Rock Protection for Stream Related Infrastructure

Introduction

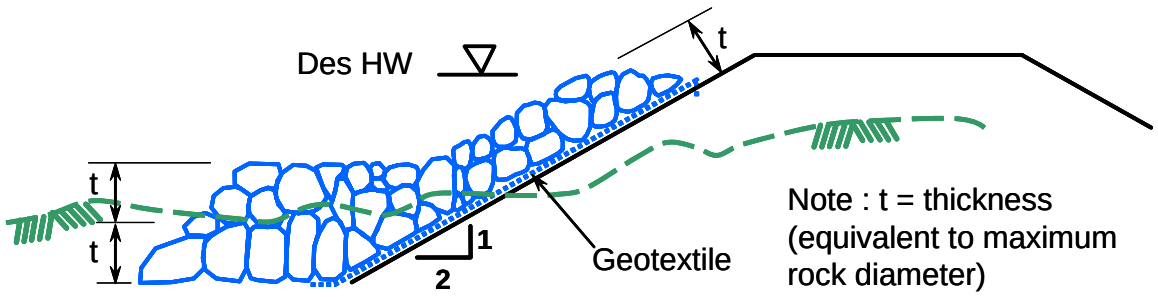
The department has successfully used rock riprap for many years to protect stream related infrastructure, including stream crossings, highway embankments, and other water management facilities potentially impacted by active streams. Typical details for rock riprap protection have been developed over several decades and used successfully at many sites. Some recent modifications to these details have been proposed that are not consistent with the department's practice. This document is intended to clarify the current practice for typical rock protection details for stream related infrastructure.

Background

Information on the department's current practice for rock protection systems for stream related highway infrastructure is available from several sources including:

- many recent examples that are consistent with current practice available in the department's inventory of DD drawings
- riprap gradations and rock sizes found in the "Specifications for Bridge Construction" document
- geotextile requirements and riprap size selection based on flow velocity provided in the "Design Guidelines for Bridge Size Culverts" document.

The typical rock protection detail involves lining the bank with a single thickness (equal to the maximum rock diameter) of the selected class of rock riprap, with a double thickness launching apron at the toe (see sketch). The sloping portion of the embankment to be protected is at a maximum slope of 2:1 (Horizontal : Vertical). The protection generally extends up to the design highwater elevation and is underlain by a geotextile filter fabric, with appropriate key-in, to prevent the loss of fines under the rock. The launching apron is generally half buried below the streambed, and is sized to extend far enough into the stream to launch into the design scour hole with a continuous single layer thickness of protection, with appropriate accounting for loss of rock. Factors affecting the size and location of the rock apron include depth to bedrock, impact of excavation on slope stability, and impact of lost flow area on hydraulics.



The protection system can be applied to a bridge fill or used with river engineering structures such as guidebanks and spurs. In the case of bridge fills, the protection works extend u/s and d/s so that the ends of the protection tie into the channel bank. On streams with a high degree of lateral mobility, a river engineering analysis is required to determine the extent and composition of the protection works system.

Recently, the application of bio-engineering and bio-technical solutions has been promoted by various agencies for channel restoration and fish habitat compensation. Although these techniques may be suitable for those purposes, the department does not consider them appropriate for protection of stream related highway infrastructure. The current rock protection systems are preferred for the following reasons:

- Over 40 years of proven performance history with rock systems that can resist drift, abrasion and ice forces with the flexibility to accommodate settlement and launching
- Proven velocity based criteria for selection of rock protection systems
- Relatively low cost and generally readily available sources of rock riprap and concrete materials
- Laterally mobile streams require a “hard” fixed solution to maintain alignment through the opening
- Consequences of failure at stream crossings to public safety are severe
- Alternative systems have been tested but many have been found to be unreliable or uneconomical

Hybrid solutions, such as willow staking within a rock riprap protection system have also been proposed. However, such activities are likely to compromise the function of the geotextile fabric, and the loss of fines could result in failure of the whole system. Willow staking within the active channel may also significantly reduce the hydraulic capacity of the channel adjacent to our infrastructure, and impede bridge inspection activities. It is therefore recommended that such actions, if required, only be undertaken away from the rock protection systems that are considered critical to the protection of the infrastructure.

Recommendation

The department’s current practice for rock protection works for protection of stream related infrastructure, as specified above, should be followed. Bio-engineering and bio-technical solutions should only be considered for stream restoration and fish habitat compensation works. Also, vegetation should not be installed within the rock protection system or within the active channel adjacent to the highway infrastructure.

Contact

Questions or further information on this guideline may be directed to the Hydrotechnical Standards Engineer in the Bridge Engineering and Water Management Section of the Technical Standards Branch, Alberta Transportation.

Adopted:

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