VDOT Virginia Department of Transportation

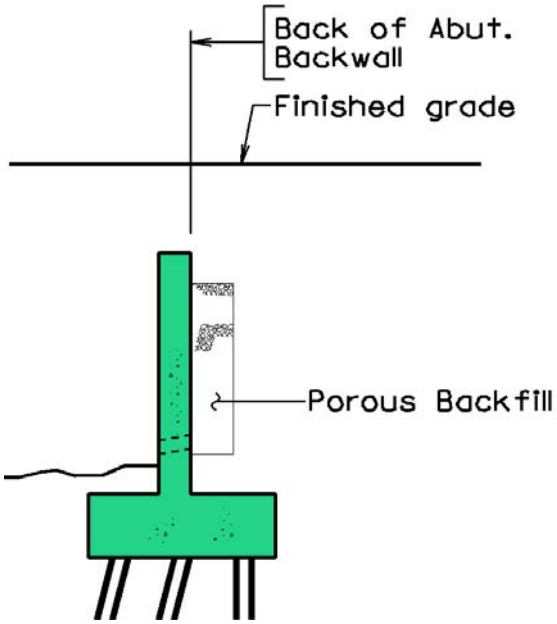
ABUTMENTS, RIPRAP & SHORING

Keith Weakley, PE

Bridge Construction Inspection School

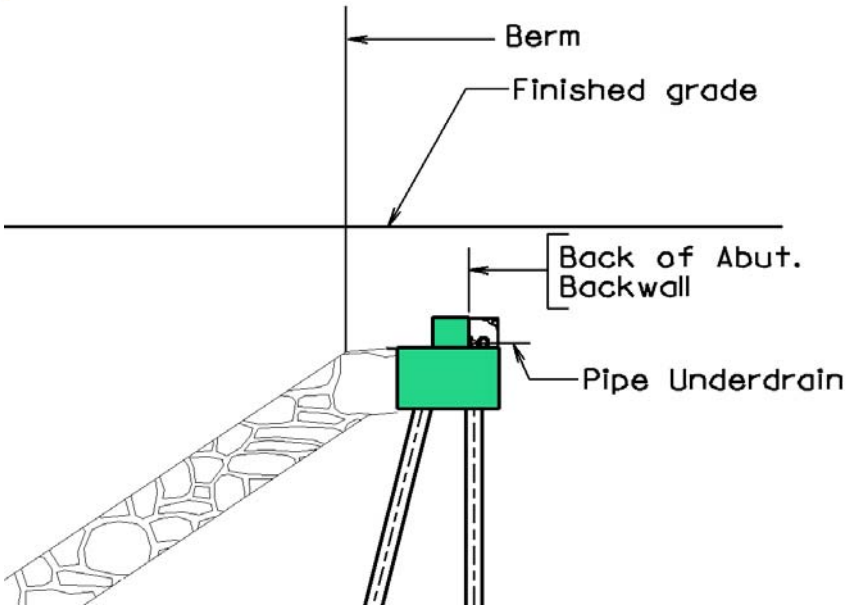
Abutments

Cantilever Abutment



Cantilever Abutment

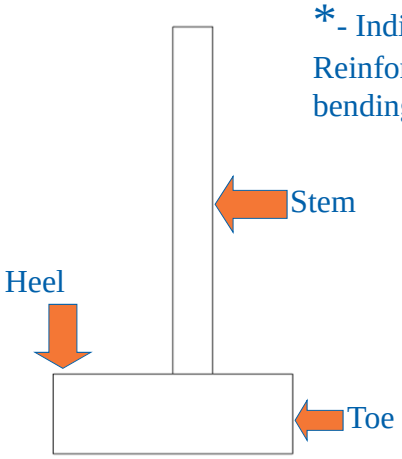
Shelf Abutment

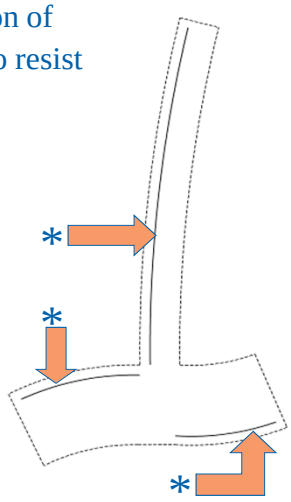


Shelf Abutment

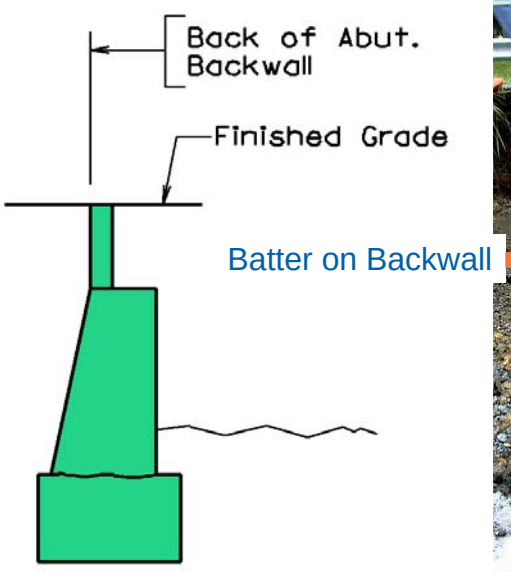
Abutment Loads & Terminology

*- Indicates location of Reinforcing Steel to resist bending.

