Washington State Department of Transportation

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What's Changed?
See the back of this form for a summary description of the major policy changes.

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Instructions:
Page numbers and corresponding sheet-counts are given in the table below to indicate portions of the *Design Manual* that are to be removed and inserted to accomplish this revision.

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Design Manual Revisions January 2008

Revisions with Highest Impact to Design Projects

Interchange Design / Spacing

Chapter 940 Interchanges

- The major changes are to 940.04(3) to **reduce confusion over interchange spacing** and removal of ramp terminal intersection guidance in 910.07 that was previously moved to the intersections chapter.
- This revision includes a new figure illustrating interchange spacing requirements (see Fig 940-2). It reminds designers of both requirements: crossroad-to-crossroad distances and minimum distances between adjacent same-direction ramps.
- The AASHTO *Policy on Design Standards – Interstate System* is the guiding document WSDOT uses for interchange spacing policy. It specifies Interstate interchange spacing and the AASHTO "Green Book" doesn't.
- Excerpt of revised text in Chapter 940 reflecting both AASHTO documents: The minimum spacing between adjacent interchanges is 1 mile in urban areas, 3 miles on the Interstate in rural areas, and 2 miles on non-Interstate in rural areas.
- The average spacing requirement has been removed from Chapter 940.

Americans with Disabilities Act (ADA) Requirements

Chapter 1025 Pedestrian Design Considerations has been rewritten to more clearly communicate guidance on pedestrian facilities, with an emphasis on providing accessibility and meeting ADA requirements.

- Many terms have been added as well as figures illustrating ADA related features. Alteration is one term to understand, as it implies a responsibility to address existing features.
- The revision addresses jurisdiction and responsibility to address ADA requirements. This should help designers determine "what" pedestrian facilities might need to be addressed in a project.
- Upon knowing what needs to be addressed, there are many geometric issues designers need to be aware of when developing pedestrian features including: minimum widths and maximum allowed slopes / grades.
- Details unique to Preservation projects are identified under the various sections.

Chapter 430 Modified Design Level

- Revised guidance in Section 430.07 Bike and Pedestrian to reflect current policy on what must be addressed in a Modified Design Level project. This change coincided with improvements to Chapter 1025.

Fall Protection Requirements per WAC 296-155

Chapter 1130 Retaining Walls and Steep Reinforced Slopes has been revised to provide current guidance on fall restraint systems in accordance with WAC 296-155

- Section 1130.04(7)(c) is updated to require a fall restraint height of 42 inches, plus or minus 3 inches. The previous height was 36 to 42 inches.

Use of Project Analysis & Corridor Analysis (& Other Changes)

Chapter 325 Design Matrix Procedures. Guidance is added to Section 325.03(5) on Project Analysis and Corridor Analysis, as follow-up to the May 1, 2008 Design Manual Supplement for scoping safety projects.

- This revision further clarifies use of project and corridor analyses to support decisions to **include, exclude, or modify design elements**.
- A project analysis is also used for multiple related design variances.
- A **corridor analysis** is also used to **establish design speed**.
- The Design Matrices you receive with this update have had the terms HAL, HAC, & PAL removed from them. WSDOT is discontinuing the use of these terms as we approach the '09-'11 biennium. New terminology (see Supplement discussed above) includes Collision Analysis Location (CAL). A future revision will incorporate the Supplement listed above.

Chapter 330 Design Documentation, Approval, and Process Review

- Added definitions for both Corridor and Project analyses.
- Figure 330-7 "Deviation Request Contents List" has been renamed such that it is also intended to be used as an outline for contents of a Project Analysis as well.
- Section 330.04(2) now states that the **design variance inventory is needed on all projects** having variances; not just NHS routes as previously required (per updated Project Summary forms.)
- Section 330.06(1)(b) clarifies WSDOT concurrence and approval authorities for the DDS. Also clarified use of WSDOT's ***Project Control and Reporting Manual*** **for project changes**.
- Updated language in Section 330.08 and in Figure 330-2a regarding **FHWA's authority to provide Design Approval prior to NEPA approval.**
- Added **the "ADA Maximum Extent Feasible Document"** to the approval table in Figure 330-3 per coordination with the rewritten Chapter 1025 on Pedestrian Design.
- Removed terms HAL, HAC, PAL, per SA&PD office, since WSDOT is discontinuing the use of these.

Traffic Barriers

Chapter 710 Traffic Barriers revisions include:

- Revised selection and placement of High Tension Cable Barrier.
- Environmental considerations when placing barrier.
- Rational for barrier placement.
- Clarification on BT installations.
- Less emphasis on Type 31NB W-Beam barrier.
- Placement case updates.
- Updates to W-Beam Barrier selection and placement.
- New/revised figures.

Other Revisions in January 2009 Revision Package

Chapter 100 Manual Description

- Deleted the section describing Project Development Approach, and moved it to Chapter 150 which covers that topic.

Chapter 150 Project Development Sequence

- Added text moved from Chapter 100.
- Also made updates per the Systems Analysis and Program Development (SA&PD) office. Design Manual chapter 150 was last revised in June 2005. Organizational and procedure changes within Strategic Analysis and Program Development have occurred since the chapter was last revised.

Chapter 640 Geometric Cross Slope

There was confusion that the cut slopes tables were superseded by a geotechnical report.
The revision clarifies that the values in the cut slope tables are desirable and justification is needed for the use of steeper slopes.
The Geotech report provides guidance on an acceptable range of slopes.

Chapter 850 Traffic Control Signals

- Section 850.05 Signal Warrants has been revised to direct designers to use the MUTCD for signal warrants.

Chapter 1020 Bicycle Facilities

- Section 1020.06(16) Bollards has been revised to provide updated design guidance on the use of bollards, with emphasis on:
    - Uniformity of bollard appearance and placement in a corridor
    - Visibility by approaching cyclists, and
    - Maintains reference to WSDOT's *Standard Plans* and to the MUTCD

Chapter 1420 Access Control

This chapter is an overview of access control presenting the designer with terminology and references related to both limited access and managed access highways. These chapter revisions are minor and include:

- Updated references to RCWs, design guidance, and supporting information
- Expanded definitions for improved clarity
- Updated web page link to WSDOT's Access Control Tracking System

Chapter 1425 IJRs
Rewrote the chapter based on meetings with Access and Hearings Section, the Design Office Policy Team, and statewide review comments. Initial revision purpose was to emphasize use of a support team and the use of a methods and assumptions document.

- Added more emphasis on establishing a Support Team and preparing an IJR Methods and Assumptions document.
- Revised section on traffic analysis tools. Removed actual software callouts and referred to Traffic web page for list of products.
- Deleted Figure 1425-3 "Interchange Justification Report Possibly Not Required". This was viewed as causing confusion.
- The content of Figure 1425-4 Interchange Justification Report Process Flow Chart was revised quite a bit. It is now Figure 1425-3.
- Removed terms: HAL, HAC, and PAL (per SA&PD.)
- This revision is a complete rewrite of the chapter; revision marks not used.

Chapter 1430 Limited Access

- New section 1430.02 (1) Project Scoping Evaluation emphasizes early need to determine limited access pursuits for budgeting R/W. Text was moved from the General section and further modified. Having "scoping" highlights like this section in the manual will be an improvement.
- Under the subsection Access Report: Removed reference to outgoing safety program terms such as: High Accident Location (HAL); High Accident Corridor (HAC); Pedestrian Accident Locations (PAL), and replaced with statement about WSDOT's Priority Array.
- Updated web page link to WSDOT's Access Control Tracking System
- Other minor clarifying text changes.

Other minor revisions include errata spot changes in Chapters 530, 642, 650, 720, 830, 1040, 1140.

What's next with the Design Manual

Due to the volume of material presented in the WSDOT Design Manual, we plan to split it into two volumes. Those that maintain a printed manual know that the notebook binder is at its limits to contain the material.

The next printing of the manual is planned for June 2009, at which time the manual will be presented in two volumes (both in print and online.)

We do not intend to make any policy changes to the manual when this occurs. The Design Office wants to thank those of you who participated in the online survey last February on this topic.

More information will be posted at this link in the near future.
http://www.wsdot.wa.gov/Design/Manual/FutureRevisions.htm

Washington State
Department of Transportation

TECHNICAL MANUAL

Design Manual

M 22-01.04

January 2009

Environmental and Engineering Programs

Design Office

Americans with Disabilities Act (ADA) Information

Materials can be provided in alternative formats: large print, Braille, cassette tape, or on computer disk for people with disabilities by calling the Office of Equal Opportunity (OEO) at 360-705-7097. Persons who are deaf or hard of hearing may contact OEO through the Washington Relay Service at 7-1-1.

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Washington State Department of Transportation

Design Manual Supplements and Instructional Letters

January 2009

Don't forget — to make your *Design Manual* complete you must have the Supplements and Instructional Letters that are in effect.

Design Manual Supplements or Instructional Letters are issued as interim guidance until they are incorporated into the *Design Manual*.

Subject/Title	**Impacted Chapter(s)**	**Effective Date**	**Document Type**
Safety Improvement Projects	325	5/01/2008	Supplement
Public Art	1360	8/06/2007	Supplement
Systems Engineering for Intelligent Transportation Systems	860	12/30/2005	Supplement

The *Design Manual* is available online through the Engineering Publications website:

www.wsdot.wa.gov/Publications/Manuals/index.htm

You can also download individual chapter files, known technical errata, and *Design Manual* Supplements here:

www.wsdot.wa.gov/design/policy

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Chapter 100 Manual Description

100.01 Purpose

The Washington State Department of Transportation (WSDOT) has developed the *Design Manual* to reflect policy, outline a uniformity of methods and procedures, and communicate vital information to its employees and others who develop projects on state highways. When properly used, the manual will facilitate the development of a highway system consistent with the needs of the traveling public.

WSDOT designers are required to comply with the *Design Manual*. The Federal Highway Administration (FHWA) has agreed to approve designs that follow guidance in the *Design Manual*; therefore, adherence to the guidance presented is not optional for state highway projects.

The information, guidance, and references contained herein are not intended as a substitute for sound engineering judgment. The *Design Manual* is not a comprehensive textbook on highway engineering, nor does it attempt to cover all the possible scenarios Washington's highways present. It is recognized that some situations encountered are beyond the scope of this presentation.

If you have design questions not answered by the *Design Manual*, contact the Headquarters (HQ) Design Office.

100.02 Presentation and Revisions

The *Design Manual* is available on the Internet. It can be accessed through the WSDOT home page, the Design Policy Internet page, or through the Engineering Publications home page. The online version of the manual enables the user to conduct a word search of the entire manual. Opening an individual chapter is faster, but a word search is limited to that chapter.

The *Design Manual* is also available on CD-ROM from the "Engineering Publications CD Library." The CD is up to date as of the date of production. Hard-copy editions are available on a department cost-recovery basis (they are free to WSDOT employees).

The *Design Manual* is continually revised to reflect changing processes, procedures, regulations, policies, and organizations. Feedback from users is encouraged to improve the manual for everyone. Comments may be submitted by any method that is convenient for you. There is a Comment Form in the front of the manual or comments may be made online at the Design Policy Internet page, using the "comments and suggestions" link (www.wsdot.wa.gov/design/policy/). Note that the Design Policy Internet page includes a link to an Errata page, which provides a list of known technical errors in the manual. Manual users are encouraged to view this page on a regular basis.

A Contents section lists all chapters, their major headings, and the last revision dates of the sections/pages. The figures list outlines all the figures in the manual and provides their page numbers. The *Design Manual* is divided into general divisions that contain specialized chapters, with an Index at the back of the manual.

Most chapters include a list of references, which are the basis for the information in the chapter, including laws, administrative codes, manuals, and other publications. Most chapters also include definitions for the specialized vocabulary used in the chapter; some words or phrases have more than one dictionary meaning.

The Index lists all significant chapter subheadings, other items selected by chapter authors and contributors, and many items suggested by users.

100.03 *Design Manual* Applications

Design Manual guidance is provided to encourage the statewide uniform application of design details under normal conditions. It also guides designers through the project development process used by WSDOT. The *Design Manual* is used by the department to:

- Interpret current design principles, including American Association of State Highway and Transportation Officials (AASHTO) policy and federal and state laws.
- Develop projects to meet driver expectations.
- Balance the benefits and costs of highway construction projects.

This manual is designed to allow for flexibility in design for specific and unusual situations. For unusual circumstances, the *Design Manual* provides mechanisms for documenting the reasons for the choices made.

The *Design Manual* is developed for use on state highways and it may not be suitable for projects on county roads or city streets.

100.04 How the *Design Manual* Is to Be Used

The WSDOT *Design Manual* is intended to be used for design of department-owned facilities, especially the transportation facilities associated with state highways as designated by RCW 47.17.

For state highway routes, all projects must be designed using the *Design Manual* geometric control criteria (see Chapter 325 and Division 4). If WSDOT guidance is not used on a project, appropriate documentation and approvals are required (see Chapters 325 and 330).

When WSDOT designs facilities that will be turned over to local jurisdictions, those facilities are to be designed using appropriate local geometric design criteria.

When local jurisdictions design any element of state highway facilities, the *Design Manual* must be used. Local jurisdictions are free to adopt this manual for their local criteria or to develop their own specialized guidance for facilities not on state highway routes.

100.05 How the *Design Manual* Is Organized

The *Design Manual* is divided into a series of divisions that address a portion of the project development and design processes. The divisions are comprised of chapters that address the general topic identified in the division in detail and are, in some cases, specific to a particular discipline.

Division 1 – General Information: Presents general background on planning, managing project delivery, project development, and programming.

- Chapter 100 – Manual Description: Chapter content and resources within the *Design Manual*.
- Chapter 110 – Design-Build Projects: How the *Design Manual* applies to design-build projects: includes terminology and reference to design-build contract documents.
- Chapter 120 – Planning: Critical information, such as Corridor Studies and Route Development Plans, relating to the corridor in which the project resides.
- Chapter 141 – Project Development Roles and Responsibilities for Projects with Structures: WSDOT's project development process: roles and responsibilities for projects with structures during the project development phase of a project.
- Chapter 150 – Project Development Sequence: The project development sequence from the *Washington Transportation Plan* through the contract document: emphasizes the Project Summary and Change Management process.

Division 2 – Hearings, Environmental, and Permits: Provides the designer with information about the public involvement and hearings process, the environmental documentation process, and the permit process.

- Chapter 210 – Public Involvement and Hearings: Developing a project-specific public involvement plan; the ingredients of an effective public involvement plan; and methods for public involvement.
- Chapter 220 – Project Environmental Documentation: An elementary background on the environmental documentation process and its requirements.
- Chapter 240 – Environmental Permits and Approvals: Permits that may be required for highway and bridge projects.

Division 3 – Project Documentation: Provides designers with information on Value Engineering, design matrices, design documentation, and approvals.

- Chapter 315 – Value Engineering: A systematic, multidisciplinary process study early in the project design stage to provide recommendations to improve scope, functional design, constructibility, environmental impacts, or project cost—required by federal law for high-cost, complex projects.
- Chapter 325 – Design Matrix Procedures: Includes design matrices that provide consistency across projects according to funding type and highway system. Each design matrix sets forth the level of development for a given type of need, which would be automatically approved by the department and FHWA. Discusses deviation approvals and how to apply the appropriate design level for the majority of Improvement and Preservation projects.

- Chapter 330 – Design Documentation, Approval, and Process Review: Building the Project File (PF) and the Design Documentation Package (DDP) and recording the recommendations and decisions that lead to a project by preserving the documents from planning, scoping, programming, and design phases (includes permits, approvals, contracts, utility relocation, right of way, advertisement and award, and construction).
- Chapter 340 – Minor Operational Enhancement Projects: Design matrices for low-cost, quick-fix projects that improve the operation of a state highway facility.

Division 4 – Project Design Criteria: Includes design criteria for basic design, modified design, and full design coinciding with the design matrices in Chapter 325.

- Chapter 410 – Basic Design Level: The required basic safety work and minor preservation and safety work included in the preservation of pavement structures and pavement service life, while maintaining safe operation of the highway.
- Chapter 430 – Modified Design Level: Design guidance unique to the modified design level of preserving and improving existing roadway geometrics and safety and operational elements.
- Chapter 440 – Full Design Level: Guidance for the highest level of highway design, used on new and reconstructed highways to improve roadway geometrics and safety and operational elements.

Division 5 – Soils and Paving: Presents guidance for investigating soils, rock, and surfacing materials; estimating tables; and guidance and criteria for the use of geosynthetics.

- Chapter 510 – Investigation of Soils, Rock, and Surfacing Materials: The requirements for qualifying a materials source, geotechnical investigations, and the documentation to be included in the Project File.
- Chapter 520 – Design of Pavement Structures: Estimating tables for the design of pavement structures.
- Chapter 530 – Geosynthetics: The types/applications of geosynthetic drainage, earthwork, erosion control, and soil reinforcement materials.

Division 6 – Geometrics: Covers an introduction to highway capacity; geometric plan elements; horizontal alignment; lane configurations and pavement transitions; geometric profile elements; vertical alignment; geometric cross sections; and sight distance.

- Chapter 610 – Traffic Analysis: A basic and limited introduction to highway capacity.
- Chapter 620 – Geometric Plan Elements: The design of horizontal alignment, lane configuration, and pavement transitions.
- Chapter 630 – Geometric Profile Elements: The design of vertical alignment.
- Chapter 640 – Geometric Cross Section: Roadway width, superelevation, and slope design.
- Chapter 641 – Turning Roadways: Widening curves to make the operating conditions comparable to those on tangent sections.
- Chapter 642 – Superelevation: Superelevating curves and ramps so design speeds can be maintained.
- Chapter 650 – Sight Distance: Passing, stopping, and decision sight distance design elements.

Division 7 – Roadside Safety Elements: Addresses design considerations for the area outside the roadway, and includes clear zone, roadside hazards, safety mitigation, traffic barriers, and impact attenuator systems.

- Chapter 700 – Roadside Safety: Clear zone design, roadside hazards to consider for mitigation, and some roadside safety features.
- Chapter 710 – Traffic Barriers: Design of traffic barriers based on the design levels identified in the design matrices.
- Chapter 720 – Impact Attenuator Systems: Permanent and work zone impact attenuator systems.

Division 8 – Traffic Safety Elements: Introduces the designer to traffic safety elements such as work zone traffic control, signing, delineation, illumination, traffic control signals, and Intelligent Transportation Systems (ITS).

- Chapter 810 – Work Zone Safety and Mobility: Planning, design, and preparation of highway project plans that address work zone safety and mobility requirements.
- Chapter 820 – Signing: The use of signing to regulate, warn, and guide motorists.
- Chapter 830 – Delineation: The use of pavement markings to designate safe traffic movement.
- Chapter 840 – Illumination: Illumination on state highway construction projects.
- Chapter 850 – Traffic Control Signals: The use of power-operated traffic control devices that warn or direct traffic.
- Chapter 860 – Intelligent Transportation Systems (ITS): Applying computer and communication technology to optimize the safety and efficiency of the highway system.

Division 9 – Interchanges and Intersections: Addresses the design considerations of at-grade intersections, roundabouts, road approaches, railroad grade crossings, and traffic interchanges.

- Chapter 910 – Intersections At Grade: Designing intersections at grade, including at-grade ramp terminals.
- Chapter 915 – Roundabouts: Guidance on the design of roundabouts.
- Chapter 920 – Road Approaches: The application and design of road approaches on state highways.
- Chapter 930 – Railroad Grade Crossings: The requirements for highways crossing railroads.
- Chapter 940 – Traffic Interchanges: The design of interchanges on interstate highways, freeways, and other multilane divided routes.

Division 10 – Auxiliary Facilities: Offers guidance on auxiliary lanes such as climbing and passing lanes; bicycle facilities; pedestrian design; safety rest areas and traveler services; weigh stations; high occupancy vehicle lanes; and transit facilities.

- Chapter 1010 – Auxiliary Lanes: Auxiliary facilities such as climbing lanes, passing lanes, slow-vehicle turnouts, shoulder driving for slow vehicles, emergency escape ramps, and chain-up areas.
- Chapter 1020 – Bicycle Facilities: Selecting and designing useful and cost-effective bicycle facilities.

- Chapter 1025 – Pedestrian Design Considerations: Designing facilities that encourage safe and efficient pedestrian access.
- Chapter 1030 – Safety Rest Areas and Traveler Services: Typical layouts for Safety Rest Areas.
- Chapter 1040 – Weigh Sites: Designing permanent, portable, and shoulder-sited weigh sites.
- Chapter 1050 – High Occupancy Vehicle Facilities: Evaluating and designing high occupancy vehicle (HOV) facilities.
- Chapter 1060 – Transit Benefit Facilities: Operational guidance and information for designing transit facilities such as park-and-ride lots, transfer/transit centers, and bus stops and pullouts.

Division 11 – Structures: Provides guidance for the design of structures for highway projects, including site data for structures, bridges, retaining walls, and noise walls.

- Chapter 1110 – Site Data for Structures: Information required by the HQ Bridge and Structures Office to provide structural design services.
- Chapter 1120 – Bridges: Basic design considerations for developing preliminary bridge plans and guidelines on basic bridge geometric features.
- Chapter 1130 – Retaining Walls and Steep Reinforced Slopes: Design principles, requirements, and guidelines for retaining walls and steep reinforced slopes.
- Chapter 1140 – Noise Barriers: Factors considered when designing a noise barrier.

Division 12 – Hydraulics: Addresses the issue of hydraulics and serves as a guide to highway designers to identify and consider hydraulic-related factors that may impact the design.

- Chapter 1210 – Hydraulic Design: Hydraulic considerations for highway projects involving flood plains, stream crossings, channel changes, and groundwater.

Division 13 – Roadside Development: Provides guidance on the portion of state highways between the traveled way and the right of way boundary.

- Chapter 1300 – Roadside Development: Managing the roadside environment, including the area between the traveled way and the right of way boundary, unpaved median strips, and auxiliary facilities such as rest areas, wetlands, and stormwater treatment facilities.
- Chapter 1310 – Contour Grading: Contour grading to achieve operational, environmental, and visual functions.
- Chapter 1320 – Vegetation: The use of vegetation in the roadside environment and when to contact the Landscape Architect.
- Chapter 1330 – Irrigation: Design considerations for irrigation on highway projects.
- Chapter 1350 – Soil Bioengineering: Design considerations for the use of bioengineering techniques on highway projects.
- Chapter 1360 – Public Art: Policy and procedure for inclusion of public art in state transportation corridors.

Division 14 – Right of Way and Access Control: Provides guidance on right of way considerations; Interchange Justification Reports; limited and managed access; surveying and mapping; monumentation; and fencing.

- Chapter 1410 – Right of Way Considerations: The right of way and easement acquisition process.
- Chapter 1420 – Access Control: WSDOT Access Control program information.
- Chapter 1425 – Interchange Justification Report: The process for access point revisions on state highways and the steps for producing an Interchange Justification Report.
- Chapter 1430 – Limited Access: Clarification on full, partial, and modified limited access control.
- Chapter 1435 – Managed Access: The classes of managed access highways and the access connection permitting process.
- Chapter 1440 – Surveying and Mapping: The procedures within WSDOT for project surveying.
- Chapter 1450 – Monumentation: Monumentation requirements and procedures.
- Chapter 1460 – Fencing: The purpose of fencing, types of fencing, and fencing design criteria.

Chapter 150 Project Development Sequence

150.01 General

The purpose of this chapter is to describe the project development sequence beginning with the *Washington Transportation Plan* (WTP) through the contract documents.

Projects go through a development process to affirm that all elements are considered; local agencies and the public have an opportunity to comment on the department's proposed action; and the final project successfully improves the functioning of the transportation system as identified in the purpose and need statement of the Project Summary. Projects are measured for performance based on the objective of the projects using "before and after" analysis and are submitted to the Washington State Department of Transportation's (WSDOT's) quarterly performance report, the Gray Notebook.

Changes in project scope, schedule, and budget are reviewed and approved using the Project Control and Reporting Process and are controlled by and reported to the Washington State Legislature. Approved changes are reported in the Gray Notebook.

150.02 References

(1) Federal/State Laws and Codes

Revised Code of Washington (RCW) Chapter 47.05.010, Priority programming for highway development

(2) Design Guidance

Environmental Procedures Manual, M 31-11, WSDOT
www.wsdot.wa.gov/Publications/Manuals/M31-11.htm

Local Agency Guidelines (LAG), M 36-63, WSDOT
www.wsdot.wa.gov/publications/manuals/fulltext/m36-63/LAGManual.pdf

Plans Preparation Manual, M 22-31, WSDOT
www.wsdot.wa.gov/publications/manuals/fulltext/M22-31/PlansPreparation.pdf

Programming and Operations Manual, M 12-51, WSDOT
www.wsdot.wa.gov/Publications/Manuals/M12-51.htm

(3) Supporting Information

*Construction Manua*l, M 41-01, WSDOT
www.wsdot.wa.gov/publications/manuals/fulltext/m41-01/construction.pdf

150.03 Definitions

benefit cost (b/c) ratio A method for prioritizing highway improvement projects. The b/c ratio is determined by dividing measurable benefits (based on improvement in performance) by measurable costs for a specific time period.

Capital Improvement and Preservation Program (CIPP) WSDOT's program of projects developed each biennium that delivers capital investments in highway, marine, and rail facilities that have been funded in part or in whole by the state Legislature. The CIPP is submitted to the Governor and, ultimately, by the Governor to the Legislature.

Capital Program Management System (CPMS) A computer database used to develop and manage the highway and marine construction programs. The CPMS allows users to establish and maintain project data and is used to manage and deliver statewide construction programs.

context sensitive solutions (CSS) *"A collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist."*[1]

Federal Highway Administration (FHWA) The division of the U.S. Department of Transportation with jurisdiction over the use of federal transportation funds for state highway and local road and street improvements.

Federal Transit Administration (FTA) The division of the U.S. Department of Transportation with jurisdiction over the use of federal funds for financial assistance to develop new transit systems and improve, maintain, and operate existing systems.

Geographic Information System (GIS) A computerized geographic information system used to store, analyze and map data. Data may be used with GIS if the data includes the Accumulated Route Mile (ARM) or State Route Milepost (SRMP) programs. Global Positioning System (GPS) technology provides a means of collecting data and is an alternative to ARM and SRMP. WSDOT's primary desktop tool to view and analyze GIS data is ArcGIS software. GIS is used to gather and analyze data to support the purpose and need as described in the Project Summary: wwwi.wsdot.wa.gov/gis/supportteam/default.asp

Highway Construction Program (HCP) A comprehensive multiyear program of highway Improvement and Preservation projects selected by the Legislature.

Highway System Plan (HSP) A WSDOT planning document that addresses the state highway system element of the *Washington Transportation Plan* (WTP). The HSP defines the service objectives, action strategies, and costs to maintain, operate, preserve, and improve the state highway system for 20 years. The HSP is the starting point for the state highway element of the CIPP and the state Highway Construction Program. It is periodically updated to reflect completed work and changing transportation needs, policies, and revenues. It compares highway needs to revenues, describes the "constrained" costs of the highway programs, and provides details of conceptual solutions and performance in the improvement program.

1 Understanding Flexibility in Transportation Design – Washington, WSDOT April 2005

Metropolitan Planning Organization (MPO) A lead agency designated by the Governor to administer the federally required transportation planning process in a metropolitan area with a population over 50,000. The MPO is responsible for the 20-year long-range plan and *Transportation Improvement Plan* (TIP).

National Highway System (NHS) A network of roadways designated by Congress that consists of all interstate routes; a large percentage of urban and rural principal arterials; and strategic highways and highway connectors.

pedestrian accident location (PAL) A highway section typically less than 0.25 mile where a six-year analysis of accident history indicates that the section has had four accidents in a 0.1-mile segment.

Planning Transportation planning is a decision-making process required by federal and state law that is used to solve complex, interrelated transportation and land use problems. (See Chapter 120, "Planning.")

Plans, Specifications, and Estimates (PS&E) The project development activity that follows Project Definition and culminates in the completion of contract-ready documents and the engineer's cost estimate.

preliminary engineering (PE) A term used to describe the Project Delivery process from project scoping through PS&E review.

priority array A collection of similar needs identified in the HSP, prioritized based on the methodology adopted by WSDOT to meet the requirements of RCW 47.05.

Priority Array Tracking System (PATS) A database that allows tracking of highway needs and their solutions. The system is designed to ensure WSDOT addresses the highest-ranked transportation needs. Deficiencies are tracked for each strategy in the HSP.

Project Control and Reporting (PC&R) The Headquarters (HQ) Project Control and Reporting Office is responsible for monitoring, tracking, and reporting delivery of the Highway Construction Program in coordination with the Program Management offices in each of the six WSDOT regions and the Urban Corridors Office.

Project Summary A document that comprises the Project Definition, Design Decisions Summary, and Environmental Review Summary. The Project Summary ensures that the project scope addresses the need identified in the HSP, that the design complies with design guidelines, and ensures that potential environmental impacts and required permits are understood. The Project Summary is prepared by the region and reviewed and approved by Headquarters prior to budget submittal.

Regional Transportation Planning Organization (RTPO) A planning organization authorized by the Legislature in 1990 as part of the Growth Management Act. The RTPO is a voluntary organization with representatives from state and local governments that are responsible for coordinating transportation planning activities within a region.

Project Scoping See Chapter 330.

Statewide Transportation Improvement Program (STIP) A planning document that includes all federally funded projects and other regionally significant projects for a three-year period.

Surface Transportation Program (STP) A federal program established by Congress in 1991 that provides a source of federal funding for highway and bridge projects.

Transportation Improvement Program (TIP) A three-year transportation improvement strategy required from MPOs by Congress. Include all federally funded or regionally significant projects in the TIP.

Transportation Information and Planning Support (TRIPS) A mainframe computer system designed to provide engineering, maintenance, planning, and accounting staff with highway inventory, traffic, and accident data.

Transportation Planning Studies Identifies the current functions of a corridor and forecasts future demands on the system. Data collection and public involvement are used to assess the vision, goals, and performance, and forecast future needs that will improve the function of a state route.

Washington State Pavement Management System (WSPMS) A computer system that stores data about the pavement condition of all the highways in the state. Information available includes the latest field review and past contracts for every main line mile of state highway. Calculations are used to determine whether a given section of pavement is a "past due," "due," or "future due" preservation need.

Washington Transportation Plan (WTP) A WSDOT planning document developed in coordination with local governments, regional agencies, and private transportation providers. The WTP addresses the future of transportation facilities owned and operated by the state as well as those the state does not own but in which it has an interest. It identifies needed transportation investments, which are defined by service objectives and specific desired outcomes for each transportation mode.

150.04 Project Development Sequence

The *Design Manual* addresses the project development process beginning with scoping, through programming with the Legislature, to Project Development Approval.

Project development is a multidisciplinary effort that evaluates a variety of solutions for project needs. The following information pertains to the needs identified in the *Highway System Plan,* which suggests a list of proposed solutions based on an incremental approach. This process bridges the gap from need identification to project construction. Project Definition documents provide the framework for further development of the project scope, schedule, and estimate, and record key decisions made early in the project development process. The contract documents provide sufficient detail to enable contractors to construct the project. Final project design decisions are documented and stored in the Design Documentation Package (DDP).

Integrating planning, program development, and project delivery are important elements for the efficient and successful delivery of the transportation projects in the Capital Improvement and Preservation Program (CIPP) approved by the Legislature. The program development process needs a global understanding in order to eliminate later corrective modifications or rework. Project modifications and rework are costly and they impact delivery commitments made to the Legislature and the public. These projects are developed such that information and processes that flow seamlessly between the planning and the implementation phases of a project.

Executive Order 1028.01 directs the department to adopt the principle of context sensitive solutions as a method that allows planners, programmers, and designers to best optimize the conditions and resources in the project vicinity. Planners, programmers, and designers are directed to:

- Engage from the project inception with representatives of the affected communities.
- Assure that transportation objectives are clearly described and discussed with local communities in a process encouraging communication.
- Pay attention to and address community and citizen concerns.
- Ensure the project is a safe facility for both users and the community.

The project development sequence is composed of the following:

(1) Washington State Highway System Plan (HSP)

The HSP is the modal element of the *Washington Transportation Plan* (WTP) that addresses the state's highway system. The HSP, managed by the HQ Systems Analysis and Program Development (SA&PD) Section of the HQ Strategic Planning and Programming Division, includes a comprehensive assessment of existing and projected 20-year needs on the state highway system. Preservation of existing assets and safety, mobility, freight, bicycle, and pedestrian issues are among the 20-year needs. The HSP also lists potential solutions addressing these needs.

The SA&PD Section has the lead role in identifying state highway needs through coordination with WSDOT Headquarters, various technical groups, and Regional Planning Offices that coordinate with external Regional Transportation Planning Organizations (RTPOs) and Metropolitan Planning Organizations (MPOs). The SA&PD Section develops a 20-year plan of construction needs based on the final policy direction from the Transportation Commission.

The HSP identifies the following four major programs used to manage the state-owned transportation system:

- Maintenance Program (M)
- Traffic Operations Program (Q)
- Preservation Program (P)
- Improvement Program (I)

You can access the *HSP* at: www.wsdot.wa.gov/planning/HSP.htm

(2) Highway Construction Program

In every odd-numbered year, the Washington State Legislature meets to consider and pass a Transportation Budget. One piece of this budget is funding for the Highway Construction Program. In order to control expenditures and track budget dollars and commitments, WSDOT groups capital projects into programs, subprograms, and categories based on the action strategies, objectives, and goals in the *HSP*. The department has identified three subprograms within the Preservation Program and six subprograms within the Improvement Program, four of which are shown in Figure 150-2.

(a) **Prioritizing Project Needs and Solutions**

Based on the 2009-2015 Strategic Plan, WSDOT uses the following elements for future investments in Washington's transportation system:

- Preservation of existing assets
- Safety
- Mobility
  Including special needs transportation
- Economic vitality
- Environment quality and health
- Stewardship

Beginning with the 2007–2026 HSP, WSDOT has developed an incremental tiered approach to address project needs.. This approach separates strategies into three investment tiers to be implemented incrementally over the life of the 20-year plan, to maximize performance improvement for every dollar invested.

The tiered approach was developed to address emerging congestion and provide interim relief when funding for major improvement work is limited. The three tiers include:

- **Tier I** focuses on low-cost projects that deliver a high return on capital investment and have short delivery schedules. These include incident management, ITS, access management projects, ramp modifications, turn lanes, and intersection improvements.
- **Tier II** focuses on moderate- to higher-cost projects that deliver potential network benefits to both highways and local roads. These include improvements to parallel corridors (including local roads) and adding auxiliary lanes and direct access ramps.
- **Tier III** focuses on highest-cost projects that can deliver corridor-wide benefits. These include commuter rail, HOV/HOT lanes, and interchange modifications (see the *Highway System Plan* online for more information).

This tiered approach is consistent with legislative direction provided in the Chapter 47.05.010 RCW.

(b) **Background Information**

The HQ Systems Analysis and Program Development (SA&PD) Section begins the prioritization process for a category of work, as required by state law, by identifying the potential benefit(s) associated with solving the needs. There are insufficient resources of time and money to analyze the benefits and costs of all needs in each category of the *Highway System Plan* each biennium, so an initial ranking system is used to reduce the effort. Because the primary objective of WSDOT's prioritization process is to provide the most beneficial improvement for the least possible cost, needs in each category are ranked based on their potential to provide a benefit. The process includes the following steps:

1. The HQ SA&PD Section works with the technical experts at Headquarters to develop the ranked lists and forwards them to the region program managers for their actions. They also place the lists of needs on the department's internal website with instructions on what to do with the ranked lists.

2. The regions scope projects to address the identified needs. The biennial programming instructions provide guidance to the regions on how far down the ranked "needs lists" to go. To obtain a consistent approach and eligibility for federal funding, WSDOT has developed a set of design matrices. Each design matrix sets forth the level of development for a given type of need that would be automatically approved by the department and FHWA (see Chapters 325 and 340).

   WSDOT has also developed a tool using GIS called the Transportation Analysis business area of the GIS Workbench. This tool provides users a common source of consistent data statewide.

   Design teams and managers are encouraged to use the WSDOT Project Management Online Guide to map out the direction and the expectations for the project (www.wsdot.wa.gov/Projects/ProjectMgmt/Process.htm). They are also encouraged to make use of GIS and the Transportation Analysis business area of the GIS Workbench to analyze transportation and environmental resource data in the project area.

3. The regions prepare a cost estimate for the approved scope of work and compare the cost to the potential benefit in order to determine which projects are the most beneficial to construct.

In order to minimize disruptions to the public and take advantage of cost savings, the department may adjust priorities by combining solutions to HSP-identified needs into a single contract. However, adjusting priorities is generally limited to a six-year period.

(c) **Building the Program**

The basic building blocks for the Highway Construction Program are the project phases in the Capital Improvement and Preservation Program (CIPP).

- "Carry-forward" project commitments typically represent job phases that will continue into the next biennium.
- The "book-building process," which includes a list of projects that will be started, continued, or completed in the next biennium, starts with carry-forward projects.

The regions need to review the carryforward projects and determine the potential for project delays and cost overruns in the current biennium that could affect the next biennium. Maintain close coordination between the region, the HQ Project Control and Reporting Office, the HQ SA&PD Section, the Project Development Engineer, and the Construction Engineer to ensure projects under development and under construction are accomplished as planned.

New Improvement project phase starts are proposed based on improvement(s) in system performance and the cost-effectiveness of the proposed project. These new project starts represent needs that are identified in the *Highway System Plan (HSP)*. The HQ SA&PD Section can then determine the needs the regions will develop projects to solve. Once Headquarters has established the level of needs to scope, the regions will begin scoping projects for the Highway Construction Program. Note: Regions cannot propose a project unless a need has been identified in the HSP.

After the new projects have been selected and the carryforward projects identified and their planned expenditures and schedules verified, the program of projects is developed and the project data is inputted into CPMS for balancing to the projected revenue—for both dollars and workforce (FTEs). Project summaries are then developed to document the proposed scope. The program of projects is shared with region executives and their input is incorporated. Adjustments are made to ensure the program can be accomplished within the constraints of the available workforce and facilities in the region.

(d) **Roles and Responsibilities Within WSDOT for Developing the Highway Construction Program**

WSDOT regions, working with support offices, such as Environmental, Utilities, Right of Way, and Construction, develop and design the projects that deliver the transportation program. Designers have a tool called the Project Management Online Guide: www.wsdot.wa.gov/Projects/ProjectMgmt/. Executive Order 1032.00 directs the department to ensure capital projects are consistent with the principles of the project management process.

Executive Order 1028.01 directs the department to use the principles of Context Sensitive Solutions (CSS). www.wsdot.wa.gov/eesc/design/Urban/PDF/UnderstandingFlexibilityInTransportationDesignWashington.pdf CSS involves public outreach, coordination, and collaborative decision making. Designers are encouraged to consider the public outreach process in the project work plan.

The HQ Budget and Financial Analysis Office and various offices in the HQ Strategic Planning and Programming Division share responsibility for developing a capital investment plan. The plan includes a forecast of available revenue by fund source and recommends investment levels based on the *Washington Transportation Plan*. The HQ Systems Analysis and Program Development (SA&PD) Section issues programming instructions, based on the preliminary budget targets, which assist the regions as they begin scoping highway projects.

Once a ten-year plan has been determined and the proposed projects scoped, the SA&PD Section finalizes a budget request, including a project list for submittal to the Legislature. The Legislature sets funding levels for the different programs within WSDOT that will deliver the project list for the funding amount identified in the scoping document.

(e) **Categories of Work**

The HSP presents the budgets for the Maintenance (M), Operations (Q), Preservation (P), and Improvement (I) programs. Strategies and conceptual solutions are limited to the Preservation and Improvement programs. Each of these programs is divided into subprograms, as shown in the Figures 150-1 and 150-2.

(3) Project Summary

The Project Summary is developed in the region when a project is proposed for programming. The regions prepare the Project Summary during project scoping. The information provided guides the project through the design process to project approval.

The Project Summary:

- Defines the purpose and need for the project and spells out the scope of work.
- Includes a cost/benefit measure to determine the project's cost-effectiveness.
- Documents the design decisions or assumptions that the region made while determining the project scope.
- Identifies the major factors that will influence the scope, schedule, and budget and includes a cost increase factor for unidentified risks.
- Establishes initial preliminary engineering, right of way, and construction cost estimates.
- Documents the project delivery schedule.
- Requires approval by the HQ SA&PD Section prior to submittal to the Legislature for programming consideration.
- Documents the potential environmental impacts and permits that may be required.

The intent of the Project Summary is to initiate the development of a project by identifying the need that generated the project and the proposed solution to solve that need.

Regions are encouraged to place special emphasis on project scoping, estimating, and scheduling during program development as a means to verify that program delivery stays within the appropriated dollars and workforce. Resources available to the regions include the *Highway System Plan*; *Route Development plans*; Design Matrices; *Roadside Classification Plan*; Environmental Workbench and other planning; and design and environmental documents to ensure project scoping is consistent.

The initial environmental classification and documentation required for the project is established in the Environmental Review Summary (ERS) section of the Project Summary. Environmental classification at the Project Summary stage has several benefits. It helps in under-standing the impacts associated with a project and also helps to establish a realistic schedule and PE cost estimate. All projects require supporting State Environmental Policy Act (SEPA) documentation. For projects eligible for federal funding, National Environmental Policy Act (NEPA) documentation is also required.

Regions are encouraged to take full advantage of expertise available from the HQ Systems Analysis and Program Development (SA&PD) Section of the Strategic Planning and Programming Division, FHWA, the HQ Environmental Services Office, and local agencies when scoping projects as a means to assist them in affirming that all aspects are considered and the proposed solution is eligible for available funding. These resources can help the regions evaluate a project's impacts and provide the appropriate project direction.

The HQ SA&PD Section coordinates review of the Project Summary and forwards any comments to the regions for resolution prior to approval. Once all comments and outstanding issues are resolved, the Project Summary can be approved and copies distributed.

(4) Environmental Document

The “Environmental Document” is a statement that identifies impacts to the natural and constructed environment as a result of a project and potential mitigation. The statement may consist of one or two pages for categorically exempted projects, a SEPA checklist, documented Categorical Exclusion (DCE), or an Environmental Assessment (EA) or Environmental Impact Statement (EIS) for major projects (see Chapter 220).

(5) Design Documentation Package (DDP)

The DDP is a formal document of design considerations and conclusions reached in the development of a project. The Project File records various design recommendations that are reviewed within the department and, when approved, become the project design (see Chapter 330).

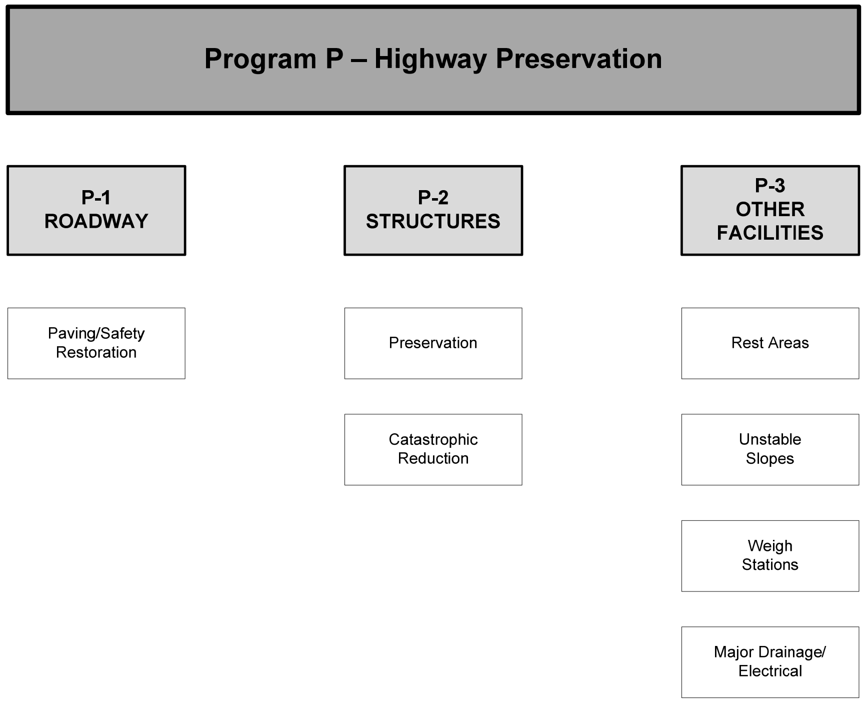
(6) Right of Way/Limited Access Plans

Right of Way/Limited Access Plans are the official state documents used to acquire real estate, property, and access rights. These plans determine rights of access from abutting property owners, interchange/intersection spacing, access points per mile, or other selective approaches to a highway facility. Right of way plans are used to obtain the “Order of Public Use and Necessity,” which is the authority to acquire real property and property rights under eminent domain.

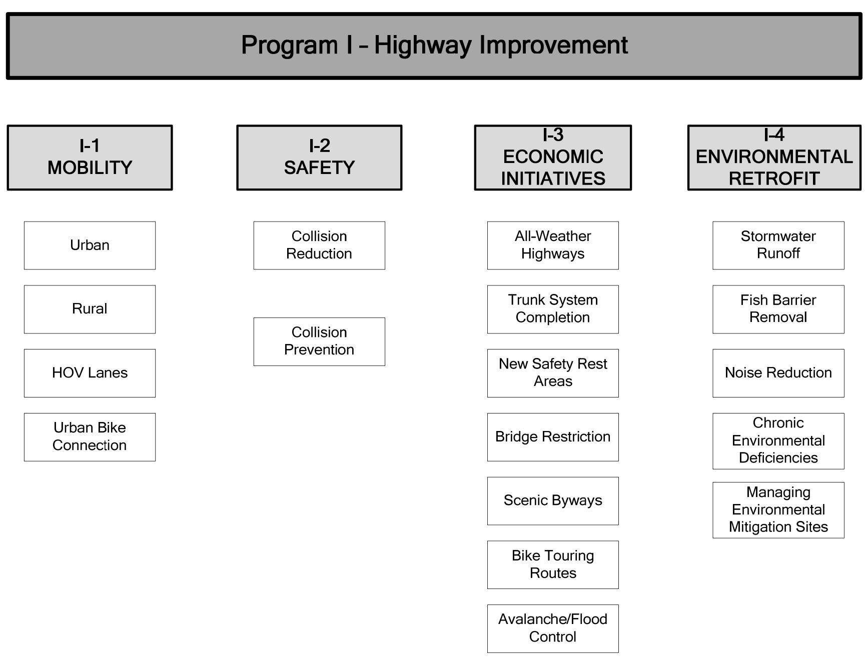
The establishment of limited access control is considered whenever major improvements, reconstruction, relocation, significant new rights of way, or new facilities are required. (See Chapters 1420, 1430, and 1435, and the *Plans Preparation Manual* for more information.)

(7) Contract Documents

The contract Plans, Specifications, and Estimates (PS&E) are the final documents needed for the advertisement of a construction contract. Contract plans conform to the basic design features approved in the Project Summary, the environmental documents, and the Design Documentation Package. Present the work in the plans and contract specifications in a clear and concise manner to avoid misinterpretation. A tool available to the designer to check whether required items are addressed during the PS&E preparation is the “PS&E Review Checklist,” available at: www.wsdot.wa.gov/Design/ProjectDev/. Projects may go through PS&E preparation, but they will not be advertised for construction until required work and approvals are complete (see the *Plans Preparation Manual*).

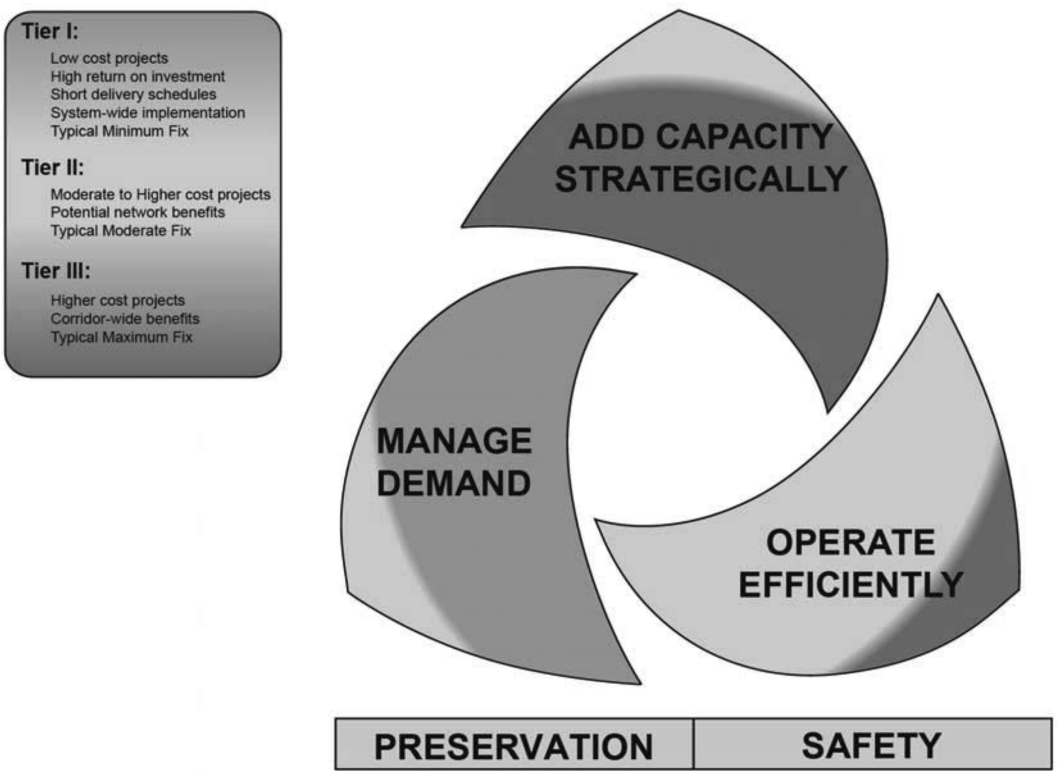


Program Elements: Highway Preservation
Figure 150-1



Program Elements: Highway Improvement
Figure 150-2

Washington State *Highway System Plan*: Implementation –
Safety, Economic Vitality, and Mobility Strategies



Highway System Plan Implementation
Figure 150-3

A **deviation** is required when an existing or proposed design element differs from the specified design level for the project and neither DE nor EU processing is indicated. (See Chapter 330 regarding documentation.)

DE or EU with /F or /M in a cell means that the design element is to be analyzed with respect to the specified design level. For instance, a DE/F is analyzed with respect to full design level and might be recorded as having an existing design element that does not meet or exceed current full design level. An EU/M is analyzed to decide whether or not to upgrade any existing design element that does not meet or exceed the current modified design level.

(5) Terminology in Notes

F/M Full for freeways/Modified for nonfreeway uses the word **freeway** to mean a divided highway facility that has a minimum of two lanes in each direction, for the exclusive use of traffic and with full control of access. For matrix cells with an F/M designation, analyze freeway routes at full design level and nonfreeway routes at modified design level.

The **Access Control Tracking System** mentioned in note (3) in Design Matrices 3, 4, and 5 is a database list related to highway route numbers and mileposts. The Tracking System is available at: http://www.wsdot.wa.gov/design/accessandhearings. (See Chapter 1420 for access control basics and 1430 and 1435 for limited and managed access, respectively.)

The **corridor or project analysis** mentioned in notes (2) and (4) on Design Matrices 3, 4, and 5 is the documentation needed to support a change in design level from the indicated design level, and to support decisions to include, exclude, or modify design elements. The first step is to check for recommendations for future improvements in an approved *Route Development Plan* or other approved study. If none are available, an analysis can be based on route continuity and other existing features. (See Chapter 330 regarding documentation.) A Project Analysis is also used for multiple related design variances. Check with HQ Design before using this approach. A corridor analysis is also used to establish design speed, as stated in Chapters 430 and 440.

Note **(21) Analyses required** appears only on Design Elements for Risk projects on Design Matrices 3, 4, and 5. These design elements are to be evaluated using benefit/cost (B/C) to compare and rank each occurrence of the design element. The B/C evaluation supports engineering decisions regarding which proposed solutions are included in a Risk project.

Most components of a Risk project will have a B/C of 1.0 or greater. Proposed solutions with a B/C ratio less than 1.0 may be included in the project based on engineering judgment of their significant contribution to corridor continuity. Risk program size, purpose and need, or project prioritization may lead to instances where design elements with a ratio greater than 1.0 are excluded from a project. The analysis, design decisions, and program funding decisions are to be documented in the Design Documentation Package. Decisions regarding which design elements to include in a project are authorized at the WSDOT Region level.

State Route	NHS Route Description	Begin SR MP	Begin ARM	End SR MP	End ARM
US 2	I-5 to Idaho State Line	0.00B	0.00	334.51	326.64
US 2 Couplet	Brown Street Couplet	287.45	0.00	288.08	0.63
US 2 Couplet	Division Street Couplet	289.19	0.00	290.72	1.53
SR 3	US 101 to SR 104	0.00	0.00	60.02	59.81
SR 4	US 101 to I-5	0.00	0.00	62.28	62.27
I-5	Oregon State Line to Canadian Border	0.00	0.00	276.56	276.62
SR 8	US 12 to US 101	0.00	0.00	20.67	20.67
SR 9	SR 546 to Canadian Border	93.61	93.52	98.17	98.08
SR 9 Spur	Sumas Spur	98.00	0.00	98.25	0.24
SR 11	I-5 to Alaskan Ferry Terminal	19.93	19.93	21.28	21.28
US 12	US 101 to Idaho State Line	0.00	0.00	434.19	430.76
US 12 Couplet	Aberdeen Couplet	0.33	0.00	0.68	0.35
SR 14	I-5 to US 97	0.00	0.00	101.02	100.93
SR 14 Spur	Maryhill Spur	100.66	0.00	101.05	0.39
SR 16	I-5 to SR 3	0.00	0.00	29.19	27.01
SR 16 Spur	SR 16 to SR 3	28.74	0.00	29.13	0.39
SR 17	US 395 to I-90	7.43	0.00	50.89	43.40
SR 18	SR 99 to I-5	2.20B	0.00	0.00	0.53
SR 18	I-5 to I-90	0.00	0.53	27.91	28.41
SR 20	US 101 to I-5	0.00	0.00	59.54	59.49
SR 20 Spur	SR 20 to San Juan Ferry	47.89	0.00	55.67	7.78
SR 22	US 97 to I-82	0.70	0.00	4.00	3.31
SR 26	I-90 to US 195	0.00	0.00	133.53	133.61
SR 26 Spur	SR 26 to US 195	133.44	0.00	133.51	0.07
SR 28	US 2 to SR 281	0.00B	0.00	29.77	33.91
I-82	I-90 to Oregon State Line	0.00	0.00	132.60	132.57
I-90	I-5 to Idaho State Line	1.94	0.00	299.82	297.52
I-90 Reverse Lane	Reversible lane	1.99	0.00	9.44	7.45
SR 96	I-5 to McCollum Park and Ride	0.00	0.00	0.52	0.52
US 97	Oregon State Line to SR 22	0.00B	0.00	61.44	61.30
US 97	I-90 to Canadian Border	133.90	118.80	336.48	321.62
US 97 Couplet	Maryhill Couplet	2.59	0.00	2.68	0.09
US 97 Spur	US 97 to US 2 (Orondo)	213.36	0.00	213.62	0.26
SR 99	188th to SeaTac Airport	18.35	14.70	18.77	15.12
SR 99	SR 509 to SR 104	26.04	22.40	43.60	39.84
US 101	Oregon State Line to SR 401	0.00	0.00	0.46	0.46
US 101	SR 4 to I-5	28.89	28.89	367.41	365.78
US 101 Couplet	Aberdeen Couplet	87.49	0.00	91.66	4.17
US 101 Couplet	Port Angeles Couplet	249.65	0.00	251.32	1.67
SR 104	US 101 to I-5	0.20	0.00	29.67	29.14
SR 109	Pacific Beach Access	0.00	0.00	30.25	30.29
SR 125	Oregon State Line to SR 125 Spur	0.00	0.00	6.09	6.08
SR 125 Spur	SR 125 to US 12	6.09	0.00	6.76	0.67
SR 127	US 12 to SR 26	0.03	0.00	27.05	27.05
SR 128	US 12 to Idaho State Line	0.00	0.00	2.30	2.30

NHS Highways in Washington
Figure 325-2

State Route	NHS Route Description	Begin SR MP	Begin ARM	End SR MP	End ARM
SR 166	SR 16 to Bay St	0.02	0.00	3.40	3.38
SR 167	I-5 to SR 900 / S 2nd St	0.00	0.00	27.28	28.60
I-182	I-82 to US 395	0.00	0.00	15.19	15.19
US 195	Idaho State Line to I-90	0.00B	0.00	95.99	93.37
US 195 Spur	US 195 to Idaho State Line	0.06	0.00	0.60	0.54
I-205	Oregon State Line to I-5	26.59	0.00	37.16	10.57
SR 240	I-182 to Coast St / Bypass Hwy – Hanford Access	30.63	28.86	34.87	33.10
SR 270	US 195 to Idaho State Line	0.00	0.00	9.89	9.89
SR 270	Pullman Couplet	2.67	0.00	2.90	0.23
SR 281	I-90 to SR 28	0.00	0.00	10.55	10.55
SR 281 Spur	SR 281 to I-90	2.65	0.00	4.34	1.69
SR 303	SR 304 to SR 3	0.00B	0.00	9.16	9.32
SR 304	SR 3 to Bremerton Ferry	0.00	0.00	3.51	3.24
SR 305	Winslow Ferry to SR 3	0.02	0.00	13.52	13.50
SR 307	SR 305 to SR 104	0.00	0.00	5.25	5.25
SR 310	SR 3 to SR 304	0.00	0.00	1.84	1.84
US 395	Congressional High-Priority Route/I-82 to Canadian Border	13.05	19.81	270.26	275.09
SR 401	US 101 to SR 4	0.00	0.00	12.13	12.13
I-405	I-5 to I-5	0.00	0.00	30.32	30.30
SR 432	SR 4 to I-5	0.00	0.00	10.33	10.32
SR 433	Oregon State Line to SR 432	0.00	0.00	0.94	0.94
SR 500	I-5 to SR 503	0.00	0.00	5.96	5.96
SR 501	I-5 to Port of Vancouver	0.00	0.00	3.83	3.42
SR 502	I-5 to SR 503	0.00B	0.00	7.56	7.58
SR 503	SR 500 to SR 502	0.00	0.00	8.09	8.09
SR 509	12th Place S to SR 99	24.35B	26.13	29.83	33.11
SR 509	Pacific Ave. to Marine View Drive	0.22	1.44	3.20	4.42
SR 512	I-5 to SR 167	0.00	0.00	12.06	12.06
SR 513	Sandpoint Naval Air Station	0.00	0.00	3.35	3.35
SR 516	I-5 to SR 167	2.03	2.02	4.72	4.99
SR 518	I-5 to SR 509	0.00	0.00	3.81	3.42
SR 519	I-90 to Seattle Ferry Terminal	0.00	0.00	1.14	1.14
SR 520	I-5 to SR 202	0.00	0.00	12.83	12.82
SR 522	I-5 to US 2	0.00	0.00	24.68	24.68
SR 524	Cedar Way Spur to I-5	4.64	4.76	5.32	5.44
SR 524 Spur	Cedar Way Spur – Lynnwood Park and Ride to SR 524	4.64	0.00	5.14	0.50
SR 525	I-5 to SR 20	0.00	0.00	30.49	30.72
SR 526	SR 525 to I-5	0.00	0.00	4.52	4.52
SR 529	I-5 to Everett Homeport	0.00	0.00	2.72	2.72
SR 539	I-5 to Canadian Border	0.00	0.00	15.16	15.16
SR 543	I-5 to Canadian Border	0.00	0.00	1.09	1.09
SR 546	SR 539 to SR 9	0.00	0.00	8.02	8.02
I-705	I-5 to Schuster Parkway	0.00	0.00	1.50	1.50
SR 970	I-90 to US 97	0.00	0.00	10.31	10.31

NHS Highways in Washington
Figure 325-2 (continued)

⇩ Project Type																Bridges			Barriers		
Design Elements ⇨	Horiz. Align.	Vert. Align.	Lane Width	Shldr Width (13)	On/Off Conn.	Median Width	Cross Slope Lane	Cross Slope Shldr	Fill/Ditch Slopes	Clear Zone	Sign. (10)	Delini. (9)	Illumin.	Vert. Clear. (11)	Bike & Ped.	Lane Width	Shldr Width	Structural Capacity	Term. & Trans. Section (12)	Std Run	Bridge Rail (14)(19)
(1-1) Preventive Maintenance																					
Pavement Restoration																					
(1-2) Diamond Grinding										EU	EU	F		DE					F	EU	F
(1-3) Milling with HMA Inlays									EU	F	EU	F		DE					F	EU	F
(1-4) Nonstructural Overlay				DE			EU	EU	EU	F	EU	F		EU					F	F	F
Pavement Rehab./Resurf.																					
(1-5) HMA Structural Overlays	EU	DE	F	F	F(17)	DE	F	EU	F	F	EU	F	F	F		F	DE		F	F	F
(1-6) PCCP Overlays	EU	DE	F	F	F(17)	DE	F	EU	F	F	EU	F	F	F		F	DE		F	F	F
(1-7) Dowel Bar Retrofit	EU	DE	F	F	F(17)	DE	DE		F	F	EU	F	F	DE			DE		F	F	F
Bridge Rehabilitation																					
(1-8) Bridge Deck Rehabilitation												F		F		F	DE	(11)	F(6)	F(22)	F
Safety																					
(1-9) Median Barrier				DE															F(20)	F(20)	
(1-10) Guardrail Upgrades				DE						F									F	F(23)	
(1-11) Bridge Rail Upgrades																			F	F(22)	F
Reconstruction (16)																					
(1-12) New/Reconstruction	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F

Design Matrix 1:
Interstate Routes (Main Line)
Figure 325-3

☐ Not Applicable

F Full design level. See Chapter 440.

DE Design Exception to full design level.

EU Evaluate Upgrade to full design level.

(6) Applies only to bridge end terminals and transition sections.

(9) Continuous shoulder rumble strips required in rural areas. See Chapter 700.

(10) See Chapter 820.

(11) See Chapter 1120.

(12) Impact attenuators are considered as terminals.

(13) See Chapters 440 and 640.

(14) Includes crossroad bridge rail. See Chapter 710.

(16) For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 325.03(2).

(17) DE for existing acceleration/deceleration lanes when length meets posted freeway speed and no significant accidents. See Chapter 940.

(19) The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.

(20) Applies to median elements only.

(22) Upgrade barrier, if necessary, within 200 ft of the end of the bridge.

(23) See description of Guardrail Upgrades Project Type, 325.03(1) regarding length of need.

Design Matrix 1:
Interstate Routes (Main Line)
Figure 325-3 (continued)

⇩ Project Type	Ramps and Collector Distributors														Ramp Terminals			Barriers			Cross Road								Barriers		
Design Elements ⇨	Horiz. Align.	Vert. Align.	Lane Width	Shldr Width	Lane Tran- sition	On/Off Conn.	Cross Slope Lane	Cross Slope Shldr	Fill/ Ditch Slopes	Limited Access	Clear Zone	Sign., Del., Illumin. [9][10]	Vertical Clear. [11]	Bike & Ped.	Turn Radii	Angle	I/S Sight Dist.	Term. & Trans. Section [12]	Std Run	Bridge Rail [14][19]	Lane Width	Shldr Width	Fill/ Ditch Slopes	Limited Access	Clear Zone	Sign., Del., Illumin. [10]	Vert. Clear. [11]	Ped. & Bike	Term. & Trans. Section [12]	Std Run	Bridge Rail [14][19]
(2-1) Preventive Maintenance																															
Pavement Restoration																															
(2-2) Diamond Grinding											EU	F[15]						F	EU	F					EU	F[15]			F	EU	F
(2-3) Milling with HMA Inlays									EU		F	F[15]	F	M				F	F	F			EU		F	F[15]		M	F	F	F
(2-4) Nonstructural Overlay							EU	EU	EU		F	F[15]	F	M				F	F	F			EU		F	F[15]		M	F	F	F
Pavement Rehab./Resurf.																															
(2-5) HMA Structural Overlays	EU	DE	F	F	F	F[17]	F	EU	F	F	F	F[15]	F	M	F	F	F	F	F	F	DE	DE	DE	F	F	F[15]	F	M	F	F	F
(2-6) PCCP Overlays	EU	DE	F	F	F	F[17]	F	EU	F	F	F	F[15]	F	M	F	F	F	F	F	F	DE	DE	DE	F	F	F[15]	F	M	F	F	F
(2-7) Dowel Bar Retrofit	DE		DE	DE	F	F[17]	DE		F	F	F	F[15]	DE		F	F	F	F	F	F				F		F[15]			F	F	F
Bridge Rehabilitation																															
(2-8) Bridge Deck Rehabilitation													F	M				F[6]	F[22]	F							F	M	F[6]	F[22]	F
Safety																															
(2-9) Intersection			F	F	F				F	F	F	F		M	F	F	F	F	F	F			F	F	F	F	F	M	F	F	F
(2-10) Guardrail Upgrades				DE							F							F	F[23]										F	F[23]	
(2-11) Bridge Rail Upgrades																		F	F[22]	F									F	F[22]	F
Reconstruction [16]																															
(2-12) New/Reconstruction	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F

Design Matrix 2:
Interstate Interchange Areas
Figure 325-4

☐ Not Applicable
F Full design level. See Chapter 440.
M Modified design level. See Chapter 430.
DE Design Exception to full design level.
EU Evaluate Upgrade to full design level.

(6) Applies only to bridge end terminals and transition sections.
(9) Continuous shoulder rumble strips required in rural areas. See Chapter 700.
(10) See Chapter 820.
(11) See Chapter 1120.
(12) Impact attenuators are considered as terminals.
(14) Includes crossroad bridge rail. See Chapter 710.
(15) EU for signing and illumination.
(16) For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 325.03(2).
(17) DE for existing acceleration/deceleration lanes when length meets posted freeway speed and no significant accidents. See Chapter 940.
(19) The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.
(22) Upgrade barrier, if necessary, within 200 ft of the end of the bridge.
(23) See description of Guardrail Upgrades Project Type, 325.03(1) regarding length of need.

Design Matrix 2:
Interstate Interchange Areas
Figure 325-4 (continued)

⇩ Project Type / Design Elements ⇨	Horiz. Align.	Vert. Align.	Lane Width	Shldr Width	Lane Transition	On/Off Conn.	Median Width	Cross Slope Lane	Cross Slope Shldr	Fill/ Ditch Slopes	Access(3)	Clear Zone(18)	Sign., Del., Illumin.	Basic Safety	Bike & Ped.	Bridges(11): Lane Width	Bridges(11): Shldr Width	Bridges(11): Vertical Clear-ance	Bridges(11): Structural Capacity	Intersections: Turn Radii	Intersections: Angle	Intersections: I/S Sight Dist.	Barriers: Term. & Trans. Section(12)	Barriers: Std Run	Barriers: Bridge Rail(14)(19)
Preservation																									
Roadway																									
(3-1) Non-Interstate Freeway	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F		B	B		DE/F	DE/F	F					F	B	F
(3-2) HMA/PCCP/BST Overlays	DE/M	DE/M	DE/M	DE/M	DE/F	DE/F	DE/M	DE/M	DE/M	DE/M			B	B	M	DE/M	DE/M	F				B	F	B	F
(3-3) Replace HMA w/ PCCP at I/S	DE/M	DE/M	EU/M	EU/M	DE/F		DE/M	EU/M	DE/M	DE/M			B	B	M	DE/M	DE/M	F				B	F	B	F
Structures																									
(3-4) Bridge Replacement	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)		F	F		F	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	F
(3-5) Bridge Deck Rehab.													B	B	M			F					F(6)	F(22)	F
Improvements(16)																									
Mobility																									
(3-6) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F
(3-7) Urban	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	F
(3-8) Rural	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	F
(3-9) HOV	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	F
(3-10) Bike/Ped. Connectivity	(5)	(5)	(5)	(5)	(5)			(5)	(5)	(5)	(5)	(5)	(5)		F	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Safety																									
(3-11) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F		F	F	F	F	F	F
(3-12) Intersection(1)			F(2)	F(2)	F					F(2)	F	F	F		M					F	F	F	F	F	F
(3-13) Corridor(1)(24)	M(4)	M(4)	M(4)	M(4)	F	F(17)	M(4)	M(4)	M(4)	M(4)	F	F	F		F	M(4)	M(4)	F		M(4)	M(4)	F	F	F	F
(3-14) Median Barrier				DE/F																			F(20)	F(20)	
(3-15) Guardrail Upgrades				DE/F																			F	F(23)	
(3-16) Bridge Rail Upgrades																							F	F(22)	F
(3-17) Risk: Roadside										F	EU/F	F	F										F	F	F
(3-18) Risk: Sight Distance	F/M(21)	F/M(21)	F/M(21)	F/M(21)						F/M(21)	F(21)	F(21)	F		F	F(21)	F(21)	F(21)		F/M(21)	F/M(21)	F(21)	F	F	F
(3-19) Risk: Roadway Width			F/M(21)	F/M(21)	F(21)	F(21)	F/M(21)	F/M(21)	F/M(21)	F/M(21)	F	F	F		F	F(21)	F(21)	F(21)		F/M(21)	F/M(21)	F(21)	F	F	F
(3-20) Risk: Realignment	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F		F(2)	F(2)	F(2)	F	F	F
Economic Development																									
(3-21) Freight & Goods (Frost Free)(8)	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)	EU/F	F	B		EU/F(26)	DE/F	DE/F	F	F	EU/F	EU/F	EU/F	F	F	F
(3-22) Four-Lane Trunk System	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F
(3-23) Rest Areas (New)	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F		F	F	F	F	F	F
(3-24) Bridge Restrictions	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F(2)		F	F		EU/F(26)	F(2)	F(2)	F	F	F(2)	F(2)	F	F	F	F
(3-25) Bike Routes (Shldrs)			EU/M	(7)	EU/F				EU/M	EU/M			B	B	F	EU/M	EU/M	F				B	F	B	EU/F

Design Matrix 3:
Main Line NHS Routes (Except Interstate)
Figure 325-5

- ☐ Not Applicable
- **F** Full design level. See Chapter 440.
- **M** Modified design level. See Chapter 430.
- **B** Basic design level. See Chapter 410.
- **F/M** Full for freeways/Modified for nonfreeway
- **DE** Design Exception
- **EU** Evaluate Upgrade

(1) Collision Reduction, or Collision Prevention (At-Grade Removal, Signalization & Channelization). Specific deficiencies that created the project must be upgraded to design level as stated in the matrix.

(2) Modified design level may apply based on a corridor or project analysis. See 325.03(5).

(3) If designated as L/A acquired in the Access Control Tracking System, limited access requirements apply. If not, managed access applies. See 325.03(5).

(4) Full design level may apply based on a corridor or project analysis. See 325.03(5).

(5) For bike/pedestrian design see Chapters 1020 and 1025.

(6) Applies only to bridge end terminals and transition sections.

(7) 4 ft minimum shoulders.

(8) If all weather structure can be achieved with spot digouts and overlay, modified design level applies to NHS highways and basic design level applies to non-NHS highways.

(11) See Chapter 1120.

(12) Impact attenuators are considered as terminals.

(14) Includes crossroad bridge rail. See Chapter 710.

(16) For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 325.03(2).

(17) DE for existing acceleration/deceleration lanes when length meets posted freeway speed and no significant accidents. See Chapter 940.

(18) On managed access highways within the limits of incorporated cities and towns, City and County Design Standards apply to areas outside the curb or outside the paved shoulder where no curb exists.

(19) The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.

(20) Applies to median elements only.

(21) Analyses required. See 325.03(5) for details.

(22) Upgrade barrier, if necessary, within 200 ft of the end of the bridge.

(23) See description of Guardrail Upgrades Project Type, 325.03(1) regarding length of need.

(24) Apply Full design level to projects that realign or reconstruct significant portions of the alignment.

(26) Sidewalk ramps must be addressed for ADA compliance. See Chapter 1025.

Design Matrix 3:
Main Line NHS Routes (Except Interstate)
Figure 325-5 (continued)

⇩ Project Type	Ramps and Collector Distributors																				Cross Road											
															Ramp Terminals			Barriers												Barriers		
Design Elements ⇨	Horiz. Align.	Vert. Align.	Lane Width	Shldr Width	Lane Tran- sition	On/Off Conn.	Cross Slope Lane	Cross Slope Shldr	Fill/ Ditch Slopes	Access(3)	Clear Zone	Sign, Del., Illumin.	Basic Safety	Bike & Ped.	Turn Radii	Angle	I/S Sight Dist.	Term. & Trans. Section(12)	Std Run	Bridge Rail (14)(19)	Lane Width	Shldr Width	Fill/ Ditch Slopes	Access(3)	Clear Zone	Sign., Del., Illumin.	Basic Safety	Vert. Clear.(11)	Ped. & Bike	Term. & Trans. Section(12)	Std . Run	Bridge Rail(14)(19)
Preservation																																
Roadway																																
(4-1) Non-Interstate Freeway	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F	DE/F		B	B	M	DE/F	DE/F	DE/F	F	B	F	DE/F	DE/F	DE/F			B	B	F	M	F	B	F
(4-2) HMA/PCCP/BST												B	B	M			B	F	B	F						B	B	F	M	F	B	F
Overlays Ramps																																
Structures																																
(4-3) Bridge Replacement	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F	F	F	F	F	F	F(2)	F(2)	F(2)	F	F	F		F	F	F	F	F
(4-4) Bridge Deck Rehab.												B	B	M				F(6)	F(22)	F						B	B	F	M	F(6)	F(22)	F
Improvements(16)																																
Mobility																																
(4-5) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F
(4-6) Urban	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F	F	F	F	F(2)	F(2)	F(2)	F	F	F		F	F	F	F	F
(4-7) Rural	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F	F	F	F	F(2)	F(2)	F(2)	F	F	F		F	F	F	F	F
(4-8) HOV By Pass	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F	F	F	F	F(2)	F(2)	F(2)	F	F	F		F	F	F	F	F
(4-9) Bike/Ped. Connectivity	(5)	(5)	(5)	(5)	(5)		(5)	(5)	(5)	(5)	(5)	(5)		F	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)			(5)		(5)	F	(5)	(5)	(5)
Safety																																
(4-10) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F		M	F	F	F	F	F	F	F	F	F	F	F	F		F	M	F	F	F
(4-11) At Grade(1)(25)	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F(2)	F(2)	F	F	F	F	F(2)	F(2)	F(2)	F	F	F		F	F	F	F	F
(4-12) Intersection(1)			F(2)	F(2)	F				F(2)	F	F	F		M	F	F	F	F	F	F			F(2)	F	F	F		F	M	F	F	F
(4-13) Guardrail Upgrades				DE/F														F	F(23)											F	F(23)	
(4-14) Bridge Rail Upgrades																														F	F(22)	F
(4-15) Risk: Roadside									F	EU/F	F	F											F	EU/F	F	F				F	F	F
(4-16) Risk: Sight Distance	F/M(21)	F/M(21)	F/M(21)	F/M(21)					F/M(21)	F(21)	F(21)	F		F	F/M(21)	F/M(21)	F	F	F	F			F/M(21)	F(21)	F(21)			F(21)	F			
(4-17) Risk: Roadway Width			F/M(21)	F/M(21)	F	F(21)	F/M(21)	F/M(21)	F/M(21)	F	F	F		F	F/M(21)	F/M(21)	F	F	F	F	F/M(21)	F/M(21)	F/M(21)	F	F			F(21)	F	F	F	F
(4-18) Risk: Realignment	F(2)	F(2)	F(2)	F(2)	F	F(2)	F(2)	F(2)	F(2)	F	F	F		F	F/M(21)	F/M(21)	F	F	F	F	F(2)	F(2)	F(2)	F	F			F(21)	F	F	F	F
Economic Development																																
(4-19) Four-Lane Trunk System	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F		F		F	F	F

Design Matrix 4:
Interchange Areas, NHS (Except Interstate) and Non-NHS
Figure 325-6

☐ Not Applicable
F Full design level. See Chapter 440.
M Modified design level. See Chapter 430.
B Basic design level. See Chapter 410.
F/M Full for freeways/Modified for nonfreeway
DE Design Exception
EU Evaluate Upgrade

(1) Collision Reduction, or Collision Prevention (At-Grade Removal, Signalization & Channelization). Specific deficiencies that created the project must be upgraded to design level as stated in the matrix.

(2) Modified design level may apply based on a corridor or project analysis. See 325.03(5).

(3) If designated as L/A acquired in the Access Control Tracking System, limited access requirements apply. If not, managed access applies. See 325.03(5).

(4) Full design level may apply based on a corridor or project analysis. See 325.03(5).

(5) For bike/pedestrian design see Chapters 1020 and 1025.

(6) Applies only to bridge end terminals and transition sections.

(11) See Chapter 1120.

(12) Impact attenuators are considered as terminals.

(14) Includes crossroad bridge rail. See Chapter 710.

(16) For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 325.03(2).

(19) The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.

(21) Analyses required. See 325.03(5) for details.

(22) Upgrade barrier, if necessary, within 200 ft of the end of the bridge.

(23) See description of Guardrail Upgrades Project Type, 325.03(1) regarding length of need.

(25) For main line, use the Project Type row for Safety, Non-Interstate Freeway on Matrix 3 for NHS and on Matrix 5 for non-NHS.

Design Matrix 4:
Interchange Areas, NHS (Except Interstate) and Non-NHS
Figure 325-6 (continued)

⇩ Project Type / Design Elements ⇨	Horiz. Align.	Vert. Align.	Lane Width	Shldr Width	Lane Tran- sition	Median Width	Cross Slope Lane	Cross Slope Shldr	Fill/ Ditch Slopes	Access[3]	Clear Zone [18]	Sign, Del., Illumin.	Basic Safety	Bike & Ped.	Bridges[11]: Lane Width	Bridges[11]: Shldr Width	Bridges[11]: Vertical Clear.	Bridges[11]: Structural Capacity	Intersections: Turn Radii	Intersections: Angle	Intersections: I/S Sight Dist.	Barriers: Term. & Trans. Section [12]	Barriers: Std Run	Barriers: Bridge Rail[19]
Preservation																								
Roadway																								
(5-1) HMA/PCCP												B	B	M			F				B	F	B	F
(5-2) BST																								
(5-3) BST Routes/Basic Safety												B	B								B	F	B	F
(5-4) Replace HMA with PCCP at I/S			EU/M	EU/M		DE/M	EU/M					B	B	M			F					F	B	F
Structures																								
(5-5) Bridge Replacement	M	F	M	M	F		M	M	M		F	F		F	F[2]	F[2]	F	F	M	M	F	F	F	F
(5-6) Bridge Repl. (Multilane)	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]		F	F		F	F[2]	F[2]	F	F	F[2]	F[2]	F	F	F	F
(5-7) Bridge Deck Rehab												B	B	M								F[6]	F[22]	F
Improvements[16]																								
Mobility																								
(5-8) Urban (Multilane)	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	EU/F	EU/F	F	F	F	F
(5-9) Urban	M	M	M	M	F		M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-10) Rural	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-11) HOV	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-12) Bike/Ped. Connectivity	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)		F	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Safety																								
(5-13) Non-Interstate Freeway	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F		F[2]	F[2]	F	F	F	F
(5-14) Intersection[1]			M[4]	M[4]	F				M[4]	F	F	F		M					M[4]	M[4]	F	F	F	F
(5-15) Corridor[1]	M[4]	M[4]	M[4]	M[4]	F	M[4]	M[4]	M[4]	M[4]	F	F	F		M	M[4]	M[4]	F		M[4]	M[4]	F	F	F	F
(5-16) Median Barrier				DE/F																		F[20]	F[20]	
(5-17) Guardrail Upgrades				DE/F																		F	F[23]	
(5-18) Bridge Rail Upgrades																						F	F[22]	F
(5-19) Risk: Roadside									M[4]	EU/F	F	F										F	F	F
(5-20) Risk: Sight Distance	F/M[21]	F/M[21]	F/M[21]	F/M[21]					F/M[21]	F[21]	F[21]	F		F	F[21]	F[21]	F[21]		F/M[21]	F/M[21]	F[21]	F	F	F
(5-21) Risk: Roadway Width			F/M[21]	F/M[21]	F	F/M[21]	F/M[21]	F/M[21]	F/M[21]	F	F	F		F	F[21]	F[21]	F[21]		F/M[21]	F/M[21]	F[21]	F	F	F
(5-22) Risk: Realignment	F/M	F/M	F/M	F/M	F	F/M	F[2]	F[2]	F/M	F	F	F		F	F[21]	F[21]	F[21]		F/M[21]	F/M[21]	F[21]	F	F	F
Economic Development																								
(5-23) Freight & Goods (Frost Free)[8]	EU/M	EU/M	EU/M	EU/M	EU/F	EU/M	M	M	EU/M		F	B	B	EU/F[26]	DE/M	DE/M	F		EU/M	EU/M	EU/F	F	B	F
(5-24) Rest Areas (New)	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F			F	F	F	F	F	F
(5-25) Bridge Restrictions	M	F	M	M	F	M	M	M	M		F	F		EU/F[26]	M	M	F	F	M	M	F	F	F	F
(5-26) Bike Routes (Shldrs)			EU/M	(7)	EU/F			EU/M	EU/M			B	B	F	EU/M	EU/M					B	F	B	EU/F

Design Matrix 5:
Main Line Non-NHS Routes
Figure 325-7

- ☐ Not Applicable
- **F** Full design level. See Chapter 440.
- **M** Modified design level. See Chapter 430.
- **B** Basic design level. See Chapter 410.
- **F/M** Full for freeways/Modified for nonfreeway
- **DE** Design Exception
- **EU** Evaluate Upgrade

(1) Collision Reduction, or Collision Prevention (At Grade Removal, Signalization & Channelization). Specific deficiencies that created the project must be upgraded to design level as stated in the matrix.

(2) Modified design level may apply based on a corridor or project analysis. See 325.03(5).

(3) If designated as L/A acquired in the Access Control Tracking System, limited access requirements apply. If not, managed access applies. See 325.03(5).

(4) Full design level may apply based on a corridor or project analysis. See 325.03(5).

(5) For bike/pedestrian design see Chapters 1020 and 1025.

(6) Applies only to bridge end terminals and transition sections.

(7) 4 ft minimum shoulders.

(8) If all weather structure can be achieved with spot digouts and overlay, modified design level applies to NHS highways and basic design level applies to non-NHS highways.

(11) See Chapter 1120.

(12) Impact attenuators are considered as terminals.

(16) For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 325.03(2).

(18) On managed access highways within the limits of incorporated cities and towns, City and County Design Standards apply to areas outside the curb or outside the paved shoulder where no curb exists.

(19) The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.

(20) Applies to median elements only.

(21) Analyses required. See 325.03(5) for details.

(22) Upgrade barrier, if necessary, within 200 ft of the end of the bridge.

(23) See description of Guardrail Upgrades Project Type, 325.03(1) regarding length of need.

(26) Sidewalk ramps must be addressed for ADA compliance. See Chapter 1025.

Design Matrix 5:
Main Line Non-NHS Routes
Figure 325-7 (continued)

Chapter 330 Design Documentation, Approval, and Process Review

330.01 General

The Project File (PF) contains the documentation for planning, scoping, programming, design, approvals, contract assembly, utility relocation, needed right of way, advertisement, award, construction, and maintenance review comments for a project. A Project File is completed for all projects and is retained by the Region office responsible for the project. Responsibility for the project may pass from one office to another during the life of a project, and the Project File follows the project as it moves from office to office. Portions of the Project File that are not designated as components of the Design Documentation Package (DDP) may be purged when retention of the construction records is no longer necessary.

The Design Documentation Package is a part of the Project File. It documents and explains design decisions and the design process that was followed. The Design Documentation Package is retained in a permanent, retrievable file for a period of 75 years, in accordance with WSDOT records retention policy.

For operational changes and developer projects, design documentation is also needed and is retained by the Region office responsible for the project, in accordance with WSDOT records retention policy. All participants in the design process are to provide the appropriate documentation for their decisions.

330.02 References

(1) Federal/State Laws and Codes

23 CFR 635.111, Tied bids

23 CFR 635.411, Material or product selection

RCW 47.28.030, Contracts – State forces – Monetary limits – Small businesses, minority, and women contractors – Rules

RCW 47.28.035, Cost of project, defined

"Washington Federal-Aid Stewardship Agreement," as implemented in the design matrices (Chapter 325)

(2) Design Guidance

Advertisement and Award Manual, M 27-02, WSDOT

Directional Documents Index, WSDOT: wwwi.wsdot.wa.gov/docs/

Executive Order E 1010.00, "Certification of Documents by Licensed Professionals," WSDOT

Hydraulics Manual, M 23-03, WSDOT

Master Plan for Limited Access Highways, WSDOT

Plans Preparation Manual, M 22-31, WSDOT

Project Control and Reporting Manual, M 3026, WSDOT

Roadside Classification Plan, M 25-31, WSDOT

Washington State Highway System Plan, WSDOT

(3) Supporting Information

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

330.03 Definitions

Corridor Analysis Documentation that justifies a change in design level and / or decisions to include, exclude, or modify design elements. A corridor analysis addresses needs and design solutions within a substantial segment of roadway. A corridor analysis is useful beyond a specific project contained within it, and is an appropriate document to address design speed.

Design Approval Documented approval of the design criteria, which becomes part of the Design Documentation Package. This approval is an endorsement of the design criteria by the designated representative of the approving organization, as shown in Figures 330-2a and 2b.

design exception (DE) Preauthorization to exclude improvement of an existing design element for various types of projects, as designated in the design matrices (see Chapter 325). A DE designation indicates that the design element is normally outside the scope of the project type (see Figure 330-1).

design variance A recorded decision to differ from the design level specified in the *Design Manual*, such as an Evaluate Upgrade (EU) not upgraded, a DE, or a deviation. EUs leading to an upgrade are documented but are not considered to be variances. A project or corridor analysis may also constitute a design variance if that analysis leads to a decision to use a design level or design classification that differs from what the *Design Manual* specifies for the project type.

Design Variance Inventory (DVI) A list of design elements that will not be improved in accordance with the *Design Manual* criteria designated for the project.

Design Variance Inventory System (DVIS) A database application developed to generate the DVI form. The DVIS also provides query functions, giving designers an opportunity to search for previously granted variances. The DVIS database is intended for internal WSDOT use only, and WSDOT staff access it from: www.wsdot.wa.gov/design/projectdev

deviation A documented decision granting approval at project-specific locations to differ from the design level specified in the *Design Manual* (see Figures 325-3 through 7 and Figure 330-1).

environmental documents:

- ***NEPA*** National Environmental Policy Act
- ***SEPA*** [Washington] State Environmental Policy Act
- ***CE*** NEPA: Categorical Exemption
- ***DCE*** Documented Categorical Exclusion
- ***CE*** SEPA: Categorical Exception
- ***EA*** Environmental Assessment
- ***ECS*** Environmental Classification Summary
- ***EIS*** Environmental Impact Statement
- ***ERS*** Environmental Review Summary
- ***FONSI*** Finding Of No Significant Impact
- ***ROD*** Record of Decision

evaluate upgrade (EU) A decision-making process to determine whether or not to update an existing design element as designated in the design matrices. Documentation is required (see Figure 330-1)

FHWA Federal Highway Administration.

HQ The Washington State Department of Transportation Headquarters organization.

Project Analysis Documentation that justifies a change in design level and /or decisions to include, exclude, or modify design elements (also see Chapter 325.)

Project Change Request Form A form used to document and approve revisions to project scope, schedule, or budget, from a previously approved Project Definition (see Project Summary).

Project Development Approval Final approval of all project development documents by the designated representative of the approving organization prior to the advertisement of a capital transportation project (see Figures 330-2a and 2b).

Project File (PF) A file containing all documentation and data for all activities related to a project (see 330.01 and 330.04).

- ***Design Documentation Package (DDP)*** The portion of the Project File, including Project Development Approval, that will be retained long term in accordance with WSDOT document retention policies. Depending on the scope of the project, it contains the Project Summary and some or all of the other documents discussed in this chapter. Common components are listed in Figure 330-5. Technical reports and calculations are part of the Project File, but are not designated as components of the DDP. Include estimates and justifications for decisions made in the DDP (see 330.04(2)). The DDP explains how and why the design was chosen, and documents approvals (see 330.01).

Project Summary A set of electronic documents consisting of the Design Decisions Summary (DDS), the Environmental Review Summary (ERS), and the Project Definition (PD). The Project Summary is part of the design documentation required to obtain Design Approval and is ultimately part of the design documentation required for Project Development Approval (see 330.06).

- ***Design Decisions Summary*** An electronic document that records major design decisions regarding roadway geometrics, roadway and roadside features, and other issues that influence the project scope and budget.
- ***Environmental Review Summary*** An electronic document that records the environmental requirements and considerations for a specific project.
- ***Project Definition*** An electronic document that records the purpose and need of the project, along with program level and design constraints.

scoping phase The first phase of project development for a specific project. It follows identification of the need for a project and precedes detailed project design. It is the process of identifying the work to be done and developing a cost estimate for completing the design and construction. The Project Summary, engineering and construction estimates, and several technical reports (geotechnical, surfacing, bridge condition, etc.) are developed during this phase.

330.04 Design Documentation

(1) Purpose

Design documentation records the evaluations and decisions by the various disciplines that result in design recommendations. Design assumptions and decisions made prior to and during the scoping phase are included. Changes that occur throughout project development are documented. Required justifications and approvals are also included.

The DDP identifies the purpose of and need for the project and documents how the project addresses the purpose and need. The “Design Documentation Checklist” has been developed as a tool (optional) to assist in generating the contents of the DDP and the PF: www.wsdot.wa.gov/design/projectdev/

(2) Design Documents

The DDP portion of the PF preserves the decision documents generated during the design process. In each package, a summary (list) of the documents is recommended.

The design documents commonly included in the PF and DDP for all but the simplest projects are listed in Figure 330-5.

Documentation is not required for components not related to the project.

The DVI is <u>needed</u> for all projects having design variances. The DVI lists all EUs not upgraded to the applicable design level, DEs, and deviations as indicated by the design matrices. Record variances resulting from a project or corridor analysis in the DVI. Use the DVIS database to record and manage:

- Individual design variances identified during Project Development
- Variances resulting from a project or corridor analys

The Design Variance Inventory System database is found at the Project Development website: www.wsdot.wa.gov/design/projectdev

The ERS and the PD are required for most projects. Exceptions will be identified by the Project Control and Reporting Office.

The DDS is not required for the following project types unless they involve reconstructing the lanes, shoulders, or fill slopes. Since these and some other project types are not included in the design matrices, evaluate them with respect to modified design level (M) for non-NHS routes and full design level (F) for NHS routes. Include in the evaluation only those design elements specifically impacted by the project. Although the following list illustrates some of the project types that do not require a DDS, the list is not intended to be a complete accounting of all such projects. Consult with the HQ System Analysis and Program Development Office for projects not included in the list.

- Bridge painting
- Crushing and stockpiling
- Pit site reclamation
- Lane marker replacement
- Guidepost replacement
- Signal rephasing
- Signal upgrade
- Seismic retrofit
- Bridge joint repair
- Navigation light replacement
- Signing upgrade
- Illumination upgrade
- Rumble strips
- Electrical upgrades
- Major drainage
- Bridge scour
- Fish passage
- Other projects as approved by the HQ Design Office

(3) Certification of Documents by Licensed Professionals

All original technical documents must bear the certification of the responsible licensee (see Executive Order E 1010.00).

(4) Design Exception (DE), Evaluate Upgrade (EU), and Deviation Documentation

In special cases, projects may need to address design elements, which are shown as blank cells in a design matrix (see Figure 330-1). These special cases must be coordinated with the appropriate Assistant State Design Engineer (ASDE) and the HQ Project Control and Reporting Office. When this is necessary, document the reasons for inclusion of that work in your project.

When the design matrices specify a DE for a design element, the DE documentation specifies the matrix and row, the design element, and the limits of the exception. When a DVI is required for the project, the DE locations are recorded in the inventory.

The EU process determines if an item of work will or will not be done, through analysis of factors such as benefit/cost, route continuity, accident reduction potential, environmental impact, and economic development. Document all EU decisions to the DDP using the list in Figure 330-6 as a guide for the content. The cost of the improvement must always be considered when making EU decisions. EU examples on the Internet can serve as models for development of EU documentation. The appropriate approval authority for EUs is designated in Figures 330-2a and 2b.

Deviation requests are stand-alone documents requiring enough information and project description for an approving authority to make an informed decision of approval or denial. Documentation of a deviation contains justification and is approved at the appropriate administrative level, as shown in Figures 330-2a and 2b. Submit the request as early as possible because known deviations are to be approved prior to Design Approval.

When applying for deviation approval, it is necessary to provide two explanations. The first identifies the design element and explains why the design level specified in the design matrices was not or cannot be used. The second provides the justification for the design that is proposed. Justification for a deviation is to be supported by at least two of the following:

- Accident history and accident analysis
- Benefit/cost analysis
- Engineering judgment
- Environmental issues
- Route continuity

Engineering judgment includes a reference to another publication, with an explanation of why that reference is applicable to the situation encountered on the project.

If the element meets current AASHTO guidance adopted by FHWA, such as *A Policy on Geometric Design of Highways and Streets*, but not the *Design Manual* criteria, it is a deviation from the *Design Manual* that does not require approval by FHWA or the HQ Design Office. The following documentation is required:

- Identify the design element
- Explain why the design level specified in the design matrices was not used
- Explain which AASHTO guidance was used (including the title of the AASHTO guidance, the publication date, and the chapter and page number of the guidance)

Deviation approval is at the appropriate administrative level, as shown in Figures 330-2a and 2b.

