Technical Publications Committee
Meeting Agenda
1:00 PM June 17, 2021
Microsoft TEAMS Meeting
E-mail distribution message will include connection instructions

Call to Order

Roll Call of Attendees

Approval of Minutes of 4-15-2021 Meeting

Unfinished Business

3	DD-666 Impact Attenuators	T. Whitmore	10-1-20
4	DD-812 Salvage Value of Materials		1-28-21
5	DD-204 Guidance for Use of CPM Schedules for Projects Under Design	R.J. Scites	4-15-21
6	DD-503 Selection of Pipe Materials	D. Kirk	4-15-21
7	DD-621 Intersection Sight Distance	M. Dougherty	4-15-21
8	DD-702 Signing and Sealing Professional Work	M. Dougherty	4-15-21
9	DD-803 Determination of Contract Completion Date	M. Dougherty	4-15-21
10	Standard Detail DR4 for Elliptical Concrete Safety End Sections	A. Gillispie	4-15-21
11	DD-612 New Design Directive – Project Categories	R.J. Scites	4-15-21
12	New Standard Detail GR18 – Type X Median Barrier	J. Hall	4-15-21
13	Rescind Existing Standard Detail GR17 – Type 10 Median Barrier	J. Hall	4-15-21

Continued

New Business

14	DD-105 – Technical Committees		6-17-21
15	Standard Detail Sheet DR4 2 of 2 Round RCP End Sections Erratum Correction	A. Gillispie	6-17-21

Next Meeting – Wednesday August 25, 2021, via Microsoft Teams. Deadline for submissions July 26, 2021.

Adjournment

Technical Publications Committee
Meeting Minutes
April 15, 2021

Meeting was called to order at 1:00 by Chair Martin Dougherty

Attendees:

DOH

Dougherty, Martin - DS	Hall, Joe - DD	Foster, Jason - HD
Boggs, Steve - DS	Thompson, Conner - FM	Murray, Bill* - OM
Smith, Shawn* - FC	Whitmore, Ted* - DT	Kirk, Douglas - DD
Neeley, Barrett - DD	Long, Travis - DS	Hardy, Donna - DT
Conley-Rinehart, Laura - DD	Jack, Shawn - FM	Brayack, Daniel* - FM
Adam Gillispie - FM	Brown, Phillip - FM	Cummings, John - FM
Scites, RJ* - DD	Bodnar, David - DD	Mongi, Ahmed - DD
Hoover-Trent, Kimberly - OM	Thaxton, Andrew - FM	

*Voting Delegate

Others:

John Susong – Rinker Pipe	Don McNutt – ACPA	John Turner – Forterra
Sandy Collins-Carmargo – ADS	Yuvonne Smith – FHWA	Wes Hevener - AMT
Pat Parsons – CAWV/WVAPA	Chris LeRose - M&M	Yogesh Patel – WVDEP
Mark Haverty – Kelly Paving	Tony Anders – Triton	Kyle Stollings – Potesta
Andrew Cunningham – Bear Cont.		

Minutes of January 28, 2021 meeting were approved without objection.

Unfinished Business

DD-251 Temporary Erosion Control
This is a major revision to the directive to address changes in the NPDES Permit issued by WVDEP. After brief discussion of the changes since the last meeting, the revised directive was accepted by 4-0 vote.

Rescind WVDOH Erosion and Sediment Control Manual
No discussion, rescission of the E&SC Manual was accepted 4-0. This makes the WVDEP's Best Management Practices Manual the default E&S manual for the DOH.

DD-666 – Impact Attenuators
This directive is intended to provide guidance to designers on the use of impact attenuators and discourages their use when a more cost effective device (i.e. end terminal) or other solution can be employed. Such guidance is not currently provided. An update to the Specifications related to attenuators was accomplished last year. This directive is written to closely correlate with the revised specifications.

There was small discussion on this item; however, due to the large amount of changes presented a vote was not taken to allow further review.

DD-644 – Asphalt Pavement
After a brief discussion the revisions to this directive were accepted by vote of 4-0.

DD-812 – Salvage Value of Materials
Several revisions were discussed. FHWA had several comments, industry had many comments. Vote was not taken. Meetings will be held internally and with FHWA.

Attachment to DD-706 – PS&E Checklist
The revisions add the Salvage Value Memo, the Design Exception Report, the FA Resurfacing 'Operational and Safety Review Checklist', added email to the contact information, moved the Incentive/Disincentive Spec. Prov. to the Proposal Section, deleted requirement Geotech Report be on CD, corrected spelling errors. Revisions accepted by vote of 5-0

New Business

DD-204 Guidance for Use of CPM Schedules for Projects Under Design
With the June 7 "Go Live" date for the Hub, it is necessary to rewrite the Directive on Design Project Scheduling. This is a total rewrite of the existing Directive and so is presented as a clean version. The Hub is the replacement software for the legacy Project Tracking System. Project Managers will utilize *Microsoft Project* to communicate with the Hub. This revised Directive will provide some guidance to project managers as to the necessary procedures. There was minimal discussion.

DD-503 Selection of Pipe Materials
With the success of previous revisions to this Directive, and with more and better performance data available, the DOH wants to expand the use of polymer pipe materials. The revisions are presented in redline form. The revisions are limited to Table 503-1 and address the ADT break points and use of Type F Trench. Significant discussion between the polymer pipe and concrete pipe representatives in attendance.

DD-621 Intersection Sight Distance
Changes are to reference the latest edition of the AASHTO Green Book (currently it refers to the 2011 Edition), add Case G (roundabouts) to the list of turning movements, suggest methods of improvement to the sight distance, and require improved documentation by the designer. There was no discussion.

DD-702 Signing and Sealing Professional Work
The change is to return some words that were inadvertently omitted from the last revisions. Division Directors and District Engineers will be allowed to delegate their responsible charge duties to other W. Va. registered professional engineers. There was no discussion.

DD-803 Determination of Contract Completion Date
With changes to the Department of Environmental Protection's NPDES permitting requirements, it is necessary to provide designers with revised production rate tables to allow for the Contractor's NPDES Permit registration time. Though the time frames may seem large, this time overlaps with other aspects of the construction such as ordering materials and fabricating components. Other revisions include: 1) changing the name of the *PS&E Unit* to *Contract Development Section*, 2) stating that full oversight projects are required to have a pre-PS&E submission, and 3) simplifying some language in several

locations. Comments were received from industry (Tony Anders) for both the proposed NPDES permitting/registration and some existing production rates:

a) NPDES Permitting under 100 Acres, allows 8 months. Comment: "12 months needed."
b) NPDES Permitting over 100 Acres, allows 10 months. Comment: "15 months minimum especially with larger waste areas involved."
c) Aggregate Base Course 2,500 Tons/day on mainlines. Comment: "Trucking not available to exceed 1,500 tons/day."
d) Excavation, 1,000 CY/day urban. Comment: "Very difficult if traffic involved."
e) Pipe, less than 60" 300 LF/day. Comment: "Unrealistic if traffic involved."
f) Forming and pouring footings, 1-2 days per bent, increase for complicated layouts. Comment: "Too aggressive and allow cure time for superimposed loads."
g) Expansion Device, 35 working days. Comment: "Standard quote notes are 12 to 14 weeks after shop drawings."
h) 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. Comment: "Too aggressive for deeper plates"
i) Approach Slabs. Comment: "Please allow for sleeper slabs."
j) Deck replacement concrete curing time, 4 days/pour. Comment: "Specs are 7 days."

DOH will hold internal meetings to address these comments.

Standard Detail for Elliptical Concrete Safety End Sections

With the shifted paradigm of using more concrete pipe the DOH now sees the need for standard drawings for elliptical concrete end sections. Adoption of standard drawings saves much effort and time in the materials acceptance procedures. These drawings are based on the existing Drawings DR4 Sheet 2 of 2 for round RCP end sections. This is an entire new drawing. No comments were received.

DD-6?? New Design Directive – Project Categories

In the 2018 Edition of the AASHTO Green Book the concept of *Project Categories* is established. The use of project categories provides a designer with greater flexibility than otherwise would exist. This directive provides guidance to designers as to how to use the flexibility.

New Standard Detail - Type X Median Barrier

This proposed new Standard Detail Drawing is currently being used as a Special Detail. This is an unreinforced MASH compliant 42" median barrier. To be assigned number GR18. There was minimal discussion.

Rescind Existing Standard Detail GR17 – Type 10 Median Barrier

With the acceptance of The Type X barrier, the use of Type 10 barrier will no longer be needed and Standard Detail Drawing GR17 should be rescinded.

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

Adjournment

Technical Publications Committee
Agenda Introductions
June 17, 2021

Unfinished Business

DD-666 – *Impact Attenuators*
This directive is intended to provide guidance to designers on the use of impact attenuators and discourage their use when a more cost effective device (i.e. end terminal) or other solution can be employed. An update to the Specifications related to attenuators was approved last year. This directive is written to closely correlate with the revised specifications.
The directive provides guidance regarding design requirements or features that should be incorporated to better facilitate the use of these devices and to insure that they function as intended and tested (i.e. barrier wall end transitions, minimizing or eliminating curbs on approaches, cross slopes, etc.) It is presented as a redline copy showing changes since the last meeting

DD-812 *Salvage Value of Materials* is presented as a redline copy updating the version presented at the April Meeting. The revisions change the formula for estimating the value of asphalt cuttings. This is the third time to Committee and is eligible for vote, passage is expect at this meeting.

DD-204 *Guidance for Use of CPM Schedules for Projects Under Design*
With the July 19th "Go Live" date for the Hub, it is necessary to rewrite the Directive on Design Project Scheduling. This is a total rewrite of the existing. The Hub is the replacement software for the legacy Project Tracking System. Project Managers will utilize *Microsoft Project* to communicate with the Hub. This revised Directive will provide some guidance to project managers as to the necessary procedures. It is presented as a redline copy showing the changes since the last meeting. This is the second time to committee, passage is expected today.

DD-503 *Selection of Pipe Materials*
The DOH wants to expand the use of polymer pipe materials. The revisions are limited to Table 503-1 and address the ADT break points and use of Type F Trench. HDPE, PVC profile wall, and PP profile wall will be allowed up to 6,000 ADT without Type F trench. It is believed these revisions will result in decreased construction costs as more options will be available and decreased maintenance costs over the long term. This is the second time to committee, passage is expected today.

DD-621 *Intersection Sight Distance*
Changes are to reference the latest edition of the AASHTO Green Book (current version refers to the 2011 Edition), to add Case G (roundabouts) to the list of turning movements, suggest methods of improvement to the sight distance, and require improved documentation by the designer. Two comments received from the FHWA after the last meeting are to move the location of the table and give it a name. Since both changes are minor in nature this directive is presented as an unmarked version. This is the second time to committee, passage is expected today.

DD-702 ***Signing and Sealing Professional Work***
The change is to return some words that were inadvertently omitted from the last revisions. Division Directors and District Engineers will be allowed to delegate their responsible charge duties to other W. Va. registered professional engineers. There are no changes from the last meeting. This is the second time to committee, passage is expected today.