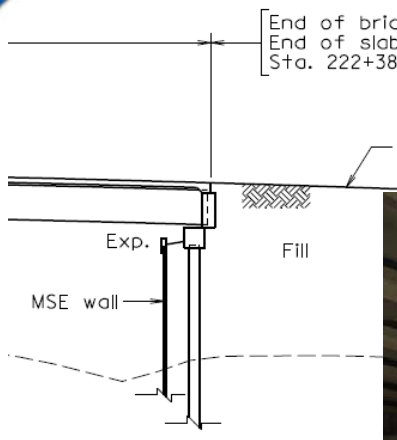




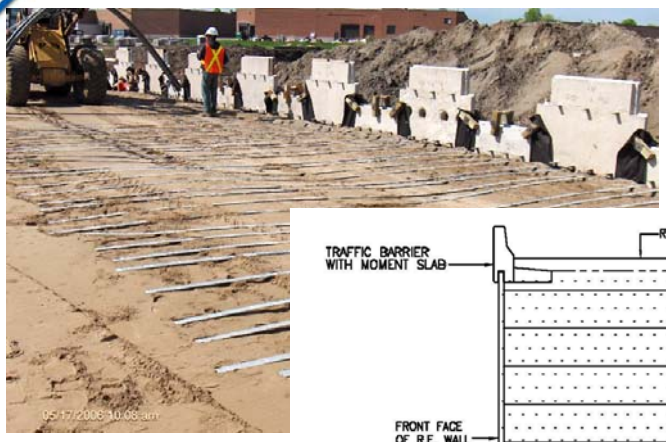
Gravity Abutment

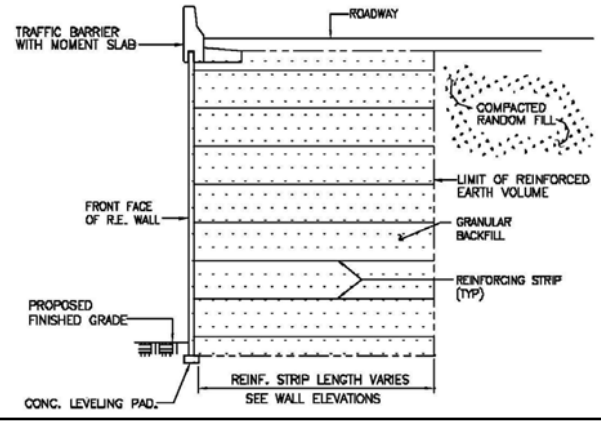


MSE Abutment



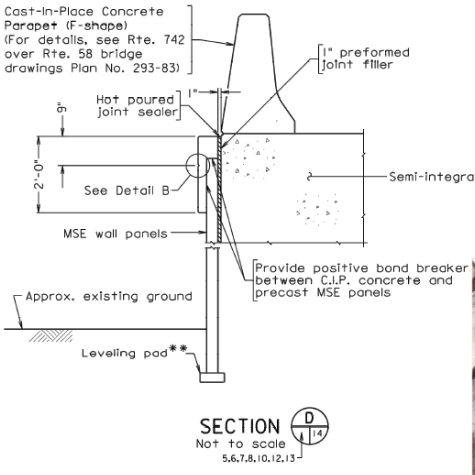
MSE Abutment



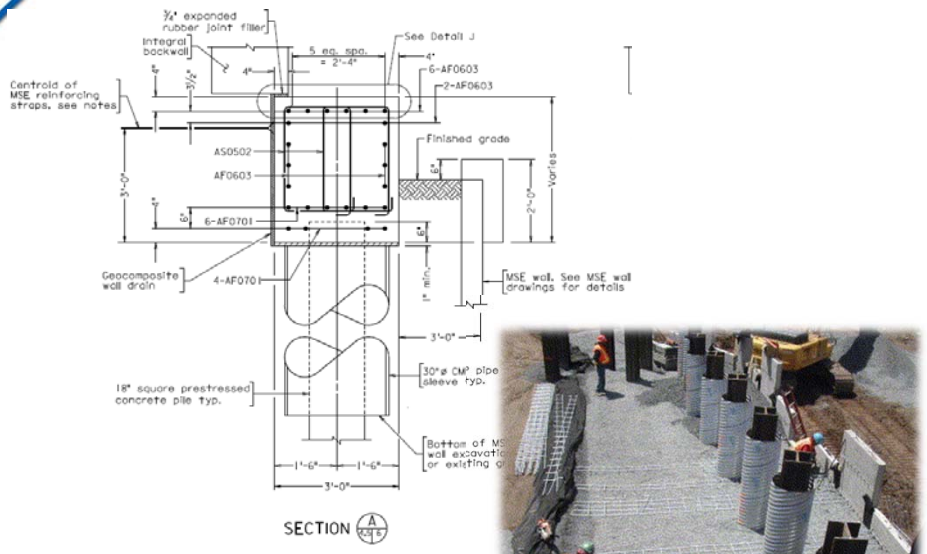


MSE Abutment

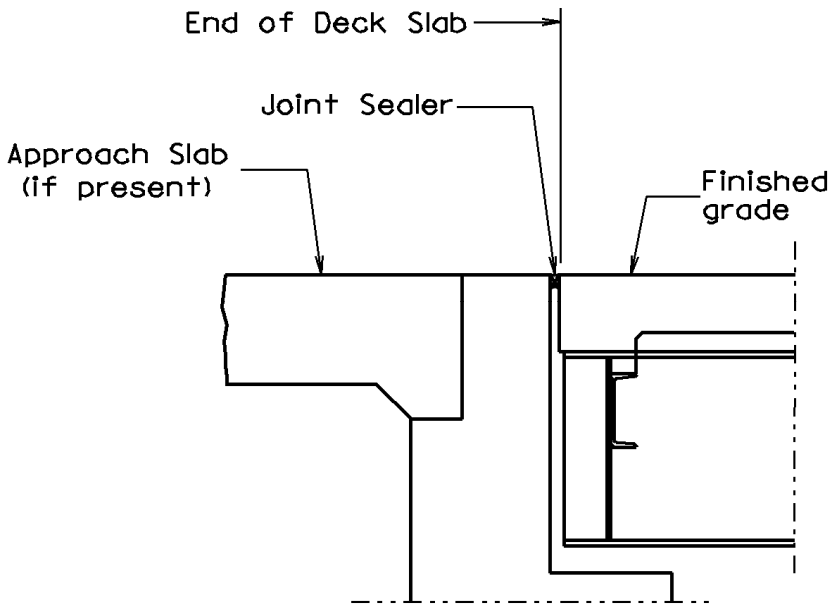
MSE Abutments (Shop Drawings)



