1230.01 General

Geometric cross sections for state highways are governed by functional classification criteria, traffic volume, and whether the highway is in a rural or an urban area. (See Chapter 1140 for information on functional class.)

Consider High-Occupancy Vehicle (HOV) lanes when continuous through lanes are to be added within the limits of an urban area with a population over 200,000 (see Chapter 1410).

When a state highway within an incorporated city or town is a portion of a city street, develop the design features in cooperation with the local agency. (See Chapter 1140 for guidance on geometric design data when a state highway within an incorporated city or town is a portion of a city street.)

For additional information, see the following chapters:

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<th>Subject</th>
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<td>Geotechnical investigation</td>
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</tbody>
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1230.02 References

(1) Design Guidance

Highway Runoff Manual, M 31-16, WSDOT

Local Agency Guidelines (LAG), M 36-63, WSDOT

Plans Preparation Manual, M 22-31, WSDOT

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT

Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications), M 41-10, WSDOT

(2) Supporting Information

A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO, 2004

1230.03 Definitions

auxiliary lane The portion of the roadway adjoining the through lanes for parking, speed change, turning, storage for turning, weaving, truck climbing, and other purposes supplementary to through-traffic movement.

divided multilane A roadway with two or more through lanes in each direction and a median that physically or legally prohibits left turns except at designated locations.

freeway A divided highway that has a minimum of two lanes in each direction, for the exclusive use of traffic, and with full control of access.

high pavement type Portland cement concrete pavement or hot mix asphalt (HMA) pavement on a treated base.

intermediate pavement type Hot mix asphalt pavement on an untreated base.

lane A strip of roadway used for a single line of vehicles.

lane width The lateral design width for a single lane, striped as shown in the Standard Plans and the Standard Specifications.

low pavement type Bituminous surface treatment (BST).

median The portion of a highway separating the traveled ways for traffic in opposite directions.

outer separation The area between the outside edge of the traveled way for through traffic and the nearest edge of the traveled way of a frontage road or a collector-distributor road.

roadway The portion of a highway, including shoulders, for vehicular use.

rural design area An area that meets none of the conditions to be an urban design area.

shoulder The portion of the roadway contiguous with the traveled way, primarily for accommodation of stopped vehicles, emergency use, lateral support of the traveled way, and use by pedestrians.
shoulder width The lateral width of the shoulder, measured from the outside edge of the outside lane to the edge of the roadway.

superelevation The rotation of the roadway cross section in such a manner as to overcome part of the centrifugal force that acts on a vehicle traversing a curve.

daveled way The portion of the roadway intended for the movement of vehicles, exclusive of shoulders and lanes for parking, turning, and storage for turning.

turning roadway A curve on an open highway, a ramp, or the connecting portion of the roadway between two intersecting legs of an intersection.

undivided multilane A roadway with two or more through lanes in each direction on which left turns are not controlled.

urban area An area designated by the Washington State Department of Transportation (WSDOT) in cooperation with the Transportation Improvement Board and Regional Transportation Planning Organizations, subject to the approval of the Federal Highway Administration (FHWA).

urban design area An area where urban design criteria are appropriate, that is defined by one or more of the following:

• An urban area.
• An area within the limits of an incorporated city or town.
• An area characterized by intensive use of the land for the location of structures, that receives such urban services as sewer, water, and other public utilities, as well as services normally associated with an incorporated city or town. This may include an urban growth area defined under the Growth Management Act (see Chapter 36.70A RCW, Growth management – planning by selected counties and cities), but outside the city limits.
• An area with not more than 25% undeveloped land.

1230.04 Roads

The cross sections shown in Exhibits 1230-1, 2, 3, 4a, and 4b represent minimum values for full design level. (See Chapter 1140 for additional design information for full design level and Chapter 1130 for cross sections and design information for modified design level.)

(1) Traveled Way Cross Slope

The cross slope on tangents and curves is a main element in roadway design. The cross slope or crown on tangent sections and large radius curves is complicated by the following two contradicting controls:

• Reasonably steep cross slopes aid in water runoff and minimize ponding as a result of pavement imperfections and unequal settlement.

• Steeper cross slopes are noticeable in steering, increase the tendency for vehicles to drift to the low side of the roadway, and increase the susceptibility of vehicles to slide to the side on icy or wet pavements.

