above time factors considered and totaled, a contract completion date will be entered in the Contractor's proposal at the appropriate location.

GUIDELINES FOR PRODUCTION

RATES AND CHART

FOR

CONTRACT DURATION

MARCH ~~1996~~2021

MAJOR GRADE AND DRAIN PROJECTS

OVER 1 MILLION CUBIC YARDS

Operation	Rate Per Working Day
NPDES Permitting	Under 100 acres, 8 months (240 Calendar days, 176 Working days) Over 100 acres, 10 months (300 Calendar days, 220 Working days)
Clearing and Grubbing	5-8 acres/day, not to exceed 15 days (overlap with grading).
Excavation	8,000 CY/8 hour shift (adjust down proportionally for percentage of rock or up for rural and terrain as appropriate).
Aggregate Base Course	2,500 tons/day on mainlines. 1,200 tons/day on ramps and side alignments.
Asphalt Pavement	1,500 tons/day on mainlines. 800 tons/day on ramps and side alignments.
Concrete Pavement	5,000 SY/day on mainlines. 1,500 SY/day for ramps and side alignments - add 2 days for throats, tapers, etc.
Pipes	Less than 60-inch 300-foot/day. 60-inch and greater 100-foot/day.
Curbs, Curbs and Gutters	1,000 LF/day on mainlines. 500 LF/day on non-mainline.
Guardrail	3,000 LF/day on new construction. 1,500 LF/day all others.
Fencing	2,000 LF/day (should overlap with excavation).
Seeding	3 acres/day (normally occurs with excavation - allow 3 days at end for closeup of project).

MINOR GRADE AND DRAIN PROJECTS

1 MILLION CUBIC YARDS OR LESS

Operation	Rate Per Working Day
NPDES Permitting	Up to 100 acres, 8 months (240 Calendar days, 176 Working days) Over 100 acres, 10 months (300 Calendar days, 220 Working days)
Grading	8 AC/day rural high volume. 1 AC/day urban low volume.
Excavation	6,000 CY/day rural. 1,000 CY/day urban.
Aggregate Base	3,000 Tons/day rural. 1,000 Tons/day urban.
Asphalt Pavement	1,000 Tons/day mainline. 500 Tons/day other.
Concrete Pavement	5,000 SY/day new mainline. 1,500 SY/day other.
Pipe	Less than 60-inch - 300 LF/day. 60-inch and up - 100 LF/day.
Curbs, Curbs and Gutters	500 LF/day.
Guardrail	2,000 LF/day mainline. 500 LF/day urban and old alignments.
Fencing	1,000 LF/day (overlap with excavation).
Seeding	3 AC/day (not to exceed 10 days at end for closure of project - should proceed with excavation).

MAJOR PAVING PROJECTS

Roadway Operation	Rate Per Working Day
■ NPDES Permitting	1 acre to under 3 acres, 4 months (120 Calendar days, 88 Working days) 3 or more acres, 8 months (240 Calendar days, 176 Working days)
■ Fine Grade	2,500 LF per 24-foot lane.
■ Aggregate Base Course	3,000 to 3,500 tons/day mainline. 1,000 to 1,500 tons/day on ramps.
■ Chemical Stabilized	Show overlaps with paving except 12 working days for placement and curing.
■ Soil Type Base Course	2,000 to 3,000 tons/day.
■ Bituminous Surface Treatment	5,000 to 10,000 SY/day.
■ Asphalt Pavement	3,000 to 3,500 tons/day on mainline. 1,000 to 1,500 tons on ramps.
■ Concrete Pavement	2,500 LF per 24-foot lane. 3,500 LF per 12-foot lane. 1 ramp per day.
■ Shoulder Construction	800 to 1,200 CY/day.
■ Curbs and Curb and Gutter	1,500 to 2,000 LF/day.
■ Guardrail	2,000 to 2,500 LF/day.
■ Seeding and Mulching	8 to 10 acres/day not to exceed 16 working days.

SMALL RURAL PROJECTS

Roadway Operation	Rate Per Working Day
■ NPDES Permitting	1 acre to under 3 acres, 4 months (120 Calendar days, 88 Working days) 3 or more acres, 8 months (240 Calendar days, 176 Working days).
■ Clearing and Grubbing	2 acres/day.
■ Excavation (Unclassified, Draining Ditch, Undercut and Borrow)	400 to 600 CY/day.
■ Aggregate Base Course	400 to 600 tons/day.
■ Chemical Stabilized Subgrade and Base	Show overlaps with paving except 12 work days for placement and curing.
■ Soil Type Base Course	300 to 500 CY/day.
■ Bituminous Surface Treatment	5,000 to 10,000 SY/day.
■ Asphalt Pavement	800 to 1,000 tons/day.
■ Concrete Pavement	N/A.
■ Pipe	100 to 200 LF/day.
■ Inlets/Manholes	1 Ea/day.
■ Curbs and Curb and Gutter	500 to 700 LF/day.
■ Guardrail	1,500 to 2,000 LF/day.
■ Fencing	600 to 750 LF/day.
■ Seeding and Mulching	5 acres/day not to exceed 10 working days.

SMALL URBAN PROJECTS

Roadway Operation	Rate Per Working Day
NPDES Permitting	1 acre to under 3 acres, 4 months (120 Calendar days, 88 Working days) 3 or more acres, 8 months (240 Calendar days, 176 Working days).
Clearing and Grubbing	1 acre/day - must consider other incidentals, i.e. pipe removal, pavement removal, etc.
Excavation (Unclassified, Draining Ditch, Undercut, Borrow)	100 to 500 CY/day.
Aggregate Base Course	300 to 500 tons/day.
Chemical Stabilized Subgrade and Base	Show overlaps with paving except 12 working days for placement and curing.
Soil Type Base Course	200 to 500 CY/day.
Bituminous Surface Treatment	2,000 to 5,000 SY/day.
Asphalt Pavement	300 to 600 tons/day.
Concrete Pavement	N/A.
Pipe	50 to 200 LF/day.
Inlets/Manholes	1 Ea/day.
Curbs and Curb and Gutter	300 to 500 LF/day.
Guardrail	1,000 to 1,200 LF/day.
Fencing	300 to 500 LF/day.
Seeding and Mulching	3 to 5 acres/day.

RESURFACING

Roadway Operation	Rate Per Working Day
■ NPDES Permitting	If Shoulders and Ditches is included: 1 acre to under 3 acres, 4 months (120 Calendar days, 88 Working days) 3 or more acres, 8 months (240 Calendar days, 176 Working days).
■ Asphalt Base Course	500 to 1,000 tons/day.
■ Asphalt Surface Course	0.6 to 1-inch - 500 to 800 tons/day. 1-inch - 500 to 1,000 tons/day.
■ Asphalt Patching and Leveling Course	300 to 600 tons/day.
■ Shoulders and Ditches	1 mile/day.
■ For other items see Small Rural or Small Urban Projects depending on type of resurfacing.	

STRUCTURES, CULVERTS AND OVERLAYS

The following working days required for the various operations are based on using one crew. In many instances, more than one crew can be used to an advantage on a certain structure, or an entire project. However, reason and judgement must be used in reducing the required time, when using more than one crew, since sometimes it cannot be reduced regardless of the number of crews, e.g. curing time.

