Chapter 1239  Geometric Cross Section – Shoulders, Side Slopes, Curbs, and Medians

1239.01 Introduction

This chapter provides information on geometric cross section components that are common to many facility types. Cross section elements include: shoulders, medians and outer separations, side slopes, and curbing.

1239.02 Shoulders

Shoulders are typically used on high, or intermediate speed limited and non-limited access facilities, some rural contexts, as well as intermediate-speed locations that do not have streetsides (curb-sections) (see Chapter 1238). Intermediate-speed locations in suburban and urban contexts that utilize streetsides do not need to include a shoulder unless determined to be necessary by shoulder function, (where intended for bicyclists for example) or safety performance analysis, hydraulic analysis or engineering judgment.

Shoulders provide space to escape potential collisions or reduce their severity. They also provide a sense of openness, contributing to driver ease at higher speeds. Shoulders also convey drainage away from the traveled way as determined by hydraulic analysis.
1239.02(1) Shoulder Width

Shoulder width ranges for highways are shown in Exhibit 1239-1. Use the mode/function/performance approach (Chapter 1106) to choose a dimension from the range given.

Exhibit 1239-1 Shoulder Widths for Highways

<table>
<thead>
<tr>
<th>Posted Speed</th>
<th>Highway Type</th>
<th>Shoulder Width [1][2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>High speed (≥50mph)</td>
<td>Freeway (including Interstate)</td>
<td>See Chapter 1232</td>
</tr>
<tr>
<td></td>
<td>Other highway</td>
<td>4’ – 10’</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>0’ – 8’ [2]</td>
</tr>
<tr>
<td>Intermediate speed (40 &amp; 45 mph)</td>
<td>All</td>
<td>4’ – 8’ [3]</td>
</tr>
<tr>
<td>Low speed (≤35mph)</td>
<td>All</td>
<td>2’ – 8’ [3]</td>
</tr>
</tbody>
</table>

Notes:

[1] Part time shoulder minimum width range is 10 ft to 13 ft. A Design Analysis is required. See Exhibit 1430-2.
[2] If curb or barrier present, see Exhibit 1239-11.
[3] Intermediate-speed and low-speed locations in urban and suburban contexts utilizing streetsides do not need to include a shoulder unless necessary for safety performance, hydraulic performance or engineering judgment. See Exhibit 1231-4, Exhibit 1231-5 (A & B), Exhibit 1231-6 (B & C), and Section 1239.02.

1239.02(1)(a) Shoulder Width Considerations

Exhibit 1239-2 lists considerations for choosing an appropriate shoulder width from the range given. The considerations listed help one to understand the modal needs and function associated with different shoulder widths.

Contact the Area Maintenance Superintendent to determine/verify the shoulder width appropriate for maintenance operations. In some cases, a continuous width is not necessary; instead, the focus is placing the shoulder width near assets with high-frequency maintenance needs. Compare the added cost of the wider shoulders to the added benefits to maintenance operations as well as other benefits that may be derived (see Chapter 301).

The usable shoulder is the width necessary to provide the desired function (see Exhibit 1239-2). Usable shoulder width is less than the constructed shoulder width when vertical features (such as traffic barrier or walls) are at the edge of the shoulder. This is because roadway users tend to shy away from the vertical feature. For widening for traffic barrier, see Chapter 1610. For requirements for lateral clearance to barrier or curb, see Section 1239.06. When walls are placed adjacent to shoulders, see Chapter 730 and Chapter 740 for barrier guidance.

Shoulder widths greater than 10 feet may encourage use as a travel lane. Therefore, use shoulders wider than 10 feet only to meet one of the listed functions (see Exhibit 1239-2).
### Exhibit 1239-2 Shoulder Function & Modal Accommodation Width Considerations

