

Rock Cut Slopes

Design Manual
Chapter 200
Geotechnical Design

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This section addresses the typical rock slope configurations routinely used by the Iowa DOT during the planning of roadway projects. Rock mass improvement techniques such as bolting, dowelling, shotcreting, etc., to produce a stable slope are not covered herein.

The Soils Design Section is generally responsible for determining precisely where rock excavation is necessary and where rock backslopes will be used, but coordination with the Design Section is necessary. Rock excavation procedures are outlined in Section [5B-1](#). The guidelines for rock cut slopes contained herein are similar to soil cut slopes configurations outlined in Section [200F-11](#).

Rock Mass Information

Rock slope design relies heavily upon the quality of the rock, which is determined by surface mapping and rock coring to assess discontinuities (fracture/joint) patterns and conditions. Discontinuities strongly control rock mass quality and slope stability. If surface mapping is not feasible due to the presence of overburden soil, or for other reasons, rock coring should be performed to obtain the required rock mass quality data. In addition, the groundwater conditions, and particularly water seepage present in rock discontinuities, should be evaluated as part of the subsurface exploration. The rock quality data will be summarized in the S3 and/or S4 event submittals.

Quick Tips:

- The Soils Design Section is generally responsible for identifying precisely where rock excavation is necessary and where rock backslopes will be used, but coordination with the Design Section is necessary.
- Finalization of the required rock slope typical section should be done jointly between the Design Section and the Soils Design Section.
- Steepened backslopes should be avoided in areas of shale, weathered, or broken and weathered limestone, and similar inferior rock unless specifically reviewed and analyzed by the Soils Design Section and the Design Section.

Rock Slope Configurations

Design Details [4110](#) or [4111](#) should be used to begin design of rock backslope sections for rock cuts greater than 5 feet. Finalization of rock backslope design should be done jointly between the applicable Design Section and the Soils Design Section to insure the optimum section and to define the rock excavation requirements for the project. Steepened backslopes should be avoided in areas of shale, weathered or broken and weathered limestone, or similar inferior rock unless specifically reviewed and analyzed by the Soils Design Section and the Design Section.

Where the depth of rock excavation in any given area is 5 feet or less, design practice is to provide a normal ditch section; however, this is typically reviewed on a case-by-case basis. A flat bottom ditch with a minimum width of 10 feet is generally required for all rock cut slopes as shown in Design Detail [4101](#).

Limestone, Dolomites, Cemented Sandstones, and other Hard Rocks

Rock slopes in good-quality limestones, dolomites, and cemented sandstones may be cut nearly vertical or with a slight inclination. An inclination of 0.5H:1V is used for normal rock excavation, and an inclination of 0.25V:1H is used when pre-splitting is performed for rock excavation. Benches should be provided at a vertical spacing not to exceed 35 feet for cut slopes greater than 35 feet high. Benches should generally be a minimum of 10 feet wide. Benches may be provided at the contacts

of different formations (not necessarily at 35 feet) and may vary in width. The typical rock slope configurations for excavation of rock with and without presplitting are shown in Design Details [4110](#) and [4111](#). The Soils Design Section determines when pre-splitting of the rock is needed and appropriate based on rock quality, rock hardness, etc., and prepares a pre-splitting tab, Tab [107-25](#).

Shales, Siltstone, and other Soft Rocks

Cut slopes in shale, siltstone, and other soft rocks should be inclined at no steeper than 2H:1V.

Detailed Rock Slope Design

If the project requires a detailed rock cut design or stabilization techniques, FHWA HI-99-007 [Rock Slopes Reference Manual](#), (Munfakh, et al., 1998) should be used in the design. In addition, if development of blasting plans for rock cut excavation is required, FHWA-HI-92-001 [Rock Blasting and Overbreak Control](#), (Konya and Walter, 1991) should be used.

References

1. Konya, C. J., and Walter, E. J., 1991, [Rock Blasting and Overbreak Control](#), Federal Highway Administration, FHWA-HI-92-001.
2. Munfakh, G., Wyllie, D., and Mah, C. W., 1998, [Rock Slopes Reference Manual](#), Federal Highway Administration, FHWA HI-99-007.

Chronology of Changes to Design Manual Section:

200F-008 Rock Cut Slopes

8/17/2016 Revised
Replaced link to 5A-1 with link to 5B-1.

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