A 2% cross slope is normally used for tangents and large radius curves on high and intermediate pavement types. With justification, cross slopes may vary by ± 0.5% from the target 2% cross slope. Do not design cross slopes flatter than 1.5%.
On low pavement types, the cross slope may be increased to 3% to allow for reduced construction control and greater settlement.

Superelevation on curves is a function of the design speed and the radius of the curve. (See Chapter 1250 for guidance on superelevation design.)

(2) Turning Roadways

The roadway on a curve may need to be widened to make the operating conditions comparable to those on tangents. There are two main reasons to do this. One is the offtracking of vehicles such as trucks and buses. The other is the increased difficulty drivers have in keeping their vehicles in the center of the lane. (See Chapter 1240 for width guidelines on turning roadways.)

To maintain the design speed, highway and ramp curves are usually superelevated to overcome part of the centrifugal force that acts on a vehicle. (See Chapter 1250 for superelevation guidelines.)

(3) Shoulders

Pave the shoulders of all highways where high or intermediate pavement types are used. Where low pavement type is used, treat the roadway as full width.

Shoulder cross slopes are normally the same as the cross slopes for adjacent lanes. With justification, shoulder slopes may be increased to 6%. On the high side of a roadway with a plane section, such as a turning roadway in superelevation, the shoulder may slope in the opposite direction from the adjacent lane. The maximum difference in slopes between the lane and the shoulder is 8%. Locations where it may be desirable to have a shoulder slope different than the adjacent lane are:

- Where curbing is used.
- Where shoulder surface is bituminous, gravel, or crushed rock.
- Where overlays are planned and it is desirable to maintain the grade at the edge of the shoulder.
- On divided highways with depressed medians where it is desirable to drain the runoff into the median.
- On the high side of the superelevation on curves where it is desirable to drain stormwater or meltwater away from the roadway.

Where extruded curb is used, see the Standard Plans for widening. Widening is normally provided where traffic barrier is installed (see Chapter 1610).

It is preferred that curb not be used on high-speed facilities (design speed above 45 mph). In some areas, curb may be needed to control runoff water until ground cover is attained to control erosion. Plan for the removal of the curb when the ground cover becomes adequate. Arrange for curb removal with region maintenance staff as part of the future maintenance plans. When curb is used in conjunction with guardrail, see Chapter 1610 for guidance.

Exhibits 1230-5a and 5b present shoulder details and guidelines.
1230.05 Medians and Outer Separations

(1) Purpose
The main function of a median is to separate opposing traffic lanes. The main function of an outer separation is to separate the main roadway from a frontage road. Medians and outer separations also provide space for:

- Drainage facilities.
- Undercrossing bridge piers.
- Vehicle storage space for crossing and left-turn movements at intersections.
- Headlight glare screens, including planted or natural foliage.
- Visual separation of opposing traffic.
- Refuge areas for errant or disabled vehicles.
- Storage space for snow and water from traffic lanes.
- Increased safety, comfort, and ease of operations.
- Access control.
- Enforcement.

(2) Design
Exhibits 1230-6a through 6c give minimum design criteria for medians. (See Chapters 1130 and 1140 for minimum median widths.) Median widths in excess of the minimums are highly desirable. When the horizontal and vertical alignments of the two roadways of a divided highway are independent of one another, determine median side slopes in conformance with Exhibit 1230-1. Independent horizontal and vertical alignment, rather than parallel alignment, is desirable.

Considerable latitude in grading treatment is intended on wide, variable-width medians, provided the minimum geometrics, safety, and aesthetics are met or exceeded. Unnecessary clearing, grubbing, and grading are undesirable within wide medians. Use selective thinning and limited reshaping of the natural ground when feasible. For median clear zone criteria, see Chapter 1600, and for slopes between the face of traffic barriers and the traveled way, see Chapter 1610.

In areas where land is expensive, make an economic comparison of wide medians to narrow medians with barrier. Consider right of way, construction, maintenance, and accident costs. The widths of medians need not be uniform. Make the transition between median widths as long as practicable. (See Chapter 1210 for minimum taper lengths.)

