REVIEW DRAFT
for
January 2025
ODOT Highway Design Manual

Oregon Department of Transportation

ODOT Highway Design Manual

Delivery & Operations Division | Engineering & Technical Services Branch

Review Draft - June 2024

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Note: This review draft version contains only the section being revised for the 2025 Highway Design Manual (HDM). The full 2024 version is available from the ODOT HDM website at https://www.oregon.gov/odot/Engineering/Pages/Hwy-Design-Manual.aspx

Preface

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Oregon Department of Transportation

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Notes to Reviewers

This review draft for the 2025 ODOT Highway Design Manual (HDM) contains only the parts, sections, and appendices with proposed revisions. If a part, section, or appendix is not included in this review draft, no changes are being proposed for the January 2025 version. The full 2024 ODOT Highway Design Manual is available form the ODOT Highway Design Manual website.

See the first page of each part for reviewer notes applicable to that part.

All proposed revisions are show as "Track Changes" according to the following:

- Added Text
- ~~Deleted Text~~

Review comments can be submitted using the 2025 HDM Comment Log on the ODOT Highway Design Manual website. Follow instructions contained in the comment log for recording and submitting comments.

Part 100 Design Policies and Procedures

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

101.1 Documentation and Approval Font Key

Text within some parts of this manual is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown.

Table 100-1 shows the four text fonts used, along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 100-1: Font Key

Font ~~Key Term~~	~~Font~~Documentation	Approver
Bold text	Design Exceptions	State ~~Traffic~~-Roadway Engineer (S~~T~~RE) and for some projects~~,~~ FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 101.2 for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 101.2 and 101.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 101.3 and 101.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

101.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. ~~All Standard statements appear in bold type in design parameters.~~ The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 101.4~~Options. A design exception is required to modify a Standard. The State Traffic-Roadway Engineer (STRE) gives formal approval, and FHWA approves as required.~~).

101.3 Guidelines

A guideline is a statement of recommended practice in typical situations. ~~All Guideline statements appear in bold italicized type in design parameters.~~ The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 101.4~~Options. While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is required. Region approval, with input from Technical Experts, is formally recorded for urban projects via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website.~~).

101.4 ~~Option~~ Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. ~~Option~~Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. ~~All Option statements appear in italic type in design parameters sections.~~ The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate ~~Option~~Best Practice statements. The verbs "shall" and "should" are not used in ~~Option~~Best Practice statements. The adjectives "required" and "recommended" are only used in ~~Option~~Best Practice statements to describe required or recommended design features as they relate to optional design features. ~~While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is best practice.~~

~~**General Text** Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.~~

110.2 ADA Requirements for Paving Projects

~~When~~An ADA ramp may require reconstruction when paving alterations occur adjacent to ~~ADA ramps,~~ the ADA ramp ~~is required to be accessible.~~ **Reconstruct ADA ramps ~~that are both~~when all of the following conditions apply:**

- **ADA Ramp is triggered by adjacent ~~to~~ pavement alterations according to Section 110.2.1, Section 110.2.2~~and~~, or Maintenance Operational Notice MG100-107 in Appendix H**
- **ADA Ramp is listed as having a poor functional ~~status~~condition in the ODOT ADA Ramp inventory~~.~~**
- **ADA Ramp does not have a settlement remediation year in the inventory**

Contact the Statewide Asset Specialist for additional information or to verify evaluation of ADA Ramps. This requirement applies to all projects under the Interstate Maintenance, 1R, 3R, 4R, and SF standards. ~~Refer to Bridge Manual, Appendix B for paving alterations near bridges with walkways.~~ **Radial driveway curb cuts are ~~required~~reconstructed to be ~~upgraded~~accessible when the paving limits incorporate portions of the private approach and impact the pedestrian access route.** Pavement treatments are described in ~~detailing~~Maintenance Operational Notice MG 100-107 in Appendix H and in Section 1.2.10 of the Bridge Design Manual, which detail alterations versus maintenance treatments (e.g. chip seal alone is not an alteration paving treatment however when multiple surface treatments are combined it may result in an alteration). Paving alterations are not limited to just asphalt roadbeds and include other surfacing materials such as reinforced concrete sections. Utility trench work is typically not considered a paving alteration; consultation with ~~Statewide~~Engineering and Technical Services~~, Traffic~~ Branch, Roadway Engineering Section is recommended.

110.2.1 ADA Ramp Triggers with Paving Alterations

Paving alterations change the usability of the roadway facility, which includes pedestrian crosswalks. Paving alterations include reconstruction, rehabilitation, resurfacing, widening, and similar work while maintenance activities are treatments which are applied to seal and

protect the road surface and improve friction for the vehicular use. [1] Refer to MG100-107 in Appendix H, which outlines when paving work is considered an alteration requiring ADA ramps and crosswalks to be addressed.

The requirement to provide curb ramps is intended to ensure that people with disabilities can access pedestrian walkways that cross a curb. The following illustrations show the curb ramp triggers based on various paving scenarios commonly encountered with projects. Curb ramps must be constructed and completed at the time the work or construction activity is triggered, or prior to the alteration work. Curb ramp reconstruction for a triggered crosswalk often involves geometric revisions and reconstruction of the second curb ramp at the existing corner as it may have interdependent features.

[1] FHWA Joint Memo Technical Assistance on the Title II of the ADA Requirements to Provide Curb Ramps when Streets, Roads, or Highway are Altered through Resurfacing.

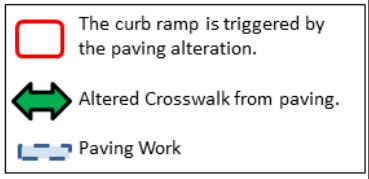
Figure 100-11: Example 1 - 1R Paving Scenario Existing Conditions and Requirements

Example 1

- Paving of highway
- Two existing directional ramps at each corner
- ADA Ramps at the intersection are in Poor Functional Condition, or does not meet ODOT accessibility standards, or does not meet ADA standards.

Requirements

- Reconstruct ADA Ramps without settlement remediation year
- ADA Ramps must be constructed to meet ODOT accessibility standards.



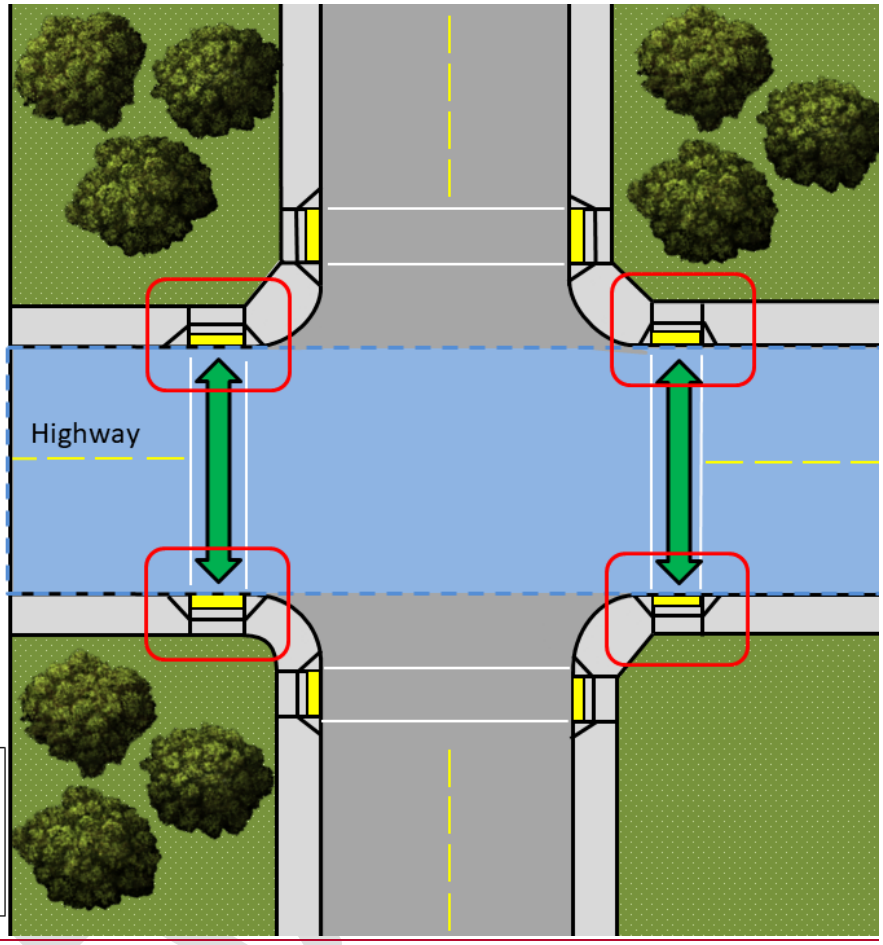


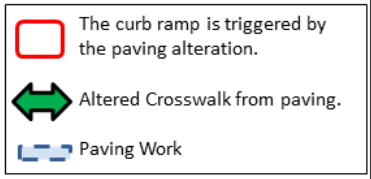
Figure 100-12: Example 2 - 1R Paving Scenario Existing Conditions and Requirements

Example 2

- Paving of highway and street approach at crosswalk.
- Two existing directional ramps at each corner
- ADA Ramps at the intersection are in Poor Functional Condition, or does not meet ODOT accessibility standards, or does not meet ADA standards.

Requirements

- Reconstruct ADA Ramps without settlement remediation year
- ADA Ramps must be constructed to meet ODOT accessibility standards.



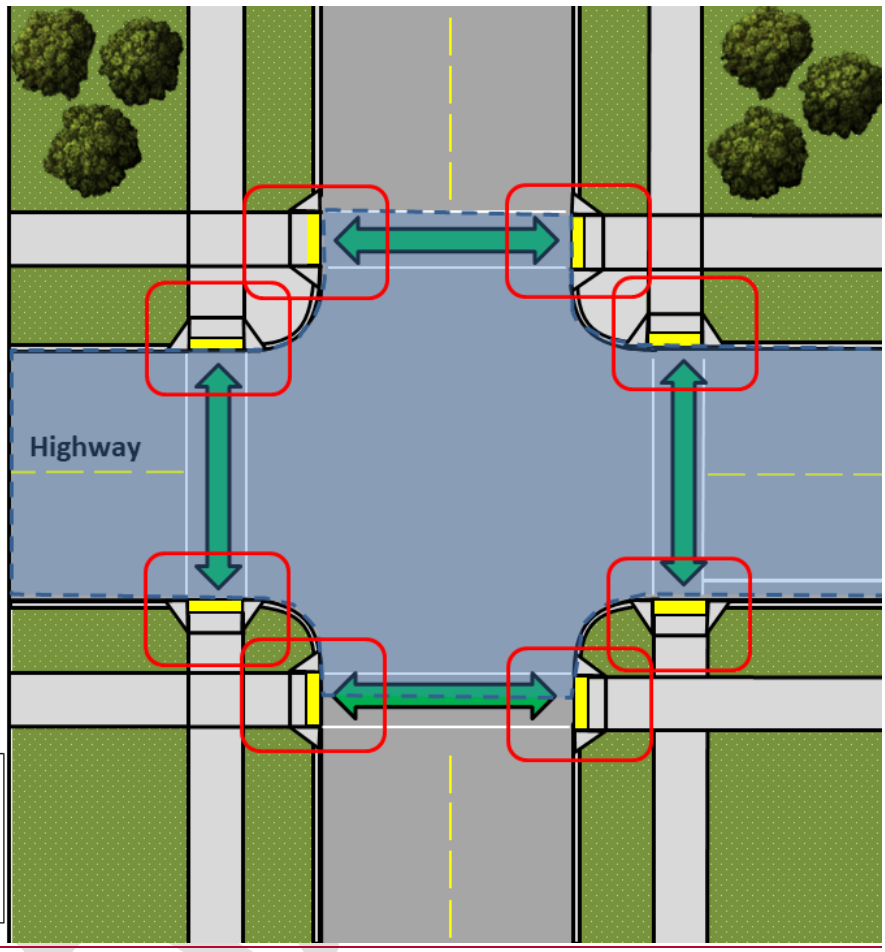


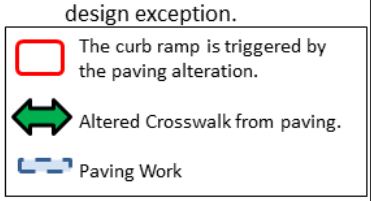
Figure 100-13: Example 3 - 1R Paving Scenario Existing Conditions and Requirements

Example 3

- Paving of highway
- One existing diagonal ramps at each corner
- ADA Ramps at the intersection are in Poor Function Condition, or does not meet ODOT accessibility standards, or does not meet ADA standards.

Requirements

- Reconstruct ADA Ramps without settlement remediation year
- ADA Ramps must be constructed to meet ODOT accessibility standards.
- Evaluate two directional curb ramps per corner; a single diagonal curb ramp may be appropriate with design exception.



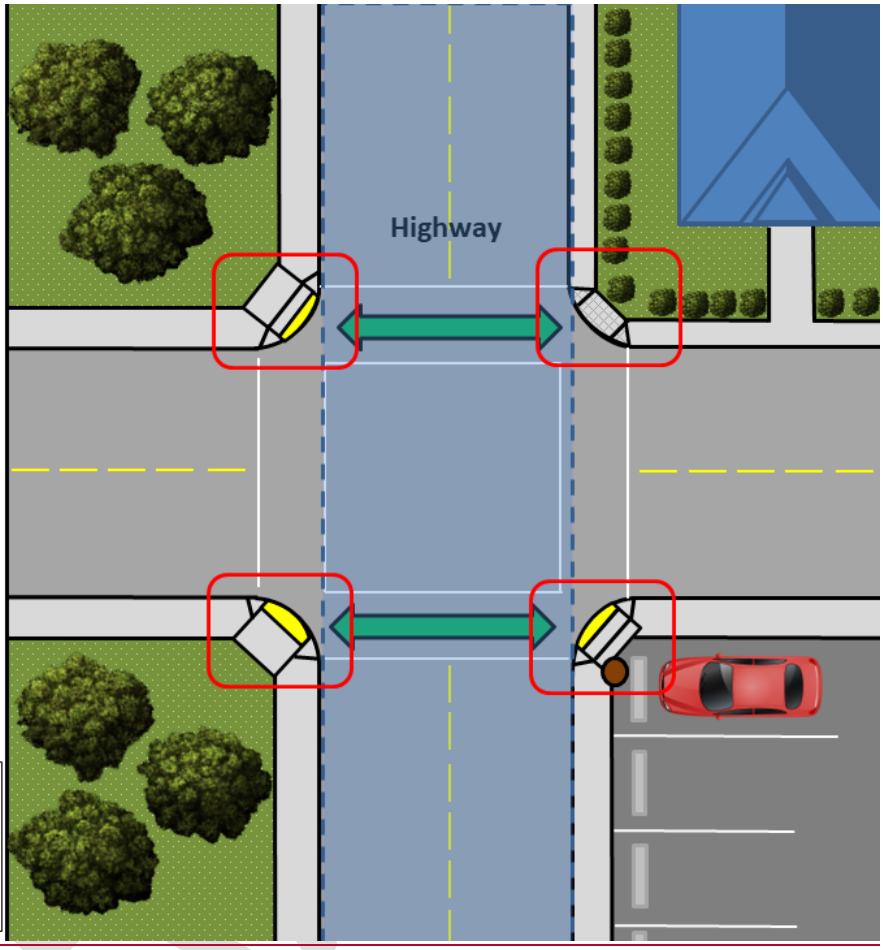


Figure 100-14: Example 4 - 1R Paving Scenario Existing Conditions and Requirements

Example 4

- Paving alteration
- ADA Ramps at the intersection are in Poor Functional Condition, or does not meet ODOT accessibility standards, or does not meet ADA standards.

Requirements

- Reconstruct ADA Ramps without settlement remediation year
- ADA Ramps must be constructed to meet ODOT accessibility standards.
- Evaluate two directional curb ramps per corner; a single diagonal curb ramp may be appropriate with design exception.

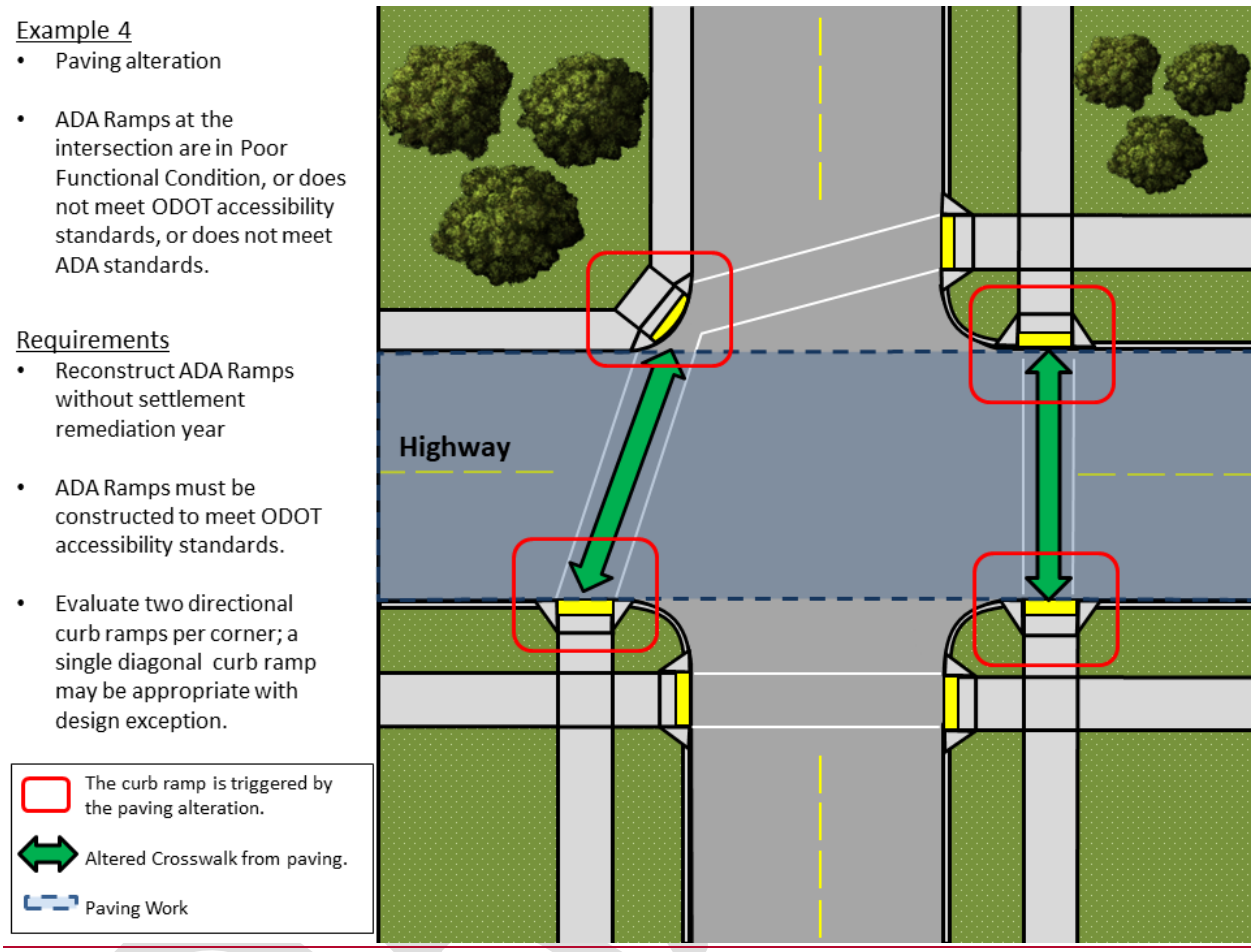


Figure 100-15: Example 6 - 1R Paving Scenario Existing Conditions

Existing Conditions:

- Sidewalk with no curb ramps on the north side of the highway
- Paved shoulder south side of the highway

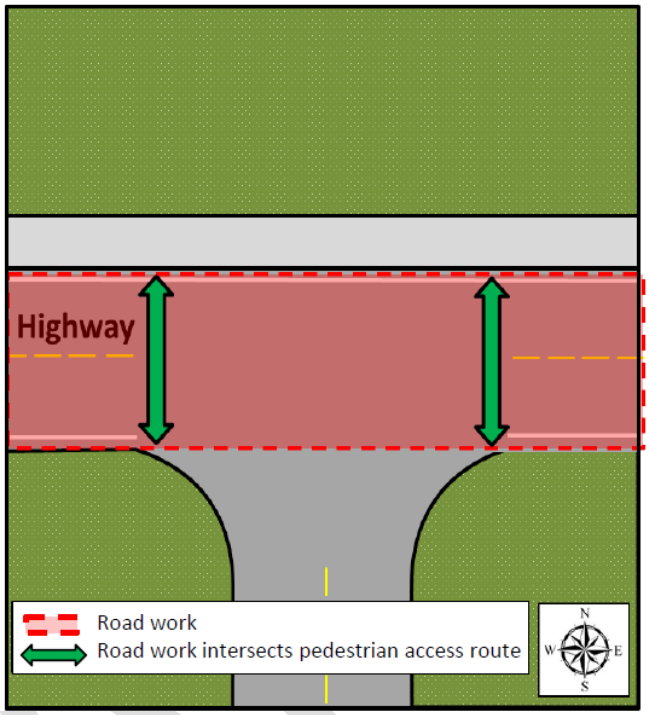


Figure 100-16: Example 6 - 1R Paving Scenario Requirements

Required:

- New curb ramps will need to be installed on the sidewalk on the north side as part of this project

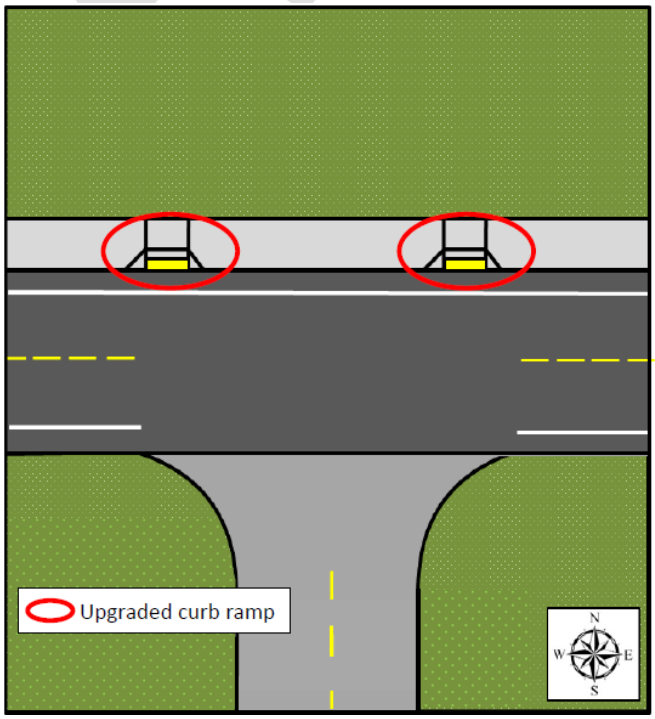


Figure 100-17: Example 7 - 1R Paving Scenario Existing Conditions

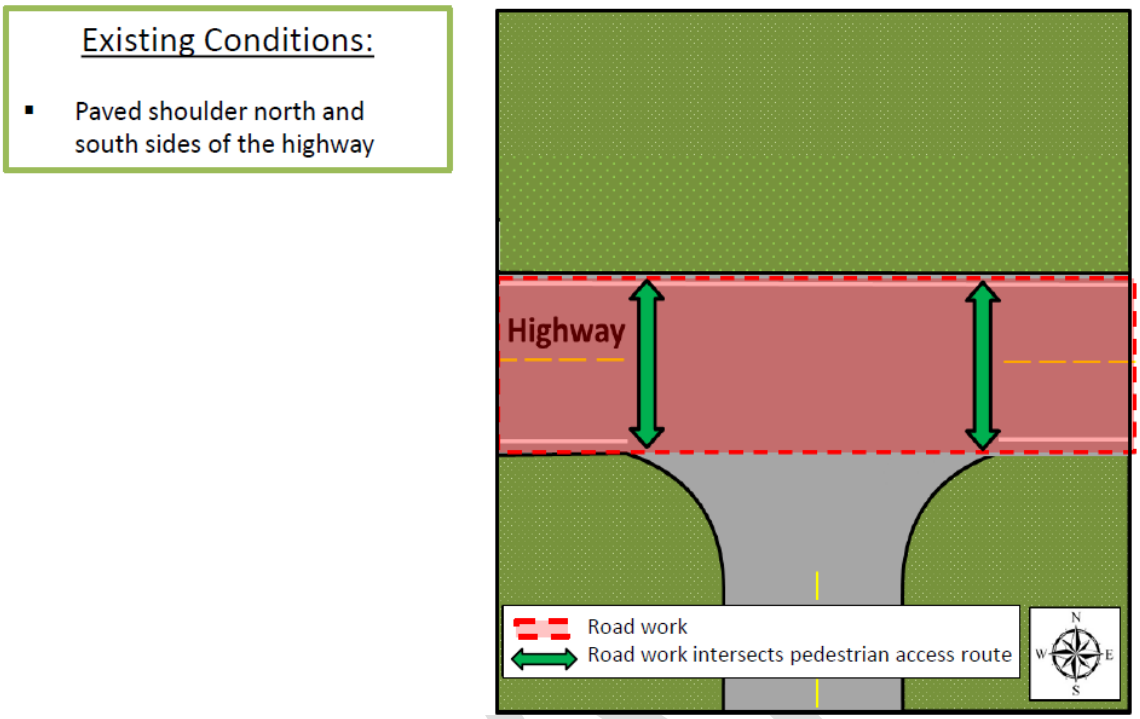
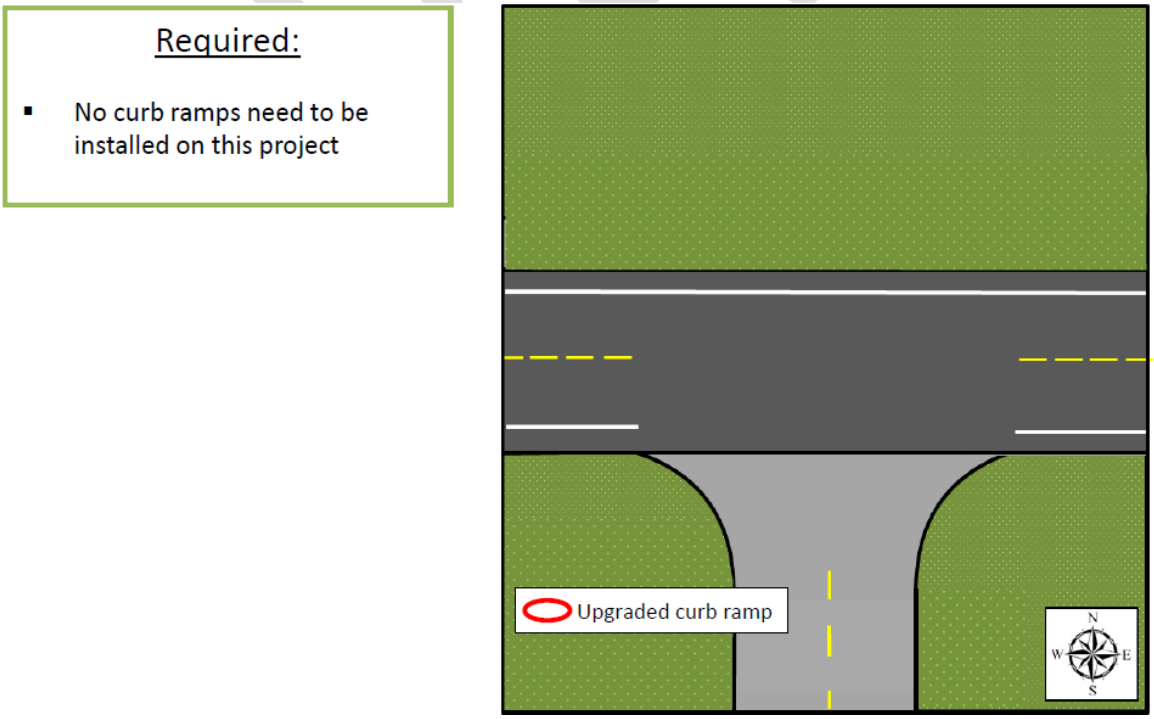


Figure 100-18: Example 7 - 1R Paving Scenario Requirements



110.2.2 ADA Ramp Triggers at Bridges

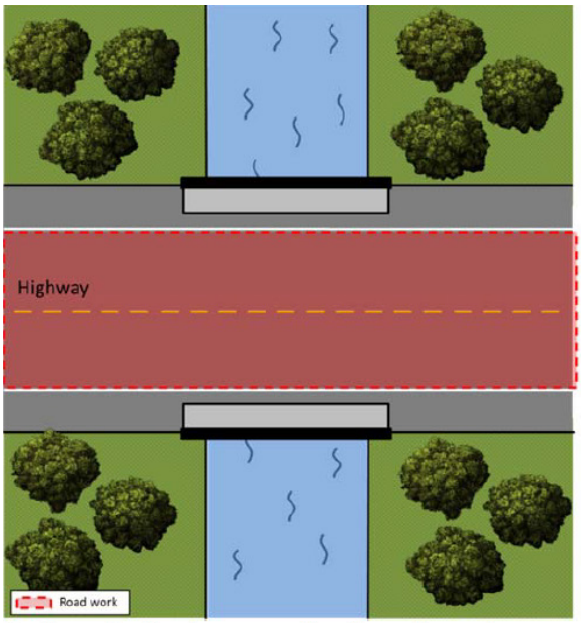
Bridges provide a facility for both vehicular and pedestrian travel to cross over features such as a waterway or another transportation facility. At many locations the paved shoulder is the only space available for pedestrian use. Ensure the paving does not degrade the existing pedestrian usability and maintain a clear continuous route in the shoulder where there is no available walkway.

The sidewalk of a bridge is a facility that, when provided, must be accessible and usable by people with disabilities, regardless of whether the bridge is in an urban or rural setting. To determine whether the adjoining surface of a bridge rail is a walkway or a bridge safety curb (brush curb), refer to the Bridge Design Manual Section 1.2.10 Safety and Accessibility. Many existing bridges were constructed preceding accessibility requirements and may have only provided a narrow pedestrian sidewalk surface without a sloped end connection. Point constraints less than 32 inches do not negate the primary use for pedestrian activity and walkway determination. Many existing walkways have had alterations to the pedestrian railing to provide safety improvements for vehicular departures, and therefore reduced the intended sidewalk pedestrian access route at bridge rail transitions. Refer to Section 800 for geometric design requirements for walkways at bridge approaches and curb ramp design.

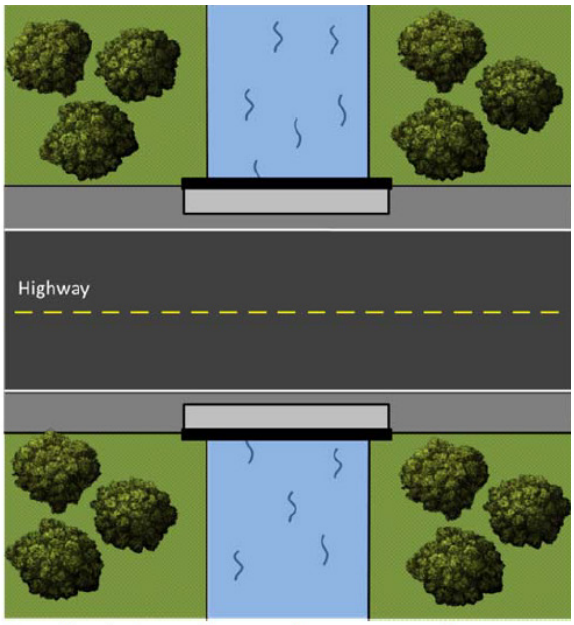
Usability of a bridge walkway can be affected when project work involves paving by a walkway, resurfacing a walkway, reconstructing a walkway, or altering (retrofitting) the bridge railing. When ADA Ramps at a bridge are missing or are in "Poor" condition in the FACS-STIP asset layer, construct or reconstruct ADA Ramps to provide access to the walkway. If existing ADA ramps are not included in the inventory, utilize the curb ramp assets numbering conventions for bridges as shown on the Exhibit A: Curb Ramp Location and Numbering on the ODOT Asset webpage.

The following illustrations show the curb ramp triggers based on various paving scenarios commonly encountered with projects. Curb ramps must be constructed and completed at the time the work or construction activity is triggered, or prior to the alteration work.

Figure 100-19: Example 1 - Paving in Lane

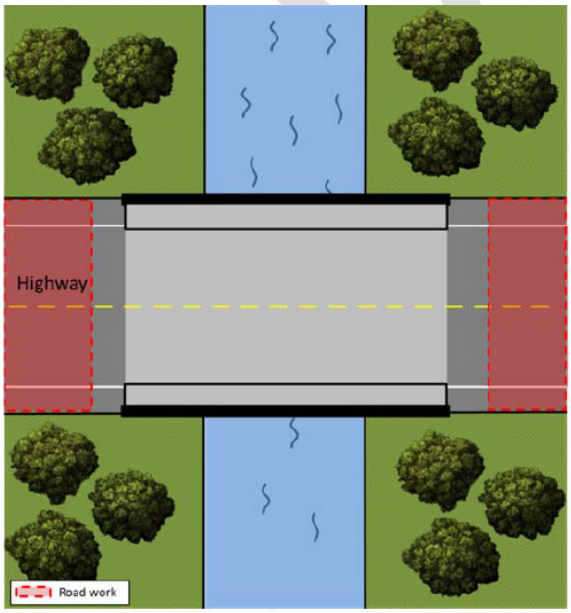


Project: Paving between fog lines through intersections.
Existing Conditions: Roadway with paved shoulder. Bridge with sidewalks (width ≥ 32”).

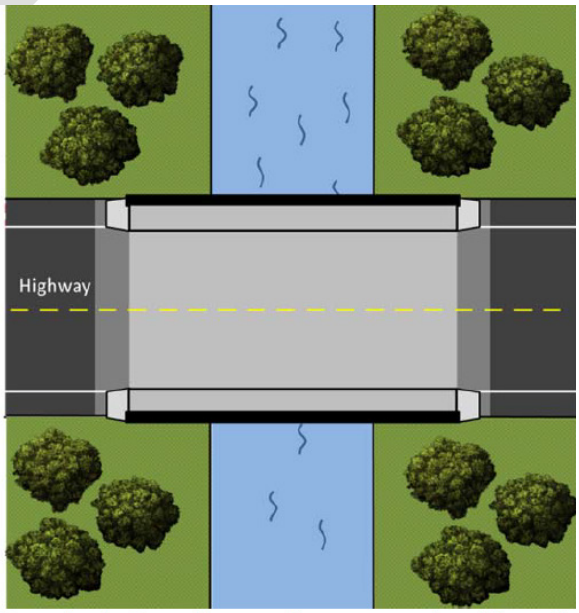


Required: Compliant curb ramps at all street crossings. Curb ramps are not required to be upgraded for the sidewalk on the bridge.

Figure 100-20: Example 2 - Full Width Paving Near Bridge Approach

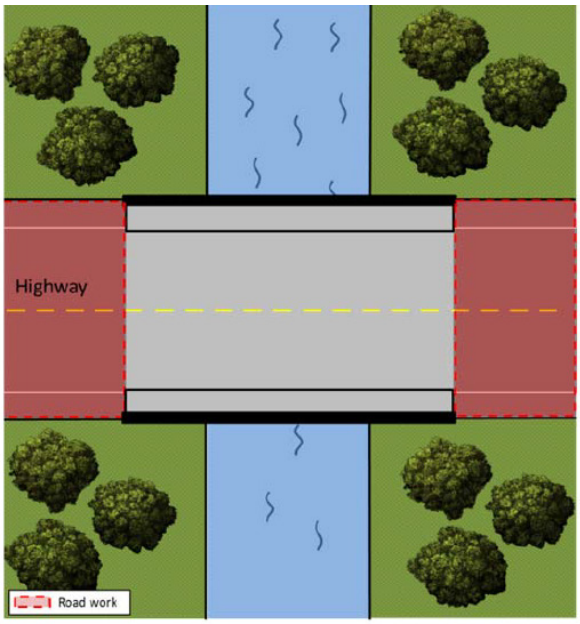


Project: Full-width paving on highway surrounding bridge.
Existing Conditions: Roadway with paved shoulder. Bridge with sidewalks (width ≥ 32”).

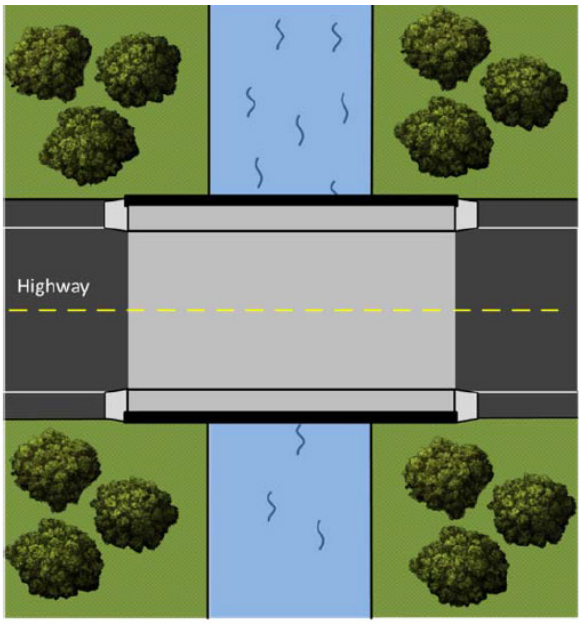


Required: Compliant curb ramps to the sidewalks on the bridge.

Figure 100-21: Example 3 - Full Width Paving to Bridge End

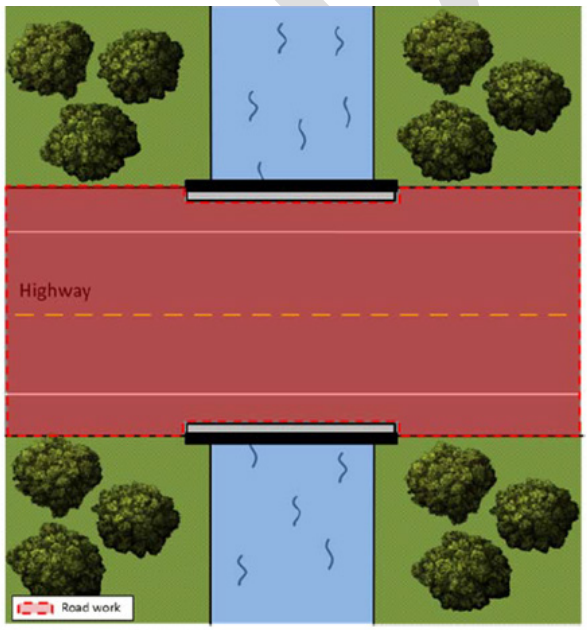


Project: Full-width paving to edge of concrete bridge deck.
Existing Conditions: Roadway with paved shoulder. Bridge with sidewalks (width ≥ 32”).

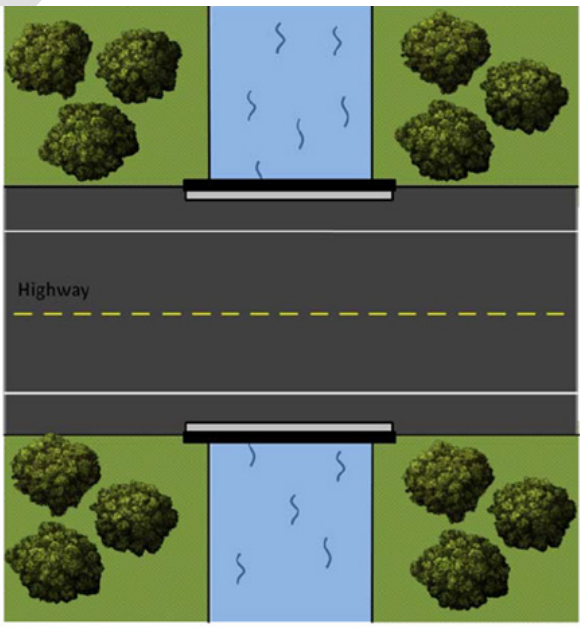


Required: ADA ramps to bridge sidewalks.

Figure 100-22: Example 4 - Full Width Paving Over Bridge with Brush Curb (Safety Curb)

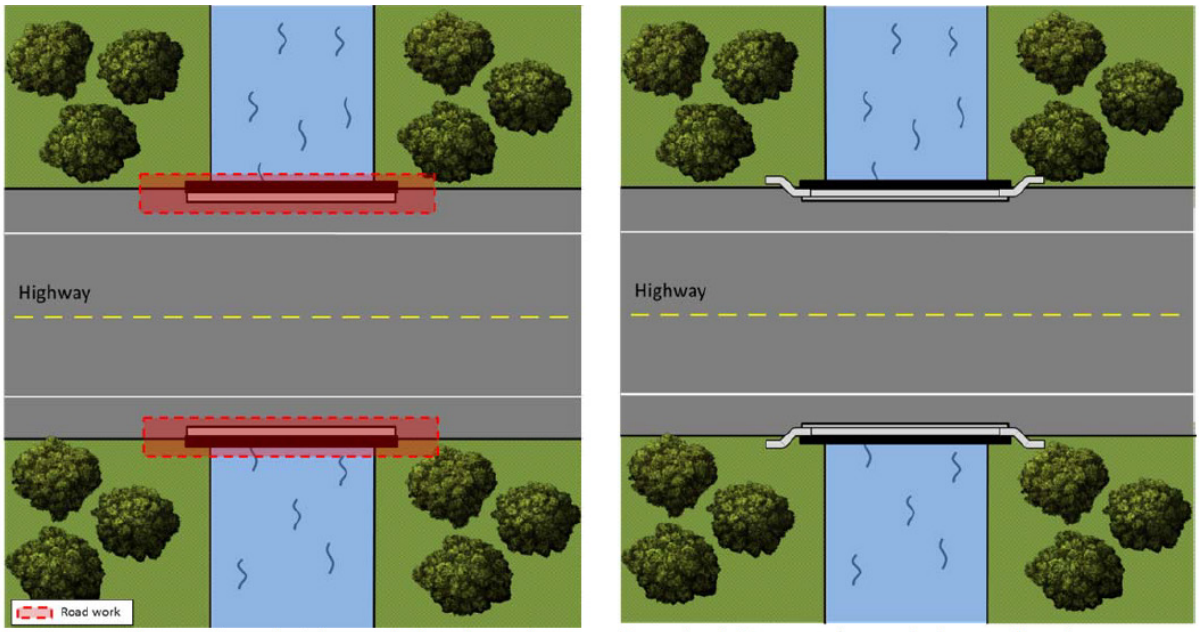


Project: Full-width paving over bridge.
Existing Conditions: Roadway with paved shoulder. Bridge without sidewalk (<32” width).



Required: Ensure the pedestrian access route is maintained along shoulder.

Figure 100-23: Example 5 - Bridge Rail Retrofit with Brush Curb (Safety Curb)



Project: Rail retrofit on bridge with brush curb (width <32").
Existing Conditions: Roadway with paved shoulder. Bridge without sidewalk (<32" width).

Required: Ensure that existing pedestrian access route is maintained along shoulder.

Section 111 ODOT 1R Standard

With agreement from FHWA, the ODOT 1R standard is intended to preserve the highway paving with single lift overlays or inlays that are considered non-structural. As such, these projects meet the FHWA definition of "alterations". See Section 110.2 for ADA requirements for paving alterations. Generally, no specific pavement design life is considered, but it is intended to provide at least 8-years of service. Since these are considered alterations and not reconstruction projects, the Oregon statute ORS 366.514 (Bike Bill) requirements are not triggered. However, shoulder widening and other bicycle related design items can be added to 1R projects if other funding alternatives are used and the addition of the design items does not delay the project.

In addition to bicycle design elements, safety analysis and inclusion of safety improvements or safety countermeasures is an important aspect of the 1R program. The replacement of safety items such as guardrail, guardrail terminals, concrete barrier, impact attenuators, and signs may also be included in the 1R project if funding other than Preservation funding is used and the added work will not delay the scheduled bid date. Additionally, any existing safety features that are impacted by the proposed resurfacing must be adjusted or replaced by the 1R project. ~~1R projects may also be able to take advantage of restriping options to allow reconfiguration of~~

~~cross section elements to provide upgraded bicycle facilities at little to no additional project cost.~~ As noted above in the project requirements, Section 110.2, all projects that include resurfacing (except for chip seals) are to install or upgrade curb ramps.

Where additional funds are available, additional work can be added to a project using the 1R design standard. In this case, the project is considered to be a 1R+ project. The additional work would generally use the 4R standard. 1R projects may include minor restriping, such as narrowing travel lanes from 12 feet to 11 feet to upgrade bicycle facilities at little to no additional cost to the project. Major restriping, such as a road diet, would not be appropriate for a 1R project without additional funds for design.

111.3 Paving Criteria – 1R Projects

1. A paving project is initially designated 1R based on the appropriate paving treatment. 1R pavement treatments are defined as a single lift overlay or inlay and are considered as non-structural pavement preservation according to agreement with FHWA. For preservations design life expectation see ODOT Pavement Design Guide (ODOT PDG) Section 7.1 and other related guidance in the ODOT PDG.
    - Pavement Services is the final authority regarding the pavement design.
2. Where less than approximately 5 percent of a project (based on lane miles paved) includes more than a single lift non-structural overlay or inlay, the project may be designated 1R.
3. Where up to approximately 25 percent of a project (based on lane miles paved) includes more than a single lift non-structural overlay, the project may be designated 1R; however, this requires the approval of a design exception.
4. Where more than approximately 25 percent of a project (based on lane miles paved) includes more than a single lift non-structural overlay, the project must be designated 3R.
5. As an exception to this rule, a grind and inlay plus an overlay may also be considered for development under the 1R standard; however, this would be uncommon and requires the approval of a design exception.
6. Where the appropriate course of action is not clear based on the percentages noted above, include Technical Services, Roadway Engineering Unit staff in the discussion.
7. Chip seals are 1R projects and subject to the requirements of the 1R standard. Chip seals alone are not paving alterations resulting in ADA Ramp work as described in Section 110.2 and ~~.~~MG 100-107 in Appendix H.
8. Requirements for Unprotected and Unconnected Bridge Ends -1R Projects

On 1R paving projects, any bridge rail with unprotected ends or unconnected transitions exposed to traffic must be mitigated. Provide an end treatment meeting the current standard, or a design exception must be obtained. (Note: In very specific, one-way roadway locations a protected bridge rail trailing end may not be required. Contact the Senior Roadway/Roadside Design Engineer in the Engineering and Technical Services Branch (ETSB), ~~Traffic~~ Roadway Engineering Section for guidance.) For possible funding options, contact the Senior Roadway / Roadside Design Engineer in the ODOT Technical Services ~~Traffic~~ Roadway Engineering Section.

- Unprotected ends – Where the end of the bridge rail is exposed with no end treatment such as a transition to guardrail or a crash cushion.
- Unconnected transition – Where there is no crashworthy transition between the end of the bridge rail to the guardrail or other barrier.

Section 112 ODOT 3R Design Standards

The 3R standard is intended to preserve and extend the service life of existing highways and enhance safety using cost-effective solutions. Service life is extended with structural rehabilitation without complete reconstruction.

ODOT 3R Design Standards are found in several Parts of the HDM. ODOT 3R design criteria are located in Parts 200 and 300, which contain information dealing with pavement widths, horizontal curvature, superelevation, and other design areas specific to this type of work. The 3R requirements are similar to TRB Special Report #214, but with additional guidance in respect to context, performance-base design, and design flexibility. Guidance from other research such as NCHRP Report 876, Guidelines for Integrating Cost-Effectiveness into Resurfacing, Restoration, and Rehabilitation (3R) Projects ~~is incorporated.~~ may be applicable. ODOT 3R standards have been developed for both Urban and Rural areas and are arranged according to functional class. 3R type projects located on designated expressways are to use the appropriate urban or rural arterial 3R standard.

118.2.1 Additional Roadside Inventory for 3R Projects

If it is determined that the 1R/3R Record of Decision Documentation results in the preservation project being 3R, additional roadside inventory features may be needed. As discussed previously, the scoping team should determine the level of effort that will be required, use the FACS-STIP tool for asset inventory, and use Region Scoping forms to assist project teams in capturing the appropriate level of roadside inventory. Very definite parameters should be set as to which roadside obstacles need to be inventoried. The intent is that projects using 3R standards are not inventoried to the level of a project using 4R standards. It may not be necessary to inventory every object near the roadway. Continuous runs of utility poles or trees at the R/W line may not need to be inventoried on every project. However, if objects are within the established clear zone, options to prevent or lessen potential vehicle impacts like delineation or shielding are a necessary consideration for need and feasibility.

Other than roadside features, the field work on these projects should be limited to the amount needed for quantity calculations. In general, field work should focus on addressing 3R requirements, including leveling for crown and super correction, lane and shoulder widths, bridge widths, existing rumble strips, and pavement detection loops. By their nature, urban projects may require some additional work, but every effort should be made to limit the survey work to the minimum needed for the particular project. By their nature, preservation projects on sections of highway having low crash history place special emphasis on pavement preservation even while recognizing that certain cost-effective safety improvements may be necessary and desirable. The following guidance discusses additional 3R inventory requirements for freeways and other state highways.

ODOT 3R Freeway Projects

If it is determined that the freeway preservation project is a 3R project, there are other assets and roadside inventory features that should be considered for identification to address other design requirements such as Interstate Maintenance Design Features (see Section 310.3). The FACS-STIP tool can be used to capture additional assets.

1. Interchange Ramp Surfacing
2. Other roadside obstacles not addressed above in the 1R/3R decisions document
3. Delineators
4. Fencing

5. Signing, Illumination, and Signal Loops
6. Rumble Strips
7. Striping
8. Drainage
9. Drop-offs at Pavement Edge
10. Cattle and/or Equipment Pass Headwalls

ODOT 3R Urban and Rural Highways

If it is determined that the urban or rural non-freeway preservation project is a 3R project, there are other assets and roadside inventory features that should be considered for identification to address other design requirements. In addition to the features listed below, the designer should be aware of other 3R design requirements that may impact the roadside inventory such as Mandatory 3R Design Features and the Urban Preservation Strategy (see Part 300).

1. Roadside Obstacles Within Clear Zone or R/W
    a. Trees
    b. Luminaires
    c. Utility Poles
    d. Misc. Fixed Objects (mailboxes, fire hydrants, railroad crossing warning devices, etc.)
2. Existing Guardrail, Cable Rail, and Concrete Barrier, including Bridge Rail Connections
3. Public Road Intersections with Stopping Sight Distance Less Than ODOT New Construction Standards
4. Horizontal Curves More Than 15 mph below project design speed, and the current year ADT is 2000 or greater.
5. Vertical Curves More Than 20 mph below the project design speed (Current year ADT greater than 2000), Hiding Intersections, Sharp Horizontal Curves, or Narrow Bridges
6. Accessible elements and facility deficiencies in the inventory or ADA Transition Plan
7. Drop-offs at Pavement Edge
8. Cattle and/or Equipment Pass Headwalls

Following is a further explanation of the above inventory items and some thoughts on appropriate mitigation measures that may be incorporated on this type of project.

1. Roadside Obstacles:

With the emphasis on pavement preservation, the inventory of roadside obstacles is limited under most circumstances to R/W or clear zone, whichever is less. Inventories wider than clear zone are not considered a good expenditure of engineering budgets as only under unusual circumstances will substantial widening or realignment be included in the project. For guidance on the level of effort to be expended on the inventory of roadside obstacles, the designer should rely on the scoping report from the project team and the project development team.

2. Existing Guardrail~~ – All existing guardrail including bridge connections and end treatments should be inventoried. Guardrail terminals rated as passing NCHRP Report 350 criteria can remain in place. Bridge connections shall consist of positive bridge connection, transition guardrail, and current standard terminal.~~:

During the inventory/analysis process, the project team should also be looking for opportunities to modify existing installations that do not adequately protect obstacles either by extending or burying ends in cuts, or considering new runs based on existing obstacles. ~~Once any portion of the guardrail installation is modified, even for height, the entire run must be brought to new construction standards, or a design exception must be obtained from the State Traffic Roadway Engineer.~~

3. Intersection Sight Distance:

Most of this analysis can be done in the office from As-Constructed Plans. Many times, those intersections with deficient sight distance will also show up during the crash analysis. These intersections will probably have opportunities to incorporate low-cost mitigation elements with the project to diminish crash potential. Deficient intersections should be reviewed on-site with the Region Traffic Engineer to aid in identifying mitigation measures.

4. Horizontal Alignment:

Horizontal curve deficiencies can best be identified by a review of As-Constructed plans, but superelevation rates need to be measured in the field. As a minimum, superelevation should be corrected as close as reasonably possible to the new construction standard with the project. Additional mitigation (delineation, signing, etc.) may also be appropriate due to site-specific conditions. The Region Traffic Engineer should be consulted for input.

5. Vertical Alignment:

As-Constructed Plans should be used as a starting point for identifying vertical alignment deficiencies. Field verification is needed to determine if major driveways or intersections

are hidden by the vertical curves. If a crash history exists at these locations or horizontal curve locations, it may be appropriate to include major safety improvements with the project. This need should be identified early, during project scoping, so funding can be procured.

6. Americans with Disabilities Act:

Accessible elements and facility deficiencies in the inventory or ADA Transition Plan and barriers to the transportation system are predominantly in urban preservation projects however they occur in rural communities also. Accessibility accommodation is more than a standard; it is a legal requirement under Federal law. Intersection accommodation by installation of curb ramp and pedestrian ramp upgrades is an absolute minimum regardless of jurisdictional ownership of the sidewalks or walkway. Driveways, gaps, deficiencies or obstacles in the sidewalk or walkway should be carefully reviewed for potential improvements and may provide good opportunities to partner with local jurisdictions or ODOT Public and Active Transportation Program for a better overall facility. In rural areas, shoulders often serve pedestrians; shoulder widening may be considered as an incremental improvement.

118.2.2 Roadside Inventory for 4R Projects

The purpose of the inventory is to identify all objects and configurations that do not conform to the 2011 AASHTO "Roadside Design Guide" and the AASHTO Green Book geometric design standards and non-geometric standards (non-geometric standards relate to structural strength, safety features and traffic control). 4R projects shall have a full roadside inventory completed ~~and should be brought up to full standards, including sight distance, horizontal and vertical alignment, ORS 366.514 (Bike Bill) requirements, and accessibility requirements~~. In addition, safety projects identified through the All Roads Transportation Safety (ARTS) Program shall have a full roadside inventory completed.

The clear zone concept is discussed in the 2011 AASHTO "Roadside Design Guide". This guide provides an excellent elaboration on the clear zone concept and is a valuable working tool.

Guidelines

Region scoping forms and the FACS-STIP Tool were developed to assist project teams in the scoping effort. The Region scoping forms and/or the FACS-STIP Tool should be used to provide an inventory of conforming and nonconforming objects and provide appropriate details to be used in the development of the project.

An inventory of non-conforming items should include, but not be limited to the following list of items:

1. Trees
2. Rock Outcrops
3. Steep Cut or Fill Slopes (1:3 or steeper)
4. Barriers (Guardrail, Cable Rail, and Concrete Barrier)
5. Impact Attenuators
6. Bridge Rails
7. Signs
8. Luminaires
9. Drainage Facilities
10. Curb Ramps & Pedestrian Ramps
11. Bicycle Facilities
12. Sidewalks and Walkways
13. Bridges
14. Utilities
15. Public Transit Stops/Facilities
16. Other:
    a. Roadway Surfaces and Dimensions
    b. Sight Distances
    c. Driveways
    d. Mailboxes
    e. Structure Columns
    f. Signals, ATR and ITS structures
    g. Drop-offs at Pavement Edge
    h. Cattle and/or Equipment Pass Headwalls

The following is a further explanation of the above inventory items.

1. Trees present some interesting problems. The easy recommendation is to remove them if they are within clear zone, but in many cases the public sentiment is to save them at almost any cost. Some trees may be entitled to specific protection because of historic or ecological significance. In addition, federal legislation titled, Infrastructure Investment and Jobs Act (IIJA), encourages adding street trees to address urban heat islands to help mitigate urban conditions. Reasonable protection, such as extending a barrier required

for another obstacle, may be more expensive but also more acceptable to the public than removal of the tree. See Part 400 regarding street and median trees.

2. Rock outcrops in cut slopes can sometimes be removed, but large outcrops or solid rock cuts may need guardrail or barrier protection. These are easily overlooked as they have seldom been considered for protection. Decisions on the proper protection of slopes must be made only after considering the magnitude of the problem and the costs involved.

3. Fill slopes steeper than 1:3 ~~require~~within the clear zone should be considered for protection or flattening. While slope flattening is the desirable action, 3R projects, and at times, 4R projects seldom have adequate material available and R/W is frequently inadequate. Flattening may not be feasible due to streams or wetlands at the toe of the fill. Provision of barrier, guardrail, or cable rail is the usual solution. While vehicles can traverse a 1:3 slope, they cannot recover, and the large clear zone required (over 120 feet at 70 mph) frequently cannot be provided within the R/W.

   Cut slopes steeper than 1:3 within the clear zone should be flattened or considered for protection. Provide a 1:3 or 1:4 "safety slope" area at the bottom of steeper cuts if possible. Decisions on the proper protection of slopes must be made only after considering the magnitude of the problem and the costs involved.

4. Barriers include guardrail, cable rail, and concrete barriers. Barrier that does not meet NCHRP-Report 350 or MASH criteria must be replaced. Guardrail must be checked against current standards for type of rail, height, flare rates, anchors, bridge connectors, terminals, lap direction, miscellaneous hardware, etc. If the terminal can be buried in the backslope it should be considered even though only a flare may be required. Concrete barrier sloped ends are allowable only when design speed is less than 45 mph, or the sloped end is outside the clear zone.

   Concrete barrier shall meet current standards for size and shape. Consider the effect of overlays, past or present. At the base of the barrier the finished surface of the overlay must not be higher than the top of the vertical 3-inch portion of the barrier for proper functioning. Flare rates and terminal treatments (buried end, etc.) must conform with current standards. Narrow base barrier must be supported with embankment behind it.

   Guardrail protecting fixed objects needs approximately 6.5 feet from face of rail to object to provide space for adequate deflection. If deflection room cannot be provided, contact the Senior Roadside Design Engineer for possible solutions. Exposed guardrail and barrier ends that cannot be properly flared or buried, such as in exit ramp gores, should be protected with an impact attenuator.

