10.1 Riprap - General

Riprap is a protective layer of material used to protect earth slopes and channels from the effects of erosion by runoff or scour by stream flow. Riprap can be a hand placed layer of small stones, a layer of sandbags filled with concrete, or a layer of large boulders or rocks necessary to prevent scour or erosion in streams with higher flow velocities.

- Riprap relies on an angular irregular shape to resist being rolled away by the force of running water.

- Riprap must be placed uniformly and carefully to eliminate any weak area where erosion can get a start.

- The Contractor may be required to obtain a permit, agreement or authorization to obtain heavy rock riprap.

- The Bridge Inspector should review with the Contractor that all requirements have been satisfactory met prior to loading and hauling any riprap.

10.2 Environmental Constraints

Be aware of the environmental constraints governing the site as outlined under the Environmental Code of Practice. Note the following requirements:

- The period permitted for any instream activity.

- Ensure equipment is clean when working in or adjacent to the stream.

- Cleanup all oil leaks and spills

- Prevent loose material from washing into the stream.

- Removal and disposal of all earthworks, such as berms and access before final acceptance of the rock riprap slope protection.

- Cleanup of the bridge site, roads, stream channel and adjacent property acceptably completed.

- Receipt of written evidence that cleanup is satisfactory to the property owner if adjacent property outside the right-of-way has been affected.

- Restoration of all disturbed stream banks and/or borrow pits satisfactorily reclaimed.

10.3 Safety

Refer to the Alberta's Occupational Health and Safety Regulation, General Safety Requirements for specific safety requirements:

- Part 3 Health and Safety Plans
- Part 4 Hazard Assessment, Elimination and Control
- Part 15 Personal Protective Equipment
- Part 16 Powered Mobile Equipment
- Part 27 Excavation, Tunnelling and Trenching
- Issue "STOP WORK" order to the Contractor if necessary.

10.4 Bridge Inspector's Record

The Bridge Inspector should keep an accurate record of the following information:

- All survey information to ensure that the pay quantities can be calculated.
- All discussions and agreed upon arrangements between Contractor and private landowner pertaining to disposal areas.

10.5 Materials

The rock riprap material shall be hard, durable and angular in shape, resistant to weathering and water action.

- The rock source should be selected well in advance as the Contractor may be required to submit a sample for testing and approval.
- The material should be free of overburden, spoil, shale or organic material and must meet the gradation requirements for the class specified.

10.5.1 Hand Laid Riprap

Hand laid riprap consists of fieldstone or rough unhewn quarry stone. The stones are preferably rectangular in shape with broad flat stones chosen in preference to round or cubic stones.

10.5.2 Sandbag Riprap

Sandbag riprap is a "man-made" riprap consisting of burlap bags filled with fresh concrete and placed in a dense layer before the concrete has set.

10.5.3 Heavy Rock Riprap

Heavy rock riprap is intended to resist the effects of heavy stream flows. The rocks or boulders must be hard, durable, and resistant to weather and water action.

- The rock must be clean with no overburden, or organic material and it must be angular in shape.
- Heavy rock riprap must have a gradation conforming to the class specified.
- The Specifications limit elongated pieces to have a minimum dimension not less than one third of the maximum and the density must be greater than 2.5 t/m^3.

10.6 Placing

Rock riprap must be placed accurately in the locations shown on the plans and in the size and thickness of layers specified to be effective. Rock riprap must meet the gradation requirements for the classes specified.

10.6.1 Hand Laid Riprap

Hand laid riprap is very seldom utilized in bridge construction. However, when it is required, the following procedure should be observed:

- Hand laid riprap is to be placed beginning with the larger stones on the bottom row.
- Each stone in succeeding rows is to be placed with its broad flat surface resting on a horizontal bed prepared for it, such that each stone rests on horizontal steps in the earth and not on the underlying stones.

- Stones are to be laid in close contact in successive rows or layers proceeding up the slope, with the joints staggered to leave a "shingled" effect.

- Voids between stones are to have smaller broken pieces rammed into them as fillers.

10.6.2 Sandbag Riprap

Sandbag riprap is to be placed on a surface that is trimmed and dressed to the lines and grades shown on the plans. A trench may be required at the base of the slope to receive the bags. Sandbag riprap is used mainly as drain trough terminal protection as detailed in the applicable specification.