MSE Abutment



Traditional Abutment

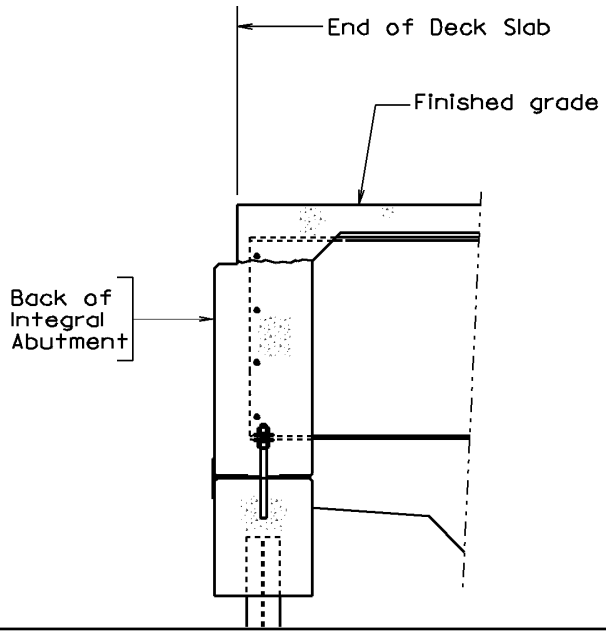


Traditional Abutment

Water Damage at Joints

Integral Bridges

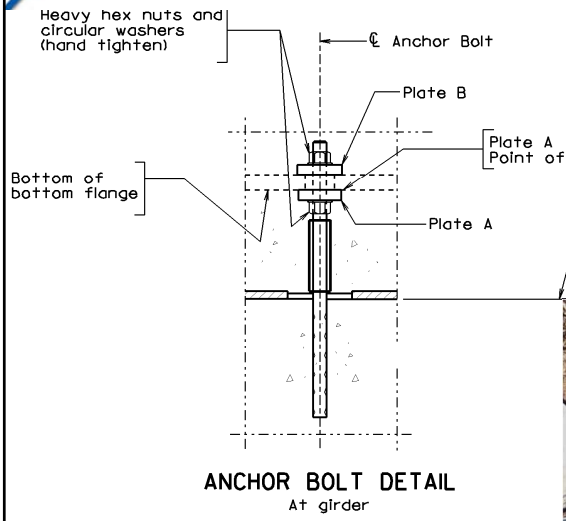
Integral Abutment



Integral Abutment

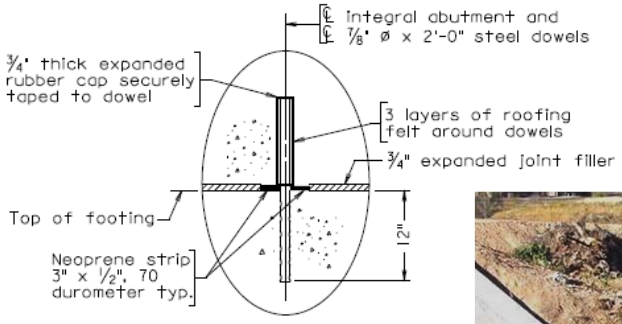
Integral Abutment

Beam Support



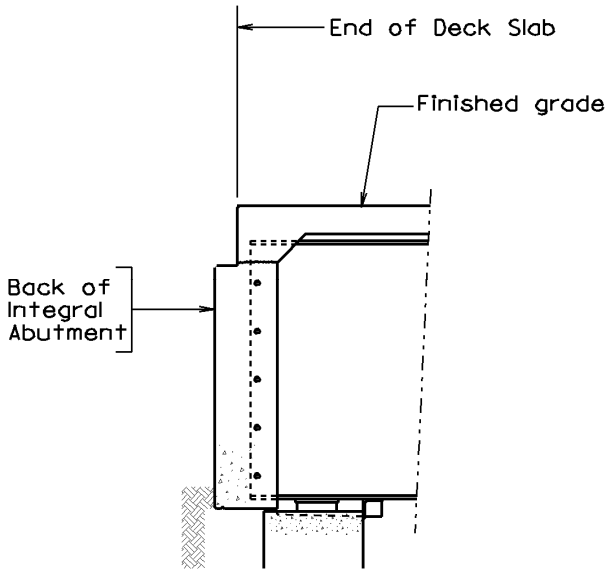
ANCHOR BOLT DETAIL
At girder

Dowels



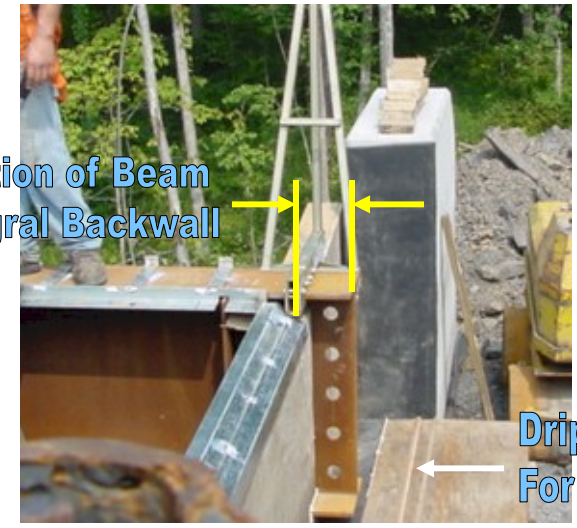
HINGE DETAIL
Not to scale

Semi-Integral

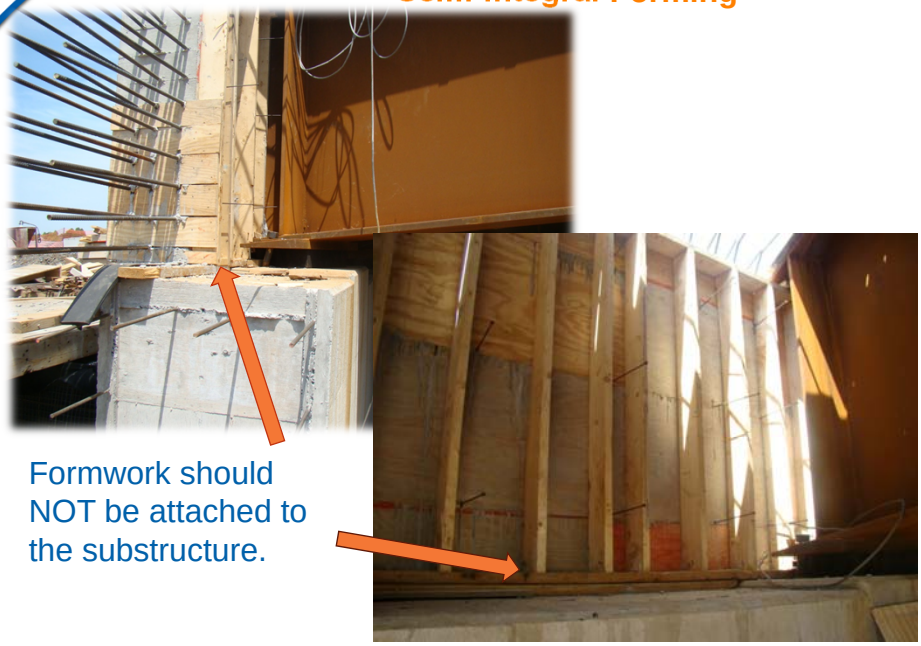