   Contact the Senior Roadside Design Engineer in the ODOT Technical Services, Roadway Engineering Unit for guidance if there are questions concerning these items.

5. Existing impact attenuators must meet NCHRP-Report 350 criteria and be properly maintained with no modifications that are not approved by the manufacturer. Provide careful inspection by experienced personnel using the manufacturer's specification book. The District Manager, Senior Roadside Design Engineer, or manufacturer's representative may be appropriate sources of expert assistance. If a bridge or other significant structure is affected, include Bridge Engineering in the discussion.

6. The 2011 AASHTO Roadside Design Guide identifies acceptable bridge rail shapes. If in doubt as to acceptability of a particular rail type, consult Bridge Engineering. The concrete "safety shape" should be used on freeways. Guardrail connections to bridge rail are a critical area. Chapter 7 of the “Roadside Design Guide”, Bridge Railings and Transitions provides an excellent guidance.

7. Signs must be mounted on breakaway posts if within the clear zone. The need for a multidirectional breakaway base should be considered. The slope on unidirectional single-support breakaway bases must be in the correct direction.

   Breakaways must not be in the ditch and should be at or above the ground surface, but not over 4 inches above the surface. Proper bolts, washers, slip plates, etc., must be in place with no modifications, such as welding, that may alter the function of the breakaway.

   The hinge mechanism must also have all hardware in place. No auxiliary sign panels should span the hinge in such a way as to alter its function. The hinge mechanism should be a minimum of 7 feet, above the ground. On fills the nearest sign post should be at least 30 feet outside the edge of the traveled way (fog line) so the vehicle will not be airborne when it strikes the sign. Signs mounted on wood posts must not have concrete foundation collars or support plates. Wood post installations must comply with the Oregon Standard Drawings.

8. Luminaires must have frangible or slip bases if within the clear zone. Some older frangible bases may not function properly with the newer small cars. Consult the Traffic Structures Engineer for acceptability of specific frangible bases. If luminaires cannot be readily relocated or protected, a study of the need for them should be considered. Eliminating them may be less hazardous than retaining them.

9. Drainage facilities should be studied carefully. Many transverse or longitudinal culverts may need stabilization, rehabilitation, or replacement. The structural integrity of each drainage facility should be evaluated prior to considering extending the culvert for widening a roadway. Contact ~~the Highway Maintenance Supervisor for the project area~~ODOT maintenance personnel for information (i.e., maintenance records and inspection reports) pertaining to the existing culvert~~ when the structure is less than 48 inches in diameter. If the culvert is 48 inches in diameter or larger contact the~~. ODOT’s Drainage Facilities Management System (DFMS) also has data on existing culverts, including condition assessments. The Technical Services Hydraulic Engineering

~~Unit~~Section or the Region Hydraulics Engineer can also be contacted for assistance. ~~If inadequate~~In addition to agency staff resources, neighboring landowners can be another invaluable resource for helping to understand a project site. Interviews with adjacent property owners can provide information ~~is available, a thorough culvert inspection should be performed per Drainage Facilities Management System (DFMS) procedures~~such as known history of the site, including recollections of past floods and damages.

Many cross culverts can be lengthened to eliminate open ends, outlet ditches, etc., within the clear zone. Even though paved end slopes exist, they may not provide a safe end, since many of the 1:3 paved ends are inletted into 1:4 or 1:6 slopes, creating a ditch across the clear zone. Paved end slope installations must be constructed as shown in the Oregon Standard Drawings, with particular attention to warping or contouring the slope as shown.

Metal end sections on culvert pipes require appropriate end treatments. Safety end sections should be considered on larger pipes (See Oregon Standard Drawings). Recontouring around some existing paved end slopes must be considered if erosion and settlement have allowed the upper end of some paved end slopes to project more than 6 inches above the ground.

Longitudinal drainage ditches must be uniform and not eroded. Pipes under driveways and crossroads are to be reviewed to determine compliance with the Roadside Design Guide so that vehicles hitting them are not stopped abruptly or launched into the air. Type "M-E" or "M-O" inlets or modifications of them, may be required to accomplish these flatter end slopes. Pay particular attention to crash history when evaluating these features.

10. Most inventories for preservation and 4R projects are in conjunction with overlay or paving projects so correction of poor pavement conditions is an integral part of the project. Drop-offs, roughness, raveling joints, etc., must be analyzed if repaving is not already part of the proposed project.

Certain design elements can best be analyzed in the office using "As Constructed" plans. These include horizontal and vertical alignment and typical sections. Elements such as sight distance for merges, lane drops, road approaches, and intersections should also be analyzed in the field so the interaction of all elements can be better evaluated.

A broad viewpoint must be maintained so that possible hazards that don't fit conveniently in the categories already mentioned are not overlooked. Utilities (poles, valves, etc.) slope breaks that can launch a car or stop it as solidly as a barrier, cattle and equipment passes hidden by vegetation, erosion around culvert ends hidden by weed growth, etc., are easily overlooked. Shoulders on structures should be full width, according to current standards.

A working knowledge of the 2011 AASHTO "Roadside Design Guide", the Project Delivery Guidebook, the HDM, and the AASHTO Green Book will assist in project scoping and data information collection. A good understanding of how the clear zone requirement is determined by considering design speed, side slope, ADT, and curvature is needed. All nonconforming items are to be inventoried, even though it may appear to be difficult to bring them into conformance with the appropriate standard. ODOT's Practical Design Strategy document provides guidance in respect to project scope, economics and practicality of upgrading nonconforming elements.

The implementation of the 1R Preventive Maintenance Paving Program along with the 1R Safety Features Upgrade Program mark a fundamental change in ODOT's approach to maintaining the highway system while systematically improving safety.

Part 200 Geometric Design and Context

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

201.1 Documentation and Approval Font Key

Text within ~~some parts of~~ this ~~manual~~part is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown. Table 200-1 shows the four text fonts used, along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 200-1: Documentation and Approval Font Key

Font ~~Key Term~~	~~Font~~Documentation	Approver
Bold text	Design Exceptions	State ~~Traffic~~-Roadway Engineer (S~~T~~RE) and for some projects~~,~~ FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 201.2~~. shows~~ for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 201.2 and 201.3~~four text fonts used that include Standard, Guidance, Option, and General Text along with their~~ for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 201.3 and 201.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

201.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. ~~All Standard statements appear in bold type in design parameters.~~ The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 201.4~~Options. A design exception is required to modify a Standard. The State Traffic-Roadway Engineer (STRE) gives formal approval, and FHWA approves as required.~~).

201.3 Guidelines

A guideline is a statement of recommended practice in typical situations. ~~All Guideline statements appear in bold italicized type in design parameters.~~ The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 201.4~~Options. While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is required. Region approval, with input from Technical Experts, is formally recorded for urban projects via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website.~~).

201.4 ~~Option -~~ Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. ~~Option~~Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. ~~All Option statements appear in italic type in design parameters sections.~~ The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate ~~Option~~Best Practice statements. The verbs "shall" and "should" are not used in ~~Option~~Best Practice statements. The adjectives "required" and "recommended" are only used in ~~Option~~Best Practice statements to describe required or recommended design features as they relate to optional design features. ~~While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is best practice.~~

~~**General Text** - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.~~

204.1 Other Roadway Designations or Characteristics

While context and OHP roadway classification can provide general guidelines for the type and activity level of different users, there are other roadway designations or characteristics that impact planning and design of roadways in urban areas. Table 200-3 summarizes some of these additional factors and the design criteria they can potentially affect. Section 207 provides more details related to how specific design elements are impacted by these designations or characteristics.

Table 200-3 Designations/Characteristics Impacting Design Decisions

Factors	Data Sources	Affected Design Criteria
Reduction Review Route	• ODOT designation – defined and stipulated by statute; ORS 366.215 and OAR 731-012	• Anything that constitutes a permanent change to overall roadway horizontal and vertical clearance
Level of Access Management[1]	• Driveway density[2] • Intersection density[2]	• Median type • Median opening spacing • Signal spacing • Intersection spacing • Frequency of pedestrian crossings • Bicycle facility design • Target speed
Freight Activity	• Percent and volume of heavy vehicles • Need for loading/unloading zones	• Design vehicle • Lane width • Intersection curb-return radii • Bicycle facility design
Transit Activity	• Presence of transit routes/stops • Transit ridership • Local transit plans – Transit Development Plan, Transit Master Plan or Coordinated Plan	• Lane width and use restrictions • Sidewalk and bicycle connections • Frequency of pedestrian crossings • Bicycle facility design • Transit stop location and layout
Seismic Lifeline Route / Tsunami Evacuation Route	• Oregon designation	• Lane width • Shoulder width
Scenic Byways	• Oregon designation	• Consideration of natural and historic resources along the corridor

[1] ODOT standards are defined and stipulated by statute OAR 734-051 and PD-03 Access Management

[2] *Driveway density and intersection density are directly related to ODOT State Highway Designations*

The Oregon Highway Plan identifies three special overlay designations for the state highway system. They include: a state highway freight network, Lifeline/Evacuation Routes (Seismic/Tsunami/Flood/Wildfire), and Scenic Byways. Designs on these designated routes have special considerations.

- **State Highway Freight System** - The primary purpose of the State Highway Freight System is to facilitate efficient and reliable interstate, intrastate, and regional truck movement through a designated freight system. This system includes routes on the National Highway System (NHS) as well as routes designated from legislative action ORS 366.215 and OAR 731, Division 12 that encompass the Reduction Review Route network.

  Projects on highways that are designated as part of the Reduction Review Route network must follow the process identified in OAR 731, Division 12 to include input and support from interested parties affected by any permanent changes to the roadway. The Mobility Advisory Committee, or MAC, provides review and feedback on agency projects through the lens of freight mobility and work zone safety as it applies to both temporary and permanent reductions or restrictions on the state highway system. In addition to the Reduction Review Route highways subject to ORS 366.215 and OAR 731, Division 12, the MAC also advises the agency on planning and design of projects that propose permanent reductions or restrictions on state highways not subject to ORS 366.215 but have stakeholder engagement requirements per Department policy. Projects of this type may include safety and/or traffic calming features like roundabouts, pedestrian islands with raised features, new traffic signals, or other items that permanently change the roadway cross-section and may affect mobility of freight movements. ***For state highway projects on Reduction Review Routes or projects per Department policy that have potential to permanently impact freight mobility, include the Mobility Advisory Committee (MAC) early in the design process to solicit feedback that may affect final design parameters.***

  National Network Routes are subject to 23 CFR Part 658, which contains requirements to accommodate minimum vehicle lengths, widths, and weights, as well as access, use, and other requirements. Changes to National Network Routes, including but not limited to additions or deletions of segments, dimensional restrictions, weight restrictions, and access restrictions, must follow the approval procedures in 23 CFR Part 658.

- **Lifeline/Evacuation Routes** - Earthquakes, flooding, landslides, wildfires, and other natural and man-made disasters may destroy or block key access routes to emergency facilities and create episodic demand for highway routes into and out of a stricken area. ODOT's investment strategy should recognize the critical role that some highway facilities, particularly bridges, play in emergency response and evacuation. It is the policy of the State of Oregon to provide a secure lifeline network of streets, highways, and bridges to facilitate emergency services response and to support rapid economic recovery after a disaster.

- **Scenic Byways** - While every state highway has certain scenic attributes, the Oregon Transportation Commission has designated Scenic Byways throughout the state on federal, state, and local roads which have exceptional scenic value. It is the policy of the State of Oregon to preserve and enhance designated Scenic Byways, and to consider design elements for natural conditions and aesthetics in conjunction with safety and performance considerations on designated Byways.

207.10.3 Target Speed

Target Speed is a term and concept developed in the 2010 Institute of Transportation Engineers (ITE) publication, Designing Walkable Urban Thoroughfares: A Context Sensitive Approach and is used primarily in urban locations. ITE defined target speed as the highest operating speed at which vehicles should ideally operate on a roadway in a specific context. AASHTO has a working definition of target speed that defines it as the operating speed that the designer intends for drivers to use. For ODOT purposes, target speed is the appropriate speed at which drivers should be operating a vehicle on a section of roadway based on context, classification and overall operations. Target speed differs from design speed in that it is often an aspirational goal of a project and may be the ultimate goal for speed reduction along a roadway segment. ~~*Design speed for a project can be set at the posted speed limit, but it is not set below the posted speed limit.*~~ ***Depending on context, roadway operations and characteristics, target speed may be established below the posted speed limit when appropriate speed reduction is a project goal.*** Target speeds need to be determined with realistic goals in mind. Target speed needs to fit with the context and operational needs of a location. Setting a target speed 15 mph below the posted speed on a major, urban arterial in a Commercial Corridor context may not be realistic when considering the design element options available to achieve that much of a speed reduction. *Other than a roundabout, no single design treatment will afford significant speed reduction. Research has shown speed reductions of 5 mph and sometimes as high as 10 mph can be achieved when combinations of design treatments are utilized together.*

Reducing vehicle operating speeds on highways within urban areas can encourage walking and bicycling and reduce fatal and serious injury crashes. *Considering the target speed (desired operating speed) and identifying strategies to achieve the desired speed are key priorities for urban projects.* Understanding the relationship between the target speed, design speed, and posted speed can help practitioners consider the trade-offs from a speed perspective and how speed may influence the characteristic of the roadway and its users.

208.1 Rural to Urban Transitions

One of the most important elements of arterial urban highway design is the transition area. Transition areas occur when a rural highway enters an urban area, when urban expressways enter slower speed urban centers or between other different urban environments such as between a rural area and a suburban fringe. The types and treatments of transitions will vary depending upon the type of transition.

A very common type of transition is the transition from a rural high-speed highway to an urban highway. In many small communities or rural communities, the length of transition is very short. The main emphasis for a designer in these areas is to try to change the look and feel of the highway segment. This often involves establishing urban design features such as sidewalks, buffer strips, marked crosswalks, landscaping, bike lanes, raised medians, and illumination. Generally, these types of features will portray to the motorist that they are entering a changing environment that is urbanized and requires slower speeds and greater attention to pedestrians, bicyclists, and transit vehicles. Designing for the context of the roadway can also include designing for the intended operating speed of a roadway segment. Speed is part of the context of a roadway. In some of these transition areas, reducing the cross section width may be an appropriate option, but is only one of many ways to help transition speeds. Changing the roadway culture, including elements outside of the roadway section, can also help to create transition areas. Any modifications of the actual cross section elements should be consistent with the design criteria for a particular urban environment and context. Many of these standards are also applicable to transitioning from a high-to-moderate speed urban expressway to other urban environments. The key message to send to motorists is that the culture and function of the highway has changed.

Transitions to downtown/central business district type of environment are very important. These areas are often very low speed and controlling operating speeds is important to the success of these areas. A recommended approach to dealing with transitions into downtown environments is the use of a “Gateway” approach. A “Gateway” is essentially a special entry that sends a message to motorists that this is a downtown environment. Features such as curb extensions, on-street parking, wider sidewalks, pedestrian scale lighting, landscaping and/or other roadside features, are good visual cues and can be incorporated into a Gateway concept. Other tools include narrow cross sections utilizing reduced shoulder, median, shy distance, and/or lane widths. Gateways should include a vertical element that helps effect a visual narrowing. There are many different options to help achieve this result.

In summary, the goal of transition areas is to affect motorists’ perceptions of the area, establish speed expectations, establish the function of the highway, and make motorists aware that

something has changed. Designing effective transition areas is not always easy. Resources are available to assist with design concepts and strategies for transition areas. These include staff resources from Technical Services including Roadway, Bicycle and Pedestrian Program, ~~and~~ Traffic Management units, and Roadside Development Program, as well as written guidance ~~from *Main Street… When a Highway Runs Through It: A Handbook for Oregon Communities, DLCD/ODOT; Oregon Roadway Design Concepts, ODOT;*~~listed in Section 225 and ~~*Metro's Street Design Guide, Creating Livable Streets – Street Design Guidelines for 2040, the NACTO Urban Street Design Guide,* as well as~~ others.

Section 212 Role of Planning Documents and Design Criteria

Coordinating planning activities with project design is critical to ensure decisions and commitments made during the planning process are incorporated into final project designs. This is particularly important in urban locations where community desires of local jurisdictions have been included in long range planning documentation. Planning documents such as corridor plans, refinement plans, regional or local transportation system plans, and facility plans including Interchange Area Management Plans (IAMPs) provide valuable guidance to designers. These documents have undergone extensive public involvement to select the type and level of infrastructure improvements that address the identified problems. The designer needs to be aware of and understand the context of the recommendations contained in these planning documents when preparing project designs. Contact the Region Planning Manager and staff to help identify and interpret the information in these plans. ~~*In the case of*~~*The Chief Engineer must provide concurrence on* ***Interchange Area Management Plans (IAMP) and other types of*** ~~*planned*~~ ***facility*** ~~*designs the Chief Engineer's approval is required*~~*plans*.

The types of plans discussed above are all plans adopted by local jurisdictions and/or the Oregon Transportation Commission. Therefore, transportation improvement projects must be consistent with these adopted plans. **Design elements and features on State Highways must meet ODOT Design Standards. The Department cannot construct, fund or permit design elements or features that do not meet standard criteria unless a Design Exception has been approved by the State** ~~**Traffic**~~ **Roadway Engineer.** Because pertinent information may not be available in these early planning processes, exceptions to design standards are typically processed during project development and are approved in writing at that time. Similarly, any traffic control changes such as traffic signals, signing, or striping must ~~have~~receive the ~~written approval of~~appropriate approvals. Consult with the ~~State~~ODOT Traffic ~~Roadway Engineer~~ Section.

However, since Transportation Plans commonly have design elements and features of State Highways discussed in them, there are times when deviations to design standards need to be

addressed during planning to ensure they are incorporated in the final project development when the planning documents are actually implemented. These design elements and features may include roadway cross-sections, centerline alignments, interchange layout configurations, bike facilities, sidewalks, shoulders, and shared use paths.

Issues corresponding to interpretation can occur when the design elements and features shown in Transportation Plans differ from those in the Highway Design Manual. Since ODOT prepared, funded or reviewed the plan, local government or the public often think that the design elements and features shown have been approved by ODOT and that ODOT will construct or allow the construction of these elements and features according to the plan. Unless a Design Exception has been previously sought, future projects linked to an adopted plan may be required to follow ODOT standards regardless of the design elements or features that may have been identified in the plan.

To avoid this problem, planning studies that lead to potential adoption of plans affecting the state highway system that include, but are not limited to, Regional Transportation Plans, Regional Mobility Plans, Interchange Area Management Plans (IAMP), Transportation System Plans, or other local Mobility Plans should follow ODOT Design Standards or seek a Design Exception; Part 1000 of the Highway Design Manual describes the Design Exception process. With the introduction of performance-based, practical design and greater flexibility for urban locations, it is important to address how context related design criteria will be developed to ensure future projects meet desired goals and outcomes of the planning process.

Below are some guidelines for inclusion of design elements and features in planning documents that include State Highways:

1. Don't show specific dimensions for any design elements.
2. If you do show dimensions, they should be to ODOT standards.
3. For planning studies that have non-standard design elements and features that may be constructed within five years, obtain a Design Exception before incorporation of dimensions into the final plan.
4. For planning studies that have non-standard design elements and features that may be constructed within five to ten years, submit a Draft Design Exception request and obtain a written indication or concurrence that a Design Exception is warranted and would probably be approved from the State ~~Traffic~~ Roadway Engineer before incorporation of dimensions into the final plan.
5. Planning documents cannot select an alternative with non-standard elements or features as the preferred alternative unless a Design Exception has been obtained or the State ~~Traffic~~ Roadway Engineer has indicated that one would probably be approved.
6. In consideration of overall safety along a highway segment, proposed cross-sections with multiple non-standard design elements should be avoided. When avoidance is not possible, the cumulative effect on operations and safety of introducing multiple

non-standard elements in the same cross-section must be considered and evaluated carefully.

Planning documents are often long range. Their use is for planning land use and infrastructure options over 15 and 20-year periods of time or more. These long-term plans designate future areas of development. Designers must ensure the safety of all users when designing projects that travel through these future areas of development. Consideration should be given to long range planning efforts and how those efforts impact the proposed roadway projects. The designer should work with the Project Team, Region Planning Manager, and/or Area Manager to gain a better understanding of the planning efforts and processes completed or underway for a particular area.

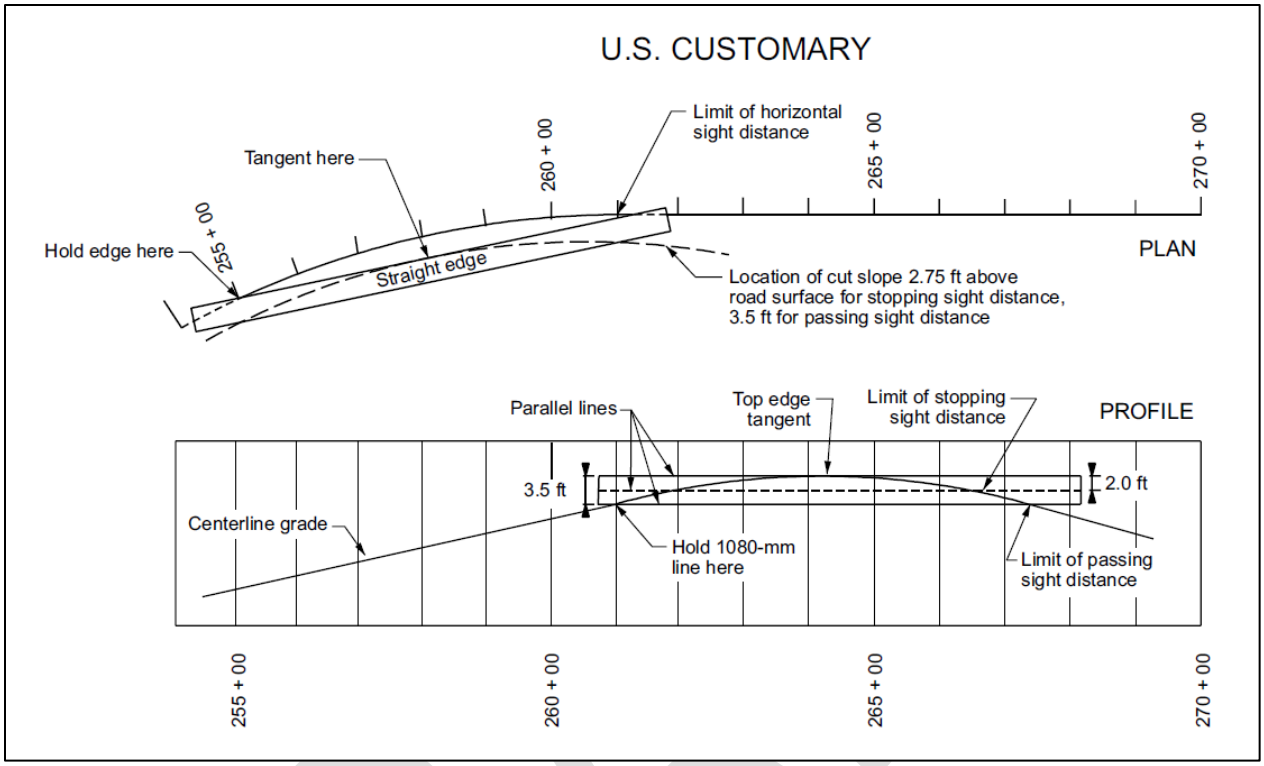
217.2 Stopping Sight Distance

Stopping sight distance is the minimum distance required for a vehicle traveling at a particular design speed to come to a complete stop after an obstacle on the road becomes visible. Stopping sight distance is normally sufficient to allow an alert and prudent driver to come to a hurried stop under normal circumstances. **Stopping sight distance is measured from the driver's eye (assumed to be 3.5 feet above the roadway surface) to an object 2 feet above the roadway surface.** Stopping sight distance is the summation of two distances: the distance traveled by a vehicle from the time the driver sees an object that requires a stop to the instant the brakes are applied, and the distance required to stop the vehicle from the time the brakes are applied. These two distances are called brake reaction distance and braking distance. **Table 200-10 contains the stopping sight distance minimums.**

Stopping sight distance must, at a minimum, be obtained on all vertical and horizontal alignments~~.~~, including adjustments for grade. Figure 200-50 and Figure 200-51 show the minimum stopping sight distance requirements for crest and sag vertical curves (See Part 600, Table 600-4 for sight distance on ramps). Figure 200-17 indicates the minimum stopping sight distance for horizontal curves. Care must be taken to ensure that these minimum distances are obtained in project design. Roadside elements such as cut slopes, guardrail, tunnels, retaining walls, bridge rail, and barriers can obstruct the view of the driver and must be properly located to ensure that proper stopping sight distance is achieved. As noted previously, other types of sight distance may control in a design, as well. For example, it would be desirable to flatten a crest vertical curve in order to provide full intersection sight distance from a side street.

Highway grades can have a significant effect on stopping sight distances. Refer to Figure 200-16 for manually determining Stopping Sight Distance. Table 3-1 on page 3-4 of the 2018 AASHTO Green Book provides Stopping Sight Distance values for level roadways. For information about the effects of grades on Stopping Sight Distances, see Table 3-2 on page 3-6 of the 2018 AASHTO Green Book.

Figure 200-16: Determining Stopping Sight Distance



Source: AASHTO 2018

Table 200-10: Stopping Sight Distance

Design Speed	Stopping Sight Distance
25 mph	155 ft.
30 mph	200 ft.
35 mph	250 ft.
40 mph	305 ft.
45 mph	360 ft.
50 mph	425 ft.
55 mph	495 ft.
60 mph	570 ft.
65 mph	645 ft.
70 mph	730 ft.

Source: 2018 AASHTO

217.4 Intersection Sight Distance

Obtaining intersection sight distance is important in the design of intersections. Intersection sight distance is considered adequate when drivers at or approaching an intersection have an unobstructed view of the entire intersection and of sufficient lengths of the intersecting highways to permit the drivers to anticipate and avoid potential collisions. Sight distance must be unobstructed along both approaches at an intersection and across the corners to allow the vehicles simultaneously approaching, to see each other and react in time to prevent a collision. Intersection sight distance is determined by using a 3.5 foot eye height and a 3.5 foot height of object.

It is desirable to provide intersection sight distance at every road approach, whether it is a signalized intersection or private driveway. On high-speed, high-volume roadway intersections, providing intersection sight distance will minimize operational and safety problems and is a prudent goal. However, in some locations, intersection sight distance may not be obtainable. In these instances, minimum stopping sight distance is required. However. many urban locations present specific challenges to meeting either intersection sight distance or minimum stopping sight distance. **In these locations, analysis is required to support the**

design and a Design Exception is required if minimum stopping sight distance cannot be achieved.

When reviewing intersection sight distance, items such as building clearances, street appurtenances, potential sound walls, landscaping, on-street parking and other roadway elements must be taken into consideration in determining and obtaining the appropriate sight distance at intersections. Railroad and rail crossings are treated in the same manner as roadway intersections in determining intersection sight distance for the vehicle crossing the tracks. For placement of trees within the intersection sight distance triangle, see Part 300 and Part 400.

Pages 9-35 through 9-59 of the AASHTO Green Book indicate intersection sight distance for traffic turning left, crossing, or turning right onto a major highway. It is desirable to obtain intersection sight distance at all intersections. ~~However, stopping sight distance is the minimum requirement.~~

218.3 3R Freeway Horizontal Curvature and Superelevation

Horizontal alignment, superelevation, and superelevation transition shall meet the minimum standards outlined in the AASHTO Green Book. Existing non-spiraled alignments are allowed as long as AASHTO superelevation transition design control requirements (tangent-to-curve transition) are met. ODOT 4R standards are to be used for horizontal and vertical curve corrections.

Because of terrain and high design speeds, rural freeways should have very gentle horizontal and vertical alignments. In rural areas, the designer should be able to create a safe and efficient facility while taking into consideration the aesthetic potential of the freeway and surrounding terrain. Most freeways are constructed near ground level and the designer should take advantage of the existing topography to create not only a functional freeway, but also one that looks and drives well and fits into the existing topography.

218.6.1 Spiral Transitions

Spirals provide a transition between tangents and curves and between circular curves of substantially different degrees of curve (spiral segment). The natural path of a vehicle entering a curve is to drive a spiral. Spirals also provide a location for developing superelevation. Standard spiral lengths are based on the number of lanes being rotated and the super rate for the curve. **Apply spirals to all curves of 1° or sharper. This applies to secondary as well as to primary highways. Curves with a degree of curve flatter than 1° are not required to be spiraled.** ~~It is recommended that~~Consider using spirals ~~be used~~ for curves with a degree of curve flatter than 1° to assist in developing the superelevation runoff. When designing an unspiraled curve, refer to Figure 200-20. Longer spirals than the standard may be used wherever advantage in their use is apparent. Many existing alignments on the highway system include longer than standard spirals and operate very well. *Consider using longer spirals appropriate for a section with additional lanes when future widening is anticipated.* The standard spiral lengths for typical design speeds in open road, urban, and suburban settings are presented in Table 200-11, Table 200-12, and Table 200-13. The minimum spiral length for any curve not covered by these tables can be calculated using the three formulas also presented on Table 200-11, Table 200-12, and Table 200-13. Note that the spiral lengths presented in the tables are based on the formulas and then adjusted to provide a consistent progression in the "a" value. The "a" value is a measure of the rate of change of the curvature. (Change in Degree of curve x 100 / length of spiral). This results in a consistent feel for the driver. Spiral lengths are normally rounded up to the nearest 5 feet.

Design exceptions are required when using spirals that are less than standard. Using longer spirals than standard does not require an exception. Using unequal spiral lengths is not an exception if both meet or exceed standards. This arrangement is most commonly found on ramps. Designers always need to consider potential operational effects and the roadway context in making alignment decisions.

Prior versions of design standards were based on using inside edge super rotation. Current standards allow for using other rotation points when developing superelevation.

Ramp profile grades are typically carried at the ramp alignment and rotated about the ramp centerline.

~~*It's common for ramp alignments in the "terminal area" (where the ramp meets the crossroad) to have a spiral on one end only.* The portion of the curve closest to the crossroad typically has to have reduced or no super in order to get intersection grades to work. A spiraled alignment in this situation isn't usually too beneficial. See Part 600 for additional information. ***An exception is not required for this situation.***~~

See Part 600 for ramp alignment requirements.

The minimum length of the simple curve between spirals is 50 feet. *At times it may be appropriate to install a spiral segment to transition from one central curve to another central curve.* These are called compound curves. The spiral segment assists in providing a smooth transition between two curves in close proximity to each other. *Back to back spirals between reversing curves are permissible.*

The type and location of the facility (urban or rural in nature) will dictate the proper combination of curve, spiral, and superelevation rate.

On some low speed non-superelevated roadways, the use of spirals may not be warranted. In addressing the six urban contexts for urban arterials, the lack of spirals and/or reduced superelevation rate or the use of a crown section may be warranted in these environments to provide design flexibility in relation to urban context. **Smooth curvature is still required and angle points require an approved design exception.** In some narrow lane locations where spiral transition is not provided, widening of the outside shoulder may be of benefit for smoother curve transition for drivers. **Designing such roadways without spirals and standard superelevation requires a design exception.**

Section 222 Design Vehicles and Accommodation of Design Vehicles

In selecting the appropriate design vehicle, many factors must be considered such as the number and type of trucks, functional classification of the highway, freight route designation, and the effect on other modes including pedestrians and bicycles. Space allocation for all modes of transportation must be considered, not just the needs of the largest vehicles. The design vehicle is typically the largest vehicle that normally uses the highway without a special permit. After determining the appropriate design vehicle, a decision needs to be made as to the appropriate level of accommodation in the design for the location. For example, at an intersection, will the radii be designed for the design vehicle, or will it be designed to accommodate the design vehicle? *The concept of designing for the design vehicle is to provide a path for the vehicle that is free of encroachments upon other lanes. Providing a design that accommodates the design vehicle means that some level of encroachment upon other lanes is necessary for the vehicle to make a particular movement (see Part 500).* A balanced design approach takes into consideration more than just the amount of room the design vehicle requires. For example, what is the intended operating speed of the facility? Fully designing for a large design vehicle may result in higher than desired speeds. What is the context? In a traditional downtown, it is desirable to provide priority to pedestrians over other modes. An example of an intersection that would need to be designed for the design vehicle with no encroachment into adjacent lanes would be a rural stop-controlled intersection with a state highway, the highway being two lane or multi-lane with higher speeds and/or high traffic volumes. If a traffic study concludes that finding a gap in multiple traffic flows is not possible, the intersection would need to be designed for the design vehicle so it can turn into a

single lane. *Other factors to consider are the effects on pedestrians and bicycles: For example, large turning radii at intersections* ~~*result in long crossing distances and longer exposure times for pedestrians with potential negative impact to safety.*~~ ~~Also, with~~*will accommodate* *larger* ~~radii, motorists tend to take turns at higher~~*design vehicles but can increase vehicle* *speeds*~~.~~ *and create a larger distance for pedestrian crossings.* So, designing for a large design vehicle tends to make the intersection less desirable for most of the users of the intersection. Therefore, rather than designing for the design vehicle, the design should normally accommodate the design vehicle in consideration of the overall safety of the highway.

In addition to the design vehicle, the occasional larger vehicle may need to use the highway. Coordination with the Commerce and Compliance Division and the Statewide Mobility Program group in the Statewide Project Delivery Branch is required to determine if any vehicles larger than the design vehicle are allowed on a highway by permit and what level of accommodation needs to be provided. The Commerce and Compliance Division (CCD) receives requests to move special loads through the state. Although these loads are not to be used for design purposes, there will be occasion where the appropriate route for these special loads, which are typically accompanied by pilot vehicles, will need to be developed. These special load requests from CCD normally are sent to Technical Services, but the Region Technical Centers may also receive the requests. Region staff should work with the Region Mobility liaison and with Technical Services when CCD requests for these special loads occur. Additional information can also be found in the ODOT Mobility Procedures Manual.

For more information on design vehicle accommodation for private and public road approaches and intersections, see Part 500 (Intersection Design).

Part 300 Cross Section Elements

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

301.1 Documentation and Approval Font Key

Text within ~~some parts of~~ this ~~manual~~part is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown. Table 300-1 shows the four text fonts used ~~that include Standard, Guidance, Option, and General Text,~~ along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 300-1: Font Key

~~Font~~ Key Term	~~Font~~Documentation	Approver
Bold text	Design Exceptions	State ~~Traffic~~-Roadway Engineer (S~~T~~RE) and for some projects~~,~~ FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 301.2 for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 301.2 and 301.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 301.3 and 301.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

301.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. ~~All Standard statements appear in bold type in design parameters.~~ The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 301.4~~Options. A design exception is required to modify a Standard. The State Traffic-Roadway Engineer (STRE) gives formal approval, and FHWA approves as required.~~).

301.3 Guidelines

A guideline is a statement of recommended practice in typical situations. ~~All Guideline statements appear in bold italicized type in design parameters.~~ The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 301.4~~Options. While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is required. Region approval, with input from Technical Experts, is formally recorded for urban projects via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website.~~).

301.4 ~~Option~~ Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. ~~Option~~Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. ~~All Option statements appear in italic type in design parameters sections.~~ The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate ~~Option~~Best Practice statements. The verbs "shall" and "should" are not used in ~~Option~~Best Practice statements. The adjectives "required" and "recommended" are only used in ~~Option~~Best Practice statements to describe required or recommended design features as they relate to optional design features. ~~While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is best practice.~~

~~**General Text** – Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.~~

Section 303 Cross Section Elements

The Standard Roadbed Sections and the ODOT 4R/New Standards outlined in Part 300 give the dimensions to be used for the design of new facilities, the modernization of existing facilities, and the preservation of facilities. These include shoulders, travel lanes, medians, and other cross-sectional elements. Design frontage roads in accordance with the anticipated traffic and their location.

~~*When the width computed for the lateral support of the surfacing material is a fractional width, round the lateral support width up to the nearest foot.*~~

308.5.5 End Treatments

Starting and ending raised median treatments can create conflict areas to roadway users and must be designed carefully. Raised median sections should be designed with logical starting and ending points within a given section of highway. End treatments are critical to ensure the appropriate and safe function of the raised median.

Haphazardly placing small sections of raised median throughout a highway segment may offset any safety benefits and may actually increase the crash frequency over that anticipated without any median treatment. In urban situations, it is preferred to have the median begin and end at an intersection. Rural areas may not allow this intersection approach. In these cases, the designer is to determine logical termini based upon the intended function of the median and roadside character of the highway. It is important to remember that raised medians are a barrier and can be a roadway hazard.

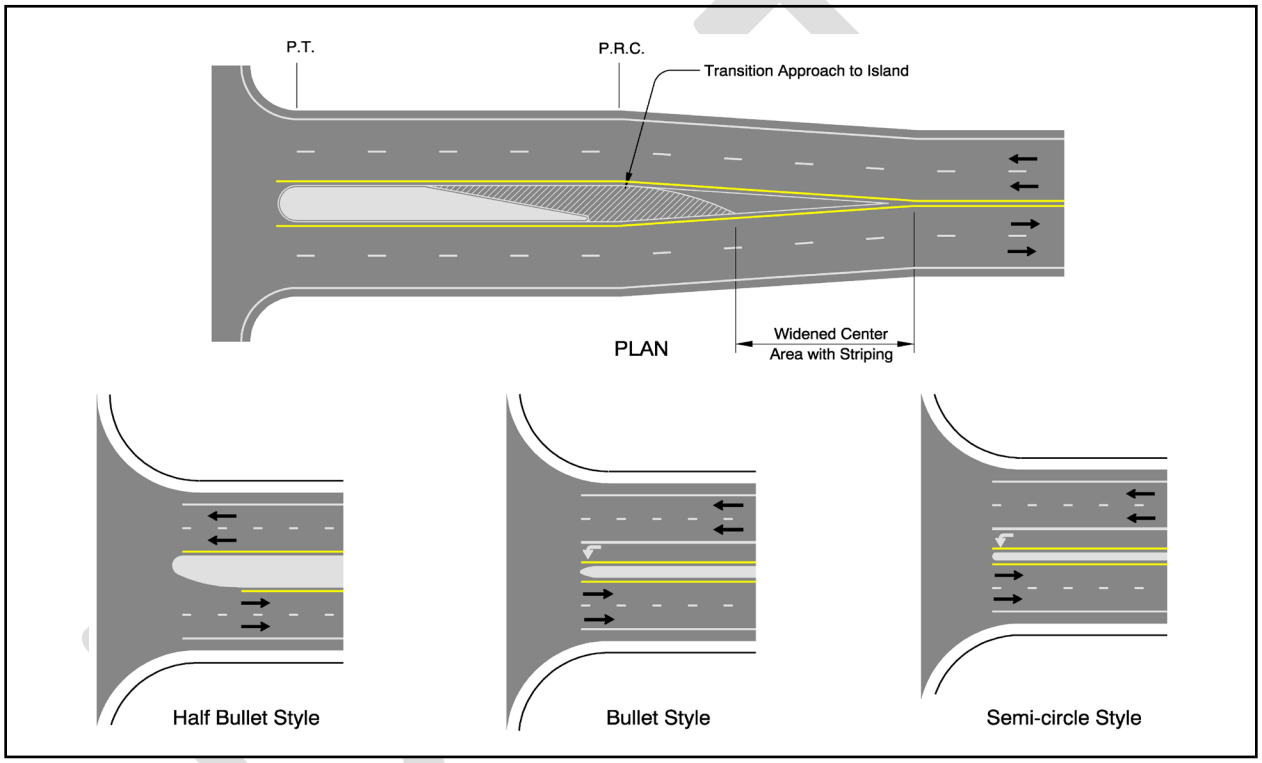
~~**Concrete barriers generally require an impact attenuator**~~Impact attenuators are used to protect ~~**the**~~concrete barrier ends. The type of attenuator used must conform to the ODOT approved materials list. AASHTO's "Roadside Design Guide - 2011" can provide additional information regarding end treatment design for concrete barriers.

Raised curbed medians generally do not require any special end treatments but a squared off, blunt end style is an unacceptable end treatment. *In high-speed situations, design speeds over 45 mph, and where pedestrian accommodation in the median is not required, the curb line should be tapered to 2 inches in height.* This tapered section should be accomplished over 15 feet. Standard Drawing RD706 provides additional detail for this tapered treatment.

Two other concerns about end treatments are pedestrian refuges and truck off-tracking. At signalized intersections, the preferred median treatment is to stop the raised median prior to the cross walk. Generally, the pedestrian movement through a signalized intersection should be made in one stage. Pedestrian refuges create two stage crossings. At a signalized intersection, the refuge requires additional signal equipment and signal timing that needs to be considered prior to adding the refuge feature. *The preferred design, when providing a pedestrian refuge for crossings at unsignalized intersections, is to utilize the cut-through option. This treatment requires a protective nose area that should be at least 13 square feet or more.* The nose can be designed with either a semi-circle or half bullet type design. The semi-circle design type is only recommended for median traffic separator widths of 4 feet or less. Wider medians should utilize the half bullet type design to better facilitate truck turning movements. All end treatment designs need to consider the off-tracking characteristics of the appropriate design vehicle. The designer must use caution when providing a pedestrian refuge and using the half bullet type nose design. The

half bullet design may reduce the available refuge for pedestrians. In some situations, the crossing may need to be moved back slightly to provide a full width refuge. This is especially prevalent where the nose must be moved back to provide for adequate truck turning movements. The transition approach to island area at the beginning and end of a raised median is the appropriate location for additional low-cost warnings, such as rumble strips or painted chevrons. These additional warnings are not required at all locations. *Figure 300-17 provides additional detail regarding end treatments for raised curb medians. For additional design specifics, see Part 500 Intersection Design.*

Figure 300-17: End Treatments



Section 309 ADA Requirements for Resurfacing, Rehabilitation and Reconstruction Projects

When paving alterations occur adjacent to an ADA ramp, the ADA ramp is required to be accessible. Reconstruct ADA ramps that are both adjacent to pavement alterations and listed as having a poor functional status in the ODOT ADA Ramp inventory. This requirement applies to all projects under the Interstate Maintenance,1R, 3R, 4R, and SF standards discussed in the following sections in Part 300. Refer to the Bridge Design Manual Appendix B for paving alterations near bridges with walkways. **Curb ramps at radial driveways are required to be upgraded when the paving limits incorporate portions of the private approach and impact the pedestrian access route.** Pavement treatments are described in MG100-107 (see Appendix H) detailing alterations versus maintenance treatments (e.g. chip seal alone is not an alteration paving treatment however when multiple surface treatments are combined it may result in an alteration). Paving alterations are not limited to just asphalt roadbeds and include other surfacing materials such as reinforced concrete sections. Utility trench work is typically not considered a paving alteration; consultation with the Technical Services, ~~Traffic~~ Roadway Engineering Section is recommended.

Section 322 Rumble Strips

Safety is a very important component of design and roadway departure. Head-on crashes make up a significant portion of Oregon's fatalities and serious injury crashes. Rumble strips are a relatively low-cost engineering treatment designed to alert drivers of a lane departure through vibration and noise created when a vehicle's tires contact the rumble strip. Rumble strips may be placed on the shoulders, between opposing travel lanes (centerline), or in the travel lanes (transverse). **Rumble strips ~~are considered a traffic control device and~~ require the approval of either the State Traffic ~~Roadway~~ Engineer or Region Traffic Engineer depending on the application.**

Guidelines have been established on when it may be necessary to install the rumble strips for safety reasons on state highways. Historically, rumble strips have not been used often on urban highways. However, there are sections of urban highways that could benefit from the application of rumble strips. There are newer rumble strip designs that can reduce the noise level of tires running over the strips. ***If rumble strips are proposed, the accommodation of bicyclists and shoulder width should be considered along with maintenance activities.*** The ODOT Traffic Manual provides specific details to determine if a particular project should have rumble strips installed.

Part 400 Roadside Design

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

Section 401 Introduction

The design of the roadside environment is a critical part of any highway segment. A well-designed roadside can significantly improve the safety and operation of a particular segment. Steep slopes or obstacles should be avoided or mitigated where possible and practical. Fixed object and run off the road often account for a significant number of crashes on a segment of highway. Therefore, providing a safe roadside environment should be a goal of every project. The 2011 AASHTO "Roadside Design Guide" should be used to determine the clear zone distance and mitigation measures to use for different highway conditions. The following sections of Part 400 provide additional information and examples on proper clear zone requirements and roadside design.

As AASHTO's "Roadside Design Guide" directs, the preferred treatment of roadside obstacles is to relocate them outside of the clear zone. Only where this is not possible or cost effective, should shielding be considered. ~~Where a barrier along a roadway is used to shield a roadside obstacle, provide a 2-foot shy distance from the normal edge of shoulder to the face of barrier. This shy distance maintains the useable shoulder width and provides some additional distance from the traveled way to the barrier.~~

401.1 Documentation and Approval Font Key

Text within this part is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown. Table 400-1 shows the four text fonts used, along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 400-1: Font Key

Font	Documentation	Approver
Bold text	Design Exceptions	State Roadway Engineer (SRE) and for some projects FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 401.2 for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 401.2 and 401.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 401.3 and 401.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support

design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

401.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 401.4).

401.3 Guidelines

A guideline is a statement of recommended practice in typical situations. The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 401.4).

401.4 Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate Best Practice statements. The verbs "shall" and "should" are not used in Best Practice statements. The adjectives "required" and "recommended" are only used in Best Practice statements to describe required or recommended design features as they relate to optional design features.

Section 402 Clear Zone

A clear zone is the unobstructed traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles. The design clear zone is determined by several factors, including design speed, ADT, horizontal curvature, and embankment slope. The distances given in the tables in this section are not absolute and the design options selected to mitigate the effect of roadside obstacles require good engineering judgment in order to balance cost effectiveness with the expected increase in safety.

When water with a depth of 2 feet or more is located with a likelihood of encroachment by an errant vehicle it is considered a roadside obstacle and is to be evaluated for mitigation.

The AASHTO "Roadside Design Guide - 2011" suggests considering the following options when evaluating a roadside obstacle for mitigation:

1. Removing or redesigning the obstacle
2. Relocating the obstacle
3. Reduce impact severity by breakaway devices
4. Redirection of vehicle by installation of barrier device
5. Delineation of object

General information on clear zone requirements for 3R and 4R projects follows. There are no specific clear zone requirements for 1R projects.

402.2 4R Clear Zone (All Highways)

This section will address elements of roadside design including clear zone; clear zone requirements; clear zone distances; horizontal curve adjustments; and sideslopes. ~~This section will also address the lateral clearances required, both vertical and horizontal, for interstate freeway single lane clearance envelopes.~~

The AASHTO "Roadside Design Guide - 2011" is the most recent publication written to provide guidance in roadway design regarding roadside clearances. The AASHTO "Roadside Design Guide - 2011" gives procedures and tables to determine the correct clear zone distance for use in the placement of barrier, sign installation, guard rails, ditch location, and other roadside appurtenances. It provides the criteria for the placement or removal of any object which may influence the trajectory of a vehicle which has left the travel lanes, either in a controlled or uncontrolled situation.

The AASHTO "Roadside Design Guide – 2011", in chapter 10, gives additional assistance to designers with clear zone in the urban context. Understanding of the role delineation plays

between the travel way and non-travel way along a highly urban environment gives the designer more options than before.

~~The clear zone is determined by several factors, including design speed, ADT, horizontal curvature, and embankment slope. The distances given in the tables in this section are not absolute and the design options selected to mitigate the effect of roadside obstacles require good engineering judgment in order to balance cost effectiveness with the expected increase in safety.~~

~~When water with a depth of 2 feet or more is located with a likelihood of encroachment by an errant vehicle it is considered a roadside obstacle and is to be evaluated for mitigation.~~

~~The AASHTO "Roadside Design Guide - 2011" suggests considering the following options when evaluating a roadside obstacle:~~

~~1. Removing or redesigning the obstacle~~

~~2. Relocating the obstacle~~

~~3. Reduce impact severity by breakaway devices~~

~~4. Redirection of vehicle by installation of barrier device~~

~~5. Delineation of object~~

~~General information on clear zone is covered in and .~~ Of specific importance for both rural and urban freeways is the safety slope located at the back of curb or from edge of travel lane. **In order to provide a recommended ditch section, the 1:6 rock foreslope and ditch section must be followed by a 1:4 backslope for a minimum of 10 feet**. A variable back slope can then be used. These standards should also be followed when designing center medians. **In a curbed median section, a 4-foot (2 percent) slope shall be followed by the 1:4 back safety slope.**

The design clear zone distance can be determined by using Table 400-2 and Table 400-3 shown at the end of this section. These tables were taken from the AASHTO "Roadside Design Guide - 2011". They are provided as a quick reference for the experienced designer who is already familiar with the determination process. Table 400-2 is used to determine general clear zone distance. Table 400-3 is used for horizontal curve adjustments. **Obstacles located within the design clear zone distance must be evaluated and mitigated using one of the 5 options listed at the beginning of Section 402.**

Care must be taken in arriving at the proper clear zone distance. Table 400-2 lists the different clear zone distances for cut and fill slopes. Many times, multiple slopes have to be used to determine the appropriate clear zone distance. At times, the roadway typical section will have both a foreslope and backslope. When this occurs the procedure for determining the proper clear zone requires more than pulling a number from Table 400-2. **An urban freeway may also include a curbed section that is followed by 2 percent slope for 4 feet. The 2 percent slope must then be followed by a 1:4 or flatter back safety slope for a minimum of 10 feet. The backslope adjacent to the 1:4 safety slope can then be varied**. This urban treatment will meet

the recommended ditch section requirements of the "Roadside Design Guide - 2011". Following is an example of the proper procedure for determining clear zone distance for a typical section that includes both a foreslope and a backslope.

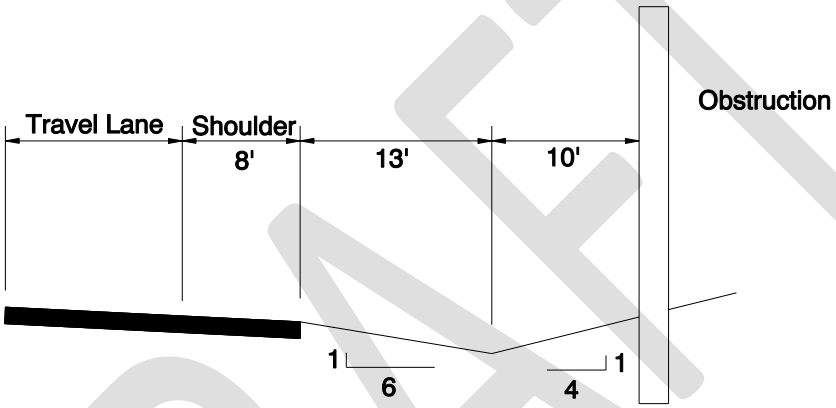
Example:

Design ADT: 7000

Design Speed: 60 mph

Recommended clear zone for 1:6 slope (fill): 30 to 32 feet from Table 400-2

Recommended clear zone for 1:4 slope (cut): 24 to 26 feet from Table 400-2



Discussion: Since the example is within the preferred channel cross section, Table 400-2 can be used to determine the clear zone. However, when the suggested clear zone exceeds the available recovery area for the foreslope, the backslope may be considered as additional available recovery area. The range for the suggested clear zone for the foreslope of 30 to 32 feet extends past the slope break into the backslope. Since the backslope has a suggested clear zone of 24 to 26 feet which is less than the foreslope the larger of the two values should be used. In addition, fixed objects should not be located near the center of the channel where the vehicle is likely to funnel. An appropriate clear zone range for this example is 30 to 32 feet.

For further information and more detailed procedures it is recommended all designers read the AASHTO *"Roadside Design Guide - 2011"*.

Design exceptions for clear zone on 4R projects are approved by the State ~~Traffic~~ Roadway Engineer.

Table 400-2: Clear Zone Distances

Design Speed (mph)	Design ADT	Fill Slopes			Cut Slopes		
		1V:6H or flatter	1V:5H to 1V:4H	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or flatter
≤ 40	UNDER 750	7 - 10	7 - 10	[b]	7 - 10	7 - 10	7 - 10
	750 - 1500	10 - 12	12 - 14	[b]	10 - 12	10 - 12	10 - 12
	1500 - 6000	12 - 14	14 - 16	[b]	12 - 14	12 - 14	12 - 14
	OVER 6000	14 - 16	16 - 18	[b]	14 - 16	14 - 16	14 - 16
45 - 50	UNDER 750 [c]	10 - 12	12 - 14	[b]	8 - 10	8 - 10	10 -12
	750 - 1500	14 - 16	16 - 20	[b]	10 - 12	12 - 14	14 - 16
	1500 - 6000	16 - 18	20 - 26	[b]	12 - 14	14 - 16	16 - 18
	OVER 6000	20 - 22	24 - 28	[b]	14 - 16	18 - 20	20 - 22
55	UNDER 750 [c]	12 - 14	14 - 18	[b]	8 - 10	10 -12	10 - 12
	750 - 1500	16 - 18	20 - 24	[b]	10 - 12	14 - 16	16 - 18
	1500 - 6000	20 - 22	24 - 30	[b]	14 - 16	16 - 18	20 - 22
	OVER 6000	22 - 24	26 - 32 [a]	[b]	16 - 18	20 - 22	22 - 24
60	UNDER 750 [c]	16 - 18	20 - 24	[b]	10 - 12	12 - 14	14 - 16
	750 - 1500	20 - 24	26 - 32 [a]	[b]	12 - 14	16 - 18	20 - 22
	1500 - 6000	26 - 30	32 - 40 [a]	[b]	14 - 18	18 - 22	24 - 26
	OVER 6000	30 - 32 [a]	36 - 44 [a]	[b]	20 - 22	24 - 26	26 - 28
65 - 70	UNDER 750 [c]	18 - 20	20 - 26	[b]	10 - 12	14 - 16	14 - 16
	750 - 1500	24 - 26	28 - 36 [a]	[b]	12 - 16	18 - 20	20 - 22
	1500 - 6000	28 - 32 [a]	34 - 42 [a]	[b]	16 - 20	22 - 24	26 - 28
	OVER 6000	30 - 34 [a]	38 - 46 [a]	[b]	22 - 24	26 - 30	28 - 30

[a] When a site-specific investigation indicates a high probability of continuing crashes or when such occurrences are indicated by crash history, the designer may provide clear-zone distances greater than the clear zone shown in this table. Clear zones may be limited to 30 ft for practicality and to provide a consistent roadway template if previous experience with similar projects or designs indicates satisfactory performance.

[b] Because recovery is less likely on the unshielded traversable 1V:3H fill slopes, fixed objects should not be present in the vicinity of the toe of these slopes. Recovery of high-speed vehicles that encroach beyond the edge of the shoulder may be expected to occur beyond the toe of slope. Determination of the width of the recovery area at the toe of slope should consider right-of-way availability, environmental concerns, economic factors, safety needs, and crash histories. Also, the distance between the edge of the through traveled lane and the beginning of the 1V:3H slope should influence the recovery area provided at the toe of slope.

While the application may be limited by several factors, the foreslope parameters that may enter into determining a maximum desirable recovery area are illustrated in Table 400-3. A 10-ft recovery area at the toe of slope should be provided for all traversable, non-recoverable fill slopes.

[c] For roadways with low volumes it may not be practical to apply even the minimum values found in this table. Refer to Chapter 12 in the AASHTO's "*Roadside Design Guide - 2011*" for additional considerations for low-volume roadways and Chapter 10 for additional guidance for urban applications.

405.1.1 General

This section provides information to the designer concerning guardrail and concrete barrier. ~~Information on offsets, single slope barrier, cast in place, and slip form barrier is provided.~~ The AASHTO *"Roadside Design Guide - 2011"* shall be used to determine guardrail and concrete barrier locations. Exceptions to this guide are to be approved by the State ~~Traffic~~ Roadway Engineer. Standard Drawings in the RD400 series deal with guardrail while Standard Drawings in the RD500 series deal with concrete barrier. Barrier treatment in rural areas should consider impacts to animal crossings and the designer should contact the region environmental representative for assistance.

Regardless of the type of the barrier system used, when a median is proposed to be closed with a barrier system discussion with the Oregon State Police needs to occur to discuss cross over locations for emergency access.

Existing barrier systems used to mitigate lack of clear zone at a minimum shall meet NCHRP Report 350 crash testing criteria. No design exception will be granted to leave existing hardware that does not meet the minimum crash testing requirements on 3R and 4R projects.

405.2.3 Guardrail Terminals

Guardrail terminals are protective systems that prevent errant vehicles from impacting obstacles, by either gradually decelerating the vehicle to a stop when the terminal is hit head-on, or by redirecting the vehicle away from the obstacle when struck on the side. These systems are connected to the ends of runs of guardrail and work in concert with the guardrail run to shield rigid objects or hazardous conditions that cannot be removed, relocated, or break away.

~~Some terminals utilize W-Beam rail and breakaway timber posts, which are set in two steel foundation tubes for ease of replacement. Some end terminals utilize hinged breakaway steel posts. The rest of the breakaway posts are drilled. All systems establish the third post from the end as length-of-need point, referred to in the AASHTO "*Roadside Design Guide - 2011*".~~

Approved end terminals are listed in the Qualified Products List (QPL). ***Also available are terminals that are designed for a lower speed impact (under 45 mph) that are called Test Level 2 terminals.*** They are shortened versions of the standard terminals. With the competition as it is, all products undergo routine adjustments to design that make it impractical to list current models. The designer should refer to the QPL, as the QPL stays abreast with all changes and regularly posts updates. **Provide crashworthy end terminals on all leading guardrail ends exposed to traffic; and, provide crashworthy end terminals on all trailing guardrail ends exposed to traffic on undivided highways even if located outside the clear zone for opposing traffic.** A downstream anchor terminal may be used on trailing guardrail ends on divided highways where there is no reasonable way for opposing traffic to hit the terminal head on.

405.7 Freeway Median Barriers Warrant

For warranting median barrier on Interstate freeways and Non-Interstate freeways use the following:

1. Any open median 100 feet in width or less shall be closed with an appropriate barrier. The median width is measured between the inside fog lines of opposing directions of traffic.
2. For freeway medians greater than 100 feet wide, regions should evaluate site specific conditions and crash data to determine if the median should be closed. Regions are also encouraged to identify and evaluate any other sections of divided highways that they determine look and feel like interstate and non-interstate freeways to determine if the median should be closed.