<table>
<thead>
<tr>
<th>Shoulder Function</th>
<th>Shoulder Width Guidance [7][10]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stopping out of the traffic lanes</td>
<td>8 ft – 12 ft [1]</td>
</tr>
<tr>
<td>Minimum lateral clearance to curb or barrier</td>
<td>See Section 1239.06</td>
</tr>
<tr>
<td>Part time shoulder. (Requires a Design Analysis) [6]</td>
<td>10 ft to 13 ft [2] See Section 1232.03 and Chapter 1430 See 1410.02(3)(c) for HOV</td>
</tr>
<tr>
<td>Bicyclist use</td>
<td>4 ft of usable shoulder [3]</td>
</tr>
<tr>
<td>Pedestrian use</td>
<td>See Section 1510.06</td>
</tr>
<tr>
<td>Off-tracking of large accommodated vehicles</td>
<td>See Section 1310.02(5)</td>
</tr>
<tr>
<td>U-turn turnouts</td>
<td>Varies – See Chapter 1310</td>
</tr>
<tr>
<td>Maintenance operations (Consult Area Superintendent)</td>
<td>Varies [4] [5]</td>
</tr>
<tr>
<td>Law enforcement, emergency services &amp; incident response</td>
<td>8 ft to 12 ft [5]</td>
</tr>
<tr>
<td>Transit stops</td>
<td>See Section 1730.02 and Exhibit 1730-2</td>
</tr>
<tr>
<td>Slow-vehicle turnouts</td>
<td>See Section 1270.04</td>
</tr>
<tr>
<td>Slow-vehicle shoulder driving</td>
<td>See Section 1270.05</td>
</tr>
<tr>
<td>Metered shoulder (Requires a Design Analysis)</td>
<td>10 ft – 13 ft [9]</td>
</tr>
<tr>
<td>HOV ramp meter bypass (Requires a Design Analysis)</td>
<td>10 ft – 14 ft [6]</td>
</tr>
<tr>
<td>Ferry holding</td>
<td>8 ft – 12 ft [1]</td>
</tr>
<tr>
<td>For use as a lane during reconstruction of the through lanes</td>
<td>8 ft – 12 ft [1]</td>
</tr>
<tr>
<td>Structural support of pavement</td>
<td>2 ft</td>
</tr>
<tr>
<td>Improve horizontal sight distance in cut sections or sections with barrier or fixed objects that block sight lines.</td>
<td>See Chapter 1260</td>
</tr>
<tr>
<td>Chain-Up and Chain-Off Areas</td>
<td>20 ft [8]</td>
</tr>
</tbody>
</table>

Notes:

[1] 10 ft minimum for freight or transit vehicles.
[2] Selected width should be determined with transit provider when buses are allowed.
[3] Minimum usable shoulder function width for bicyclists. Additional width may be needed when combined with shoulder rumble strips, rumble stripes, profiled or embossed lines, curb, or barrier (see Chapter 1600 and the Standard Plans). For guidance, see Chapter 1520 for accommodating bicyclists.
[4] 10 ft usable width to park a maintenance truck out of the through lane; 14 foot width for equipment with outriggers to work out of traffic (consult Area Maintenance Superintendent).
[5] For additional information, see Chapter 1370, Chapter 1410 and Chapter 1720. Determine location and dimensions for shoulder areas needed for law enforcement purposes (e.g., pullouts) with local Washington State Patrol District office.
[6] Determine width with transit provider, and see Section 1239.06 for lateral clearance requirements.
[7] Presence of barrier or curb may require additional width for lateral clearance See Section 1239.06. Use auto turn studies for non-tangent alignments based on the design vehicle and the accommodated vehicle.
[8] Where traffic volumes are low and trucks are not present, the width may be reduced to 15 ft.
[10] Drainage may require a certain amount of shoulder width (see Hydraulic Manual).
Exhibit 1239-3 Shoulder Grading Details

Shoulder Design on the Low Side of the Roadway for Cross Slopes Steeper Than 2% (4H:1V or Flatter Side Slope Shown See Exhibit 1238-4 for Steeper Than 4H:1V)

Shoulder Design on High Side Divided Roadways and Outsides of Curves (4H:1V or Flatter Side Slope Shown See Exhibit 1239-4 for Steeper Than 4H:1V)

Shoulder Design on the High Side of Divided Roadways and Outsides of Curves where the Shoulder Slopes Away From the Roadway (4H:1V or Flatter Side Slope Shown See Exhibit 1239-4 for Steeper Than 4H:1V)

*AP = Angle point in the subgrade
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 Chapter 1250).

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


General:
These drawings illustrate the location of the subgrade angle points to drain stormwater away from the roadbed.