- The bags are to be filled approximately two-thirds full with concrete with the tops folded closed and they are to be placed immediately when the concrete is fresh.

- The bags are to be the prepared surface with the ends in the same direction in a manner that results in a shingled effect.

- The upstream end of any bag must be under the end of the bag placed next to it.

- The bags are to be placed from the downstream edge towards the upstream edge, and from the bottom row towards the top.

- The folded ends of the bags must be placed underneath.

- The bags are to be rammed and packed against each other to leave a uniform surface, with the layer not less than 130 mm thick.

10.6.3 Heavy Rock Riprap

Heavy rock riprap is placed by dumping directly from trucks, by pushing with bulldozers or loaders or by placing individual boulders by crane or a backhoe.

- The required cross-section will be shown on the plans.

- The finished surface must be reasonably uniform without large cavities, and without individual stones protruding above the surface.

- Control of the gradation of heavy rock riprap is to be done by visual inspection. The Contractor is required to arrange two samples, one near the site and one at the source, with the individual pieces weighed and marked with the weight.

- The Bridge Inspector can do his inspection by comparing the rock being placed with the displayed sample.

- The Contractor's staff loading the material can use the source sample to ensure that a proper gradation is loaded.

- The Contractor is required to provide all assistance necessary to confirm that the rock being placed conforms to the Specifications.

- Ensure that the depth and the width of the apron meet the Specifications and that the elevation of the apron are that specified.

10.7 Checklist

10.7.1 Bridge Inspector's Responsibilities

- Review the applicable Specification section and study the Drawings.

- Ensure that the Contractor obtains the necessary permits, agreements or authorizations necessary for heavy rock riprap.

- Check the excavations and elevations of the prepared areas.

- Check that the hand laid riprap meets requirements for shape and size.

- Check that the hand laid riprap is started from the bottom layer, and that each stone is set on a prepared horizontal bed, which results in a shingled effect.

- Check that the surface for sandbag riprap is prepared with trench base if required. FOR DRAIN TROUGH TERMINAL PROTECTION, ENSURE THAT THE BAGS ARE PLACED LEVEL AND OVERLAPPED TO FORM THE "DISHED" CATCH BASIN.

- Check that the concrete conforms to the Specifications, bags are filled two-thirds full, and tops are folded underneath.

- Ensure that the placing of sandbags starts at the lower downstream edge and that the upstream side of each bag is beneath an adjacent bag for a shingled effect.

- Check that the proposed heavy rock has the approved performance records, or that sample results are submitted to the Consultant and approved before use.

- Check that the heavy rock riprap has an angular shape and is clean, free from spoil, overburden, organic, and meets gradation requirements.

- Check that the heavy rock riprap is placed in trench or as shown on the drawings.
- Compare the heavy rock riprap material being placed to the sample set out by the Contractor.
- Survey as required to measure the heavy rock riprap if paid by volume.
- Measure and calculate the quantities for payment.
- If heavy rock riprap is paid by mass, ensure that the scale is approved. Record the weight of all loads.

10.7.2 Bridge Project Engineer's Responsibilities

Discuss the following items with the Contractor and the Bridge Inspector:

- The final grade of the headslope.
- The acceptability of the rock riprap pertaining to the quality and the gradation.
- The required apron bottom elevation.
- The required final elevation.
- The final cleanup requirement.

SECTION 10

RIPRAP

10-1 Load cell scale and hardware used to weigh heavy rock riprap at site

10-4 Hoes were utilized to weigh rocks at the site

10-2 Digital read out for the scale

10-5 Weighing heavy rock riprap on the scale at the pit

10-3 Heavy rock riprap sampled at site with weights painted on each rock

10-6 Heavy rock riprap sampled at pit with weights painted on each rock

SECTION 10

RIPRAP

10-7 Placing heavy rock riprap

10-10 Placing heavy rock riprap

10-8 Heavy rock riprap stockpile

10-11 Placing heavy rock riprap on spur

10-9 Placing filter fabric on well trimmed slope prior to placement of heavy rock riprap

10-12 Final heavy rock riprap product