DD-803 ***Determination of Contract Completion Date***
With changes to the Department of Environmental Protection's NPDES permitting requirements, it is necessary to provide designers with revised production rate tables to allow for the Contractor's NPDES Permit registration time. Changes presented at the last meeting have been accepted. Several comments were received regarding the production rate tables shortly before the last meeting and have since been addressed. The resulting revisions to the DD are shown as redline changes. This is the second time to committee, passage is expected today.

Standard Detail for ***Elliptical Concrete Safety End Sections*** **DR4**
With the shifted paradigm of using more concrete pipe, as opposed to CMP, the DOH now sees the need for standard drawings for elliptical concrete end sections. Adoption of standard drawings saves much effort and time in the materials acceptance procedures. This drawing will reduce paperwork during the construction phase. To clarify the drawing and to make it more similar to the round RCP end sections the "Side View" is changed to a section view. This is the second time to committee, passage is expected today.

DD-612 New Design Directive – ***Project Categories***
In the 2018 Edition of the AASHTO Green Book the concept of *Project Categories* is established. The use of project categories provides a designer with greater flexibility than otherwise would exist. This directive provides guidance to designers as to how to use the flexibility. Comments received prior to the last meeting were presented then as redline changes. Those changes were accepted. This is the second time to committee, passage is likely today.

New Standard Detail GR18 – ***Type X Median Barrier***
This proposed new Standard Detail Drawing is currently being used as a Special Detail. This is an unreinforced MASH compliant 42" median barrier. Do to being unreinforced this will likely bid less expensive than the existing Type 10 barrier. No comments were received. This is the second time to committee, passage is expected today.

Rescind Existing Standard Detail GR17 – ***Type 10 Median Barrier***
If and when the Type X barrier is accepted, the use of Type 10 reinforced barrier will no longer be needed and Standard Detail Drawing GR17 should be rescinded. No comments were received. This is the second time to committee. If Drawing GR18 is approved, then passage is expected today.

New Business

DD-105 ***Specification, Publication, and Material Procedures Approval Process***

With the creation of the Technical Support Division, the Specifications Committee and Technical Publications Committee functions moved to the new division. The revisions reflect that change. Additional changes are: 1) remove Engineering Division from the MP Committee and replace it with the Technical Support Division, 2) to delete a few sentences from the MP Committee Section to improve committee efficiency, and 3) replace the requirement that the use of certain Special Provisions be approved by the *DSHE-Construction & Development* with approval by the *appropriate DSHE*. This is the first time to committee.

Erratum on Existing Standard Detail DR4 Sheet 2 of 2

At the last meeting, a commenter pointed out that the elliptical RCP end section drawing shows dimension "A" differently than the round RCP end section drawing. It turns out the 'round' drawing is incorrect. We believe this to be a simple erratum correction. Without objection from any voting delegate or the FHWA we will process this as the minor correction it is.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 666
IMPACT ATTENUATORS

Draft of June 4, 2021

First Edition

The purpose of this Directive is to establish the Division's guidelines for the use of permanent and temporary attenuators. The scope of this Directive includes a description and explanation of attenuators, guidelines as to when attenuators should be incorporated, 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

Attenuators are traffic safety devices that prevent errant vehicles from impacting fixed objects. Attenuators have the ability to shield the object from vehicles approaching from the front and either side. Attenuators function during front, head-on impacts by gradually decelerating vehicles to a safe stop. During side impacts, attenuators are designed to either function as a rigid barrier which redirects vehicles away from the attenuator 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. 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 this type attenuator.

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, its more formidable size in relation to the object that the attenuator shields.. Attenuators should only be utilized when other options recommended in the AASHTO *Roadside Design Guide* (RDG) have been considered and it is determined that an 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. An attenuator should not be selected to shield the end of a run of single faced guardrail unless unique circumstances require otherwise. 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. To a lesser extent, 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.

The RDG lists typical fixed objects that generally merit shielding when located within the clear zone.

It is 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.

SECTION 3.1 – SPEED CATEGORIZATION

Attenuators are subject to industry crash testing requirements mandated by the FHWA. Current crash testing requirements are contained in the AASHTO publication *Manual 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 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 attenuators for particular applications. Designers for the WVDOH shall specify ~~TL-2 attenuators where the normal posted speed limit in effect at the location of the device is 40 MPH or less~~the attenuator test level to be used based on the table provided in Section 4. ~~Otherwise, a TL-3 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

Attenuators may be categorized as gating or non-gating. Non-gating 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, 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 attenuators perform essentially the same as non-gating attenuators. During side impacts, they are designed to capture and gradually decelerate the vehicle and do not have any ability to redirect vehicles. Gating attenuators typically are sand barrel arrays. 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. In some cases, the vehicle may impact only one of the barrels before impacting the fixed object. Due to this and other concerns, gating 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 attenuators that are designed to shield relatively wide objects.

SECTION 3.3 – WIDTH CATEGORIZATION

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

In some cases, particular manufacturers do not offer models of an 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.

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 and is subject to modification based on changes to the Approved Products List (APL). 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 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 generally less costly but more sacrificial than Class 1 devices typically requiring almost complete replacement after a design impact. 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.
The TL-2 and TL-3 descriptions in the bid items refer to the crash testing Test Level. The Test Levels are 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

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, 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 attenuator 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 attenuator 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 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 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:

- 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 width of the obstacle is not specified as part of the temporary 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 recognized the availability of a “Temporary Impact Attenuating Device” for the next phase of a project using the Remove and Reset pay 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 attenuator. These transitions are included in the 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 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 attenuator installations is the need for these areas to be nearly uniform in longitudinal and lateral 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.

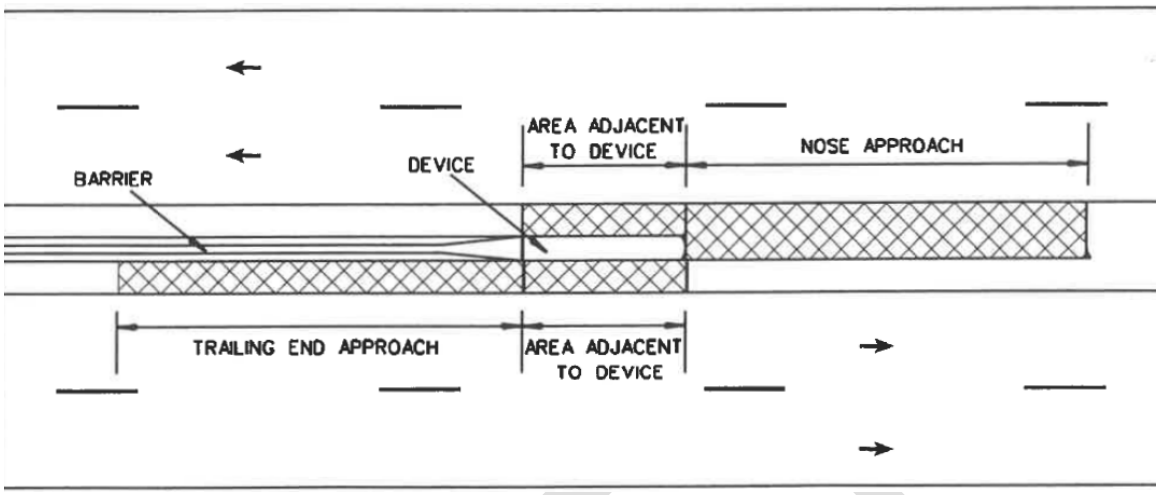

Figure 5.1

If the approach areas are non-uniform, 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 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 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 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 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, cross slope in the area leading up to and adjacent to where an 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 attenuator is to be placed should be 1V:11 H or flatter.

Sight Distance

The 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.

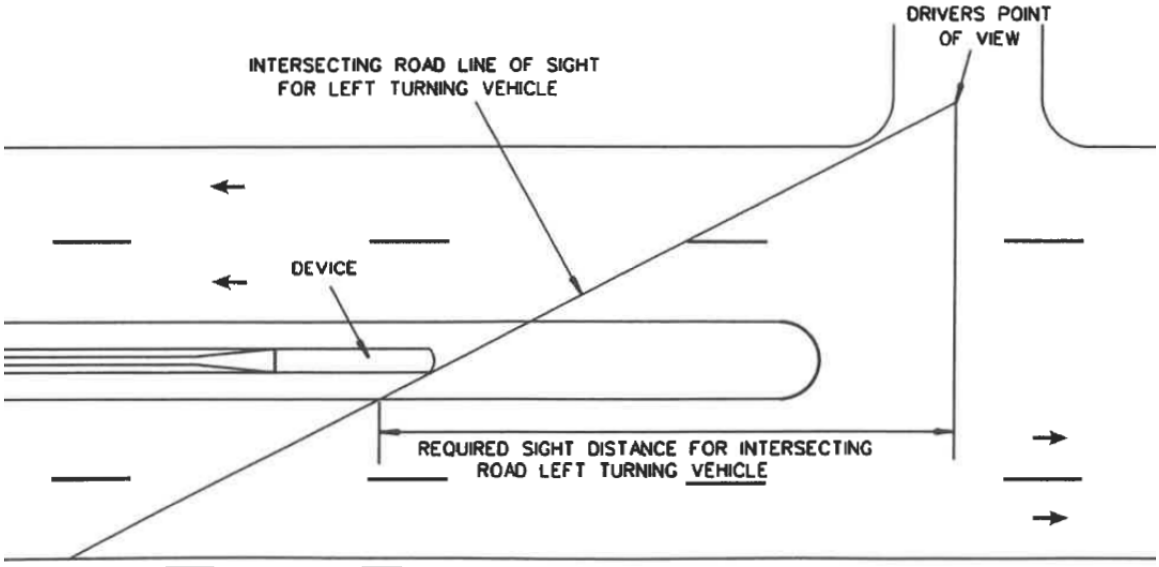

Figure 5.2

Impact Attenuator Accommodating Transitions

In most cases, 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 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 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 attenuator manufacturer provided transitions will be used to transition from the 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. 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.

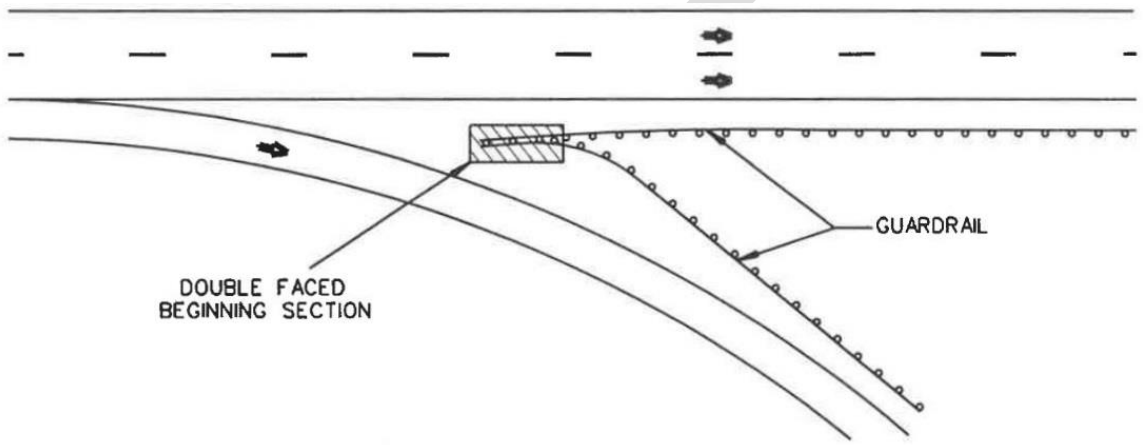

Figure 5.3

Figure 5.3 depicts a situation where penetration within the perimeter of the guardrail is unacceptable due to terrain issues that cannot be addressed by grading or other features or obstacles that cannot be addressed by removal or other means. Depending on the site conditions, alternative designs or devices may be more desirable or appropriate. If there is ample gore traversable area and therefore frequent impacts of the nose are not expected, a thrie beam bull nose treatment may be more cost effective. If penetration by vehicles approaching the nose is acceptable, separate tangent end terminals for each run of guardrail with proper lateral spacing between each may also be more cost effective and will provide for more ease of access within the perimeter for maintenance activities.

