Rock Filter Dam (RD)

CD

Practice Description

A rock filter dam is a stone embankment designed to help capture sediment in natural or constructed drainageways on construction sites. This practice can also be used as a forebay to a sediment basin to help capture coarser particles of sediment. It is usually located so that it intercepts runoff (primarily from disturbed areas), is accessible for periodic sediment removal, and does not interfere with construction activities

Planning Considerations

Rock filter dams are used across drainageways to help remove coarser sediment particles and reduce off-site sediment delivery. Since rock filter dams are installed in flowing water, all local, state and federal laws and regulations must be followed during the design and construction process.

Dams should be designed so that impounded water behind the structures will not encroach on adjoining property owners or on other sediment- and erosion-control measures that outlet into the impoundment area.

Dams should be located so that the basin intercepts runoff (primarily from disturbed areas) and has adequate storage, and so that the basin can be accessed for sediment removal. Dams should also be located, as much as possible, in areas that do not interfere with construction activities.

Rock filter dams are not permanent structures. The design life of the structure is 3 years or less.

Design Criteria and Construction

Drainage Area

The drainage area above the dam should not exceed 10 acres.

Dam Height

The height of dam will be limited by the channel bank height or 8 feet, whichever is less. The dam height should also not exceed the elevation of the upstream property line. Water will bypass over the top of the dam, and the back slope of the rock dam should be designed to be stable.

Spillway Capacity

The top of the dam should be designed to handle the peak runoff from a 10-year, 24-hour design storm with a maximum flow depth of 1 foot and freeboard of 1 foot. Therefore, the center portion of the dam should be at least 2 feet lower than the outer edges at the abutment (see Figure RD-1).

Dam Top Width

The minimum top width should be 6 feet (see Figure RD-2).

Dam Side Slopes

Side slopes should be 3:1 (horizontal: vertical) or flatter on the back slope and 2.5:1 (horizontal: vertical) or flatter on the front slope.

Outlet Protection

The downstream toe of the dam should be protected from erosion by placing a riprap apron at the toe. The apron should be placed on a zero grade with a riprap thickness of 1.5 feet. The apron should have a length equal to the height of the dam as a minimum (and longer, if needed) to protect the toe of the dam.

Location

The dam should be located as close to the source of sediment as possible so that it will not cause water to back up onto adjoining property.

Basin Requirements

The basin behind the dam should provide a surface area that maximizes the sediment trapping efficiency. The basin should have a sediment storage capacity of 67 cubic yards per acre of drainage area.

Riprap Requirements

Stone for riprap should consist of field stone or rough, unhewn quarry stone of approximately rectangular shape. The stone should be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering, and it should be suitable in all other respects for the purpose intended. The specific gravity of the individual stones should be at least 2.5.

The minimum median stone size should be 9″. The gradation of rock to be used should be specified using Tables RD-1 and RD-2. Table RD-1 is used to determine the weight of the median stone size (d_{50}). Using this median weight, a gradation can be selected from Table RD-2, which shows the commercially available riprap gradations as classified by the Mississippi Department of Transportation.

The dam should be faced with 1 foot of smaller stone (½″ to ¾″ gravel) on the upstream side to increase efficiency for trapping coarser particles.

Table RD-1 Size of Riprap Stones

Weight	**Mean Spherical Diameter (ft)**	**Rectangular Shape** Length	Width, Height (ft)
50	0.8	1.4	0.5
100	1.1	1.75	0.6
150	1.3	2.0	0.67
300	1.6	2.6	0.9
500	1.9	3.0	1.0
1000	2.2	3.7	1.25
1500	2.6	4.7	1.5
2000	2.75	5.4	1.8
4000	3.6	6.0	2.0
6000	4.0	6.9	2.3
8000	4.5	7.6	2.5
20000	6.1	10.0	3.3

Table RD-2 Graded Riprap

Class	**Weight (lbs.)**					
	d_{10}	d_{15}	d_{25}	d_{50}	d_{75}	d_{90}
1	10	-	-	50	-	100
2	10	-	-	80	-	200
3	-	25	-	200	-	500
4	-	-	50	500	1000	-
5	-	-	200	1000	-	2000

Geotextiles

Geotextiles should be used as a separator between the graded stone, the soil base, and the abutments. Class I geotextile, as specified in Table RD-3 below, should be used. Geotextile should be placed immediately adjacent to the subgrade with no voids between the fabric and the subgrade.