Exhibit 1239-4 Shoulder Widening Details

A gutter pan of a different color than the roadway can be part of the shoulder, but cannot be part of a lane or traveled way.
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Geometric Cross Section – Shoulders, Side Slopes, Cross Sections, and Medians

Notes:

[1] Provide widening and slope rounding outside the shoulder when foreslope is steeper than 4H:1V.
[3] For additional requirements for sidewalks, see Chapter 1510.
[4] See Section 1239.05 for curb design guidance.
[5] Provide paved shoulders wherever extruded curb is placed. (See the Standard Plans for additional details and dimensions.)
[6] Consider using the same application of slope rounding on all ramps and crossroads, as well as the main roadway. Use end rounding on the crossroad just beyond the ramp terminals and at a similar location where only a grade separation is involved.
[7] When widening beyond the edge of usable shoulder for curb or barrier, additional widening for slope rounding may be omitted.
[8] For widening guidelines for guardrail and concrete barrier, see Chapter 1610 and Exhibit 1610-10.
[9] Permanent precast unanchored barrier shown above. See Exhibit 1610-3 for other barrier deflection distances.
[10] There is no minimum width between pavement and break point for side slopes 4H:1V or flatter and 1 foot minimum width between pavement and break point for side slopes steeper than 4H:1V.

General:
On divided multilane highways, see Exhibit 1239-15 through Exhibit 1239-17 for additional details for median shoulders.

1239.03 Fill Sections, Cut Sections, and Ditch Sections

The design for side slopes can affect shoulder design, clear zone requirements, and whether or not traffic barrier is warranted.

There are three basic roadway sections for side slopes.

Fill sections – Roadway sections where the height of the roadway is higher than the existing natural ground.

Ditch sections - Roadway sections where the height of the roadway is higher than the existing natural ground but not as high as the needed roadside ditch so that after the needed ditch is installed there is a foreslope into the ditch and a back slope out of the ditch up to where it catches the natural ground.

Cut sections - Roadway sections where the height of the roadway is lower than the existing ground. This typically produces a foreslope into the ditch and a back slope out of the ditch up to where it catches the natural ground.
When designing side slopes, attempt to fit the slope selected for any fill section, ditch section, or cut section into the existing terrain to give a smooth transitional blend from the construction to the existing landscape when practicable. Flatter slopes are desirable, especially with higher posted speeds and when the associated cost does not significantly exceed other design options. Fill side 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. Fill side slopes designed to 4H:1V or flatter are preferred. Provide widening and slope rounding outside the usable shoulder when the foreslope is steeper than 4H:1V (see Exhibit 1239-3). Do not disturb existing stable cut slopes just to meet the 4H:1V foreslope preference.

Fill slopes that are steeper than 4H:1V but not steeper than 3H:1V are considered traversable but not recoverable. When providing a slope that meets these characteristics, placement of a clear area extending from the toe of the slope to the outside edge of the design clear zone is needed for an errant vehicle runout and stop (see Chapter 1600 for design clear zone guidance). Consult with Region Maintenance to determine if mowing is contemplated. When providing fill-slopes steeper than 3H:1V, it is a best practice to document the reason for the decision in the design documentation package.

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. See Section 1600.03(1) for when to use traffic barrier to mitigate a side slope. Unmitigated critical slopes will require a Design Analysis. The steepest slope allowed is determined by the Region Materials Engineer based on soil conditions. If more material is needed to build the roadway, consider obtaining it by flattening cut slopes uniformly on one or both sides of the highway. Consult the Region Materials Engineer to determine what percentage of the excavated material will likely be suitable for fill material. Where considering wasting excess material on an existing fill side slope, consult the Region Materials Engineer to verify that the subgrade will support the additional material.

Provide for drainage from the roadway surface and drainage in ditches (see Chapter 800). For drainage ditches, see Section 1239.03(1). 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.) It is desirable to plant and establish low-growing vegetation on non-paved 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 or HQ Landscape Architect to determine the appropriate configuration of the roadway cross section and soil and plant specifications. This kind of treatment would not be done where barrier is installed along the roadway as the lift of compost or topsoil is not a suitable barrier foundation.

Flatten freeway section median cross-over foreslopes to 10H:1V (See Section 1370.03). Flatten crossroad and road approach foreslopes not steeper than 6H:1V on other highways. Grade crossroad and road approach foreslopes flatter than 6H:1V where feasible. Provide smooth transitions between the main line foreslopes and the crossroad or road approach foreslopes. Move the crossroad or road approach drainage as far away from the main line as feasible. This can locate the pipe outside the Design Clear Zone and reduce the length of pipe.

Provide slope treatment as shown in the Standard Plans (Slope treatment) 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.
1239.03(1) Drainage Ditches

Exhibit 1239-5 shows the preferred trapezoidal ditch section and the alternative V bottom ditch section. The trapezoidal ditch design is preferred as V bottom ditches tend to silt up faster than flat bottom trapezoidal ditches and Trapezoidal ditches convey more drainage than V ditches. On the other hand, Trapezoidal ditches can be more difficult to construct than V bottom ditches. The trapezoidal ditch is preferred, but a 'V' bottom ditch can be used where constraints, such as limited right of way or sensitive areas, preclude a trapezoidal ditch. Consult with the Region Hydraulic Engineer to determine if the chosen design meets the needed hydraulic performance. Consult with the Region Materials Engineer about the chosen ditch foreslope and backslope.