When using concrete barriers in depressed medians or on curves, provide for surface drainage on both sides of the barrier. The transverse notches in the base of precast concrete barrier are not intended to be used as a drainage feature, but rather as pickup points when placing the sections.
1230.06  Roadsides

(1)  Side Slopes

When designing side slopes, fit the slope selected for any cut or fill into the existing terrain to give a smooth transitional blend from the construction to the existing landscape. Flatter slopes are desirable, especially within the Design Clear Zone. Slopes not steeper than 4H:1V, with smooth transitions where the slope changes, will provide a reasonable opportunity to recover control of an errant vehicle. Where mowing is contemplated, provide slopes not steeper than 3H:1V to allow for mowing. If there will be continuous traffic barrier on a fill slope, and mowing is not contemplated, the slope may be steeper than 3H:1V.

Where unusual geological features or soil conditions exist, treatment of the slopes depends upon results of a review of the location by the Region Materials Engineer. With justification, fill slopes steeper than shown in the Fill and Ditch Slope Selection tables in Exhibits 1230-1, 2, 3, and 4b may be used when traffic barrier is installed. Do not install traffic barrier unless an object or condition is present that calls for mitigation in accordance with Chapter 1600 criteria. The steepest slope is determined by the soil conditions. Where favorable soil conditions exist, higher fill slopes may be as steep as 1½H:1V. (See Chapter 1600 for clear zone and barrier criteria.)

The values in the Cut Slope Selection tables in Exhibits 1230-1, 2, 3, and 4b are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable cut slopes just to meet the slope guidelines given in the Cut Slope Selection tables. When an existing slope is to be revised, document the reason for the change.

If borrow is necessary, consider obtaining it by flattening cut slopes uniformly on one or both sides of the highway. Where considering wasting excess material on an existing embankment slope, consult the Region Materials Engineer to verify that the foundation soil will support the additional material.

Provide for drainage from the roadway surface and drainage in ditches (see Chapter 800). For drainage ditches in embankment areas, see 1230.06(4).

At locations where vegetated filter areas or detention facilities will be established to improve highway runoff water quality, provide appropriate slope, space, and soil conditions for that purpose. (See the Highway Runoff Manual for design criteria and additional guidance.)

Except under guardrail installations, it is desirable to plant and establish low-growing vegetation on nonpaved roadsides. This type of treatment relies on the placement of a lift of compost or topsoil over base course material in the roadway cross section. Consult with the area Maintenance Superintendent and the region Landscape Architect to determine the appropriate configuration of the roadway cross section and soil and plant specifications.

Provide slope treatment as shown in the Standard Plans at the top of roadway cut slopes except for cuts in solid rock. Unless Class B slope treatment is called for, Class A slope treatment is used. Call for Class B slope treatment where space is limited, such as where right of way is restricted.
(2) Roadway Sections in Rock Cuts

Typical sections for rock cuts, illustrated in Exhibits 1230-7a and 7b, are guides for the design and construction of roadways through rock cuts. Changes in slope or fallout area are recommended when justified. Base the selection of the appropriate sections on an engineering study and the recommendations of the Region Materials Engineer (RME) and region Landscape Architect. Obtain concurrence from the Headquarters (HQ) Materials Lab.

There are two basic design treatments applicable to rock excavation (see Exhibits 1230-7a and 7b). Design A applies to most rock cuts. Design B is a talus slope treatment.

(a) Design A

This design is shown in stage development to aid the designer in selecting an appropriate section for site conditions in regard to backslope, probable rockfall, hardness of rock, and so on.

The following guidelines apply to the various stages shown in Exhibit 1230-7a:

- **Stage 1** is used where the anticipated quantity of rockfall is small, adequate fallout width can be provided, and the rock slope is ½H:1V or steeper. Controlled blasting is recommended in conjunction with Stage 1 construction.

- **Stage 2** is used when a “rocks in the road” problem exists or is anticipated. Consider it on flat slopes where rocks are apt to roll rather than fall.

- **Stage 3** represents the full implementation of all protection and safety measures applicable to rock control. Use it when extreme rockfall conditions exist.

Show Stage 3 as the ultimate stage for future construction on the Plans, Specifications, and Estimates (PS&E) if there is any possibility that it will be needed.

The use of Stage 2 or Stage 3 alternatives (concrete barrier) is based on the designer’s analysis of the particular site. Considerations include maintenance; size and amount of rockfall; probable velocities; availability of materials; ditch capacity; adjacent traffic volumes; distance from traveled lane; and impact severity. Incorporate removable sections in the barrier at approximately 200-foot intervals. Provide appropriate terminal treatment (see Chapter 1610).