Table 400-5: Interstate/Freeway List

Hwy	Route	Highway Name	Begin MP	End MP	Interstate/ Freeway
1	I-5	Pacific	0.00	308.38	Interstate
2	I-84	Columbia River	0.00	167.58	Interstate
6	I-84	Old Oregon Trail	167.58	378.01	Interstate
61	I-405	Stadium Freeway	-0.04	4.21	Interstate
64	I-205	East Portland Freeway	0.00	26.56	Interstate
70	I-82	McNary	0.00	11.21	Interstate
227	I-105	Eugene-Springfield	0.00	3.49	Interstate
30	OR 22	Willamina-Salem	24.03	26.18	Freeway
47	US 26	Sunset	53.62	73.75	Freeway
69	OR 569	Beltline	4.37	13.00	Freeway
92	US 30	Lower Columbia River	0.95	1.86	Freeway
144	OR 217	Beaverton-Tigard	0.00	7.52	Freeway
162	OR 22	North Santiam	1.68	13.74	Freeway
227	OR 126	Eugene-Springfield	3.49	9.04	Freeway

There are five barrier systems appropriate for use in the medians of freeways in Oregon. They are listed below. The minimum median widths listed in Table 400-6 are to be used as the minimum median width needed in order to use a specific barrier type. Standard median widths are covered in Part 300, Section 309.12 4R Urban and Rural Freeway Medians. Refer to 405.1 for concrete barrier guidance and AASHTO's Roadside Design Guide for barrier deflection.

Table 400-6: Median Barrier Systems

Barrier Type	Test Level	TL 3 Tested Deflection	Minimum Median Width	Comments
42-inch F-Shape Precast Concrete Barrier	NCHRP 350 TL 4 Assumed at least MASH TL 3 (assumed)	30 inches (unanchored)	8′-4″	Anchored deflection estimated to be 0 – 6 inches. Requires asphalt pad for placement. Only tested under NCHRP 350.
Modified Thrie-Beam for Medians	MASH TL3	TBD	8′-4″	Installed system approximately 42 inches wide
High Tension/ Low Maintenance Cable Barrier	MASH TL3, 4	Variable 6 – 9 feet	30 feet	Only system that can be placed on a 1:6 up to a 1:4 slope. Easy to maintain. Consider using TL 4 if trucks are a known problem.
32-inch F-Shape Concrete Barrier	MASH TL 3	30 inches	8′-4″	
Metal Median Guardrail	TBD	24 inches	24 feet	

Median barrier should be installed on a transverse slope of 1:10 or flatter~~. In medians wider than 30 feet it is preferred to use cable barrier placed near the center of the median. If placed away from the center, ensure that there is enough room for deflection to the closer side. For help in determining how to install barrier in a variable median see Sections 5.6 and 6.6 of "AASHTO's Roadside Design Guide – 2011"~~ *where possible.*

Part 500 Intersection Design

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

501.1 Documentation and Approval Font Key

Text within this part is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown. Table 500-1 shows the four text fonts used along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 500-1: Documentation and Approval Font Key

Font ~~Key Term~~	~~Font~~Documenting	Approver
Bold text	Design Exceptions	State ~~Traffic~~ Roadway Engineer (S~~T~~RE) and for some projects, FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 501.2 for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 501.2 and 501.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 501.3 and 501.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

501.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. ~~All Standard statements appear in bold type in design parameters.~~ The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 501.4~~Options. A design exception is required to modify a Standard. The State Traffic Roadway Engineer (STRE) gives formal approval, and FHWA approves as required.~~).

501.3 Guidelines

A guideline is a statement of recommended practice in typical situations. ~~All Guideline statements appear in bold italicized type in design parameters.~~ The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 501.4~~Options. While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is required. Region approval, with input from Technical Experts, is formally recorded for urban projects via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website.~~).

501.4 ~~Option -~~ Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. ~~Option~~Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. ~~All Option statements appear in italic type in design parameters sections.~~ The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate ~~Option~~Best Practice statements. The verbs "shall" and "should" are not used in ~~Option~~Best Practice statements. The adjectives "required" and "recommended" are only used in ~~Option~~Best Practice statements to describe required or recommended design features as they relate to optional design features. ~~While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is best practice.~~

~~**General Text** - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.~~

502.2 Design for or Accommodate for Design Vehicle

Intersections should be designed for the appropriate design vehicle. An important concept concerning the design vehicle when designing an intersection or road approach is the concept of "accommodating" the design vehicle or "designing for" the design vehicle.

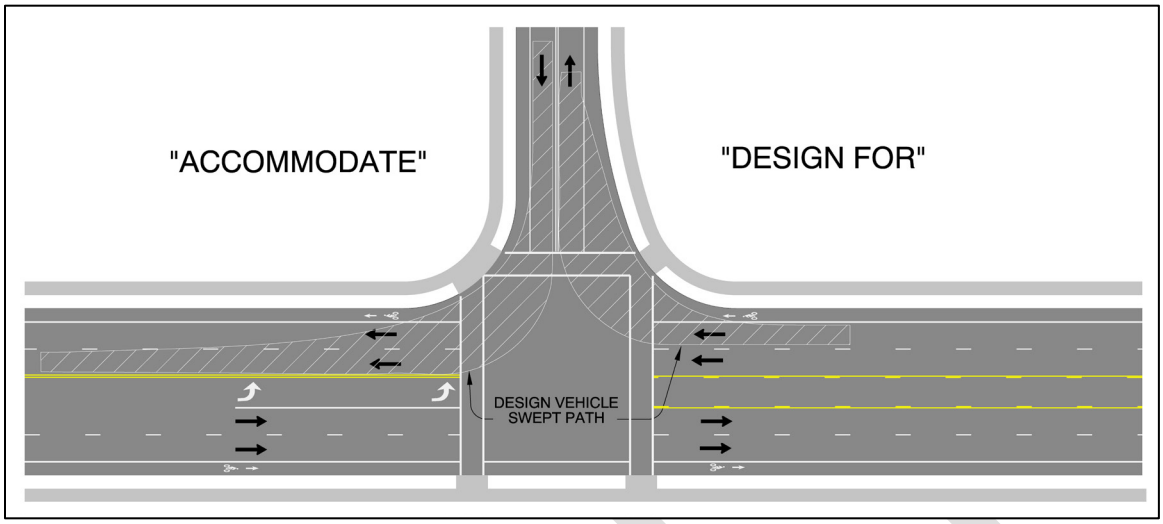
When an intersection is designed to accommodate the design vehicle, the intent is to provide enough physical space for the design vehicle to maneuver and turn through the intersection but may not be able to do so within the confines of a single lane. When an intersection is designed for the design vehicle, the design provides appropriate turning and maneuvering space to allow the design vehicle to remain within one lane.

While it is advantageous to design for the largest vehicle using the approach, often real-world constraints make it difficult or impossible to achieve. Large curb radii will accommodate larger design vehicles but can increase vehicle speeds and create a larger distance for pedestrian crossings.

Designing all approaches for a WB-67 type vehicle certainly provides a level of comfort for the variability of vehicles using the approach. However, not all approaches have a high need for WB-67 access. Freight distribution centers and industrial locations will most certainly need approaches and access designed for WB-67 type vehicles. However, most commercial and retail locations may only need access designed for single axle (SU) type delivery vehicles with accommodation for the occasional WB-67 type vehicle. See Section 222 for more information regarding design vehicle selection.

Approaches should be designed for the appropriate design vehicle. The designer must realistically consider the needs of the approach and design accordingly. Being judicious and fully analyzing the needs of an approach connection to create a design specific to the location can improve roadway conditions overall for all modal users of the state highway system. Providing an approach larger than necessary is not only inefficient in cost but can also have detrimental effects for other roadway users. Figure 500-3 illustrates the "Accommodate" and "Design For" concept.

Figure 500-3: Accommodating and Designing for a Design Vehicle



Section 502.1 is not intended to be a detailed discussion of approach road design. For more detail on approach road or median design refer to Section 506, and Parts 200 and 300.

502.4 Intersections and Interchanges - Expressways

Connections to both urban and rural expressways can be either at-grade intersections or grade separated interchanges. *At most rural expressway locations, the preferred connection type is grade separation.* ***Where appropriate, grade separated connections should also be considered at major rural highway intersections.*** However, there are many factors to consider in the design of these types of connections. For urban and Rural interchange spacing (crossroad to crossroad) and other design criteria see Part 600. Table 600-2 provides information for spacing criteria.

503.6 Access Control - Expressways

Maintaining access control on rural expressways is critical to retaining the safety and efficiency of the facility. No private approaches should be allowed on rural expressways. When an expressway is established along a highway, or if there are existing private approaches, a long term plan should be established to eliminate them or provide alternative access as opportunities occur. ~~Public~~*Space and control public* ***road connections*** ~~are controlled and spaced~~ ***according to the access management spacing standards contained in the Oregon Highway Plan, Appendix C.*** Spacing standards can also be found in OAR 734-053-4020. Traffic signals are not recommended on rural expressways, and modernization of expressways that have traversable medians will typically result in non-traversable medians.

504.6 U-Turns

Where a section of highway contains a non-traversable median for an extended length, there may be a need to accommodate U-Turning traffic. There are several design techniques available to accommodate U-Turns. The first option is at ~~an~~a standard intersection ~~without a jug handle~~. This design option generally requires widening the highway in one quadrant of the intersection to accommodate the required turning space of vehicles. Designs need to consider the type of vehicle using the U-Turn. In ~~many~~most situations, trucks will be prohibited from using this style of U-Turn. The widening can make use of a far side bus stop or can be tapered. **All U-Turns using this type of design technique at a signalized intersection must have the approval of the State Traffic- Engineer in consultation with the State Roadway Engineer.**

A second design option for accommodating U-Turning traffic is the use of a jug-handle. There are two options for jug-handle U-Turn designs. One option is the left side jug-handle. The left side jug-handle is a turning roadway alignment located on the left side of a highway. U-Turning traffic makes a left turn from the highway into the jug-handle. The jug-handle circulates the traffic back to the highway where vehicles re-enter the traffic stream as right turns through normal gaps in traffic flow. This style of jug-handle can be used at an existing "T" intersection or mid-block. *The jug-handle is only compatible with a right side "T" intersection, which may or may not be signalized. Jug-handle intersections would typically accommodate U-Turn truck movements.*

The other jug-handle design option is the right side jug-handle. The right side jug-handle is located on the right side of the highway. U-Turning traffic makes a right turn off the highway into the jug-handle, and then loops around to the left. The vehicles then make a left turn across the highway. This movement may or may not be signalized. *As with the left side jug-handle, the right side jug-handle is only compatible with a "T" intersection. In this case, however, the intersecting roadway is on the left side of the highway.* The major disadvantage of this style is traffic must make a left turn across both directions of highway traffic and is therefore less efficient and may also have additional safety risks.

See Figure 500-12 and Figure 500-13 for U-Turn treatments.

Jug-handle style U-turns can be used at mid-block locations. These may be used downstream of an intersection to improve operations and safety at an intersection as described below in the Indirect Left Turns section.

Also, see the ODOT Traffic Manual and the ODOT Traffic Signal Policy and Guidelines for traffic related design and approvals. Consult with the region Traffic Section.

Figure 500-12: U-Turns at Intersections

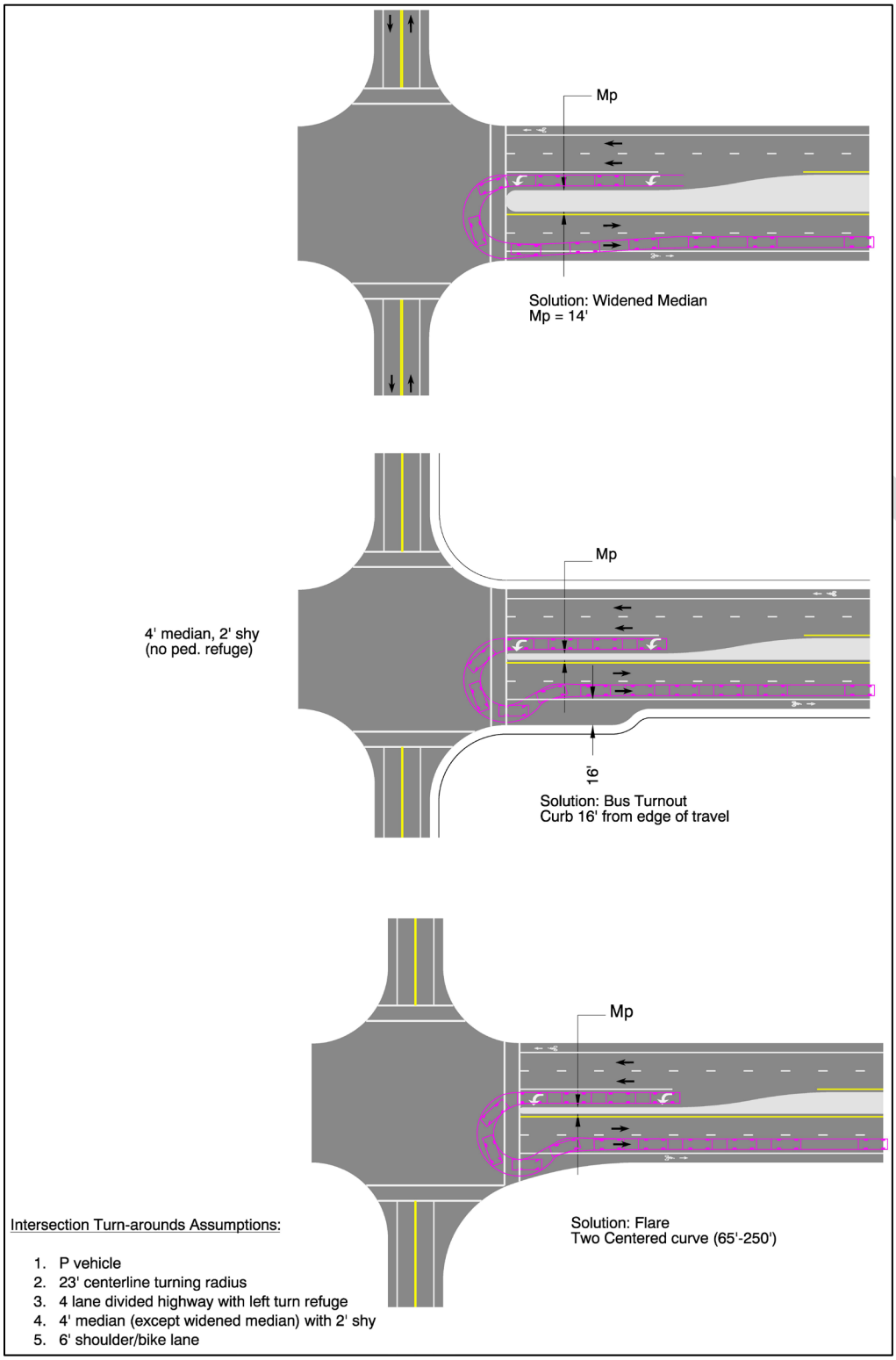
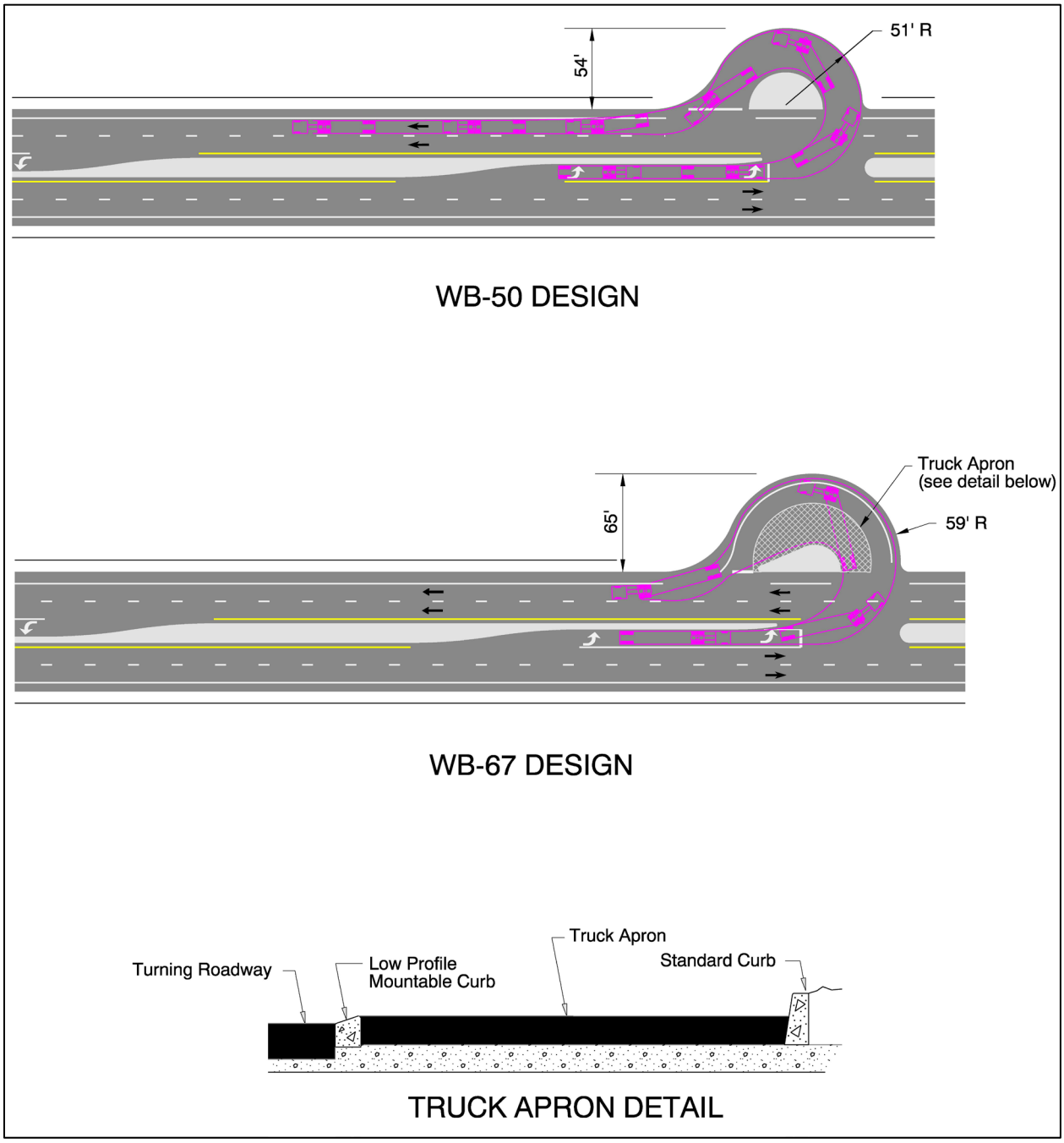


Figure 500-13: U-Turns at Mid-Block



504.7 Indirect Left Turns

One tool available is indirect left turns at intersections. In some situations, for operational capacity or safety reasons, it may be desirable to remove left turning traffic. The left turns are accomplished by other connections. The first option available is the use of a right side jug-handle just like the one described for U-Turns above. Vehicles wishing to turn left actually leave the highway on the right side then cross the highway. Generally, these designs are signalized to facilitate the crossing movement. Again, this particular type of jug-handle is only compatible with a left side "T" intersection.

A different type of indirect left turn design uses connecting roadways. This design concept is similar to the jug-handles described in the U-Turn section. Within this type of design are several options. These include the single quadrant and double quadrant. The single quadrant design provides one connecting roadway that provides for two way traffic operation. Location of the connecting roadway is dependent upon traffic flow characteristics, adjacent roadside development, need for intersection spacing, and signalization needs. The concept of the single quadrant design is to remove all left turning traffic from a specific intersection. The traffic uses the connecting roadway to gain access to the particular street. Location of the connecting roadway is critical to the operation on the highway, particularly if both intersections are to be signalized. Prior to design acceptance, the Traffic Engineering Services Unit and Transportation Planning and Analysis Unit (TPAU) should have reviewed the design concept through an engineering study, such as an Intersection Control Evaluation (ICE) and determined if the design concept is supported. The State ~~Traffic~~ Roadway Engineer approv~~id~~es the ~~final approval~~type of the ~~ICE.~~traffic control for the intersection.

As mentioned previously, another option is the double quadrant design. This design is very similar to a jug-handle style interchange, except that the intersecting roadways are not grade separated. Again, turning traffic, generally left turns, use the connecting roadways. The roadways may provide for all movements or may be right in/right out only depending upon traffic capacity and safety needs. The Traffic Engineering Services Unit and TPAU should review and support this type of design prior to design acceptance. In addition, there may be access management issues on these connecting roadways. The Region Access Management Engineer should be consulted to identify and address these issues. In many situations, these last two design alternatives may be a phased approach towards grade separation in the future. ~~The State Traffic Roadway Engineer provides the final approval of the ICE.~~

505.1 Design Requirements for Private Road Approaches

Private approaches are connections to adjacent businesses, residences, or other private roadways. Generally, private approaches provide access to/from the highway and an adjacent property across the highway right of way. These approaches service all land use types including residential, commercial, and industrial. Typically, private approaches in urban areas will use a 'dust pan' style approach. This style drops the curb and possibly the sidewalk to highway grade to allow vehicular access. ***Use Standard Drawings RD725 through RD750 when designing "dust pan" style private approach roads. For high volume driveways or driveways that are part of a signalized intersection, use a radius design style similar to that used by a public approach. Refer to Table 500-2 to determine the style of approach to be used. The Signal Design Manual, Section 5.1.6 has additional information for driveways at signals.***

There are three general types of private road approaches. These are:

- Type A Non-curbed, ditch section highway with radius style approach.
- Type B Curbed highway section with "dust pan" style approach.
- Type C Curbed highway section with radius style approach.

Design Type C private approaches in accordance with Section 506 General Intersection Design. The design of Types A and B are described below.

The design of private road approaches is affected by many factors. The type of access, volume of vehicles, type of vehicles, grades, alignment, and adjacent land use all influence the design. ***The spacing of approach roads should be consistent with the spacing guidelines specified in the Oregon Highway Plan, Appendix C. ~~The designer is encouraged to read~~Use the Access Management Policy contained in the OHP and Oregon Administrative Rule (OAR) 734, Division 51 for ~~clarification of~~ spacing guidelines and other guidance pertaining to access management.***

1. ***All road approaches should be placed so that intersection sight distance is provided.*** The vehicle entering the traffic stream should have a view along the highway equal to the intersection sight distance for the design speed of the highway. **At a minimum, stopping sight distance for the design speed of the highway must be provided at all approaches.** For more information on intersection and stopping sight distances refer to the AASHTO Green Book and HDM Part 200, Section 217.4 for Intersection Sight Distance. ***Any proposed approach that cannot provide sight distance as required by Oregon Revised Statute (OAR) 734, Division 51 must obtain an approval from the***

Region Access Management Engineer (RAME). For more information related to access management deviations, see Section 503. Cut slopes may need to be widened and roadside vegetation removed ~~in order~~ to provide required sight distance.

2. ***Both public and private road approach grades should be designed so that drainage from the approach does not run on or across the traffic lane, shoulder areas, or sidewalk.*** ~~In no case should the~~***The normal slope of the shoulder should not be altered.*** In urban areas where the drainage is along a curb and gutter, only the paved approach area to the right of way line may drain into the gutter. In the case of an approach below the street grade, a short vertical curve should be used to confine the drainage in the gutter line. In some instances, inlets may be required on each side of the approach to collect runoff without ponding or to ensure that roadway drainage does not leave the right of way. *For approach road design, provide a flat landing area for vehicles entering the highway for at least 20 feet from the edge of the shoulder. A grade of two percent is desirable for these landings and four percent is the maximum. Approach grades steeper than four percent should be carefully evaluated by the Designer.*

3. **The maximum grade break between highway shoulder and approach is eight percent for Type A and B approaches.** *In addition, a 20 foot landing area should be provided.* In some situations, the maximum break cannot be met. When this is the design condition, the designer should attempt to achieve a roadway-to-approach transition as smooth as possible. This may require using a short vertical curve.

4. **The approach must at least accommodate the appropriate design vehicle.** Generally, commercial accesses are designed for at least a Single Unit (SU) truck design vehicle. Vehicles larger than an SU are not to be treated as the design vehicle unless 3 or more WB-40 or larger trucks are anticipated between 7:00AM and 7:00PM. ***Anytime the design vehicle is larger than a SU, the approach is designed as a radius style.*** When vehicles larger than an SU are anticipated, but are not the design vehicle as described above, the approach must accommodate the larger vehicle. ('Accommodation' only refers to the physical ability to make the maneuver including encroaching on other lanes, whereas 'designed for' means that design elements do not require encroachment. A site visit and discussion with maintenance personnel along with information gathered from property and business owners will help determine the appropriate design for an approach. (See Figure 500-3 for more detail concerning "design for" and "accommodate for".)

5. **All approaches must be designed to aid in the longitudinal crossing of pedestrians.** It is preferable to maintain sidewalks at a continuous grade. However, without a buffer strip or set back to provide a ramp down area to street grade, this is nearly impossible. Route continuity is also important to pedestrians. If a curbside sidewalk cannot be set back for a significant longitudinal distance, it is best to leave it curbside rather than break up the pedestrian continuity. **Sidewalk cross-slope must be maintained at 2 percent or less for accessibility.** To meet this requirement approaches may need to be designed with more than one slope to transition from roadway grade to final approach

grade. Roadway standard drawings in the RD700 series and RD900 series provide information and various design options for curb, sidewalk, and driveway design at approaches and curb ramps.

6. *All curbs and delineators used at approaches on highways without continuous curbs should be placed at the normal shoulder width from the edge of the traveled way to provide adequate shoulder adjacent to the approach.*

7. *Approaches on opposite sides of the highway should be located across from each other whenever possible. However, under high speed and or high traffic volume conditions, approaches may need to be ~~separated~~offset to reduce the complexity and number of conflicts (see Figure 500-10).* In addition to reduction in conflict points, separating approaches breaks the crossing maneuvers into distinct steps and isolates them, reducing driver tasks and anxiety. When designing, the approaches need to be separated far enough that they operate independently outside their functional areas (see Figure 500-1). Although this situation is possible at some high volume private approaches, this treatment is generally only appropriate for public road approaches. Not all intersection locations are good candidates for separated approaches. The Technical Services Roadway Engineering Unit and the Region Access Management Engineer should be contacted when considering separation of private approach roads. Major public roads with large volumes of through traffic should generally not be separated.

8. *Approach roads should not be constructed within the functional area of an adjacent intersection.* Refer to the Access Management Policies from the Oregon Highway Plan and OAR 734, Division 51 for more information on functional area (see Figure 500-1).

9. ***Where a private approach serves a high volume of traffic, additional design and/or traffic controls may need to be incorporated into the design.*** High volume approaches often will require channelization along the highway. Refer to Section 506 for details on left and right turn lanes. In some instances, the approach may require a traffic signal ~~in order~~ to operate safely and efficiently. A private approach located opposite of a signalized intersection forms an additional approach to the intersection and all approaches to a signalized intersection must be signalized. It is best to avoid this type of driveway configuration. However, when it is necessary, see the Signal Design Manual, Section 5.1.6 for guidance. The designer should work with the Region Access Management Engineer to determine solutions for high volume private approaches and potential private approaches opposite signalized intersections. Private approaches are not allowed directly opposite interchange ramp terminals.

NOTE: All traffic signals must be approved by the State Traffic ~~**Roadway**~~ Engineer prior to installation. Generally, only public road approaches should be considered for signalization. Avoid signalizing private approaches.

10. *Type A approaches need to be designed to minimize the pedestrian longitudinal distance.* This may require the design to incorporate a two-centered curve rather than a single radius when accommodating design vehicles larger than a Single Unit (SU) truck.

11. *The approach design and corresponding site circulation plan should specify the entry/exit throat distance.* This throat distance is critical ~~in order~~ to provide an efficient and functional connection between the highway and adjacent property. Throat lengths are critical for commercial and industrial type land use approaches. The Transportation Planning Analysis Unit or the Region Access Management Engineer can assist with determining the appropriate throat distance. See Figure 500-2.

Table 500-2: Typical Private Approach Style and Width

Land Use Type	Approach Peak Hour Volume	Approach Style	Typical Throat Width[1]
Single Family Residential[2]	0 – 10	Dust Pan	16′
	11+	Dust Pan	24′
Multiple Family Residential	0 – 10	Dust Pan	16′
	11 – 150	Dust Pan	24′ – 28′
	151 – 300	Dust Pan[3]	36′ – 40'
	301 – 399	Radius[4]	Variable[5]
	400+	Radius	Variable[5]
Commercial	0 – 20	Dust Pan	24′
	21 – 150	Dust Pan	28′ – 32′
	151 – 300	Dust Pan[3]	36′ – 46′
	301 – 399	Radius[4]	Variable[5]
	400+	Radius	Variable[5]
Industrial		Dust Pan/Radius[6]	Variable[5]
Special Uses[7]		Radius	Variable[5]

1 The typical throat widths are only to be used as guides to the designer or permit specialist. The throat width needs to be checked to ensure traffic movements are accommodated acceptably.

2 Generally, multiple single-family residences don't share a single approach unless they are on a public road.

3 The dust pan style designs are primarily to be used. However, a radius style may be used if the traffic composition at the driveway contains a substantial number of recreational vehicles, buses, and single unit trucks, and the highway posted speed is greater than 35 mph, or access spacing each side is 660 feet or more.

4 The radius style design should generally be used. However, a dust pan style may be considered where the highway posted speed is 30 mph or less and access spacing is 165 feet or less.

5 The typical width is variable dependent upon approach style, design vehicle, and number of lanes.

6 Special care should be used when determining the appropriate style. Some industrial uses operate similar to commercial uses and should use commercial style approaches and dimensions. Heavy industrial/warehouse uses that serve significant truck volumes should use a radius style.

7 Special Uses include developments such as truck stops, amusement parks, stadiums, distribution centers, etc.

506.4 Travel Lane Alignment

Similar to through travel lane width, travel lane alignment should remain constant through an intersection. *If a proposed design creates misalignment of lanes across an intersection, rather than introducing angle points that create abrupt deflections to vehicle pathways across the intersection, a better design option would be to incorporate slight alignment and striping changes upstream and downstream of the intersection to better transition lanes smoothly, thereby effectively reducing or eliminating the lane shift.* The alignment changes upstream and downstream should provide curvature to smooth the transition. This is particularly true with intersections on curves. Shifting of lanes through signalized or stop controlled intersections is strongly discouraged and should only be done when site constraints make it infeasible to keep lane alignment consistent. **Travel lanes on the mainline highway shall not be shifted at uncontrolled intersections.**

At signalized intersections, lane lines should line up through the entire intersection and not be offset. This helps to not only discourage unintentional lane changes through the intersection area, but also minimizes the possibility of a driver inadvertently encroaching on the adjacent lane. ***However, in cases where it is deemed necessary to shift a lane through a signalized intersection, refer to the following guidance provided in the remainder of Section 506.4 and Figure 500-17 (Travel Lane Offset Layout) for discussion of potential lane offset.***

Guidance for Lane Shift when deemed necessary:

Posted Speed Limit Less than 30 mph:

Maximum Offset – 4 feet

Posted Speed 30 mph to 35 mph:

Maximum Rate of Change Across Intersection – 1ft. lateral in 20 ft. longitudinal

Maximum Offset - 4 feet

Posted Speed 40 mph to 45 mph:

Maximum Rate of Change Across Intersection – 1ft. lateral in 30 ft. longitudinal

Maximum Offset – 3 feet

Posted Speed Greater Than 45 mph:

No Offset Permitted Across Intersection

Shifted travel lane rate of change is measured in the direction of travel between marked crosswalks by projecting a line along the center of the entering travel lane from the closest

crosswalk stripe entering the intersection to the farthest crosswalk stripe exiting the intersection. If no crosswalk is present, then project a line perpendicular from the end of the lane striping to the center of the travel lane entering the intersection to determine a beginning measuring point for the lane shift and rate of change distance. Since most controlled intersections without a marked crosswalk should have a stop bar present, the stop bar with respect to the travel lane center could also be used as an alternate method to determine a starting point. In either method, the ending point is the intersection of the projected entering lane center and the intersection of the furthest crosswalk stripe exiting the intersection. If no crosswalk is present on the exiting side of the intersection, then project a perpendicular line from the beginning of the lane striping leaving the intersection to the center of the shifted lane to determine the end point. In all cases the rate of change shall be applied evenly across the entire distance along the projected center of the entering travel lane.

Travel lane offset is measured from the center of the travel lane entering the intersection to the center of the shifted travel lane exiting the intersection. For multi-lane roadways, all travel lanes in the same direction shall be offset equally and remain parallel to one another unless site specific constraints make this infeasible. For locations where lanes cannot be shifted equally or cannot remain parallel to one another, contact Region Roadway and Traffic staff or Technical Services Traffic- and Roadway Engineering ~~Unit~~Section staff for guidance.

For stop-controlled intersections, the maximum offset that may be applied is 4 feet across the intersection.

When lanes are shifted through an intersection, care must be taken to ensure that adequate space is maintained between travel lanes and roadway features like curbs; raised median islands, signs, illumination or signal poles, etc. All proposed lane shift designs must be reviewed by appropriate staff in the Region Traffic and Region Roadway sections as well as appropriate Traffic and Roadway staff in the Technical Services Traffic- and Roadway Engineering ~~Unit~~Sections regardless of proposed lane shift amount. Agreement for the lane shift is required from the Region Roadway Manager/Engineer, the Region Traffic Manager/Engineer and the Technical Services Traffic- and Roadway Sections.

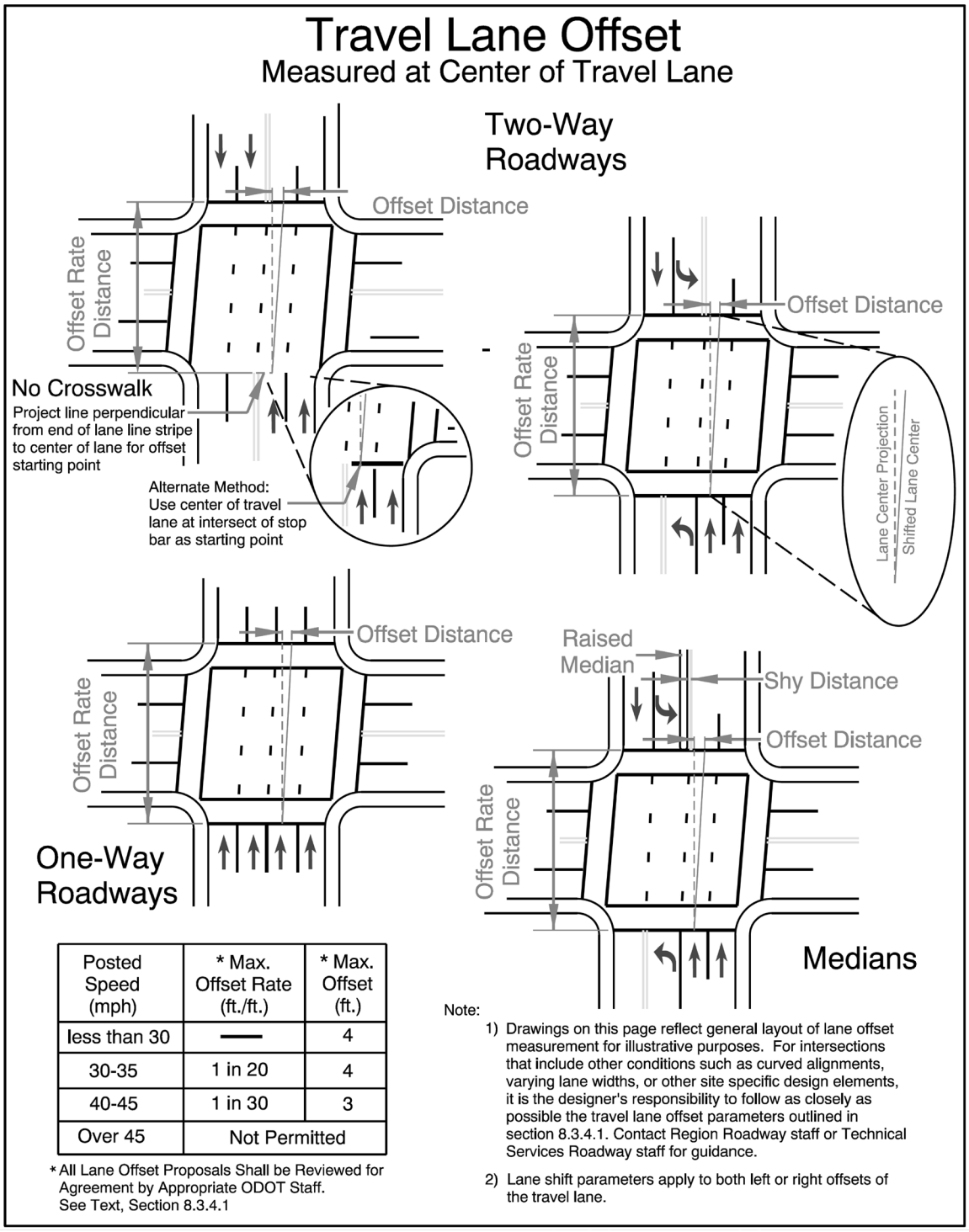
At signalized intersections, excessive shifting of lanes may cause signal head misalignment with their respective lanes. ***Signal heads should be shifted to match the lane shift. If this cannot be accomplished, then lane shift shall be limited to a maximum of two feet with ~~agreement~~approval from the Region Traffic Engineer.***

If shifting lanes through a signalized intersection is necessary, it is advantageous to carry some form of lane marking, generally dotted striping, through the intersection to inform drivers of the shift and help keep them aligned with the lanes. Contact the Region Traffic Section for appropriate use of lane markings through the intersection.

Providing guidance for layout of lane offset at intersections in this manual does not imply agreement to any specific design proposal. It is the designer's first responsibility to provide a design that transitions a vehicle from one side of an intersection to the other smoothly. Only

after it has been demonstrated and determined through the review process that a smooth transition is not feasible will a design incorporating a lane shift be considered as a viable option. Figure 500-17 Illustrates travel lane offset layout when a shift of the travel lane is necessary.

Figure 500-17: Travel Lane Offset Layout

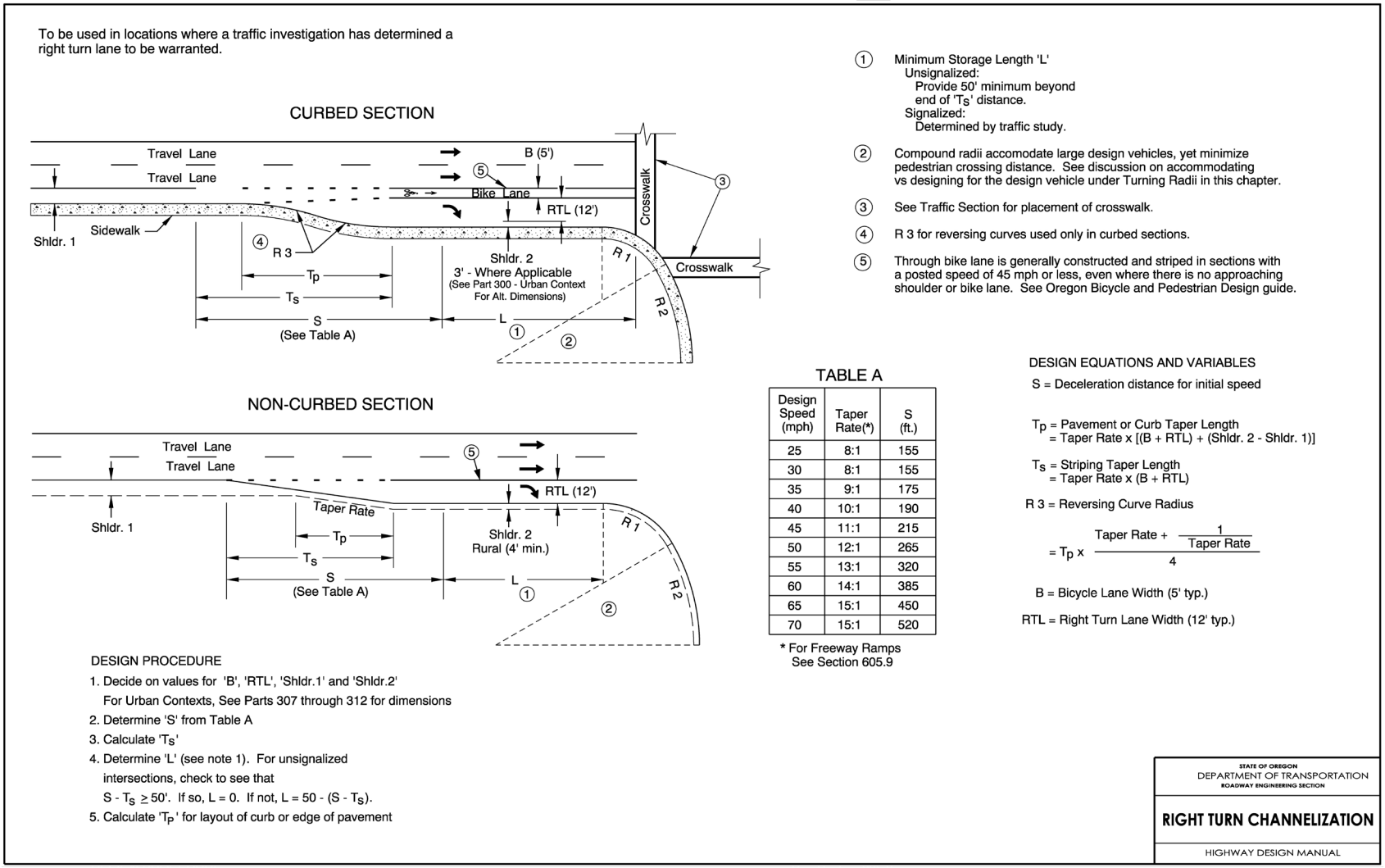


506.6 Shoulder Widths

As with travel lanes, the width of shoulders should generally remain constant through an intersection. However, two-lane highways that are flared to provide left turn channelization may require shoulder width modifications. Urban and rural design criteria will determine appropriate shoulder width at specific locations. Standard shoulder width should be utilized through rural and higher speed intersections. **In constrained locations where left turn channelization is being considered, the shoulder width may be reduced, but shall be no less than 4 feet in rural locations.** Reduction of shoulder width below the design criteria width may require a design exception. For urban shoulder width, See Part 200 and Part 300 for design criteria.

When only a minimum 6-foot bicycle lane is provided adjacent to the highway, reducing shoulder width requires discussion about bicycle accommodation needs. Part 900 and the Oregon Bicycle and Pedestrian Design Guide provide information about shoulder widths and consultation with the ODOT Bicycle and Pedestrian Design Engineer or the project resource for active transportation may provide additional appropriate design options. Shoulder widths will also require modifications where the intersection includes a right turn lane. If the design is providing only a minimum 6-foot bicycle facility adjacent to the highway, then shoulders should be designed to match the dimensions of Figure 500-18. This would provide only a minimum level of design. ~~***However, the goal of highway***~~***Highway*** ***projects*** ~~***is to***~~***should*** ***provide the highest appropriate level of bicycle and pedestrian facilities possible within project scope and funding.*** Consider separated and protected bicycle facility design options. On projects where funding categories limit project scope to specific items, there may be other sources of funding that can be allocated to include bicycle and pedestrian improvements. Contact the region Active Transportation Liaison to determine bicycle and pedestrian facilities appropriate for the project and to determine if alternate funding sources are available for even greater improvements to the bicycle and pedestrian networks along the highway.

Figure 500-18: Right Turn Channelization



506.7 Intersections on Curves and Superelevation

An intersection should not be located within a horizontal curve. Intersections on curves present design challenges that affect superelevation, sight distance, driver comfort and vehicle stability. However, in many existing situations, intersections are present within highway curves and in many of these locations, these connections cannot be effectively relocated. Signalized intersections in curves compound operational problems, as well. Stopping traffic on steep cross slopes determined by main line design superelevation needs is undesirable due to the potential for slippage under ice conditions or potential load shifting on trucks. *Intersection Sight Distance (ISD) should be achieved at all intersections.* ~~However,~~ **Stopping Sight Distance (SSD)** ~~is~~**shall meet the minimum requirement.**

When an intersection occurs within a highway curve, the highway superelevation should be kept to a minimum. However, the highway still needs to provide for safe movement of traffic through the intersection at highway speeds. As a result, the designer must balance the superelevation need of traffic on the main line in free flow conditions with operational issues of the intersection. In these types of locations, some designers prefer to merely limit maximum superelevation to 4 percent. However, in some cases, trying to hold the superelevation to 4 percent or less may result in design speeds less than desirable for a specific highway. A better solution is to determine an appropriate superelevation for a specific location based on needs at that location.

At a minimum, the superelevation at an intersection should provide speeds determined from the Comfort Speed matrix shown in Part 300 equal to the desirable design speed. This means that if the design speed for the highway segment is 45 mph, then the comfort speed for the curve at the desired superelevation must be at least 45 mph.

Example:

Using the Suburban Superelevation & Spiral Lengths in Part 300 and a design speed of 45 mph with an 8 degree curve, the design superelevation would be 6 percent. This may be an undesirable condition with a signalized intersection on a curve. An alternative is to use the Comfort Speed values. Entering the table for an 8 degree curve and following across the row until the column for 45 mph is reached returns a 4 percent superelevation. This would reduce the design superelevation by 2 percent and may be an acceptable option.

~~*When using an alternate*~~*Reducing superelevation* ~~*design, care must be taken to determine that reducing superelevation does*~~*should not compromise the overall geometry of the alignment and subsequently create a new problem while* ~~*attempting to solve a current one.*~~*using an alternate superelevation design.* **A design exception** ~~**will be**~~**is required to utilize an alternate superelevation design based on Comfort Speed in relation to Design Speed.** It is critical to ensure that connections on the high side of a superelevated highway curve provide an approach with adequate sight distance.

Ideally, intersection sight distance should be provided. Where this is not feasible or practical, as a minimum, stopping sight distance must be provided.

Another important consideration in designing a road connection on the high side of a horizontal main line curve is the comfort factor for side road traffic. Operation of the main line is the first concern, but it is important to create a comfortable transition across the superelevation for the traffic entering onto the main line. Where possible, keeping superelevation to a minimum on the main line while establishing grades on the connecting road to minimize vertical and lateral movement inside the vehicle entering onto the main line is desirable.

In addition to consideration of vehicles entering from the side road to the main line, main line traffic turning dynamics at intersections on curves must be evaluated as well. Main line turning vehicle dynamics and driver comfort also benefit from minimum superelevation when making turns onto side roads. Main line vertical grade can have great effect on turning dynamics. Negative (downhill) grades in conjunction with horizontal curvature and its respective superelevation can exacerbate turning forces acting on a vehicle. Not only can these forces be uncomfortable for drivers and passengers, in the case of trucks or other vehicles with higher centers of gravity like RVs and buses, these forces can cause loads to shift or, in extreme cases, cause roll over crashes.

When it is necessary to design or improve an intersection located on a horizontal curve, it is important to carefully analyze the interaction of the horizontal curvature and superelevation with all intersecting grades, grade breaks and vertical alignments on both the side road and the main line in relation to anticipated vehicle turning movements and dynamics. It is important to keep these forces and reactions to a minimum and within acceptable levels to ensure safe and effective operation of the intersection.

Intersections on horizontal curves can produce problems for pedestrians as well. Care must be taken to ensure sight lines to crosswalks provide ample vision for drivers to see pedestrians and for pedestrians to see approaching vehicles and adequately evaluate the approach speed and the time needed to cross the roadway.

506.9 Turning Radii

Turning radii are one of the most important design elements of intersections. The operations, safety, and efficiency of an intersection are controlled by the turning movements. If the turning vehicles are geometrically limited from completing the maneuver properly, the intersection may break down, capacity is limited, and crash potential may increase.

The appropriate design vehicle must be identified prior to designing the intersection turning movements. *Selection of the appropriate design vehicle can sometimes be difficult. Issues to take into consideration in choosing a design vehicle include number and type of trucks, functional classification of the intersecting roadways, surrounding land use, consideration of future changes in land use and traffic, freight route designation, etc.* See Part 200 and Part 300 for additional information on design

vehicle selection. After determining the appropriate design vehicle, a decision needs to be made as to the level of design accommodation. In other words, is the intersection radii to be designed for the design vehicle or merely to accommodate the design vehicle? The concept of designing for the design vehicle is to provide a path for the vehicle that is free of encroachments upon other lanes. Providing a design that only accommodates the design vehicle means that some level of encroachment upon other lanes is necessary for the vehicle to make a particular movement (see Figure 500-3). An example of an intersection that would need to be designed for trucks with no encroachment into adjacent lanes would be a stop-controlled intersection with a state highway, the highway being two lane or multi-lane with higher speeds and/or high traffic volumes. If a traffic study concludes that finding a gap in multiple traffic flows is not possible, the intersection would need to be designed for the design vehicle so that the truck driver can turn from his lane into a single lane. *Other factors to consider in turning radii are the effects on pedestrians and bicycles. Large radii create long crossing distances with increased exposure times~~. These conditions negatively impact pedestrian and bicyclist safety~~ and may add time to signal timing cycles. Large radii can also ~~encourage motorists to take turns at~~ result in higher ~~speeds that can have an effect on intersection safety as a whole.~~* ~~In general, large vehicles are a small percentage of the vehicle types and users of an intersection. Designing intersections for large vehicle maneuverability may be of benefit for the large vehicle, but it tends to make the intersection less safe for the majority of the users of the intersection. Therefore, in consideration of the overall safety of the intersection, the design should only accommodate large vehicle operation in most cases.~~*speed turns.* ***When it is necessary to design the intersection with large radii for larger vehicles, a balance needs to be obtained between the necessary radii and impacts to all intersection users.*** See Section 502.2 for accommodation for design vehicle.

Another item that must be decided is the turning radius of the design vehicle. The turning radius of the design vehicle determines the ease and comfort of making the turning maneuver. The smaller the turning radius, the larger the off-tracking of the vehicle and the slower the speed. Forcing large vehicles to use very small turning radii forces the driver to perform a very slow maneuver that may not be in the best interests of the operation of the intersection. Generally, the radius chosen is in line with the surrounding culture. Tighter radii are chosen for low and/or urban speeds, while larger radii are selected for higher speeds and rural intersections. When designing with tighter radii, it is important to evaluate the impacts of large vehicle off-tracking. ***~~Off~~Large vehicle off-tracking should not occur over pedestrian ramps ~~or~~and sidewalks or ~~impact~~interfere with signal or utility pole ~~instal~~l~~l~~oc~~ations.***

Once the design vehicle is selected and the level of design accommodation determined, then the intersection radii can be designed. Intersection radii should be kept as small as possible to minimize the size of the intersection and the pedestrian crossing distance. ***Any time the design vehicle is larger than a Single Unit (SU) truck or a bus, ~~the designer may need to~~ consider using a two-centered curve.*** Off-tracking templates or automated off-tracking programs should be used to determine the vehicle path. Once this path is identified, a two-centered curve can be developed which closely emulates this path. The designer may need to look at a range of vehicle

turning radii and the subsequent intersection designs. This allows the designer to select the best design for the design vehicle while minimizing the size of the intersection.

~~*Designers are encouraged to keep*~~*Keep the size of intersections to a minimum.* ~~*Often when*~~*When accommodating large trucks,* ~~*the*~~ *intersection radii can become very large. This can substantially increase the size of the intersection. Larger intersections generally have greater crash potential, are difficult to delineate, can be confusing, require more right-of-way, and significantly increase pedestrian and bicycle crossing times and distances.*

506.10 Left Turn Lanes

On some higher volume and higher speed highways, left turning traffic can become a major safety concern, especially on two-lane highways. *On rural highways, left turn lanes should generally only be considered at public road intersections.* The Analysis Procedures Manual (Transportation Planning and Analysis Unit) discusses citing criteria for installing left turn lanes. ~~***When these criteria are met, a***~~***A left turn lane should be considered in the design when these criteria are met.*** Generally, left turn lanes are not to be constructed for private accesses in rural areas unless the siting criteria are met and installation of a left turn lane will not create additional safety concerns on the highway. A major concern regarding left turn lanes for private access is that successive accesses may require installation of a section of a continuous two way left turn lane (CTWLTL). Using CTWLTLs in rural environments should be discouraged. ~~*However, rural*~~*Rural CTWLTLs may be considered where needed specifically for safety in short sections or within the boundaries of a rural community.*

As stated above, providing left turn lanes at multiple locations that are spaced closely may create a need for a CTWLTL. It is undesirable to provide a typical section that creates an hour glass shape. This is where a highway is widened to provide a left turn lane, then narrowed back to the original typical section, only to be immediately widened again. This situation should be avoided. ***Left turn lanes in rural areas should be selected where adequate spacing exists to avoid this hourglass problem. Figure 500-31 provides an equation to avoid an hourglass.***

Providing a left turn lane at an intersection will significantly improve the safety of the intersection. Eliminating conflicts between left turning vehicles decelerating or stopping and through traffic is an important safety consideration. ***A left turn lane must be provided at all non-traversable median openings, and they are strongly recommended to be installed at other intersections meeting the installation criteria.*** The left turn lane installation criteria are different for signalized and unsignalized intersections. Refer to Section 507 for Signalized Intersections and Section 508 for Unsignalized Intersections for the appropriate siting criteria. For additional information about siting criteria for left turn lanes, see the ODOT Analysis and Procedures Manual (APM).

Left turn lanes for rural and higher speed locations shall be 12 feet wide plus the appropriate traffic separator width and shy distance when required. For urban locations, see Part 200 and Part 300 for left turn design criteria.

The installation of a traffic separator at urban left turn lane locations is critical when there are access points to adjacent properties along the length of the left turn lane. The separator will protect the left turn lane operation and safety by eliminating the opportunity for vehicles to cross it when entering and exiting adjacent accesses. The width of the traffic separator is determined by several factors. **If the median includes a raised curb design, the traffic separator width shall be a minimum of 4 feet in higher speed locations**. **However, when pedestrians are to be accommodated on the raised portion of the median with separate phases for the crossing maneuver, the raised traffic separator shall be 6 feet minimum in width**. *Medians that use raised curb also need to provide the appropriate shy distance from the curb and adjacent through travel lanes.* The width of paint-striped ~~traffic separators~~medians is determined by the design speed of the highway and the type of land use area. **For design speeds of 55 mph or less, the paint-striped ~~separator~~median shall be 2 feet and 4 feet for design speeds of 60 mph or greater.** For more information on median design, refer to Part 300, Cross-Section Elements.

Development of left turn lanes should be in conformance with Figure 500-19. However, where the median width is developed non-symmetrically, a reversing curve ~~may~~should be used in lieu of the straight speed tapers. The reversing curve option can reduce the overall widening thereby saving construction costs and possibly saving right of way or significant features. Figure 500-19 depicts the standard left turn channelization design. Figure 500-20 depicts the reversing curve channelization option.

Left turn lanes are striped in accordance with the ODOT Traffic Line Manual. Essentially this means that the reversing curve entry taper shall be used for:

1. All dual left turn lanes;
2. All left turn lanes developed from sections without medians or with narrow medians, and
3. All left turn lanes located within wide median sections or CTWLTLs that have design speeds greater than 45 mph.

It is critical to the operation of intersections to provide adequate storage length for left turning vehicles out of the through traffic lanes. **At a minimum, provide 100 feet of storage.** ***The Region Traffic Engineering Unit and the Analysis Procedures Manual (APM) should be consulted to determine the appropriate storage length for specific intersections***. For specific analysis procedure questions or interpretation of the APM or for complex projects requiring additional study, contact the ODOT Transportation Planning and Analysis Unit (TPAU) for guidance or technical help on the particular project or methodology.

