

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

[1239.01 Introduction](#)

[1239.02 Shoulders](#)

[1239.03 Fill Sections, Cut Sections, and Ditch Sections](#)

[1239.04 Roadway Sections in Rock Cuts](#)

[1239.05 Curbs](#)

[1239.06 Lateral Clearance to Curb and Barrier](#)

[1239.07 Chain-Up and/or Chain-Off Areas](#)

[1239.08 Medians and Outer Separations](#)

[Exhibit 1239-1 Shoulder Widths for Highways](#)

[Exhibit 1239-2 Shoulder Function & Modal Accommodation Width Considerations](#)

[Exhibit 1239-3 Shoulder Grading Details](#)

[Exhibit 1239-4 Shoulder Widening Details](#)

[Exhibit 1239-5 Drainage Ditch Details](#)

[Exhibit 1239-6 Bridge End Slopes](#)

[Exhibit 1239-7 Bridge End Slope Details](#)

[Exhibit 1239-8 Roadway Sections in Rock Cuts: Design A](#)

[Exhibit 1239-9 Roadway Sections in Rock Cuts: Design B](#)

[Exhibit 1239-10 Stepped Slope Design](#)

[Exhibit 1239-11 Minimum Lateral Clearance to Barrier and Curb \[6\]](#)

[Exhibit 1239-12 Chain-Up/Chain-Off Shoulders](#)

[Exhibit 1239-13 Median Functions and Guidance: Speeds of \$\geq 50\$ mph and 40 to 45 mph](#)

[Exhibit 1239-14 Median Functions and Guidance: Speeds \$\leq 35\$ mph and 40 to 45 mph](#)

[Exhibit 1239-15 Divided Highway Median Sections](#)

[Exhibit 1239-16 Divided Highway Median Sections](#)

[Exhibit 1239-17 Divided Highway Median Sections](#)

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 limited and non-limited access facilities with speeds of ≥ 40 mph, some rural contexts, as well as locations that do not have streetsides (curb-sections) (see [Chapter 1238](#)). Locations with speeds of 40 mph and 45 mph 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

Design Speed [4]	Highway Type	Shoulder Width [1] [2]	
		Inside (median)	Outside
≥ 50 mph	Freeway (including Interstate)	See Chapter 1232	
	Other highway	4' – 10'	4' – 10'
40 mph & 45 mph	All	4' – 8'	4' – 8'[3]
≤ 35 mph	All	0' – 8'	2' – 8'[3]

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](#) for lateral clearance considerations.
- [3] Highways with posted speeds of ≤ 45 mph 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 1231-5](#), [Exhibit 1231-6 \(A & B\)](#), [Exhibit 1231-7 \(B & C\)](#), and Section [1239.02](#).
- [4] For roundabout intersections, the shoulder width is determined according to the design speed of the roundabout, not the design speed of the highway(s) approaching the roundabout. If curb is present, see [Exhibit 1239-11](#).

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 1600](#). 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](#)).

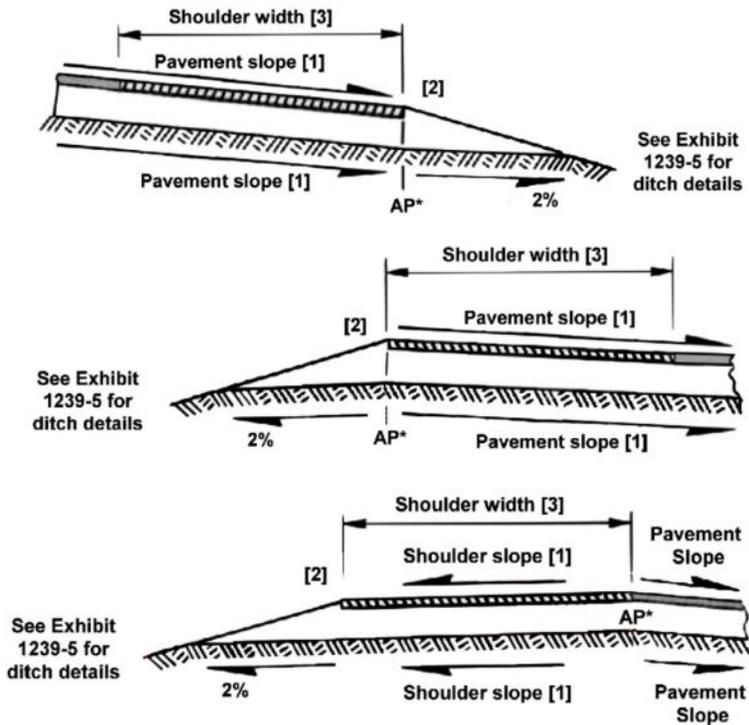
Exhibit 1239-2 Shoulder Function & Modal Accommodation Width Considerations

Shoulder Function	Shoulder Width Guidance [7] [10]
Stopping out of the traffic lanes	8 ft – 12 ft [1]
Minimum lateral clearance to curb or barrier	See Section 1239.06
Part time shoulder. (Requires a Design Analysis) [6]	10 ft to 13 ft [2] See Section 1232.03 and Chapter 1430 See 1410.02(3)(c) for HOV
Bicyclist use	4 ft of usable shoulder [3]
Pedestrian use	See Section 1510.04
Off-tracking of accommodated vehicles	See Section 1310.02(5)
U-turn turnouts	Varies – See Section 1310.02(19)
Maintenance operations (Consult Area Superintendent)	Varies [4] [5]
Law enforcement, emergency services & incident response	8 ft to 12 ft [5]
Transit stops	See Section 1730.02 and Exhibit 1730-2
Slow-vehicle turnouts	See Section 1270.04
Slow-vehicle shoulder driving	See Section 1270.05
Metered shoulder (Requires a Design Analysis)	10 ft – 13 ft [9]
HOV ramp meter bypass (Requires a Design Analysis)	10 ft – 14 ft [6]
Ferry holding	8 ft – 12 ft [1]
For use as a lane during reconstruction of the through lanes	8 ft – 12 ft [1]
Structural support of pavement	2 ft
Improve horizontal sight distance in cut sections or sections with barrier or fixed objects that block sight lines.	See Section 1260.03(5)
Chain-Up and Chain-Off Areas	20 ft [8]
Drainage	Consult Region Hydraulics

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 Section 1600.05(1)(b) and the Standard Plans). For guidance, see Section 1520.03(2) 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 Section 1370.03, Chapter 1410 and Section 1720.06(2). 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.
- [8] Where traffic volumes are low and trucks are not present, the width may be reduced to 15 ft.
- [9] See Chapter 1440.
- [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 1239-4](#) 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

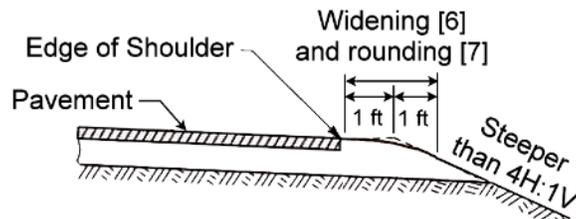
Notes:

- [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.
- [3] For shoulder width guidance, see [Exhibit 1239-1](#).