When topographic restrictions exist, consider an enclosed drainage system with appropriate inlets and outlets. 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 as close to the right of way line as feasible.

Exhibit 1239-5 Drainage Ditch Details

Notes:

[1] Side slopes:
- Foreslopes 4H:1V or flatter are desirable. See Exhibit 1239-4 for requirements for slopes steeper than 4H:1V
- Foreslopes and backslopes 3H:1V or flatter support mowing operations.
- Do not design foreslopes and/or backslopes steeper than 2H:1V without Region Materials Engineer and Region Hydraulics Engineer concurrence. See Exhibit 1600-6 for foreslopes steeper than 3H:1V.
### 1239.03(2) Bridge End Slopes

Bridge end slopes are determined by several factors, including context, 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). Whenever possible, design to avoid creating environments that might be desirable to the homeless, both for their safety and the safety of maintenance staff.

Early in the bridge plan development, determine preliminary bridge geometrics, end slope rates, and toe of slope treatments. Exhibit 1239-6 provides guidelines for use of slope rates and toe of slope treatments for overcrossings. Exhibit 1239-7 shows toe of slope treatments to be used on the various toe conditions.

### Exhibit 1239-6 Bridge End Slopes

<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></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Height</td>
<td>Rate</td>
<td>Posted speed of lower roadway</td>
</tr>
<tr>
<td>≤ 35 ft</td>
<td>1¾H:1V</td>
<td>&gt; 50 mph</td>
<td>Rounding</td>
</tr>
<tr>
<td>&gt; 35 ft</td>
<td>2H:1V [2]</td>
<td>≤ 50 mph</td>
<td>No rounding</td>
</tr>
<tr>
<td>End Piers in Cut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Match lower roadway slope [3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No rounding, toe at centerline of the lower roadway ditch.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Roadway in Cut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Match lower roadway slope [3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No rounding, toe at centerline of the lower roadway ditch.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ends in Partial Cut and Fill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></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:**

[2] Slope may be 1¾H:1V in special cases.
[3] In interchange areas, continuity may require variations.
[4] See Section 1239.03.
Exhibit 1239-7 Bridge End Slope Details

Rounding

Usable shoulder

6 ft
Level

Rounding

Cut/fill slope

Theoretical toe of fill slope

No Rounding

Usable shoulder

Cut/fill Slope

Tee of fill slope

Ditch

Toe at $C$ of Roadway Ditch
1239.04 Roadway Sections in Rock Cuts

There are two basic design treatments applicable to rock excavation. Typical sections for rock cuts, illustrated in Exhibit 1239-8 and Exhibit 1239-9, are guides for the design and construction of roadways through rock cuts. Design A applies to most rock cuts. Design B is a talus slope treatment. 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 and region Landscape Architect. Obtain concurrence from the Headquarters (HQ) Materials Lab.

1239.04(1) 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 1239-8:

- **Stage 1** is used where the anticipated quantity of rockfall is small, adequate fallout width can be provided, and the rock slope is \( \frac{1}{2}H:1V \) 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 in 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 the following:

<table>
<thead>
<tr>
<th>Rock Slope</th>
<th>H (ft)</th>
<th>W (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Vertical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 – 30</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>30 – 60</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>&gt; 60</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>0.25H:1V through 0.50H:1V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 – 30</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>30 – 60</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>60 – 100</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>&gt;100</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>
Exhibit 1239-8.
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.

<table>
<thead>
<tr>
<th>Rock Slope</th>
<th>H (ft)</th>
<th>W (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Vertical</td>
<td></td>
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<tr>
<td>20 – 30</td>
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<tr>
<td>0.25H:1V through 0.50H:1V</td>
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<tr>
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<td>20</td>
<td></td>
</tr>
<tr>
<td>&gt;100</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>
Exhibit 1239-8 Roadway Sections in Rock Cuts: Design A

**Case 1**
Use when anticipated quantity of rockfall is small, adequate fallout width can be provided, and the rock back slope is 1/2H:1V or steeper.

**Case 2**
Use when a “rocks in the road” problem exists or is anticipated. Consider this on relatively flat slopes, where rocks are apt to roll rather than fall.

