BMP 21.00 & 22.00. Slope Drain

DESIGN CONSIDERATIONS

Objectives

The purpose of a Slope Drain is to temporarily or permanently conduct concentrated stormwater run-off safely down the face of a cut or fill slope without causing erosion on or below the slope.

Description

A Slope Drain is a pipe, flexible tubing, channel created with barriers and lining, or a rock flume that extends from the top to the bottom of a cut or fill slope to prevent gullies, channel erosion, and saturation of slide-prone or erodible soils on exposed soil slopes. With the exception of a rock flume, these are temporary measures.

- *Piped*: The pipe material is typically corrugated plastic or flexible tubing.
- *Barrier*: Barriers placed parallel to the slope to form a temporary channel directing water down a geotextile lined slope. Rock may be added to the flume to provide added protection and to slow the velocity of water.
- *Rock Flume*: A riprap-lined channel to convey water down a relatively steep slope without causing erosion problems on or below the slope.

Other Names

Downdrain, Drop Pipe, Pipe Slope Drain, Rock Chute, Rock Downdrain, Rock Flume.

Applicability

Slope Drains are temporary measures that are used during grading operations until the permanent drainage structures are installed, and until the slopes are permanently stabilized. They can also be used to drain water collected from aquifers, divert small seasonal streams, and in connection with down spouts and roof drains are used to divert flows from the construction area. Slope Drains allow clean water to be kept separate from sediment-laden water. Slope Drains are used in conjunction with temporary diversion dikes along the top edge of newly constructed slopes that function to direct stormwater run-off into the Slope Drain. Energy dissipation is required at the bottom of the slope to prevent erosion at the outlet of the Slope Drain.

Rock Flume Slope Drains are permanent structures. If there is a need for the Permanent Slope Drain, it needs to be included in the plans stamped by the designer.

Selection Considerations

- Divert stormwater to the Slope Drain using foam barriers, compost berms or socks, sandbags, diversion ditches, or equivalent diversion materials.
- Slope Drains should be used in conjunction with diversion berms to convey run-off from the drainage area.
- Provide both inlet and outlet protection to minimize erosion at these locations.
- Provide sediment trapping facilities for Slope Drains conveying sediment-laden water.
- Adjust the length of the Slope Drain when the cut and fill slopes are extended.
- Thrust blocks should be installed anytime 90 degree bends are utilized. Depending on size of pipe and flow, these can be constructed with sandbags, fence posts and wire, or similar sturdy temporary devices.

Design

Design Life: One (1) season (6 months) or less

Contributing Sheet Flow: Use a configuration appropriate for the anticipated flow.

Capacity: Peak run-off from a 2-year 24-hour storm, with area cover considered; or the design discharge of the up-gradient water conveyance structure, whichever is greater. Rock flumes with a drainage area between 5 and 10 acres are lined with Class II Riprap, while rock flumes with a drainage area less than 5 acres can be lined with Class I Riprap.

Diversion Barrier Height: Minimum 12 inches higher than the top of the drain pipe and greater than or equal to the height of the barrier for the Slope Drain.

Outlet section: Stormwater discharge energy must be dissipated to prevent scour and erosion at the outlet. Silt control bags, temporary lining of the discharge

area (e.g., plastic sheeting or riprap), or dispersal pipes are some of the methods that may be used.

Relationship to Other Erosion and Sediment Control Measures

Slope Drains are used with temporary diversion dikes to facilitate channeling of run-off into the structure. Slope Drains can be used in conjunction with an Interception Ditch to transport stormwater that has been redirected around a surface that is susceptible to erosion. Inlet and outlet protection are required to minimize erosion and scour.

Common Failures or Misuses

General

- Piping of water through the berm at the entrance area.
- Incorrectly locating the Slope Drain for the flow that is actually occurring.
- Materials placed on, or construction traffic across Slope Drain, resulting in damage to the structure.