Reference a corridor or project analysis as supporting justification for design deviations dealing with route continuity issues (see Chapter 325).

Once a deviation is approved, it applies to that project only. When a new project is programmed at the same location, the subject design element is to be reevaluated and either (1) the subject design element is rebuilt to conform to the applicable design level, or (2) a new deviation is developed, approved, and preserved in the DDP for the new project. Check the DVIS for help in identifying previously granted deviations.

A change in a design level resulting from an approved corridor planning study, or a corridor or project analysis, as specified in design matrix notes, is documented similar to a deviation. Use Figure 330-7 as a guide to the outline and contents of your project analysis. Design elements that do not comply with the design level specified in an approved corridor or project analysis are documented as deviations.

To prepare a deviation request, use the list in Figure 330-7 as a general guide for the sequence of the content. The list is not all-inclusive of potential content and it might include suggested topics that do not apply to a particular project.

For Design deviation examples, see: www.wsdot.wa.gov/design/projectdev

Matrix Cell Contents	Project Addresses Design Elements That Do Not Conform to Specified Design Level	Document to File[1]	Record in DVIS[2]
Blank cell in design matrix		No[3]	No
Cell Entry			
Full (F), Modified (M), or Basic (B) (with no DE or EU qualifiers)	Yes	No	No
	No[4]	Yes[5]	Yes
Design Exception (DE)	Yes[3]	DDP	No
	No	DDP	Yes
Evaluate Upgrade (EU)[5]	Yes	DDP	No
	No	DDP	Yes

DDP = Document to Design Documentation Package

Notes:

[1] See 330.04(3).

[2] See 330.04(2).

[3] Document to the DDP if the element is included in the project as identified in the Project Summary or Project Change Request Form.

[4] Nonconformance with specified design level (see Chapter 325) requires an approved deviation.

[5] Requires supporting justification (see 330.04(4)).

Design Matrix Documentation Requirements
Figure 330-1

330.05 Project Development

In general, the Region initiates the development of a specific project by preparing the Project Summary. Some project types may be initiated by other WSDOT groups such as the HQ Bridge and Structures Office or the HQ Traffic Office, rather than the Region. The project coordination with other disciplines (such as Real Estate Services, Roadside and Site Development, Utilities, and Environmental) is started in the project scoping phase and continues throughout the project's development. The Region coordinates with state and federal resource agencies and local governments to provide and obtain information to assist in developing the project.

The project is developed in accordance with all applicable Directives, Instructional Letters, Supplements, and manuals; the *Master Plan for Limited Access Highways*; the *Washington State Highway System Plan*; approved corridor planning studies; the Washington Federal-Aid Stewardship Agreement, as implemented in the design matrices (see Chapter 325); and the Project Summary.

The Region develops and maintains documentation for each project. The Project File includes documentation of project work including planning; scoping; public involvement; environmental action; design decisions; right of way acquisition; Plans, Specifications, and Estimates (PS&E) development; project advertisement; and construction. Refer to the *Plans Preparation Manual* for PS&E documentation.

All projects involving FHWA action require NEPA clearance. Environmental action is determined through the ECS form. The environmental approval levels are shown in Figure 330-3.

Upon receipt of the ECS approval for projects requiring an EA or EIS under NEPA, the Region proceeds with environmental documentation, including public involvement, appropriate for the magnitude and type of the project (see Chapter 210).

Design Approval and approval of Right of Way plans are required prior to acquiring property. If federal funds are used to purchase the property, then NEPA clearance is also required.

The ASDEs work with the Regions on project development and conduct process reviews on projects as described in 330.10.

330.06 Scoping Phase

Development of the project scope is the initial phase of project development. This effort is prompted by the *Washington State Highway System Plan*. The project scoping phase consists of determining a project description, schedule, and cost estimate. The intent is to make design decisions early in the project development process that focus the scope of the project. During the project scoping phase, the Project Summary documents are produced.

(1) Project Summary

The Project Summary provides information on the results of the scoping phase; links the project to the *Washington State Highway System Plan* and the *Capital Improvement and Preservation Program* (CIPP); and documents the design decisions, the environmental classification, and agency coordination. The Project Summary is developed and approved before the project is funded for design and construction, and consists of ERS, DDS, and PD documents, which are electronic forms. The Project Summary database contains specific online instructions for completing the documents.

(a) **Environmental Review Summary (ERS)**. Lists the environmental permits and approvals that will be required, environmental classifications, and environmental considerations. This form lists requirements by environmental and permitting agencies. If there is a change in the PD or DDS, the information in the ERS must be reviewed and revised to match the rest of the Project Summary. The ERS is prepared during the scoping phase and is approved by the Region. During final design and permitting, revisions may need to be made to the ERS and be reapproved by the Region.

(b) **Design Decisions Summary (DDS)**. Provides the design matrix used to develop the project, and the roadway geometrics, design deviations, EUs, other roadway features, roadside restoration, and any design decisions made during the scoping of a project. The information contained in this form is compiled from various databases of departmental information, field data collection, and evaluations made in development of the PD and the ERS. Design decisions may be revised throughout the project development process based on continuing evaluations.

The appropriate ASDE concurs with the Design Decisions Summary for all projects requiring one. The Region design authority approves the DDS when confident there will be no significant change in the PD or estimated cost. Schedule, scope, or cost changes require a Project Change Request Form to be submitted and approved by the appropriate designee, in accordance with the *Project Control and Reporting Manual*.

(c) **Project Definition (PD)**. Identifies the various disciplines and design elements that will be encountered in project development. The PD states the purpose and need for the project, the program categories, and the recommendations for project phasing. This information determines the level of documentation and evaluation that is needed for Project Development Approval. The PD is completed early in the scoping phase to provide a basis for full development of the ERS, DDS, schedule, and estimate. If circumstances necessitate a change to an approved PD, process a Project Change Request Form for approval by the appropriate designee.

330.07 FHWA Approval

For all NHS projects, the level of FHWA oversight varies according to the type of project, the agency doing the work, and the funding source as shown in Figures 330-2a and 2b. Oversight and funding do not affect the level of design documentation required for a project.

FHWA approval is required for any new or revised access point (including interchanges, temporary access breaks, and locked gate access points) on the Interstate System, regardless of funding (see Chapter 1425).

Documents for projects requiring FHWA review, Design Approval, and Project Development Approval are submitted through the HQ Design Office. Include applicable project documents as specified in Figure 330-5.

330.08 Design Approval

When the Project Summary documents are complete, and the Region is confident that the proposed design adequately addresses the purpose and need for the project, a Design Approval may be entered into the Design Documentation Package. Design Approval may occur prior to NEPA approval. Approval levels for design and PS&E documents are presented in Figures 330-2a through 330-4.

The following items are typically provided for Design Approval:

- Stamped cover sheet (project description)
- A one- or two-page reader-friendly memo that describes the project
- Project Summary documents
- Corridor or project analysis
- Design Criteria worksheets or equivalent: www.wsdot.wa.gov/design/projectdev
- Design Variances Inventory (for known variances at this stage)
- Channelization plans, Intersection plans, or Interchange plans (if applicable)
- Alignment plans and profiles (if project significantly modifies either the existing vertical or horizontal alignment)
- Current cost estimate with a confidence level

Design Approval remains valid for three years or as approved by HQ Design. Evaluate policy changes or revised design criteria that are adopted by the department during this time to determine if these changes would have a significant impact on the scope or schedule of the project. If it is determined that these changes will not be incorporated into the project, document this decision with a memo from the Region Project Development Engineer that is included in the DDP. For an overview of design policy changes, consult the Detailed Chronology of Design Policy Changes Affecting Shelved Projects: www.wsdot.wa.gov/design/policy/designpolicy

(1) Alternative Project Delivery Methods

Design Approval applies to projects delivered using alternative means, including design-build projects. Design documentation begins in the project scoping phase and continues through the life of the design-build project. This documentation is thus started by WSDOT and is completed by the design-builder. Since Design Approval is related to project scoping, this milestone may very well be accomplished prior to issuing a Design-Build Request for Proposal (see Figure 110-1). However, the design-builder shall refer to the RFP for direction on approval milestones.

330.09 Project Development Approval

When all project development documents are complete and approved, Project Development Approval is granted by the approval authority designated in Figures 330-2a and 2b. The Project Development Approval becomes part of the DDP. (See 330.04 and Figure 330-5 for design documents that may lead to Project Development Approval.) Figures 330-2a through 330-4 provide approval levels for project design and PS&E documents.

The following items must be approved prior to Project Development Approval:

- Required environmental documents
- Design Approval documents (and any supplements)
- Design Variance Inventory
- Cost estimate
- Stamped cover sheet (project description)

Project Development Approval remains valid for three years. Evaluate policy changes or revised design criteria that are adopted by the department during this time to determine if these changes would have a significant impact on the scope or schedule of the project. If it is determined that these changes will not be incorporated into the project, document this decision with a memo from the Region Project Development Engineer that is included in the DDP. For an overview of design policy changes, consult the Detailed Chronology of Design Policy Changes Affecting Shelved Projects at: www.wsdot.wa.gov/design/policy/designpolicy

(1) Alternative Project Delivery Methods

For projects delivered using alternative methods, such as design-build, the design-builder shall refer to the project RFP for specification on final and intermediate deliverables and final records for the project. Project Development Approval is *required* prior to project completion.

It is a prudent practice to start the compilation of design documentation early in a project and to acquire Project Development Approval before the completion of the project. At the start of a project, it is critical WSDOT project administration staff recognize the importance of all required documentation and how it will be used in the design-build project delivery process.

330.10 Process Review

The process review is done to provide reasonable assurance that projects are prepared in compliance with established policies and procedures and that adequate records exist to show compliance with state and federal requirements. Process reviews are conducted by WSDOT, FHWA, or a combination of both.

The design and PS&E process review is performed in each Region at least once each year by the HQ Project Development Branch. The documents used in the review process are (1) the Design Documentation Checklist, (2) the PS&E Review Checklist, and (3) the PS&E Review Summary. These are generic forms used for all project reviews. Copies of these working documents are available for reference when assembling project documentation. The HQ Design Office, Project Development Branch, maintains current copies at: www.wsdot.wa.gov/design/projectdev

Each project selected for review is examined completely and systematically beginning with the scoping phase (including planning documents) and continuing through contract plans and, when available, construction records and change orders. Projects are normally selected after contract award. For projects having major traffic design elements, the HQ Maintenance and Operations Programs' Traffic Operations personnel are involved in the review. The WSDOT process reviews may be held in conjunction with FHWA process reviews.

The HQ Project Development Branch schedules the process review and coordinates it with the Region and FHWA.

A process review follows this general agenda:

1. Review team meets with Region personnel to discuss the object of the review.
2. Review team reviews the design and PS&E documents, and the construction documents and change orders (if available) using the checklists.
3. Review team meets with Region personnel to ask questions and clarify issues of concern.
4. Review team meets with Region personnel to discuss findings.
5. Review team submits a draft report to the Region for comments and input.
6. If the review of a project shows a serious discrepancy, the Region design authority is asked to report the steps that will be taken to correct the deficiency.
7. The process review summary forms are completed.
8. The summary forms and checklists are evaluated by the State Design Engineer.
9. The findings and recommendations of the State Design Engineer are forwarded to the Region design authority for action and/or information within 30 days of the review.

Project Design	FHWA Oversight Level	Deviation and Corridor/Project Approval[a][b]	EU Approval[b]	Design Approval and Project Development Approval
Interstate				
New/Reconstruction[c] • Federal funds • No federal funds	 (d) (e)	FHWA	Region	FHWA*
Intelligent Transportation Systems (ITS) over $1 million	(f)	HQ Design	Region	HQ Design
All Other[g] • Federal funds • State funds • Local agency funds	 (f) (f) (e)	HQ Design	Region	Region
National Highway System (NHS)				
Managed access highway outside incorporated cities and towns or inside unincorporated cities and towns, or limited access highway	(f)	HQ Design	Region	Region
Managed access highway within incorporated cities and towns[h] • Inside curb or EPS[i] • Outside curb or EPS	 (f) (f)	 HQ Design HQ H&LP	 Region N/A	 Region City/Town

FHWA = Federal Highway Administration

HQ = WSDOT Headquarters

H&LP = WSDOT Highways & Local Programs Office

EPS = Edge of paved shoulder where curbs do not exist

Notes:

(a) These approval levels also apply to deviation processing for local agency work on a state highway.

(b) See 330.04(4).

(c) For definition, see Chapter 325.

(d) Requires FHWA review and approval (full oversight) of design and PS&E submitted by HQ Design Office.

(e) To determine the appropriate oversight level, FHWA reviews the Project Summary (or other programming document) submitted by HQ Design Office, or by WSDOT Highways & Local Programs through the HQ Design Office.

(f) FHWA oversight is accomplished by process review (see 330.10).

(g) Reduction of through lane or shoulder widths (regardless of funding) requires FHWA review and approval of the proposal (except shoulder reductions as allowed by 440.09 for seismic retrofit projects).

(h) Applies to the area within the incorporated limits of cities and towns.

(i) Includes raised medians.

* FHWA will provide Design Approval prior to NEPA approval, but will not provide Project Development Approval until NEPA is complete.

Design Approval Level

Figure 330-2a

Project Design	FHWA Oversight Level	Deviation and Corridor/ Project Approval(a)(b)	EU Approval(b)	Design Approval and Project Development Approval
Non-National Highway System (Non-NHS)				
Improvement project on managed access highway outside incorporated cities and towns or within unincorporated cities and towns, or on limited access highway (Matrix lines 5-8 through 5-26)	N/A	HQ Design	Region	Region
Improvement project on managed access highway within incorporated cities and towns(h) • Inside curb or EPS(i) • Outside curb or EPS (Matrix lines 5-8 through 5-26)	 N/A N/A	 HQ Design HQ H&LP	 Region N/A	 Region City/Town
Preservation project on managed access highway outside incorporated cities and towns or within unincorporated cities and towns, or on limited access highway(j) (Matrix lines 5-1 through 5-7)	N/A	Region(k)	Region	Region
Preservation project on managed access highway within incorporated cities and towns(h)(j) • Inside curb or EPS(i) • Outside curb or EPS (Matrix lines 5-1 through 5-7)	 N/A N/A	 Region HQ H&LP	 Region N/A	 Region City/Town

FHWA = Federal Highway Administration

HQ = WSDOT Headquarters

H&LP = WSDOT Highways & Local Programs Office

EPS = Edge of paved shoulder where curbs do not exist

Notes:

(a) These approval levels also apply to deviation processing for local agency work on a state highway.

(b) See 330.04(4).

(h) Applies to the area within the incorporated limits of cities and towns.

(i) Includes raised medians.

(j) For Bridge Replacement projects in the preservation program, follow the approval level specified for improvement projects.

(k) For guidance on access deviations, see Chapters 1430 and 1435.

Design Approval Level

Figure 330-2b

Item	Approval Authority		
	Region	HQ	FHWA
Program Development			
Work Order Authorization		X	X[1]
Public Hearings			
Corridor Hearing Summary		X[2]	
Design Summary		X[3]	
Access Hearing Plan		X[4]	
Access Findings and Order		X[5]	
Environmental by Classification			
Environmental Classification Summary (ECS) NEPA			X
Class I NEPA (EIS)		[7]	X
Class I SEPA (EIS)		X	
Class II NEPA – Categorical Exclusion (CE)* (Per MOU)	X		
Class II NEPA – Documented Categorical Exclusion (DCE)	[6]		X
Class II SEPA – Categorical Exemption (CE)	X		
Class III NEPA – Environmental Assessment (EA)		[7]	X
SEPA Checklist	X		
Design			
Design Deviations	[8]	[8]	[8]
Experimental Features		X	X[9]
Environmental Review Summary	X		
Final Design Decisions Summary	X	X[3]	
Final Project Definition		X[10]	
Interchange Justification Report		[7]	X
Non-Interstate Interchange Justification Report		X	
Intersection Plans	X[11]		
Right of Way Plans	[12]	X	
Monumentation Map	X		
Materials Source Report		X[13]	
Pavement Determination Report		X[13]	
Roundabout Geometric Design	X[11]	X[11]	
Design Approval	[8]	[8]	[8]
Project Development Approval	[8]	[8]	[8]

Approvals
Figure 330-3

Item	Approval Authority		
	Region	HQ	FHWA
Design (continued)			
Resurfacing Report		X[13]	
Signal Permits	X[14]		
Geotechnical Report		X[13]	
Tied Bids	X[15]		X[9][15]
Bridge Design Plans (Bridge Layout)	X	X	
Hydraulic Report	X[16][17]	X[16][17]	
Preliminary Signalization Plans		X[6]	
Rest Area Plans		X	
Roadside Restoration Plans	X[18]	X[19]	
Structures Requiring TS&L's		X	X
Planting Plans	X[18]	X[19]	
Grading Plans	X[18]	X[19]	
Continuous Illumination – Main Line		X[20]	
Project Change Request Form	X[21]	X[21]	
Work Zone Transportation Management Plan/Traffic Control Plan	X[22]		
Public Art Plan – Interstate (see Chapter 1360)	X[18][23]	X[19][23]	X[9][19][23]
Public Art Plan – Non-Interstate (see Chapter 1360)	X[18][23]	X[19][23]	
ADA Maximum Extent Feasible Document (see Chapter 1025)	X	X	

X Normal procedure * If on the preapproved list

Notes:

[1] Federal-aid projects only.

[2] Approved by Environmental and Engineering Programs Director.

[3] Approved by State Design Engineer.

[4] Approved by Right of Way Plans Manager.

[5] Refer to Chapter 210 for approval requirements.

[6] Final review & concurrence required at the Region prior to submittal to approving authority.

[7] Final review & concurrence required at HQ prior to submittal to approving authority.

[8] Refer to Figures 330-2a & 2b for Design Approval and Project Development Approval levels.

[9] Applies to new/reconstruction projects on Interstate routes.

[10] Approved by HQ Project Control & Reporting.

[11] Include channelization details.

[12] Certified by the responsible professional licensee.

[13] Submit to HQ Materials Laboratory for review and approval.

[14] Approved by Region Administrator or designee.

[15] See 23 CFR 635.111.

[16] For additional guidance, see the *Hydraulics Manual*, M 23-03.

[17] Region to submit Hydraulic Report. Refer to *Hydraulics Manual*.

[18] Applies only to Regions with a Landscape Architect.

[19] Applies only to Regions without a Landscape Architect.

[20] Approved by State Traffic Engineer.

[21] Consult HQ Project Control & Reporting for clarification on approval authority.

[22] Region Traffic Engineer.

[23] The State Bridge and Structures Architect reviews and approves the Public Art Plan (see Chapter 1360 for further details on approvals).

Approvals
Figure 330-3 (continued)

Item	New/Reconstruction (Interstate only)	NHS and Non-NHS
DBE/training goals* **	(a)	(a)
Right of way certification for federal-aid projects	FHWA(b)	FHWA(b)
Right of way certification for state-funded projects	Region(b)	Region(b)
Railroad agreements	(c)	(c)
Work performed for public or private entities*	[1][2]	Region[1][2]
State force work*	FHWA[3](d)	Region[3](d)
Use of state-furnished stockpiled materials*	FHWA[4]	FHWA[4]
Stockpiling materials for future projects*	FHWA[4]	FHWA[4]
Work order authorization	[5](d)	[5](d)
Ultimate reclamation plan approval through DNR	Region	Region
Proprietary item use*	FHWA[4]	[4](c)
Mandatory material sources and/or waste sites*	FHWA[4]	Region[4]
Nonstandard bid item use*	Region	Region
Incentive provisions	FHWA	(e)
Nonstandard time for completion liquidated damages*	FHWA(e)	(e)
Interim liquidated damages*	(f)	(f)

Notes:

[1] This work requires a written agreement.

[2] Region approval subject to $250,000 limitation.

[3] Use of state forces is subject to $60,000 limitation and $100,000 in an emergency situation, as stipulated in RCWs 47.28.030 and 47.28.035.

[4] Applies only to federal-aid projects; however, document for all projects.

[5] Prior FHWA funding approval required for federal-aid projects.

Region or Headquarters approval authority:

(a) Office of Equal Opportunity

(b) HQ Real Estate Services Office

(c) HQ Design Office

(d) Project Control & Reporting Office

(e) HQ Construction Office

(f) Transportation Data Office

References:

**Plans Preparation Manual*

***Advertisement and Award Manual*

PS&E Process Approvals

Figure 330-4

Document[1]	**Required for FHWA Oversight**
Project Definition	**X**
Design Decisions Summary	**X**
Environmental Review Summary	**X**
Design Variance Inventory (and supporting information for DEs, EUs not upgraded, and deviations)[2]	**X**
Cost Estimate	**X**
SEPA & NEPA documentation	**X**
Design Clear Zone Inventory (see Chapter 700)	**X**
Interchange plans, profiles, roadway sections	**X**
Interchange Justification Report (if requesting new or revised access points)	**X**
Corridor or project analysis (see Chapter 325)	**X**
Traffic projections and analysis	
Collision analysis	
Right of way plans	
Work zone traffic control strategy	
Record of Survey or Monumentation Map	
Documentation of decisions to differ from WSDOT design guidance	
Documentation of decisions for project components for which there is no WSDOT design guidance	
Paths and Trails Calculations[3]	

Notes:

[1] For a complete list, see the Design Documentation Checklist.

[2] Required for NHS highways; recommended for all highways.

[3] See the *Plans Preparation Manual*.

Common Components of Design Documentation Package
Figure 330-5

1. **Design Element Upgraded to the Level Indicated in the Matrix**
   (a) Design element information
   - Design element
   - Location
   - Matrix number and row

   (b) Cost estimate[1]
   (c) B/C ratio[2]
   (d) Summary of the justification for the upgrade[3]

2. **Design Element Not Upgraded to the Level Indicated in the Matrix**
   (a) Design element information
   - Design element
   - Location
   - Matrix number and row

   (b) Existing conditions
   - Description
   - Accident Summary
   - Advantages and disadvantages of leaving the existing condition unchanged

   (c) Design using the *Design Manual* criteria
   - Description
   - Cost estimate[1]
   - B/C ratio[2]
   - Advantages and disadvantages of upgrading to the level indicated in the matrix

   (d) Selected design, if different from existing but less than the level indicated in the matrix
   - Description
   - Cost estimate[1]
   - B/C ratio[2]
   - Advantages and disadvantages of the selected design

   (e) Summary of the justification for the selected design[3]

Notes:

[1] An estimate of the approximate total additional cost for the proposed design. Estimate may be based on experience and engineering judgment.

[2] Include only when B/C is part of the justification. An approximate value based on engineering judgment may be used.

[3] A brief (one or two sentence) explanation of why the proposed design was selected.

Evaluate Upgrade (EU) Documentation Contents List
Figure 330-6

1. **Overview**
   (a) The safety or improvement need that the project is to meet
   (b) Description of the project as a whole
   (c) Highway classification and applicable design matrix number and row
   (d) Funding sources
   (e) Evidence of deviations approved for previous projects (same location)

2. **Design Alternatives in Question**
   (a) Existing conditions and design data
   - Location in question
   - Rural, urban, or developing
   - *Route development plan*
   - Environmental issues
   - Right of way issues
   - Number of lanes and existing geometrics
   - Present and 20-year projected ADT
   - Design speed, posted speed, and operating speed
   - Percentage of trucks
   - Terrain Designation
   - Managed access or limited access

   (b) Collision Summary and Analysis
   (c) Design using the *Design Manual* criteria
   - Description
   - Cost estimate
   - B/C ratio
   - Advantages and disadvantages
   - Reasons for considering other designs

   (d) Other alternatives (may include “No-build” alternative)
   - Description
   - Cost estimate
   - B/C ratio
   - Advantages and disadvantages
   - Reasons for rejection

   (e) Selected design requiring justification or documentation to file
   - Description
   - Cost estimate
   - B/C ratio
   - Advantages and disadvantages

3. **Concurrences, Approvals, and Professional Seals**

Deviation Request and Project Analysis Contents List
Figure 330-7

Design Speed (mph)	Side Friction Factor (*f*)	Minimum Radius for Normal 2% Crown (ft)
15	32	51
20	27	107
25	23	199
30	20	335
35	18	512
40	16	764
45	15	1041
50	14	1392
55	13	1838
60	12	2405
65	11	3137
70	10	4092
75	9	5369
80	8	7126

Side Friction Factor
Figure 430-5

430.04 Roadway Widths

Review route continuity and roadway widths. Select widths on the tangents to be consistent throughout a given section of the route. Make any changes where the route characteristics change. The design of a project must not decrease the existing roadway width.

(1) Lane and Shoulder Width

Lane and shoulder widths are shown in Figures 430-10 and 11. Consider joint use with other modes of transportation in shoulder design.

Minimum ramp lane and shoulder widths are shown in Figure 430-14. Use full design level lane and shoulder widths (see Chapter 940) for new and rebuilt ramps.

(2) Turning Roadway Widths

It might be necessary to widen the roadway on curves to accommodate large vehicles. The proposed roadway width for a curve shall not be less than that of the adjacent tangent sections.

Widening of the total roadway width of a curve by less than 2 feet is not required for existing two-lane roadways that are to remain in place.

(a) **The two-lane two-way roadway** width of a curve may not be less than that shown in Figure 430-12a or, if the internal angle (delta) is less than 90°, Figure 430-12b. The minimum total roadway width from Figure 430-12a or 12b may include the shoulder. When the shoulder is included, full-depth pavement is required.

(b) **One-way roadway and ramp** widths on a curve are shown in Figure 430-6 for existing roadways that are to remain in place. Use full design level width (see Chapters 641 and 940) for new and rebuilt ramps.

(3) Median Width

Minimum median widths are given in Figure 430-10.

Curve Radius (ft)	One-Lane[1]	Two-Lane[2]
Tangent to 1001	20	24
500	21	25
400	21	25
300	22	25
200	22	26
150	23	26
100	25	28
75	27	29
50	30	31

Notes:

[1] Includes the shoulder width.

[2] Add shoulder widths from Figure 430-10 for highways and 10 ft for ramps.

One-Way Roadway and Ramp Turning Roadway Widths: Modified Design Level

Figure 430-6

430.05 Cross Slopes

On all tangent sections, the normal cross slopes of the traveled way are 2%.

If a longitudinal contiguous section of pavement is to be removed or is on a reconstructed alignment, or if a top course is to be placed over existing pavement, design the restored pavement cross slope to full design level criteria (see Chapter 640).

The algebraic difference in cross slopes is an operational factor during a passing maneuver on a two-lane two-way roadway. Its influence increases when increased traffic volumes decrease the number and size of available passing opportunities.

A somewhat steeper cross slope may be necessary to facilitate pavement drainage in areas of intense rainfall, even though this might be less desirable from the operational point of view. In such areas, the design cross slopes may be increased to 2.5% with an algebraic difference of 5%.

For existing pavements, cross slopes within a range of 1% to 3% may remain if there are no operational or drainage problems and, on a two-lane two-way roadway, the following conditions are met:

- The algebraic difference is not greater than 4% where the ADT is greater than 2000.
- The algebraic difference is not greater than 5% where the ADT is 2000 or less.
- The algebraic difference is not greater than 6% and the road is striped or signed for no passing.

For a two-lane two-way roadway, provide an algebraic difference to meet the appropriate conditions stated above, except when facilitating drainage in areas of intense rainfall. When applying modified design level to a road with bituminous surface treatment (BST), cross slope correction is not required on the basis of algebraic differences alone.

To maintain or restore curb height, consider lowering the existing pavement level and correcting cross slope by grinding before an asphalt overlay. The cross slope of the shoulder may be steepened to maximize curb height and minimize other related impacts. The shoulder may be up to 6% with a rollover between the traveled way and the shoulder of no more than 8% (see Chapter 640).

430.06 Side Slopes

(1) Fill/Ditch Slopes

Foreslopes (fill slopes and ditch inslopes) and cut slopes are designed as shown in the Fill and Ditch Slope Selection Table in Figure 430-13 for modified design level main line roadway sections. After the foreslope has been determined, use the guidance in Chapter 700 to determine the need for a traffic barrier.

When a crossroad or road approach has steep foreslopes, there is the possibility that an errant vehicle could become airborne. Therefore, flatten crossroad and road approach foreslopes to 6H:1V where feasible and at least to 4H:1V. Provide smooth transitions between the main line foreslopes and the crossroad or road approach foreslopes. Where possible, move the crossroad or road approach drainage away from the main line. This can locate the pipe outside the Design Clear Zone and reduce the length of pipe required.

(2) Cut Slopes

Existing stable backslopes (cut slopes) are to remain undisturbed unless disturbed by other work. When changes are required to a cut slope, design them as shown in the Cut Slope Selection Table in Figure 430-13.

430.07 Bike and Pedestrian

The Americans with Disabilities Act of 1990 (ADA) requires all pedestrian facilities located within public rights of way to be ADA compliant. The Design Matrices in Chapter 325 identify that modified design level applies to bike and pedestrian design elements on specific project types. For those projects, the following guidance applies to pedestrian facilities:

- Evaluate pedestrian facilities within the project limits for compliance with ADA.
- All pedestrian facilities that are altered in any way by the project must be addressed.
- All curb ramps and crosswalks are evaluated and made ADA compliant on projects that use hot mix asphalt or Portland cement concrete pavement overlays or inlays.
- All curb ramps and crosswalks are evaluated and made ADA compliant on projects that alter pavement markings. Note: lane restriping that does not involve modal changes (such as changing a shoulder to bikeway) or lane configuration changes are not considered alterations.
- See Chapter 1025 for pedestrian facility design guidance, including jurisdictional responsibilities when city streets form part of the state highway system, and for the definition of alterations.

Bicycle elements are design exceptions on HMA or PCCP overlays or inlays on Interstate ramps or crossroads.

430.08 Bridges

Design all new and replacement bridges to full design level (see Chapter 440) unless a corridor or project analysis justifies the use of modified design level lane and shoulder widths. Evaluate bridges to remain in place using Figures 430-10 and 11. Whenever possible, continue the roadway lane widths across the bridge and adjust the shoulder widths.

Consider joint use with other modes of transportation in lane and shoulder design (see Chapters 1020, 1025, 1050, and 1060).

430.09 Intersections

Except as given below, design intersections to meet the requirements in Chapter 910.

(1) Turn Radii

The intersection turn radii (or right-turn corners) are controlled by the design vehicle. Figure 430-7 is a guide for determining the design vehicle for modified design level. Perform a field review to determine intersection type, types of vehicles that use the intersection, and adequacy of the existing geometrics. When the crossroad is a city street or county road, consider the requirements of the city or county when selecting a design vehicle.

Design right-turn corners to meet the requirements of Chapter 910 using the design vehicle selected from Figure 430-7 or from the field review.

(2) Angle

The allowable angle between any two respective legs is between 60° and 120°. When realignment is required to meet this angle requirement, consider realigning to an angle between 75° and 105°.

Intersection Type	Design Vehicle
Junction of Major Truck Routes	WB-67
Junction of State Routes	WB-40
Ramp Terminals	WB-40
Other Rural	SU[1]
Urban Industrial	SU[1]
Urban Commercial	P[1]
Residential	P[1]

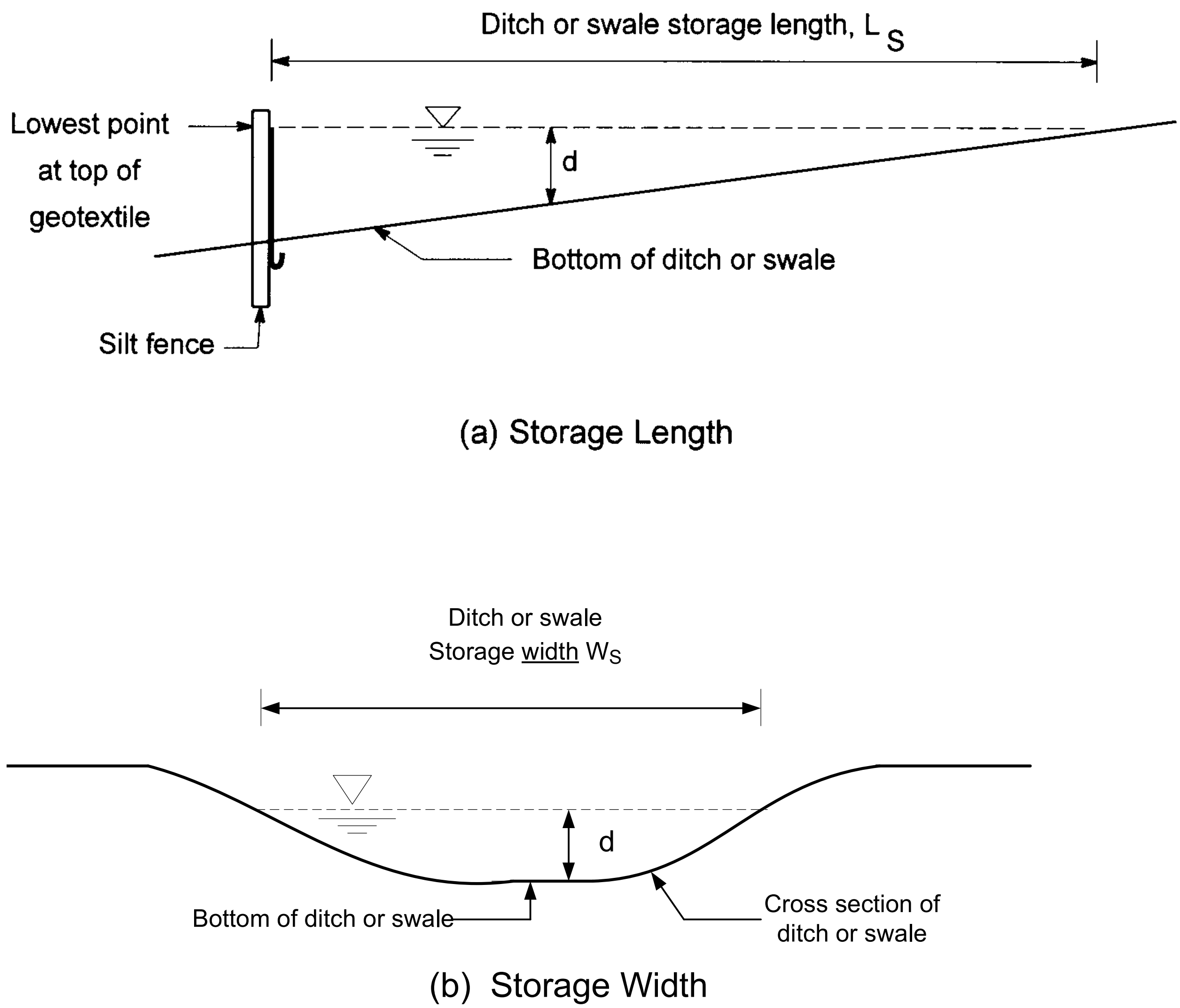
Note:

[1] When the intersection is on a transit or school bus route, use the BUS design vehicle. (See Chapter 1060 for additional guidance on transit facilities and for the BUS turning path templates.)

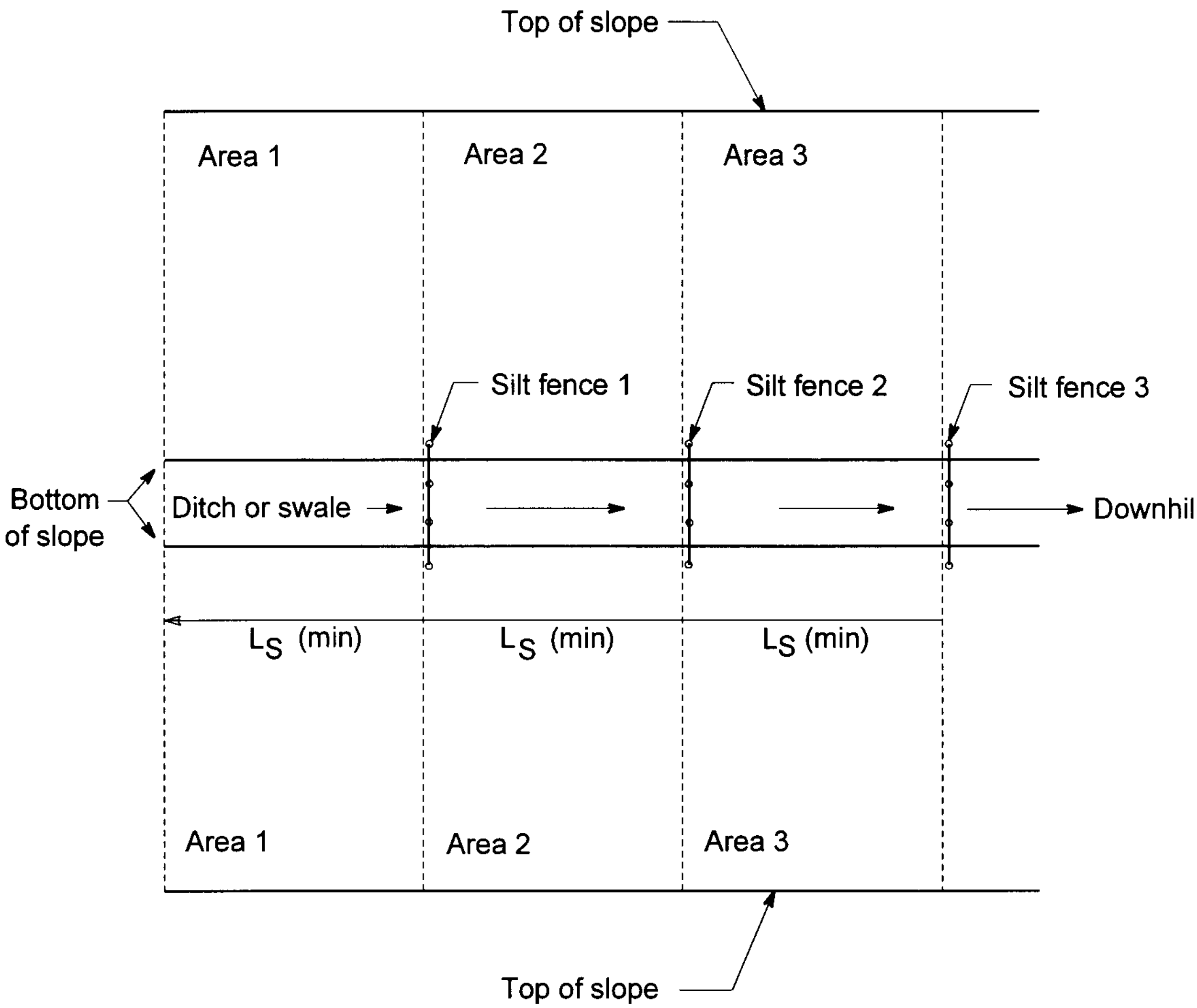
Design Vehicles: Modified Design Level
Figure 430-7

430.10 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/



Definition of Ditch or Swale Storage Length and Width
Figure 530-9



Method to keep contributing area to ditch or swale within allowable limits if contributing area too large based on Figure 530-3.

Silt Fences for Large Contributing Area
Figure 530-10

(2) Turning Roadways

The roadway on a curve may need to be widened to make the operating conditions comparable to those on tangents. There are two main reasons to do this. One is the offtracking of vehicles, such as trucks and buses. The other is the increased difficulty drivers have in keeping their vehicles in the center of the lane. (See Chapter 641 for width requirements on turning roadways.)

To maintain the desired design speed, highway and ramp curves are usually superelevated to overcome part of the centrifugal force that acts on a vehicle. (See Chapter 642 for superelevation requirements.)

(3) Shoulders

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

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

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

When extruded curb is used, see the Standard Plans for required widening. Widening is normally required when traffic barrier is installed. (See Chapter 710.)

It is preferred that curb not be used on high-speed facilities (design speed above 45 miles per hour). In some areas, curb may be needed to control runoff water until ground cover is attained to prevent erosion. Plan for the removal of the curb when the ground cover becomes adequate. Arrange for curb removal with regional maintenance as part of the future maintenance plans. When curb is used in conjunction with guardrail, see Chapter 710 for guidance.

Figures 640-5a and 5b represent shoulder details and requirements.

640.05 Medians and Outer Separations

(1) Purpose

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

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

(2) Design

Figures 640-6a through 6c give minimum design requirements for medians. (See Chapters 430 and 440 for minimum median widths.) Median widths in excess of the minimums are highly desirable. When the horizontal and vertical alignments of the two roadways of a divided highway are independent of one another, determine median side slopes in conformance with Figure 640-1. Independent horizontal and vertical alignment, rather than parallel alignment, is desirable.

No attempt has been made to cover all the various grading techniques that are possible on wide, variable-width medians. Considerable latitude in treatment is intended, provided the requirements of minimum geometrics, safety, and aesthetics are met or exceeded. Unnecessary clearing, grubbing, and grading are undesirable within wide medians. Give preference to selective thinning and limited reshaping of the natural ground. For median clear zone requirements, see Chapter 700, and for slopes into the face of traffic barriers, see Chapter 710.

In areas where land is expensive, make an economic comparison of wide medians to narrow medians with their barrier requirements. Consider right of way, construction, maintenance, and accident costs. The widths of medians need not be uniform. Make the transition between median widths as long as feasible. (See Chapter 620 for minimum taper lengths.)

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

640.06 Roadsides

(1) Side Slopes

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

Where unusual geological features or soil conditions exist, treatment of the slopes will depend upon results of a review of the location by the region’s Materials Engineer.

With justification, fill slopes steeper than shown in the Fill and Ditch Slope Selection tables in Figures 640-1, 2, 3, and 4b may be used when traffic barrier is installed. Do not install traffic barrier unless an object or condition is present that calls for mitigation in accordance with Chapter 700 criteria. The steepest slope is determined by the soil conditions. Where favorable soil conditions exist, higher fill slopes may be as steep as 1½H:1V. (See Chapter 700 for clear zone and barrier criteria.)

The values in the Cut Slope Selection tables in Figures 640-1, 2, 3, and 4b are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable cut slopes just to meet the slopes given in the Cut Slope Selection tables. When an existing slope is to be revised, document the reason for the change.

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

Provide for drainage from the roadway surface and drainage in ditches (see Chapter 1210). For drainage ditches in embankment areas, see 640.06(4).

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

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

Slope treatment, as shown in the Standard Plans, is required at the top of all roadway cut slopes, except for cuts in solid rock. Unless Class B slope treatment is called for, Class A slope treatment is used. Call for Class B slope treatment where space is limited, such as where right of way is restricted.

(2) Roadway Sections in Rock Cuts

Typical sections for rock cuts, illustrated in Figures 640-7a and 7b, are guides for the design and construction of roadways through rock cuts. Changes in slope or fallout area are recommended when justified. Base the selection of the appropriate sections on an engineering study and the recommendations of the region's Materials Engineer and Landscape Architect. Headquarters (HQ) Materials Lab concurrence is required.

There are two basic design treatments applicable to rock excavation (see Figures 640-7a and 7b). Design A applies to most rock cuts. Design B is a talus slope treatment.

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

The following guidelines apply to the various stages shown in Figure 640-7a:

- Stage 1 is used where the anticipated quantity of rockfall is small, adequate fallout width can be provided, and the rock slope is ½H:1V or steeper. Controlled blasting is recommended in conjunction with Stage 1 construction.
- Stage 2 is used when a "rocks in the road" problem exists or is anticipated. Consider it on flat slopes where rocks are apt to roll rather than fall.
- Stage 3 represents the full implementation of all protection and safety measures applicable to rock control. Use it only when extreme rockfall conditions exist.

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

The use of Stage 2 or 3 alternatives (concrete barrier) is based on the designer's analysis of the particular site. Considerations include maintenance, size and amount of rockfall, probable velocities, availability of materials, ditch capacity, adjacent traffic volumes, distance from traveled lane, and impact severity. Incorporate removable sections in the barrier at approximately 200-foot intervals. Appropriate terminal treatment is required. (See Chapter 710.)

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

Benches may be used to increase slope stability; however, the use of benches may alter the design requirements for the sections given in Figure 640-7a.

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

(b) **Design B**. A talus slope treatment is shown in Figure 640-7b. The rock protection fence is placed at any one of the three positions shown, but not in more than one position at a particular location. The exact placement of the rock protection fence in talus slope areas requires considerable judgment and should be determined only after consultation with the region's Materials Engineer.

- **Fence position a** is used when the cliff generates boulders less than 0.25 yd^3 in size, and the length of the slope is greater than 350 feet.
- **Fence position b** is the preferred location for most applications.

- **Fence position c** is used when the cliff generates boulders greater than 0.25 yd^3 in size, regardless of the length of the slope. On short slopes, this may require placing the fence less than 100 feet from the base of the cliff.
- Use of gabions may be considered instead of the rock protection shown in fence position a. However, gabion treatment is considered similar to a wall and therefore requires appropriate face and end protection for safety. (See Chapters 710 and 1130.)

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

Rock protection treatments other than those described above may be required for cut slopes that have relatively uniform spalling surfaces (consult with the region's Materials Engineer).

(3) Stepped Slopes

Stepped slopes are a construction method intended to promote early establishment of vegetative cover on the slopes. They consist of a series of small horizontal steps or terraces on the face of the cut slope. Soil conditions dictate the feasibility and necessity of stepped slopes. They are to be considered only on the recommendation of the region's Materials Engineer. (See Chapter 510.) Consult the region's landscape personnel for appropriate design and vegetative materials to be used. (See Figure 640-8 for stepped slope design details.)

(4) Drainage Ditches in Embankment Areas

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

When topographic restrictions exist, consider an enclosed drainage system with appropriate inlets and outlets. Do not steepen slopes to provide lateral clearance from toe of slope to ditch location, thereby necessitating traffic barriers or other protective devices.

Maintenance operations are also facilitated by adequate width between the toe of the slope and an adjacent drainage ditch. Where this type of facility is anticipated, provide sufficient right of way for access to the facility and place the drainage ditch near the right of way line.

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

(5) Bridge End Slopes

Bridge end slopes are determined by several factors, including location, fill height, depth of cut, soil stability, and horizontal and vertical alignment. Close coordination between the HQ Bridge and Structures Office and the region is necessary to ensure proper slope treatment. (See Chapter 1120.)

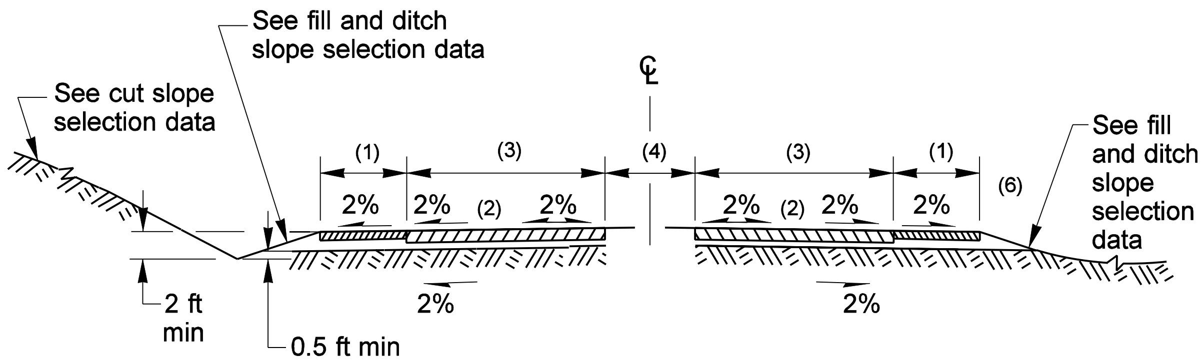
Early in the bridge plan development, determine preliminary bridge geometrics, end slope rates, and toe of slope treatments. Figure 640-9a provides guidelines for use of slope rates and toe of slope treatments for overcrossings. Figure 640-9b shows toe of slope treatments to be used on the various toe conditions.

640.07 Roadway Sections

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

640.08 Documentation

A list of the documents that are to be preserved in the Design Documentation Package (DDP) or the Project File (PF) can be found on the following web site:
http://www.wsdot.wa.gov/eesc/design/projectdev/



Design Class I-1, P-1, P-2, M-1, $U_{M/A}$-1, $U_{M/A}$-2

Height of fill/depth of ditch (ft)	Slope not steeper than (5)
10	6H:1V
10 – 20	4H:1V
20 – 30	3H:1V (6)
over 30	2H:1V (6)(8)

Fill and Ditch Slope Selection

Height of cut (ft)*	Slope not steeper than
0 – 5	6H:1V
5 – 20	3H:1V
over 20	2H:1V (7)
* From bottom of ditch	

Cut Slope Selection (9)

Notes:

(1) For shoulder details, see Figures 640-5a and 5b. For minimum shoulder width, see Chapters 430 and 440.

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

(3) For minimum number and width of lanes, see Chapters 430 and 440. For turning roadway width, see Chapter 641.

(4) For median details, see Figures 640-6a through 6c. For minimum median width, see Chapters 430 and 440.

(5) Where practicable, consider flatter slopes for the greater fill heights and ditch depths.

(6) Widen and round foreslopes steeper than 4H:1V, as shown in Figure 640-5b.

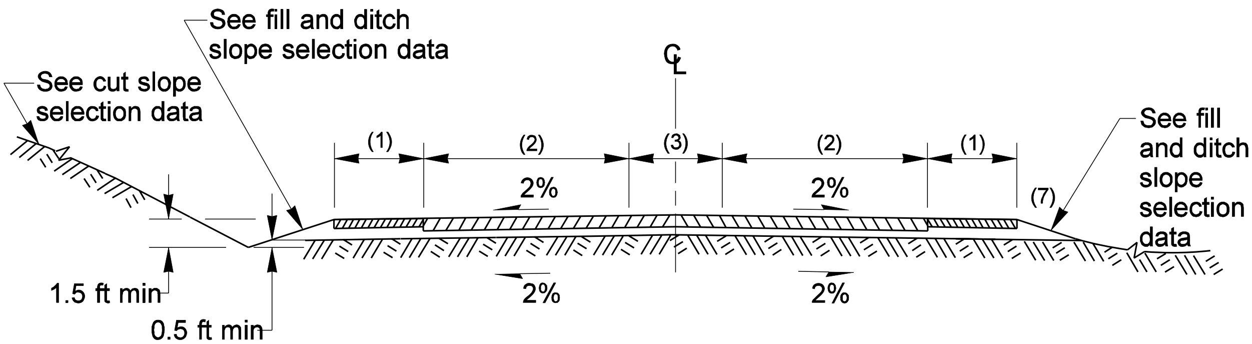
(7) Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 700 for clear zone and barrier requirements.)

(8) Fill slopes as steep as 1½H:1V may be used where favorable soil conditions exist. (See Chapter 700 for clear zone and barrier requirements.)

(9) The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slopes given in this table.

Divided Highway Roadway Sections

Figure 640-1



Design Class P-6, M-5, C-1, $U_{M/A}$-3, $U_{M/A}$-4

Height of fill/depth of ditch (ft)	Slope not steeper than (4)
0 – 5	6H:1V
5 – 20	4H:1V
20 – 30	3H:1V (7)
over 30	2H:1V (6)(7)

Fill and Ditch Slope Selection

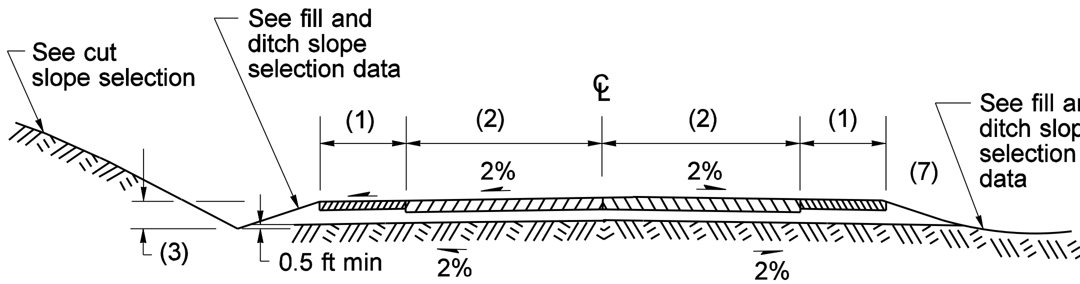
Height of cut (ft)*	Slope not steeper than
0 – 5	4H:1V
over 5	2H:1V (5)
* From bottom of ditch	

Cut Slope Selection (8)

Notes:

(1) For shoulder details, see Figures 640-5a and 5b. For minimum shoulder width, see Chapters 430 and 440.
(2) For minimum number and width of lanes, see Chapters 430 and 440. For turning roadway width, see Chapter 641.
(3) For minimum median width, see Chapters 430 and 440. For width when median is a two-way left-turn lane, see Chapter 910.
(4) Where practicable, consider flatter slopes for the greater fill heights and ditch depths.
(5) Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 700 for clear zone and barrier requirements.)
(6) Fill slopes up to 1½H:1V may be used where favorable soil conditions exist. (See Chapter 700 for clear zone and barrier requirements.)
(7) Widen and round foreslopes steeper than 4H:1V, as shown in Figure 640-5b.
(8) The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slopes given in this table.

Undivided Multilane Highway Roadway Sections
Figure 640-2



Design Class P-3, P-4, P-5. M-2, M-3, M-4, C-2, C-3, C-4, $U_{M/A}$-5, $U_{M/A}$-6

Design Class of highway	P-3, P-4, M-2, C-2, $U_{M/A}$5	P-5, M-3, M-4, C-3, C-4, $U_{M/A}$6
Height of fill/ depth of ditch (ft)	**Slope not steeper than (4)**	
0 – 10	6H:1V	4H:1V
10 – 20	4H:1V	4H:1V
20 – 30	3H:1V (7)	3H:1V (7)
over 30	2H:1V (5)(7)	2H:1V (5)(7)

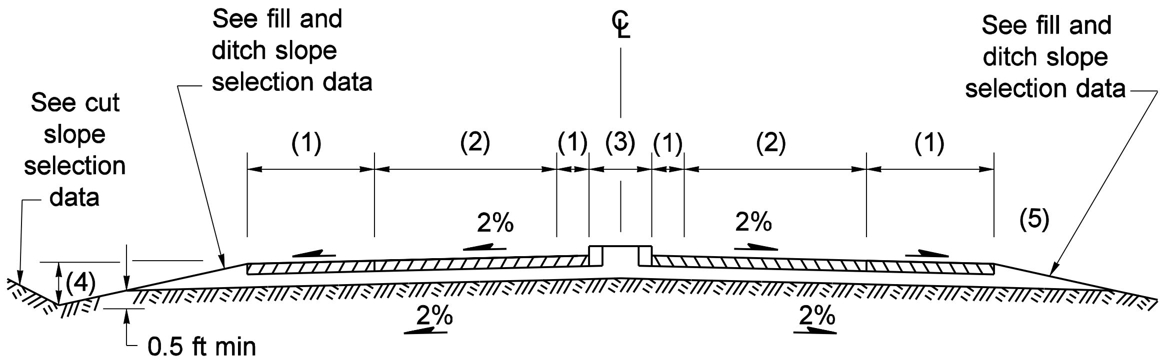
Fill and Ditch Slope Selection

Design Class of highway	P-3, P-4, M-2, C-2, $U_{M/A}$5	P-5, M-3, M-4, C-3, C-4, $U_{M/A}$6
Height of cut (ft)*	**Slope not steeper than**	
0 – 5	6H:1V	4H:1V
5 – 20	3H:1V	2H:1V (6)
over 20	2H:1V (6)	2H:1V (6)
* From bottom of ditch		

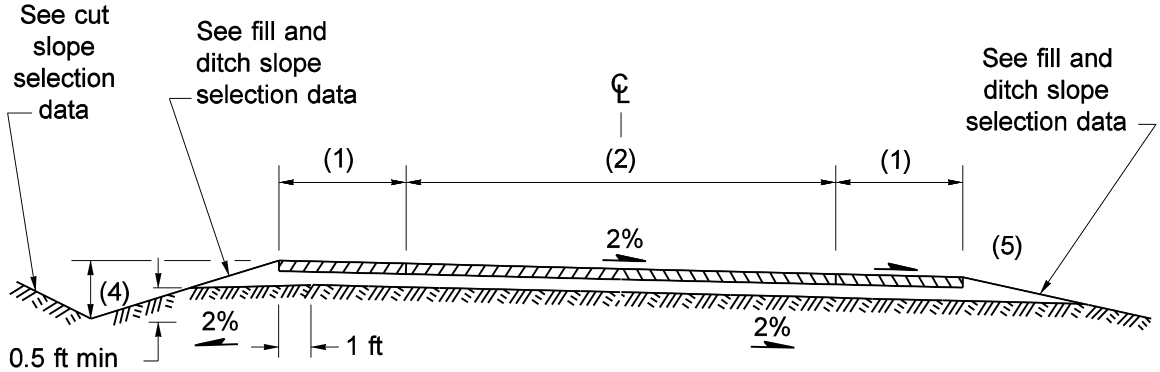
Cut Slope Selection (8)

Notes:
(1) For shoulder details, see Figures 640-5a and 5b. For minimum shoulder width, see Chapters 430 and 440.
(2) For minimum width of lanes, see Chapters 430 and 440. For turning roadway width, see Chapter 641.
(3) The minimum ditch depth is 2 feet for Design Class P3 and 1.5 feet for Design Classes P-4, P-5, M-2, M-3, M-4, C-2, C-3, C-4, UM/A-5, and UM/A-6.
(4) Where practicable, consider flatter slopes for the greater fill heights.
(5) Fill slopes up to 1½H:1V may be used where favorable soil conditions exist. (See Chapter 700 for clear zone and barrier requirements.)
(6) Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 700 for clear zone and barrier requirements.)
(7) Widen and round foreslopes steeper than 4H:1V, as shown in Figure 640-5b.
(8) The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slopes given in this table.

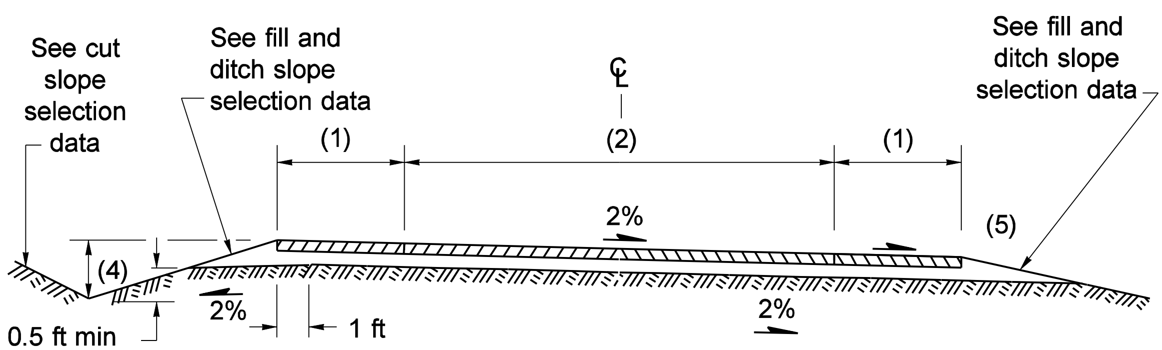
Two-Lane Highway Roadway Sections
Figure 640-3



Two-Lane Two-Way Ramp



Two-Lane One-Way Ramp



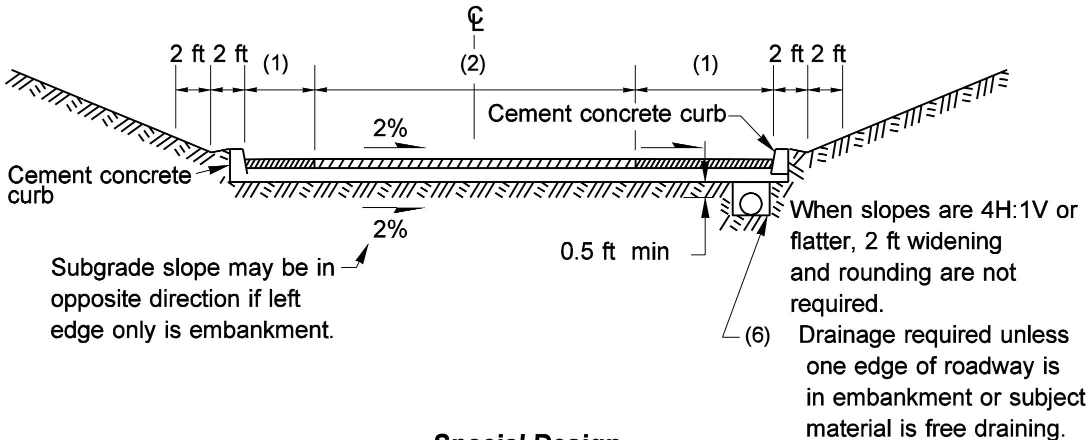
One-Lane Ramp

Note:

For notes, dimensions, and slope selection tables, see Figure 640-4b.

Ramp Roadway Sections

Figure 640-4a



Special Design

This special design section is to be used only when restrictions (high right of way costs or physical features that are difficult or costly to correct) require its consideration.

Height of fill/depth of ditch (ft)	Slope not steeper than (7)
0 – 10	6H:1V
10 – 20	4H:1V
20 – 30	3H:1V (5)
over 30	2H:1V (5) (9)

Fill and Ditch Slope Selection

Height of cut (ft)*	Slope not steeper than
0 – 5	6H:1V
5 – 20	3H:1V
over 20	2H:1V (8)
* From bottom of ditch	

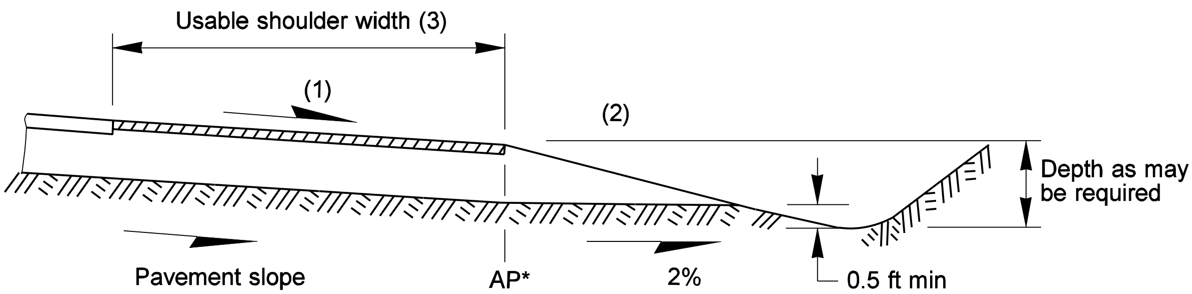
Cut Slope Selection (10)

Notes:

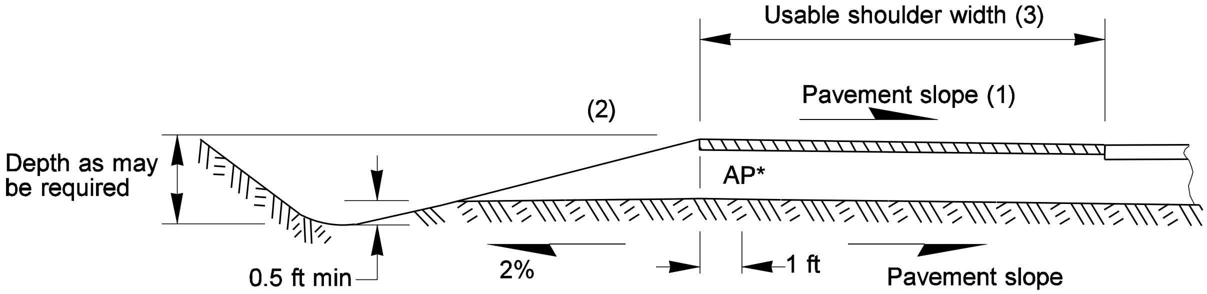
(1) For shoulder details, see Figures 640-5a and 5b. For minimum shoulder widths, see Chapter 940.
(2) For minimum ramp lane widths, see Chapter 940. For turning roadway width, see Chapter 641. For two-way ramps, treat each direction as a separate one-way roadway.
(3) The minimum median width of a two-lane two-way ramp is not less than that required for traffic control devices and their respective clearances.
(4) Minimum ditch depth is 2 feet for design speeds over 40 mph and 1.5 feet for design speeds of 40 mph or less. Rounding may be varied to fit drainage requirements when minimum ditch depth is 2 feet.
(5) Widen and round foreslopes steeper than 4H:1V, as shown in Figure 640-5b.
(6) Method of drainage pickup to be determined by the designer.
(7) Where practicable, consider flatter slopes for the greater fill heights and ditch depths.
(8) Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 700 for clear zone and barrier requirements.)
(9) Fill slopes as steep as 1½H:1V may be used where favorable soil conditions exist. (See Chapter 700 for clear zone and barrier requirements.)
(10) The values in the Cut Slopthe Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slopes given in this table.

Ramp Roadway Sections

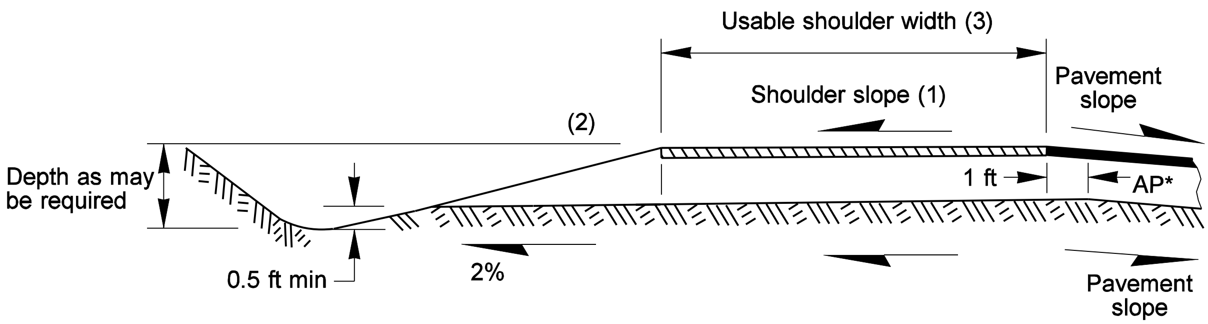
Figure 640-4b



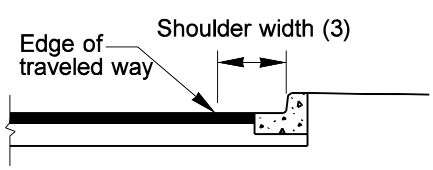
Shoulder Design on the Low Side of the Roadway for Cross Slopes Greater Than 2%.



Shoulder Design on the High Side of the Roadway on Curves and Divided Roadways.
Shoulder Slopes With Roadway.



Shoulder Design on the High Side of the Roadway on Curves and Divided Roadways.
Shoulder Slopes Away From Roadway.



Shoulder Design With Curb (5)(6).

*AP = angle point in the subgrade.

Note:

For notes, see Figure 640-5b.

Shoulder Details

Figure 640-5a

Chapter 642 Superelevation

642.01 General

To maintain the desired design speed, highway and ramp curves are usually superelevated to overcome part of the centrifugal force that acts on a vehicle.

For additional information, see the following chapters:

Chapter	Subject
430	Roadway widths and cross slopes for modified design level
440	Minimum lane and shoulder widths for full design level
940	Lane and shoulder widths for ramps

642.02 References

(1) Design Guidance

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

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

(2) Supporting Information

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

642.03 Definitions

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

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

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

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

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

superelevation runoff The length of highway needed to accomplish the change in cross slope from a section with adverse crown removed (level) to a fully superelevated section, or vice versa.

superelevation transition length The length of highway needed to change the cross slope from normal crown or normal pavement slope to full superelevation.

tangent runout The length of highway needed to change the cross slope from normal crown to a section with adverse crown removed (level).

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

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

642.04 Superelevation Rate Selection

The maximum superelevation rate allowed is 10%.

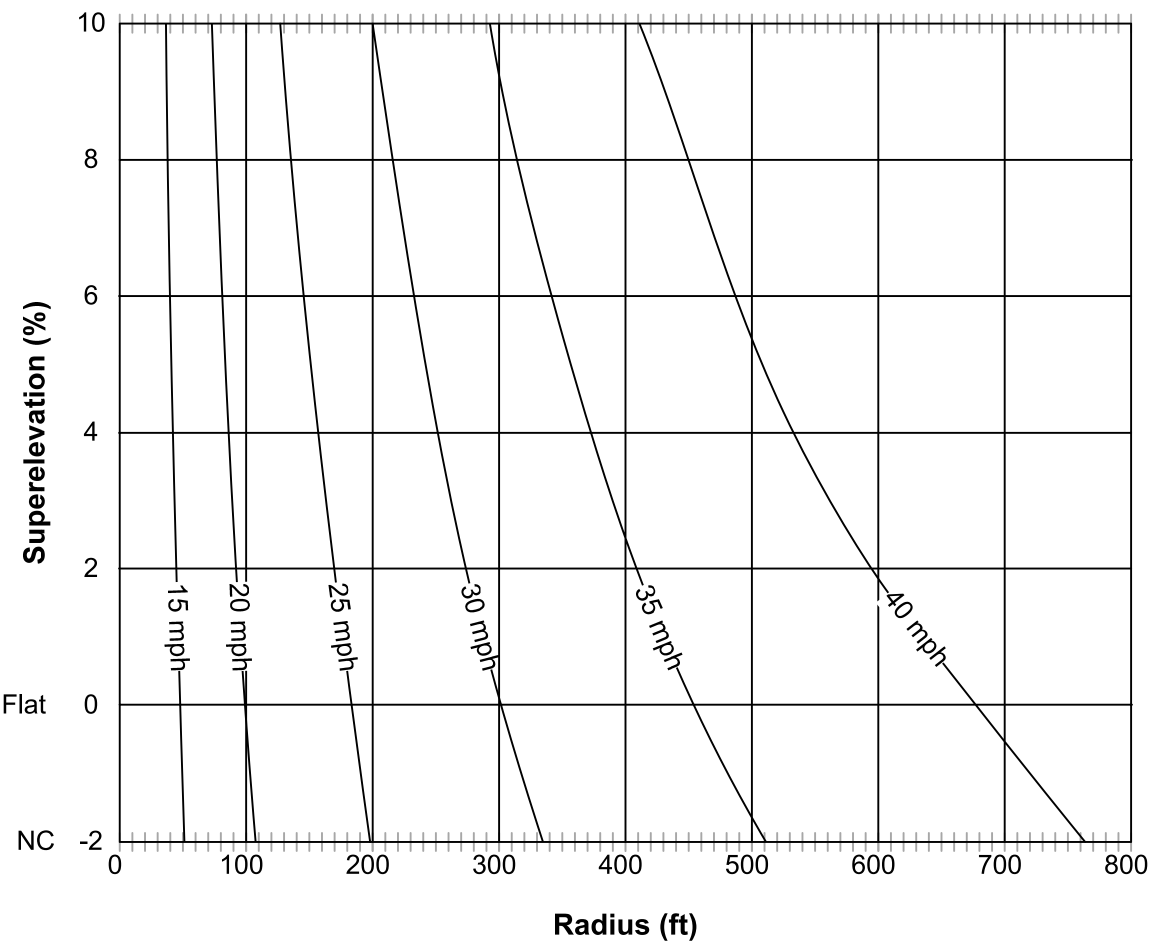
Depending on design speed, construct large-radius curves with a normal crown section. The minimum radii for normal crown sections are shown in Figure 642-1. Superelevate curves with smaller radii as follows:

- Figure 642-4a (e_{max}=10%) is preferred for all open highways, ramps, and long-term detours (especially when associated with a main line detour).
- Figure 642-4b (e_{max}=8%) may be used for freeways in urban design areas and areas where the e_{max}=6% rate is allowed but e_{max}=8% is preferred.
- Figure 642-4c (e_{max}=6% Max) may be used, with justification, for nonfreeways in urban design areas, in mountainous areas, and for short-term detours (generally implemented and removed in one construction season).
- Figure 642-5 may be used for turning roadways at intersections, for urban managed access highways with a design speed of 40 mph or less, and, with justification, for ramps in urban areas with a design speed of 40 mph or less.

When selecting superelevation for a curve, consider the existing curves on the corridor. To maintain route continuity and driver expectance on open highways, select the chart (see Figure 642-4a, 4b, or 4c) that best matches the superelevation on the existing curves.

In locations that experience regular accumulations of snow and ice, limit superelevation from the selected chart to 6% or less. In these areas, justification is required for superelevation rates greater than 6%. Vehicles moving at slow speeds or stopped on curves with supers greater than 6% tend to slide inward on the radius (downslope).

Round the selected superelevation rate to the nearest full percent.



NC = Normal crown

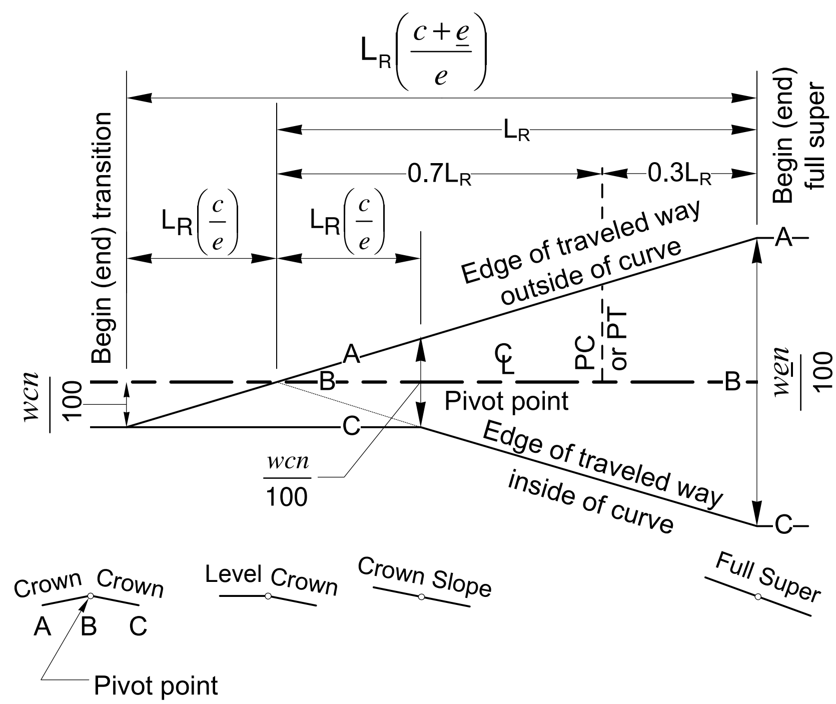
Superelevation Rates for Intersections and Low-Speed Urban Roadways
Figure 642-5

e (%)	LB=Basic Runoff in Feet for Design Speed													
	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph	45 mph	50 mph	55 mph	60 mph	65 mph	70 mph	75 mph	80 mph
2	30	30	35	35	40	40	45	50	50	55	55	60	65	70
3	45	50	50	55	60	60	65	70	75	80	85	90	95	105
4	60	65	70	75	75	85	90	95	100	105	110	120	125	135
5	75	80	85	90	95	105	110	120	130	135	140	150	160	170
6	90	95	105	110	115	125	135	145	155	160	170	180	190	205
7	110	115	120	130	135	145	155	170	180	185	195	210	220	240
8	125	130	135	145	155	165	180	190	205	215	225	240	250	275
9	140	145	155	165	175	185	200	215	230	240	250	270	285	310
10	155	160	170	180	195	205	220	240	255	265	280	300	315	345

* Based on one 12-ft lane between the pivot point and the edge of traveled way. When the distance exceeds 12 ft, use the following equation to obtain L_R: $L_R = L_B(1+0.04167X)$

Where:

X = The distance in excess of 12 ft between the pivot point and the farthest edge of traveled way, in ft



Design A – Pivot Point on Centerline Crown Section

c = Normal crown (%)

e = Superelevation rate (%)

n = Number of lanes between points

w = Width of lane

Superelevation Transitions for Highway Curves

Figure 642-6a

(d) **Existing stopping sight distance**. The costs, environmental impacts, and traffic impacts to increase sight distance on existing roadways are often higher than to provide that sight distance when building a new roadway. The existing roadway can be analyzed to determine whether there is a correctable collision trend. The less conservative existing stopping sight distance criteria may be used when the vertical and horizontal alignments are unchanged, the sightline obstruction is existing, the sight distance will not be reduced, and there is no identified correctable collision trend. The stopping distance for existing criteria is based on a travel speed less than the design speed. Also, the 2.00-foot object height (h_2) is used for existing criteria. For additional information, see 650.04(7).

(e) **Stopping sight distance design criteria selection**. Figure 650-2 gives guidance for the selection of stopping sight distance design criteria.

Type	Stopping Sight Distance	Object Height
Rural	Figures 650-1 & 650-3	0.50 ft
Urban desirable	Figures 650-1 & 650-3	0.50 ft
Urban[1]	Figure 650-1	2.00 ft
Traffic Barrier	Figures 650-1 & 650-3	2.00 ft
Existing[2]	Figure 650-13	2.00 ft

Notes:

[1] Justification required.

[2] See 650.04(1)(d).

Stopping Sight Distance: Design Criteria Selection
Figure 650-2

(2) Effects of Grade

The grade of the highway has an effect on the vehicle's stopping sight distance. The stopping distance is increased on downgrades and decreased on upgrades. Figure 650-3 gives the stopping sight distances for grades of 3% and steeper. When evaluating sight distance with a changing grade, use the grade for which the longest sight distance is needed.

Design Speed (mph)	Stopping Sight Distance (ft)					
	Downgrade			Upgrade		
	-3%	-6%	-9%	3%	6%	9%
25	158	165	173	147	143	140
30	205	215	227	190	184	179
35	258	271	288	237	229	222
40	315	333	354	289	278	269
45	378	401	428	345	331	320
50	447	474	508	405	389	375
55	520	553	594	470	450	433
60	599	638	687	539	515	495
65	683	729	786	612	585	561
70	772	826	892	690	658	631
75	867	928	1004	773	736	705
80	966	1037	1123	860	818	782

Design Stopping Sight Distance on Grades
Figure 650-3

For stopping sight distances on grades between those listed, interpolate between the values given or use the equation in Figure 650-4.

$$S = 1.47Vt + \frac{V^2}{30\left[\left(\frac{a}{32.2}\right) \pm \frac{G}{100}\right]}$$

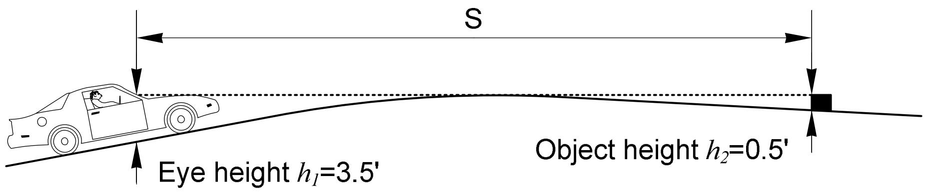
Where:
S = Stopping sight distance on grade (ft)
V = Design speed (mph)
t = Perception/reaction time (2.5 sec)
a = Deceleration rate (11.2 ft/sec^2)
G = Grade (%)

Stopping Sight Distance on Grades
Figure 650-4

(3) Crest Vertical Curves

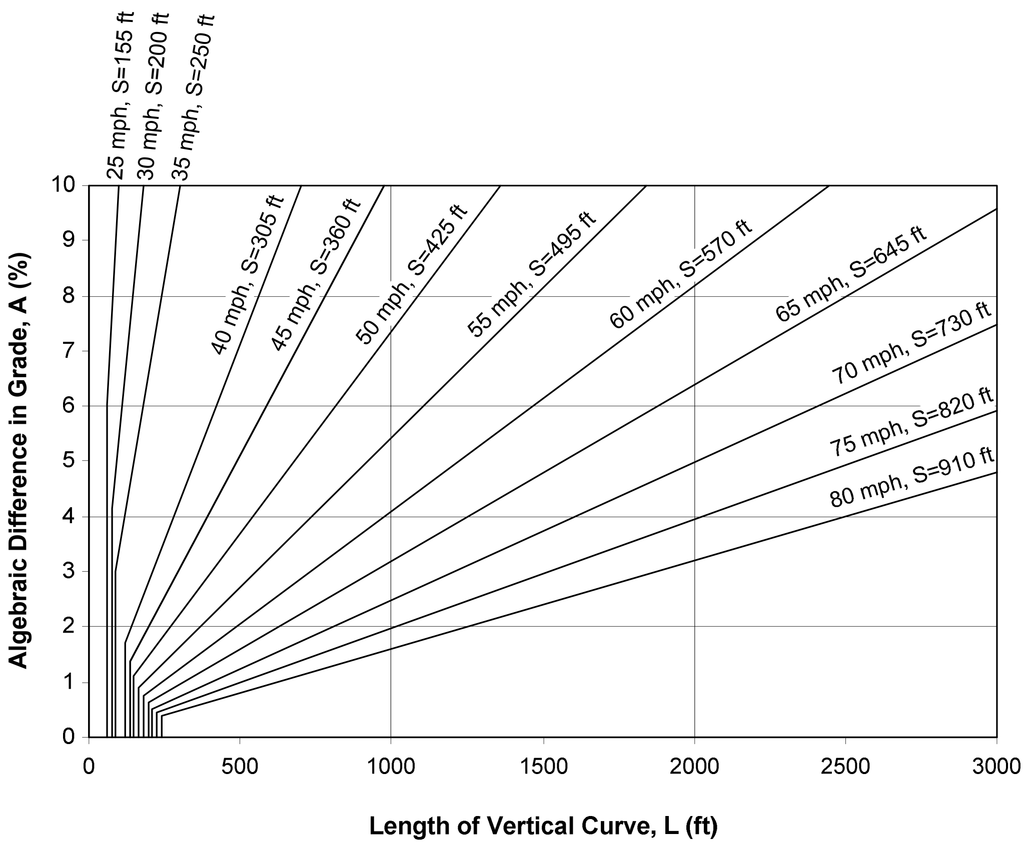
Use Figure 650-5 or the equations in Figure 650-6 to find the minimum crest vertical curve length to provide stopping sight distance when given the algebraic difference in grades. When using the equations in Figure 650-6, use h_1=3.50 feet and h_2=0.50 foot. Figure 650-5 does not use the sight distance greater than the length of curve equation. When the sight distance is greater than the length of curve and the length of curve is critical, the S>L equation given in Figure 650-6 may be used to find the minimum curve length.

When a new crest vertical curve is built or an existing one is rebuilt with grades less than 3%, provide design stopping sight distance from Figure 650-1. For grades 3% or greater, provide stopping sight distance from 650.04(2).



The minimum length can also be determined by multiplying the algebraic difference in grades by the K_C value from Figure 650-1 (L=K_C*A). Both the figure and the equation give approximately the same length of curve. Neither use the S>L equation.

* This chart is based on a 0.50-foot object height. When a higher object height is allowed (see 650.04(3) for guidance), the equations in Figure 650-6 must be used.



Stopping Sight Distance for Crest Vertical Curves
Figure 650-5

In urban design areas, with justification, an object height (h_2) of 2.00 feet may be used with the equations in Figure 650-6.

When evaluating an existing roadway, see 650.04(7).

When S>L	
$L = 2S - \frac{200\left(\sqrt{h_1}+\sqrt{h_2}\right)^2}{A}$	$S = \frac{L}{2} + \frac{100\left(\sqrt{h_1}+\sqrt{h_2}\right)^2}{A}$
When S<L	
$L = \frac{AS^2}{200\left(\sqrt{h_1}+\sqrt{h_2}\right)^2}$	$S = \sqrt{\frac{200L\left(\sqrt{h_1}+\sqrt{h_2}\right)^2}{A}}$

Where:
L = Length of vertical curve (ft)
S = Sight distance (ft)
A = Algebraic difference in grades (%)
h_1 = Eye height (3.50 ft)
h_2 = Object height—*see text* (ft)

Sight Distance: Crest Vertical Curve
Figure 650-6

(4) Sag Vertical Curves

Sight distance is not restricted by sag vertical curves during the hours of daylight. Therefore, headlight sight distance is used for the sight distance design criteria at sag vertical curves. In some cases, a lesser length may be allowed. For guidance, see Chapter 630.

Use Figure 650-7 or the equations in Figure 650-8 to find the minimum length for a sag vertical curve to provide the headlight stopping sight distance when given the algebraic difference in grades. The sight distance greater than the length of curve equation is not used in Figure 650-7. When the sight distance is greater than the length of curve and the length of curve is critical, the S>L equation given in Figure 650-8 may be used to find the minimum length of curve.

When a new sag vertical curve is built or an existing one is rebuilt with grades less than 3%, provide design stopping sight distance from Figure 650-1. For grades 3% or greater, provide stopping sight distance from 650.04(2).

When evaluating an existing roadway, see 650.04(7).

Chapter 710 Traffic Barriers

710.01 General

The Washington State Department of Transportation (WSDOT) uses traffic barriers to reduce the overall severity of accidents that occur when a vehicle leaves the traveled way. A traffic barrier presents an object that can be struck. Consider whether a barrier is preferable to the recovery area it replaces. In some cases, installation of a traffic barrier may result in more collisions. Barriers are designed so that such collisions will be less severe and not lead to secondary or tertiary collisions. However, when encounters occur, traffic barriers are not guaranteed to redirect vehicles without injury to the occupants or additional collisions.

Barrier performance is affected by the characteristics of the types of vehicles that collide with them. For example, motor vehicles with large tires and high centers of gravity are commonplace on our highways, and they are designed to mount obstacles. Therefore, they are at greater risk of mounting barriers or of not being decelerated and redirected as conventional vehicles would be.

When barriers are crash-tested, it is impossible to replicate the innumerable variations in highway conditions. Therefore, barriers are crash-tested under standardized conditions. Barriers are not placed with the assumption that the system will restrain or redirect all vehicles in all conditions. They are placed with the assumption that under normal conditions, they will provide an improved safety condition for most collisions. Consequently, barriers should not be used unless an improved safety situation is likely. No matter how well a barrier system is designed, optimal performance is dependent on drivers' proper use, maintenance, and operation of their vehicles and the proper use of vehicle restraint systems.

At the time of installation, the ultimate choice of barrier type and placement is made by using engineering judgment and having a thorough understanding of and using the criteria presented in Chapters 700 and 710.

710.02 References

(1) Design Guidance

Bridge Design Manual, M 23-50, WSDOT

Roadside Design Guide, AASHTO

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

Traffic Manual, M 51-02, WSDOT

710.03 Definitions

barrier terminal A crash-tested end treatment for longitudinal barriers that is designed to reduce the potential for spearing, vaulting, rolling, or excessive deceleration of impacting vehicles from either direction of travel. Barrier terminals include applicable anchorage.

controlled releasing terminal (CRT) post A standard-length guardrail post that has two holes drilled through it so it will break away when struck.

crash-accepted device A feature that has been proven acceptable for use under specified conditions, either through crash testing or in-service performance.

fixed feature (object to be mitigated) A fixed object, a side slope, or water that, when struck, can result in impact forces on a vehicle's occupants that may result in injury or place the occupants in a situation that has a high likelihood of injury. A fixed feature can be either constructed or natural.

impact attenuator system A device that acts primarily to bring an errant vehicle to a stop at a deceleration rate tolerable to the vehicle's occupants or to redirect the vehicle away from a fixed feature.

length of need The length of a traffic barrier used to shield a fixed feature.

longitudinal barrier A traffic barrier oriented parallel or nearly parallel to the roadway whose purpose is to contain or redirect errant vehicles. Beam guardrail, cable barrier, bridge rail, and concrete barrier are longitudinal barriers, and they are categorized as rigid, unrestrained rigid, semirigid, and flexible. They can be installed as roadside or median barriers.

shy distance The distance from the edge of the traveled way beyond which a roadside object will not be perceived as an immediate feature to be avoided by the typical driver to the extent that the driver will change the vehicle's placement or speed.

traffic barrier A longitudinal barrier, including bridge rail, or an impact attenuator used to redirect vehicles from objects located within an established Design Clear Zone. It is used to prevent median crossovers, to prevent errant vehicles from going over the side of a bridge structure, or (occasionally) to protect workers, pedestrians, or bicyclists from vehicular traffic.

transition A section of barrier used to produce the gradual stiffening of a flexible or semirigid barrier as it connects to a more rigid barrier or fixed object.

710.04 Project Requirements

This section identifies the barrier elements that are addressed according to the Design Matrices in Chapter 325. Remove barrier that is not needed. Use the criteria in Chapter 700 as the basis for removal.

(1) Barrier Terminals and Transitions

Install, replace, or upgrade transitions as discussed in 710.06(5), Transitions and Connections.

Impact attenuator criteria can be found in Chapter 720, Impact Attenuator Systems.

When installing new terminals, consider extending the guardrail to meet the length-of-need criteria in 710.05(4) as a spot safety enhancement.

Concrete barrier terminal criteria can be found in 710.08(3). When the end of a concrete barrier has been terminated with a small mound of earth (a design formerly known as a Concrete Barrier Berm), remove and replace with a crash-tested terminal, except as noted in 710.09.

Redirectional land forms, also referred to as earth berms, were formerly installed to help mitigate collisions with fixed objects located in depressed medians and at roadsides. They were constructed of materials that provided support for a traversing vehicle. With slopes in the range of 2H:1V to 3H:1V, they were intended to redirect errant vehicles. The use of redirectional land forms has been discontinued. Where redirectional land forms currently exist as mitigation for a fixed object, provide alternative means of mitigation of the fixed object, such as remove, relocate, upgrade with crash tested systems, or shield with barrier. Landforms may be used to provide a smooth surface at the base of a rock cut slope.

Replace guardrail terminals that do not have a crash-tested design with crash-tested guardrail terminals (see 710.06(4), Terminals and Anchors). Common features of systems that do not meet current crash-tested designs include:

- No cable anchor.
- A cable anchored into concrete in front of the first post.
- Second post not breakaway (CRT).
- Design A end section (Design C end sections may be left in place—see the *Standard Plans* for end section details).
- Terminals with beam guardrail on both sides of the posts (two-sided).
- Buried guardrail terminals that slope down such that the guardrail height is reduced to less than 26 inches.

When the height of a standard terminal will be reduced to less than 26 inches from the ground to the top of the rail element, adjust the height to a minimum of 26 inches and a maximum of 28 inches. A rail height of 28 inches is desirable to accommodate future overlays. Terminals are equipped with CRT posts with drilled holes that need to remain at the surface of the ground.

One terminal that was used extensively on Washington's highways was the Breakaway Cable Terminal (BCT). This system used a parabolic flare similar to the Slotted Rail Terminal (SRT) and a Type 1 anchor. (Type 1 anchor posts are wood set in a steel tube or a concrete foundation.)

Replace BCTs on Interstate routes. On non-Interstate routes, BCTs that have at least a 3-foot offset may remain in place unless the guardrail run or anchor is being reconstructed or reset. (Raising the rail element is not considered reconstruction or resetting.) Replace all BCTs that have less than a 3-foot offset.

Existing transitions that do not have a curb but are otherwise consistent with the designs shown in the *Standard Plans* may remain in place.

For preservation projects, terminal and transition work may be programmed under a separate project, as described in Chapter 410.

(2) Standard Run of Barrier

In Chapter 325, the Design Matrices offer guidance on how to address standard barrier runs for different project types. A "Standard Run" of barrier consists of longitudinal barrier as detailed in the *Standard Plans*.

(a) **Basic Design Level (B).** When the basic design level (B) is indicated in the Standard Run column of a Design Matrix, and the height of W-beam guardrail is or would be reduced to less than 26 inches from the ground to the top of the rail element, adjust the height to a minimum of 26 inches and a maximum of 28 inches. A rail height of 28 inches is desirable to accommodate future overlays.

If Type 1 Alternate W-beam guardrail is present, raise the rail element after each overlay. If Type 1 Alternate is not present, raise the existing blockout up to 4 inches higher than the top of the existing post by boring a new hole in the post.

Overlays in front of safety shape concrete barriers can extend to the top of the lower, near-vertical face of the barrier before adjustment is required.

- Allow no more than 1 foot 1 inch from the pavement to the beginning of the top near-vertical face of the safety shape barriers.
- Allow no less than 2 feet 8 inches from the pavement to the top of the single-slope barrier.
- Allow no less than 2 feet 6 inches for (Test Level 3) and 35 inches for (Test Level 4) high-tension cable barriers.

Note: There are new high-tension cable barrier systems under development, which may change selection and placement criteria. The Headquarters (HQ) Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.

(b) **Full Design Level (F).** When the full design level (F) is indicated, in addition to the requirements for the basic design level, the barrier must meet the requirements in the following:

Chapter	**Subject**
700.06	Median considerations
710.05(1)	Shy distance
710.05(2)	Barrier deflections
710.05(3)	Flare rate
710.05(4)	Length of need
710.05(5)	Median barrier selection and placement considerations
710.06	Beam guardrail
710.07	Cable barrier
710.08	Concrete barrier

Examples of barriers that are not acceptable as a "Standard Run" are:

- W-beam guardrail with 12-foot-6-inch post spacing or no blockouts, or both.
- W-beam guardrail on concrete posts.
- Cable barrier on wood or concrete posts.
- Half-moon or C-shaped rail elements.

(3) Bridge Rail

When the Bridge Rail column of a Design Matrix applies to the project, the bridge rails must meet the following requirements:

- Use an approved, crash-tested concrete bridge rail on new bridges or bridges to be widened. The *Bridge Design Manual* provides examples of typical bridge rails. Consult the HQ Bridge and Structures Office regarding bridge rail selection and design and for design of the connection to an existing bridge.
- An existing bridge rail on a highway with a posted speed of 30 mph or less may remain in place if it is not located on a bridge over a National Highway System (NHS) highway. When Type 7 bridge rail is present on a bridge over an NHS highway with a posted speed of 30 mph or less, it may remain in place, regardless of the type of metal rail installed. All other bridge rails are to be evaluated for strength and geometrics. (See 710.10 for guidance on retrofit techniques.)
- The Type 7 bridge rail is common. Type 7 bridge rails have a curb, a vertical-face parapet, and an aluminum top rail. The curb width and the type of aluminum top rail are factors in determining the adequacy of the Type 7 bridge rail, as shown in Figure 710-1. Consult the HQ Bridge and Structures Office for assistance in evaluating other bridge rails.