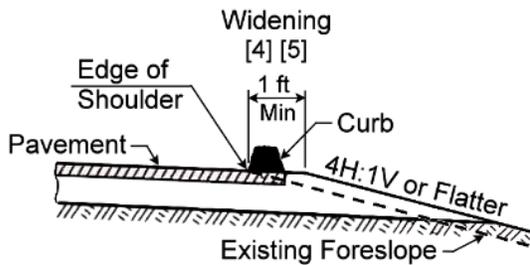
General:

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

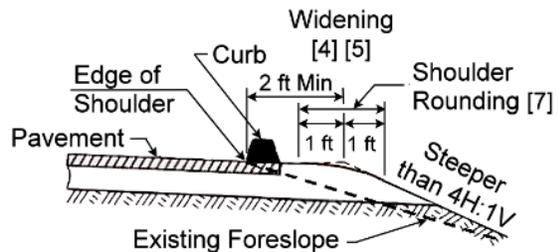
Exhibit 1239-4 Shoulder Widening Details



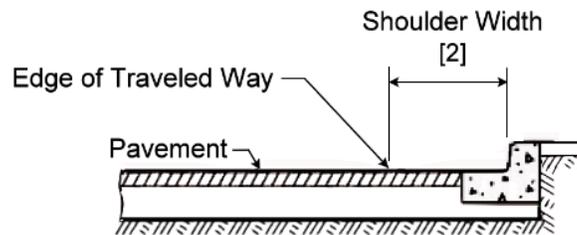
Shoulder Widening and Rounding [1] for Slopes Steeper than 4H:1V



Shoulder Widening for Curb (Side Slope 4H:1V or Flatter)

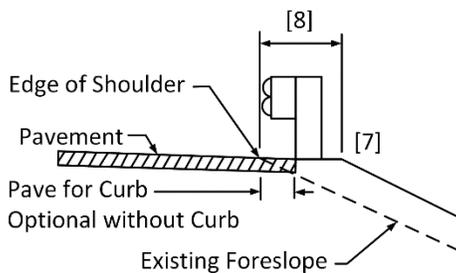


Shoulder Widening for Curb (Side Slope Steeper than 4H:1V)

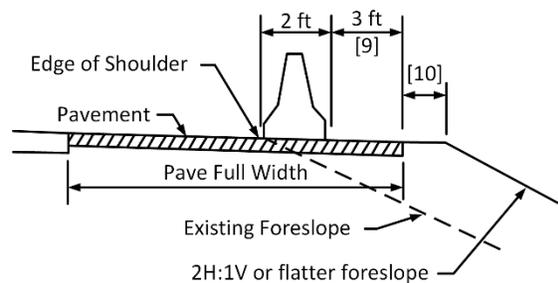


For Adding Curb and Gutter [3] [4]

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.



Shoulder Widening for Guardrail



Shoulder Widening for Permanent Concrete Barrier (Precast Unanchored Concrete Barrier Shown)

Exhibit 1239-4 Notes:

- [1] Provide widening and slope rounding outside the shoulder when foreslope is steeper than 4H:1V.
- [2] For shoulder width guidance, see [Exhibit 1239-1](#).
- [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 guardrail, additional widening for slope rounding may be omitted.
- [8] For widening guidelines for guardrail, see [Section 1610.04\(2\)](#).
- [9] Permanent precast unanchored concrete barrier deflection distance shown above. See [Section 1610.03\(5\)](#) for other concrete 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. When mowing is contemplated, provide slopes not 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.

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.

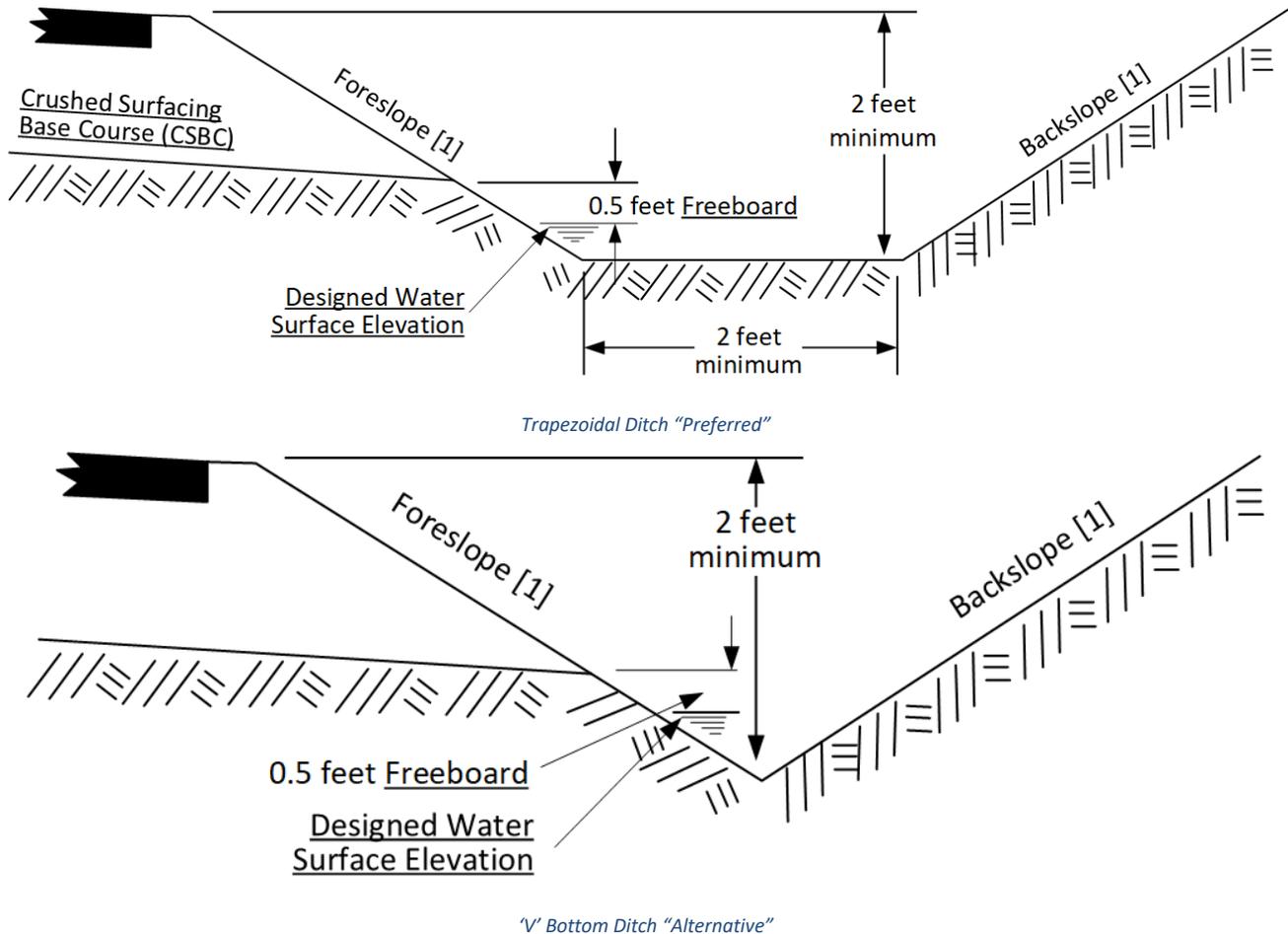
Provide slope treatment as shown in the [Standard Plans](#) (Slope treatment) at the top of roadway cut slopes except for cuts in solid rock. Unless Class B slope treatment is called for, Class A slope treatment is used. Call for Class B slope treatment where space is limited, such as where right of 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 1600-5](#) for foreslopes steeper than 3H:1V.
- See Hydraulics Manual, Section 4-3 and Figure 4-7 for ditch depth detail.