Structure Operation	Rate Per Working Day
■ NPDES Permitting	If area of Earth Disturbing Activities is: 1 acre to under 3 acres, 4 months (120 Calendar days, 88 Working days) 3 or more acres, 8 months (240 Calendar days, 176 Working days).
■ Temporary Structure	20 days including construction and removal. (100-foot bridge with 2-lane roadway.) Additional time shall be given to structures requiring the contractor to submit design drawings for approval.
■ Dismantling Structures	
• Superstructure	3 to 5 days for overall span lengths of 20 to 100 feet. 5 to 10 days for overall span lengths of 100 to 400 feet. 10 to 25 days for spans over 400 feet.
• Substructure	Time for removal of substructure will vary widely, depending upon type, size, depth below grade, and the portion required to be removed.
■ Excavation	3 to 4 days for average bent where excavation can be done in the open. 5 to 8 days where blasting rock is anticipated. 12 to 14 days when cofferdam is required (will be greater for deep water).
■ Driven Piles	10 to 12 piles/day. Add one day/bent for steel piles with anticipated length over 40 feet.

STRUCTURES, CULVERTS AND OVERLAYS (cont.)

■ Predrilled and Grouted Piles	4 to 5 piles/day. Add one day/bent for steel piles with anticipated length over 40 feet.

Structure Operation	**Rate Per Working Day**
■ Forming and Pouring Footings	1 to 2 days per bent, increase for complicated layouts (skewed, U-shaped wingwalls, etc.).
■ Forming and Pouring Columns	2 to 5 days per mid-span bent. 1 to 2 days per end bent, add 1 day to end bent for wingwalls.
■ Forming and Pouring Caps	5 days for average cap, will vary with size, length, and complexity of cap. Add 1 day to end bent when backwall is part of substructure.
■ Curing Time For Caps For Placing Superstructure	5 days (7 calendar days) unless unfavorable weather conditions require a longer period.
■ Placement of Select Embankment	Time for placement of select embankment will vary widely, depending upon length, height, difficulties due to proximity, and depth below water. Scour mat at piers - 4 days/bent. Slope protection - 100 CY/day.
■ Superstructure Fabrication	Additional time should be given if the fabrication time overruns the allotted time given to complete the work required prior to installing the superstructure. A conversion factor of 1.7 has been used to convert the calendar days to working days.
• Rolled Steel Beams	53 to 106 working days.
• Plate Girders	71 to 106 working days.
• Prestressed Concrete Beams	35 to 53 working days.
• Stressed Timber Decks	71 to 88 working days.
• Expansion Device	35 working days.

STRUCTURES, CULVERTS AND OVERLAYS (cont.)

■ Setting Rolled Steel Beams	6 to 12 beams/day, depending upon length and accessibility, add one day/span for bolting diaphragms.
■ Setting Plate Girders	3 to 4 girders/day depending on length and access with 1 day added for field splicing, and 2 to 3 days/span for bolting diaphragms.
■ Setting Prestressed Concrete Beams	4 beams/day minimum, depending upon length and site conditions (accessibility, method of erection required by conditions, etc.).
■ Setting Stressed Timber Deck	Based on a 40-foot - single lane bridge.
• Types A and C	1 day for setting modules. Add 2 days for attaching all hardware and stressing deck.
• Type B	1 day for setting modules. Add 4 days for attaching all hardware and stressing deck. Add 1 day for 2-lane bridge.
■ Installing Expansion Device	3 days/expansion device including installation and testing (if two expansion joints are on the same bridge then count 5 days for that bridge).
■ Forming, Pouring, Curing and Stripping Reinforced Concrete Deck	7 to 10 days/span with additional 5 days curing for last span only. (32 to 40-foot roadway width and 40-foot length.)
■ Grooving Bridge Deck	1 day/span.
■ Rails, Metal	3 to 4 spans/day.
■ Rails, Concrete Barrier	40 linear feet/day for bridges less than 200 feet in length. 2 days for 200-foot bridge length (assuming slipform) and additional time for bridge lengths over 200 feet (includes placing reinforcing steel and concrete).

STRUCTURES, CULVERTS AND OVERLAYS (cont.)

Structure Operation	Rate Per Working Day
■ Approach Slabs	5 days/each approach slab including temporary drainage. (Additional time required when special drainage is part of approach slab. Note that contractor must wait a certain number of days after placing the approach fill before he can construct the approach slab. If a portion of this waiting period is not taken up by overlapping project work, then the net waiting period time should be included in the determination of working days).
■ Culvert Excavation	Single barrel and maximum length of 70 feet. 5 days (wide variation depending upon method of excavation required, site conditions, amount of excavation required, need for cutting diversion channel, presence of rock in bed, etc.).
■ Concrete Culvert	Single barrel and maximum length of 70 feet with no transverse construction joints. 19 days total: 6 days forming. 2 days for wingwall footing and bottom slab. 2 days for walls. 2 days top slab assuming forms are constructed concurrent with excavation. 3 days casting. 1 day wingwall, footing and bottom slab 1 day walls, and 1 day top slab. 10 days curing, stripping forms and backfilling.
■ Overlays (LMC)	Special consideration should be given to traffic flow. In most cases traffic flow will dictate the construction process. Lead time for expansion dam fabrication should also be taken into consideration.

STRUCTURES, CULVERTS AND OVERLAYS (cont.)

Structure Operation	Rate Per Working Day
■ Class 1 Bridge Deck Removal (Machine Work)	2,500 SF/day.
■ Class 2 Bridge Deck Removal (Hand Work)	250 SF/day.
■ LMC Placement	5,000 SF/day.
■ Concrete Curing Time	4 days/pour.

TRAFFIC ITEMS

Work Item	Rate Per Working Day
■ NPDES Permitting	If as a separate project area of Earth Disturbing Activities is: 1 acre to under 3 acres, 4 months (120 Calendar days. 88 Working days) 3 or more acres, 8 months (240 Calendar days, 176 Working days).
■ Signs, Signals, Pavement Marking and/or Highway Lighting	10 days added to end of project, if total project time exceeds 80 working days.

If Project Time is less than 80 Working Days, then Traffic Item Time will have to be calculated.

Traffic Signals	Rate Per Working Day
■ Ordering Signal Equipment	75 days for projects when ordering supports. 35 days for projects when ordering control equipment only.
■ Installing Signal	15 days for a single installation. 12 days per intersection for multiple installation.

Pavement Markings	Rate Per Working Day
■ Ordering Pavement Marking Material	30 days/project.
■ Long Lines	50,000 LF/day.
■ Specialty Markers	
• Stop Lines, etc.	500 LF/day.
• Arrows and Letters	50 units/day.
• RPM's	400 to 800 units/day.

Signing	Rate Per Working Day
■ Ordering Signing Material	60 days/project.
■ Ordering Overhead Sign Structures	80 days/project.
■ Erecting Overhead Signs	10 days/structure.
■ Erecting Sign Supports	
• WF Supports	100 LF/day.
• U Channels • (Exclude Delineators)	300 LF/day.
■ Erecting Signs	1,000 SF/day.
■ Erecting Delineators	100 units/day.