If the 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.

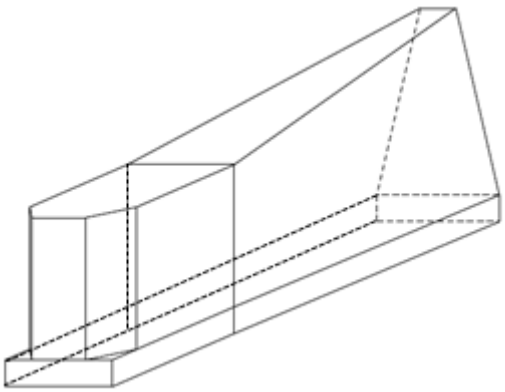

Figure 5.4

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.

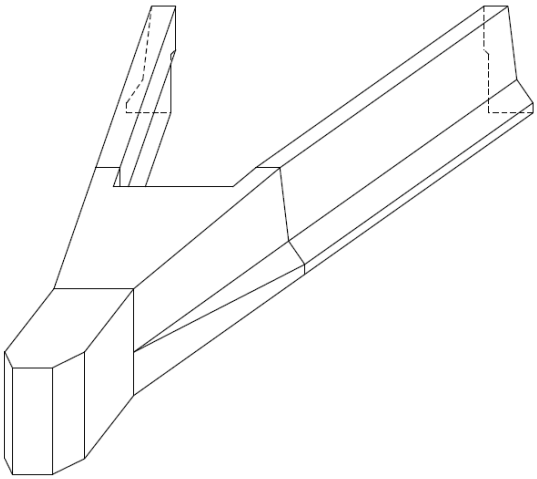

Figure 5.5

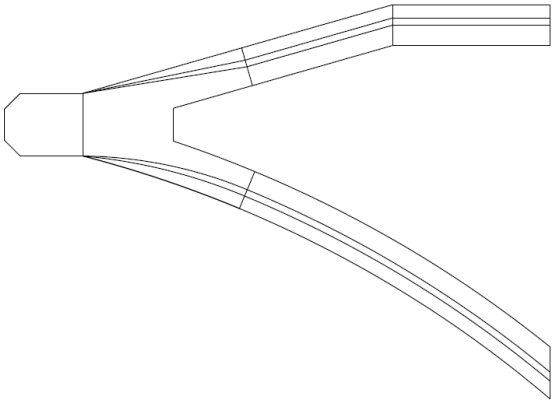

Figure 5.6

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 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. 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 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.

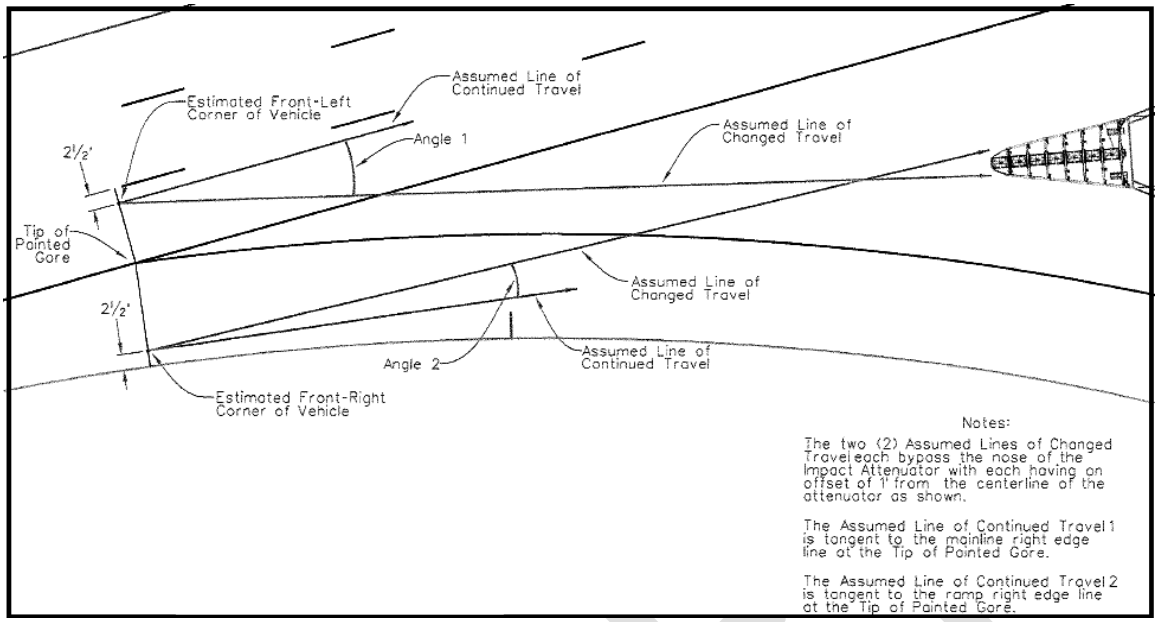

Figure 5.7

After estimating the approximate location of the nose of the 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 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.
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 812
SALVAGE VALUE OF MATERIALS

Draft of April 21, 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:

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%~~ 40% to represent the ~~intrinsic~~ value of the materials in the asphalt mix. Since a contractor is limited to 25% recycled content in a mix, without the use of upgraded binders, 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~~ 0.40 x 0.25 = ~~$4.00/ton~~ $6.40/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 ~~$4.00/ton~~ $6.40/ton= ~~$9292.54~~$14,868.06. Round to 3 significant digits, say ~~$9290~~ $14,900.

   Enter the ~~$9290~~ $14,900 in the memo in step ~~two~~ three.

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

DESIGN DIRECTIVE 204
GUIDANCE FOR USE OF PROJECT SCHEDULES
FOR PROJECTS UNDER ~~DESIGN~~DEVELOPMENT

Draft of May 13, 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~~ Do not "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 May 28, 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 ≥ 6,000 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), (type F trench required for ADT ≥12,000
Highways with an ADT < 6,000 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 (Q2) 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

May 14, 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 in Section 9 of the 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.

DESIGN VEHICLE SELECTION TABLE

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

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 provided by the designer, approved by the responsible charge engineer, and archived with the project documents.

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 May 11, 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:

1. Coordination with other government agencies
2. Emergency conditions.
3. Minimize annoyances in residential areas.
4. Minimize traffic disruption and delay in high traffic areas.
5. Coordination with other activities and other projects to be performed in the same work area.
6. Political sensitivity and public awareness.
7. 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 developed by the designer shall be submitted as part of the 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 Contract Development Section will establish the 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

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 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 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 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.

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 .

9. Contract Administration Division's Contract Development Section will use the "Chart" which is in working days and convert it to a calendar period in order to establish the project's contract completion date. Factors to be considered by the 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. 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) Advertising period.
        4) Bid review period.

5) Award time.
6) Scheduling preconstruction conference.
7) 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 2021

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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~~1,500 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~~1,500 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. Assume 75% of rates for large TTC
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~~ Asphalt 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~~ Asphalt 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~~ Asphalt 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 Item 229001, 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 the 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.
Predrilled and Grouted Piles	4 to 5 piles/day. Add one day/bent for steel piles with anticipated length over 40 feet.

STRUCTURES, CULVERTS AND OVERLAYS (cont.)

Structure Operation	Rate Per Working Day
Forming and Pouring Footings	~~1 to 2~~2 to 3 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~~ 60 to 70 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~~ 8 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.
Deck 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~~ Concrete Placement	5,000 SF/day.
Concrete Curing Time	~~4 days/pour.~~
LMC	4 days/pour
Silica Fume (Microsilica)	7 days/pour.

TRAFFIC ITEMS

Work Item	Rate Per Working Day
NPDES Permitting	If as a separate project the 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	80 days/project.
Structures	
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** ____

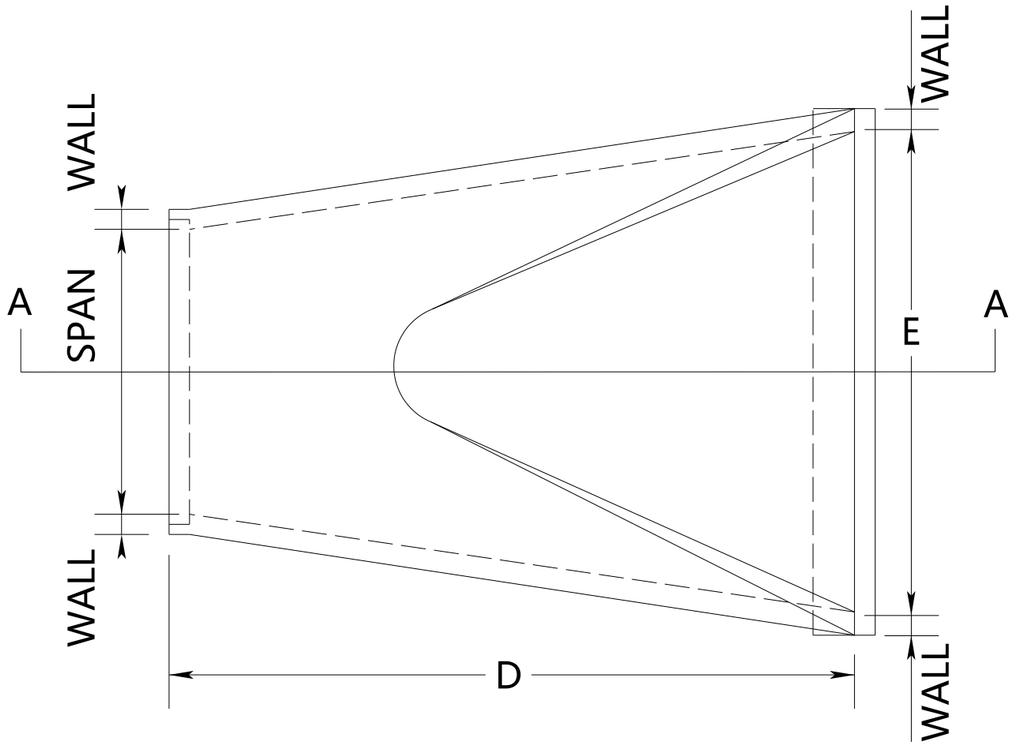
ACTIVITY	UNIT OF WORK	PROD RATE	WORK DAYS																		

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

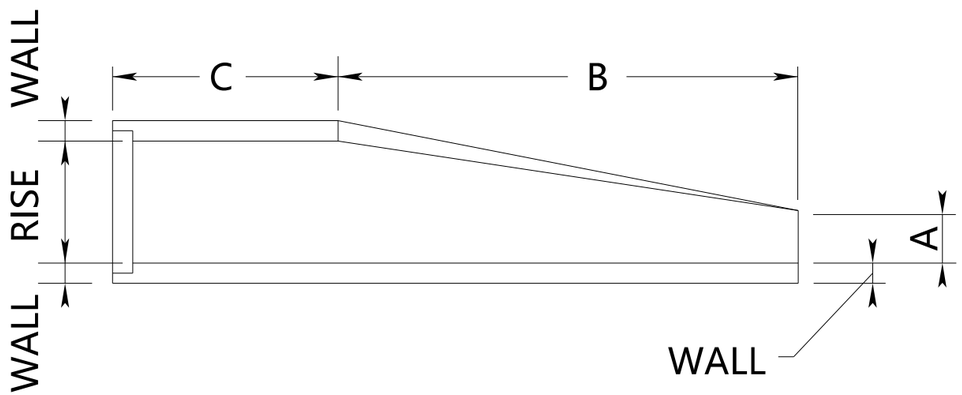
20 of 20

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.