Semi-Integral

Semi-Integral

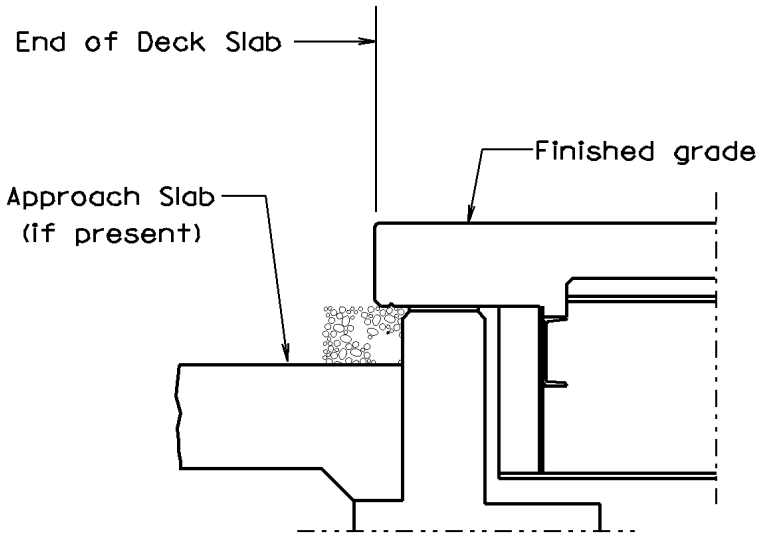


Semi-Integral-Forming

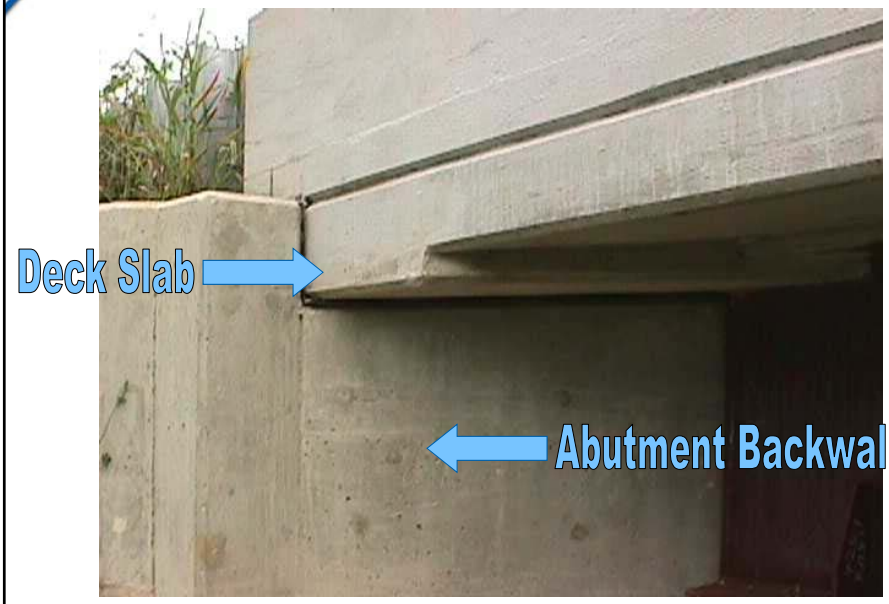


Semi-Integral

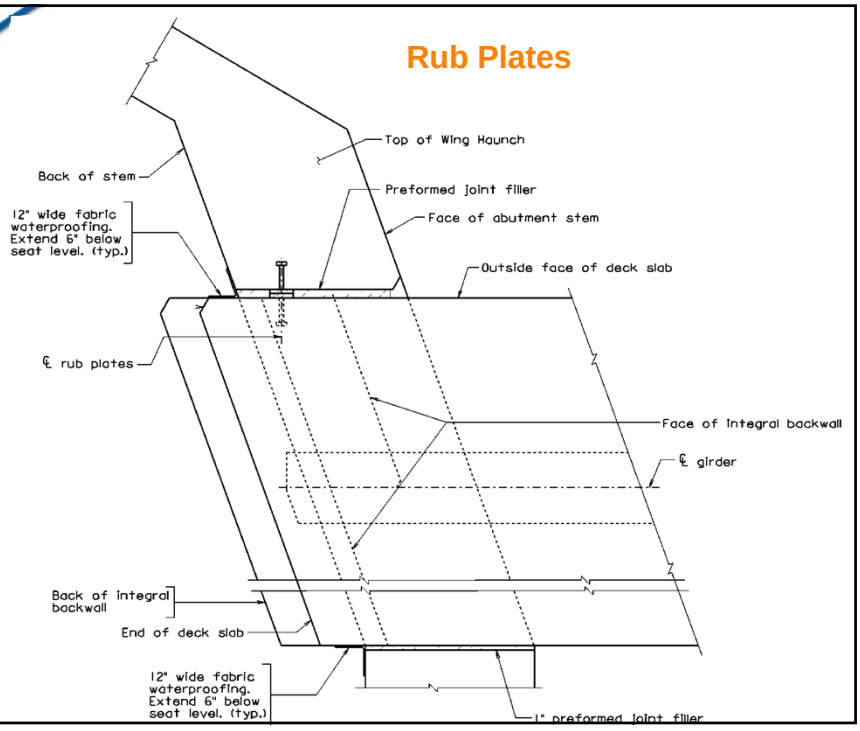
Deck Extension



Deck Extension



Rub Plates



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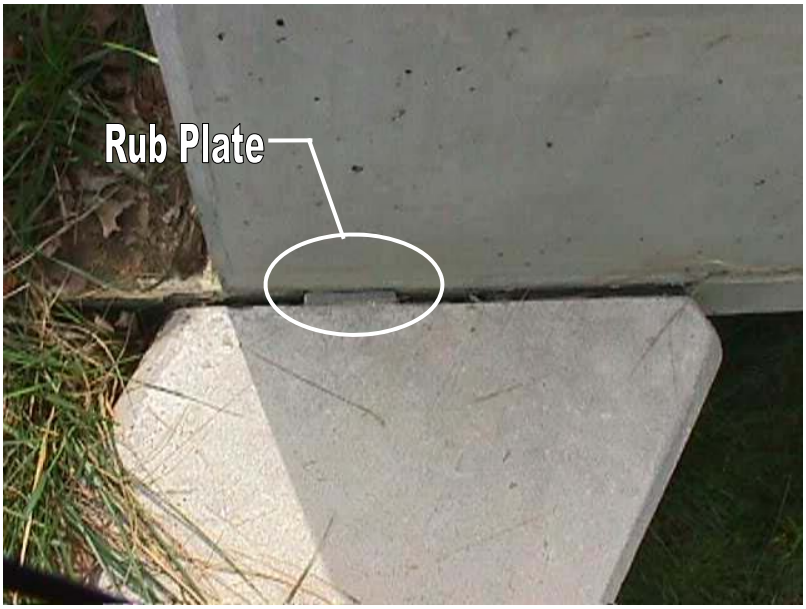

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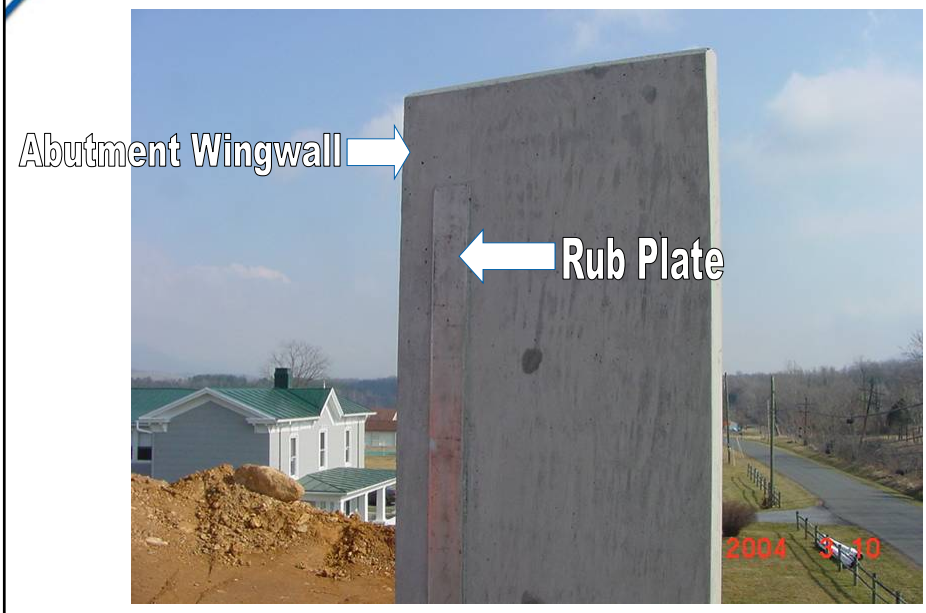
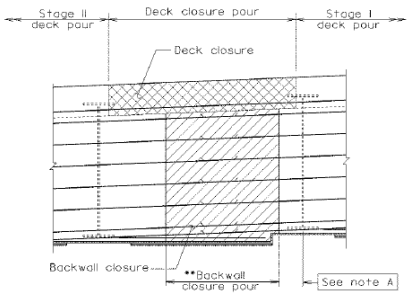
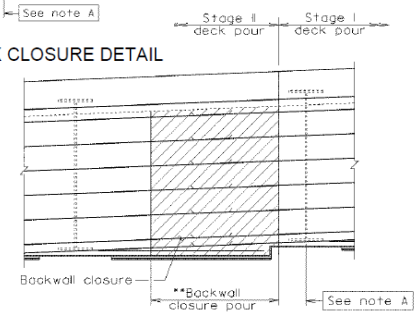