**Case 3**
Protection and safety measures applicable to rock control. (Using Guardrail)

**Case 4**
Protection and safety measures applicable to rock control. (Using Concrete Barrier – No Rock Protection Fence)

**Case 5**
Protection and safety measures applicable to rock control. (Using Concrete Barrier AND Rock Protection Fence)

Notes:

1. See Section 1239.02(1), Section 1239.02(1)(a), and Section 1239.06.
2. See Section 1610.03(3) for other concrete barrier deflections. Precast concrete barrier shown.
3. Consult with the Region Materials Engineer to make this slope as steep as the material will allow.

General:
Treat cut heights less than 20 feet as a normal roadway unless otherwise determined by the Region Materials Engineer.
1239.04(2) Design B

A talus slope treatment is shown in Exhibit 1239-9. 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 RME 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 Chapter 730 and Chapter 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 RME).
Exhibit 1239-9 Roadway Sections in Rock Cuts: Design B

**Notes:**

[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.
1239.04(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 RME (see Chapter 610). Consult the region landscape personnel for appropriate design and vegetative materials to be used. Use Exhibit 1239-10 for stepped slope design.

Exhibit 1239-10 Stepped Slope Design

Notes:

[1] Staked slope line: Maximum slope 1H:1V.
[2] Step rise: Height variable 1 foot to 2 feet.

1239.05 Curbs

Vertical curbs with a face slope of 1H:3V or steeper that are more than 4 inches tall are not considered mountable, while vertical curbs that are 4 inches tall or shorter are considered mountable. Curbs with a sloping face (flatter than 1H:3V) that are as tall as 6 inches are mountable, but using curbs 4 inches or less is recommended in order to reduce vehicle underside damage if driven over.
1239.05(1) Non-Mountable Vertical Curb Uses

a) Use vertical curbs with a height of 6 inches or more:
   To delineate the traveled way with respect to other features in the roadway cross-section such as medians, sidewalks, landscaped areas, etc.
   To delineate separations between walkways and pedestrian refuges.
   To provide vertical grade separation between raised islands and the roadway surface.
   For expediting transfer times for transit partners on low-speed roadways in urban and suburban contexts (verify curb height needed with transit provider).

b) Consider vertical curbs with a height of 6 inches or more:
   To indicate to drivers where midblock left turns are not allowed.
   To delineate divisional and channelizing islands.
   To provide a hardscape boundary for raised landscaped islands.
   To convey stormwater.

1239.05(2) Mountable Curb Uses

a) Provide mountable curbs where a curb is needed but vertical curb is not suitable for specific design user(s).

b) Use mountable curbs in roundabouts. See Chapter 1320 and Standard Plan F-10.18-01.

1239.05(3) Curb Use Based On Speed

In general, curbs are not recommended on facilities with a speed of 40 mph and faster. Avoid using curbs if the same objective can be attained with pavement markings. However, 4-inch-high mountable curbs may be used on facilities with a speed of 40 mph and faster to control drainage or for access control. Locate mountable curb no closer to the traveled way than the outer edge of the shoulder. Provide sloping end treatments where the curb is introduced and terminated. 6-inch-high mountable curbs may be considered on urban and suburban highways with a speed of 40 mph and faster where streetside zones are provided or where traffic movements are to be restricted. Provide justification for the use of vertical curb when applied to facilities with a speed of 40 mph and faster.

Intermediate speed facilities may use vertical curbs; however, consider mountable curbs for intermediate target speeds. All curb types are appropriate for low-speed facilities.

1239.05(4) Curb Used For Drainage

Where curbing is provided to direct drainage, provide a design that collects the surface water at the curb and drains it without ponding in the traveled way or flowing across the roadway.

In some areas, curb may be needed to control runoff water until ground cover is attained to control erosion. Document the plan to remove the curb when the ground cover becomes adequate. A best practice is to arrange for curb removal with region maintenance staff as part of the future maintenance plans (see Maintenance Owner’s Manual guidance in Chapter 301).

When curb is used in conjunction with guardrail, see Chapter 1610 for guidance. For existing curb, particularly on facilities with a speed of 40 mph and faster, evaluate the continued need for the curb. Remove curbing that is no longer needed.
1239.05(5) Curb Use Considerations

Curbs can provide physical guidance to drivers, but curbs are not intended to redirect errant vehicles. When an overlay will reduce the height of a curb, evaluate grinding (or replacing the curb) to maintain curb height if needed for pavement or drainage performance. (See Section 1250.02(2) for shoulder cross slope considerations.) To maintain or restore curb height, consider lowering the existing pavement level and improving cross slope by grinding before an asphalt overlay or as determined by the pavement design. The cross slope of the shoulder may be steepened to maximize curb height and minimize other related impacts. Note that grinding can cause issues with meeting ADA criteria at curb ramps for counter slope and crosswalk running slope. See Chapter 1510 for more information.