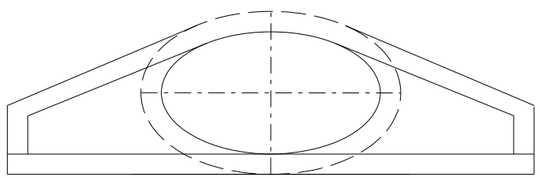


PLAN



SECTION A-A

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



END VIEW

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

ELLIPTICAL CONCRETE PIPE SAFETY SLOPE END SECTION

PREPARED 05/26/2021

REVISION DATE

STANDARD DETAIL DRAWING DR 4
SHEET 3 of 3

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 612
GEOMETRIC DESIGN PROJECT CATEGORIES

Draft of May 13, 2021
First Edition

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.

10. 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.

20. 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.

A. 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.

B. 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.

Projects such as intersection improvements, 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

* 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.

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 and superelevation from the Green Book should be applied. to meet under this category they may not be widened Since this would alter the roadway type. In this case shoulder widths may be substandard to meet criteria but under this category they may not be widened since this would alter the roadway type.

C. 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), 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. These projects are developed to restore rideability and prolong the serviceability of the existing surface.

30. 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.

A. 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.

1. New Interstate
2. New Four Lane Divided Highway
3. New Two Lane Highway

B. 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.

1. Adding Lanes or a Median
2. Adding Auxiliary Lanes
3. Widening Lanes or Shoulders
4. Intersection Improvements
5. Bridge Replacement
6. Sidewalk Construction

C. CONSTRUCTION PROJECTS ON EXISTING ROADS

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.

1. Resurfacing, Restoration and Rehabilitation (RRR)
2. NHS Resurfacing
3. Guardrail Installation
4. Bridge Deck Replacement

D. CONSTRUCTION PROJECTS ON EXISTING ROADS (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.

1. Non-NHS resurfacing
2. Slide Repair
3. Bridge Deck Overlays
4. Pipe Replacement
5. Microsurfacing

E. CONSTRUCTION PROJECTS ON EXISTING ROADS (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.

1. Joint and Pavement Sealing
2. Diamond Grinding
3. Joint Repair and Dowel Bar Retrofit
4. Paving Patching
5. Guardrail Repairs
6. Pulling and Restoration of Ditches
7. Restriping

40. POLICIES, MANUAL, AND GUIDANCE

The following represents a list of approved policies and manuals for designers to document geometric design decisions.

A. A Policy on Geometric Design of Highway and Streets, 2018, 7th Edition,
B. A Policy on Design Standards – Interstate System, May 2016

C. Highway Safety Manual, 2014, 1st Edition
D. Roadside Design Guide, 2011, 4th Edition
E. Manual for Assessing Safety Hardware, 2016, 2nd Edition,
F. LFRD Bridge Design Specifications, 9th Edition
G. Guidelines for Geometric Design of Low-Volume Roads, 2019, 2nd Edition
H. WVDOH Design Directives
I. WVDOH Bridge Design Manual
J. 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.

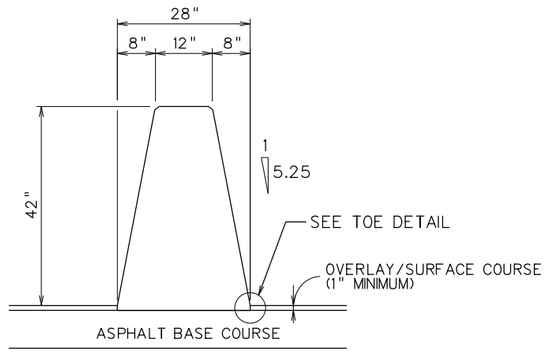
50. DOCUMENTATION

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.

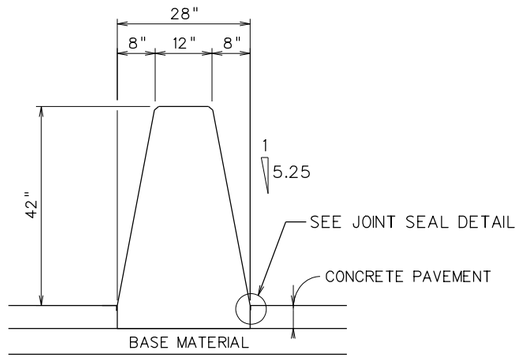
A. NEW CONSTRUCTION
The geometric design decisions shall be documented as reference to applicable manual using table, charts or section reference. Design Exception documents shall be used to identify nonstandard dimensions. The use of less than desirable values for any dimension not defined as a controlling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

B. 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.

C. 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)



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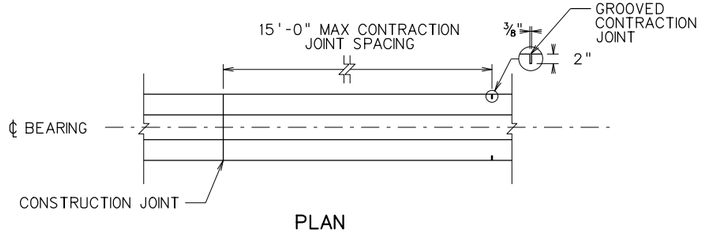
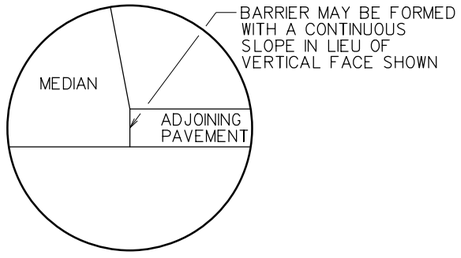
(CONCRETE PAVEMENTS)

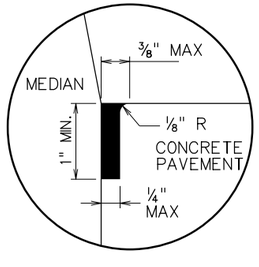


PLAN

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.

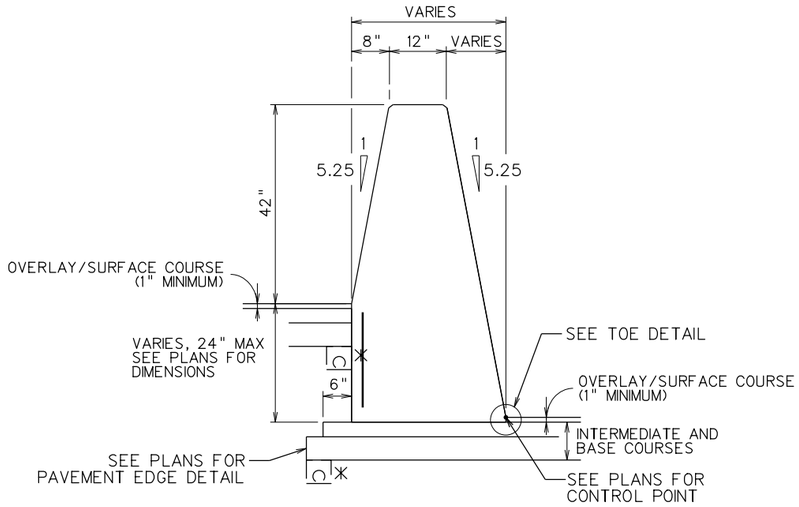
THE COST OF CONCRETE MEDIAN, REBAR, PREFORMED JOINT FILLER, DELINEATORS AND DELINEATOR MOUNTINGS SHALL BE INCLUDED IN THE COST OF THE "ITEM NUMBER 610006-010 MEDIAN, TYPE X".

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

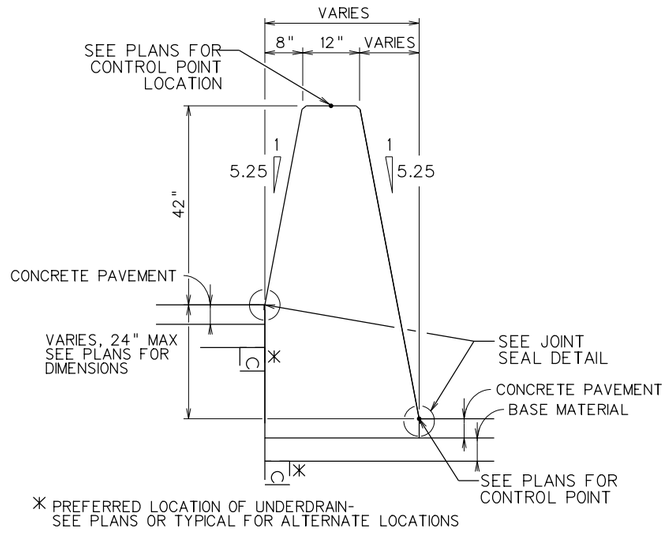
PREPARED 4-1-21
REVISION DATE

MEDIAN BARRIER TYPE X
STANDARD DETAIL

(SHEET 1 OF 2)
STANDARD SHEET GR18



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



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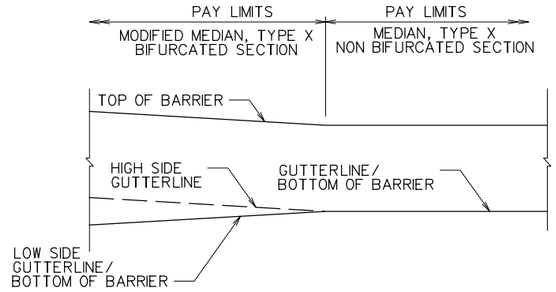
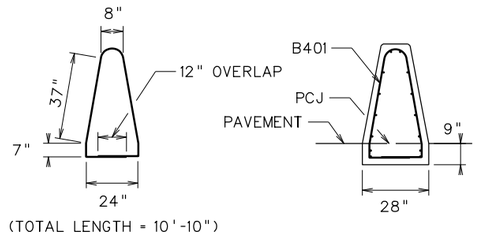
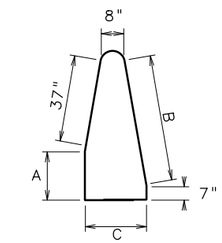


PAY LIMIT DETAIL SIDE VIEW



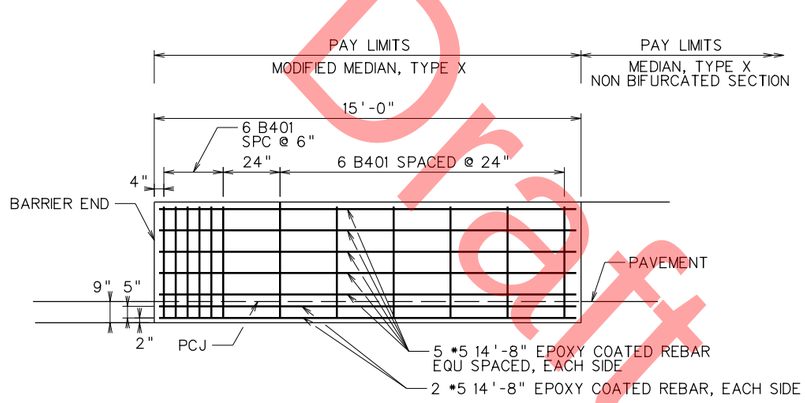
B401 BEND DIAGRAM

SECTION



(MIN. LAP SPLICE = 3'-3")

B401 BEND DIAGRAM BIFURCATED



ELEVATION

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".