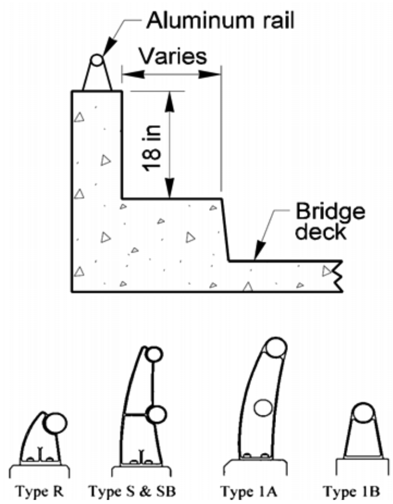
710.05 Barrier Design

When selecting a barrier, consider the flexibility, cost, and maintainability of the system. It is generally desirable to use the most flexible system possible to minimize damage to the impacting vehicle and injury to the vehicle's occupant(s). However, since nonrigid systems sustain more damage during an impact, the exposure of maintenance crews to traffic might be increased.

Maintenance costs for concrete barrier are lower than for other barrier types. In addition, deterioration due to weather and vehicle impacts is less than most other barrier systems. Unanchored precast concrete barrier can usually be realigned or repaired when moved from its alignment. However, heavy equipment may be required to reposition or replace barrier segments. Therefore, in medians, consider the shoulder width and the traffic volume when determining the acceptability of unanchored precast concrete barrier versus rigid concrete barrier.

Drainage, alignment, and drifting snow or sand are considerations that can influence the selection of barrier type. Beam guardrail and concrete barrier can contribute to snow drifts. Consider long-term maintenance costs associated with snow removal at locations prone to snow drifting. Slope flattening is recommended when the safety benefit justifies the additional cost to eliminate the need for the barrier. Cable barrier is not an obstruction to drifting snow and can be used if slope flattening is not feasible.

With some systems, such as concrete and beam guardrail, additional shoulder widening or slope flattening is common. However, selection of these types of barriers is sometimes limited due to the substantial environmental permitting and highway reconstruction requirements. Permits issued under the SEPA and NEPA processes may lead to the use of a barrier design such as cable barrier, which has fewer potential environmental impacts and costs.



Aluminum Rail Type	Curb Width	
	9 Inches or Less	Greater Than 9 inches*
Type R, S, or SB	Bridge rail adequate	Bridge rail adequate
Type 1B or 1A	Bridge rail adequate	Upgrade bridge rail
Other	Consult the HQ Bridge and Structures Office	
* When the curb width is greater than 9 inches, the aluminum rail must be able to withstand a 5 kip load.		

Type 7 Bridge Rail Upgrade Criteria
Figure 710-1

When designing a barrier for use on a Scenic Byway, consider barriers that are consistent with the recommendations in the associated *Corridor Management Plan* (if one is available). Contact the Region Landscape Architect or the Scenic Byways Coordinator in the HQ Highways and Local Programs Office to determine whether the project is on such a designated route. Low-cost options, such as using weathering steel beam guardrail (see 710.06) or cable barrier (see 710.07), might be feasible on many projects. Higher-cost options, such as steel-backed timber rail and stone guardwalls (see 710.09), might require a partnering effort to fund the additional costs. Grants might be available for this purpose if the need is identified early in the project definition phase (see Chapter 120).

(1) Shy Distance

Provide 2 feet of additional widening for shy distance when a barrier is to be installed in areas where the roadway is to be widened and the shoulder width will be less than 8 feet. This shy distance is not required when the section of roadway is not being widened or the shoulders are at least 8 feet wide. (See criteria in Chapter 440 for exceptions.)

(2) Barrier Deflections

All barriers except rigid barriers (such as concrete bridge rails) will deflect when hit by an errant vehicle. The amount of deflection is primarily dependent on the stiffness of the system. However, vehicle speed, angle of impact, and weight also affect the amount of barrier deflection. For flexible and semirigid roadside barriers, the deflection distance is designed to prevent the impacting vehicle from striking the object being shielded. For unrestrained rigid systems (unanchored precast concrete barrier), the deflection distance is designed to prevent the barrier from being knocked over the side of a drop-off or steep fill slope (2H:1V or steeper).

In median installations, design systems such that the deflection will not enter the lane of opposing traffic using deflection values that were determined from crash tests. When deciding whether to install new barriers, consider the impacts where significant traffic closures are necessary to accomplish maintenance. Use a rigid system where deflection cannot be tolerated, such as in narrow medians or at the edge of bridge decks or other vertical drop-off areas. Runs of rigid concrete barrier can be cast in place or extruded with appropriate footings.

In some locations where deflection distance is limited, anchor precast concrete barrier. Unless the anchoring system has been designed to function as a rigid barrier, some movement can be expected and repairs may be more expensive. Use of a nonrigid barrier on top of a retaining wall requires approval from the HQ Design Office.

Refer to Figure 710-2 for barrier deflection design values when selecting a longitudinal barrier. The deflection distances for cable and beam guardrail are the minimum measurements from the face of the barrier to the fixed feature. The deflection distance for unanchored concrete barrier is the minimum measurement from the back edge of the barrier to the drop-off or slope break.

(3) Flare Rate

Flare the ends of longitudinal barriers where possible. The four functions of a flare are to:

- Locate the barrier and its terminal as far from the traveled way as feasible.
- Reduce the length of need.
- Redirect an errant vehicle.
- Minimize a driver's reaction to the introduction of an object near the traveled way.

Keeping flare rates as flat as practicable preserves the barrier's redirectional performance and minimizes the angle of impact. However, it has been shown that an object (or barrier) close to the traveled way might cause a driver to shift laterally, slow down, or both. The flare reduces this reaction by gradually introducing the barrier so the driver does not perceive the barrier as an object to be avoided. The flare rates in Figure 710-3 satisfy all four functions listed above. More gradual flares may be used. Flare rates are offset parallel to the edge of the traveled way. Transition sections are not normally flared.

(4) Length of Need

The length of traffic barrier required to shield a fixed feature (length of need) is dependent on the location and geometrics of the object, direction(s) of traffic, posted speed, traffic volume, and type and location of traffic barrier. When designing a barrier for a fill slope as recommended in Chapter 700, the length of need begins at the point where barrier is recommended. For fixed objects and water, Figures 710-11a and 11b show design parameters for determining the necessary length of a barrier for both adjacent and opposing traffic on relatively straight sections of highway.

When barrier is to be installed on the outside of a horizontal curve, the length of need can be determined graphically, as shown in Figure 710-11c. For installations on the inside of a curve, determine the length of need as though it were straight. Also, consider the flare rate, barrier deflection, and barrier end treatment to be used.

When beam guardrail is placed in a median, consider the potential for impact from opposing traffic when conducting a length of need analysis. When guardrail is placed on either side of objects in the median, consider whether the trailing end of each run of guardrail will shield the leading end of the opposing guardrail. Shield the leading end when it is within the Design Clear Zone of opposing traffic (see Figure 710-11d).

Barrier Type	System Type	Deflection
Cable barrier or beam guardrail, Types 20 and 21, on G-2 posts	Flexible	Up to 12 ft (face of barrier to object)
Beam guardrail, Types 1, 1a, 2, 10, and 31	Semirigid	3 ft (face of barrier to object)
Two-sided W-beam guardrail, Types 3 and 4	Semirigid	2 ft (face of barrier to object)
Permanent concrete barrier, unanchored	Unrestrained Rigid	3 ft[1] (back of barrier to object)
Temporary concrete barrier, unanchored	Unrestrained Rigid	2 ft[2] (back of barrier to object)
Precast concrete barrier, anchored	Rigid	6 inches (back of barrier to object)
Rigid concrete barrier	Rigid	No deflection

Notes:

[1] When placed in front of a 2H:1V or flatter fill slope, the deflection distance can be reduced to 2 feet.

[2] When used as temporary bridge rail, anchor all barrier within 3 feet of a drop-off.

Longitudinal Barrier Deflection

Figure 710-2

Posted Speed (mph)	Rigid System	Unrestrained Rigid System	Semirigid System
65-70	20:1	18:1	15:1
60	18:1	16:1	14:1
55	16:1	14:1	12:1
50	14:1	12:1	11:1
45	12:1	11:1	10:1
40 or below	11:1	10:1	9:1

Longitudinal Barrier Flare Rates

Figure 710-3

Before the actual length of need is determined, establish the lateral distance between the proposed barrier installation and the object shielded. Provide a distance that is greater than or equal to the anticipated deflection of the longitudinal barrier. (See Figure 710-2 for barrier deflections.) Place the barrier as far from the edge of the traveled way as possible while maintaining the deflection distance.

If the end of the length of need is near an adequate cut slope, extend the barrier and embed it in the slope (see 710.06(4)). Avoid gaps of 300 feet or less. Short gaps are acceptable when the barrier is terminated in a cut slope. If the end of the length of need is near the end of an existing barrier, it is recommended that the barriers be connected to form a continuous barrier. Consider maintenance access issues when determining whether or not to connect barriers.

(5) Median Barrier Selection and Placement Considerations

With all barriers, the most desirable installation uses the most flexible system appropriate for the location and the one that is placed as far from the traveled way as practicable. Engineers are faced with the fact that barrier systems and vehicle fleets continue to evolve. What may be an optimal choice of barrier based on the majority of vehicles on the road today may not be the best selection for vehicles on the road tomorrow. This continuum of change does not allow engineers to predict the future with any degree of certainty. Consequently, engineering decisions must be made based on the most reliable information at hand. Furthermore, engineers are constantly striving to develop more effective design features to improve highway safety.

Economics and feasibility do not permit new designs to be employed whenever they are invented. The fact that a new design has been developed does not mean that the old design is unsafe. Although new designs may have been tested under controlled conditions, their performance under relevant applications may demonstrate unexpected performance aspects. Therefore there may be a need to modify application methods based on that practical experience.

Good engineering judgment is called for in determining the appropriate placement of barrier systems. Solutions may need to be arrived at while considering competing factors such as accident frequency and severity. As discussed previously, performance of the system relies on the interaction of the vehicle, driver, and system design at any given location.

With median barriers, the deflection characteristics and placement of the barrier for a traveled way in one direction can have an impact on the traveled way in the opposing direction. In addition, the median slopes and environmental issues often influence the type of barrier that is appropriate.

In narrow medians, avoid placement of barrier where the design deflection extends into oncoming traffic. Narrow medians provide little space for maintenance crews to repair or reposition the barrier. Therefore, avoid installing deflecting barriers in medians that provide less than 8 feet from the edge of the traveled way to the face of the barrier.

In wider medians, the selection of barrier might depend on the slopes in the median. At locations where the median slopes are relatively flat (10H:1V or flatter), unrestrained precast concrete barrier, beam guardrail, and cable barrier can be used depending on the available deflection distance. At these locations, position the barrier as close to the center as possible so that the recovery distance can be maximized for both directions. It might be necessary to offset the barrier from the flow line to avoid impacts to the drainage flow. Cable barrier is recommended with medians that are 30 feet or wider. In wide medians where the slopes are steeper than 10H:1V but not steeper than 6H:1V, cable barrier placed near the center of the median is preferred. Placement of beam guardrail requires that the barrier be placed at least 12 feet from the slope break, as shown in Figure 710-4. Do not use concrete barrier at locations where the foreslope into the face of the barrier is steeper than 10H:1V.

At locations where the roadways are on independent alignments and there is a difference in elevation between the roadways, the slope from the upper roadway might be steeper than 6H:1V. In these locations, position the median barrier along the upper roadway and provide deflection and offset distance as discussed previously. Barrier is generally not necessary along the lower roadway except where there are fixed features in the median.

When barrier is placed in a median as a countermeasure for cross-median collisions, design the barrier to be struck from either direction of travel. For example, beam guardrail should be double-sided (Types 3, 4, or 31-DS).

710.06 Beam Guardrail

(1) Beam Guardrail Systems

Beam guardrail systems are shown in the *Standard Plans*.

Strong post W-beam guardrail (Types 1 through 4, and 31) and thrie beam guardrail (Types 10 and 11) are semirigid barriers used predominantly on roadsides. They have limited application as median barrier. Installed incorrectly, strong post W-beam guardrail can cause vehicle snagging or spearing. This can be avoided by lapping the rail splices in the direction of traffic (as shown in the *Standard Plans*), by using crash-tested end treatments, and by blocking the rail away from the strong posts. However, avoid the use of blockouts that extend from the post to the rail element for a distance exceeding 16 inches.

W-beam guardrail has typically been installed with a rail height of 27 inches. However, there are some newer designs that use a 31-inch rail height. One is the 31-inch-high WSDOT Type 31. The Type 31 system uses many of the same components as the WSDOT Type 1 system. However, the main differences are that the blockouts extend 12 inches from the posts, the rail height is 31 inches from the ground, and the rail elements are spliced between posts.

The 31-inch-high system offers tolerance for future HMA overlays. The Type 31 system allows a 4-inch tolerance from 31 inches to 27 inches without adjustment of the rail element.

(2) W-Beam Barrier Selection and Placement

- Use the 31-inch-high guardrail design for new runs. The existing shoulder width may be reduced up to 4 inches to accommodate the 12-inch blockout without processing a deviation.
- Existing runs with rail height at 27 inches are acceptable to leave in place and can be extended if the design height of 27 inches is maintained in the extended section. Where future overlays are anticipated, extend with Type 1 alternate or the 31-inch design.
- For existing runs below 26 inches, adjust or replace the rail to a height of 26 inches minimum to 28 inches maximum, or replace the run with the 31-inch-high guardrail design.
- Some 31-inch-high proprietary guardrail designs that do not incorporate the use of blockouts have been successfully crash-tested. The use of this type of system may be appropriate for some applications. Contact the HQ Design Office for further details.

Some designs for Type 31 applications are under development and will be added to the HQ Design Standards (Plan Sheet Library) as soon as they are completed (🖱 www.wsdot.wa.gov/Design/Standards/PlanSheet). Plans will be housed at this location until they are transitioned into the *Standard Plans*.

(3) Additional Guidance

Weak post W-beam guardrail (Type 20) and thrie beam guardrail (Type 21) are flexible barrier systems that can be used where there is adequate deflection distance. These systems use weak steel posts. The primary purpose of these posts is to position the guardrail vertically, and they are designed to bend over when struck. These more flexible systems will result in less damage to the impacting vehicle. Since the weak posts will not result in snagging, blockouts are not necessary.

Keep the slope of the area between the edge of the shoulder and the face of the guardrail 10H:1V or flatter. On fill slopes between 6H:1V and 10H:1V, beam guardrail must not be placed within 12 feet of the break point. Do not place beam guardrail on a fill slope steeper than 6H:1V. (See Figure 710-4 for additional guidance on beam guardrail slope placement.)

On the high side of superelevated sections, place beam guardrail at the edge of shoulder prior to the slope break.

For W-beam guardrail installed at or near the shoulder, 2 feet of shoulder widening behind the barrier is generally provided from the back of the post to the beginning of a fill slope. If the slope is 2H:1V or flatter, this distance can be measured from the face of the guardrail rather than the back of the post (see Figure 710-12, Case 1).

On projects where no roadway widening is proposed and the minimum 2-foot shoulder widening behind the barrier is not practicable, long post installations are available as shown in Figure 710-12, Cases 3, 4, 5, and 6. When guardrail is to be installed in areas where the roadway is to be widened, the use of Cases 4, 5, or 6 requires a design deviation.

Rail washers on beam guardrail are not normally used. If rail washers are present, removal is not required except for posts 2 through 8 of an existing BCT installation. However, if the rail element is removed for any reason, do not reinstall rail washers. In areas where heavy snow accumulations are expected to cause the bolts to pull out, specify snowload post washers and rail washers in the contract documents. (Snowload post washers are used to prevent the bolts from pulling through the posts, and snowload rail washers are used to prevent the bolt head from pulling through the rail.) In other installations, it is normal to have the rail pull loose from the bolt head when impacted. Do not use rail washers within the limits of a guardrail terminal except at the end post where they are required for anchorage of the rail.

The use of curb in conjunction with beam guardrail is discouraged. If a curb is necessary, the 3-inch-high curb is preferred. If necessary, the 4-inch-high extruded curb can be used behind the face of rail at any posted speed. The 6-inch-high extruded curb can be used at locations where the posted speed is 50 mph or less. When replacing extruded curb at locations where the posted speed is greater than 50 mph, use 3-inch-high or 4-inch-high curb. (See the *Standard Plans* for extruded curb designs.)

When curb is used in conjunction with 31-inch-high Type 31 W-beam guardrail, it is acceptable to place a 6-inch-high curb at a 7-inch offset outside the face of the rail.

Beam guardrail is usually galvanized and has a silver color. It can also be provided in weathering steel that has a brown or rust color. Along Scenic Byways, Heritage Tour Routes, state highways through national forests, or other designated areas, consider using weathering steel guardrail, weathering steel terminals, and wooden posts to minimize the barrier's visual impact (see 710.05).

(4) Terminals and Anchors

A guardrail anchor is required at the end of a run of guardrail to develop tensile strength throughout its length. In addition, when the end of the guardrail is subject to head-on impacts, a crash tested guardrail terminal is required (see the *Standard Plans*).

(a) **Buried Terminal (BT)** is designed to terminate the guardrail by burying the end in a backslope. The BT is the preferred terminal because it eliminates the exposed end of the guardrail.

The BT uses a Type 2 anchor to develop the tensile strength in the guardrail. The backslope required to install a BT must be 3H:1V or steeper and at least 4 feet in height above the roadway. The entire BT can be used within the length of need for backslopes of 1H:1V or steeper if the barrier remains at full height in relation to the roadway shoulder to the point where the barrier enters the backslope. For backslopes between 1H:1V and 3H:1V, design the length of need beginning at the point where the W-beam remains at full height in relation to the roadway shoulder—usually beginning at the point where the barrier crosses the ditch line. If the backslope is flatter than 1H:1V, provide a minimum 20-foot-wide by 75-foot-long distance between the beginning length of need point at the terminal end to the mitigated object to be protected.

- **Buried Terminal Type 1** – Flare the guardrail into the backslope using a flare rate that meets the criteria in 710.05(3). Provide a 10H:1V or flatter foreslope into the face of the guardrail and maintain the full guardrail height to the foreslope/backslope intersection. This might require filling ditches and installing culverts in front of the guardrail face.
- **Buried Terminal Type 2** – Provide a 4H:1V or flatter foreslope into the face of the guardrail and maintain the full guardrail height to the foreslope/backslope intersection.

(b) **Nonflared Terminal.** If a BT terminal cannot be installed as described above, consider a nonflared terminal (see Figure 710-13a). There are currently two acceptable sole source proprietary designs: the ET–PLUS 31 and the SKT-MGS. These systems use W-beam guardrail with a special end piece that fits over the end of the guardrail and wood breakaway and CRT posts. When hit head on, the end piece is forced over the rail and either flattens or bends the rail and then forces it away from the impacting vehicle.

Both the SKT-MGS and the ET-PLUS 31 terminals include an anchor for developing the tensile strength of the guardrail. The length of need begins at the third post for both terminals.

While these terminals do not require an offset at the end, a flare is recommended so that the end piece does not protrude into the shoulder. These terminals may have a 2-foot offset to the first post. Four feet of widening is required at the end posts to properly anchor the system. For every foot of embankment height, 3 cubic yards of embankment are required. (See the *Standard Plans* for widening details.)

When the entire barrier run is located greater than 12 feet beyond the shoulder break point and the slopes are greater than 10H:1V and 6H:1V or flatter, additional embankment at the terminal is not necessary.

No snowload rail washers are allowed within the limits of these terminals.

When a Beam Guardrail Type 1 nonflared terminal is necessary, two other sole source proprietary terminals, the ET-PLUS or the Sequential Kinking Terminal (SKT), may be used (see Figure 710-13b).

The FHWA has granted approval to use these sole source proprietary terminals without justification.

(c) **Flared Terminal.** WSDOT does not use a flared terminal system for the Type 31 system. However, if a flared terminal is needed for other applications, there are currently two acceptable sole source proprietary designs: the Slotted Rail Terminal (SRT) and the Flared Energy Absorbing Terminal (FLEAT). Both of these designs include an anchor for developing the tensile strength of the guardrail. The length of need begins at the third post for both flared terminals.

1. The SRT uses W-beam guardrail with slots cut into the corrugations and wood breakaway and controlled release terminal (CRT) posts that are designed to break away when hit. The end of the SRT is offset from the tangent guardrail run by the use of a parabolic flare. When struck head on, the first two posts are designed to break away, and the parabolic flare gives the rail a natural tendency to buckle, minimizing the possibility of the guardrail end entering the vehicle. The buckling is facilitated by the slots in the rail. The CRT posts provide strength to the system for redirection and deceleration without snagging the vehicle. The SRT has a 4-foot offset of the first post.

2. The FLEAT uses W-beam guardrail with a special end piece that fits over the end of the guardrail and wood breakaway and CRT posts. The end of the FLEAT is offset from the tangent guardrail run by the use of a straight flare. When struck head on, the end piece is forced over the rail, bending the rail and forcing it away from the impacting vehicle.

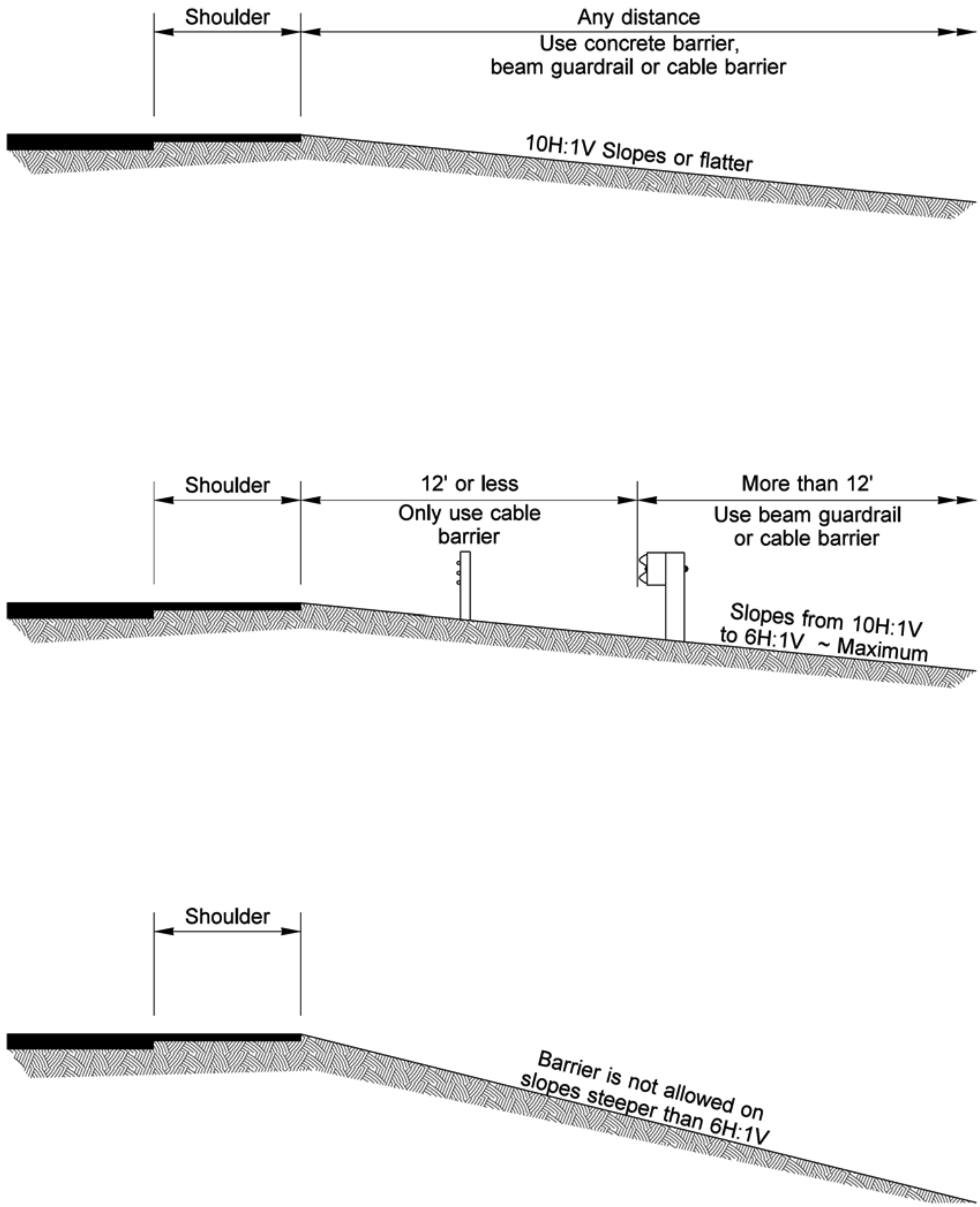
   The FLEAT is available in two designs based on the posted speed of the highway. For highways with a posted speed of 45 mph or greater, use a FLEAT 350, which has a 4-foot offset at the first post. For lower-speed highways (a posted speed of 40 mph or less), use a FLEAT TL-2, which has a 1-foot-8-inch offset at the first post.

When a flared terminal is specified, it is critical that embankment quantity also be specified so that the area around the terminal can be constructed as shown in the *Standard Plans*. For every foot of height of the embankment, 13 cubic yards of embankment are necessary.

When the entire barrier run is located greater than 12 feet beyond the shoulder break point and the slopes are greater than 10H:1V and 6H:1V or flatter, additional embankment at the terminal is not necessary.

Snowload rail washers are not allowed within the limits of these terminals.

The FHWA has granted approval to use these sole source proprietary terminals without justification.



Traffic Barrier Locations on Slopes
Figure 710-4

(d) **Terminal Evolution Considerations.** Some currently approved terminals have been in service for a number of years. During this time, there have been minor design changes. However, these minor changes have not changed the devices' approval status. All previous designs for these terminals may remain in place. (For guidance on BCT terminals, see 710.04(1).) If questions arise concerning the current approval status of a device, contact the HQ Design Office for clarification when replacement is being considered.

(e) **Other Anchor Applications.** Use the Type 10 anchor to develop the tensile strength of the guardrail on the end of Type 31 guardrail runs where a crash-tested terminal is not required. The Type 1 or Type 4 anchor is currently used for Beam Guardrail Type 1 where a crash-tested terminal is not required. Use the Type 5 anchor with the Weak Post Intersection Design (see 710.06(6), Cases 12 and 13). Use the Type 7 anchor to develop tensile strength in the middle of a guardrail run when the guardrail curves and weak posts are used (see 710.06(6), Cases 9, 12, and 13).

The old Type 3 anchor was primarily used at bridge ends (see Figure 710-5). This anchor consisted of a steel pipe mounted vertically in a concrete foundation. Bridge approach guardrail was then mounted on the steel pipe.

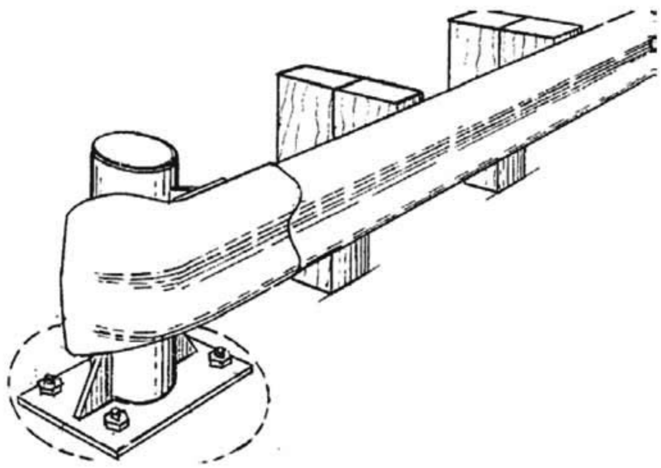
- On one-way highways, these anchors were usually positioned so that neither the anchor nor the bridge rail posed a snagging potential. When these cases are encountered, the anchor may remain in place if a stiffened transition section is provided at the connection to the post.
- On two-way highways, the anchor may present a snagging potential. In these cases, install a connection from the anchor to the bridge rail if the offset from the bridge rail to the face of the guardrail is 1 foot 6 inches or less. If the offset is greater than 1 foot 6 inches, remove the anchor and install a new transition and connection.

Locations where crossroads and driveways cause gaps in the guardrail require special consideration. Elimination of the need for the barrier is the preferred solution. Otherwise, a barrier flare might be required to provide sight distance. If the slope is 2H:1V or flatter and there are no fixed features on or at the bottom of the slope, a terminal can be used to end the rail. Place the anchor of this installation as close as possible to the road approach radius PC. If there is a feature at or near the bottom of the slope that cannot be mitigated, then the Weak Post Intersection Design (see 710.06 and the *Standard Plans*) can be used. This system can also be used at locations where a crossroad or road approach is near the end of a bridge and where installing a bridge approach guardrail placement, including guardrail transition and terminal, is not possible.

(5) Transitions and Connections

When there is an abrupt change from one barrier type to a more rigid barrier type, a vehicle hitting the more flexible barrier is likely to be caught in the deflected barrier pocket and directed into the more rigid barrier. This is commonly referred to as "pocketing." A transition stiffens the more flexible barrier by decreasing the post spacing, increasing the post size, and using stiffer beam elements to eliminate the possibility of pocketing.

When connecting beam guardrail to a more rigid barrier or a structure, or when a rigid object is within the deflection distance of the barrier, use the transitions and connections that are shown in Figures 710-6 and 710-10 and detailed in the *Standard Plans*. The transition pay item includes the connection.



Old Type 3 Anchor
Figure 710-5

Condition	Connection
Unrestrained concrete barrier	A
Rigid untapered safety shape bridge rails or barriers[1]	B
Bridge rails with curbs 9 inches or less in width	B
Bridge rails with curbs between 9 and 18 inches wide	C
Vertical walls or tapered safety shape barrier[1]	D

Note:
[1] New safety shape bridge rails are designed with the toe of the barrier tapered so that it does not project past the face of the approach guardrail.

Guardrail Connections
Figure 710-6

(6) Guardrail Placement Cases

The *Standard Plans* contains placement cases that show beam guardrail elements required for typical situations.

Case 1 is used only where there is one-way traffic. It uses a crash-tested terminal on the approach end and a Type 4 anchor on the trailing end.

Case 1A is used with Type 31 barrier only where there is one-way traffic. It uses a crash-tested terminal on the approach end and a Type 10 anchor on the trailing end.

Case 2 is used where there is two-way traffic. A crash-tested terminal is used on both ends. When flared terminals are used on both ends, a minimum of 25 feet of guardrail is required between the terminal limits.

Case 2A is used with Type 31 barrier where there is two-way traffic. A crash-tested terminal is used on both ends.

Case 3 is used at railroad signal supports on one-way or two-way roadways. A terminal is used on the approach end, but usually cannot be used on the trailing end because of its proximity to the railroad tracks. If there is a history of crossover accidents, consider additional protection such as an impact attenuator.

Case 4 is used where guardrail on the approach to a bridge is to be shifted laterally to connect with the bridge rail. A terminal is used on the approach end and a transition is required at the bridge end. A curve in the guardrail is shown to shift it to the bridge rail. However, the length of the curve is not critical and the only requirement is to provide a smooth curve that is not more abrupt than the allowable flare rate (see Figure 710-3).

Case 5 is a typical bridge approach where a terminal and a transition are required.

Case 5A is a typical bridge approach where a terminal and a transition are required when using Type 31 barrier.

Case 6 is used on bridge approaches where opposing traffic is separated by a median that is 36 feet or wider. This case is designed so that the end of the guardrail will be outside the Design Clear Zone for the opposing traffic.

Cases 7 and 8 are used with beam guardrail median barrier when median fixed features such as bridge piers are encountered. A transition is required on the approach end for each direction and the flare rate must not be more abrupt than the allowable flare rate (see Figure 710-3).

Case 9 (A, B, and C) is used on bridge approaches where opposing traffic is separated by a median less than 36 feet wide. This design, called a "Bull Nose Terminal," treats both bridge ends and the opening between the bridges. The "nose" is designed to collapse when struck head on, and the ribbon strength of the rail brings the vehicle to a controlled stop. Type 7 anchors are installed on each side of the nose to develop the ribbon strength.

Since an impacting vehicle will penetrate into the system, it is critical that no fixed feature be located within the first 30 feet of the system.

Case 10 (A, B, and C) is used at roadside fixed features (such as bridge piers) when 3 or more feet are available from the face of the guardrail to the object. The approach end is the same for one-way or two-way traffic. Case 10A is used with two-way traffic; therefore, a terminal is required on the trailing end. Case 10B is used for one-way traffic when there is no need to extend guardrail past the bridge pier and a Type 4 anchor is used to end the guardrail. Case 10C is used for one-way traffic when the guardrail will extend for a distance past the bridge pier.

Case 11 (A, B, and C) is used at roadside fixed features (such as bridge piers) when the guardrail is to be placed within 3 feet of the object. Since there is no room for deflection, the rail in front of the feature must be considered a rigid system and a transition is necessary. The trailing end cases are the same as described for Case 10.

Cases 12 and 13 are called “Weak Post Intersection Designs.” They are used where an intersection requires a gap in the guardrail or there is not adequate space for a bridge approach installation that includes a transition, a terminal, or both. These placements are designed to collapse when hit at the nose, and the ribbon strength of the rail brings the vehicle to a stop. A Type 7 anchor is used to develop the ribbon strength. These designs include a Type 5 transition for connection with bridge rail and a Type 5 anchor at the other end of the rail. The Type 5 anchor is not a breakaway anchor and therefore can only be used on low-speed side roads and driveways.

Since an impacting vehicle will penetrate into the system, it is critical that no fixed feature be located within the clear area shown in the *Standard Plans*. The 25 feet along the side road are critical for the operation of this system.

These designs were developed for intersections that are approximately perpendicular. Evaluate installation on skewed intersections on a case-by-case basis. Use the Case 22 placement if it is not feasible to install this design according to the *Standard Plans*.

Case 14 shows the approach rail layout for a Service Level 1 bridge rail system. Type 20 guardrail is used on the approach and no transition is required between the Type 20 guardrail and the Service Level 1 bridge rail since they are both weak post systems. A Type 6 transition is used when connecting the Type 20 to a strong post guardrail or a terminal.

Case 15 is used to carry guardrail across a box culvert where there is insufficient depth to install standard posts for more than 17 feet 8 inches. This design uses steel posts anchored to the box culvert to support the rail. Newer designs—Cases 19, 20, and 21—have replaced this design for shorter spans.

Cases 16 and 17 are similar to Cases 1 and 2, except that they flare the rail and terminal as far from the road as possible and reduce the length of need.

Case 18 is used on the trailing end of bridge rail on a one-way roadway. No transition is necessary.

Case 19 (A and B) is used where it is not possible to install a post at the 6-foot-3-inch spacing. This design omits one post (resulting in a span of 11 feet 6 inches, which is consistent with a post spacing of 12 feet 6 inches) and uses nested W-beam to stiffen the rail. The cases differ by the location of the splice. No cutting of the rail or offsetting of the splices is necessary or desirable.

Case 20 is similar to Cases 19A and 19B, except that it allows for two posts to be omitted (which results in a span consistent with post spacing of 18 feet 9 inches).

Case 21 has a similar intent as Cases 19A, 19B, and 20 in that it allows for the omission of posts to span an obstruction. This design uses CRT posts with additional post blocks for three posts before and after the omitted posts. The design allows for three posts to be omitted (which results in a span consistent with a post spacing of 25 feet).

Case 22 is the "Strong Post Intersection Design" that provides a stiff barrier. This design is only to be used as a last resort at crossroads or road approaches where a barrier is necessary and there isn't a clear area behind the nose or minimum distances for a "Weak Post Intersection Design" (see Cases 12 and 13).

Note: Some placement cases for use with Beam Guardrail Type 31 are currently under development. As plans become available, they will be housed in the HQ Design Standards (Plan Sheet Library) until they become *Standard Plans* (www.wsdot.wa.gov/Design/Standards/PlanSheet).

710.07 Cable Barrier

Cable barrier is a flexible barrier system that can be used on a roadside or as a median barrier. It is used primarily in medians and is preferred for many installations due in part to its high benefit-to-cost ratio. Some of the advantages of cable barrier are:

- It provides effective vehicle containment and redirection while imposing the lowest deceleration forces on the vehicle's occupant(s).
- It reduces the severity of collisions, which is of significant importance on high-speed facilities.
- After it is struck, it has a tendency not to redirect vehicles back into traffic, which can help reduce the frequency of secondary collisions.
- It can often be placed on existing facilities without the delay of extended environmental permitting and the expense of complex highway reconstruction that might be required for other barrier system choices.
- It has advantages in heavy snowfall areas because it has minimal potential to create snowdrifts.
- In crucial wildlife habitats, it can aid in some types of animal movements.
- It does not present a visual barrier, which may make it desirable on Scenic Byways (see 710.05).
- The effort (time and materials) required to maintain and repair cable barrier systems is much less than the effort required for a W-beam system.

Deflection is a consideration in narrower median areas. In many urban and other limited-width situations, use of cable barrier may not be possible or may require special designs.

For new installations, use high-tension (H.T.) cable barrier systems, which are available from several manufacturers.

(1) High-Tension Cable Barrier Placement

- For single-runs of cable median barrier, if there is at least 13 feet from edge of the nearest traveled lane to the slope breakpoint, place the cable median barrier at least 1 foot in front of the slope breakpoint. Any approved Test Level 3 or Test Level 4 high-tension barrier system may be used in this location (see Figure 710-14a).
- For double-runs of cable median barrier, if there is at least 11 feet from edge of the nearest traveled lane to the slope breakpoint, place the cable median barrier at least 1 foot in front of the slope breakpoint. Any approved Test Level 3 or Test Level 4 high-tension barrier system may be used in this location.
- Use only an approved Test Level 4 high-tension cable barrier system when placing cable barrier within the median slope breakpoints (see Figure 710-14a). Test Level 3 systems currently under development may be appropriate for placement in these locations in the future. Contact the HQ Design Office for further details.
- For shoulder applications, cable barrier can be installed up to 1 foot in front of slope breakpoints as steep as 2H:1V. Cable barrier is the only barrier that can be placed on a sideslope steeper than 10H:1V within the 12-foot area immediately beyond the slope breakpoint. Do not place this barrier on a sideslope steeper than 6H:1V. Figure 710-14b shows the placement of cable barrier for shoulder applications.
- Narrow medians provide little space for maintenance crews to repair or reposition the barrier. Whenever site conditions permit, provide at least 14 feet of clearance from the adjacent lane edge to the cable barrier.
- When cable barrier is to be connected to a more rigid barrier, a transition section is required. Contact the HQ Design Office for further details.

Note: There are new high-tension cable barrier systems under development that may change selection and placement criteria. The HQ Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.

(2) High-Tension Cable Barrier Deflection Distances

Depending on the system and post spacing, deflection distances for high-tension barrier systems currently range from 6 feet 8 inches to 9 feet 3 inches. (See Figures 710-14a and 14b for placement details.)

Note: There are new high-tension cable barrier systems under development that may change selection and placement criteria. The HQ Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.

710.08 Concrete Barrier

Concrete barriers are rigid or unrestrained rigid systems. Commonly used in medians, they are also used as shoulder barriers. These systems are stiffer than beam guardrail or cable barrier, and impacts with these barriers tend to be more severe.

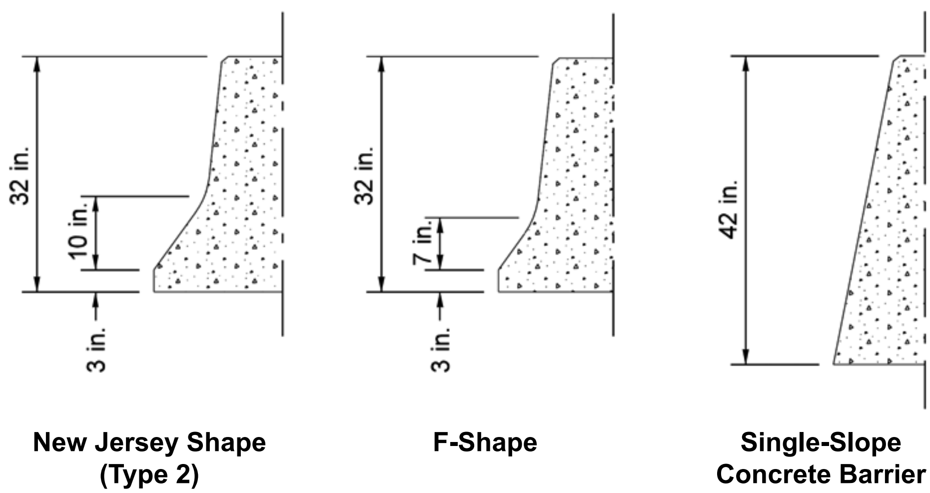
Light standards mounted on top of concrete median barrier must not have breakaway features. (See the concrete barrier light standard section in the *Standard Plans*.)

When concrete barrier is considered for use in areas where drainage and environmental issues (such as stormwater, wildlife, or endangered species) might be adversely impacted, contact the HQ Hydraulics Office and the appropriate environmental offices for guidance.

(1) Concrete Barrier Shapes

Concrete barriers use a single-slope or safety shape (New Jersey or F-Shape) to redirect vehicles while minimizing vehicle vaulting, rolling, and snagging. A comparison of these barrier shapes is shown in Figure 710-7.

The single-slope barrier face is recommended when separating roadways with different elevations (stepped medians).



Concrete Barrier Shapes
Figure 710-7

When the F-Shape face is used and precast barrier will be used on the approaches, a cast-in-place transition section is required so that no vertical edges of the barrier are exposed to oncoming traffic. For details on the F-Shape barrier or any of the bridge rail designs, see the *Bridge Design Manual*.

For aesthetic reasons, avoid changes in the shape of the barrier face within a project or corridor.

(a) **New Jersey Shape Barrier.** The New Jersey shape face is primarily used on precast concrete barrier.

Concrete barrier Type 2 (see the *Standard Plans*) is a precast barrier that has the New Jersey shape on two sides and can be used for both median and shoulder installations. This barrier is 2 feet 8 inches in height, which includes 3 inches for future pavement overlay.

The cost of precast Type 2 barrier is significantly less than the cost of the cast-in-place barriers. Therefore, consider the length of the barrier run and the deflection requirements to determine whether transitioning to precast Type 2 barrier is desirable. If precast Type 2 barrier is used for the majority of a project, use the New Jersey face for small sections that require cast-in-place barrier, such as for a light standard section.

Concrete barrier Type 4 is also a precast, single-faced New Jersey shape barrier. These units are not freestanding and must be placed against a rigid structure or anchored to the pavement. If Type 4 barriers are used back to back, consider filling any gap between them to prevent tipping.

Concrete barrier Type 5 is a precast barrier that has a single New Jersey face and is intended for use at bridge ends where the flat side is highly visible. Both Type 2 and Type 5 designs are freestanding, unanchored units connected with steel pins through wire rope loops. For permanent installation, this barrier is placed on a paved surface and a 2-foot-wide paved surface is provided beyond the barrier for its displacement during impact (see Chapter 640).

Precast barrier can be anchored where a more rigid barrier is desired. (Anchoring methods are shown in the *Standard Plans*.) The Type 1 and Type 2 anchors are for temporary installations on a rigid pavement. Type 3 anchors can be used in temporary or permanent installations on an asphalt pavement. Consult the HQ Bridge and Structures Office for details when anchoring permanent precast concrete barrier to a rigid pavement.

Precast barrier used on the approach to bridge rail must be connected to the bridge rail by installing wire rope loops embedded 1 foot 3 inches into the bridge rail with epoxy resin.

Place unrestrained (unanchored) precast concrete barrier on foundation slopes of 5% or flatter. In difficult situations, a maximum slope of 8% may be used. Keep the slope of the area between the edge of the shoulder and the face of the traffic barrier as flat as possible. The maximum slope is 10H:1V (10%).

(b) **Single-Slope Barrier**. The single-slope concrete barrier can be cast in place, slipformed, or precast. The most common construction technique for this barrier has been slipforming, but some precast single-slope barrier has been installed. The primary benefit of using precast barrier is that it can be used as temporary barrier during construction and then reset into a permanent location.

Single-slope barrier is considered a rigid system regardless of the construction method used. For new installations, the minimum height of the barrier above the roadway is 2 feet 10 inches, which allows 2 inches for future overlays. The minimum total height of the barrier section is 3 feet 6 inches, with a minimum of 3 inches embedded in the roadway wearing surface. This allows for use of the 3-foot-6-inch barrier between roadways with grade separations of up to 5 inches. A grade separation of up to 10 inches is allowed when using a 4-foot-6-inch barrier section, as shown in the *Standard Plans*. The barrier must have a depth of embedment equal to or greater than the grade separation. Contact the HQ Bridge and Structures Office for grade separations greater than 10 inches.

(c) **Low-Profile Barrier.** Low-profile barrier designs are available for median applications where the posted speed is 45 mph or less. These barriers are normally used in urban areas. They are typically 18 to 20 inches high and offer sight distance benefits. For barrier designs, terminals, and further details, contact the HQ Design Office.

(2) High-Performance Concrete Barrier

High-Performance Concrete Barrier (HP Barrier) is a rigid 42-inch-high barrier designed to function better during heavy-vehicle collisions. This taller barrier may also offer the added benefits of reducing headlight glare and reducing noise in surrounding environments. HP Barrier is generally considered single-slope barrier. (See the *Standard Plans* for barrier details.) For additional available shapes, contact the HQ Design Office.

For new/reconstruction, use HP Barrier in freeway medians of 22 feet or less. Also, use HP Barrier on interstate or freeway routes where accident history suggests a need or where roadway geometrics increase the possibility of larger trucks hitting the barrier at a high angle (for example, on-ramps for freeway-to-freeway connections with sharp curvature in the alignment).

Consider the use of HP Barrier at other locations, such as nonfreeway narrow medians, near highly sensitive environmental areas, near densely populated areas, over or near mass transit facilities, or on vertically divided highways.

(3) Concrete Barrier Terminals

Whenever possible, bury the end of the concrete barrier in the backslope. The backslope required to bury the end must be 3H:1V or steeper and at least 4 feet in height above the roadway. Flare the concrete barrier into the backslope using a flare rate that meets the criteria in 710.05(3). Provide a 10H:1V or flatter foreslope into the face of the barrier and maintain the full barrier height to the foreslope/backslope intersection. This might require filling ditches and installing culverts in front of the barrier face.

The 7-foot-long precast concrete terminal end section for concrete barrier Type 2 and the 10- to 12-foot single slope barrier terminal may be used:

- Outside the Design Clear Zone.
- On the trailing end of the barrier when it is outside the Design Clear Zone for opposing traffic.
- On the trailing end of one-way traffic.
- Where the posted speed is 25 mph or less.

Another available end treatment for Type 2 barriers is a precast or cast-in-place tapered terminal section having a minimum length of 48 feet and a maximum length of 80 feet. It is used infrequently for special applications and can only be used for posted speeds of 35 mph or less. For details, contact the HQ Design Office or refer to the Plan Sheet Library: www.wsdot.wa.gov/Design/Standards/PlanSheet/.

When the “Barrier Terminals and Transitions” column of a Design Matrix applies to a project, existing sloped-down concrete terminals that are within the Design Clear Zone must be replaced when they do not meet the above criteria.

When the end of a concrete barrier cannot be buried in a backslope or terminated as described above, terminate the barrier using a guardrail terminal and transition or an impact attenuator (see Chapter 720).

(4) Assessing Impacts to Wildlife

The placement of concrete barriers in locations where wildlife frequently cross the highway can influence traffic safety and wildlife mortality. When wildlife encounter physical barriers that are difficult to cross, they often travel parallel to those barriers. With traffic barriers, this means that they often remain on the highway for a longer period, increasing the risk of wildlife/vehicle collisions or vehicle/vehicle collisions as motorists attempt avoidance.

Traffic-related wildlife mortality may play a role in the decline of some species listed under the Endangered Species Act. To address public safety and wildlife concerns, see Figure 710-8 to assess whether concrete barrier placement requires an evaluation by the HQ Environmental Services Office to determine its effect on wildlife. Conduct this evaluation early in the project development process to allow adequate time for discussion of options.

(5) Assessing Impacts to Stormwater and Wetlands

In locations where medians or roadsides are used for drainage, the retention of stormwater or the existence of wetlands can influence the choice and use of barrier systems. For example, the placement of concrete barrier and beam guardrail in many of these cases may require the need for additional impervious material, which can result in complete retrofit and reconstruction of the existing systems. When water is drained, stored, or treated, and where wetlands exist, the ability to provide alternative facilities that replace the functions of the existing ones may be nonexistent or prohibitively expensive to provide elsewhere.

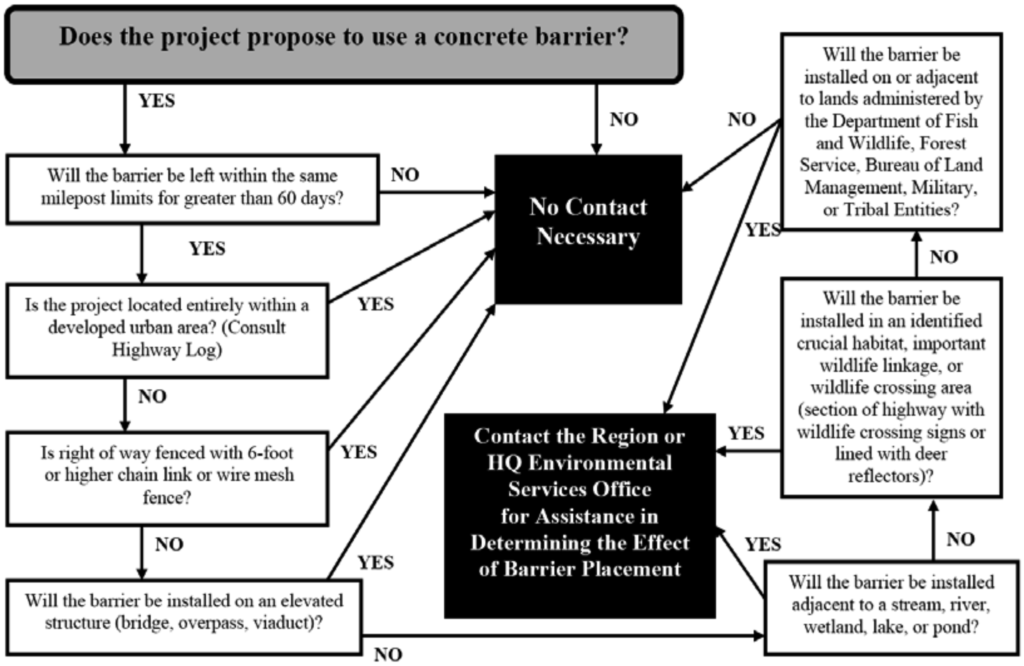
To address public safety, stormwater, and wetland concerns assess whether concrete barrier or beam guardrail placement requires an evaluation by the HQ Environmental Services Office. Conduct this evaluation early in the project development process to allow adequate time for discussion of options.

710.09 Special-Use Barriers

The following barriers may be used on designated Scenic Byway and Heritage Tour routes if funding can be arranged (see 710.05 and Chapter 120).

(1) Steel-Backed Timber Guardrail

Steel-backed timber guardrails consist of a timber rail with a steel plate attached to the back to increase its tensile strength. There are several variations of this system that have passed crash tests. The nonproprietary systems use a beam with a rectangular cross section that is supported by either wood or steel posts. A proprietary (patented) system called the Ironwood Guardrail is also available. This system uses a beam with a round cross section and is supported by steel posts with a wood covering to give the appearance of an all-wood system from the roadway. The Ironwood Guardrail can be allowed as an alternative to the nonproprietary system. However, specifying this system exclusively requires approval by an Assistant State Design Engineer of a public interest finding for the use of a sole source proprietary item.



Concrete Barrier Placement Guidance: Assessing Impacts to Wildlife
Figure 710-8

The most desirable method of terminating the steel-backed timber guardrail is to bury the end in a backslope, as described in 710.06(4). When this type of terminal is not possible, the use of the barrier is limited to highways with a posted speed of 45 mph or less. On these lower-speed highways, the barriers can be flared away from the traveled way and terminated in a berm.

For details on these systems, contact the HQ Design Office.

(2) Stone Guardwalls

Stone guardwalls function like rigid concrete barriers but have the appearance of natural stone. These walls can be constructed of stone masonry over a reinforced concrete core wall or of simulated stone concrete. These types of barriers are designed to have a limited projection of the stones that will not affect the redirectional characteristics of the barrier. The most desirable method of terminating this barrier is to bury the end in a backslope, as described in 710.08(3). When this type of terminal is not possible, the use of the barrier is limited to highways with a posted speed of 45 mph or less. On these lower-speed highways, the barrier can be flared away from the traveled way and terminated in a berm outside the Design Clear Zone.

For details on these systems, contact the HQ Design Office.

710.10 Bridge Traffic Barriers

Bridge traffic barriers redirect errant vehicles and prevent them from going over the side of the structure. (See the *Bridge Design Manual* for information regarding bridge barrier on new bridges and replacement bridge barrier on existing bridges.)

For new bridge rail installations, use a 2-foot-10-inch-high single slope or a 2-foot-8-inch-high safety shape (F-Shape) bridge barrier. A transition is available to connect the New Jersey shape (Type 2 concrete barrier) and the F-Shape bridge barrier. (See the *Standard Plans* for further details.) Use taller 3-foot-6-inch safety shape or single-slope bridge barriers on interstate or freeway routes where accident history suggests a need or where roadway geometrics increase the possibility of larger trucks hitting the barrier at a high angle (such as on-ramps for freeway-to-freeway connections with sharp curvature in the alignment).

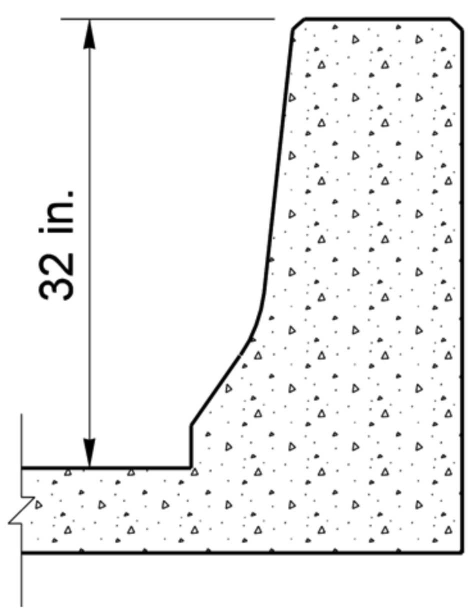
For further guidance on bridges where high volumes of pedestrian traffic are anticipated, see Chapter 1020.

Approach barriers, transitions, and connections are usually required on all four corners of bridges carrying two-way traffic and on both corners of the approach end for one-way traffic. (See 710.06(5) for guidance on transitions.)

If the bridge barrier system does not meet the criteria for strength and geometrics, modifications to improve its redirectional characteristics and its strength may be required. The modifications can be made using one of the retrofit methods described below.

(1) Concrete Safety Shape

Retrofitting with a new concrete bridge barrier (see Figure 710-9) is costly and requires justification when no widening is proposed. Consult the HQ Bridge and Structures Office for design details and to determine whether the existing bridge deck and other superstructure elements are of sufficient strength to accommodate this bridge barrier system.



Safety Shape Concrete Bridge Rail Retrofit
Figure 710-9

(2) Thrie Beam Retrofit

Retrofitting with thrie beam is an economical way to improve the strength and redirectional performance of bridge barriers. The thrie beam can be mounted to steel posts or the existing bridge barrier, depending on the structural adequacy of the bridge deck, the existing bridge barrier type, the width of curb (if any), and the curb-to-curb roadway width carried across the structure.

The HQ Bridge and Structures Office is responsible for the design of thrie beam bridge barrier. Figure 710-15 shows typical installation criteria. Contact the HQ Bridge and Structures Office for assistance with thrie beam retrofit design.

Consider the Service Level 1 (SL-1) system on bridges with wooden decks and for bridges with concrete decks that do not have adequate strength to accommodate the thrie beam system. Contact the HQ Bridge and Structures Office for information required for the design of the SL-1 system.

A sidewalk reduction of up to 6 inches as a result of a thrie beam retrofit can be documented as a design exception.

The funding source for retrofit of existing bridge rail is dependent on the length of the structure. Bridge rail retrofit, for bridges less than 250 feet in length (or a total bridge rail length of 500 feet), is funded by the project (Preservation or Improvement). For longer bridges, the retrofit can be funded by the I-2 subprogram. Contact HQ Program Development to determine if funding is available.

710.11 Other Barriers

(1) Dragnet

The Dragnet Vehicle Arresting Barrier consists of chain link or fiber net that is attached to energy absorbing units. When a vehicle hits the system, the Dragnet brings the vehicle to a controlled stop with limited damage. Possible uses for this device include the following:

- Reversible lane entrances and exits
- Railroad crossings
- Truck escape ramps (instead of arrester beds—see Chapter 1010)
- T-intersections
- Work zones
- Swing span bridges

For permanent installations, this system can be installed between towers that lower the unit into position when needed and lift it out of the way when it is no longer needed. For work zone applications, it is critical to provide deflection space for stopping the vehicle between the system and the work zone. For additional information on the Dragnet, contact the HQ Design Office.

710.12 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/

<table>
<tr><th colspan="3">Connecting W-Beam Guardrail to: Transitions and Connections</th><th>Transition Type*</th><th>Connection</th></tr>
<tr><td rowspan="9">Bridge Rail</td><td colspan="2">New</td><td>20, 21, 4[4]</td><td>D</td></tr>
<tr><td rowspan="3">Existing Concrete</td><td>Concrete Parapet > 20 inches</td><td>20, 21, 4[4]</td><td>Figure 710-6</td></tr>
<tr><td>Concrete Parapet < 20 inches</td><td>2, 4[4]</td><td>Figure 710-6</td></tr>
<tr><td>Existing W-Beam Transition</td><td>2[1][5], 4[4]</td><td>[1]</td></tr>
<tr><td rowspan="2">Thrie Beam at face of curb[4]</td><td>Approach end</td><td>21</td><td>n/a</td></tr>
<tr><td>Trailing end
(two-way traffic only)</td><td>21</td><td>n/a</td></tr>
<tr><td rowspan="2">Thrie Beam at bridge rail (curb exposed)[4]</td><td>Approach end</td><td>22</td><td>n/a</td></tr>
<tr><td>Trailing end
(two-way traffic only)</td><td>22</td><td>n/a</td></tr>
<tr><td colspan="2">Weak Post Intersection Design (see 710.06(4), Cases 12 & 13)</td><td>5</td><td>Figure 710-6</td></tr>
<tr><td rowspan="2">Concrete Barrier</td><td colspan="2">Rigid Restrained</td><td>21, 4[4]</td><td>Figure 710-6</td></tr>
<tr><td colspan="2">Unrestrained</td><td>2, 4[4]</td><td>A</td></tr>
<tr><td>Weak Post Barrier Systems (Type 20 and 21)</td><td colspan="2"></td><td>6</td><td>n/a</td></tr>
<tr><td rowspan="2">Rigid Structures such as Bridge Piers</td><td colspan="2">New Installation (see Case 11)</td><td>16, 17, 18</td><td>n/a</td></tr>
<tr><td colspan="2">Existing W-Beam Transition</td><td>[2]</td><td>n/a</td></tr>
<tr><th colspan="3">Connecting Thrie Beam Guardrail to:</th><td></td><td></td></tr>
<tr><td>Bridge Rail or Concrete Barrier</td><td colspan="2">New installation (example: used with thrie beam bull nose)</td><td>1B</td><td>Figure 710-6</td></tr>
</table>

* Consult Section C of the *Standard Plans* for details on transition types.

Notes:

[1] If work requires reconstruction or resetting of the transition, upgrade as shown above. Raising the guardrail is not considered reconstruction. If the transition is not being reconstructed, the existing connection may remain in place. When Type 3 anchors are encountered, see 710.06(4)(d) for guidance.

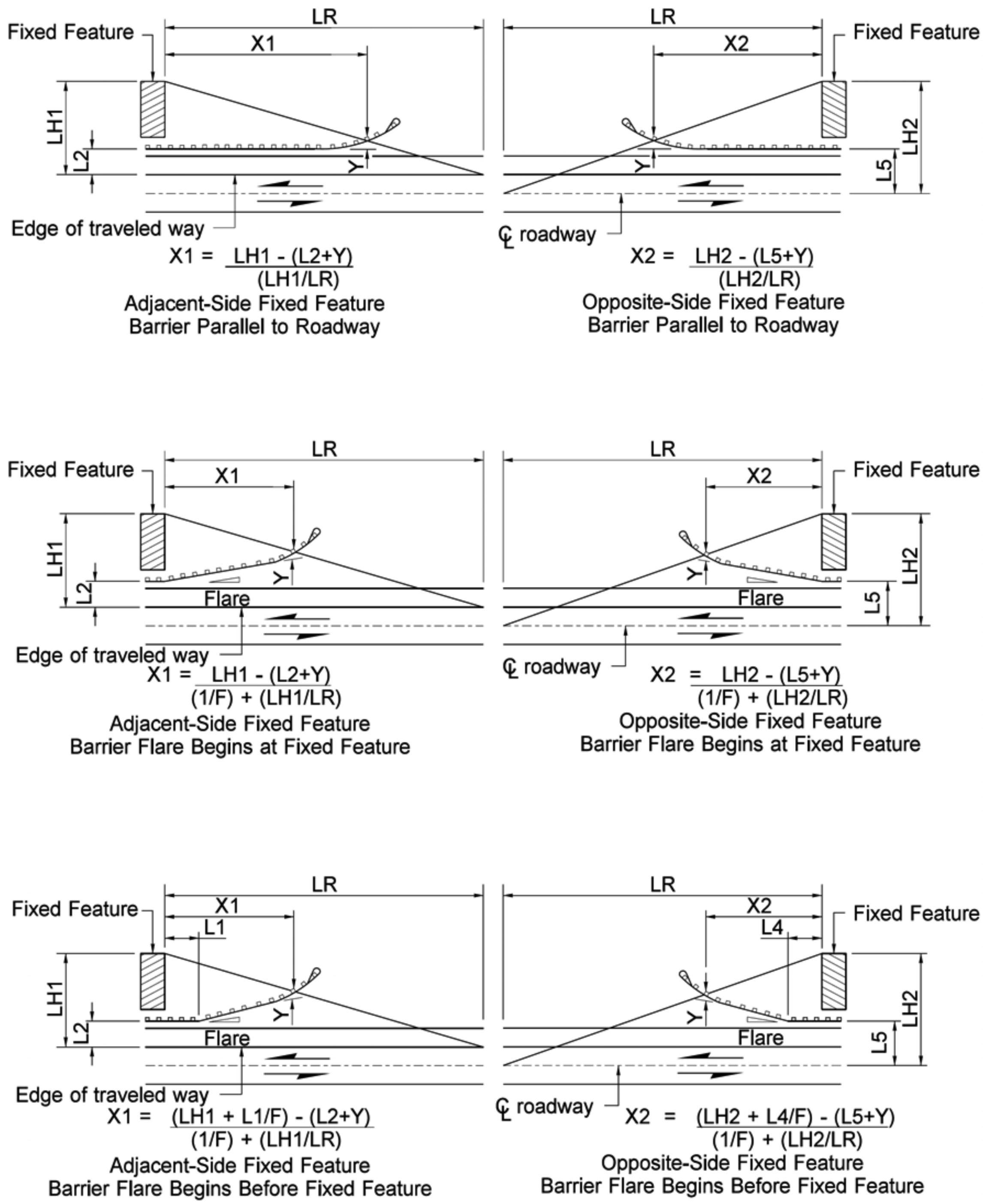
[2] For new/reconstruction, use Case 11 (thrie beam). For existing Case 11 with W-beam, add a second W-beam rail element.

[3] For Service Level 1 bridge rail, see 710.06(6), Case 14.

[4] Use on highways with speeds 45 mph or less.

[5] If existing transition has adequate guardrail height—three 10″ x 10″ (nominal) posts and three 6″ x 8″ (nominal) posts spaced 3′-1.5″ apart—it is acceptable to nest existing single W-beam element transitions.

Transitions and Connections
Figure 710-10



Barrier Length of Need on Tangent Sections

Figure 710-11a

Posted Speed (mph)	Design Parameters						
	ADT				Barrier Type		
	Over 10,000	5,000 to 10,000	1,000 to 4,999	Under 1,000	Rigid Barrier	Unrestrained Barrier	Semirigid Barrier
	LR (ft)	LR (ft)	LR (ft)	LR (ft)	F	F	F
65 & 70	460	395	345	295	20	18	15
60	360	295	260	230	18	16	14
55	310	260	230	195	16	14	12
50	260	215	180	165	14	12	11
45	245	195	165	150	12	11	10
40	215	180	150	130	11	10	9
35	185	155	130	115	11	10	9
30	165	135	115	105	11	10	9
25	150	125	105	95	11	10	9

L1 = Length of barrier parallel to roadway from adjacent-side fixed feature to beginning of barrier flare. This is used if a portion of the barrier cannot be flared (such as a bridge rail and the transition).

L2 = Distance from adjacent edge of traveled way to portion of barrier parallel to roadway.

L4 = Length of barrier parallel to roadway from opposite-side fixed feature to beginning of barrier flare.

L5 = Distance from centerline of roadway to portion of barrier parallel to roadway. Note: If the fixed feature is outside the Design Clear Zone when measured from the centerline, it may only be necessary to provide a crash-tested end treatment for the barrier.

LH1 = Distance from outside edge of traveled way to back side of adjacent-side fixed feature. Note: If a fixed feature extends past the Design Clear Zone, the Design Clear Zone can be used as LH1.

LH2 = Distance from centerline of roadway to back side of opposite-side fixed feature. Note: If a fixed feature extends past the Design Clear Zone, the Design Clear Zone can be used as LH2.

LR = Runout length—measured parallel to roadway.

X1 = Length of need for barrier to shield an adjacent-side fixed feature.

X2 = Length of need for barrier to shield an opposite-side fixed feature.

F = Flare rate value.

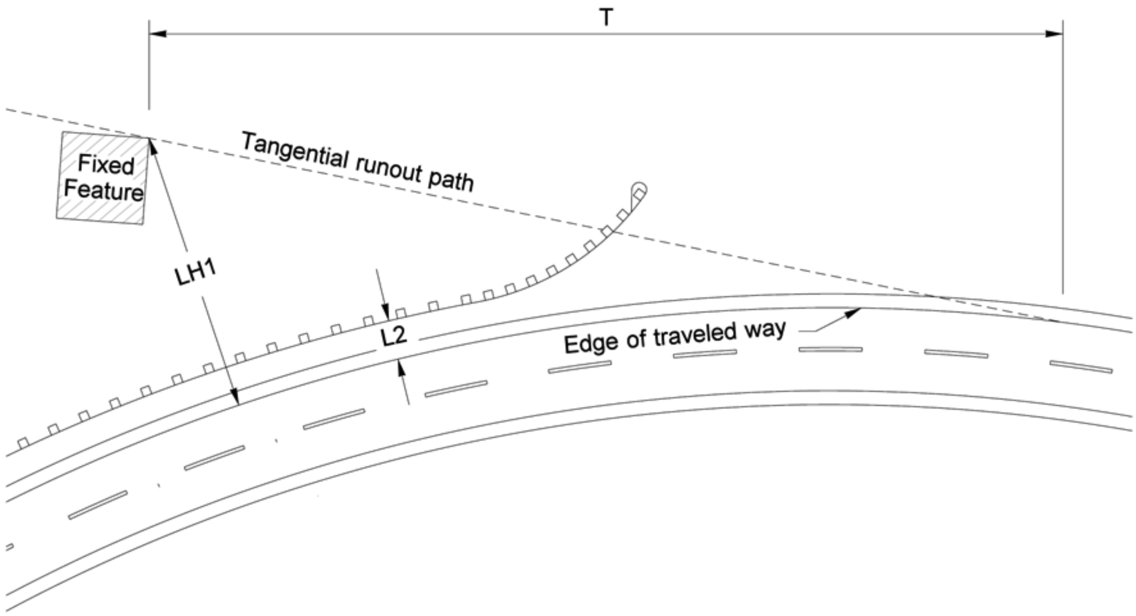
Y = Offset distance required at the beginning of the length of need.

Different end treatments require different offsets.

- For the SRT 350 and FLEAT 350, use Y = 1.8 feet.
- For evaluating existing BCTs, use Y = 1.8 feet.
- For the FLEAT TL-2, use Y = 0.8 feet.
- No offset is required for the nonflared terminals or impact attenuator systems. Use Y = 0.
- Buried terminal end treatments are used with barrier flares and have no offset. Use Y = 0.

Barrier Length of Need

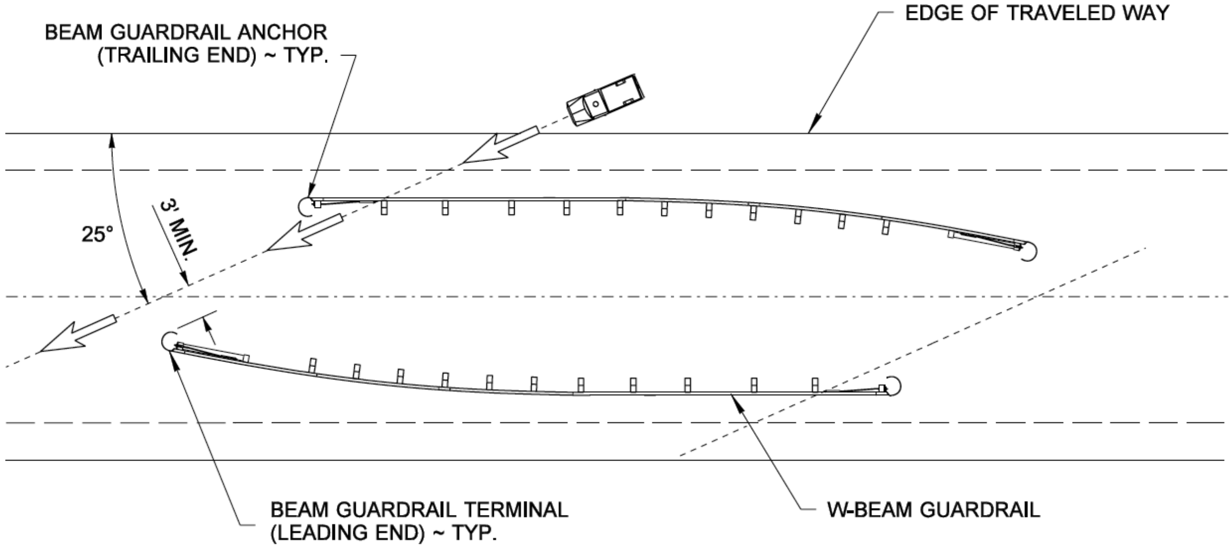
Figure 710-11b



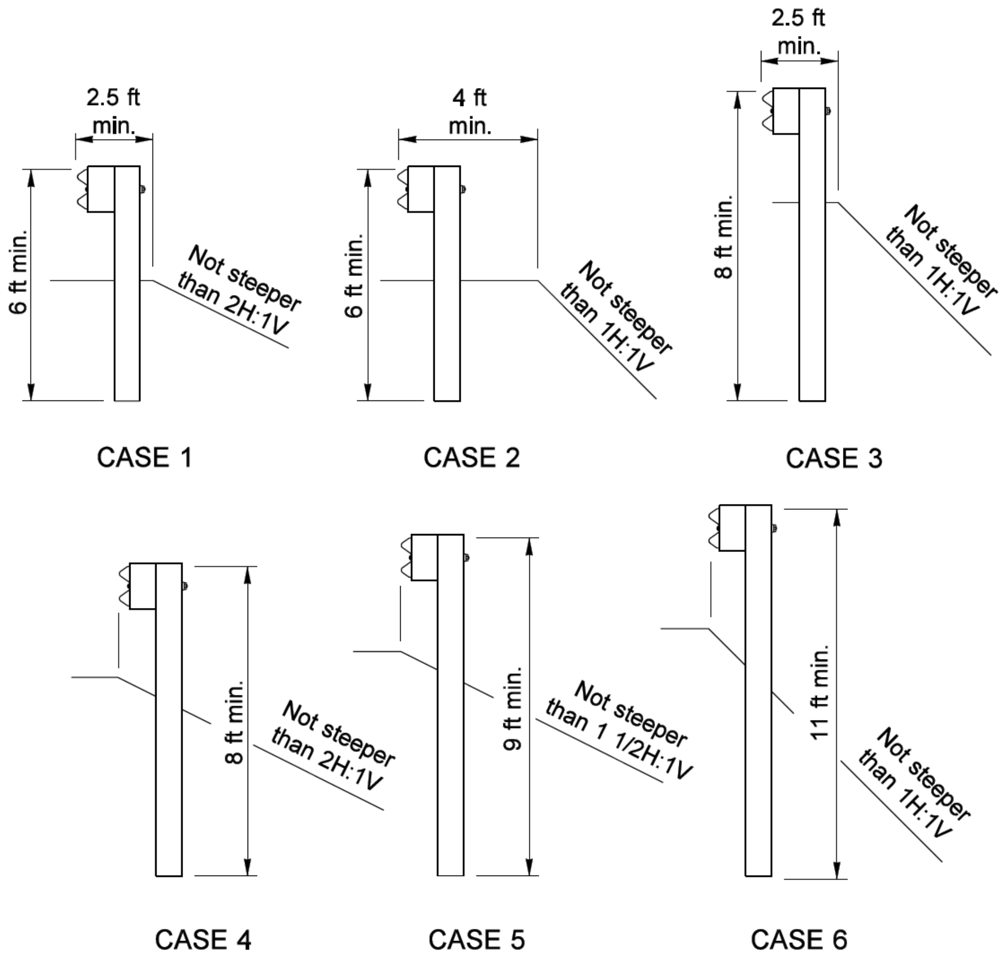
Notes:

- This is a graphical method for determining the length of need for barrier on the outside of a curve.
- On a scale drawing, draw a tangent from the curve to the back of the fixed feature. Compare T to LR from Figure 710-11b and use the shorter value.
- If using LR, follow Figures 710-11a and 11b.
- If using T, draw the intersecting barrier run to scale and measure the length of need.

Barrier Length of Need on Curves
Figure 710-11c



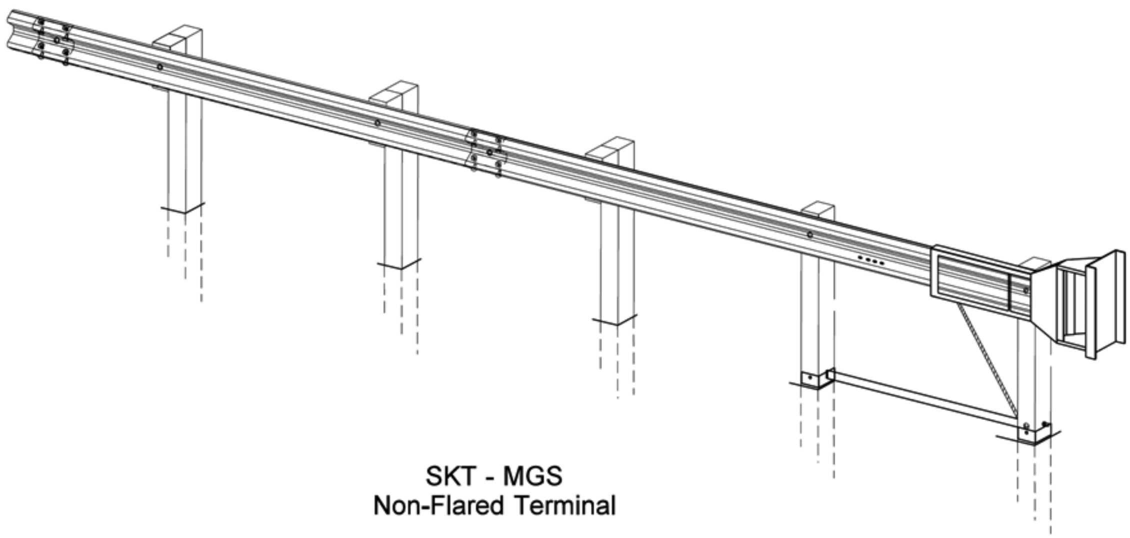
W-Beam Guardrail Trailing End Placement for Divided Highways
Figure 710-11d



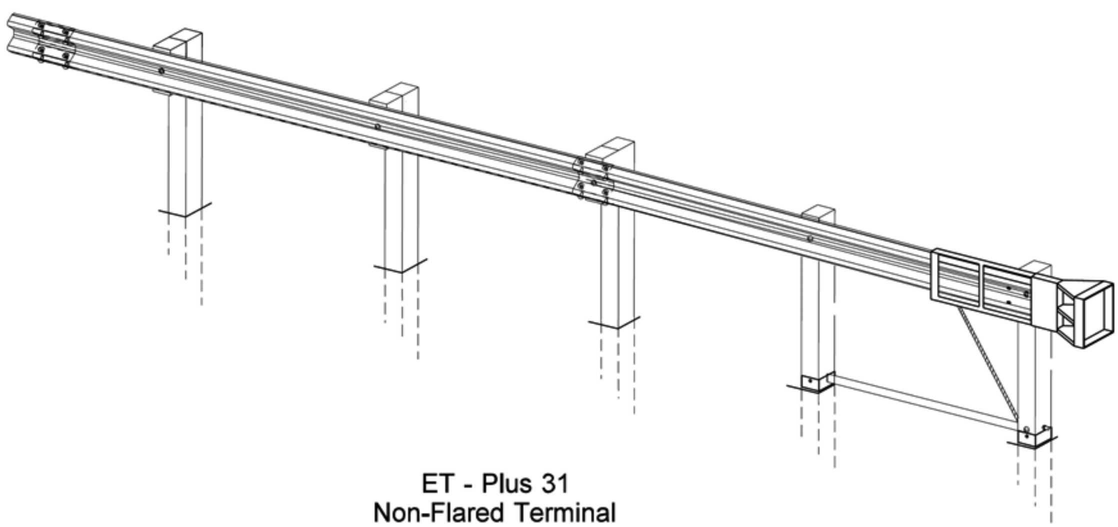
Notes:

- Use Cases 1 and 3 when there is a 2.5-foot or greater shoulder widening from face of guardrail to the breakpoint.
- Use Case 2 when there is a 4.0-foot or greater shoulder widening from the face of the guardrail to the breakpoint.
- Use Cases 4, 5, and 6 when there is less than a 2.5-foot shoulder widening from face of guardrail to the breakpoint.

Beam Guardrail Post Installation
Figure 710-12

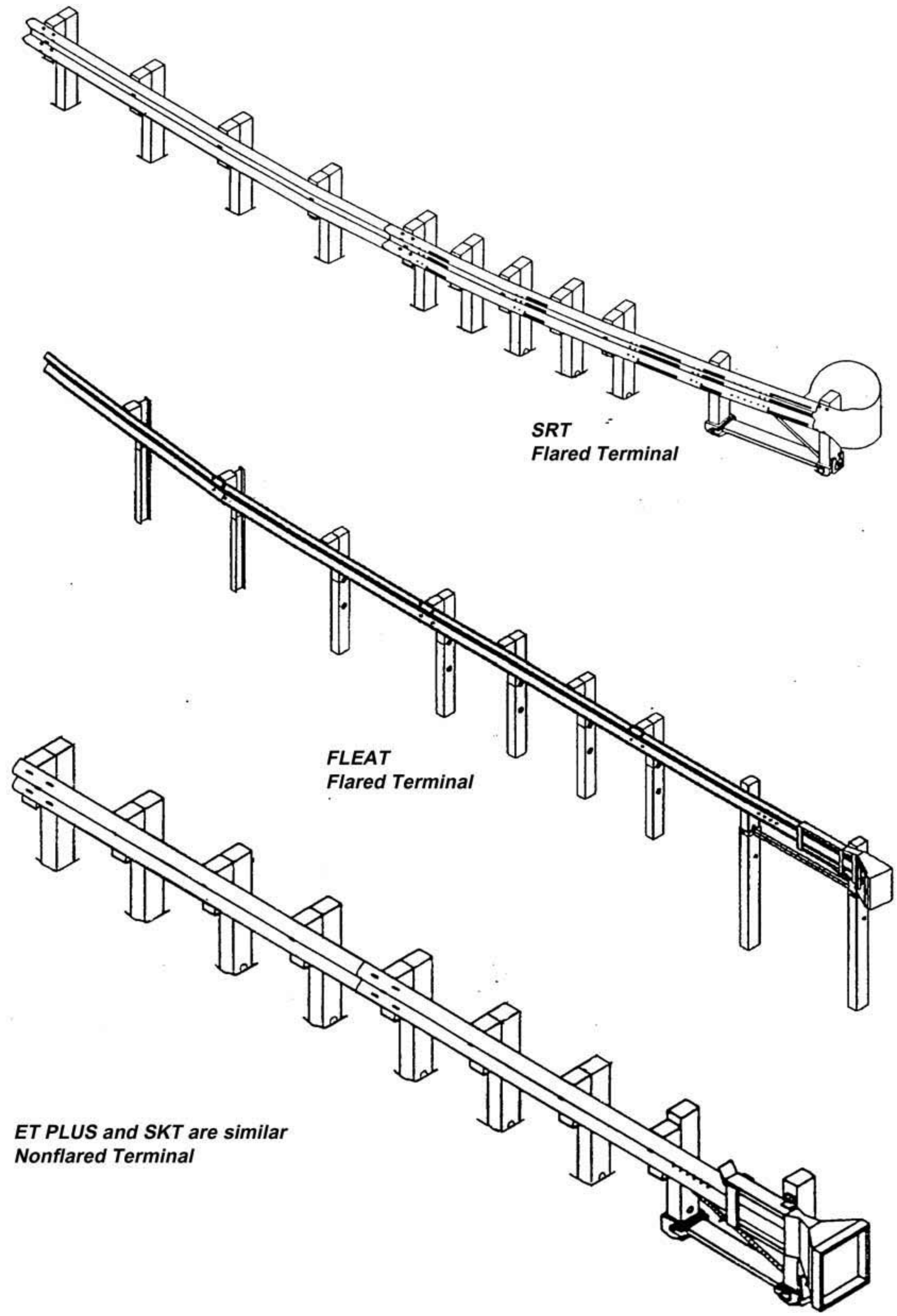


SKT - MGS
Non-Flared Terminal

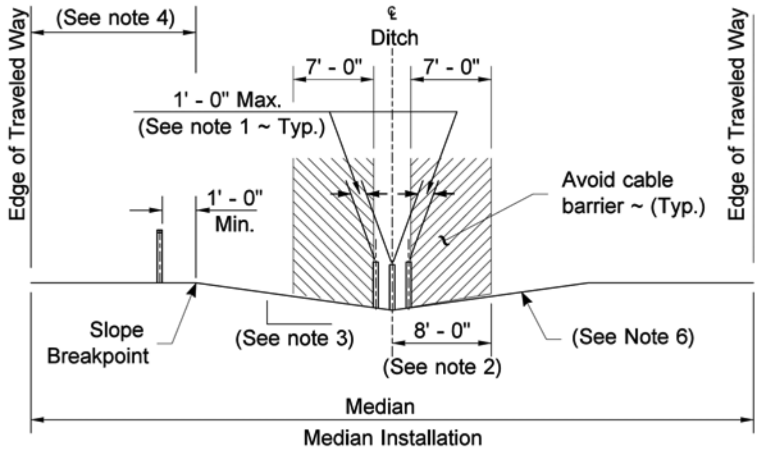


ET - Plus 31
Non-Flared Terminal

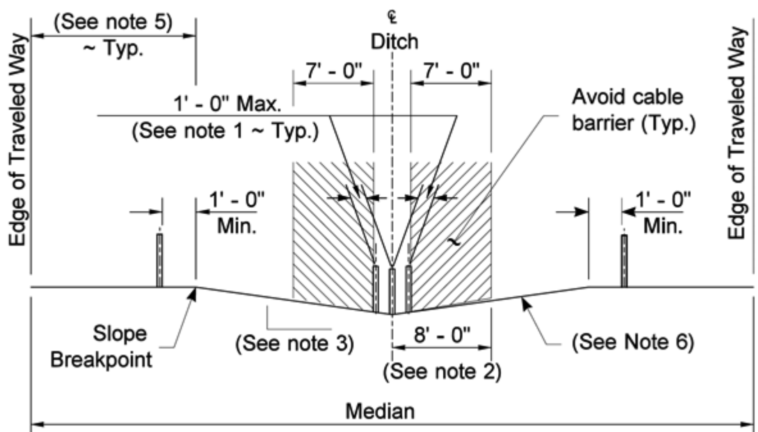
Beam Guardrail Terminals
Figure 710-13a



Beam Guardrail Terminals
Figure 710-13b



Median Installation
(Single Run)



Median Installation
(Double Run)

Notes:

[1] Cable barrier may be installed in the center of the ditch. The cable barrier may be offset from the ditch centerline a maximum of 1 foot in either direction.

[2] Avoid installing cable barrier within a 1-foot to 8-foot offset from the ditch centerline.

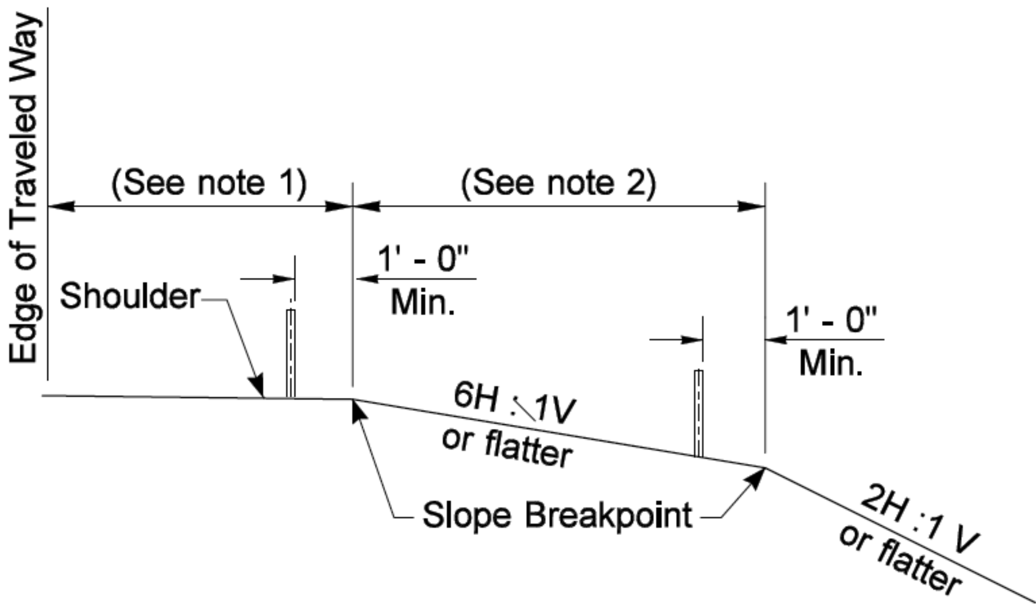
[3] Applies to slopes between 10H:1V and 6H:1V.

[4] For single-runs of cable median barrier, if there is at least 13 feet from edge of the nearest traveled lane to the slope breakpoint, place the cable median barrier at least 1 foot in front of the slope breakpoint. Any approved Test Level 3 or Test Level 4 high-tension barrier system may be used in this location.

[5] For double-runs of cable median barrier, if there is at least 11 feet from edge of the nearest traveled lane to the slope breakpoint, place the cable median barrier at least 1 foot in front of the slope breakpoint. Any approved Test Level 3 or Test Level 4 high-tension barrier system may be used in this location.

[6] Use only an approved Test Level 4 high-tension cable barrier system within the acceptable locations shown between slope breakpoints.

Cable Barrier Locations on Median Slopes
Figure 710-14a



Shoulder Installation

Notes:

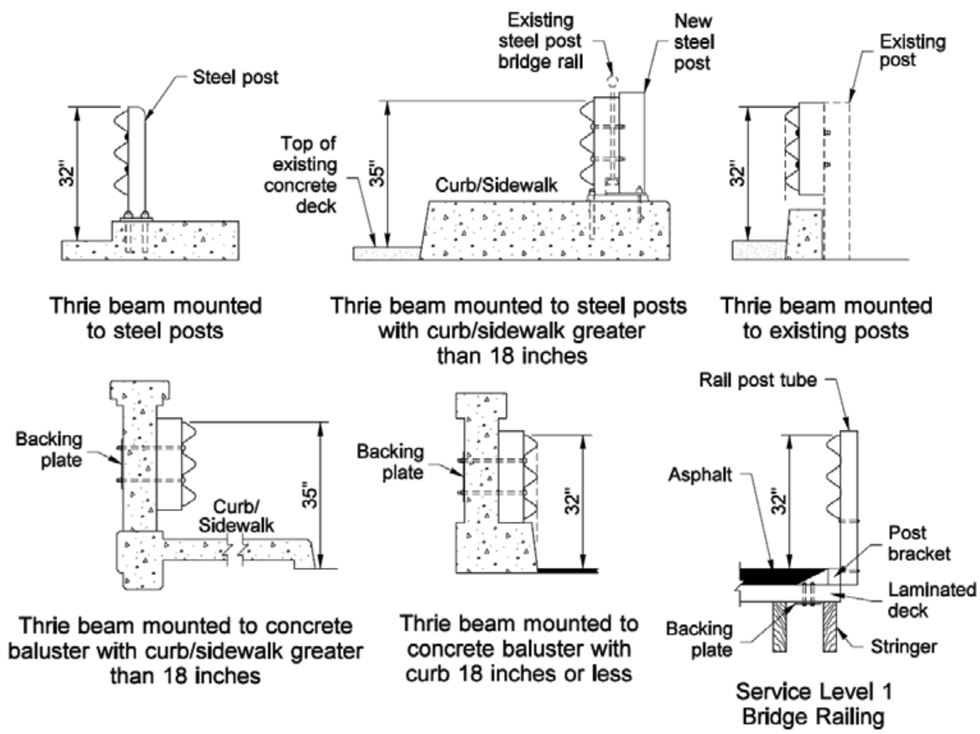
[1] Any approved Test Level 3 or Test Level 4 high-tension barrier system may be used in this location.

[2] Use only an approved Test Level 4 high-tension cable barrier system within the acceptable locations shown between slope breakpoints.

Test Level 3 systems currently under development may be appropriate for placement in these locations in the future. Contact the HQ Design Office for further details.

Cable Barrier Locations on Shoulder Slopes
Figure 710-14b

Curb Width	Bridge Width	Concrete Bridge Deck		Wood Bridge Deck or Low- Strength Concrete Deck
		Concrete Bridge Rail (existing)	**Steel or Wood Post Bridge Rail (existing)**	
<18 inches		Thrie beam mounted to existing bridge rail[2] and blocked out to the face of curb. Height = 32 inches	Thrie beam mounted to steel posts[2] at the face of curb. Height = 32 inches	Service Level 1 Bridge Rail[2]
>18 inches	**> 28 ft (curb to curb)**	Thrie beam mounted to steel posts[2] at the face of curb.[1] Height = 32 inches		Height = 32 inches
>18 inches	**< 28 ft (curb to curb)**	Thrie beam mounted to existing bridge rail.[2] Height = 35 inches	Thrie beam mounted to steel posts[2] in line with existing rail. Height = 35 inches	Curb or wheel guard must be removed



Notes:

[1] Thrie beam may be mounted to the bridge rail to accommodate pedestrians (height = 35 inches).

[2] Contact the HQ Bridge and Structures Office for design details on bridge rail retrofit projects.

Thrie Beam Rail Retrofit Criteria
Figure 710-15

(g) **Reusable Energy Absorbing Crash Terminal (REACT** 350)

1. **Purpose:** The REACT 350 is an end treatment for concrete barriers and is also used for fixed objects up to 3 feet wide.

2. **Description:** The system consists of polyethylene cylinders with varying wall thickness, redirecting cables, a steel frame base, and a backup structure. (See Figure 720-2d.)

3. **Function:** The redirecting cables are anchored in the concrete foundation at the front of the system and in the backup structure at the rear of the system. When hit head-on, the cylinders compress, absorb the impact energy, and immediately return to much of their original shape, position, and capabilities. For side impacts, the cables restrain the system enough to prevent penetration and redirect the vehicle. It is anticipated that this system will require very few replacement parts or extensive repair.

4. **Foundation:** The system is installed on a concrete foundation.

5. **Slope**: If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is required. Excessive is defined as steeper than 8% for the REACT 350.

6. **Manufacturer/Supplier:** Energy Absorption Systems

(h) (REACT 350 Wide)

1. Purpose: The REACT 350 Wide is a device that can be used to shield objects with widths up to 10 feet wide.

2. Description: The system consists of polyethylene cylinders with varying wall thickness, internal struts, space frame diaphragms, and a monorail. (See Figure 720-2d.)

3. Function: When hit head-on, the cylinders compress, absorb the impact energy, and immediately return to much of their original shape, position, and capabilities. For side impacts, the system is designed to restrain and redirect the vehicle. It is anticipated that this system will require very few replacement parts or extensive repairs.

4. Foundation: The system is installed on a concrete foundation.

5. Slope: If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is required. Excessive is defined as steeper than 8% for the REACT 350 Wide.

6. Manufacturer/Supplier: Energy Absorption Systems

(i) **Inertial Barrier**

Inertial barrier configurations are shown in the Standard Plans. If a situation is encountered the configurations in the Standard Plans are not appropriate, contact the HQ Design Office for further information.

1. **Purpose:** Inertial barrier is an end treatment for concrete barrier and is used to mitigate fixed objects. This system does not provide redirection from a side impact.