Semi-Integral



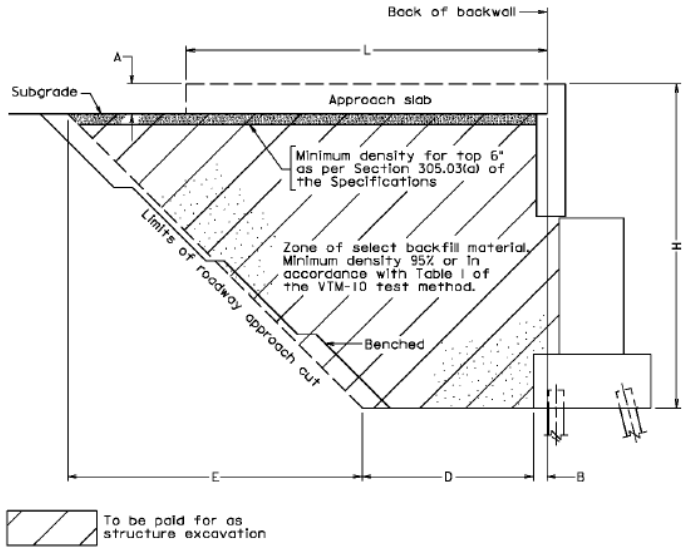
SEMI-INTEGRAL ABUTMENT – WITH DECK CLOSURE DETAIL



SEMI-INTEGRAL ABUTMENT - WITHOUT DECK CLOSURE DETAIL

Backfilling Integrals

Structural Backfill

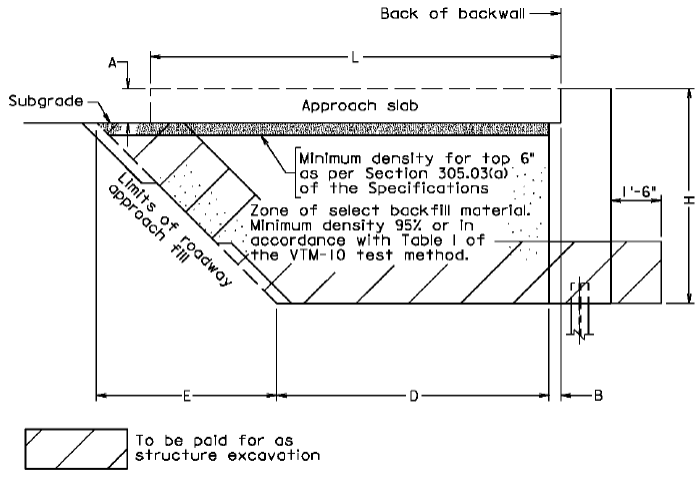


SECTION THROUGH ABUTMENT - CUT SECTION

Abutment drainage not shown

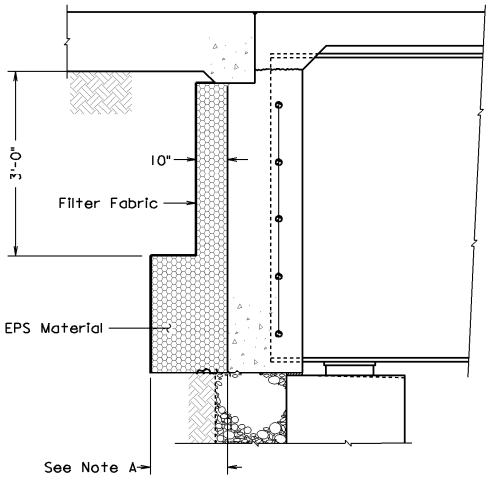
Not to scale

Structural Backfill



SECTION THROUGH ABUTMENT - FILL SECTION

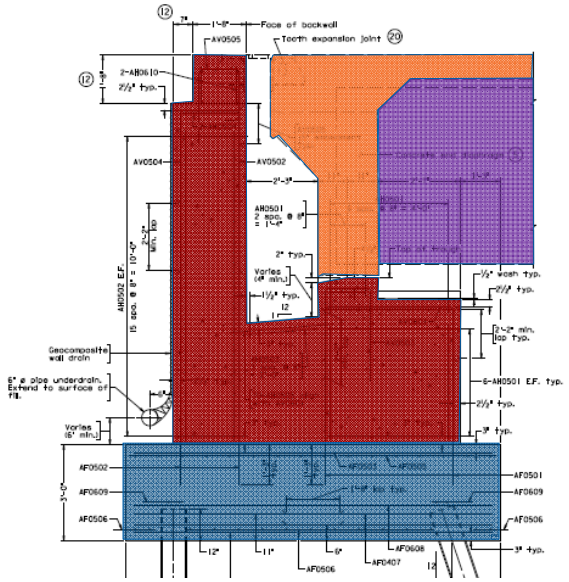
Elastic Inclusion (EPS)



SECTION
(Showing Semi-Integral)

Elastic Inclusion (EPS)

Virginia Abutment



Virginia Abutment

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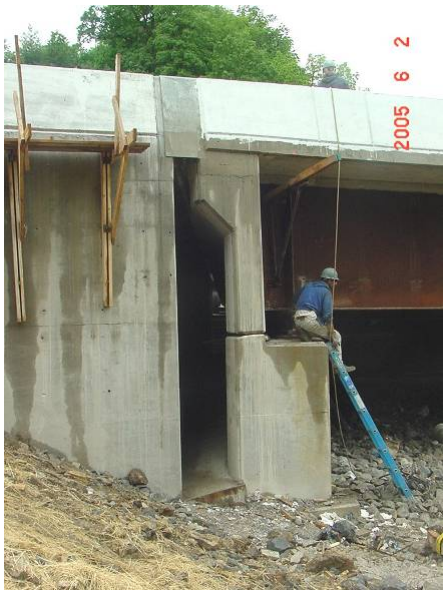


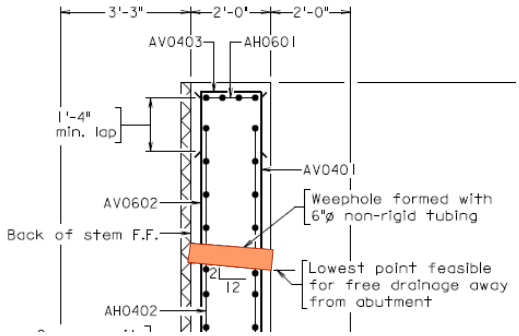
Virginia Abutment

Weepholes

Weep Holes

Weep holes are necessary to reduce water pressure behind the abutment. It is critical that they are installed correctly, since they are part of the design.

Weep Holes



"Lowest Point Feasible for Free Drainage" means as low as you can get it, but still be above the ground, once all of the final grading has been completed. The weep hole will be the top of the water table behind the abutment, so it needs to be as low as possible to minimize the water pressure.

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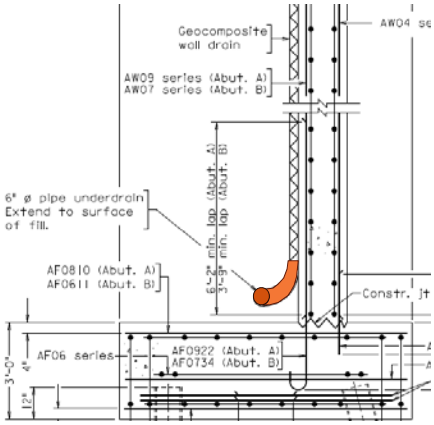
Weep Hole Alternatives



You may encounter abutments that have no weep hole, but instead a piped drainage system. Just ensure this is installed per plan and “daylighted” so that it drains properly.