Highway Lighting	Rate Per Working Day
■ Ordering Lighting Material	75 days/project.
■ Erecting Lighting	3 days/support.

Impact Attenuators	Rate Per Working Day
■ Ordering Material	30 days/project for permanent devices and 15 days for temporary attenuators and sand barrels.
■ Installing Attenuators	1 to 3 days/unit.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
CHART FOR ESTIMATED CONTRACT TIME

DATE_____ **SHEET** ____ **OF** ____

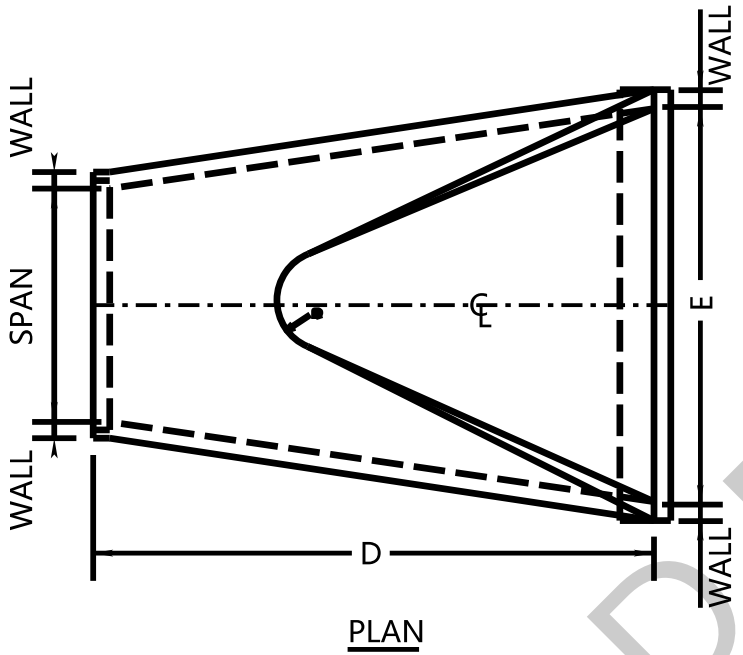
ACTIVITY	UNIT OF WORK	PROD RATE	WORK DAYS																		

FEDERAL-AID PROJECT NO. _____ **STATE PROJECT NO.** _____ **COUNTY**_____
NAME _____ **PHONE NO.**_____ **WORK DAYS FROM MATRIX = CONTRACT TIME** _____

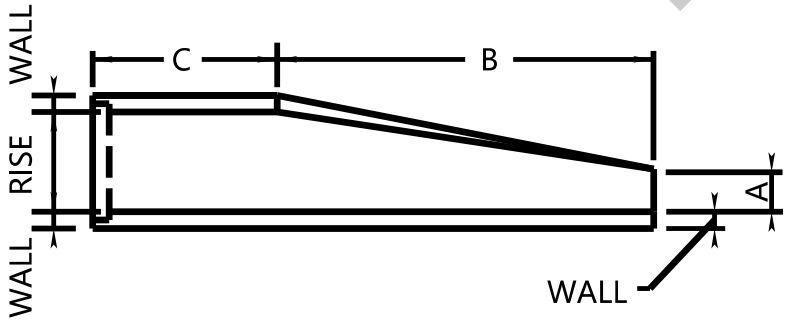
21 of 21

DD-803

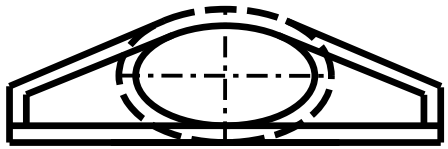
CONCRETE TO BE 3200 PSI MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS. ALL REINFORCING STEEL TO CONFORM TO THE REQUIREMENTS OF 709.1 AND 709.4 OF THE SPECIFICATIONS. THE COST OF CONCRETE, STEEL REINFORCING, ALL OTHER REQUIRED ITEMS, SUCH AS, GASKET, GROUT, BEDDING, BACKFILL MATERIAL, PLACEMENT, ETC. IS INCLUDED IN THE COST OF THE CONCRETE PIPE SAFETY SLOPE END SECTION.



PLAN



SIDE VIEW



END VIEW

NOMINAL SIZE	EQUIVALENT ROUND PIPE SIZE	ACTUAL RISE	ACTUAL SPAN	See Drawing For Dimensions Below					
				WALL	A	B	C	D	E
	Inches								
14X23	18	14-14.75	22.75-23	2.75	6.0-8.0	26-27	45	71-72	36
19X30	24	19-19.25	30-30.25	3.25	8.5-9	31-39	33-42	72-73	48
22X34	27	21.5-22	34	3.5-3.75	9-10.5	33-54	18-40	72-73	54-60
24X38	30	24	37.75-38	3.5	9.5-12	44-54	18	62-72	60
27X42	33	27-29	42-45.5	4.5	11-0-12.0	60-63	33-36	96	72
29X45	36	28.75-29	45-45.5	4.5	11-0-12.0	60-63	33-36	96	72
34X53	42	34	53-53.25	5	15.75-18	47-60	36-51	96-98	78
38X60	48	38-38.5	60	5.5	21-22	48-60	36-50	96-98	84
43X68	54	43-43.25	67.5-68	6	22-26	60-65	31-36	96	90
48X76	60	48	76	6.5	31	60	36	96	96
53X83	66	53	83	7	33	58	38	96	102
58X91	72	58	91	7.5	37.5	78	27	105	108

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

ELLIPTICAL CONCRETE PIPE SAFETY SLOPE END SECTION

STANDARD DETAIL DRAWING DR 4
SHEET 3 of 3

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
DESIGN DIRECTIVE

DD-6##
GEOMETRIC DESIGN PROJECT CATEGORIES

Draft of April 1, 2021

The purpose of the design directive is to provide guidance to designers on the selection of geometric design criteria for the category of projects based on American Association of State Highway and Transportation Officials (AASHTO) and Federal Highway Administration (FHWA) manuals and guidance.

INTRODUCTION

This directive shall be used by designers to evaluate the project category and apply proper geometric design criteria. Each project category defines the appropriate level of compliance to various levels of geometric criteria. Geometric criteria are defined by AASHTO's Policy on Geometric Design of Highways and Streets ("Green Book") as well as various other approved manuals developed by AASHTO. FHWA also provides guidance and direction for roads on the National Highway System (NHS). Designers will identify the category of the project early in plan development and address any deviations from the criteria with project notes or design exceptions. If appropriate design criteria cannot be met, exceptions must be documented using DD-605 *Design Exception Policy*.

Many manuals and documents provide information to designers when adjustments are needed. Policies are trending to provide more flexibility to rigid standardization allowing for designs to better fit to the environment around them. For many years the Green Book has provided rigid values to be used based on road classification and volumes. The newest version of the Green Book has expanded the definition of the roads from the traditional functional systems to include contextual setting of the roadway. Performance based practical designs are becoming featured to find better solutions for DOTs as funding becomes more critical to the decision making process. Flexibility and context sensitive solutions allow for designers to meet the purpose and need of the project within budgetary limits.