In some instances, dual left turn lanes may need to be considered. **When designing dual left turn lanes, there must be dual receiving lanes on the connecting roadway with adequate length downstream prior to any merge points.** The designer must determine the appropriate design vehicles to use for side-by-side operation through the turning movement. *In rare locations, like at freeway ramp terminals leading to truck stops or warehousing districts, the design may need to be two WB-67 vehicles making the turn simultaneously. However, in most locations, a WB-67 and an SU vehicle side-by-side is adequate for design. In other locations where truck volumes are low, an SU vehicle and a passenger vehicle may be sufficient.*

Figure 500-19: Left-Turn Channelization

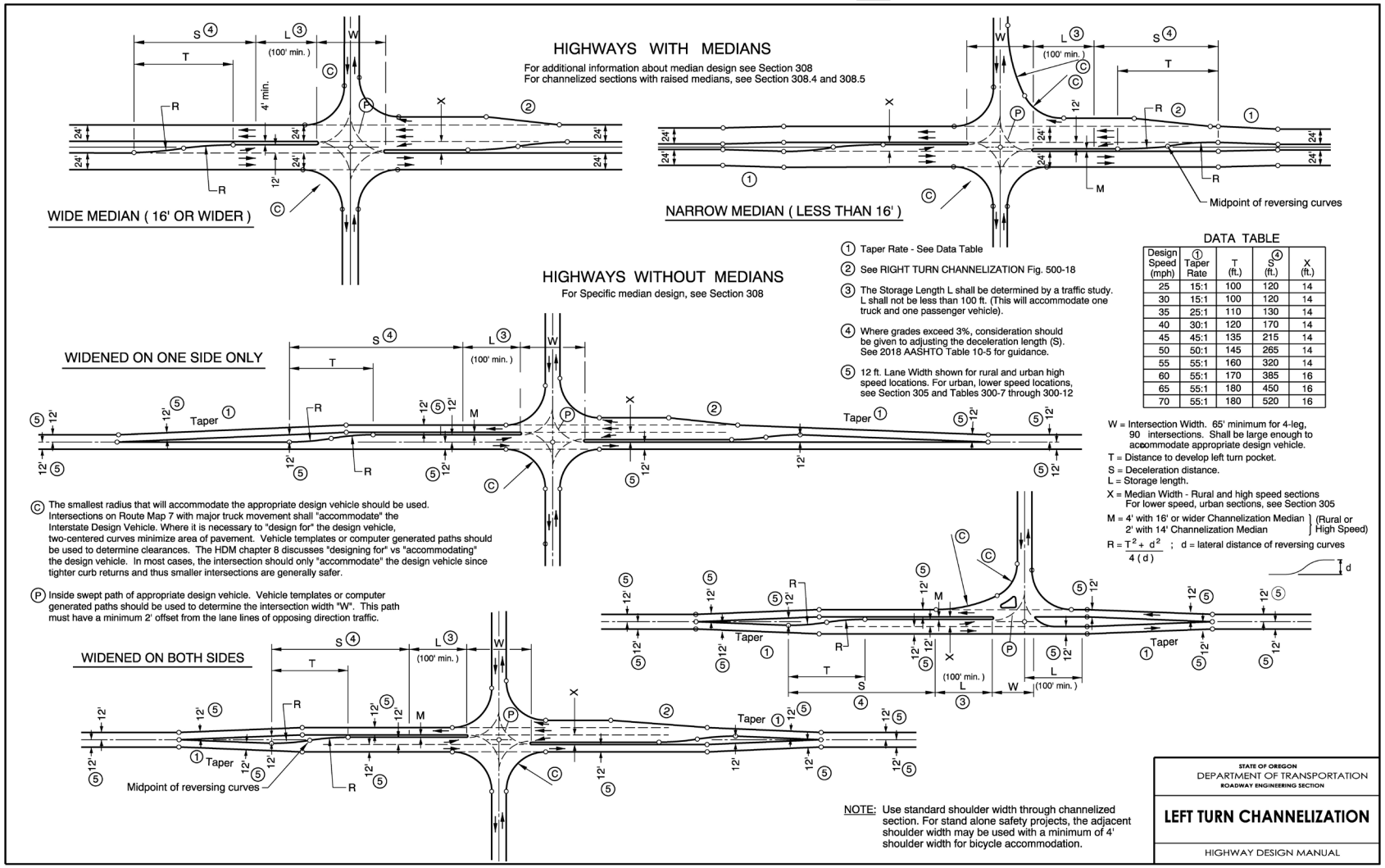
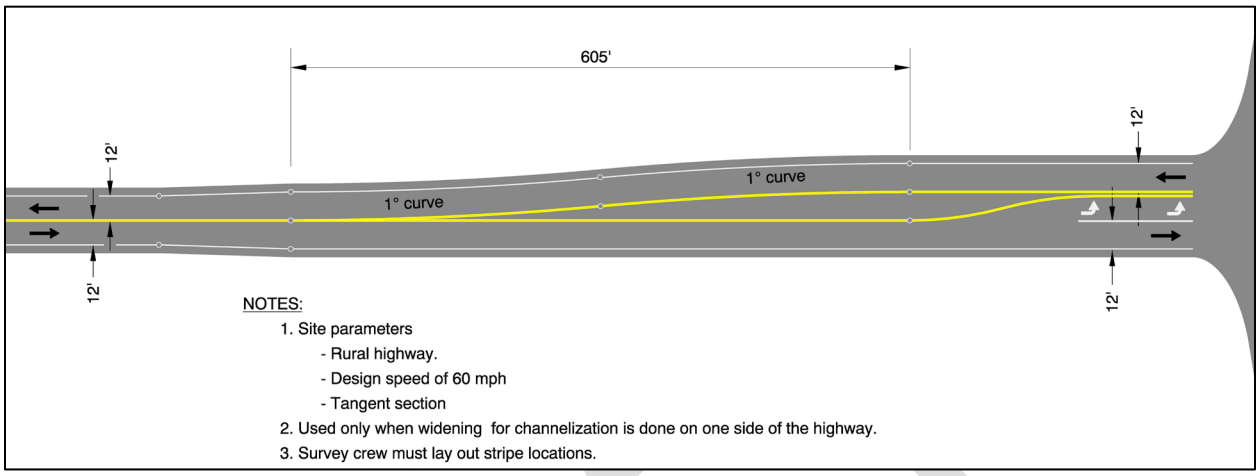


Figure 500-20: Reversing Curve Option for Left-Turn Channelization – Rural Highway



506.11 Right Turn Lanes

Similar to left turns, right turning traffic may sometimes create a safety issue at some intersections. However, right turn traffic does not normally need to come to a complete stop and wait for an opposing gap to complete the maneuver, except in the case of a pedestrian crossing. Therefore, the safety implications are not as significant as with left turning vehicles. ~~However, at~~At some intersections, the volumes on the highway and the right turning traffic may be significant enough to create a safety problem. The Analysis Procedures Manual (Transportation Planning and Analysis Unit) discusses siting criteria for installing a right turn lane. ***A right turn lane should be considered only at public road intersections that meet these criteria. Right turn lanes should not be used for private drives unless the access has significant turning volume, a specific crash problem could be corrected by utilizing a right turn lane, or the access is within a rural community area and meets the criteria from the Analysis Procedures Manual.***

Speed differential between right turning traffic and through traffic can create significant safety problems at intersections. To reduce this conflict, installation of right turn lanes may be appropriate at some intersections. Right turn lanes also help improve traffic operations and mobility standards at some intersections. *Installation of right turn lanes should be considered at intersections that meet the siting criteria. For information about siting criteria for right turn lanes, see the ODOT Analysis and Procedures Manual (APM).*

(https://www.oregon.gov/odot/Planning/Pages/APM.aspx)

Not all intersections that meet the siting criteria should have right turn lanes installed. In urban situations, only significant public roads and large private approaches should be

considered for installation of a right turn lane. A proliferation of right turn lanes along an urban arterial is undesirable for bicycles and pedestrians, creates an aesthetically unpleasing typical section, and may not improve safety throughout the section. Multiple right turn lanes could, in effect, create a continuous right turn lane, which is not desirable on state highways.

Right turn lanes should be designed in conformance with Figure 500-18. Preferably, a right turn lane should be 12 feet wide with a shoulder of 3 feet or 4 feet for curbed or non-curbed sections respectively. This allows for additional space for larger turning vehicles. In some instances, right turn lanes could be considered a turning roadway. Turning roadways are usually thought of in relation to interchange ramps. However, according to AASHTO, turning roadways include interchange ramps and intersection curves for right-turning vehicles. The AASHTO publication, "*A Policy on Geometric Design of Highways and Streets - 2011*" has extensive information on turning roadway design including sections on minimum radii, control radii, corner islands, minimum edge of traveled way, lane configuration and swept paths. However, in urban locations where space is constrained by the built environment, flexibility is necessary when laying out right turn lanes. *For urban locations, the dimensions in Figure 500-18 may be modified to meet context needs for flexibility.* See Part 200 for context information and Part 300, Sections 307 - 312 for urban right-turn lane design criteria.

When designing an urban right turn lane, bicyclist movements need to be accommodated. The goal for highway projects is to provide the highest appropriate level bicycle and pedestrian facilities possible within project scope and funding at a given location. It is desirable to connect new and existing networks while projects are being constructed. ***Contact the region Active Transportation Liaison to determine bicycle and pedestrian facilities appropriate for the project and to determine if alternate funding may be available.***

Where minimum bicycle lanes adjacent to the travel lane are existing or proposed, add~~ing~~ a bike lane to the left of the right turn lane. This helps reduce conflicts between right turning vehicles and through cyclists. In addition, providing the bike lane between the through travel lane and the right turn lane better aligns the cyclist with the downstream shoulder or continuation of the established bike lane. ~~However, creating~~Creating a bike lane between the through lane and the right turn lane establishes ~~a~~the conflict point further back from the intersection where the paths of right turning vehicles and cyclists must cross. ***Care must be taken to balance bicycle speeds, right turning vehicle speeds and operational queue lengths in the right turn lane to establish the appropriate bike and motor vehicle crossing location.*** Part 900 provides guidance for designing bicycle facilities. In this conflict area, the bike lane is generally marked with short skip striping. ~~However, more recently, the~~ The MUTCD and FHWA ~~have allowed~~now allow this area to be colored green ~~as an experimental condition~~inside of the skip stripe to draw more attention to the conflict area. Region Traffic and Roadway sections, ODOT bicycle and pedestrian coordinators and the ODOT, Technical Services, ~~Traffic~~ Roadway Engineering Section should be consulted for current guidance if it is determined that using this treatment in this location would be beneficial.

The standard width for a bike lane between a through travel lane and a right turn lane is 5 feet. This width is narrower than a standard bike lane against a curb. However, it is a minimum width and if the bike lane is too wide, it may appear to vehicle drivers as an added lane. Also, width added to a bike lane increases the overall width of the roadway section that must be crossed by pedestrians. Width of the right turn lane is critical as well. *The preferred width is 15 feet (12' lane, 3' shoulder) from the adjacent travel lane or bike lane to curb for most right turn lanes.* The additional 3 feet provides space for truck off-tracking and minimizes the need for a right turning truck to encroach on the adjacent lane when making the turn. In some instances, a 3-foot shoulder may not be adequate and additional width might be needed. However, that additional width has consequences. Right turn lane width in conjunction with bicycle lane width is a balance between providing enough space for the respective vehicle's lane use but minimizing the crossing distance for pedestrians at an intersection within the space available. *In urban locations, narrower than preferred right turn lanes may be appropriate. Part 200 and Part 300 provide design criteria for urban cross-sections and urban right-turn lanes.*

In some instances, dual right turn lanes may need to be considered. If used, dual right turn lanes need to be carefully evaluated for overall performance and impacts. When designing dual right turn lanes, there must be two lanes on the connecting roadway to turn into and there must be adequate length provided downstream before any lanes merge. The designer also must determine the appropriate design vehicles to use for side-by-side operation through the turning movement. *In rare locations, like at freeway ramp terminals leading to truck stops or warehousing districts, that may need to be two WB-67 vehicles making the turn simultaneously. However, in most locations, a WB-67 and an SU vehicle side-by-side is adequate for design. In other locations where truck volumes are low, an SU vehicle and a passenger vehicle may be sufficient. When considering dual right turn lanes as an option, consult the Region Traffic Section for input.* Dual right turn lanes are also difficult for pedestrians and bicyclists to navigate. Part 900 and the Oregon Bicycle and Pedestrian Design Guide provide information in regard to bicycle and pedestrian accommodation at dual right turn lanes. Consult the ODOT Bicycle and Pedestrian Design Engineer or the project resource for active transportation for guidance on design alternatives.

506.13 At-Grade Right Turn Acceleration Lanes

At-grade intersections generally should not have short tapers or acceleration lanes constructed for vehicles entering the state highway from a crossroad or another state highway. *Acceleration lanes are generally only provided at grade separated facilities. However, in some situations, acceleration lanes may be justified.* ***The following criteria outlines where at-grade right turn acceleration lanes can be considered. All of the criteria must be satisfied and requires joint approval from the State Traffic- Engineer and State Roadway Engineer through the design exception process.***

1. The posted speed on the main highway shall be 45 MPH or greater.

2. The V/C ratio of the right-turn movement without the acceleration lane shall exceed the maximum value listed in Tables 6 and 7 of the OHP for the corresponding highway category and location.
    a. Exception 2a: If trucks represent at least 10 percent of all right-turning vehicles entering the highway, then the V/C criteria may be waived.
    b. Exception 2b: If substandard sight distance exists at an intersection or right-turning vehicles must enter the highway on an ascending grade of greater than 3 percent, then the V/C criteria may be waived.
    c. Exception 2c: If crash data in the vicinity of the intersection shows a history of crashes at or beyond the intersection attributed to right-turning vehicles entering the highway, then the V/C criteria may be waived.
3. The peak hour volume of right-turning vehicles from the side street onto the state highway shall be at least 10 vehicles/hour for Rural Expressways and 50 vehicles/hour for all other highways.
4. **No other access points or reservations of access shall exist on both sides of the highway within the design length, taper, and downstream from the end of the taper within the decision sight distance, based on the design speed of the highway.**
    a. Exception 4a: **If positive separation between opposing directions of traffic exist such as raised medians or concrete barriers, then access control is only needed in the direction of the proposed acceleration lane.**

The State Traffic~~-Roadway~~ Engineer shall determine if a right-turn acceleration lane proposal meets the above criteria. Proposals are submitted to the State Traffic~~-Roadway~~ Engineer from the region and include an engineering investigation with data supporting the above criteria and a drawing encompassing the intersection and design length of the acceleration lane showing all access points and reservations of access to the highway. Only proposals for right-turn acceleration lanes from public streets should be considered. If the State Traffic Engineer determines that a right-turn acceleration lane proposal meets the above criteria, the proposal will be forwarded to the State Roadway Engineer for consideration of design standards. All right-turn acceleration lane proposals shall require the joint approval of the State Traffic-Engineer and State Roadway Engineer.

Special consideration is given to cyclists and pedestrians. Acceleration lanes create an unexpected condition for both pedestrians and cyclists. Every reasonable effort must be made to create conditions that make the crossing safer and easier for pedestrians and cyclists. **The acceleration lane shall be designed in accordance with Figure 500-21 "Right Turn Acceleration Lane from At-Grade Intersection".**

Free-flow acceleration lanes may be considered in rural or suburban areas provided the turning radius is tightened and the angle of approach is kept as close to a right angle as possible. These

combined elements will force right-turning drivers to slow down and look ahead, where pedestrians and bicyclists may be present, before turning and accelerating onto the roadway.

Figure 500-21: Right Turn Acceleration Lane from at Grade Intersection

RIGHT TURN ACCELERATION LANE FROM AT GRADE INTERSECTION

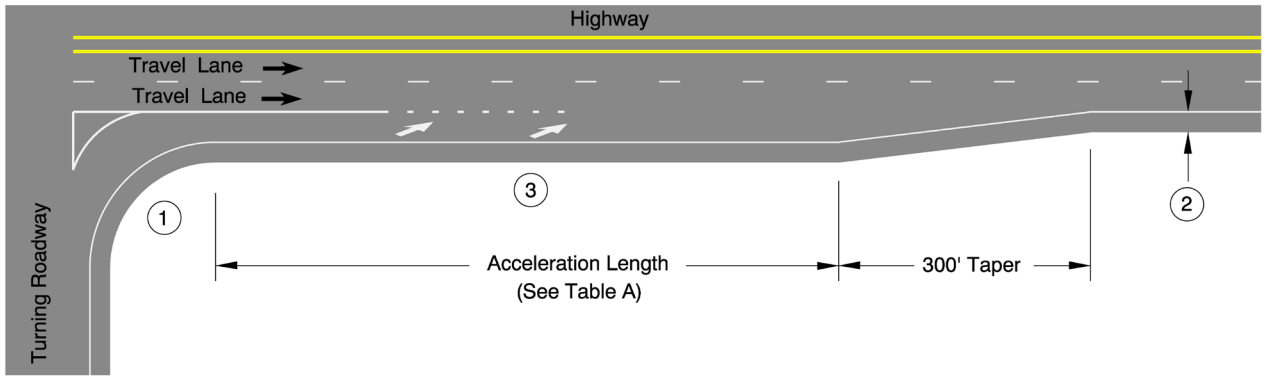


TABLE A
MINIMUM ACCELERATION LENGTH

Design Speed of Highway (mph)	Design Speed of Turning Roadway	
	Stop Condition	15 mph
50	720	660
55	960	900
60	1200	1140
65	1410	1350
70	1620	1560

TABLE B
MAINLINE GRADE AJUSTMENT FACTORS

Design Speed of Highway (mph)	% Grade	Upgrade	Downgrade
50	3% to less than 5%	1.3	0.65
55		1.35	0.625
60		1.4	0.6
65		1.45	0.6
70		1.5	0.6
50	5% and over	1.5	0.55
55		1.6	0.525
60		1.7	0.5
65		1.85	0.5
70		2.0	0.5

NOTES:

1. Radius shall accomodate design vehicles, yet minimize pedestrian crossing distance. Compound radii are recommended for larger design vehicles. Radii are measured to the edge of travel lane or face of curb.
2. Design shoulder width as required per Highway Design Manual
3. Use Table B to determine acceleration lenght adjustment due to grade.

STATE OF OREGON
DEPARTMENT OF TRANSPORTATION
ROADWAY ENGINEERING SECTION

RIGHT TURN ACCELERATION LANE FROM AT GRADE INTERSECTION

HIGHWAY DESIGN MANUAL

506.14 Median Acceleration Lanes

For ODOT purposes, a median acceleration lane is a lane added to the median of a roadway at an un-signalized intersection to allow left turning vehicles from a side road to gain speed and merge with main line traffic. Median acceleration lanes may seem like a reasonable solution to left turn problems onto busy, high-speed roadways and, in some locations, they may be an acceptable feature. However, their use should be reserved for locations with specific needs. Improper installation of a median acceleration lane may create unanticipated problems greater than the problems the installation is attempting to solve. ***Any location where a median acceleration lane is proposed must be analyzed carefully before a median acceleration lane is considered to be appropriate.*** Overall, there is little definitive research or information available on the use or effectiveness of median acceleration lanes. ~~What does seem to be known, however, is that~~The location is of critical importance to the effective function of a median acceleration lane. ~~*Therefore, site*~~*Site specific analysis is paramount in determining the appropriateness of installing a median acceleration lane.*

Median acceleration lanes function best on rural, multi-lane, free flowing roadways with ample median width and decision sight distance to accommodate not only the turning movements of all vehicle types, but to also provide the acceleration lane itself. ***Median width must be provided over a long enough distance to allow the accelerating driver to choose a gap in the traffic stream and merge smoothly prior to the end of the median acceleration lane.*** Median acceleration lane length will likely need to be longer than typical right side acceleration lane length ~~in order~~ to ensure adequate, comfortable and safe merge maneuvers into the traffic stream. *Additional run-out length should be provided downstream of the median acceleration lane taper. This will provide a "bail out" area or escape route ~~in the event that~~if no adequate gap is available for the accelerating vehicle in the main line traffic stream.* **Median acceleration lanes are ~~generally~~ not always appropriate for two lane roadways on the state highway system and shall not be installed on ~~such facilities in either rural or urban locations~~state highways without State Traffic~~ and State~~ Roadway Engineer approval~~s~~.** Figure 500-22 and Figure 500-23 provide information about Median Acceleration Lane layout.

Although not recommended, it may be possible to install a median acceleration lane on some limited access, divided, urban arterials or expressways with posted speeds of 45 mph or greater. However, this type of installation must be considered carefully. ***Median width and intersection spacing must be appropriate to allow the acceleration lane to function.*** **In addition, there shall be no right-side access points to the main line highway along the length of the median acceleration lane or within decision sight distance of the left side merge taper.** Right side accesses along a section of roadway with a median acceleration lane on the left side create the scenario of the main line traffic being impacted from both sides of the roadway at the same time. **Median acceleration lanes shall not be installed in locations with posted speeds below 45 mph.** When speeds are

below 45 mph, the differential of an accelerating vehicle and the traffic stream are not as great, and a median acceleration lane does not provide added benefit.

As discussed in the preceding paragraphs, in limited situations, a median acceleration lane may provide an incremental improvement to a multi-lane expressway by providing left turning vehicles an opportunity to accelerate and reduce speed differential before entering the traffic stream. This is particularly true where there are large numbers of left turning trucks. Where sufficient gaps exist in the main line traffic stream, a median acceleration lane is not needed and the cost of installation as well as potential environmental impacts of adding new impervious surface may not be justified. However, where there are few gaps in the main traffic stream and there is a high demand for left turning trucks or other large vehicles like RVs, motor homes or buses from the side road, a median acceleration lane may serve as an acceptable interim solution. ***A median acceleration lane is not a typical design. Contact Technical Services Roadway Engineering Unit staff for information regarding the installation of median acceleration lanes.*** **Before any median acceleration lane can be installed on the state highway system, approval from the State Traffic- and State Roadway Engineers must be obtained.**

Consideration may be given to install a median acceleration lane when all of the following criteria are met:

1. A multi-lane, divided expressway or arterial highway with a posted speed of 45 mph or greater
2. Adequate Median width to allow for desirable dimensions as shown in Figure 500-22 and Figure 500-23
3. Large left turning volume from side road – particularly truck volumes and recreational vehicle
4. Insufficient gaps or inadequate intersection sight distance (Particularly AASHTO B1, Right Side)
5. No right side accesses onto main line along the length of the acceleration lane or within decision sight distance of the end of the taper
6. Significant crash history – particularly truck crashes

Table 500-3: Desirable Length of Full Width Median Acceleration Lane

Posted Speed (mph)	2/3 of Posted Speed (mph)	Desirable Length of Full Width Median Acceleration Lane, Rounded (ft.)
45	30	810
50	34	995
55	37	1203
60	40	1435
65	44	1680

Note: Desirable Length Based on 200lb/hp Truck Accelerating to 2/3 posted speed
Minimum Median Acceleration Lane Length – 810'

The 200 pound per horsepower truck equates to the 85 percent truck in the national fleet based on studies reported in NCHRP Report 505, Review of Truck Characteristics as Factors in Roadway Design published in 2003. Table 29 in NCHRP Report 505 lists average acceleration capabilities for several different weight to power ratio classes of trucks. For the 200 pound per horsepower vehicles, the average acceleration listed is 1.22 ft./s^2. The following formula for uniform acceleration was used to determine the desirable lengths for Median Acceleration Lanes listed in Table 500-3.

$$V_f^2 = V_i^2 + 2AS$$

Where:

V_f = Final speed achieved at the end of distance S, ft./sec.

V_i = Initial speed, ft./sec. for Table 500-3, $V_i = 0$

A = Acceleration, ft./sec^2. A=1.22 ft./sec^2

S = Distance to accelerate to 2/3 of posted speed, ft.

Figure 500-22: Median Acceleration Lane - Narrow Median

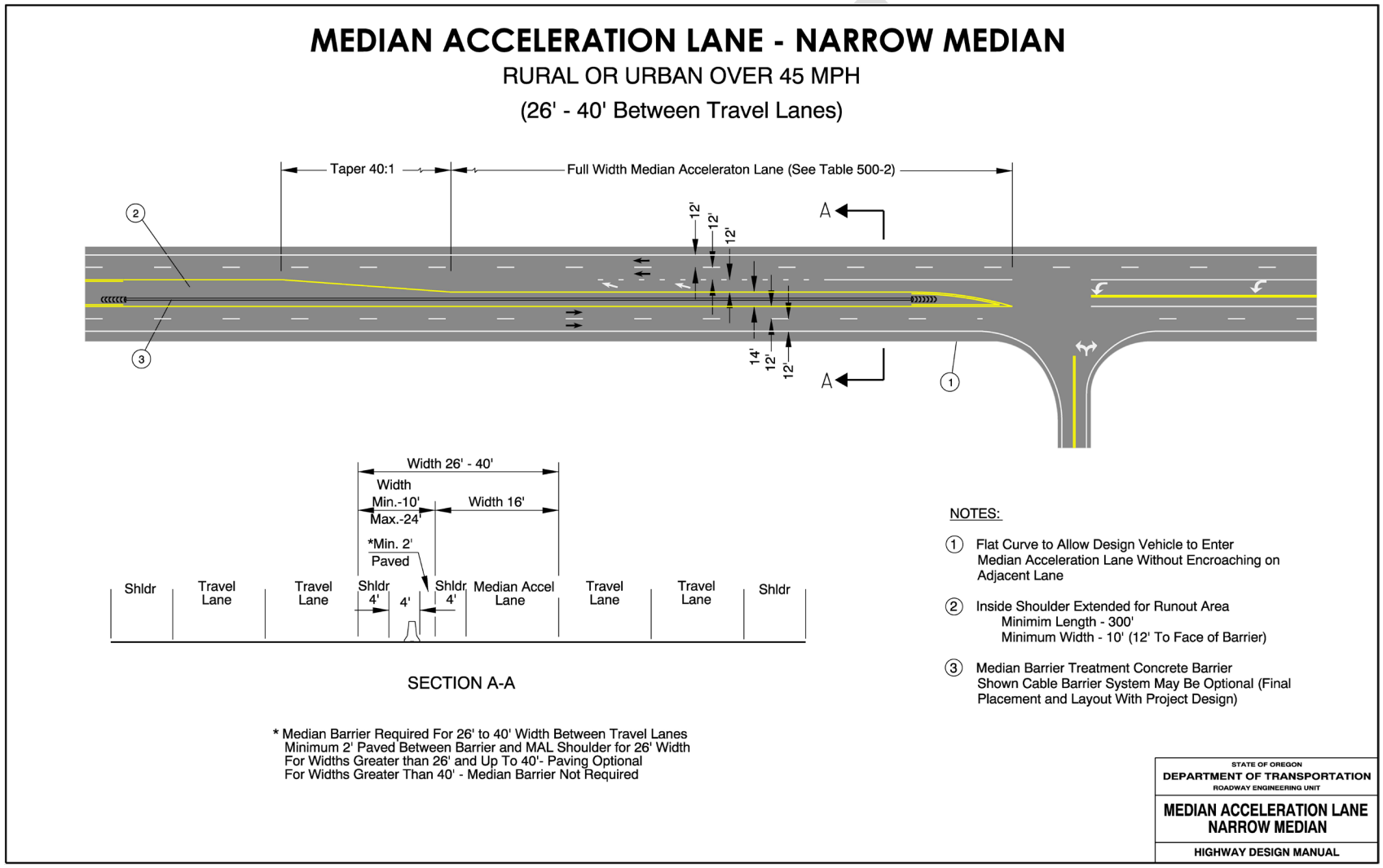
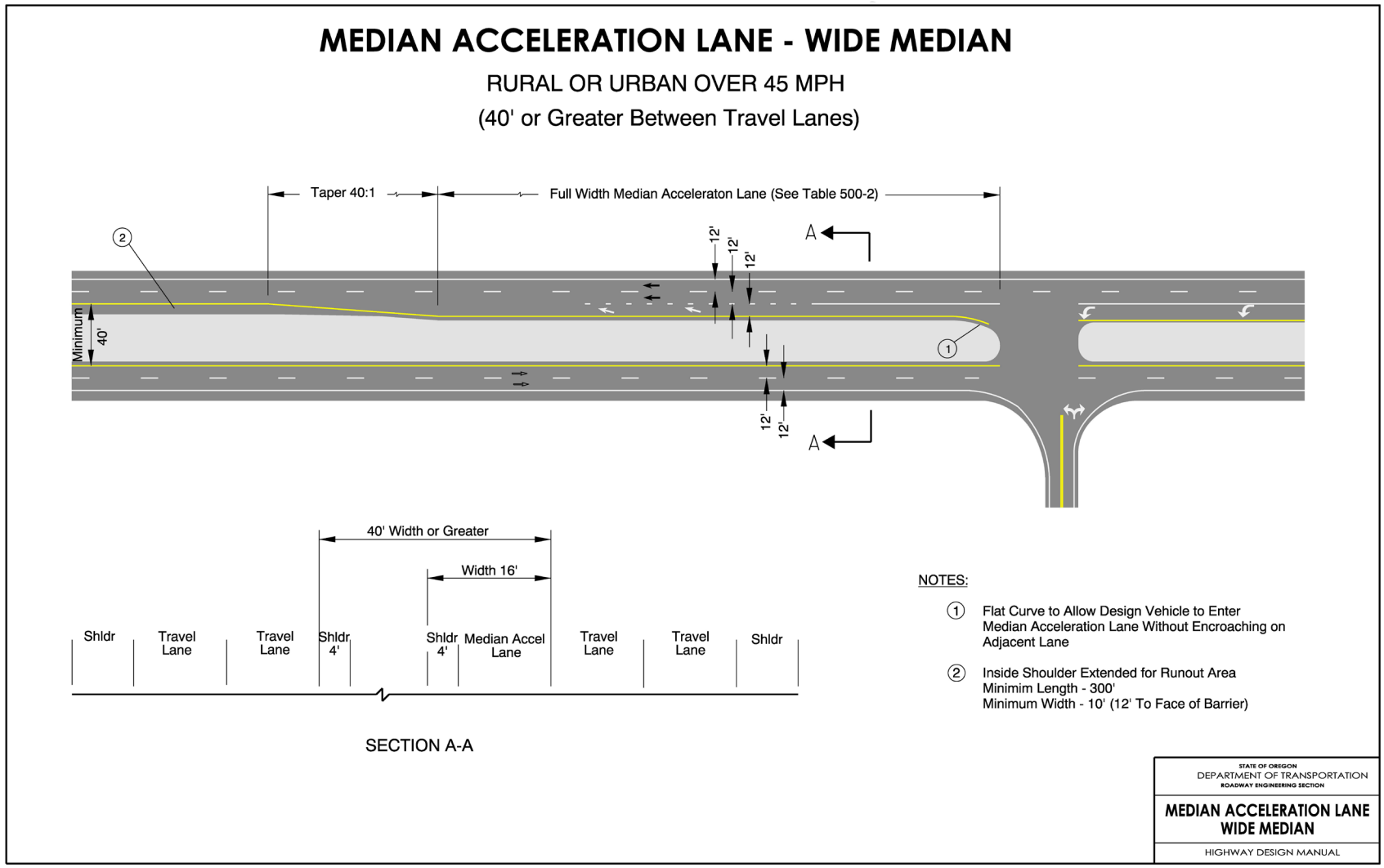


Figure 500-23: Median Acceleration Lane - Wide Median



506.18 Bicycle and Pedestrian Needs

The design of intersections ~~takes into account~~ must consider the needs of bicyclists and pedestrians. The level and amount of design effort required to ensure adequate design for these modes will vary among locations. ***Inclusive intersection designs keep the crossing distances and pedestrian exposure to a minimum. Pedestrians and motorists must be able to see each other clearly and understand how the other will proceed through the intersection.*** This can sometimes be difficult at major intersections that accommodate multiple turn lanes. When intersections become excessively large and complex, pedestrian safety is often at a higher risk. The roadway designer should provide mitigation measures to reduce the crossing distance to balance impacts for roadway users.

Providing pedestrians with a crossing that can be completed in one movement can improve crossing impacts. *However, when pedestrians must cross an excessive number of traffic lanes or a combination of excessive traffic lanes and a large skew angle, consider an appropriately sized pedestrian median refuge to enable pedestrians to cross the street in two phases.* A right turn channelization island can also be considered to reduce the pedestrians' exposure to both through and right turning vehicles. Curb extensions are a treatment available to reduce the crossing distance for roadways with on-street parking. Median refuges and right turn channelization islands may be more appropriate in suburban locations, and curb extensions may be a more appropriate treatment in more compact areas such as STAs or Commercial Business Districts. However, any of these treatments could apply in a multitude of situations. A general rule of thumb is to consider pedestrian crossing treatments when the crossing distance exceeds 90 feet in typical urban environments such as Urban Business Areas (UBAs) or Commercial Corridors and 72 feet in compact densely developed areas such as STAs, Traditional Downtown, or Urban Mix contexts.

Use protected intersection design to provide safer intersection operations for all users. See Part 900 for guidance on protected intersections.

ADA requirements shall be met in every intersection design. Issues such as curb ramps, location of pedestrian and signal poles, obstructions, fixed objects, drainage, etc., need to be reviewed and designed to be accessible and accommodate all roadway and intersection users. Part 800 for Pedestrian Design and Part 900 for Bicycle Facility design provides additional information on intersection accommodation.

506.19 Intersection Design Affecting Pedestrians

There are several aspects of intersection design that impact the safety, comfort ~~or~~, and access needs of pedestrians. For each identified issue, measures that can be used to mitigate these

effects will be proposed. In addition to the issues discussed below, see Part 800 for additional information about pedestrian design for intersections. The ODOT Traffic Manual is another resource available to roadway designers. Traffic control options for intersections are covered by the ODOT Traffic Section. Coordinate with the Region Traffic Section and the ETSB, Traffic Engineering Services Unit staff.

509.1 General

This section provides basic information and site criteria on both single lane and multi-lane roundabouts. Please contact the Technical Services, Traffic~~-~~ and Roadway Sections for additional design criteria and recommendations.

Traffic signals, stop signs and modern roundabouts are all forms of intersection control. Signal control and stop control are more established forms of intersection control and are well known to motorists, pedestrians and bicyclists. Signal control and stop control function by separating out individual traffic movements at an intersection in physical and temporal space. Each road user takes a turn or is delegated time and reasonable opportunity to move through the intersection space in sequence. However, intersections controlled by signals and stop signs do not always afford the most efficient or safest operation. When traffic volumes are low, signals can cause unnecessary delay by stopping traffic flow when conflicts do not exist. When traffic volumes are high, stop signs can cause long queues and extended delay. In addition, when motorists, pedestrians or bicyclists make mistakes or push the limits at signalized or stop controlled intersections, the results often cause severe injury or fatal crashes.

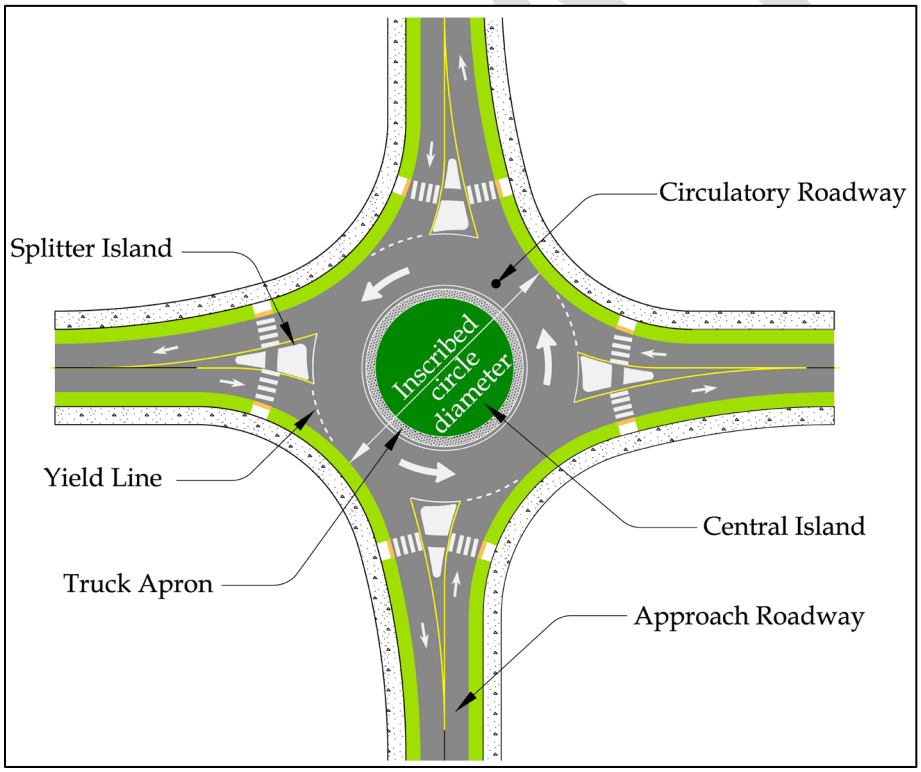
Modern roundabout controlled intersections have the potential to function much more efficiently and safely than signal controlled or stop sign controlled intersections ~~and~~because they do not stop traffic flow unnecessarily. By design, roundabouts allow for more consistent flow by slowing all vehicles through the intersection. By reducing delay, they improve vehicle fuel efficiency and reduce overall vehicle emissions at the intersection. They also function well during power outages or severe storm conditions. Modern roundabouts are an effective intersection control option on evacuation routes.

Modern roundabouts can also be safer than signalized or stop controlled intersections. By reducing conflict points, reducing speeds, and keeping traffic flowing in the same direction, both crash frequency and severity have been shown to be reduced when compared to other intersection control types. Roundabouts have been shown to be safer for pedestrians and bicyclists as well. By design, roundabouts lower vehicle speeds. Lower vehicle speeds translate to less kinetic energy transfer between vehicle-to-vehicle crashes, vehicle-to-bicycle crashes, and vehicle-to-pedestrian crashes. As a result, if a crash does occur in a roundabout, the severity is greatly reduced lessening the potential for a fatality or serious injury. Roundabouts are an effective tool when designing from a Safe System approach and part of an effective strategy to reduce fatalities and serious injuries at intersections.

~~However, roundabouts are not as prevalent as signals or stop signs and some~~Some people, including motor vehicle drivers, pedestrians, and bicyclists~~,~~ are unsure how to use ~~them.~~roundabouts because they are less prevalent than signals and stop signs. As a result, they

approach roundabouts with concern, both when discussing proposed installations and when encountering one on the highway. In some cases, drivers remember circular intersections of the past that were called “traffic circles” or “rotaries”. Many of these older circular intersections did not function well. As a result, many drivers have negative impressions of circular intersections that carry over to the present. By their design, however, modern roundabouts eliminate the undesirable design features of older traffic circles or rotaries and create an efficient and effective intersection control option with specific characteristics. The distinctive characteristics of a modern roundabout that separate it from a traffic circle or rotary include a raised central island with a circulatory roadway, raised splitter islands at the entry to introduce deflection to the vehicle path, and yield control for approaching vehicles. In older style circular intersections, circulating traffic yielded to the entering traffic and caused capacity problems that eventually leads to intersection lock-up at peak times. In various locations around the United States, operations at many of the original traffic circles and rotaries have been improved by incorporating some of the modern roundabout concepts into them where feasible. In some locations, the older style traffic circles have been removed entirely. Figure 500-33 details several major roundabout elements.

Figure 500-33: Elements of a Modern Roundabout



Studies have shown, even in communities where the initial majority viewpoint concerning the installation of roundabouts was negative, once roundabouts were installed and the community became used to driving them, the roundabouts have become a popular form of safe and

effective intersection control and the community viewpoint changed to positive for the installation of roundabouts.

509.3 Roundabout Selection Criteria and Approval Process

Roundabouts are proposed for a variety of reasons including safety improvements, operation improvements, community livability, traffic calming, aesthetic gateway treatments, etc. ***The State Traffic~~-Roadway~~ Engineer has been delegated the authority to approve the installation of roundabouts on State Highways~~.~~ in consultation with the State Roadway Engineer.*** Requests for roundabout evaluations are a collaborative process between the Region Traffic Unit and Region Roadway Unit. ***All roundabout requests sent to the State Traffic- Engineer and State Roadway Engineer for consideration shall be jointly sent by the Region Traffic Manager and Region Roadway Manager, accompanied by an Engineering Investigation that includes purpose, need and intent of installation of the proposed roundabout.*** In addition, the Engineering Investigation shall address the considerations as described in the following discussion.

Once the State Traffic~~-Roadway~~ Engineer receives a request, the Traffic- and Roadway Sections will coordinate a review with other technical staff from Technical Services and the Transportation Planning Analysis Unit (TPAU) to make a recommendation to the State Traffic-~~Roadway~~ Engineer. Analysis is performed to evaluate the roundabout option in relation to other traffic control options. This is ~~often considered as~~ an Intersection Control Evaluation (ICE) and may follow FHWA guidelines grounded in safety analysis. If the information provided is insufficient or not appropriate in methodology (see the ODOT Analysis Procedures Manual (APM))as determined by the Department) the State Traffic~~-Roadway~~ Engineer may request further analysis.

The approval process for roundabouts is divided into two phases: Conceptual Approval and Design Approval. ***The State Traffic~~-Roadway~~ Engineer will make the decision whether roundabouts will receive Conceptual Approval and move to the Design Approval phase~~.~~ in consultation with the State Roadway Engineer. Conceptual Approval must follow ODOT procedures that assure the roundabout can accommodate freight movement on the highway and this requires the Region to have conversations with the freight industry through the freight mobility committee review process (ORS 366.215; OAR 731-012). The State ~~Traffic -~~Roadway Engineer will make the final decision on the approval of the geometric design in the Design Approval phase.***

Conceptual Approval will constitute official approval under the Delegated Authorities of the State Traffic~~-Roadway~~ Engineer for a roundabout to be used as traffic control at a particular intersection. For Conceptual Approval, an Intersection Traffic Control Study addressing all

pertinent considerations described in this section will be required. ***In addition, a Conceptual Design of the intersection shall be submitted to the State Traffic~~-Roadway~~ Engineer for review by Traffic- and Roadway ~~Section~~Engineering Sections staff. Conceptual Approval will not be granted until staff in the Traffic- and Roadway ~~Section staff verifies~~Engineering Sections verify that Region has followed the ODOT procedures related to vehicle carrying capacity*** (*ORS 366.215; OAR 731-012*).

Design Approval will constitute the final approval phase of the roundabout at a particular intersection. The geometrics of roundabout designs (including channelization plans) must be submitted to the State ~~Traffic~~ Roadway Engineer for review and approval.

The Department has developed a list of considerations that should be addressed in the Engineering Investigation that is submitted for proposed roundabout locations. These considerations should not be interpreted as roundabout warrants, nor should they be considered pass/fail criteria for installation of a roundabout. ~~Rather, they~~These have been identified as important considerations to ~~take into account~~evaluate when proposing roundabout intersections on state highways.

1. Freight Mobility needs should be sufficiently defined and addressed prior to Conceptual Approval.
2. Motorized user mobility needs must be balanced with the mobility needs of non-motorized road users. The ability for bicyclists and pedestrians to safely move through the roundabout intersection is equally important as the mobility needs of motorized vehicles. Designers are encouraged to first utilize separated bicycle facilities with their roundabout designs where applicable and appropriate. At a minimum, bicyclists are given the option to use either the circulating roadway with other vehicles or the pedestrian crosswalks outside the circulatory roadway. Special design considerations are needed for the pedestrian crosswalk at the entrances and exits on all legs of the roundabout where vehicles are either decelerating to enter the roundabout or accelerating to exit the roundabout. Multi-lane roundabouts, like other multi-lane intersections, have potential for "multiple threat" conflicts between vehicles and pedestrians, particularly low vision and blind pedestrians. The Public Rights-Of-Way Accessibility Guide (PROWAG) has identified the need for pedestrian-activated crossing capability at multi-lane roundabouts. Although not explicitly required at this time, rulemaking is proposed, and it is prudent to design a multi-lane roundabout for easy installation of the necessary equipment in the future. Crosswalk placement, striping, installing conduit as well as identifying and reserving necessary equipment locations even though final installation of all the equipment is not necessary at this time, is good design practice and can save money in the future. Generally, Rectangular, Rapid Flashing Beacons (RRFB) are being installed at multi-lane roundabout entrances on state highways.

3. Roundabout design should consider the needs and desires of the local community including speed management and aesthetics.
4. Intersection safety performance is a primary consideration when pursuing a roundabout for intersection control. Predicted reductions in fatal and serious injury crashes is compared with other types of intersection control such as traffic signals or other alternatives supported by crash modification factors (CMF) from the AASHTO Highway Safety Manual.
5. Roundabout entrance geometry, circulating geometry and exit geometry is designed to allow the design vehicle to traverse the roundabout in a reasonable and expected manner commensurate with best design practices as shown in NCHRP Report 1043, Guide for Roundabouts and the HDM. This design utilizes a representative template of the design vehicle, and the vehicle path is demonstrated ~~through the use of~~using computer-generated path simulation software.
6. Roundabouts should meet acceptable v/c ratios for the appropriate Design Life. Analysis ~~takes into account~~considers when in the Design Life the roundabout will most likely reach capacity. Roundabouts can still function well at V/C values of 0.90. Building a roundabout too large for initial operations can negatively impact safety performance (See subsection 1206.3 Design Guidelines regarding design life for possible exceptions to this consideration.)
7. Roundabouts proposed for the state highways with posted speeds higher than 35 mph will require special design considerations (e.g., possibly longer splitter islands, specific landscaping, possibly reversing curve alignments approaching the roundabout, etc.) to transition the roadside environment from higher to lower speeds approaching the roundabout intersection. A roundabout needs to be seen by approaching drivers and in higher speed locations needs a higher level of conspicuity.
8. For roundabouts with more than 4 approach legs, special design considerations should be made for the layout of the approach legs.
9. Roundabout proposals should address how roundabout operations would impact the corridor immediately upstream and downstream from the roundabout intersection. (If the proposed roundabout is in a location where exiting vehicles would be interrupted by queues from signals, railroads, draw bridges, ramp meters, or by operational problems created by left turns or accesses, these problems should be addressed by the Engineering Investigation.

For brevity, the following is summarized from the ODOT Traffic Manual, Section 403, Roundabouts, and is included in a bulleted, step-wise listing. For the full text, reference the ODOT Traffic Manual.

Steps in the Roundabout Selection Criteria and Approval Process include:

1. Perform an engineering Investigation including a comprehensive Intersection Traffic Control Study. In addition to site specific intersection data, the investigation should include comparisons of intersection control types (i.e., stop controlled, signal controlled, roundabout, etc.)
2. Determine design Life – generally 20 years for STIP projects and 10 years for development review.
3. Submit a scaled Conceptual Design of the proposed roundabout to the State Traffic-~~Roadway~~ Engineer for approval including roundabout type, geometry, topography, influence area, approximate right-of-way required as well as other pertinent design information and impacts. Figure 500-33 illustrates major design elements of a roundabout.
4. After Concept Design Approval has been obtained, submit a refined Design Package to obtain Design Approval from the State ~~Traffic~~ Roadway Engineer. This Design Package should include:
    a. Channelization plans, completed per the Department's guidance for roundabout pavement markings found in the Traffic Line Manual and for splitter islands found in the Highway Design Manual.
    b. A summary of the documented design decisions including
        i. how the requirements of Highway Division Directive DES 02 have been net, or
        ii. How the OAR 731-012 process (Reduction of Vehicle Carrying Capacity) has been met.
    c. Identified deviations from design standards where design exceptions might be needed.
    d. Roundabout geometric data, including:
        - Approach, entry, exit, and circulating design speeds for all approach legs including any bypass legs for right-turning vehicles. (Bypass legs should be designed for speeds no more than 5 mph greater than the design speed of the circulatory roadway in order to accommodate bicycles and pedestrians crossing the bypass leg);
        - The design vehicle for each movement and accommodations for other special vehicles (e.g., permitted loads, farm equipment, etc.);
        - A table or drawing summarizing the roundabout design details, including inscribed diameter, central island diameter, truck apron designed to accommodate the appropriate design vehicle for the roundabout, and cross slope of the circulating roadway;

- Detailed drawings showing the fastest path for each movement, with speed and radius for each curve;
- A table summarizing stopping and intersection sight distance on each leg; and
- Computer generated (AutoTurn) paths showing design vehicle and largest oversize vehicle movements (The Highway Division Directive DES 02 process will help identify the oversized loads that could be expected).

5. Detailed drawings of the splitter islands on each leg. These should include pedestrian and bicycle accommodation, ramps, etc.
6. Preliminary signing and illumination plans.

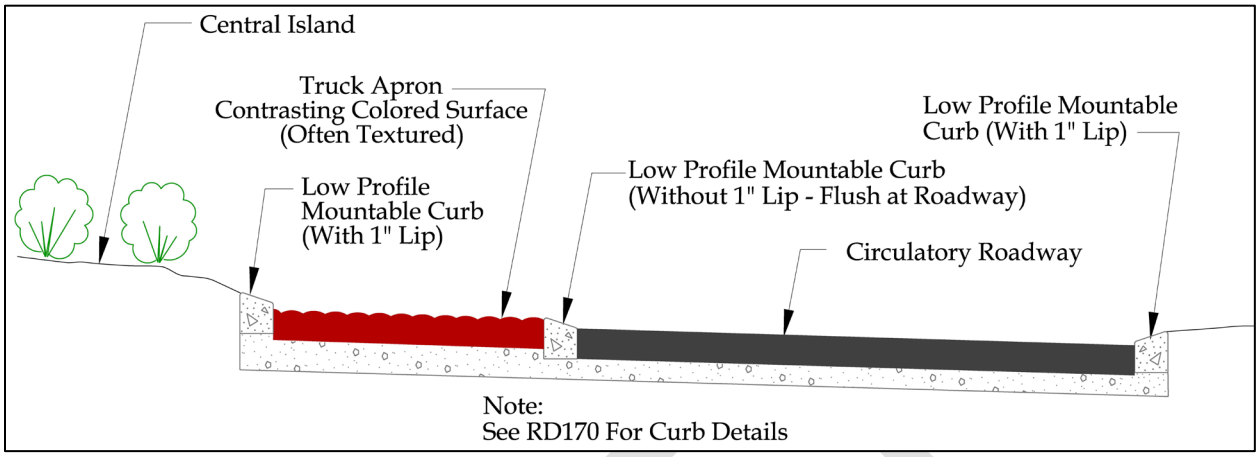
509.7 Inscribed Circle and Central Island

The inscribed circle is the outside edge of travel of the circulatory roadway. The central island is the raised area surrounded by the circulatory roadway. There are two areas of a central island, the mountable truck apron and the non-traversable center raised area. Figure 500-38 shows a typical cross-section of a roundabout including the basic elements of the truck apron, circulating roadway and central island.

Low profile mountable curbing is used for roundabouts on the state highway system. ***For truck aprons or where it is anticipated that trucks will need to mount the curb to maneuver through a roundabout, the low-profile curb is installed without the 1-inch lip and the edge of the slope is flush with the roadway finish surface. On splitter islands approaching the roundabout, the low-profile curb is generally installed with the 1-inch lip at the roadway finish surface. However, if there are locations along the splitter island where it is intended for large or over-sized vehicles to mount the curb ~~in order~~ to traverse the roundabout, the curb can be installed without the lip and flush with the roadway finish surface. See RD170 for curb details at roundabouts on the state highway system.***

It is important to maintain color differentiation between roadway areas, apron areas and splitter islands. This helps drivers see and understand the different areas of a roundabout and where they should be driving. It is strongly recommended to use red brick coloring for concrete truck apron and splitter island surfaces~~.~~ if using concrete as the traveled lanes near and inside the roundabout. This will provide strong color differentiation when either concrete or asphalt is used for the roadway surfacing. Patterning the apron and the splitter island surfaces is also recommended. Patterning discourages passenger vehicles from using the apron area unless necessary.

Figure 500-38: Typical Roundabout Cross-Section Elements



The Interstate Design Vehicle (WB-67 class truck) is the standard design vehicle for roundabouts on the state highway system. ***Vehicles larger than a WB-67 vehicle will be accommodated at roundabouts where necessary as determined through conversation with the ODOT Statewide Mobility Program and appropriate highway user groups.***

The truck apron is a key roundabout design element to provide passage and accommodation of the design vehicle and larger vehicles through the roundabout. Encroachment onto the truck apron is permitted and encouraged ~~in order~~ for large vehicles to effectively traverse a roundabout; however, vehicles smaller than the Interstate Design Vehicle may be accommodated without encroachment.

To minimize circulatory roadway width for single lane roundabouts, some states use the design philosophy that the circulatory roadway should be only wide enough to allow passage of a standard bus, fire truck, or ambulance without using the truck apron and therefore, all larger vehicles would use the truck apron for off-tracking. This is good design practice to minimize the circulatory roadway width, reduce cost, reduce impacts to adjacent properties, and provide a more comfortable ride for passengers. ~~However, design~~

Design each roundabout to fit the location needs and to provide the most appropriate design elements for the traffic stream expected to use it. In the case of mini-roundabouts or compact roundabouts, the central island may need to be mounted by all larger vehicles. In rare, single lane locations where high proportions of heavy vehicles are expected, the design of adequate circulatory roadway width with minimal use of the truck apron might be appropriate. ~~However, it~~It is anticipated that ~~these~~ locations with wider circulating lane width would be the exception as a special case ~~and few in number.~~ .

Increasing circulatory roadway width or inscribed diameter to accommodate large vehicles within the circulatory roadway will generally increase the fastest path speeds through the roundabout for smaller vehicles, thereby potentially negating some of the safety benefits

afforded by roundabouts. *A balance must be maintained between accommodating large vehicles and the safe, effective passage of general traffic for which the roundabout is intended.*

NCHRP Report 1043, Guide for Roundabouts lists ranges of acceptable inscribed diameters for both single lane and multi-lane roundabouts. For a WB-67 vehicle and a single lane roundabout, suggested inscribed diameters are from 130 feet to 180 feet and for multi-lane roundabouts the suggested range is from 165 feet to 220 feet for 2-lane roundabouts and up to 300 feet for 3-lane roundabouts. However, NCHRP Report 1043 was written to cover roundabouts in all applications including national highways, state highways and local jurisdictions.

For general design parameters on the state highway system, the inscribed circle diameter for a single lane and multi-lane roundabouts accommodating the Interstate Design Vehicle generally follows the inscribed circle diameter of the NCHRP Report 1043. However, for Oregon state highways, ORS 366.215, OAR 731-012, and directive DES-02 must also be considered and appropriate procedures followed when determining the design inscribed diameter of a roundabout. Table 500-5 provides guidance for inscribed diameters. For roundabouts proposed on a reduction review route, the OAR 731-012 process leads to a record of support and documents collaboration with interested parties. See Oregon Revised Stature 366.215 Implementation Guidance for more information. On non-reduction review routes, the DES-02 process provides agreement of the roundabout being "properly sized".

If a smaller vehicle than a WB-67 class vehicle has been deemed the appropriate design vehicle, a smaller inscribed diameter may be acceptable. **~~Use of~~Using inscribed diameters smaller than the minimums described above require design concurrence and/or design exceptions. Contact the Technical Services, ~~Traffic~~ Roadway Engineering Section for guidance.**

In addition to design vehicle considerations, there are many other factors to consider when determining the inscribed diameter for a proposed roundabout. There may be locations where a smaller inscribed diameter is appropriate to accomplish overall intersection control goals. These locations should be considered on a case-by-case basis and designed accordingly to achieve the necessary intersection control. These designs may be based on a smaller design vehicle if deemed appropriate through conversation with the ODOT Statewide Mobility Program and the requisite highway user groups.

If a WB-67 class vehicle is the design vehicle and a smaller diameter is proposed, then the truck apron may need to be widened for accommodation. However, widening the truck apron will reduce the central Island diameter and may create undesirable visibility and sight lines across the roundabout. In lower speed, urban locations, this may not be a substantial consideration.

Table 500-5: Roundabout Inscribed Diameters

ROUNDABOUT INSCRIBED DIAMETER		
	NCHRP Report 1043	ODOT Range

Design Vehicle	**Single Lane	Multi-Lane		**Single lane	Multi-Lane (2-Lane)
		2-Lane	3-Lane		
WB-67	120 ft. - 180 ft.	140 ft. – 180 ft.	190 ft. - 240 ft.	*130 ft. -180 ft.	*175 ft. – 220 ft.
SU-30 Bud-40 WB40/ WB-50	65 ft. - 130 ft.	135 ft. – 160 ft.	190 ft. - 240 ft.	*95 ft. -130 ft.	*165 ft. – 220 ft.

* Design exception required for smaller inscribed diameters

** Mini-roundabouts and compact roundabouts are special cases of single Lane designs and have general diameters from 45ft. – 90ft. and from 65ft. – 120ft. respectively

In addition to the inscribed diameters shown in Table 500-5, there are inscribed diameter ranges of smaller diameters that can be utilized in certain locations to meet operation and safety needs with minimal to no right-of-way acquisition. Depending on diameter and agency terminology, these types have been termed “mini-roundabout” or “compact roundabout”. In general, mini-roundabouts fall into a diameter range of 45 ft. to 90 ft. and compact roundabouts are considered in the 90 ft. to 130 ft. range. These are generally used on city or county roadways with minimal or no large vehicle traffic.

For the needs and vehicles that utilize the state highway system, there are few places where these smaller diameter roundabouts would be appropriate. However, there may be some locations where a mini or compact roundabout would work well on the state system and these two additional types of roundabouts should not be arbitrarily dismissed. The safety benefits afforded by roundabouts, even small diameter ones, are well documented. Roundabouts should be considered whenever intersection safety improvements are considered. If a smaller inscribed diameter roundabout is proposed for a design, contact the Technical Services Roadway Engineering Unit for guidance. In the right location and with proper design, mini and compact roundabouts can provide safe and efficient intersection traffic control for minimal cost.

509.8 Roundabout Cross Section

Once the inscribed diameter has been established, circulatory roadway width and truck apron width can be determined. The circulatory roadway is the area between the outside curb and the truck apron. This is the area where the majority of traffic will traverse the roundabout. For single lane roundabouts, circulatory roadway widths should provide adequate width for most vehicles to comfortably maneuver through the roundabout, provide for some off-tracking of larger vehicles up to the design vehicle, but not be so wide that drivers may feel there is more than one lane in the roundabout.

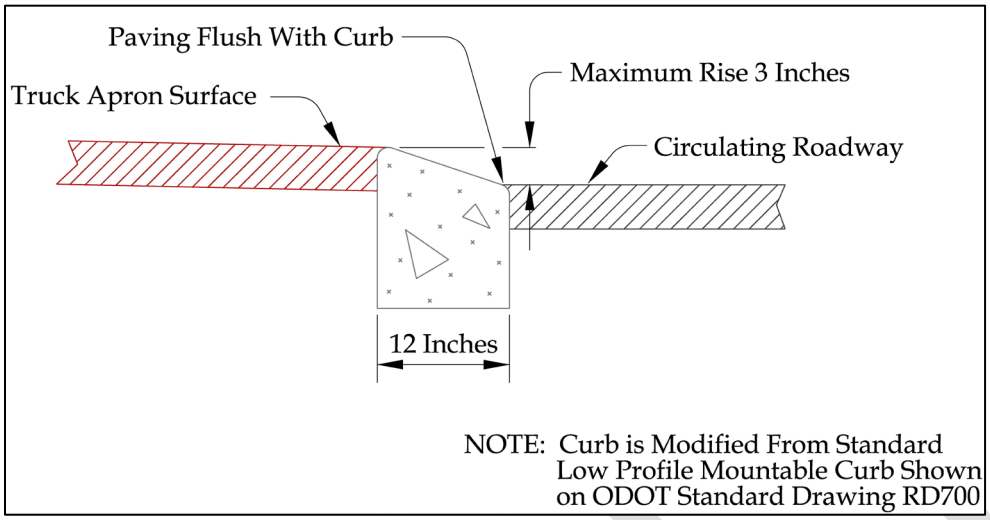
~~For all roundabouts, circulatory~~Circulatory roadway width is based on the number of entering lanes and the turning requirements of the design vehicle. Generally, the circulating width should be at least as wide as the maximum entry width and in some cases~~,~~ it may be appropriate to increase the width up to 120 percent of entry width.

The recommended circulatory roadway width for a single lane roundabout on the state highway system is 21 feet, excluding the truck apron width. For multi-lane roundabouts, the suggested circulating width is 14 feet to 16 feet per lane or 28 feet to 32 feet for a two-lane roundabout on the state highway system. The suggested circulatory roadway widths are based on general design characteristics. Circulating widths ~~for specific designs~~ should be checked using design vehicle turning characteristics and overall intersection control parameters governing the intended need for the roundabout installation. ~~Circulatory roadway width should not jeopardize intended speed control of a roundabout.~~ Larger diameters and wider lanes tend to increase circulating speeds which could jeopardize the intended speed control of a roundabout.