Weep Hole Alternatives

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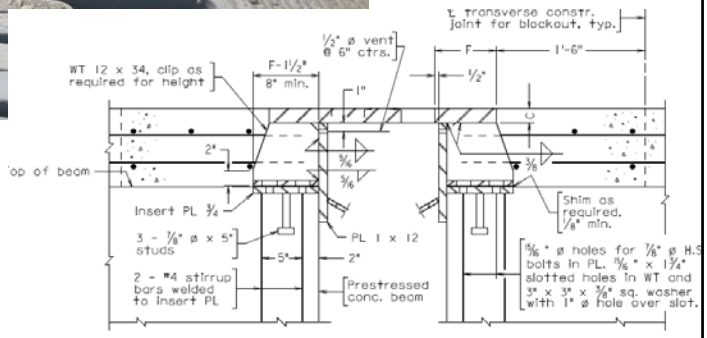
Wall Drain

Geocomposite Wall Drains (Ameridrain, Miradrain, etc).
See Sec. 401.03 (2016 Specs).
-Overlap
-Filter Fabric
-Installation

Tooth Expansion Joints (Finger Joints)

Tooth Expansion Joints (Finger Joints)



PART SECTION AT CONCRETE BEAM

Tooth Expansion Joints

Tooth Expansion Joints

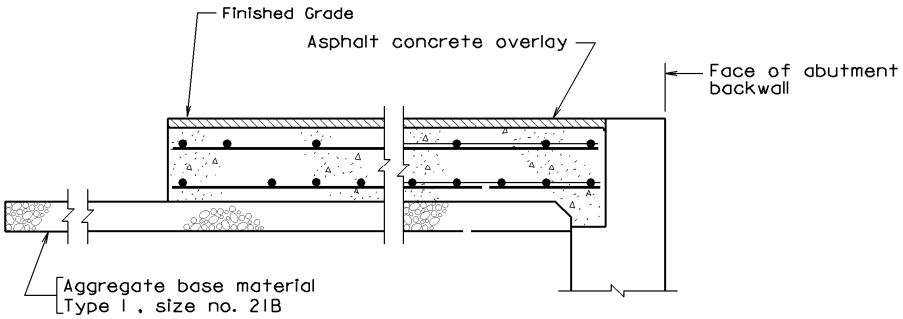
Tooth Expansion Joints-Things to remember

- Alignment is extremely important!
- Realignment will likely be necessary after the deck pour(s). Both Vertical and Horizontal.
- The Construction Joint at the Finger Joint is there for a reason!