Piped

- Failure to compact soil around and under the pipe entrance, resulting in undercutting.
- Slope Drain sections not securely fastened together; fittings not water tight, resulting in leakage.
- Slope Drain sections not securely anchored to the slope, resulting in displacement of the structure.
- Under-sizing the pipe for the contributing area.

Barrier

- Unless properly secured to the ground, run-off can flow underneath the barrier and cause failure.
- Unless properly secured, barriers can be dislodged or transported by high flows.

Rock Flume

- Using rounded rock
- Sloughing.
- Stone size too small or backslope too steep, resulting in stone displacement.
- Sediment accumulation in flume channel, resulting in reduced capacity.
- Channel width too narrow, resulting in over topping and erosion.

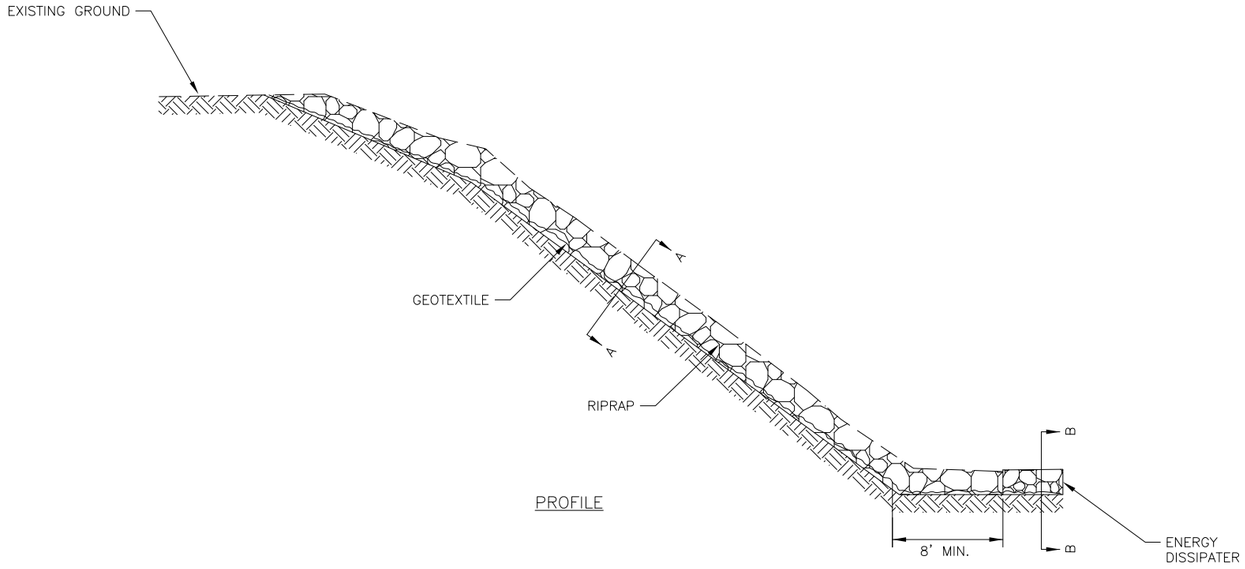
SPECIFICATIONS

Standard Specification

- 681 – Slope Drain

Drawings

- BMP-21.00 Slope Drain (Rock Flume)
- BMP-22.00 Slope Drain (Pipe)



PROFILE

ROCK FLUME SLOPE DRAIN NOTES:

MATERIALS

RIPRAP: RIPRAP, CLASS I OR CLASS II, (SECTION 611)

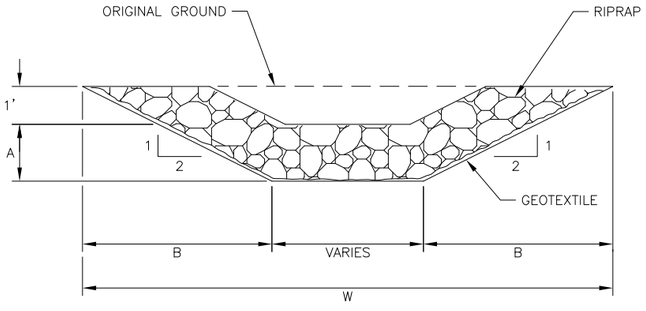
GEOTEXTILE: GEOTEXTILE LINER (SECTION 631 AND 729–2.02).

