



Subject: Rock Slope Design

Date: September 17, 2002	Author: Michael F. Oliver, P.Eng
Bulletin Number: GM02001	Action Required: Immediate
Bulletin Type: Change to Standard	Effective Date: Immediate
Contacts	Standards Affected
Michael F. Oliver, P. Eng Chief Geotechnical, Materials and Pavement Engineer Al Brown, P.Eng. Mgr. Geotechnical Services, South Coast Region	Figure 440.G Solid Rock Cut Sections Replaces the existing BC Supplement to TAC Geometric Design Guide for all roads except LVR. To be used for Preliminary and Conceptual rock ditch and rock slope design.

Background

These notes and sections are for preliminary and conceptual rock slope design and there remains a requirement for site specific geotechnical investigation for detailed design. However, detailed design shall be undertaken in full consideration of these guidelines and the need to reduce rock slope excavation costs.

The purpose of the rockfall catchment area is to prevent rockfall originating from the slope above the highway from reaching highway lanes. Wider catchment in conjunction with appropriate geometry in general equates to improved catchment reliability. However, the width of catchment increases the volume of rock excavated and excavation cost .

For high rock cuts, catchment width that would successfully retain all rockfall from reaching travelled highway lanes is considered excessively expensive and conservatively wide in most cases. Such designs in isolation would be rarely used. As an alternative to wider catchment, applied on-slope stabilization measures may provide options to improve rockfall catchment reliability at lower cost.

Preliminary and conceptual design shall consider general geometric requirements for ditch width, depth and slope stabilization treatment as outlined in this bulletin.

Detailed design involves site specific slope angles, site specific slope stabilization measures, site specific catchment widths, hydraulic considerations and conformance with seismic design policy. Detailed design shall also encompass risk assessment, and comparison of catchment widths, slope stabilization measures and costs to optimize the design.

All rock slope designs assume smooth wall controlled blasting techniques and scaling as minimum slope construction and stabilization techniques. Rock slope construction and slope stabilization methods such as slope mesh and rock bolting are to be undertaken as necessary to reduce risk, following the latest Ministry Standard Specifications for Highway Construction unless otherwise specified. It is expected that a prescriptive approach will be taken during construction to address requirements for rock slope stabilization.



General:

The following definitions are to be used for preliminary and conceptual rockslope design purposes:

Catchment Width: Horizontal distance from the break in slope at the edge of the shoulder to the rock face as shown in Figure 1.

Catchment Depth: Elevation difference between the top of the Shoulder and the lowest point in the catchment.

Slope Angle: The angle of the rock slope up from the horizontal. Assume for conceptual and preliminary design that all slopes will be cut at 0.25:1 (76 degrees). The detailed design will determine actual design slope angle to be used for construction.

Catchment Slope Angle: The angle of the catchment bottom slope, down from the horizontal, extending from the break in slope at the shoulder to the rock face. The catchment slope angle to be used is 4:1. This design is effective in retaining rock to the catchment area and favored over flat bottom catchment.

Recommended Preliminary/Conceptual Catchment Design:

1. Rock Cut Heights up to 8 m.

For rock cuts up to 8 m, catchment width is 3 m. The catchment depth is 0.75 m. There is no requirement for enhanced slope stabilization/remediation.

2. Rock Cut Heights from 8 m to 16 m.

For rock cuts from 8 m to 16 m, catchment width is 4 m. The catchment depth is 1.00 m. Enhanced slope stabilization/remediation is required for slope heights above 10 metres.

3. Rock Cut Heights over 16 m.

For rock cuts over 16 m, catchment width is 5 m. The catchment depth is 1.25 m. There is a requirement for complete remediation/stabilization of the slope.

Remediation/slope stabilization design involves potentially the application of mesh to 10 m above road grade, pattern bolt installation, shotcrete application and/or catch fence/barrier. For preliminary/conceptual design estimates, year 2002 typical cost of enhanced slope treatment is \$100/m².

