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### **15.1 Grade Separations**

In general, there are three types of slope paving used at the abutments of grade separation bridges; cast-in-place concrete, crushed aggregate or select crushed material, and concrete block. Concrete cast-in-place is used in urban areas or where appearance is a prime consideration. Bituminous stabilized crushed aggregate or select crushed material is used in rural areas or where appearance is not as important. Refer to Slope Paving Structures standard details for additional information.

Precast concrete blocks (approximately 4 x 16 x 24 inches) were the standard applications during the late 50's and early 60's. Many blocks settled or washed out of place due to erosion of bedding under the blocks. They are no longer specified except on widening jobs to match existing slope paving.



## **15.2 Stream Crossing**

Heavy riprap is used for slope protection at stream crossings due to its superior performance over medium random riprap. In general, due to the favorable performance and relatively low cost of geotextile fabrics, they are used under heavy riprap whenever heavy riprap is specified for a project.

Many factors influence the criteria used to select end slopes. These include:

1. The type of soil. (granular, cohesive, borrow or in-situ)
2. Type and impact of a failure to stream/roadway/structure.
3. Type of abutment foundation support. (spread footings vs. piles)
4. History of the existing slopes at structure replacement sites.
5. Additional bridge costs when structures are lengthened due to flatter slopes.

The current standard for slopes is 1.5:1. However, for conditions where the vertical height of fill from berm to toe of slope exceeds 15 feet, consider flattening slopes to 2:1, or breaking up the slope by providing a plateau area halfway through the slope.

Furthermore, if slope soil materials are “fairly granular”, use current standards. For other soil types, flatten slopes to 2:1. If existing problems are noted or there is no historical information at the site, analyze site geometry to determine slope.

Refer to the Standard Detail for placement of heavy riprap. Any additional riprap not covered by the standard is not part of the structure plans.