

# **SURFACE STABILIZATION**

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## **Riprap Slope Protection**



*Riprap slope protection is an erosion control measure consisting of geotextile fabric and stone riprap that is placed on an unvegetated slope to protect the soil from erosive forces.*

### **Purpose**

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To protect slopes or similar areas subject to erosion by water.

### **Specifications**

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#### **Slope**

A ratio of 2:1 or flatter (designed by a qualified individual/professional engineer; slopes exceeding 2:1 may require additional design considerations).

#### **Minimum Thickness**

Two times the designed  $d_{50}$  (see Appendix A – Glossary) stone diameter plus the depth of the bedding material.

#### **Materials**

- Riprap
  - Hard, angular, and weather resistant.
  - Specific gravity of at least 2.5.
  - Size and gradation that will withstand velocities of storm water discharge flow design.
  - Well-graded mixture of stone with 50 percent of the stone pieces, by weight, larger than the designed  $d_{50}$  size.
  - Largest pieces should not exceed two times the designed  $d_{50}$  and no more than 15 percent of the pieces (by weight) should be less than three inches.

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- Bedding Material – Geotextile fabric, sand, or crushed aggregate [Indiana Department of Transportation CA No. 9, 11, or 12 (see Appendix D)].

## Installation

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### Subgrade Preparation

1. Remove brush, trees, stumps, and other debris and dispose of in designated areas.
2. Excavate foundation subgrade below design elevation to allow for thickness of the bedding material and riprap.
3. Compact any fill material to the density of the surrounding undisturbed soil.
4. Cut a keyway in stable material at the slope base to reinforce the toe; keyway depth should be one and one-half times the design thickness of the stone and should extend a horizontal distance equal to the design thickness (see Riprap Slope Protection Worksheet).
5. Smooth the graded foundation.

### Placement of Bedding Material

1. If using geotextile fabric, place on the smoothed foundation, overlap the edges at least 12 inches and secure with anchor pins spaced every three feet along the overlap. (For large riprap, consider a four inch layer of sand to protect the fabric.)
2. If using sand or aggregate bedding material, spread the well-graded bedding material in a uniform layer to the required thickness (six inches minimum). If two or more layers are specified, place the layer of the smaller gradation first and avoid mixing the layers.

**Note:** Omission of the bedding material or damage to it may result in erosion and/or piping beneath the riprap or movement of the underlying soil through the voids in the riprap.

### Riprap Placement

1. Immediately after installing the bedding material, add riprap to the lines and elevations shown in the construction plans. Place the riprap in one operation, taking care not to damage the bedding material. (Do not dump through chutes or use any method that causes segregation of stone sizes or that will dislodge or damage the underlying bedding material.)
2. If geotextile fabric tears when placing riprap, repair immediately by laying and stapling a piece of fabric over the damaged area, overlapping the undamaged areas by at least 12 inches.

## **RIPRAP SLOPE PROTECTION**

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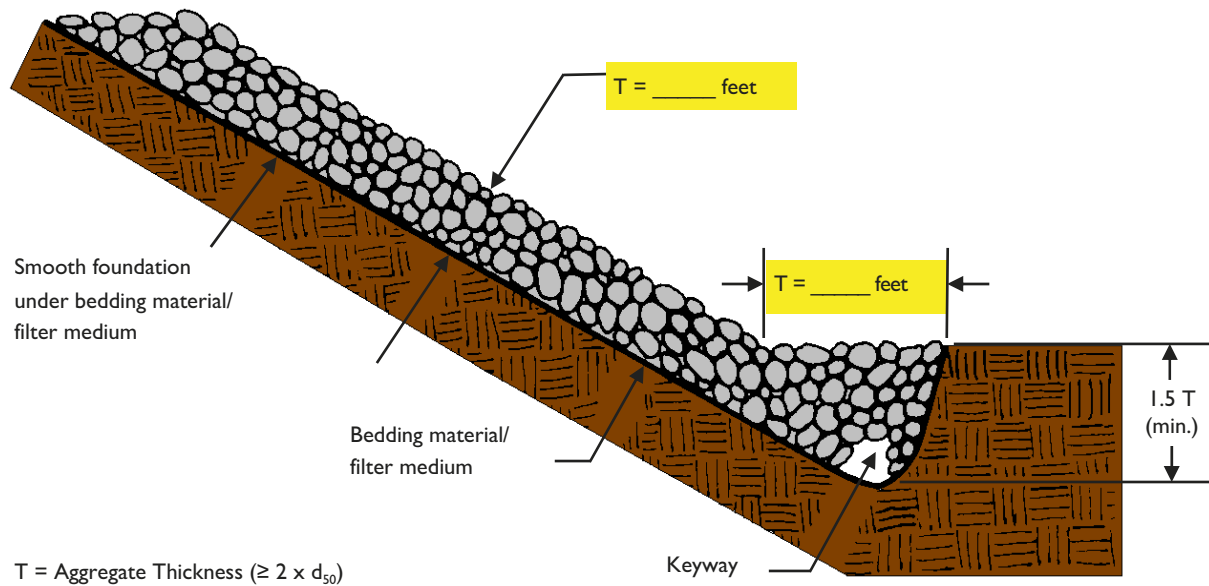
3. Place smaller stone in voids to form a dense, uniform, well-graded riprap mass. (Selective loading at the quarry and some hand placement may be needed to ensure an even distribution of stone material.)
4. Blend the riprap surface smoothly with the surrounding area to eliminate protrusions or overfalls.

### **Maintenance**

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- Inspect within 24 hours of each rain event and at least once every seven calendar days.
- Check for displacement of riprap material, slumping, and erosion along the edges, especially on the down-slope side. (Properly designed and installed riprap usually requires very little maintenance.)

## Riprap Slope Protection Worksheet



Source: Adapted from North Carolina Erosion and Sediment Control Planning and Design Manual, 1993