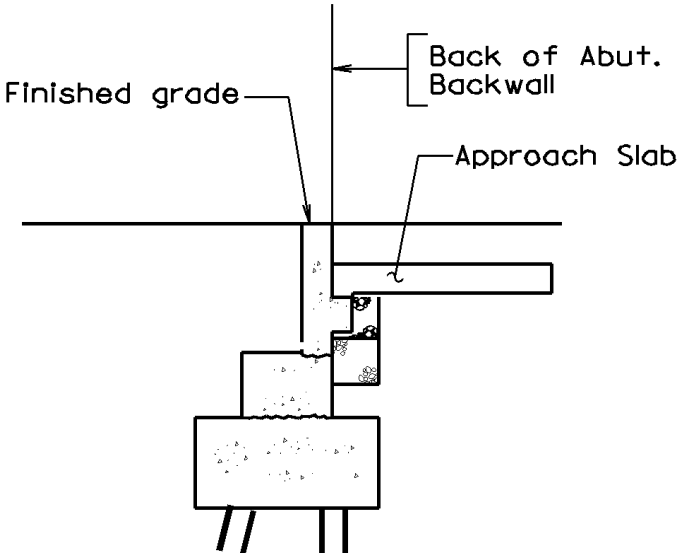
Approach Slabs

Traditional Approach Slabs

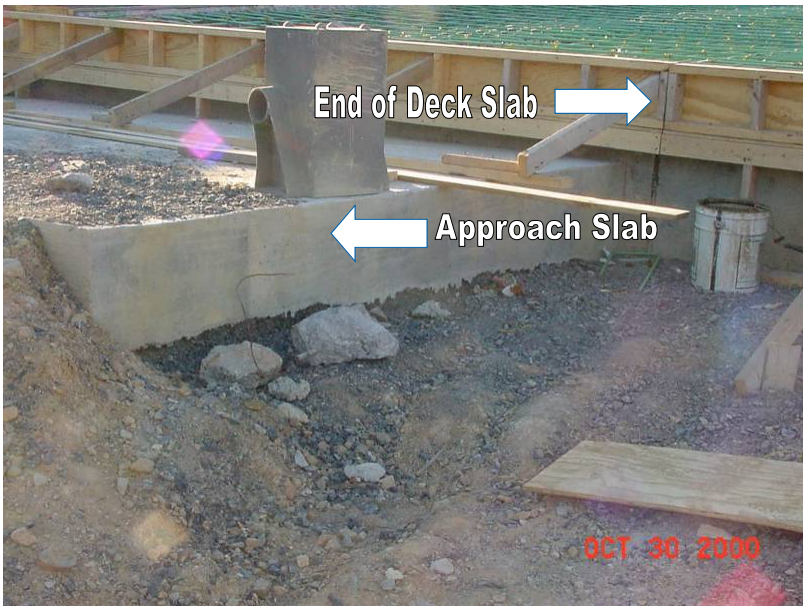
Traditional Approach Slabs



Buried Approach Slabs

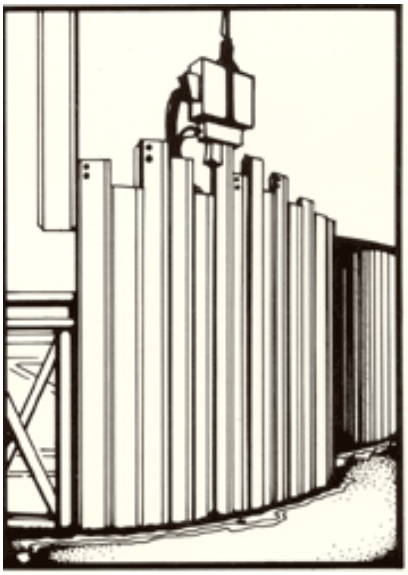


Buried Slabs



Buried Approach Slabs

Shoring

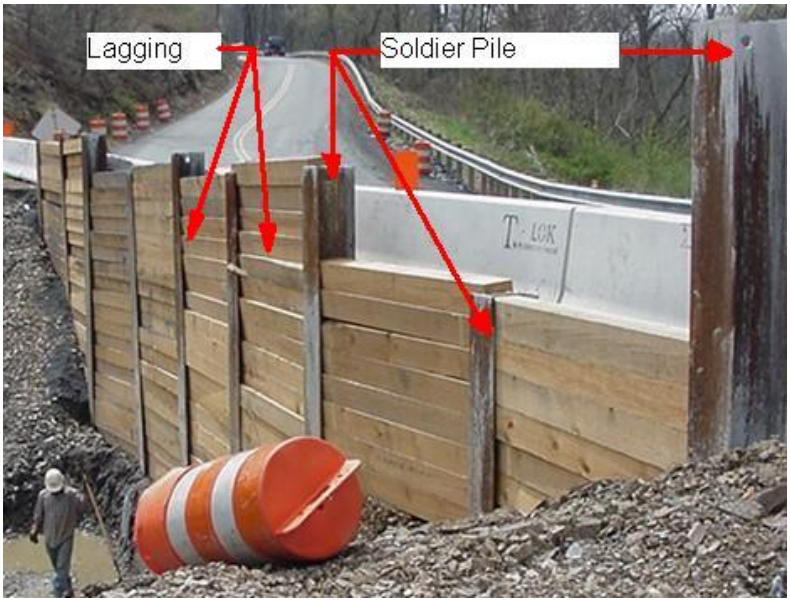


Pier Excavation

Sheet Piling

Sheeting & Attachments

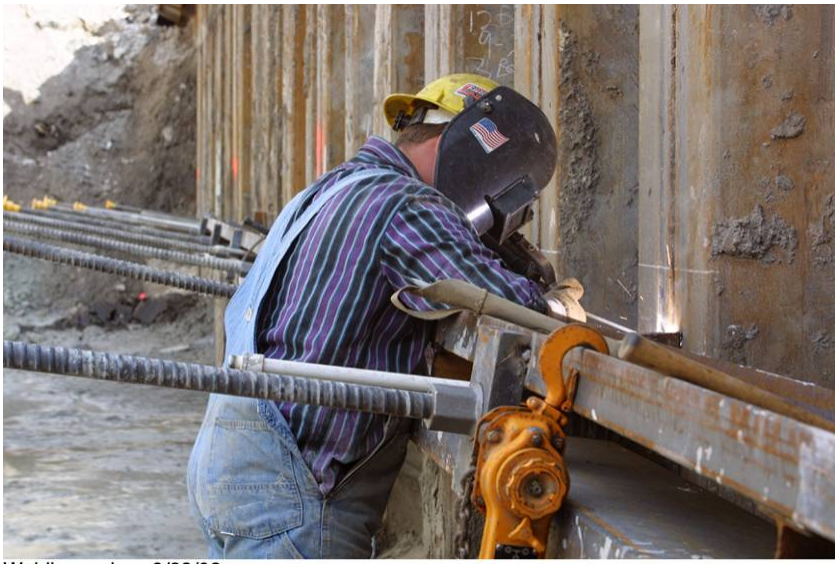
Soldier Piles



Soldier Piles

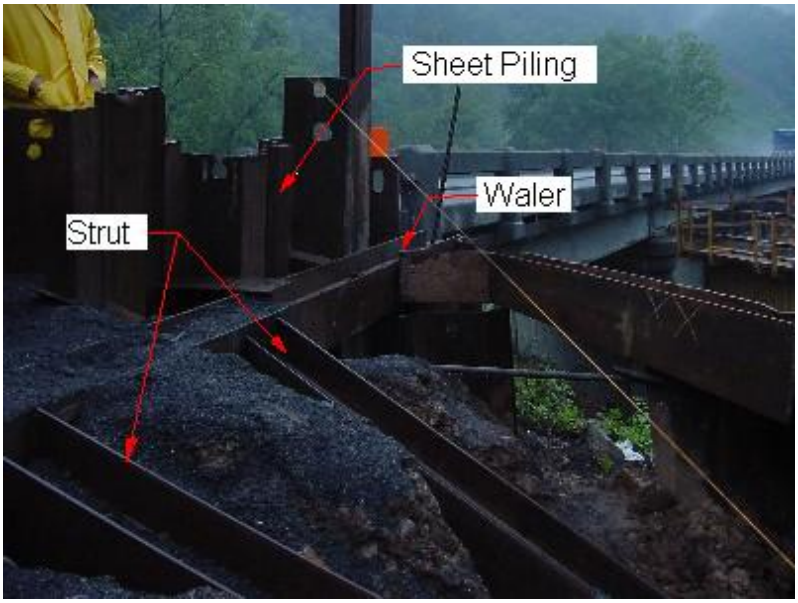
Soldier Piles

Tie Backs



Welding waler - 9/23/02

Strut & Waler



Shoring

Things to keep in Mind

- When driving sheeting/piles, be sure that the depth reached meets or exceeds that specified by the approved shoring plans.
- Closely inspect all connections, especially those to, or near the abutments, as this is usually the deepest part of the excavation.
- Be sure to compare the approved plans to what is actually built in the field. If there are any differences, let someone know!

Things to keep in Mind

- Most important, lives may be at stake. The shoring may be holding up the roadway, but at a minimum is holding the excavation open for the workers & Inspectors.
- Closely monitor the shoring for movement. If you are unsure whether there is a danger-call your Construction Manager, or the Bridge office.

Shoring Payment

TEMPORARY SHORING NOTES:

Temporary shoring utilized by the Contractor to support the existing and proposed structures and roadway while open to the traveling public shall be designed by a registered professional engineer holding a valid license to practice engineering in the Commonwealth of Virginia. Working drawings and design calculations of the shoring shall be submitted to the Engineer for review 30 days prior to installation of the shoring in accordance with Section 105.10. The drawings shall include plan and profile views, details of sheet piling, waiers, rakers, connections, welds, fasteners, all structural members, soldier piles, tiebacks or other means of support as determined by the Contractor and his Engineer. The Contractor shall determine the methods and means of support required for the loads imposed by the roadway, traffic, the structure and any loads imposed by construction equipment during the construction of the project.

Approximate limits of temporary shoring shown on the plans are for informational purposes only. The Contractor shall be responsible for determining the actual limits and quantities of temporary shoring. The limits of temporary shoring shall be defined as that length necessary for structure excavation or minor structure excavation, and for maintaining minimum temporary slopes in accordance with OSHA requirements around the limits of structure excavation or minor structure excavation for each stage of construction. The cost of the design, installation, and removal of the temporary shoring, when no longer required, shall be included in the bid price for the temporary shoring for both stages. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals required for the satisfactory completion of the work. This price shall include all temporary shoring required for construction of the structure whether or not shown on the plans. Temporary shoring shall be paid for on a lump sum basis and shall include both construction phases.

- In response to claims, and in a effort to reduce them, the Temporary Shoring bid item has been changed from Square Yard to Lump Sum. Check the plans for your specific job for the verbiage, but you should find that the Lump Sum bid item includes anything required to retain the excavation.

Crib Walls

Wire Wall

Slope Protection & Riprap

Riprap

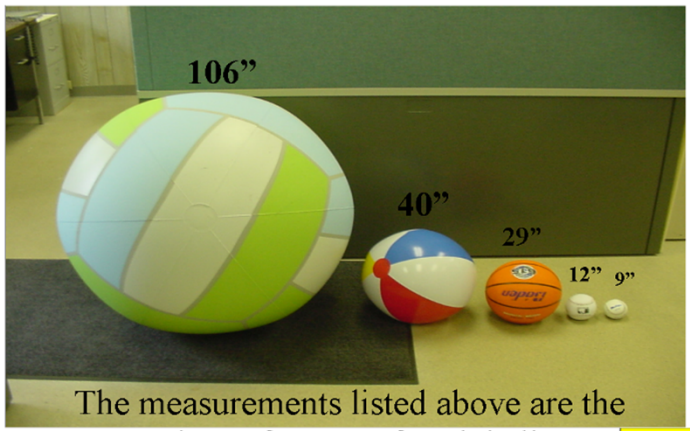
VDOT Specifications

- Class III Rip-Rap - **500-1500lbs** At least 50% weigh more than 900lbs and approximately 10% may weigh less than 500lbs
- Class II Rip-Rap - **150-500lbs** At least 50% weigh more than 300lbs and approximately 10% may weigh less than 150lbs
- Class I Rip-Rap - **50-150lbs** At least 60% weigh more than 100lbs and approximately 10% may weigh less than 50lbs
- Class I-A Rip-Rap - **25-75lbs** approximately 10% may weigh less than 25lbs and 10% may weigh 75-100lbs
- Gabion - **4-30lbs** 5% may weigh less than 4lbs or more than 30lbs At least 50% weigh more than 10lbs