For conceptual and preliminary design, if a narrow catchment width already exists (as is a case for many rock cuts along BC Highways), then an alternative involving enhanced remediation/stabilization measures should be considered to reduce excavation quantities and to minimize the disturbance to the existing rock slopes.

This bulletin is not intended to address issues of global stability, which must be independently assessed.

Table 1 summarizes the catchment widths and stabilization requirements to be used for conceptual and preliminary rock slope design.

Table 1 Recommended Catchment Widths and Stabilization Requirements

Slope Height (m)	Catchment Width “B” (m)	Remediation Stabilization Requirement	Costs for Remediation Stabilization
0 – 8	3	No	0
8 – 16	4	Above 10 m	\$500 per linear metre
16 – 24	5	Yes	\$1,000 per linear metre
24 to 32	5	Yes	\$2,000 per linear metre
Over 32	5	Yes	\$3,000 per linear metre

Design Assumptions:

- Catchment shape is 4:1 slope from edge of shoulder to rock cut face and slope angle is 0.25 to 1.
- Where natural slopes exist above the excavated rock slopes and these slopes have potential stability problems, an increase in the remedial stabilization measures will be required.
- Detailed design will be based on site specific conditions determined from detailed site investigation.

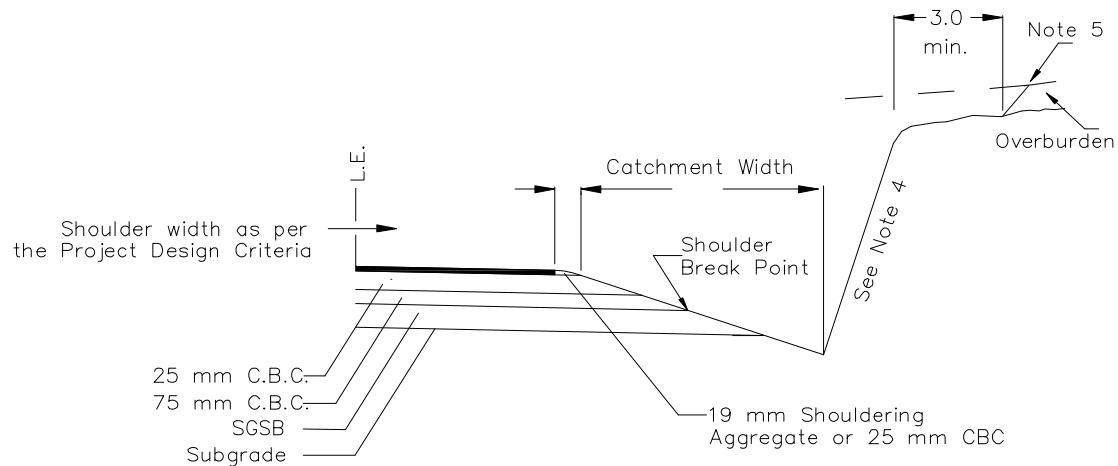


Figure 1 Typical Cross Section

See Notes on the following page



Notes:

1. Rock cut height is measured from the outside catchment point to the top of the rock face, excluding overburden.
2. All rock cuts to be excavated to subgrade line.
3. A geological investigation is to be carried out for all cuts greater than 8 m and for all cuts where natural slope extends upward beyond section limits.
4. Use 1:4:1 backslopes unless a different slope angle is recommended in a geological investigation.
5. Overburden slope is normally cut to 1.5:1 but can be varied, depending on the type of material.
6. Barrier, clear zone and drainage requirements will be reviewed in the detailed design phase.

Action:

- Place this Technical Bulletin between page 440-6 and 440-7 of the BC MoT Supplement;
- Put a note on Figure 440.G cross-referencing to this Technical Bulletin.

References:

1. "BC Supplement to TAC Geometric Design Guide, 2001 Edition", BC Ministry of Transportation, Engineering Branch

Abbreviations:

- TAC: Transportation Association of Canada
- LVR: Low Volume Roads
- CBC (Crushed Base Course) & SGSB (Select Granular Sub Base)