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.

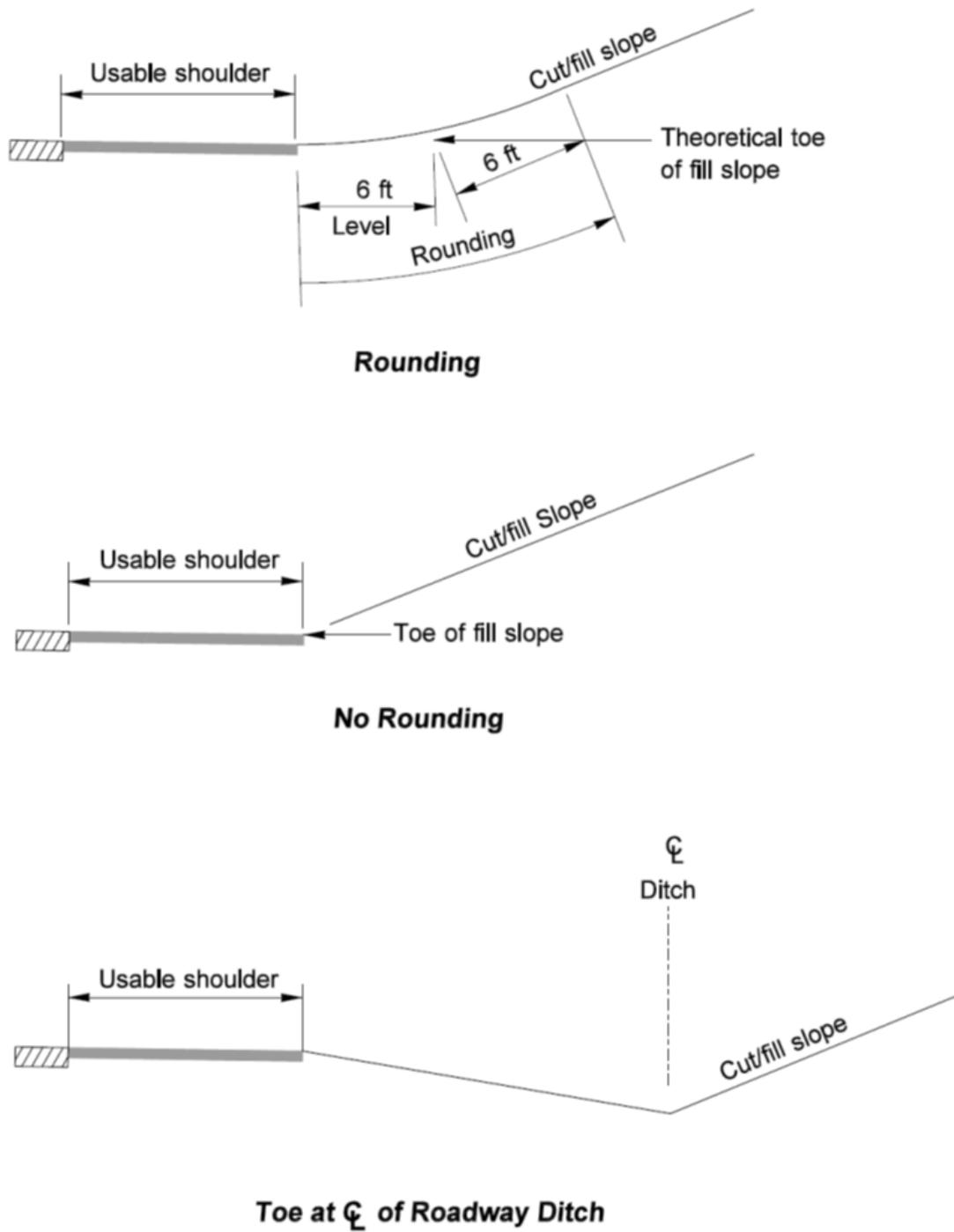
Exhibit 1239-6 Bridge End Slopes

Bridge End Condition	Toe of Slope End Slope Rate		Lower Roadway Treatment [1]		Slope Rate
	Height	Rate	Posted speed of lower roadway	Treatment	
End Piers on Fill	≤ 35 ft	1¾H:1V	> 50 mph	Rounding	
	> 35 ft	2H:1V [2]	≤ 50 mph	No rounding	
End Piers in Cut	Match lower roadway slope [3]		No rounding, toe at centerline of the lower roadway ditch.		[4]
Lower Roadway in Cut	Match lower roadway slope [3]		No rounding, toe at centerline of the lower roadway ditch.		[4]
Ends in Partial Cut and Fill	When the cut depth is > 5 ft and length is > 100 ft, match cut slope of the lower roadway		When the cut depth is > 5 ft and length is > 100 ft, no rounding, toe at centerline of the lower roadway ditch		[4]
	When the cut depth is ≤ 5 ft or the length is ≤ 100 ft, it is designer's choice		When the cut depth is ≤ 5 ft or the length is ≤ 100 ft, it is designer's choice		[4]

Notes:

- [1] See [Exhibit 1239-7](#).
- [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



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 Geotechnical Office.