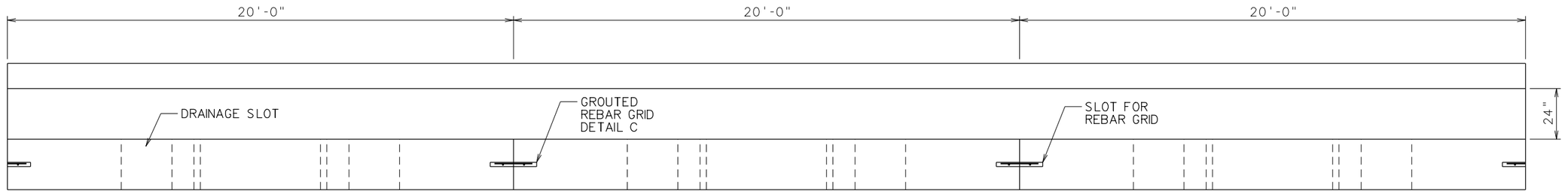
MODIFIED MEDIAN, TYPE X CONCRETE BARRIER END ANCHORAGE

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

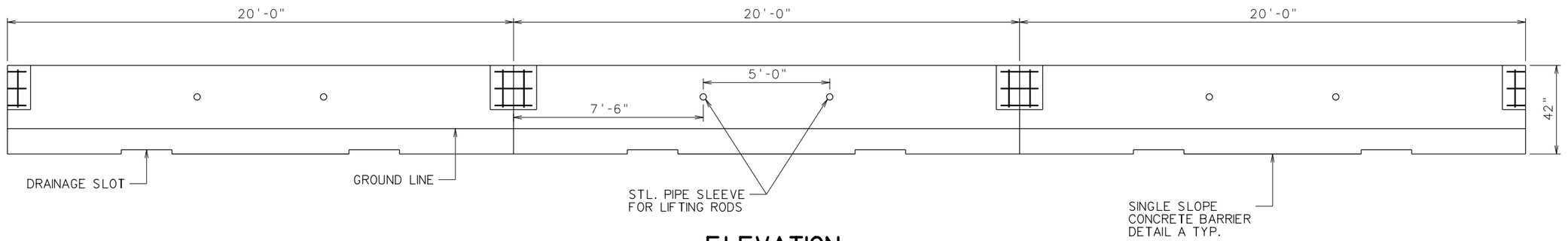
PREPARED 4-1-21
REVISION DATE

MEDIAN BARRIER TYPE X
STANDARD DETAIL

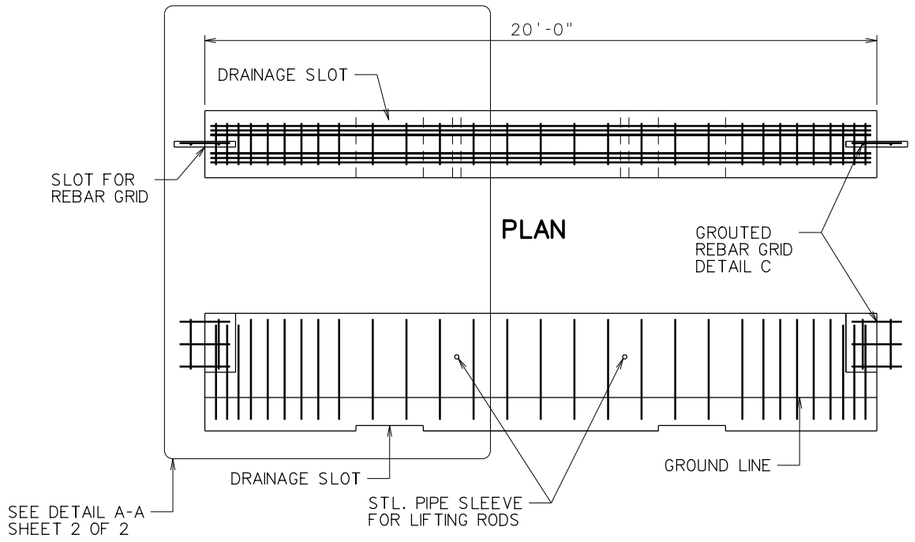
(SHEET 2 OF 2)
STANDARD SHEET GR18



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

PREPARED 12-15-17
REVISION DATE

MEDIAN BARRIER TYPE 10
STANDARD DETAIL

(SHEET 1 OF 2)
STANDARD SHEET GR17

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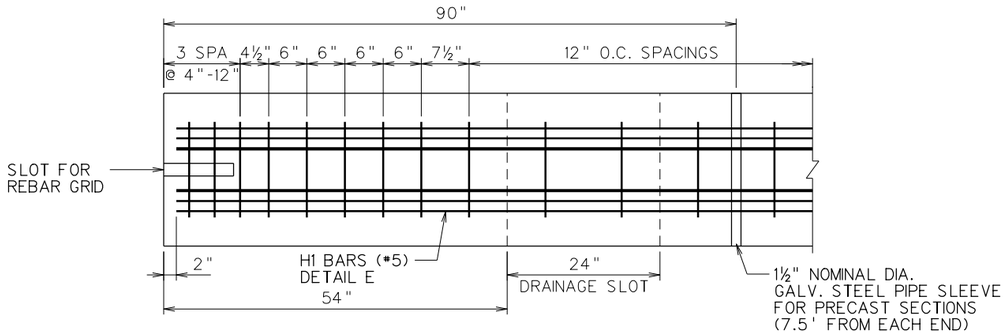
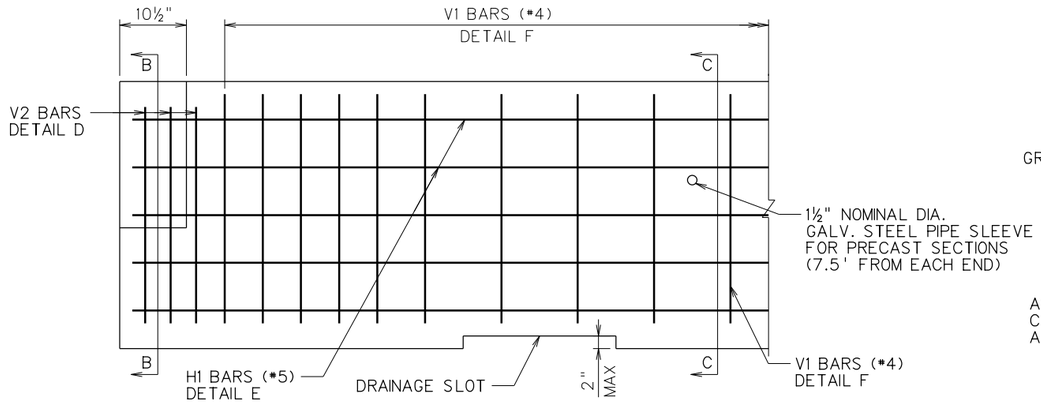
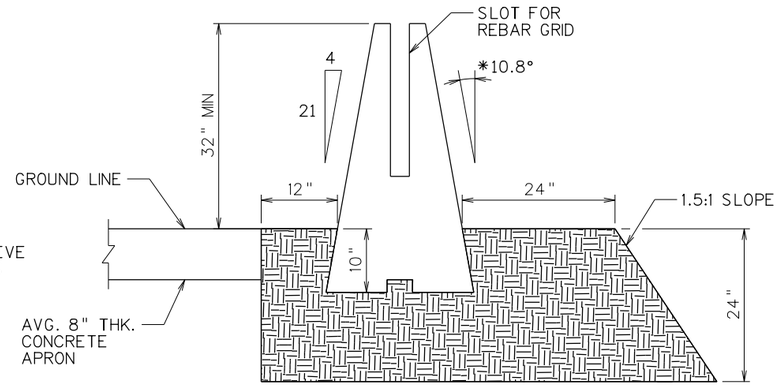


PLAN - DETAIL A-A



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.

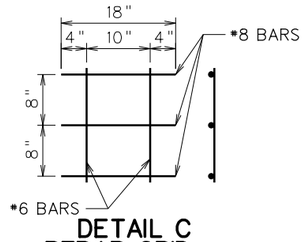
DIMENSION ON 180 DEGREE HOOKS TO BE SHOWN ONLY WHERE NECESSARY TO RESTRICT HOOK SIZE, OTHERWISE STANDARD HOOKS ARE TO BE USED.