LUCK STONE

Riprap

Reference Size's



The measurements listed above are the circumference of each ball

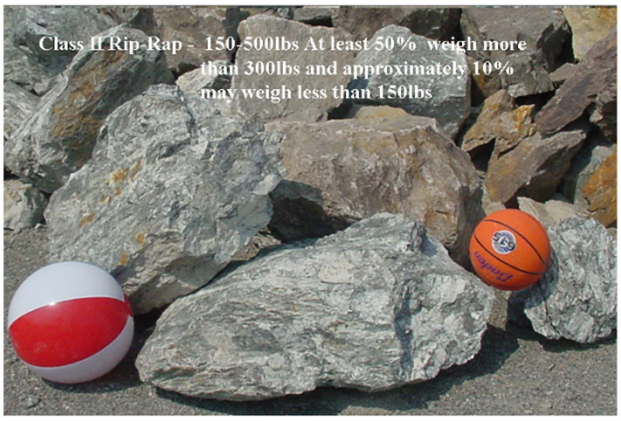
LUCK STONE

Riprap

Class III Rip-Rap

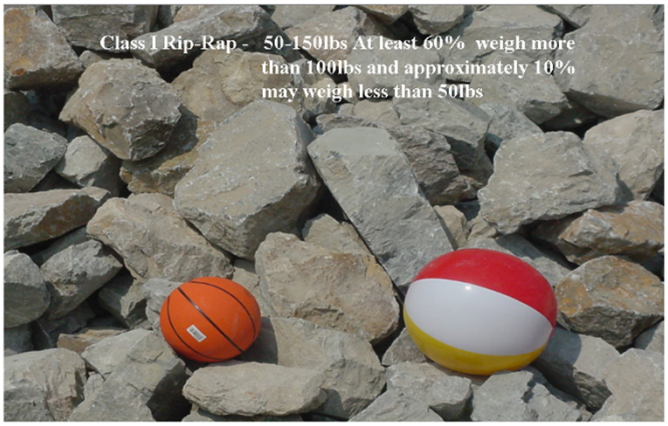
Riprap

Class II Rip-Rap



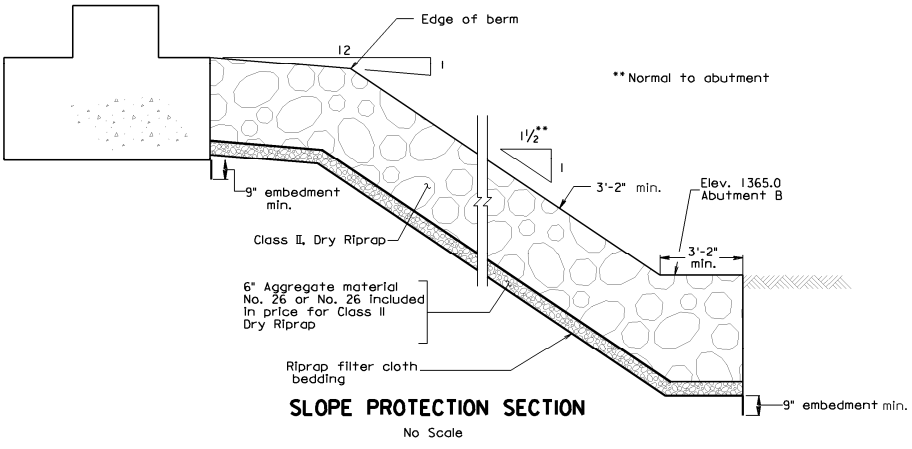
Riprap

Class I Rip-Rap



LUCK STONE

Riprap



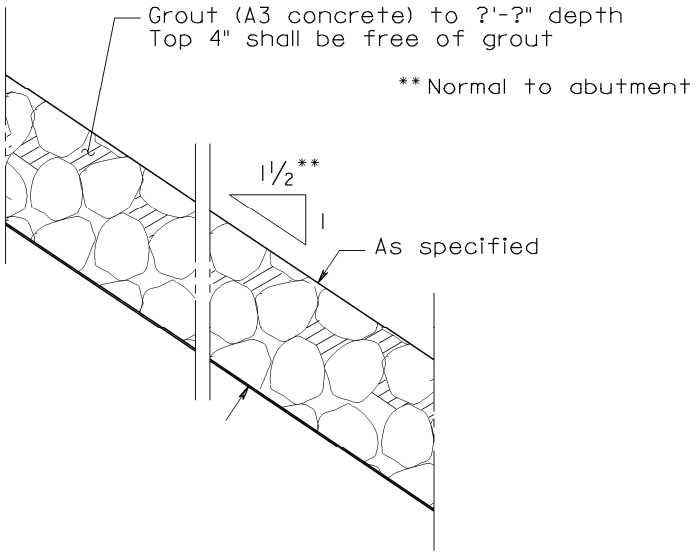
Riprap

Filter Fabric

Aggregate Material

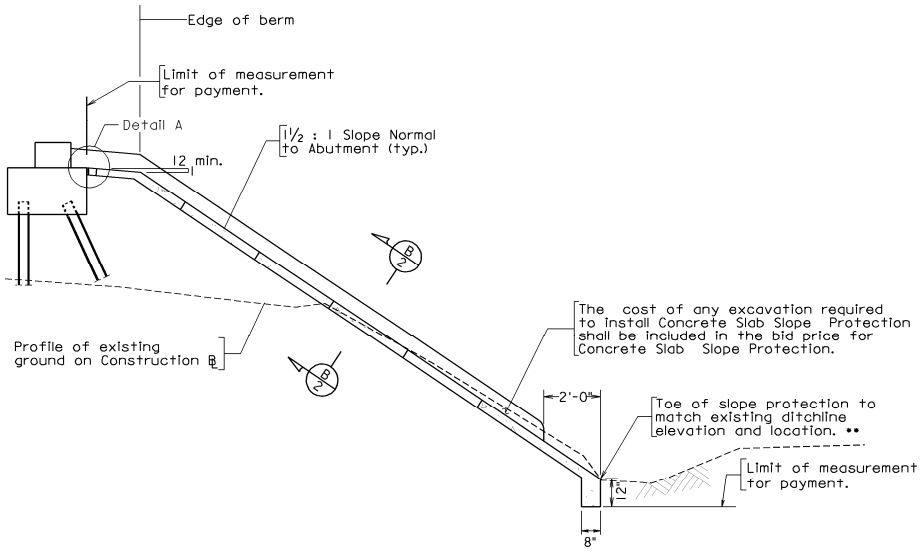
These are important to prevent fines from washing through and causing the riprap to fail. They are part of the scour protection system, along with the riprap.

Grouted Riprap



Grouted Riprap-WRONG!

Concrete Slope Protection



Concrete Slope Protection

Things to keep in Mind

- If the plan details show bedding material and filter cloth, then make sure the contractor installs these items.
- The correct installation of riprap/slope protection will almost always require excavation. Unless specified otherwise, the contractor does not get paid for this excavation.

Things to keep in Mind

- When installing grouted riprap, pay particular attention to the plan details. “Grouted” does not mean “flooded”. The grout should barely be visible from the surface.
- When installing riprap in the stream, refer to the environmental permit sketch in the contract. This will direct what operations are allowed. Any deviation must be cleared with the Environmental

Questions