PROJECT CATEGORIES

Project categories are developed to direct the designer on the proper geometric design criteria that shall be followed for the type of project to be designed. The categories are based on the type of work to be done, whether the route is on the NHS, the functional system characteristics, traffic volumes and design speed. The criteria in the different manuals and guides are based on historical values, studies and engineering judgement. The values provide guidelines to expedite the decision making and documentation of design selections.

The categories used to develop design criteria are new construction, reconstruction and "construction on existing roads". These categories are further defined as project types in the Green Book. Each category uses a performance based practical design approach to the decision making used to develop design values. New construction projects are on new alignments that use strict adherence to values and criteria developed in manuals and guides. Reconstruction projects use the existing alignment but alter the road type. Construction on existing roads are projects on existing alignments that would not be changing the roadway type and would be developed to address a specific need.

All categories shall be evaluated for their applicability as an alteration project. An alteration project is any project that meets the requirements or project description whereby Americans with Disabilities Act (ADA) facilities must be addressed. Any project defined as alteration must meet the Public Rights of Way Accessibility Guidelines for Pedestrian Facilities∗ (PROWAG) standards for curb ramp opening, slopes and widths. Any PROWAG standard that cannot be met must be documented and submitted for an ADA design exception per DD-811, "ACCESSIBILITY STANDARDS, CURB RAMPS AND SIDEWALKS".

Context and location of the roadway are fundamental items used to develop design values for flexible practical design. New construction can even be evaluated based on context of rural or urban environments. Formal design criteria can be used in rural areas due to fewer constraints than in urban, developed areas. Urban area constraints will influence the geometric design criteria and variations to criteria will need documented using performance factors based on function and context of the roadway.

NEW CONSTRUCTION

Projects that are developed in the New Construction category will use the design criteria in chapters 2 through 10 of the Green Book or other formal geometric design guidance. Generally, projects in this category shall apply "desirable" or other preferred values to geometric alignments and cross section elements. Functional and context classifications found in chapter 1 of the green book should be used to determine values for controlling criteria. There is flexibility allowed for these project categories, but the decisions shall be determined on performance based analysis and thoroughly documented.

RECONSTRUCTION

Projects developed under the Reconstruction category utilize existing alignments or minor changes but result in a change in roadway type. Changes in roadway type result in changes to cross sectional elements to address project needs or scope. These projects present problems when trying to adapt documented design criteria to new facilities due to existing context and constraints. These projects may not necessitate forecasting for future performance but should be part of a performance based approach to address facility needs. Green Book chapters 2 through 10 should be reviewed for geometric and cross-sectional guidance but facility context may drive decisions due to constraint within the corridor.

∗ Even though the Accessibility Guidelines are "Proposed", the guidelines are the standard the Federal Highway Administration and the U.S. Department of Justice use to evaluate compliance with the ADA.

Projects such as intersection improvements, adding additional lanes, adding auxiliary lanes and lane or shoulder widening would change the roadway type but would only cause minor changes to the existing alignment. These projects may not use the full criteria found in the Green Book due to nearby or corridor constraints.

An interstate reconstruction project is a project where variable design criteria may be applied. For example, cross slope criteria from A POLICY on DESIGN STANDARDS – INTERSTATE SYSTEM may be utilized to correct cross slopes, while other criteria from the Green Book would be applied. Or, interstate shoulder widths may be substandard to new construction criteria but may not be widened due to corridor or right-of-way constraints.

CONSTRUCTION PROJECTS ON EXISTING ROADS

Projects developed under the Construction Projects on Existing Roads (CPER) category are projects that have no or minor changes to the existing alignment and no changes to the roadway type. These projects use flexible criteria based on existing performance to address the facility needs or scope of the project. Projects may use Green Book design criteria, but other manuals may also be used for documenting design criteria such as GUIDELINES for GEOMETRIC DESIGN of LOW-VOLUME ROADS. The CPER category will encompass several other subcategories based on the requirements of the project. CPER projects may include 3R (restoration, rehabilitation, resurfacing) , , slide correction, bridge deck replacements, and other preventive maintenance projects.

A subcategory of the CPER is a maintenance project. An example of a maintenance project is the common resurfacing project. These projects use the existing alignments and are not intended to alter the roadway type. Green Book Section 1.7.3 also allows CPER to address project needs or street improvements to repair infrastructure condition, reduce current or anticipated traffic operational congestion, or reduce anticipated crash patterns. These projects are developed to restore rideability and prolong the serviceability of the existing surface.

PROJECT CATEGORY EXAMPLES

The following are definitions and examples of work types for the project categories. The bulleted lists below are not all inclusive, especially for CPER. Any project meeting the criteria of Alteration Project must meet standards defined in PROWAG.

NEW CONSTRUCTION

Defined as an alteration project, on new alignment meeting full compliance with design guidance. Guidance can be found in the following manuals Green Book, AASHTO A POLICY on DESIGN STANDARDS – INTERSTATE SYSTEM, Roadside Design Guide, AASHTO LRFD, etc.

- New Interstate
- New Four Lane Divided Highway
- New Two Lane Highway

RECONSTRUCTION

Defined as an alteration project, on an existing alignment (or make only minor changes to the alignment) that alters the basic roadway type. Designers use standards approved in various design guidance criteria to make performance based practical design decisions that are documented. These concepts generally follow guidance provided in Green Book allowing for more flexibility based on surrounding system characteristics and context.

- Adding Lanes or a Median
- Adding Auxiliary Lanes
- Widening Lanes or Shoulders
- Intersection Improvements
- Bridge Replacement
- Sidewalk Construction

CONSTRUCTION PROJECTS ON EXISTING ROADS (CPER)

Defined as an alteration project, on an existing alignment (except for minor changes) that maintains the basic roadway type and uses practical engineering concepts to re-establish some portion of initial serviceability or Level of Service. Projects may not follow the formal DD-202 process, but quality assurance and control may be supplemented by Safety Reviews, ADA Exception Justification Reports and other documentation to support design decisions.

- Resurfacing, Restoration and Rehabilitation (RRR)
- NHS Resurfacing
- Guardrail Installation
- Bridge Deck Replacement

CONSTRUCTION PROJECTS ON EXISTING ROADS (CPER- MAINTENANCE)

Defined as an alteration project, on an existing alignment (except for minor changes) that maintains the basic roadway type and uses practical engineering concepts to re-establish the rideability or corridor functionality.

- Non-NHS resurfacing
- Slide Repair
- Bridge Deck Overlays
- Pipe Replacement
- Microsurfacing

CONSTRUCTION PROJECTS ON EXISTING ROADS (CPER- PREVENTIVE MAINTENANCE)

Defined as a non-alteration project, on an existing alignment (except for minor changes) that maintains the basic roadway type and uses practical engineering concepts to extend the service life.

- Joint and Pavement Sealing
- Diamond Grinding
- Joint Repair and Dowel Bar Retrofit
- Paving Patching
- Guardrail Repairs
- Pulling and Restoration of Ditches
- Restriping

POLICIES, MANUAL, AND GUIDANCE

The following represents a list of approved policies and manuals for designers to document

geometric design decisions.