ENERGY DISSIPATOR: PIPE TEE, RIPRAP PAD, OR EQUIVALENT PIPE DISSIPATION.

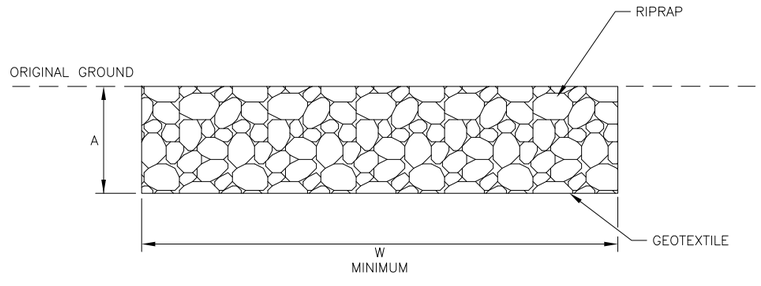
INSTALLATION

1. EXCAVATE TO PLACE ROCK SO THAT THE TOP OF FLUME SIDES ARE AT ORIGINAL GROUND.
2. IF ROCK IS ENCOUNTERED DURING FLUME CONSTRUCTION, ROCK SHALL BE EXCAVATED TO FINISHED FLUME LEVEL AND NO RIPRAP OR GEOTEXTILE SHALL BE REQUIRED.
3. SHAPE THE CHANNEL TO PROPER GRADE AND CROSS–SECTION AS SHOWN IN THE PLANS, WITH NO ABRUPT DEVIATIONS FROM DESIGN GRADE OR HORIZONTAL ALIGNMENT.
4. PLACE GEOTEXTILE PRIOR TO PLACEMENT OF RIPRAP.
5. INSTALL PERPENDICULAR TO SLOPE CONTOURS.
6. EXTEND THE DRAIN BEYOND THE TOE OF THE SLOPE AND PROVIDE RIPRAP OR GEOTEXTILE OUTLET PROTECTION.
7. DISCHARGE TO A STABILIZED WATERCOURSE, SEDIMENT RETENTION FACILITY, OR STABILIZED OUTLET.

RIPRAP TYPE	DIMENSIONS	
	A	B
CLASS I	1.5'	5'
CLASS II	3.0'	8'