REBAR QUANTITES BASED ON EACH 20FT SECTION OF MEDIAN BARRIER

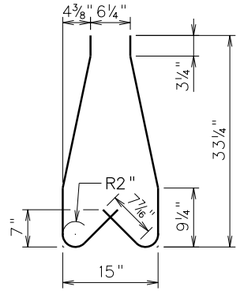
PREFIXES

B = BARRIER

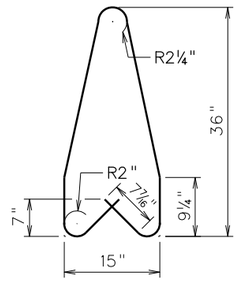
* ANY BARRIER CONSTRUCTED FOR BIFURCATION SHALL MAINTAIN THE SLOPE RATIO ON THE VERTICAL FACE



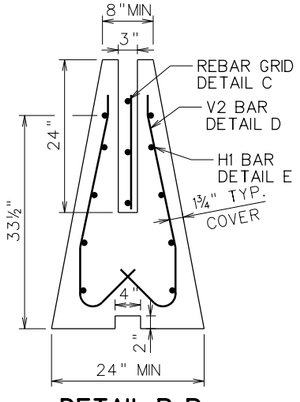
DETAIL C
REBAR GRID



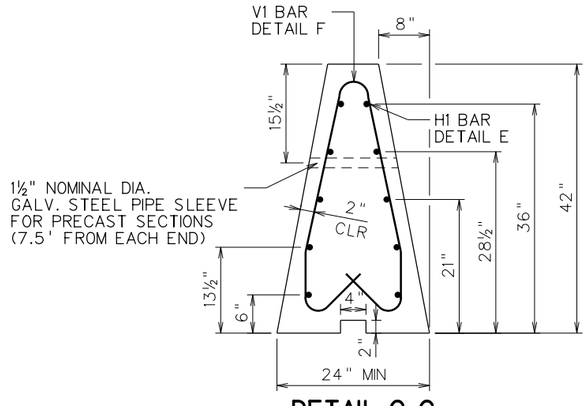
DETAIL D
V2 BAR (#4)



DETAIL F
V1 BAR (#4)

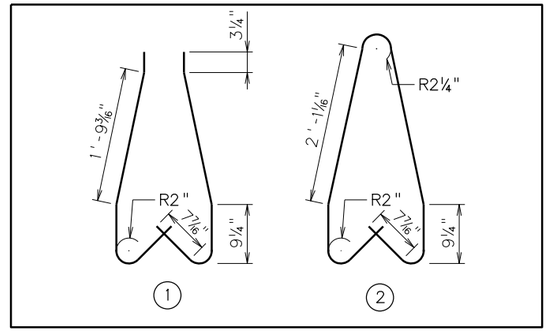


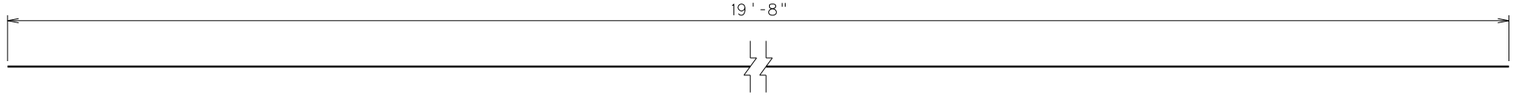
DETAIL B-B



DETAIL C-C

BAR TYPES





DETAIL E H1 BAR (#5)

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED 12-15-17
REVISION DATE

MEDIAN BARRIER TYPE 10
STANDARD DETAIL

(SHEET 2 OF 2)
STANDARD SHEET GR17

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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 105
SPECIFICATION, PUBLICATION, AND MATERIAL PROCEDURE APPROVAL PROCESS

Draft of June 10, 2021
Supersedes August 1, 2019

This Design Directive outlines the procedure that has been accepted by the Division for preparing and processing proposed Specifications and Special Provisions, Publications, and Material Procedures for approval.

10. Specifications

The general processing of Specifications and Special Provisions is administered through the ~~Contract Administration Division~~Technical Support Division by the Specification Engineer.

Standard Specifications will be issued periodically as the need dictates. Supplemental Specifications to accompany the Standard Specifications are issued annually on January 1st and are effective on all projects let to contract thereafter. Each new Supplemental Specification replaces the previous one and incorporates changes from all previous supplemental specifications.

A searchable version of the Standard Specifications book and Supplemental Specifications is available from the Specifications webpage, located online at http://transportation.wv.gov/highways/contractadmin/specifications/

10.1 Procedure for Processing Specification Changes

Permanent specifications changes to the Standard Specifications or Supplemental Specifications should be submitted electronically to DOHSpecifications@wv.gov by the 'champion'. The originating Division will prepare the specification changes in a format conforming to Design Directive 820. A brief overview of the item and background information with reason for the changes should accompany the request.

The Specifications Engineer will review all recommendations received and transmit to the Specifications Committee for action. The champion should attend all committee meetings pertaining to their respective specification. A proposed specification must be presented at two committee meetings before it can be recommended or rejected by the Specifications Committee.

10.2 Procedure for Processing Special Provisions for Individual Projects

There may be a need to use an innovative product or an experimental procedure to address unique demands of a project. Often, these items are not covered by existing specifications, so they may require new or modified specifications to describe their material requirements, construction requirements and payment. Special Provisions (SPs) are written to address these situations.

Before drafting a SP, check with the Specifications Engineer (or ProjectWise folder: Approved Project Specific Provisions (PDF)) to determine if a SP already exists that meets the needs of the project.

SPs are processed as outlined above in 10.1. In general, the originating Division should submit proposed SP at least six months prior to their project's PS&E submission. This provides adequate time to process and resubmit any changes that may be requested by the committee.

When time does not permit this procedure, the following procedures should be followed:

a. The originating Division will prepare the draft Special Provision in a format conforming to Design Directive 820, coordinating with the ~~Contract Administration Division~~Technical Support Division, Specifications Engineer for review, comment, assignment of an appropriate section number and/or pay item number.
b. The originating Division will secure the approval of the Applicable Deputy State Highway Engineer and the Federal Highway Administration as appropriate for that project. The approval of the Special Provision would only apply to the specific project. The submission for approval shall follow Design Directive 202 and may only encompass the PS&E package for advertising the project.

There are Project Specific Special Provisions that require management approval prior to their use on projects. These are listed in ProjectWise subfolder title "Requires Management Approval". The Project Manager shall provide justification of why the SP is needed to the Appropriate Deputy State Highway Engineer ~~– Construction & Development~~ for approval.

10.3 Specifications Committee

The Specifications Committee review and recommend actions to proposed Specifications and Special Provisions. The committee meets on call by the Specifications Engineer with regular meetings scheduled every other month and follow the Open Government Meeting Act. Details of this act are available at: https://ethics.wv.gov/openmeetings/Pages/default.aspx.

The Specifications Committee consists of voting and non-voting members who provide expertise to review and recommend action of the proposed Specifications and Special Provisions. The committee requests comments on the provisions in the meeting agenda; and review/discuss them during the meeting. The committee meeting agenda will designate the items that are up for approval and dependent upon comments/discussion/changes the Specifications Engineer has the right to call for a vote on the final version.

The voting members consist of one representative from each of the following Divisions:

- Engineering Division
- Materials Control, Soil and Testing Division
- Traffic Engineering Division
- Maintenance Division
- Contract Administration Division

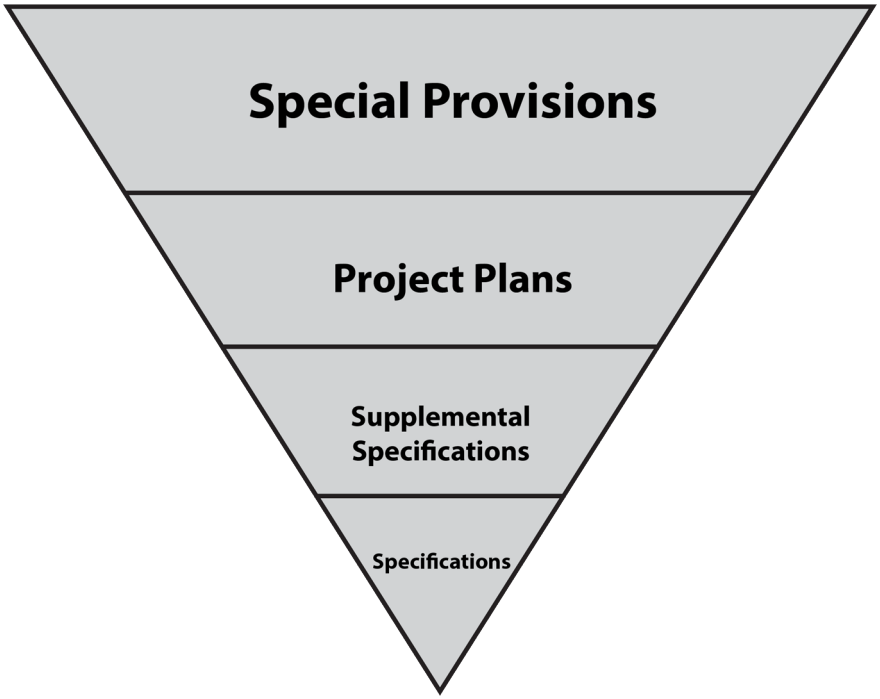
A quorum of 3 voting members must exist for the meeting to be valid. A majority of the present voting members is required to pass the proposed item. The Specifications Engineer

shall have the authority to cast the deciding vote when a tie occurs. All approved specification changes will be sent to FHWA for comment and concurrence.

The non-voting members consist of one or more representatives from the following agencies: Federal Highway Administration, Contractors Association of West Virginia, ACEC – WV, Asphalt Pavement Association of West Virginia, American Concrete Pavement Association, Builders Supply Association of West Virginia, various vendors, and anyone from the Division or Industry that has knowledge of the specifications being discussed.

10.4 Coordination of Specifications, Special Provisions, and Project Plans

The Specifications, Supplemental Specifications, Special Provisions, and project plans are essential parts of the Contract; and a requirement occurring in one is as binding as though occurring in all. In case of discrepancy, Supplemental Specifications will govern over Specifications; Plans will govern over Specifications and Supplemental Specifications; Special Provisions will govern over Specifications, Supplemental Specifications, and Plans as prescribed in Section 105.4 of the Standard Specifications. Below is a graphic display of the hierarchy of contract documents; where the items shown above, govern over items below it.



Project plans or plan notes should not be used to change specifications. The procedure outlined in this Design Directive should be utilized when this is necessary.

20. Publications

The general processing of Publications is administered through the ~~Technical Section of the Engineering Division~~Technical Support Division by the Standards/Publications Unit Leader.

Publications will be issued periodically as the need dictates. Each revised Publication supersedes the previous one and incorporates changes from all previous Publications.

Publications are available in electronic format on the Division of Highways' Engineering Division Publications webpage, located online at https://transportation.wv.gov/highways/engineering/Pages/publications.aspx.

20.1 Procedure for Processing Publication Changes

Proposed changes to any of the Division of Highways' Publications should be submitted electronically to the ~~Engineering~~ Technical Support Division's Standards/Publications Unit Leader. The originating Division will prepare the Publication changes in a format conforming to that particular Publication. A brief overview of the Publication and background information with reasons for the changes should accompany the request.

The Standards and Publications Unit Leader will review all recommendations received and transmit them to the Publications Committee for action. A proposed Publication or Publication revision must be presented at two committee meetings before it can be recommended or rejected by the Publications Committee, unless considered by the committee to be a minor change.

20.2 Publications Committee

The Publications Committee will review and recommend actions to proposed Publications/Publication revisions. The committee meets on call by the Standards/Publications Unit Leader with regular meetings scheduled every other month (and as needed) and follow the Open Government Meeting Act. Details of this act are available at: https://ethics.wv.gov/openmeetings/Pages/default.aspx.

The Publications Committee consists of voting and non-voting members who provide expertise to review and recommend action of the proposed Publications/Publication revision. The committee requests comments on the Publications/Publication revisions in the meeting agenda; and reviews/discusses them during the meeting. The committee meeting agenda will designate the items that are up for approval and dependent upon comments/discussion/changes the Standards/Publications Unit Leader has the right to call for a vote on the final version.