Central island truck aprons are an integral design element of a roundabout that provides accommodation for large vehicles while maintaining deflection and design controls for general traffic to achieve effective roundabout design at an intersection. A truck apron is generally designed in such a way that when traversed by a passenger car, it would feel uncomfortable but not unsafe. **Truck aprons shall be designed to allow for efficient transition to and from the circulatory roadway for large vehicles. Modified, low profile curbs no higher than 3 inches shall be used for delineation and transition between the circulatory roadway and the truck apron.** ***For some designs with specific needs, the total rise of the modified low profile curb could be lowered to 2 inches to facilitate specific vehicles.*** However, this is not a standard curb cross-sectional shape and will potentially require additional hand work to form and construct. This can increase cost and construction complexity. **Curbs for the truck apron shall be installed flush with the circulatory roadway.** See Figure 500-39. For full curb design at roundabouts. (See Standard Drawing RD170.)

As discussed in Section 509.7, it is important to maintain color differentiation between roadway areas, apron areas and splitter islands. ***It is strongly recommended to use red brick coloring for concrete truck apron and splitter island surfaces.*** This will provide strong color differentiation when either concrete or asphalt is used for the roadway surfacing. Patterning the apron and the splitter island surfaces is also recommended. Patterning generally discourages passenger vehicles from using the apron area unless necessary. (See Figure 500-38, Typical Roundabout Cross-Section Elements.)

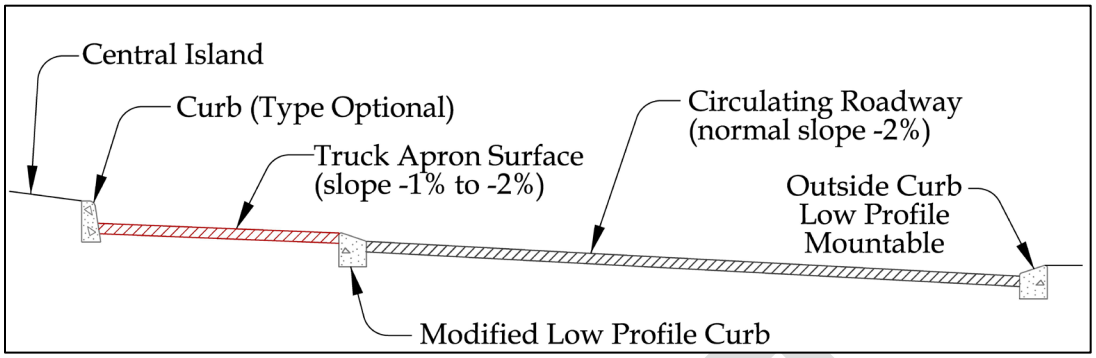
Figure 500-39: Truck Apron Modified Low Profile Mountable Concrete Curb



Truck apron width is determined by turning requirements of the design vehicle and other large vehicles being accommodated through the roundabout. Vehicle paths can be simulated using computer software to determine off-tracking needs. *Typical truck apron widths range from 10 feet to 20 feet~~.~~ ~~However~~, but wider aprons can be used to accommodate specific vehicle movements as needed. Central islands and truck aprons do not need to be limited to a circular shape. While this is the typical configuration, they can be shaped to meet turning movement needs.* Figure 500-42 illustrates a non-circular central island.

In general, past design practice set cross-slope of the truck apron at 2 percent from the roundabout center to the apron curb (-2 percent). However, more recent design philosophy is leaning to utilizing a 1 percent cross-slope to better accommodate specific large vehicle combinations. Truck apron cross-slope needs to be carefully determined ~~in order~~ to not introduce undesirable dynamics to large vehicles as they traverse the apron. This is particularly true when accommodating low–boy trailers, oversize loads, loads with high centers-of-gravity or loads that can shift, like bulk liquid loads. Low-boy trailers can pose ~~particular~~ problems with the vertical profile between the apron and the circulating roadway. Some low-boy trailers have only six inches of clearance from the ground to the bottom of the trailer frame. Truck apron cross-slope should be only as steep as necessary to provide adequate drainage. Smooth transitions between the circulating roadway and the apron are crucial to effective design and in most all cases should not be greater than 2 percent in differential slope.

Figure 500-40: Typical Truck Apron and Circulating Roadway Cross-Slope



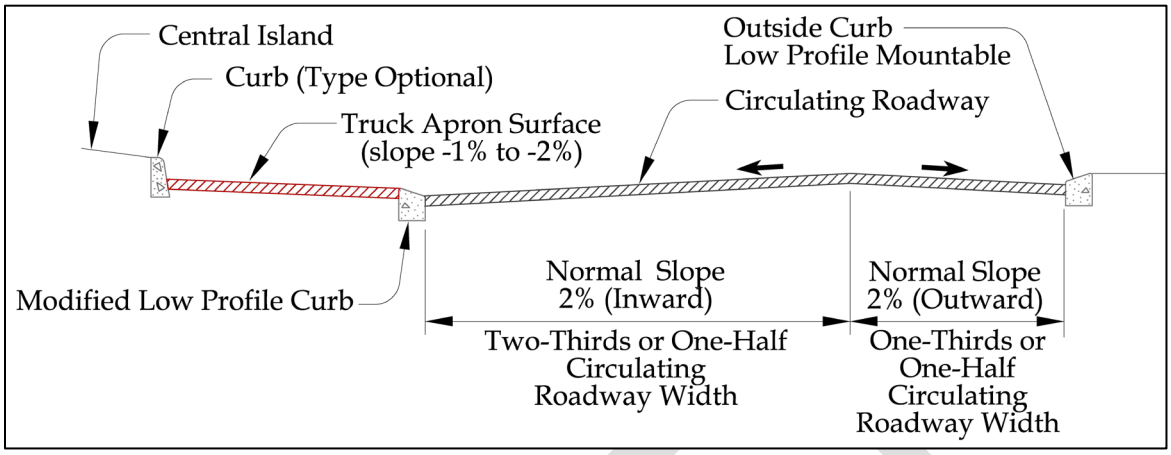
Cross-slope of the circulating roadway is also usually at 2% outward (-2%) keeping the truck apron and circulating roadway relatively parallel with each other. Figure 500-40 Illustrates typical truck apron and circulating roadway cross-slope. Advantages to this cross-slope design include:

1. Raising the central island and improving its visibility,
2. Lowering circulating speeds by introducing adverse superelevation,
3. Minimizing breaks in the cross-slope of the entrance and exit lanes. And
4. Helping drain surface water to the outside of the roundabout minimizing the drainage system.

In the past, significantly altering the cross-slope relationship between the truck apron and the circulating roadway was generally not an accepted practice. However, more recent research and analysis investigating varying this relationship from the typical -2% across the truck apron and circulatory roadway has shown there may be some benefit to certain vehicle movements through roundabouts, as well as potential drainage benefits.

Some agencies have opted to slope the truck apron inward toward the central island. In locations subjected to high incidence of precipitation, this option can reduce runoff across the circulating roadway. This can also have a beneficial effect of less ice buildup on the circulating roadway in colder climates. Depending on adjacent geometry of a particular roundabout, sloping the truck apron inward can also have a positive effect in minimizing the potential for load shifting. However, sloping the circulating roadway inward may require additional drainage for storm water removal.

Figure 500-41: Truck Apron and Crowned Circulating Roadway Cross-Slope



Some agencies are developing roundabout geometries that include a crown section on the circulating roadway. In this option, the inner portion of the circulating roadway is sloped inward towards the truck apron and the outer portion is sloped outward away from the truck apron. The crown section is usually divided into two-thirds of the circulating roadway width sloping inward and one-third sloping outward. The roadway width could also be divided in a half inward and a half outward scenario. Figure 500-41 illustrates the crowned circulating roadway concept.

Agencies that are developing these alternative cross-sections feel they may be of benefit in accommodating oversize and overweight vehicles at roundabouts. The theory is to minimize vertical movement as a large vehicle transitions on and off the truck apron. Disadvantages to using a crowned circulating roadway section are:

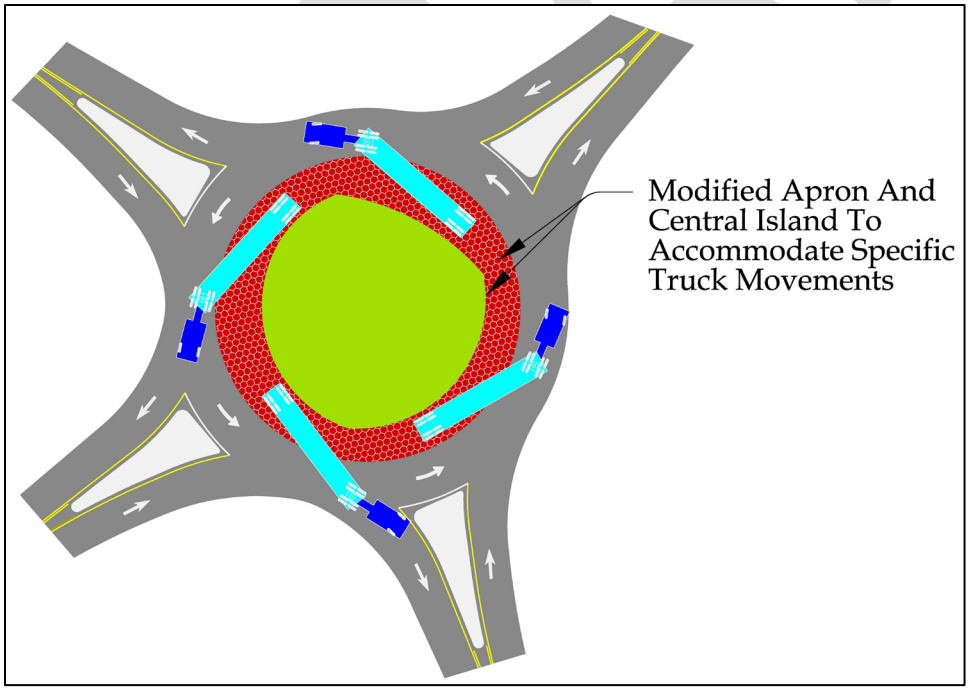
1. More inlets are required to handle the drainage and the drainage system is more complex with the potential for increased maintenance.
2. The crown section introduces a break point in the vehicle path at entrances and exits that must be adequately blended for both comfort and clearance problems for low ground clearance vehicles.
3. Sloping the circulating roadway inward reduces or eliminates the adverse superelevation of the fastest path through the roundabout. This can increase some vehicle speeds on the circulating roadway.

The alternative roundabout cross-sections discussed in this section are not the preferred cross-section for roundabouts on the state highway system in Oregon. They are discussed here because some agencies are using them, and they seem to have benefits in certain locations. However, their use is not wide spread, and more information is needed to understand if there are unforeseen negative impacts.

However, the cross-section of a roundabout is designed, the vertical profile that a vehicle traversing a roundabout follows is a critical piece of the overall roundabout design. Designers must analyze the design profile for the paths of all vehicles that will be using the roundabout. This is particularly important for large vehicles that will need to utilize the truck apron and for low-boy trailers with limited ground clearance. The vertical clearance can be checked by drawing a chord across the truck apron in the position of the trailer's swept path. It is also important to analyze vertical clearance along the circulatory roadway itself. In some cases, the warping of the profile to blend transitions at exits and entrances can create high spots that a turning trailer may contact under dynamic loading or twisting of the trailer frame.

The truck apron is a critical element of a roundabout and there is no set truck apron width. It needs to be wide enough to accommodate appropriate vehicle movements. A 10 foot to 15 foot width is a good starting point. Large vehicles making left (270 degree) turns will generally have the greatest off-track. Apron width may need to be increased to accommodate this movement for some vehicles. Truck aprons and the corresponding central island do not necessarily need to be round. There are examples of oval shaped central islands and odd shaped aprons that have been used to accommodate specific vehicles. Truck aprons utilizing "cut-out" central island sections have also been employed ~~in order~~ to optimize truck movements at some locations. Figure 500-42 illustrates modifying the truck apron and central island to accommodate truck movements.

Figure 500-42: Modified Truck Apron



Modifying the central island and truck apron can be beneficial in small diameter roundabouts by keeping the footprint small and still accommodating large vehicles. This can also work well at normal sized roundabouts that accommodate oversize vehicles. However, care must be taken

in not creating an apron wider than necessary. Widening the truck apron will decrease the remaining raised center area.

One important reason for the raised center area is to provide a visual screen using vegetation to restrict visibility from one side of the roundabout to the other. The term used in roundabout design for blocking the view across a roundabout with earth mounding or vegetation is "Terminal Vista". The center area needs to be visible to approaching drivers to indicate to them the existence of the roundabout. If an approaching driver can see across the roundabout, there may be a tendency to think the road continues straight through the intersection and the driver may be unaware of the necessity to deviate and maneuver around the circulatory roadway. Long range approach visibility of the central island is important at all roundabouts, but it is paramount at rural locations where approaching vehicles are traveling at a greater speed differential between normal roadway speed and roundabout entrance speed. A driver needs time to understand and slow down on approach to the entrance. The roundabout needs to be conspicuous to drivers.

In a positive sense, wider aprons can increase sight distance to the left for a driver judging a gap when entering a roundabout. Balance needs to be maintained between a truck apron wide enough to accommodate vehicles and aid in entering sight distance, but not create visibility or recognition problems for approaching traffic. If a roundabout's inscribed diameter needs to be in the smaller end of the suggested NCHRP Report 1043 range for design, a wider apron may be necessary to accommodate large vehicles. Designing for these situations needs careful consideration to ensure compromises do not negatively affect overall roundabout performance.

509.15 Design for Bicyclists

~~*As in general roadway design for bicyclists, greater*~~Greater emphasis is being placed on separated bicycle facilities at roundabouts. ~~*That is the*~~*The preferred method is to accommodate cyclists* ~~*and all efforts should be made to achieve*~~*on separated facilities.* ~~*However, not*~~Not all locations will have the ability to include fully separated designs. When fully separated designs are not possible, bicyclists are given a choice to enter a roundabout as a vehicle and occupy a lane until exiting the roundabout, or to use the sidewalks and crosswalks with pedestrians. Occupying a lane through the roundabout will, in most cases, be the most expedient method of traversing a roundabout for a bicyclist. ~~However, riding~~Riding with traffic in a roundabout may not be comfortable for many bicyclists. For these bicyclists, a bike ramp is provided for them to exit the bike lane on approach to the roundabout and use the sidewalk and crosswalks in the manner of a pedestrian.

In single lane roundabouts, occupying a lane through the roundabout is less complicated than occupying a lane in a multi-lane roundabout. With a single lane roundabout, bicyclists will generally be traveling at relative speed to other vehicles on the roadway. Since it is easier to command the lane in a single lane roundabout, there is less chance of a bicyclist being cut off at

an exit by a motorist. Also, bicyclists are more visible to motorists in a single lane roundabout, as there is less room and less distraction for vehicle drivers.

Multi-lane roundabouts pose greater challenges to bicyclists when occupying a lane to navigate through them. The greater complexity of multi-lane roundabouts may cause bicyclists to be less visible to motorists. Bicyclists will have a greater challenge in controlling the lanes in a multi-lane roundabout and there is greater potential to be cut off at an exit. Depending on roundabout configuration and bicyclist destination, a bicyclist may need to enter the roundabout in the left lane of a multi-lane roundabout. This may not be familiar or expected by other roundabout users. When considering bicycle access and movement through a multi-lane roundabout, it is important to remember that ORS 811.292 and ORS 811.370 have provision for "commercial motor vehicles" to operate outside a single lane in a multi-lane roundabout when necessary. Like other vehicle drivers traversing a roundabout, bicyclists must not pass or ride beside a commercial vehicle. In Oregon, by statute (ORS811.292), it is a Class C Traffic Violation to drive beside or pass a commercial vehicle in a roundabout.

If bicyclists choose to ride with traffic through any roundabout, single lane or multi-lane, they ~~are afforded the same roundabout design concepts as motor vehicle drivers. They~~ are expected to be a vehicle and should not be given individual direction to maneuver in a manner unexpected or different than a motor vehicle. They should be provided with efficient, safe and effective means of traversing the roundabout, as are other roundabout users. Bicyclists choosing to use the travel lane through a roundabout are given ample space and distance to merge into the travel lane prior to the roundabout entry to allow motorists time to recognize them.

Do not provide a bike lane within the circulatory roadway of a roundabout. Providing a bike lane to the actual circulatory roadway entrance will compound the merge maneuver for the bicyclist and create a conflict point between the bicyclist and motorist who are both concentrating on entering a gap in roundabout traffic. Providing a bike lane within the circulatory roadway of a roundabout would create a condition with greater potential for conflicts between vehicles and bikes than if bicyclists use the travel lane. Figure 500-52 provides the recommended design options for roundabout approach legs that have a shoulder or bike lane.

The shoulder/bike lane should terminate at a distance sufficient to allow bicyclists to merge into traffic before drivers' attention is on roundabout traffic coming from the left. Bicycle ramps are placed where the shoulder/bike lane terminates, allowing bicyclists to access the sidewalk should they choose to utilize it and the crosswalks to traverse the roundabout. **End the bike lane 165 feet in advance of the yield line and provide a bicycle ramp 100 feet in advance of the yield line.**

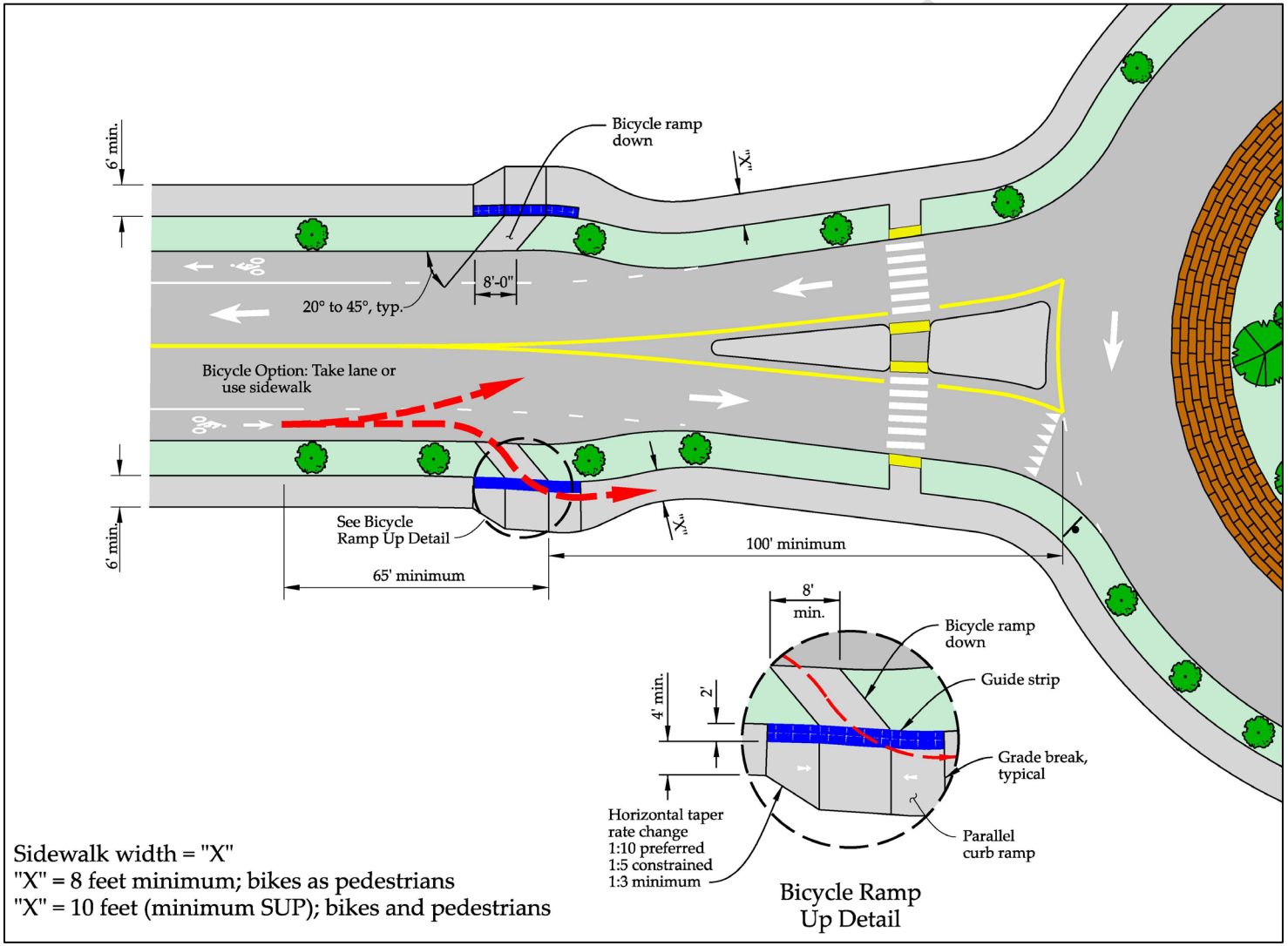
Bicycle ramps are not intended to serve pedestrian traffic. If there is no sidewalk on the approach to a roundabout, the ramp to a path serving the roundabout functions for both bicyclists and pedestrians. Use a pedestrian curb ramp rather than a bicycle ramp in that case.

The width of the bicycle ramp depends on the layout. Where a bicycle ramp is in line with the approaching bicycle lane, the bicycle ramp may be equal in width to the approaching bicycle lane. Where the bicycle ramp requires bicycles to move parallel to the bicycle lane, **provide a bicycle ramp with minimum of 8 feet width.** General design practice attempts to keep roundabout entrances relatively flat with a suggested maximum grade of 4 percent. However, this is not always possible due to existing topographic conditions. Even a maximum grade of 4 percent sustained over a long enough distance can slow a cyclist. *Approach grade and expected cyclist speed in relation to vehicle speed at the lane merge point is an important design consideration when designing for bicyclists to use the travel lane through a roundabout.*

Bicycle ramps can be confused with curb ramps by low vision and blind pedestrians. **Include a Detectable Guide Strip adjacent to bicycle ramps.** Refer to Oregon Standard Drawing RD909 for placement of detectable guide strips. Gaining popularity is the use of Tactile Wayfinding Tiles also called Tactile Walking Surface Indicators across the top of the bicycle ramp and sidewalk. This option is relatively new and is ODOT's preferred method (See Part 981, Figure 900-19). More direction will be available when the next addition of the AASHTO Bicycle Design Guide is published. Contact the Bicycle and Pedestrian Design Engineer or the Senior ADA Standards Engineer in the Technical Services Roadway Engineering Unit for more information on installing Tactile Walking Surface Indicators at roundabouts. *It is preferred to locate bicycle ramps in a buffer zone. In these locations, the bike ramp is considered as part of the traveled way that needs to be detectable to pedestrians.*

The least desirable location for the bicycle ramp is within the sidewalk itself. Use this design option only if necessary and no other option will work. Review Oregon Standard Drawing RD909 for detectable guide strip placement.

Figure 500-52: Bike Accommodation



Where bike ramps will provide bicyclists access to use the sidewalks and crosswalks, minimum sidewalk width is 8 feet. ***10 feet or more is preferred for the width to allow for bicycles and pedestrians to function as a shared use path.*** If there is a separated bicycle facility, apart from the sidewalk, the sidewalk width may be 6 feet, although wider sidewalks are preferred**.** In locations where bicycle riding on the sidewalk is prohibited by statute, appropriate signage is necessary to inform bicyclists.

Bicycle ramps up from the roadway to the sidewalk should be placed at a 35 degree to 45 degree angle with the roadway allowing bicyclists to use the bike ramp, while discouraging them from entering the sidewalk area at too great a speed. Since the bicycle ramp is not a pedestrian curb ramp, its slope is not limited to a maximum of 1 in 12 (8.33%), however wheelchairs and power assisted mobility devices are permitted to use the shoulder and may use the bike ramp to enter the sidewalk.

If necessary, the slope may be greater than 1 in 12. Ramps steeper than 1 in 12 can be a clue for low vision and blind pedestrians to differentiate between the bicycle ramp and the pedestrian curb ramp. Steeper ramps can also slow bicycle traffic as it enters the sidewalk zone. In general, bike ramps should only be as steep as necessary to fit the location with a potential maximum of 1 in 5 (20%) in extreme circumstances. Bicycle ramps from the sidewalk down to the roadway at roundabout exits can be placed with an angle as small as 20 degrees with the roadway since it is not necessary for a bicyclist to slow upon entry to the roadway. A flatter angle can be beneficial in allowing a bicyclist to enter the bike lane or travel lane at a relative speed to traffic. However, some discernible angle is preferred to provide information to pedestrians with vision disabilities that the bicycle ramp is not the pedestrian curb ramp.

When roadways leading up to a roundabout location have been designed utilizing a separated or protected bicycle facility like a cycle track, side path or multi-use path, there may be several options for providing accommodation for bicyclists to navigate the roundabout. For guidance in melding the bicycle facility design with the roundabout design, contact the ODOT Bicycle and Pedestrian Design Engineer in the Technical Services, Roadway Engineering Unit. For more information on bicycle facility design at roundabouts, see Part 900.

509.23 Artwork at Roundabouts

Artwork added to the central island of a roundabout installation can provide aesthetic value, promote placemaking, and provide community recognition as a gateway treatment to a city or town. There also is recognition that artwork (coordinated effectively with landscaping) placed in the roundabout can benefit safety by making the intersection a focal point that provides greater recognition by drivers of expected roadway operation thereby promoting lower speeds which translates to potential for improved safety. There are many successful roundabout artwork installations in Oregon, across the United States and around the world. However, each roundabout location has different needs and artwork installed at roundabouts must be carefully

determined on a case-by-case basis. Not all roundabouts are good candidates for artwork. This is particularly true for small diameter roundabouts where there is minimal room to provide an acceptable clear zone. When artwork is requested at a roundabout location, follow requirements and guidance in this section of the Highway Design Manual and the ODOT Highway Directive Hwy 01 for Placement of Artwork on State Highway Right of Way.

As with artwork installed anywhere within the Oregon State Highway Right of Way, artwork proposed for roundabouts must be suitable for heavy traffic conditions, comply with highway safety requirements and practices, not degrade highway safety and operations, be long-term durable, and be weather and vandal resistant. The following requirements include specific guidance for artwork at roundabouts and do not supersede ODOT's Highway Directive HWY 01, Placement of Artwork on State Highway Right of Way. Rather, they supplement directive HWY 01and provide guidance for applying the directive in relation to specifics of artwork installed at roundabouts that Highway Directive HWY 01 may not directly address, since it is focused more on artwork placement outside the roadway. Artwork placed within the central island of a roundabout is similar to placement of an object within the median of a roadway section between travel lanes.

To better understand overall traffic operations after a roundabout is constructed at a specific location, it is recommended that a two-year waiting period be provided prior to artwork installation to determine and verify any specific design parameters including allowable clear zone needed in relation to the artwork installation. The 2-year period from day of opening provides a real-world, art free test and allows drivers to adjust to the traffic change before artwork is installed. District input and crash history over the first two years after opening can be reviewed by the Region Traffic and Roadway managers before proceeding with artwork installation.

When artwork is proposed for a roundabout location, the selection, funding, installation, and a maintenance is the responsibility of the local jurisdiction where the roundabout is located. In many cases, the time frame to obtain funding, work through the RFP and artist/artwork selection process, ODOT approval process, and final installation may take much, if not all, of the two-year suggested waiting period. During this time, region traffic, roadway, and maintenance units should be reviewing traffic operations at the roundabout for indications of potential issues with artwork placement. Communication with the local jurisdiction of any problems or operational conditions that would affect final decisions on artwork placement is critical in the overall process during this interim time.

ODOT's responsibility is for the appropriateness and placement of the artwork in terms of safety and operation of the highway, not the aesthetic value of the artwork itself. While the selected artwork must fit with the roundabout design and there are specific parameters for materials, signs, symbols, and objects that can be used in artwork placed within the state highway right of way, the local jurisdiction chooses the content, context, and overall aesthetic theme of the artwork selected. In addition, an intergovernmental agreement is established between ODOT and the local jurisdiction to provide direction and define responsibilities for

installation and long-term maintenance of the artwork. ODOT reserves the right to remove any artwork that is not maintained or becomes a safety or operations concern.

509.23.1 Parameters for Roundabout Artwork Installations

Artwork must not interfere with the operation, maintenance, or use of the highway. The safety of the highway system and travelers is of utmost concern for ODOT. Although a desired benefit of the Artwork is to make the central island more conspicuous (thus improving safety), it must not cause an unsafe distraction for motorists and other travelers. Artwork must:

1. Be of a size and scale that fits within the allowable area, must be coordinated to match the aesthetic design of the roundabout, and not demand a driver's attention to cause distraction from blinking or bright lights, glaring materials, or reflective surfaces.
2. Be placed in compliance with clear zone requirements as determined by ODOT policy for applicable installation areas at roundabouts. (See process outlined below in the Location of Artwork Within the Central Island section)
3. Not imitate a traffic control device.
4. Not have moving elements or water, nor simulate movement.
5. Not have elements that would cause the proposed Artwork to obscure the form of the roundabout, nor be a distraction to (e.g., not cause glare for, nor impair the safe vision of) motorists and other travelers.
6. Not attract pedestrians nor cyclists to the center island area.
7. Not contain text, interpretation of the Artwork, information on the artist, nor advertising or other form of a commercial message (business, product, or brand name, logo, phone number, web page, etc.), nor represent or pay tribute to a specific individual.
8. Utilize long lasting materials and construction techniques which will require minimal care and resist vandalism.
9. Must utilize shielded illumination to prevent light from being directed at the highway and of such low intensity or brilliance as to not cause glare or impair vision of motorists on the highway and must meet all state and local illumination codes.
10. Not have any foundation or base of the artwork installation exposed more than 4 inches above the ground.
11. Utilize breakaway features or frangible materials to the maximum extent feasible.

The artist(s) must coordinate design work closely with ODOT traffic and roadway engineers and with the state and local jurisdiction landscape architects and meet all federal, state, or local

restrictions for aesthetic elements of the roundabout for compatibility and to match the aesthetic design of the roundabout, provide a site plan, and provide design plans stamped by a professional engineer registered in the State of Oregon demonstrating structural stability, the ability to withstand the necessary wind loads, and the means or method of installation (e.g., foundation and footing drawings complete with structural calculations and details of the interface and connection between the art and the foundation and/or footing). The artist(s) must provide a one-year warranty of the art structure, foundation/footing and workmanship from the date of final approval of the installation of the project.

509.23.2 Location of Artwork Within the Central Island

Once it has been established that artwork is appropriate at a roundabout location, it must be determined where within the central island it will be acceptable to install the chosen artwork piece. Artwork adds aesthetic value to a roundabout installation and can play a key role in placemaking as a gateway treatment to local communities. In addition to the aesthetic value artwork can also improve the overall safety and operations of the roundabout as well. Artwork adds increased conspicuity to the central island and the roundabout in total. Increasing the visual awareness for drivers approaching the roundabout can improve drivers understanding and recognition of operations of the roadway ahead and help prepare them to enter the roundabout.

Any object placed along the roadway like signs, signals, bridge columns, guardrail, shoulder barrier, etc., poses some risk that vehicles may collide with the object. Artwork placed within the roundabout central island also carries some risk of potential collision from an errant vehicle. As with placing any object along the roadway, minimizing the risk of collision is paramount. To determine appropriate placement of the artwork piece and minimize risk of impact, follow the process outlined below.

Determine Artwork Placement Design Speed and Design ADT - Design Speed for the artwork installation is considered to be the determined approach speed to the roundabout. Engineering judgement is needed to establish an appropriate speed. The Artwork Placement Design Speed could be the posted speed approaching the roundabout or it could be posted speed+5 mph or even posted speed+10 mph depending on location specific context.

After establishing an appropriate Artwork Placement Design Speed, use the Clear Zone Distance Table (Table 400-1) found in the ODOT Highway Design Manual to determine an initial Artwork Placement Design Clear Zone

Based on the Horizontal Curve Adjustment Table (Table 400-2) found in the ODOT Highway Design Manual use a 1.5 adjustment factor applied to the initial clear zone value determined in step 2 above to determine a calculated Artwork Placement Clear Zone value.

The Artwork Design Clear Zone is measured from the inside edge of the circulating roadway towards the center of the central island and includes the truck apron. This determines the area within the center of the central island where artwork may be located to minimize the risk of collision. It is best to keep this area as small as practicable.

After determining an appropriate area for artwork installation from the procedure described in previous steps, perform a visual check by using a computer-generated simulation on a plan view of the roundabout establishing a reasonable errant passenger vehicle pathway projected along an assumed approach alignment into the central island. Based on engineering judgement, adjustments may need to be made to the previously determined allowable installation area based on the outcome of the simulation.

Final determination and agreement of the artwork installation area is a collaborative effort of Region Traffic and Roadway Mangers and Technical Services, Traffic Engineering Section and Roadway Engineering Section staff.

Document the decision process in project files for future reference.

While artwork can be an integral part of a roundabout installation, artwork may not be appropriate at all roundabout locations. Having a process to determine an area for artwork installation does not, in itself, dictate the inclusion of artwork at a roundabout location. ODOT reserves the right to not allow artwork installations at any roundabout location based on overall safety, operational needs, or other significant impacts to the roadway section attributed to the artwork installation.

509.23.3 Roundabout Artwork Placement Evaluations

Example 1: Higher speed multi-Lane roadway – Posted Speed Approaching – 55 mph

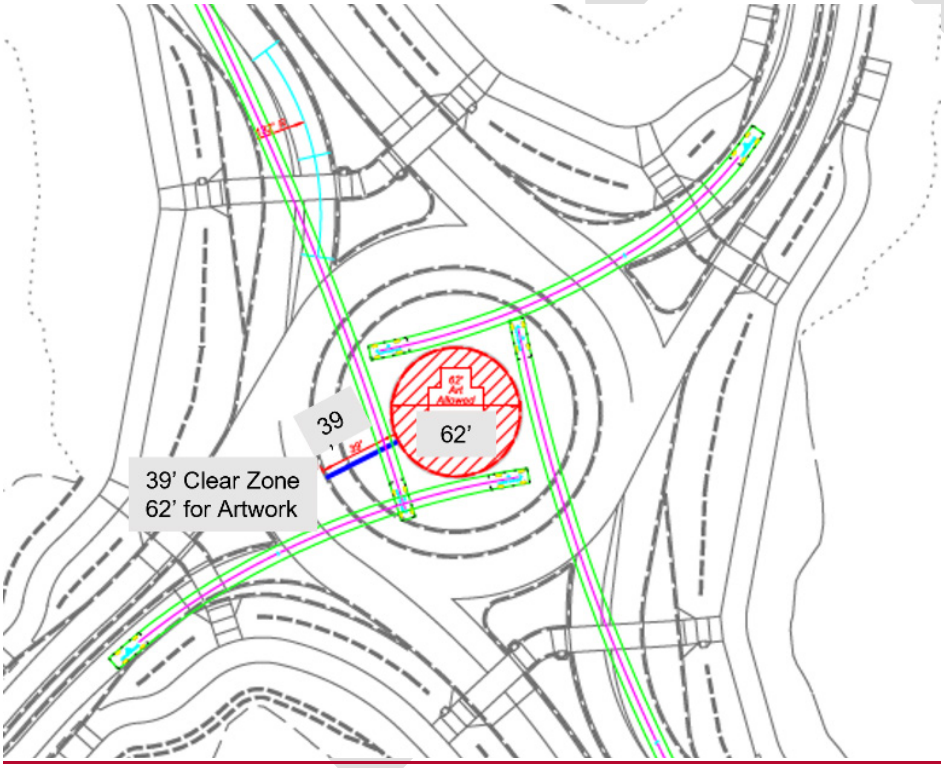
- Multi-Lane Roundabout Design
- Fastest Path (Calculated) – 28-29 mph
- Target Speed (Circulating) – 20-25 mph

1. Determine artwork placement design speed - Since multi-lane higher speed roadway approaching the roundabout location, a posted speed + 5 mph could be used – use 60 mph.
2. From HDM Table 400-1 for 60 mph – Initial Artwork Placement Clear Zone = 26 ft.
3. Apply adjustment factor - Calculated Artwork Placement Clear Zone = 26 x 1.5 = 39 ft.
4. Define potential area where artwork could be allowed – Total width across central island including truck apron minus the artwork placement clear zone

times 2. Width across central island - 140ft. – 2(39ft. clear zone) = 62ft. for potential artwork area.

5. As a visual verification, use computer generated simulation of an errant passenger vehicle alignment into the central island.
6. Evaluate final allowable artwork area – graphic representation agrees with calculated area at 62ft.
7. Obtain agreement on determined area with Region Traffic and Roadway mangers and with Technical Services Traffic and Roadway Engineering Sections staff.
8. Document decision in project files.

Figure 500-59: Roundabout Artwork - Higher Speed Multi-Lane Roadway



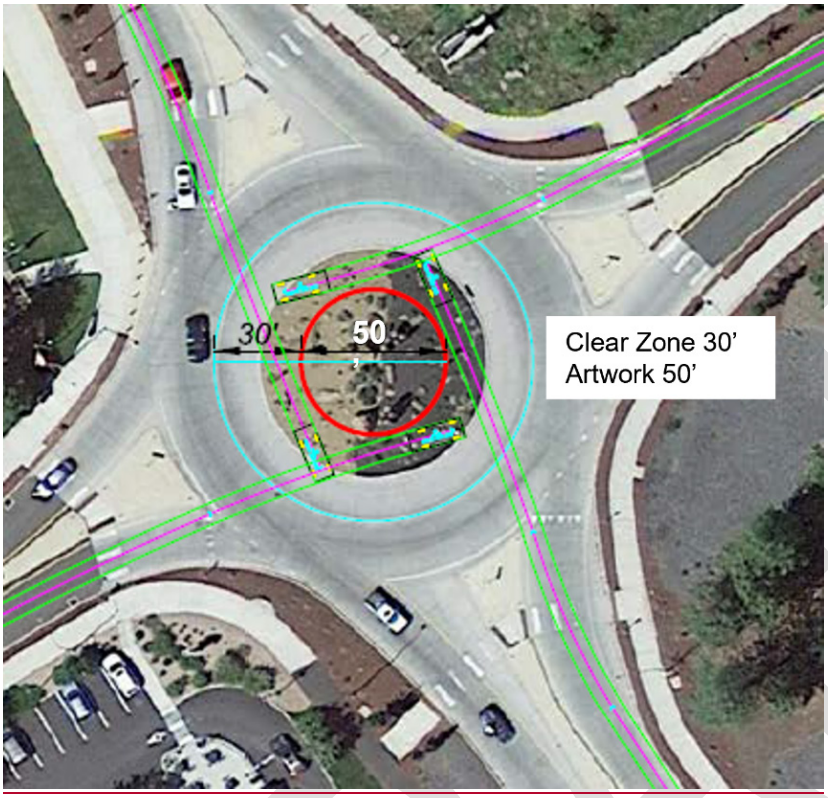
Example 2: Lower Speed Urban Roadway - Posted Speed Approaching – 35 mph

- Single Lane Roundabout Design
- Entrance Fastest Path (Calculated) – 25-26 mph
- Target Speed (Circulating) – 15-20 mph

1. Determine artwork placement design speed – Single-lane urban roadway approaching the roundabout location, a posted speed of 35 or posted speed + 5 mph could be used – both are in the same category on Table 400-1 - use 40 mph.
2. From HDM Table 400-1 for 40 mph – Initial Artwork Placement Clear Zone = 16 ft.
3. Apply adjustment factor - Calculated Artwork Placement Clear Zone = 16 x 1.5 = 24 ft.
4. Define potential area where artwork could be allowed – Total width across central island including truck apron minus the artwork placement clear zone times 2.

   Width across central island – 110 ft. – 2(24 ft. clear zone) = 62 ft. for potential artwork area.
5. As a visual verification, use computer generated simulation of an errant passenger vehicle alignment into the central island.
6. Evaluate final allowable artwork area – Based on roundabout approach geometry and splitter island placement, the visual representation of a reasonable errant vehicle path is outside the calculated artwork clear zone and inside the potential area for artwork. Increase the artwork placement clear zone to 30 ft. and reduce the final allowable area for artwork to 50 ft. (110 ft. – 2(30 ft.) = 50 ft.)
7. Obtain agreement on determined area with Region Traffic and Roadway mangers and with Technical Services Traffic and Roadway Engineering Sections staff.
8. Document decision in project files.

Figure 500-60: Roundabout Artwork - Lower Speed Urban Roadway



Part 600 Interchanges and Grade Separations

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

601.1 Documentation and Approval Font Key

~~Within~~Text within this ~~manual text~~part is presented in specific fonts that ~~are used to~~ show the required documentation and/or approval ~~that is required~~ if the design does not meet the requirements shown. Table 600-1 shows the four text fonts used, along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 600-1: Font Key

Font ~~Key Term~~	~~Font~~Documentation	Approver
Bold text	Design Exceptions	State ~~Traffic~~ Roadway Engineer (S~~T~~RE) and for some projects~~,~~ FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 601.2 for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 601.2 and 601.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 601.3 and 601.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support

design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

601.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 601.4).

601.3 Guidelines

A guideline is a statement of recommended practice in typical situations. The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 601.4~~See Part 100, Section 101 for additional information.~~).

601.4 Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate Best Practice statements. The verbs "shall" and "should" are not used in Best Practice statements. The adjectives "required" and "recommended" are only used in Best Practice statements to describe required or recommended design features as they relate to optional design features.

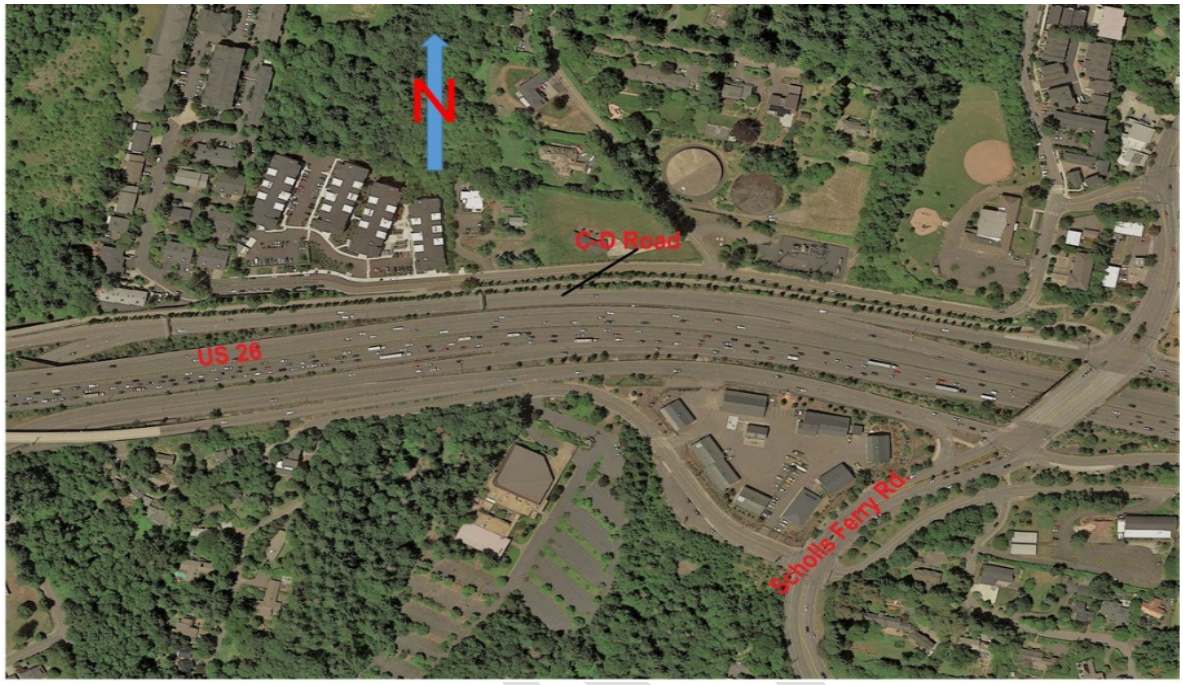
603.6 Collector-Distributor (C-D) Roads

C-D roads are introduced to freeway systems to eliminate weaving directly on mainline through lanes. They are physically separated from the through roadway and connect to it by way of slip ramps. They may be provided within a single interchange, between two adjacent interchanges, or even continuously between several interchanges of a freeway segment. Ramp connections occur on the C-D road, which then conveys traffic to the mainline lanes.

C-D roads are one-way facilities similar to frontage roads except that access to abutting property is not permitted. ***The design speed of the C-D can be less than the through roadway, although it's preferred to keep that differential to no more than 10 mph***. They may have single lane or more commonly, multi-lane configurations. **Typical cross sections for C-D roads ~~should, as a minimum, match~~use the ODOT standard ramp dimensions as shown in Figure 600-32.** The outer separation between edges of travelled way should be a minimum of 20 feet (preferably 30 feet) with an appropriate barrier separating the two roadways. Slip ramp connections to or from the through lanes are configured the same as any other exit or entrance ramp.

Figure 600-3 shows a C-D road system on a freeway in Portland. A two lane exit from the freeway forms the backbone, which also serves as a directional connection to an urban arterial highway. Local access ramps enter and leave from the C-D road rather than the freeway mainline.

Figure 600-3: Collector Distributor System (US 26 Sylvan Interchange - Portland)



Section 604 Interchange Types and Forms

Regardless of the type of facility, it is very important that the basic form of the interchanges fits the basic function it is expected to perform. Inappropriate applications can lead to early obsolescence and safety issues.

There are two basic types of interchanges – "System" and "Service". System interchanges connect two or more freeways. The focus is on providing free flow and higher speed connections to facilitate mobility. System interchange examples in Oregon include I-5/I-205 in Tualatin, I-84/I-82 near Hermiston, and I-5/I-105/OR 126 in Eugene-Springfield. Service interchanges connect freeways (or other expressways) to local facilities. Mobility is also an important function of service interchanges, but it needs to be balanced with the need to get access to the surrounding area and the rest of the local roadway network. The majority of ODOT interchanges are service types.

The selection of interchange form should take into account vertical clearance requirements and mobility concerns. Some interchange forms do not provide for a direct "up and over" movement where larger oversized freight vehicles can exit the freeway and then return to the freeway at the same interchange (usually due to the oversized load being impacted by the existing vertical clearance at the interchange structure). As interchange options are explored, vertical clearance requirements for the interchange and the corridor, along with alternate "up and over" options, should be considered.

A preliminary layout of guide signing is a very useful tool when comparing interchange alternatives. The sign plan may help to identify potential confusion points for drivers navigating the facility and helps to show where design features might cause operational problems. A sign concept should be developed for each alternative considered during early stages of design.

Figure 600-4 illustrates basic system interchange forms. System interchanges are often complex and need to be customized to local conditions. Because of this, they may not fit exactly to the basic forms shown. ODOT has relatively few system interchanges on its facilities, and the majority of them are in the Portland Metro area.

Figure 600-5 illustrates basic service interchange forms. They tend to be much simpler in configuration. With very few exceptions, service interchanges provide for all moves to and from the main facility. Figure 600-6 shows compact service forms. ODOT has not used the compact forms extensively, but they are considered proven concepts (when applied in the proper context).

In a few cases, system movements are provided within the confines of a service interchange, such as the I-5/Chemawa Rd/Salem Parkway and Canby/Charbonneau/Wilsonville-Hubbard Highway interchanges. A standard diamond interchange is "superimposed" over a directional Y (See Figure 600-7). For these types, additional care must be taken with respect to spacing

between consecutive ramps, lane balance, guide signing, the length of speed change lanes, and providing for driver expectations. Each of these areas are discussed in more detail later in this chapter.

A few Non-freeway interchange forms are shown in Figure 600-8. These types of solutions are not appropriate for Interstates or other freeways.

Figure 600-9 shows interchange forms for specialized situations. ODOT has used the Trumpet form in a few locations. It is suitable for connecting two highways as a low level system interchange, and as a service type. The Three-Level diamond is appropriate for connecting two limited access facilities, using a third level to handle turning movements through at-grade intersections, completely separate from thru moves. It too can serve as a low level system type connection. It may be adaptable in non-freeway situations where adequate access control is provided on both facilities. ODOT has not used this form, but it is used in several midwestern states and in Texas.

Partial interchanges (1/2 diamond or "Y") have sometimes been used in less developed areas to connect local roads or bypassed routes that have no access to other highways. These are limited applications, and usually consist of a pair of interchanges. Examples include I-84 Exits 313/317 (Encina/Pleasant Valley) in Region 5, and I-5 Exits 76A & 76B (Wolf Creek) in Region 3. Partial interchanges tend to violate driver expectations, and thus can lead to operational and safety problems, especially for unfamiliar users. Drivers using service interchanges expect to be able to exit and enter the highway at the same location. FHWA policy strongly discourages the use of partial interchanges on the Interstate system.

Less than "full movement" interchanges may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., Transit, HOV or HOT lanes) or major Park and Ride Lots. The same logic applies to non-Interstate facilities. Contact the ODOT Interchange Engineer for guidance.

Each situation and context have unique characteristics, so it is not possible to say which interchange form is most appropriate for all situations. In general, it is best to avoid using configurations that require heavy left turn demands to go through standard signalized intersections. The exceptions to this are the Single Point and Diverging Diamond forms, where the left turns are handled in a way that works better with through traffic. Also, it is good practice to use the simplest interchange form that will meet expected demands. Driver expectancy is key – drivers should be presented with clear choices and the fewest number of decisions necessary to navigate the interchange (or series of interchanges). Details for Single Point intersection layout are found in Figure 600-23 and Figure 600-24.

Full cloverleaf interchanges have operational issues that make their use problematic, even when Collector-Distributor (C-D) roads are used. The key problem is that loop ramps on the same side of the through roadway have significant safety and operational problems. Loop ramps generally have tight curvature (25 – 30 mph). The speed differentials between entering and exiting traffic combined with relatively short weaving/speed change lanes are a serious safety

concern. C-D roads (discussed in detail in 603.6) can provide some limited benefits by removing the weaving and speed change maneuvers from the mainline. Traffic congestion on the C-D facility can also reach levels where backups onto freeway mainlines occur – thus rendering the C-D facility obsolete. These issues make it highly preferable to use other interchange forms**; ODOT will not approve the use of full or ¾ cloverleafs in any context.**

Partial Cloverleafs with loops in opposite quadrants are considered acceptable, although exit loop configurations have additional issues. Loop ramps of necessity are designed with sharper curves and require longer speed change lanes. Exit loops on the far side of a crossroad can have sight lines obscured by fills, or in the case of depressed interchanges, the mainline profile. Areas prone to regular freezing conditions may see more issues with vehicles sliding off loop ramps. **Transitions to exit loops on downgrades require longer spirals and the loop itself needs to have a minimum radius of 191′ (30° curve).** The area beyond the exit loop gore needs to be kept as free of obstructions as possible and should be contour graded.

There are cases where loop ramps on the same side of the crossroad work adequately. They are not configured as free-flowing ramps, but rather as "T" intersections in a Folded Diamond configuration. Figure 600-10 depicts I-84 Exit 261 (OR 82 Wallowa Lake Hwy.) in La Grande; a good example of the concept.