Table RD-3 Requirements for Nonwoven Geotextile

Property	Test method	Class I	Class II	Class III	Class IV [1]
Tensile strength (lb)[2]	ASTM D 4632 grab test	180 minimum	120 minimum	90 minimum	115 minimum
Elongation at failure (%)[2]	ASTM D 4632	≥ 50	≥ 50	≥ 50	≥ 50
Puncture (pounds)	ASTM D 4833	80 minimum	60 minimum	40 minimum	40 minimum
Ultraviolet light (% residual tensile strength)	ASTM D 4355 150-hr exposure	70 minimum	70 minimum	70 minimum	70 minimum
Apparent opening size (AOS)	ASTM D 4751	As specified max. no. 40[3]	As specified max. no. 40[3]	As specified max. no. 40[3]	As specified max. no. 40[3]
Permittivity sec^{-1}	ASTM D 4491	0.70 minimum	0.70 minimum	0.70 minimum	0.10 minimum

Table copied from NRCS Material Specification 592.

1 Heat-bonded or resin-bonded geotextile may be used for Classes III and IV. They are particularly well suited to Class IV. Needle-punched geotextile are required for all other classes.

2 Minimum average roll value (weakest principal direction).

3 U.S. standard sieve size.

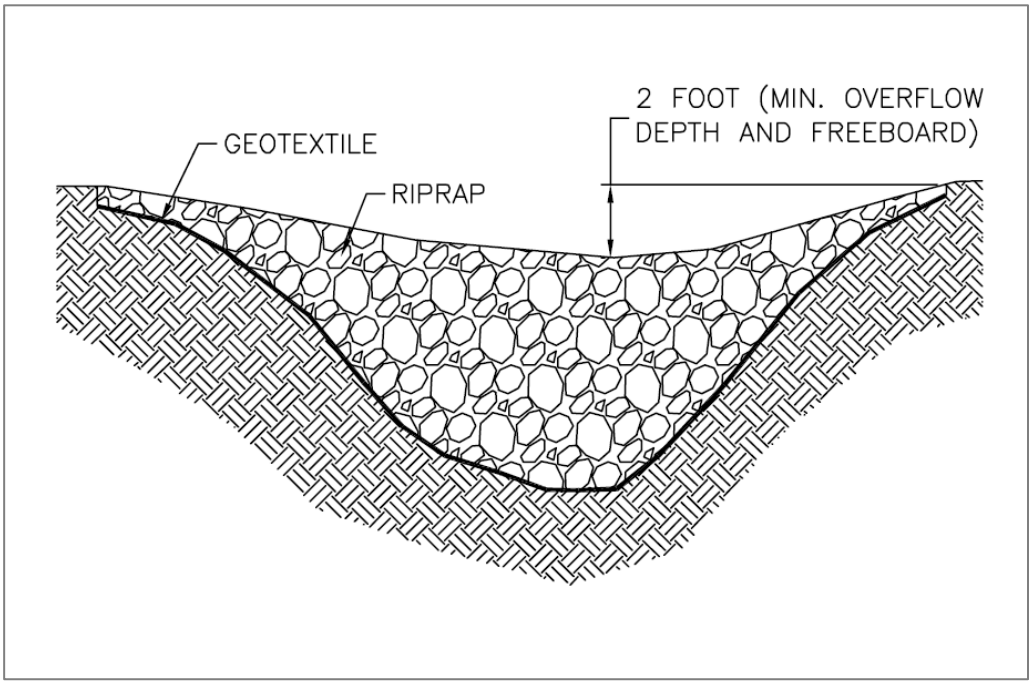

Figure RD-1 Typical Front View of Rock Filter Dam

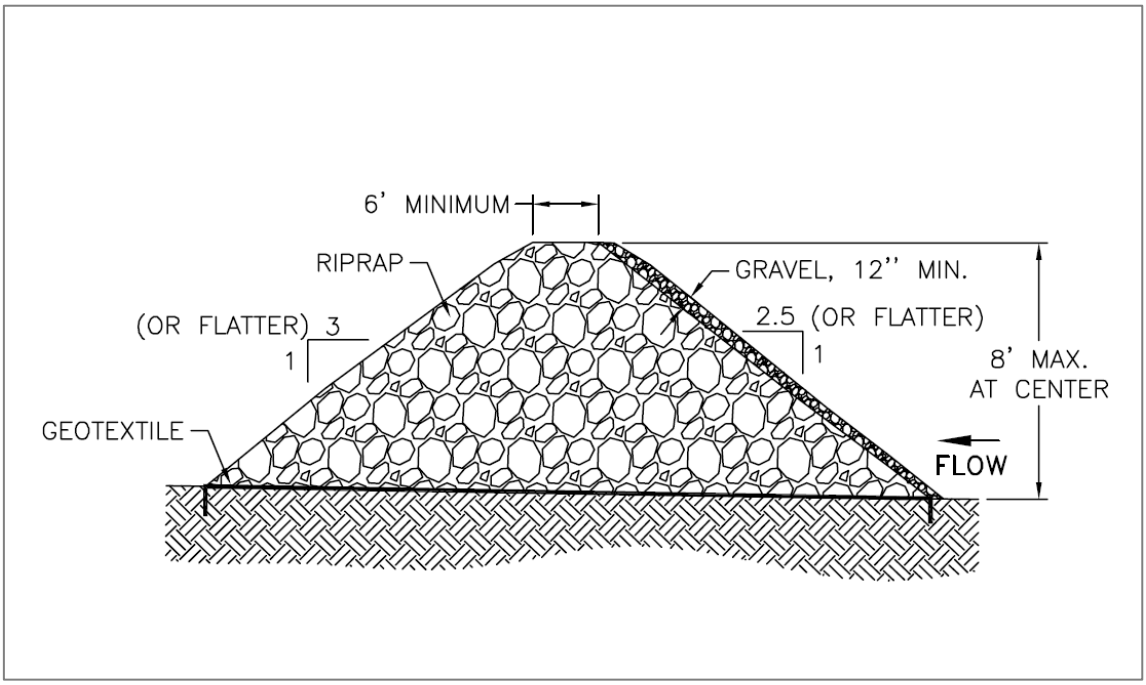

Figure RD-2 Typical Section of Rock Filter Dam

Construction

Prior to start of construction, rock filter dams should be designed by a qualified design professional. The rock filter dam plan should include details on dam height, dam top width, dam side slopes, and rock size(s). Plans and specifications should be referred to by field personnel throughout the construction process.

Site Preparation

Determine exact location of underground utilities, and avoid construction over and under utilities.

Clear and grub the area under the dam, removing and properly disposing of all root material, brush, and other debris.

Divert runoff from undisturbed areas away from the rock dam and basin area. Smooth the dam foundation.

If specified, cover the foundation with geotextile fabric, making sure the upstream strips overlap the downstream strips at least 1 foot and the upslope end is embedded into the foundation at least 1 foot.