1239.04(1) Design A

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

The following guidelines apply to the various cases shown in [Exhibit 1239-8](#):

- **Case 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.
- **Case 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.
- **Cases 3, 4, and 5** represent the full implementation of all protection and safety measures applicable to rock control. Use these when extreme rockfall conditions exist.
 - **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 with no rock protection fence.
 - **Case 5** – Protection and safety measures applicable to rock control using concrete barrier and rock protection fence.

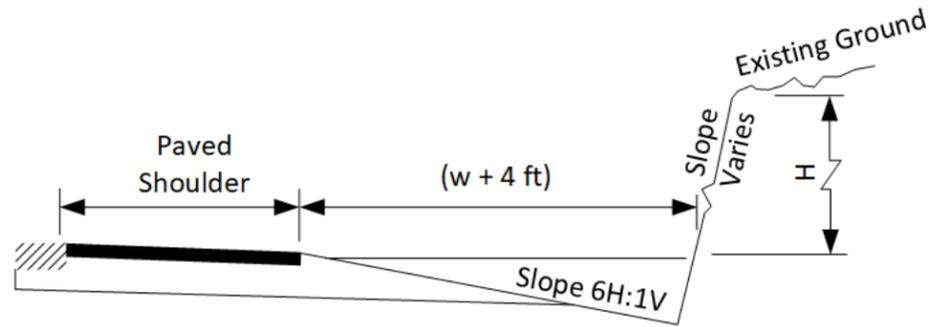
The use of Cases 2, 4, or 5 (concrete barrier) is based on the designer’s analysis of the particular site. Considerations include maintenance; size and amount of rockfall; probable velocities; availability of materials; ditch capacity; adjacent traffic volumes; distance from traveled lane; and impact severity. Incorporate removable sections in the barrier at approximately 200-foot intervals. Provide appropriate terminal treatment (see Section [1610.06\(3\)](#)).

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 1239-8](#).

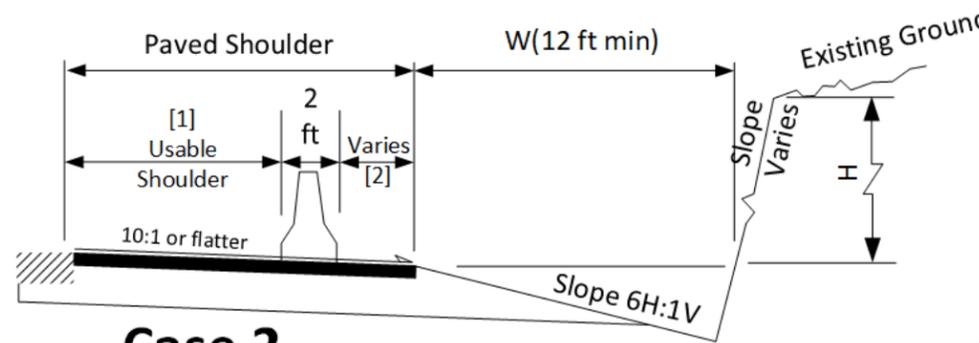
The necessity for benches, as well as their width and vertical spacing, is established after an evaluation of slope stability. Make benches at least 20 feet wide. Provide access for maintenance equipment to the lowest bench and to the higher benches if feasible. Greater traffic benefits in the form of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

Exhibit 1239-8 Roadway Sections in Rock Cuts: Design A



Case 1

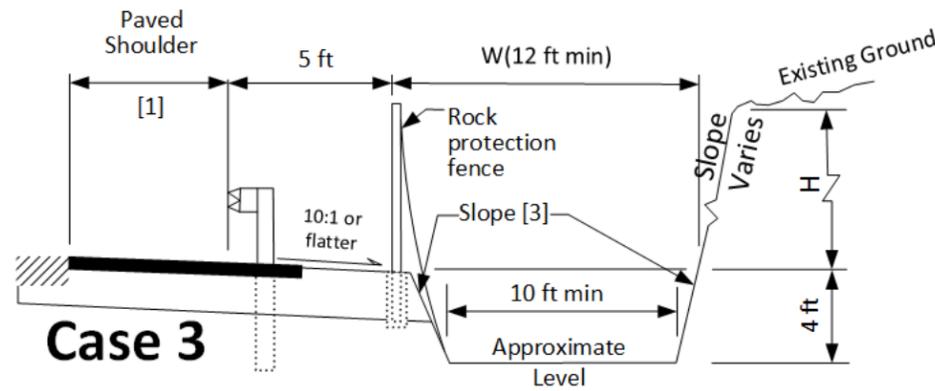
Use when anticipated quantity of rockfall is small, adequate fallout width can be provided, and the rock back slope is 1/2H:1V or steeper.



Case 2

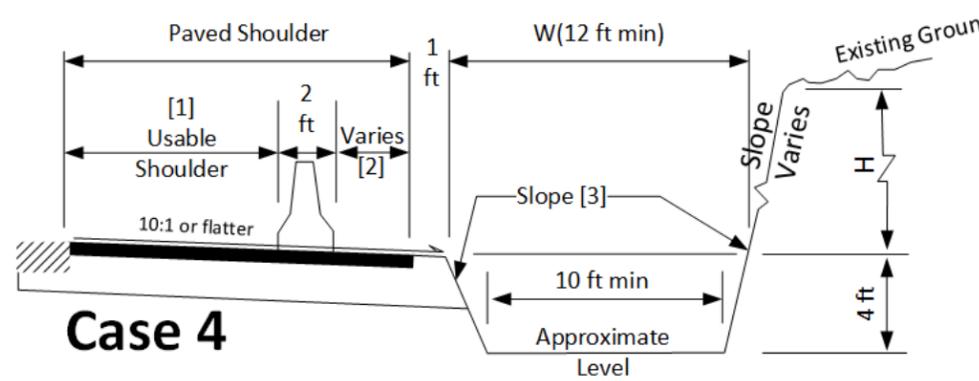
Use when a “rocks in the road” problem exists or is anticipated. Consider this on relatively flat slopes, where rocks are apt to roll rather than fall.