Figure 600-4: Examples of System Interchange Forms

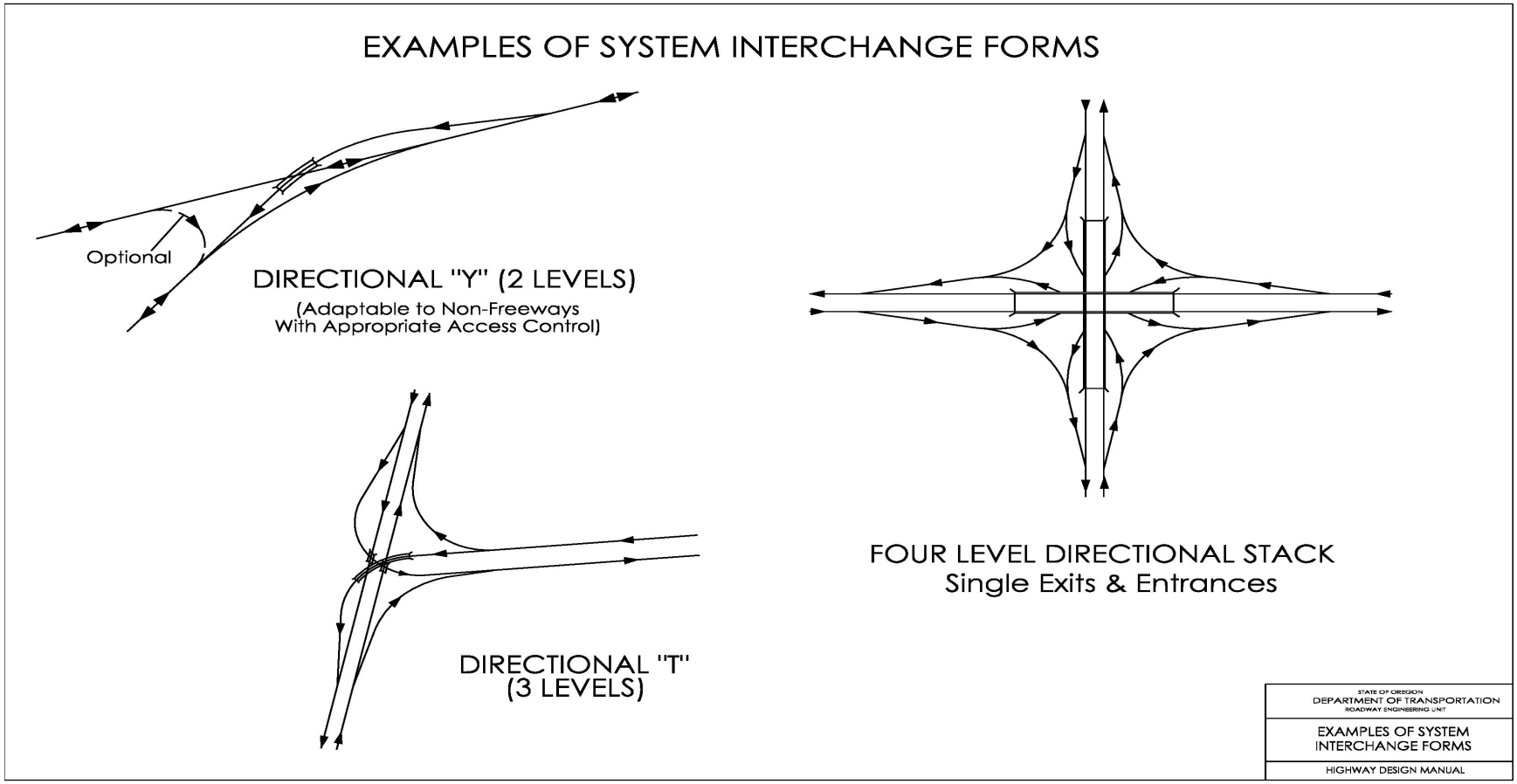


Figure 600-5: Common Service Interchange Forms

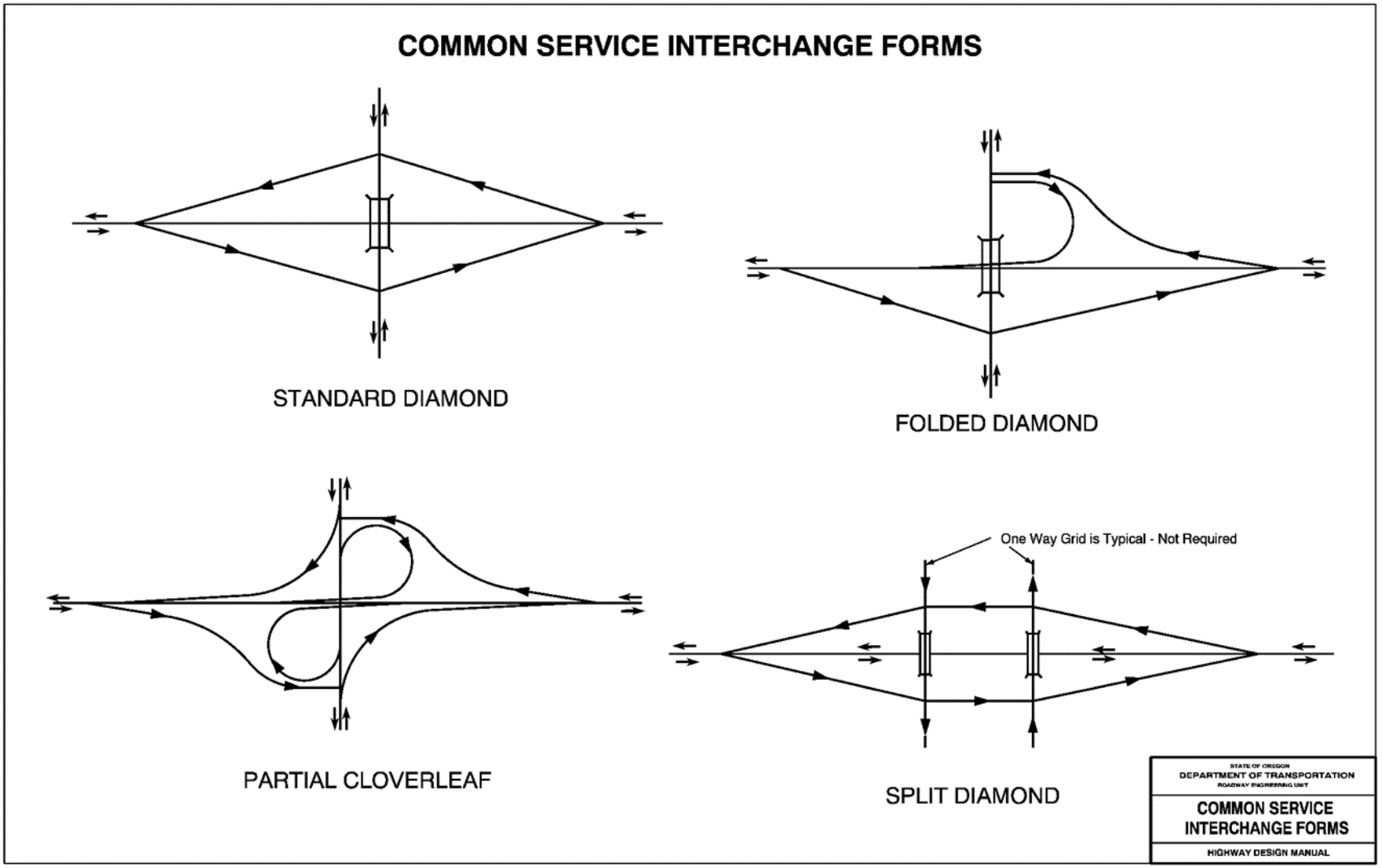


Figure 600-6: Examples of Compact Diamond Interchange Forms

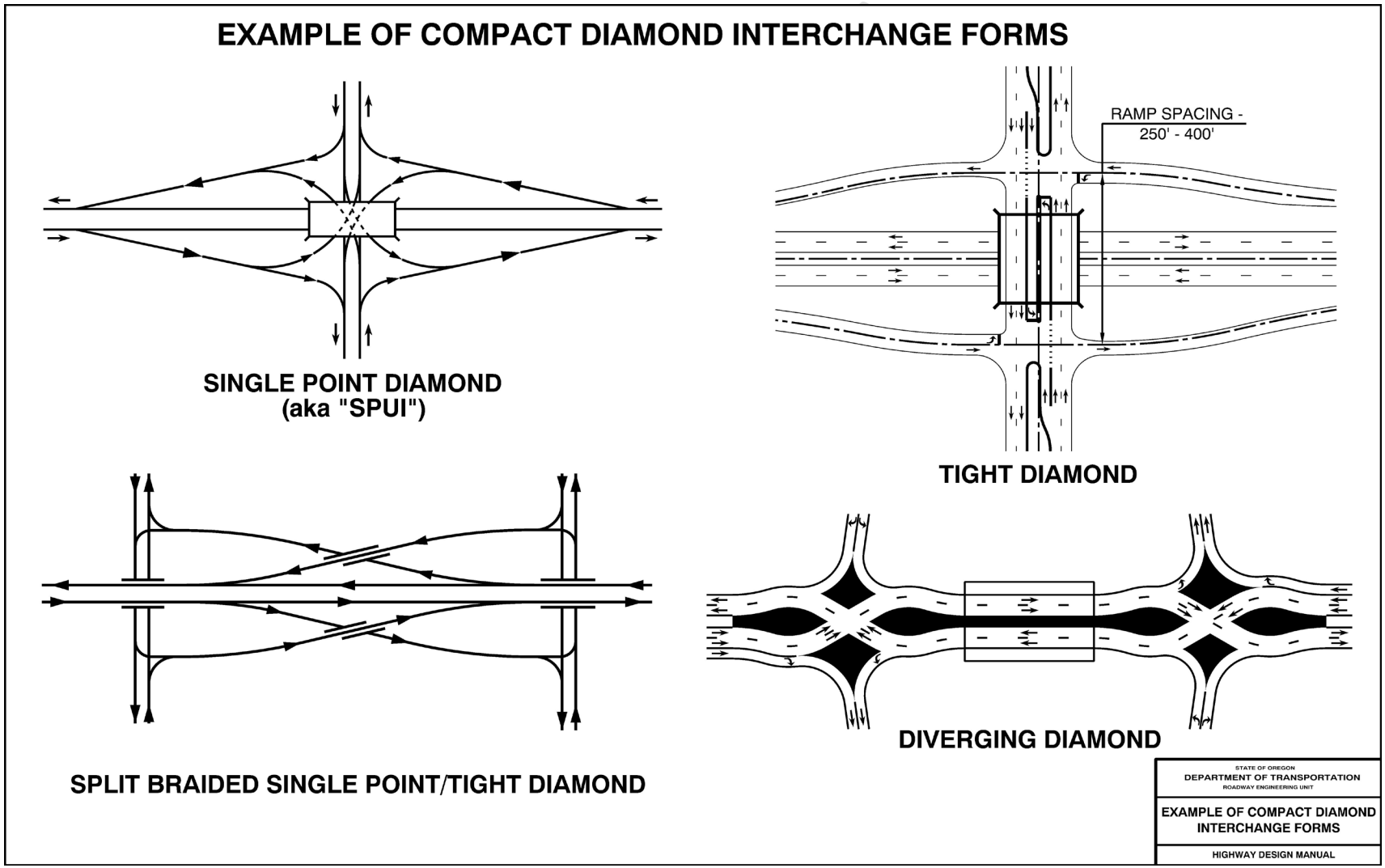


Figure 600-7: Superimposed Interchange in Keizer, OR (I-5 Exit 260)

Figure 600-8: Non-Freeway Interchange Forms

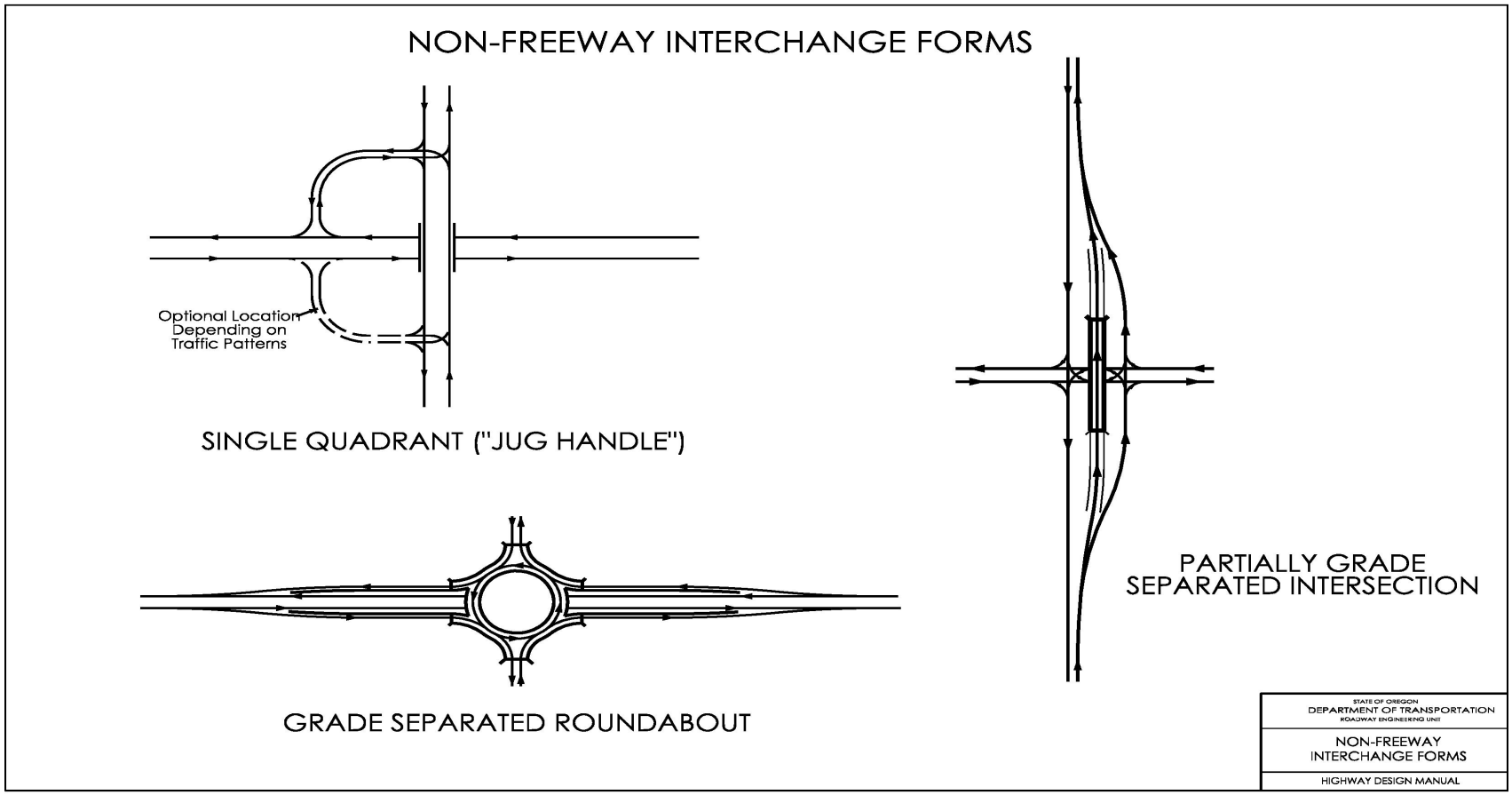


Figure 600-9: Examples of Specialized Interchange Forms

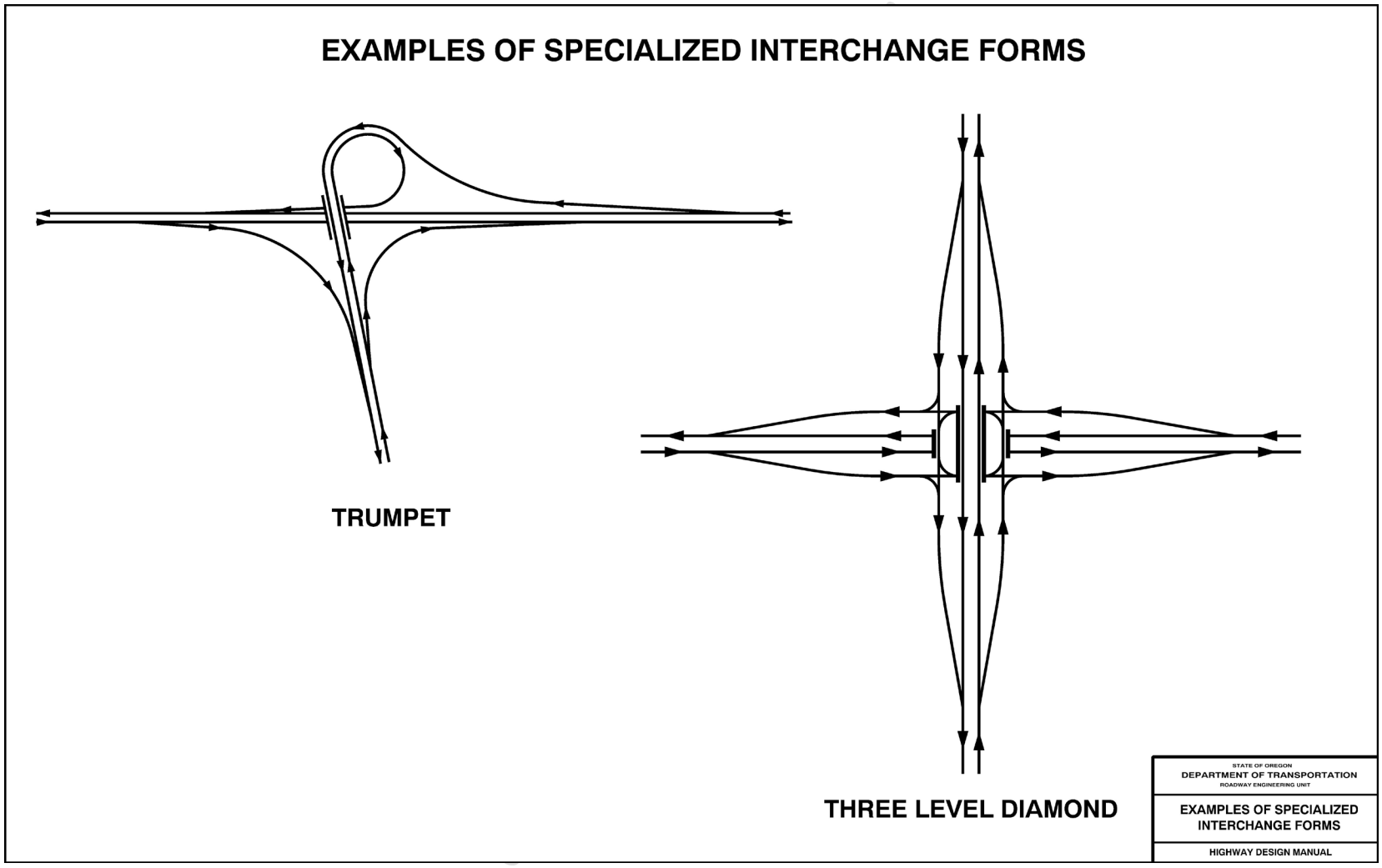


Figure 600-10: I-84 Exit 261 in La Grande

Several features and issues are common to all types of interchanges. These items are important to consider in all contexts. New or Existing facilities, Freeway or Non-Freeway, Urban, Rural or Transitional Areas - these features must be evaluated for all projects.

Common elements include:

1. Clear Sight Lines (vertical & horizontal)
2. Interchange Form – appropriate for traffic types and patterns
3. Appropriate Horizontal/Vertical Geometry
4. Adequate Speed Change Lanes
5. Driver Expectancy/Positive Guidance – adequate perception/reaction distances for typical maneuvers – all exits/entrances to the right of through traffic
6. Design Vehicle Offtracking
7. Adequate Storage for Vehicle Queues
8. Bike, Pedestrian and Transit Needs (accessibility features under the ADA for site arrival and destinations points)
9. Adequate Accommodation for Signing
10. Long Range Planning Vision for the Interchange – including the crossroad facility
11. Adaptability/Flexibility for Changing Needs Over Time

"Ideal" designs are typically not possible, especially in retrofit situations and in fully developed areas. In retrofit situations evaluating deficiencies and making tradeoffs is necessary. Designers must still consider the key features and how to make safety and operational improvements whenever possible. Tools such as the Highway Safety Manual, Interactive Highway Safety Design Model (IHSDM) and FHWA's Interchange Safety Analysis Tool – Enhanced (ISAT-E) are available to help in evaluations. ODOT Interchange Engineer and the State Traffic Safety Engineer are available to help in using tools and providing guidance on tradeoff situations.

605.2 Interchange Ramp Design

An interchange ramp is a connecting roadway that provides for movement between grade separated roadways as part of an interchange. Well planned and designed ramps are important to the proper functioning of interchanges, which in turn are a key feature of well-planned and designed access controlled highways. Because interchange ramps are the transition roadway between high speed, free flowing traffic and the local road system, they need to accommodate the various things drivers are dealing with at that point. That functional transition needs to guide design decisions in all contexts. Designs that require drivers to deal with too much information or maneuvering in a short time span will often have operational and safety problems. Another significant problem is queuing on interchange exit ramps, sometimes extending to the mainline. Queue length is a function of interchange ramp intersection operations, in turn a function of crossroad operations. The point to remember is that interchanges work as a system, and each part of that system that struggles to function will create issues for the rest of the system.

Interchange ramps consist of three discrete elements and functions:

1. The Speed Change Area (including the gores).
2. The Main Transition Area (sometimes called the "Main Curve", although it may be on tangent alignment).
3. The Terminal Area – which is in some ways an extension of the intersection with the crossroad.

Each discrete piece of the ramp has design features intended to accommodate typical things drivers are dealing with in that area. Interchange exit ramps that experience significant queuing will limit the speed change area's ability to function well. Peak hour mainline speeds may be significantly less than off-peak speeds, so the speed change function is somewhat mitigated. The speed change on entrances is likewise altered during peak hours. Finding gaps and safely making the entry maneuver becomes more difficult; the length of the parallel portion of the interchange ramp needs to not only meet minimums but be as long as possible.

The Main Transition portion of the interchange ramp needs to provide for a smooth, "stepped down" driving path. This approach provides for a smooth and logical transition from freeway speeds and conditions to the situation where drivers are dealing with an at grade intersection. Stepping speeds down makes sense to users and is relatively easy to negotiate. Although stopping sight distance is the minimum criteria, every effort should be made to improve on this – decision sight distance being the goal. ***When the HDM makes reference to Design Speed on interchange ramps, it is referring to the Main Transition Area. The main transition area should***

have a design speed of between 50 and (preferably) 70 to 85 percent of the mainline. (See Figure 600-11.)

Terminal Areas should continue the "stepped down" approach for design speed (between 50 and 85 percent of the main transition curve). Refer to Figure 600-11, Figure 600-13, and Figure 600-14. It's very common for the terminal curve area to also have queue storage. The interchange ramp horizontal and vertical alignments need to provide appropriate stopping sight distance for this condition. Terminal curves have their own set of standard spiral lengths and superelevation rates; these are shown in Figure 600-25.

In cases where interchange ramps connect two freeways in a System Interchange, the Terminal Area is replaced with a second Speed Change Area - an exit at the leading end and entrance at the trailing end. **Two lane entrances ~~should be~~ramps are designed according to the information in Figure 600-16.**

Oregon uses parallel type entrance ramps only. **Tapered entrances are not permitted**. **ODOT uses a tapered configuration for both single and multi-lane exits**. In certain multi-lane exit situations it is appropriate to provide an auxiliary parallel deceleration area next to the outermost through lane. An example of this is the two lane SB exit at the I-5/OR 22 (Mission St.) interchange in Salem (Exit 253).

Figure 600-11: Discrete Areas of Typical Ramps

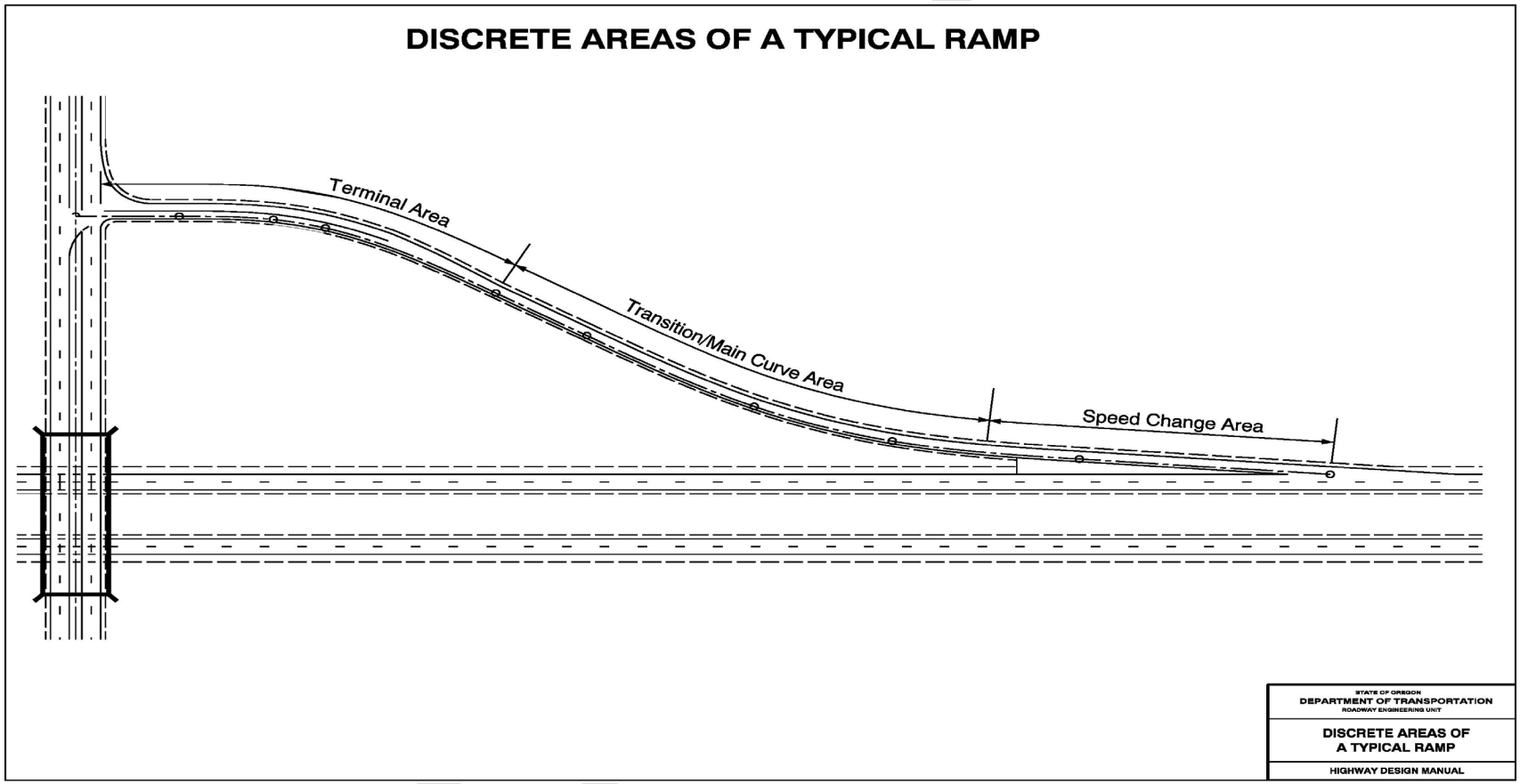


Figure 600-12 illustrates examples of different types of interchange ramps. Some types are only appropriate for non-freeway applications. Assuming adequate access control is in place, the other types can be adapted for non-freeway use as well.

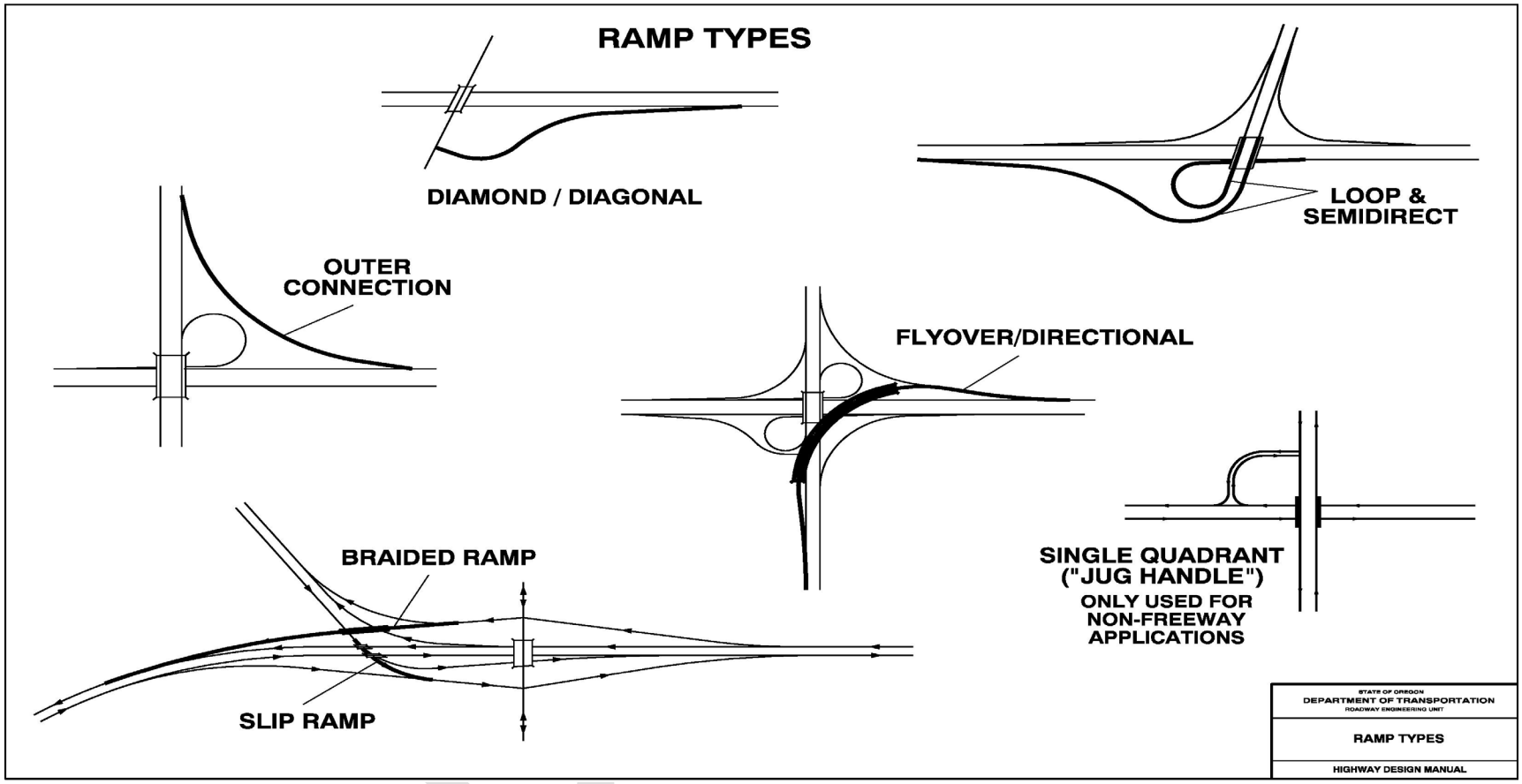
Interchange ramp designs need to provide flexibility for the future. This doesn't mean over-designing, just making sure that there is flexibility to deal with changing needs. Providing additional deceleration length and at least 100' of tangent on the horizontal alignment between the main curve and the terminal curve will often help in this regard. Designing to bare minimums often leads to operational and safety issues. Another consideration is an interchange where future lanes may be added to the right. Interchange ramp gores in these situations should be developed to fit the future condition so that the interchange ramp itself would not have to be rebuilt. The interim condition will provide added speed change length.

For interchange ramps, provide for adequate speed change length, sufficient storage for vehicles stopped on the ramp, suitable intersection design and control at the cross-road, sight distances, and standard geometry. Each of these elements needs to be checked to make sure they will be adequate and appropriate for expected operations. Coordinate with the Interchange Engineers in Technical Services Roadway Engineering Unit when questions arise.

As a minimum the speed change length shall be long enough for traffic to stop before reaching the end of 95 percent queue length on the ramp. Provide for deceleration to a complete stop from mainline design speed. Coordinate with signal detection locations and operations to allow vehicle queues to clear.

Interchange ramp terminal intersection design and controls have a significant impact on the safety and efficiency of the entire interchange. If interchange ramp intersections are not able to manage the traffic demands at an appropriate level, it can quickly lead to queues building up on interchange exit ramps and the cross street. This can occur because of deficient geometric design or intersection controls that are inappropriate for the context. Geometric issues are normally easy to identify but sometimes difficult to correct, especially in more fully developed areas. Evaluation of the intersection controls should be done in a timely enough manner to be incorporated into project scoping efforts.

Figure 600-12: Ramp Types



605.10 Freeway Ramp Typical Sections

The number of lanes at the actual exit or entry point determines how a ramp is categorized. Single lane ramps that taper to multiple lanes after exiting are still considered one lane – standard shoulders for one-lane ramps are appropriate. Some entrance ramps include added lanes and then taper to a single lane prior to actual freeway entry – again these are considered single lane ramps. Figure 600-32 shows standard dimensions for freeway ramps.

Standard single-lane freeway ramps are 26 feet wide. The 26' width provides for continued operation if a stalled heavy vehicle or maintenance activity requires using some of the width, although a large truck offtracking in relatively sharp ramp curves can make this more difficult. **When roadside barriers are introduced, the right shoulder is widened by 2 feet.** The left shoulder is normally not widened when barriers are used.

If an additional lane is being added to the ramp, it will normally only require adding eight feet of width – enough to get two 12 foot wide travel lanes. **If multiple lanes are needed, they should all be a minimum of 12 feet wide.** More width may be needed to accommodate truck offtracking on relatively sharp curvature. **Use a taper rate of at least 10:1 when adding the width.** The width can be added either to the left or right of the horizontal alignment as appropriate. Evaluate truck offtracking as part of the ramp design process.

Two lane interchange ramps are normally only used at system interchanges, although there are a few two lane loop connections on ODOT facilities that use two lane criteria. **Two-lane ramps consist of two 12 foot wide lanes, ten foot right and 6 foot left shoulders for a total of 40 feet width.** ***Two lane loops*** ~~***should use the same cross section.***~~***may need additional width for offtracking.*** Two lane entrance~~s~~ and ~~exits between~~exit ramps at service interchanges normally use single lane ramp shoulders. When standard shoulders are provided and barriers are present on two-lane ramps, no additional shoulder width is normally necessary (apart from the 2-foot "e" distance to right side barriers). When tighter horizontal geometry requires extra width for truck offtracking (as on loop ramps), or horizontal sight lines are restricted, more width may be necessary. The horizontal alignment for two-lane ramps is carried on the center of the traveled way (on the skip stripe between the two lanes). If more lanes are added past the gore, the location of the horizontal alignment remains the in the same place.

Non-freeway ramps can take different forms and may have slightly reduced typical cross section dimensions. **Refer to Figure 600-33 for those dimensions.** The horizontal alignment in that case is carried 2 feet from the left edge of traveled way. **As with freeway style ramps, add 2 feet (also referred to as "e" distance) to the right shoulder width when roadside barriers are present, but not to the left shoulder.**

Many non-freeway ramps are basically the same configuration as the freeway style with slightly reduced cross sectional dimensions. Jug-handle style ramps often have two-way operations and require a physical separator between directions of travel. Concrete median barrier is often not

appropriate for this situation. A raised traffic separator (as shown in Standard Drawing RD706) is often preferable. Each direction of travel on jug handle ramps needs to be the same width as shown in Figure 600-33 (22′ total).

Figure 600-32: Freeway Ramps Standard Typical Sections

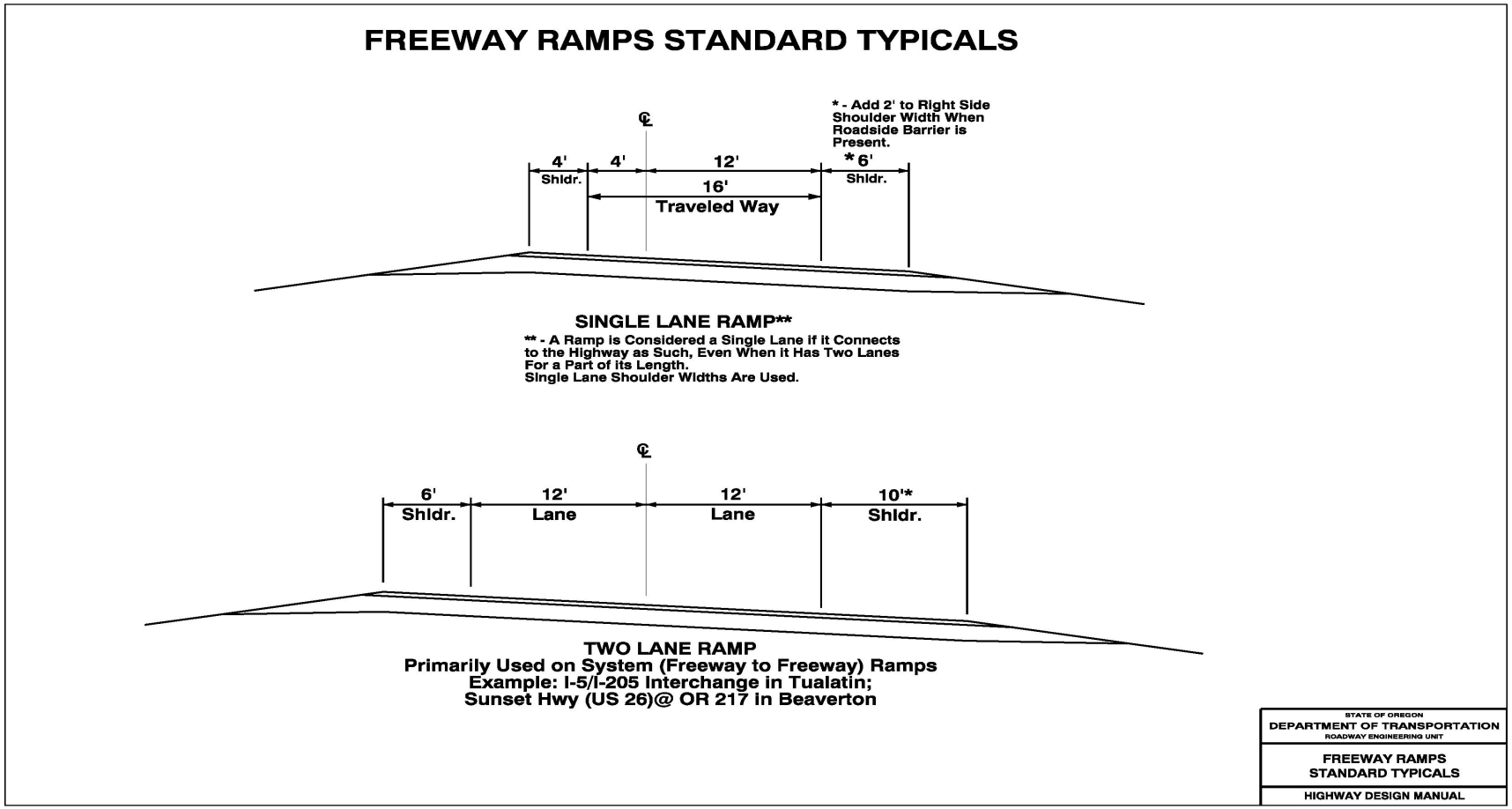
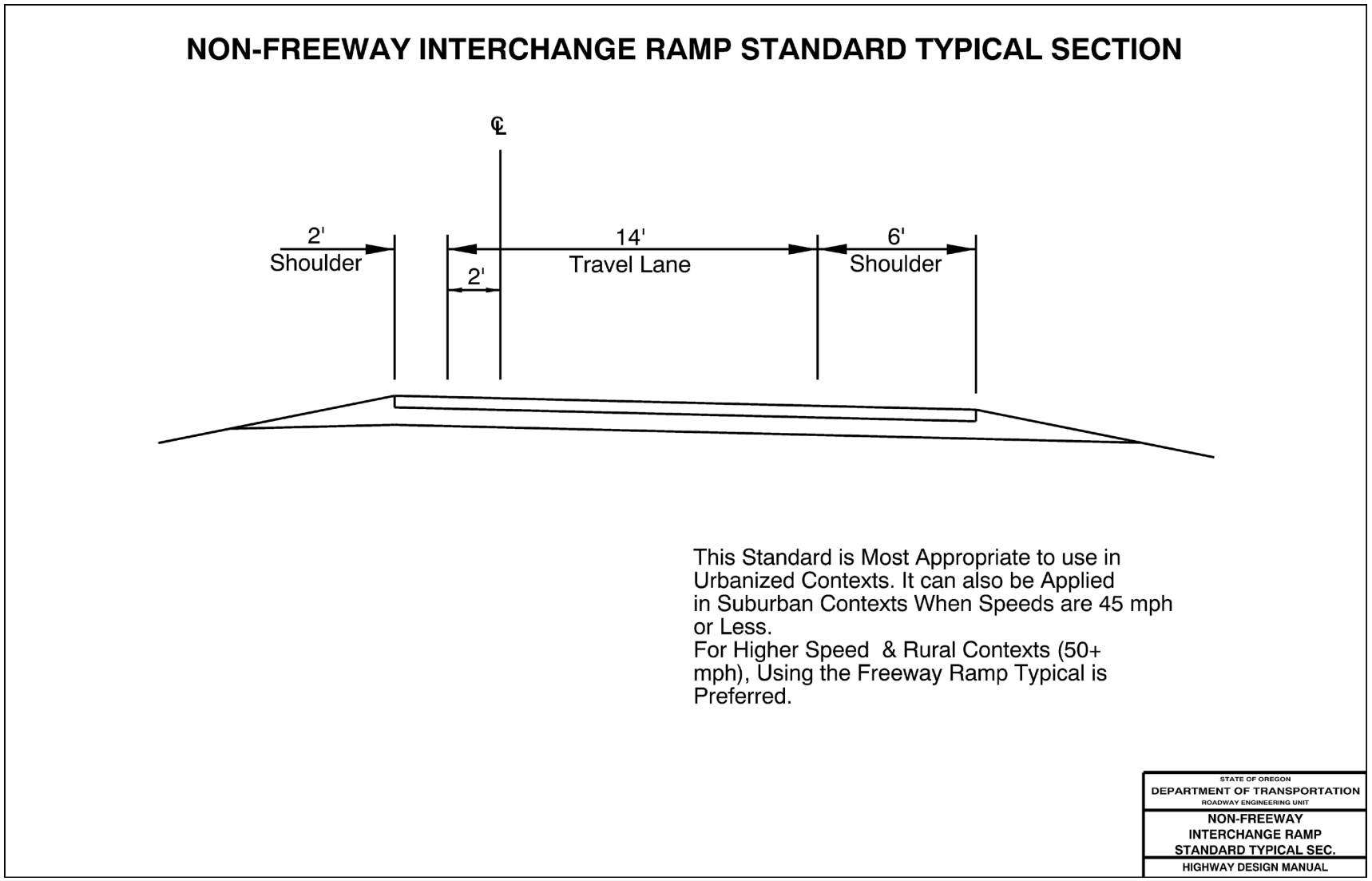


Figure 600-33: Non-Freeway Interchange Ramp Typical Section



605.11 Loop Ramps

Loop ramps should be as large as practical and with a minimum of a 36 degree curve. When designing an exit loop ramp where the crossroad is below the freeway, the maximum degree of curve ~~should be~~is 30 degrees, and using spirals longer than the standard is recommended. Details for fitting loop ramp horizontal alignments are located in Figure 600-36 and Figure 600-37. Loop ramp connections usually come parallel to the crossroad using a spiral rather than an angled connection but can also terminate at a regular intersection. Figure 600-34 and Figure 600-35 show details for loop intersections at crossroads.

Adjacent loop ramps on the same side of the freeway are not usually permitted unless the weaving section is carried on a Collector-Distributor (C-D) road. Free flowing Loop ramps on the same side of the crossroad are discouraged due to the short weaving section normally available between them.

Loop ramp intersections with the crossroad must make appropriate provision for bicycle and pedestrian traffic. For rural interchanges the configuration shown in Figure 600-34 is typically the appropriate design. In urban or urbanizing areas, the treatment in Figure 600-35 is normally the most appropriate configuration. Each location must be evaluated for the most appropriate treatment to use, based on current and projected traffic conditions, the physical constraints on the roadway design, and other factors such as potential land use changes in the interchange area. HDM Part 800 and 900 provide guidance for various design situations. Contact the ODOT Bicycle and Pedestrian Design Engineer for additional guidance.

Loop exit ramps have issues that make their use undesirable in some situations. Deceleration areas need to be substantially longer due to tight radii on the ramps, especially on downgrades. When the loop is located beyond a grade separation structure and fills, it is not as visible to approaching users. Increasing the length of the structure to provide greater visibility can create longer spans (or more short spans with barriers) and can be costly. Significant superelevation is needed on the sharper curves, and this can create problems in areas with snow and ice. Trucks also have more issues negotiating the sharper curves. When loops exit on a downgrade, such as in a depressed interchange, many of the above issues can combine to create operational problems. When considering new interchanges, designs that include loop exits should be used with caution. Existing loop exits need to be evaluated to make sure they sufficiently provide for the above concerns. It may not be feasible to deal with every issue, but opportunities for making incremental improvements should always be sought.

Figure 600-34: Partial Cloverleaf Intersection Detail

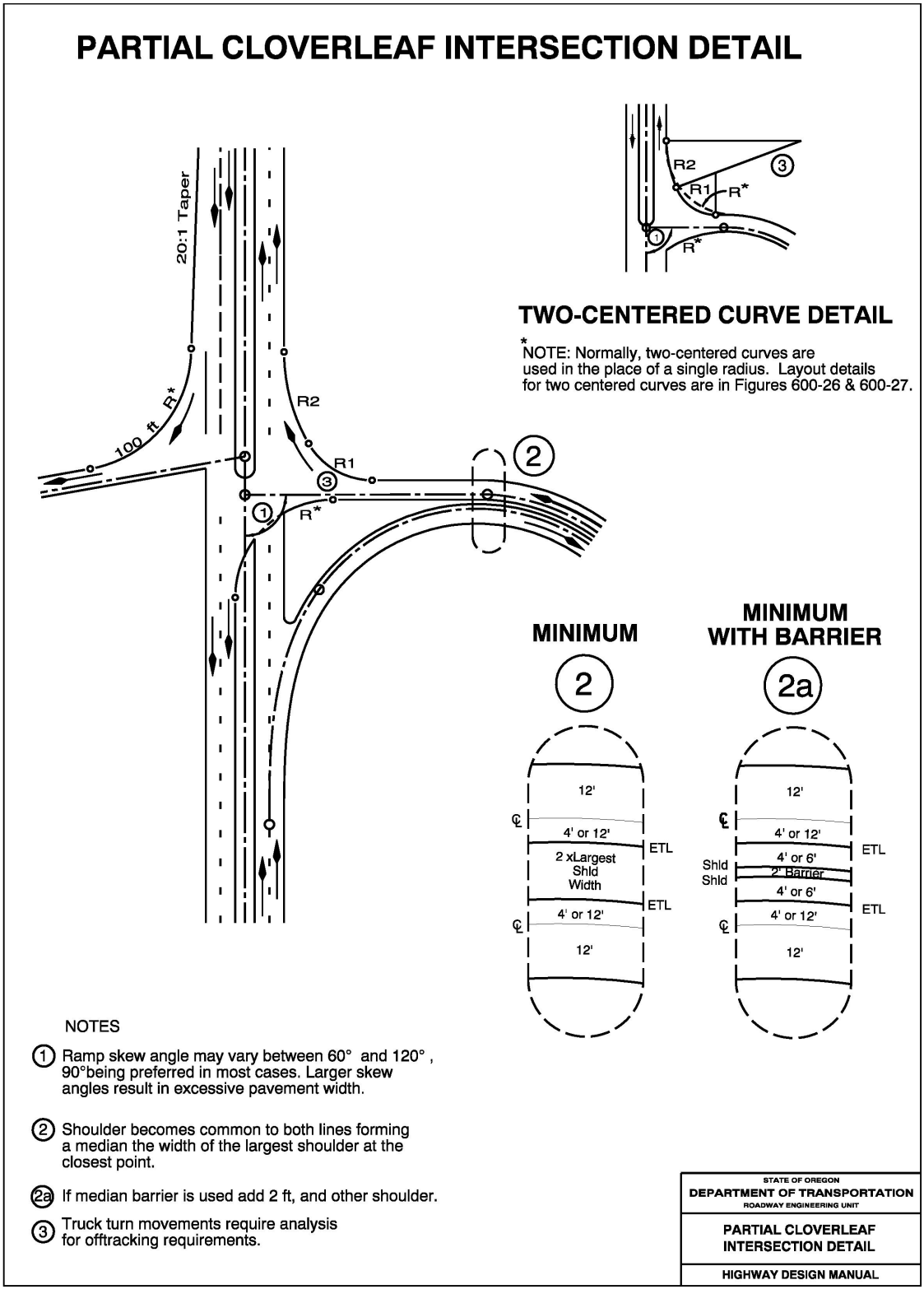


Figure 600-35: Folded Diamond Terminal Detail

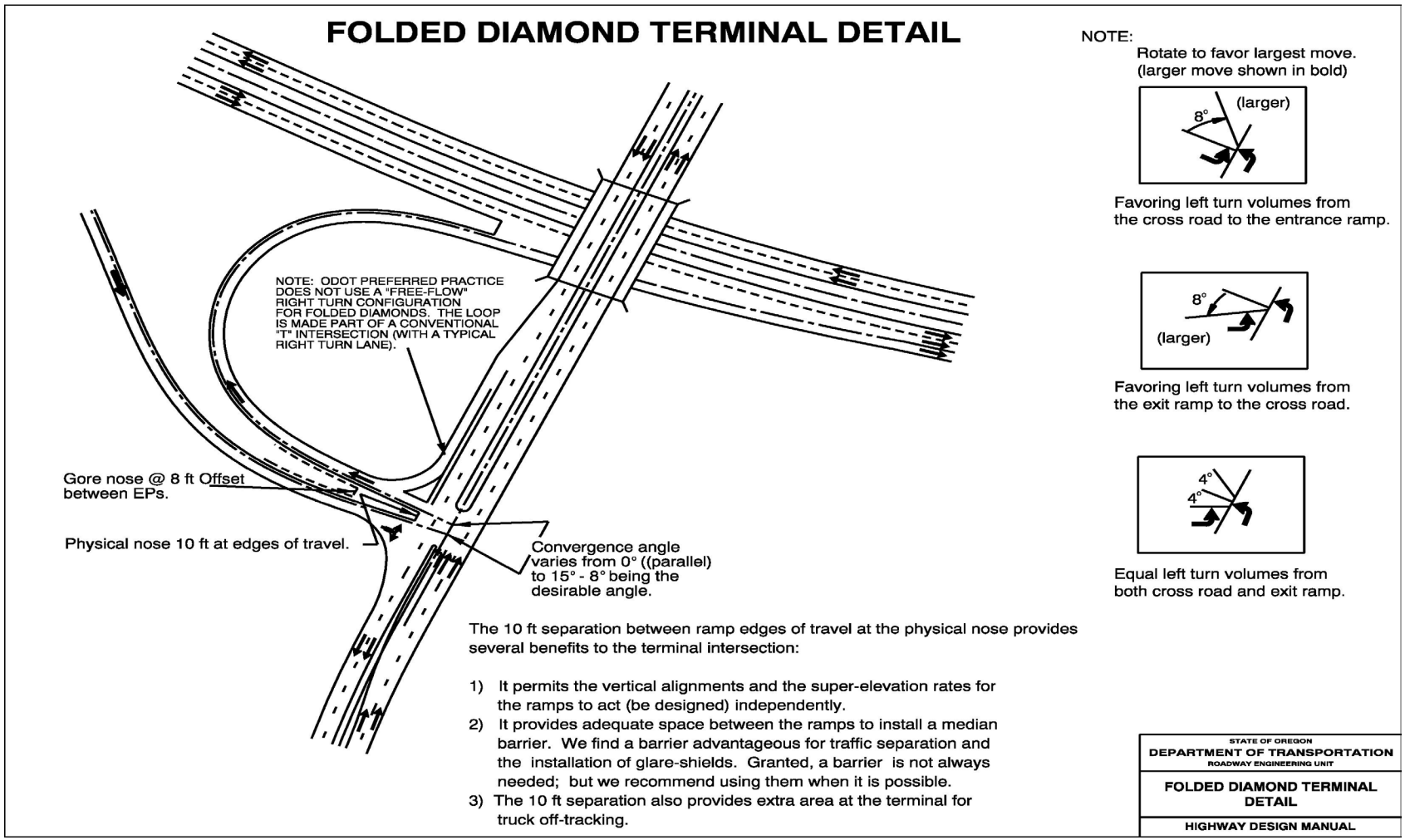
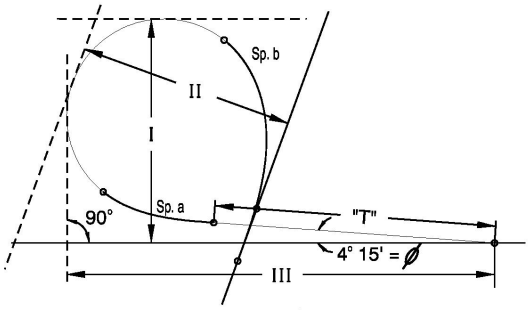


Figure 600-36: Loop Fitting Data (Single Lane)

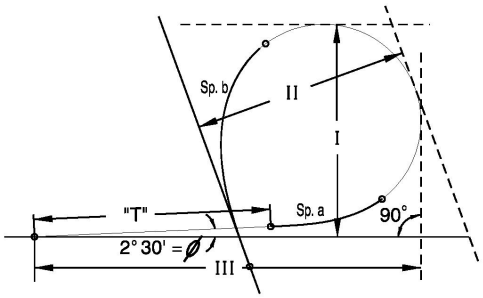
LOOP FITTING DATA (1 LANE)

EXIT LOOP



$I = (R+p)\cos\varnothing + (T+q)\sin\varnothing + R$ $\quad II = 2R + p_b$

ENTRANCE LOOP



$III = (T+q)\cos\varnothing - (R+p)\sin\varnothing + R$

Highway Design Speed=70 mph																
SPEED MPH	CURVE RADIUS	Sp. a LENGTH	p_a	q_a	Sp. b LENGTH	p_b	q_b	EXIT * "T"	I	II	III	ENTRANCE "T"	I	II	III
30	238.73	200	6.9377	99.4180	400	27.2356	195.4112	420	522.2203	504.7005	738.5158	366.81	504.5053	504.7005	693.8000
25	220.37	200	7.5077	99.3175	400	29.3778	194.6327	450	488.3270	470.1146	751.2878	366.81	468.3598	470.1146	676.1118
25	204.63	200	8.0758	99.2092	400	31.4902	193.7978	450	457.4475	440.7458	736.5636	366.81	437.4563	440.7458	660.9248
25	190.99	200	8.6417	99.0931	400	33.5708	192.9079	450	430.7571	415.5427	723.7750	366.81	410.7459	415.5427	647.7373
25	179.05	200	9.2054	98.9692	400	35.6177	191.9644	450	407.4696	393.7163	712.5577	366.81	387.4418	393.7163	636.1730
25	168.52	200	9.7667	98.8376	400	37.6291	190.9687	450	386.9840	374.6631	702.6331	366.81	366.9423	374.6631	625.9442
25	159.15	200	10.3256	98.6984	400	39.6030	189.9224	450	368.8326	357.9129	693.7846	366.81	348.7793	357.9129	616.8270

** Minimum deceleration lengths for exit ramps with heavy truck volumes								
SPEED MPH	CURVE RADIUS	Sp. a LENGTH	p_a	q_a	EXIT * "T"	I	II	III
30	238.73	200	6.9377	99.4180	700	542.9707	504.7005	1017.7459
25	220.37	200	7.5077	99.3175	745	510.1890	470.1146	1045.4766
25	204.63	200	8.0758	99.2092	745	479.3095	440.7458	1030.7524
25	190.99	200	8.6417	99.0931	745	452.6191	415.5427	1017.9638
25	179.05	200	9.2054	98.9692	745	429.3316	393.7163	1006.7465
25	168.52	200	9.7667	98.8376	745	408.8460	374.6631	996.8219
25	159.15	200	10.3256	98.6984	745	390.6946	357.9129	987.9734

NOTES:

* Exit Loop "T" Distances variable for grades in excess of 3%.

** Consideration for use should be given whenever truck volumes reach or exceed 6 trucks per hour.
A 36° exit loop is considered very minimal for design; using 30° or flatter is highly desirable. A 30°curve (or flatter) is required on exit loops on a downgrade.

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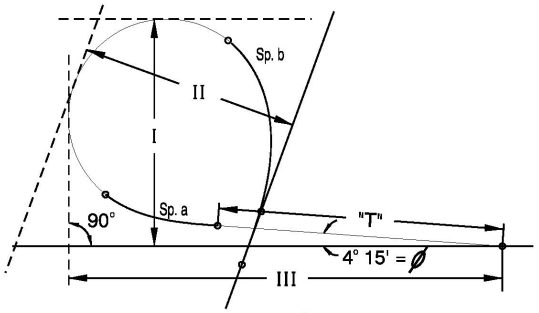
LOOP FITTING DATA (1 LANE)

HIGHWAY DESIGN MANUAL

Figure 600-37: Loop Fitting Data (Two Lane)

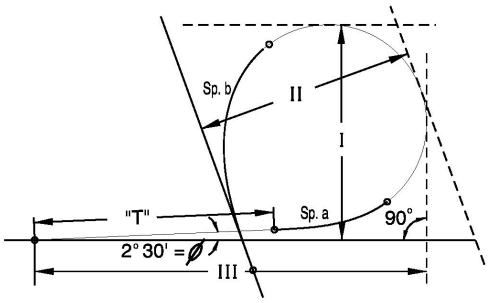
LOOP FITTING DATA (2 LANE)

EXIT LOOP



$I = (R+p)\cos\varnothing + (T+q)\sin\varnothing + R$ $\quad II = 2R + p_b$

ENTRANCE LOOP



$III = (T+q)\cos\varnothing - (R+p)\sin\varnothing + R$

Highway Design Speed=70 mph																
SPEED MPH	CURVE RADIUS	Sp. a LENGTH	p_a	q_a	Sp. b LENGTH	p_b	q_b	EXIT * "T"	I	II	III	ENTRANCE "T"	I	II	III
30	238.73	240	9.9629	118.9964	400	27.2356	195.4112	510	533.3578	504.7005	847.5688	550.2141	516.3816	504.7005	896.4580
25	220.37	240	10.7762	118.8236	400	29.3778	194.6327	540	499.7018	470.1146	860.2506	550.2141	480.4760	470.1146	878.6869
25	204.63	240	11.5856	118.6375	400	31.4902	193.7978	540	469.0573	440.7458	845.4309	550.2141	449.8103	440.7458	863.4117
25	190.99	240	12.3907	118.4381	400	33.5708	192.9079	540	442.5992	415.5427	832.5415	550.2141	423.3352	415.5427	850.1306
25	179.05	240	13.1911	118.2255	400	35.6177	191.9644	540	419.5412	393.7163	821.2182	550.2141	400.2637	393.7163	838.4673
25	168.52	240	13.9867	118.0000	400	37.6291	190.9687	540	399.2822	374.6631	811.1825	550.2141	379.9941	374.6631	828.1344
25	159.15	240	14.7771	117.7616	400	39.6030	189.9224	540	381.3544	357.9129	802.2180	550.2141	362.0581	357.9129	818.9081

** Minimum deceleration lengths for exit ramps with heavy truck volumes								
SPEED MPH	CURVE RADIUS	Sp. a LENGTH	p_a	q_a	EXIT * "T"	I	II	III
30	238.73	240	9.9629	118.9964	790	554.1082	504.7005	1126.7988
25	220.37	240	10.7762	118.8236	835	521.5638	470.1146	1154.4394
25	204.63	240	11.5856	118.6375	835	490.9193	440.7458	1139.6197
25	190.99	240	12.3907	118.4381	835	464.4612	415.5427	1126.7303
25	179.05	240	13.1911	118.2255	835	441.4032	393.7163	1115.4070
25	168.52	240	13.9867	118.0000	835	421.1442	374.6631	1105.3714
25	159.15	240	14.7771	117.7616	835	403.2164	357.9129	1096.4068

NOTES:

* Exit Loop "T" Distances variable for grades in excess of 3%.

** Consideration for use should be given whenever truck volumes reach or exceed 6 trucks per hour.

A 36° (R-159.15') exit loop is considered very minimal for design; using 30° (R-190.99') or flatter is highly desirable.

STATE OF OREGON
DEPARTMENT OF TRANSPORTATION
ROADWAY ENGINEERING UNIT

LOOP FITTING DATA (2 LANE)

HIGHWAY DESIGN MANUAL

Part 700 Public Transportation and Guidelines

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

701.1 Documentation and Approval Font Key

Text within this part is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown. Table 700-1 shows the four text fonts used, along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 700-1: Font Key

Font	Documentation	Approver
Bold text	Design Exceptions	State Roadway Engineer (SRE) and for some projects FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 701.2 for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 701.2 and 701.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 701.3 and 701.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

701.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 701.4).

701.3 Guidelines

A guideline is a statement of recommended practice in typical situations. The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 701.4).

701.4 Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate Best Practice statements. The verbs "shall"

and "should" are not used in Best Practice statements. The adjectives "required" and "recommended" are only used in Best Practice statements to describe required or recommended design features as they relate to optional design features.

703.2 Bus Stop Locations Selection

In general, bus stop spacing affects overall travel time, and therefore, demand for transit. However, *bus stops should be spaced per Table 700-1 to minimize pedestrian walking distances near major passenger generators*. Bus stop locations are generally determined by the local transit agency and are based on goals to meet the needs of the passengers and maximize passenger convenience. Table 700-1 lists some typical bus stop spacing that would be expected based on highway segment designations. These spacing distances are ~~not intended to be suggested spacing. They are~~ ranges ~~of spacing distances~~between stops that have been determined from analysis of information provided by transit agencies throughout Oregon. Generally, the more urban and pedestrian oriented a highway segment designation is, the greater density of transit stops needed.

Table 700-2: Typical Ranges for Bus Stop Spacing Based on Highway Segment Designation

Area	Spacing Range (feet)
CBDs and STAs [1]	330 – 1000
Urban/Developed Areas, CCs, and UBAs [2]	650 – 1300
Suburban Areas	740 – 2300
Unincorporated Communities/Rural Lands	As Needed

[1] Central Business Districts (CBDs) and Oregon Highway Plan designated Special Transportation Areas (STAs)

[2] Commercial Centers (CCs) and Urban Business Areas (UBAs)

Communication between ODOT and the local transit agency is important. The location of the bus stop must address both traffic operation issues and passenger accessibility issues. If possible, the bus stop should be located in an area where typical improvements, such as a bench or shelter, can be placed in the public right of way. Bus stop location should consider potential ridership, traffic and rider safety, and bus operation elements that require site-specific evaluation. *Significant emphasis should be placed on factors affecting personal security*; well-lit open spaces visible from the street create a safer environment for waiting passengers. Elements to consider in bus stop placement include the following:

1. Use:
    a) Proximity to major trip generators and/or at major transfer points;
    b) Presence of or need for addition of sidewalks, crosswalks, and curb ramps;
    c) Connection to nearby pedestrian circulation system;
    d) Access for people with disabilities- Minimum 8'x5' landing area
    e) Accessible sidewalk connections;
    f) Convenient passenger transfers to other routes; and
    g) Convenient connections to other transportation modes.
2. Traffic and Rider Safety:
    a) Conflict between buses and other motor vehicle traffic;
    b) Passenger protection from passing traffic;
    c) All weather surface to step to/from the bus;
    d) Open and lighted spaces for personal security and passenger visibility; and
    e) Street illumination
3. Bus Operations:
    a) Adequate curb space for the number of buses expected at the stop at one time;
    b) On-street automobile parking and truck delivery zones;
    c) Traffic control devices near the bus stop, such as signals or stop signs;

d) Volumes and turning movements of other traffic, including bicycles;
e) Adequate sidewalk width to accommodate expected ridership;
f) Pedestrian activity through intersections;
g) Proximity and traffic volumes of nearby driveways;
h) Street and sidewalk grades;
i) Ease of re-entering traffic stream; and
j) Proximity to rail crossings.

Bus stops are generally located at intersections where they may be placed near-side or far-side. They may also be placed mid-block. In general, a near-side stop is preferred for non-signalized intersection on two lane streets when the bus stops in the lane and vehicles will not pass around a stopped bus. In the case of a street with wide shoulders or multiple lanes where vehicular traffic may pass uncontrolled around the bus, a far-side stop is preferred for sight distance issues. In the case of a street with wide shoulders or multiple lanes where vehicular traffic is controlled by a signal, the bus stop may be located either near-side or far-side. Far-side bus stops at signalized intersections should have a pull-out area to minimize vehicle queuing back into the intersection. Stops should be placed to minimize the difficulties associated with bus lane changes and bus weaving maneuvers on the approach to a left turn. Where it is not acceptable to stop the bus in traffic and a bus pullout is warranted, (see following discussion, "Guidelines for Special Treatments"), a far-side or mid-block stop is generally preferred. As with other elements of the roadway, consistency of stop placement lessens the potential for operator and passenger confusion. In order to minimize conflicts and maintain sight distance, bus stops should not be located close to driveways. Table 700-2 presents a comparison of the advantages and disadvantages of each bus stop type.