Rock Placement

Construct the dam by placing well-graded, hard, angular, durable rock of the specified size over the foundation to planned dimensions and securely embed into both channel banks.

Once the dam is in place, clear the sediment basin area and dispose of the cleared material.

Set a marker stake to indicate the clean-out elevation (i.e., point at which the basin is 50% full of sediment).

Erosion and Sediment Control

Stabilize all disturbed areas with either *Temporary* or *Permanent Seeding.*

Construction Verification

Check materials and finished elevations of the rock filter dam for compliance with specifications.

Common Problems

Consult with a qualified design professional if any of the following occurs:

Variations in topography on site indicate rock filter dam will not function as intended; changes in plan may be needed.

Materials specified in the plan are not available.

Maintenance

Inspect the rock dam and basin after each storm event.

Check the dam for rock displacement and the abutments for erosion and repair immediately when repair is needed. If rock size appears too small or embankment slope is too steep, replace stone with larger size or reduce slope.

Check the drainageway at toe of dam for erosion. If erosion is occurring, a repair involving geotextile fabric (including another toe-in) and additional rock are probably needed to establish a stable outlet.

Remove sediment from the pond reservoir area when it accumulates to ½ the design volume. If the basin does not drain between storms because the filter stone (small gravel) on the upstream face has become clogged, the clogged filter stone should be replaced with clean stone.

Once the construction site is permanently stabilized, remove the structure and any unstable sediment. Smooth the basin site to blend with the surrounding area and stabilize. Sediment should be placed in designated disposal areas and stabilized.

References

BMPs from Volume 1

Chapter 4

Mulching (MU)	4-48
Permanent Seeding (PS)	4-53
Temporary Seeding (TS)	4-103