2. **Description:** This system consists of an array of plastic containers filled with varying weights of sand. (See Figure 720-2d.)

3. **Function:** The inertial barriers slow an impacting vehicle by the transfer of the momentum of the vehicle to the mass of the barrier. This system is not suitable where space is limited to less than the widths shown in the Standard Plans. Whenever possible, align inertial barriers so that an errant vehicle deviating from the roadway by 10° would be on a parallel path with the attenuator alignment. (See the Standard Plans.) In addition, inertial barriers do not provide any redirection and are not appropriate where high angle impacts are likely.

4. **Foundation**: A concrete or paved surface is recommended.

5. **Slope**: If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is required. Excessive is defined as steeper than 5% for inertial barriers.

(j) **SCI100GM / SCI70GM**

1. **Purpose:** The SCI100GM / SCI70GM are end treatments that can be used for concrete barrier and beam guardrail with widths up to 2 feet.

2. **Description:** The system for both models consists of telescoping quadruple corrugated fender panels mounted on both sides of a series of tubular steel support frames. (See Figure 720-2e.)

3. **Function:** A hydraulic cylinder is compressed during a head-on impact.

4. **Foundation:** The system is installed on a concrete or asphalt foundation. (See manufacturer's installation requirements for details.)

5. **Slope:** 12H:1V or flatter slope between the edge of the traveled way and the near face of the unit.

6. **Manufacturer/Supplier:** Work Area Protection Corp.

In addition to the systems approved above, the TRACC impact attenuator may be considered for permanent use, with the concurrence of Maintenance personnel.

(2) Work Zone (Temporary) Installation

Several of the impact attenuators previously listed under the heading "Permanent Installations" are also appropriate for use in work zones or other temporary locations. The following is a list of these devices:

- QuadGuard
- QuadGuard Elite
- REACT 350
- REACT 350 Wide
- Inertial Barriers
- SCI100GM
- SCI70GM

The following systems are appropriate only in work zones or other temporary installations.

A description of each work zone (or other temporary) system's purpose, parts, and functionality, as well as requirements for transition, foundation, and slope, are provided as follows and in Figure 720-5:

(a) **ABSORB 350**

1. **Purpose:** The ABSORB 350 is an end treatment limited to temporary installations for both concrete barrier and the Quickchange Moveable Barrier (QMB).

2. **Description:** The system contains water-filled Energy Absorbing Elements. Each element is 2 feet wide, 2 feet 8 inches high, and 3 feet 3 ½ inches long. (See Figure 720-3.)

3. **Function:** The low-speed (below 45 mph) system uses five Energy Absorbing Elements and the high-speed (45 mph and above) system uses eight. The energy of an impact is dissipated as the elements are crushed.

4. **Foundation:** The system does not require a paved foundation.

5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.

6. **Manufacturer/Supplier:** Barrier Systems, Inc.

(b) **Advanced Dynamic Impact Extension Module 350 (ADIEM 350)**

1. **Purpose:** The ADIEM 350 is limited to temporary installations where vehicle speeds are 45 mph or less. It is generally used as an end treatment for concrete barrier. Currently, there are a few existing permanent units in service. It is permissible to reset these existing devices. However, some of these units may exhibit significant deterioration and replacement may be the appropriate option.

2. **Description:** The system is 30 feet long and consists of 10 lightweight concrete modules on an inclined base. (See Figure 720-3.)

3. **Functionality:** An inclined base provides a track for placement of the modules and provides redirection for side impacts for roughly half the length. The energy of an impact is dissipated as the concrete modules are crushed.

4. **Foundation:** The system does not require a paved foundation.

5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is required. Excessive is defined as steeper than 8% for the ADIEM 350.

6. **Manufacturer/Supplier:** Trinity Industries, Inc.

(c) **QuadGuard CZ**

This system is like the permanent QuadGuard listed for permanent systems above except that it can be installed on a 6-inch-minimum-depth asphalt concrete surface that has a 6-inch-minimum-depth compacted base. (See Figure 720-2b.)

(d) **Reusable Energy Absorbing Crash Terminal (REACT 350)**

This is the same system listed for permanent systems above except that it can be installed on a 6-inch-minimum-depth asphalt concrete surface that has a 6-inch-minimum-depth compacted base. (See Figure 720-2d.)

(e) **Non-Redirecting Energy Absorbing Terminal (N-E-A-T)**

1. **Purpose:** The N-E-A-T system is an end treatment for temporary concrete barrier where vehicle speeds are 45 mph or less.

2. **Description:** The N-E-A-T System's cartridge weighs about 300 pounds and is 9 feet-8 inches long. The system consists of aluminum cells encased in an aluminum shell with steel backup, attachment hardware, and transition panels. It can be attached to the ends of New Jersey shaped portable concrete barrier and the QuickChange Moveable Barrier. (See Figure 720-3.)

3. **Functionality:** The energy of an impact is dissipated as the aluminum cells are crushed.

4. **Foundation:** The system does not require a paved foundation.

5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.

6. **Manufacturer/Supplier:** Energy Absorption Systems

(f) **Trinity Attenuating Crash Cushion (TRACC)**

1. **Purpose:** The TRACC is an end treatment for concrete barriers. It is limited to use in construction or other work zones on a temporary basis.

2. **Description:** The 21-foot-long TRACC includes four major components: a pair of guidance tracks, an impact sled, intermediate steel frames, and 10 gauge W-beam fender panels. (See Figure 720-3.)

3. **Functionality:** The sled (impact face) is positioned over the upstream end of the guidance tracks and contains a hardened steel blade that cuts the metal plates on the sides of the guidance tracks as it is forced backward when hit head-on.

4. **Foundation:** The system requires a concrete foundation.

5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.

6. **Manufacturer/Supplier:** Trinity Industries, Inc.

(g) **Inertial Barrier**

This is the same system listed for permanent systems above. It is not suitable where space is limited to less than the widths shown in the Standard Plans. (See Figure 720-2d.)

(h) **Truck Mounted Attenuator (TMA)**

TMAs are portable systems mounted on trucks. They are intended for use in work zones and for temporary hazards.

(i) **Triton CET**

1. **Purpose:** The Triton CET is an end treatment limited to temporary concrete barrier installations.

2. **Description:** The system contains water-filled Energy Absorbing Elements. (See Figure 720-3.)

3. **Function:** The system uses six Energy Absorbing Elements. The energy of an impact is dissipated as the elements are crushed.

4. **Foundation:** The system does not require a paved foundation.

5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.

6. **Manufacturer/Supplier:** Energy Absorption, Inc.

(j) **QUEST**

1. **Purpose:** The QUEST is an end treatment limited to temporary applications. This system is designed to shield hazards 2 feet or less in width.

2. **Description:** The system consists of two front anchor assemblies; a nose assembly containing an integrated trigger assembly; two shaper rail assemblies; a support rail assembly with two energy absorbing tube shapers; a diaphragm assembly; a bridge assembly; two rear rails; a freestanding backup assembly; and W-beam fender panels. Transition panels are required when traffic approaches from the rear of the unit.

3. **Function:** During head-on impacts, the Quest system telescopes rearward and energy is absorbed through momentum transfer, friction, and deformation. When impacted from the side, the QUEST System restrains lateral movement by dynamic tension developed between the end restraints.

4. **Foundation:** The system is installed on a concrete or asphalt foundation. (See manufacturer's installation requirements for details.) The unit is attached to the road surface with 30 to 34 anchors.

5. **Slope:** 12H:1V (8%) or flatter slope between the edge of the traveled way and the near face of the unit is required. In addition, if the slope varies (twists) more than 2% over the length of the system, a concrete leveling pad may be required.

6. **Manufacturer/Supplier:** Energy Absorption Systems Inc.

(3) Older Systems

The following systems are in use on Washington State highways and may be left in place or reset. New installations of these systems require approval from the HQ Design Office.

(a) **Sentre**

The Sentre is a guardrail end treatment. Its overall length of 17 feet allowed it to be used where space was not available for a guardrail transition and terminal. The system is very similar to the QuadTrend 350 in both appearance and function except that it uses thrie beam fender panels instead of the quadruple corrugated panels. This system requires a transition when used to terminate rigid barriers. (See Figure 720-4a.)

(b) **TREND**

The TREND is an end treatment with a built-in transition and was used at the end of rigid barriers including bridge rails. The system is similar to the QuadTrend 350 except that it uses thrie beam fender panels. (See Figure 720-4a.)

(c) **G-R-E-A-T (Guard Rail Energy Absorption Terminal)**

This system was primarily used as an end treatment for concrete barrier. It is similar to the QuadGuard except that it uses thrie beam fender panels. (See Figure 720-4a.)

(d) **Low Maintenance Attenuator System (LMA)**

The LMA is an end treatment for concrete barrier and beam guardrail and was used for fixed objects up to 3 feet wide. The system is similar to the QuadGuard Elite except that it uses thrie beam fender panels and rubber cylinders. See Figure 720-4b.

(e) **Hex-Foam Sandwich**

The Hex-Foam Sandwich system is an end treatment for beam guardrail and concrete barrier and was also used for fixed objects 3 feet or more in width. This system consists of a number of Hex-Foam cartridges containing an energy absorption material separated by a series of diaphragms and restrained by anchor cables. It is installed on a concrete slab. Impact energy is absorbed by the internal shearing of the cartridges and crushing of the energy absorption material. The lapped panels on the perimeter serve to redirect vehicles for side impacts. If the site has grade or cross slope in excess of 5%, additional site preparation or modification to the units in accordance with the manufacturer's literature is required. (See Figure 720-4b.)

720.02 Design Criteria

The following design criteria apply to all new or reset permanent and temporary impact attenuators. The design criteria also apply to existing systems to be left in place when the Barrier Terminals and Transition Sections columns on a design matrix applies to the project. (See Chapter 325.)

Impact attenuators must be placed so that they do not present a hazard to opposing traffic. For median and reversible lane locations, the backup structure or attenuator-to-object connection must be designed to prevent opposing traffic from being snagged. It is desirable that all existing curbing be removed and the surface smoothed with asphalt or cement concrete pavement before an impact attenuator is installed. However, curbs 4 inches or less in height may be retained depending on the practicality of their removal. In general, attenuators are aligned parallel to the roadway except the inertial barriers.

720.03 Selection

When selecting an impact attenuator system, consider the following:

- Posted speed
- Available space (length and width)
- Maintenance costs
- Initial cost
- Duration (permanent or temporary use)
- The portion of the impact attenuator that is redirective/nonredirective. (See figures 720-5 and 6.)

It is very important for designers to consider the portion of an impact attenuator that will redirect vehicles during a side impact of the unit. It is crucial to consider that fixed objects, either permanent or temporary (such as construction equipment), should not be located behind the non-redirective portion of these devices.

The posted speed is a consideration in the selection of the QuadGuard, REACT 350, Universal TAU-II and the Inertial Barrier systems. Use Figure 720-1 to select permanent system sizes required for the various posted speeds.

Posted Speed (mph)	Quad Guard (Bays)	Universal TAU-II(1) (Bays)	REACT 350 (Cylinders)	Inertial Barrier (Type)
40 or less	3	2-3	4	1
45	4	3-4	6	2
50	5	4-5	6	3
55	6	5-7	6	4
60	6	7-8	9	5
65	8	7-8	9	6
70	9	7-8	9	6
(1) Dependent on the width of the system				

Impact Attenuator Sizes
Figure 720-1

If it is anticipated that a large volume of traffic will be traveling at speeds greater than the posted speed limit, then the next larger unit may be specified.

For a summary of space and initial cost information related to the impact attenuator systems, see Figure 720-5.

When considering maintenance costs, anticipate the average annual impact rate. If few impacts are anticipated, lower-cost devices such as inertial barriers might meet the need. Inertial barriers have the lowest initial cost and initial site preparation. However, maintenance will be costly and necessary after every impact. Labor and equipment are necessary to clean up the debris and install new containers (barrels). Also, inertial barriers must not be used where flying debris might be a danger to pedestrians.

The REACT 350 and the QuadGuard Elite have a higher initial cost, requiring substantial site preparation, including a backup or anchor wall in some cases and cable anchorage at the front of the installation. However, repair costs are comparatively low, with labor being the main expense. Maintenance might not be required after minor side impacts with these systems.

For new installations where at least one impact is anticipated per year, limit the selection of impact attenuators to the low maintenance devices (QuadGuard Elite and REACT 350). Consider upgrading existing ADIEM, G-R-E-A-T, and Hex-Foam impact attenuators with these low maintenance devices when the repair history shows one to two impacts per year over a three to five year period.

In selecting a system, one consideration that must not be overlooked is how dangerous it will be for the workers making repairs. In areas with high exposure to danger, a system that can be repaired quickly is most desirable. Some systems require nearly total replacement or replacement of critical components (such as cartridges or braking mechanisms) after a head-on impact, while others only require resetting.

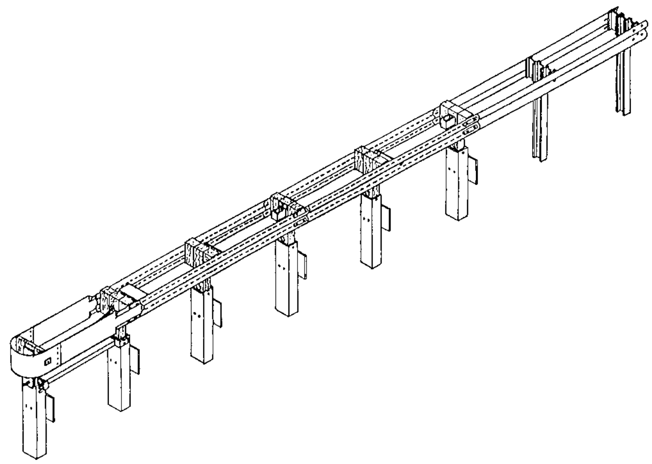
It is very important to consider that each application is unique when selecting impact attenuators for use in particular applications. This applies to both permanent and temporary installations. When specifying the system or systems that can be used at a specific location, the list shown in Figure 720-5 is to be used as a starting point. As the considerations discussed previously are analyzed, inappropriate systems may be identified and eliminated from further consideration. Systems that are not eliminated may be appropriate for the project. When the site conditions vary, it might be necessary to have more than one list of acceptable systems within a contract. Systems are not to be eliminated without documented reasons. Also, wording such as or *equivalent* is not to be used when specifying these systems. If only one system is found to be appropriate, then approval from the Assistant State Design Engineer of a public interest finding for the use of a sole source proprietary item is required.

When a transition to connect with a concrete barrier (see Figure 720-5) is required, the transition type and connection must be specified and are included in the cost of the impact attenuator. (See Chapter 710 for information on the transitions and connections to be used.)

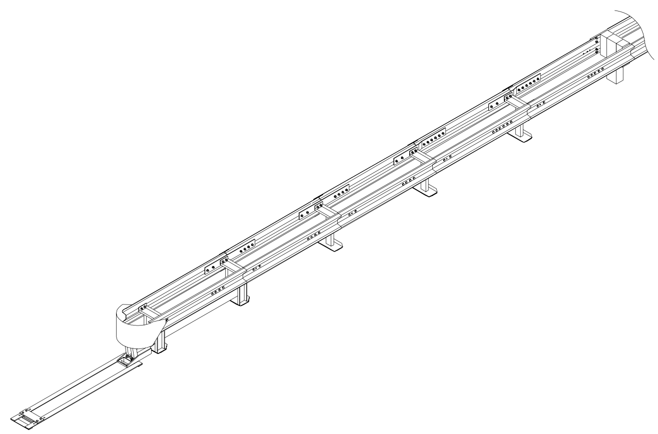
Contractors can be given more flexibility in the selection of work zone (temporary) systems, since long-term maintenance and repair are not a consideration.

720.04 Documentation

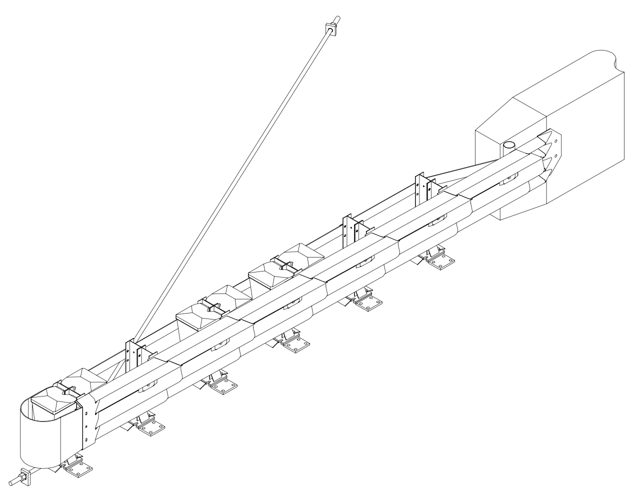
For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/



CAT - 350

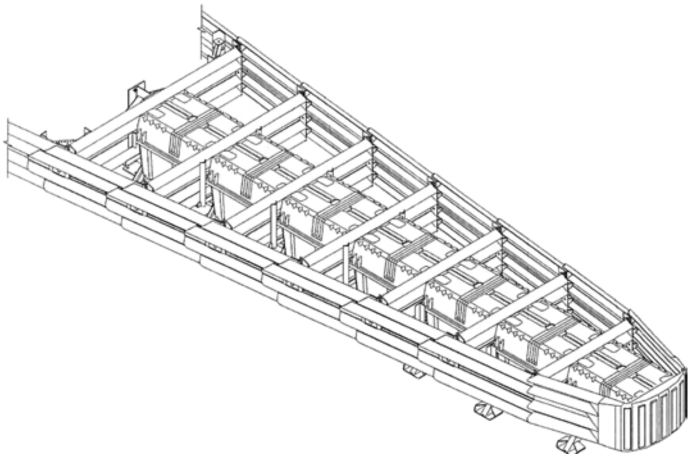


Brakemaster 350

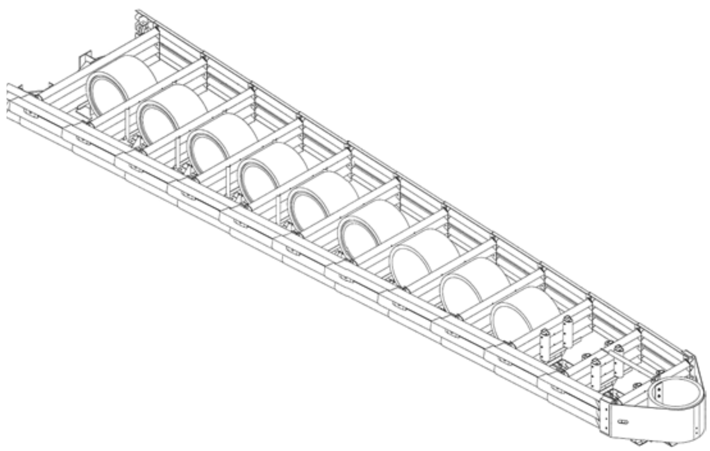


QuadTrend 350

Impact Attenuator Systems – Permanent Installations
Figure 720-2a



QuadGuard



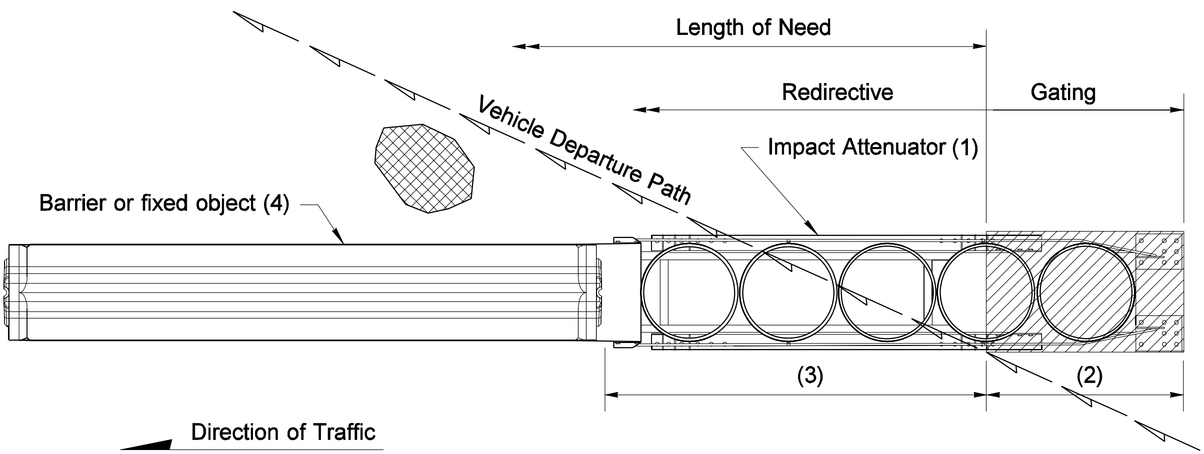
QuadGuard Elite

Impact Attenuator Systems – Permanent Installations
Figure 720-2b

(1) A ($5,000 to $10,000); B ($10,000 to $15,000); C ($15,000 to $25,000); D ($25,000 to $50,000). These are rough initial cost estimates - verify actual costs through manufacturers/suppliers. Some products are priced very close to the margin between cost categories.
(2) Generally for use with double-sided beam guardrail. Use as an end treatment for concrete barrier requires a transition.
(3) The N-E-A-T, inertial barriers, Triton CET, and ABSORB 350 may only be used beyond the required length of need.
(4) For sizes or configuration type, see Figure 720-1.
(5) The lengths of the Universal TAU-II, QuadGuard, QuadGuard Elite, REACT 350, REACT 350 Wide, ABSORB 350, QuadGuard CZ, and Inertial Barriers vary because their designs are dependent upon speed. Costs indicated are for a typical 60 mph design. In addition to length, several of the systems also vary in width. For estimating purposes, the following model widths were considered.
- Universal TAU II – 24”
- QuadGuard – 24”
- QuadGuard Elite – 24”
- REACT 350 Wide – 60”
- QuadGuard CZ – 24”

(6) Generally for use at the ends of bridges where installation of a beam guardrail transition and terminal is not feasible.
(7) Generally for use with concrete barrier. Other uses may require a special transition design.
(8) Use limited to highways with posted speeds of 45 mph or less.
(9) Test Level 3 version on high-speed facilities should be limited to locations where the likelihood of being hit is low.
(10) The given dimension is the approximate outside width of each system. In most cases, this width is slightly wider than the effective width. To determine the width of an object that may be shielded refer to the manufacturer’s specifications. (See the WSDOT Design Policy, Standards, & Safety Research Unit web site for links to this information.)
(11) The given dimension is the approximate system length. The effective length may vary depending on such factors as the physical design and type of anchorage used. To determine the total length needed, refer to the manufacturer’s specifications. (See the WSDOT Design Policy, Standards, & Safety Research Unit web site for links to this information.)
(12) May be considered for permanent installations with concurrence of Maintenance personnel.

Impact Attenuator Comparison
Figure 720-5b



(1) Impact Attenuator type and manufacturer varies with application. (See Figure 720-5).

(2) Distance beyond the length of need. (See Figure 720-5). This portion is non-redirective, (Gating).

(3) This portion is re-directive and can be included as part of the barrier needed to satisfy length of need requirerments.

(4) Concrete barrier shown for illustration purposes only. Type of object varies.

Impact Attenuator Distance Beyond Length of Need
Figure 720-6

Ice Chisel Snow Removal Areas					
Roadway Classification	**Marking Type(3)**				
	Centerlines(5)	**Lane Lines(5)**	**Edge Lines**	**Wide Lines**	**Transverse Markings**
Interstate	N.A.	Grooved Plastic(1)	Paint	Paint	Paint
Major Arterial	Paint & RRPMs(4) or Plastic (2)& RRPMs(4)	Paint	Paint	Paint	Paint
Minor Arterial	Paint	Paint	Paint	Paint	Paint
Collector	Paint	Paint	Paint	Paint	Paint
Steel Blade Snow Removal Areas					
Roadway Classification	**Marking Type(3)**				
	Centerlines(5)	**Lane Lines(5)**	**Edge Lines**	**Wide Lines**	**Transverse Markings**
Interstate-Urban	N.A.	Plastic(2)	Paint or Plastic(2)	Paint or Plastic(2)	Paint or Plastic(2)
Interstate-Rural	N.A.	Paint	Paint or Plastic(2)	Paint or Plastic(2)	Paint or Plastic(2)
Major Arterial	Paint & RRPMs(4) or Plastic(2) & RRPMs(4)	Paint	Paint or Plastic(2)	Paint or Plastic(2)	Paint or Plastic(2)
Minor Arterial	Paint	Paint	Paint	Paint or Plastic(2)	Paint or Plastic(2)
Collector	Paint	Paint	Paint	Paint or Plastic(2)	Paint or Plastic(2)
Rubber Blade Snow Removal Areas					
Roadway Classification	**Marking Type(3)**				
	Centerlines(5)	**Lane Lines(5)**	**Edge Lines**	**Wide Lines**	**Transverse Markings**
Interstate-Urban	N.A.	PMMA(6) only or PMMA(6) & RPMs	Paint or Plastic(2)	Plastic(7)	FMMA(8)
Interstate-Rural	N.A.	PMMA only or (6) PMMA & RPMs	Paint	Plastic(2)(7)	FMMA(8)
Major Arterial	Paint & RPMs or Plastic(2) & RPMs	(7)	Paint	Plastic(7)(2)	Plastic(2)(7)
Minor Arterial	Paint & RPMs	Paint & RPMs	Paint	Plastic(2)	Plastic(2)
Collector	Paint & RPMs	Paint	Paint	Plastic(2)	Plastic(2)

Notes:

(1) Grooved Plastic is a line constructed by cutting a groove into the pavement surface and spraying, extruding, or gluing pavement marking material into the groove.

(2) Plastic refers to methyl methacrylate (MMA), thermoplastic, or preformed tape.

(3) For RPM substitute applications and RPM applications supplementing paint or plastic, see the Standard Plans, Section M.

(4) RRPMs refer to RPMs installed in a groove ground into the pavement. RRPMs are identified as "Recessed Pavement Markers" in the Standard Specifications and the Standard Plans.

(5) Type 2 RPMs are not required with painted or plastic centerline or lane line in illuminated sections.

(6) PMMA refers to profiled methyl methacrylate.

(7) Consult region striping policy.

(8) FMMA refers to flat methyl methacrylate.

Pavement Marking Material Guide

Figure 830-1

Highway Type	Guideposts on Tangents (See Notes 1 & 3)	Guideposts on Horizontal Curves (See Notes 1 & 3)
Divided Highways With Continuous Illumination		
Main Line	None	None
Bridge Approaches	None	None
Intersections	None	None
Lane Reductions	Standard Plan, Section H	Standard Plan, Section H
Median Crossovers	None	None
Ramps	Standard Plan, Section H	Standard Plan, Section H
Divided Highways Without Continuous Illumination		
Main Line with RPMs	None	Standard Plan, Section H
Main Line without RPMs	Right Side Only (0.10 mile spacing)	Standard Plan, Section H
Bridge Approaches	Standard Plan, Section H	Standard Plan, Section H
Intersections	Standard Plan, Section H	Standard Plan, Section H
Lane Reductions	Standard Plan, Section H	Standard Plan, Section H
Median Crossovers	Standard Plan, Section H	Standard Plan, Section H
Ramps	Standard Plan, Section H	Standard Plan, Section H
Undivided Highways With Continuous Illumination		
Main Line	None	None
Bridge Approaches	None	None
Intersections	None	None
Lane Reductions	Standard Plan, Section H	Standard Plan, Section H
Undivided Highways Without Continuous Illumination		
Main Line	See Note 2	Standard Plan, Section H (See Note 2)
Bridge Approaches	Standard Plan, Section H	Standard Plan, Section H
Intersections with Illumination	None	None
Intersections without Illumination	Standard Plan, Section H	Standard Plan, Section H
Lane Reductions	Standard Plan, Section H	Standard Plan, Section H

Notes:

1. For lateral placement of guideposts, see the Standard Plans, Section H.
2. Installation of guideposts on tangents and on the inside of horizontal curves is allowed at locations approved by the region's Traffic Engineer.
3. Barrier delineation is required when the traffic barrier is 4 feet or less from the roadway. Use delineator spacing of 40 feet or less.

Guidepost Placement

Figure 830-2

- Intersection control beacons
- Lane control signals
- Moveable bridge signals
- Portable signals
- Ramp meter signals
- Pedestrian signals
- Temporary signals

Emergency vehicle signals require annual permit renewal. The region's traffic office reviews the installation for compliance with standards. If satisfactory, the permit is renewed by the Regional Administrator by way of a letter to the operating agency. A copy of this letter is also sent to the State Traffic Engineer.

Permits are not required for hazard identification beacons that are not installed overhead at an intersection, speed limit sign beacons, stop sign beacons, and lane assignment signals at toll facilities.

When it is necessary to increase the level of control, such as changing from an intersection control beacon to a conventional traffic signal, a new permit application is required. If the change results in a reduction in the level of control, as in the case of converting a conventional signal to a flashing intersection beacon, or if the change is the removal of the signal, submit the "Report of Change" portion of the traffic signal permit to the Regional Administrator with a copy to the State Traffic Engineer.

(2) Responsibility for Funding, Construction, Maintenance, and Operation

Responsibility for the funding, construction, maintenance, and operation of traffic signals on state highways has been defined by legislative action and transportation commission resolutions. See Figure 850-3. Responsibilities vary depending on location, jurisdiction, and whether or not limited access control has been established. Limited access as used in this chapter refers to full, partial, or modified limited access control as identified in the "Master Plan for Limited Access Highways Route Listing".

(a) **Inside the corporate limits of cities with a population of less than 22,500.** The Department of Transportation is responsible for funding, construction, maintenance, and operation of traffic signals.

(b) **Inside the corporate limits of cities with a population of 22,500 or greater where there is no established limited access control.** The city is responsible for the funding, construction, maintenance, and operation of traffic signals.

(c) **Inside the corporate limits of cities with a population of 22,500 or greater where there is established limited access control.** The Department of Transportation is responsible for funding, construction, maintenance, and operation of traffic signals.

(d) **Outside the corporate limits of cities and outside established limited access control areas.** The Department of Transportation is responsible for funding, construction, maintenance, and operation of a signal when a new state highway crosses an existing county road. The Department of Transportation is responsible for only the maintenance and operation when a new county road intersects an existing state highway. The county is responsible for the construction costs of the signal and associated illumination. When it is necessary to construct a traffic signal at an existing county road and state highway intersection, the construction cost distribution is based on the volume of traffic entering the intersection from each jurisdiction's roadway. The county's share of the cost, however, is limited to a maximum of fifty percent. The state is responsible for maintenance and operation. See WAC 468-18-040 for details.

(e) **Outside the corporate limits of cities and inside established limited access control areas**. The Department of Transportation is responsible for funding, construction, maintenance, and operation of traffic signals.

(f) **Emergency Vehicle Signals**. The emergency service agency is responsible for all costs associated with emergency vehicle signals.

(g) **Third Party Agreement Signals**. At those locations where the Department of Transportation is responsible for signals and agrees that the proposed signal is justified but where funding schedules and priorities do not provide for the timely construction of the signal requested by others, the following rules apply:

- The third party agrees to design and construct the traffic signal in conformance with the Department of Transportation's standards.
- The third party agrees to submit the design and construction documents to the Department of Transportation for review and approval.
- The third party obtains a traffic signal permit.

850.05 Signal Warrants

A signal warrant is a minimum condition which must be met before a signal may be installed. Satisfying a warrant does not mandate the installation of a traffic signal. The warranting condition indicates that an engineering study, including a comprehensive analysis of other traffic conditions or factors, is needed to determine whether the signal or another improvement is justified. For a list of the traffic signal warrants and information on how to use them, see the MUTCD.

850.06 Conventional Traffic Signal Design

(1) General

The goal of any signal design is to assign right of way in the most efficient manner possible and still be consistent with traffic volumes, intersection geometrics, and safety.

(2) Signal Phasing

As a general rule, although there are exceptions, the fewer signal phases the more efficient the operation of the traffic signal. The number of phases required for safe, efficient operation is related to the intersection geometrics, traffic volumes, the composition of the traffic flow, turning movement demands, and the level of driver comfort desired. The traffic movements at an intersection have been standardized to provide a consistent system for designing traffic signals. See Figure 850-4 for standard intersection movements, signal head numbering, and the standard phase operation. Figure 850-5 shows the phase diagrams for various signal operations.

(a) **Level of Service.** The efficiency of a traffic signal is measured differently than highways. While highways use the number and width of

Chapter 940 Interchanges

940.01 General

The primary purpose of an interchange is to reduce conflicts caused by vehicle crossings and to minimize conflicting left-turn movements. Provide interchanges on all Interstate highways, freeways, and at other locations where traffic cannot be controlled reasonably safely and efficiently by intersections at grade.

For additional information, see the following chapters:

Chapter	Subject
640	Ramp sections
641	Turning widths
642	Superelevation
910	Intersections
1050	HOV lanes
1055	HOV direct access connections
1420	Access control
1425	Interchange Justification Report
1430	Limited access

940.02 References

(1) Design Guidance

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)

Plans Preparation Manual, M 22-31, WSDOT

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

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

(2) Supporting Information

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

A Policy on Design Standards – Interstate System, AASHTO, 2005

Highway Capacity Manual (Special Report 209), Transportation Research Board

Procedure for Analysis and Design of Weaving Sections, A User's Guide, Jack E. Leisch, October 1985

940.03 Definitions

For definitions of ***frontage road, design speed, divided multilane, expressway, highway, outer separation, roadway, rural design area, suburban area, traveled way, undivided multilane***, and ***urban design area***, see Chapter 440; for ***basic number of lanes***, see Chapter 620; for ***lane***, ***median***, and ***shoulder***, see Chapter 640; for ***decision sight distance***, ***sight distance***, and ***stopping sight distance***, see Chapter 650; for ***intersection at grade***, see Chapter 910; and for ***auxiliary lane***, see Chapter 1010.

collector-distributor road (C-D road) A parallel roadway designed to remove weaving from the main line and to reduce the number of main line entrances and exits.

gore The area downstream from the intersection of the shoulders of the main line and exit ramp. Although generally the area between a main line and an exit ramp, the term may also be used to refer to the area between a main line and an entrance ramp.

gore nose At an exit ramp, the point at the end of the gore area where the paved shoulders of the main line and the ramp separate (see Figures 940-11a and 11b) or the beginning of traffic barrier, not including any impact attenuator. Also, the similar point at an entrance ramp.

Interstate System A network of routes selected by the state and the FHWA under terms of the federal-aid acts as being the most important to the development of a national transportation system. The Interstate System is part of the principal arterial system.

interchange A system of interconnecting roadways, in conjunction with one or more grade separations, providing for the exchange of traffic between two or more intersecting highways or roadways.

painted nose The point where the main line and ramp lanes separate.

physical nose The point, upstream of the gore, with a separation between the roadways of 16 to 22 feet (see Figures 940-11a and 11b).

ramp A short roadway connecting a main lane of a freeway with another facility.

ramp connection The pavement at the end of a ramp that connects it to a main lane of a freeway.

ramp meter A traffic signal at a freeway entrance ramp that allows a measured or regulated amount of traffic to enter the freeway.

ramp terminal An intersection at the end of a ramp.

weaving section A length of highway over which one-way traffic streams cross by merging and diverging maneuvers.

940.04 Interchange Design

(1) General

All freeway exits and entrances, except HOV direct access connections, are to connect on the right of through traffic. Deviations from this will be considered only for special conditions.

HOV direct access connections may be constructed on the left of through traffic when they are designed in accordance with Chapter 1055.

Provide complete ramp facilities for all directions of travel wherever possible. However, give primary consideration to the basic traffic movement function that the interchange is to fulfill.

Few complications will be encountered in the design and location of rural interchanges that simply provide a means of exchanging traffic between a limited access freeway and a local crossroad. Carefully consider the economic and operational effects of locating traffic interchanges along a freeway through a community, particularly with respect to local access, to provide the best local service possible without reducing the capacity of the major route(s).

Where freeway-to-freeway interchanges are involved, do not provide ramps for local access unless they can be added conveniently and without detriment to safety or reduction of capacity, either ramp or freeway main line. When exchange of traffic between freeways is the basic function, and local access is prohibited by access control restrictions or traffic volume, separate interchanges for local service may be needed.

(2) Interchange Patterns

Basic interchange patterns have been established that can be used under certain general conditions and modified or combined to apply to many more. Consider alternatives in the design of a specific facility, but the conditions in the area and on the highway involved govern and the final design of the interchange.

Selection of the final design based on a study of projected traffic volumes, site conditions, geometric controls, criteria for intersecting legs and turning roadways, driver expectancy, consistent ramp patterns, continuity, and cost.

The patterns most frequently used for interchange design are those commonly described as directional, semidirectional, cloverleaf, partial cloverleaf, diamond, and single point (urban) interchange (see Figure 940-1).

(a) **Directional.** A directional interchange is the most effective design for connection of intersecting freeways. The directional pattern has the advantage of reduced travel distance, increased speed of operation, and higher capacity. These designs eliminate weaving and have a further advantage over cloverleaf designs in avoiding the loss of sense of direction drivers experience in traveling a loop. This type of interchange is costly to construct, commonly using a four-level structure.

(b) **Semidirectional.** A semidirectional interchange has ramps that loop around the intersection of the highways. This results in multiple single-level structures and more area than the directional interchange.

(c) **Cloverleaf.** The full cloverleaf interchange has four loop ramps for the left-turning traffic. Outer ramps provide for the right turns. A full cloverleaf is the minimum type interchange that will suffice for a freeway-to-freeway interchange. Cloverleaf designs often incorporate a C-D road to minimize signing difficulties and to remove weaving conflicts from the main roadway.

The principal advantage of this design is the elimination of all left-turn conflicts with one single-level structure. Because all movements are merging movements, it is adaptable to any grade line arrangement.

The cloverleaf has some major disadvantages. The left-turn movement has a circuitous route on the loop ramp, the speeds are low on the loop ramp, and there are weaving conflicts between the loop ramps. The cloverleaf also needs a large area. The weaving and the radius of the loop ramps are a capacity constraint on the left-turn movements.

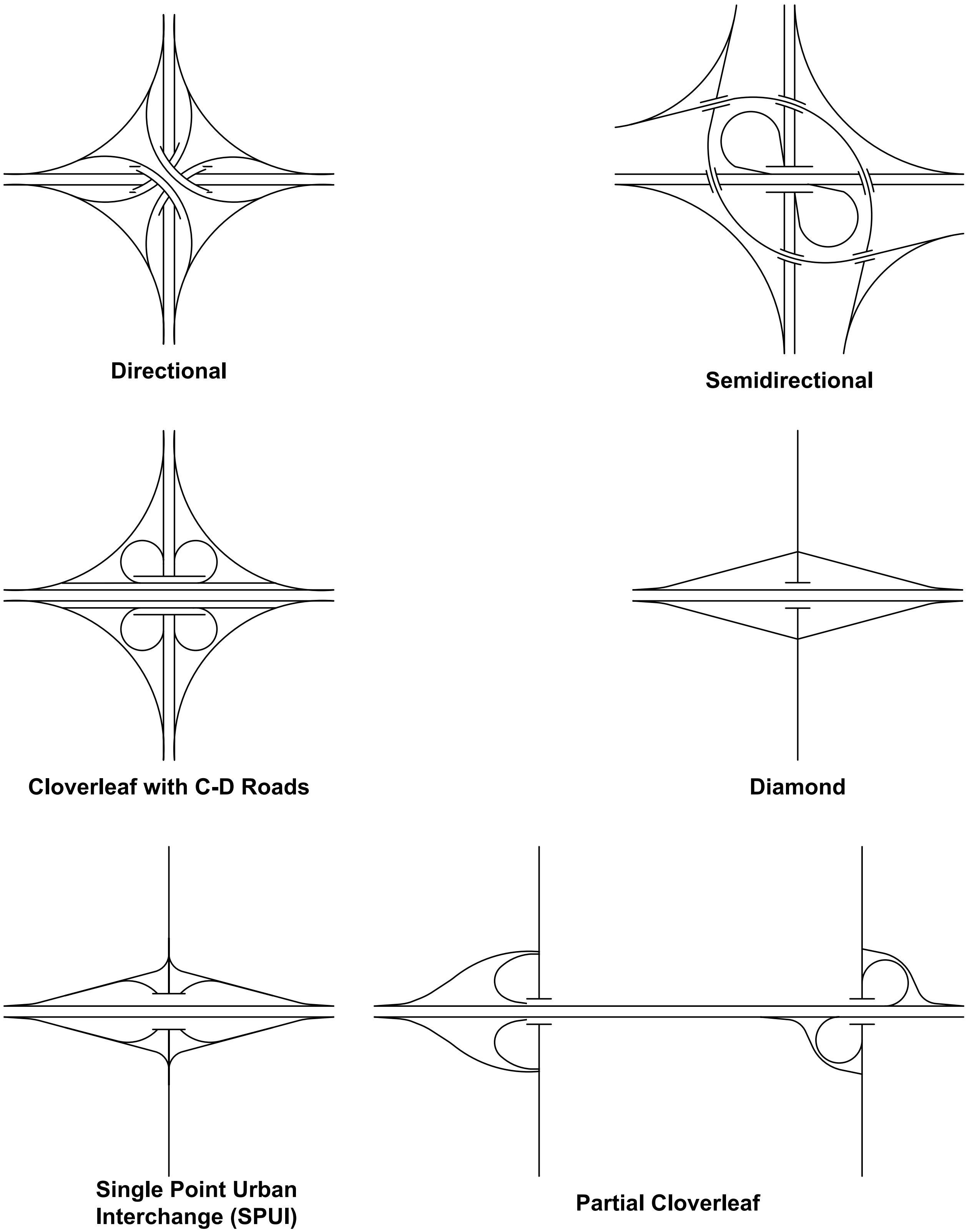
(d) **Partial Cloverleaf (PARCLO).** A partial cloverleaf has loop ramps in one, two, or three quadrants that are used to eliminate the major left-turn conflicts. These loops may also serve right turns for interchanges where ramp can not be built in one or two quadrants. Outer ramps are provided for the remaining turns. Design the grades to provide sight distance between vehicles approaching these ramps.

(e) **Diamond.** A diamond interchange has four ramps that are essentially parallel to the major arterial. Each ramp provides for one right and one left-turn movement. Because left-turns are made at grade across conflicting traffic on the crossroad, intersection sight distance is a primary consideration.

The diamond design is the most generally applicable and serviceable interchange configuration and usually with less space than any other type. Consider this design first unless another design is clearly dictated by traffic, to pography, or special conditions.

(f) **Single Point Urban (SPUI).** A single point urban interchange is a modified diamond with all of its ramp terminals on the crossroad combined into one signalized at-grade intersection. This single intersection accommodates all interchange and through movements.

A single point urban interchange can improve the traffic operation on the crossroad with less right of way than a typical diamond interchange, but a larger structure.



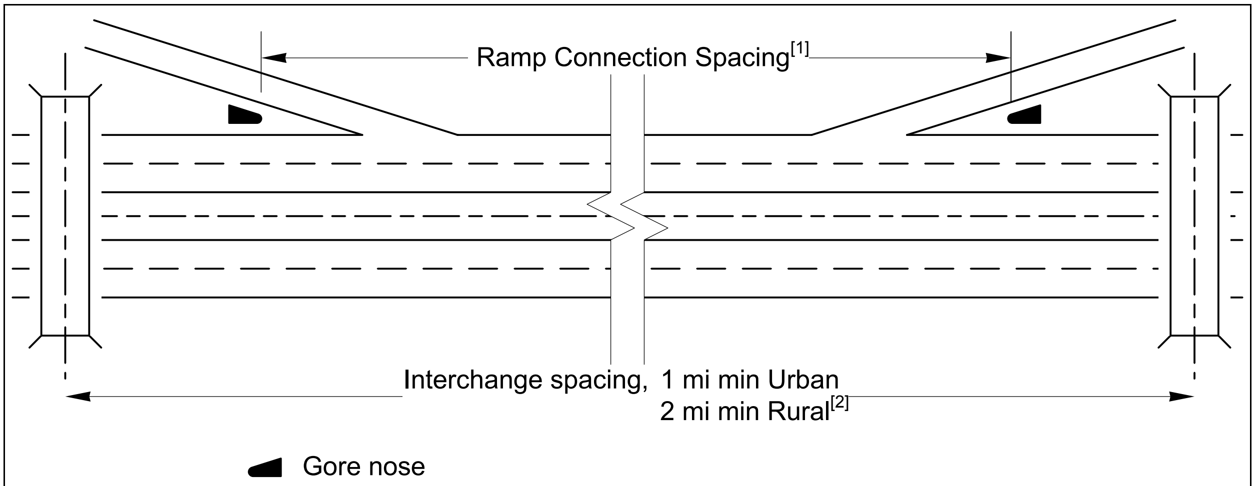
Basic Interchange Patterns
Figure 940-1

(3) Spacing

To avoid excessive interruption of main line traffic, consider each proposed facility in conjunction with adjacent interchanges, intersections, and other points of access along the route as a whole.

The minimum spacing between adjacent interchanges is 1 mile in urban areas, 3 miles on the Interstate in rural areas, and 2 miles on non-Interstate in rural areas (see Figure 940-2). In urban areas, spacing less than 1 mile may be used with C-D roads or grade-separated (braided) ramps. Interchange spacing is measured along the freeway centerline between the center lines of the crossroads.

The spacing between interchanges may also be dependent on the spacing between ramp connections. The minimum spacing between the gore noses of adjacent ramps is given in Figure 940-3.



Notes:

[1] As a minimum, provide length for weaving and adequate signing, but not less than given in Figure 940-3.
[2] 3 miles on the Interstate System.

Interchange Spacing
Figure 940-2

Consider either frontage roads or C-D roads to facilitate the operation of near-capacity volumes between closely spaced interchanges or ramp terminals. C-D roads may be needed where cloverleaf loop ramps are involved or where a series of interchange ramps have overlapping speed change lanes. Base the distance between successive ramp terminals on capacity. Check the intervening sections by weaving analyses to determine whether adequate capacity, sight distance, and effective signing can be provided without the use of auxiliary lanes or C-D roads.

Justification is required for existing interchanges with less-than-desirable spacing or ramp connection spacing to remain in place.

(4) Route Continuity

Route continuity is providing the driver of a through route a path on which lane changes are minimized and other traffic operations occur to the right.

In maintaining route continuity, interchange configuration may not always favor the heavy traffic movement, but rather the through route. In this case, design the heavy traffic movements with multilane ramps, flat curves, and reasonably direct alignment.

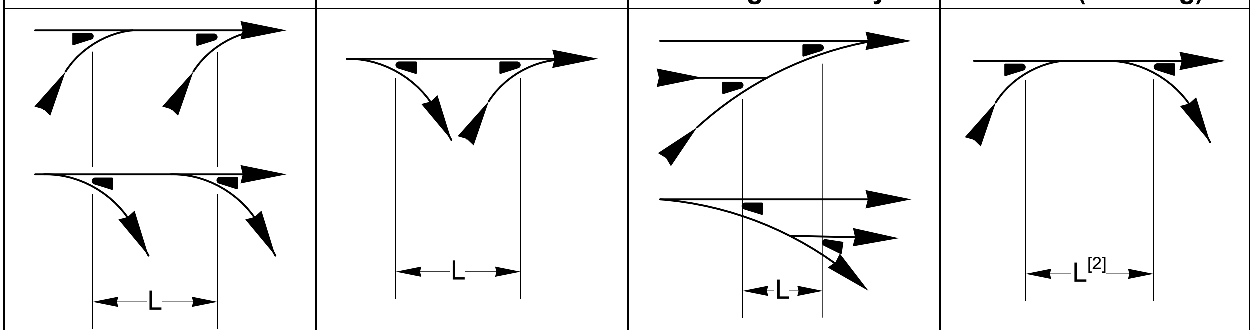
(5) Drainage

Avoid interchanges located in proximity to natural drainage courses. These locations often result in complex and unnecessarily costly hydraulic structures.

The open areas within an interchange can be used for stormwater detention facilities.

(6) Uniformity of Exit Pattern

While interchanges are of necessity custom-designed to fit specific conditions, it is desirable that the pattern of exits along a freeway have some degree of uniformity. From the standpoint of driver expectancy, it is desirable that each interchange have only one point of exit, located in advance of the crossroad.



On-On or Off-Off		Off-On		Turning Roadways		On-Off (Weaving)			
Freeway	C-D Road	Freeway	C-D Road	System[2] Interchange	Service[3] Interchange	A	B	C	D
1000	800	500	400	800	600	2000	1600	1600	1000

Gore nose

L = Minimum distance in feet from gore nose to gore nose.
A Between two interchanges connected to a freeway: a system interchange[2] and a service interchange[3].
B Between two interchanges connected to a C-D road: a system interchange[2] and a service interchange[3].
C Between two interchanges connected to a freeway: both service interchanges[3].
D Between two interchanges connected to a C-D road: both service interchanges[3].

Notes:
These recommendations are based on operational experience, need for flexibility, and adequate signing. Check them in accordance with Figure 940-12 and the procedures outlined in the *Highway Capacity Manual* and use the larger value.
[1] With justification, these values may be reduced for cloverleaf ramps.
[2] A system interchange is a freeway-to-freeway interchange.
[3] A service interchange is a freeway-to-local road interchange.

Minimum Ramp Connection Spacing
Figure 940-3

940.05 Ramps

(1) Ramp Design Speed

The design speed for a ramp is based on the design speed for the freeway main line.

It is desirable that the ramp design speed at the connection to the freeway be equal to the free-flow speed of the freeway. Meet or exceed the upper range values from Figure 940-4 for the design speed at the ramp connection to the freeway. Transition the ramp design speed to provide a smooth acceleration or deceleration between the speeds at the ends of the ramp. However, do not reduce the ramp design speed below the lower-range speed of 25 mph. For loop ramps, use a design speed as high as feasible, but not less than 25 mph.

These design speed guidelines do not apply to the ramp in the area of the ramp terminal at-grade intersection. In the area of the intersection, a design speed of 15 mph for turning traffic or 0 mph for a stop condition is adequate. Use the allowed skew at the ramp terminal at-grade intersection to minimize ramp curvature.

For freeway-to-freeway ramps and C-D roads, the design speed at the connections to both freeways is the upper range values from Figure 940-4; however, with justification, the midrange values from Figure 940-4 may be used for the remainder of the ramp. When the design speed for the two freeways is different, use the higher design speed.

Existing ramps meet design speed criteria if acceleration or deceleration criteria are met (see Figure 940-9 or 940-10) and superelevation meets or will be corrected to meet the criteria in Chapter 642.

Main Line Design Speed (mph)		**50**	**55**	**60**	**65**	**70**	**80**
Ramp Design Speed (mph)	Upper Range	45	50	50	55	60	70
	Midrange	30	40	45	45	50	60
	Lower Range	25	25	25	25	25	25

Ramp Design Speed
Figure 940-4

(2) Sight Distance

Design ramps in accordance with the provisions in Chapter 650 for stopping sight distances.

(3) Grade

The maximum grade for ramps for various design speeds is given in Figure 940-5.

Ramp Design Speed (mph)		**25–30**	**35–40**	**45 and above**
Ramp Grade (%)	Desirable	5	4	3
	Maximum*	7	6	5
* On one-way ramps, downgrades may be 2% greater.				

Maximum Ramp Grade
Figure 940-5

(4) Cross Section

Provide the minimum ramp widths given in Figure 940-6. Ramp traveled ways may need additional width to these minimums as one-way turning roadways. (See Chapters 640 and 641 for additional information and roadway sections.)

Cross slope and superelevation criteria for ramp traveled ways and shoulders are as given in Chapters 640 and 642 for roadways. At ramp terminals, the intersection lane and shoulder width design guidance shown in Chapter 910 may be used.

Whenever feasible, make the ramp cross slope at the ramp beginning or ending station equal to the cross slope of the through lane pavement. Where space is limited and superelevation runoff is long, or when parallel connections are used, the superelevation transition may be ended beyond (for on-ramps) or begun in advance of (for off-ramps) the ramp beginning or ending station, provided that the algebraic difference in cross slope at the edge of the through lane and the cross slope of the ramp does not exceed 4%. In such cases, provide smooth transitions for the edge of traveled way.

Number of Lanes			1	2
Ramp Width (ft)	Traveled Way[1]		15[2]	25[3]
	Shoulders	Right	8	8
		Left	2	4
	Medians[4]		6	8

Notes:

[1] See Chapter 641 for turning roadway widths and Chapter 1050 for additional width when an HOV lane is present.

[2] May be reduced to 12 ft on tangents.

[3] Add 12 ft for each additional lane.

[4] The minimum median width is not less than that for traffic control devices and their respective clearances.

Ramp Widths
Figure 940-6

Ramp shoulders may be used by large trucks for offtracking and by smaller vehicles cutting to the inside of curves. To accommodate this increased use, pave shoulders full depth.

(5) Ramp Lane Increases

When off-ramp traffic and left-turn movement volumes at the ramp terminal at-grade intersection cause excessive queue length, it may be desirable to add lanes to the ramp to reduce the queue length caused by congestion and turning conflicts. Make provision for the addition of ramp lanes whenever ramp exit or entrance volumes, after the design year, are expected to result in an undesirable level of service (LOS). (See Chapter 620 for width transition design.)

(6) Ramp Meters

Ramp meters are used to allow a measured or regulated amount of traffic to enter the freeway. When operating in the "measured" mode, they release traffic at a measured rate to keep downstream demand below capacity and improve system travel times. In the "regulated" mode, they break up platoons of vehicles that occur naturally or result from nearby traffic signals. Even when operating at near capacity, a freeway main line can accommodate merging vehicles one or two at a time, while groups of vehicles will cause main line flow to break down.

The location of the ramp meter is a balance between the storage and acceleration criteria. Locate the ramp meter to maximize the available storage and so that the acceleration lane length, from a stop to the freeway main line design speed, is available from the stop bar to the merging point. With justification, the average main line running speed during the hours of meter operation may be used for the highway design speed to determine the minimum acceleration lane length from the ramp meter. (See 940.06(4) for information on the design of on-connection acceleration lanes and Chapter 860 for additional information on the design of ramp meters.)

Driver compliance with the signal is required for the ramp meter to have the desired results. Consider enforcement areas with metered ramps.

Consider HOV bypass lanes with ramp meters. (See Chapter 1050 for design data for ramp meter bypass lanes.)

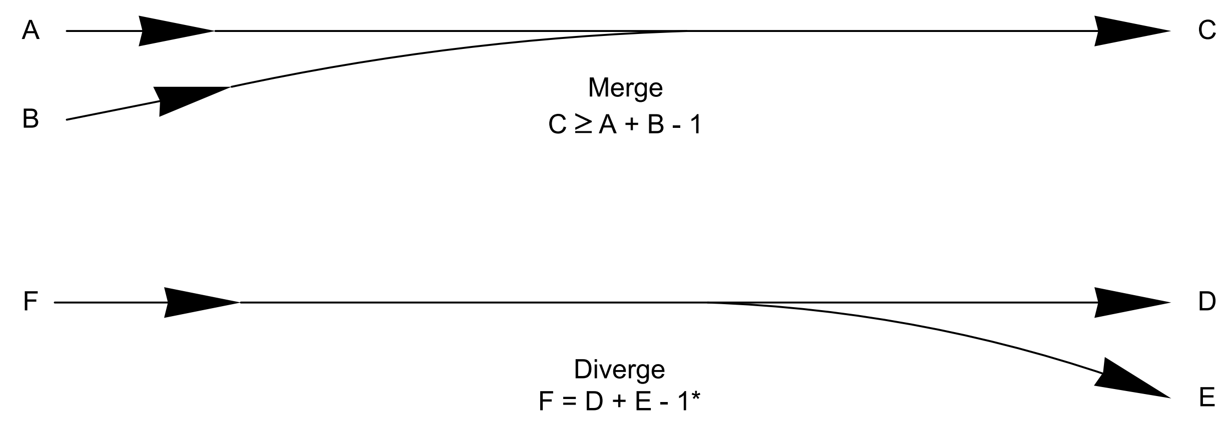
940.06 Interchange Connections

To the extent practical, provide uniform geometric design and uniform signing for exits and entrances in the design of a continuous freeway. Do not design an exit ramp as an extension of a main line tangent at the beginning of a main line horizontal curve.

Provide spacing between interchange connections as given in Figure 940-3.

Avoid on-connections on the inside of a main line curve, particularly when the ramp approach angle is accentuated by the main line curve, the ramp approach results in a reverse curve to connect to the main line, or the elevation difference will cause the cross slope to be steep at the nose.

Keep the use of mountable curb at interchange connections to a minimum. Provide justification when curb is used adjacent to traffic with a design speed of 40 mph or higher.



* Number of lanes (F) may increase by one lane, when the lane is an auxiliary lane between closely spaced entrance and exit ramps.

Lane Balance
Figure 940-7a

(1) Lane Balance

Design interchanges to the following principles of lane balance:

(a) At entrances, make the number of lanes beyond the merging of two traffic streams not less than the sum of all the lanes on the merging roadways less one (see Figure 940-7a).

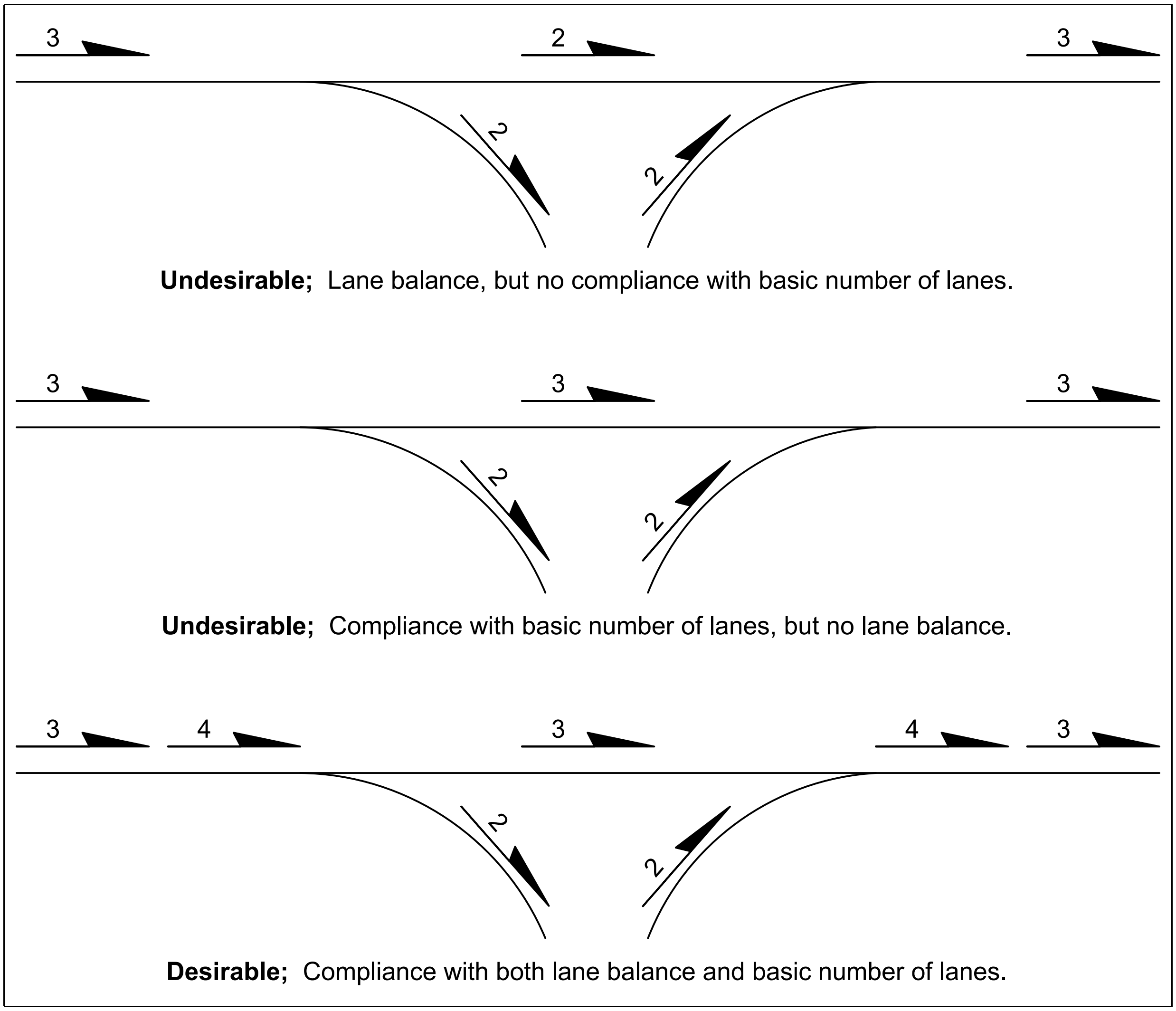
(b) At exits, make the number of approach lanes equal the number of highway lanes beyond the exit plus the number of exit lanes less one (see Figure 940-7a). Exceptions to this are at a cloverleaf or at closely spaced interchanges with a continuous auxiliary lane between the entrance and exit. In these cases the auxiliary lane may be dropped at a single-lane, one-lane reduction off-connection (Figure 940-14c), with the number of approach lanes being equal to the sum of the highway lanes beyond the exit and the number of exit lanes. Closely spaced interchanges have a distance of less than 2100 feet between the end of the acceleration lane and the beginning of the deceleration lane.

Maintain the basic number of lanes, as described in Chapter 620, through interchanges. When a two-lane exit or entrance is used, maintain lane balance with an auxiliary lane (see Figure 940-7b). The exception to this is when the basic number of lanes is changed at an interchange.

(2) Main Line Lane Reduction

The reduction of a basic lane or an auxiliary lane may be made at a two-lane exit or may be made between interchanges. When a two-lane exit is used, provide a recovery area with a normal acceleration taper. When a lane is dropped between interchanges, drop it 1500 to 3000 feet from the end of the acceleration taper of the previous interchange. This will allow for adequate signing but not be so far that the driver will become accustomed to the number of lanes and be surprised by the reduction (see Figure 940-8).

Reduce the traveled way width of the freeway by only one lane at a time.



Lane Balance
Figure 940-7b

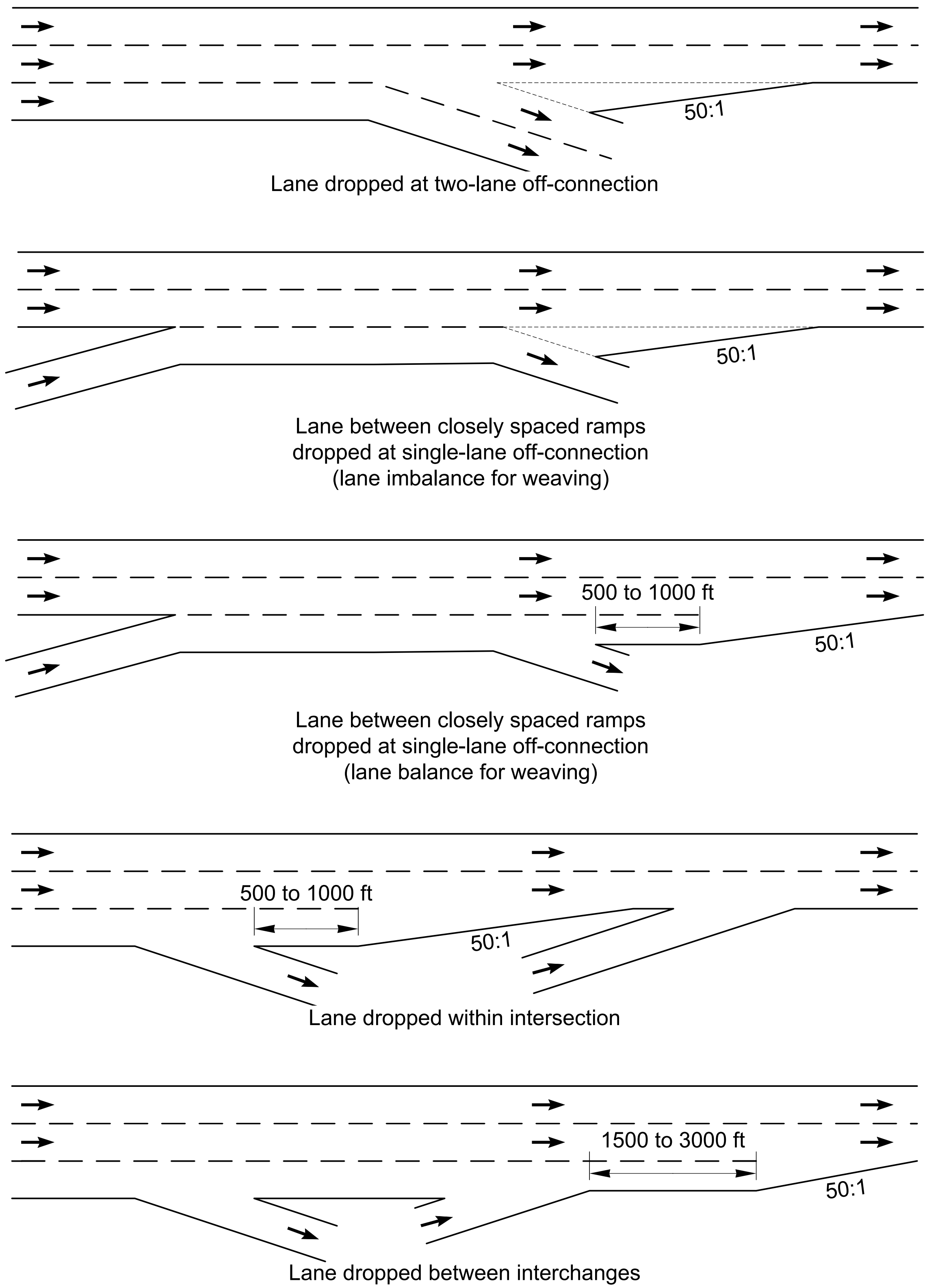
(3) Sight Distance

Locate off-connections and on-connections on the main line to provide decision sight distance for a speed/path/direction change as described in Chapter 650.

(4) On-Connections

On-connections are the paved areas at the end of on-ramps that connect them to the main lane of a freeway. They have two parts: an acceleration lane and a taper. The acceleration lane allows entering traffic to accelerate to the freeway speed and evaluate gaps in the freeway traffic. The taper is for the entering vehicle to maneuver into the through lane.

On-connections are either tapered or parallel. The tapered on-connection provides direct entry at a flat angle, reducing the steering control needed. The parallel on-connection adds a lane adjacent to the through lane for acceleration with a taperat the end. Vehicles merge with the through traffic with a reverse curve maneuver similar to a lane change. While less steering control is needed for the taper, the parallel is narrower at the end of the ramp and has a shorter taper at the end of the acceleration lane.



Main Line Lane Reduction Alternatives
Figure 940-8

(a) **Acceleration Lane**, Provide the minimum acceleration lane length, given in Figure 940-9, for each ramp design speed on all on-ramps. When the average grade of the acceleration lane is 3% or greater, multiply the distance from the Minimum Acceleration Lane Length table by the factor from the Adjustment Factor for Grades table.

For existing ramps that do not have significant accidents in the area of the connection with the freeway, the freeway posted speed may be used to calculate the acceleration lane length for preservation projects. If corrective action is indicated, use the freeway design speed to determine the length of the acceleration lane.

Document as a design exception the existing ramps that will remain in place and that have an acceleration lane length less than the design speed. Also, document in the Project File the ramp location, the acceleration length available, and the accident analysis that shows there are not significant accidents in the area of the connection.

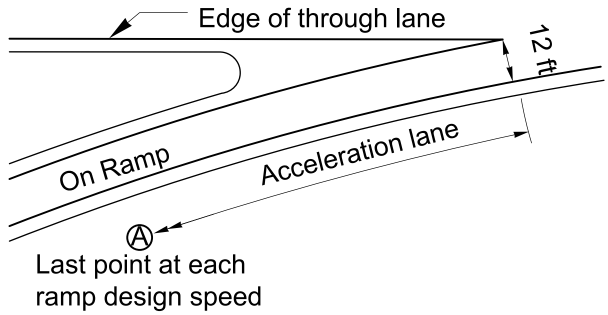
The acceleration lane is measured from the last point designed at each ramp design speed (usually the PT of the last curve for each design speed) to the last point with a ramp width of 12 feet. Curves designed at higher design speeds may be included as part of the acceleration lane length.

(b) **Gap Acceptance**, For parallel on-connections, provide the minimum gap acceptance length (Lg) to allow entering motorists to evaluate gaps in the freeway traffic and position their vehicles to use the gap. The length is measured beginning at the point that the left edge of traveled way for the ramp intersects the right edge of traveled way of the main line to the ending of the acceleration lane (see Figures 940-13b and 13c). The gap acceptance length and the acceleration length overlap with the ending point controlled by the longer of the two.

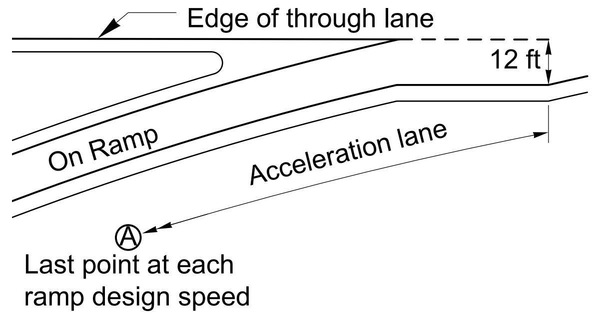
(c) **Single-lane on-connections** may be either tapered or parallel. The tapered is preferred; however, the parallel may be used with justification. Design single-lane tapered on-connections, as shown in Figure 940-13a and single-lane parallel on-connections as shown in Figure 940-13b.

(d) **For two-lane on-connections**, the parallel is preferred. Design two-lane parallel on-connections as shown in Figure 940-13c. A capacity analysis will normally be the basis for determining whether a freeway lane or an auxiliary lane is to be provided.

When justification is documented, a two-lane tapered on-connection may be used. Design two-lane tapered on-connections in accordance with Figure 940-13d.



Tapered On-Connection



Parallel On-Connection

Highway Design Speed (mph)	Ramp Design Speed (mph)										
	0	15	20	25	30	35	40	45	50	60	70
30	180	140									
35	280	220	160								
40	360	300	270	210	120						
45	560	490	440	380	280	160					
50	720	660	610	550	450	350	130				
55	960	900	810	780	670	550	320	150			
60	1200	1140	1100	1020	910	800	550	420	180		
65	1410	1350	1310	1220	1120	1000	770	600	370		
70	1620	1560	1520	1420	1350	1230	1000	820	580	210	
80	2000	1950	1890	1830	1730	1610	1380	1200	970	590	210

Minimum Acceleration Lane Length (ft)

Highway Design Speed (mph)	Grade	Upgrade				Downgrade
		Ramp Design Speed				All Ramp Design Speeds
		20	30	40	50	
40	3% to less than 5%	1.3	1.3			0.70
45		1.3	1.35			0.675
50		1.3	1.4	1.4		0.65
55		1.35	1.45	1.45		0.625
60		1.4	1.5	1.5	1.6	0.60
70		1.5	1.6	1.7	1.8	0.60
40	5% or more	1.5	1.5			0.60
45		1.5	1.6			0.575
50		1.5	1.7	1.9		0.55
55		1.6	1.8	2.05		0.525
60		1.7	1.9	2.2	2.5	0.50
70		2.0	2.2	2.6	3.0	0.50

Adjustment Factors for Grades Greater Than 3%

Acceleration Lane Length

Figure 940-9

(5) Off-Connections

Off-connections are the paved areas at the beginning of an off-ramp, connecting it to a main lane of a freeway. They have two parts: a taper for maneuvering out of the through traffic and a deceleration lane to slow to the speed of the first curve on the ramp. Deceleration is not assumed to take place in the taper.

Off-connections are either tapered or parallel. The tapered is preferred because it fits the path preferred by most drivers. When a parallel connection is used, drivers tend to drive directly for the ramp and not use the parallel lane. However, when a ramp is on the outside of a curve, the parallel off-connection is preferred. An advantage of the parallel connection is that it is narrower at the beginning of the ramp.

(a) **Deceleration Lane**, Provide the minimum deceleration lane length given in Figure 940-10 for each design speed for all off-ramps. Also, provide deceleration lane length to the end of the anticipated queue at the ramp terminal. When the average grade of the deceleration lane is 3% or greater, multiply the distance from the Minimum Deceleration Lane Length table by the factor from the Adjustment Factor for Grades table.

For existing ramps that do not have significant accidents in the area of the connection with the freeway, the freeway posted speed may be used to calculate the deceleration lane length for preservation projects. If corrective action is indicated, use the freeway design speed to determine the length of the deceleration lane.

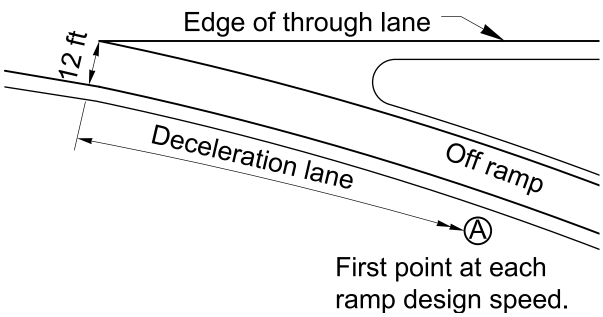
Document as a design exception the existing ramps that will remain in place and that have a deceleration lane length less than the design speed. Also, document in the Project File the ramp location, the deceleration length available, and the accident analysis that shows there are not significant accidents in the area of the connection.

The deceleration lane is measured from the point where the taper reaches a width of 12 feet to the first point designed at each ramp design speed (usually the PC of the first curve for each design speed). Curves designed at higher design speeds may be included as part of the deceleration lane length.

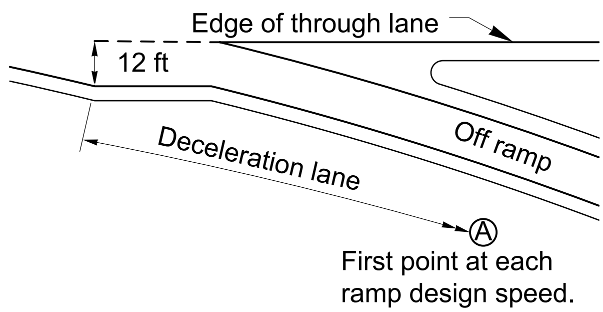
(b) **Gores** (see Figures 940-11a and 11b) are decision points that must be clearly seen and understood by approaching drivers. In a series of interchanges along a freeway, it is desirable that the gores be uniform in size, shape, and appearance.

The paved area between the physical nose and the gore nose is the reserve area. It is reserved for the installation of an impact attenuator. The minimum length of the reserve area is controlled by the design speed of the main line (see Figures 940-11a and 11b).

In addition to striping, raised pavement marker rumble strips may be placed for additional warning and delineation at gores. (See the *Standard Plans* for striping and rumble strip details.)



Tapered Off-Connection



Parallel Off-Connection

Highway Design Speed (mph)	Ramp Design Speed (mph)										
	0	15	20	25	30	35	40	45	50	60	70
30	235	200	170	140							
35	280	250	210	185	150						
40	320	295	265	235	185	155					
45	385	350	325	295	250	220	155				
50	435	405	385	355	315	285	225	175			
55	480	455	440	410	380	350	285	235	180		
60	530	500	480	460	430	405	350	300	240		
65	570	540	520	500	470	440	390	340	280	185	
70	615	590	570	550	520	490	440	390	340	240	
80	735	710	690	670	640	610	555	510	465	360	265

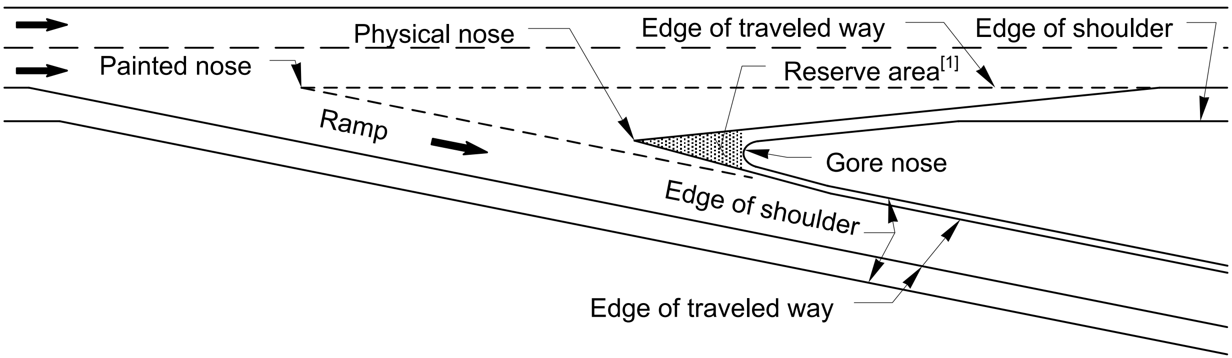
Minimum Deceleration Lane Length (ft)

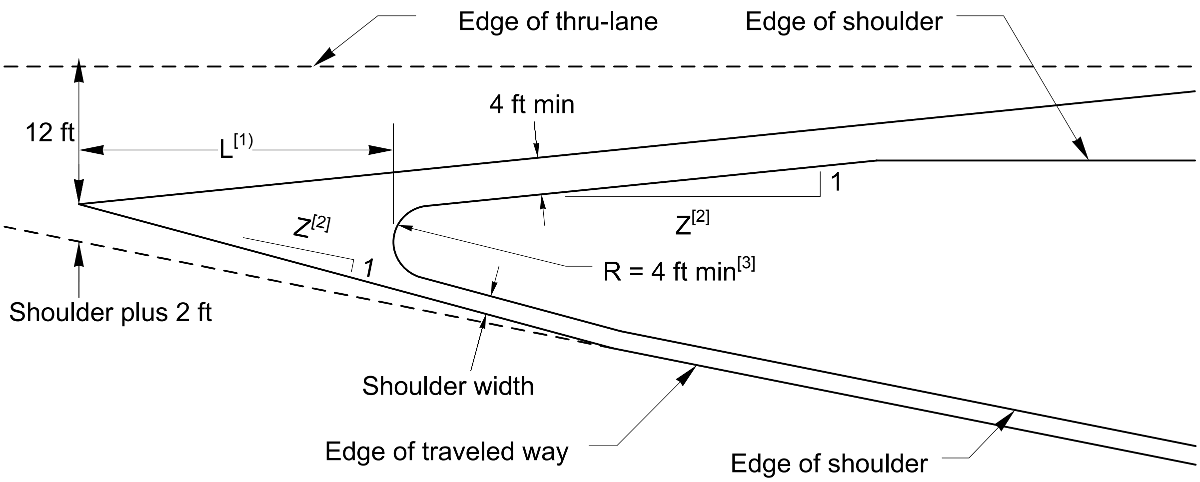
Grade	Upgrade	Downgrade
3% to less than 5%	0.9	1.2
5% or more	0.8	1.35

Adjustment Factors for Grades Greater Than 3%

Deceleration Lane Length

Figure 940-10





Single-Lane Off-Connections No Lane Reduction

Notes:

[1] The reserve area length (L) is not less than:

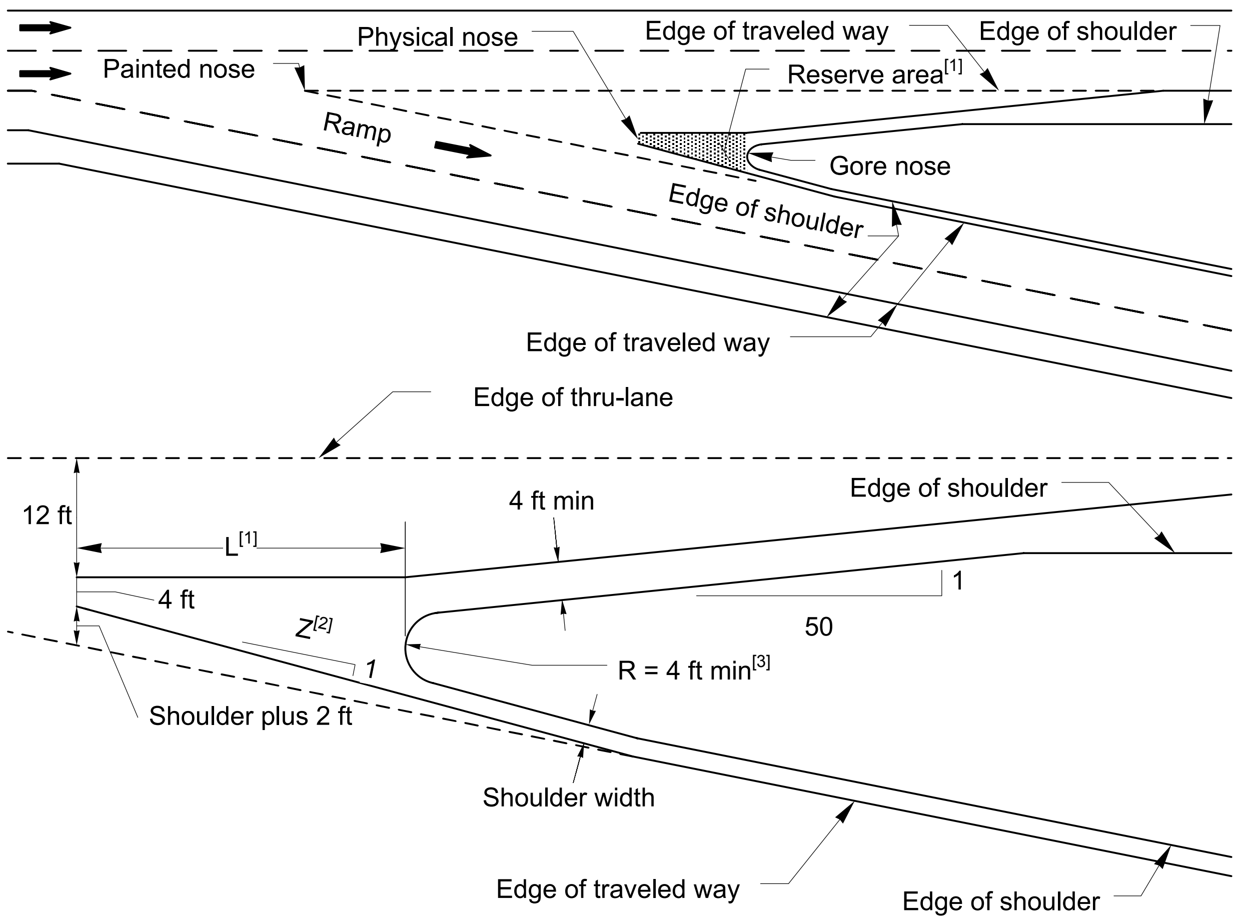
Main Line Design Speed (mph)	40	45	50	55	60	65	70	80
L (ft)	25	30	35	40	45	50	55	70

[2] $Z = \frac{\text{Design Speed}}{2}$, design speed is for the main line.

[3] Radius may be reduced, when protected by an impact attenuator.

Gore Area Characteristics

Figure 940-11a



Single-Lane, One-Lane Reduction Off-Connections and All Two-Lane Off-Connections

Notes:

[1] The reserve area length (L) is not less than:

Main Line Design Speed (mph)	40	45	50	55	60	65	70	80
L (ft)	25	30	35	40	45	50	55	70

[2] $Z = \frac{\text{Design Speed}}{2}$, design speed is for the main line.

[3] Radius may be reduced, when protected by an impact attenuator.

Gore Area Characteristics
Figure 940-11b

The accident rate in the gore area is greater than at other locations. Keep the unpaved area beyond the gore nose as free of obstructions as possible to provide a clear recovery area. Grade this unpaved area as nearly level with the roadways as possible. Avoid placing obstructions such as heavy sign supports, luminaire poles, and structure supports in the gore area.

When an obstruction is placed in a gore area, provide an impact attenuator (see Chapter 720) and barrier (see Chapter 710). Place the beginning of the attenuator as far back in the reserve area as possible, preferably after the gore nose.

(c) For **single-lane off-connections**, the tapered is preferred. Use the design shown in Figure 940-14a for tapered single-lane off-connections. When justification is documented, a parallel single-lane off-connection, as shown in Figure 940-14b, may be used.

(d) The **single-lane off-connection with one lane reduction**, shown in Figure 940-14c, is used when the conditions from lane balance for a single lane exit, one lane reduction, are met.

(e) The **tapered two-lane off-connection** design, shown in Figure 940-14d, is preferred where the number of freeway lanes is to be reduced, or where high volume traffic operations will be improved by the provision of a parallel auxiliary lane and the number of freeway lanes is to be unchanged.

(f) The **parallel two-lane off-connection**, shown in Figure 940-14e, allows less operational flexibility than the taper, requiring more lane changes. Provide justification for use of a parallel two-lane off-connection.

(6) Collector-Distributor (C-D) Roads

A C-D road can be within a single interchange, through two closely spaced interchanges, or continuous through several interchanges. Design C-D roads that connect three or more interchanges to be two lanes wide. All others may be one or two lanes in width, depending on capacity. Consider intermediate connections to the main line for long C-D roads.

(a) Figure 940-15a shows the designs for collector-distributor outer separations. Use Design A, with concrete barrier, when adjacent traffic in either roadway is expected to exceed 40 mph. Design B, with mountable curb, may be used when adjacent traffic will not exceed 40 mph.

(b) The details shown in Figure 940-15b apply to all single-lane C-D road off-connections. Where a two-lane C-D road off-connections, a reduction in the number of freeway lanes, an auxiliary lane, or a combination of these is used, design it as a normal off-connection per 940.06(5).

(c) Design C-D road on-connections per Figure 940-15c.

(7) Loop Ramp Connections

Loop ramp connections at cloverleaf interchanges are distinguished from other ramp connections by a low-speed ramp on-connection followed closely by an off-connection for another low-speed ramp. The loop ramp connection design is shown in Figure 940-16. The minimum distance between the ramp connections is dependent on a weaving analysis. When the connections are spaced far enough apart that weaving is not a consideration, design the on-connection per 940.06(4) and the off-connection per 940.06(5).

(8) Weaving Sections

Weaving sections may occur within an interchange, between closely spaced interchanges, or on segments of overlapping routes. Figure 940-12 gives the length of the weaving section for preliminary design. The total weaving traffic is the sum of the traffic entering from the ramp to the main line and the traffic leaving the main line to the exit ramp in equivalent passenger cars. For trucks, a passenger car equivalent of two may be estimated. Use the *Highway Capacity Manual* for the final design of weaving sections.

Because weaving sections cause considerable turbulence, interchange designs that eliminate weaving or remove it from the main roadway are desirable. Use C-D roads for weaving between closely spaced ramps when adjacent to high-speed highways. C-D roads are not required for weaving on low-speed roads.

940.07 Ramp Terminal Intersections at Crossroads

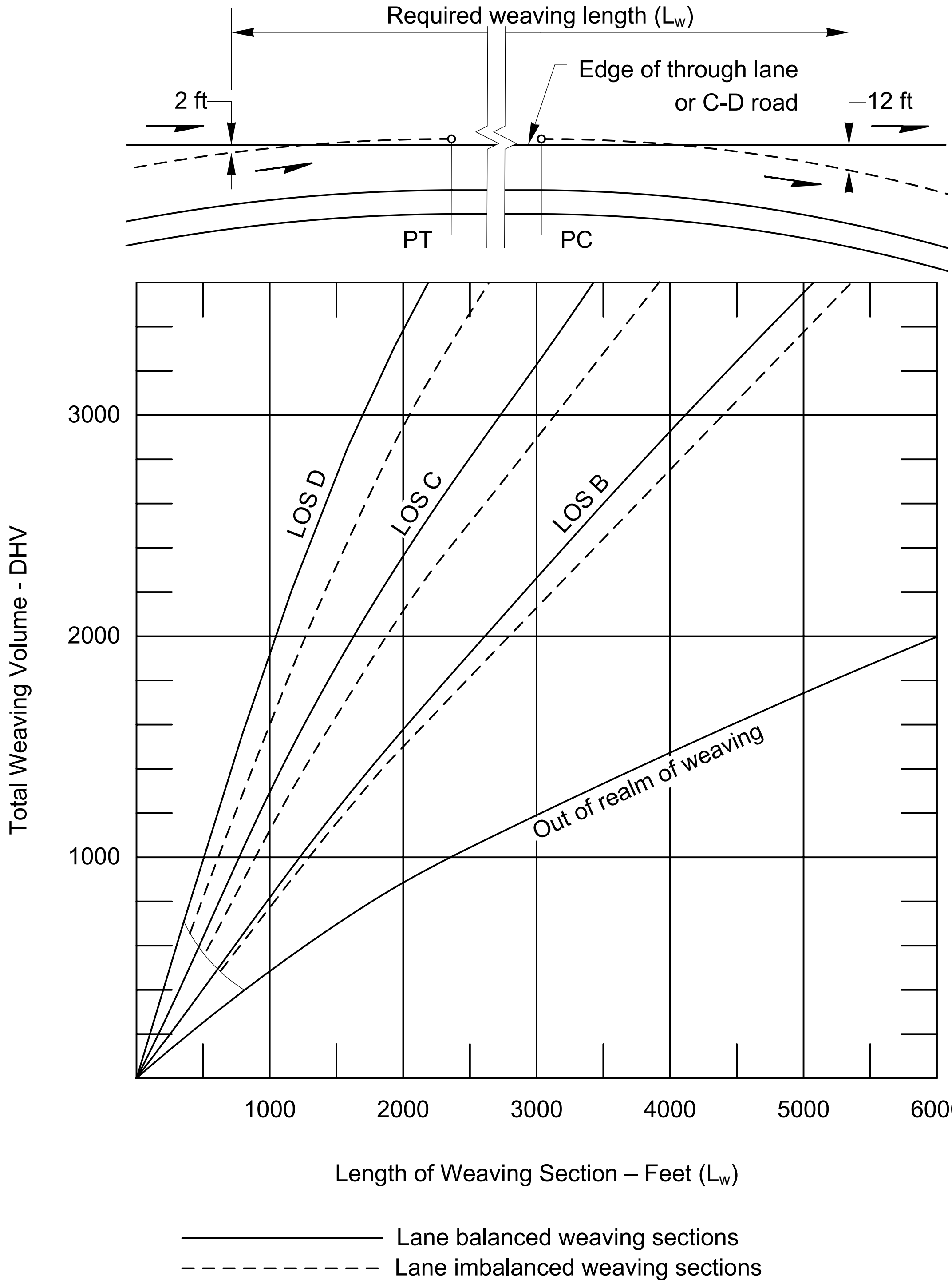
Design ramp terminal intersections at grade with crossroads as intersections at grade (see Chapters 910 and 915). Whenever possible, design ramp terminals to discourage wrong-way movements. Locate ramp terminal intersections at grade with crossroads to provide signal progression if the intersection becomes signalized in the future. Provide intersection sight distance as described in Chapter 910 or 915.

940.08 Interchanges on Two-Lane Highways

Occasionally, the first stage of a conventional interchange will be built with only one direction of the main roadway and operated as a two-lane two-way roadway until the ultimate roadway is constructed.

The design of interchanges on two-lane two-way highways may vary considerably from traditional concepts due to the following conditions:

- The potential for cross-centerline collisions due to merge conflicts or motorist confusion
- The potential for wrong-way or U-turn movements
- Future construction considerations
- Traffic type and volume
- The proximity to multilane highway sections that might influence a driver’s impression that these roads are also multilane



Note: See Figure 940-8 to determine whether or not lane balance for weaving exists.

Length of Weaving Sections
Figure 940-12

Provide the deceleration taper for all exit conditions. Design the entering connection with either the normal acceleration taper or a “button hook” configuration with a stop condition before entering the main line. Consider the following items:

- Design the stop condition connection in accordance with a tee (T) intersection in Chapter 910. Use this type of connection when an acceleration lane is not possible. Provide decision sight distance as described in Chapter 650.
- Since each design will probably vary from project to project, analyze each project for the most efficient signing placement, such as one-way, two-way, no passing, do not enter, directional arrows, guideposts, and traffic buttons.
- Prohibit passing through the interchange area on two-lane highways by means of signing, pavement marking, or a combination of both. The preferred treatment is a 4-foot median island, highlighted with raised pavement markers and diagonal stripes. When using a 4-foot median system, extend the island 500 feet beyond any merging ramp traffic acceleration taper. The width for the median can be provided by reducing each shoulder 2 feet through the interchange (see Figure 940-17).
- Include signing and pavement markings to inform both the entering and through motorists of the two-lane two-way characteristic of the main line.
- Use as much of the ultimate roadway as possible. Where this is not possible, leave the area for future lanes and roadway ungraded.
- Design and construct temporary ramps as if they were permanent unless second-stage construction is planned to rapidly follow the first stage. In all cases design the connection to meet the needs of the traffic.

940.09 Interchange Plans for Approval

Figure 940-18 is a sample showing the general format and data for interchange design plans.

Compass directions (W-S Ramp) or crossroad names (E-C Street) may be used for ramp designations to best clarify each interchange configuration and circumstance.