- ⇨ A Policy on Geometric Design of Highway and Streets, 2018, 7th Edition,
- ⇨ A Policy on Design Standards – Interstate System, May 2016
- ⇨ Highway Safety Manual, 2014, 1st Edition
- ⇨ Roadside Design Guide, 2011, 4th Edition
- ⇨ Manual for Assessing Safety Hardware, 2016, 2nd Edition,
- ⇨ LFRD Bridge Design Specifications, 9th Edition
- ⇨ Guidelines for Geometric Design of Low-Volume Roads, 2019, 2nd Edition
- ⇨ WVDOH Design Directives
- ⇨ WVDOH Bridge Design Manual
- ⇨ Any errata, supplemental or new editions of the listed documents, formally adopted by FHWA on federal aid eligible projects. The use of AASHTO approved documents prior to FHWA adoption on non-NHS projects is acceptable.

DOCUMENTATION

The following shall provide a minimum of documentation requirements of the project category. The flexibility provided in the geometric design policy may necessitate additional documentation on performance based decisions. The documentation, if not based on published standards, shall thoroughly address design applicability in type, nature and context to function of the corridor or facility. The use of practical engineering concepts for CPER should be based on long held performance-based decisions that meet system wide goals.

NEW CONSTRUCTION

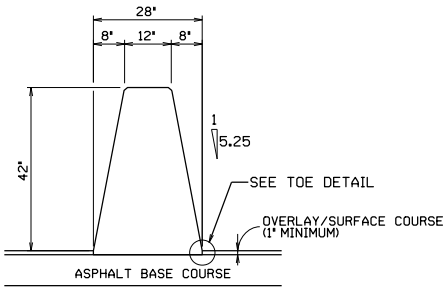
The geometric design decisions shall be documented as reference to applicable manual using table, charts or section reference. Design Exception documents shall be used to identify nonstandard dimensions. The use of less than desirable values for any dimension not defined as a controlling criteria value, shall be submitted for approval by the appropriate Deputy State Highway Engineer.

RECONSTRUCTION

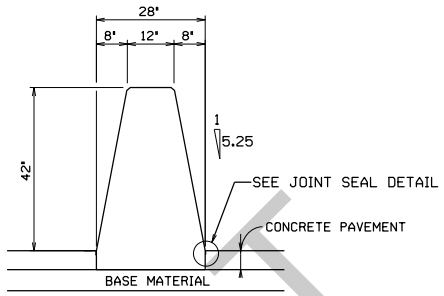
The geometric design decisions affecting roadway type shall be documented and referenced to the applicable manual using table, charts or section reference. Design Exceptions narrative should reflect performance based practical design decisions that identify the context of the surrounding area and improvements to the facility within funding constraints.

CONSTRUCTION PROJECTS ON EXISTING ROADS

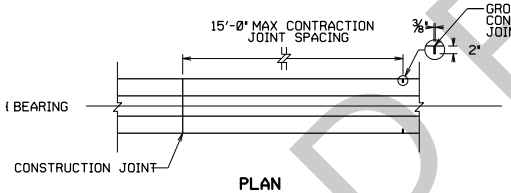
Projects designated as CPERs shall use flexible performance based solutions to address facility needs. Depending on facility designation as an NHS route, the documentation will vary. Based on the type of work, the project may be documented using formal documentation, or decisions can be based on historical performance that meet the yearly fiscal or program monetary constraints. In all cases the designer shall analyze safety concerns, accident data and address ADA concerns when documenting project decisions.



TYPE X MEDIAN
SINGLE SLOPE CONCRETE BARRIER
(ASPHALT PAVEMENTS)

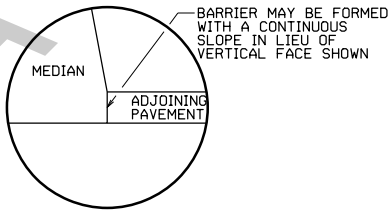


TYPE X MEDIAN
SINGLE SLOPE CONCRETE BARRIER
(CONCRETE PAVEMENTS)

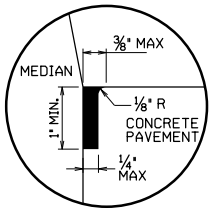


PLAN

JOINT LAYOUT



TOE DETAIL



JOINT SEAL DETAIL

NOTES

CAST-IN-PLACE OR SLIP FORMED CONCRETE MEDIAN BARRIER SHALL BE CONSTRUCTED IN SECTIONS AS SHOWN HEREIN AND SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE APPLICABLE PROVISIONS OF SECTION 610 OF THE SPECIFICATIONS.

CONCRETE SHALL MEET A MINIMUM DESIGN STRENGTH OF 4000 PSI, AND ANY APPLICABLE PROVISIONS OF SECTION 601, 501 OR 708 OF THE SPECIFICATIONS. REBAR MAY BE EITHER GRADE 40 OR 60.

MEDIAN BARRIER CONTRACTION JOINTS OVER EXISTING PAVEMENT CONTRACTION JOINTS SHALL BE SEPARATED BY OPEN JOINTS, MEDIAN JOINTS SHALL HAVE THE SAME WIDTH AS THE PAVEMENT JOINTS FOR THE FULL EXPOSED DEPTH OF THE MEDIAN.

AT ALL OTHER MEDIAN BARRIER CONTRACTION JOINTS A GROOVE 3/8" WIDE AND 2" DEEP, SHALL BE SAWED OR FORMED ACROSS THE TOP AND ALONG THE SIDES FOR THE ENTIRE DEPTH OF THE MEDIAN OR A FULL DEPTH BUTT JOINT SHALL BE FORMED. CONTRACTION JOINTS SHALL BE FORMED AT 15' INTERVALS ALONG THE LENGTH OF THE MEDIAN. THESE GROOVED OR BUTT JOINTS SHALL TRANSVERSELY ALIGN, WITHIN A PLUS OR MINUS ONE-FOOT TOLERANCE WITH THE JOINTS IN THE CONCRETE PAVEMENT.

EXPANSION JOINTS SHALL BE PLACED IN THE BARRIER MEDIAN AT STRUCTURES, OPPOSITE EXPANSION JOINTS IN THE CONCRETE PAVEMENT, OVER EXISTING EXPANSION JOINTS IN UNDERLYING CONCRETE PAVEMENT, AND AT OTHER LOCATIONS AS SHOWN ON THE PLANS OR DIRECTED BY THE ENGINEER. EXPANSION AT THESE JOINTS SHALL NOT REQUIRE END ANCHORAGE UNLESS INDICATED ON THE PLANS. AT EXPANSION JOINTS, MEDIAN BARRIER SECTIONS SHALL BE 3/4" APART AND THE OPENING FILLED, FOR THE ENTIRE DEPTH OF THE MEDIAN, WITH 3/4" PREFORMED JOINT FILLER WHICH COMPLIES WITH THE REQUIREMENTS OF SECTION 610 OF THE SPECIFICATIONS. THE FILLER SHALL BE RECESSED 1/4" IN FROM THE SIDES AND THE TOP OF THE MEDIAN AND THE COMPLETED JOINT SHALL RECEIVE NO FURTHER TREATMENT; E.G., SEALING WITH A WATERPROOF SEALER IS PROHIBITED.