Curbs can hamper snow-removal operations. In areas of heavy snowfall, ask the Area Maintenance Superintendent to review and concur with the use of curbing.

For curbs at traffic islands, see Chapter 1310. For curbs at roundabouts, see Chapter 1320 and Standard Plan F-10.18-01.

1239.06 Lateral Clearance to Curb and Barrier

Lateral clearance to curb or barrier is the perpendicular distance from edge of traveled way to the face of a curb or a traffic barrier (guardrail, concrete barrier, etc.). Lateral clearance includes the shoulder width. The minimum lateral clearance to the face of a curb or barrier is shown in Exhibit 1239-11. See also Chapter 1310 for intersections including clearance to curb at traffic islands.

Exhibit 1239-11 Minimum Lateral Clearance to Barrier and Curb [7]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High Speed (≥50mph)</td>
<td>4 ft; curb not recommended [4]</td>
<td>4 ft; curb not recommended [4]</td>
<td>4 ft</td>
</tr>
<tr>
<td>Intermediate Speed (40 &amp; 45mph)</td>
<td>4 ft; curb not recommended [4]</td>
<td>4 ft; curb not recommended [4]</td>
<td></td>
</tr>
<tr>
<td>Ramps [5]</td>
<td></td>
<td>4 ft</td>
<td>4 ft</td>
</tr>
</tbody>
</table>

Notes:

[1] For HOV lanes on arterials streets, see Section 1410.04(4)(d)
[3] On low-speed urban roadways (35 mph or less), maintaining shoulder width is desirable; however, with justification, curb (mountable or vertical) may be placed at the edge of traveled way.
[4] With justification, mountable curb may be placed at the edge of traveled way for access management in urban areas. Adding mountable curb reduces lane and/or shoulder width and may require additional documentation.
[5] Raised median for two-way ramps (see Section 1360.03(5)).
[6] 2 ft min. for ramp design where speeds are ≤35mph (usually near the ramp terminal intersection) and 4 ft. min. where design speeds are > 35mph.
1239.07 Chain-Up and/or Chain-Off Areas

Provide chain-up areas in order to allow chains to be put on vehicles out of the through lanes at locations where traffic enters chain enforcement areas. Provide chain-off areas to remove chains out of the through lanes for traffic leaving chain enforcement areas.

Chain-up or chain-off areas are widened shoulders designed as shown in Exhibit 1239-12. Locate chain-up and chain-off areas where the grade is 6% or less and desirably on a tangent section.

Consider illumination for chain-up and chain-off areas on multilane highways. When deciding whether or not to install illumination, consider traffic volumes during the hours of darkness and the availability of power. See Section 1040.02(7).

The wide shoulders at chain-up and chain-off areas may encourage parking. When parking is undesirable, consider parking restrictions.
Exhibit 1239-12 Chain-Up/Chain-Off Shoulders

Notes:

[1] Where traffic volumes are low and trucks are prohibited, the width may be reduced to 15 ft.
[2] 2% desirable. (See Chapter 1250 for traveled way cross slope.)
1239.08 Medians and Outer Separations

Medians are either restrictive or nonrestrictive. Restrictive medians physically limit motor vehicle encroachment, using raised curb, median barrier, fixed delineators, vegetative strips, or vegetative depressions. Nonrestrictive medians limit motor vehicle encroachment legally, and use pavement markings to define locations where turns are permissible. The main functions of an outer separation are to separate the main roadway from a frontage road or service lane, or to provide modal segregation. Consider medians or outer separations to optimize the desired performance objective, such as safety, throughput operations, pedestrian mobility needs, etc.

Provide a median or outer separation to:

- Separate traffic lanes such as ETL, HOV lanes, bike lanes, etc.
- Separate divided highways with differing alignments.
- Separate opposing traffic to reduce the risk of head-on collisions.
- Manage speed.
- Provide a refuge area for emergency parking.
- Allow for future widening of a planned phase.
- Separate collector-distributor lanes, frontage roads, weigh sites, or rest areas.
- Accommodate drainage facilities.
- Accommodate bridge piers at undercrossings.
- Provide vehicle storage space for crossing and left-turn movements at intersections.
- Accommodate headlight glare screens, including planted or natural foliage.
- Provide recovery areas for errant or disabled vehicles.
- Provide a pedestrian refuge area at crossing locations.
- Provide storage space for snow and water away from traffic lanes.
- Separate modes for increased safety, comfort, and ease of operations.
- Control access.
- Provide enforcement areas.