The voting members consist of one representative from each of the following Divisions:

- Engineering Division
- Materials Control, Soil and Testing Division
- Traffic Engineering Division
- Maintenance Division
- Contract Administration Division

A quorum of 3 voting members must exist for the meeting to be valid. A majority of the present voting members is required to pass the proposed item.

The Standards and Publications Unit Leader shall have the authority to cast the deciding vote when a tie occurs.

The non-voting members consist of one or more representatives from the following agencies: Federal Highway Administration, Contractors Association of West Virginia, ACEC – WV, Asphalt Pavement Association of West Virginia, American Concrete Pavement Association, Builders Supply Association of West Virginia, various vendors, and anyone from the Division or Industry that has knowledge of the Publications being discussed.

30. Material Procedures

The Material Procedures (MP) are updated on a four (4) year cycle unless the need dictates otherwise, as determined by the Materials Control Engineer who is the Chairperson of this committee. This person is referred to as "Chairperson" throughout the rest of this section. The MP Committee shall be modeled after AASHTO's Committee on Materials and Pavements (COMP); specifically, how this committee reconfirms various AASHTO procedures and processes. The Chairperson is the default Champion for the updating of these MPs, though the Chairperson may assign a Champion for a particular MP or accept a volunteer Champion.

A new MP may also be submitted by a Champion to the Committee.

30.1 Material Procedures Committee

The Material Procedures Committee consists of voting and non-voting members who provide expertise to review and recommend action on the proposed additions or changes.

The Material Procedures Committee meets on call by the Chairperson with regular meetings usually scheduled on a four (4) to eight (8) week basis.

A quorum of 3 voting members must exist for the meeting to be valid. A majority of present voting members at any meeting shall be required for approval. The Chairperson shall have the authority to cast the deciding vote when a tie occurs.

The voting members consist of one (1) representatives from the following:

- ~~Engineering~~ Technical Support
- Materials Control, Soil and Testing
- Traffic Engineering
- Maintenance
- Contract Administration

The non-voting members consist of one or more representatives from the following agencies: Federal Highway Administration, Contractors Association of West Virginia, ACEC – WV, Asphalt Pavement Association of West Virginia, American Concrete Pavement Association, Builders Supply Association of West Virginia, Various Venders, and anyone from the Division or Industry that has knowledge of the MP being discussed.

30.2 Procedure for Adding a New MP

All proposals are to be submitted by the Champion to the Chairperson. The purpose for the changes or reason(s) for the new MP should accompany the request. These changes shall be submitted within fourteen (14) calendar days prior to the next meeting to be considered at the meeting. The Champion must be present for all meetings pertaining to their respective MP or the MP will be pushed back to the next meeting that the Champion can be present. This requirement can be waived at the discretion of the Chairperson.

A proposed MP must be presented at two (2) Committee Meetings before it can be recommended or rejected by the Committee. ~~All Committee members must receive a copy for comment fourteen (14) calendar days in advance of the meeting. These comments should be returned to the Chairperson seven (7) calendar days prior to the Committee meeting to give the Champion time to review them.~~

If a proposed MP is designated as minor or inconsequential in its intent, only one (1) Committee Meeting will be required for a vote of recommendation or rejection. Any voting member, or the FHWA representative may veto this designation as minor or inconsequential.

30.3 Procedure for Changing an Existing MP

A proposed MP change must be presented by the Champion at Two (2) Committee meetings before the MP can be recommended or rejected by the Committee. All Committee members should receive a copy of the MPs on the agenda for comment fourteen (14) calendar days in advance of the meeting. These comments should be returned to the Chairperson seven (7) calendar days prior to the Committee meeting to give the Champion time to review them.

If a proposed MP change is designated as minor or inconsequential in its intent, only one (1) Committee meeting will be required for a vote of recommendation or rejection. Any voting member, or the FHWA representative may veto this designation as minor or inconsequential.

30.4 Procedure for Submission of Recommended Approvals

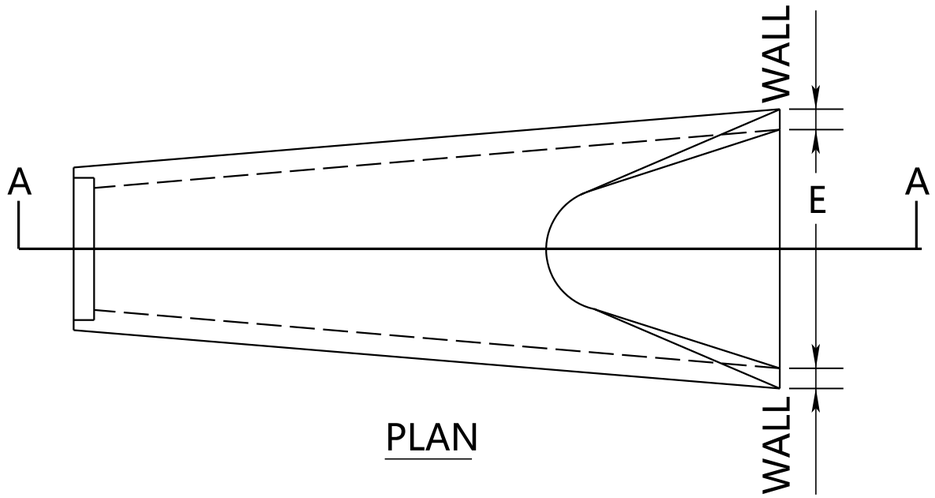
Pending the recommendation for approval from the committee, the Chairperson will forward the Provisional MP through the chain of command to FHWA.

A minor or inconsequential MP will not require the approval of FHWA, but will be forwarded through the chain of command at the DOH for approval. The FHWA representative for the MP Committee Meeting shall be given a chance to veto the minor or inconsequential status of the MP.

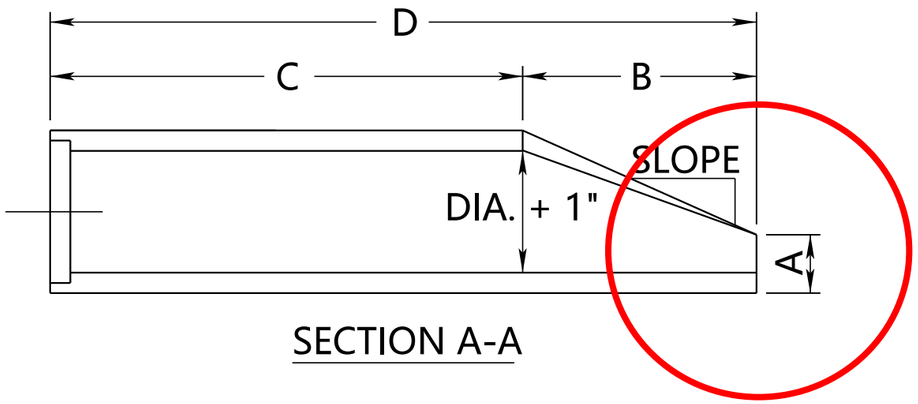
Upon receiving comment and approval by FHWA (if applicable), the updated or new MP will be published on the MCS&T webpage and be distributed to District Materials Supervisors and other interested parties.

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.

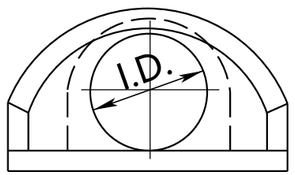
Inside Pipe Diameter	See Drawing For Dimensions Below					Wall Thickness	Slope
	A	B	C	D	E		
Inches	Inches						
12	3.75 - 8.75	23 - 27.25	45.5 - 52	69.5 - 77	23.5 - 24	2 - 2.75	2.2:1 - 3:1
15	5.5 - 11	26.5 - 27.75	42.75 - 49.5	69.5 - 77	30 - 32	2.25 - 5.5	1.5:1 - 3:1
18	9 - 14.5	25 - 29.25	42.25 - 49.5	69 - 76.5	35.75 - 36	2.5 - 5.75	1.5:1 - 3:1
21	9 - 11	33 - 35	38 - 42	73 - 77	42	2.75	2.2:1 - 3:1
24	9.5 - 16	43 - 44	25.75 - 36.5	69.25 - 78.5	47.5 - 48	3 - 6.5	2:1 - 3:1
27	10.5	48	25.5	73.5 - 77.5	54	3.25	2.4:1 - 3:1
30	9.5 - 19.25	53.75 - 54	15 - 21	69 - 77.75	59.5 - 60	3.5 - 6.75	1.9:1 - 3:1
33	13 - 21	59 - 60	39 - 40	94.5 - 98	66	3.75	2.4:1 - 3:1
36	15 - 23.5	62.5 - 64	23.25 - 36.75	92.5 - 99.75	69.75 - 72	4 - 4.75	2:1 - 3:1
42	20.5 - 21	62.5 - 63	34 - 39	97.5 - 101.5	77.25 - 78	4.5 - 4.75	2.4:1 - 3:1
48	24 - 24.75	71.75 - 72	26 - 26.75	97 - 98.5	81.75 - 84	5	2.4:1 - 3:1
54	27	65	35	100	90	5.5	1.9:1 - 2:1
60	30	60	39	99	96	6	1.6:1 - 2:1
66	36	78	21	99	102	6.25	2:1
72	34 - 42	78	21	99	108	7	1.7:1 - 2:1