THE FINISHED SURFACE OF THE MEDIAN BARRIER SHALL BE SMOOTH, DENSE, UNPITTED AND FREE FROM AIR BUBBLE POCKETS, DEPRESSIONS, AND HONEYCOMB. IF DEEMED NECESSARY BY THE ENGINEER, THE ABOVE MENTIONED FINISHED SURFACE WILL BE OBTAINED BY THE USE OF WATER AND A WOOD BLOCK OR CARBORUNDUM BRICK.

THE MEDIAN BARRIER SHALL BE ADEQUATELY TERMINATED AT EACH END, AS SHOWN OR SPECIFIED ELSEWHERE IN THE PROJECT PLANS.

DRAINAGE OPENINGS SHALL BE PROVIDED IN THE BARRIER MEDIANS WHERE INDICATED ON THE PLANS OR DIRECTED BY THE ENGINEER.

UNLESS OTHERWISE SPECIFIED, BI- DIRECTIONAL DELINEATORS, MEETING THE REQUIREMENTS OF 661 OF THE SPECIFICATIONS, SHALL BE SECURED AND MOUNTED ON SUITABLE SUPPORTS. DELINEATORS SHALL BE SPACED ALONG THE LENGTH OF THE MEDIAN BARRIER AS SHOWN AND SPECIFIED IN STANDARD DETAILS BOOK, VOLUME II.

TYPE OF SURFACE ADJACENT TO THE MEDIAN BARRIER SHALL BE SPECIFIED IN THE PLANS SHALL BE PAID FOR SEPARATELY.

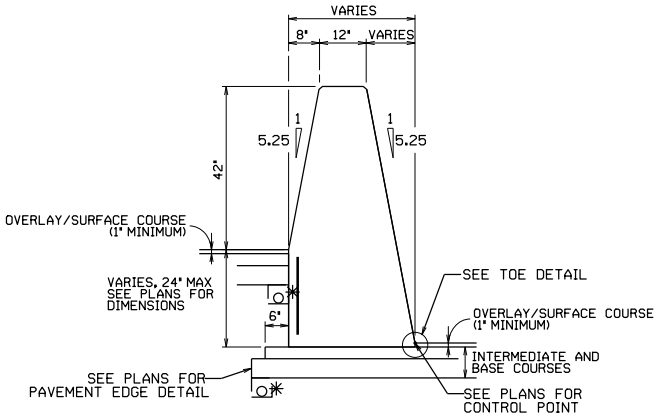
THE COST OF CONCRETE MEDIAN, REBAR, PREFORMED JOINT FILLER, DELINEATORS AND DELINEATOR MOUNTINGS SHALL BE INCLUDED IN THE COST OF THE "ITEM NUMBER 610006-010 MEDIAN, TYPE X".

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

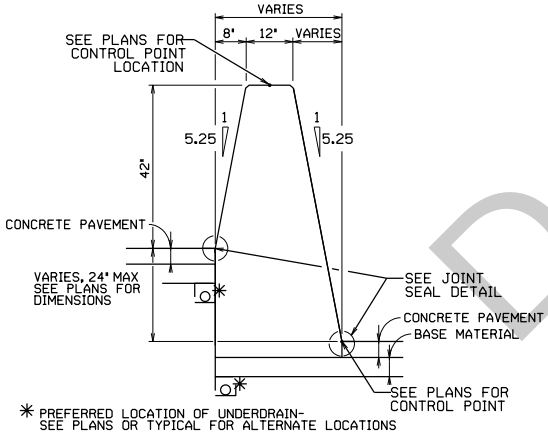
REVISION DATE
PREPARED 4-1-21

MEDIAN BARRIER TYPE X
STANDARD DETAIL

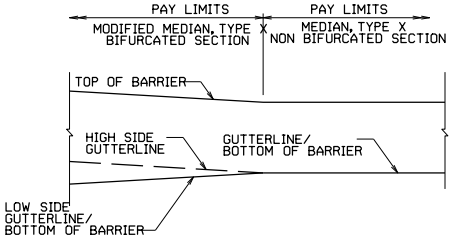
(SHEET 1 OF 2)
STANDARD SHEET GR18



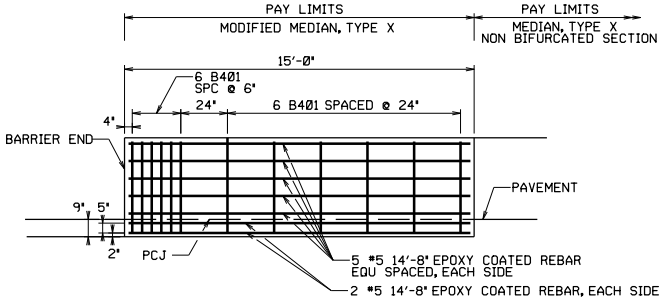
TYPE X MEDIAN MODIFIED BIFURCATED SINGLE SLOPE CONCRETE BARRIER (ASPHALT PAVEMENTS)



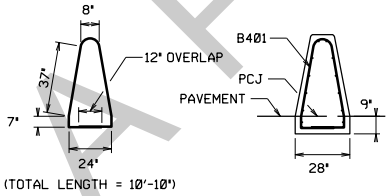
TYPE X MEDIAN MODIFIED BIFURCATED SINGLE SLOPE CONCRETE BARRIER (CONCRETE PAVEMENTS)



PAY LIMIT DETAIL SIDE VIEW

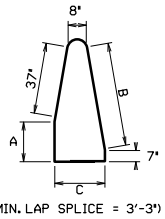


ELEVATION



B401 BEND DIAGRAM

SECTION



B401 BEND DIAGRAM BIFURCATED

REINFORCED END ANCHORAGE ARE REQUIRED AT THE ENDS OF CONCRETE BARRIER RUNS. END ANCHORAGE IS ALSO REQUIRED WHEN EXPANSION JOINT SPACING EXCEEDS 800'. AT THESE EXPANSION JOINTS, CONSTRUCT END ANCHORAGE ON BOTH SIDES OF JOINT WITH A 2"JOINT. MAXIMUM EXPANSION JOINT SPACING SHALL BE 800'. THIS DETAIL SHALL NOT BE USED AT CONSTRUCTION JOINTS OR OTHER EXPANSION JOINT LOCATIONS. DIMENSIONS A, B AND C SHALL BE SHOWN IN THE PLANS.

COST OF REBAR AND FILLER MATERIAL SHALL BE INCLUDED IN THE UNIT BID PRICE OF THE "ITEM NUMBER 610006-100 MODIFIED MEDIAN, TYPE X".