Occasionally, the existing ground above the top of the cut is on a slope approximating the design cut slope. The height (H) is to include the existing slope or that portion that can logically be considered part of the cut. Select cut slopes for a project that provide stability for the existing material.

Benches may be used to increase slope stability; however, the use of benches may alter the design given in Exhibit 1230-7a.

The necessity for benches, as well as their width and vertical spacing, is established after an evaluation of slope stability. Make benches at least 20 feet wide. Provide access for maintenance equipment to the lowest bench and to the higher benches if feasible. Greater traffic benefits in the form of added safety, increased horizontal sight distance on curves, and other desirable attributes may be realized from widening a cut rather than benching.
(b) **Design B**

A talus slope treatment is shown in Exhibit 1230-7b. The rock protection fence is placed at any one of the three positions shown, but not in more than one position at a particular location. Consult with the Region Materials Engineer for the placement of the rock protection fence in talus slope areas.

- **Fence position a** is used when the cliff generates boulders less than 0.25 yd$^3$ in size and the length of the slope is greater than 350 feet.
- **Fence position b** is the preferred location for most applications.
- **Fence position c** is used when the cliff generates boulders greater than 0.25 yd$^3$ in size regardless of the length of the slope. On short slopes, this may require placing the fence less than 100 feet from the base of the cliff.
- Use of gabions may be considered instead of the rock protection shown in fence position a. Because gabion treatment is considered similar to a wall, provide appropriate face and end protection (see Chapters 730 and 1610).

Use of the alternate shoulder barrier is based on the designer’s analysis of the particular site. Considerations similar to those given for Design A alternatives apply.

Evaluate the need for rock protection treatments other than those described above for cut slopes that have relatively uniform spalling surfaces (consult with the Region Materials Engineer).

(3) **Stepped Slopes**

Stepped slopes are a construction method intended to promote early establishment of vegetative cover on the slopes. They consist of a series of small horizontal steps or terraces on the face of the cut slope. Soil conditions dictate the feasibility and necessity of stepped slopes. They are to be considered on the recommendation of the Region Materials Engineer (see Chapter 610). Consult the region landscape personnel for appropriate design and vegetative materials to be used. (See Exhibit 1230-8 for stepped slope design details.)

(4) **Drainage Ditches in Embankment Areas**

Where a drainage ditch is located adjacent to the toe of a roadway embankment, consider the stability of the embankment. A drainage ditch placed immediately adjacent to the toe of an embankment slope has the effect of increasing the height of the embankment by the depth of the ditch. In cases where the foundation soil is weak, the extra height could result in an embankment failure. As a general rule, the weaker the foundation and the higher the embankment, the farther the ditch should be from the embankment. Consult the Region Materials Engineer for the proper ditch location.

When topographic restrictions exist, consider an enclosed drainage system with appropriate inlets and outlets. Do not steepen slopes to provide lateral clearance from toe of slope to ditch location, thereby necessitating traffic barriers or other protective devices.
Maintenance operations are also facilitated by adequate width between the toe of the slope and an adjacent drainage ditch. Where this type of facility is anticipated, provide sufficient right of way for access to the facility and place the drainage ditch near the right of way line.

Provide for disposition of the drainage collected by ditches in regard to siltation of adjacent property, embankment erosion, and other undesirable effects. This may also apply to top of cut slope ditches.

(5) Bridge End Slopes

Bridge end slopes are determined by several factors, including location, fill height, depth of cut, soil stability, and horizontal and vertical alignment. Coordinate bridge end slope treatment with the HQ Bridge and Structures Office (see Chapter 720).

Early in the bridge plan development, determine preliminary bridge geometrics, end slope rates, and toe of slope treatments. Exhibit 1230-9a provides guidelines for use of slope rates and toe of slope treatments for overcrossings. Exhibit 1230-9b shows toe of slope treatments to be used on the various toe conditions.

1230.07 Roadway Sections

Provide a typical roadway section for inclusion in the PS&E for each general type used on the main roadway, ramps, detours, and frontage or other roads (see the Plans Preparation Manual).