The width of a median is measured from edge of traveled way to edge of traveled way and includes shoulders. Median widths can vary greatly based on the functional use of the median, the functional use of the shoulders, target speed, and context. Guidance for median and shoulder widths depending on their function and context is given in:

- Exhibit 1239-13 (high & intermediate speed medians),
- Exhibit 1239-14 (low & intermediate speed medians), and
- Exhibit 1239-2 (shoulders).

1239.08(1) Median Design: High and Intermediate Speed

Exhibit 1239-13 lists width considerations for median functions common on high and intermediate speed facilities.

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 Section 1239.03 and Chapter 1600 and Chapter 1610. Independent horizontal and vertical alignment, rather than parallel alignment, can allow for reduced grading or cut sections.
Considerable latitude in grading treatment is intended on wide, variable-width medians, provided the minimum performance needs 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 safety performance. The widths of medians need not be uniform. Make the transition between median widths as long as practical. (See Chapter 1210 for minimum taper lengths.)

When using concrete barriers in depressed medians or on the insides of curves, provide for surface drainage on both sides of the barrier or provide MASH compliant scupper barrier.

At locations where the median will be used to allow vehicles to make a U-turn, provide the widths in Exhibit 1310-28. (For information on U-turns, see Section 1310.03(8)) Document the selected design vehicle and provide alternate route information for vehicles not serviced by the U-turn.

Where feasible, widen medians at intersections on rural divided multilane highways. Provide sufficient width to store vehicles crossing the expressway or entering the expressway with a left turn.

When the median is to be landscaped, or where fixed objects are to be placed in the median, see Chapter 1600 for traffic barrier and clear zone guidance. When the median will transition for use as a left-turn lane, see Chapter 1310 for left-turn lane design considerations.
### Exhibit 1239-13 Median Functions and Guidance: High and Intermediate Speeds

<table>
<thead>
<tr>
<th>Median Functional Use</th>
<th>Width Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separating opposing traffic</td>
<td>Varies(^1) and see Chapter 1600 and Chapter 1610</td>
</tr>
<tr>
<td>Separating alignments</td>
<td>Varies See Section 1239.03 and Chapter 1600 (^2)</td>
</tr>
<tr>
<td>Recovery/Refuge areas for errant vehicles</td>
<td>See Section 1239.03 and Chapter 1600</td>
</tr>
<tr>
<td>Storage space for snow</td>
<td>Consult Region Maintenance and Representatives of affected modes.</td>
</tr>
<tr>
<td>Raised island with signing</td>
<td>Width of the sign plus 2 feet on either side minimum. (See Exhibit 1310-3)</td>
</tr>
<tr>
<td>Raised island with illumination (no signing)</td>
<td>Width of the luminaire plus 2 feet on either side minimum.</td>
</tr>
<tr>
<td>Enforcement/observation areas</td>
<td>See Chapter 1370 and Chapter 1410, and consult with Washington State Patrol and/or city/town police</td>
</tr>
<tr>
<td>Vehicle storage space for crossing at intersections</td>
<td>See Chapter 1310, and consult with region traffic engineer</td>
</tr>
<tr>
<td>Median U-turn or Median crossover</td>
<td>See Chapter 1310 and Chapter 1370</td>
</tr>
<tr>
<td>Outer separation for frontage or collector-distributor roads</td>
<td>12 ft min plus shoulders (^1) See Exhibit 1360-27 and Chapter 1360, Chapter 1600 and Chapter 1610</td>
</tr>
<tr>
<td>Transit use</td>
<td>Varies; see Chapter 1420 and discuss with Transit Agency (^3)</td>
</tr>
<tr>
<td>Pedestrian and bicyclist refuge for crossing locations</td>
<td>6 ft minimum, excluding curb width (see Section 1510.11 &amp; Exhibit 1510-21 for pedestrians and See Section 1520.04(5) &amp; Exhibit 1520-11 for bicyclists.)</td>
</tr>
</tbody>
</table>

Notes:

1. Conduct a safety performance analysis and include potential countermeasures identified to obtain the desired safety performance. Consult with maintenance; additional width may be appropriate for unconstrained right of way locations, maintenance functions, or for divided highways on independent alignments.

