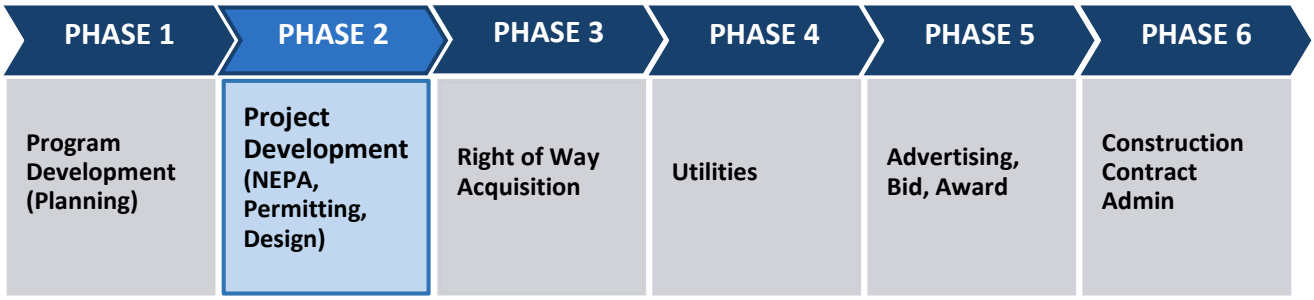
Chapter 9. General Design Requirements

This chapter and the following chapters of this manual relate to the design phase of Federal Highway Administration (FHWA) funded Certified Local Public Agency (LPA) projects:

- Chapter 9, General Design Requirements
- Chapter 10, Design Approval
- Chapter 14, Plans, Specifications, and Estimates (PS&E)

In the sequence of project delivery, design occurs during project development, but prior to advertising for bids and award.



9.1 OVERVIEW

The American Association of State Highway and Transportation Officials (AASHTO) guidelines have been adopted as the design standard for FHWA funded projects on local national highway system (NHS) routes and projects on the LPA's transportation system. Design standards for projects on the state highway system must conform to the requirements detailed in ODOT's current Highway Design Manual (HDM), other ODOT manuals, and ODOT technical bulletins and directives.

The approving agency identified for the various phases of work is indicated in the Approval Authority Matrix. See the resources section at the end of this chapter.

Different standards apply to the design of:

- New construction / reconstruction projects,
- Resurfacing, restoration, and rehabilitation projects; and
- Low-volume roads (local or minor collector roads with design average daily traffic volume of 2,000 vehicles per day or less).

Each of these standards is defined in separate sections below. LPAs should determine which standards apply before beginning their project design.

For FHWA funded projects, current AASHTO standards apply based on the federal functional classification of the roadway. Additional classification information is availableon ODOT's Federal Functional Classification website.

Generally, context sensitive design concepts should be considered for all project designs. Additional information related to context sensitive design can be found at the Oregon Transportation and Growth Management website and in ODOT HDM Part 200.

9.2 VALUE ENGINEERING

Value Engineering (VE), as stated in ODOT Policy Number DES 01-03, is a project analysis technique that often generates significant cost reduction; however, the primary focus is value improvement. VE will help ODOT and LPAs in the goals of providing cost-effective projects and procedures, and improved productivity and efficiency. Transportation agencies canuse VE in all aspects of transportation such as design, traffic operations, construction, maintenance, specifications, standard drawings, and planning.

The VE methodology is a systematic approach used to identify opportunities for reductionsin cost, schedule, and risk, while increasing lifecycle performance. FHWA states that VE is "the most effective technique for identifying and eliminating unnecessary costs and enhancing value".

All ODOT highway construction projects in the Statewide Transportation Improvement Program (STIP) shall be screened based upon established criteria to determine the need to conduct a formal Value Engineering Study.

As of January 1, 2020, ODOT has adopted value engineering guidance outlined in DES 01-03 for STIP projects. While LPAs are exempt from DES 01-03, they are required to meet the following FHWA regulations (23 CFR 627):

- All projects with an estimated total cost of $50 million or more are required to have a Value Engineering Study regardless of funding source or NHS designation.
- All federal aid funded bridge projects on the NHS with an estimated total cost of $40 million or more are required to have a Value Engineering Study (23 CFR 627).
- VE analysis is not required for projects delivered using the design-build.
- Method of construction (23 USR 106(e)(5))

Regardless of project cost, ODOT encourages LPAs to consider performing VE for projects with one or more of the following attributes:

- Projects that have significantly exceeded preliminary cost estimates
- Projects with initial total cost estimates approaching and that may exceed federal thresholds through project development and construction
- Projects with alternative solutions to documented problems
- Major structures
- Complex projects
- Projects using critical or high-cost materials and procedures
- Projects with multiple phases
- Projects that include extensive or expensive environmental or geotechnical requirements
- Projects with complex traffic staging
- Projects being considered for alternative contracting methods
- Projects of high cost

See ODOT Risk Management, Value Engineering, and Constructability Reviews webpage and 23 CFR 627 for additional VE information.