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	20
	>100	25



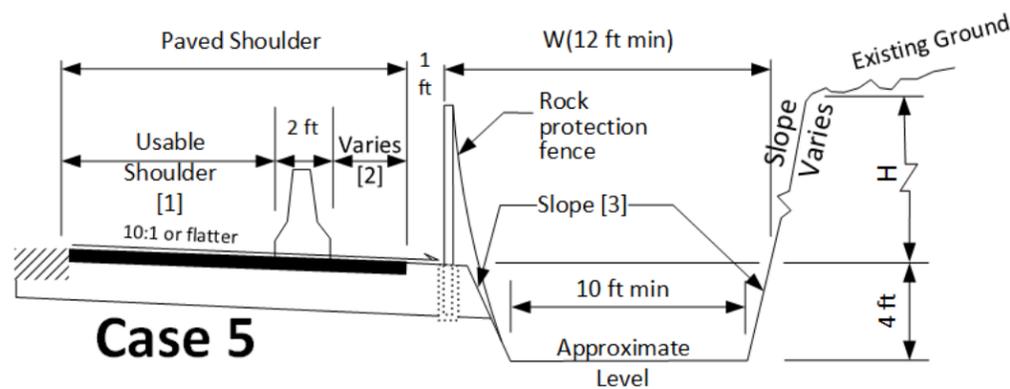
Case 3

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.

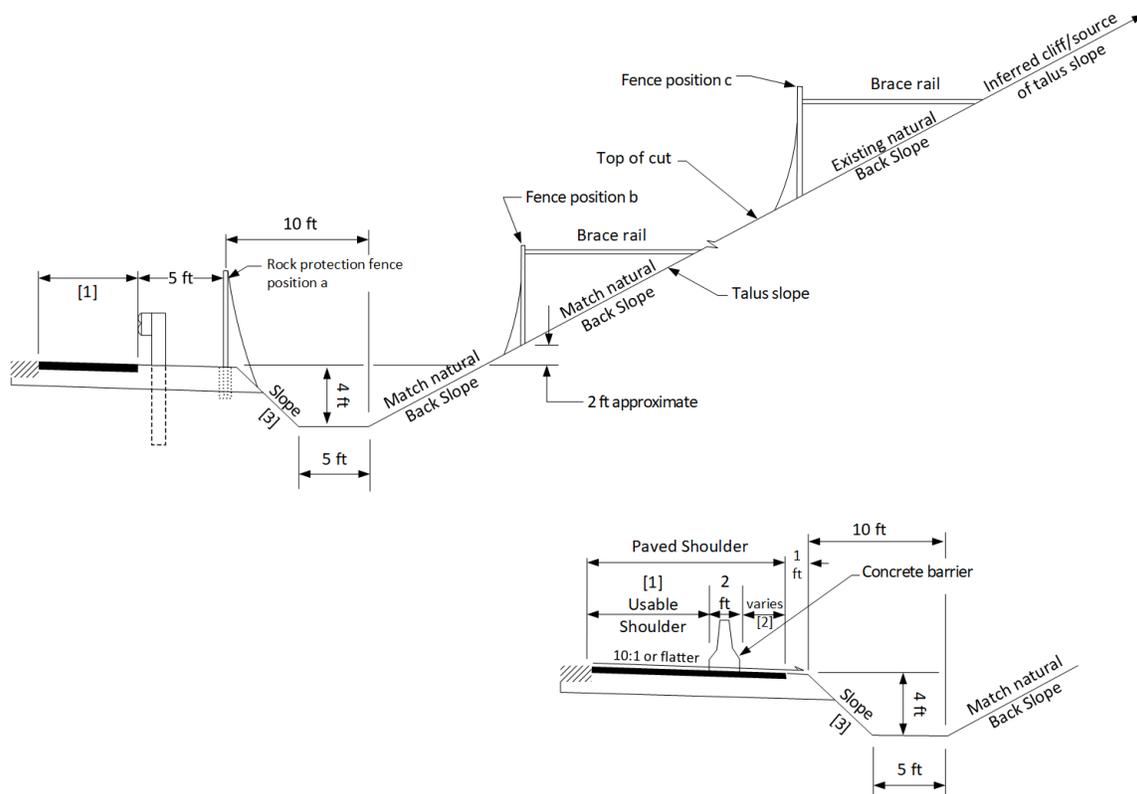
- **Fence position a** is used when the cliff generates boulders less than 0.25 yd^3 in size and the length of the slope is greater than 350 feet.
- **Fence position b** is the preferred location for most applications.
- **Fence position c** is used when the cliff generates boulders greater than 0.25 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](#).
- [2] Permanent precast concrete barrier. See Section [1610.03\(5\) Barrier Deflections](#).
- [3] Consult with the Region Materials Engineer to make this slope as steep as the natural material will allow.

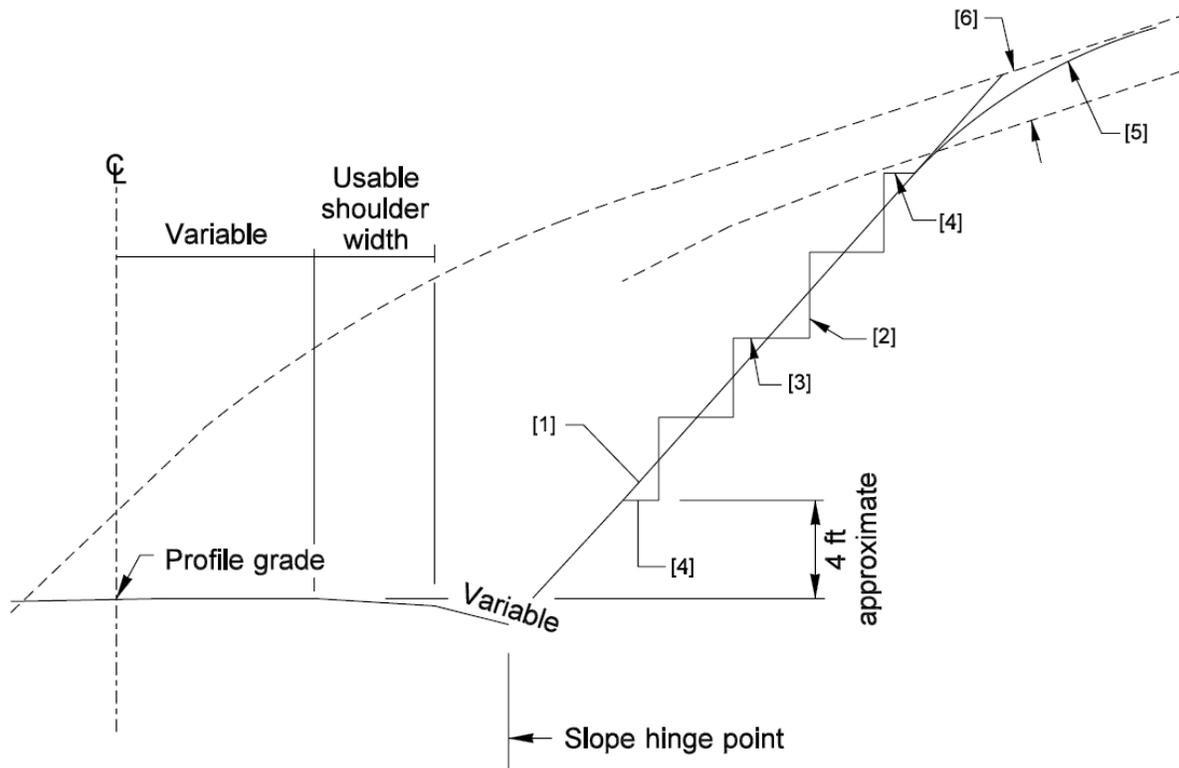
General:

- 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.
- [3] Step tread: Width = staked slope ratio x step rise.
- [4] Step termini: Width ½-step tread width.
- [5] Slope rounding.
- [6] Overburden area: Variable slope ratio.

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

Use vertical curbs with a height of 6 inches:

- 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 roadways with posted speeds of ≤ 35 mph in urban and suburban contexts (curb height may exceed 6 inches if needed by transit provider).

Consider vertical curbs with a height of 6 inches:

- 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

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

Use mountable curbs in roundabouts. See [Chapter 1320](#) and Standard Plan F-10.18-01.

1239.05(3) Curb Use Based on Speed

Avoid using curbs if the same objective can be attained with pavement markings. Where the highway speed is 40 mph or faster, 4-inch-high mountable curbs may be used to control drainage or for access control and 6-inch-high mountable curbs may be considered where streetside zones are provided or where traffic movements are to be restricted. Locate mountable curb no closer to the traveled way than the outer edge of the shoulder (4' minimum). With justification, mountable curb may be placed at the edge of traveled way for access management in urban areas.

With justification, vertical curb can be used on a 40 mph or faster highway if the lateral clearance is 4 or more feet wide. All curb types are appropriate for facilities with posted speeds of ≤ 35 mph.

See [Exhibit 1239-11](#) for lateral clearance to curb for highways with posted speeds of ≤ 35 mph and ramps.

With all curb types, provide sloping end treatments where the curb is introduced and terminated. Adding curb reduces lane and/or shoulder width and may require additional documentation.

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 [6]

Design Speed	Curb - Median [1] [2]	Curb - Right [1] [2]	Barrier
≥ 50 mph	See Section 1239.05(3)	See Section 1239.05(3)	4 ft
40 mph & 45 mph	See Section 1239.05(3)	See Section 1239.05(3)	
≤ 35 mph	0 - 2 ft	0 - 2 ft	2 ft
Ramps [4]	[5]	4 ft	4 ft

Notes:

- [1] For HOV lanes on arterials streets, see Section [1410.04\(4\)\(d\)](#)
- [2] Measured from the edge of traveled way to the face of curb.
- [3] At roundabout intersections the lateral clearance is determined by the design speed of the roundabout, not the posted speed of the highway.
- [4] Raised median for two-way ramps (see Section [1360.03\(5\)](#)).
- [5] 2 ft min. for ramp design where speeds are ≤ 35 mph (usually near the ramp terminal intersection) and 4 ft. min. where design speeds are > 35 mph.
- [6] See [Exhibit 1430-2](#) for part-time shoulders and [Exhibit 1440-2](#) for metered shoulders.

1239.07 Chain-Up and/or Chain-Off Areas

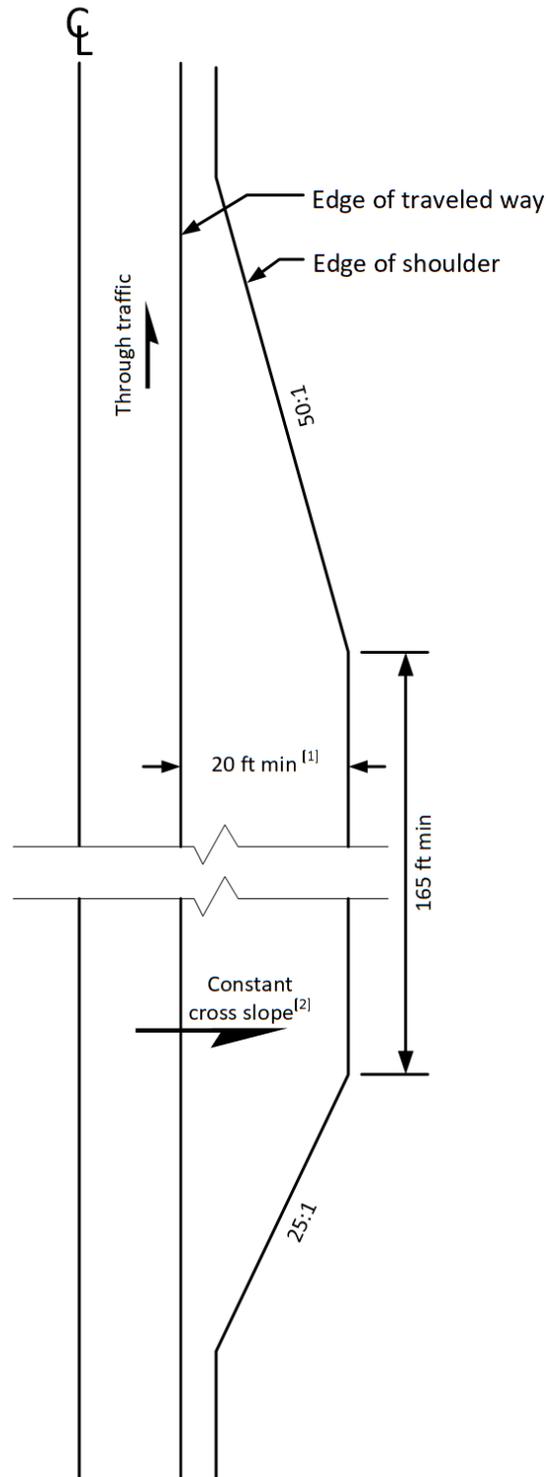
Provide chain-up areas in order to allow chains to be put on vehicles out of the through lanes at locations where traffic enters chain enforcement areas. Provide chain-off areas to remove chains out of the through lanes for traffic leaving chain enforcement areas.