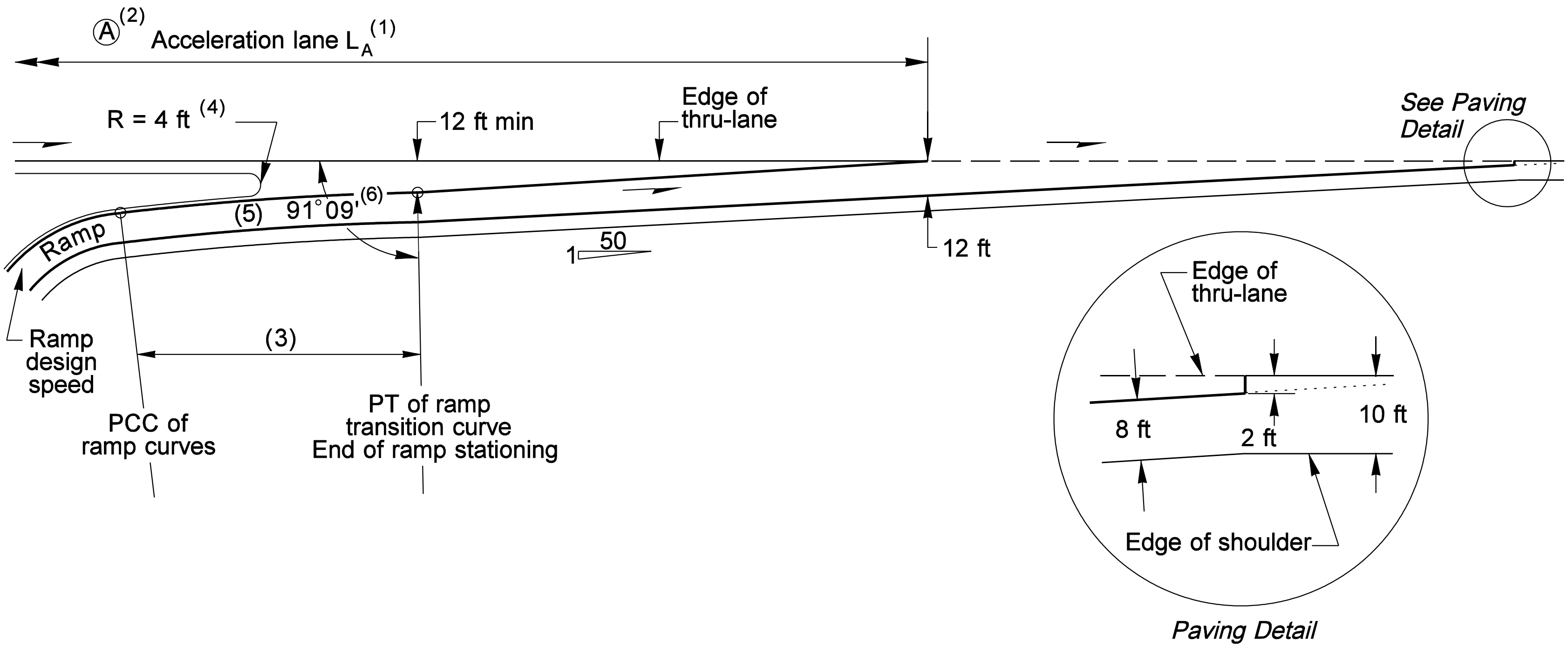
Include the following, as applicable:

- Classes of highway and design speeds for main line and crossroads (see Chapter 440)
- Curve data on main line, ramps, and crossroads
- Numbers of lanes and widths of lanes and shoulders on main line, crossroads, and ramps
- Superelevation diagrams for the main line, the crossroad, and all ramps (may be submitted on separate sheets)
- Channelization (see Chapter 910)
- Stationing of ramp connections and channelization
- Proposed right of way and access control treatment (see Chapters 1410, 1420, and 1430)
- Delineation of all crossroads, existing and realigned (see Chapter 910)
- Traffic data to justify the proposed design (include all movements)
- For HOV direct access connections on the left, include the statement that the connection will be used solely by HOVs or will be closed

Prepare a preliminary contour grading plan for each completed interchange. Show the desired contours of the completed interchange, including details of basic land formation, slopes, graded areas, or other special features. Coordinate the contour grading with the drainage design and the roadside development plan.

940.10 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/Design/ProjectDev/



Notes:

[1] For acceleration lane length LA, see Figure 940-9.

[2] Point Ⓐ is the point controlling the ramp design speed.

[3] A transition curve with a minimum radius of 3000 ft is desirable. The desirable length is 300 ft. When the main line is on a curve to the left, the transition may vary from a 3000-ft radius to tangent to the main line.

[4] Radius may be reduced when concrete barrier is placed between the ramp and main line.

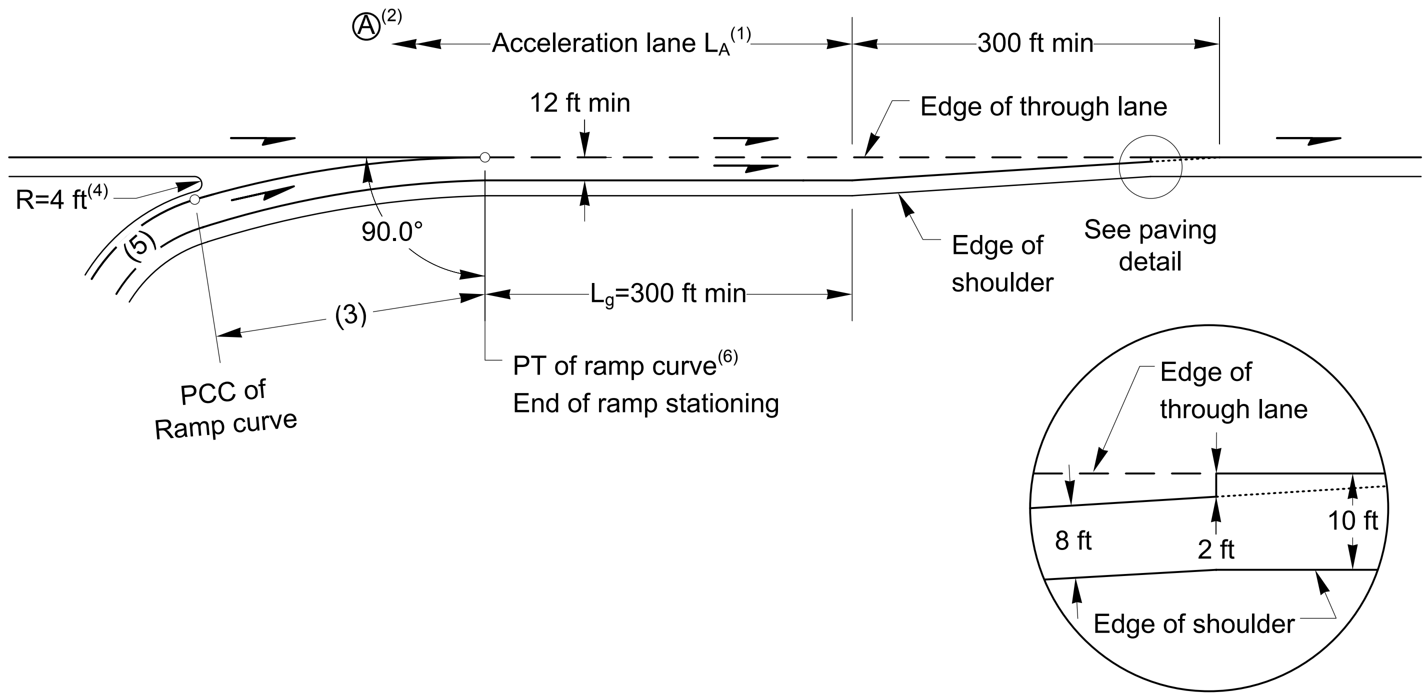
[5] For ramp lane and shoulder widths, see Figure 940-6.

[6] Approximate angle to establish ramp alignment.

[7] For striping, see the *Standard Plans*.

On-Connection: Single-Lane, Tapered

Figure 940-13a



Paving detail

Notes:

[1] For acceleration lane length LA, see Figure 940-9.

[2] Point Ⓐ is the point controlling the ramp design speed.

[3] A transition curve with a minimum radius of 3000 ft is desirable. The desirable length is 300 ft. When the main line is on a curve to the left, the transition may vary from a 3000-ft radius to tangent to the main line. The transition curve may be replaced by a 50:1 taper with a minimum length of 300 ft.

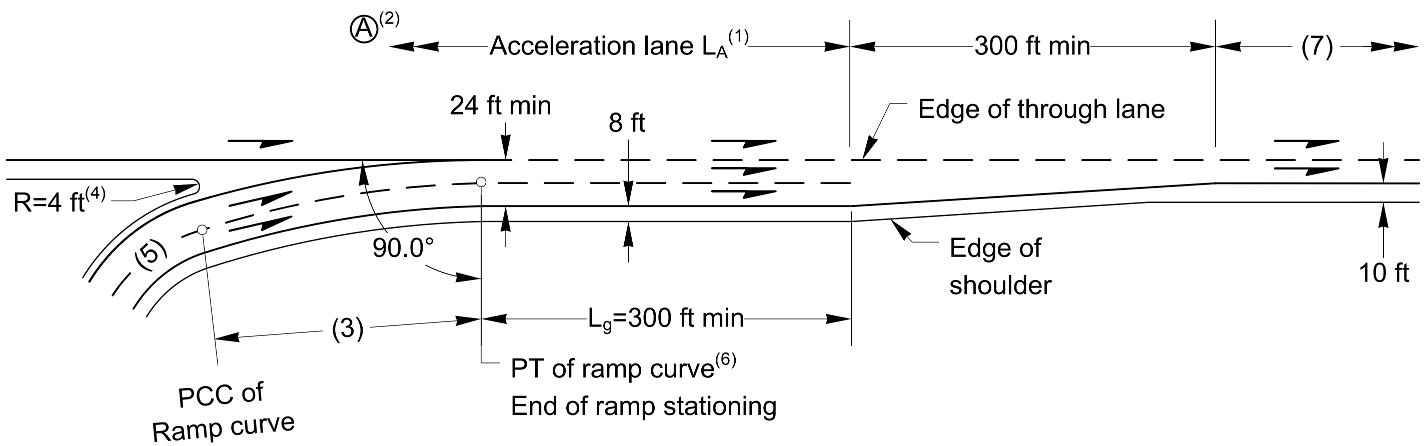
[4] Radius may be reduced when concrete barrier is placed between the ramp and main line.

[5] For ramp lane and shoulder widths, see Figure 940-6.

[6] Ramp stationing may be extended to accommodate superelevation transition.

[7] For striping, see the *Standard Plans*.

On-Connection: Single-Lane, Parallel
Figure 940-13b



Notes:

[1] For acceleration lane length LA, see Figure 940-9.

[2] Point Ⓐ is the point controlling the ramp design speed.

[3] A transition curve with a minimum radius of 3000 ft is desirable. The desirable length is 300 ft. When the main line is on a curve to the left, the transition may vary from a 3000-ft radius to tangent to the main line. The transition curve may be replaced by a 50:1 taper with a minimum length of 300 ft.

[4] Radius may be reduced when concrete barrier is placed between the ramp and main line.

[5] For ramp lane and shoulder widths, see Figure 940-6.

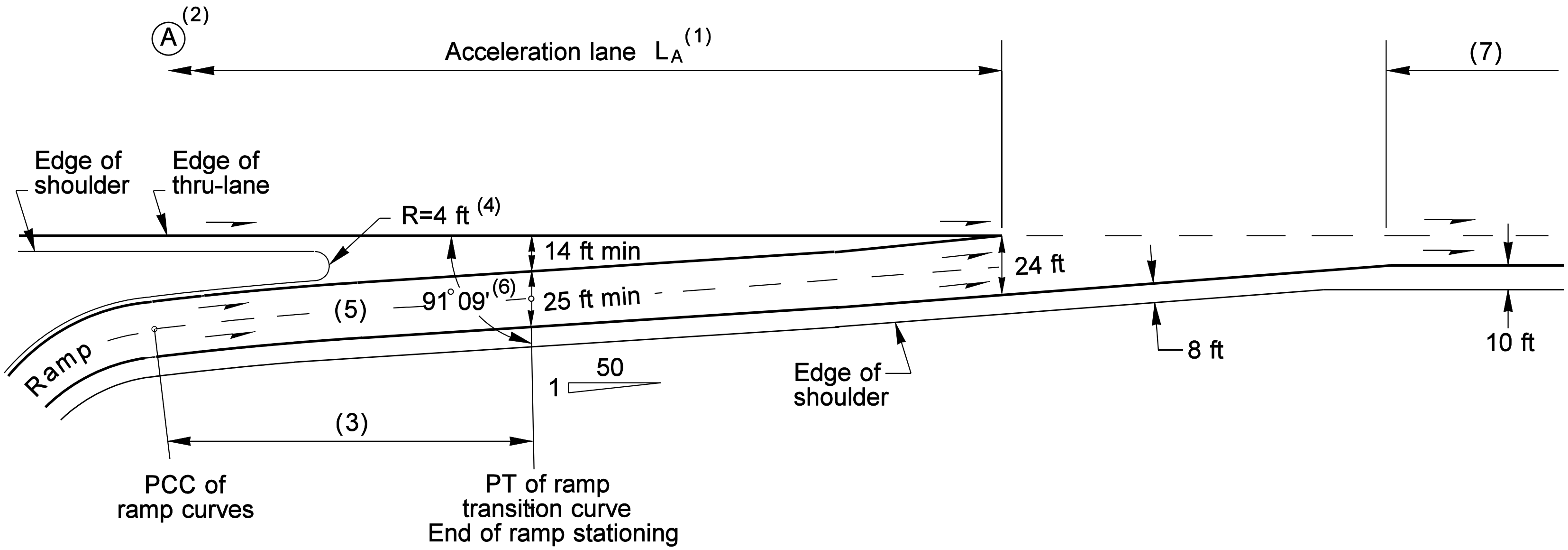
[6] Ramp stationing may be extended to accommodate superelevation transition.

[7] Added lane or 1500-ft auxiliary lane plus 600-ft taper.

[7] For striping, see the *Standard Plans*.

On-Connection: Two-Lane, Parallel

Figure 940-13c



Notes:

[1] For acceleration lane length LA, see Figure 940-9.

[2] Point Ⓐ is the point controlling the ramp design speed.

[3] A transition curve with a minimum radius of 3000 ft is desirable. The desirable length is 300 ft. When the main line is on a curve to the left, the transition may vary from a 3000-ft radius to tangent to the main line.

[4] Radius may be reduced when concrete barrier is placed between the ramp and main line.

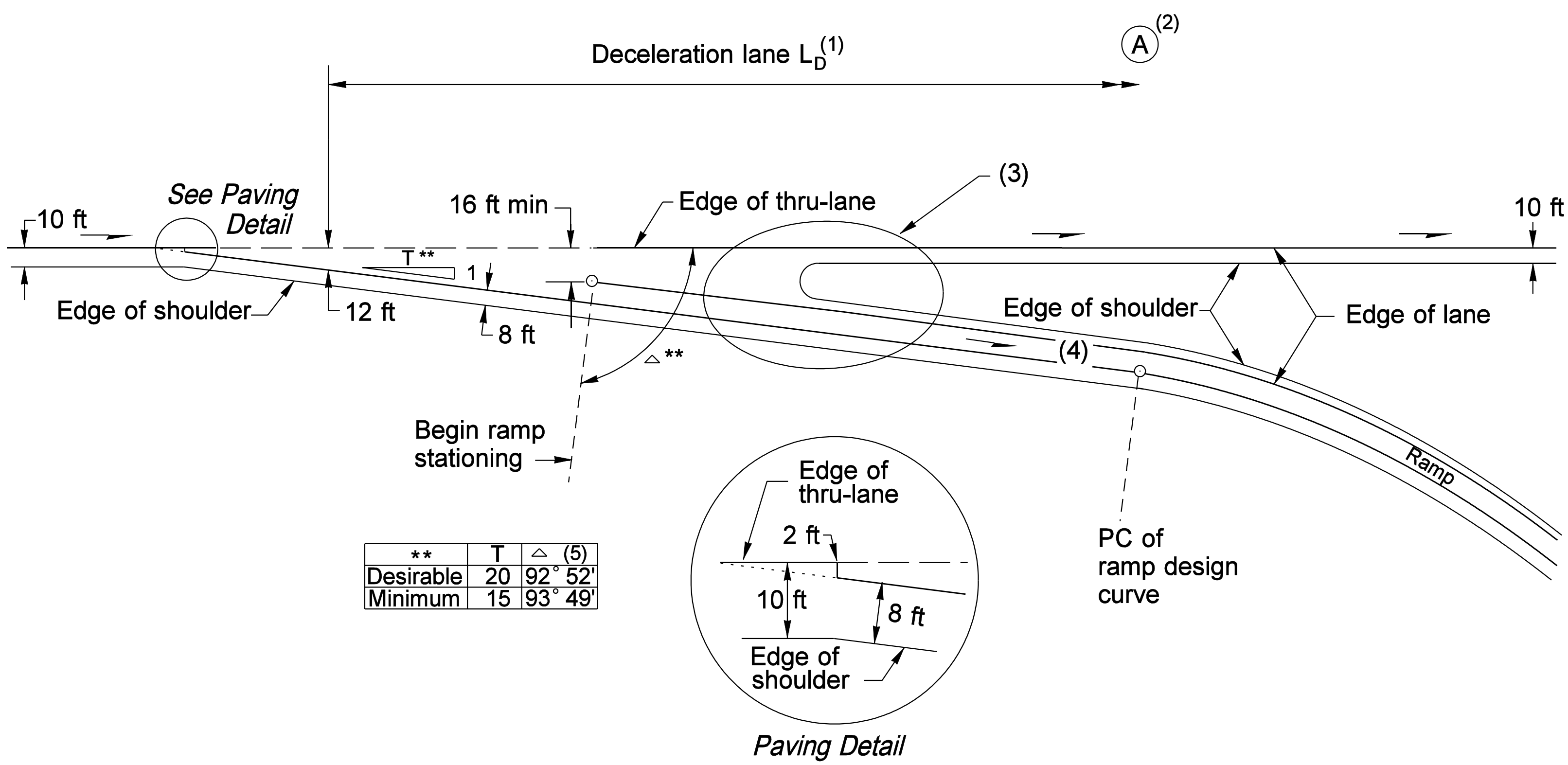
[5] For ramp lane and shoulder widths, see Figure 940-6.

[6] Approximate angle to establish ramp alignment.

[7] Added lane or 1500-ft auxiliary lane plus 600-ft taper.

[8] For striping, see the *Standard Plans*.

On-Connection: Two-Lane, Tapered
Figure 940-13d



**	T	△ (5)
Desirable	20	92° 52'
Minimum	15	93° 49'

Notes:

[1] For deceleration lane length LD, see Figure 940-10.

[2] Point Ⓐ is the point controlling the ramp design speed.

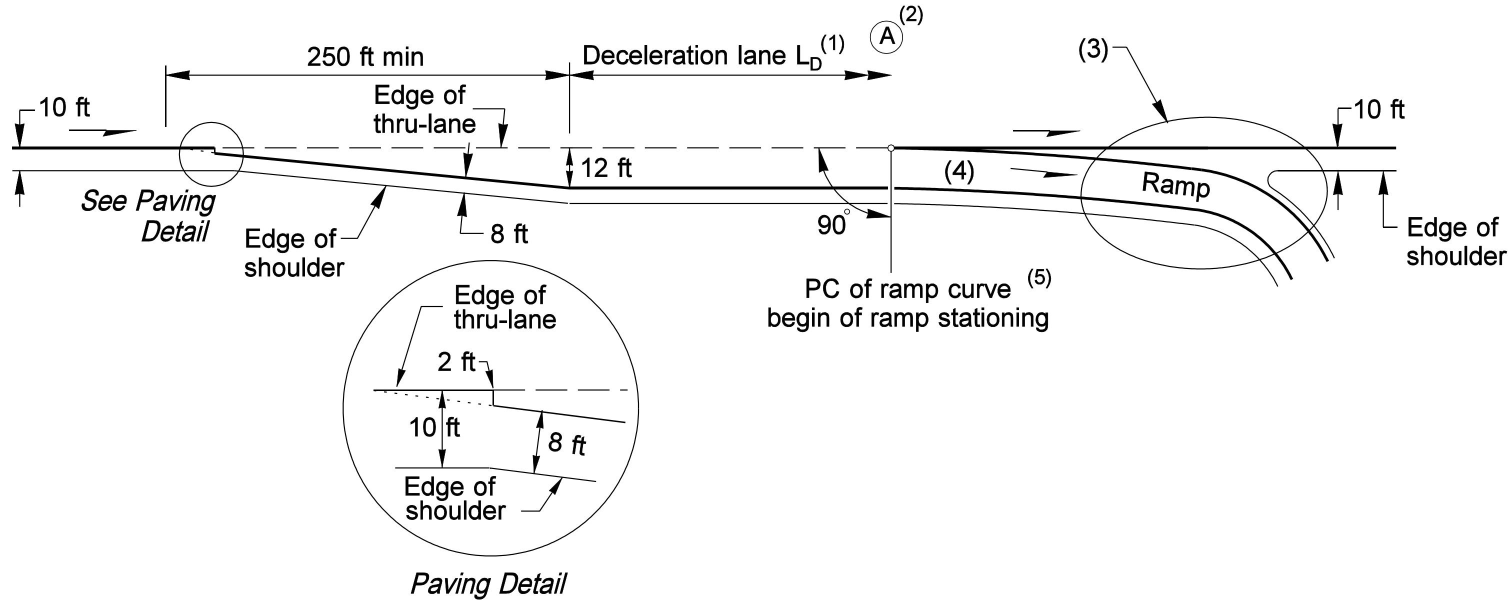
[3] For gore details, see Figure 940-11a.

[4] For ramp lane and shoulder widths, see Figure 940-6.

[5] Approximate angle to establish ramp alignment.

[6] For striping, see the *Standard Plans*.

Off-Connection: Single-Lane, Tapered
Figure 940-14a



Notes:

[1] For deceleration lane length LD, see Figure 940-10.

[2] Point A is the point controlling the ramp design speed.

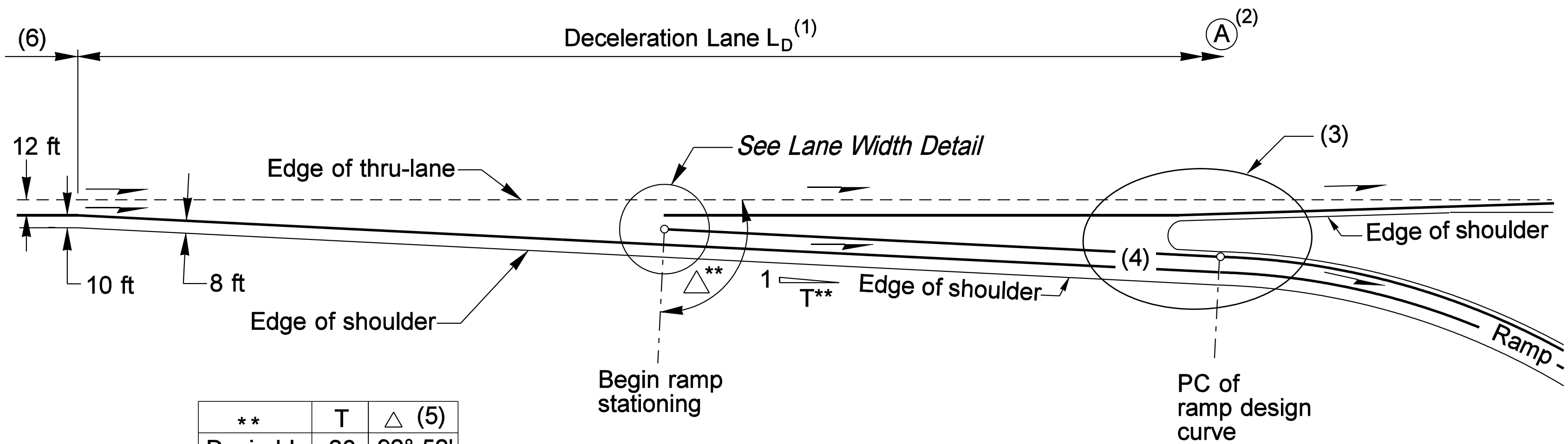
[3] For gore details, see Figure 940-11a.

[4] For ramp lane and shoulder widths, see Figure 940-6.

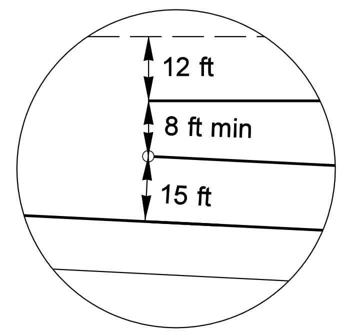
[5] Ramp stationing may be extended to accommodate superelevation transition.

[6] For striping, see the *Standard Plans*.

Off-Connection: Single-Lane, Parallel
Figure 940-14b



**	T	△ (5)
Desirable	20	92° 52'
Minimum	15	93° 49'

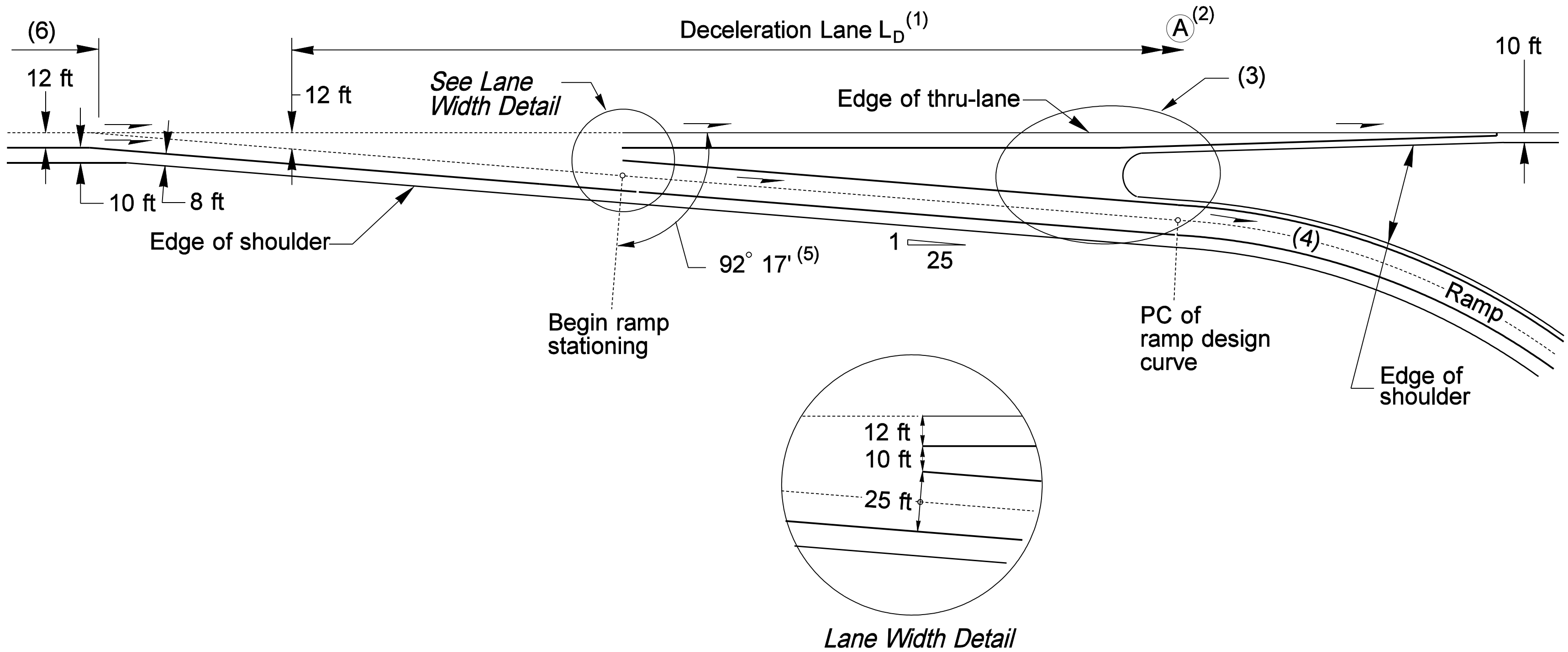


Lane Width Detail

Notes:

[1] For deceleration lane length LD, see Figure 940-10.
[2] Point Ⓐ is the point controlling the ramp design speed.
[3] For gore details, see Figure 940-11b.
[4] For ramp lane and shoulder widths, see Figure 940-6.
[5] Approximate angle to establish ramp alignment.
[6] Auxiliary lane between closely spaced interchanges to be dropped.
[7] For striping, see the *Standard Plans*.

Off-Connection: Single-Lane, One-Lane Reduction
Figure 940-14c



Notes:

[1] For deceleration lane length LD, see Figure 940-10.

[2] Point (A) is the point controlling the ramp design speed.

[3] For gore details, see Figure 940-11b.

[4] For ramp lane and shoulder widths, see Figure 940-6.

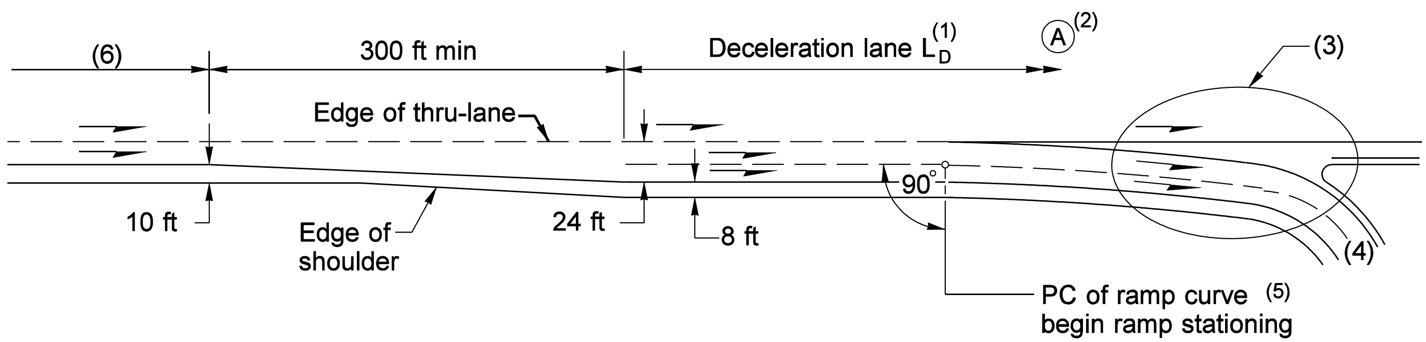
[5] Approximate angle to establish ramp alignment.

[6] Lane to be dropped or auxiliary lane with a minimum length of 1500 ft with a 300-ft taper.

[7] For striping, see the *Standard Plans*.

Off-Connection: Two-Lane, Tapered

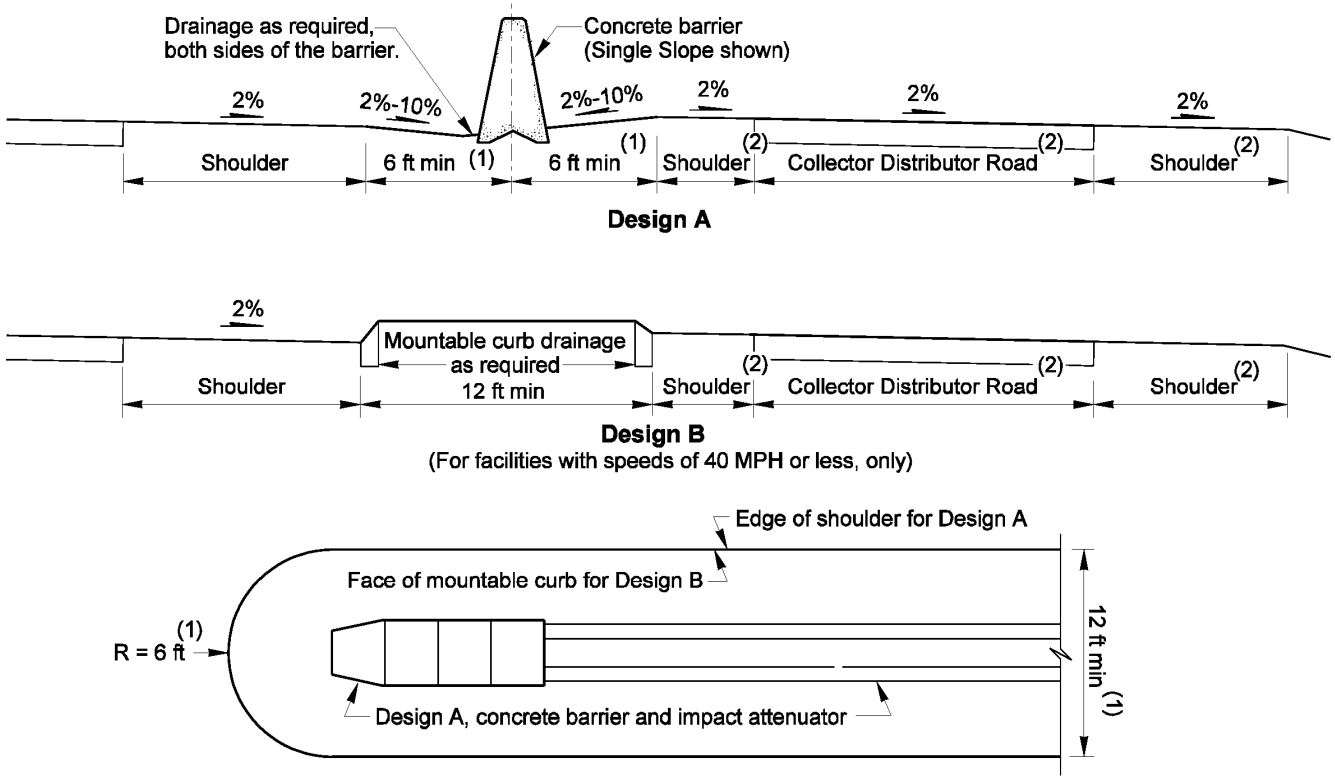
Figure 940-14d



Notes:

[1] For deceleration lane length LD, see Figure 940-10.
[2] Point A is the point controlling the ramp design speed.
[3] For gore details, see Figure 940-11b.
[4] For ramp lane and shoulder widths, see Figure 940-6.
[5] Ramp stationing may be extended to accommodate superelevation transition.
[6] Lane to be dropped or auxiliary lane with a minimum length of 1500 ft with a 300-ft taper.
[7] For striping, see the *Standard Plans*.

Off-Connection: Two-Lane, Parallel
Figure 940-14e

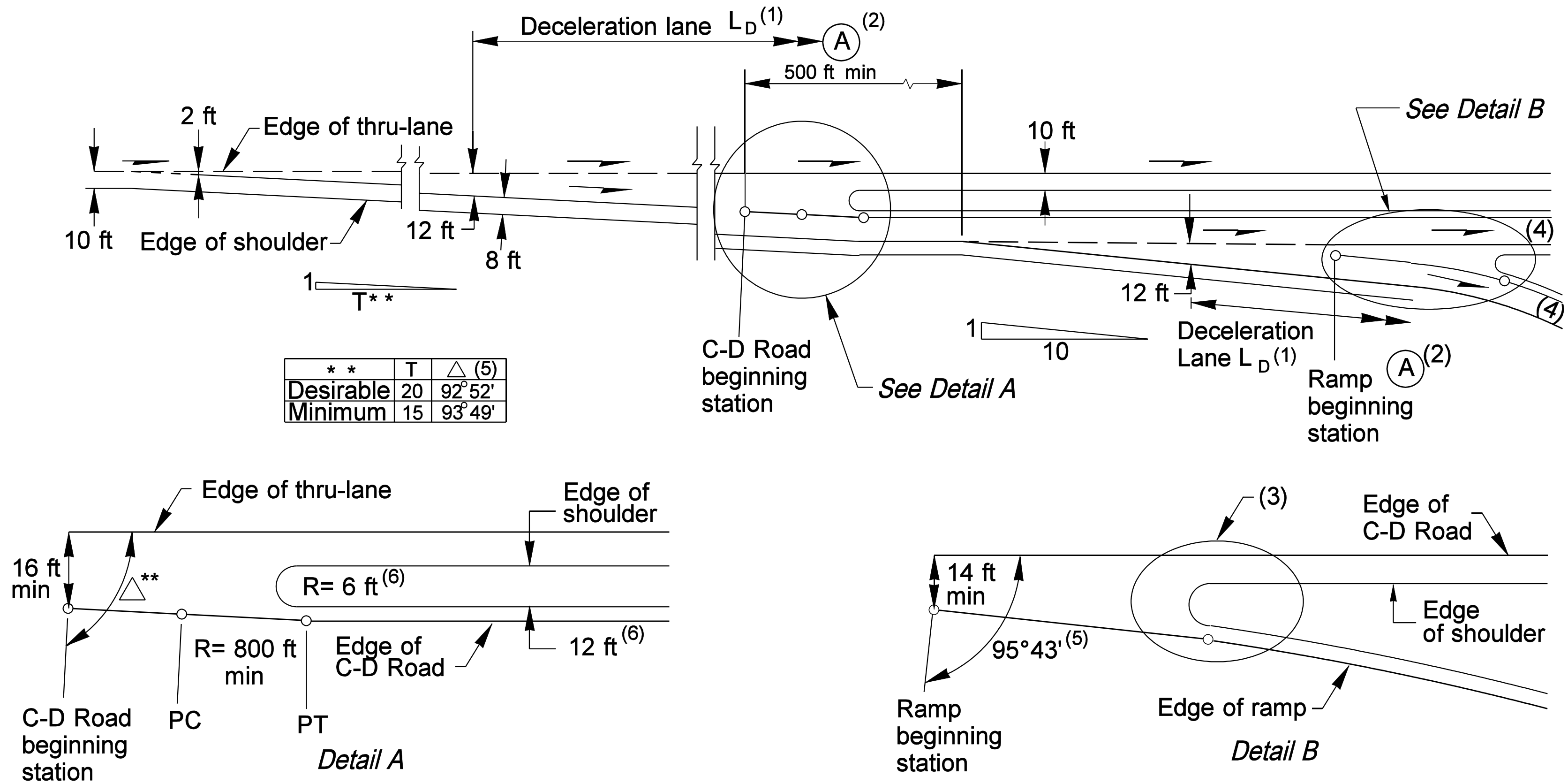


Notes:

[1] With justification, the concrete barrier may be placed with 2 ft between the edge of either shoulder and the face of barrier. The minimum width between the edge of through-lane shoulder and the edge of C-D road shoulder will be reduced to 6 ft, and the radius at the nose will be reduced to 3 ft.

[2] For collector-distributor road lane and shoulder widths, see ramp lane and shoulder widths, Figure 940-6.

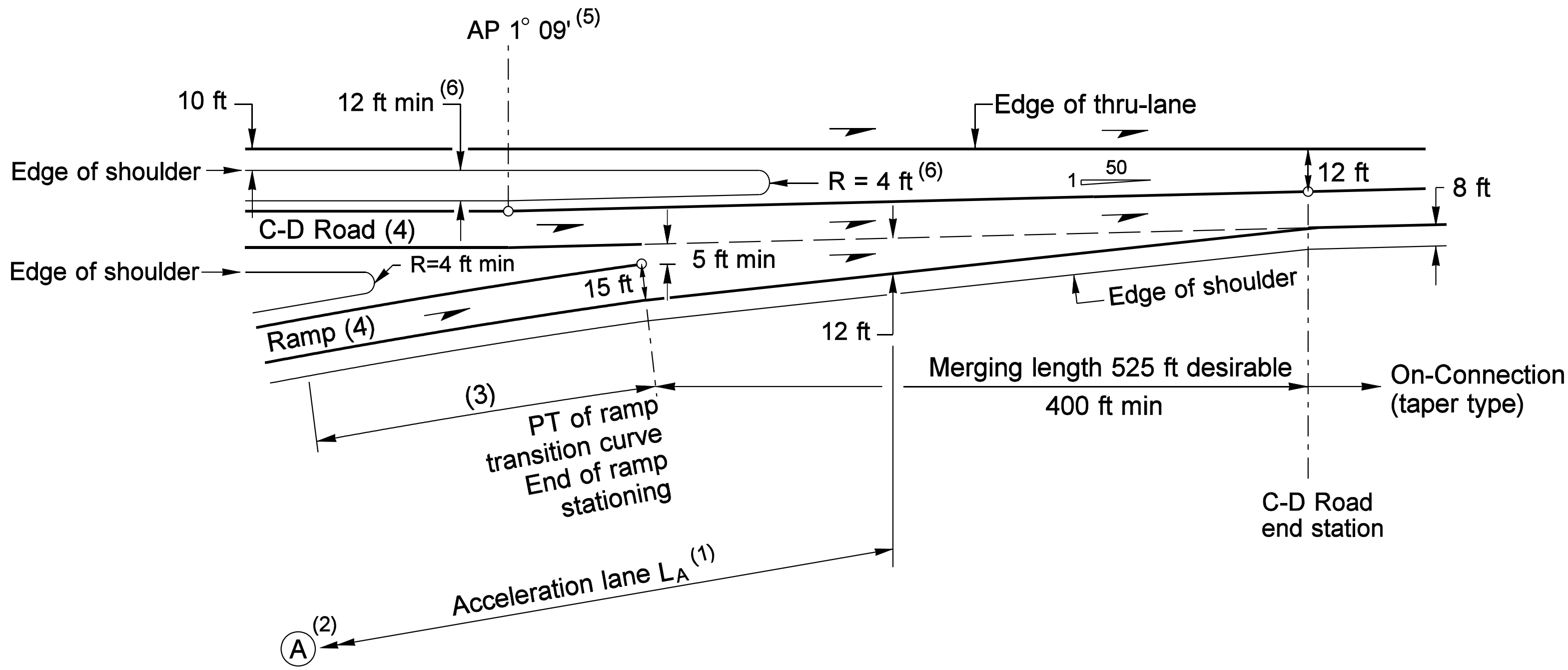
Collector-Distributor: Outer Separations
Figure 940-15a



Notes:

[1] For deceleration lane length LD, see Figure 940-10.
[2] Point Ⓐ is the point controlling the C-D road or ramp design speed.
[3] For gore details, see Figure 940-11a.
[4] For C-D road and ramp lane and shoulder widths, see Figure 940-6.
[5] Approximate angle to establish alignment.
[6] May be reduced with justification (see Figure 940-15a).
[7] For striping, see the *Standard Plans*.

Collector-Distributor: Off-Connections
Figure 940-15b



Notes:

[1] For acceleration lane length LA, see Figure 940-9.

[2] Point Ⓐ is the point controlling the ramp design speed.

[3] A transition curve with a minimum radius of 3000 ft is desirable. The desirable length is 300 ft. When the C-D road is on a curve to the left, the transition may vary from a 3000-ft radius to tangent to the C-D road.

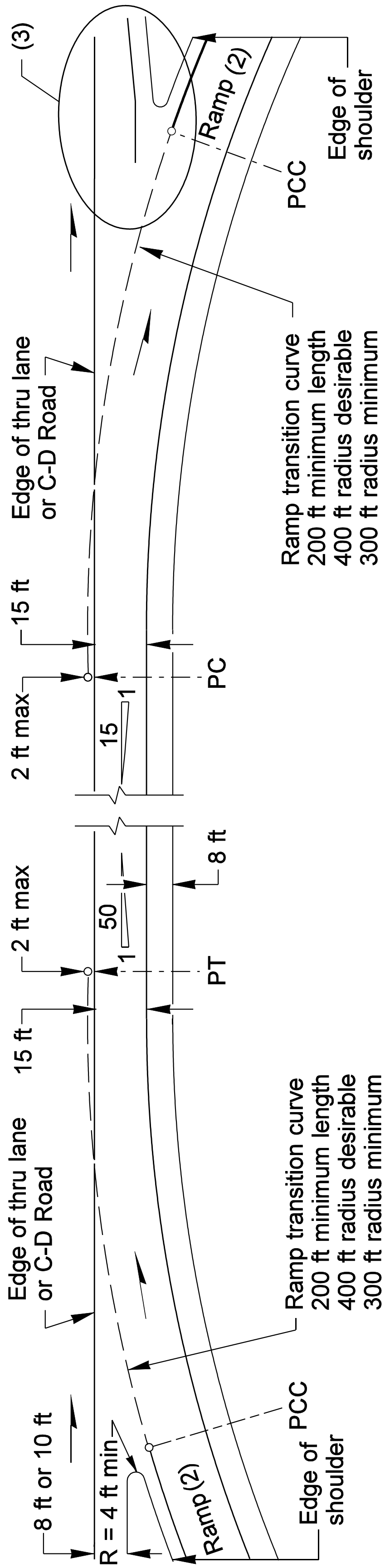
[4] For C-D road and ramp lane and shoulder widths, see Figure 940-6.

[5] Approximate angle to establish alignment.

[6] May be reduced with justification (see Figure 940-15a).

[7] For striping, see the *Standard Plans*.

Collector-Distributor: On-Connections
Figure 940-15c



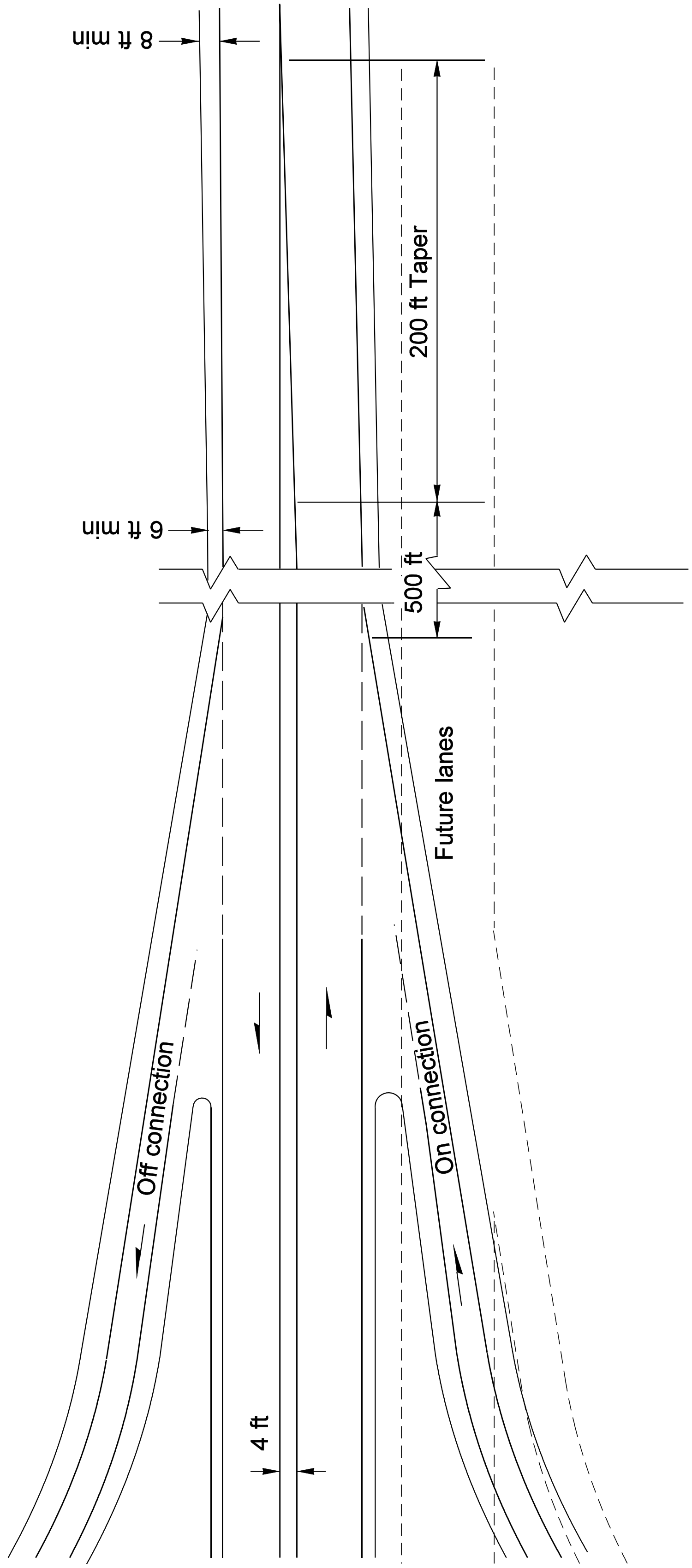
Notes:

[1] For minimum weaving length, see Figure 940-12.

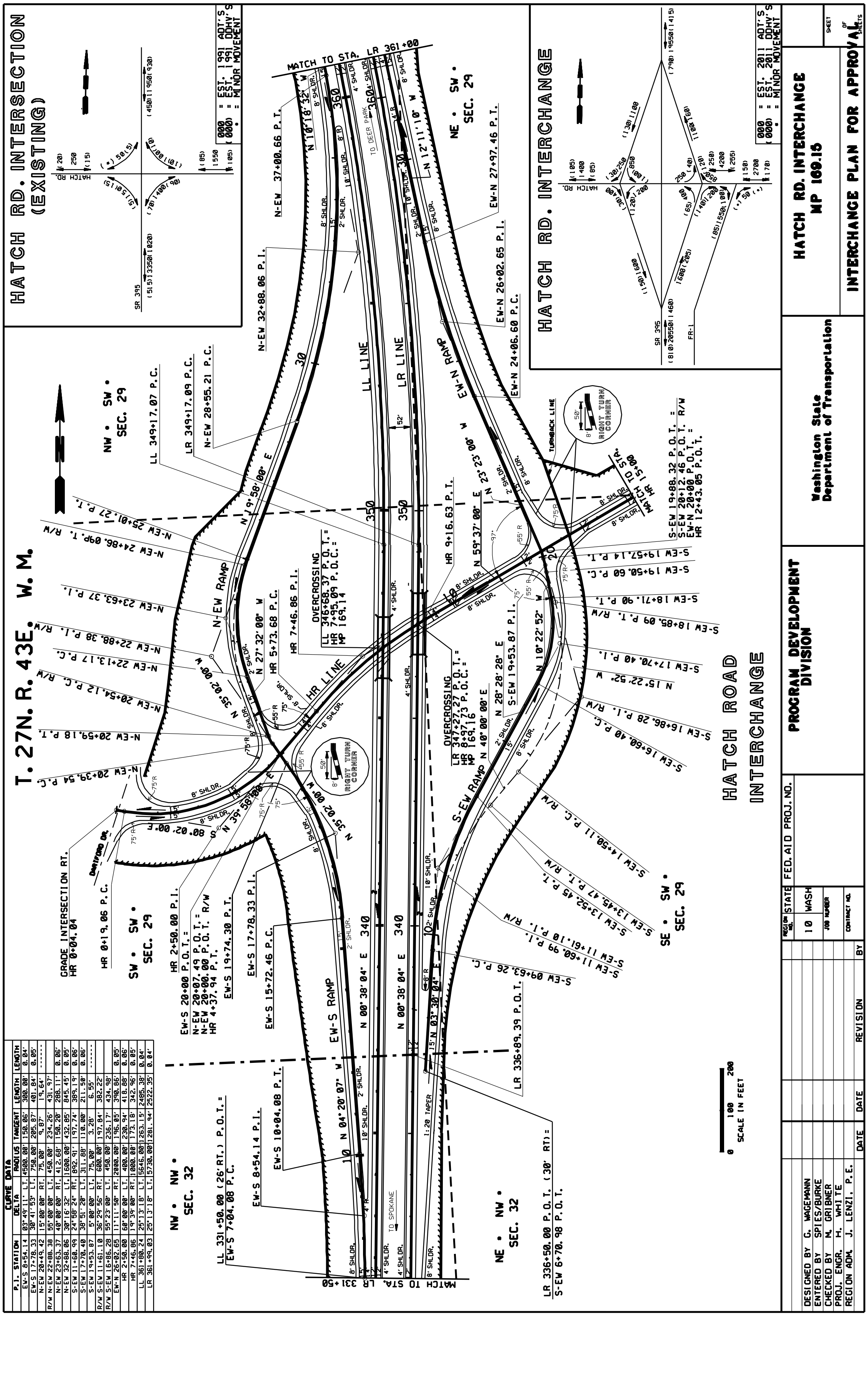
[2] For minimum ramp lane and shoulder widths, see Figure 940-6.

[3] For gore details, see Figure 940-11b.

Loop Ramp Connections
Figure 940-16



Temporary Ramps
Figure 940-17



Interchange Plan
Figure 940-18

On structures, the bridge railing type and height are part of the structure design. Contact the HQ Bridge and Structures Office for further information. (See Chapter 1120 for additional considerations.)

(15) Drainage

Sloping the pavement surface to one side usually simplifies longitudinal drainage design and surface construction, and is the preferred practice. (See 1020.06(8) for cross slope requirements.) Generally, surface drainage from the path will be adequately dissipated as it flows down the side slope. However, a shared-use path constructed on the side of a hill might require a drainage ditch on the uphill side to intercept the hillside drainage. Where necessary, install catch basins with drains to carry intercepted water under the path. (See Chapter 1210 for other drainage criteria.)

Locate drainage inlet grates and manhole covers off the pavement of shared-use paths. If manhole covers are needed on a path, install them to minimize the effect on bicyclists. Design manhole covers level with the surface of the path.

Drainage inlet grates on bicycle facilities must have openings narrow enough and short enough to ensure that bicycle tires will not drop into the grates. Replace existing grates that are not bicycle-safe with grates designed for bicycles (a WSDOT vaned grate, herringbone grate, or other grate with an opening perpendicular to the direction of travel, 4 inches or less center to center).

(16) Bollards

Install bollards at entrances to shared-use paths to prevent motor vehicles from entering. Do not use bollards to divert or slow path traffic. When locating such installations, ensure barriers are well marked and visible to bicyclists, day and night. Bollards located in or adjacent to bike paths represent an object that needs to be avoided by a cyclist. To increase the potential for appropriate maneuvering to occur by the bicyclist, provide designs where the post is clearly visible and recognizable to a cyclist.

When designing bollards, the following information applies:

- The desirable design is to provide a single bollard installed in the middle of the path to reduce confusion.
- When multiple bollard posts are required in wide path sections, use a minimum 5-foot spacing between bollard posts to permit passage of bicycle-towed trailers, wheelchairs, and adult tricycles, and to ensure adequate room for safe bicycle passage without dismounting.
- Provide 4 feet (5 feet desirable) between face of bollard and edge of path.
- At a minimum, provide stopping sight distance to bollards. An ideal location for bollard placement is in a relatively straight area of the path such that the post placement meets stopping sight distance requirements in Figure 1020-15. Do not place bollards in difficult-to-see locations; for example, immediately upon entering a tunnel.
- For cases where multiple posts are required longitudinally along the path, locate them at least 20 feet apart, with the first post in line from each direction meeting sight distance requirements.
- Use a contrasting striping pattern on the post.
- Use reflective materials on the post, such as a band at the top and at the base.
- Design all bollards along a corridor to be uniform in appearance. This ensures frequent bikers are familiar with the posts and will recognize them easily.
- Pavement markings per the MUTCD are required at all bollards on paved paths.
- Use removable bollards (Bollard Type 1) to permit access by emergency and service vehicles. Ensure the bollard sleeve is flush with the pavement surface.
- Nonremovable bollards (Bollard Type 2) may be used where access is not required.

Refer to the *Standard Plans* for bollard designs and the MUTCD for pavement markings at bollards.

(17) Signing and Pavement Markings

For guidance and directions regarding signing and pavement markings on bicycle facilities, see the MUTCD. Consider centerline markings to separate opposing directions of travel where there is heavy use, on curves where there is restricted sight distance, and where the path is unlighted and nighttime riding is expected. An edge line helps to delineate the path if nighttime use is expected.

(18) Lighting

The level of illumination required on a bicycle facility is dependent upon the amount of nighttime use expected and the nature of the area surrounding the facility. Provide illumination at intersections. (See Chapter 840 for guidance on bicycle facility illumination.)

1020.07 Bike Lane Design

Bike lanes are established along streets in corridors where there is current or anticipated bicycle demand and where it would be unsafe for bicyclists to ride in the travel lane. Provide bike lanes where it is desirable to delineate available road space for preferential use by bicyclists. Consider bike lanes in and around schools, parks, libraries, and other locations where young cyclists are present. (See Figure 1020-8.) Bike lanes delineate the rights of way assigned to bicyclists and motorists and provide for movements that are more predictable by each. Bike lanes can be provided by reducing the number or width of lanes or prohibiting parking, if an analysis shows that traffic will not be unduly degraded and adjacent businesses will not be excessively impacted by the loss of parking.

Bike Lane
Figure 1020-8

Where street improvements are not possible, improve the bicyclist's environment by providing shoulder sweeping programs and special signal facilities.

(1) Widths

The minimum width for a bike lane is 4 feet. Some typical bike lane configurations are illustrated in Figure 1020-18 and are described below:

- **Figure 1020-18, Design A,** depicts bike lanes on an urban-type curbed street where parking stalls (or continuous parking stripes) are marked. Locate bike lanes between the parking area and the traffic lanes. Minimum widths are shown. When the combined width of the bike lane and the parking lane is less than 15 feet, an increased probability of bicycle/car door collisions exists. When wider widths are not available, consider eliminating bike lane marking and signing.

  Do not place bike lanes between the parking area and the curb. Such facilities create hazards for bicyclists, such as the opening ofcar doors and poor visibility at intersections. Also, they prevent bicyclists from leaving the bike lane to turn left and they cannot be effectively maintained.

- **Figure 1020-18, Design B,** depicts bike lanes on an urban-type curbed street where parking is permitted without pavement markings between the bike lane and the parking lane. Establish bike lanes in conjunction with the parking areas. 12 feet (15 feet preferred) is the minimum total width of the bike lane and parking lane. This design is satisfactory where parking is not extensive and where the turnover of parked cars is infrequent. However, an additional width of 1 to 2 feet is recommended if parking is substantial or the turnover of parked cars is high. Delineated parking lanes are preferred.

- **Figure 1020-18, Design C,** depicts bike lanes along the outer portions of a roadway, with and without curb, where parking is prohibited. This configuration eliminates potential conflicts (such as the opening of car doors) with motor vehicle parking. Minimum widths are shown. Both the 5-foot width with curb or barrier and the 3 feet between a gutter and the traveled way must be achieved. With curb, guardrail, or barrier, the minimum bike lane width is 5 feet. When a gutter is present, a minimum width of 3 feet is required from the edge of the gutter. Additional width is desirable, particularly where motor vehicle operating speeds exceed 40 miles per hour. Prohibit parking when necessary.

High-speed truck, bus, and recreational vehicle traffic can cause problems along a bike lane because of aerodynamic effects and vehicle widths. Increase shoulder widths to accommodate large vehicles and bicycle traffic when truck, bus, or recreational vehicle traffic makes up 5% or more of the daily traffic.

Bike lanes are not advisable on long, steep downgrades where bicycle speeds greater than 30 miles per hour can be expected. As grades increase, downhill bicycle speeds will increase, which increases the handling problems if bicyclists are riding near the edge of the roadway. In such situations, bicycle speeds can approach those of motor vehicles, and experienced bicyclists will generally move into the motor vehicle lanes to increase sight distance and maneuverability. However, this situation might place other bicyclists in a hazardous position. When steep downgrades are unavoidable, provide full design-level shoulder width and signing in accordance with the MUTCD to alert bicyclists of the grade and the need to control their speeds.

Bike lanes are usually placed on the right side of one-way streets. Consider placing the bike lane on the left side when it produces fewer conflicting movements between bicycles and motor vehicles.

(2) Intersection Design

Design bike lanes at intersections in a manner that will minimize confusion for motorists and bicyclists and will permit both users to operate in accordance with the Rules of the Road (see RCW 46.61).

Figure 1020-19 illustrates a typical intersection of multilane streets, with bike lanes on all approaches. Some common movements of motor vehicles and bicycles are shown.

Figures 1020-20a and 20b illustrate two design options where bike lanes cross off- and on-ramps or wye connections. Option 1 provides a defined crossing point for bicyclists who want to stay on their original course. This option is desirable when bicyclists do not have a good view of traffic. Use Option 2 where bicyclists normally have a good view of traffic entering or exiting the roadway and will adjust their path to cross ramp traffic. A bike-crossing sign to warn motorists of the possibility of bicyclists crossing the roadway is recommended.

Figure 1020-21 illustrates the recommended options where bike lanes cross a channelized right-turn-only lane. When approaching such intersections, bicyclists will have to merge with right-turning motorists. Since bicyclists are typically traveling at speeds less than motorists, they can signal and merge where there is a sufficient gap in right-turning traffic, rather than at any predetermined location. For this reason, it is most effective to end bike lane markings at the approach of the right-turn lane or to extend a single, dotted bike lane line across the right-turn lane. Parallel lines (delineating a bike lane crossing) to channelize the bike merge are not recommended, as they encourage bicyclists to cross at predetermined locations. In addition, some motorists might assume they have the right of way and neglect to yield to bicyclists continuing straight.

A dotted line across the right-turn-only lane is not recommended where there are double right-turn-only lanes. For these types of intersections, drop all pavement markings to permit judgment by the bicyclists to prevail.

For signing and pavement marking requirements, see the MUTCD and the Standard Plans.

(3) Traffic Signals

At signalized intersections, consider bicycle traffic needs and intersection geometry when timing the traffic signal cycle and when selecting the method of detecting the presence of the bicyclist. Contact the region's Bicycle Coordinator for assistance in determining the timing criteria. Consider the installation of effective loop detectors or other methods of detecting a bicycle within the bike lane (in advance of the intersection) and turn lanes, in addition to push button actuators. Select loop detectors sensitive enough to detect bicycles. Bicyclists generally prefer not to use push button actuators, as they must go out of their way to actuate the signal. For additional guidance on signal design, see Chapter 850.

(4) Signing and Pavement Markings

Use the MUTCD and the Standard Plans for signing and pavement marking criteria. (See Chapter 820 for additional information on signing and Chapter 830 for information on pavement markings.)

(5) Drainage Grates and Manhole Covers

Locate drainage inlet grates and manhole covers to avoid bike lanes. When drainage grates or manhole covers are located in a bike lane, minimize the effect on bicyclists. A minimum of 3 feet of lateral clearance is needed between the edge of a drainage inlet grate and the shoulder stripe. Install and maintain grates and manhole covers level with the surface of the bike lane.

For additional information on drainage, see 1020.06(15).

1020.08 Shared Roadway Design

Generally, lower-speed/lower-volume streets are adequate for bicycle travel, so additional signing and pavement markings for bicycle use are unnecessary. (See Figure 1020-9.)

Shared Roadway
Figure 1020-9

The region's Traffic Engineer is responsible for determining which sections of state highways are inappropriate for bicycle traffic. The State Traffic Engineer, after consultation with the Bicycle Advisory Committee, prohibits bicycling on sections of state highways through the traffic regulation process. Contact the region Traffic Operations Office for further information.

Bicyclists traveling between cities or on recreational trips may use many rural highways. Providing and maintaining paved shoulders, with or without an edge stripe, can significantly improve safety and convenience for bicyclists and motorists along such routes.

A shared roadway bike route with improvements for bicycles can offer a greater degree of service to bicyclists than other roadways. Improvements on shared roadways to facilitate better bicycle travel include widening the shoulders to full design level width (a minimum of 4 feet); adding pavement markings; improving roadside maintenance (including periodic sweeping); and removing surface hazards such as drain grates not compatible with bicycle tires.

Where public transport and cycling facilities meet, an integrated design that ensures neither mode inconveniences the other is desirable. When buses and bicyclists share the same roadway, consider the following recommendations:

- Where bus speeds and volumes are high, separate facilities for buses and bicyclists are desirable
- Where bus speeds and volumes are low, consider a shared-use bus/bicycle lane

Consider providing bicycle parking facilities near public transportation stops.

1020.09 Signed Shared Roadway

Signed shared roadways are shared roadways that have been identified as preferred bike routes by posting bike route signs. (See Figure 1020-10.) Provide connections for continuity to other bicycle facilities. Designate preferred routes through high bicycle-demand corridors. As with bike lanes, signing shared roadways as bike routes is an indication to bicyclists that there are advantages to using these bike routes, as compared with alternative routes. (Signing also alerts motor vehicle operators that bicycles are present.) Provide improvements to make these routes suitable as bike routes, and maintain in a manner consistent with the needs of bicyclists.

Signed Shared Roadway (Designated Bike Route)
Figure 1020-10

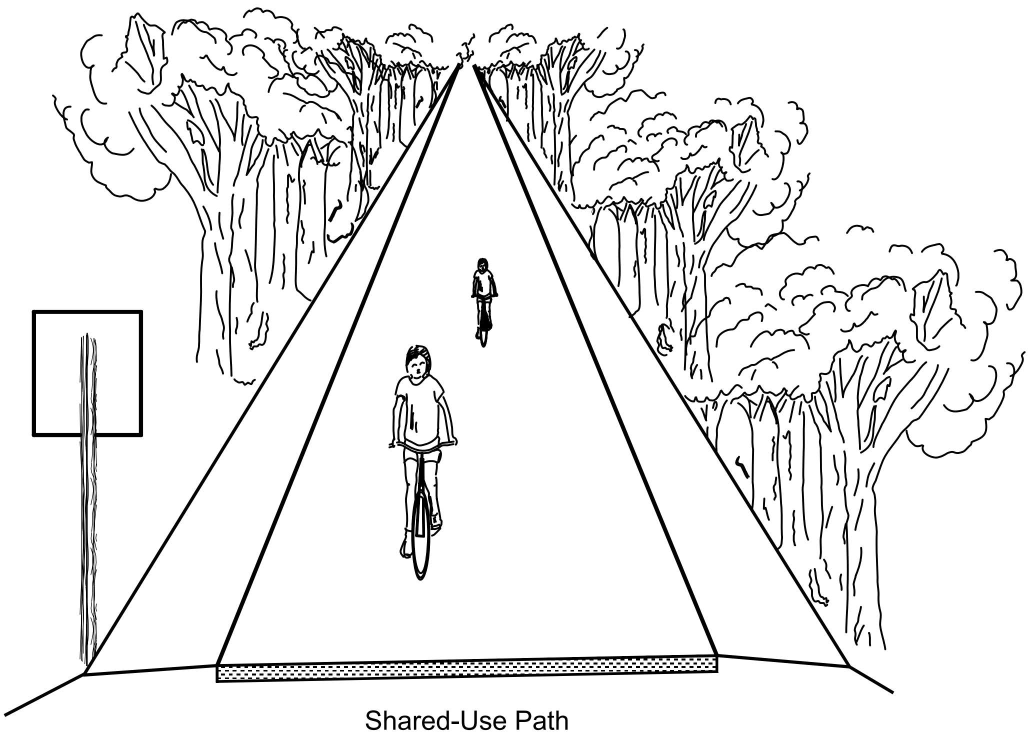
Use the following criteria to aid in determining whether or not to designate and sign a bike route:

- The route offers a higher degree of service than alternative streets
- The route provides for through and direct travel in bicycle corridors
- The route connects bicycle facilities
- Traffic control devices have been adjusted to accommodate bicyclists
- Street parking is prohibited for improved safety where lane width is critical
- Surface hazards to bicyclists have been corrected
- Maintenance of the route is at a higher level than comparable streets, such as more frequent street sweeping and repair

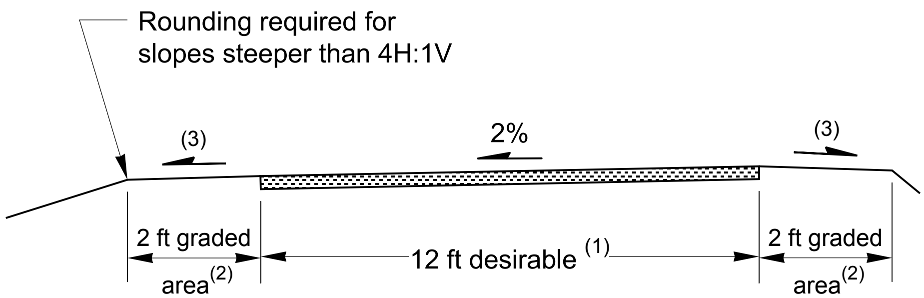
Establish a signed shared roadway bike route by placing the MUTCD Bicycle Route signs or markers along the roadways. When the signed shared roadway designates an alternate route, consider destination signing.

1020.10 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/



Shared-Use Path



Notes:

(1) For further discussion on bicycle path widths, see 1020.06(1).

(2) Where the paved width is wider than 10 feet, the graded area may be reduced accordingly.

(3) Not steeper than 6H:1V.

Two-Way Shared-Use Path
(Separate Right of Way)
Figure 1020-11a

Chapter 1025 Pedestrian Design Considerations

1025.01 General

Pedestrian travel is a vital transportation mode. It is used at some point by nearly all citizens and is the main link to everyday life for many others. Washington State Department of Transportation (WSDOT) designers must be aware of the various physical needs and abilities of pedestrians. Accommodate this variation in design to allow universal access.

The Americans with Disabilities Act of 1990 (ADA) requires that pedestrian facilities be designed and constructed so they are readily accessible and usable by individuals with disabilities. This chapter provides accessibility criteria to design pedestrian facilities that meet state and national standards.

In addition to the ADA requirements, design pedestrian facilities using guidance in the *Roadside Manual*, the *Design Manual*, and the *Standard Plans*.

Designers face multiple challenges developing reasonably safe and efficient facilities that address pedestrian needs within a limited amount of right of way. Designers must:

- Become familiar with all the accessibility criteria requirements.
- Evaluate all pedestrian facilities within project limits for compliance with ADA.
- Recognize those features and elements in existing pedestrian facilities that meet or do not meet accessibility criteria.
- Design facilities that meet accessibility criteria.
- Balance intersection designs to meet the needs of pedestrians and vehicles.
- Design pedestrian access routes to be free of obstacles.
- Avoid the use of pedestrian space for snow storage in areas of heavy snowfall. (Coordinate with region maintenance staff.)

Consider the maintainability of all designs for accessible pedestrian facilities. Title II of the Americans with Disabilities Act requires that all necessary features be accessible and maintained in operable working condition for use by individuals with disabilities.

1025.02 References

(1) Federal/State Laws and Codes

Americans with Disabilities Act of 1990 (ADA) (28 Code of Federal Regulations [CFR] Part 36, Appendix A, as revised July 1, 1994)

23 CFR Part 652

28 CFR Part 35

49 CFR Part 27 (Authority: Section 504 of the Rehabilitation Act of 1973, as amended – 29 USC 794)

Revised Code of Washington (RCW) 35.68, Sidewalks, gutters, curbs and driveways – All cities and towns

RCW 35.78, Streets – Classification and design standards

RCW 46.04.160, Crosswalk

RCW 46.61.235, Crosswalks

RCW 46.61.240, Crossing at other than crosswalks

RCW 46.61.261, Sidewalks, crosswalks – Pedestrians, bicycles

RCW 47.24.010, City streets as part of state highways, Designation – Construction, maintenance – Return to city or town

RCW 47.24.020, City streets as part of state highways – Jurisdiction, control

RCW 47.30.030, Facilities for nonmotorized traffic

RCW 47.30.050, Expenditures for paths and trails

(2) Design Guidance

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

Accessible Rights-of-Way: A Design Guide, U.S. Access Board, Washington D.C.
www.access-board.gov/prowac/alterations/guide.htm

Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines (ADAAG), July 23, 2004, U.S. Access Board
www.wbdg.org/ccb/ASTAND/ada_aba.pdf

"Design Guidance, Accommodating Bicycle and Pedestrian Travel, A Recommended Approach," USDOT Policy Statement, 2001
www.fhwa.dot.gov/environment/bikeped/Design.htm

Designing Sidewalks and Trails for Access – Parts I & II, USDOT, FHWA, 2001
www.fhwa.dot.gov/environment/bikeped/publications.htm

Guide for the Planning, Design, and Operation of Pedestrian Facilities, AASHTO, 2004. Provides guidance on the planning, design, and operation of pedestrian facilities along streets and highways. Specifically, the guide focuses on identifying effective measures for accommodating pedestrians on public rights of way. The guide can be purchased through the AASHTO website.

Highway Capacity Manual, Transportation Research Board (TRB), 2000

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)

Pedestrian Facilities Guidebook: Incorporating Pedestrians Into Washington's Transportation System, OTAK, 1997 www.wsdot.wa.gov/publications/manuals/fulltext/M0000/PedFacGB.pdf

Pedestrian Facilities User's Guide – Providing Safety and Mobility, FHWA, 2002. Provides useful information regarding walkable environments, pedestrian crashes and their countermeasures, and engineering improvements for pedestrians.
www.drusilla.hsrc.unc.edu/cms/downloads/PedFacility_UserGuide2002.pdf

Revised Draft Guidelines for Accessible Public Rights-of-Way (PROWAG), Nov. 23, 2005, U.S. Access Board
www.access-board.gov/prowac/draft.htm

Roadside Manual, M 25-30, WSDOT

Special Report: Accessible Public Rights-of-Way – Planning & Designing for Alterations, Public Rights-of-Way Access Advisory Committee, July 2007
www.access-board.gov/PROWAC/alterations/guide.htm

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

Understanding Flexibility in Transportation Design – Washington, WSDOT, 2005

Washington State Bicycle and Pedestrian Plan
http://wsdot.wa.gov/bike/Bike_Plan.htm

1025.03 Definitions

accessible A facility in the public right of way that is approachable and usable by persons with disabilities.

accessible pedestrian signals A device that communicates information about the "WALK" phase in audible and vibrotactile (vibrating surface that communicates information through touch, located on the accessible pedestrian signal button) formats.

accessible route See ***pedestrian access route***.

ADA An abbreviation for the Americans with Disabilities Act of 1990. The ADA is a civil rights law that identifies and prohibits discrimination based on disability. Title II of the ADA requires public entities to design new facilities or alter existing facilities, including sidewalks and trails, to be accessible to people with disabilities.

alternate pedestrian access route A temporary accessible route to be used when the existing pedestrian access route is blocked by construction, alteration, maintenance, or other temporary condition.

alterations A change to a facility in the public right of way that affects or could affect access, circulation, or use.

Alterations include but are not limited to renovation; rehabilitation; reconstruction; historic restoration; resurfacing of circulation paths or vehicular ways; or changes or rearrangement of structural parts or elements of a facility.

Alterations do not include pavement patching and liquid-applied sealing, chip seal, lane restriping that does not involve modal (such as changing a shoulder to a bikeway) or lane configuration changes, and short-term maintenance activities.

bituminous surface treatment (BST) Also known as a seal coat or chip seal, a BST is a thin, protective wearing surface that is applied to the pavement.

buffer A shoulder, bike lane, planter strip a minimum of 4 feet wide, or parking lane.

counter slope Any slope opposite the running slope of a curb ramp, such as the roadway slope or landing slope.

cross slope The slope measured perpendicular to the direction of travel.

crosswalk A marked or unmarked pedestrian crossing, typically at an intersection, that connects the designated pedestrian access route (such as a sidewalk, shoulder, or pathway) on opposite sides of a roadway. A crosswalk must meet accessibility standards.

A crosswalk is also defined as:

1. "…the portion of the roadway between the intersection area and a prolongation or connection of the farthest sidewalk line or in the event there are no sidewalks then between the intersection area and a line ten feet therefrom, except as modified by a marked crosswalk" (RCW 46.04.160).
2. "(a) That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway, and in the absence of a sidewalk on one side of the roadway, the part of the roadway included within the extension of the lateral lines of the sidewalk at right angles to the center line; (b) Any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by lines on the surface, which may be supplemented by contrasting pavement texture, style, or color" (MUTCD, 2003; *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, AASHTO, 2004).

curb extension A curb and sidewalk bulge or extension out into the parking lane or shoulder used to decrease the length of a pedestrian crossing and increase visibility for the pedestrian and driver.

curb flare The sloped area that may occur between the curb ramp and the sidewalk to accommodate the change in grade.

curb line A line at the face of the curb that marks the transition between the curb and the gutter, street, or highway.

curb ramp A combined ramp and landing to accomplish a change in level at a curb. This element provides street and sidewalk access to pedestrians using wheelchairs. Curb ramp is the term used in the ADA. (The WSDOT *Standard Plans* and *Standard Specifications* use the term "sidewalk ramp.")

> ***diagonal curb ramp*** A curb ramp that is positioned at the apex of an intersection. It is aligned so that a straight path of travel down the ramp will lead diagonally into the center of the intersection. Diagonal curb ramps have restricted application and are discouraged from use. For new or alteration projects, the use of a diagonal curb ramp requires the approval of the Region Traffic Engineer.

parallel curb ramp A curb ramp design where the sidewalk slopes down to a landing at road level and then slopes back up to the sidewalk so that the running slope is in line with the direction of sidewalk travel.

perpendicular curb ramp A curb ramp design where the ramp path is perpendicular to the curb or meets the gutter grade break at right angles.

design area

rural design area An area that meets none of the conditions to be an urban area (see Chapter 440).

suburban design area A term for the area at the boundary of an urban area. Suburban settings may combine the higher speeds common in rural areas with activities that are associated with urban settings.

urban design area An area defined by one or more of the following:

- Adjacent to and including a municipality or other urban place having a population of 5000 or more, as determined by the latest available published official federal census (decennial or special), within boundaries to be fixed by a state highway department, subject to the approval of the FHWA.
- Within the limits of an incorporated city or town.
- Characterized by intensive use of the land for the location of structures and receiving such urban services as sewer, water, and other public utilities and services normally associated with an incorporated city or town.
- With not more than 25% undeveloped land (see Chapter 440).

detectable warning surface A tactile surface feature of truncated dome material built into or applied to the walking surface to alert persons with impairments of vehicular ways. Detectable warning surfaces shall contrast visually with the adjacent gutter, street or highway, and walkway surface. Note: The only acceptable detectable warnings are truncated domes as detailed in the *Standard Plans*.

driveway A vehicular access point to a roadway or parking facility with a curb or a slope (typically perpendicular to the curb) that cuts through or is built up to the curb to allow vehicles to effectively negotiate the elevation change between the street and the sidewalk.

element An architectural or mechanical component or design feature of a space, site, or public right of way.

facility All or any portion of buildings, structures, improvements, elements, and pedestrian or vehicular routes located in a public right of way.

feature A component of a pedestrian access route, such as a curb ramp, driveway, crosswalk, or sidewalk.

flangeway gap The space between the inner edge of a rail and the crossing surface or the gap for the train wheel.

grade break The intersection of two adjacent surface planes of different grade.

gutter slope The counter slopes of adjoining gutters and road surfaces immediately adjacent to the curb ramp.

hand rail A narrow rail for support along walking surfaces, ramps, and stairs.

landing A level (0 to 2% grade in any direction) paved area, within or at the top and bottom of a stair or ramp, designed to provide turning and maneuvering space for wheelchair users and as a resting place for pedestrians.

midblock pedestrian crossing A marked pedestrian crossing located between intersections.

passenger loading zone An area where persons can enter a vehicle safely.

pedestrian Any person afoot or using a wheelchair, power wheelchair, or means of conveyance (other than a bicycle) propelled by human power, such as skates or a skateboard.

pedestrian access route (same as ***accessible route***) A continuous, unobstructed walkway within a pedestrian circulation path that provides accessibility.

The pedestrian access route is connected to street crossings by curb ramps or blended transitions. It may include walkways; sidewalks; street crossings and crosswalks; overpasses and underpasses; courtyards; elevators; platform lifts; stairs; ramps; and landings. Where sidewalks are not provided, pedestrian circulation paths may be provided in the shoulder unless pedestrian use is prohibited.

Not all transportation facilities need to accommodate pedestrians. However, those that do accommodate pedestrians need to have an accessible route.

pedestrian circulation path A prepared exterior or interior way of passage provided for pedestrian travel.

pedestrian Design Clear Zone The area within the pedestrian access route that is to remain free of obstructions.

pedestrian facilities Walkways such as sidewalks, highway shoulders, walking and hiking trails, shared-use paths, pedestrian grade separations, crosswalks, and other improvements provided for the benefit of pedestrian travel. Pedestrian facilities are intended to be accessible routes.

pedestrian overpass or underpass A grade-separated pedestrian facility, typically a bridge or tunnel structure, over or under a major highway or railroad, that allows pedestrians to cross at a different level.

pedestrian refuge island An island in the roadway that physically separates the directional flow of traffic, provides pedestrians with a place of refuge, and reduces the crossing distance. Note: Islands with cut-through paths are more accessible to persons with disabilities than are raised islands.

pedestrian travel zone (same as ***pedestrian access route***) A continuous, unobstructed walkway within a pedestrian circulation path that provides accessibility.

person with disability An individual who has an impairment, including a mobility, sensory, or cognitive impairment, that results in a functional limitation in access to and use of a building or facility.

rail platform A level area for entering and exiting a light rail, commuter rail, and intercity rail system.

railroad track crossings Locations where a pedestrian access route intersects and crosses a railroad track.

raised median A raised island in the center of a road used to restrict vehicle left turns and side street access. Note: Islands with cut-through paths are more accessible to persons with disabilities than are raised islands.

ramp A ramp is defined as:

1. A sloped transition between two elevation levels (AASHTO).
2. A walking surface between two level landings with a running slope steeper than 20H:1V (*Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines*, July, 2004).

running slope A slope measured in the direction of travel, normally expressed as a percent.

roadway See Chapter 440.

sidewalk That portion of a highway, road, or street between the curb line, or the edge of a roadway and the adjacent property line that is paved or improved and intended for use by pedestrians.

sidewalk ramp See c***urb ramp***.

site A parcel of land bounded by a property line or a designated portion of a public right of way.

street furniture Sidewalk equipment or furnishings, including garbage cans, benches, parking meters, and telephone booths.

"To the maximum extent feasible" From the U.S. Department of Justice, 28 CFR Part 36.402, Alterations: The phrase "to the maximum extent feasible" applies to the occasional case where the nature of the existing facility makes it virtually impossible to comply fully with applicable accessibility standards through a planned alteration.*

*DOJ & ADAAG: Maximum Extent [technically] Feasible – "Occasionally, the nature of a facility makes it impossible to comply with all of the alterations standards. In such a case, features must only be made accessible to the extent that it is technically feasible to do so. The fact that adding an accessibility feature during an alteration may increase costs does not mean compliance is technically infeasible..." II-6.3100(4) & FHWA Memorandum on "Clarification of FHWA's Oversight Role in Accessibility 09-12-2006"

traffic calming Design techniques that have been shown to reduce traffic speeds and unsafe maneuvers. These techniques can be stand-alone or used in combination, and they include lane narrowing, sidewalk extensions, surface variations, and visual clues in the vertical plane.

train dynamic envelope The clearance required for a train and its cargo overhang due to any combination of loading, lateral motion, or suspension failure.

transit stop An area designed for bus boarding and disembarking.

traveled way (same as ***vehicular way***) A route provided for vehicular traffic. The portion of the roadway intended for the movement of vehicles, exclusive of shoulders and lanes for parking, turning, and storage for turning.

truncated domes Small raised protrusions of a detectible warning surface that are between ⅞ inch and 1 7/16 inch in diameter and 3/16 inch in height arranged in a distinctive pattern that is readily detected and recognized by a vision-impaired person using the sense of touch guidance. The *Standard Plans* shows the appropriate pattern and dimensions.

universal access A facility that provides access to all persons regardless of ability or stature.

walk interval That phase of a traffic signal cycle during which the pedestrian is to begin crossing, typically indicated by a WALK message or the walking person symbol and its audible equivalent.

walkway The continuous portion of the pedestrian access route that is connected to street crossings by curb ramps or blended transitions (*Revised Draft Guidelines for Accessible Public Rights-of-Way*, 11-23-05, and *Pedestrian Facilities Guidebook*, WSDOT et al., 1997).

wheeled mobility device A wheelchair, scooter, walker, or other wheeled device that provides mobility to those with limited physical abilities.

1025.04 Policy

(1) General

Provide pedestrian facilities along and across sections of state routes and city streets as an integral part of the transportation system. Federal Highway Administration (FHWA) and WSDOT policy is that bicycle and pedestrian facilities be given full consideration on all highway improvement projects. Coordinate with the Region Planning and Traffic Offices to identify planning studies that detail current traffic and forecast growth and pedestrian generators in the project vicinity. FHWA is designated by the Department of Justice to ensure compliance with the Americans with Disabilities Act of 1990 (ADA) for transportation projects. Design pedestrian facilities to provide universal access for all people. Provide pedestrian facilities on highway projects unless one or more of the following conditions are met:

- Pedestrians are prohibited by law from using the facility.
- The cost of the improvements is excessive and disproportionate to the original need or probable use (as a guide, more than 20% of the project estimate).*
  In these instances, evaluate options to modify the scope of the pedestrian improvements or investigate funding for a separate pedestrian project. Comply with ADA accessibility requirements for any improvements made. Include documentation of the results of the investigation for funding a separate pedestrian project.
- Planning/land use documents indicate that low population density is projected for the area in the 20-year planning horizon.

*Guide for the Planning, Design and Operation of Pedestrian Facilities, AASHTO, July 2004

*"Design Guidance Accommodating Bicycle and Pedestrian Travel" – A USDOT Policy Statement on Integrating Bicycling and Walking into Transportation Infrastructure, FHWA, 2000

Consider whether or not the project is within a city or an urban growth area that is ultimately intended to be developed as an urban density area with urban services, including transit. Inside incorporated cities, design pedestrian facilities in accordance with the city design standards adopted in accordance with RCW 35.78.030 on the condition they comply with the most current ADA requirements. Exceptions to adopted design standards—other than ADA (see below)—require a deviation approved by the designated authority identified in Chapter 330.

Title II of the Americans with Disabilities Act requires that a public entity shall maintain in operable working condition those features of facilities and equipment that are required to be readily accessible to and usable by persons with disabilities. Consider the maintenance needs of accessible pedestrian facilities during the design of those elements.

(2) ADA Compliance

Wherever pedestrian facilities are intended to be a part of the transportation facility, 28 CFR Part 35 requires that those pedestrian facilities meet ADA guidelines. Federal regulations require that all new construction, reconstruction, or alteration of existing transportation facilities be designed and constructed to be accessible and useable by those with disabilities and that existing facilities be retrofitted to be accessible. Design pedestrian facilities to accommodate all types of pedestrians, including children, adults, the elderly, and persons with hearing, visual, or cognitive impairments.

(a) **Improvement Projects**

Improvement projects address the construction of a new roadway, reconstruction such as roadway widening to add an additional lane, or modal (transit or bicycle) or lane configuration changes to an existing roadway. For these projects, pedestrians' needs are assessed and included when applicable. Develop pedestrian facilities consistent with the accessibility criteria listed in Figures 1025-18 and 1025-22.

(b) **Pavement Preservation (Alteration) Projects**

- Pavement preservation projects are considered alterations of the roadway.
- BSTs, pavement patching, sealing, and lane restriping that does not involve modal or lane configuration changes are not considered alterations.

For alteration projects, accessible features need to be inventoried and assessed to determine whether the design elements meet the accessibility criteria in Figure 1025-22. Address pedestrian needs and include, to the maximum extent feasible, access for persons with disabilities. If an existing curb ramp adjacent to the roadway meets the accessibility criteria for alteration projects, no further action is required. If elements of an existing ramp do not meet the accessibility criteria, the ramp will need to be upgraded. This may require reconstruction or modification of ADA features to meet the guidelines.

It is not always possible to build pedestrian facilities to full ADA standards. If such a situation is encountered, the designer needs to contact the appropriate ASDE to confirm the finding. After the ASDE confirms the finding that it is not possible to build the pedestrian feature to full ADA standards, the designer then designs the feature to the maximum extent feasible and documents which elements were and which were not designed to ADA standards.

When a preservation project is going through an area with pedestrian facilities that meet the ADA requirements, the only documentation required is an inventory showing that all the elements of each feature in the project limits are compliant with ADA standards. If the project is within a city, coordinate with the city to develop an inventory.

(3) Jurisdiction

When city streets form a part of the state highway system within the corporate limits of cities and towns, the city has full responsibility for and control over any facilities beyond the curbs and, if no curb is installed, beyond that portion of the highway used for highway purposes (RCW 47.24.020). When proposed projects will damage or remove existing sidewalks or other pedestrian access routes or features within a city's jurisdiction, work with the city to reconstruct the affected facilities to meet accessibility criteria. When proposed alteration projects are within the city limits, curb ramps will be looked at and upgraded to meet accessibility criteria.

The title to limited access facilities within incorporated cities and towns remains with the state. If a turnback agreement has not been completed, the state maintains full jurisdiction within these areas (see Chapters 1410, 1420, and 1430).

(4) Access Control

Access control on highways is either "limited" or "managed" and is discussed in Division 14. Various designations of access control affect how and where pedestrian facilities are located.

(a) **Full Limited Access Control**

On roadways designated as having full limited access control, pedestrian access routes, hiking trails, and shared-use paths within the right of way are separated from vehicular traffic with physical barriers. These facilities can connect with other facilities outside the right of way once proper documentation has been obtained. Contact the Headquarters (HQ) Access and Hearings Unit and the HQ Real Estate Services Office to determine the required documentation. Grade separations are provided when the trail or path crosses the highway. (See Chapter 1430 for limited access.)

(b) **Partial or Modified Limited Access Control**

On these facilities, pedestrian access routes and shared-use paths may be located between the access points of interchanges or intersections. Pedestrian crossings are usually either at grade or grade-separated. Consider midblock pedestrian crossings at pedestrian generators when the roadway has the characteristics associated with an urban or suburban area and has appropriate operational and geometric characteristics that allow for a crossing. Note that the installation of a midblock pedestrian crossing on a state highway is a design deviation that requires approval and documentation. Pedestrian circulation paths must include a pedestrian access route.

Consider providing sidewalks at signalized intersections. Evaluate extending sidewalks on a project-by-project basis. (See Chapter 1430 for limited access.)

(c) **Managed Access Control Highways**

On these routes, in rural areas, paved shoulders are normally used for pedestrian travel. When pedestrian activity is high, separate walkways may be provided. Sidewalks are typically used in urban growth areas where there is an identified need for pedestrian facilities.

Consider providing sidewalks at signalized intersections. Evaluate extending sidewalks on a project-by-project basis.

Trails and shared-use paths, separated from the roadway alignment, are used to connect areas of community development. Pedestrian crossings are typically at grade.

1025.05 Pedestrian Facility Design

(1) Facilities

The type of pedestrian facility provided is based on access control of the highway; local transportation plans; comprehensive plans and other plans (such as Walk Route Plans) developed by schools and school districts; the roadside environment; pedestrian volumes; user age group(s); safety-economic analyses; and the continuity of local walkways along or across the roadway. Pedestrian access routes can either be immediately adjacent to streets and highways or separated from them by a buffer.

(2) Pedestrian Travel Along Streets and Highways

Examples of various types of pedestrian access routes are shown in Figure 1025-18. A generalized method of assessing the need for and adequacy of pedestrian facilities is shown in Figure 1025-19.

To determine what type of pedestrian facility to use, consider a study that addresses roadway classification, traffic speed, crash data, pedestrian generators, school zones, transit routes, and land use designation.

(a) **Basic Criteria for Pedestrian Accessible Routes**

(1) **Surfacing**

The surface of the pedestrian access route needs to be firm, stable, slip-resistant, and smooth. Use cement or asphalt concrete surfaces; crushed gravel is not considered to be a stable, firm surface.

Utility vaults and junction boxes with lids designed to reduce tripping and slipping hazards are used for installations in sidewalks (see the *Standard Plans*).

(2) **Vertical Clearance**

Hanging or protruding objects within the walkway may present obstacles for pedestrians with visual impairments. The minimum vertical clearance for objects (including signs) overhanging a walkway is 7 feet (84 inches).

(3) **Horizontal Encroachment**

The minimum clear width for an ADA pedestrian accessible route is 4 feet. Where the pedestrian access route is less than 5 feet in width, provide a 5-foot × 5-foot passing space at 200-foot intervals.

Fixtures located in the sidewalk are obstacles for pedestrians and they reduce the clear width of the sidewalk. Provide a continuous, unobstructed route for pedestrians. When an unobstructed route is not possible, provide the minimum clear width for an accessible route around obstructions.

Objects that protrude more than 4 inches into the walkway are considered to be obstacles, and warning devices are necessary where feasible. Equip wall-mounted and post-mounted objects that protrude 4 inches or more into the walkway between 27 inches and 80 inches above the sidewalk with warning devices detectable by persons with impaired vision using a cane (see Figure 1025-1).

When relocation of utility poles and other fixtures is necessary for a project, determine the impact of their new location on all pedestrian walkways. Look for opportunities to eliminate obstructions, including existing utilities that obstruct the pedestrian route.

Acceptable Pedestrian Access Route

Unacceptable Pedestrian Access Route

Accessible Sidewalk

Sidewalk With Obstruction

Pedestrian Route Geometrics
Figure 1025-1

(4) **Geometrics of the Pedestrian Accessible Route**

When considering both new and existing pedestrian-accessible routes, the geometric elements need to be evaluated for the running slope of the route, cross slope, width, amount of vertical rise over the length of the route, vertical differences at changes in surface grades (tripping hazards), and access across and through a vertical barrier (curb ramps).

Where the walkway is located behind guardrail, cut off protruding guardrail bolts or install a rub rail to prevent snagging on the bolts. Consider the installation of “W” beam on the pedestrian side of the posts to reduce snagging and as a guide for sight-impaired pedestrians. Specify these construction requirements in the contract.

Provide a nonsnagging finish to vertical surfaces adjacent to a pedestrian facility to prevent snagging or abrasive injuries from accidental contact with the surface.

(3) Shoulders

Paved shoulders are an extension of the roadway and can be an acceptable pedestrian facility along rural roadways where pedestrian activity is minimal. Although pedestrians are allowed to travel along the shoulder, its main purpose is to provide a safe area for disabled vehicles, a recovery area for errant vehicles, and positive drainage away from the roadway.

Determine whether the roadway shoulders are of sufficient width and condition to permit safe travel for pedestrians. Paved shoulders are preferable for an all-weather walking surface. A 4-foot-wide shoulder is acceptable where pedestrian activity is minimal and school and other pedestrian generators are not present. Wider shoulders are desirable along high-speed highways, particularly when truck volumes or pedestrian activities are high.

Longitudinal travel along shoulders with cross slopes greater than 2% can be difficult for people with disabilities. Horizontal curves are usually superelevated and can have cross slopes steeper than 2%. The shoulders on these curves often have the same cross slope as the roadway. If pedestrians will use the shoulder frequently, consider a separate pedestrian access route.