SECTION A–A



SECTION B–B

ROCK FLUME SLOPE DRAIN

NOT TO SCALE

REVISIONS		
Date	Description	By

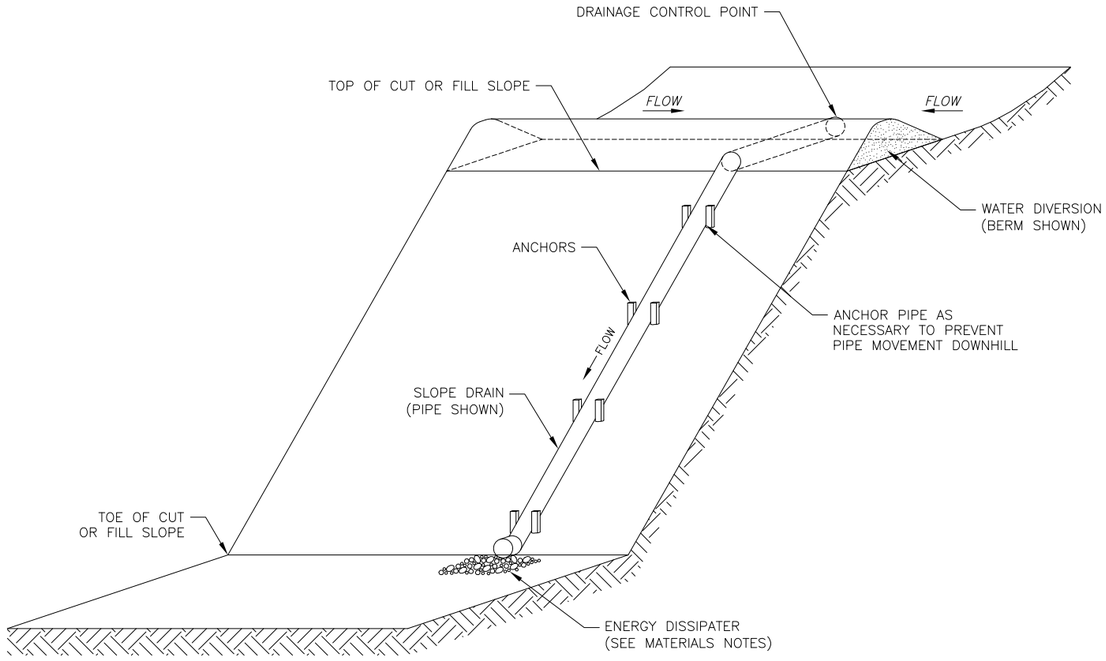
State of Alaska DOT&PF

SLOPE DRAIN
(ROCK FLUME)

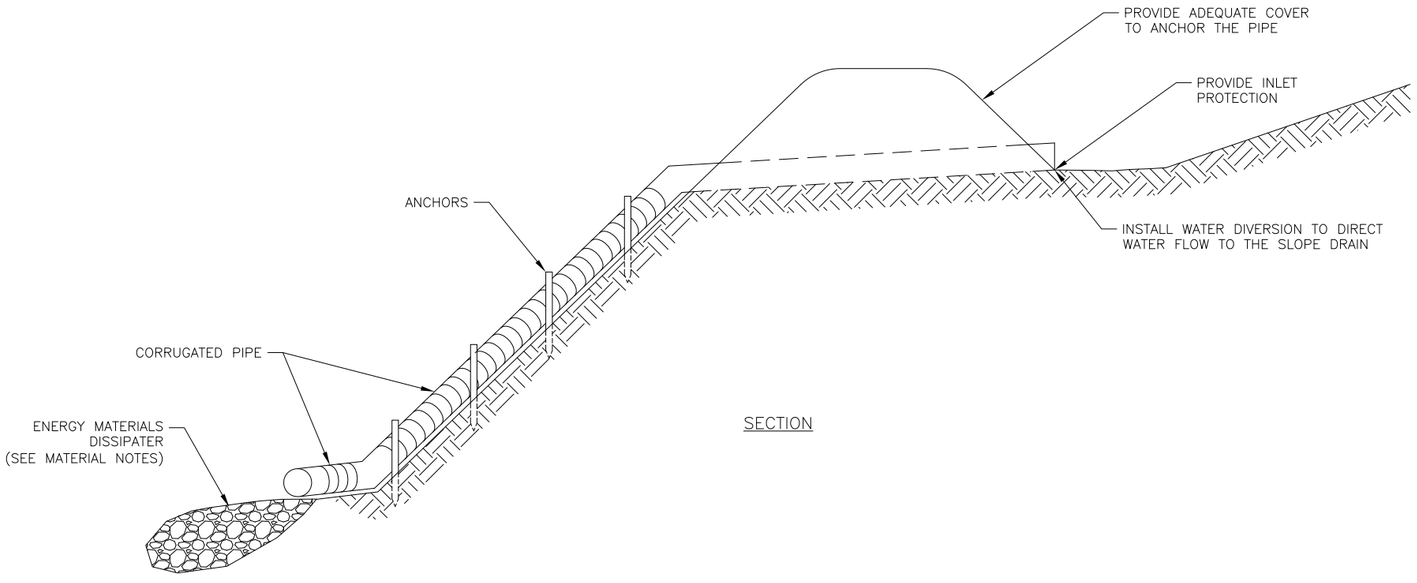
APPROVED

Date 12/2015 X/XX/XX

BMP-21.00



PERSPECTIVE



SECTION

PIPE SLOPE DRAIN
NOT TO SCALE

PIPE SLOPE DRAIN NOTES:

MATERIALS

WATER DIVERSION: EARTHEN BERM, FIBER ROLL, PREFABRICATED BARRIER SYSTEM, OR EQUIVALENT.