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](#) (medians with speeds of ≥ 40 mph),
- [Exhibit 1239-14](#) (medians with speeds of ≤ 45 mph), and
- [Exhibit 1239-2](#) (shoulders).

1239.08(1) Median Design: Speeds ≥ 40 mph

[Exhibit 1239-13](#) lists width considerations for median functions common on facilities with speeds of ≥ 40 mph.

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 1310-30](#). (For information on U-turns, see [Section 1310.02\(19\)](#)) 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: Speeds of ≥ 50 mph and 40 to 45 mph

Median Functional Use	Width Guidance
Separating opposing traffic	Varies ^[1] and see Chapter 1600 and Chapter 1610
Separating alignments	Varies See Section 1239.03 and Chapter 1600 and Chapter 1610 ^[2]
Recovery/Refuge areas for errant vehicles	See Section 1239.03 and Chapter 1600
Storage space for snow	Consult Region Maintenance and Representatives of affected modes.
Raised island with signing	Width of the sign plus 2 feet on either side minimum. (See Exhibit 1310-5)
Raised island with illumination (no signing)	Width of the luminaire plus 2 feet on either side minimum.
Enforcement/observation areas	See Chapter 1370 and Chapter 1410 , and consult with Washington State Patrol and/or city/town police
Vehicle storage space for crossing at intersections	See Chapter 1310 , and consult with the Region Traffic Engineer
Median U-turn or Median crossover	See Chapter 1310 and Chapter 1370
Outer separation for frontage or collector-distributor roads	12 ft min plus shoulders ^[1] See Exhibit 1360-26 and Chapter 1360 , Chapter 1600 and Chapter 1610
Transit <u>stop</u>	<u>10 ft min. [3]</u> and discuss with Transit Agency(s) See Chapter 1730 and Sections 1231.07 and 1231.07(5) .
Pedestrian and bicyclist refuge for crossing locations	6 ft minimum, excluding curb width (see Section 1510.09(7) & Exhibit 1510-30 for pedestrians and See Section 1520.04(5) & Exhibit 1520-12 for bicyclists.)

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] Consider width needed for transit stop, plantings and/or street furniture to facilitate transit users.

1239.08(2) Median Design: Speeds ≤ 45 mph

[Exhibit 1239-14](#) provides design guidance for medians within transportation contexts with posted speeds of ≤ 45 mph. In urban and suburban contexts with posted speeds of ≤ 35 mph, 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](#).

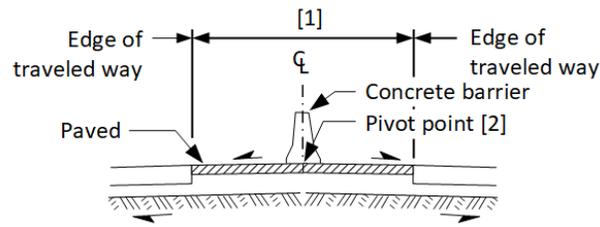
Exhibit 1239-14 Median Functions and Guidance: Speeds ≤ 35 mph and 40 to 45 mph

Median Functional Use	Width Guidance
Access Control – Restrictive	Width of raised median feature ^{[1] [2]}
Access Control – Non-restrictive	1 ft minimum ^[3] (see Chapter 540)
Raised median/cut-through island for a pedestrian and/or bicyclist refuge that allows crossing in two stages	6 ft minimum, excluding curb width (see Section 1510.09(7) & Exhibit 1510-30 for pedestrians and See Section 1520.04(5) & Exhibit 1520-12 for bicyclists.)
Raised island with signing	Width of the sign plus 2 feet on either side minimum. (See Chapter 1310)
Raised island with illumination (no signing)	Width of the luminaire plus 2 feet on either side minimum.
Speed management and/or aesthetic design – Vegetated	Varies ^{[2] [4]} (see Chapter 1103)
Drainage or treatment facilities	Varies ^[5]
Bicyclist buffer treatment	2 ft – 3 ft (see Chapter 1520)
Transit stop	<u>10 ft min.</u> ^[6] <u>Discuss with Transit Agency(s)</u> See Chapter 1730 , Section 1231.07(4) and Section 1231.07(5)

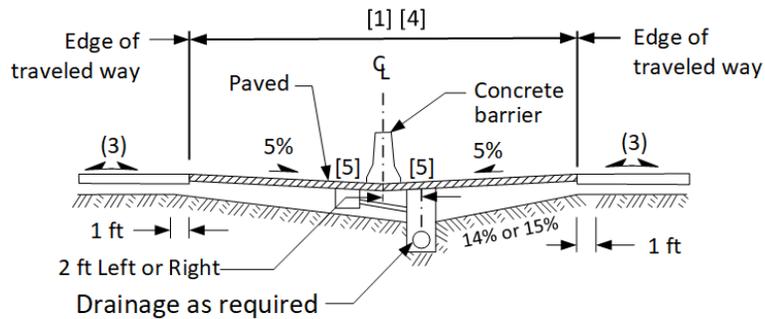
Notes:

- [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 transit stop, plantings and/or street furniture to facilitate transit users.

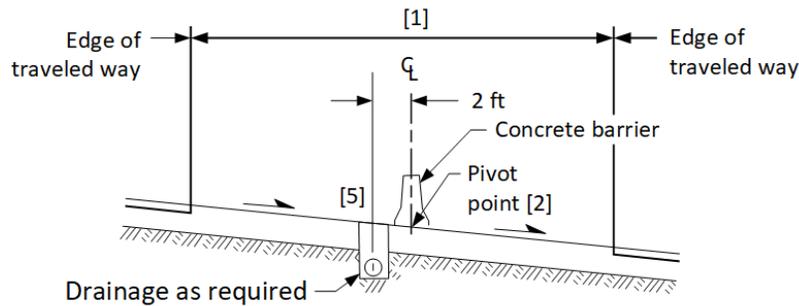
Exhibit 1239-15 Divided Highway Median Sections