(4) Shared-Use Paths

Shared-use paths are used by pedestrians and bicyclists (see Figure 1025-2). Comply with accessibility criteria in their design. Pedestrian facilities differ from bicycle facilities in their design criteria and goals, and they are not always compatible. When it is determined that a shared-use path is in the best interests of both groups, see Chapter 1020, "Bicycle Facilities," and AASHTO's *Guide for the Development of Bicycle Facilities*.

Shared-Use Path
Figure 1025-2

(5) Sidewalks

Plan the design of sidewalks carefully to include a pedestrian access route that provides universal access. Sidewalk design elements are found in Figure 1025-18 and Figure 1025-22, and details for raised sidewalks are shown in the *Standard Plans*. Wherever appropriate, make sidewalks continuous and provide access to side streets. The most desirable installation for the pedestrian is a sidewalk separated from the traveled way by a planted buffer strip. For example, a 6-foot sidewalk with a 3-foot buffer is more desirable than a 9-foot sidewalk.

Sidewalk With Buffer
Figure 1025-3

Consider buffer strips of 4 feet for collector routes and 6 feet for arterial routes. If trees or shrubs are included, coordinate with the Region or HQ Landscape Architect and refer to the *Roadside Manual*. Plants should not limit the visibility of motorists or pedestrians or pose obstructions on the pedestrian access route (see Chapter 920). Design subsurface infrastructure (such as structural soils), and select plants so that root systems do not cause sidewalks to buckle or heave. Coordinate buffer planting with maintenance personnel.

Shoulders, bike lanes, and on-street parking can also be used to provide adequate buffer zones for pedestrian facilities. The minimum clear width for a sidewalk with a buffer strip at least 3 feet wide is 5 feet (see the *Standard Plans*). Where a sidewalk is separated from the roadway with only a curb, the minimum sidewalk width is 6 feet (see Figure 1025-18). Wider sidewalks are preferable in areas of high pedestrian traffic, such as a central business district (CBD) and along parks, schools, and other major pedestrian generators. Coordinate with the city for appropriate sidewalk width and funding participation.

Where the walkway (sidewalk) of a pedestrian access route is adjacent to a street or highway, its running slope can match, but not exceed, the general grade established for the adjacent street or highway. On roadways with prolonged grades greater than 8.3%, consider hand railings* and level landings adjacent to the sidewalk as resting areas.

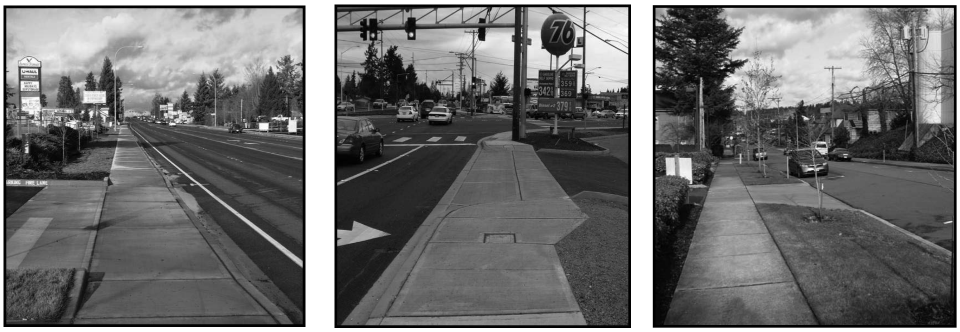
**Guide for the Planning, Design, and Operation of Pedestrian Facilities*, AASHTO.

If the sidewalk meanders, following a separate horizontal or vertical alignment, the running slope must comply with ADA standards. The maximum running slope allowed is 8.3%. Provide landings with every 30-inch vertical rise.

Design sidewalks with cross slopes no more than 2%. Steeper cross slopes are difficult for people in wheelchairs to negotiate.

In areas with snowfall that must be removed from the roadway, consider wider sidewalks or a sidewalk with a buffer to provide snow storage and minimize the disruption to pedestrian travel. Make sure maintenance access is not obstructed.

Driveways can be a barrier for persons with disabilities. Provide accessible crossings in locations where a sidewalk meets a driveway. An accessible route is 4 feet wide minimum with a cross slope of 2% or less. (See Figure 1025-4 for examples of driveway crossings.)



Driveway/Sidewalk Crossings
Figure 1025-4

Consider limiting or consolidating driveways (vehicle access points). Construct driveways in accordance with ADA requirements, or provide an ADA-accessible route. (See Chapter 1420 for access control information and the *Standard Plans* for vehicle approach details and ADA requirements.) Where a driveway is present within the longitudinal limits of the sidewalk, provide a pedestrian accessible route to maintain continuity along the sidewalk. (See Figure 1025-22 for design element requirements.)

The sideslope adjacent to the sidewalk is a critical design element (see Figure 1025-18). On embankment slopes of 4H:1V or flatter, provide a 1-foot widening at the back of the sidewalk. On steeper embankment slopes, provide a 4-foot embankment widening or use a sidewalk design with a 1-foot widening and a raised 4-inch-high lip at the back edge of the sidewalk. When the adjacent roadway has a posted speed of 35 mph or less and there is a vertical drop-off of 2 feet 6 inches or more directly behind the sidewalk, provide a pedestrian railing when embankment widening is not possible (see Figure 1025-18).

The pedestrian railing is installed between the walkway and the vertical drop-off. Consider the width of pedestrian railing installation in design and ensure that adequate pedestrian clear zone is provided on the sidewalk. Pedestrian railings are not always designed to withstand vehicular impacts or redirect errant vehicles. When a vertical drop-off is present on a higher-speed roadway, the Design Clear Zone is the primary consideration. A crashworthy traffic barrier is required if the drop-off is within the Design Clear Zone (see Chapter 700).

Where the walkway is adjacent to a vertical drop-off and is separated from the roadway, consider installing the traffic barrier between the traveled way and the walkway. The pedestrian railing is installed between the walkway and the vertical drop-off.

(6) Curb Ramps (Sidewalk Ramps)

Curbs ramps are required at all corners of all intersections where sidewalks are present, except where pedestrian crossing is prohibited. Curb ramps are also required at midblock crossings where sidewalks are present. These ramps provide an accessible connection from a raised sidewalk down to the roadway surface.

(a) **Types of Curb Ramps**

Different types of curb ramps are available: perpendicular, parallel, combination, and diagonal. Wherever possible, it is desirable to provide a buffer around the corner to separate the sidewalk from the curb, allowing the curb ramp to be installed with curb returns that facilitate direction-finding for the visually impaired.

A separate curb ramp is preferred for each crossing because the crossing distance is shorter and people with vision impairments or in wheelchairs have fewer difficulties negotiating turns and determining the correct pedestrian access route.

1. **Perpendicular**

   This curb ramp is commonly used to provide access from the sidewalk to the street. The landing is to be located at the top of the curb ramp.

   a. Advantages
      - Ramp aligned with the crosswalk.
      - Straight path of travel on tight radius.
      - Two ramps per corner.

   b. Disadvantage
      - May not provide a straight path of travel on larger-radius corners.

2. **Parallel**

   This curb ramp works well in a narrower area with right of way limitations. The landing is to be located at the bottom of the curb ramp.

   a. Advantages
      - Requires minimal right of way.
      - Provides an area to align with the crossing. The bottom landing is contained in the sidewalk and not the street.
      - Allows ramps to be extended to reduce ramp grade.
      - Provides edges on the side of the ramp that are clearly defined for pedestrians with vision impairments.

   b. **Disadvantages**
      - Pedestrians need to negotiate two or more ramp grades (may make it more difficult to traverse).
      - Improper design can result in the accumulation of water or debris on the landing at the bottom of the ramp.

3. **Combination**

   This combines the use of perpendicular and parallel types of curb ramps. The landing may be shared in this application. This curb ramp works well in areas where grades may be a problem.

   a. Advantages
      - Does not require turning or maneuvering on the ramp.
      - Ramp aligned perpendicular to the crosswalk.
      - Level maneuvering area at the top and bottom of ramps.

   b. Disadvantage
      - Visually impaired pedestrians need to negotiate curb ramps.

4. **Diagonal**

   A single ramp, serving two crossings, is sometimes necessary where constraints make the installation of separate ramps infeasible. This style of curb ramp is not to be used in new construction; rather, it should only be considered in alterations where utilities prevent the installation of two perpendicular ramps, at unsignalized intersections, or in some residential areas with low traffic volumes. For new or alteration projects, the use of a diagonal curb ramp requires the approval of the Region Traffic Engineer. If inside an incorporated city, the city approves the use of a diagonal ramp. Include documentation of the use of a diagonal curb ramp in the Design Documentation Package (DDP).

   The bottom of diagonal curb ramps have a clear space of 4 feet minimum outside of active traffic lanes of the roadway or within marked crossings in locations that have marked crosswalks (see Figure 1025-5c).

   a. **Advantages**
      - Can be used where channelization of intersection and the alignment of the associated crosswalks prevent use of separated ramps.
      - Can be used where existing utilities prevent use of perpendicular ramps.
      - Can be used where right of way is limited.

   b. **Disadvantages**
      - Directs pedestrian travel to the center of the intersection which is confusing to persons with visual disabilities.
      - Difficult for wheelchair users to negotiate.
      - Can put pedestrians into traffic.

(b) **Curb Ramp Common Elements**

To comply with ADA requirements, curb ramps are:

- 4 feet wide minimum

1. **Landings**

   A level landing is necessary at the top or bottom of a curb ramp as noted above for the type of curb ramp used. The top landing is provided to allow a person in a wheelchair room to maneuver into a position to use the ramp or bypass it. The lower landing allows a wheelchair user to transition from the ramp to the roadway crossing.

   - The width of the landing matches the width of the curb ramp.
   - In preservation projects, the length of the landing is at least 3 feet.
   - In new construction, provide a 4-foot-square landing.
   - When right of way constraints are not an issue, it is desirable to provide a larger 5-foot-square landing.
   - If the landing is next to a vertical wall, a 5-foot-wide clear area is desirable to allow a person in a wheelchair more room to maneuver and change directions.
   - The running and cross slopes of landings for curb ramps on midblock crossings are permitted to be warped to meet street or highway grade.
   - Exception: In preservation projects (alterations), where there is no landing at the top of curbs ramps, curb ramp flares shall be provided and shall not be steeper than 12H:1V.

2. **Running Slope**

   - 12H:1V or flatter (in new construction and preservation projects).
   - Exception: For preservation projects, when space limitations make a 12H:1V running slope technically infeasible,* ramps may have a running slope not steeper than 8H:1V for a rise of 3 inches, or not steeper than 10H:1V for a rise of 6 inches. If this application is used, it must be approved by the Assistant State Design Engineer and well documented as to why it was technically infeasible to achieve a 12H:1V or flatter running slope.

*Technically infeasible means that it has little likelihood of being accomplished because other existing physical or site constraints prohibit modification or addition of elements which are in full compliance with the minimum requirements and which are necessary to provide accessibility. Physical or site constraints refer to such things as a building (structural) or rugged terrain.

3. **Cross Slope**

   - Not greater than 2%.

4. **Curb Ramp Flares**

   - Do not exceed 10%.

5. **Counter Slope**

   - Provide a counter slope of the gutter or street at the foot of the curb ramp or landing of 5% maximum. When the algebraic difference between the counter slope of the gutter or street and ramp running slope is equal to or greater than 11%, consider a 2-foot level strip at the base of the ramp (see Figures 1025-6 and 1025-22).

In all cases, detectable warning strips are to be installed. Detectable warning devices must contrast visually with the background material. ADAAG requires that detectable warnings “shall contrast visually with adjoining surfaces either light-on-dark or dark-on-light.” The Access Board report “Visual Detection of Detectable Warning Materials by Pedestrians with Visual Impairments” recommends the use of federal yellow as a visual contrast.

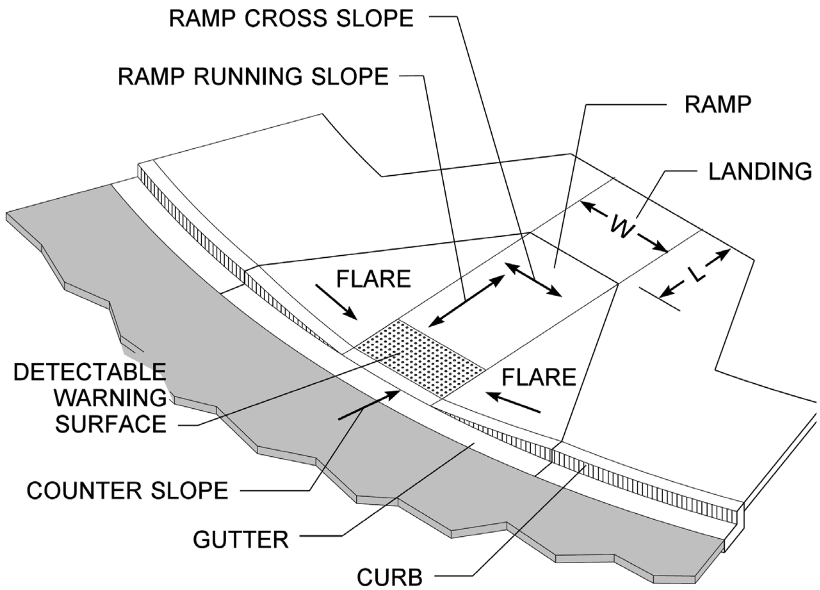
At signalized intersections, pedestrian push buttons on separate poles are located near each curb ramp for ADA accessibility. Provide paved access to the pedestrian push button. (See Chapter 850 for information on pedestrian guidelines at traffic signal locations.)

Perpendicular Ramp

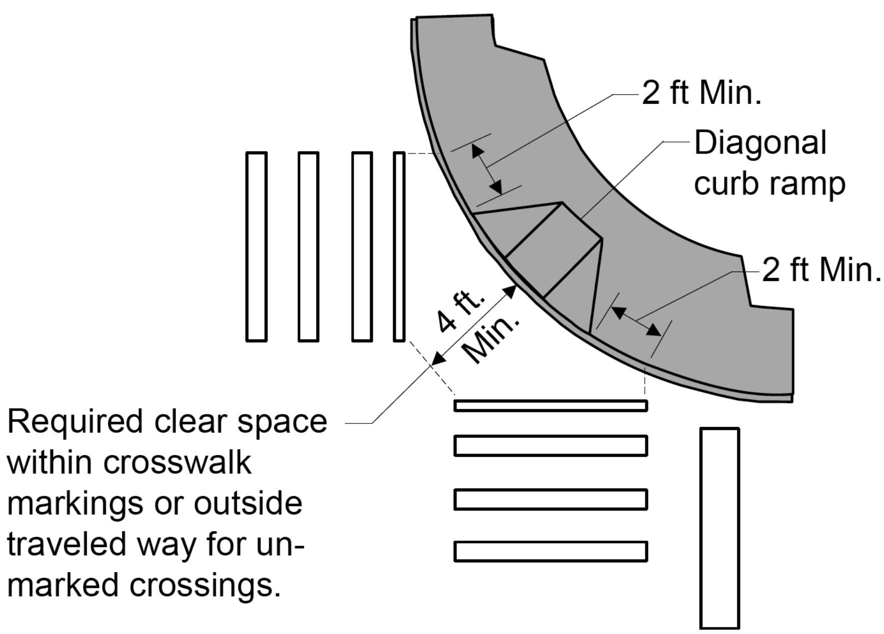
Parallel Ramp

Combination Ramp

Curb Ramps
Figure 1025-5a

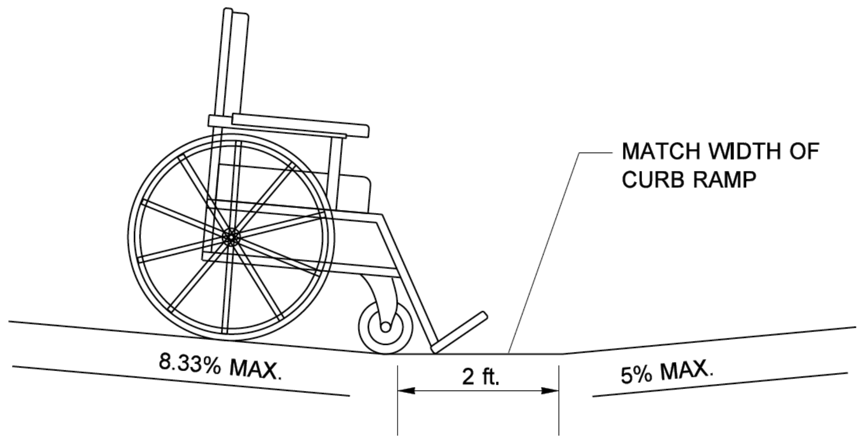


Curb Ramp Common Elements
Figure 1025-5b



Clear Space for Diagonal Ramp

Diagonal Ramp Elements
Figure 1025-5c

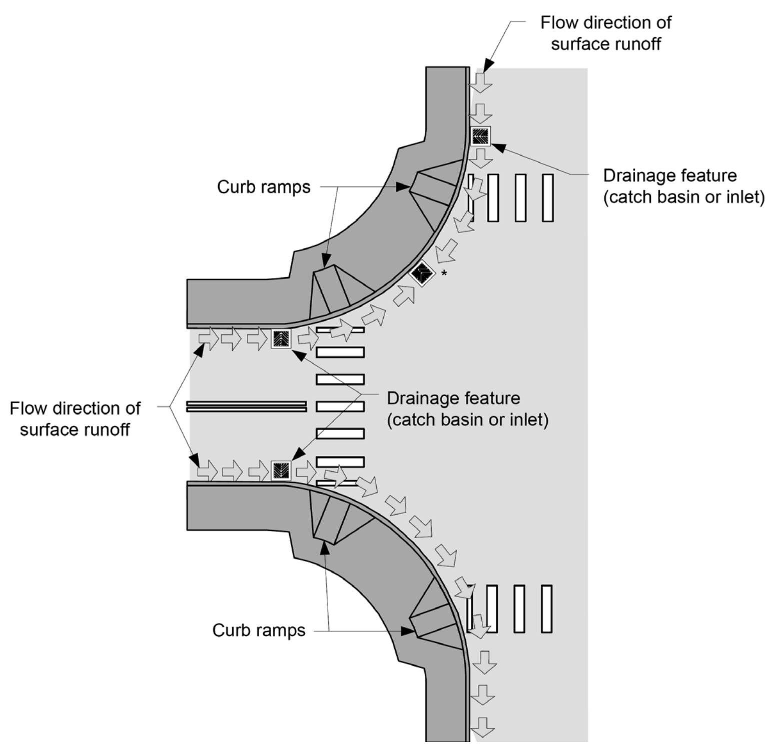


Consider a 2-foot level strip if algebraic difference > 11%.

Source: AASHTO

Counter Slope Alternative
Figure 1025-6

The lower terminus of the curb ramp is located at the beginning of a marked or unmarked crosswalk. Surface water runoff from the roadway can flood the lower end of a curb ramp. Determine the grades along the curb line and verify that the base of the curb ramp is not the lowest point of the gutter. Provide catch basins or inlets to prevent the flooding of the ramps. Figure 1025-7 shows examples of how drainage structures are located. Verify that drainage structures will not be in the pedestrian access route.



* If ponding could occur, consider an additional grate inlet.

Curb Ramp Drainage
Figure 1025-7

(7) Vehicle Bridges and Underpasses

Provide for pedestrians on vehicle bridges and underpasses where pedestrians are allowed (contact the HQ Bridge and Structures Office). Provide either raised sidewalks or ramps on the approaches to bridges when there are raised sidewalks on the bridge. The ramp is constructed of either asphalt or cement concrete and has a slope of 20H:1V or flatter. These ramps can also be used as a transition from a raised sidewalk down to a paved shoulder. The ramp provides pedestrian access and mitigates the raised, blunt end of the concrete sidewalk for vehicles.

In underpasses where pedestrians are allowed, it is desirable to provide sidewalks and to maintain the full shoulder width. When bridge columns are placed on either side of the roadway, consider placing the walkway between the roadway and the columns for pedestrian visibility and security. Provide adequate lighting and drainage for pedestrian safety and comfort.

(8) Pedestrian Crossings at Grade

To meet ADA requirements, equal access to cross the highway shall be provided to all pedestrians unless a crossing has been determined to be inaccessible to all pedestrians. Consult with the Region Traffic Office when considering a prohibited crossing and:

- Provide a reasonable alternative crossing.
- Make the leg on each side of the crossing inaccessible to all pedestrians.
- Install signs along with a physical barrier restricting all pedestrians from crossing at that location.

All pedestrian crossings need to provide a pedestrian access route that meets ADA guidelines. Figure 1025-20 provides recommendations for determining pedestrian markings based on vehicular traffic volume and speed. Pedestrian crossings at grade are permitted along the length of most highways. Pedestrian crossing on all legs of an intersection is also permitted. An illegal pedestrian crossing only occurs when signs prohibit a particular crossing at an intersection or the crossing occurs between two adjacent signalized intersections (RCW 46.61.240).

(a) **Accessible Pedestrian Signals (APS)**

Use ADA-compliant audible/vibrotactile pedestrian signals at all locations where pedestrian signals are installed. Consult with region and city maintenance personnel regarding maintenance requirements for these devices. Installation of these devices may require improvements to existing sidewalks and ramps to ensure ADA compliance. (See Chapter 850 and the MUTCD for additional information.)

(9) Crosswalks at Intersections

Legal crosswalks, whether marked or not, exist at all intersections. An unmarked crosswalk is the 10-foot-wide area across the intersection behind a prolongation of the curb or edge of the through traffic lane (RCW 46.04.160). At roundabouts and intersections with triangular refuge islands or slip lanes (see Chapter 910), the desired pedestrian crossings are not consistent with the definition of an unmarked crosswalk, and marked crossings are necessary. Inside city limits where the population exceeds 25,000, the decision to mark crosswalks resides with the city. WSDOT approves the installation and type only (RCW 47.24.020(13)). In unincorporated areas and within cities with populations less than 25,000, WSDOT has decision authority. WSDOT maintains decision authority in limited access areas. Coordinate with the city regardless of population.

The ADA requires that a pedestrian access route be provided at all marked and unmarked pedestrian crossings. This can be part or all of the crosswalk width. The accessibility criteria require a pedestrian access route within crosswalks of 4 feet minimum, with a running slope less than or equal to 5% and a cross slope less than or equal to 2% (see Figures 1025-21 and 1025-22).

Marked crosswalks are not to be used indiscriminately. Marked crosswalks are used at signalized intersections, intersections with triangular refuge islands, and roundabouts so that pedestrians know where they are to cross. Perform an engineering study before installing marked crosswalks away from highway traffic signals or stop signs. When considering a marked crosswalk, at a minimum evaluate the following factors:

- The crosswalk would serve 20 pedestrians per hour during the peak hour, 15 elderly and/or children per hour, or 60 pedestrians total for the highest consecutive 4-hour period.
- The crossing is on a direct route to or from a pedestrian generator such as a school, library, hospital, senior center, community center, shopping center, park, employment center, or transit center (see the MUTCD). Generators in the immediate proximity of the highway are of primary concern. Pedestrian travel distances greater than ¼ mile do not generally attract many pedestrians.
- The local agency's comprehensive plan includes the development of pedestrian facilities in the project vicinity.
- The location is 300 or more feet from another crossing.
- The location has decision stopping sight distance consistent with Chapter 650, or sight distance will be improved prior to marking the crossing.
- Safety considerations do not preclude a crosswalk.

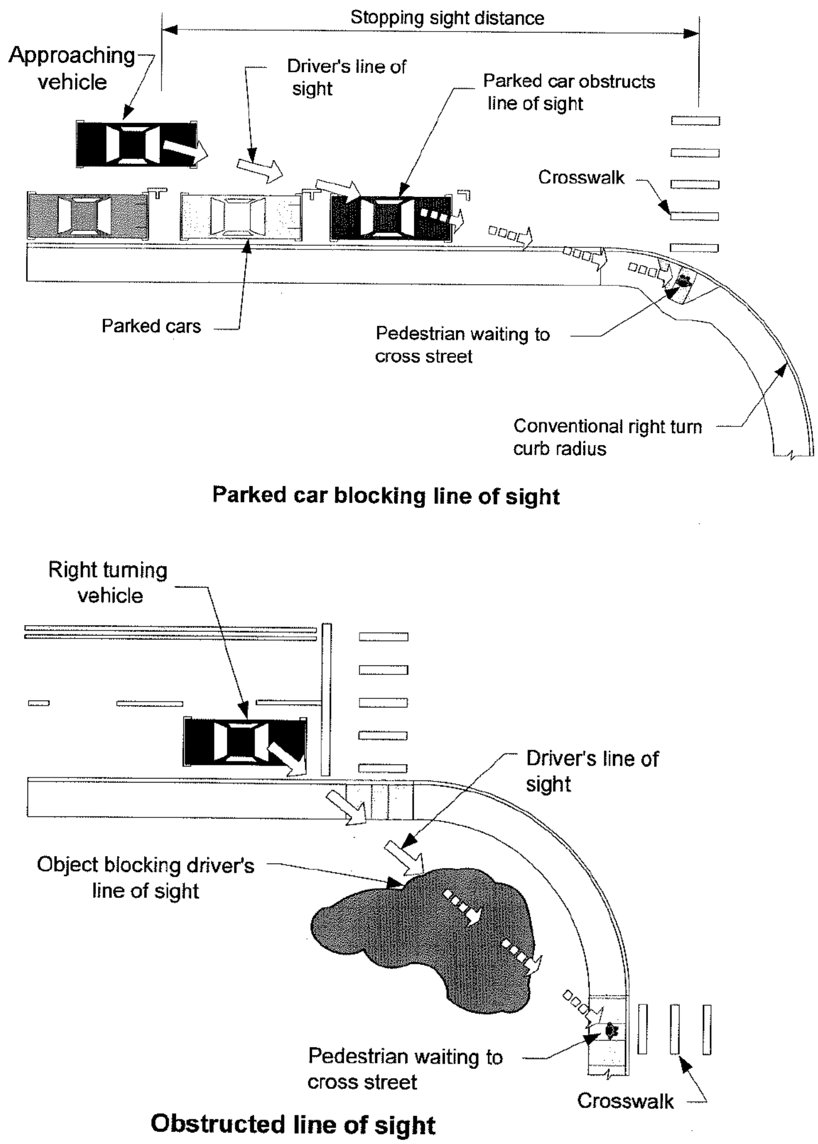
For marked crosswalks, the standard crosswalk marking consists of a series of wide white lines aligned with the longitudinal axis of the roadway. Crosswalk widths are at least 8 feet. A width of 10 feet is preferred in central business districts.* The lines are positioned at the edges and centers of the traffic lanes to place them out of the normal wheel path of vehicles. The preferred type of crosswalk is a longitudinal pattern known as a Ladder Bar and is shown in the *Standard Plans*. Set back "stop" and "yield" lines to provide for sight distance to all approaches to an intersection. Stop and yield line dimensions and placement must conform to the MUTCD and are shown in the *Standard Plans*.

**Guide for the Planning, Design, and Operation of Pedestrian Facilities*, 3.3.4; AASHTO 2004: 6 feet minimum, 10 feet desirable.

*MUTCD crosswalks should be at least 6 feet wide.

Communities sometimes request specially textured crosswalks (such as colored pavement, bricks, or other materials). Consider that some textured materials may cause confusion for visually impaired pedestrians and can create discomfort for wheelchair users. These crosswalks do not always fall within the legal definition of a marked crosswalk, and parallel white crosswalk lines are recommended to enhance visibility and delineate the crosswalk (see the MUTCD or the Local Agency Crosswalk Options website: www.wsdot.wa.gov/Design/Standards/PlanSheet/PM-2.htm). Provide a nonslip surface on crosswalk markings appropriate for wheelchair use.

When locating crosswalks at intersections, consider the visibility of the pedestrian from the motorist's point of view. Shrubbery, signs, parked cars, and other roadside appurtenances can block the motorist's view of the pedestrian. Figure 1025-8a illustrates these sight distance considerations.

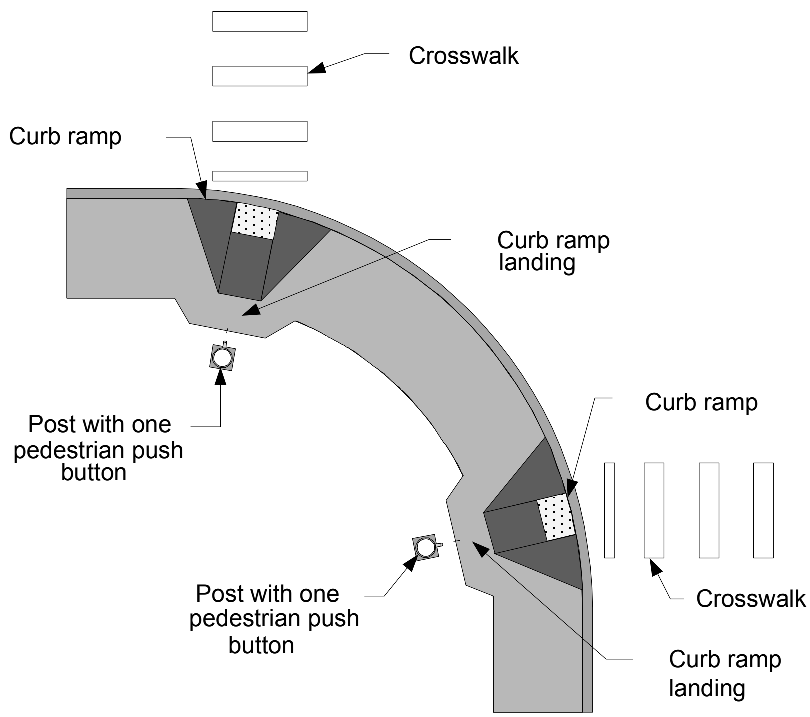


Obstructed Line of Sight at Intersection
Figure 1025-8a

When designing crosswalks and pedestrian signals, consider the needs of older pedestrians and pedestrians with disabilities as they might walk at a significantly slower pace than the average pedestrian. Determine whether there are pedestrian generators in the project vicinity that might attract older and disabled pedestrians. Adjust signal timing accordingly, and include countdown clocks where appropriate. Consult with region and city maintenance personnel regarding maintenance requirements for these devices.

- Locate pedestrian push buttons within reasonable proximity to the curb ramp and crosswalk (see Figure 1025-8b and the MUTCD).
- Clearly identify which crossing is controlled by the push button.
- Provide a level surface at each push button for wheelchair users.
- Locate push button a maximum height of 3 feet 6 inches from level landing surface.*

*FHWA, Designing Sidewalks and Trails for Access 4.4.7 Pedestrian Actuated Controls, 1999



Pedestrian Push Button Locations
Figure 1025-8b

(10) Midblock Crossings

On roadways with pedestrian crossing traffic caused by nearby pedestrian generators, consider a midblock pedestrian crossing. (See 1025.05(9) for crosswalk criteria and Figure 1025-20 for marked crosswalk recommendations at unsignalized intersections.) For midblock crossings, the pedestrian access route may have a cross slope that matches the running slope of the roadway (PROWAG R305.2.2.3). Note that the installation of a midblock pedestrian crossing on a state highway is a design deviation that requires ASDE approval and documentation. An example of a midblock crossing is shown in Figure 1025-9a.

Midblock Pedestrian Crossing
Figure 1025-9a

Conditions that might favor a midblock crossing include the following:

- Significant pedestrian crossings occur.
- The proposed crossing can concentrate or channel multiple pedestrian crossings to a single location.
- The crossing is at an approved school crossing on a school walk route.
- The adjacent land use creates high concentrations of pedestrians needing to cross the highway at that location.
- The pedestrians fail to recognize the best or safest place to cross along a highway and it is advisable to delineate the optimal location.
- There is adequate sight distance for motorists and pedestrians.
- It is further than 300 feet from an existing intersection.
- Speeds are less than 40 MPH.
- It is further than 600 feet from another pedestrian crossing.
- Pedestrian needs to cross two or fewer lanes of traffic in the same direction.

Consider the use of a warning beacon, as shown in Figure 1025-9b.

Midblock Crossing With Beacon
Figure 1025-9b

(11) Raised Medians/Islands

Wide, multilane streets are often difficult for pedestrians to cross, particularly when there are insufficient gaps in vehicular traffic because of heavy volumes. Consider the use of raised medians with cut-throughs (see Figure 1025-10) on roadways with the following conditions:

- Two-way arterial street with high speeds (above 45 mph), high average daily traffic (ADT), and large pedestrian volumes.
- A significant pedestrian collision history, especially near a school or other community center.
- The crossing distance exceeds 60 feet.
- Complex or irregularly shaped intersections.

The minimum width of a raised median refuge area is 6 feet to provide pedestrian refuge; however, raised medians that exceed the minimum are encouraged. The width of the pedestrian pass-through (perpendicular to the direction of pedestrian travel) is recommended to be a minimum of 5 feet, which will contain a pedestrian access route and include passing space for two wheelchairs. This pass-through connects with the two separate roadways and cannot exceed a grade of 5%. Detectable warning surfaces are required on both sides of a median cut-through.

Raised Island With Cut-Through
Figure 1025-10

Design ramp terminals for both off-ramps and on-ramps as at-grade intersections (see Chapters 900, 910, 915, and 940).

For pedestrian safety, design turn lanes so that turning speeds are kept low and sight distance is not compromised. Consider the following measures to help reduce conflict:

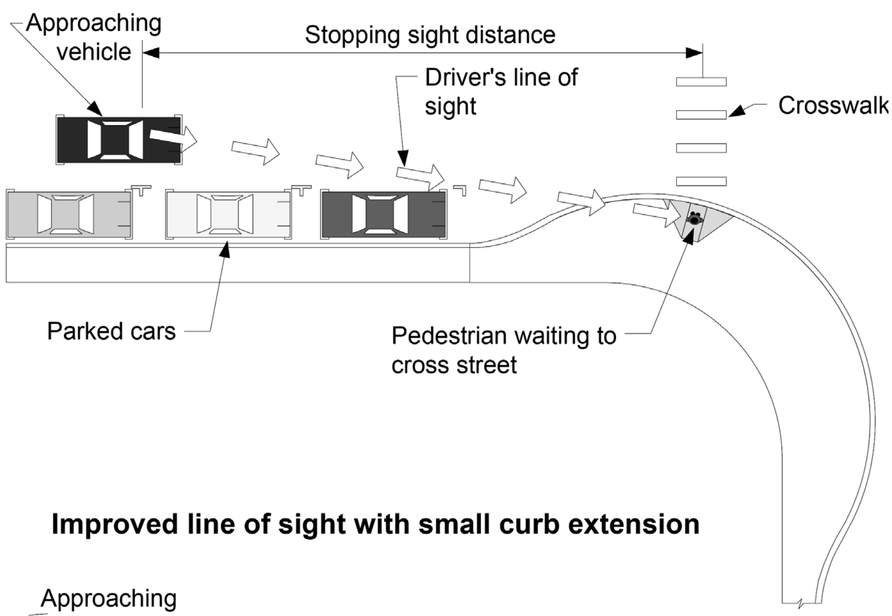
- Minimize turning radii (see Chapter 910).
- Prohibit right turns on red.
- Place crosswalks so they are visible and adjacent to the pedestrian facility.
- Use a separate left-turn phase along with a "WALK/DON'T WALK" signal.
- Restrict left turns at certain times.
- Shorten crossing distance.
- Use a raised median.
- Use pedestrian signals.
- Use signage.
- Place crosswalks as close as practicable to the intersection traveled way.
- Provide pedestrian-level lighting.

The island used for channelized right-turn slip lanes can provide a pedestrian refuge, but may promote faster turning speeds. To reduce conflicts, keep the lane as narrow as practicable and attempt to maintain a 90º intersection angle. (See Chapter 910 for turn lanes, Chapter 940 for interchange ramps, and Chapter 915 for pedestrian accommodations in roundabouts.)

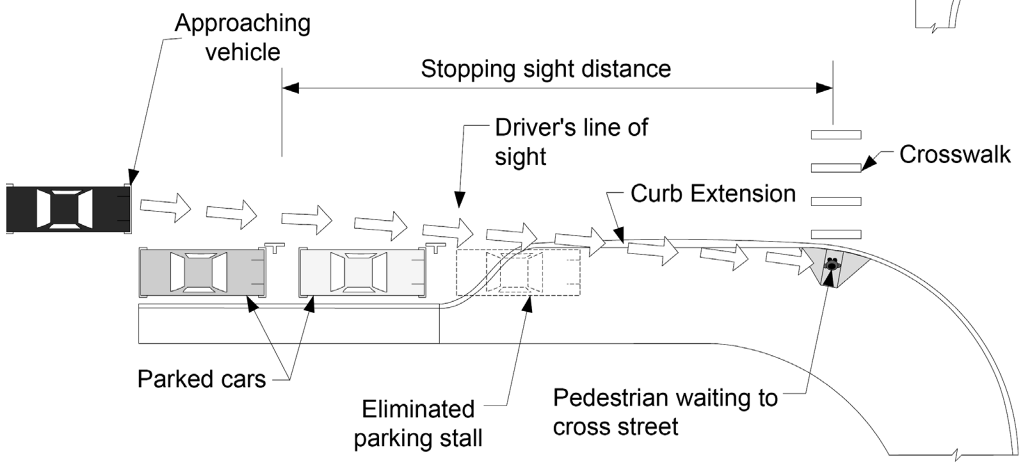
(12) Curb Extensions

Curb extensions are traffic calming measures that, when used appropriately, may improve sight distance and reduce pedestrian crossing times, limiting pedestrian exposure. Designing a curb extension will help eliminate the sight distance problem with parked cars limiting driver/pedestrian visibility. Curb extensions may allow for better curb ramp design.

Extend the curb to the width of the parking lane. Consider low-level landscaping that does not create a sight obstruction and an approach nose. At intersections with traffic signals, the curb extensions can be used to reduce pedestrian signal timing. Examples of sidewalk curb extensions are shown below in Figures 1025-11a and 1025-11b.



Improved line of sight with small curb extension



Improved line of sight with longer curb extension

Improved Line of Sight at Intersection
Figure 1025-11a

Curb Extension Examples
Figure 1025-11b

The right-turn path of the design vehicle or the vehicle most likely to make this turn is a critical element in determining the size and shape of the curb extension. Sidewalk curb extensions tend to restrict the width of the roadway and can make right turns difficult for large trucks.

Avoid interrupting bicycle traffic with curb extensions. If the route is identified as a local, state, or regional significant bike route, mark bicycle lanes along the roadway and through the intersection whenever possible. When bicycle lanes are not feasible, provide a minimum shoulder width of 4 feet (see Chapter 1020). Do not use curb extensions on state highways when:

- The design vehicle is required to encroach on curbs, opposing lanes, or same-direction lanes, and mountable curbs or other solutions will not improve the circumstances. (See Chapter 910 for more information on the design vehicle.)
- Shoulder parking is not present.
- The posted speed is above 35 mph.

Plantings that do not obstruct pedestrians' or drivers' vision may be used as traffic calming measures by creating the illusion of narrow streets. Consider motorist and pedestrian visibility and Design Clear Zone guidelines (see Chapter 700).

Consider narrower lane widths on portions of non-NHS two-lane routes to reduce the expanse of visible pavement to the motorist and help slow traffic:

- Within incorporated cities.
- When there is high pedestrian use.

For minimum lane widths, see Chapters 430 and 440.

(13) Railroad Crossings at Grade

Design of pedestrian facilities across railroad tracks often presents challenges due to the conflicting needs of pedestrians and trains. In particular, the flangeway gap required for trains to traverse a crossing surface may create a significant obstacle for a person who requires a wheelchair, crutches, or walking aids for mobility. Whenever practicable, make crossings perpendicular to the tracks in order to minimize potential problems related to flangeway gaps (see Figure 1025-13). Crossing surfaces may be constructed of timber planking, rubberized materials, or concrete. Concrete materials generally provide the smoothest and most durable crossing surfaces. When used at railroad crossings, place detectable warning surface according to the stop line placement requirements in the MUTCD.

There are a number of railroad crossing warning devices intended specifically for pedestrian facilities (see the MUTCD). When selecting warning devices, consider such factors as train and pedestrian volumes, train speeds, available sight distance, number of tracks, and other site-specific characteristics. Coordination with the railroad should occur early in the design process so that all relevant factors are considered and agreement may be reached regarding design of both warning devices and crossing surface.

Pedestrian Railroad Warning Device
Figure 1025-12

Except for crossings located within the limits of First Class cities, the Washington Utilities and Transportation Commission (WUTC) must approve proposals for any new railroad at-grade crossings or changes to warning devices or geometry at existing crossings. Additionally, any project that requires the railroad to perform work such as installation of warning devices or crossings surfaces will require a railroad construction and maintenance agreement. Contact the HQ Design Office Railroad Liaison to coordinate with both WUTC and the railroad company. Coordinate with the HQ Utilities, Railroad, and Agreements Section.

Undesirable

Recommended

Pedestrian Railroad Crossings
Figure 1025-13

1025.06 Pedestrian Facility Design – Structures

(1) Pedestrian Grade Separations

In extreme cases where there is a pedestrian collision history and the roadway cannot be redesigned to accommodate pedestrians at grade, consider providing a pedestrian grade separation along freeways and other high-speed facilities. When considering a pedestrian structure, determine whether the conditions that require the crossing are permanent. If there is a likelihood that pedestrians will not use a grade separation, consider less-costly solutions.

Locate the grade-separated crossing where pedestrians are most likely to cross the roadway. A crossing might not be used if the pedestrian is required to deviate significantly from a more direct route.

It is sometimes necessary to install fencing or other physical barriers to channel the pedestrians to the structure and reduce the possibility of undesired at-grade crossings. The HQ Bridge and Structures Office is responsible for the design of pedestrian structures.

Consider grade-separated crossings where:

- There is moderate-to-high pedestrian demand to cross a freeway or expressway.
- There are large numbers of young children, particularly on school routes, who regularly cross high-speed or high-volume roadways.
- The traffic conflicts that would be encountered by pedestrians are considered unacceptable (such as on wide streets with high pedestrian volumes combined with high-speed traffic).*
- The crossing conditions are extremely hazardous for pedestrians.
- There are documented collisions or close calls involving pedestrians and vehicles.
- One or more of the conditions stated above exists in conjunction with a well-defined pedestrian origin and destination (such as a residential neighborhood across a busy street from a school).*

**Guide to Planning, Design, and Operation of Pedestrian Facilities*, AASHTO, July, 2004

(2) Pedestrian Bridges

Pedestrian grade-separation bridges (see Figure 1025-14) are more effective when the roadway is below the natural ground line, as in a “cut” section. Elevated grade separations, where the pedestrian is required to climb stairs or use long approach ramps, tend to be underutilized. Pedestrian bridges require adequate right of way to accommodate accessible ramps.

For the minimum vertical clearance from the bottom of the pedestrian structure to the roadway beneath, see Chapter 1120. This minimum height requirement can affect the length of the pedestrian ramps to the structure. To comply with ADA requirements, the approaches to the pedestrian bridge are identified as either a pedestrian access route or a pedestrian access ramp and shall meet the requirements of 1025.07(1). When ramps are not feasible, provide both elevators and stairways. Stairways are to be designed in accordance with the *Standard Plans*.

Railings are provided on pedestrian bridges. Protective screening is sometimes desirable to deter objects from being thrown from an overhead pedestrian structure (see Chapter 1120). The minimum clear width for pedestrian bridges is 8 feet. Consider a clear width of 14 feet when a pedestrian bridge is enclosed or shared with bicycles.

Pedestrian Bridges
Figure 1025-14

(3) Pedestrian Tunnels

Tunnels are an effective method of providing crossings for roadways located in embankment sections. Well-designed tunnels can be an attractive crossing for pedestrians. When possible, design the tunnel with a nearly level profile to provide complete vision from portal to portal (see Figure 1025-15). Some pedestrians may be reluctant to enter a tunnel with a depressed profile because they are unable to see whether the tunnel is occupied. Police officers also have difficulty patrolling depressed profile tunnels. Provide vandal-resistant daytime and nighttime illumination within the pedestrian tunnel. Installing gloss-finished tile walls and ceilings can also enhance light levels within the tunnel. The minimum overhead clearance for a pedestrian tunnel is 10 feet. The minimum width for a pedestrian tunnel is 12 feet. Consider a tunnel width between 14 and 18 feet depending on usage and the length of the tunnel.

Pedestrian Tunnel
Figure 1025-15

(4) Transit Stops and School Bus Stops

The location of transit stops is an important consideration in providing appropriate pedestrian facilities. (Coordinate with the local transit provider.) Newly constructed transit stops must conform to ADA requirements (see Chapter 1060). On new construction, design the transit stop so that it is accessible from the sidewalk or paved shoulder. A transit stop on one side of a street usually has a counterpart on the opposite side because transit routes normally function in both directions on the same roadway. Provide adequate crossing facilities for pedestrians.

When locating transit stops, consider transit ridership and land use demand for the stop. Also, consider compatibility with the following roadway/traffic characteristics:

- ADT
- Traffic speed
- Crossing distance
- Collision history
- Sight distance
- Connectivity to a pedestrian access route
- Traffic generator density

If any of these suggests an undesirable location for a pedestrian crossing, consider a controlled crossing or another location for the transit stop.

When analyzing locations with high pedestrian collision rates, consider the presence of nearby transit stops and opportunities for pedestrians to reasonably safely cross the street. At-grade midblock pedestrian crossings may be effective at transit stop locations on roadways with lower vehicular volumes. Pedestrian grade separations are appropriate at midblock locations when vehicular traffic volumes prohibit pedestrian crossings at grade. (See Figure 1025-20 for recommendations for marked crosswalks at unsignalized intersections.)

School bus stops are typically adjacent to sidewalks in urban areas and along shoulders in rural areas. Determine the number of children using the stop and provide a waiting area that allows the children to wait reasonably safely for the bus. Coordinate with the local school district. Because of their smaller size, children might be difficult for motorists to see at crossings or stops. Determine whether utility poles, vegetation, and other roadside features interfere with the motorist's ability to see the children. When necessary, remove or relocate the obstructions or move the bus stop. Parked vehicles can also block visibility and parking prohibitions might be advisable near the bus stop.

1025.07 Other Pedestrian Access Ramps

(1) Transit, Park & Ride, Rest Areas, and Buildings and Facilities

An access ramp provides an accessible pedestrian route from a sidewalk to a facility such as a transit stop, park & ride, rest area, pedestrian overcrossing or undercrossing structure, building, or other facilities. When the running slope is 5% or less, it is a pedestrian access route; when the running slope is greater than 5%, it is a pedestrian access ramp. (See Figure 1025-22 for the design requirements.)

Provide a running slope not steeper than 12H:1V on newly constructed pedestrian access ramps. The cross slope is not to exceed 2%. The minimum clear width of ramps is 3 feet. Do not exceed 2 feet 6 inches on the vertical rise of ramps between landings. Provide landings at the top and bottom of each access ramp run.

Match ramp landing widths to the widest ramp entering the landing. Landings must have a minimum clear length of 5 feet with a 2% maximum cross slope. If a change in direction is needed, a 5-foot × 5-foot landing is required (see Figure 1025-22).

For preservation projects, ramps may have a running slope of 10H:1V to 8H:1V for a rise of 3 inches, or 10H:1V to 12H:1V for a rise of 6 inches. A running slope of 5% is desirable on both new construction and preservation projects. Running slopes steeper than 8H:1V are not allowed under ADA guidelines (see Figures 1025-16 and 1025-22).

Pedestrian Access Ramp
Figure 1025-16

1025.08 Illumination and Signing

In Washington State, the highest number of collisions between vehicles and pedestrians occur during November through February, when there is poor visibility and fewer daylight hours. Illumination of pedestrian crossings and other walkways is an important design consideration because lighting has a major impact on a pedestrian's safety and sense of security. Illumination provided solely for vehicular traffic is not always effective in lighting parallel walkways for pedestrians. Consider pedestrian-level (mounted at a lower level) lighting for walkways, intersections, and other pedestrian crossing areas with high nighttime pedestrian activity, such as shopping districts, transit stops, schools, community centers, and other major pedestrian generators or areas with a history of pedestrian accidents. (See Chapter 840 for design guidance on illumination and Chapter 820 and the MUTCD for pedestrian-related signing.)

1025.09 Work Zone Pedestrian Considerations

Providing access and mobility for pedestrians through and around work zones is an important design concern and must be addressed in the temporary traffic control plans if the project occurs in a location accessible to pedestrians. It is advised that the designer determine pedestrian needs in the proposed work zone during the public process and through field visits. In work zones, consider:

- Separating pedestrians from conflicts with work zone equipment and operations.
- Separating pedestrians from traffic moving through or around the work zone.
- Providing pedestrians with reasonably safe, accessible, and convenient travel paths that duplicate, as closely as possible, the characteristics of sidewalks or footpaths.

Provide walkways that are clearly marked and pedestrian barriers that are continuous, nonbendable, and detectable to persons with impaired vision using a cane. Also, keep:

- The pedestrian head space clear.
- Walkways free from pedestrian hazards such as holes, debris, and abrupt changes in grade or terrain.
- Wheelchair access along sidewalks clear of construction traffic control signs.
- A minimum clear width path throughout: 4 feet for pedestrians or 10 feet for pedestrians and bicyclists.
- Walkways clear of obstructions that would snag a cane.

Make temporary pedestrian facilities within the work zone detectable, and include accessibility features consistent with applicable ADA requirements (see Figures 1025-17 and 1025-22).

Consider the use of flaggers if pedestrian generators such as schools are in the work zone vicinity.

Consider spotters prepared to help pedestrians through the work zone.

Provide advance notification of sidewalk closures in the contract Special Provisions and plans.

Where transit stops are affected or relocated because of work activity, provide an accessible route to temporary transit stops.

For further information or guidance on work zone pedestrian considerations, see Chapter 810, the *Plans Preparation Manual*, and the MUTCD.

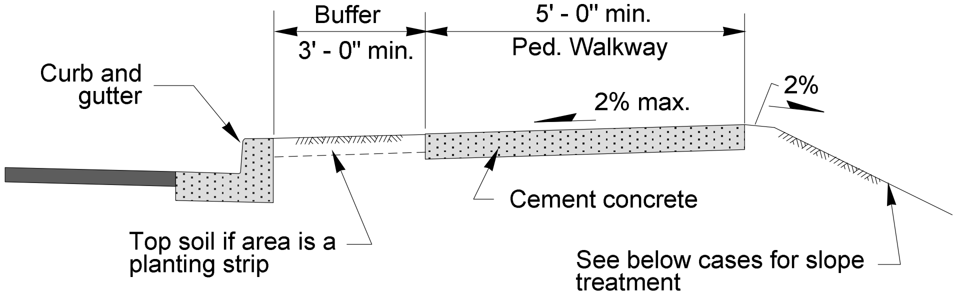
Meets ADA Requirements

Does Not Meet ADA Requirements

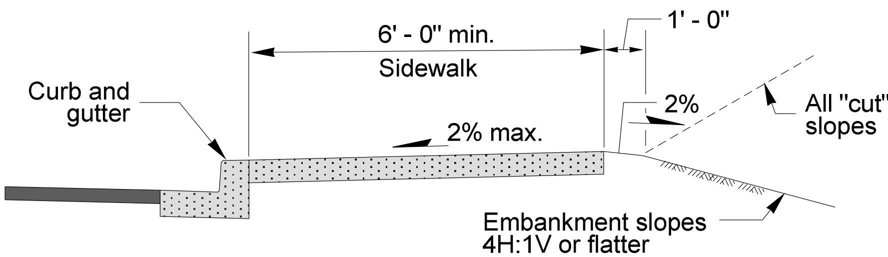
Work Zones and Pedestrian Facilities
Figure 1025-17

1025.10 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/



Case A



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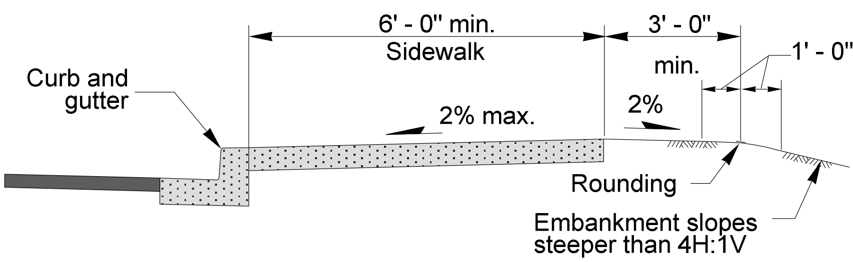

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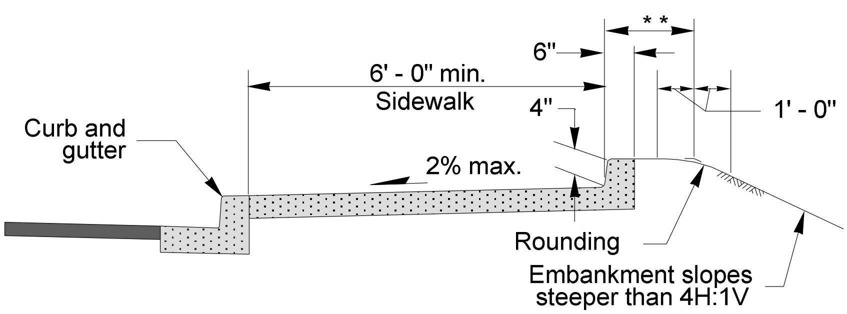
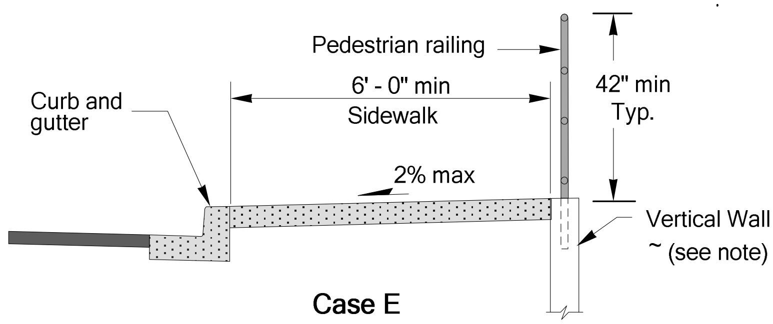


Case D

** See the *Standard Plans*.

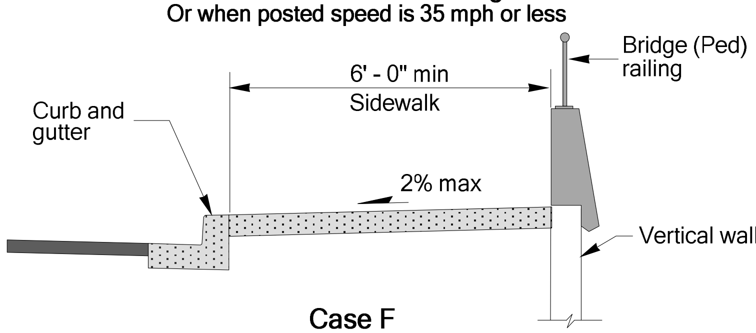
Pedestrian Access Route
Figure 1025-18



Case E

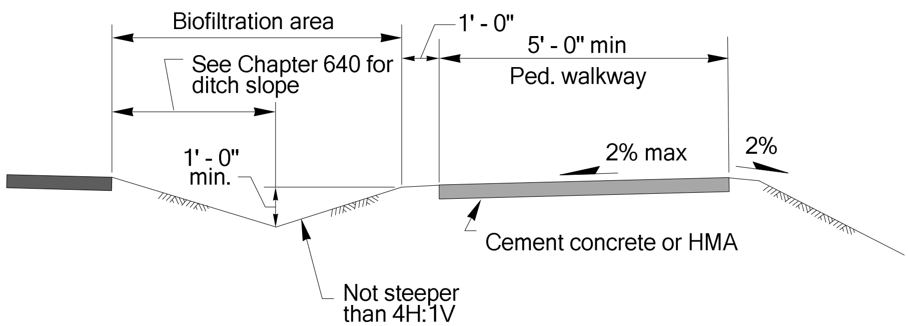
When the wall is outside of the Design Clear Zone

Or when posted speed is 35 mph or less

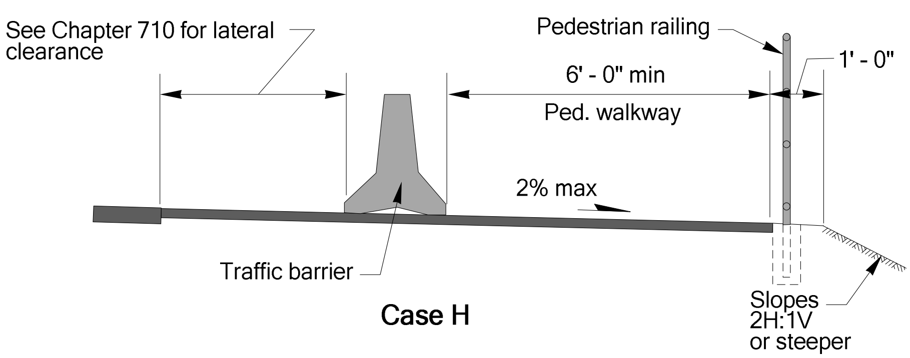


Case F

When the wall is within the Design Clear Zone



Case G



Case H

Notes for Case E:

If vertical drop is >2 feet 6 inches, railing is indicated.

If vertical drop is < 2 feet 6 inches, a 4-inch curb is adequate.

Pedestrian Access Route

Figure 1025-18 (continued)

Roadway Classification and Land Use Designation	Sidewalk Recommendations					
			Desirable		Recommended	
	No sidewalk recommended	4-foot-wide paved shoulders adequate	Sidewalk on one side	Sidewalks on both sides	Sidewalk on one side	Sidewalks on both sides
Rural highways/interchanges outside urban growth areas	X[1]	X[1]				
Suburban highways with 1 or less dwelling unit per acre		X	X			
Suburban highways with 2–4 dwelling units per acre				X	X	
Major arterial in residential area						X
Collector or minor arterial in residential area						X
Local street in residential area with less than 1 dwelling unit per acre		X	X			
Local street in residential area with 1–4 dwelling units per acre				X	X	
Local street in residential area with more than 4 dwelling units per acre						X
Streets in commercial area						X
Streets in industrial area				X	X	

Note:

[1] Consider an engineering study to identify a need.

Sidewalk Recommendations

Figure 1025-19

Traffic Volume (ADT)	Posted Speed	Roadway Type			
		2 lanes	2 lanes, raised median[1]	4 lanes, raised median[1][7]	6 lanes, raised median[1][7]
Less than or equal to 9,000	30 mph and slower	Marked crosswalk	Marked crosswalk	Additional enhancement	
	35 mph to 40 mph	Marked crosswalk	Marked crosswalk	Additional enhancement	
	45 mph and higher	Additional enhancement	Additional enhancement	Active enhancement	
9,000 to 15,000	30 mph and slower	Marked crosswalk	Marked crosswalk	Additional enhancement	
	35 mph to 40 mph	Marked crosswalk	Marked crosswalk	Additional enhancement	
	45 mph and higher	Additional enhancement	Additional enhancement	Active enhancement	
15,000 to 30,000	30 mph and slower	Additional[2] enhancement	Additional enhancement	Additional[2] enhancement	Active[4] enhancement
	35 mph to 40 mph	Additional[2] enhancement	Additional enhancement	Active enhancement	Active[4] enhancement
	45 mph and higher	Active[4] enhancement	Active enhancement	See note [3]	See note [3]
Greater than 30,000	45 mph and lower	Active[4] enhancement	Active enhancement	Pedestrian[6] traffic signal	Pedestrian[6] traffic signal

Inside city limits where the population exceeds 25,000, the decision to mark crosswalks resides with the city, subject to WSDOT approval of the installation and type. Provide documentation for all marked crosswalks.

Notes:

[1] Raised refuge island with a pass-through path minimum width of 5 feet and a median width of 6 feet. A TWLTL is not considered a median.

[2] Consider active enhancement treatment for roadways exceeding 20,000 ADT.

[3] Provide alternate routes for pedestrian crossings or construct a grade-separated facility.

[4] Location may be approaching the need for a controlled crossing. A pedestrian signal may be appropriate, based on engineering analysis.

[5] Raised refuge island required.

[6] Refer to Region Traffic Engineer for approval and design of a pedestrian traffic signal.

[7] Facilities with four or more lanes that meet the crossing warrants require a raised median.

Minimum guidelines (additive for each level)

“marked crosswalk”

- Marked/signed in accordance w/MUTCD, Section 3B.17 & 2C.41 (signed @ crossing only)
- Pedestrian-view warning signs
- Illumination

“additional enhancement”

- Minimum guidelines listed under “marked crosswalk”
- Stop line in accordance w/MUTCD
- Advance signing in accordance w/MUTCD, Section 2C.41

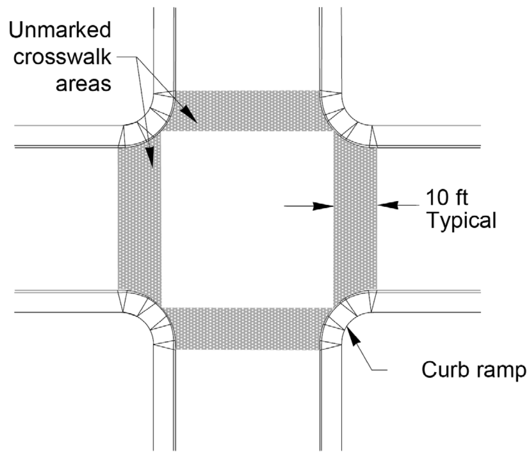
“active enhancement”

- Minimum guidelines listed under “additional enhancement”
- Pedestrian-actuated warning beacons—overhead for roadway w/4 or more lanes

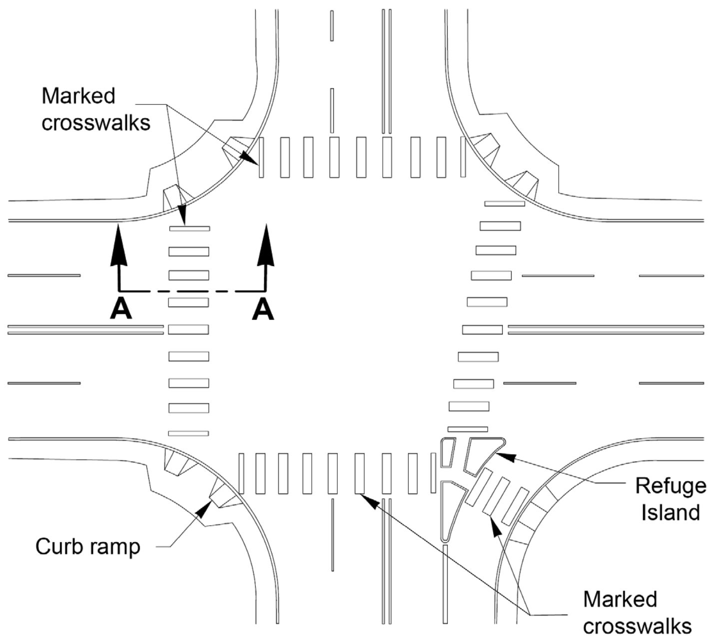
For additional considerations that may be appropriate based on a site-specific engineering analysis, see 1025.05(3).

Marked Crosswalk Recommendations at Unsignalized Crossings

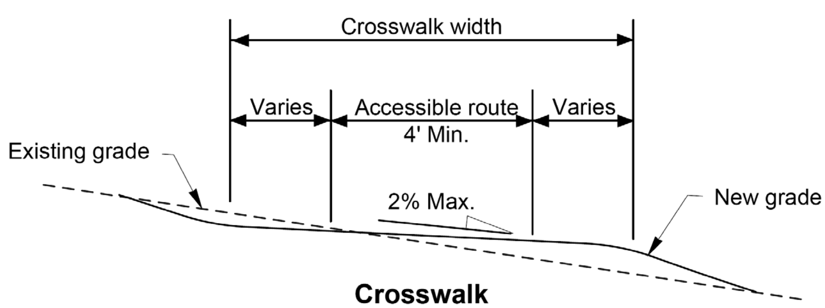
Figure 1025-20



Unmarked Crosswalks



Marked Crosswalk



Crosswalk

Section A - A

Crosswalks and Pedestrian Access Route Cross Slope
Figure 1025-21

Design Feature / Design Element	Curb Ramp	Sidewalk	Driveway Crossing	Crosswalk	Landing	Crossing Through Island/Median	Pedestrian Access Route (Inc. Shared-Use Paths)	Building and Facilities Ramp[1][2]
Width	4 ft Min [1025.05(6)]	4 ft Min for accessible route within sidewalk width[3][5] [1025.05(5)]	4 ft Min – See Std Plans	4 ft Min for accessible route within crosswalk[4] [1025.05(8),(9),(10)]	See **Curb Ramp or Building and Facilities Ramp** requirements	Pass-through: 5 ft Min – Island: 6 ft Min [1025.05(11)]	4 ft Min[5] [1025.05(2)] [1025.05(4)]	At least the width of widest ramp run connected to landing – 3 ft Min
Cross Slope	2% Max [1025.05(6)]	2% Max [1025.05(5)]	2% Max – See Std Plans	2% Max for accessible portion	2% Max	2% Max	2% Max	2% Max
Running Slope	8.3% Max[7] (12H:1V) [1025.05(6)]	5% Max[6] [1025.05(5)]	See Note 6 [1025.05(5)]	5% Max	2% Max	5% Max [1025.05(11)] If curb ramp is used, see **Curb Ramp** requirements	5% Max[6] [1025.05(2)] [1025.05(4)]	8.3% Max[7]
Maximum Vertical Rise	N/A	N/A	N/A	N/A	N/A	N/A	2.5 ft[6] when grade is greater than 5%	Landing every 2.5 ft vertical rise [1025.07(1)]
Grade Break	Flush –See Std Plans	Flush	½ inch between roadway gutter & curb	Flush	Flush	Flush	Flush	Flush
Surface Discontinuities	N/A	**New:** Flush **Existing:** See Note 8	N/A	N/A	N/A	N/A	**New:** Flush **Existing:** See Note 8	**New**: Flush **Existing:** See Note 8
Curb Flare Slope	10% Max	N/A	10% Max[9]	N/A	N/A	If curb ramp is used, see **Curb Ramp** requirements	N/A	N/A
Horizontal Encroachment	4 inches Max [1025.05(2)(a)(3)]	4 inches Max	4 inches Max	4 inches Max	4 inches Max	4 inches Max	4 inches Max	4 inches Max

U. S. Access Board Accessibility Requirements for Pedestrian Facility Design
(For WSDOT guidance, see referenced chapter sections in table)
Figure 1025-22

Design Feature / Design Element	Curb Ramp	Sidewalk	Driveway Crossing	Crosswalk	Landing	Crossing Through Island/Median	Pedestrian Access Route (Inc. Shared-Use Paths)	Building and Facilities Ramp[1][2]
Vertical Clear Area	80 inches Min[10] [1025.05(2)]	80 inches Min[10] [1025.05(2)]	80 inches Min[10]	80 inches Min[10]	80 inches Min[10]	80 inches Min[10]	80 inches Min[10]	80 inches Min[10]
Counter Slope	5% Max [1025.05(6)]	N/A	N/A	See **Curb Ramp**	N/A	N/A	N/A	N/A
Landing	Width: Min match curb ramp width Length: **New:** 4 ft min **Alteration**: 3 ft [1025.05(6)]	N/A	N/A	Diag. curb ramp: Provide 4 ft by 4 ft clear area within crosswalk markings or outside traveled way [1025.05(6)]	– – – –	N/A unless a curb ramp is used – See **Curb Ramp** requirements	When grade > 5% & for separate alignment, provide level landing every 2.5 ft vertical rise[6]	Level landing required for every 2.5 ft vertical rise – Match landings to the width of the widest ramp leading into the landing[11]
Detectable Warning Surface [1025.05(6)]	2 ft wide, 6 inches behind face of curb, full width of ramp	N/A	N/A	N/A	N/A	2 ft wide, each side, 6 inches behind face of curb, full width of opening	2 ft wide, full width when path joins roadway shoulder	N/A

Notes:

[1] A ramp with a rise greater than 6 inches in this context is on a walkway on a separate alignment that is not adjacent to or parallel to a roadway; ramps may have slopes greater than 5% and 8.3% max.

[2] Ramps with a rise greater than 6 inches. Also, ramps require edge protection and shall have handrails.

[3] Required sidewalk width: 5 ft where buffer is included, 6 ft when sidewalk is next to curb.

[4] Unmarked crosswalks require a 10 ft wide area across intersection. Marked crosswalks are required to be 8 ft min., 10 ft desirable. (See RCW 46.04.160 and the MUTCD for crosswalks.)

[5] If less than 5 ft wide, provide 5 ft x 5 ft passing areas every 200 ft.

[6] Allowed to match the roadway grade when located adjacent to and parallel to the roadway; landings would not be required.

[7] For preservation projects: 10H:1V to 12H:1V for rises to 6 inches; 8H:1V to 10H:1V for rises to 3 inches.

[8] Changes in level of ¼ inch max are allowed to be vertical; changes between ¼ inch and ½ inch max to be beveled at 2H:1V.

[9] Required when sidewalk is provided behind the driveway.

[10] 7 ft min. vertical clearance required to bottom of signs (see the MUTCD and the *Standard Plans*).

[11] Change of direction requires 5 ft x 5 ft landing.

U.S. Access Board Accessibility Requirements for Pedestrian Facility Design
(For WSDOT guidance, see referenced chapter sections in table)

Figure 1025-22 (continued)

1040 Weigh Sites

1040.01 General

Truck weighing facilities are needed to protect state highways from overweight vehicles, to provide for vehicle safety inspection, and to provide a source of data for planning and research. The development, construction, and maintenance of these facilities is a cooperative effort between the Washington State Department of Transportation (WSDOT) and the Washington State Patrol (WSP).

1040.02 Definitions

Commercial Vehicle Information Systems and Networks (CVISN) A network that links intelligent transportation systems (ITS) to share information on commercial vehicles. When in operation at a weigh site it can enable commercial vehicles to clear the facility without stopping.

decision sight distance The sight distance required for a driver to detect an unexpected or difficult-to-perceive information source or hazard, interpret the information, recognize the hazard, and select and complete an appropriate maneuver safely and efficiently.

functional classification The grouping of streets and highways according to the character of the service they are intended to provide. (See Chapter 440.)

frontage road An auxiliary road that is a local road or street located beside a highway for service to abutting property and adjacent areas and for control of access.

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

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

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

roadway The portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways.

sight distance The length of roadway visible to the driver.

shoulder The portion of the roadway contiguous with the traveled way, primarily for accommodation of stopped vehicles, emergency use, lateral support of the traveled way, and use by pedestrians and bicycles.

static scale A scale that requires a vehicle to stop for weighing.

stopping sight distance The sight distance required to safely stop a vehicle traveling at design speed.

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

usable shoulder The width of the shoulder that can be used by a vehicle for stopping.

weigh in motion (WIM) A scale facility capable of weighing a vehicle without the vehicle stopping.

1040.03 Planning, Development, and Responsibilities

The WSP works with the WSDOT's Planning and Programming Service Center to develop a prioritized list of weigh facility needs for each biennium. The list includes:

- New permanent facilities
- New portable facilities
- New shoulder sites

- WIM equipment
- Vehicle inspection facilities
- Scale approach slab reconstruction

The WSP provides Program Management a project definition, that includes:

- A statement of need, the purpose of the project, and the type of work
- The general location of the project

Program Management sends this information to the region for preparation of a Project Summary. The region works with the WSP to identify the specific location of the facility, prepares a design decision estimate, and submits it to Program Management.

The region negotiates and the Regional Administrator executes any formal agreements with the WSP required for the design, construction, or maintenance of vehicle weighing and inspection facilities.

The Memorandum of Understanding Related to Vehicle weighing and Equipment Inspection Facilities on State Highways, Figure 1040-8, contains details about the various responsibilities of the WSDOT and the WSP.

1040.04 Permanent Facilities

Permanent truck weighing facilities have permanent scales and may have buildings. When these facilities are in operation, trucks are required stop. However, when Weigh In Motion (WIM) and Commercial Vehicle Information Systems and Networks (CVISN) capabilities have been installed, the driver may be notified to continue without stopping. The notification to continue may be through the use of signs or transponders.

(1) Site Locations

The exact location of a truck weighing facility is generally controlled by topography, highway alignment, and geometrics. It is also desirable to select a site where adequate right of way is already available. Select the most economical site to minimize site preparation, expense, or impact on the environment. Water, electricity availability, and sewage treatment and disposal are other considerations for site selection.

Locate the facility so that its operation will not hinder the operation of the highway or other related features such as intersections and interchanges.

To the extent possible, locate the facility to prevent truck traffic avoiding the facility on other roadways and the type and volume of truck traffic using the highway.

An Access Point Decision Report is required for weigh sites on multilane divided highways with access control. (See Chapter 1425.)

(2) Design Features

On multilane highways, provide standard off- and on-connections, as shown in Chapter 940. Figure 1040-1 is the minimal design of a weigh site on multilane highways.

Design weigh facilities on two-lane highways to best fit the existing conditions, with particular consideration given to the matter of access to and from the site. Standard off- and on-connections, as shown in Chapter 940, are preferred; however, with justification on-connections may be designed as intersections. (See Chapter 910.) Figure 1040-2 is a guide for the design of weigh sites on two-lane highways.

The following special design features apply:

- Level cement concrete approach slabs are required at both ends of the scales.

  Hot mix asphalt approach slabs will be allowed only when adequate soil conditions exist, projected truck volume is light, and benefit/cost analysis justifies the hot mix asphalt based on the small percentage of time the scales will be in operation.

  The approach slabs must be level and in the same plane as the scale.

- Provide adequate parking and storage to ensure that trucks do not impede the main-line through traffic. The WSDOT Regional Administrator and the WSP agree on the area to be provided.

- On multilane divided highways, install illuminated electronically controlled “open” and “closed” message signs that can be operated from the scale house or the control cabinet. Provide permanent signing for the facility, as requested by the WSP.
- The need for a vehicle safety inspection facility at any site is identified by the WSP. Figure 1040-3 is a guide for a site plan for a single bay vehicle inspection facility. Additional bays and site adaptation will be on a site by site basis. The WSDOT Regional Administrator and the WSP agree on the area to be provided.
- The need for some form of approach protective treatment for the scale house or a protective fence between the scale and roadway is identified by the WSP and agreed upon by the WSDOT Regional Administrator and the WSP. The need for the device is to protect the scale house from errant vehicles. See Chapter 700 for additional clear zone considerations.
- The need for WIM or CVISN capabilities is identified by the WSP. Design the in-place facilities to provide the ability to notify drivers whether to continue on or to stop for further investigation before they reach the exit for the static scale. The design is agreed upon by the WSDOT Regional Administrator and the WSP.
- Where WIM and CVISN are not included in the project, provide conduit for their future installation.
- With justification, at locations where space is limited, the depressed outer separation between the weigh facility and the through lanes may be replaced with concrete traffic barrier. (See Collector Distributor Outer Separations, Chapter 940.)
- Provide a clear view of the entire weigh site for the facility’s operator and the driver of an approaching vehicle.
- Hot mix asphalt is acceptable for use on the ramp and storage areas. Design the depth in accordance with the surfacing report.
- To optimize scale efficiency, make the storage area flat; however, to facilitate drainage, the slope may be up to 2%.
- Provide illumination when requested by the WSP. Illumination is required if the facility is to be operated during the hours of darkness and may be desirable at other locations to deter unauthorized use of the facility. See Chapter 840 for additional information on illumination.

1040.05 Portable Facilities

Portable truck weighing facilities have no permanent scales or buildings. When these facilities are in operation, they operate in the same manner as permanent facilities.

(1) Site Locations

Design portable truck weighing facilities located on two-lane and multilane roadways to best fit the existing conditions. Minor portable scale sites, as shown on Figure 1040-4, are used with two-way traffic and on multilane highways with low traffic volumes. Major portable scale sites, Figure 1040-5, are for use on expressways, freeways, and where traffic volumes are high.

Locate the weighing facility so that its operation will not hinder the operation of the highway or other related features such as an intersection.

An Access Point Decision Report is required for weigh sites on multilane divided highways with access control. (See Chapter 1425.)

(2) Design Features

The following special design features apply:

- Off- and on-connections, as shown in Figures 1040-4 and 5, are preferred; however, with justification on highways with no access control, on-connections may be designed as intersections. (See Chapter 910.)
- With justification, at locations where space is limited, the depressed outer separation between the weigh facility and the through lanes may be replaced with concrete traffic barrier. See the collector distributor outer separation figure in Chapter 940.

- Provide adequate parking and storage to ensure that trucks do not impede the main-line through traffic. The WSDOT Regional Administrator and the WSP agree on the area to be provided.
- Hot mix asphalt is acceptable for use on the ramp and storage areas. Design the depth in accordance with the surfacing report.
- To optimize portable scale efficiency, make the storage area flat; however, to facilitate drainage, the slope may be up to 2%.
- Provide permanent signing for the facility, as requested by the WSP.
- Provide illumination when requested by the WSP. Illumination is required if the facility is to be operated during the hours of darkness and may be desirable at other locations to deter unauthorized use of the facility. See Chapter 840 for additional information on illumination.

1040.06 Shoulder Sites

Shoulder sites are used by the WSP to pull a truck over for inspection and weighing with portable scales.

(1) Site Locations

Design shoulder sites to best fit the existing conditions. Small shoulder sites (Figure 1040-6) are for use on lower volume roadways (ADT 5,000 or less) with two-way traffic. Large shoulder sites (Figure 1040-7) are to be used with higher volume two-way roadways and multilane highways.

Locate the weighing facility so that its operation will not hinder the operation of the highway or other related features such as an intersection.

(2) Design Features

Shoulder sites are designed in coordination with the WSP. Input from the local WSP Commercial Vehicle Enforcement personnel will ensure that the proposed site will meet their needs without over-building the facility. Obtain written concurrence from the WSP for the length, width, and taper rates before the design is finalized.

When the ADT is 1,500 or less and with the written approval of the WSP, the tapers at small shoulder sites may be eliminated. The shoulders on either side of the site may be used as acceleration and deceleration lanes, whether or not they were designed for this use. Therefore, provide adequate strength to support truck traffic.

Hot mix asphalt is acceptable for use on all shoulder sites. Design the depth in accordance with the surfacing report. Design the shoulder pavement at this depth for a length not less than the deceleration lane length before, and the acceleration lane length after, the site (Chapter 940).

When the shoulders are designed to be used for deceleration and acceleration lanes, the minimum width is 12 ft with full pavement depth for the deceleration/acceleration lane lengths (Chapter 940).

Use a maximum of 2% slope in order to optimize portable scale efficiency and to facilitate drainage.

1040.07 Federal Participation

Federal funds appropriate to the system being improved may be used for the acquisition of right of way and the construction of truck weighing facilities and vehicle inspection facilities. This includes, but is not limited to on and off ramps, deceleration and acceleration lanes, passing lanes, driveways, parking areas, scale approach slabs, vehicle inspection facilities, roadway illumination, and signing.

1040.08 Procedures

Prepare site plans for all truck weigh facilities that include:

- Class of highway and design speed for main line (Chapter 440).
- Curve data on main line and weigh site.
- Numbers of lanes and widths of lanes and shoulders on main line and weigh site.
- Superelevation diagrams for the main line and weigh site.
- Stationing of ramp connections and channelization.

Chapter 1130 Retaining Walls and Steep Reinforced Slopes

1130.01 References

(1) Federal/State Laws and Codes

Washington Administrative Code (WAC) 296-155, Safety standards for construction work

(2) Design Guidance

Bridge Design Manual, M 23-50, WSDOT

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

Plans Preparation Manual, M 22-31, WSDOT

Roadside Manual, M 25-39, WSDOT

1130.02 General

The function of a retaining wall is to form a nearly vertical face through confinement and/or strengthening of a mass of earth or other bulk material. Likewise, the function of a reinforced slope is to strengthen the mass of earth or other bulk material such that a steep (up to 1H:2V) slope can be formed. In both cases, the purpose of constructing such structures is to make maximum use of limited right of way. The difference between the two is that a wall uses a structural facing, whereas a steep reinforced slope does not require a structural facing. Reinforced slopes typically use a permanent erosion control matting with low vegetation as a slope cover to prevent erosion. (See the *Roadside Manual* for more information.)

To lay out and design a retaining wall or reinforced slope, consider the following items:

- Functional classification
- Highway geometry
- Design Clear Zone requirements (Chapter 700)
- The amount of excavation required
- Traffic characteristics
- Constructibility
- Impact to any adjacent environmentally sensitive areas
- Impact to adjacent structures
- Potential added lanes

- Length and height of wall
- Material to be retained
- Foundation support and potential for differential settlement
- Ground water
- Earthquake loads
- Right of way costs
- Need for construction easements
- Risk
- Overall cost
- Visual appearance

If the wall or toe of a reinforced slope is to be located adjacent to the right of way line, consider the space needed in front of the wall/slope to construct it.

(1) Retaining Wall Classifications

Retaining walls are generally classified as gravity, semigravity, nongravity cantilever, or anchored. Examples of the various types of walls are provided in Figures 1130-1a through 1c.

Gravity walls derive their capacity to resist lateral soil loads through a combination of dead weight and sliding resistance. Gravity walls can be further subdivided into rigid gravity walls, prefabricated modular gravity walls, and Mechanically Stabilized Earth (MSE) gravity walls.

Rigid gravity walls consist of a solid mass of concrete or mortared rubble and use the weight of the wall itself to resist lateral loads.

Prefabricated modular gravity walls consist of interlocking soil or rock filled concrete, steel, or wire modules or bins (gabions, for example). The combined weight resists the lateral loads from the soil.

MSE gravity walls use strips, bars, or mats of steel or polymeric reinforcement to reinforce the soil and create a reinforced soil block behind the face. The reinforced soil block then acts as a unit and resists the lateral soil loads through the dead weight of the reinforced mass. MSE walls may be constructed as fill walls, with fill and reinforcement placed in alternate layers to create a reinforced mass, or reinforcement may be drilled into an existing soil/rock mass using grouted anchor technology to create a reinforced soil mass (soil nail walls).

Semigravity walls rely more on structural resistance through cantilevering action of the wall stem. Generally, the backfill for a semigravity wall rests on part of the wall footing. The backfill, in combination with the weight of the wall and footing, provides the dead weight for resistance. An example of a semigravity wall is the reinforced concrete wall provided in the *Standard Plans*.

Nongravity cantilever walls rely strictly on the structural resistance of the wall in which vertical elements of the wall are partially embedded in the soil or rock to provide fixity. These vertical elements may consist of piles (soldier piles or sheet piles, for example), caissons, or drilled shafts. The vertical elements may form the entire wall face or they may be spanned structurally using timber lagging or other materials to form the wall face.

Anchored walls derive their lateral capacity through anchors embedded in stable soil or rock below or behind all potential soil/rock failure surfaces. Anchored walls are similar to nongravity cantilevered walls except that anchors embedded in the soil/rock are attached to the wall facing structure to provide lateral resistance. Anchors typically consist of deadmen or grouted soil/rock anchors.

Reinforced slopes are similar to MSE walls in that they also use fill and reinforcement placed in alternate layers to create a reinforced soil mass. However, the face is typically built at a 1.2H:1V to 1H:2V slope.

Rockeries (rock walls) behave to some extent like gravity walls. However, the primary function of a rockery is to prevent erosion of an oversteepened but technically stable slope. Rockeries consist of large well-fitted rocks stacked on top of one another to form a wall.

An example of a rockery and reinforced slope is provided in Figure 1130-1d.

The various wall types and their classifications are summarized in Table 1(a-f).

1130.03 Design Principles

The design of a retaining wall or reinforced slope consists of seven principal activities:

- Developing wall/slope geometry
- Adequate subsurface investigation
- Evaluation of loads and pressures that will act on the structure
- Design the structure to withstand the loads and pressures
- Design the structure to meet aesthetic requirements
- Wall/slope constructibility
- Coordination with other design elements

The structure and adjacent soil mass <u>needs to</u> also be stable as a system, and the anticipated wall settlement <u>needs to</u> be within acceptable limits.

1130.04 Design Requirements

(1) Wall/Slope Geometry

Wall/slope geometry is developed considering the following:

- Geometry of the transportation facility itself
- Design Clear Zone requirements (Chapter 700)
- Flare rate and approach slope when inside the Design Clear Zone (Chapter 710)
- Right of way constraints
- Existing ground contours
- Existing and future utility locations
- Impact to adjacent structures
- Impact to environmentally sensitive areas
- For wall/slope geometry, also consider the foundation embedment and type anticipated, which requires coordination among the various design groups involved.

Retaining walls are designed to limit the potential for snagging vehicles by removing protruding objects (such as bridge columns, light fixtures, or sign supports).

Provide a traffic barrier shape at the base of a new retaining wall constructed 12 ft or less from the edge of the nearest traffic lane. The traffic barrier shape is optional at the base of the new portion when an existing vertical-faced wall is being extended (or the existing wall may be retrofitted for continuity). Standard Concrete Barrier Type 4 is recommended for both new and existing walls except when the barrier face can be cast as an integral part of a new wall. Deviations may be considered but require approval as prescribed in Chapter 330. For deviations from the above, deviation approval is not required where sidewalk exists in front of the wall or in other situations where the wall face is otherwise inaccessible to traffic.

(2) Investigation of Soils

All retaining wall and reinforced slope structures require an investigation of the underlying soil/rock that supports the structure. Chapter 510 provides guidance on how to complete this investigation. A soil investigation is an integral part of the design of any retaining wall or reinforced slope. The stability of the underlying soils, their potential to settle under the imposed loads, the usability of any existing excavated soils for wall/reinforced slope backfill, and the location of the ground water table are determined through the geotechnical investigation.

(3) Geotechnical and Structural Design

The structural elements of the wall or slope and the soil below, behind, and/or within the structure are designed together as a system. The wall/slope system is designed for overall external stability as well as internal stability. Overall external stability includes stability of the slope of which the wall/reinforced slope is a part and the local external stability (overturning, sliding, and bearing capacity). Internal stability includes resistance of the structural members to load and, in the case of MSE walls and reinforced slopes, pullout capacity of the structural members or soil reinforcement from the soil.

(4) Drainage Design

One of the principal causes of retaining wall/slope failure is the additional hydrostatic load imposed by an increase in the water content in the material behind the wall or slope. This condition results in a substantial increase in the lateral loads behind the wall/slope since the material undergoes a possible increase in unit weight, water pressure is exerted on the back of the wall, and the soil shear strength undergoes a possible reduction. To alleviate this, adequate drainage for the retaining wall/slope needs to be considered in the design stage and reviewed by the region's Materials Engineer during construction. The drainage features shown in the *Standard Plans* are the minimum basic requirements. Underdrains behind the wall/slope need to daylight at some point in order to adequately perform their drainage function. Provide positive drainage at periodic intervals to prevent entrapment of water.

Native soil may be used for retaining wall and reinforced slopes backfill if it meets the requirements for the particular wall/slope system. In general, use backfill that is free-draining and granular in nature. Exceptions to this can be made depending on the site conditions as determined by the Geotechnical Services Branch of the Headquarters (HQ) Materials Laboratory.

A typical drainage detail for a gravity wall (in particular, an MSE wall) is shown in Figure 1130-2. Include drainage details with a wall unless otherwise recommended to be deleted by the region's Materials Engineer or HQ Geotechnical Services Branch.

(5) Aesthetics

Retaining walls and slopes can have a pleasing appearance that is compatible with the surrounding terrain and other structures in the vicinity. To the extent possible within functional requirements and cost effectiveness criteria, this aesthetic goal is to be met for all visible retaining walls and reinforced slopes.

Aesthetic requirements include consideration of the wall face material, the top profile, the terminals, and the surface finish (texture, color, and pattern). Where appropriate, provide planting areas and irrigation conduits. These will visually soften walls and blend walls with adjacent areas. Avoid short sections of retaining wall or steep slope where possible.

In higher walls, variations in slope treatment are recommended for a pleasing appearance. High, continuous walls are generally not desirable from an aesthetic standpoint, as high, continuous walls can be quite imposing. Consider stepping high or long retaining walls in areas of high visibility. Plantings may be considered between wall steps.

Approval from the State Bridge and Structures Architect is required on all retaining wall aesthetics including finishes, materials, and configuration (see Chapter 1360).

(6) Constructibility

Consider the potential effect that site constraints might have on the constructibility of the specific wall/slope. Constraints to be considered include, but are not limited to, site geometry, access, time required to construct the wall, environmental issues, and impact on traffic flow and other construction activities.

(7) Coordination with Other Design Elements

(a) **Other Design Elements.** Retaining wall and slope designs are to be coordinated with other elements of the project that might interfere with or impact the design and/or construction of the wall/slope. Also consider drainage features, utilities, luminaire or sign structures, adjacent retaining walls or bridges, concrete traffic barriers, and beam guardrails. Locate these design elements in a manner that will minimize the impacts to the wall elements. In general, locate obstructions within the wall backfill (such as guardrail posts, drainage features, and minor structure foundations) a minimum of 3 ft from the back of the wall facing units. Greater offset distances may be required depending on the size and nature of the interfering design element. If possible, locate these elements to miss reinforcement layers or other portions of the wall system. Conceptual details for accommodating concrete traffic barriers and beam guardrails are provided in Figure 1130-3.

Where impact to the wall elements is unavoidable, the wall system needs to be designed to accommodate these impacts. For example, it may be necessary to place drainage structures or guardrail posts in the reinforced backfill zone of MSE walls. This may require that holes be cut in the upper soil reinforcement layers, or that discrete reinforcement strips be splayed around the obstruction. This causes additional load to be carried in the adjacent reinforcement layers due to the missing soil reinforcement or the distortion in the reinforcement layers.

The need for these other design elements and their impact on the proposed wall systems is to be clearly indicated in the wall site data that is submitted so that the walls can be properly designed. Contact the Bridge and Structures Office (or the Geotechnical Services Branch, for geosynthetic walls/slopes and soil nail walls) for assistance regarding this issue.

(b) **Fall Protection.** Department of Labor and Industries regulations require that, when employees are exposed to the possibility of falling from a location 10 ft or more above the roadway (or other lower area), the employer is to ensure that fall restraint or fall arrest systems are provided, installed, and implemented.

Design fall protection in accordance with WAC 296-155-24510 for walls that create a potential of a fall of 10 feet or more. During construction or other temporary or emergency condition, fall protection will follow WAC 296-155-505. Any need for maintenance of the wall's surface or the area at the top can expose employees to a possible fall. If the area at the top will be open to the public, see Chapter 1025, "Pedestrian Design Considerations," and Chapter 1460, "Fencing."

For maintenance of a tall wall's surface, consider harness tie-offs if other protective means are not provided.

For maintenance of the area at the top of a tall wall, a fall restraint system is required when all of the following conditions will exist:

- The wall is on a cut slope.
- A possible fall will be of 10 ft or more.
- Periodic maintenance will be performed on the area at the top.
- The area at the top is not open to the public.

Recommended fall restraint systems are:

- Wire rope railing with top and intermediate rails of one-half inch diameter steel wire rope.
- Brown vinyl coated chain link fencing.
- Steel pipe railing with one and one-half inch nominal outside diameter pipe as posts and top and intermediate rails.
- Concrete as an extension of the height of the retaining wall.

A fall restraint system is to be 42 inches high, plus or minus 3 inches, measured from the top of the finished grade, and capable of withstanding a 200 lb force from any direction, at the top, with minimal deflection. An intermediate cable or rail shall be halfway between the top rail and the platform. A toe board with a minimum height of 9 inches will be provided. Post spacing is no more than 8 feet on centers. (See the *Construction Manual* and WAC 296-155 for fall arrest and protection information.)

The designer is to contact Maintenance regarding fall protection and debris removal considerations.

Contact the Bridge and Structures Office for design details for any retrofit to an existing retaining wall and for any attachments to a new retaining wall.

1130.05 Guidelines for Wall/Slope Selection

Wall/slope selection is dependent on the following considerations:

- Whether the wall/slope will be located primarily in a cut or fill (how much excavation/shoring will be required to construct the wall or slope?)
- If located in a cut, the type of soil/rock present
- The need for space between the right of way line and the wall/slope or easement
- The amount of settlement expected
- The potential for deep failure surfaces to be present
- The structural capacity of the wall/slope in terms of maximum allowable height
- The nature of the wall/slope application
- Whether or not structures or utilities will be located on or above the wall
- Architectural requirements
- Overall economy

(1) Cut and Fill Considerations

Due to the construction technique and base width required, some wall types are best suited for cut situations whereas others are best suited for fill situations. For example, anchored walls and soil nail walls have soil reinforcements drilled into the in-situ soil/rock and, therefore, are generally used in cut situations. Nongravity cantilevered walls are drilled or cut into the in-situ soil/rock, have narrow base widths, and are also well suited to cut situations. Both types of walls are constructed from the top down. Such walls are also used as temporary shoring to allow other types of walls or other structures to be constructed where considerable excavation will otherwise be required.

MSE walls and reinforced slopes, however, are constructed by placing soil reinforcement between layers of fill from the bottom up and are therefore best suited to fill situations. Furthermore, the base width of MSE walls is typically on the order of 70 percent of the wall height, which requires considerable excavation in a cut situation. Therefore, in a cut situation, base width requirements usually make MSE structures uneconomical and possibly unconstructible.

Semigravity (cantilever) walls, rigid gravity walls, and prefabricated modular gravity walls are free-standing structural systems built from the bottom up but they do not rely on soil reinforcement techniques (placement of fill layers with soil reinforcement) to provide stability. These types of walls generally have a narrower base width than MSE structures, (on the order of 50 percent of the wall height). Both of these factors make these types of walls feasible in fill situations as well as many cut situations.