Table 700-3: Advantages and Disadvantages of Far-side, Near-side and Mid-block Bus Stops

FAR-SIDE STOP	
Advantages	**Disadvantages**
• Minimizes conflict between buses and right turning vehicles traveling in the same direction • Minimizes sight distance problems on approaches to the intersection • Encourages pedestrians to cross behind the bus • Minimizes area needed for curbside bus zone • If placed just beyond a signalized intersection in a bus pullout, buses may more easily reenter the traffic stream • If a pullout is provided, vehicle capacity through intersection is unaffected	• If bus stops in travel lane, could result in traffic queued into intersection behind the bus (pullout will allow traffic to pass around the stopped bus and should be installed with signalized intersections) • If bus stops in travel lane, could result in a high rate of rear-end accidents as motorists fail to anticipate stopped traffic • May cause passengers to access buses further from crosswalk • May interfere with right turn movement from cross street
NEAR-SIDE STOP	
Advantages	**Disadvantages**
• Minimizes interference when traffic is heavy on the far side of an intersection • Allows passengers to access buses close to crosswalk • Driver may use the width of the intersection to pull away from the curb • Allows passengers to board and alight when the bus is stopped for a red light • Provides the driver with the opportunity to look for oncoming traffic, including other buses with potential passengers when more than one route stop is located at the intersection	• Stopped bus may interfere with a dedicated right turn lane • May cause sight distance problem for cross-street traffic and pedestrians • If located at a signalized intersection, and if the shoulder width at the stop is such that buses will exit the traffic stream, a traffic queue at a signal may make it difficult for buses to re-enter the traffic stream • At single lane, signalized intersections with no pullout, prohibits through traffic movement with green light, similar to far-side stop without a bus pullout • May cause pedestrians to cross in front of the bus at intersections
MID-BLOCK STOP	
Advantages	**Disadvantages**
• Minimizes sight distance problems for vehicles and pedestrians • May result in passenger waiting areas experiencing less pedestrian congestion • May be closer to passenger origins or destinations on long blocks • May result in less interference with traffic flow	• Requires additional distance for no-parking restrictions • Increases walking distance for patrons crossing at intersection, or requires special features to assist pedestrians with mid-block crossing

Source: Adapted from the Guidelines for Planning, Designing, and Operating Bus-related Street Improvements. Texas Transportation Institute.

703.3 Bus Stop Layout and Delineation

The bus stop must be clearly delineated to ensure that other traffic will not use the stop area and to give bus operators direction on where to stop the bus. *Delineation may include appropriate signing and pavement markings at and near to the bus stop location.* ***For curbside stops, the bus stop zones (no parking designation) should be a minimum of 100 feet for near-side stops and 80 feet for far-side stops. Curbside mid-block stop zones should be a minimum of 150 feet. Bus stop zones are lengthened 20 feet for articulated buses.*** *Bus stop zones may be shortened significantly with curb extensions as discussed in the next subsection.* Designs should be coordinated with the local jurisdiction and transit agency.

Generally, buses and bicycles are able to share available road space. However, stopped buses hinder a bicyclist's progression and slower moving bicycles can hinder buses. On routes heavily traveled by both bicyclists and buses, separation of the two modes can reduce conflict and is the preferred method. Final design of separating bus and bicyclist can take many forms and should be considered on a case by case basis. One method is an adjacent bike lane to delineate the areas. Another method is a completely separated bike path or cycle track behind the bus stop. See Section L107 in the Bicycle and Pedestrian Design Guide and Section 984. There may also be other appropriate ways to accomplish bicycle and bus separation specific to a site. Potential right of way needs may be associated with bus stop and bicycle design and should be considered early in the development process.

More than one bus may occupy a stop at a given time. The number of bus-loading positions required at a given location depends on:

1. The rate of bus arrivals, and
2. Passenger service time at the stop.

Curb space for one bus will typically be adequate for up to 30 buses per hour. If passenger service time is more than 30 seconds per bus and bus arrivals exceed 30 buses per hour, then more than one loading/unloading position will likely be required. ***Bus stop area should be lengthened by 50 feet for each additional single unit bus and 70 feet for each additional articulated bus.***

703.4.1 Bus Pullout

Bus stops may be designed with a pullout, which allows the transit vehicle to pick up and discharge passengers in an area outside the traveled way. Bus pullouts are provided primarily on high-volume and/or high-speed arterials. Since most ODOT facilities have a roadway classification of arterial, bus pullouts should be considered at all stops on state highways. Lower vehicle speeds, greater public acceptance of delay, development intensity and limited right of way may make pullouts inappropriate in some urban situations. Bus pullouts are frequently constructed at bus stops with a high number of passenger boardings such as large shopping centers, factories, and office buildings. Bus pullouts reduce potential conflicts between bicyclists and passengers exiting the bus. They also provide a means for bicyclists to pass a stopped bus and continue along the roadway. Providing a bus pullout for bus stop locations is the preferred design option on state highways. However, when a bicycle lane is present, the bus driver must be careful when crossing the bike lane to enter and exit the pullout.

Well placed, carefully designed bus pullouts offer safe passenger loading and unloading with minimal delays to both transit and other roadway traffic. While serving as a bus stop, they may also be used simultaneously as a schedule layover area. Table 700-3 lists the advantages and disadvantages that should be considered in the decision to provide a bus pullout:

Table 700-4: Advantages and Disadvantages of Bus Pullouts

Advantages	Disadvantages
• Allows traffic, including bicycles to proceed around bus, reducing delay for other roadway traffic • Assists in maximizing the vehicle capacity of the roadway • Defines bus stop • Passenger loading and unloading may be conducted in a more relaxed manner • Less potential for rear-end accidents	• More difficult to reenter traffic, increasing bus delay and slower average travel time for bus • Bus may need to cross bike lane • Uses additional space, may require additional right of way • May increase rates of sideswipe accidents • Cost • Impacts transit operation times

The Yield to Bus Law, ORS 811.167, gives a bus the right of way when pulling away from a bus stop when it is displaying a standardized sign that flashes "YIELD." This law should improve the operational problem of buses re-entering the traffic stream.

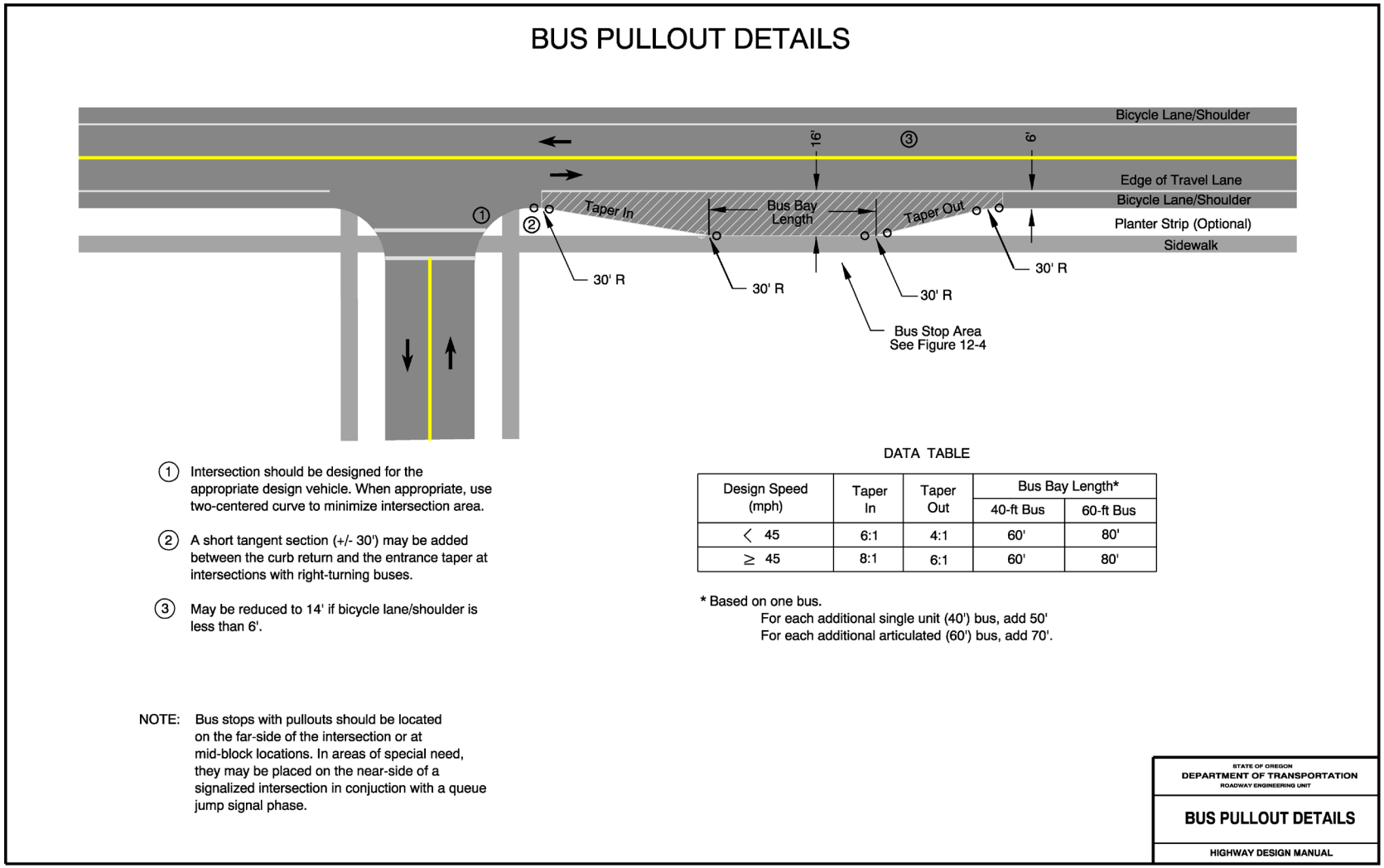
A bus pullout is most appropriate when one or more of the following situations exist:

1. Average vehicle speed exceeds 40 mph;
2. Traffic in the curb lane exceeds 250 vehicles during the peak hour;
3. History of a high rate of accidents, particularly rear-end accidents;
4. More than 5 bus stops per hour;
5. Passenger boardings exceed 30 boardings per hour; or
6. Transit agency desires an area for dwelling time.
7. A bike lane is present or in a high bike use area

Multilane, one-way streets may have sufficient gaps in the traffic stream to allow all other traffic, including bicycles to pass around a stopped bus. Bus pullouts are generally not appropriate on these roadways.

When a bus pullout is justified, it should be placed to allow buses to easily reenter the traffic flow. The design of a bus pullout should allow through vehicle and bicycle traffic to flow freely without the obstruction of stopped buses. They should generally be placed on the far-side of a signalized intersection so that the signal can create gaps in traffic. Due to the highly concentrated wheel loadings on the pavement, bus pullouts should generally be constructed of plain doweled concrete pavement. ~~Typical~~**Design bus pullouts per typical dimensions** ~~for a bus pullout are~~ **shown in Figure 700-1**. ***The bay length should be increased by 50 feet for each additional single unit bus expected to concurrently use the pullout***. Figure 700-1 and related bus pullout drawings shown are intended to provide design guidance for transit stops to comply with minimum ODOT requirements. Local transit agencies may have their own design criteria that differ from the ODOT minimum. The designer should contact the local transit agency to determine specific transit stop design criteria to comply with the local agency. Collaboration between ODOT and the local transit agency using the state highway is critical to successfully design transit stops.

Figure 700-1: Typical Bus Pullout Details



(Consult Local Transit Agency for Project Specific Details Required)

703.4.2 Curb Extensions

A curb extension may be constructed along streets with on-street parking in areas with high pedestrian use such as downtown shopping districts and central business districts. Curb extensions may be designed in conjunction with bus stops to facilitate bus operations and passenger access. The combination of curb extension and pullout can make design a challenge, particularly the drainage design. The placement of a bus stop on a curb extension should follow the same guidelines as those previously stated (a near-side stop is preferred on two lane streets where vehicles will not pass around a stopped bus. In the case of a street with wide shoulders or multiple lanes where vehicular traffic may pass uncontrolled around the bus, a far-side stop is preferred for sight distance issues). A bus stop on the near-side of a single lane entrance into an uncontrolled intersection should completely obstruct the traffic behind it. Where it is not acceptable to have stopped buses obstruct a lane of traffic, and a bus pullout is justified according to the previously discussed conditions, a bus stop may be placed far-side in the parking strip just beyond the curb extension. It may be appropriate to place a bus stop on a far-side curb extension at an uncontrolled intersection if the warrants for a bus pullout are not met and its placement will not create undue traffic hazards.

Near side curb extensions are usually about the width of the parking lane and of sufficient length to allow passengers to use the front and back doors of a bus. ~~Typical dimensions of~~**Design curb** ~~extensions with~~**extension at near side bus stops** ~~are~~**per the typical dimensions shown in Figure 700-2**. Besides reducing the pedestrian crossing distances, curb extensions with near side bus stops can reduce the impact to parking (compared to typical bus zones), mitigate traffic conflicts between autos and buses merging back into the traffic stream, make crossing pedestrians more visible to drivers, and create additional space for passenger amenities such as a shelter and/or a bench.

In areas where curb extensions are desired, but it is not acceptable to have the bus stop in the travel lane, a far side pullout area can be created in the parking strip as shown in Figure 700-3. **Design curb extensions at far side stops per the typical dimensions in Figure 700-3.** This location and design, which is generally preferred for low-speed, high volume, four lane roadways, eliminates the safety hazard of vehicles passing the bus prior to entering the intersection.

Figure 700-2: Near-Side Bus Stop with Curb Extensions

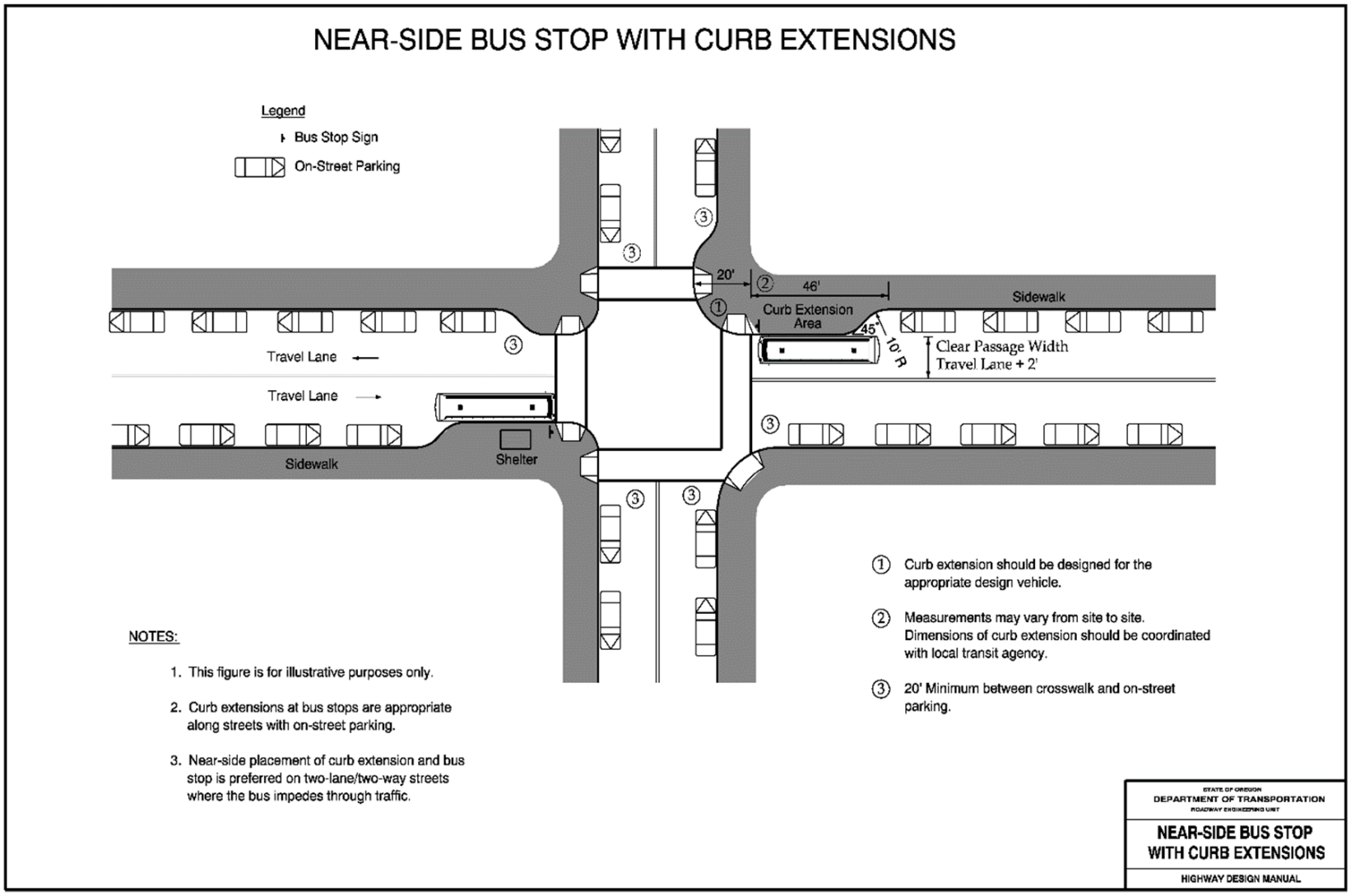
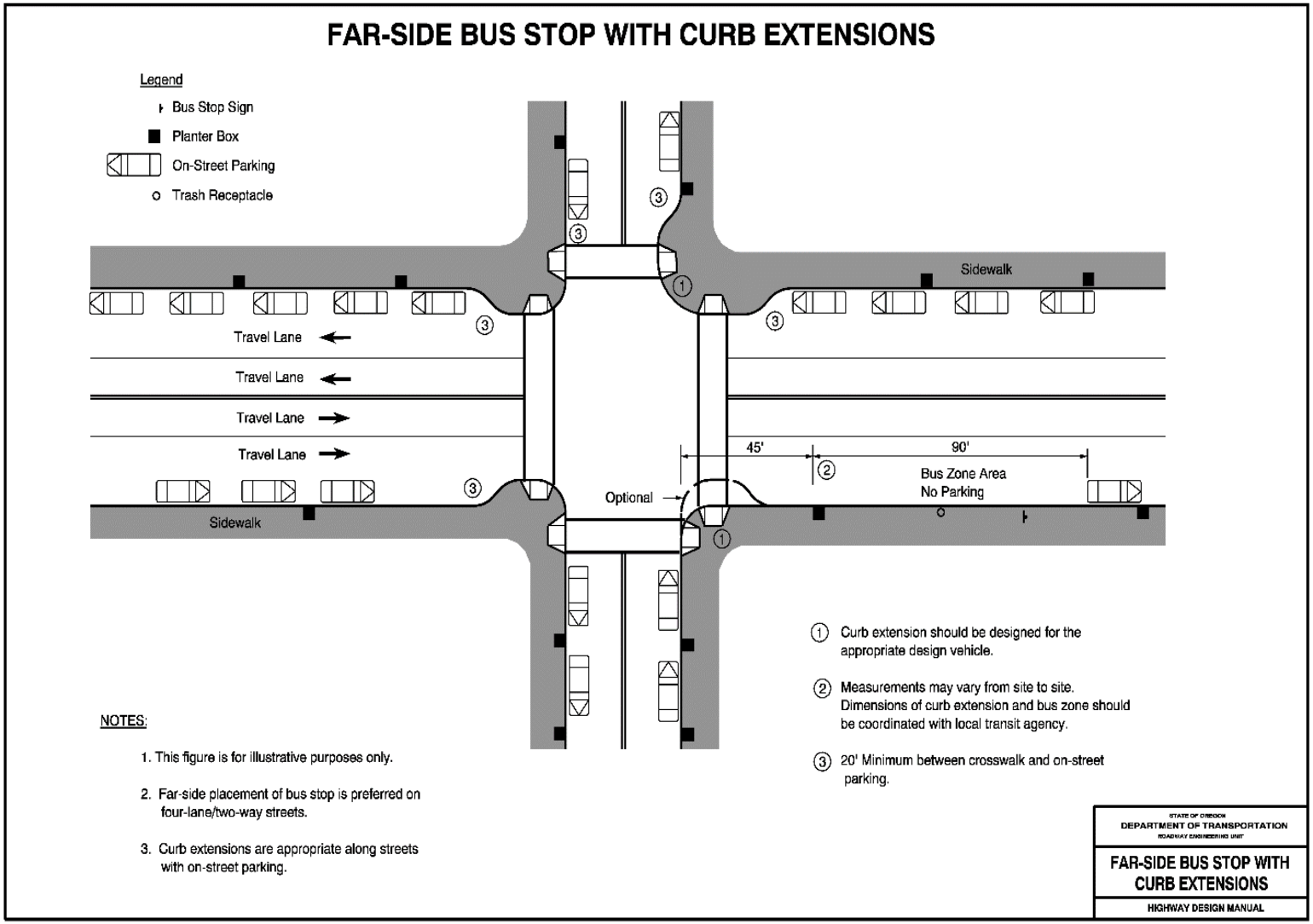


Figure 700-3: Far-Side Bus Stop with Curb



Section 704 Transit Accessibility and Amenities

704.3 Amenities for Waiting Passengers

Transit ridership is enhanced by the provision of safe, pleasant and comfortable places for waiting passengers. Protection from the elements, seating, and personal security are key to a pleasant waiting experience. The following amenities are recommended to be placed where feasible and cost effective. The list is not a complete compilation of amenities available. It is merely a starting point for possible inclusion. The local transit agencies typically have guidelines for amenities and should be contacted to determine which amenities should be included in the project.

704.3.1 Bus Shelter

Type, size, and placement of shelter depends on land use characteristics, transit frequency, and transit capacity. A standard-size bus shelter requires at least a 6 foot x 10 foot pad. **The shelter ~~should be~~is placed at least 2 feet from the back of curb when the opening faces away from the street and at least 4 feet when the opening faces towards the street. The adjacent sidewalk must still have a 5 foot clear passage for the pedestrian zone.** Orientation of the shelter should take into account prevailing winter winds. Sidewalks separated from the roadway with a planter strip offer a unique opportunity to provide a bus shelter out of the path of passing pedestrians. See Part 800 for additional bus shelter site design guidance.

704.3.2 Signing

Appropriate pedestrian scale directional signing (way finding) can help people find major transit stops such as intercity bus stops, transit centers, and park-and-ride lots. **Place bus stop identification sign at least 2 feet from the curb zone.**

704.3.3 Seating

Benches can make waiting more pleasant for transit passengers. In particular, people with a disability may be unable to stand for long periods while waiting for the bus; seating may increase their ability to used fixed route transit service. **Evaluate space for ADA companion seating and clear space requirements when benches are provided. Benches shall be accessible from connecting pedestrian circulation area and placed on an accessible surface.**

704.3.4 Shade

The strategic placement of shelters, benches, and bus stops should also account for trees (existing, new) to provide shade for passengers. Deciduous shade trees which cast afternoon shade on the bus stop are generally most effective.

Shade trees can make waiting more pleasant for transit passengers and trees provide multiple other benefits in urban settings. Species should be thoughtfully selected and measures taken during installation to eliminate the risk of roots heaving pavement. Plant trees outside of clear zone and comply with Highway Directive DES 20-01 Ornamental Landscaping. See Section 406 Roadside and Median Trees for other considerations.

706.3.7 Bicycle Parking

Almost all facilities will see some bicycle usage. **At a minimum, bicycle racks should be provided**. The provision of bicycle storage lockers will depend upon usage. Providing convenient and secure bicycle parking or storage is important to encourage the utilization of bicycles in combination with transit as a viable commute option. When a transit rider is comfortable knowing their bicycle is safe from theft during the time they are at work and they do not have to go through the hassle of loading the bike on the transit vehicle, they may be more willing to leave the car at home and ride the few miles to the park and ride. The bicycle parking area should be relatively close to the transit loading area, separated from motor vehicles by a curb or other barrier, and have a direct route from the adjacent streets. **The bicycle parking area should not conflict with passenger waiting and loading areas.** For additional information on bicycle facilities, see Part 900 and Chapter 3 of the Bicycle and Pedestrian Design Guide.

Part 800 Pedestrian Design

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

Section 801 Introduction

801.1 Documentation and Approval Font Key

Text within this part is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown. Table 800-1 shows the four text fonts used, along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 800-1: Font Key

Font ~~Key Term~~	~~Font~~Documentation	Approver
Bold text	Design Exceptions	State ~~Traffic~~ Roadway Engineer (S~~T~~RE) and for some projects~~,~~ FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 0 for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 801.2 and 801.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 801.3 and 801.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

801.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. ~~All Standard statements appear in bold type in design parameters.~~ The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 801.4~~Options. A design exception is required to modify a Standard. The State Traffic-Roadway Engineer (STRE) gives formal approval, and FHWA approves as required.~~).

801.3 Guidelines

A guideline is a statement of recommended practice in typical situations. ~~All Guideline statements appear in bold italicized type in design parameters.~~ The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 801.4~~Options. While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is required. Region approval, with input from Technical Experts, is formally recorded via the Urban Design Concurrence Document in the Design Decision portion.~~).

801.4 ~~Option~~ Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. ~~Option~~Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. ~~All Option statements appear in italic type in design parameters sections.~~ The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate ~~Option~~Best Practice statements. The verbs "shall" and "should" are not used in ~~Option~~Best Practice statements. The adjectives "required" and "recommended" are only used in ~~Option~~Best Practice statements to describe required or recommended design features as they relate to optional design features.

~~While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is best practice.~~

~~**General Text** Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.~~

801.6 Acronyms

A list of acronyms specifically introduced in Part 800 is below. Acronyms defined in other Parts of the Highway Design Manual are not repeated in this section.

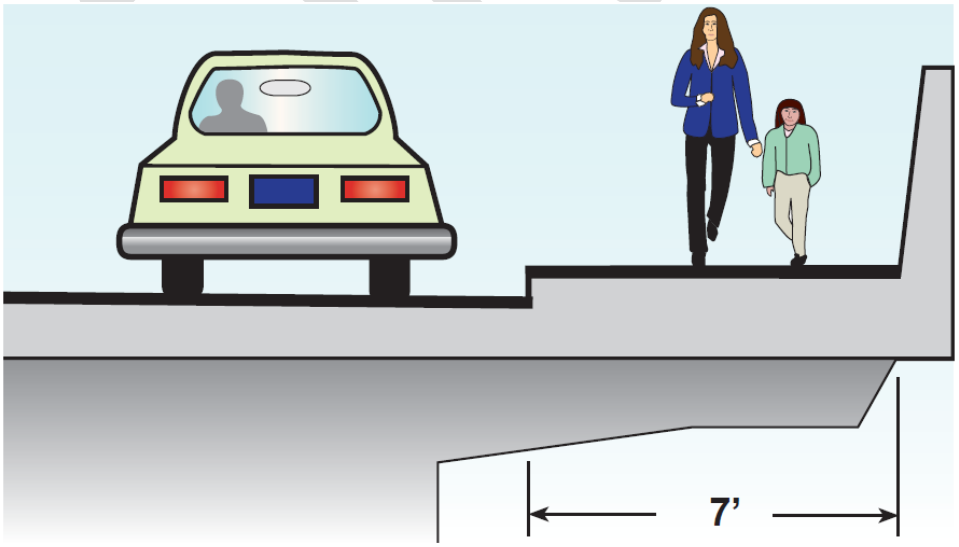
ABA	**Architectural Barriers Act**
ADA	Americans with Disabilities Act
APS	**Audible Pedestrian Signal**
CQCR	Comment, Question, Concern, or Request
FRA	Federal Rail Administration
OECR	Office of Equity and Civil Rights
PROWAG	Public Right of Way Accessibility Guidelines
TPARP	Temporary Pedestrian Access Route Plan
US DOT	United States Department of Transportation
US DOJ	United States Department of Justice

810.7.2 Walkways on Bridges

Provide walkways on both sides of bridges where pedestrian use can be expected. When designing walkways for bridges, the design life of a structure is 75 years or more. The walkway width will be in place for generations to come and is difficult to adjust later due to the impacts on the substructure design. Walkways on bridges are often a destination for pedestrian viewing of waterway features including boating, wildlife, and recreational fishing. Wider walkways allow for both the transportation need and occasional or planned recreational usage. See discussion on Shared Use Path design in Section 845.

Provide a Pedestrian Zone at least 7 feet wide on bridges when the walkway is for transportation use only to account for shy distances. See Section 900 for shared use path design width requirements. The Pedestrian Zone is exclusive of any curb, railing or concrete barrier on the bridge. **A 1-foot pedestrian shy distance is needed from each concrete barrier and/or pedestrian railings constructed on bridge walkways.** This shy distance is both from moving traffic and from the outside bridge rail, as some people feel uncomfortable walking close to a high vertical drop. Consider wider sidewalks in urban settings with high pedestrian use based on the Urban Context. **The bridge sidewalk must not be narrower than the approaching sidewalk at the bridge ends, see Figure 800-41 Bridge Sidewalk Transition to Roadway Sidewalk and Clear Width. Walkways on bridges with design speeds greater than 40 MPH require a vehicle traffic barrier at the Curb Zone.**

Figure 800-17: Minimum Bridge Sidewalk Width



Walkways on bridges also have additional pedestrian access route concerns that need to be reviewed in coordination with the bridge designer. Clear widths for pedestrian access routes are measured from the nearest vertical surface exceeding ¼ inch in height or any object/feature that protrudes into the Pedestrian Zone and excludes the Curb Zone, see Figure 800-42 Bridge Clear Width Measurement. Monolithic construction of the Curb Zone and walkway occurs frequently on bridges for various structural reasons. There is an implied curb and curb zone width (6 inches) which does not count towards the clear width requirement. Grout railing pads, decorative lighting, guardrail posts, and bridge rail connections often reduce the effective width of the Pedestrian Zone and pedestrian access route. (See discussion on Pedestrian Railing in Section 810.9.) Walkways on bridges include bridge expansion joints that are required to meet the pedestrian access route surface requirements and should be flush (See discussion in 810.5 on pedestrian access routes).

Vertical clearances over a bridge walkway are provided to ensure accessibility requirements are met. **A vertical clearance of 10 feet is required for shared use paths across a bridge to accommodate cyclist, see Section 845.2.6.** Horizontal clear widths measurements are reduced by objects that are less than 7 feet above the walking surface along the pedestrian accessible route. In some cases, greater than 10 feet vertical clearance is advisable when there is equestrian use, or emergency and maintenance vehicles are expected to traverse the walkway. When 10 feet of vertical clearance is not achieved, advance warning signs should be considered as a mitigation.

810.8 Walkway Surfaces

Walkways must provide a surface for the intended pedestrian use considering the long-term costs, construction accuracy and maintenance requirements. **Sidewalks, pedestrian lanes, and shared use paths must be firm, stable and slip resistant to meet ADA requirements throughout all weather conditions year-round.** Firm means that the surface must resist deformation or indentation. Slip resistance is not defined by a coefficient friction value, rather agencies must determine what is best practice based on engineering principles and construction practices for slip resistance. Slip resistance is historically provided with a broomed surface finish on Portland cement concrete on walkways. **Trails must provide a stable and slip resistant walking surface to meet ADA requirements.**

Concrete is the preferred material for walkways on site improvements, sidewalks, shared use paths and the pedestrian access route. It provides a smooth, durable finish that is easier to grade, repair and meet ADA surface requirements. Concrete surfaces are finished to smooth and uniform texture by troweling, floating and cross brooming to provide slip resistance. Industry construction for concrete is more precise making it easier to achieve ADA slope requirements during finishing. Concrete's service life can easily span several decades requiring little to no maintenance of the surface. **Walkway surfaces comprised of Portland Cement**

concrete shall provide natural unpigmented Portland Cement concrete in the pedestrian zone. The tone of the final construction is dependent on the source materials including but not limited to the limestone, aggregates, and sand. Attempts to mimic existing material coloring where alteration occurs are difficult to achieve.

Asphalt pavement is not the preferred material for sidewalks and shared use paths as slopes are more difficult to control and the life span of the material is shorter. Asphalt walkways are more susceptible to cracking and irregularities due to freeze thaw conditions, tree root growth, and poor compaction of the foundation material. Asphalt is typically a lower cost alternative that can meet the ADA surface requirements however compaction tools create greater variability in the finished slopes. Asphalt pavement surfaces are a more accessible surface for recreational outdoor trails and reduce maintenance needs compared to an unimproved trail.

Bricks and ornamental landscape pavers should not be used as the primary walking surface or in the pedestrian access route. They may be used for aesthetics or providing contrast in the buffer and frontage zones. Walkway embellishments in the buffer and frontage zones can also be achieved by treating concrete with colored dyes or with decorative scoring. Bricks and pavers installed with a great degree of smoothness can meet the ADA surface requirements when constructed flush with no horizontal gaps and with no beveled edges. Do not utilize bricks or landscape pavers that are beveled or "pillowed". Bricks and pavers will need to have a slip-resistant surface when installed; they are often manufactured with smooth finishes and when wet will become slippery. Long-term maintenance costs should be recognized when selecting bricks or pavers as the walkway surface. Bricks and pavers overtime are more likely to become displaced because of freeze and thaw conditions, or tree roots which create vertical discontinuities (lips) in the pedestrian access route and pedestrian circulation areas.

Bricks and pavers are a type of hardscaping that is considered walkable that maybe utilized in the buffer zone for aesthetics. **Bricks and paver ~~should~~ shall not be installed in the vicinity of curb ramps in lieu of flared sides without additional treatments.** See additional discussion in Section 815 for curb ramp design requirements. Low vision and blind travelers cannot distinguish the difference between bricks and Portland cement concrete underfoot and confuse these type of surfacing materials as something that is intended to be walked on in many situations in other environments. Bricks and pavers can be aggravating and painful for some people with spinal cord injuries and other conditions as vibrations occur when mobility device users traverse the surface joints. ASTM-E3028 is a standard for determining wheelchair pathway roughness index related to comfort, passibility, and whole-body vibrations.

An alternative to pavers is stamped and dyed concrete. This alternative provides much of the aesthetic value of bricks with the durability and smooth surface of concrete. Decorative treatments in the street or crosswalk which consist of concrete color or scored patterns are not a marked crossing. See the Traffic Manual for pavement markings at crosswalks. Colored concrete provides contrast which may assist with wayfinding for people with vision impairments when used on the edges of the pedestrian zone or pedestrian access route. **Do not use stamped concrete patterns that create rough surfaces in the pedestrian access route or**

pedestrian circulation areas. Treatments such as grouted durable rock require approval for installation. ***Use of stamped concrete patterned areas in the vicinity of curb ramps will require concurrence from the Senior ADA Standards Engineer.***

815.2 Curb Ramp Triggers and Scoping

Refer to the Engineering for Accessibility webpage for resources about curb ramp triggers in the current Directives, Bulletins, Advisories, Operational Notices and ODOT's ADA Curb Ramp Process (Appendix G). Triggering activities occur when an alteration occurs that effects the usability of a pedestrian crosswalk, sidewalk or walkway, and therefore presents the opportunity to construct an accessible curb ramp. When the concrete material (surfacing), or curb and gutter pan of the curb ramp system is disrupted, the curb ramp has been altered and requires reconstruction to the standard.

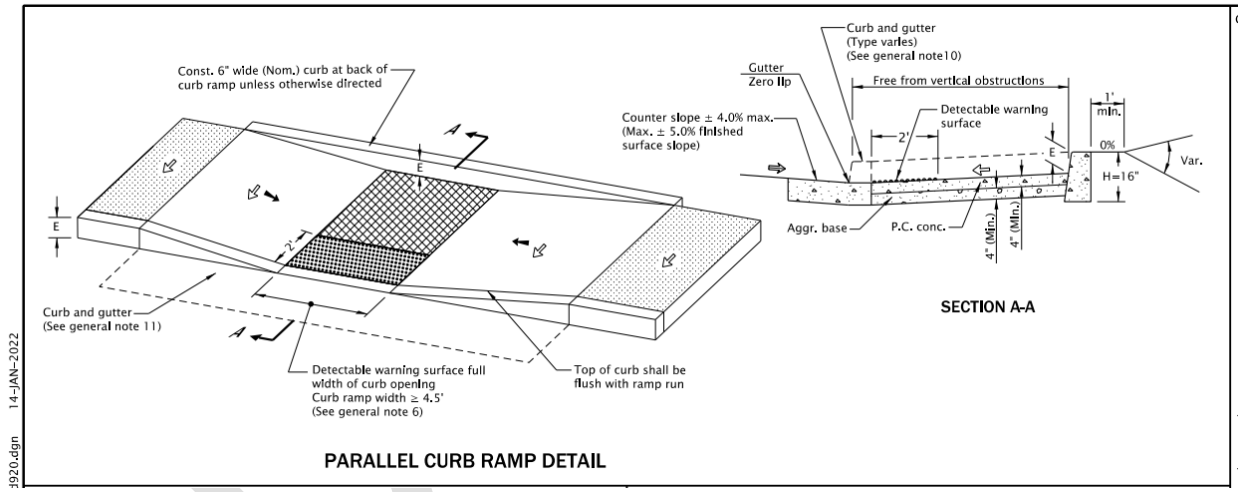
Right of way shall be planned for projects with curb ramp improvements per TSB18-03(D). The ADA requires upgrading curb ramps in alteration projects. The US DOT and US DOJ ~~recently~~ issued a memorandum of joint technical assistance to define when resurfacing projects are considered an alteration, which triggers the need to upgrade curb ramps. As a result, all 1R projects need to address curb ramps, except projects that only include chip seals~~.~~ (see Section 110.2 for ADA requirements for paving projects). See Maintenance and Operational Notice MG 100-107~~-1 for~~ in Appendix H for direction on what is considered a maintenance pavement activity. See Maintenance and Operational Notice MG 144-03 for direction on what is considered a signal maintenance activity for accessibility features on the pedestrian signal.

~~Locations of curb~~Curb **ramps that do not comply with the ODOT standard shall be upgraded when triggered by a project activity**. Contact the ODOT Roadway Engineering Section for assistance with determining curb ramp triggers. Consult the ODOT ADA Transition Plan for other ADA project needs that should be incorporated into the project scope to meet the transition plan goals and schedule, utilizing state funds as efficiency as practical. Consult with the Active Transportation Liaison for CQCR requests that are to be addressed with the project scope.

815.3.2 Parallel Curb Ramps

"Parallel curb ramps have a running slope that is in-line with the direction of sidewalk travel and lower the sidewalk to a level turning space where a turn is made to enter the pedestrian street crossing."[1] Parallel curb ramps should be reserved for constrained public right of way in curb ramp alterations where there are building foundation conflicts, large existing retaining walls, or bridge rail constraints. The elevation difference for the curb height is stretched over one ramp run parallel with the vehicular travel way with a level area and turn space at the bottom of the ramp runs. This style of curb ramp tends to separate the curb ramp opening for each crosswalk distance significantly at an intersection. This results in poor alignment with the receiving curb ramps and orientation cues for low vision and blind travelers.

Figure 800-34: Parallel Curb Ramp System



Review the RD900 series for additional layouts and construction requirements on parallel curb ramps systems. The Figure 800-34 above is an example of a parallel curb ramp.

When determining whether or not to include curbing at the back of a sidewalk, there are several items that need to be considered. Consider the following items, but note that the following list is not all inclusive and other factors may have an influence:

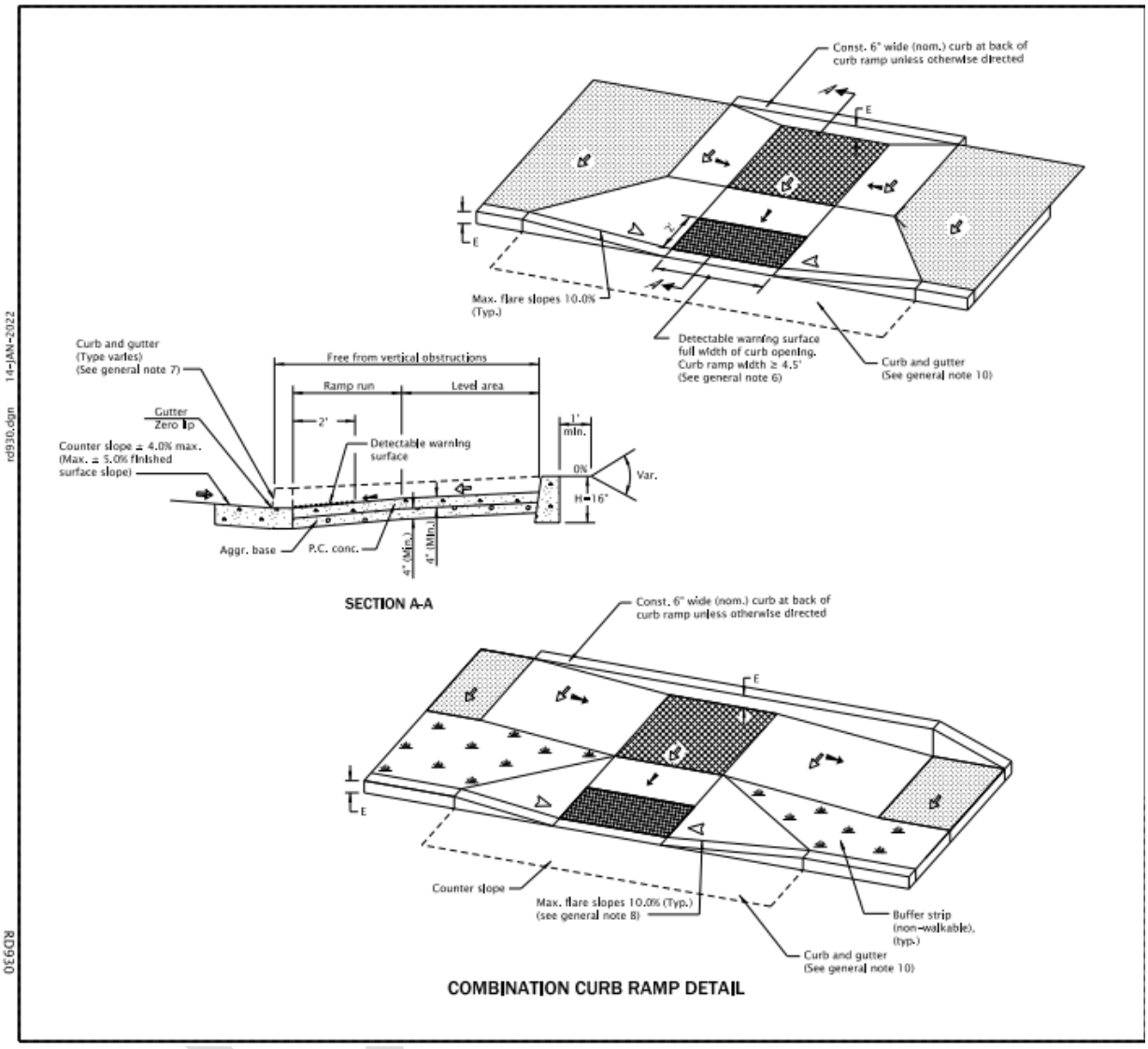
[1] PROWAG Preamble R304.3

1. If the curb ramp is located adjacent to a steep slope, the curb may provide protection against a wheelchair or other wheeled device from unintentionally leaving the back of the ramp.
2. The curb may serve a drainage function to keep runoff from leaving the highway right of way and flowing onto adjacent properties particularly if no storm sewer is in place or nearby.
3. The curb may serve a drainage function to keep unwanted runoff or debris from entering at the curb ramp instead of following the intended drainage path.
4. The curb may not be warranted when the curb ramp is constructed such that it is abutting a building or retaining wall for example and might impact the foundations.
5. The curbing should be removed if installation impacts the redirecting capabilities of adjacent guardrail.

815.3.3 Combination Curb Ramps

Combination curb ramps provide the most flexibility for design in meeting the ADA standards and reducing the footprint of the improvements. The elevation difference for the curb height is stretched over two separate ramp runs (one perpendicular and one parallel to the curb line) with a level area and turn space to change directions. This style of curb ramp can also facilitate larger or irregular shaped level areas to meet ADA requirements at signalized intersection with push buttons. This style of curb ramp is good for providing connections to the building entrances and adjoining walkways to private property/businesses. This style of curb ramp allows for directional curb ramps that align parallel with the intended crosswalk. Directional curb ramps are the preference for design.

Figure 800-35: Combination Curb Ramp System



Review the RD900 series for additional layouts and construction requirements on combination curb ramps systems. The Figure 800-35 above is an example of a combination curb ramp. When determining whether or not to include curbing at the back of a sidewalk, here are several items that need to be considered. Review discussion related to curb at the back of walk at parallel curb ramps in Section 815.3.2.

815.3.4 Curb Ramps Next to Driveways

As discussed in the walkway design section (Section 810), curb ramps provide pedestrian access to the sidewalk or walkway. Providing positive separation between the vehicular access

driveway throat and curb ramp opening is needed. Each site will need a design based on the existing site topography, property boundary, and access management considerations. Coordination with the Region Access Management Engineer is required when developing the project's Access Management Strategy or modifying a driveway. Identify the system limits of both the curb ramp system and driveway system on the plan set details to reduce confusion during contract administration on unique designs. *Consider deeper concrete surface thickness for ease of construction and conforming to the driveway performance needs.* **Older designs where the curb ramp and driveway are one facility shared by the pedestrian and vehicle providing access from the Travelway Realm are no longer permitted.** In rare circumstances would that be considered a viable solution.

Details are shown for new driveway construction with horizontal separation distances for accessible routes which include 5 feet between successive ramp runs of the curb ramp system and the driveway system (see RD700s) when constructed. This is **Criteria P1** on the ADA Curb Ramp Design Checklist. Driveway design includes a certain amount of off tracking by a vehicle identified as the "p" distance on the standard drawings for driveway construction. Off tracking simulation software should be used to evaluate the design of a curb ramp driveway combination configuration based on the design vehicle. The available lane widths and shoulder widths vary with each corridor and impact the space for vehicles off tracking and approach speeds of drivers while turning. Creativity is key in designing a curb ramp driveway combination that meets all accessible route requirements and functions for the design vehicle.

Provide at least 5 feet of separation between the driveway throats and edge of the curb ramp throat (typically the turn space or level area) when constructed, Criteria P2. This situation typically occurs when the pedestrian access route of the driveway is at the same level as the curb ramp pedestrian access route. See Figure 800-36 and Figure 800-37 as some examples of design strategies to meet the separation requirement for the curb ramp and the driveway systems. Refer to the local jurisdiction driveway construction standard drawings, Options H thru Options N, when space is constrained between the driveway and curb ramp locations. The flared construction is much smaller and may be a design solution for meeting the separation requirement.

Figure 800-36: Driveway Separation Requirement Example 1, Criteria P2

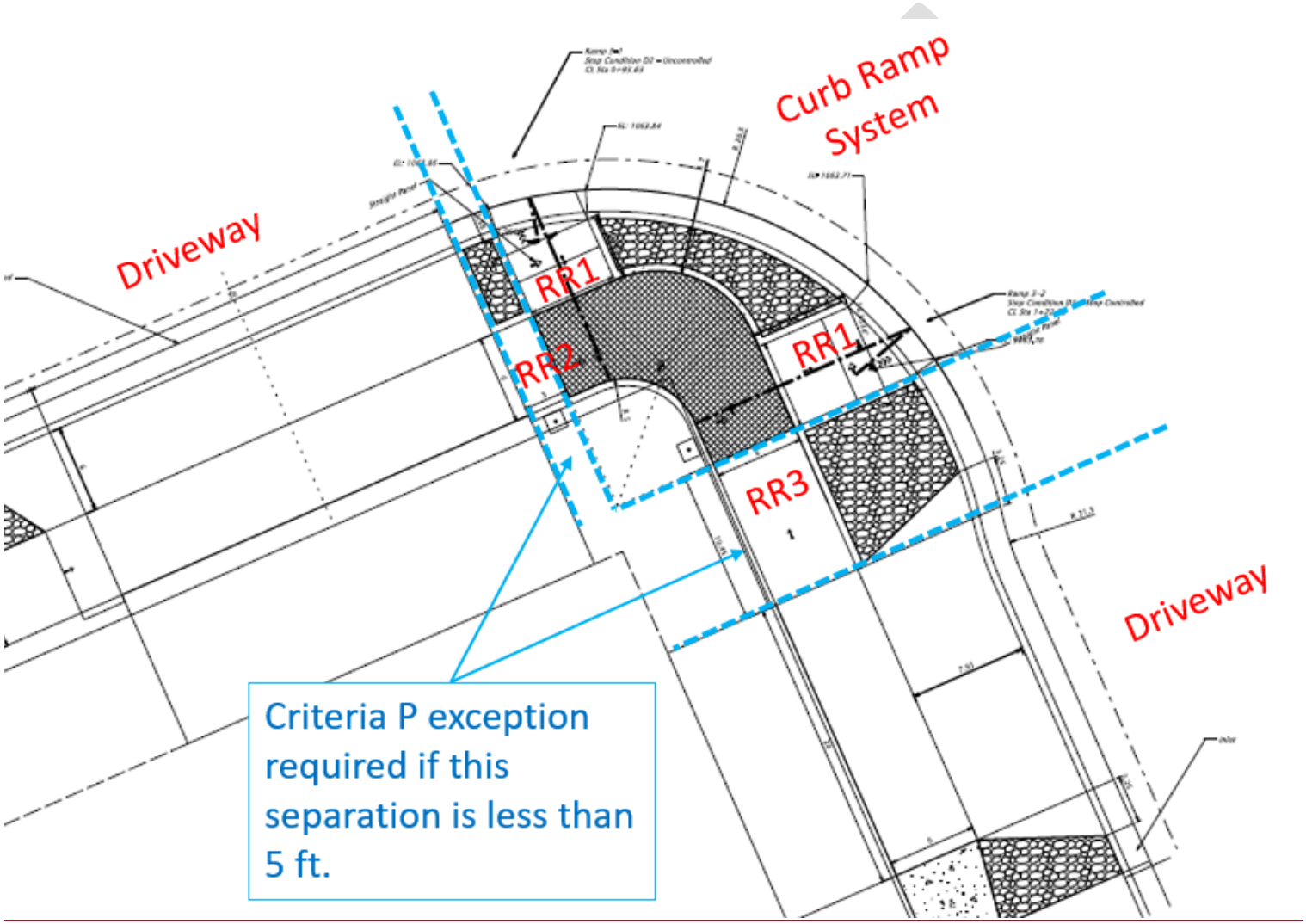
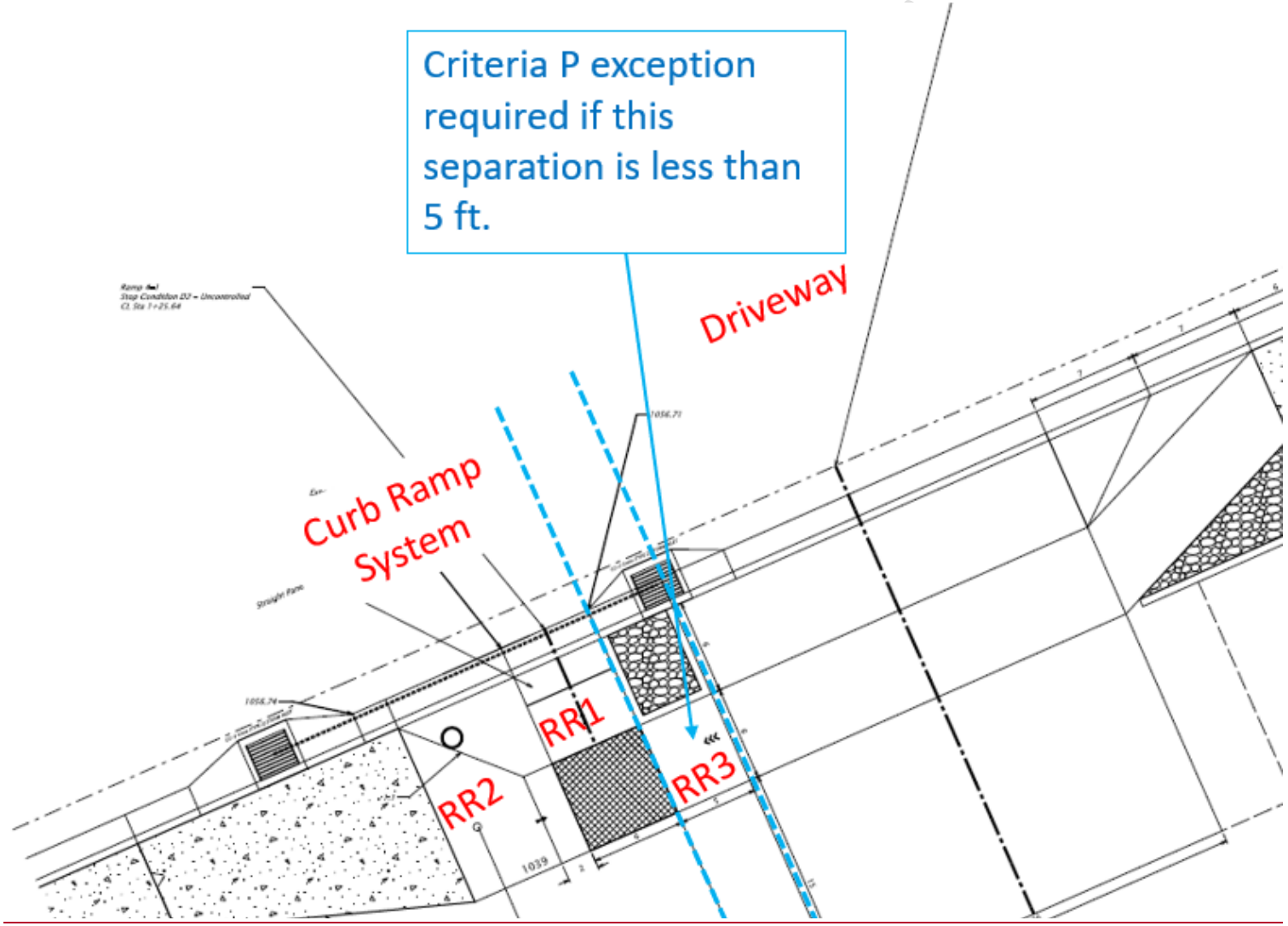


Figure 800-37: Driveway Separation Example 2, Criteria P2



Designs that utilize a raised curb section to physically separate the curb ramp opening and driveway throat are evolving, see Figure 800-37. ***Provide constant curb exposure height (denoted "E") between 4 inches to 6 inches in height on the curbing.*** Curbs for vehicles have vertical differences of 4 inches or more (See Part 300, Section 318 for curb types). This would replace what would otherwise be a flared wing or flared side to ensure white cane detectability, conspicuity, and depth perception of the area. Softscape materials included in the interior of the small, raised island provides the best performance of all desired attributes for pedestrians: detectability, conspicuity, contrast, visual appeal, and space for vegetation. **A minimum area of 3 feet by 3 feet from face of curb to face of curb may be considered when horizontally constrained in either direction (see Section 800 on Buffer Zone requirements, RD721)**. To be effective, the size should be as large as practical. Smaller areas will require additional mitigation measures (i.e., white tubular markers) and will require approval as described in the Traffic Line Manual.

815.3.6 Unique Curb Ramps

Unique curb ramps styles are typically parallel style curb ramps that are missing ramp run components. This could include either Ramp Run position 2 or Ramp Run position 3, or both. A pedestrian pad is a unique curb ramp for inspection and inventory purposes as both Ramp Run 2 and Ramp Run 3 are missing.

When determining whether or not to include curbing at the back of a sidewalk, as show in RD960, there are several items that need to be considered. Review discussion for parallel curb ramp in Section 815.3.2 related to the curb at the back of walk. Evaluate whether the curbing will unintentionally preclude or obstruct natural pedestrian circulation onto the side street. Evaluate whether the surrounding material at the back of walk can be graded to provide for easier debris or snow removal instead of installing the curbing. The curbing adjacent to the turn space (landing) should be aligned parallel with the intended or marked crosswalk when installed to allow low vision and blind users to orient themselves to the crosswalk.

815.3.8 Bridge End Curb Ramps

Where a project includes a bridge with a pedestrian access route on a walkway, provide an accessible sloped connection for pedestrians to proceed from the bridge walkway to the roadway. In most cases, a bridge walkway is a continuation of a shoulder, a sidewalk, or adjacent intersection. Use the following guidance for designing accessible curb ramps for each of these facilities.

Bridge Sidewalk Transitions to a Shoulder

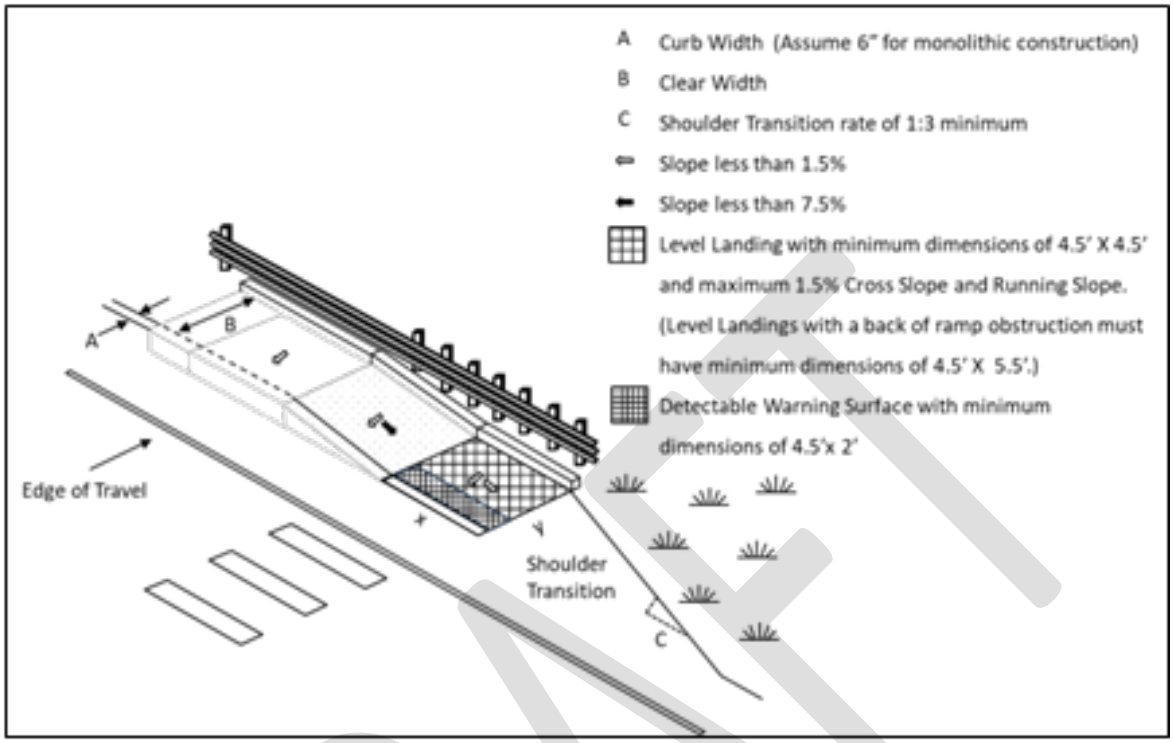
When a curb ramp is used to transition from a bridge sidewalk to the roadway shoulder, the curb ramp must meet accessibility requirements. Refer to the RD900 series drawings for curb ramp drawings and illustrations. Typically RD950 or RD952 is used in design at bridge ends. Accessible connections are designed with the following criteria:

1. **A designed cross slope of less than or equal to 1.5%, Criteria C1.**
2. **A designed ramp run running slope of less than or equal to 7.5%, Criteria B1.**
3. **A designed level landing or turning space with a cross slope of less than or equal to 1.5% in both perpendicular and parallel directions. Provide a landing or turn space with a minimum dimension of 4.5 feet x 4.5 feet (Criteria J1 and Criteria J2). Where there is a curb or other constraint at the back of walk, provide 5.5 feet in the direction of the crosswalk when the location is coincident with a crosswalk (Criteria J3).**

Where the existing bridge sidewalk has a cross slope that is greater than 2.0% and it is to remain in place unaltered, a transition panel is necessary. Transition the cross slope of the existing bridge sidewalk to provide a designed cross slope of less than 1.5%. Utilize the warp rate discussed in the geometric controls in Section 815.4.4 Cross Slope.