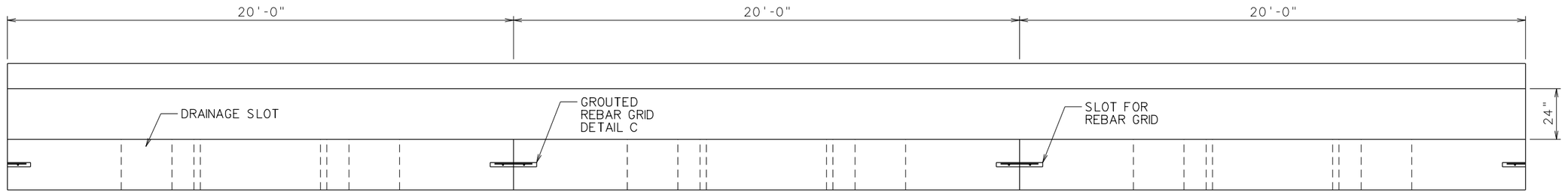
MODIFIED MEDIAN, TYPE X CONCRETE BARRIER END ANCHORAGE

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

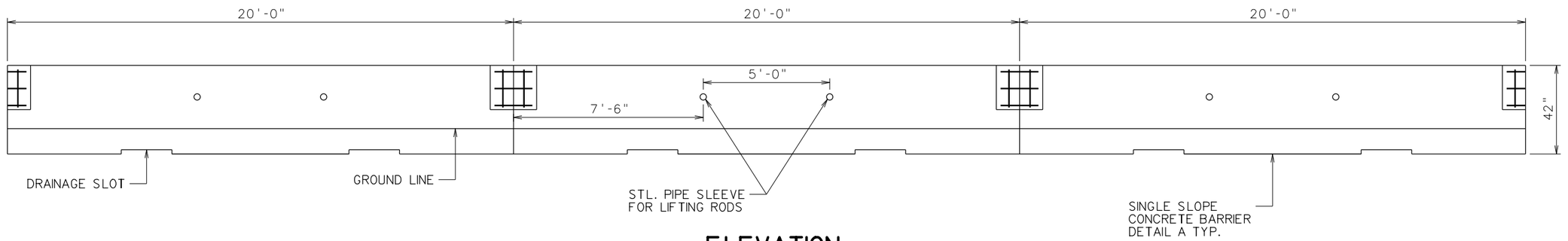
PREPARED 4-1-21
REVISION DATE

MEDIAN BARRIER TYPE X
STANDARD DETAIL

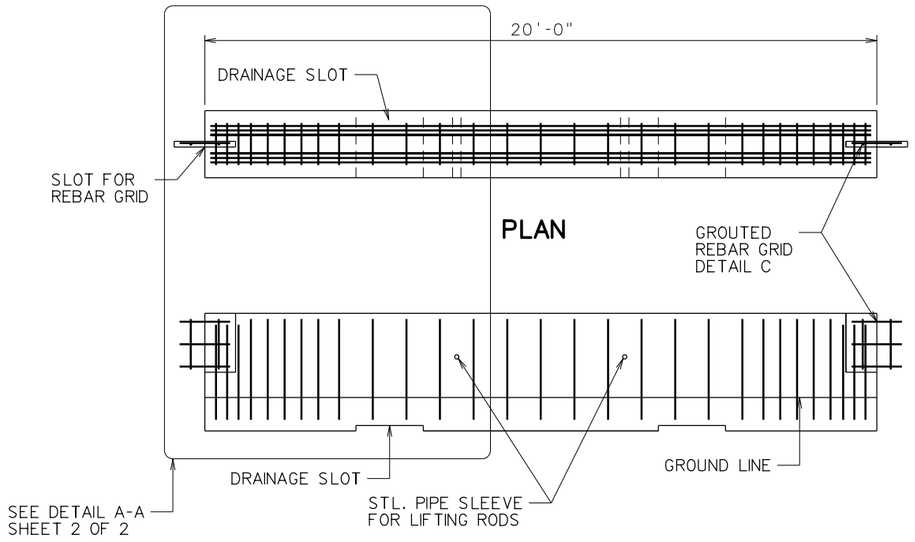
(SHEET 2 OF 2)
STANDARD SHEET GR18



PLAN



ELEVATION



ELEVATION

DETAIL A
SINGLE SLOPE
CONCRETE BARRIER

NOTES

PERMANENT CONCRETE BARRIER MAY BE CONSTRUCTED IN SECTIONS AS SHOWN HEREIN AND SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE APPLICABLE PROVISIONS OF SECTION 610 OF THE STANDARD SPECIFICATIONS.

EXPANSION JOINTS SHALL BE PLACED IN THE MEDIAN BARRIER AT 20FT INTERVALS ALONG THE LENGTH OF THE MEDIAN.

THE FINISHED SURFACE OF THE MEDIAN BARRIER SHALL BE SMOOTH, DENSE, UNPITTED AND FREE FROM AIR BUBBLE POCKETS, DEPRESSIONS, AND HONEYCOMB. IF DEEMED NECESSARY BY THE ENGINEER, THE ABOVE MENTIONED FINISHED SURFACE WILL BE OBTAINED BY THE USE OF WATER AND A WOOD BLOCK OR CARBORUNDUM BRICK.

UNLESS OTHERWISE SPECIFIED, BI-DIRECTIONAL DELINEATORS, MEETING THE REQUIREMENTS OF THE SECTION 661 OF THE STANDARD SPECIFICATIONS AND MOUNTED ON SUITABLE SUPPORTS SHALL BE SECURED TO, AND SPACED ALONG THE LENGTH OF, MEDIAN BARRIER AS SHOWN AND SPECIFIED ON STANDARD SHEET TE 11-5 OF THE STANDARD DETAILS BOOK, VOLUME II.

ANY BARRIER CONSTRUCTED FOR BIFURCATION SHALL MAINTAIN THE SLOPE RATIO ON THE VERTICAL FACE.

MATERIAL PROPERTIES

CONC. BARRIER f'c = 4,000 psi
ALL REBAR = GRADE 60
GROUT = 4,000 psi MIN.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PRE-CAST