Reinforced slopes generally require more room overall to construct than a wall because of the sloping face, but are typically a feasible alternative to a combination wall and fill slope to add a new lane. Reinforced slopes can also be adapted to the existing ground contours to minimize excavation requirements where fill is placed on an existing slope. Reinforced slopes might also be feasible to repair slopes damaged by landslide activity or deep erosion.

Rockeries are best suited to cut situations, as they require only a narrow base width, on the order of 30 percent of the rockery height. Rockeries can be used in fill situations, but the fill heights that they support needs to be kept relatively low as it is difficult to get the cohesive strength needed in granular fill soils to provide minimal stability of the soil behind the rockery at the steep slope typically used for rockeries in a cut (such as 1H:6V or 1H:4V).

The key considerations in deciding which walls or slopes are feasible are the amount of excavation or shoring required and the overall height. The site geometric constraints are defined to determine these elements. Another consideration is whether or not an easement will be required. For example, a temporary easement might be required for a wall in a fill situation to allow the contractor to work in front of the wall. For walls in cut situations, especially anchored walls and soil nail walls, a permanent easement may be required for the anchors or nails.

(2) Settlement and Deep Foundation Support Considerations

Settlement issues, especially differential settlement, are of primary concern for selection of walls. Some wall types are inherently flexible and can tolerate a great deal of settlement without suffering structurally. Other wall types are inherently rigid and cannot tolerate much settlement. In general, MSE walls have the greatest flexibility and tolerance to settlement, followed by prefabricated modular gravity walls. Reinforced slopes are also inherently very flexible. For MSE walls, the facing type used can affect the ability of the wall to tolerate settlement. Welded wire and geosynthetic wall facings are the most flexible and the most tolerant to settlement, whereas concrete facings are less tolerant to settlement. In some cases, concrete facing can be placed, after the wall settlement is complete, such that the concrete facing does not limit the wall’s tolerance to settlement. Facing may also be added for aesthetic reasons.

Semigravity (cantilever) walls and rigid gravity walls have the least tolerance to settlement. In general, total settlement for these types of walls needs to be limited to approximately 1 in or less. Rockeries also cannot tolerate much settlement, as rocks can shift and fall out. Therefore, semigravity cantilever walls, rigid gravity walls, and rockeries are not used in settlement prone areas.

If very weak soils are present that will not support the wall and that are too deep to be overexcavated, or if a deep failure surface is present that results in inadequate slope stability, select a wall type capable of using deep foundation support and/or anchors. In general, MSE walls, prefabricated modular gravity walls, and some rigid gravity walls are not appropriate for these situations. Walls that can be pile supported such as concrete semigravity cantilever walls, nongravity cantilever walls, and anchored walls are more appropriate for these situations.

(3) Feasible Wall and Slope Heights and Applications

Feasible wall heights are affected by issues such as the capacity of the wall structural elements, past experience with a particular wall, current practice, seismic risk, long-term durability, and aesthetics.

See Table 1 for height limitations.

(4) Supporting Structures or Utilities

Not all walls are acceptable to support other structures or utilities. Issues that are to be considered include the potential for the wall to deform due to the structure foundation load, interference between the structure foundation and the wall components, and the potential long-term durability of the wall system. Using retaining walls to support other structures is considered to be a critical application, requiring a special design. In general, soil nail walls, semigravity cantilever walls, nongravity cantilever walls, and anchored walls are appropriate for use in supporting bridge and building structure foundations. In addition to these walls, MSE and prefabricated modular gravity walls may be used to support other retaining walls, noise walls, and minor structure foundations such as those for sign bridges and signals. On a project specific basis, MSE walls can be used to support bridge and building foundations, as approved by the Bridge and Structures Office.

Also consider the location of any utilities behind the wall or reinforced slope when making wall/slope selections. This is mainly an issue for walls that use some type of soil reinforcement and for reinforced slopes. It is best not to place utilities within a reinforced soil backfill zone because it will be impossible to access the utility from the ground surface without cutting through the soil reinforcement layers, thereby compromising the integrity of the wall.

Sometimes utilities, culverts, pipe arches, etc. must penetrate the face of a wall. Not all walls and facings are compatible with such penetrations. Consider how the facing can be formed around the penetration so that backfill soil cannot pipe or erode through the face. Contact the Bridge and Structures Office for assistance regarding this issue.

(5) Facing Options

Facing selection depends on the aesthetic and the structural needs of the wall system. Wall settlement may also affect the feasibility of the facing options. More than one wall facing may be available for a given system. Consider available facing options when selecting a particular wall.

For MSE walls, facing options typically include the following:

- Precast modular panels
- In some cases, full height precast concrete panels. (Full height panels are generally limited to walls with a maximum height of 20 ft placed in areas where minimal settlement is expected.)
- Welded wire facing
- Timber facing
- Shotcrete facing with various treatment options that vary from a simple broom finish to a textured and colored finish
- Segmental masonry concrete blocks
- Cast-in-place concrete facing with various texturing options.

Plantings on welded wire facings can be attempted in certain cases. The difficulty is in providing a soil at the wall face that is suitable for growing plants and meets engineering requirements in terms of soil compressibility, strength, and drainage. If plantings in the wall face are attempted, use only small plants, vines, and grasses.

Small bushes may be considered for plantings between wall steps. Larger bushes or trees are not considered in these cases due to the loads on the wall face that they can create.

Geosynthetic facings are not acceptable for permanent facings due to potential facing degradation when exposed to sunlight. For permanent applications, use some type of timber, welded wire, or concrete face for geosynthetic walls . (Shotcrete, masonry concrete blocks, cast-in-place concrete, welded wire, or timber are typically used for geosynthetic wall facings.)

Soil nail walls can use either architecturally treated shotcrete or a cast-in-place facia wall textured as needed to produce the desired appearance.

For prefabricated modular gravity walls, the facing generally consists of the structural bin or crib elements used to construct the walls. For some walls, the elements can be rearranged to form areas for plantings. In some cases, textured structural elements might also be feasible. This is also true of rigid gravity walls, though planting areas on the face of rigid gravity walls are generally not feasible. The concrete facing for semigravity cantilever walls can be textured as needed to produce the desired appearance.

For nongravity cantilevered walls and anchored walls, a textured cast-in-place or precast facia wall is usually installed to produce the desired appearance.

(6) Cost Considerations

Usually, more than one wall type is feasible for a given situation. Consider initial and future maintenance costs throughout the selection process. Decisions in the selection process that may affect the overall cost might include the problem of whether to shut down a lane of traffic to install a low cost gravity wall system that requires more excavation room or to use a more expensive anchored wall system that will minimize excavation requirements and impacts to traffic. In this case, determine if the cost of traffic impacts and more excavation justifies the cost of the more expensive anchored wall system. Consider long-term maintenance costs when determining wall type.

Decisions regarding aesthetics can also affect the overall cost of the wall system. In general, the least expensive aesthetic options use the structural members of the wall as facing (welded wire, concrete or steel cribbing or bins, for example), whereas the most expensive aesthetic options use textured cast-in-place concrete facias. In general, concrete facings increase in cost in the following order: shotcrete, segmental masonry concrete blocks, precast concrete facing panels, full height precast concrete facing panels, and cast-in-place concrete facing panels. Special architectural treatment usually increases the cost of any of these facing systems. Special wall terracing to provide locations for plants will also tend to increase costs. Therefore, weigh the costs against the value of the desired aesthetics.

Other factors that affect costs of wall/slope systems include wall/slope size and length, access at the site and distance to the material supplier location, overall size of the project, and competition between wall suppliers. In general, costs tend to be higher for walls or slopes that are high, but short in length, due to lack of room for equipment to work. Sites that are remote or have difficult local access increase wall/slope costs. Small wall/slope quantities result in high unit costs. Lack of competition between materials or wall system suppliers can result in higher costs as well.

Some of the factors that increase costs are required parts of a project and are, therefore, unavoidable. Always consider such factors when estimating costs because a requirement may not affect all wall types in the same way. Current cost information can be obtained by consulting the *Bridge Design Manual* or by contacting the Bridge and Structures Office.

(7) Summary

For wall/slope selection, consider factors such as the intended application, the soil/rock conditions in terms of settlement, need for deep foundations, constructibility, impact to traffic, the overall geometry in terms of wall/slope height and length, location of adjacent structures and utilities, aesthetics, and cost. Table 1 provides a summary of many of the various wall/slope options available, including their advantages, disadvantages, and limitations. Note that specific wall types in the table may represent multiple wall systems, some or all of which will be proprietary.

1130.06 Design Responsibility and Process

(1) General

The retaining walls available for a given project include standard walls, nonstandard walls, and reinforced slopes.

Standard walls are those walls for which standard designs are provided in the WSDOT *Standard Plans*. *Standard Plans* are provided for reinforced concrete cantilever walls up to 35 ft in height. The internal stability design, and the external stability design for overturning and sliding stability, have already been completed for these standard walls. Determine overall slope stability and allowable soil bearing capacity (including settlement considerations) for each standard-design wall location.

Nonstandard walls may be either proprietary (patented or trademarked) or nonproprietary. Proprietary walls are designed by a wall manufacturer for internal and external stability, except bearing capacity, settlement, and overall slope stability which are determined by WSDOT. Nonstandard nonproprietary walls are fully designed by WSDOT.

The geosynthetic soil reinforcement used in nonstandard nonproprietary geosynthetic walls is considered to be proprietary. It is likely that more than one manufacturer can supply proprietary materials for a nonstandard nonproprietary geosynthetic wall.

Reinforced slopes are similar to nonstandard nonproprietary walls in terms of their design process.

Some proprietary wall systems are preapproved. Preapproved proprietary wall systems have been extensively reviewed by the Bridge and Structures Office and the Geotechnical Services Branch. Design procedures and wall details for preapproved walls have already been agreed upon between WSDOT and the proprietary wall manufacturers, allowing the manufacturers to competitively bid a particular project without having a detailed wall design provided in the contract plans.

Note that proprietary wall manufacturers might produce several retaining wall options, and not all options from a given manufacturer have necessarily been preapproved. For example, proprietary wall manufacturers often offer more than one facing alternative. It is possible that some facing alternatives are preapproved, whereas other facing alternatives are not preapproved. WSDOT does not preapprove the manufacturer, but specific wall systems by a given manufacturer can be preapproved.

It is imperative with preapproved systems that the design requirements for all preapproved wall alternatives for a given project be clearly stated so that the wall manufacturer can adapt the preapproved system to specific project conditions. For a given project, coordination of the design of all wall alternatives with all project elements that impact the wall (such as drainage features, utilities, luminaires and sign structures, noise walls, traffic barriers, guardrails, or other walls or bridges) is critical to avoid costly change orders or delays during construction.

In general, standard walls are the easiest walls to incorporate into project plans, specifications, & estimate (PS&E), but they may not be the most cost effective option. Preapproved proprietary walls provide more options in terms of cost effectiveness and aesthetics and are also relatively easy to incorporate into a PS&E. Nonstandard state-designed walls and nonpreapproved proprietary walls generally take more time and effort to incorporate into a PS&E because a complete wall design needs to be developed. Some nonstandard walls (state-designed geosynthetic walls, for example) can be designed relatively quickly, require minimal plan preparation effort, and only involve the region and the Geotechnical Services Branch. Other nonstandard walls such as soil nail and anchored wall systems require complex designs, involve both the Bridge and Structures Office and the Geotechnical Services Branch, and require a significant number of plan sheets and considerable design effort.

The Bridge and Structures Office maintains a list of the proprietary retaining walls that are preapproved. The region consults the Bridge and Structures Office for the latest list. The region consults the Geotechnical Services Branch for the latest geosynthetic reinforcement list to determine which geosynthetic products are acceptable if a critical geosynthetic wall or reinforced slope application is anticipated.

Some proprietary retaining wall systems are classified as experimental by the FHWA. The Bridge and Structures Office maintains a list of walls that are classified as experimental. If the wall intended for use is classified as experimental, a work plan is to be prepared by WSDOT and approved by the FHWA.

An approved public interest finding, signed by the State Design Engineer, is required for the use of a sole source proprietary wall.

Gabion walls are nonstandard walls that are to be designed for overturning, sliding, overall slope stability, settlement, and bearing capacity. A full design for gabion walls is not provided in the *Standard Plans*. Gabion baskets are typically 3 ft high by 3 ft wide, and it is typically safe to build gabions two baskets high (6 ft) but only one basket deep, resulting in a wall base width of 50 percent of the wall height, provided soil conditions are reasonably good (medium dense to dense granular soils are present below and behind the wall).

(2) Responsibility and Process for Design

A flow chart illustrating the process and responsibility for retaining wall/reinforced slope design is provided in Figure 1130-4a. As shown in the figure, the region initiates the process, except for walls developed as part of a preliminary bridge plan. These are initiated by the Bridge and Structures Office. In general, it is the responsibility of the design office initiating the design process to coordinate with other groups in the department to identify all wall/slope systems that are appropriate for the project in question. Coordinate with the region, Bridge and Structures Office, Geotechnical Services Branch, and the State Bridge and Structures Architect as early in the process as possible.

HQ or region consultants, if used, are considered an extension of the HQ staff and must follow the process summarized in Figure 1130-4a. All consultant designs, from development of the scope of work to the final product, are to be reviewed and approved by the appropriate HQ offices.

(a) **Standard Walls.** The regions are responsible for detailing retaining walls for which standard designs are available.

For standard walls greater than 10 ft in height, and for all standard walls where soft or unstable soil is present beneath or behind the wall, a geotechnical investigation will be conducted, or reviewed and approved, by the Geotechnical Services Branch. Through this investigation, provide the foundation design including bearing capacity requirements and settlement determination, overall stability, and the selection of the wall types most feasible for the site.

For standard walls 10 ft in height or less where soft or unstable soils are not present, it is the responsibility of the region materials laboratory to perform the geotechnical investigation. If it has been verified that soil conditions are adequate for the proposed standard wall that is less than or equal to 10 ft in height, the region establishes the wall footing location based on the embedment criteria in the *Bridge Design Manual*, or places the bottom of the wall footing below any surficial loose soils. During this process, the region also evaluates other wall types that may be feasible for the site in question.

The *Standard Plans* provides design charts and details for standard reinforced concrete cantilever walls. The *Standard Plans* are used to size the walls and determine the factored bearing pressure to compare with the factored bearing resistance determined from the geotechnical investigation. The charts provide maximum soil pressure for the LRFD service, strength, and extreme event limit states. Factored bearing resistance for the LRFD service, strength, and extreme event limit states can be obtained from the Geotechnical Services Branch for standard walls over 10 feet in height and from the region materials laboratories for standard walls less than or equal to 10 feet in height. The *Standard Plans* can be used for the wall design if the factored bearing resistance exceeds the maximum soil pressure shown in the *Standard Plans* for the respective LRFD limit states.

Contact the Bridge and Structures Office if the factored bearing resistance provided by the geotechnical investigation does not exceed the maximum soil pressure shown in the *Standard Plans* for one or all of the LRFD limit states. The wall is considered a nonstandard wall design and the *Standard Plans* cannot be used.

If the standard wall must support surcharge loads from bridge or building foundations, other retaining walls, noise walls, or other types of surcharge loads, a special wall design is required. The wall is considered to be supporting the surcharge load and is treated as a nonstandard wall if the surcharge load is located within a 1H:1V slope projected up from the bottom of the back of the wall. Contact the Bridge and Structures Office for assistance

The *Standard Plans* provide eight types of reinforced concrete cantilever walls (which represent eight loading cases). Reinforced concrete retaining walls Type 5 through Type 8 are not designed to withstand Western Washington earthquake forces and are not to be used in Western Washington (west of the Cascade crest).

Once the geotechnical and architectural assessment have been completed, the region completes the PS&E for the standard wall option(s) selected including a generalized wall profile and plan, a typical cross-section as appropriate, details for desired wall appurtenances, drainage details, and other details as needed.

Metal bin walls, Types 1 and 2, have been deleted from the *Standard Plans* and are therefore no longer standard walls. Metal bin walls are seldom used due to cost and undesirable aesthetics. If this type of wall is proposed, contact the Bridge and Structures Office for plan details and toe bearing pressures. The applied toe bearing pressure will then have to be evaluated by the Geotechnical Services Branch to determine if the site soil conditions are appropriate for the applied load and anticipated settlement.

(b) **Preapproved Proprietary Walls.** Final approval of preapproved proprietary wall design, with the exception of geosynthetic walls, is the responsibility of the Bridge and Structures Office. Final approval of the design of preapproved proprietary geosynthetic walls is the responsibility of the Geotechnical Services Branch. It is the region's responsibility to coordinate the design effort for all preapproved wall systems.

The region materials laboratory performs the geotechnical investigation for preapproved proprietary walls 10 ft in height or less that are not bearing on soft or unstable soils. In all other cases, it is the responsibility of the Geotechnical Services Branch to conduct, or review and approve, the geotechnical investigation for the wall. The region also coordinates with the State Bridge and Structures Architect to ensure that the wall options selected meet the aesthetic requirements for the site.

Once the geotechnical and architectural assessments have been completed and the desired wall alternatives selected, it is the responsibility of the region to contact the suppliers of the selected preapproved systems to confirm in writing the adequacy and availability of the systems for the proposed use.

Include a minimum of three different wall systems in the PS&E for any project with federal participation that includes a proprietary wall system unless specific justification is provided. Standard walls can be alternatives.

Once confirmation of adequacy and availability has been received, the region contacts the Bridge and Structures Office for special provisions for the selected wall systems and proceeds to finalize the contract PS&E in accordance with the *Plans Preparation Manual*. Provide the allowable bearing capacity and foundation embedment criteria for the wall, as well as backfill and foundation soil properties, in the special provisions. In general, assume that gravel borrow or better quality backfill material will be used for the walls when assessing soil parameters.

Complete wall plans and designs for the proprietary wall options will not be developed until after the contract is awarded, but will be developed by the proprietary wall supplier as shop drawings after the contract is awarded. Therefore, include a general wall plan, a profile showing neat line top and bottom of the wall, a final ground line in front of and in back of the wall, a typical cross-section, and the generic details for the desired appurtenances and drainage requirements in the contract PS&E for the proprietary walls. Estimate the ground line in back of the wall based on a nominal 1.5 ft facing thickness (and state this on the wall plan sheets). Include load or other design acceptance requirements for these appurtenances in the PS&E. Contact the Bridge and Structures Office for assistance regarding this.

It is best to locate catch basins, grate inlets, signal foundations, and the like outside the reinforced backfill zone of MSE walls to avoid interference with the soil reinforcement. In those cases where conflict with these reinforcement obstructions cannot be avoided, <u>indicate</u> the location(s) and dimensions of the reinforcement obstruction(s) relative to the wall on the plans. Contact the Bridge and Structures Office for preapproved wall details and designs for size and location of obstructions, and to obtain the generic details that <u>are to</u> be provided in the plans. If the obstruction is too large or too close to the wall face, a special design may be required to accommodate the obstruction, and the wall is treated as a nonpreapproved proprietary wall.

A special design is required if the wall <u>will</u> support structure foundations, other retaining walls, noise walls, signs or sign bridges, luminaires, or other types of surcharge loads. The wall is considered to be supporting the surcharge load if the surcharge is located within a 1H:1V slope projected from the bottom of the back of the wall. For MSE walls, the back of the wall is considered to be the back of the soil reinforcement layers. If this situation occurs, the wall is treated as a nonpreapproved proprietary wall.

For those alternative wall systems that have the same face embedment criteria, the wall face quantities depicted in the plans for each alternative <u>are to</u> be identical. To provide an equal basis for competition, the region determines wall face quantities based on neat lines.

Once the detailed wall plans and designs are available as shop drawings after contract award, the Bridge and Structures Office will review and approve the wall shop drawings and calculations, with the exception of geosynthetic walls which are reviewed and approved by the Geotechnical Services Branch.

(c) **Nonpreapproved Proprietary Walls.** Final approval authority for nonpreapproved proprietary wall design is the same as for preapproved proprietary walls. The region initiates the design effort for all nonpreapproved wall systems by submitting wall plan, profile, cross-section, and other information for the proposed wall to the Bridge and Structures Office, with copies to the Geotechnical Services Branch and the State Bridge and Structures Architect. The Bridge and Structures Office coordinates the wall design effort.

Once the geotechnical and architectural assessments have been completed and the desired wall types selected, the Bridge and Structures Office contacts suppliers of the nonpreapproved wall systems selected to obtain and review detailed wall designs and plans to be included in the contract PS&E.

To ensure fair competition between all wall alternatives included in the PS&E, make the wall face quantities for those wall systems subject to the same face embedment requirements identical.

The Bridge and Structures Office develops the special provisions and cost estimates for the nonpreapproved proprietary walls and sends the wall PS&E to the region for inclusion in the final PS&E in accordance with the *Plans Preparation Manual*.

(d) **Nonstandard Nonproprietary Walls.** With the exception of rockeries over 5 ft high, nonproprietary geosynthetic walls and reinforced slopes, and soil nail walls, the Bridge and Structures Office coordinates with the Geotechnical Services Branch and the State Bridge and Structures Architect to carry out the design of all nonstandard, nonproprietary walls. In this case, the Bridge and Structures Office develops the wall preliminary plan from site data provided by the region, completes the wall design, and develops the nonstandard nonproprietary wall PS&E package for inclusion in the contract.

For rockeries over 5 ft high, nonproprietary geosynthetic walls and reinforced slopes, and soil nail walls, the region develops wall/slope profiles, plans, and cross-sections and submits them to the Geotechnical Services Branch to complete a detailed wall/slope design.

For geosynthetic walls and slopes, and for rockeries, the region provides overall coordination of the wall/slope design effort, including coordination with the State Bridge and Structures Architect regarding aesthetics and finishes, and the region's or HQ Landscape Architect if the wall uses vegetation on the face. The Geotechnical Services Branch has overall approval authority for the wall design. Once the wall design has been completed, the Geotechnical Services Branch, and in some cases the Bridge and Structures Office, provides geotechnical and structural plan details to be included in the region plan sheets and special provisions for the PS&E. The region then completes the PS&E package.

For soil nail walls, once the Geotechnical Services Branch has performed the geotechnical design, the Bridge and Structures Office, in cooperation with the Geotechnical Services Branch, coordinates the design effort and completes the PS&E package.

(3) Guidelines for Wall/Slope Data Submission for Design

(a) **Standard Walls, Proprietary Walls, Geosynthetic Walls/Slopes, and Soil Nail Walls.** Where HQ involvement in retaining wall/slope design is required (as for standard walls and preapproved proprietary walls over 10 ft in height, gabions over 6 ft in height, rockeries over 5 ft in height, all nonpreapproved proprietary walls, geosynthetic walls/slopes, and all soil nail walls), the region submits the following information to the Geotechnical Services Branch or Bridge and Structures Office as appropriate:

- Wall/slope plans.
- Profiles showing the existing and final grades in front of and behind the wall.
- Wall/slope cross-sections (typically every 50 ft) or CAiCE files that define the existing and new ground-line above and below the wall/slope and show stations and offsets.
- Location of right of way lines as well as other constraints to wall/slope construction.
- Location of adjacent existing and/or proposed structures, utilities, and obstructions.
- Desired aesthetics.
- Date design must be completed.
- Key region contacts for the project.

Note that it is best to base existing ground measurements, for the purpose of defining the final wall geometry, on physical survey data rather than solely on photogrammetry. In addition, the region is to complete a Retaining Wall/ Reinforced Slope Site Data Check List, DOT Form 351-009 EF, for each wall or group of walls submitted.

(b) **Nonstandard Walls, Except Geosynthetic Walls/Slopes and Soil Nail Walls.** In this case, the region is to submit site data in accordance with Chapter 1110. Additionally, a Retaining Wall Site Data Check List, DOT351-009EF, for each wall or group of walls must be completed by the region.

1130.07 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/

Specific Wall Type	Advantages	Disadvantages	Limitations
Steel soil reinforcement with full height precast concrete panels	Relatively low cost.	Can tolerate little settlement; generally requires high quality backfill; wide base width required (70% of wall height).	Applicable primarily to fill situations; maximum feasible height is approximately 20 feet.
Steel soil reinforcement with modular precast concrete panels	Relatively low cost; flexible enough to handle significant settlement.	Generally requires high-quality backfill; wide base width required (70% of wall height).	Applicable primarily to fill situations; maximum height of 33 feet; heights over 33 feet require a special design.
Steel soil reinforcement with welded wire and cast-in-place concrete face	Can tolerate large short-term settlements.	Relatively high cost; cannot tolerate long-term settlement; generally requires high-quality wall backfill soil; wide base width required (70% of wall height); typically requires a settlement delay during construction.	Applicable primarily to fill situations; maximum height of 33 feet for routine designs; heights over 33 feet require a special design.
Steel soil reinforcement with welded wire face only	Can tolerate large short-term settlements; low cost.	Aesthetics, unless face plantings can be established; generally requires high quality backfill; wide base width required (70% of wall height).	Applicable primarily to fill situations; maximum height of 33 feet for routine designs; heights over 33 feet require a special design.
Segmental masonry concrete block-faced walls, generally with geosynthetic soil reinforcement	Low cost; flexible enough to handle significant settlement.	Internal wall deformations may be greater for steel reinforced systems, but are acceptable for most applications; generally requires high-quality backfill; wide base required (70% of wall height).	Applicable primarily to fill situations; in general, limited to a wall height of 20 feet or less; greater wall heights may be feasible by special design in areas of low seismic activity and when geosynthetic products are used in which long-term product durability is well defined. (See *Qualified Products List*.)
Geosynthetic walls with a shotcrete or cast-in-place concrete face	Very low cost, especially with shotcrete face; can tolerate large short-term settlements.	Internal wall deformations may be greater than for steel reinforced systems, but are still acceptable for most applications; generally requires high quality backfill; wide base width required (70% of wall height).	Applicable primarily to fill situations; in general, limited to wall height of 20 feet or less unless using geosynthetic products in which long-term product durability is well defined. (See *Qualified Products List*.) For qualified products, heights of 33 feet or more are possible.

Summary of Mechanically Stabilized Earth (MSE) Gravity Wall/Slope Options Available
Table 1(a)

Specific Wall Type	Advantages	Disadvantages	Limitations
Geosynthetic walls with a welded wire face	Very low cost; can tolerate large long-term settlements.	Internal wall deformations may be greater than for steel reinforced systems, but are still acceptable for most applications; generally requires high quality wall backfill soil; wide base width required (70% of wall height).	Applicable primarily to fill situations; in general, limited to wall height of 20 feet or less, unless using geosynthetic products in which long-term product durability is well defined. (See *Qualified Products List*.) For qualified products, heights of 33 feet or more are possible.
Geosynthetic walls with a geosynthetic face	Lowest cost of all wall options; can tolerate large long-term settlements.	Internal wall deformations may be greater than for steel reinforced systems, but are still acceptable for most applications; generally requires high quality backfill; wide base width required (70% of wall height); durability of wall facing.	Applicable primarily to fill situations; use only for temporary applications due to durability of facing; can be designed for wall heights of 40 feet or more.
Soil nail walls	Relatively low cost; can be used in areas of restricted overhead or lateral clearance.	Allow adequate standup time for soil/rock to stand in a vertical cut approximately 6 feet high for at least 1 to 2 days; not feasible for bouldery soils; may require an easement for the nails.	Applicable to cut situations only; not recommended in clean or water-bearing sands and gravels, in bouldery soils that can interfere with nail installation, or in landslide deposits, especially where deep potential failure surfaces are present; maximum wall heights of 35 feet are feasible, though greater wall heights are possible in excellent soil/rock conditions. A special design is always required.

Table 1(a) Continued

Specific Wall Type	Advantages	Disadvantages	Limitations
Concrete crib walls	Relatively low cost; quantity of high quality backfill required relatively small; relatively narrow base width, on the order of 50 to 60% of the wall height; can tolerate moderate settlements.	Aesthetics.	Applicable to cut and fill situations; reinforced concrete can typically be designed for heights of up to 33 feet and unreinforced concrete up to 16 feet; not used to support bridge or building foundations.
Metal crib walls	Quantity of high quality backfill required relatively small; relatively narrow base width on the order of 50 to 60% of the wall height; can tolerate moderate settlements.	Relatively high cost; aesthetics.	Applicable to cut and fill situations; can be designed routinely for heights up to 35 feet; not used to support bridge or building foundations.
Timber crib walls	Low cost; minimal high quality backfill required; relatively narrow base width, on the order of 50 to 60% of the wall height; can tolerate moderate settlements.	Design life relatively short; aesthetics.	Applicable to cut and fill situations; can be designed for heights up to 16 feet; not used to support structure foundations.
Concrete bin walls	Relatively low cost; narrow base width, on the order of 50 to 60% of the wall height; can tolerate moderate settlements.	Aesthetics.	Applicable to cut and fill situations; can be designed routinely for heights up to 25 feet; not used to support bridge or building foundations.
Gabion walls	Relatively narrow base width, on the order of 50 to 60% of the wall height; can tolerate moderate settlements.	Relatively high cost, depending on proximity to source of high quality angular rock to fill baskets.	Applicable to cut and fill situations; can be designed routinely for heights up to 15 feet, and by special design up to 21 feet; not used to support structure foundations.

Summary of Prefabricated Modular Gravity Wall Options Available
Table 1(b)

Specific Wall Type	Advantages	Disadvantages	Limitations
Mortar rubble masonry walls	Quantity of high quality backfill required is relatively small.	High cost; relatively wide base width, on the order of 60 to 70% of the wall height; cannot tolerate settlement.	Applicable mainly to fill situations where foundation conditions consist of very dense soil or rock; due to expense, only used in areas where other mortar rubble masonry walls are present and it is desired to match aesthetics; typically, can be designed for maximum heights of 25 feet.
Unreinforced concrete gravity walls	Quantity of high quality backfill required is relatively small.	High cost; relatively wide base width, on the order of 60 to 70% of the wall height; cannot tolerate settlement.	Applicable mainly to fill situations where foundation conditions consist of very dense soil or rock; due to expense, only used in areas where other gravity walls are present and it is desired to match aesthetics; typically can be designed for maximum heights of 25 feet.
Reinforced concrete cantilever walls	Relatively narrow base width on the order of 50 to 60% of the wall height; can be used to support structure foundations by special design.	High cost; cannot tolerate much settlement; relatively deep embedment might be required on sloping ground due to toe in front of face wall.	Applicable to cut and fill situations; can be routinely designed for heights up to 35 feet.
Reinforced concrete counterfort walls	Relatively narrow base width on the order of 50 to 60% of the wall height; can be used to support structure foundations by special design.	High cost; cannot tolerate much settlement; relatively deep embedment might be required on sloping ground due to toe in front of wall face.	Applicable to cut and fill situations; can be routinely designed for heights up to 50 feet; proprietary versions are typically 33 feet maximum.

Summary of Rigid Gravity and Semigravity Wall Options Available

Table 1(c)

Specific Wall Type	Advantages	Disadvantages	Limitations
Soldier pile wall	Very narrow base width; deep embedment to get below potential failure surfaces; relatively easy to obtain.	Relatively high cost.	Applicable mainly to cut situations; maximum feasible exposed height is on the order of 10 feet; difficult to install in bouldery soil or soil with water-bearing sands.
Sheet pile wall	Low to moderate cost; very narrow base width.	Difficult to get embedment in dense or bouldery soils; difficult to protect against corrosion.	Applicable mainly to cut situations in soil; maximum feasible exposed height is on the order of 10 feet.
Cylinder pile wall	Relatively narrow base width; can produce stable wall even if deep potential failure surfaces present.	Very high cost.	Applicable mainly to cut situations; maximum feasible exposed height is on the order of 20 to 25 feet depending on the passive resistance available; can be installed in bouldery conditions, though cost will increase.
Slurry wall	Relatively narrow base width; can produce stable wall even if deep potential failure surfaces present.	Very high cost; difficult construction.	Applicable mainly to cut situations; maximum feasible exposed height is on the order of 20 to 25 feet, depending on passive resistance available.

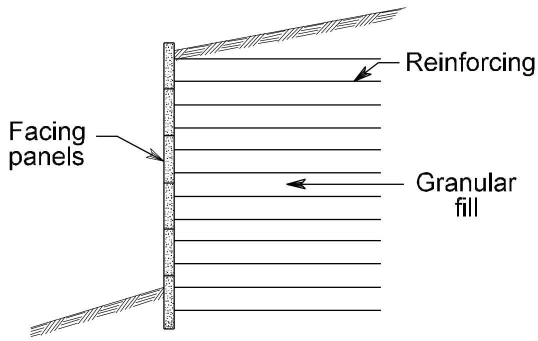
Summary of Nongravity Wall Options Available
Table 1(d)

Specific Wall Type	Advantages	Disadvantages	Limitations
All nongravity cantilever walls with tiebacks	Relatively narrow base width; can produce stable wall even if deep potential failure surfaces present.	Very high cost; difficult to install in areas where vertical or lateral clearance is limited; easements may be necessary; installation activities may impact adjacent traffic.	Applicable only to cut situations; can be designed for heights of 50 feet or more depending on the specifics of the structure of the wall.
All nongravity cantilever walls with deadman anchors	Relatively narrow base width; can produce stable wall even if deep potential failure surfaces present.	Moderate to high cost; access required behind wall to dig trench for deadman anchor; may impact traffic during deadman installation; easements may be necessary.	Applicable to partial cut/ fill situations; can be designed for wall heights of approximately 16 feet.

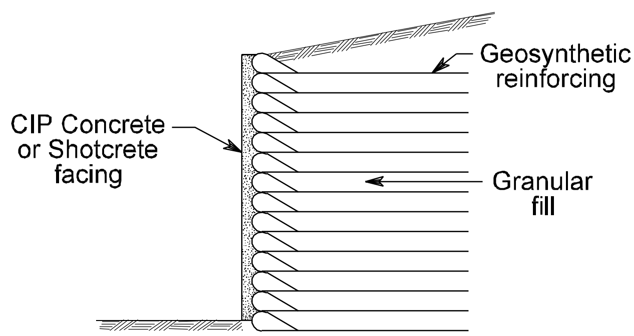
Summary of Anchored Wall Options Available
Table 1(e)

Wall/Slope Classification	Specific Wall Type	Advantages	Disadvantages	Limitations
Rockeries	Only variations are in rock sizes used and overall wall dimensions.	Low cost; narrow base width on the order of 30% of the wall height required.	Slope needs to be at least marginally stable without rockery present; cannot tolerate much settlement.	Applicable to both cut and fill situations; maximum feasible height in a cut, even for excellent soil conditions, is approx. 16 feet and 8 feet in fill situations.
Reinforced slopes	Only variations are in geosynthetic products used and in erosion-control techniques used on slope face.	Low cost; can tolerate large settlements; can adapt well to sloping ground conditions to minimize excavation required; high quality fill is not a requirement.	Room required between the right of way line and the edge of the shoulder to install a 1H:1V slope.	Best suited to sloping fill situations; maximum height limited to 30 feet, unless geosynthetic products are used in which long-term product durability is well defined. Certain products can be used in critical applications and for greater slope heights on the order of 60 feet or more, but consider need, landscaping maintenance, and the reach of available maintenance equipment.

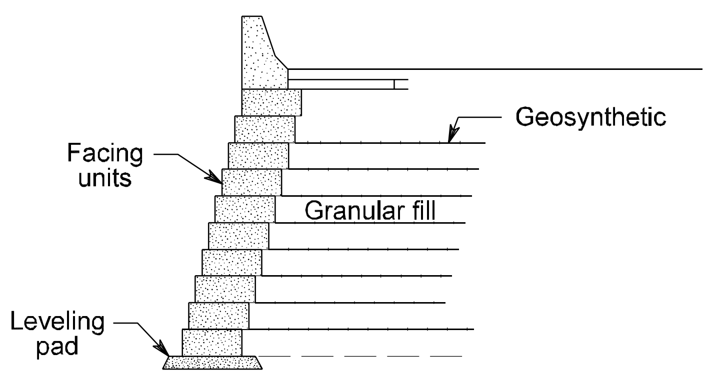
Other Wall/Slope Options Available
Table 1(f)



MSE Wall with Modular Precast Concrete Facing Panels

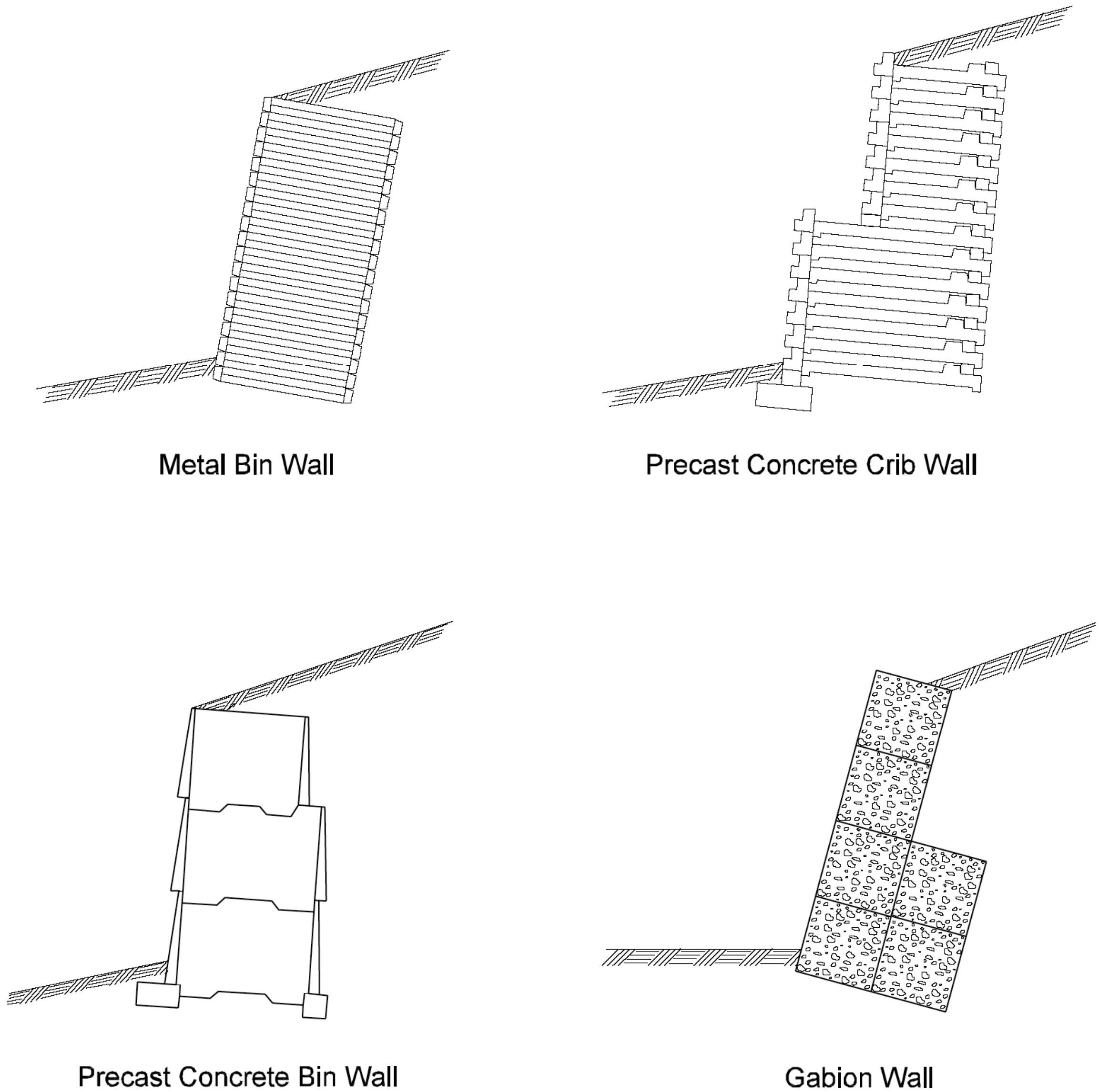


MSE Wall with Geosynthetic Reinforcement and CIP Concrete or Shotcrete Facing

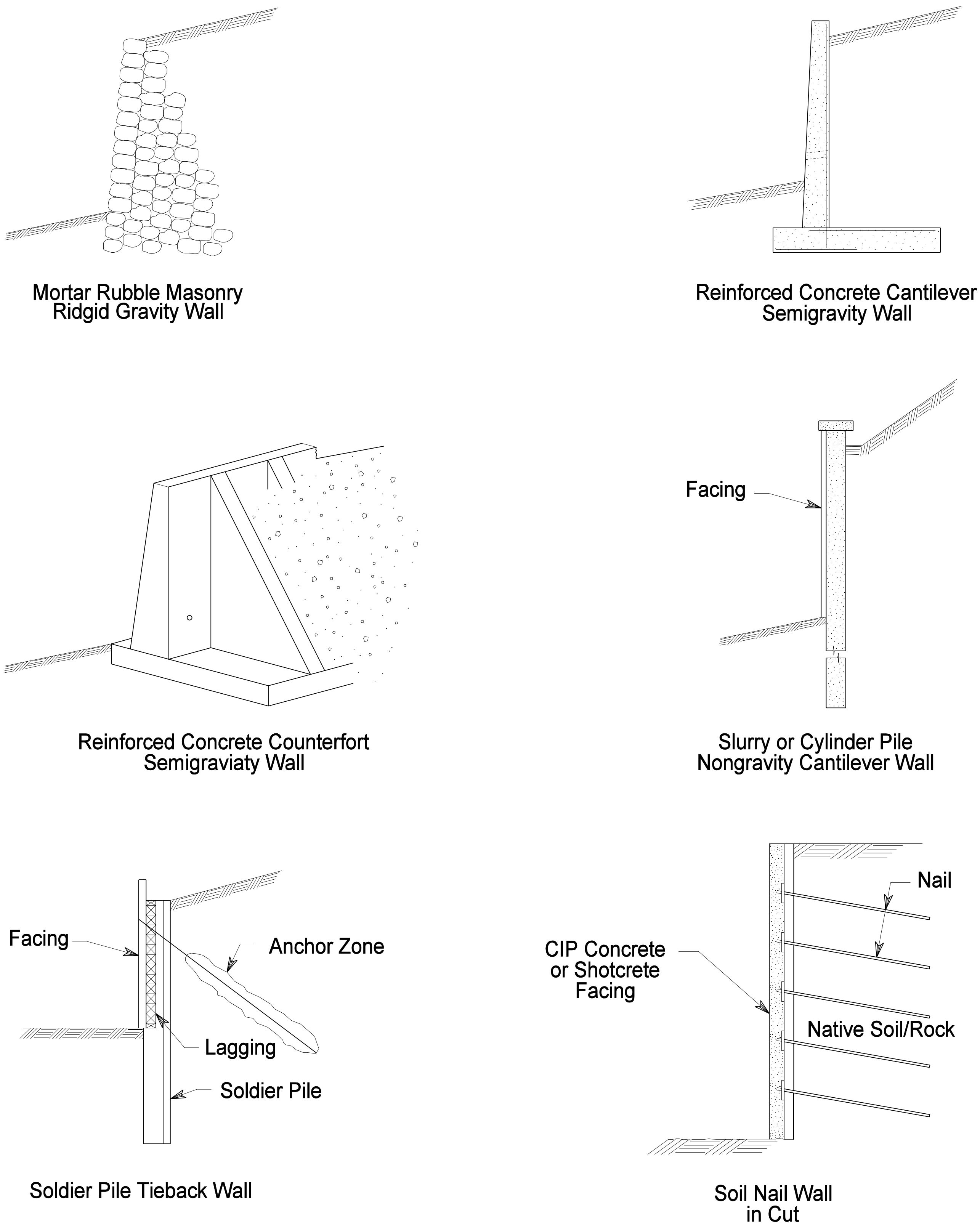


MSE Wall with Segmental Concrete Block Facing

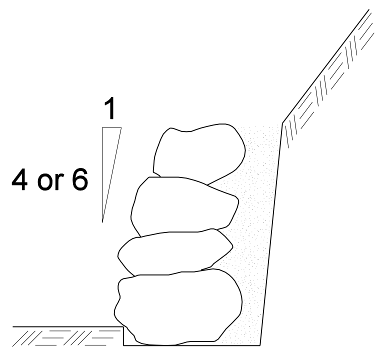
Typical Mechanically Stabilized Earth Gravity Walls
Figure 1130-1a



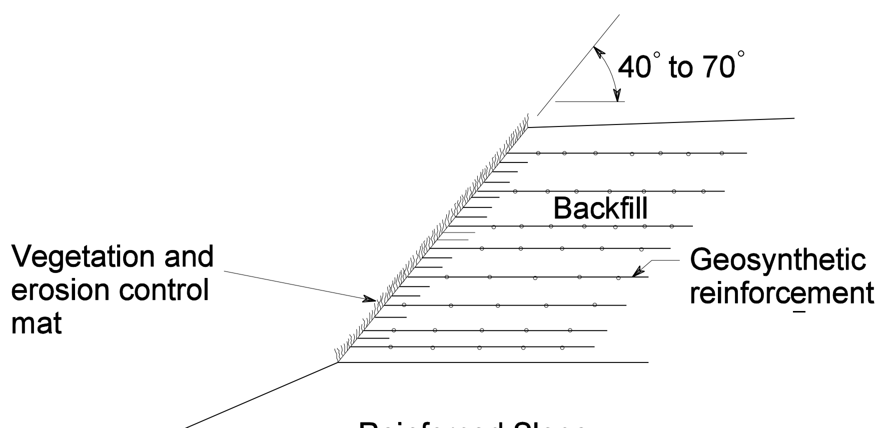
Typical Prefabricated Modular Gravity Walls
Figure 1130-1b



Typical Rigid Gravity, Semigravity Cantilever, Nongravity Cantilever, and Anchored Walls
Figure 1130-1c

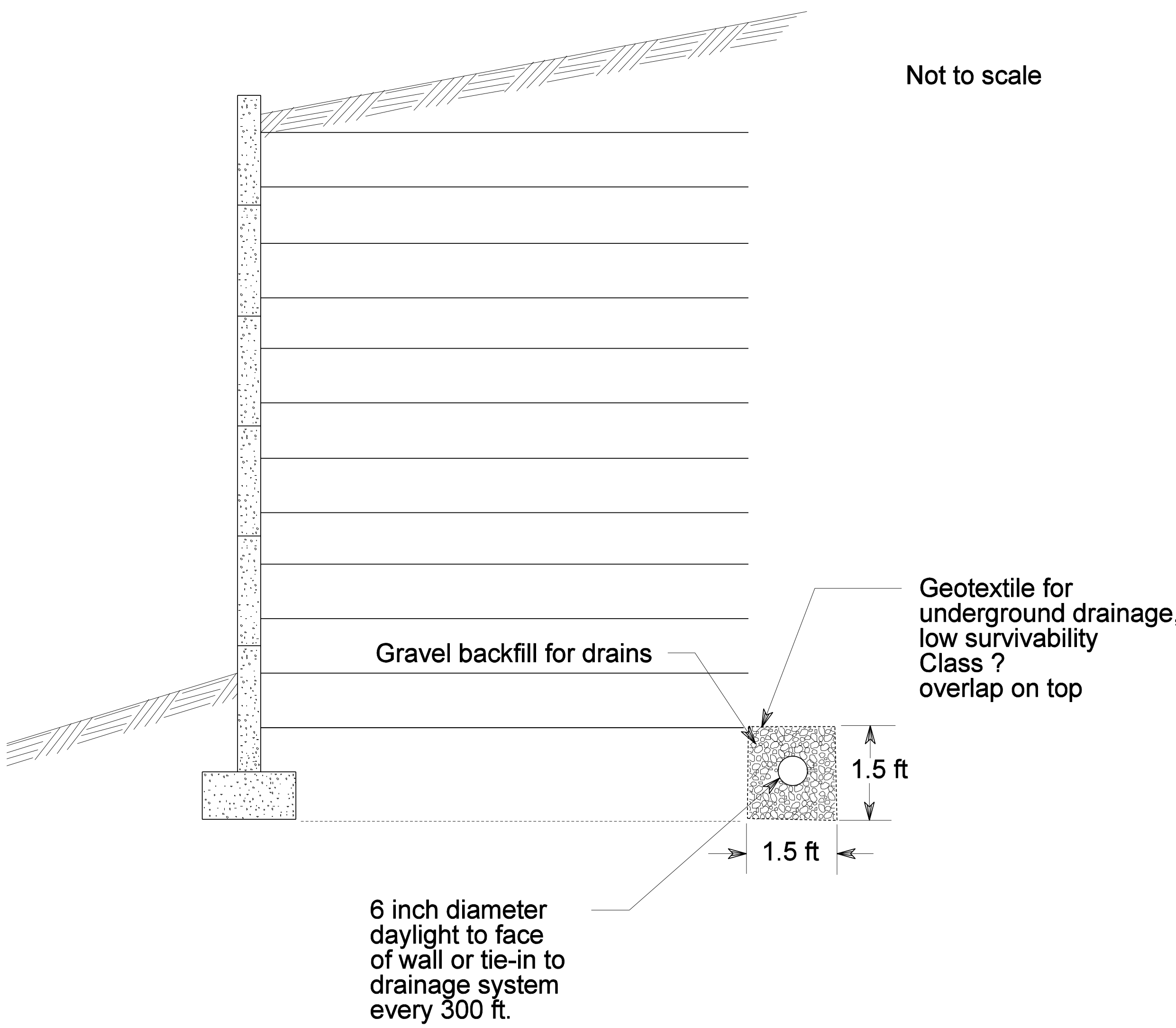


Rockery

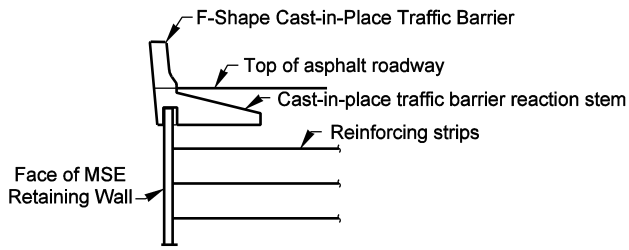


Reinforced Slope

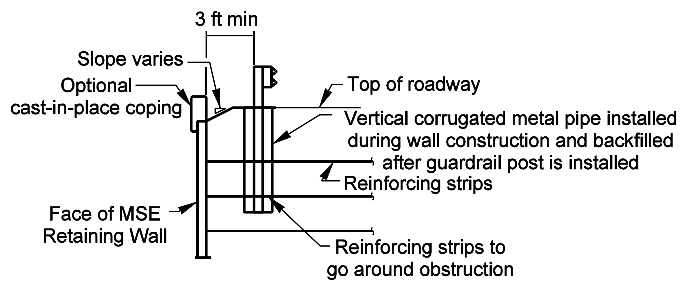
Typical Rockery and Reinforced Slopes
Figure 1130-1d



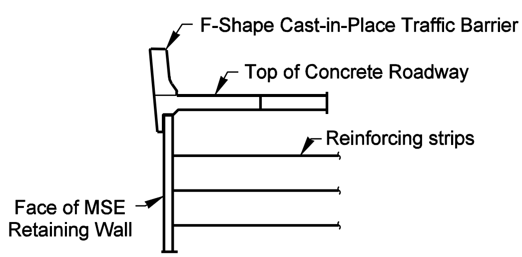
MSE Wall Drainage Detail
Figure 1130-2



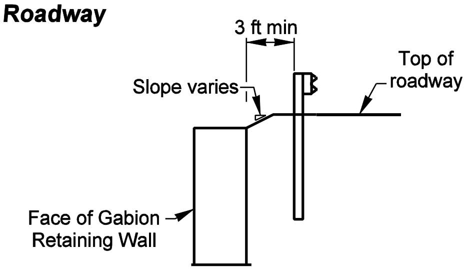
Concrete Traffic Barrier with Asphalt Roadway



Beam Guardrail on Top of MSE Retaining Wall



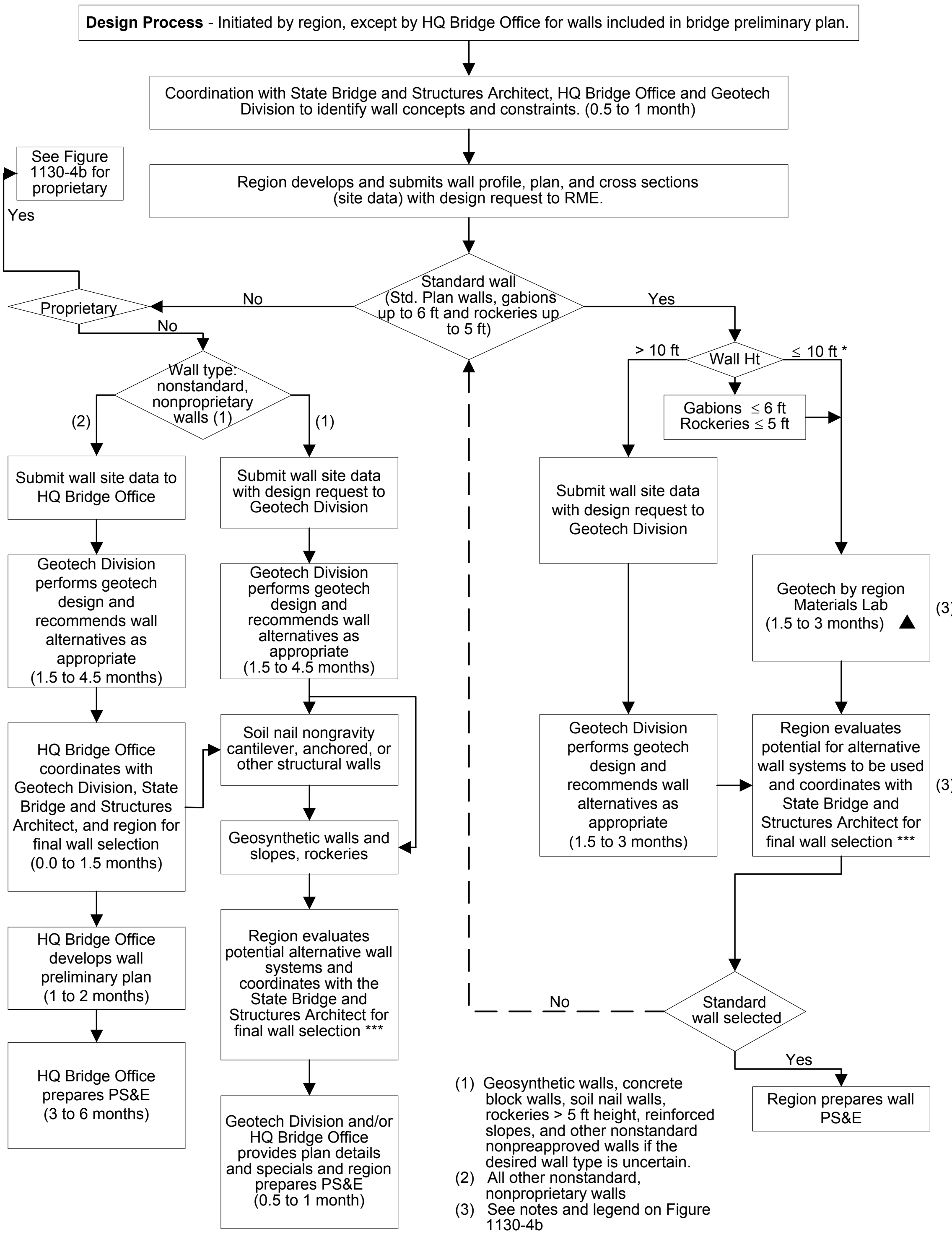
Concrete Traffic Barrier with Concrete Roadway



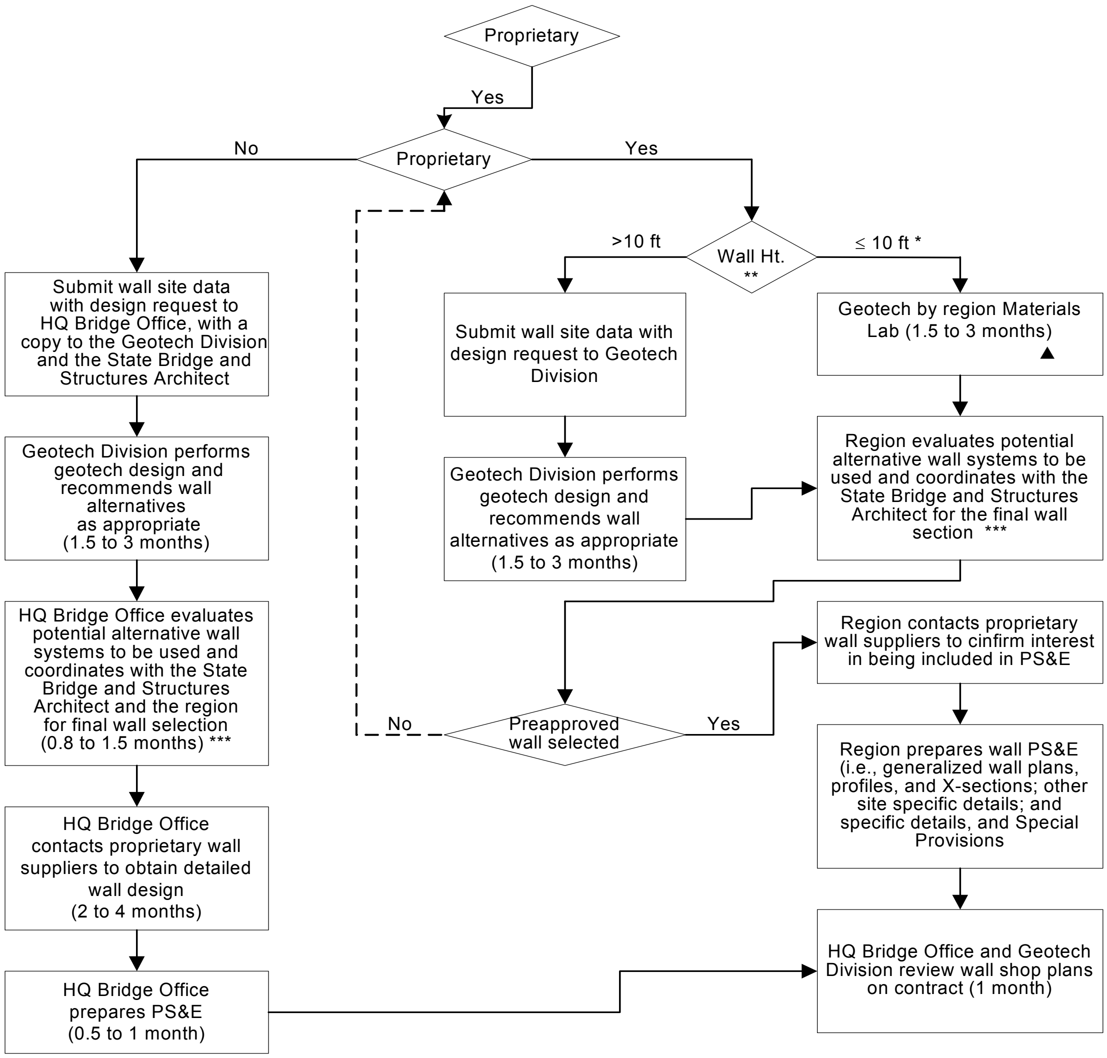
Beam Guardrail on Top of Gabion Wall

Retaining Walls With Traffic Barriers

Figure 1130-3



Retaining Wall Design Process
Figure 1130-4a



Notes:

The "HQ Bridge Office" refers to the WSDOT Bridge and Structures Office.

The "Geotech Division" refers to the WSDOT Geotechnical Division at Headquarters.

The "State Bridge and Structures Architect" refers to the Architecture Section of the HQ Bridge and Structures Office.

Regarding time estimates:

Assumes no major changes in the wall scope during design.

Actual times may vary depending on complexity of project.

Contact appropriate design offices for more accurate estimates of time.

Legend:

▲ Region provides courtesy copy of region's geotechnical report to Geotechnical Division.

* Assumes soft or unstable soil not present and wall does not support other structures.

** The preapproved maximum wall height is generally 33 feet. Some proprietary walls might be less. (Check with the HQ Bridge and Structures Office.)

*** If the final wall selected is a different type than assumed, go back through the design process to ensure that all the steps have been taken.

Retaining Wall Design Process – Proprietary

Figure 1130-4b

Chapter 1140 Noise Barriers

1140.01 General

The function of a noise barrier is to reduce traffic noise levels at adjoining areas. The noise abatement decisions are made during the environmental stage of the project development process. This is a highly interactive process. Before a noise barrier is designed, the department must be confident that there is significant need, a cost effective and environmentally acceptable noise barrier, a source of funds, and acceptance by adjacent property owners, local governmental agencies, and the general public.

The designer will find the following preliminary design information in the noise report:

- Sources of noise
- Noise receiver locations
- Predicted level of noise reduction
- Locations of existing and future noise impacts along the project corridor
- Barrier location and height recommendations based on what is feasible and reasonable

Design of a noise barrier project is the result of a team effort coordinated by the project engineer.

This chapter addresses the factors that are considered when designing a noise barrier and the associated procedures and documentation requirements.

1140.02 References

Environmental Procedures Manual, M 31-11, WSDOT

Guide Specifications for Structural Design of Sound Barriers, AASHTO

Roadside Manual, M 25-30, WSDOT

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

1140.03 Design

The two basic types of noise barriers are the earth berm and the noise wall. An earth berm can be constructed to the full height required for noise abatement or to partial height in conjunction with a noise wall to reach the required height. A noise wall can be made of concrete, masonry, metal, wood, or other approved innovative products, and can be supported by spread, pile, shaft, or trench footings.

Consideration of the noise report and the visual characteristics of adjacent land forms, vegetation, and structural elements (such as buildings, bridges, and retaining walls) will determine whether a proposed noise barrier might be berm, wall, or both.

An earth berm is the primary alternative if the visual and environmental quality of the corridor will be preserved or enhanced and materials and right of way widths are available. See the *Roadside Manual* for criteria for determining if a vegetated earth berm is appropriate.

The region uses the noise report and other environmental documents (see the *Environmental Procedures Manual*) to help determine the location, exposure conditions, length, and heights of the proposed noise barrier.

To design and locate a noise barrier of any kind, consider the following:

- Desired noise abatement
- Future right of way needs
- Cost and constructibility
- Neighborhood character
- Visual character and quality of the corridor
- Future maintenance of the noise barrier and the whole right of way
- Wind

- Supporting soil
- Earthquakes
- Ground water
- Existing drainage systems and water courses
- Exposure to vehicular impacts
- Potential vandalism
- Existing vegetation and roadside restoration required
- Access for maintenance equipment and enforcement, traffic service, and emergency vehicles
- Access to fire hydrants from both sides
- Pedestrian and bicycle access
- Available and attainable width of right of way for berms
- Aesthetic and structural characteristics of available wall designs
- Visual compatibility of each wall design with other transportation structures within the corridor
- Construction limits for footings
- Locations of existing survey monuments
- Access to, and maintenance of, right of way behind a wall, including drainage structures
- Use of right of way and wall by adjacent property owners
- Drainage and highway runoff
- Drainage from adjacent land
- Existing utilities and objects to relocate or remove
- Water and electricity; needs, sources, and access points

A noise barrier must not have anything (such as bridge columns, light fixtures, or sign supports) protruding in such a way as to present a potential for snagging vehicles.

(1) Earth Berm

(a) Berm slopes are a function of the material used, the attainable right of way width, and the desired visual quality. Slopes steeper than 2H:1V (3H:1V for mowing) are not recommended. Design the end of the berm with a lead-in slope of 10H:1V and curve it toward the right of way line.

(b) See the *Roadside Manual* for guidance regarding vegetation on berms.

(2) Noise Wall

(a) When feasible, to encourage competitive bidding, include several alternate noise wall designs in the contract and permit the contractor to submit alternate designs under the value engineering specification.

(b) There are standard noise wall designs in the Standard Plans manual. Additional designs are in various stages of development to become standard plans. The draft-standard design sheets and other preapproved plans are available from the Bridge and Structures Office. The Bridge and Structures Office also works with the regions to facilitate the use of other designs as bidding options.

(c) When a noise wall has ground elevations that are independent of the roadway elevations, a survey of ground breaks (or cross sections at 25-ft intervals) along the entire length of the wall is needed for evaluation of constructibility and to assure accurate determination of panel heights.

(d) Size of openings (whether lapped, door, or gated) depends on the intended users. Agencies such as the local fire department can provide the necessary requirements. Unless an appropriate standard plan is available, such openings must be designed and detailed for the project.

(e) When a noise wall is inside the Design Clear Zone, design its horizontal and vertical (ground elevation) alignment as if it were a rigid concrete traffic barrier. See Chapter 710 for maximum flare rates.

Chapter 1420 Access Control

1420.01 General

The Washington State Department of Transportation (WSDOT) controls access to the state's highways (with a few exceptions) in order to preserve the safety and efficiency of these highways as well as to preserve the public investment. All Washington State highways are distinguished as being either *limited access* or *managed access* highways. Control of access is accomplished by either acquiring rights of access from abutting property owners (limited access control) or by regulating access connections to the highway (managed access control). Until limited access rights have been acquired from abutting property owners, the route is a managed access highway. Managed access permits are issued either by a local authority (city or town) or by WSDOT.

Numerous studies have shown that controlling and limiting access to highways is a cost-effective way to help maintain the safety, capacity, and functional integrity of a highway. Adding more lanes to an existing highway is expensive and frequently not possible. Controlling access to our state highways, by promoting the use of frontage roads or other existing county or city roads and advocating the internal shared circulation within adjacent developments, is a proactive and cost-effective way to accomplish this objective.

WSDOT has been purchasing access rights and implementing limited access control since 1951 (Chapter 47.52 RCW). While this has been effective, it is an expensive way to control access to the state highway system. Adequate funding to accomplish the purchasing of access rights has not kept up with the state's continuous population growth and land use development over the years. As a result, state lawmakers debated a bill in the early 1990s titled "Highway Access Management," cognizant that controlling access to the state highway system by regulation was a cost-effective means to preserve the safety and capacity of our state highway system.

In 1991, the Legislature passed and the Governor approved Chapter 47.50 RCW, titled "Highway access management." This new law directed WSDOT to develop new rules to be included in the Washington Administrative Code (WAC) for those state highways not already limited access highways. The result was a new class of access control called managed access.

Chapter 1430 describes limited access highways in greater detail. Chapter 1435 describes managed access highways in greater detail.

The following references and definitions apply to Washington's access control as presented in Chapters 1430 and 1435.

1420.02 References

(1) Federal/State Laws and Codes

Chapter 18.43 Revised Code of Washington (RCW), Engineers and land surveyors

Chapter 35.78 RCW Streets-Classification and Design Standards

Chapter 46.61 RCW, Rules of the road

Chapter 47.17 RCW, State highway routes

Chapter 47.24 RCW, City streets as part of state highways

Chapter 47.32 RCW, Obstructions on right-of-way

Chapter 47.50 RCW, Highway access management

Chapter 47.52 RCW, Limited access facilities

Chapter 468-51 Washington Administrative Code (WAC), Highway access management access permits – administrative process

Chapter 468-52 WAC, Highway access management – access control classification system and standards

Chapter 468-54 WAC, Limited access hearings

Chapter 468-58 WAC, Limited access highways

(2) Design Guidance

Agreements Manual, M 22-99, WSDOT

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on Uniform Traffic Control Devices for Streets and Highways" (MUTCD)

Plans Preparation Manual, M 22-31, WSDOT

Right of Way Manual, M 26-01, WSDOT

Utilities Accommodation Policy, M 22-86, WSDOT

WSDOT Headquarters (HQ) Access and Hearings Internet page:
www.wsdot.wa.gov/design/accessandhearings

(3) Supporting Information

MOU between WSDOT and USFS, *Highways Over National Forest Lands*, M 22-50, 2002 www.wsdot.wa.gov/publications/manuals/fulltext/M22-50/ForestLands.pdf

Access Management Manual, Transportation Research Board (TRB), Washington DC, 2003

1420.03 Definitions

access A means of entering or leaving a public road, street, or highway with respect to abutting property or another public road, street, or highway.

access control The limiting and regulating of public and private access to Washington State's highways, as required by state law.

Access Control Tracking System Limited Access and Managed Access Master Plan A database list, related to highway route numbers and mileposts, that identifies either the level of limited access or the class of managed access at: www.wsdot.wa.gov/design/accessandhearings

access connection See ***approach and access connection***.

access connection permit A written authorization issued by the permitting authority for a specifically designed access connection to a managed access highway at a specific location, for a specific type and intensity of property use, and for a specific volume of traffic for the access connection, based on the final stage of the development of the applicant's property. The actual form used for this authorization is determined by the permitting authority.

access deviation A deviation (see Chapter 330) that authorizes deferring or staging acquisition of limited access control, falling short of a 300-foot requirement, or allowing an existing access point to stay within 130 feet of an intersection on a limited access highway. Approval by the State Design Engineer is required (see Chapter 1430).

access hearing plan A limited access plan prepared for presentation at an access hearing.

access point Any point that allows private or public entrance to or exit from the traveled way of a state highway (this includes "locked gate" access and maintenance access points).

access point spacing On a managed access highway, the distance between two adjacent access points on one side of the highway, measured along the edge of the traveled way from one access point to the next (also see ***corner clearance***).

access report plan A limited access plan prepared for presentation to local governmental officials at preliminary meetings before preparation of the access hearing plan.

access rights Property rights that allow an abutting property owner to enter and leave the public roadway system.

allowed Authorized.

application for an access connection An application provided by the permitting authority to be completed by the applicant for access to a managed access highway.

approach and access connection These terms are listed under the specific access section to which they apply. The first section below is for limited access highways and uses the term approach. The second section below is for managed access highways and uses the term access connection.

Approaches and access connections include any ability to leave or enter a highway right of way other than at an intersection with another road or street.

(a) ***limited access highways: approach*** An access point, other than a public road/street, that allows access to or from a limited access highway on the state highway system. There are five types of approaches to limited access highways that are allowed:

- ***Type A*** An off and on approach in a legal manner, not to exceed 30 feet in width, for the sole purpose of serving a single-family residence. It may be reserved by the abutting owner for specified use at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways.
- ***Type B*** An off and on approach in a legal manner, not to exceed 50 feet in width, for use necessary to the normal operation of a farm, but not for retail marketing. It may be reserved by the abutting owner for specified use at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways.
- ***Type C*** An off and on approach in a legal manner, for a special purpose and width to be agreed upon. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways and on full control limited access highways where no other reasonable means of access exists, as solely determined by the department.
- ***Type D*** An off and on approach in a legal manner, not to exceed 50 feet in width, for use necessary to the normal operation of a commercial establishment. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is only allowed on modified control limited access highways.
- ***Type E*** This type is no longer allowed to be constructed because of the requirements that there be only one access point per parcel on a limited access state highway.
- ***Type F*** An off and on approach in a legal manner, not to exceed 30 feet in width, for the sole purpose of serving a wireless communication site. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is only allowed on partial control limited access highways. (See Chapter 468-58-080(vi) WAC for further restrictions.)

(b) ***managed access highways: access connection*** An access point, other than a public road/street, that permits access to or from a managed access highway on the state highway system. There are five types of access connection permits:

- ***conforming access connection*** A connection to a managed access highway that meets current WAC and WSDOT location, spacing, and design criteria.
- ***grandfathered access connection*** Any connection to the state highway system that was in existence and in active use on July 1, 1990, and has not had a significant change in use.
- ***joint-use access connection*** A single connection to a managed access highway that serves two or more properties.

- ***nonconforming access connection*** A connection to a managed access highway that does not meet current WSDOT location, spacing, or design criteria, pending availability of a future conforming access connection.
- ***variance access connection*** A connection to a managed access highway at a location not normally allowed by current WSDOT criteria.

(c) ***managed access connection category*** There are four access connection permit categories for managed access connections to state highways: Category I, Category II, Category III, and Category IV (see Chapter 1435).

annual daily traffic (ADT) The volume of traffic passing a point or segment of a highway, in both directions, during a period of time, divided by the number of days in the period and factored to represent an estimate of traffic volume for an average day of the year.

average annual daily traffic (AADT) The average volume of traffic passing a point or segment of a highway, in both directions, during a year.

average weekday vehicle trip ends (AWDVTE) The estimated total of all trips entering plus all trips leaving the applicant's site based on the final stage of proposed development.

connection See ***approach and access connection***.

contiguous parcels Two or more pieces of real property under the same ownership with one or more boundaries that touch and have similarity of use.

corner clearance On a managed access highway, the distance from an intersection of a public road or street to the nearest access connection along the same side of the highway. The minimum corner clearance distance (see Chapter 1435, Figure 1435-1) is measured from the closest edge of the intersecting road or street to the closest edge of the traveled way of the access connection, measured along one side of the traveled way (through lanes) (also see ***access point spacing***).

DHV Design hourly volume.

E&EP WSDOT's Environmental and Engineering Programs Division.

easement A documented right, as a right of way, to use the property of another for designated purposes.

findings and order (F&O) A legal package containing information based on the hearing record from a limited access hearing (see Chapters 210 and 1430).

findings and order (F&O) plan A limited access plan, prepared after a limited access hearing, which is based on the hearing record.

HQ WSDOT's Headquarters in Olympia.

intersection An at-grade access point connecting a state highway with a road or street duly established as a public road or public street by the local governmental entity.

limited access Full, partial, or modified access control is planned and established for each corridor and then acquired as the right to limit access to each individual parcel.

- ***planned limited access control*** Limited access control is planned for sometime in the future, however no access hearing has been held.
- ***established limited access control*** An access hearing has been held and the Director, Environmental and Engineering Programs has adopted the Findings and Order, which *establishes* the limits and level of control.
- ***acquired limited access control*** Access rights have been purchased.

limited access highway All highways listed as "Established L/A" on the Master Plan for Limited Access Highways and where the rights of direct access to or from abutting lands have been acquired from the abutting landowners.

- ***full access control*** This most restrictive level of limited access provides access, using interchanges, for selected public roads/streets only, and prohibits highway intersections at grade.
- ***partial access control*** The second most restrictive level of limited access. At-grade intersections with selected public roads are allowed and there may be some crossings and some driveway approaches at grade. Direct commercial access is not allowed.
- ***modified access control*** The least restrictive level of limited access. Characteristics are the same as for partial access control except that direct commercial access is allowed.

managed access highway Any highway not listed as "Established L/A" on the *Master Plan for Limited Access Highways* and any highway or portion of a highway designated on the Master Plan as "Established L/A" until such time as the limited access rights are acquired. Under managed access legislation, the property owner's access rights are regulated through an access connection permitting process.

Master Plan for Limited Access Highways A map of Washington State that shows established and planned limited access highways. The map is available here:
http://www.wsdot.wa.gov/design/accessandhearings

median The portion of a divided highway separating vehicular traffic in opposite directions.

median opening An opening in a continuous median for the specific purpose of allowing vehicle movement.

MOU Memorandum of Understanding. There is one MOU between the United States Forest Service (USFS) and WSDOT (*Highways Over National Forest Lands)* that requires the USFS to obtain a road approach permit for new access to a state highway that is crossing Forest Service land.

permit holder The abutting property owner or other legally authorized person to whom an access connection permit is issued by the permitting authority.

permitted access connection A connection for which an access connection permit has been issued by a permitting authority.

permitting authority The agency having legal authority to issue managed access connection permits: for access connections in unincorporated areas, WSDOT; for access connections within corporate limits, a city or town.

right of way (R/W) A general term denoting land or interest therein, acquired for or designated for transportation purposes. More specifically, lands that have been dedicated for public transportation purposes or land in which WSDOT, a county, or a municipality owns the fee simple title, has an easement devoted to or required for use as a public road/street and appurtenant facilities, or has established ownership by prescriptive right.

Right of Way and Limited Access Plan (R/W and L/A plan) A right of way plan that also shows limited access control details.

road approach A road or driveway built to provide private access to or from the state highway system.

shoulder The portion of the highway contiguous with the traveled lanes for the accommodation of stopped vehicles for emergency use and, where allowed, for bicycles (see Chapter 1430).

state highway system All roads, streets, and highways designated as state routes in compliance with Chapter 47.17 RCW.

1420.04 Vocabulary

These entries demonstrate the difference in terminology between limited access and managed access in the applicable WACs. For instance, there is nothing about *permit*, *connection*, *category*, or *class* in the limited access vocabulary and, likewise, nothing about *approach* or *type* in the managed access vocabulary.

Chapter 920's vocabulary uses *road approach* in a generic way, unrelated to WAC legalese, and makes no distinction related to access control.

The entries shown on Figure 1420-1 are examples of suitable wording for the distinctly different types of access control in Chapters 1430 and 1435.

Access Vocabulary	
functional classification of highways	Chapter 440
intersections at grade, geometrics	Chapter 910
roundabout geometrics	Chapter 915
road approach geometrics	Chapter 920
interchange geometrics	Chapter 940
freeway access point	Chapter 1425
Limited Access Highway (Chapter 1430)	**Managed Access Highway (Chapter 1435)**
Access point (freeway ramp, or other access break) Approach (street, road, driveway) • Road approach (street, road, driveway) • Driveway approach (not street or road)	Access point (public or not) • Public access point • Access connection (not public)
(Level of) limited access (highway) • Full/partial/modified control limited access highway	Managed access highway class • Class (1-5) managed access highway
Type (A, B, C, D, F) approach Type A approach = Type A road approach	Category (I-IV) access connection
Allowed (policy)	Permitted (a document) or allowed (policy)
	Conforming access connection permit (among others)

Terms Not Used in Chapter 1430	Terms Not Used in Chapter 1435
class	classification (except functional)
category	type
connection	approach
permit or permitted	

Access Vocabulary
Figure 1420-1

Chapter 1425 Interchange Justification Report

1425.01 General

An Interchange Justification Report (IJR) is the document used to request a new access point or access point revision on limited access freeways in Washington State. This chapter provides policy and guidance on developing the required documentation for an IJR, and the sequence of an IJR presentation, for both Interstate and non-Interstate limited access routes.

Federal law requires Federal Highway Administration (FHWA) approval of all revisions to the Interstate system, including changes to limited access. Both FHWA and WSDOT policy require the formal submission of a request to either break or revise the existing limited access on Interstate routes. Breaking or revising existing limited access on state routes must be approved by an Assistant State Design Engineer. An IJR is a stand-alone document that includes the necessary supporting information needed for a request. It documents the IJR team's assumptions, the planning process, the evaluation of the alternatives considered, the design of the preferred alternative, and the coordination that supports and justifies the request for an access revision.

Engineers at the WSDOT Headquarters Design Office Access and Hearings Section specialize in providing support for meeting the guidance provided in this chapter. To ensure project success, consult with them before any of the IJR work is started. They can help you during the development of the corridor transportation study, Methods and Assumptions document, and the Interchange Justification Report.

Establish an IJR support team to help integrate the planning, programming, environmental, traffic, safety, and design efforts that lead to development of a proposal. The team includes representatives from the HQ Access and Hearings Section and the FHWA (for Interstate routes) to help determine the priority and level of detail of each policy point and the scale of the required documentation.

The scale and complexity of the report varies considerably with the scope of the proposed access point revision. See Figures 1425-1 and 2 for an idea of what an IJR will include. The support team, including HQ Access and Hearings, decides what an IJR will include. Each IJR has certain policy points that are of a higher priority than others, depending on project complexity. These priorities are set by the support team and documented in their Methods and Assumptions document.

The support team reviews regional and state transportation plans to check if the need and proposed solution are already indentified. Proposals to request new or reconstructed interchanges should align with those plans.

When a local agency or developer, is proposing an access point revision, WSDOT requires that a study team be formed.

1425.02 References

(1) Federal/State Laws and Codes

23 Code of Federal Regulations (CFR) Part 450 (implementing 23 United States Code [USC] Section 135)

40 CFR Parts 51 and 93 (regarding federal conformity with state and federal air quality implementation plans)

23 USC Sections 111 (requires the U.S. Secretary of Transportation to approve access revisions to the Interstate System), 134 (metropolitan transportation planning), and 135 (statewide transportation planning)

Chapter 36.70A Revised Code of Washington. Growth management – Planning by selected counties and cities.

(2) Design Guidance

The WSDOT Access and Hearings web page provides guidance and timelines for preparing IJRs and example Methods and Assumptions documents:
www.wsdot.wa.gov/Design/AccessAndHearings

Highway Capacity Manual, Special Report No 209 (HCM), Transportation Research Council

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

Traffic Analysis Toolbox Report, FHWA. Provides guidance, recommendations, and examples on the selection and use of traffic analysis tools:
http://ops.fhwa.dot.gov/trafficanalysistools/toolbox.htm

(3) Supporting Information

Notice of policy statement: "Additional Interchanges to the Interstate System," FHWA notice published in the Federal Register, October 22, 1990 (Vol. 55, No. 204)

Notice of policy statement: "Additional Interchanges to the Interstate System," FHWA notice published in the Federal Register Vol. 63, No. 28 on February 11, 1998 (Federal Highway Administration Notices):
www.access.gpo.gov/su_docs/fedreg/a980211c.html

State Highway System Plan: www.wsdot.wa.gov/planning/HSP

1425.03 Definitions

access A means of entering or leaving a public road, street, or highway with respect to abutting property or another public road, street, or highway.

access break Any point from inside or outside the state limited access right of way limited access hachures that crosses over, under, or physically through the plane of the limited access, is an access break or "break in access," including, but not limited to, locked gates and temporary construction access breaks.

access point Any point from inside or outside the limited access hachures that allows entrance to or exit from the traveled way of a limited access freeway, including "locked gate" access and temporary construction access.

access point revision A new access point or a revision of an existing interchange/intersection configuration. Locked gates and temporary construction breaks are also access point revisions.

alternatives Possible solutions to accomplish a defined purpose and need. These include local and state transportation system mode and design options, locations, and travel demand management and transportation system management-type improvements such as ramp metering, mass transit, and high occupancy vehicle (HOV) facilities.

area of influence The area that will be directly impacted by the proposed action: freeway main line, ramps, crossroads, immediate off-system intersections, state and local roadway systems.

baseline The existing transportation system configuration and traffic volumes for a specific year against which to compare possible alternative solutions.

break See ***access break***.

collision rate Collisions per one million vehicle miles traveled and fatal rates per one hundred million vehicle miles.

design year 20 years from the beginning of construction.

ECS Environmental Classification Summary (Documented Categorical Exclusion).

FONSI Finding of No Significant Impact (Environmental Assessment).

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

Interchange Justification Report (IJR) The document used to propose a revision to limited access freeways.

limited access Full, partial, or modified access control is planned and established for a corridor and then acquired as the right to limit access to each individual parcel.

Methods and Assumptions document A document developed at the beginning of the IJR phase to record IJR assumptions, methodologies, criteria, and decisions (see 1425.04(1)(c)).

need A statement that identifies the transportation problem(s) that the proposal is designed to address and explains how the problem will be resolved. An existing or anticipated travel demand that has been documented through the transportation study process to require a change in access to the state's limited access freeway system.

no-build condition The baseline, plus state transportation plan and comprehensive plan improvements, expected to exist, as applied to the year of opening or the design year.

policy point There are eight policy points that are addressed in the IJR.

proposal The combination of projects/actions selected through the corridor transportation study process to meet a specific transportation system need.

purpose General project goals such as improve safety, enhance mobility, or enhance economic development.

Record of Decision (ROD) Under the National Environmental Policy Act, the Record of Decision accompanies the Final Environmental Impact Statement; explains the reasons for the project decision; discusses alternatives and values considered in selection of the preferred alternative; and summarizes mitigation measures and commitments that will be incorporated in the project.

study area The transportation system area to study in the study process and for an IJR. The study area is a minimum of one interchange upstream and downstream from the proposal. The study area should be expanded as necessary to capture operational impacts of adjacent interchanges in the vicinity that are, or will be, bottlenecks or chokepoints that influence the operations of the study interchange.

support team An integral part of the IJR process consisting of an assemblage of people from FHWA (for Interstates), WSDOT HQ Access and Hearings, and other representatives organized to develop and analyze alternatives to meet the need of a proposal.

Transportation Management Area (TMA) Urbanized areas with populations of 200,000 or greater are federally designated as Transportation Management Areas.

travel demand Local travel demand represents short trips that should be made on the local transportation system, such as intracity roads and streets. Regional travel demand represents long trips that are made on the regional transportation system, such as Interstate, regional, and/or intercity/interregional roads, streets, or highways.

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

trips Short trips are normally local. Long trips are normally interstate, regional, or interregional.

1425.04 Procedures

Gaining concurrence and approval for an access point revision is a multistep process. It begins with assembling a support team to conduct a transportation study. If the study shows that the purpose and need of the proposal cannot be achieved with improvements to the local infrastructure only, the next step would normally be an IJR (see the IJR Process Flow Chart, Figure 1425-3).

Steps in the IJR process include:

1. Assemble support team to engage subject experts and decision makers.
2. Determine whether a corridor transportation study needs to be prepared or whether one exists.
3. Confirm that proposal is in *State Highway System Plan* and *Regional Transportation Plan*.
4. Prepare Methods and Assumptions document to lay the groundwork for the IJR.
5. Support team endorses assumptions, study methodologies, and strategies to prepare the IJR.
6. Prepare IJR.
7. IJR Review and Approval.

Figures 1425-1 and 2 list the project types most likely to affect freeway safety and operations, requiring the submission of an IJR. Consult the HQ Access and Hearings Section early for specific direction.

Guidance and examples on assumptions documents are provided here:
www.wsdot.wa.gov/design/accessandhearings

(1) Organize Support Team and Conduct Study

(a) **Corridor Transportation Study.** Study the transportation systems in the area. This study will identify the segments of both the local and regional network that are currently experiencing congestion or safety deficiencies, or where planned land use changes will prompt the need to evaluate the demands on and the capacity of the transportation system. The study area includes the affected existing and proposed interchanges/intersections upstream and downstream from the proposed access point revision. Extend the study far enough that the proposal creates no significant impacts to the adjacent interchanges/intersections, then analyze only through the area of influence. When the area of influence extends beyond the one interchange upstream and downstream, extend the analysis far enough to include the extent of the traffic impacts.

Segments of the local and regional network within the study area will be evaluated for system improvements. Part of the study process is to identify local infrastructure needs and develop a proposal. The study must consider investments in local infrastructure improvements to meet the needs of the proposal, because those improvements may provide the desired solution.

During the study process and while developing a proposal, it is important to use the data and analysis methods required for an IJR. If the study indicates that an IJR is warranted, the study data can be utilized in the IJR.

(b) **Support Team.** Establish a support team for the study. This same support team would also be involved with the IJR process if the study shows that either a revision or a new access point is needed to meet the proposal purpose and need.

The support team normally consists of the following:

- FHWA Area Engineer and Traffic Specialist (for Interstate projects)
- Region Planning, Design, or Project Development Engineer, or Designee
- HQ Assistant State Design Engineer
- HQ Access and Hearings Section Engineer
- HQ Traffic Office Representative
- Representative from local agencies (city, county, port, or tribal government)
- Recorder
- IJR writer

A support team comprised of subject experts and approval authorities will ensure your IJR the highest possible level of success.

The support team enlists specialists, including:

- Metropolitan Planning Organization (MPO)
- Regional Transportation Planning Organization (RTPO)
- WSDOT region (planning, design, environmental, maintenance, and traffic)
- WSDOT Headquarters (design, bridge, traffic, and geotechnical)
- Project proponent specialists (region, local agency, developer)
- Transit agencies

The support team works together, from the corridor study through preparation of the assumptions document and completion of the IJR.

The support team's role is to:

- Review regional and state transportation plans to see if the request is consistent with needs and solutions shown in those plans.
- Develop a charter that includes the processes for reaching agreement, resolving disputes, and assigning responsibility for final decisions.
- Develop purpose, need, and vision statements for the study. This should be consistent with the project environmental document.
- Expedite the study steps (and, if needed, the IJR development and review process) through early communication and agreement.
- Agree on area of influence, baseline transportation improvements to be included, and future travel demand forecasts for each of the alternatives being considered.
- Develop the Methods and Assumptions document.
- Provide guidance and support.
- Evaluate data and identify possible alternatives for the proposal during the transportation study and, if needed, for an IJR.
- Contribute material for the report that documents the discussions and decisions.
- Review results and determine whether an IJR is warranted.
- Ensure the compatibility of data used in various studies.
- Ensure integration of the Project Definition process, Value Engineering studies, public involvement efforts, environmental analyses, operational analyses, safety analyses, other analyses for the transportation study (and, if needed, to prepare an IJR). This encourages the use of consistent data.
- Address design elements. Status of known deviations must be noted in Policy Point 4. Deviations are discouraged on new accesses.

(c) **Methods and Assumptions Document.** This document is developed to record assumptions used in the IJR, along with methodologies, criteria, and support team decisions. The document presents the proposed traffic analysis tool and approach, study area, peak hour(s) for analysis, traffic volumes, design year, opening year, travel demand forecasts, baseline conditions, and design year conditions. It also documents the team's decisions on how much detail will be included in each policy point. The signed Methods and Assumptions document represents endorsement by the support team on the IJR approach, tools, data, and criteria used throughout the IJR process.

The Methods and Assumptions document is dynamic, and is updated and re-endorsed when changed conditions warrant. The document also serves as an historical record of the processes, dates, and decisions made by the team. WSDOT and FHWA highly support development and acceptance of the document, because early agreement on details results in the highest level of success of the IJR process.

Example Methods and Assumptions documents and an outline of this process are provided online at: www.wsdot.wa.gov/Design/AccessAndHearings

(2) Conduct Analysis and Prepare IJR

Prepare a detailed IJR using the guidance in 1425.05, Interchange Justification Report and Supporting Analyses, and Figure 1425-3.

The IJR addresses the following eight specific policy topics (see Figures 1425-1 and 2 for exceptions):

1. Need for the Access Point Revision
2. Reasonable Alternatives
3. Operational and Collision Analyses
4. Access Connections and Design
5. Land Use and Transportation Plans
6. Future Interchanges
7. Coordination
8. Environmental Processes

The IJR is initiated early in the environmental process. Traffic analyses help define the area of impact and the range of alternatives. Since the traffic data required for the National Environmental Policy Act (NEPA) or the State Environmental Policy Act (SEPA) and the operational/safety analyses of the IJR are similar, these documents are usually developed together using the same data sources and procedures.

(3) IJR Review and Approval

Concurrence and approval of a new or revised access point is based on the IJR. The IJR contains sufficient information about and evaluation/analysis of the proposal to provide assurance that safety and operations of the freeway system are not adversely impacted.

The region, or proponents, with the help of the support team, prepares the IJR and submits four draft copies, including backup traffic data, for review. All IJRs are submitted to the HQ Access and Hearings Section for review.

For a final IJR submittal, contact the HQ Access and Hearing Section for the necessary number of copies.

An IJR is formally approved concurrently with the approval of the project environmental document.

(a) **Interstate IJR.** On Interstate projects, a submittal letter is sent by the region through the HQ Access and Hearings Section, requesting final FHWA approval of the IJR. Interstate IJRs are submitted by Headquarters to FHWA for concurrence and approval.

Interstate access point revisions are reviewed by both WSDOT Headquarters and FHWA. If they are found to be acceptable, FHWA issues a finding of engineering and operational acceptability. Some Interstate IJRs are reviewed and approved by the local FHWA Division Office. Other Interstate IJRs are reviewed and approved by the FHWA Headquarters Office in Washington, DC. Additional review time is necessary for reports that have to be submitted to Washington DC (see Figure 1425-1.)

Final IJR approval by FHWA is provided when the appropriate final environmental decision is complete: ECS, FONSI, or ROD (see definitions).

(b) **Non-Interstate IJR.** On non-Interstate projects, a similar process is followed, except that the appropriate WSDOT Assistant State Design Engineer grants the final approval, not the FHWA. Send a submittal letter to the HQ Access and Hearings Section requesting final approval of the IJR. The Assistant State Design Engineer's approval is given concurrently with environmental approval (see Figure 1425-3).

1425.05 Interchange Justification Report and Supporting Analyses

The eight policy points, which apply to both urban and rural areas, are presented below. Consult with the HQ Access and Hearings Section for guidance. Factors that affect the scope include location (rural or urban), access points (new or revised), ramps (new or existing), and ramp terminals (freeway or local road).

(1) Policy Point 1: Need for the Access Point Revision

What are the current and projected needs? Why are the existing access points and the existing or improved local system unable to meet the proposal needs? Is the anticipated demand short or long trip?

Describe the need for the access point revision and why the existing access points and the existing or improved local system do not address the need. How does the proposal meet the anticipated travel demand? Provide the analysis and data to support the need for the access request.

(a) **Project Description.** Describe the needs being addressed and the proposal. Demonstrate that improvements to the local transportation system and the existing interchanges cannot be improved to satisfactorily accommodate the design year travel demands. Describe traffic mitigation measures considered at locations where the level of service is (or will be) below agreed upon service standards in the design year. See the *State Highway System Plan* for further information on LOS standards.

The access point revision is primarily to meet regional, not local, travel demands. Describe the local and regional traffic (trip link and/or route choice) benefiting from the proposal.