2. An economic comparison of wide medians to narrow medians with barrier is recommended.

3. For planning and scoping purposes, 32 ft can be the assumed minimum for two-way transit operations or 22 ft for one-way transit operations.
# 1239.08(2) Median Design: Low and Intermediate Speeds

Exhibit 1239-14 provides design guidance for medians within low and intermediate speed transportation contexts. In low-speed urban and suburban contexts, see Chapter 1600 for Design Clear Zone requirements.

A common form of restrictive median on urban managed access highways is the raised median. For more information on traffic volume thresholds for restrictive medians on managed access highways, see Chapter 540.

## Exhibit 1239-14 Median Functions and Guidance: Low and Intermediate Speeds

<table>
<thead>
<tr>
<th>Median Functional Use</th>
<th>Width Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Control – Restrictive</td>
<td>Width of raised median feature[^1][^2]</td>
</tr>
<tr>
<td>Access Control – Non-restrictive</td>
<td>1 ft minimum[^3] (see Chapter 540)</td>
</tr>
<tr>
<td>Raised median/cut-through island for a pedestrian and/or bicyclist refuge that allows crossing in two stages</td>
<td>6 ft minimum, excluding curb width (see Section 1510.11 &amp; Exhibit 1510-21 for pedestrians and See Section 1520.04(5) &amp; Exhibit 1520-11 for bicyclists.)</td>
</tr>
<tr>
<td>Raised island with signing</td>
<td>Width of the sign plus 2 feet on either side minimum. (See Chapter 1310)</td>
</tr>
<tr>
<td>Raised island with illumination (no signing)</td>
<td>Width of the luminaire plus 2 feet on either side minimum.</td>
</tr>
<tr>
<td>Speed management and/or aesthetic design – Vegetated</td>
<td>Varies[^2][^4] (see Chapter 1103)</td>
</tr>
<tr>
<td>Drainage or treatment facilities</td>
<td>Varies[^5]</td>
</tr>
<tr>
<td>Bicyclist buffer treatment</td>
<td>2 ft – 3 ft (see Chapter 1520)</td>
</tr>
<tr>
<td>Outer separation for frontage or collector-distributor roads</td>
<td>12 ft min. plus shoulders[^6][^6][^7] See Exhibit 1360-27, Design B</td>
</tr>
</tbody>
</table>

### Notes:

[^1]: The width of a raised median can be minimized by using a dual-faced cement concrete traffic curb, a precast traffic curb, or an extruded curb.
[^2]: Consider width necessary for lateral clearance. See Section 1239.06.
[^3]: 2 ft minimum if adjacent lane widths are less than 11 ft.
[^4]: Consult Region Landscape Architect; width will depend on type of plantings. Over-excavation may be necessary to prepare soil for the selected plantings to ensure mature heights are obtained.
[^5]: Consult Hydraulic Manual for width necessary for drainage or treatment facilities.
[^6]: Consider width needed for plantings or street furniture to create the appropriate pedestrian zone segregation and environment.
[^7]: See also Chapter 1510
Exhibit 1239-15 Divided Highway Median Sections

Design A: Crowned Median

Design B: Depressed Median

Alternate Design 1: Treatment on Curves (Single Pivot Point)

Alternate Design 2: Treatment on Curves (Separate Pivot Points) [2]

Note:
For applicable notes, see Exhibit 1239-17.
Exhibit 1239-16 Divided Highway Median Sections

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 1239-17.
Chapter 1239  Geometric Cross Section – Shoulders, Side Slopes, Cross Sections, and Medians

Exhibit 1239-17 Divided Highway Median Sections

Notes:

[1] For guidance on median widths, see Exhibit 1239-13 and Exhibit 1239-14
[2] Consider vertical clearances, drainage, and aesthetics when locating the pivot point.
[3] Generally, slope pavement away from the median. When barrier is present and the roadway is in a superelevation, size the shoulder so that standing water is not in the travel lane. Where appropriate, a crowned roadway section may be used in conjunction with the depressed median.
[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 Section 1250.02(2) 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 guidance on shoulder widths, see Section 1250.02.
[10] Designs C, D, and E are rural high-speed median designs. See Exhibit 1239-13 for recommended median widths.
[11] 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] See Sections 1239.05 and 1239.06 for curb design guidance.

1239.09 Documentation

Refer to Chapter 300 for design documentation requirements and approving authorities.