1230.08 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:

www.wsdot.wa.gov/design/projectdev/
Design Class I-1, P-1, P-2, M-1, U, M/A-1, U, M/A-2

Fill and Ditch Slope Selection

<table>
<thead>
<tr>
<th>Height of fill/depth of ditch (ft)</th>
<th>Slope not steeper than[^5]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>6H:1V</td>
</tr>
<tr>
<td>10 – 20</td>
<td>4H:1V</td>
</tr>
<tr>
<td>20 – 30</td>
<td>3H:1V[^6]</td>
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<tr>
<td>over 30</td>
<td>2H:1V[^6][^8]</td>
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Cut Slope Selection[^9]

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<th>Height of cut (ft)*</th>
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<td>0 – 5</td>
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<tr>
<td>5 – 20</td>
<td>3H:1V</td>
</tr>
<tr>
<td>over 20</td>
<td>2H:1V[^7]</td>
</tr>
</tbody>
</table>

[^1]: For shoulder details, see Exhibits 1230-5a and 5b. For minimum shoulder width, see Chapters 1130 and 1140.

[^2]: Generally, provide the crown slope as follows:
   - Four-lane highway: Slope all lanes away from the median (plane section).
   - Six-lane highway: Slope all lanes away from the median unless high rainfall intensities would indicate otherwise.
   - Eight-lane highway: Slope two of the four directional lanes to the right and two to the left unless low rainfall intensities indicate that all four lanes could be sloped away from the median.

[^3]: For minimum number and width of lanes, see Chapters 1130 and 1140. For turning roadway width, see Chapter 1240.

[^4]: For median details, see Exhibits 1230-6a through 6c. For minimum median width, see Chapters 1130 and 1140.

[^5]: Where practicable, consider flatter slopes for the greater fill heights and ditch depths.

[^6]: Widen and round foreslopes steeper than 4H:1V, as shown in Exhibit 1230-5b.

[^7]: Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 1600 for clear zone and barrier guidelines.)

[^8]: Fill slopes as steep as 1½H:1V may be used where favorable soil conditions exist. (See Chapter 1600 for clear zone and barrier guidelines.)

[^9]: The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slope guidelines given in this table.
Chapter 1230

Fill and Ditch Slope Selection

<table>
<thead>
<tr>
<th>Height of fill/depth of ditch (ft)</th>
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<td>4H:1V</td>
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<tr>
<td>over 30</td>
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Cut Slope Selection[^8]

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<th>Height of cut (ft)*</th>
<th>Slope not steeper than</th>
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</thead>
<tbody>
<tr>
<td>0 – 5</td>
<td>4H:1V</td>
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<tr>
<td>over 5</td>
<td>2H:1V[^5]</td>
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</tbody>
</table>

[^1] For shoulder details, see Exhibits 1230-5a and 5b. For minimum shoulder width, see Chapters 1130 and 1140.

[^2] For minimum number and width of lanes, see Chapters 1130 and 1140. For turning roadway width, see Chapter 1240.

[^3] For minimum median width, see Chapters 1130 and 1140. For width when median is a two-way left-turn lane, see Chapter 1310.


[^5] Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 1600 for clear zone and barrier guidelines.)

[^6] Fill slopes up to 1½H:1V may be used where favorable soil conditions exist. (See Chapter 1600 for clear zone and barrier guidelines.)

[^7] Widen and round foreslopes steeper than 4H:1V, as shown in Exhibit 1230-5b.

[^8] The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slope guidelines given in this table.
Design Class P-3, P-4, P-5, M-2, M-3, M-4, C-2, C-3, C-4, U, M/A-5, U, M/A-6

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<tr>
<td>0 – 10</td>
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</tr>
<tr>
<td>over 30</td>
<td>2H:1V 2H:1V[^6][^7]</td>
</tr>
</tbody>
</table>

[^1]: For shoulder details, see Exhibits 1230-5a and 5b. For minimum shoulder width, see Chapters 1130 and 1140.
[^2]: For minimum width of lanes, see Chapters 1130 and 1140. For turning roadway width, see Chapter 1240.
[^3]: The minimum ditch depth is 2 feet for Design Class P3 and 1.5 feet for Design Classes P-4, P-5, M-2, M-3, M-4, C-2, C-3, C-4, U, M/A-5, and U, M/A-6.
[^4]: Where practicable, consider flatter slopes for the greater fill heights.
[^5]: Fill slopes up to 1½H:1V may be used where favorable soil conditions exist. (See Chapter 1600 for clear zone and barrier guidelines.)
[^6]: Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 1600 for clear zone and barrier guidelines.)
[^7]: Widen and round foreslopes steeper than 4H:1V, as shown in Exhibit 1230-5b.
[^8]: The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slope guidelines given in this table.