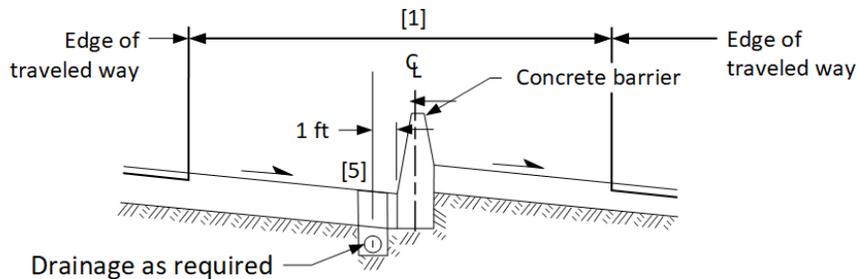
Design A: Crowned Median



Design B: Depressed Median



Alternate Design 1: Treatment on Curves (Single Pivot)

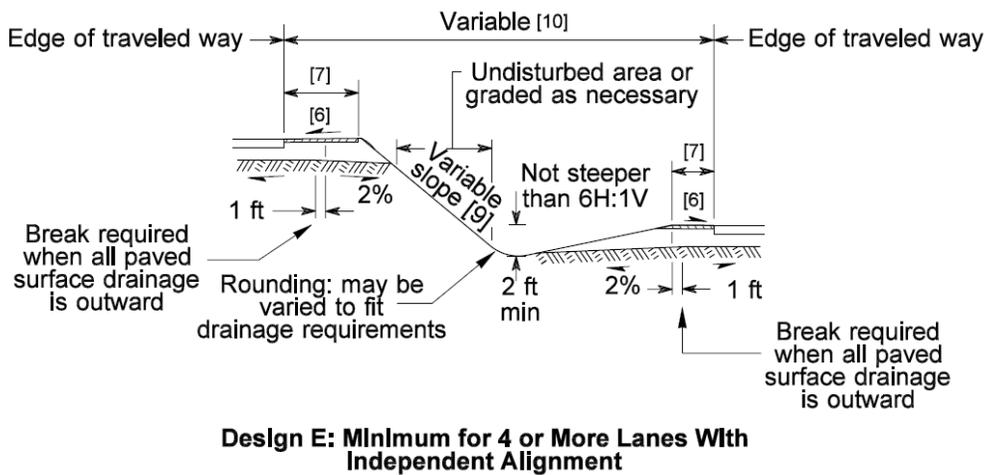
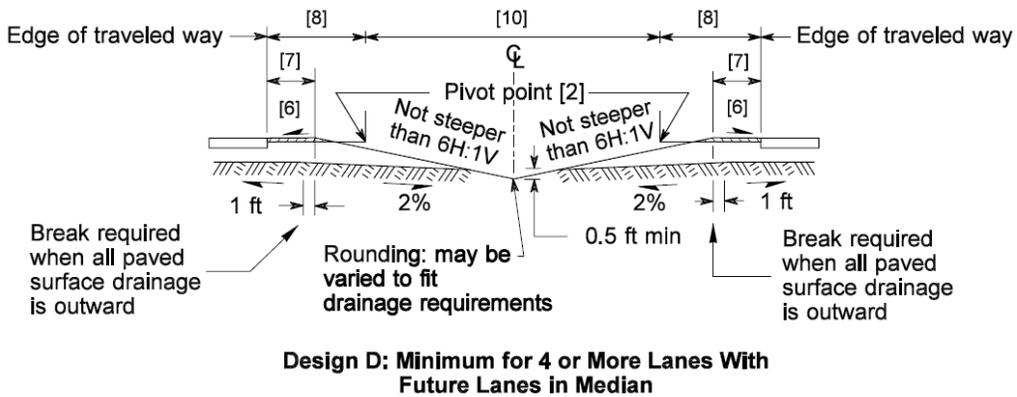
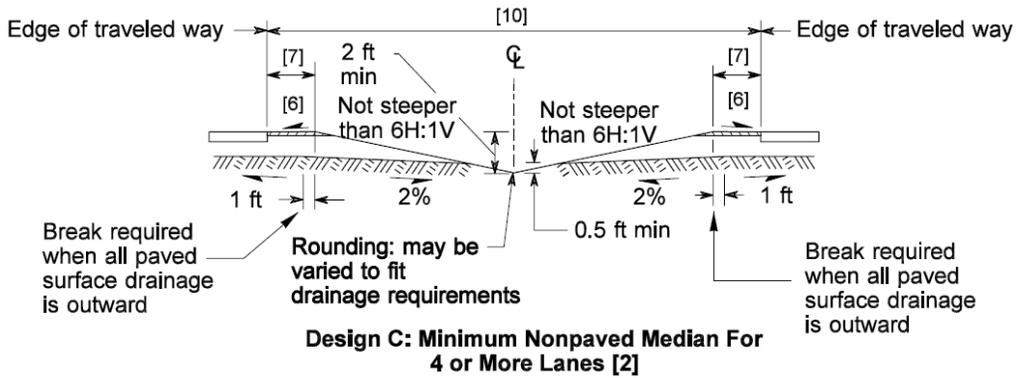


Alternate Design 2: Treatment on Curves (Separate Pivot Points) [2]

Note:

For applicable notes, see [Exhibit 1239-17](#).

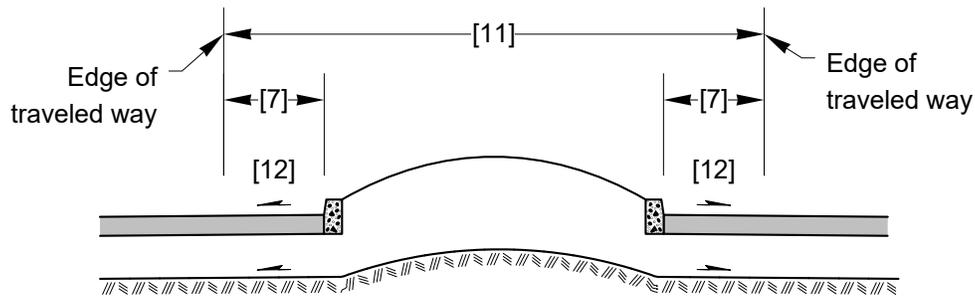
Exhibit 1239-16 Divided Highway Median Sections



Note:

For applicable notes, see [Exhibit 1239-17](#).

Exhibit 1239-17 Divided Highway Median Sections

Design F: Raised Median^[13]

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.
- [5] Method of drainage pickup to be determined by the designer.
- [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](#).
- [8] Future lane width of a planned phase.
- [9] Widen and round foreslopes steeper than 4H:1V as shown in [Exhibit 1239-3](#). See [Chapter 1600](#) for barrier recommendations.
- [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.