PLAN



SECTION A-A



FRONT VIEW

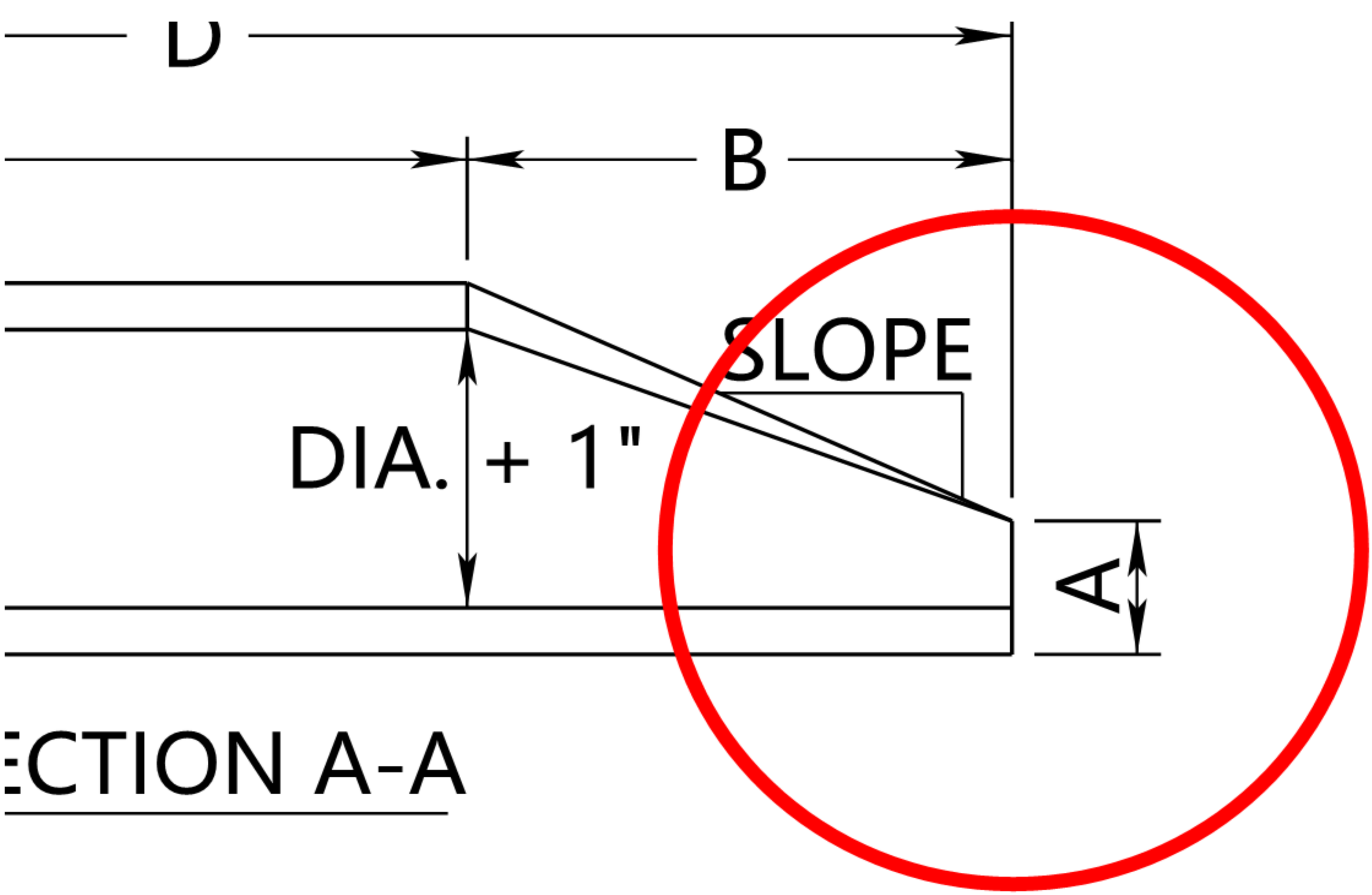
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PREPARED 08/04/2020

REVISION DATE

CONCRETE SAFETY SLOPE END SECTION for CONCRETE PIPE

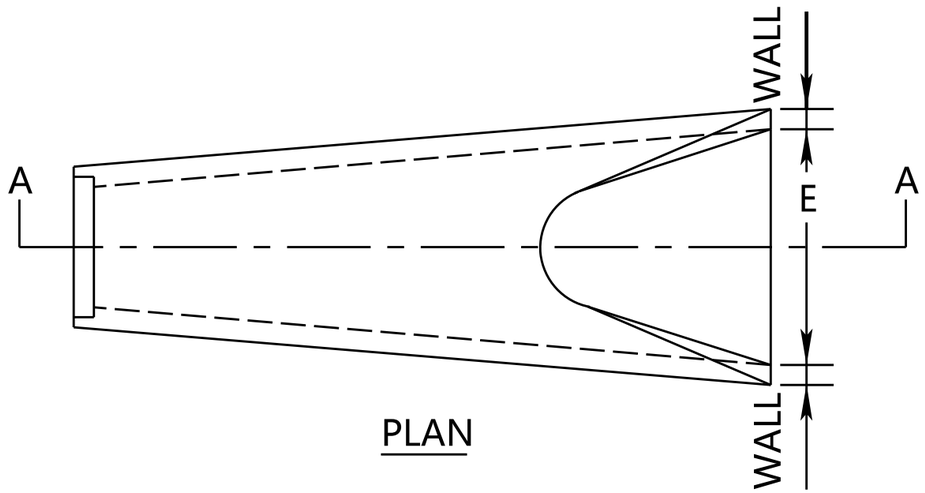
STANDARD DETAIL SHEET DR4
SHEET 2 of 2



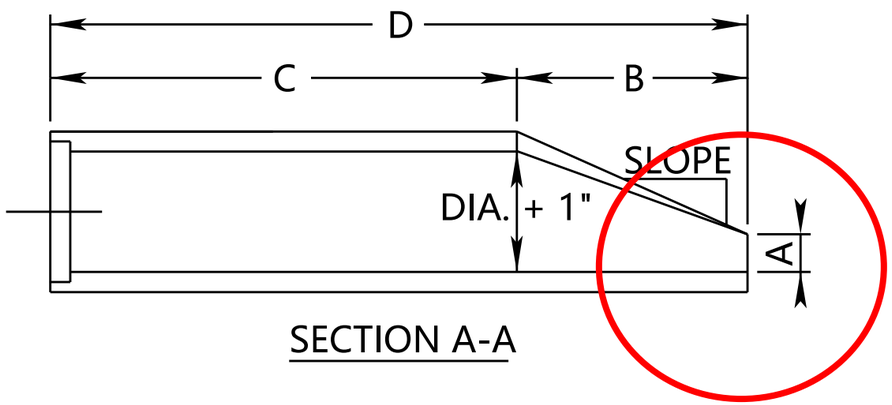
ECTION A-A

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.

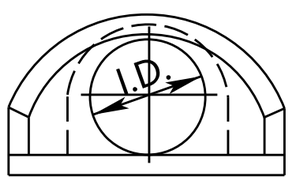
Inside Pipe Diameter	See Drawing For Dimensions Below					Wall Thickness	Slope
	A	B	C	D	E		
Inches	Inches						
12	3.75 - 8.75	23 - 27.25	45.5 - 52	69.5 - 77	23.5 - 24	2 - 2.75	2.2:1 - 3:1
15	5.5 - 11	26.5 - 27.75	42.75 - 49.5	69.5 - 77	30 - 32	2.25 - 5.5	1.5:1 - 3:1
18	9 - 14.5	25 - 29.25	42.25 - 49.5	69 - 76.5	35.75 - 36	2.5 - 5.75	1.5:1 - 3:1
21	9 - 11	33 - 35	38 - 42	73 - 77	42	2.75	2.2:1 - 3:1
24	9.5 - 16	43 - 44	25.75 - 36.5	69.25 - 78.5	47.5 - 48	3 - 6.5	2:1 - 3:1
27	10.5	48	25.5	73.5 - 77.5	54	3.25	2.4:1 - 3:1
30	9.5 - 19.25	53.75 - 54	15 - 21	69 - 77.75	59.5 - 60	3.5 - 6.75	1.9:1 - 3:1
33	13 - 21	59 - 60	39 - 40	94.5 - 98	66	3.75	2.4:1 - 3:1
36	15 - 23.5	62.5 - 64	23.25 - 36.75	92.5 - 99.75	69.75 - 72	4 - 4.75	2:1 - 3:1
42	20.5 - 21	62.5 - 63	34 - 39	97.5 - 101.5	77.25 - 78	4.5 - 4.75	2.4:1 - 3:1
48	24 - 24.75	71.75 - 72	26 - 26.75	97 - 98.5	81.75 - 84	5	2.4:1 - 3:1
54	27	65	35	100	90	5.5	1.9:1 - 2:1
60	30	60	39	99	96	6	1.6:1 - 2:1
66	36	78	21	99	102	6.25	2:1
72	34 - 42	78	21	99	108	7	1.7:1 - 2:1



PLAN



SECTION A-A



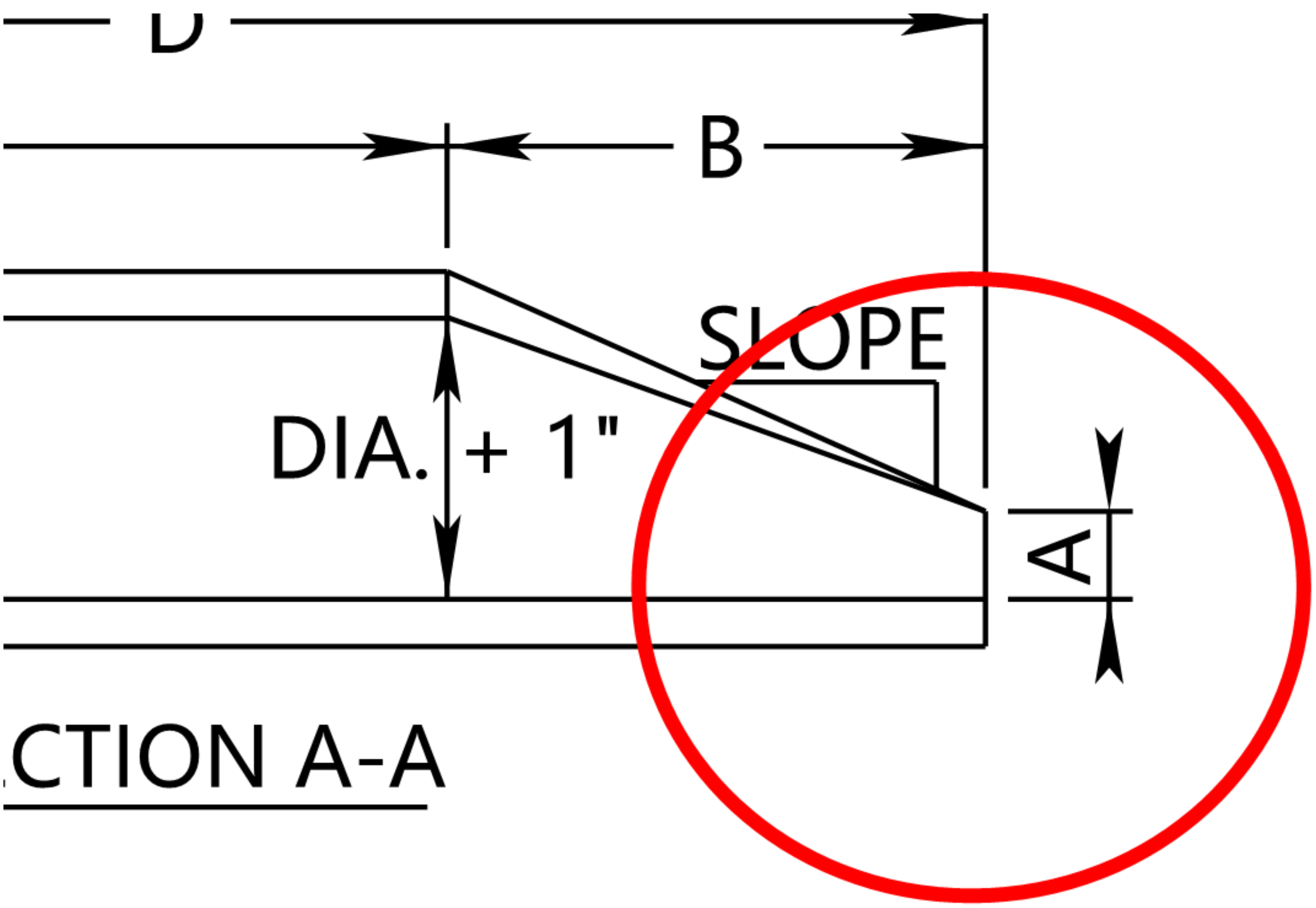
FRONT VIEW

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED 08/04/2020
REVISION DATE
5/26/21

CONCRETE PIPE SAFETY SLOPE END SECTION

STANDARD DETAIL DRAWING DR 4
SHEET 2 of 2



CTION A-A