PREPARED 12-15-17

REVISION DATE

MEDIAN BARRIER TYPE 10
STANDARD DETAIL

(SHEET 1 OF 2)
STANDARD SHEET GR17

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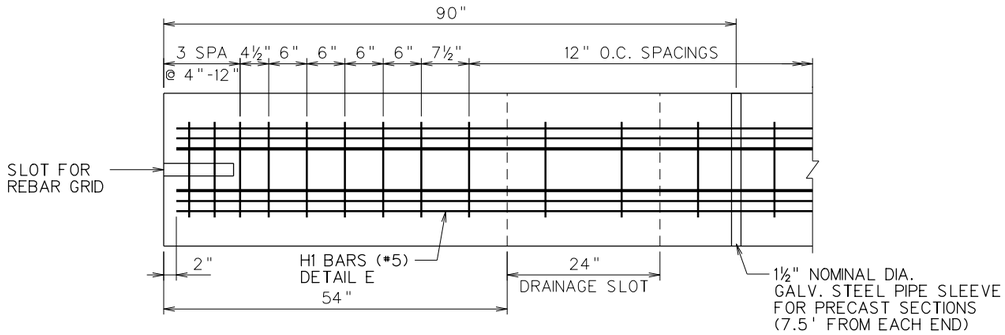
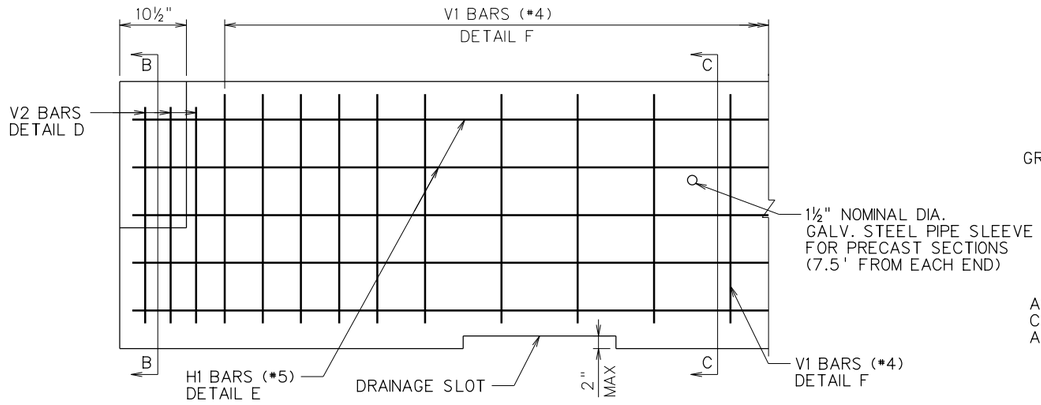
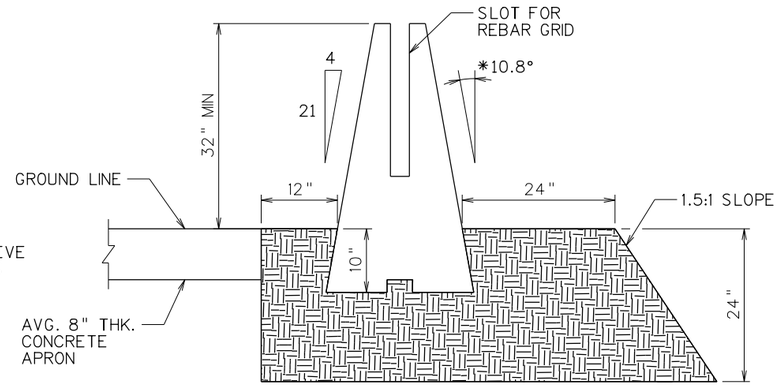


PLAN - DETAIL A-A



ELEVATION - DETAIL A-A



END VIEW A-A
SHOULDER APPLICATION

MARK	TYPE	NUMBER	LENGTH	A	B	C	D	E	R
BARRIER									
B401E	1	6	7' - 4"	3' - 8"	3' - 8"				
B402E	2	23	8' - 1"						
B501E	STR	5	19' - 8"						
B601E	STR	6	1' - 6"						
B801E	STR	6	1' - 6"						

REINFORCEMENT NOTES:

SEE ACI DETAILING MANUAL FOR STANDARD HOOK DIMENSIONS. ALL DIMENSIONS ARE OUT TO OUT.

FIGURES IN CIRCLES SHOW BAR TYPES.

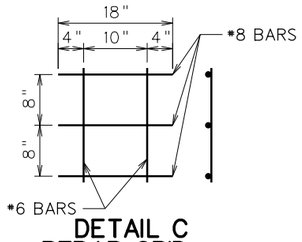
DIMENSION ON 180 DEGREE HOOKS TO BE SHOWN ONLY WHERE NECESSARY TO RESTRICT HOOK SIZE, OTHERWISE STANDARD HOOKS ARE TO BE USED.

REBAR QUANTITES BASED ON EACH 20FT SECTION OF MEDIAN BARRIER

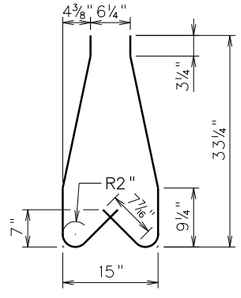
PREFIXES

B = BARRIER

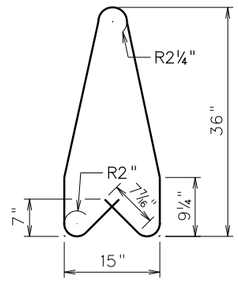
* ANY BARRIER CONSTRUCTED FOR BIFURCATION SHALL MAINTAIN THE SLOPE RATIO ON THE VERTICAL FACE



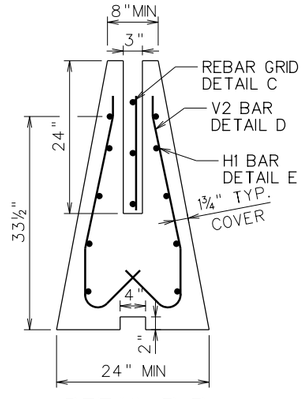
DETAIL C
REBAR GRID



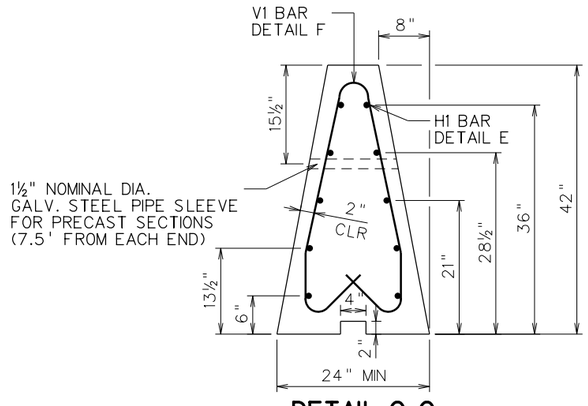
DETAIL D
V2 BAR (#4)



DETAIL F
V1 BAR (#4)

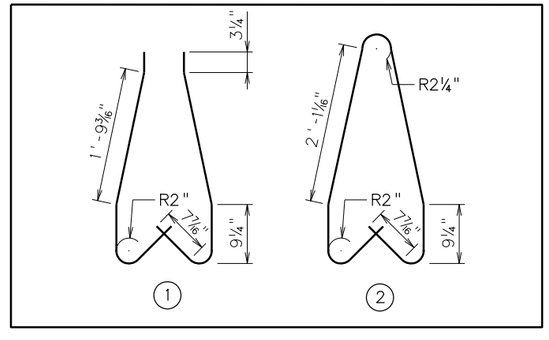


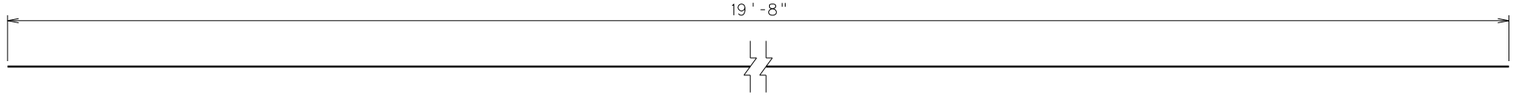
DETAIL B-B



DETAIL C-C

BAR TYPES





DETAIL E H1 BAR (#5)

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PRE-CAST

MEDIAN BARRIER TYPE 10 STANDARD DETAIL

PREPARED 12-15-17

REVISION DATE

(SHEET 2 OF 2)
STANDARD SHEET GR17

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