Where the landing coincides with a crosswalk at an intersection, a detectable warning surface will be installed. The detectable warning surface is placed on the level landing surface along the back of the curb when the bridge end is at the top of a T intersection. The detectable warning surface is placed at the bottom of the ramp run when it terminates at the intersection serving a side street intersection crosswalk. **The detectable warning surface is required to be a minimum of 2.0 feet deep in the direction of the crosswalk (Criteria R1).** Figure 800-38~~80038~~ below shows the required elements of a bridge sidewalk to transition to a shoulder at a crosswalk at the top of a T intersection.

Figure 800-38: Bridge Curb Ramp at Crosswalk, T Intersection



A pedestrian access route on a bridge sidewalk aligned with the existing shoulder of a roadway may be partially or completely outside of the shoulder area, or may be wide enough to encompass the bridge walkway. The following describes curb ramp treatments from bridge sidewalk to a shoulder.

Tapered shoulder curb ramp:

When a bridge sidewalk is partially or completely outside of the shoulder area, provide a tapered shoulder to transition users to the existing shoulder with a level landing that acts as a turning space at the bottom of the curb ramp as illustrated in Figure 800-39 Bridge Curb Ramp Tapered to Narrow Shoulder.

Continuous wide shoulder curb ramp

When the bridge sidewalk is within the full width of the shoulder provide a curb ramp from the sidewalk to the shoulder as illustrated in Figure 800-40 Bridge Curb Ramp to Continuous Wide Shoulder.

Figure 800-39 Bridge Curb Ramp Tapered to Narrow Shoulder

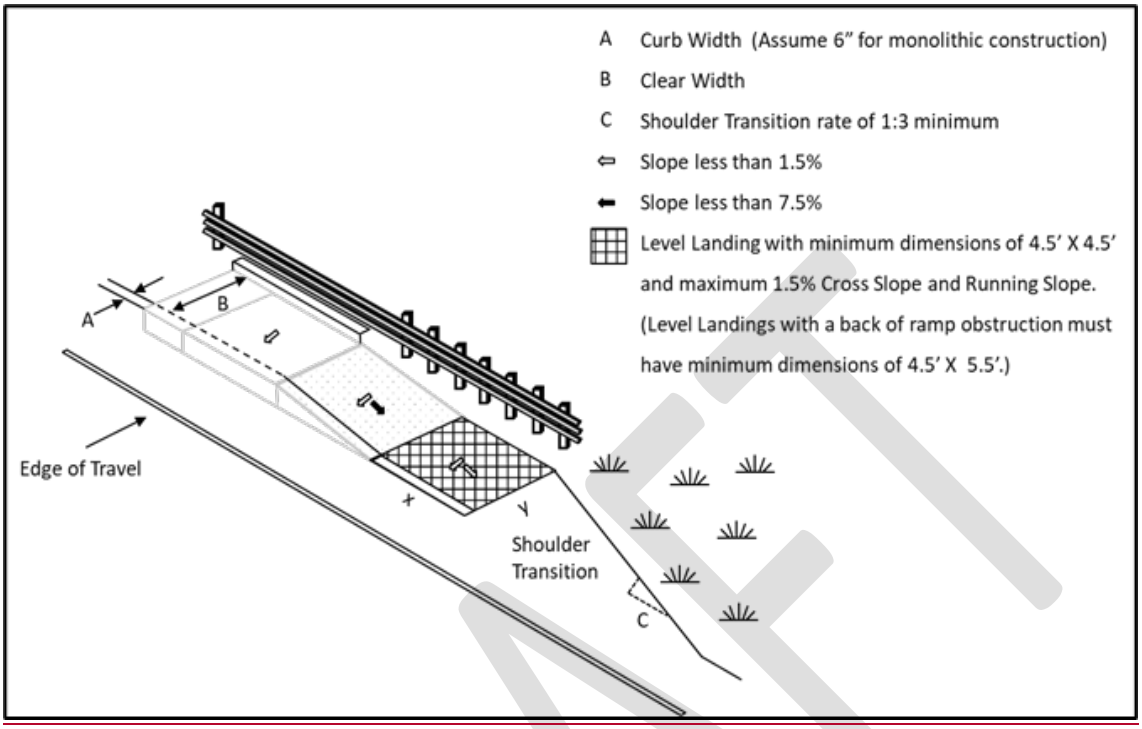
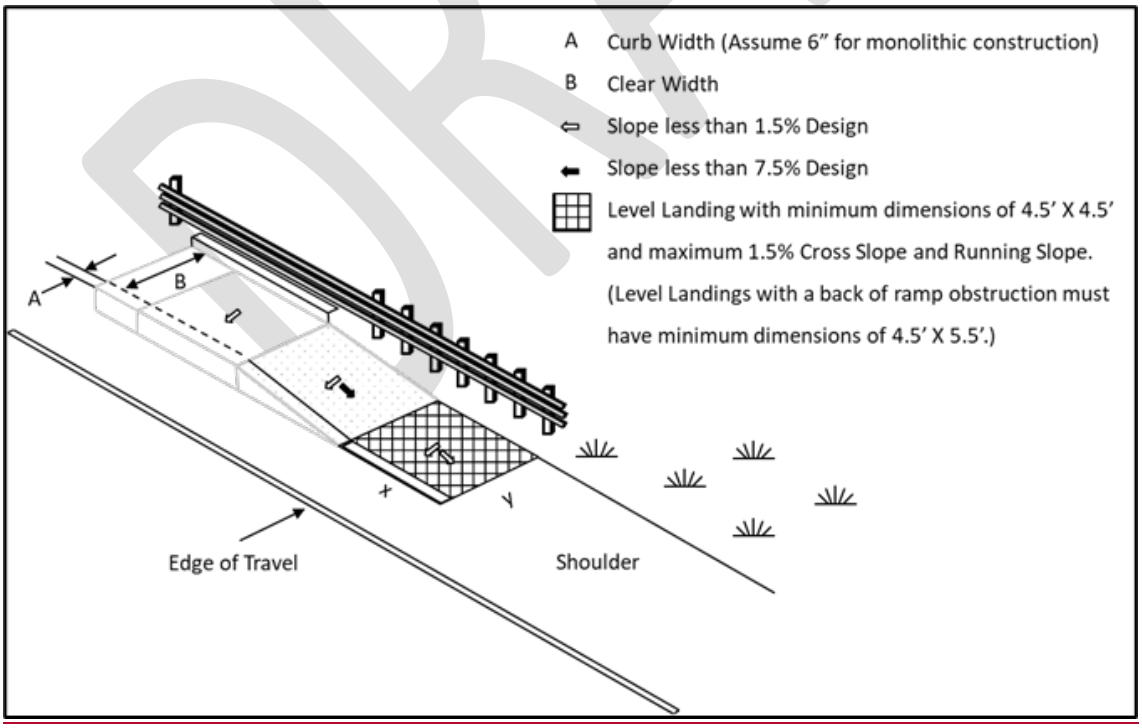


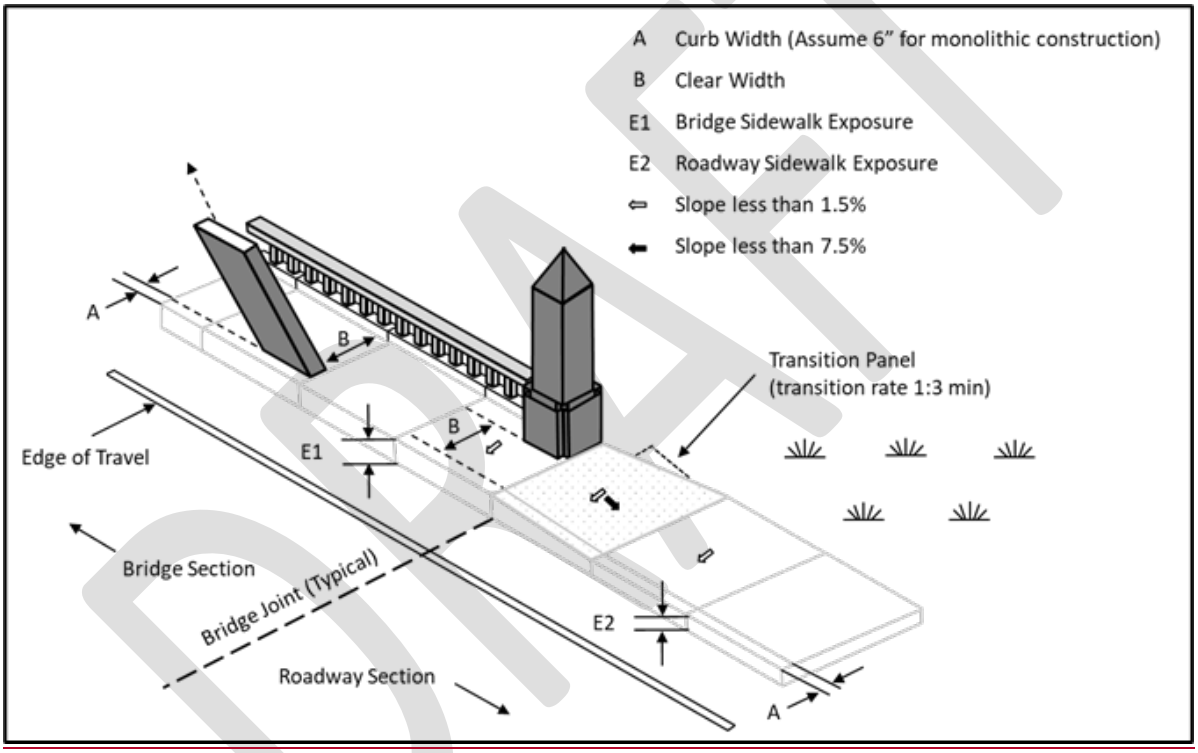
Figure 800-40 Bridge Curb Ramp to Continuous Wide Shoulder



Bridge Sidewalk to an Approach Sidewalk

Existing bridge sidewalks are often narrower and have a larger curb exposure height compared to a standard sidewalk. When connecting a bridge sidewalk to a standard sidewalk, it may be necessary to provide a transition panel between the existing roadway sidewalk and the bridge sidewalk. This transition panel can also be used to warp the cross slope from the bridge sidewalk to meet the cross slope of the roadway sidewalk. Figure 800-41~~80041~~ illustrates the use of transition panel to match the width and exposure height of the roadway sidewalk.

Figure 800-41 Bridge Sidewalk Transition to Roadway Sidewalk and Clear Width

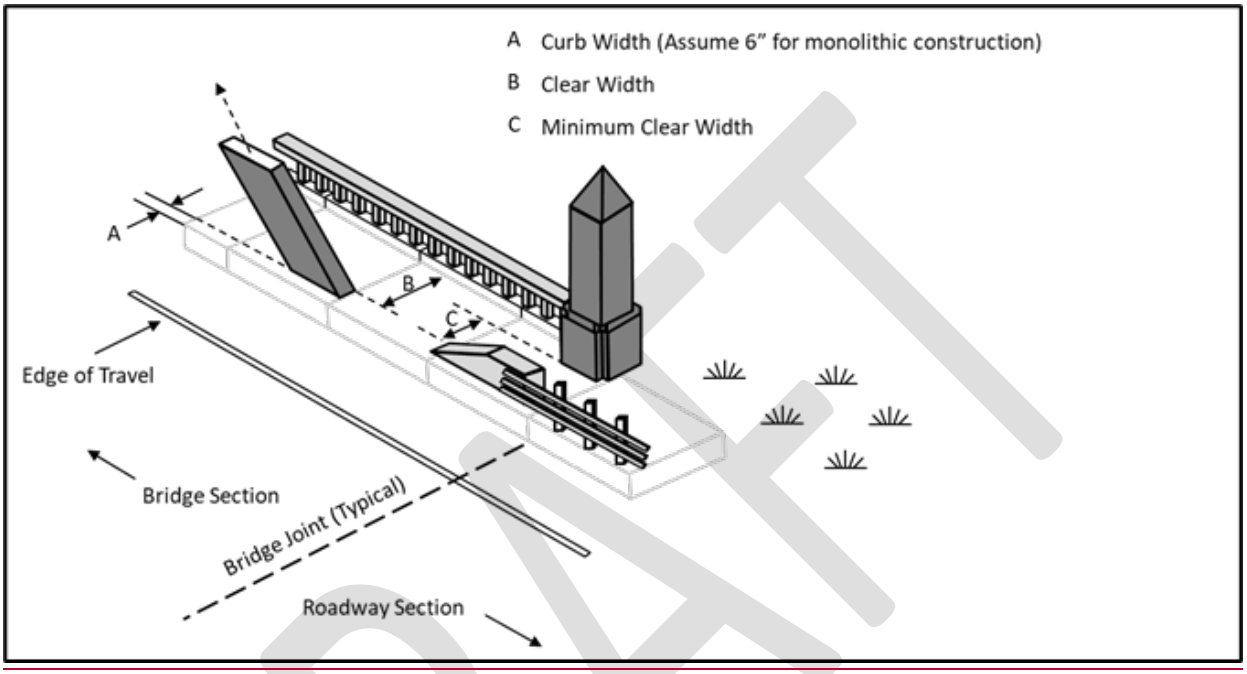


Clear width for pedestrian access routes is measured perpendicular to the direction of pedestrian travel from the back of the curb to the nearest vertical surface that exceeds 1/4 inch in height or any object that protrudes into the pedestrian access route. When monolithic construction is used, a top curb width of 6 inches is assumed and is not measured in the clear width. Figure 800-41 also illustrates potential clear width obstructions in the walkway on a bridge structure. Bridge sidewalks may have structural or historical objects that may reduce the clear width along the pedestrian access route. Figure 800-42 shows an example of how to determine the clear width when encountering these objects.

Refer to Section 810.7.2 when designing walkways on bridges. Vertical clearances over a bridge walkway are provided to ensure accessibility requirements are met. **A vertical clearance**

of 10 feet is required for shared use paths across a bridge to accommodate cyclist, see Section **845.2.6**. Clear widths measurements are reduced by objects that are less than 7 feet above the walking surface along the pedestrian accessible route, see Section 810.9.4.

Figure 800-42 Bridge Clear Width Measurement



Part 900 Bikeway Design

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

901.1 Documentation and Approval Font Key ~~Language~~

Text within this part is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown. Table 900-1 shows the four text fonts used, along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 900-1: Font Key

Font ~~Key Term~~	~~Font~~Documentation	Approver
Bold text	Design Exceptions	State ~~Traffic~~ Roadway Engineer (S~~T~~RE) and for some projects~~,~~ FHWA
Bold Italics text	Design Decisions Document	Region with Tech Expert input or other approver as described
Italics Text	Document decisions	Engineer of Record (EOR)
General Text (Not bold or italics)	N/A	N/A

Bold Text - Some standards appear in a bold font style. A design exception is required to justify and document not meeting a standard that appears in bold. The State Roadway Engineer (SRE) gives formal approval, and FHWA approves as required. See 901.2 for a description of design standards. In the case of 3R clear zone approvals and local agency projects off the state highway system, design exceptions can be approved by someone other than the State Roadway Engineer (see sections 402 and 1003.5).

Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 901.2 and 901.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 901.3 and 901.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

901.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. ~~All Standard statements appear in bold type in design parameters.~~ The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 901.4~~Options. A design exception is required to modify a Standard. The State Traffic-Roadway Engineer (STRE) gives formal approval, and FHWA approves as required.~~).

901.3 Guidelines

A guideline is a statement of recommended practice in typical situations. ~~All Guideline statements appear in bold italicized type in design parameters.~~ The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 901.4~~Options. While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is required. Region approval, with input from Technical Experts, is formally recorded via the Urban Design Concurrence Document in the Design Decision portion.~~).

901.4 ~~Option -~~ Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. ~~Option~~Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. ~~All Option statements appear in italic type in design parameters sections.~~ The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate ~~Option~~Best Practice statements. The verbs "shall" and "should" are not used in ~~Option~~Best Practice statements. The adjectives "required" and "recommended" are only used in ~~Option~~Best Practice statements to describe required or recommended design features as they relate to optional design features. ~~While a formal design exception is not required, documentation of the decisions made by the Engineer of Record in the Design Decision documentation or other engineering reports is best practice.~~

~~**General Text** - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.~~

~~See Part 100, Section 101 for additional information.~~

Part 1000 Design Exceptions

Notes to Reviewers:

There are no standards revisions in Part 1000 for the Draft 2025 version of the HDM.

Part 1100 3D Design

Notes to Reviewers:

There are no standards revisions in Part 1100 for the Draft 2025 version of the HDM.

Part 1200 Other Technical Disciplines

Notes to Reviewers:

This part contains only the sections and subsections that have been revised for the Draft 2025 version of the HDM.

Section 1201 Introduction

This section contains processes and guidance for roadway design as it relates to other technical disciplines. Consult the other technical disciplines for specific design guidance and to ensure an appropriate level of coordination between roadway and other disciplines.

1201.1 Documentation and Approval Font Key

Text within this part is presented in specific fonts that show the required documentation and/or approval if the design does not meet the requirements shown. Table 1200-1 shows the four text fonts used, along with their descriptions. The text in figures, tables, exhibits, equations, footnotes, endnotes, and captions typically does not utilize the font key.

Table 1200-1: Documentation and Approval Font Key

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Italics Text	Document decisions	Engineer of Record (EOR)
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Bold Italics Text - Both standards and guidelines may appear in a bold italics font style. While a formal design exception is not required when not meeting a standard or guideline that appears in bold italics, document and justify the decisions made by the Engineer of Record in decision documents or other engineering reports. When not meeting a standard or guideline that appears in bold italics, region approval with input from Technical Experts, or other approval as described in the HDM, is required. For urban projects, formally record decisions via the Urban

Design Concurrence Document in the Design Decision portion. The Urban Design Concurrence document is located on the Highway Design Manual website. See 1201.2 and 1201.3 for descriptions of design standards and guidelines.

Italics Text - Design decisions that require documentation appear in italic font style in design parameters sections. While a formal design exception is not required, document the design decisions made by the Engineer of Record in decision documents or other engineering reports. See 1201.3 and 1201.4.

General Text - Any informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The remaining text in the manual is general text and may include supporting information, background discussion, commentary, explanations, information about design process or procedures, description of methods, or potential considerations and all other general discussion. General text statements do not include any special text formatting. General text may be used to inform and support design exception requests, particularly where narrative explanations show best practices or methods of design that support the requested design exception.

1201.2 Standards

A standard is a statement of required, mandatory, or specifically prohibitive practice regarding a roadway geometric feature or appurtenance. The verb "provide" is typically used. The adjective "required" is typically used in figures to illustrate Standard statements. The verbs "should" and "may" are not used in Standard statements. The adjectives "recommended" and "optional" are only used in Standard statements to describe recommended or optional design features as they relate to required design features. Standard statements are sometimes modified by Best Practices (see 1201.4).

1201.3 Guidelines

A guideline is a statement of recommended practice in typical situations. The verb "should" is typically used. The adjective "recommended" is typically used in figures to illustrate Guideline statements. The verbs "provide" and "may" are not used in Guideline statements. The adjectives "required" and "optional" are only used in Guideline statements to describe required or optional design features as they relate to recommended design features. Guideline statements are sometimes modified by Best Practices (see 1201.4).

1201.4 Best Practices

A Best Practice is a statement of practice that is a permissive condition and carries no requirement or recommendation. Best Practice statements sometimes contain allowable ranges within a Standard or Guideline statement. The verb "may" is typically used. The adjective "optional" is typically used in figures to illustrate Best Practice statements. The verbs "shall" and "should" are not used in Best Practice statements. The adjectives "required" and "recommended" are only used in Best Practice statements to describe required or recommended design features as they relate to optional design features.

Section 1207 Transportation Analysis

1207.3 Design Guidelines

Table 1200-2 shows the acceptable v/c ratios for project development/design. Table 1200-2 applies to all modernization projects and should be applied within other project categories except for development review. A design exception ~~should be processed~~is required if the volume/capacity ratios in Table 1200-2 cannot be met. If it is known early in the planning or project development process that the v/c measures cannot be met, the design exception should be sought at that time instead of later in the project design phase.

The volume/capacity ratios shown in Table 1200-2 are generally different than those shown in the Oregon Highway Plan (OHP). The v/c ratio values in the OHP are used to assist in the planning phase identifying future system deficiencies. The OHP v/c ratio values also allow flexibility for land use applications and Transportation System Plans by having at-capacity v/c ratios in urban areas. The HDM v/c ratio values are different as the expectation is to provide a mobility solution that corrects those previously identified deficiencies and provides the best investment for the State in establishing 20-year design life solution. The Table 1200-2 values, although v/c oriented, are based upon the *AASHTO's "A Policy on Geometric Design of Highways and Streets"*.

Issues may arise when a large difference occurs between the design and planning v/c ratios particularly when alternative mobility standards have been adopted. The issues occur due to different interpretations of which measure applies. Technical Services should be contacted if agreement between Region Planning and Design staff cannot be reached on the use of the design-life requirement.

Although traffic data is needed in the design of all highway improvements, preservation type projects are primarily focused on extending the service life of the pavement while looking at cost-effective safety enhancements. Traffic forecasts can assist in making decisions regarding needed safety improvements as part of the 3R project (adding turn lanes, signals) or as a future standalone project. Table 1200-2 v/c ratios should be used as guidance in making cost effective safety improvement decisions for 3R preservation projects.

Region Traffic Unit and Region Roadway Design Unit need to determine when a design-life design exception request is required for a new or modified traffic signal. Consensus on the proposed improvements needs to be reached prior to submitting design exception requests for design life to Technical Services.

Design Life exceptions are not required on the following project types:

1. Private approaches
2. Unsignalized public approaches that do not modify their capacity

3. Development review projects
4. Operation STIP projects
5. Maintenance projects not in the STIP
6. Transportation System Plans
7. Traffic Growth Management (TGM) projects that do not have design details and would not be considered a 4R project in the design phase, however, any future build scenarios for TGM projects are to use the v/c ratios in Table 1200-2.

Table 1200-2: 20 Year Design-Mobility Standards (Volume/Capacity [V/C]) Ratio

Highway Category	Land Use Type/Speed Limits					
	Inside Urban Growth Boundary				Outside Urban Growth Boundary	
	STAs	MPO	Non-MPO outside of STAs where non-freeway speed limit <45 mph	Non-MPO where non-freeway speed limit >= 45 mph	Unincorporated Communities	Rural Lands
Interstate Highways and Statewide (NHS) Expressways	N/A	0.75	0.70	0.65	0.60	0.60
Statewide (NHS) Freight Routes	0.85	0.75	0.70	0.70	0.60	0.60
Statewide (NHS) Non-Freight Routes and Regional or District Expressways	0.90	0.80	0.75	0.70	0.60	0.60
Regional Highways	0.95	0.85	0.75	0.75	0.70	0.65
District/Local Interest Roads	0.95	0.85	0.80	0.75	0.75	0.70

Notes:

- Interstates and Expressways shall not be identified as Special Transportation Areas (STAs).
- The peak hour is the 30th highest annual hour. This approximates weekday peak hour traffic in larger urban areas.
- MPO category includes areas within the planning boundaries of the Bend, Corvallis, Eugene/Springfield, Medford, Portland (METRO) and Salem/Keizer Metropolitan Planning Organizations, and any other MPO areas that are designated after the completion of this manual.

Section 1212 Hydraulics

1212.2 Hydraulic Engineering Design Risks

One of the first steps in project delivery is the identification and characterization of project elements and the associated disciplines required to evaluate and design the project. When hydraulic engineering is necessary on a project, there are a variety of hydraulic engineering tasks and associated risks that should be evaluated. These risks can be easily mitigated by assigning professionals with the appropriate level of expertise to deliver the hydraulic engineering tasks, eliminating the need to identify these risks in the project risk register.

The following factors must be considered when evaluating the appropriate level of risk associated with project-specific hydraulic engineering features and tasks.

1212.2.1 Primary Risk Factors:

1. Safety to travelling public
2. Infrastructure replacement and life cycle cost
3. Environmental and regulatory requirements
4. Potential property damage and other liabilities
5. Design complexity

Site conditions and geography may also be considered. Consulting with a senior hydraulic engineer is recommended to determine the applicable project-specific risk factors.

After the level of risk has been evaluated, the risk is then mitigated by assigning professionals with the appropriate level of expertise to deliver the hydraulic engineering tasks. The five primary risk factors listed above were used to develop the contents of the matrix provided in Table 1200-6. This table should be used as a tool to quickly evaluate the appropriate level of expertise necessary to complete hydraulic engineering project tasks.

This approach replaces the past practice of using pipe diameter to determine the risk threshold.

Table 1200-6: Hydraulic Design Level of Risk

Hydraulic Engineering Task	Low Risk	Med Risk	High Risk
CHANNELS			
Channel - Roadside or Median drainage and Slope 5% or flatter	X		
Channel - Roadside or Median drainage and Slope steeper than 5%		X	
Channel – Stream Conveyance (All locations)			X
Channel - All Others			X
CULVERTS[1]			
Culvert, Non-Cross (public approach crossings, access roads, side drains, etc.)	X		
Culvert, Cross (State Highway) - Roadside or Median drainage only	X		
Culvert, Stream Conveyance (All locations)			X
Culvert extensions		X	
Culvert, Cross (State Highway) – All Others			X
STORMWATER[5]			
Inlet Capacity, Spacing, and Location	X		
Pavement / Pedestrian Facility Drainage	X		
New storm drain systems with 5 or less catch basins/manholes that converge into a single trunk line and do not discharge into a treatment or flow control facility	X		
New storm drain systems with 6 to 10 catch basins/manholes that converge into a single trunk line and do not discharge into a treatment or flow control facility		X	
New storm drain systems with more than 10 catch basins/manholes that converge into a single trunk line and do not discharge into a treatment or flow control facility			X
Modification of existing inlets or storm drain piping system without collecting additional contributing area	X		
Modification of existing inlets or storm drain piping system that collects additional contributing area		X	
Storm drain systems with stream conveyance			X
Storm drain systems that discharge into a treatment or flow control facility		X	

[1] Pipe materials and outlet protection are considered an element of the primary Hydraulic Engineering Task.

Table 1200-6: (Continued) Hydraulic Design Level of Risk

Hydraulic Engineering Task	Low Risk	Med Risk	High Risk
STORMWATER (Cont'd)			
Modification or removal of any existing treatment or flow control facility		X	
Offsite Drainage Contribution		X	
Combined flows from multiple jurisdictions			X
Flow control and associated features (detention, gates, valves, weirs, etc.)			X
Stormwater Treatment			X
Infiltration Facilities			X
Underground Injection Control Systems (UICs)			X
Stormwater Temporary Water Management		X	
OTHER			
Bank Protection (Rivers, Natural Channels)			X
Bridge Hydraulics / Scour Analysis /Abutment Protection			X
Scour Mitigation Plan of Action		X	
Downstream impacts and hydraulic connectivity zones			X
Facility Markers	X		
Fish Passage (All Locations)			X
Floodplains / Floodways			X
Minor structures (headwalls, wingwalls, vaults, special manholes, cutoff walls, etc.)			X[2]
Pump Station			X
Siphon			X
Temporary Water Management			X
Tide Gates			X
Trenchless Pipe Rehabilitation			X
Trenchless Pipe Replacement			X[3]
Waterway Enhancement			X
Anything not in the Hydraulic Design Manual			X

[2] Collaboration with a structural engineer may be required

[3] Collaboration with a geotechnical engineer is required

Table 1200-7: Professional Expertise Requirements

Risk Level	Design	Quality Control
Low	Professional Engineer	Professional Engineer
Medium	Professional Engineer	Hydraulic Engineer
High	Hydraulic Engineer[4]	Hydraulic Engineer

Professional Engineer: a licensed engineer as described in ORS 672 and OAR 820 and regulated by the Oregon State Board of Examiners for Engineers and Land Surveyors.

ODOT Hydraulic Engineer: a professional engineer who specializes in the hydraulic components related to the repair and replacement of bridges, culverts, and roadway embankments. These projects occur in the river environment and adjacent to other large bodies of water such as lakes and coastal environments. These professionals also work with stormwater and help design projects that are related to the movement, control, and treatment of water. Hydraulic engineers must have a strong understanding of hydrology and fluid mechanics relating to the design and protection of the transportation system.

ODOT Hydraulic engineers also assist with water resources, flood control planning, and adhere to federal, state, and local environmental regulations and standards. They must have a strong understanding of how Oregon drainage law has been established by case history. They also create designs for flood control and waterway enhancement and communicate with governing bodies to address their concerns about stormwater, stream stability, and scour. Hydraulic Engineering falls under the broader career category of the Civil Engineering branch of Professional Engineering. Several indications that a Civil Engineer may have expertise in hydraulic engineering include:

- Work environment (team members primarily design hydraulic features or conduct hydraulic studies)
- Mentorship received from a senior hydraulic engineer
- Number and complexity of hydraulic engineering designs completed
- Number and quality of hydraulic engineering training classes completed
- Working Title (ODOT Only) of “Hydraulic Designer/Engineer”

[4] Consult with the ODOT State Hydraulic Engineer for exceptions to hydraulic designer qualification requirements.

Part 1300 Deliverables

Notes to Reviewers:

There are no standards revisions in Part 1300 for the Draft 2025 version of the HDM.

Appendix H

Highway Division Maintenance Operational Notice: MG100 Through 107

Notes to Reviewers:

Appendix H is a new appendix for the Draft 2025 version of the HDM.

Oregon Department of Transportation

Highway Division Maintenance Operational Notice

Number	Supersedes	Effective Date	Cancellation Date
MG 100 thru 107	Jan 1, 2015	Oct 18, 2016	Until Further Notice
Subject		Issuing Body	
Guidelines for Pavement Maintenance Activities and their impact on ADA requirements.		Maintenance and Operations Engineer	

PURPOSE:

The purpose of this notice is to define maintenance activities that do and do not trigger the need to install or upgrade curb ramps so that maintenance forces can make informed decisions as they scope and plan their work. The purpose of this guidance is to ensure compliance with Title II of the Americans with Disabilities Act of 1990 (ADA) and the Rehabilitation Act of 1973 (Section 504).

BACKGROUND:

The ADA prohibits discrimination and ensures equal opportunity for persons with disabilities in employment, State and local government services, public accommodations, commercial facilities, and transportation. The ADA is codified in the Code of Federal Regulations Title 28, Chapter 1, Part 35 (28 CFR 35).

The Federal Highway Administration (FHWA) is responsible for implementation of pedestrian access requirements from the ADA and Section 504. This is accomplished through stewardship and oversight over public agencies that build and maintain highways and roadways, regardless of fund source.

The ADA requires installing or upgrading existing curb ramps in projects that alter streets, roadways or highways. Clarification for this requirement was provided in a June 28, 2013 memorandum of joint technical assistance (https://www.fhwa.dot.gov/civilrights/programs/doj_fhwa_ta.cfm) by the US Department of Justice (USDOJ) and FHWA. It describes when maintenance activities such as resurfacing are considered alterations, triggering the requirement for curb ramp installation where none exist and curb ramp upgrades where existing ramps are non-compliant. Further clarification on these requirements was provided in additional guidance from USDOJ/FHWA dated December 1, 2015.

This recent guidance has direct impacts on traditional maintenance activities, some of which would now be considered *alterations* triggering curb ramp installation and upgrades at the ends of affected crosswalks, thus increasing the scope and cost of a routine maintenance project. This increase may be significantly magnified if ROW or utility relocates are required for the curb ramp work.

The US DOJ / FHWA memorandum defines an *alteration* as:

> "... a change that affects or could affect the usability of all or part of a building or facility. Alterations of streets, roads, or highways include activities such as reconstruction, rehabilitation, *resurfacing*, widening, and projects of similar scale and effect. Maintenance activities on streets, roads, or highways, such as filling potholes, are not alterations."

GENERAL GUIDANCE

When paving work is considered an alteration, curb ramps adjoining each intersecting crosswalk within the limits of the paving work must be addressed. Curbs ramps are required to be addressed, installed or upgraded if a sidewalk is present and existing curb ramps don't meet minimum standards.

1. Review the planned work
2. Determine if the work is considered an alteration[1]
3. If not, proceed with the work but document:
    a. Conditions that warrant patch repairs (why limited to the area's patched)
    b. The review and determination
    c. Retain this documentation
4. If yes, before proceeding with the work:
    a. Request an evaluation for ramp compliance and needs analysis from Roadway Section (phone/email)
    b. If impacted ramps are noncompliant or ramps need to be installed where none exist, work with the Tech Center to provide plans, specs and estimates
    c. Include the ramp work with the paving work or where pavement conditions deteriorate so rapidly that planning is prohibited, necessary ramp work should be planned and built as soon as practicable, document this
    d. Project limits may need to be reduced because the project estimate exceeds available budget, if so document this

ALTERATION DEFINITION

Reference the exampled in the attached diagram, Figure 1, to assist in determining if planned work is considered an alteration.

Alteration work is one or more of the paving activities below that spans from one intersection to another or, in unique cases, resurfacing of just the crosswalk itself.

1. Overlays of additional material, with our without milling; or
    a. Reconstruction
    b. Rehabilitation
    c. Open-graded friction course
    d. Microsurfacing[2]
    e. Thin lift overlays
    f. Cape seal
    g. In-place asphalt recycling
    h. Blade patching

[1] To help ensure consistent determination and to see if there are improvement that need to be made in this Ops Notice, for a period of one year after the date of this notice, review your determinations for paving/patching that **do not trigger** with Ray Mabey, Maintenance Services Manager, 503-986-3570, raymond.mabey@odot.state.or.us

[2] Micro-surfacing involves spreading a properly proportioned mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives on a paved surface. It differs from a slurry seal in that it can be used on high volume roadways to correct wheel path rutting.

2. Combination of maintenance work (listed below) that results in additional thickness such as a chip seal with a slurry seal.

Maintenance work that does not require curb ramp work is:

1. Maintenance patching – work listed in items 1 and 2 above that does not span from one intersection to another and is less than ¾ of the full roadway width.
2. Individual activities that don't result in additional pavement thickness that can span multiple intersections and full width such as
    a. Crack filling and sealing
    b. Surface sealing
    c. Chip seals[3]
    d. Slurry seals
    e. Fog seals
    f. Scrub seals
    g. Joint crack seals
    h. Joint repairs
    i. Dowel retrofits
    j. Spot high friction treatments
    k. Diamond grinding
    l. Rut filling (without grinding)

RAMP WORK CONSIDERATIONS

Early Planning

Plan ahead to include ramp work in your paving project. The "parent-child" project concept is no longer acceptable. Ramp work, if triggered, should be coincident with the paving work.

When pavement conditions deteriorate so rapidly that planning is prohibited, necessary ramp work should be planned and built as soon as practicable. These situations should be very rare and considered the exception. Documentation of the deterioration and need for immediate paving should be retained.

Ramp Evaluation

TransGIS can be used to see if a ramp meets minimum standards, however the ramp should be field verified before scoping is completed. Contact your Tech Center staff or Roadway Section of Technical Services Branch to have trained qualified staff to perform evaluations.

Pedestrian Signal Button Poles & Landing

Ramp construction may impact signal button poles or the landing at the pedestrian button. If so, upgrades to signal button poles and landings will be required if needed. In those cases work with your Tech Center to perform the scoping and design work.

[3] Chip Seals involve placing graded stone (chips) on liquid emulsified asphalt sprayed on pavement surface. The surface is rolled to enable seating of chips.

Design and Construction

Technical Services Branch has developed a ramp evaluation form, standard designs, construction specifications, and final inspection procedures to ensure constructed ramps are compliant with standards and that temporary pedestrian routes, accessible to pedestrians with disabilities, are provided through or around work zones. Rely on your Tech Center staff to help you through this work.

MAINTENANCE PATCHING CONSIDERATIONS

Crosswalks Defined in Law

All legs of an intersection, marked or unmarked, including tangent sides of T-intersections are considered legal crosswalks (ORS 801.220), unless signed as closed (ORS 810.080).

Intersections

Generally an intersection is an at-grade crossing of two or more streets. Private drives and alleys are not considered streets. When a street intersects with one direction of a separated (by a median for example) roadway, the other direction is not part of the intersection. Highway ramps would be considered a street for this definition.

Avoidance

Maintenance activities shall not be modified for the purpose of avoiding triggering ADA upgrades. The intent of this document is to clarify and communicate ADA requirements.

Documentation

Document the pavement conditions for the areas you are patching. Include why patch limits were selected; especially when limit is adjacent to a crosswalk (see examples 3 and 5 in the attached diagram). The conditions should warrant the patch work as compared to unpatched areas. Retain this documentation.

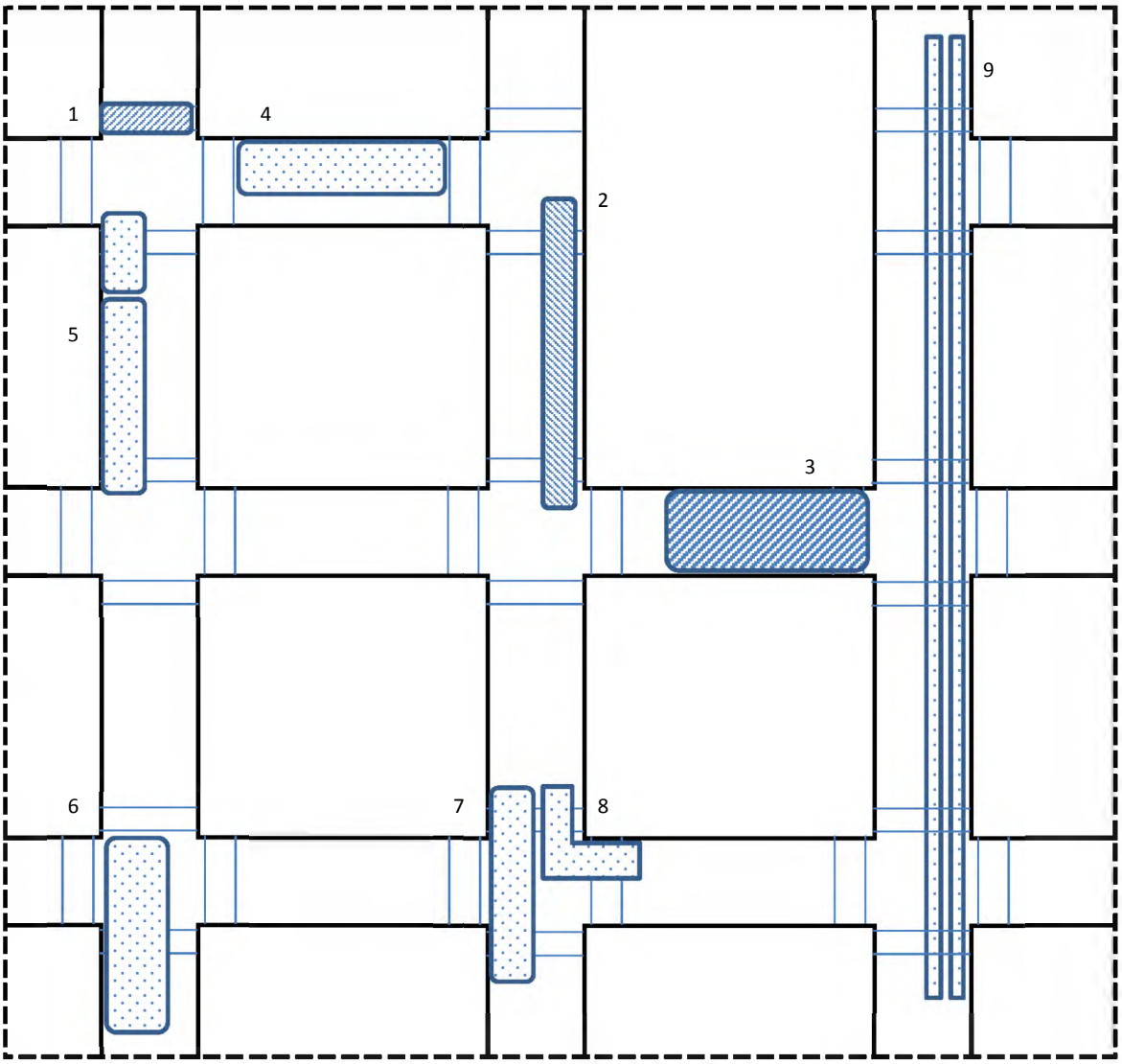
Transitions in Crosswalks

To ensure a smooth transition from existing pavement to patched pavement lip between the two shall be no greater than 1/4".

Damage to Existing Curbs

Do not damage the curb or drain pan at the ramp while performing maintenance activities or patching. If this occurs adjoining curbs ramps are required to be addressed, installed or upgraded if the curb ramps don't meet minimum standards.

FIGURE 1: Definition of Maintenance Patching



Examples of Pavement Treatment Alterations and Maintenance Patching

1. Alteration - resurfacing of a crosswalk only is an alteration. DOJ/DOT Joint Technical Assistance topic #4.
2. Alteration - resurfacing spanning from one intersection to another and includes overlays of additional material, with or without milling. Resurfacing would be defined as one or more of the "Treatments that are considered alterations of the road surface" and possibly combinations of "Treatments that are considered maintenance of the road surface" as found inthe Glossary of Terms for the Joint Technical Assistance. DOJ/DOT Joint Technical Assistance topics #2 and #3.
3. Alteration - resurfacing does not span from one intersection to another but is greater than 75% width.
4. Maintenance patch - resurfacing does not span from one intersection to another and less than 75% width.
5. Maintenance patch - larger patch is a grind and inlay, smaller patch is a fog seal.
6-8. Maintenance patches - resurfacing does not span from one intersection to another , is less than 75% of the roadway width, and is not intended a resurfacing of the crosswalk itself but is for roadway conditions. If 6 and 7 happen coincidently and the combined width is greater than 75% of the roadway width, it would be considered an alteration. If not, it would be a maintenance patch.
9. Maintenance patch - rut filling *without* a grind and inlay, rut line patches must not meet or overlap

Each of the "maintenance" scenarios assumes that the existing curbs and curb ramps are not damaged from the patching activities. Once the curb ramp or curbs are damaged, it would be considered an alteration requiring evaluation for ramp upgrade or installation of missing ramps.

Appendix J

Highway Division Maintenance Operational Notice MG144-03: Traffic Signal Work and Americans with Disabilities Act (ADA)

Notes to Reviewers:

Appendix J is a new appendix for the Draft 2025 version of the HDM.

Oregon Department of Transportation

Highway Division Maintenance Leadership Team Operational Notice

Number	Supersedes	Effective Date	Cancellation Date
MG 144-03	Oct 18, 2017	Dec 1, 2017	
Subject		**Issuing Body**	
Traffic Signal Work and Americans with Disabilities Act (ADA)		Maintenance and Operations Engineer	

PURPOSE:

Provide guidance on when traffic signal work activities trigger the obligation to upgrade a traffic signal for compliance with the ADA requirements.

DEFINITIONS:

"Trigger" is a work activity that requires verification of three pushbutton features: 1) Mounting height 2) Reach range 3) Level landing area. If pushbuttons meet all three requirements, as determined by inventory or field verification by trained staff, then the work activity can move forward. If not, then seek guidance from the Region Tech Center on the required action.

"Work activity related to a part failure, damage from the public, or acts of god" is needed to keep the signal operational and is a reactive unplanned event. This work is NOT considered an upgrade to the signal and is typically not a trigger.

"Work activity related to preventative maintenance" is intended to keep the signal operational by replacing parts on a known life cycle to limit failures. For example we do not wait for vehicle signal LED modules to burn out before we replace them. This work is NOT considered an upgrade to the signal and is typically not a trigger.

"Work activity related to planned and systematic upgrade" is associated with items that are not at their end of life. For this type of work, there is always adequate time to plan, design and implement the changes without the urgency associated with replacing broken or unreliable aging items to ensure the traffic signal is functional in the immediate future. An example would be replacing a non-countdown pedestrian signal head that is only 1 year old and in working condition. This work is considered an upgrade to the signal and is typically a trigger.

"End of life" is defined as any item that is at or has exceeded its normal useful life. For example vehicle signal LED modules have a useful life of 5 years. It would be good preventative maintenance to change out all vehicle signal LED modules at 4 years of life to avoid failures.

BACKGROUND:

There is a wide range of traffic signal work that is performed on a regular basis to keep a traffic signal operational and running smoothly. Signal maintenance work that does not impact pedestrian pushbuttons or pedestrian signals is not a trigger. Pursuant to the requirements of the settlement agreement, the signal work activities that are triggers have been identified in this document. This is not an exhaustive list, but addresses the most common work activities that are performed. In addition, a Frequently Asked Questions (FAQ) section is included in this document to provide further clarification.

WORK FLOW PROCESS:

If the traffic signal work you are performing is not a trigger, you can perform the signal work without any further required steps. If the work you are doing is a trigger or you are unsure if the work is a trigger, contact the Region Tech Center for help in verifying whether or not the work is a trigger and what the required action will be. See the flowchart in this document for a more detailed view of the decision making process.

WORK ACTIVITIES & TRIGGERS

1 **Pedestrian pedestal/post or signal pole replacement with an existing pushbutton mounted on it**

Work activity related to a part failure, damage from the public, or acts of god.

Not a Trigger	Replace a knocked down mast arm pole, strain pole, vehicle pedestal, ped pedestal, or push button post on the existing foundation. Button height needs to be 36" to 48" vertical.
Not a Trigger	Replace a knocked down mast arm pole, strain pole, vehicle pedestal, ped pedestal, or push button post on the existing foundation. The existing foundation anchor rods and foundation need some repair also. Button height needs to be 36" to 48" vertical.
Trigger	Replace a knocked down mast arm pole, strain pole, vehicle pedestal, ped pedestal, or push button post on new foundation. This is a trigger because a new foundation requires adequate time to plan, design & construct.

Work activity related to preventative maintenance (note mast arm pole & strain pole replacement is not considered preventive maintenance)

Not a Trigger	Replace an existing end of life vehicle pedestal, ped pedestal, or push button post on the existing foundation. Button height needs to be 36" to 48" vertical.
Not a Trigger	Replace an existing end of life vehicle pedestal, ped pedestal, or push button post on the existing foundation. The existing foundation anchor rods and foundation need some repair also. Button height needs to be 36" to 48" vertical.
Trigger	Replace an existing end of life vehicle pedestal, ped pedestal, or push button post on new foundation. This is a trigger because a new foundation requires adequate time to plan, design & construct.

Work activity related to planned and systematic upgrade

Trigger	Replace an existing mast arm pole, strain pole, vehicle pedestal, ped pedestal, or pushbutton post on the existing foundation
Trigger	Replace an existing mast arm pole, strain pole, vehicle pedestal, ped pedestal, or pushbutton post on new foundation

2 **New installation of pushbuttons, new audible pushbuttons, or new pedestrian pedestal/post where pushbuttons did not exist previously**

Work activity related to a part failure, damage from the public, or acts of god.

N/A	Does not apply since this talks about adding where they did not exist

Work activity related to preventative maintenance

N/A	Does not apply since this talks about adding where they did not exist

Work activity related to planned and systematic upgrade

Trigger	Install a new pushbutton (or new audible pushbutton) on an existing pole/pedestal/post prior to end of life preventative maintenance schedule
Trigger	Install a new pushbutton (or new audible pushbutton) on a new vehicle pedestal, ped pedestal, or push button pole on new foundation

3 **Change an existing non-countdown pedestrian signal head to a countdown pedestrian signal head**

Work activity related to a part failure, damage from the public, or acts of god.

Not a Trigger	Replace the failed head/module. Requires replacement of all the heads on the same crossing (generally two). It is NOT OK to have one countdown and one non-countdown on the same crossing.

Work activity related to preventative maintenance

Not a Trigger	Replace an existing end of life pedestrian signal head. Requires replacement of all the heads on the same crossing (generally two). It is NOT OK to have one countdown and one non-countdown on the same crossing.

Work activity related to planned and systematic upgrade

Trigger	Replace an existing pedestrian signal head. Requires replacement of all the heads on the same crossing (generally two). It is NOT OK to have one countdown and one non-countdown on the same crossing.

4 **New controller and firmware installation**

Work activity related to a part failure, damage from the public, or acts of god **OR** Work activity related to preventative maintenance **OR** Work activity related to planned and systematic upgrade

Not a Trigger	Change out the firmware on existing controller (Voyage 5.1 to Voyage 5.2)
Not a Trigger	Change out a 170 to another 170. Change out a 2070 to another 2070. Change out an ATC to another ATC.
Not a Trigger	Change out a 170 to a 2070 or ATC. Change out a 2070 to ATC.

5 **Change an existing pushbutton to an audible pushbutton**

Work activity related to a part failure, damage from the public, or acts of god **OR** Work activity related to preventative maintenance **OR** Work activity related to planned and systematic upgrade

Trigger	Change an existing pushbutton to an audible pushbutton. This is a trigger because there is adequate time to plan and install this upgrade.

6 **Change an existing audible pushbutton to a new audible pushbutton**

Work activity related to a part failure, damage from the public, or acts of god.

Not a Trigger	Replace only the failed audible pushbutton. Button height needs to be 36" to 48" vertical.

Work activity related to preventative maintenance

Not a Trigger	Replace an existing end of life audible pushbutton. Button height needs to be 36" to 48" vertical.

Work activity related to planned and systematic upgrade

Trigger	Replace an existing audible pushbutton

7 **Add a new pedestrian signal head where one did not exist previously**

Work activity related to a part failure, damage from the public, or acts of god.

n/a	Does not apply since this talks about adding where they did not exist

Work activity related to preventative maintenance

n/a	Does not apply since this talks about adding where they did not exist

Work activity related to planned and systematic upgrade

Trigger	Install new pedestrian signal head (typically two for a crossing)

8 **Replace a controller cabinet**

Work activity related to a part failure, damage from the public, or acts of god **OR** Work activity related to preventative maintenance **OR** Work activity related to planned and systematic upgrade

Not a Trigger	Replace existing controller cabinet with new controller cabinet of same size
Not a Trigger	Replace existing controller cabinet with a new controller cabinet of a different size. Note: The type of audible pedestrian pushbuttons ODOT uses makes this not a trigger (all the electronics are contained within the ped head & button, not the controller cabinet)

FREQUENTLY ASKED QUESTIONS

The questions and answers below are for maintenance activities only, NOT planned work or systematic work or new construction.

Q1: Is it OK to have one countdown and one non-countdown pedestrian signal on the same crossing?

A1: No. Each pedestrian crossing must use the same type (matched pairs)

Q2: Can I use my supply of older non-standard parts like H Frame mounts?

A2: Yes. You can replace in kind. If the mount is the new style, then that is what should be reinstalled. The button height needs to be 36" to 48" vertical.

Q3: I don't have any of the older H Frame mounts; can I install the new style mount?

A3: Yes. This is considered replacement in kind. It doesn't need to be the exact same part. The button height needs to be 36" to 48" vertical.

Q4: The RPS service was hit by a car. I want to install a BMC service. Can I do this?
A4: Maybe. The work needs to avoid sidewalk ramps or restricting pedestrian paths. Contact the Region Tech Center for guidance.

Q5: Region Traffic offered to pay for upgrading 170 controllers to ATC controllers. Can I accept?
A5: Yes, this is not a trigger.

Q6: A 170 controller just failed and I do not have a spare. Can I install a 2070 controller or ATC?
A6: Yes, this is not a trigger.

Q7: My 336 controller cabinet is too small, can I upgrade to a 332 controller cabinet (bigger cabinet)?
A7: Yes, this is not a trigger. Note: The type of audible pedestrian pushbuttons ODOT uses makes this not a trigger (all the electronics are contained within the ped head & button, not the controller cabinet)

Q8: Who defines "end of life" of traffic signal components? (For example 5 years on LED modules)
A8: Each electrical maintenance crew. This should be documented. Some items can use state wide times, while others may vary if they are located on the coast or eastern Oregon. The Traffic Standard Crew can assist if needed.

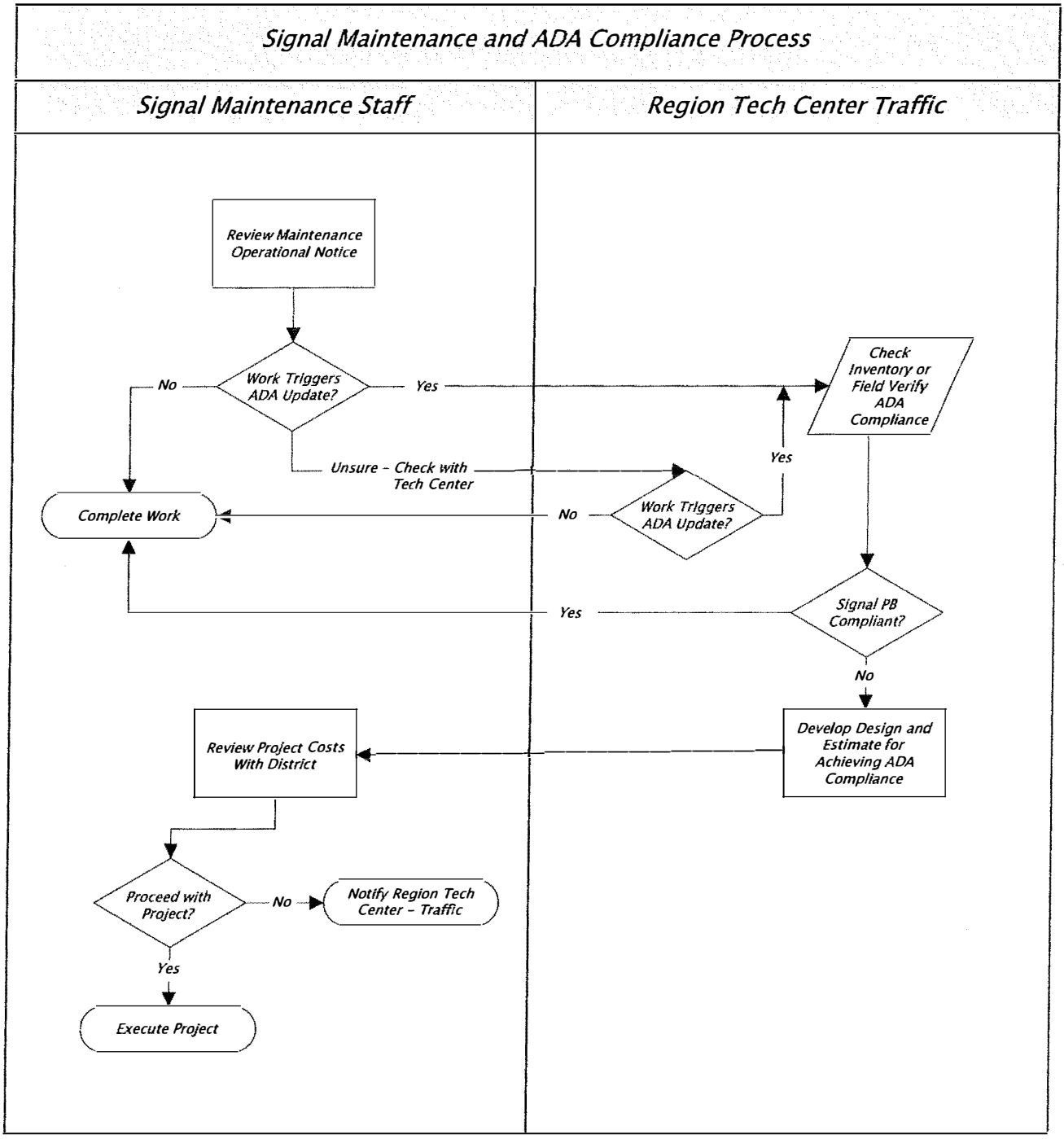
Q9: Who defines the list of items we do preventative maintenance on?
A9: Each electrical maintenance crew. This should be documented. Most will included short life items like LED modules, air filters, etc.

Q10: If there are no pushbuttons on an existing signal (downtown ped recalled system) will signal work trigger ADA?
A10: No. Work can be completed at the signal. There are no ped push buttons that would trigger ADA. Also, there is no requirement to add pushbuttons.

Q11: If I have a trigger, who measures the three pushbutton features (vertical, horizontal, landing)?
A11: The Traffic-Roadway Section or staff they have trained.

Q12: If I am installing a new ped pole and new foundation, do I look at all buttons or just the corner where the work is?
A12: Just the corner where the work is. A general rule for upgrades is if you touch it you fix it.

Q13: Can I replace components inside the controller cabinet used for pushbuttons or pedestrian signals?
A13: Yes, this is not a trigger.


Signal Maintenance and ADA Compliance Process
Signal Maintenance Staff
Region Tech Center Traffic
Review Maintenance Operational Notice
Work Triggers ADA Update?
No
Yes
Unsure – Check with Tech Center
Check Inventory or Field Verify ADA Compliance
Yes
Work Triggers ADA Update?
No
Complete Work
Signal PB Compliant?
Yes
No
Develop Design and Estimate for Achieving ADA Compliance
Review Project Costs With District
Proceed with Project?
No
Notify Region Tech Center – Traffic
Yes
Execute Project