Two-Lane Highway Roadway Sections

Exhibit 1230-3
See cut slope selection data
See fill and ditch slope selection data

Two-Way Ramp

*AP = Angle point in the subgrade

Note:
For applicable notes, dimensions, and slope selection tables, see Exhibit 1230-4b.
This special design section may be used when restrictions (high right of way costs or physical features) make construction difficult or costly.

### Fill and Ditch Slope Selection

<table>
<thead>
<tr>
<th>Height of fill/depth of ditch (ft)</th>
<th>Slope not steeper than[^9]</th>
</tr>
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<tbody>
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### Cut Slope Selection[^12]

<table>
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<tr>
<th>Height of cut (ft)*</th>
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<tbody>
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<td>0 – 5</td>
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<td>5 – 20</td>
<td>3H:1V</td>
</tr>
<tr>
<td>over 20</td>
<td>2H:1V[^10]</td>
</tr>
</tbody>
</table>

[^8]: From bottom of ditch

**Notes:**

[^1]: For shoulder details, see Exhibits 1230-5a and 5b. For minimum shoulder widths, see Chapter 1360.
[^2]: For minimum ramp lane widths, see Chapter 1360. For turning roadway width, see Chapter 1240.
[^3]: For two-way ramps, treat each direction as a separate one-way roadway.
[^4]: Minimum ditch depth is 2 feet for design speeds over 40 mph and 1.5 feet for design speeds of 40 mph or less. Rounding may be varied to fit drainage requirements when minimum ditch depth is 2 feet.
[^5]: Widen and round foreslopes steeper than 4H:1V, as shown in Exhibit 1230-5b.
[^6]: 2-foot widening and rounding may be omitted when slopes are 4H:1V or flatter.
[^7]: Subgrade may slope to the left if the left edge is in embankment.
[^8]: Provide drainage unless one edge of the roadway is in embankment or subject material is free draining. Method of drainage pickup is to be determined by the designer.
[^9]: Where practicable, consider flatter slopes for the greater fill heights and ditch depths.
[^10]: Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 1600 for clear zone and barrier guidelines.)
[^11]: Fill slopes as steep as 1½H:1V may be used where favorable soil conditions exist. (See Chapter 1600 for clear zone and barrier guidelines.)
[^12]: The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slope guidelines given in this table.
*AP = Angle point in the subgrade

Note:
For applicable notes, see Exhibit 1230-5b.
Notes:

[1] Shoulder cross slopes are normally the same as the cross slopes for adjacent lanes. (For examples and additional information for locations where it may be desirable to have a shoulder cross slope different than the adjacent lane, see 1230.04(3).)

[2] Provide widening and slope rounding outside the usable shoulder when foreslope is steeper than 4H:1V.

[3] For minimum shoulder width, see Chapters 1130, 1140, and 1360.

[4] For additional requirements for sidewalks, see Chapter 1510.

[5] It is desirable that curb not be used on high-speed facilities (posted speed >40 mph).

[6] Provide paved shoulders wherever extruded curb is placed. Use curb only to control drainage from roadway runoff. (See the Standard Plans for additional details and dimensions.)

[7] When rounding is provided, use it uniformly on all ramps and crossroads, as well as the main roadway. End rounding on the crossroad just beyond the ramp terminals and at a similar location where only a grade separation is involved.

[8] When widening beyond the edge of usable shoulder for curb, barrier, or other purposes, additional widening for slope rounding may be omitted.

[9] For widening guidelines for guardrail and concrete barrier, see Chapter 1610.

General:
On divided multilane highways, see Exhibits 1230-6a through 6c for additional details for median shoulders.
Note:
For applicable notes, see Exhibit 1230-6c.
Design C: Minimum Nonpaved Median For 4 or More Lanes [2]

Design D: Minimum for 4 or More Lanes With Future Lanes In Median

Design E: Minimum for 4 or More Lanes With Independent Alignment

Note:
For applicable notes, see Exhibit 1230-6c.