(b) **Analysis and Data.** The proposal analysis, data, and study area must be agreed upon by the support team. Use a Methods and Assumptions document to detail the specific items and record the team's agreement to them. Establishing assumptions upfront ensures the project will have the highest rate of success. For further guidance and examples on assumptions documents, see:
www.wsdot.wa.gov/design/accessandhearings

Show that a preliminary (planning level) analysis, comparing build to no-build data, was conducted for the current year, year of opening, and design year, comparing baseline, no-build condition, and build alternatives. Include the following steps:

1. Define the study area. The study area is a minimum of one interchange upstream and downstream from the proposal. The study area should be expanded as necessary to capture operational impacts of adjacent interchanges in the vicinity that are, or will be, bottlenecks or chokepoints that influence the operations of the study interchange.
2. Establish baseline transportation networks and future land use projections for the study area. The baseline transportation network typically includes local, regional and state transportation improvement projects that are funded. The land use projection includes population and employment forecasts consistent with the regional (MPO or RTPO) and local jurisdiction forecasts.
3. Collect and analyze current traffic volumes to develop current year, year of opening, and design year peak hour traffic estimates for the regional and local systems in the area of the proposal. Use regional transportation planning organization-based forecasts, refined by accepted travel demand estimating procedures. Forecasts for specific ramp traffic can require other methods of estimation procedures and must be consistent with the projections of the travel demand models. Modeling must include increased demand caused by anticipated development.
4. Using existing information, identify the origins and destinations of trips on the local systems, the existing interchange/intersections, and the proposed access.
5. Develop travel demand forecasts corresponding to assumed improvements that might be made to:
    - The local system: widen, add new surface routes, coordinate the signal system, control access, improve local circulation, or improve parallel roads or streets.
    - The existing interchanges: lengthen or widen ramps, add park-and-ride lots, or add frontage roads.
    - The freeway lanes: add collector-distributor roads or auxiliary lanes.
    - Transportation system management and travel demand management measures.
6. Describe the current year, year of opening, and design year level of service at all affected locations within the study area, including local systems, existing ramps, and freeway lanes.

(2) Policy Point 2: Reasonable Alternatives

Describe the reasonable alternatives that have been evaluated.

Describe all reasonable alternatives that have been considered. These include the design options, locations, and transportation system management-type improvements such as ramp metering, mass transit, and HOV facilities that have been assessed and that meet the proposal design year needs.

After describing each of the alternatives that were proposed, explain why reasonable alternatives were omitted or dismissed from further consideration.

Future projects must be coordinated as described in Policy Point 7, Coordination.

(3) Policy Point 3: Operational and Collision Analyses

How will the proposal affect safety and traffic operations at year of opening and design year?

Policy Point 3 documents the procedures used to conduct the operational and collision analyses and the results that support the proposal.

The preferred operational alternative is selected, in part, by showing that it will meet the access needs without causing a significant adverse impact on the operation and safety of the freeway and the affected local network, or that the proposal impacts will be mitigated.

Document the results of the following analyses in the report:

- "No-Build" Analysis – An operational analysis of the current year, year of opening, and design year for the existing limited access freeway and the affected local roadway system. This is the baseline plus state transportation plan and comprehensive plan improvements expected to exist at the year of opening or design year. All of the alternatives will be compared to the no-build condition. The report should document the calibration process and results that show the current year operations match actual field conditions.
- "Build" Analysis – An operational analysis of the year of opening and design year for the proposed future freeway and the affected local roadway system.
- A collision analysis for the most current data year, year of opening, and design year of the existing limited access freeway and the affected local roadway system for the "no-build." A collision analysis should also be performed for the "build" as well.

The data used must be consistent with the data used in the environmental documentation. If not, provide justification for the discrepancies.

(a) **Operational Analyses.** Demonstrate that the proposal does not have a significant adverse impact on the operation of the freeway and the affected local roadway system. If there are proposal impacts, explain how the impacts will be mitigated.

To understand the proposal's positive and negative impacts to main line, crossroad, and local system operations, the selection of the appropriate analysis tool(s) is critical. This is a major piece of the assumptions process. Record the support team's tool selection agreement in the Methods and Assumptions document. FHWA's *Traffic Analysis Toolbox* provides an overview and details for making the best tool category selection.

Document the selected operational analysis procedures. For complex urban projects, a refined model might be necessary. WSDOT supports the traffic analysis and traffic simulation software listed on the HQ Traffic Operations web page at: www.wsdot.wa.gov/Design/Traffic/Analysis/

All operational analyses shall be of sufficient detail, and include sufficient data and procedure documentation, to allow independent analysis during FHWA and Headquarters evaluation of the proposal. For Interstates, Headquarters must provide concurrence before it transmits the proposal to FHWA with its recommendation.

Prepare a layout displaying adjacent interchanges/intersections and the data noted below, which should show:

- Distances between intersections or ramps of a proposed interchange, and those of adjacent existing and known proposed interchanges.
- Design speeds.
- Grades.
- Truck volume percentages on the freeway, ramps, and affected roadways.
- Adjustment factors (such as peak hour factors).
- Affected freeway, ramp, and local roadway system traffic volumes for the "no-build" and each "build" option. This will include: a.m. and p.m. peaks (noon peaks, if applicable); turning volumes; average daily traffic (ADT) for the current year; and forecast ADT for year of opening and design year.
- Affected main line, ramp, and local roadway system lane configurations.

The study area of the operational analysis on the local roadway system includes documenting that the local network is able to safely and adequately collect and distribute any new traffic loads resulting from the access point revision. Expand the limits of the study area, if necessary, to analyze the coordination required with an in-place or proposed traffic signal system. Record the limits of the analysis as well as how the limits were established in the project Methods and Assumptions document.

Document the results of analyzing the existing access and the proposed access point revision at all affected locations within the limits of the study area, such as weave, merge, diverge, ramp terminals, collision sites, and HOV lanes; along the affected section of freeway main line and ramps; and on the affected local roadway system. In the report, highlight the following:

- Any location for which there is a significant adverse impact on the operation or safety of the freeway facility, such as causing a reduction of the operational efficiency of a merge condition at an existing ramp; introducing a weave; or significantly reducing the level of service on the main line due to additional travel demand. Note what will be done to mitigate this adverse impact.
- Any location where a congestion point will be improved or eliminated by the proposal, such as proposed auxiliary lanes or collector-distributor roads for weave sections.
- Any local roadway network conditions that will affect traffic entering or exiting the freeway. If entering traffic is to be metered, explain the effect on the connecting local system (for example, vehicle storage).
- When the existing local and freeway network does not meet agreed upon level of service standards, show how the proposal will improve the level of service or keep it from becoming worse than the no-build condition in the year of opening and the design year.

(b) **Collision Analysis.** This analysis identifies areas where there may be a safety concern. The study limits are the same as for operational analyses.

Identify and document all safety program (I2) locations. Identify and document collision histories, rates, and types for the freeway section and the adjacent affected local surface system. Project the rates that will result from traffic flow and geometric conditions imposed by the proposed access point revision. Document the basis for all assumptions.

Demonstrate (1) that the proposal does not have a significant adverse impact on the safety of the freeway or the adjacent affected local surface system, or (2) that the impacts will be mitigated. The safety analysis for both existing and proposed conditions should include the following:

1. Type of Collisions
   - What types of collisions are occurring (overturns, rear-ends, enter-at-angle, hitting fixed object)?
   - What types of collision s are most prevalent?
   - Are there any patterns of collision type or cause?
2. Severity of Collisions (fatalities, serious, evident injuries, property damage)
3. Collision Rates and Numbers
   - Document the number and rate of collisions within the study limits for existing and proposed conditions.
   - What are the existing and anticipated crash/serious injury/fatality rates and numbers by proximity to the interchange exit and entrance ramps?
   - How do these rates compare to similar corridors or interchanges?
   - How do these rates compare to the future rates and numbers?
   - What are the existing and anticipated crash/serious injury/fatality rates and numbers for the impacted adjacent and parallel road system (with and without the access revision)?
4. Contributing Factors and Conclusions
   - Document contributing causes of collisions and conclusions. What are the most prevalent causes?
   - Evaluate and document the existing and proposed roadway conditions for geometric design standards, stopping sight distance, and other possible contributing factors. Would the proposal reduce the frequency and severity of collisions?

(4) Policy Point 4: Access Connections and Design

Will the proposal provide fully directional interchanges connected to public streets or roads, spaced appropriately, and designed to full design level geometric control criteria?

Wherever feasible, provide for all directions of traffic movement. The intent is to provide full movement at all interchanges, whenever feasible. Partial interchanges are discouraged. Less than fully directional interchanges for special-purpose access for transit vehicles, for HOVs, or to or from park-and-ride lots, will be considered on a case-by-case basis.

A proposed new or revised interchange access must connect to a public freeway, road, or street and be endorsed by the local governmental agency or tribal government having jurisdiction over said public freeway, road, or street.

Explain how the proposed access point relates to present and future proposed interchange configurations and the *Design Manual* spacing criteria. Note that urban and rural interchange spacing for crossroads also includes additional spacing requirements between adjacent ramps, as noted in Chapter 940.

Develop the proposal in sufficient detail to conduct a design and operational analysis. Include the number of lanes, horizontal and vertical curvature, lateral clearance, lane width, shoulder width, weaving distance, ramp taper, interchange spacing, and all traffic movements. This information is presented as a sketch or a more complex layout, depending on the complexity of the proposal.

The status of all known or anticipated project deviations must be noted in this policy point, as described in Chapter 330.

(5) Policy Point 5: Land Use and Transportation Plans

Is the proposed access point revision compatible with all land use and transportation plans for the area?

Show that the proposal is consistent with local and regional land use and transportation plans. Before final approval, all requests for access point revisions must be consistent with the metropolitan and/or statewide transportation plan, as appropriate (see Chapter 120). The proposed access point revision will affect adjacent land use and, conversely, land use will affect the travel demand generated. Therefore, reference and show compatibility with the land use plans, zoning controls, and transportation ordinances in the affected area.

Explain the consistency of the proposed access point revision with the plans and studies, the applicable provisions of 23 CFR Part 450, the applicable transportation conformity requirements of 40 CFR Parts 51 and 93, and Chapter 36.70A RCW.

If the proposed access is not specifically referenced in the transportation plans, define its consistency with the plans and indicate the process for the responsible planning agency to incorporate the project. In urbanized areas, the plan refinement must be adopted by the metropolitan planning organization (MPO) before the project is designed. The action must also be consistent with the multimodal *State Transportation Plan*.

(6) Policy Point 6: Future Interchanges

Is the proposed access point revision compatible with a comprehensive network plan? Is the proposal compatible with other known new access points and known revisions to existing points?

The report must demonstrate that the proposed access point revision is compatible with other known new access points and known revisions to existing points.

Reference and summarize any comprehensive freeway network study, plan refinement study, or traffic circulation study.

Explain the consistency of the proposed access point revision with those studies.

(7) Policy Point 7: Coordination

Are all coordinating projects and actions programmed and funded?

When the request for an access point revision is generated by new or expanded development, demonstrate appropriate coordination between the development and the changes to the transportation system.

Show that the proposal includes a commitment to complete the other noninterchange/nonintersection improvements that are necessary for the interchange/intersection to function as proposed. For example, if improvements to the local circulation system are necessary for the proposal to operate, they must be in place before new ramps are opened to traffic. If future reconstruction is part of the mitigation for design year level of service, the reconstruction projects must be in the *State Highway System Plan* and *Regional Transportation Plan*.

All elements for improvements are encouraged to include a fiscal commitment and an anticipated time for completion. If the project is to be constructed in phases, it must be demonstrated in Policy Point 3 that each phase can function independently and does not affect the safety and operational efficiency of the freeway. Note the known funding sources, the projected funding sources, and the estimated time of completion for each project phase.

(8) Policy Point 8: Environmental Processes

What is the status of the proposal's environmental processes? This section should be something more than just a status report of the environmental process; it should be a brief summary of the environmental process.

All requests for access point revisions on freeways must contain information on the status of the environmental approval and permitting processes.

The following are just a few examples of environmental status information that may apply:

- Have the environmental documents been approved? If not, when is the anticipated approval date?
- What applicable permits and approvals have been obtained and/or are pending?
- Are there hearings still to be held?
- Is the environmental process waiting for an engineering and operational acceptability decision?
- Does the environmental document include a traffic analysis?

1425.06 Report Organization and Appendices

Begin the IJR with an executive summary. Briefly describe the access point revision being submitted for a decision and why the revision is needed. Include a brief summary of the proposal.

The IJR must be assembled in the policy point order noted in 1425.04(2).

Formatting for the IJR includes (1) providing numbered tabs in the report for each policy point section and each appendix, and (2) numbering all pages, including references and appendices. A suggestion for page numbering is to number each individual section, such as "Policy Point 3, PP3–4" and "Appendix 2, A2–25." This allows for changes without renumbering the entire report.

On the bottom of each page, place the revision date for each version of the IJR. As an individual page is updated, this revision date will help track the most current version of that page. Also, include the title of the report on the bottom of each page.

Use a three-ring binder for ease of page replacement. Do not use comb or spiral binding.

Appendix A is reserved for the Methods and Assumptions document. Include meeting notes where subsequent decisions are made as additional appendixes to the original signed assumption document.

Additional appendices may include documents such as technical memorandums, memos, and traffic analysis operations output.

1425.07 Updating an IJR

Recognizing that the time period between the approval of the IJR, the environmental documentation, and the construction contract commonly spans several years, the approved IJR will be reviewed and updated to identify changes that may have occurred during this time period. Submit a summary assessment to the HQ Design Office for evaluation to determine whether the IJR needs to be updated. The HQ Design Office will forward the assessment to FHWA if necessary. The assessment is a document summarizing the significant changes since it was approved. Contact the HQ Access and Hearings Section to coordinate this summary assessment.

1425.08 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/

Project Type	Support Team	Policy Point								Concurrence	Approval
		1	2	3	4	5	6	7	8		
Interstate Routes											
New freeway-to-crossroad interchange in a Transportation Management Area[1]	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
New partial interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
New HOV direct access	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
New freeway-to-freeway interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
Revision to freeway-to-freeway interchange in a Transportation Management Area[1][2]	Yes	✓	✓	✓	✓	✓	✓	✓	✓	FHWA and HQ	FHWA DC
New freeway-to-crossroad interchange not in a Transportation Management Area[1]	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Revision to freeway-to-freeway interchange not in a Transportation Management Area[1][2]	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Revision to interchange[2][3]	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Revision to existing interchange—no adverse impacts to main line	No	[6]	[6]	✓	✓	[6]	[6]	[6]	[6]	HQ	FHWA
Transit flyer stop on main line	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Transit flyer stop on an on-ramp	No	✓		✓	✓					HQ	FHWA
Addition of entrance or exit ramps that complete basic movements at an existing interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Abandonment of a ramp[4]	Yes	✓	✓	✓	✓	✓	✓	✓	✓	HQ	FHWA
Locked gate[7]	No	✓			[5]					HQ	FHWA
Access breaks that do not allow any type of access to main line or ramps	No	✓	✓		[5]					HQ	FHWA
Pedestrian structure	No	✓			[5]					HQ	FHWA
Construction/emergency access break	No	✓	✓	✓	✓					Region	FHWA

Notes:

All policy points must be addressed on all studies. The scale and scope of the project dictate the level of effort to address each policy point. Blank cells in the table above indicate that the policy point will need to be addressed briefly in the IJR. Consult the HQ Access and Hearings Section for direction.

[1] In Washington, designated Transportation Management Areas include Clark, King, Kitsap, Pierce, Snohomish, and Spokane counties.

[2] "Revision" includes changes in interchange configuration, even though the number of access points does not change. Changing from a cloverleaf to a directional interchange is an example of a "revision."

[3] Revisions that might adversely affect the level of service of the through lanes. Examples include: doubling lanes for an on-ramp with double entry to the freeway; adding a loop ramp to an existing diamond interchange; and replacing a diamond ramp with a loop ramp.

[4] Unless it is a condition of the original approval.

[5] Update the Right of Way/Limited Access Plan as necessary.

[6] If the results of the operational analysis show an adverse impact to the main line, the remaining policy points must be fully, not briefly, addressed.

[7] As part of Policy Point 1, include a narrative stating that all other alternatives are not feasible.

Interstate Routes – Interchange Justification Report Content and Review Levels

Figure 1425-1

Project Type	Support Team	Policy Point								Concurrence	Approval
		1	2	3	4	5	6	7	8		
Non-Interstate Routes											
New freeway-to-crossroad interchange on a predominately grade-separated corridor	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Region	HQ
New freeway-to-freeway interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Region	HQ
Revision to freeway-to-freeway interchange	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Region	HQ
New freeway-to-crossroad interchange on a predominately at-grade corridor	No	✓		✓	✓					Region	HQ
Revision to interchange[1]	No	✓		✓	✓					Region	HQ
Addition of entrance or exit ramps that complete basic movements at an existing interchange	No	✓		✓	✓					Region	HQ
Abandonment of a ramp[2]	No	✓		✓						Region	HQ
Transit flyer stop on main line	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Region	HQ
Transit flyer stop on an on-ramp	No	✓		✓	✓					Region	HQ
Locked gate[4]	No	✓			[3]					Region	HQ
Pedestrian structure	No	✓			[3]					Region	HQ
Construction/emergency access break	No	✓	✓	✓						Region	HQ

Notes:

All policy points must be addressed on all studies. The scale and scope of the project dictate the level of effort to address each policy point. Blank cells in the table above indicate that the policy point will need to be addressed briefly in the IJR. Consult the HQ Access and Hearings Section for direction.

[1] Revisions that might adversely affect the level of service of the through lanes. Examples include: doubling lanes for an on-ramp with double entry to the freeway; adding a loop ramp to an existing diamond interchange; and replacing a diamond ramp with a loop ramp.

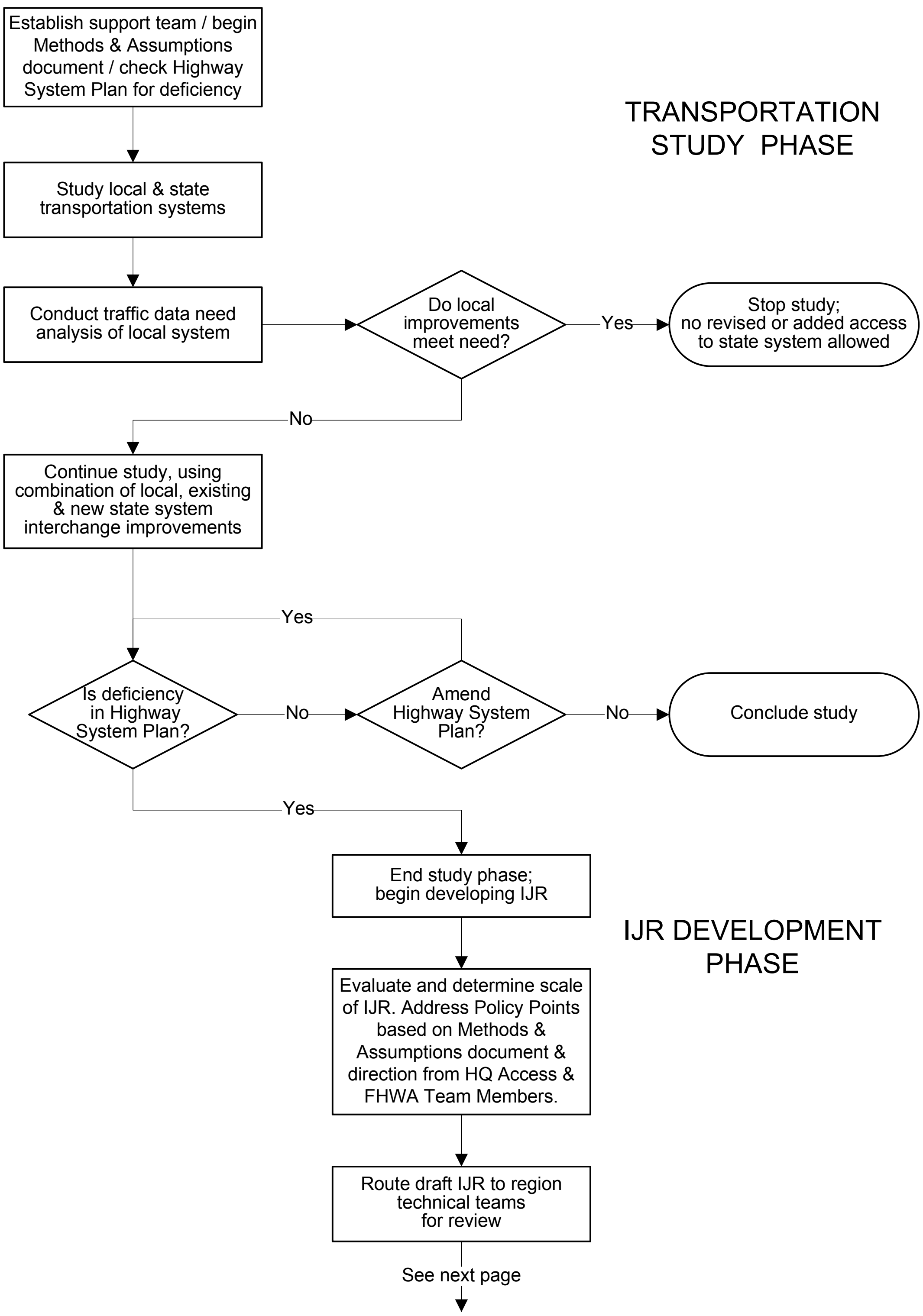
[2] Unless it is a condition of the original approval.

[3] Update the Right of Way/Limited Access Plan as necessary.

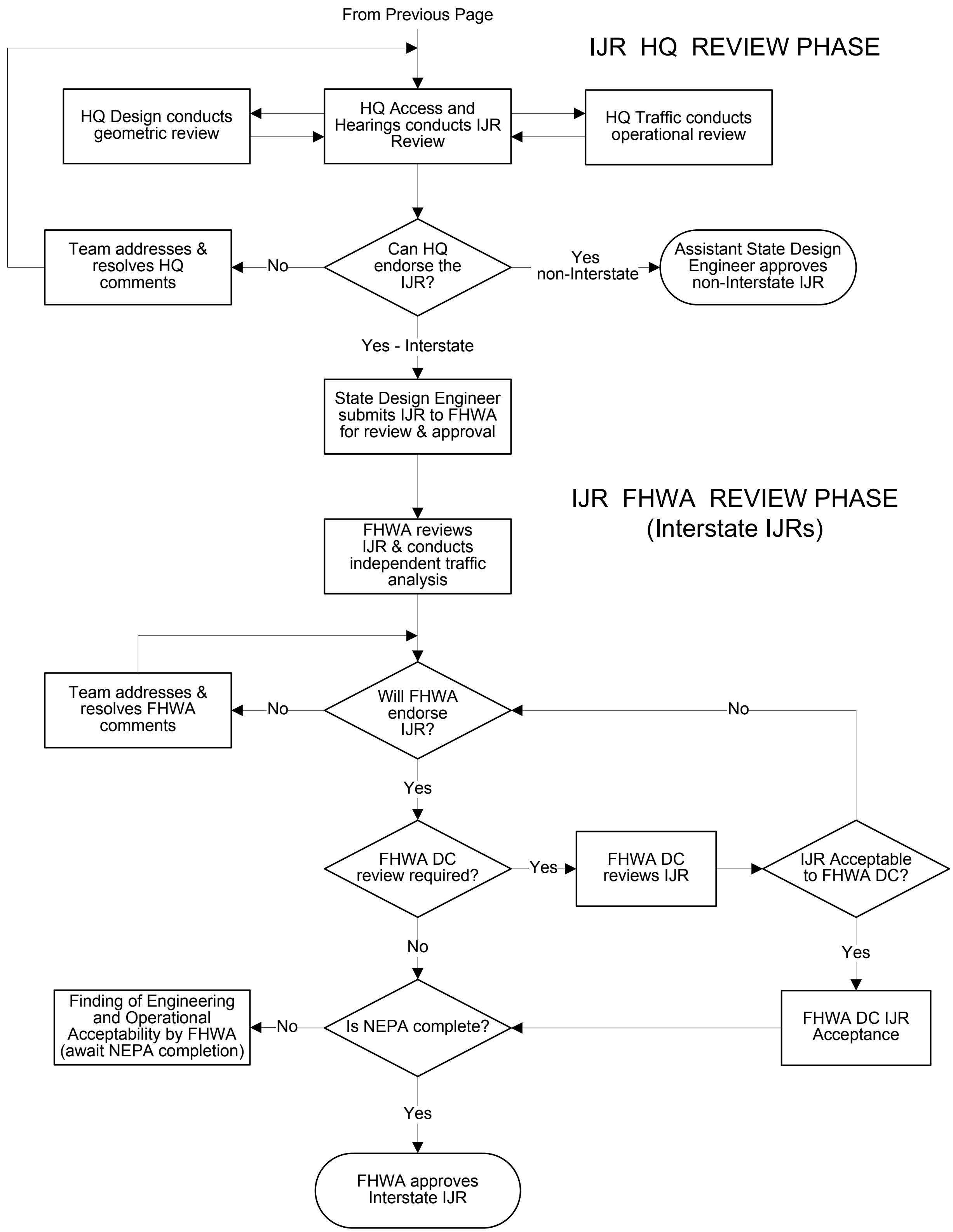
[4] As part of Policy Point 1, include a narrative stating that all other alternatives are not feasible.

Non-Interstate Routes – Interchange Justification Report Content and Review Levels

Figure 1425-2



Interchange Justification Report Process Flow Chart
Figure 1425-3



Interchange Justification Report Process Flow Chart
Figure 1425-3 (Continued)

1430.01 General

Limited access control is established to preserve the safety and efficiency of specific highways and to preserve the public investment. Limited access control is achieved by acquiring access rights from abutting property owners, and by selectively limiting approaches to a highway. (For an overview of access control, and the references list and definitions of terminology for this chapter, see Chapter 1420, "Access Control.")

Requirements for the establishment of limited access highways are set forth in RCW 47.52. The level of limited access control is determined during the early stages of design in conformance with this chapter.

Highways controlled by acquiring abutting property owners' access rights are termed limited access highways and are further distinguished as having *full, partial, or modified* control. The number of access points per mile, the spacing of interchanges or intersections, and the location of frontage roads or local road/street approaches are determined by:

- The functional classification and importance of the highway.
- The character of the traffic.
- Current and future land use.
- The environment and aesthetics.
- The highway design and operation.
- The economic considerations involved.

The Federal Highway Administration (FHWA) has jurisdiction on the Interstate System. WSDOT has full jurisdiction on all other limited access highways, whether they are inside or outside incorporated city limits.

WSDOT maintains a record of the status of limited access control, by state route number and milepost, in the *Access Control Tracking System Limited Access and Managed Access Master Plan* database. The database is available here:
http://www.wsdot.wa.gov/design/accessandhearings

Nothing in this chapter is to be construed in any way that would prevent acquisition of short sections of full, partial, or modified control of access.

1430.02 Achieving Limited Access

(1) Project Scoping Evaluation

The acquisition of full, partial, or modified control is to be evaluated during project scoping if the route is shown in the *Access Control Tracking System* database as either "established" or "planned" for limited access. The matrices in Chapter 325 list several project types for which acquisition is indicated as a Design Element.

The cost of acquiring limited access must be evaluated during project scoping to determine if those costs will be included in the project. The evaluation includes consideration of societal costs of collisions, current and future land use development, and the improved level of service of limited access highways. This cost will be evaluated against the cost to realign the highway in the future if limited access is not acquired at current prices.

(2) Process

All Washington State highways are managed access highways (see Chapter 1435), except where limited access rights have been acquired. The Right of Way and Limited Access Plans for routes show the acquired limited access boundaries. This is further represented in WSDOT's *Access Control Tracking System Limited Access and Managed Access Master Plan* – a database identifying the status and type of access control for all state highways. The database lists the specific types of limited access control (full, partial, or modified) and identifies if the control is planned, established, or acquired for a specific route segment. If limited access has not been acquired, the database reports the type of managed access classification that currently applies. For help determining the status of limited access control for any state highway, consult the HQ Access and Hearings Unit.

To achieve limited access control, the following procedure is followed:

(a) The Secretary of Transportation (or a designee) first identifies a highway as "Planned for Limited Access."

(b) To establish or revise limited access on a new or existing highway, a limited access hearing is held. (See Chapter 210, "Public Involvement and Hearings" regarding hearings, and Chapter 1410 for the phases of appraisal and acquisition.)

- **Phase 1.** The region develops a Limited Access Report and a Limited Access Report Plan for department approval and presentation to local officials. The plan notes the level of limited access proposed to be established.
- **Phase 2.** The region develops a Limited Access Hearing Plan for State Design Engineer (or designee) approval and for presentation at the hearing.
- **Phase 3.** After the hearing, the region develops the Findings and Order and revises the Limited Access Hearing Plan to become the Findings and Order Plan. The Findings and Order is processed to the Headquarters (HQ) Access and Hearings Unit for review and approval.

(c) The Director, Environmental and Engineering Programs, adopts the Findings and Order and thus establishes the limits and level of limited access control to be acquired.

(d) The Findings and Order Plan is now revised by the HQ Right of Way Plans Section for approval by the State Design Engineer (or designee) as a Phase 4 final Right of Way and Limited Access Plan.

(e) Real Estate Services acquires limited access rights from individual property owners based on final design decisions and updates the Right of Way and Limited Access Plans, and also updates the property deed.

(f) These highways or portions thereof are now limited access highways and no longer fall under the managed access program.

(3) Access Report

The Access Report is developed by the region to inform local governmental officials of the proposed limited access highway and the principal access features involved, and to secure their approval. This report is not furnished to abutting property owners. Three copies of the report are submitted to the HQ Access and Hearings Unit for review and approval prior to submission to local authorities.

The Access Report consists of:

(a) A description of the existing and proposed highways, including data on the history of the existing highway, which may include references to collisions and locations identified in WSDOT's Priority Array.

(b) Traffic analyses pertaining to the proposed highway, including available information concerning current and potential future traffic volumes on county roads and city streets crossing or severed by the proposed highway, and reference sources such as origin-destination surveys.

Traffic data developed for the Design Decision Summary, together with counts of existing traffic available from state or local records, is normally adequate. Special counts of existing traffic are obtained only if circumstances indicate that the available data is inadequate or outdated.

(c) A discussion of factors affecting the design of the subject highway, including:

- Design level.
- Level of limited access, with definition.
- Roadway section.
- Interchange, grade separation, and intersection spacing.
- Pedestrian and bicycle trails or paths.
- Operational controls with emphasis on proposed fencing, the general concept of illumination, signing, and other traffic control devices.
- Locations of utilities and how they are affected.
- Proposed plan for landscaping and beautification, including an artist's graphic rendition or design visualization.

(d) Governmental responsibility, and comprehensive planning, land use, and community service relative to the new highway.

(e) The disposition of frontage roads, city street and county road intersections, and excess right of way.

(f) An appendix containing:
- A glossary of engineering terms.
- A traffic volume diagram(s).
- Pages showing diagrammatically or graphically the roadway section(s), operational controls, and rest areas (if rest areas are included in the project covered by the report).
- A vicinity map.
- An Access Report Plan and profiles for the project.

The Limited Access Report Plan shows the effects of the proposed highway on the street and road system by delineating the points of public access. (See the *Plans Preparation Manual* for a list of the minimum details to be shown on the plan and for a sample plan.)

(g) Notifications and Reviews. Upon receipt of the State Design Engineer's approval of Phase 1 (see Figure 1410-1), the region publishes the necessary copies, submits the Limited Access Report to the county and/or city officials for review and approval, and meets with all involved local governmental agencies to discuss the report. Providing a form letter with a signature block for the local agency to use to indicate their approval of the Limited Access Report can help expedite the review and approval process.

Including local agencies as stakeholders from the onset of the project helps establish project expectations and positive working relationships, making reviews and approvals run as smoothly as possible. The region reviews any requests for modification and submits recommendations, with copies of any correspondence or minutes relating thereto, to the HQ Access and Hearings Unit.

(4) Access Hearing Plan

The region prepares a Limited Access Hearing Plan to be used as an exhibit at the public hearing (see Chapter 210 for hearings) and forwards it to the HQ Right of Way Plans Branch for review. (See the *Plans Preparation Manual* for a list of data to be shown on the Access Hearing Plan in addition to the Access Report Plan data.)

When the plan review is completed by Headquarters, the Access Hearing Plan is placed before the State Design Engineer for approval of Phase 2 authority (see Figure 1410-1).

(5) Documentation

Documentation for the establishment of limited access control is in Chapter 210.

1430.03 Full Control (Most Restrictive)

(1) Introduction

Full control limited access highways provide almost complete freedom from disruption by allowing access only through interchanges at selected public roads/streets, rest areas, viewpoints, or weigh stations, and by prohibiting at-grade crossings and approaches. Gated approaches are occasionally allowed, with approval of the requirements listed in Chapter 1425, Figures 1425-1 and 2.

At times, on state highways (except Interstate) where full access control has been established, staged acquisition of Limited access may be used (subject to the approval of an access deviation), with initial acquisition as partial or modified control and with ultimate acquisition of full control planned on the highway. Where there is no feasible alternative within reasonable cost, the decision to defer acquisition of limited access control must be documented and is subject to the approval of an access deviation.

(2) Application

Terminate full control limited access sections at apparent logical points of design change. The following guidelines are to be used for the application of full control on limited access highways:

(a) **Interstate.** Full control is required on Interstate highways.

(b) **Principal Arterial.** Documentation assessing the evaluation of full control is required for principal arterial highways requiring four or more through traffic lanes within a 20-year design period, unless approved for partial or modified control on existing highways.

(c) **Minor Arterial and Collector.** Minor arterial and collector highways will not normally be considered for development to full control.

(3) Crossroads at Interchange Ramps

The extension of limited access control beyond an intersection is measured from the centerline of ramps, crossroads, or parallel roads (as shown in Figures 1430-1a, 1b, and 1c), from the terminus of transition tapers (see Figure 1430-2), and in the case of ramp terminals at single point urban interchanges, as shown in Figure 1430-3. (See Chapter 940 for guidance on interchange spacing.)

(a) **Ramps.** At-grade intersections and approaches are prohibited within the full length of any interchange ramp. The ramp is considered to terminate at its intersection with the local road or street.

(b) **Frontage Roads.** Direct access from the highway to a local service or frontage road is allowed only via the interchange crossroad (see Figures 1430-1a, 1b, and 1c).

(c) **Interchange Crossroads.** In both urban and rural areas, full control limited access must be established and then acquired along the crossroad at an interchange for a minimum distance of 300 feet beyond the centerline of the ramp or the end of the transition taper.

If a frontage road or local road is located at or within 350 feet of a ramp, limited access will be established and then acquired along the crossroad and for an additional minimum distance of 130 feet in all directions from the centerline of the intersection of the crossroad and the frontage or local road (see Figures 1430-1a and 1b).

For interchanges incorporating partial cloverleaf and/or buttonhook ramps (see Figure 1430-1b), limited access is required for all portions of the crossroad and frontage roads between the ramp terminals, and for a distance of 300 feet beyond the ramp terminals. If an at-grade intersection for a local road or street is served directly opposite the ramp terminals, limited access will be extended for a minimum of 300 feet along that leg of the intersection.

When the intersection in question is a roundabout, see Figure 1430-1c. This shows extension of full control to be 300 feet, measured from the center of the roundabout for an intersection with a ramp terminal. Figure 1430-1c also shows that if a frontage road or local road is located at or within 350 feet of a ramp terminal, limited access will be established and then acquired along the crossroad (between the roundabouts) and for an additional minimum distance of 130 feet in all directions along the local frontage roadway, measured from the outside edge of the circulating roadway of the roundabout.

Figure 1430-2 shows the terminus of transition taper and that full control limited access is extended a minimum distance of 300 feet beyond the end of the farthest taper.

For a single point urban interchange (SPUI) with a right- or left- turn "ramp branch" separated by islands, limited access control is established and acquired for a minimum distance of 300 feet from the intersection of the centerline of the ramp branch with the centerline of the nearest directional roadway (see Figure 1430-3.)

(d) **Levels of Limited Access – Location of Approaches.** Provide full control for 300 feet from the centerline of the ramp or terminus of a transition taper (see Figures 1430-1a, 1b, and 1c, and 1430-2 and 3).

If the economic considerations to implement full control for the entire 300 feet are excessive, then provide full control for at least the first 130 feet and partial or modified control may be provided for the remainder, for a total minimum distance of 300 feet of limited access. Contact the HQ Access and Hearings Unit when considering this option.

An approved access deviation is required if the limited access control falls short of 300 feet <u>or</u> for any approach that has been allowed to remain within the first 130 feet.

Ensure that approaches are far enough away from a frontage road intersection to provide efficient intersection operation.

(4) Location of Utilities, Bus Stops, and Mailboxes

(a) **Utilities.** Connecting utility lines are allowed along the outer right of way line between intermittent frontage roads. (See the *Utilities Accommodation Policy* regarding the location of and access to utilities.)

(b) **Bus Stops.** Common carrier or school bus stops are not allowed, except at:

- Railroad crossings (see Chapter 930).
- Locations provided by the state on the interchanges (such as flyer stops).
- In exceptional cases, along the main roadway where pedestrian separation is available.

(c) **Mailboxes.** Mailboxes are not allowed on full control limited access highways. Mail delivery will be from frontage roads or other adjacent local roads.

(5) Pedestrian and Bicycle Crossings and Paths

All nonmotorized traffic is limited as follows:

- At-grade pedestrian crossings are allowed only at the at-grade intersections of ramp terminals.
- Pedestrian separations or other facilities provided specifically for pedestrian use.
- Bicyclists using facilities provided specifically for bicycle use (separated paths).
- Shared-use paths for bicyclists, pedestrians, and other forms of nonmotorized transportation.
- Bicyclists using the right-hand shoulders, except where such use has been specifically prohibited. Information pertaining to such prohibition is available from the Traffic Operations Office of the HQ Maintenance and Operations Division.

Pedestrians and bicycles are allowed, consistent with "Rules of the Road" (RCW 46.61), within the limits of full control limited access highways. When paths are allowed they must be documented on the Right of Way and Limited Access Plan. The plan shows the location of the path and where the path crosses limited access, and provides movement notes (see 1430.10(1)).

1430.04 Partial Control

(1) Introduction

Partial control may be established, when justified, on any highway except Interstate. Partial control provides a considerable level of protection from traffic interference and protects the highway from future strip-type development.

Upon acquisition of partial control limited access rights, the number, type, and use of access approaches of abutting property are frozen. The abutting property access rights and type of use are recorded on the property deed. The rights and use may not be altered by the abutting property owner, the local jurisdiction, or the region. This authority resides with the State Design Engineer (see 1430.10).

(2) Application

Partial control will not normally be used in urban areas, or inside corporate limits on existing principal arterial highways where traffic volumes are less than 700 design hourly volume (DHV).

Terminate limited access sections at apparent logical points of design change.

(a) **Principal Arterial.** Partial control is required when the estimated traffic volumes exceed 3000 average daily traffic (ADT) within a 20-year design period on principal arterial highways requiring two through traffic lanes. For multilane principal arterial highways, see 1430.03(2)(b).

(b) **Minor Arterial.** The minimum route length is: urban, 2 miles; rural, 5 miles; and combination urban and rural, 3 miles.

Partial control is required on:

- Rural minor arterial highways at both new and existing locations.
- Urban minor arterial highways at new locations, requiring four or more through traffic lanes within a 20-year design period, or requiring only two through traffic lanes where the estimated traffic volumes exceed 3000 ADT within a 20-year design period.

Other rural minor arterial highways with only two lanes may be considered for partial control if any of the following conditions apply:

- The partial control can be acquired at a reasonable cost.
- The route connects two highways of a higher functional classification.
- The potential land development can result in numerous individual approaches, such as encountered in recreational or rapidly developing areas.
- The highway traverses publicly-owned lands where partial control is desirable.

(c) **Collector (New Alignment).** Partial control is required on collector highways in new locations requiring four or more through traffic lanes in a 20-year design period.

(d) **Collector (Existing).** Existing collector highways will normally be considered for partial control limited access only when all of the following conditions apply:

- The highway serves an area that is not directly served by a higher functional classification of highway.
- Existing or planned development will result in traffic volumes significantly higher than what is required for partial control on minor arterials.
- Partial control can be established without a major impact on development of abutting properties within the constraints of established zoning at the time the partial control is proposed.

(3) Interchanges and Intersections

(a) **Interchanges.** When an interchange occurs on a partial control limited access highway, full control applies at the interchange and interchange ramps. Refer to 1430.03(3) and see Figures 1430-1a, 1b, and 1c for required minimum lengths of access control along the crossroad. (See Chapter 940 for guidance on interchange spacing.)

(b) **Intersections.** At an at-grade intersection on a partial control limited access highway, control will be established and acquired along the crossroad for a minimum distance of 300 feet from the centerline of the highway (see Figure 1430-4).

If another frontage or local road is located at or within 350 feet of the at-grade intersection, limited access will be established and then acquired along the crossroad, between the intersections, and:

- For an additional minimum distance of 130 feet in all directions from the centerline of the intersection of the frontage or local road (see Figure 1430-4).

- Or, in the case of a roundabout, for an additional minimum distance of 300 feet along the crossroad, measured from the center of the roundabout as shown in Figure 1430-5a.

On multilane highways, measurements will be made from the centerline of the nearest directional roadway.

An approved access deviation is required if the limited access control falls short of 300 feet or for any access that has been allowed to remain within the first 130 feet.

At-grade intersections with public roads are limited to the number allowed for the functional classification of highway involved, as follows:

- **Principal Arterial.** If the ADT of the crossroad is less than 2000, 1-mile spacing (minimum), centerline to centerline. If over 2000 ADT within 20 years, plan for grade separation.
- **Minor Arterial.** If the ADT of the crossroad is less than 2000, ½-mile spacing (minimum), centerline to centerline. If over 2000 ADT within 20 years, plan for grade separation.
- **Collector.** Road (or street) plus property approaches, not more than six per side per mile.

With approval from the State Design Engineer, shorter intervals may be used where topography or other conditions restrict the design. When intersecting roads are spaced farther apart than one per mile, median crossings may be considered for U-turns, in accordance with Chapter 910. Keep U-turns to a minimum, consistent with requirements for operation and maintenance of the highway.

To discourage movement in the wrong direction on multilane highways, locate private approaches 300 feet or more from an at-grade intersection. At a tee intersection, a private approach may be located directly opposite the intersection or a minimum of 300 feet away from the intersection. Ensure that a private approach directly opposite a tee intersection cannot be mistaken for a continuation or part of the public traveled way.

(4) Access Approach

Partial control is exercised to the level that, in addition to intersections with selected public roads, some crossings and private driveways may be allowed.

(a) **Approach Types.** Partial control limited access highways allow at-grade intersections with selected public roads and private approaches using Type A, B, C, and F approaches. (See Chapter 1420 for the definitions of approach types.)

Type D, commercial approaches, are not allowed direct access to partial control limited access highways. Commercial access is allowed only by way of public roads.

The type of approach provided for each parcel takes into consideration current and potential land use and is based on an economic evaluation. (See 1430.05(4) for a list of considerations.)

(b) **Design Considerations.** The following considerations are used to determine the number and location of access approaches on partial control limited access highways.

1. Access approaches must be held to a minimum. The number is limited as follows:
    - Principal arterial: two per side per mile
    - Minor arterial: four per side per mile
    - Collector: six per side per mile, including at-grade intersections
2. Approaches in excess of the number listed above may be allowed as stage construction if approved by the State Design Engineer.
3. Approaches are not allowed for parcels that have reasonable access to other public roads, unless a parcel has extensive highway frontage.
4. Relocate or close approaches located in areas where sight limitations create undue hazards.
5. Allow only one approach for each parcel, except for very large ownerships, or where terrain features do not allow the property to be served by a single approach. This includes contiguous parcels under a single ownership.
6. Where possible, locate a single approach to serve two or more parcels.
7. The approved design is to provide for future development of frontage roads that will eliminate an excessive number of approaches.

(5) Location of Utilities, Bus Stops, and Mailboxes

(a) **Utilities.** Connecting utility lines are allowed along the outer right of way line between intermittent frontage roads. (See the Utilities Accommodation Policy regarding the location of and access to utilities.)

(b) **Bus Stops.** Bus stops for both common carriers and school buses are not allowed on either two-lane or four-lane highways, except as follows:

- At railroad crossings (see Chapter 930)
- At locations of intersections with necessary pullouts to be constructed by the state
- Where shoulder widening has been provided for mail delivery service
- For a designated school bus loading zone on the traveled lane or adjacent thereto, which has been approved by WSDOT

Buses are not allowed to stop in the traveled lanes blocking at-grade intersections or private approaches to load or unload passengers.

School bus loading zones on partial control limited access highways must be posted with school bus loading zone signs, in accordance with the latest edition of the *Manual on Uniform Traffic Control Devices* (MUTCD).

(c) **Mailboxes.** Locate mailboxes on frontage roads or at intersections, with the following exceptions for properties that are served by Type A or B approaches:
- Locate mailboxes on a four-lane highway only on the side of the highway on which the deeded approach is provided.
- Locate mailboxes on a two-lane highway on the side of the highway that is on the right in the direction of the mail delivery.

Whenever mailboxes are allowed on a partial control limited access highway, provide mailbox turnouts to allow mail delivery vehicles to stop clear of the through traffic lanes. (See Chapter 700 for additional information concerning mailbox locations and turnouts.)

(6) Pedestrian and Bicycle Crossings and Paths

Pedestrian crossings are allowed when grade-separated.

At-grade pedestrian crossings are allowed:
- Only at intersections where an at-grade crossing is provided in accordance with Chapter 1025.
- On two-lane highways at mailbox locations.
- On two-lane highways not less than 100 feet from a school bus loading zone (pullout) adjacent to the traveled lane, if school district and WSDOT personnel determine that stopping in the traveled lane is hazardous.
- On two-lane highways where the school bus is stopped on the traveled lane to load or unload passengers and the required sign and signal lights are displayed.

On partial control limited access highways, pedestrian and bicycle traffic is allowed, consistent with “Rules of the Road” (RCW 46.61), except when unusual safety conditions support prohibition. Information pertaining to such prohibitions is available from the Traffic Operations Office of the HQ Maintenance and Operations Division.

When paths are allowed, they must be documented on the Right of Way and Limited Access Plan. The plan shows the location of the path and where the path crosses limited access, and provides movement notes (see 1430.10(1)).

1430.05 Modified Control (Least Restrictive)

(1) Introduction

Modified control is intended to prevent further deterioration in the safety and operational characteristics of existing highways by limiting the number and location of access points.

Upon acquisition of modified control limited access, the number, type, and use of access approaches of abutting property are frozen. The abutting property access rights and type of use are recorded on the property deed. The rights and use may not be altered by the abutting property owner, the local jurisdiction, or the region. This authority resides with the State Design Engineer (see 1430.10).

(2) Application

In general, modified control is applied where some level of control is desired, but existing and potential commercial development precludes the implementation of full or partial control.

(a) **Existing Highways.** Modified control may be established and acquired on existing highways other than Interstate. Priority is given to highway segments where one or both of the following conditions applies:

- Commercial development potential is high, but most of the adjoining property remains undeveloped.
- There is a reasonable expectation that the adjoining property will be redeveloped to a more intensive land use, resulting in greater traffic congestion.

(b) **Design Analysis.** Selection of highways on which modified control may be applied is based on a design analysis that includes the following factors:

- Traffic volumes
- Level of service
- Safety
- Design class
- Route continuity
- Population density
- Local land use planning
- Current and potential land use
- Predicted growth rate
- Economic analysis

(c) **Exceptions.** Where modified control is to be established, developed commercial areas may be excepted from control when all or most of the abutting property has been developed to the extent that few, if any, additional commercial approaches will be required with full development of the area. Contact the HQ Access and Hearings Unit when considering this option. If this exception is within the limits of access control requirements, an approved access deviation is required.

(3) Intersections

At an intersection on a modified control limited access highway, access control will be established and acquired along the crossroad:

- For a minimum distance of 130 feet, measured from the centerline of a two-lane highway (see Figure 1430-6).
- For a minimum distance of 130 feet, measured from the centerline of the nearest directional roadway of a four-lane highway (see Figure 1430-6).
- For a minimum distance of 130 feet, measured from the outside edge of the circulating roadway of a roundabout (see Figure 1430-5b).

Approaches are allowed within this area only when there is no reasonable alternative. An approved access deviation is required for any access that has been allowed to remain within the first 130 feet.

(4) Access Approach

The number and location of approaches on a highway with modified control must be carefully planned to provide a safe and efficient highway compatible with present and potential land use.

(a) **Approach Types.** Modified control limited access highways allow at-grade intersections with selected public roads and with private approaches using Type A, B, C, D, and F approaches. (See Chapter 1420 for definitions of the approach types.)

The type of approach provided for each parcel takes into consideration present and potential land use and is based on an economic evaluation that considers the following:

- Local comprehensive plans, zoning, and land use ordinances
- Property covenants and/or agreements
- City or county ordinances
- The highest and best use of the property
- The highest and best use of adjoining lands
- A change in use by merger of adjoining ownerships
- All other factors bearing upon proper land use of the parcel

(b) **Design Considerations.** The following considerations are used to determine the number and location of approaches:

1. Parcels that have access to another public road or street are not normally allowed direct access to the highway.
2. Relocate or close approaches located in areas where sight limitations create undue hazards.
3. Hold the number of access approaches to a minimum. Access approaches are limited to one approach for each parcel of land, or when adjoining parcels are under one contiguous ownership.
4. Encourage joint use of access approaches where similar use of land allows.
5. Additional approaches may be allowed for future development consistent with local zoning. Once limited access has been acquired, this will require a value determination process (see 1430.10).
6. Close existing access approaches not meeting the considerations above.

(5) Location of Utilities, Bus Stops, and Mailboxes

(a) **Utilities.** Connecting utility lines are allowed along the outer right of way line between intermittent frontage roads. (See the Utilities Accommodation Policy regarding location of and access to utilities.)

(b) **Bus Stops.** Bus stops and pedestrian crossings are allowed as follows:

- In rural areas, bus stops and pedestrian crossings are subject to the same restrictions as in 1430.04(5) and (6).
- In urban areas, bus stops for both commercial carriers and school buses are allowed. (See Chapter 1060 for requirements.)

(c) **Mailboxes.** Locate mailboxes adjacent to or opposite all authorized approaches as follows:

- On a four-lane highway only on the side of the highway on which the deeded approach is provided.
- On a two-lane highway on the side of the highway that is on the right in the direction of the mail delivery.

Where mailboxes are allowed, a mailbox turnout is recommended to allow mail delivery vehicles to stop clear of the through traffic lanes. (See Chapter 700 for additional information concerning mailbox locations and turnouts.)

(6) Pedestrian and Bicycle Traffic and Paths

Pedestrians and bicyclists are allowed, consistent with "Rules of the Road" (RCW 46.61), on modified control limited access highways, except where unusual safety considerations support prohibition. Information pertaining to such prohibitions is available from the Traffic Operations Office of the HQ Maintenance and Operations Division.

When paths are allowed, they must be documented in the Right of Way and Limited Access Plan. The plan shows the location of the path and where the path crosses limited access, and provides movement notes (see 1430.10(1)).

1430.06 Access Approaches

(1) General

Access approaches may be allowed on limited access highways consistent with the requirements outlined in 1430.03, 1430.04, and 1430.05.

For additional information pertaining to approaches, refer to Chapters 915 (roundabouts), 920 (approach design templates), and 1410 (right of way), and the *Plans Preparation Manual*.

(2) Definitions

The widths for the approach types are negotiated, and only the negotiated widths are shown on the Right of Way and Limited Access Plan. (See Chapter 1420 for specific definitions of the approach types.)

1430.07 Frontage Roads

Local agency approval is required for any planned frontage roads, county roads, city streets, or cul-de-sacs. The local agency must also agree in writing to accept and maintain the new section as a county road or city street.

(1) General

Frontage roads are provided in conjunction with limited access highways to:

- Limit access to the main line.
- Provide access to abutting land ownerships.
- Restore the continuity of the local street or roadway system.

Refer to Chapter 620 for frontage road general policy and Chapter 330 for required documentation.

By agreement under which the state is reimbursed for all costs involved, frontage roads that are not the responsibility of the state may be built by the state upon the request of a local political subdivision, a private agency, or an individual.

(2) County Road and City Street

To connect roads or streets that have been closed off by the highway, short sections of county roads or city streets that are not adjacent to the highway may be constructed if they will serve the same purpose as, and cost less than, a frontage road.

(3) Cul-de-sacs

For a frontage road or local street bearing substantial traffic that is terminated or closed at one end, provide a cul-de-sac (or other street or roadway consistent with local policy or practice) that is sufficient to allow vehicles to turn around without encroachment on private property.

1430.08 Turnbacks

When WSDOT transfers jurisdiction of operating right of way to a city, town, or county, a turnback agreement is required. (See the *Agreements Manual* for turnback procedures.)

Locate the turnback limits at points of logical termination. This will allow WSDOT to retain an adequate amount of right of way for maintenance of the highway and for other operational functions.

In areas where limited access rights have been acquired from the abutting property owners, the limited access rights will continue to be required for highway purposes; thus the limited access rights will not be included as part of a turnback agreement.

When a signalized intersection is in the area of a turnback, locate the turnback limit outside of the detector loops if WSDOT is continuing the ownership, operation, and maintenance of the signal system. For a roundabout, locate the turnback limit at the back of the raised approach splitter island if WSDOT is continuing the ownership, operation, and maintenance of the roundabout.

1430.09 Adjacent Railroads

(1) General

A limited access highway and a railroad are considered adjacent when they have a common right of way border with no other property separating them. The allowed approaches only apply to adjacent railroad property that is directly used for current railroad operation.

(2) Requirements

It is in the public interest to provide access to the railroad right of way, from limited access highways, for maintenance of the railroad and the utilities located on the railroad right of way when other access is not feasible. This applies to both new highways and to existing highways where limited access has been acquired.

Direct access is allowed when local roads are infrequent or there are few highway-railroad crossings from which trail-type access for maintenance purposes is feasible, and when unique topography or other unusual conditions justify its use.

Direct access from the highway is considered unnecessary and is not allowed when:

- There are local roads adjacent to or crossing the railroad.
- A trail-type road can be provided by the railroad between crossroads.
- The limited access highway is paralleled by a frontage road adjacent to the railroad.
- No highway previously existed adjacent to the railroad.

(3) Restrictions

To justify direct approaches for access to railroad right of way, all of the following conditions must be met:

- A maximum of one approach is allowed for every 2 miles of highway.
- The approach must not adversely affect the design, construction, stability, traffic safety, or operation of the highway.
- Except when the railroad is located in the median area, the approach is to be accomplished in a legal manner by right turns only, to and from the roadway nearest the railroad. Median crossing is not allowed.
- The approach is secured by a locked gate under arrangements satisfactory to the department. (See Approach Type C in Chapter 1420, and Chapter 1425.)
- The parking of any vehicles or railroad equipment is prohibited within limited access highway right of way.
- A special emergency maintenance permit must be obtained for periods of intensive railroad maintenance.
- The approach must be closed if the railroad operation ceases.
- Approaches are limited to use by the railroad company, unless specific provisions for other use are shown on the Right of Way and Limited Access Plan and included in the right of way negotiations.

1430.10 Modifications to Limited Access Highways

(1) General

Modifications to limited access highways can only be made by the application of current design requirements, and with the approval of the E&EP Director (or designee) and FHWA (when appropriate).

Any change is a modification to limited access; for example, new fence openings, closing existing fence openings, adding trails that cross into and out of the right of way, and widening existing approaches. The Right of Way and Limited Access Plan must be revised and, if private approaches are involved, deeds must be redone.

Any changes proposed on interstate limited access facilities must include environmental documentation in the request. Contact the HQ Access and Hearings unit for assistance.

Consider the following factors when evaluating a request for modification of a limited access highway:

- Existing level of control on the highway
- Functional classification and importance of the highway
- Percentage of truck traffic
- Highway operations
- Present or future land use
- Environment or aesthetics
- Economic considerations
- Safety considerations

Evaluate all revisions to limited access highways to determine if access hearings are required.

For requirements to be met for selected modifications to full control limited access highways, such as the Interstate System and multilane state highways, see Chapter 1425, "Interchange Justification Report."

(2) Modifications for Private Access Approaches

(a) **Requirements.** Examples of access modifications requested by abutting property owners include additional road approaches, changes in the allowed use, or additional users of existing road approaches.

Plan revisions that provide for additional access to abutting properties after WSDOT has purchased the access rights are discouraged. However, these revisions may be considered if all of the following can be established:

- There are no other reasonable alternatives
- The efficiency and safety of the highway will not be adversely impacted
- The existing situation causes extreme hardship on the owner(s)
- The revision is consistent with the limited access highway requirements

(b) **Procedures.** The region initiates a preliminary engineering review of the requested modification to or break in limited access. This preliminary review will be conducted with the HQ Access and Hearings Unit to determine if conceptual approval can be granted for the request. If conceptual approval can be granted, then:

- The region initiates an engineering review of the requested modification.
- The region prepares and submits to the HQ Plans Branch a preliminary Right of Way and Limited Access Plan revision, together with a recommendation for approval by the E&EP Director. When federal-aid funds are involved in any phase of the project, the proposed modification will be sent to FHWA for its review and approval.
- The recommendation will include an item-by-item analysis of the factors listed in 1430.10(1) and 1430.10(2)(a).

(c) **Valuation Determination.** Upon preliminary approval, region Real Estate Services prepares an appraisal for the value of the access change using a before and after appraisal.

- The appraisal follows the requirements set forth in the *Right of Way Manual*.
- The appraisal is reviewed by the HQ Real Estate Services Office. If the appraisal data does not support a value of $1500 or more, a minimum value of $1500 is used.
- The appraisal package is sent to the HQ Real Estate Services Office for review and approval.
- If federal-aid funds were involved in purchasing access control, the HQ Real Estate Services will send a copy of the appraisal package to FHWA for its review and approval.

(d) **Final Processing**

- Region Real Estate Services informs the requestor of the approved appraised value for the change.
- If the requestor is still interested, the region prepares a "Surplus Disposal Package" for HQ Real Estate Services Office review and approval.
- At the same time, the preliminary Right of Way and Limited Access Plan revision previously transmitted is processed for approval.
- After the department collects the payment from the requestor, the region issues a permit for the construction, if required.
- If an existing approach is being surrendered, region Real Estate Services obtains a conveyance from the property owner.
- The HQ Real Estate Services Office prepares and processes a deed granting the change to the access rights.

(3) Modifications for Public At-Grade Intersections

(a) **Requirements**

- Public at-grade intersections on partial control limited access highways serve local arterials that form part of the local transportation network.
- Requests for new intersections on limited access highways must be made by or through the local governmental agency to WSDOT. The region will forward this request, including the data referenced in 1430.10(1) and 1430.10(2)(a) to the HQ Access and Hearings Unit.
- New intersections require full application of current limited access acquisition and conveyance to WSDOT. The access acquisition and conveyance must be completed prior to beginning construction of the new intersection. The new intersection will meet WSDOT design and spacing requirements.

(b) **Procedures**

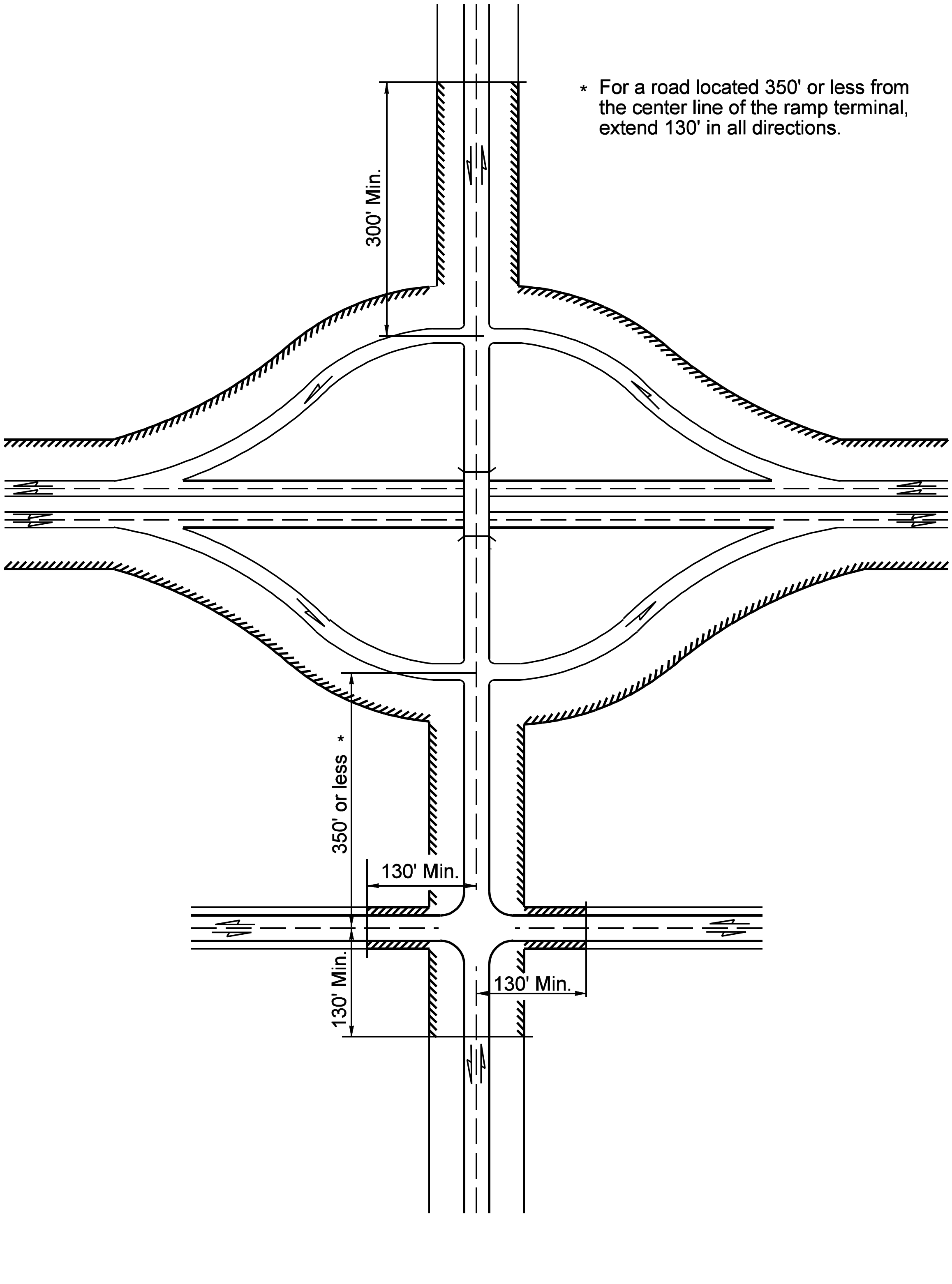
- The region evaluates the request for modification and contacts the HQ Access and Hearings Unit for conceptual approval.
- The region submits an intersection plan for approval (see Chapter 910) and a Right of Way and Limited Access Plan revision request (see the *Plans Preparation Manual*). This plan includes the limited access design requirements along the proposed public at-grade intersection.
- The State Design Engineer approves the intersection plan.
- The E&EP Director (or designee) approves the access revision.
- The region submits the construction agreement to the State Design Engineer (see the *Agreements Manual*).
- The E&EP Director (or designee) approves the construction agreement.

(c) **Valuation Determination**

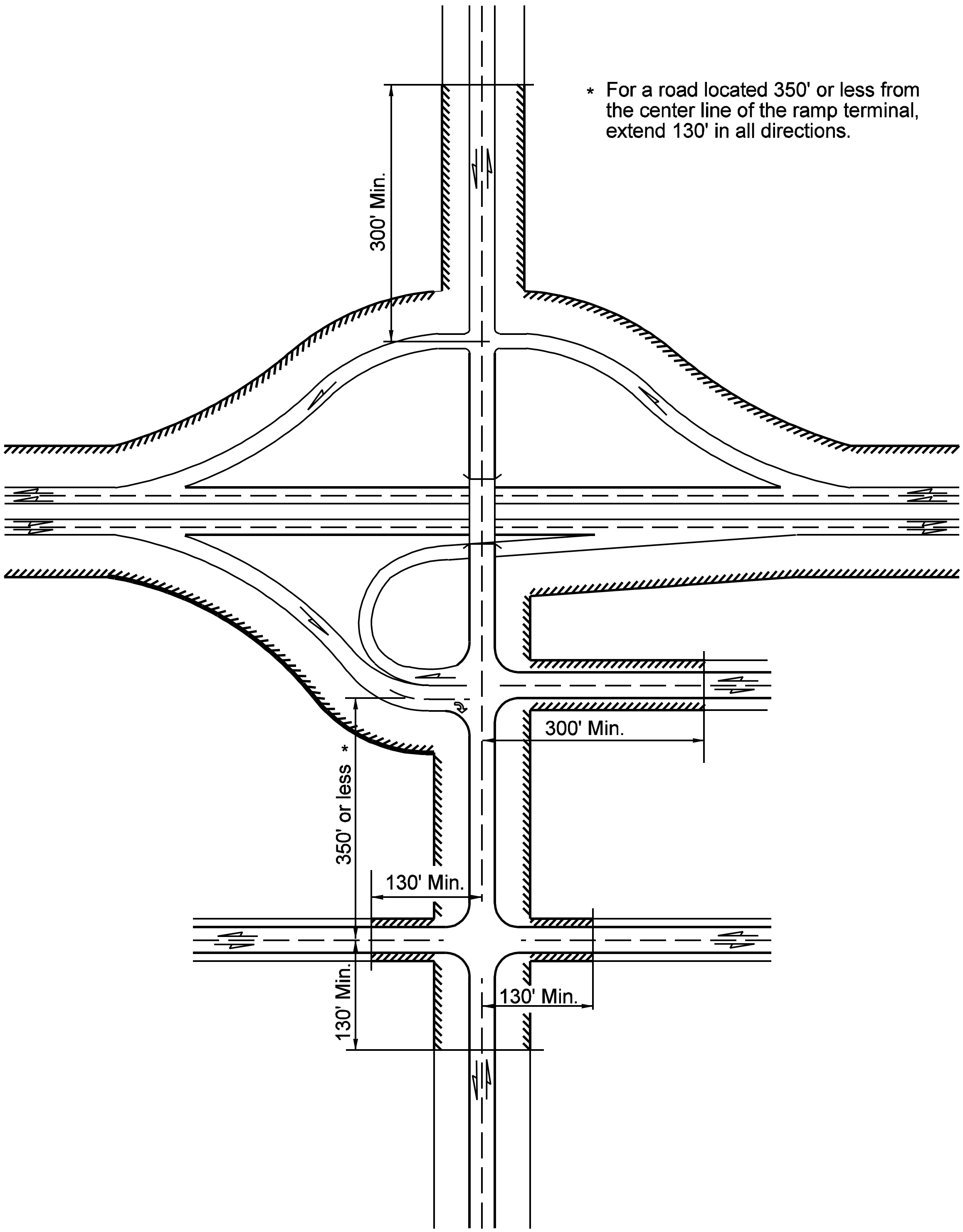
- When a requested public at-grade intersection will serve a local arterial that immediately connects to the local transportation network, compensation will not be required.
- When a requested public at-grade intersection will serve only a limited area, does not immediately connect to the local transportation network, or is primarily for the benefit of a limited number of developers, compensation for the access change will be addressed in the plan revision request. In these situations, compensation is appropriate and a value will be determined as outlined in 1430.10(2)(c).

1430.11 Documentation

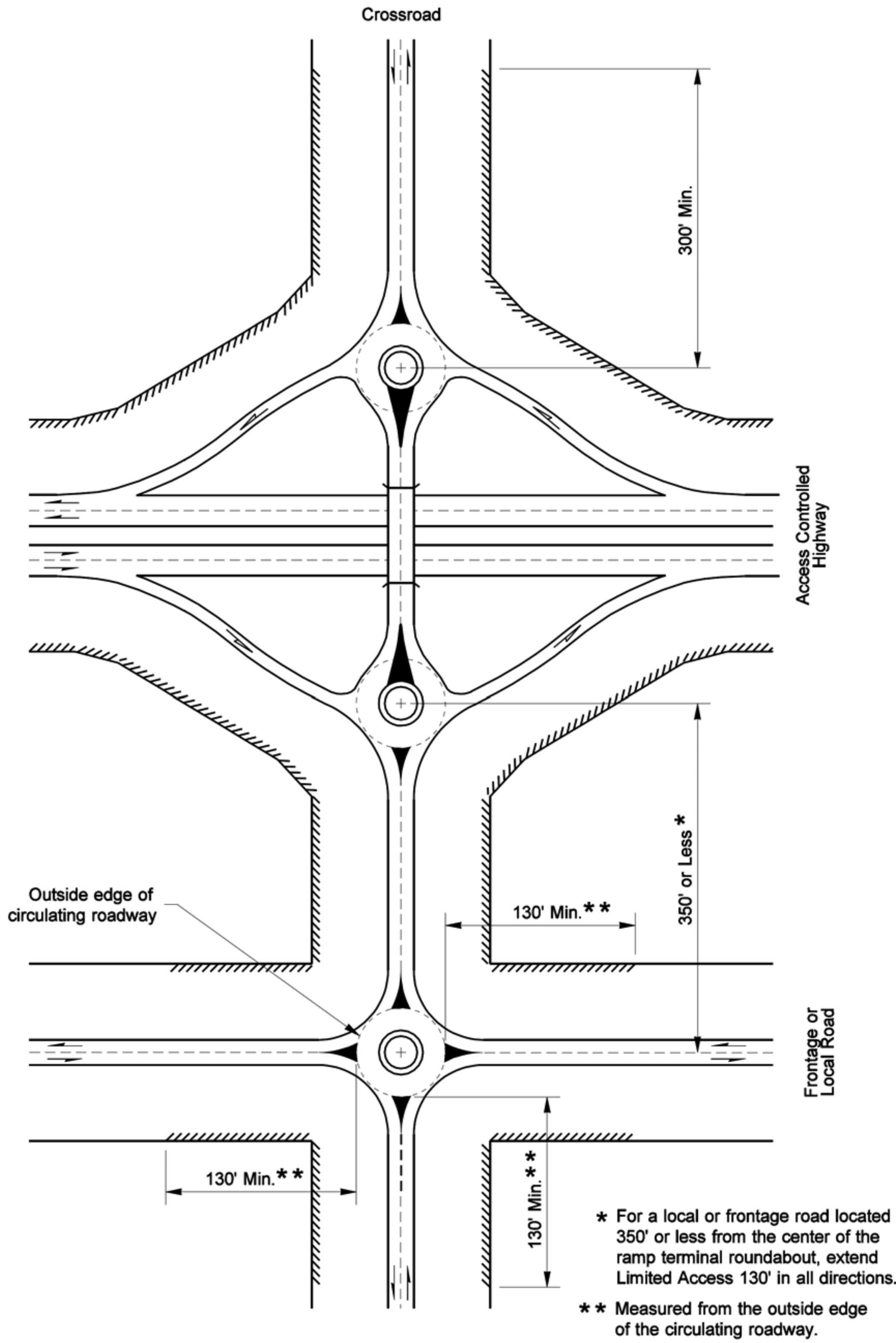
For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/



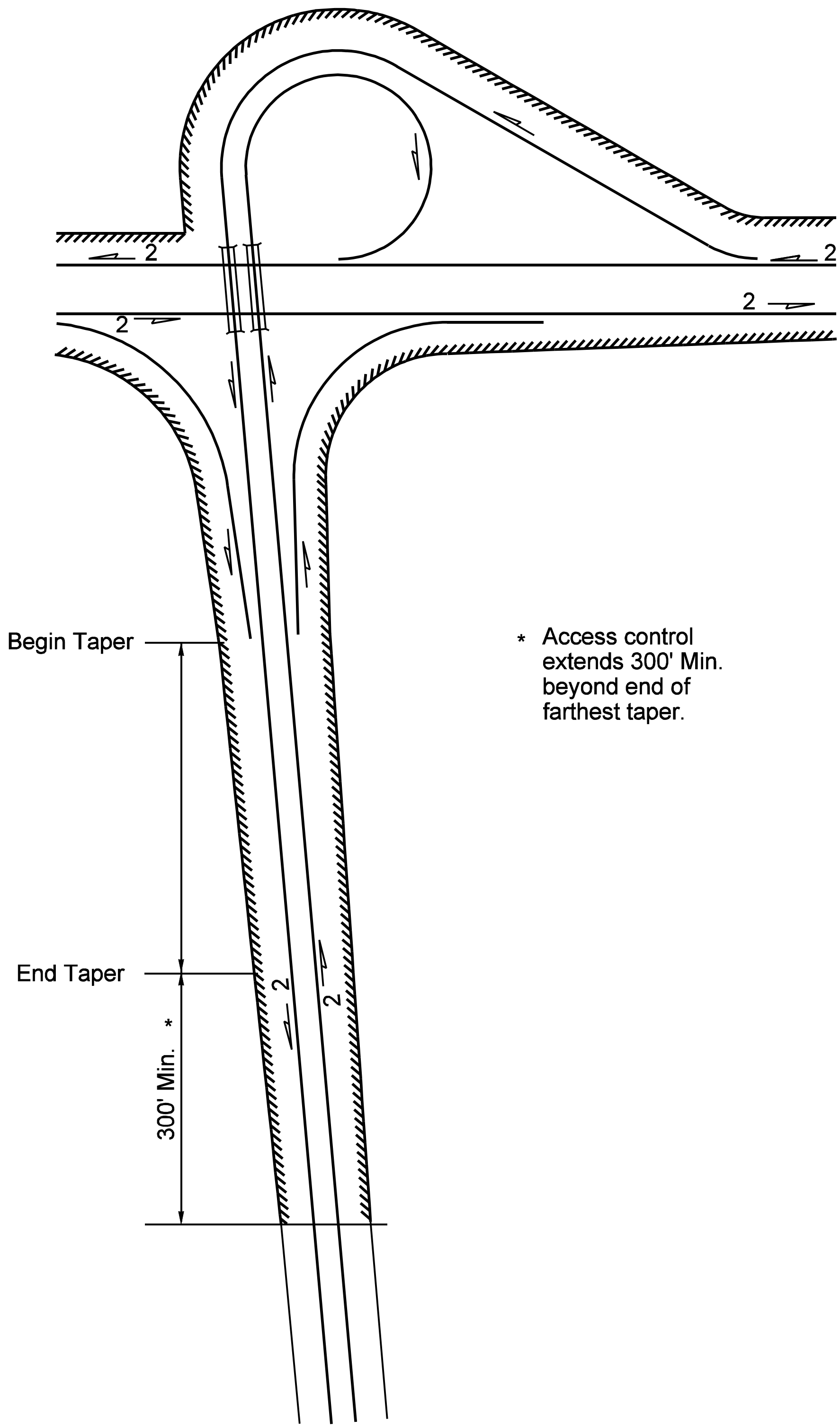
Full Access Control Limits – Interchange
Figure 1430-1a



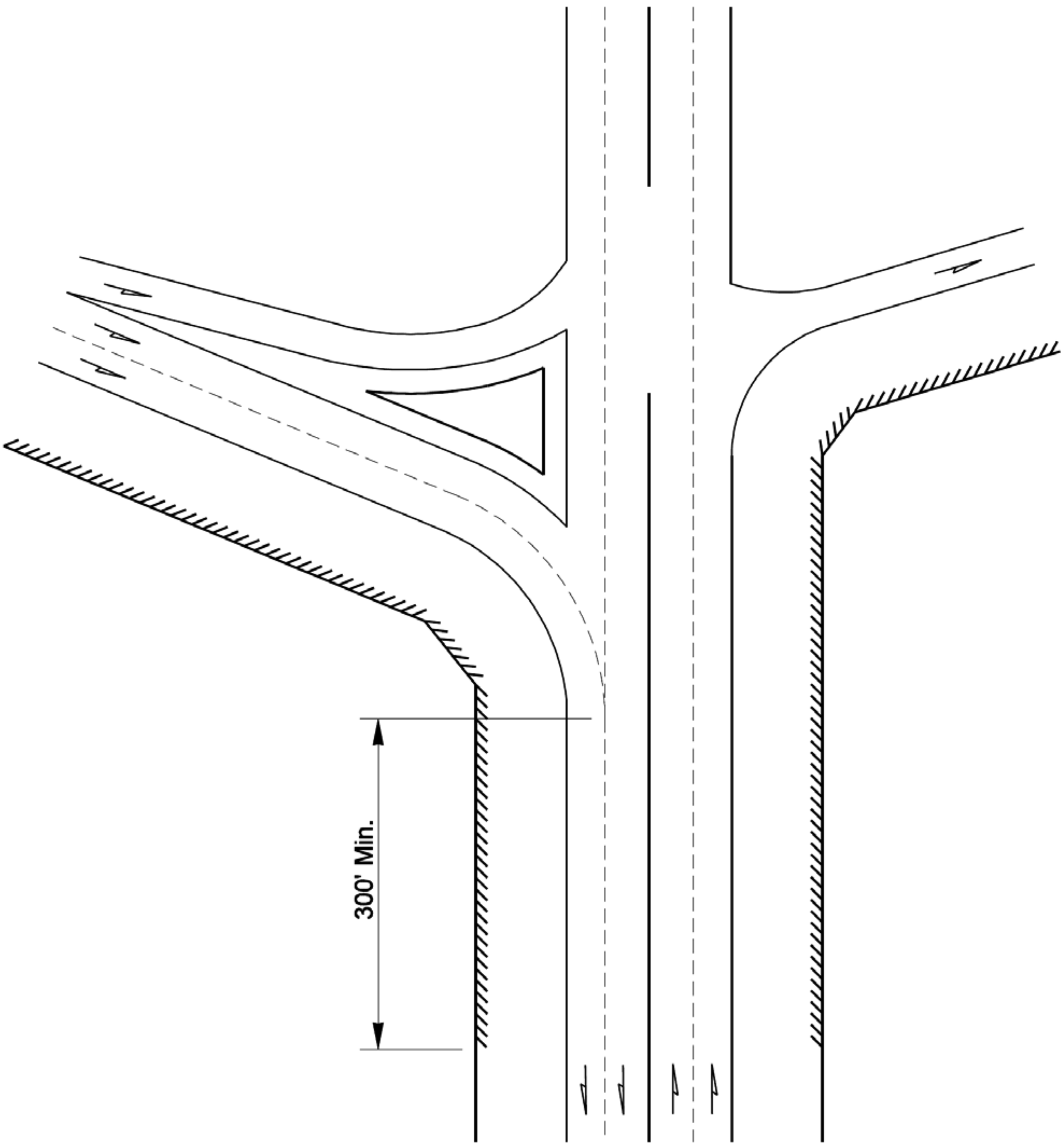
Full Access Control Limits – Interchange
Figure 1430-1b



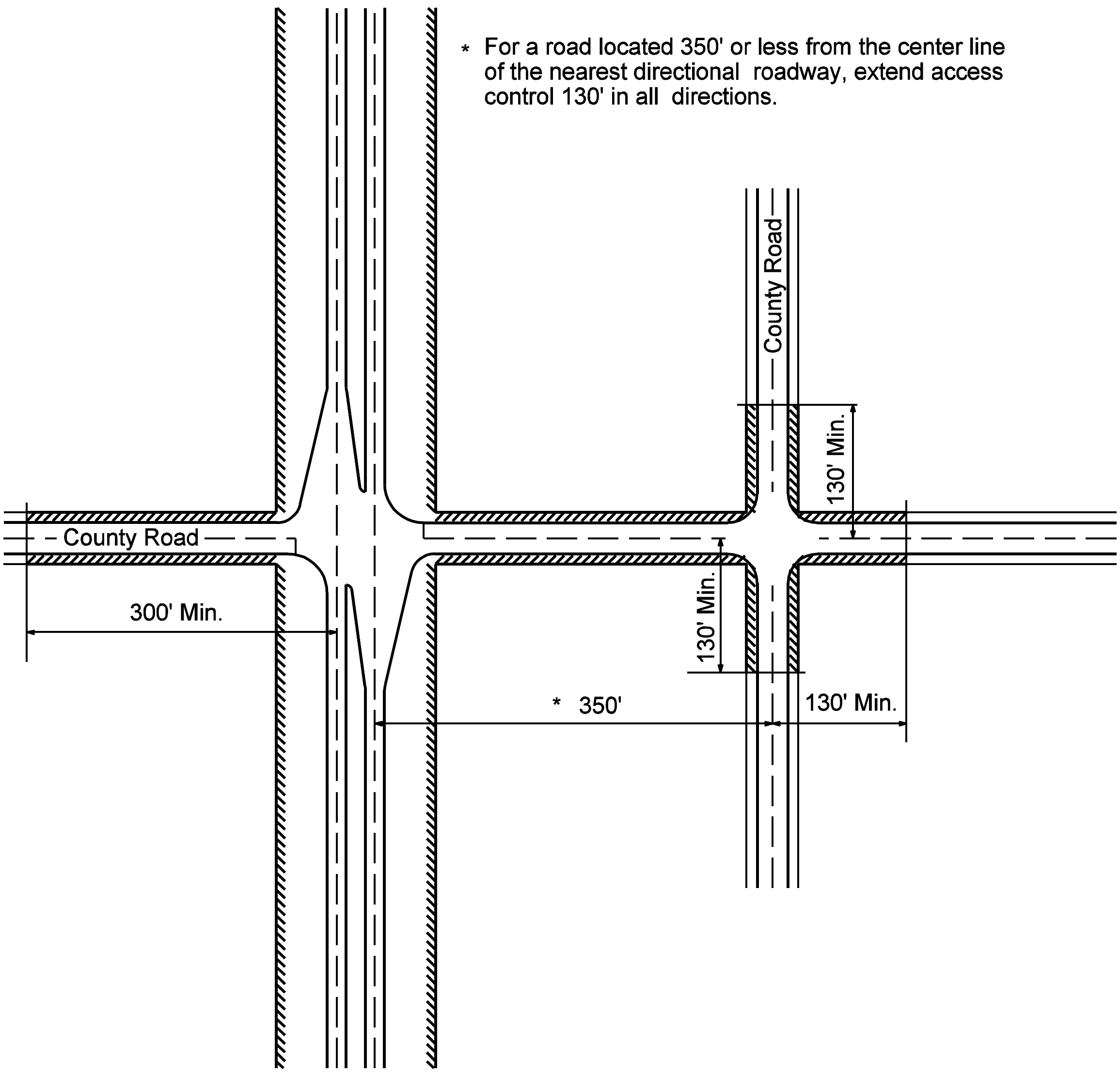
Full Access Control Limits – Interchange With Roundabouts
Figure 1430-1c



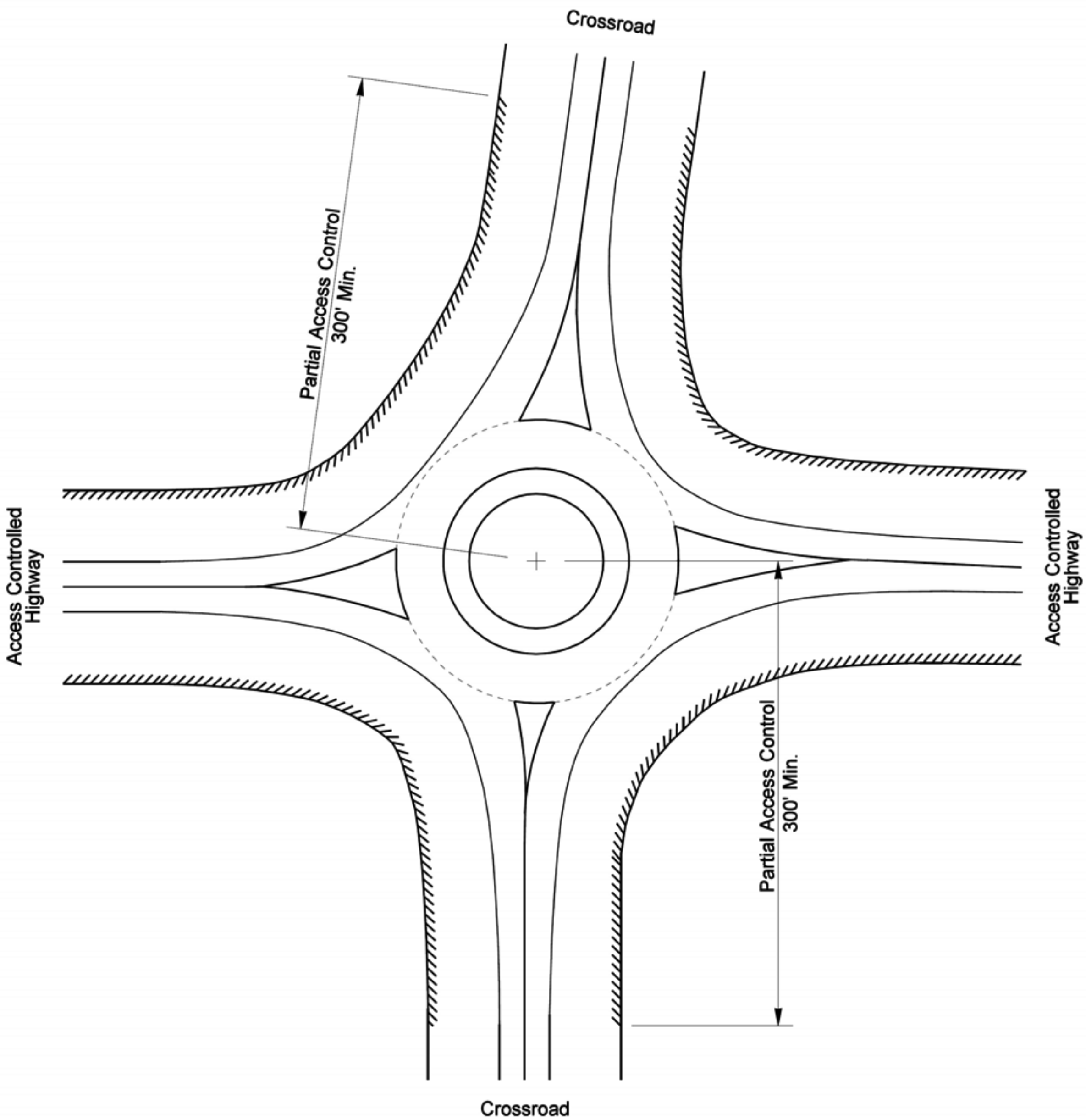
Full Access Control Limits – Ramp Terminal With Transition Taper
Figure 1430-2



Full Access Control Limits – Single Point Urban Interchange
Figure 1430-3



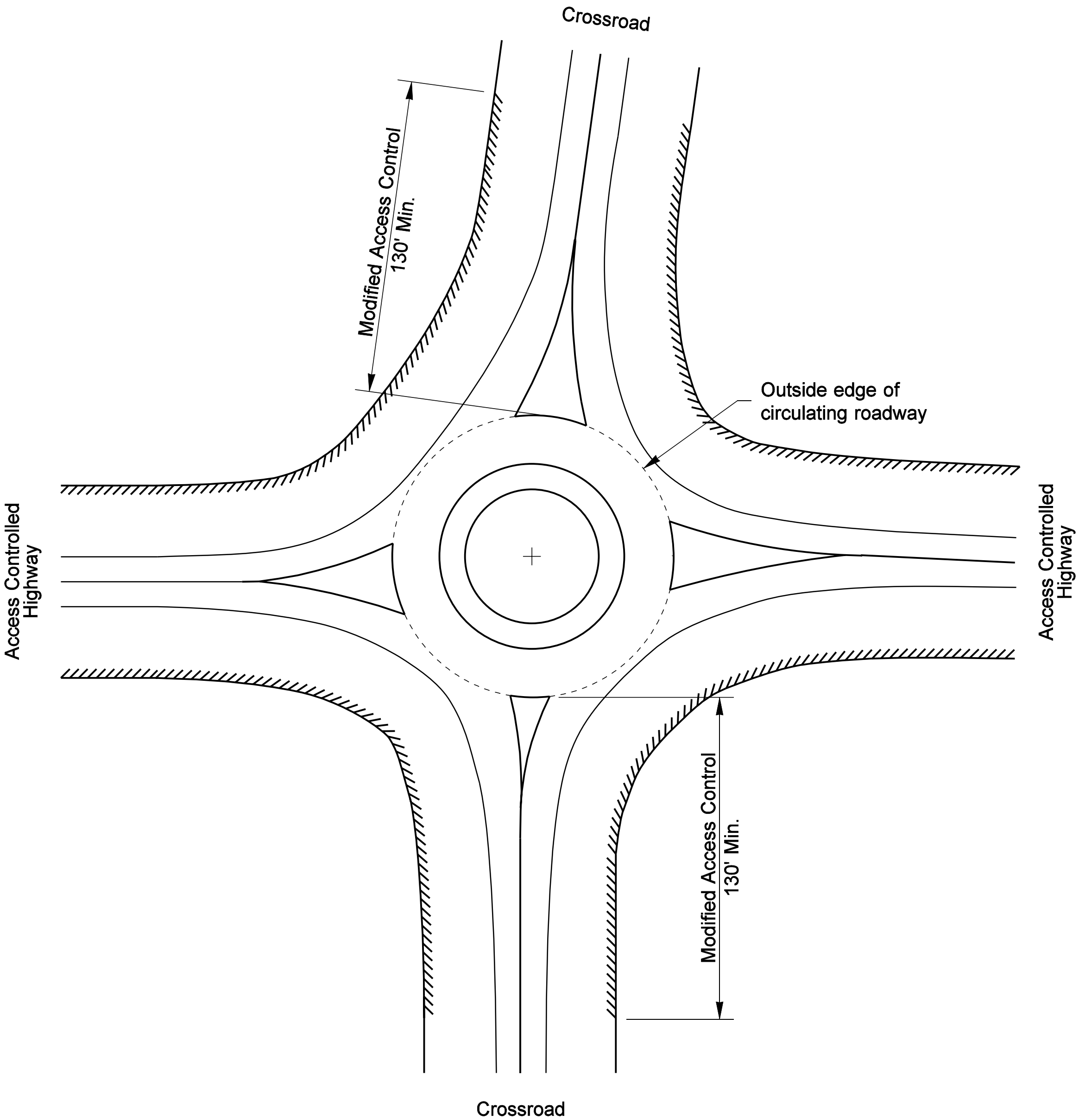
Partial Access Control Limits – At-Grade Intersections
Figure 1430-4



Note:

Partial access control is measured from the center of the roundabout.

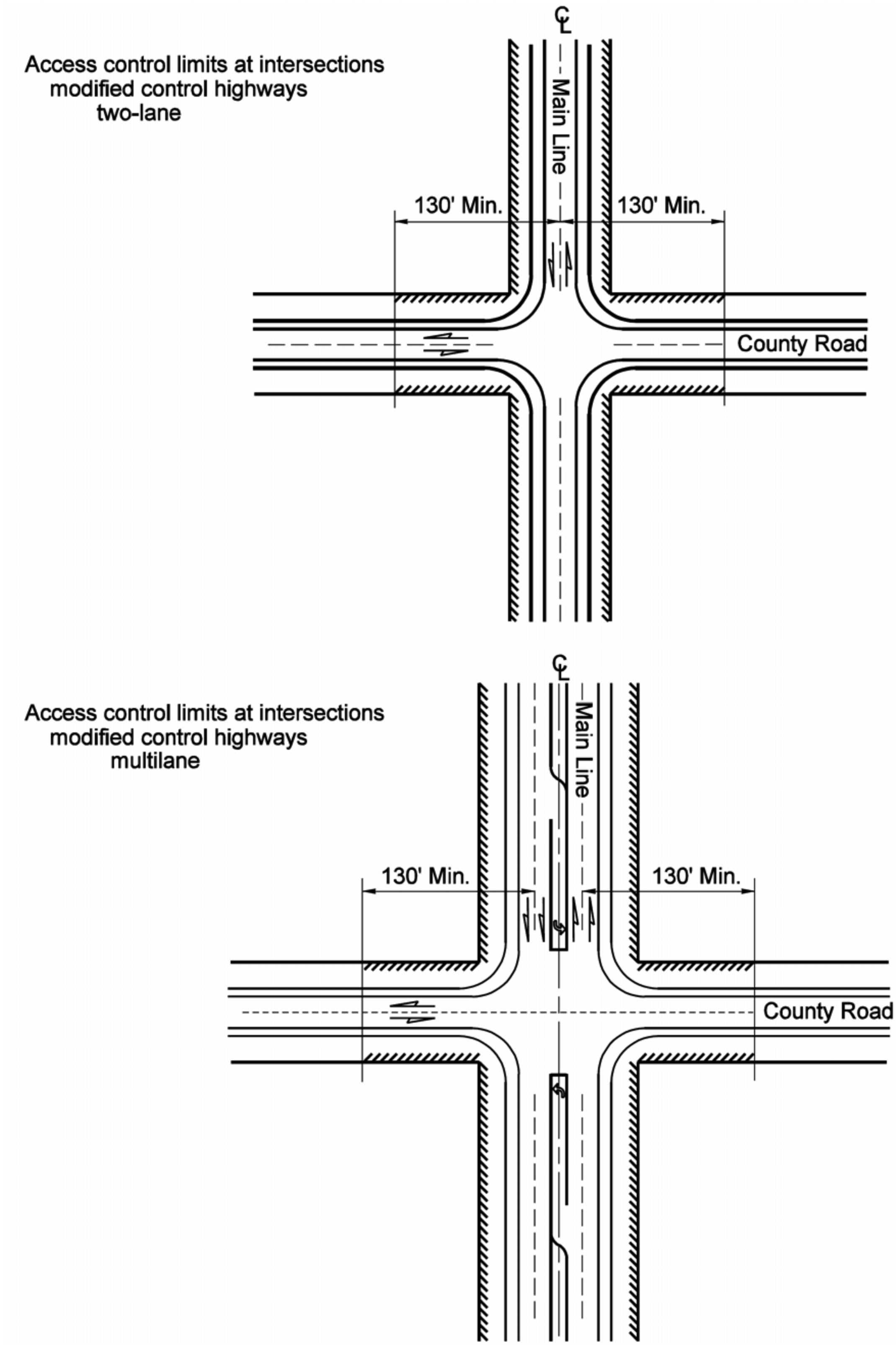
Partial Access Control Limits – Roundabout Intersections
Figure 1430-5a



Note:

Modified access control is measured from the outside edge of the circulating roadway.

Modified Access Control Limits – Roundabout Intersections
Figure 1430-5b



Modified Access Control Limits – Intersections
Figure 1430-6

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