ENERGY DISSIPATER: PIPE TEE, RIPRAP PAD, OR EQUIVALENT ENERGY DISSIPATION.

SLOPE DRAIN: HEAVY DUTY FLEXIBLE MATERIAL, SUCH AS CORRUGATED PLASTIC PIPE OR PLASTIC TUBING. AS AN ALTERNATIVE, TWO BARRIERS WITH A CHANNEL LINING BETWEEN THEM TRENCHED AT THE TOP OF THE SLOPE CAN BE USED. SEE PREFABRICATED BARRIER SYSTEM BMP–13.00, COMPOST SOCK BMP–05.00, OR EQUIVALENT BARRIER.

INLET SECTION: STANDARD FLARED END SECTION FOR METAL PIPE CULVERTS, OR GEOTEXTILE FOR INLET PROTECTION.

ANCHORS: GROMMETS, STAKES, ANCHORS, OR EQUIVALENT FASTENERS.

INSTALLATION

1. PLACE SLOPE DRAINS ON UNDISTURBED GROUND OR WELL–COMPACTED FILL AT LOCATIONS SPECIFIED ON THE PLANS.
2. ENSURE THE DRAINAGE CONTROL POINT AT THE TOP OF THE SLOPE IS AT THE LOWEST POINT ALONG THE BARRIER.
3. INSTALL PERPENDICULAR TO SLOPE CONTOURS.
4. EXTEND THE DRAIN BEYOND THE TOE OF THE SLOPE AND PROVIDE RIPRAP OR GEOTEXTILE OUTLET PROTECTION.
5. CONSTRUCT THE TOP OF THE DIVERSION BERM 12 INCHES ABOVE THE TOP OF THE SLOPE DRAIN ENTRANCE.
6. DISCHARGE TO A STABILIZED WATERCOURSE, SEDIMENT RETENTION FACILITY, OR STABILIZED OUTLET.
7. INSTALL INLET PROTECTION USING END SECTION FOR PIPES OR GEOTEXTILE.
8. USE WATERTIGHT FITTINGS AT ALL SLOPE DRAIN CONNECTIONS.
9. SECURELY ANCHOR THE EXPOSED SECTION OF THE PIPE AT 10–FOOT SPACING.
10. ANCHOR INLET SECURELY WITH BERM OR SANDBAGS.

INSPECTION

1. INSPECT THE PIPE FOR BREAKS OR BLOCKAGE.
2. CHECK FOR ANY DAMAGED OR DISPLACED ANCHORS.
3. INSPECT FOR EROSION AROUND THE INLET AND OUTLET THAT COULD RESULT IN UNDERCUTTING OR BYPASSING.

MAINTENANCE

1. INSTALL A HEADWALL IF NECESSARY TO CONTROL EROSION AROUND THE INLET.
2. REPAIR ANY BREAKS IN THE PIPE.
3. TIGHTEN FITTINGS AT LEAKING CONNECTION POINTS.
4. CLEAR ANY CLOGS, DEBRIS, OR BLOCKAGE THAT REDUCE FLOW THROUGH THE PIPE.
5. REPAIR ANY EROSION AROUND THE INLET OR OUTLET; INSTALL RIPRAP OR SANDBAGS IF NECESSARY.

REMOVAL

1. AFTER THE SLOPE IS PERMANENTLY STABILIZED AND THE PERMANENT DRAINAGE SYSTEM IS INSTALLED, REMOVE THE SLOPE DRAINS AND PERMANENTLY STABILIZE THE REMAINING DISTURBED AREAS.

REVISIONS		
Date	Description	By

State of Alaska DOT&PF

SLOPE DRAIN (PIPE)

APPROVED

Date 12/2015 *X/XX/XX*

BMP–22.00