Divided Highway Median Sections
Exhibit 1230-6b
Notes:
[1] For minimum median width, see Chapters 1130 and 1140.
[2] Consider vertical clearances, drainage, and aesthetics when locating the pivot point.
[3] Generally, slope pavement away from the median. Where appropriate, a crowned roadway section may be used in conjunction with the depressed median. (See Exhibit 1230-1 for additional crown information.)
[4] Design B may be used uniformly on both tangents and horizontal curves. Use Alternate Design 1 or Alternate Design 2 when the "rollover" between the shoulder and the inside lane on the high side of a superelevated curve exceeds 8%. Provide suitable transitions at each end of the curve for the various conditions encountered in applying the alternate to the basic median design.
[6] Median shoulders normally slope in the same direction and rate as the adjacent through lane. (See 1230.04(3) for examples and additional information for locations where it may be desirable to have a shoulder cross slope different than the adjacent lane.)
[7] For minimum shoulder width, see Chapters 1130 and 1140.
[8] Future lane. (See Chapter 1140 for minimum width.)
[9] Widen and round foreslopes steeper than 4H:1V, as shown in Exhibit 1230-5b.
[10] Designs C, D, and E are rural median designs. (See Chapter 1140 for minimum rural median widths.) Rural median designs may be used in urban areas when minimum rural median widths can be achieved.
[11] For minimum median width, see Chapter 1140. Raised medians may be paved or landscaped. For clear zone and barrier guidelines when fixed objects or trees are in the median, see Chapter 1600.
[12] Lane and shoulders normally slope away from raised medians. When they slope toward the median, provide for drainage.
[13] The desirable maximum design speed for a raised median is 45 mph. When the design speed is above 45 mph, Design A or Design B is desirable.
Rock Slope | H (ft) | W (ft)
--- | --- | ---
Near Vertical | 20 – 30 | 12
| 30 – 60 | 15
| > 60 | 20
0.25H:1V through 0.50H:1V | 20 – 30 | 12
| 30 – 60 | 15
| 60 – 100 | 20
| >100 | 25

Notes:
[1] For widening for guardrail and concrete barrier, see Chapter 1610.

General:
- Treat cut heights less than 20 feet as a normal roadway unless otherwise determined by the Region Materials Engineer.
- Stage 2 and Stage 3 Alternates may be used when site conditions dictate.
- Fence may be used in conjunction with the Stage 3 Alternate. (See Chapter 1600 for clear zone guidelines.)

Roadway Sections in Rock Cuts: Design A

*Exhibit 1230-7a*
Note:
[1] For widening for guardrail and concrete barrier, see Chapter 1610.

General:
• Ordinarily, place fence within a zone of 100 feet to 200 feet maximum from base of cliff, measured along the slope.
• Rock protection fence may be used in conjunction with the Shoulder Barrier Alternate when site conditions dictate.

Roadway Sections in Rock Cuts: Design B

Exhibit 1230-7b
Notes:

[1] Staked slope line: Maximum slope 1H:1V.
[2] Step rise: Height variable 1 foot to 2 feet.
[4] Step termini: Width \( \frac{1}{2} \)-step tread width.

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**Roadway Sections With Stepped Slopes**

*Exhibit 1230-8*
### Bridge End Slopes

**Exhibit 1230-9a**

<table>
<thead>
<tr>
<th>Bridge End Condition</th>
<th>Toe of Slope End Slope Rate</th>
<th>Lower Roadway Treatment[^1]</th>
<th>Slope Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>End Piers on Fill</td>
<td>Height</td>
<td>Rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤ 35 ft</td>
<td>1¾H:1V</td>
<td>&gt; 50 mph</td>
</tr>
<tr>
<td></td>
<td>&gt; 35 ft</td>
<td>2H:1V[^2]</td>
<td>≤ 50 mph</td>
</tr>
<tr>
<td>Ends in Partial Cut and Fill</td>
<td>When the cut depth is &gt; 5 ft and length is &gt; 100 ft, match cut slope of the lower roadway.</td>
<td>When the cut depth is &gt; 5 ft and length is &gt; 100 ft, no rounding, toe at centerline of the lower roadway ditch.</td>
<td>[^4]</td>
</tr>
<tr>
<td></td>
<td>When the cut depth is ≤ 5 ft or the length is ≤ 100 ft, it is designer’s choice.</td>
<td>When the cut depth is ≤ 5 ft or the length is ≤ 100 ft, it is designer’s choice.</td>
<td>[^4]</td>
</tr>
</tbody>
</table>

**Notes:**

[^1]: See Exhibit 1230-9b.
[^2]: Slope may be 1¾H:1V in special cases.
[^3]: In interchange areas, continuity may require variations.
[^4]: See 1230.06.
Bridge End Slopes

Exhibit 1230-9b