9.3 RESURFACING, RESTORATION, AND REHABILITATION PROJECTS (3R)

Resurfacing, restoration, and rehabilitation work on the state highway shall be designed to ODOT 3R standards found in ODOT's HDM. This type of work on non-state routes may be designed to ODOT 3R or AASHTO standards. Care should be taken to ensure that the standards chosen are appropriate for the functional classification of the road in question.

Additional design guidance for 3R projects may be found in Transportation Research Board (TRB) Special Report 214. Additional information for 3R projects geared toward the urban environment may be found in NCHRP Report #876.

Preservation projects may include small portions of modernization activities as part of the project, such as affecting subgrade, re-basing, adding a turn lane or minor curve modifications. If these elements do not account for over 50 percent of the project length, the appropriate ODOT 3R standard is to be used for work on the state highway. Otherwise, the project is treated as modernization and the appropriate ODOT 4R or new construction standard shall be used. For additional information, refer to ODOT HDM. For work not on the state highway ODOT and/or AASHTO standards and NCHRP Report #876 guidelines may be applied.

9.4 NEW CONSTRUCTION/RECONSTRUCTION PROJECTS (4R)

A reconstruction project is designed to meet the design criteria for new construction for the functional class. Reconstruction includes significant changes in cross section or shifts in both vertical and horizontal alignment.

Reconstruction may require acquisition of additional right of way and may include work usually associated with new construction, including but not limited to the design considerations outlined in items 9.6.1 through 9.6.15 in section 9.6 below. New construction/reconstruction projects on routes under state jurisdiction shall be designed to the 4R standards found in the ODOT HDM.

Projects on other routes shall be designed to the standards found in the current version of AASHTO's A Policy on Geometric Design of Highways and Streets. AASHTO manuals can be purchased at the AASHTO bookstore website.

If it is not clear which standard should be used, contact the ODOT project contact. It is important that the standards chosen are appropriate for the functional classification of the road in question.

9.5 DESIGN OF LOW-VOLUME LOCAL ROADS (ADT < 2000)

A low-volume road is a road that is functionally classified as a local road and has a design ADT of 2,000 vehicles per day or less. Design standards for low-volume local agency roads can be found in the AASHTO Guidelines for Geometric Design of Low-Volume Local Roads.

The AASHTO Guidelines for Geometric Design of Low-Volume-Roads is intended for application in the design of new construction or improvements to existing very low-volume roads. These guidelines apply in both urban and rural areas.

The design guidelines enable designers to apply design criteria that are generally less restrictive than those used on higher-volume roads. The risk assessment upon which these guidelines are based shows that these less restrictive design criteria can be applied on low-volume roads without compromising safety.

AASHTO manuals can be purchased at the AASHTO bookstore website.

9.6 DESIGN CONSIDERATIONS

9.6.1 Roadside Inventory

A Roadside Inventory (see ODOT HDM) is an integral part of all projects and should include:

- Upgrading existing substandard roadway design elements
- Improving existing operational features
- Reducing the potential hazard of existing roadside features
- Upgrading bridge safety features

9.6.2 Roadway Geometrics

Designs shall be based upon accepted engineering practices and the requirements listed in this manual.

9.6.3 Pavement Determination

To be eligible for federal funding, pavements shall be designed to provide a service life of 20 years for new or reconstructed pavements and 15 years for rehabilitated pavements. Any departure from these service life requirements will be considered a design deviation. See the Design Exceptions/Deviations section below for additional details on the design exception process. Refer to ODOT's Pavement Design Guide for additional information.

ODOT must approve all pavement designs for LPA projects on the state highway system. The determination of pavement type is of major importance in the development of plans for any urban street and road paving improvement.

9.6.4 Structural Design

Design procedures shall conform to AASHTO's Load and Resistance Factor Design (LRFD) methodology.

The AASHTO LRFD Bridge Design Specifications can be purchased at the AASHTO bookstore website. Bridge deck protection is required for all FHWA funded bridge construction. The recommended protective systems are outlined in ODOT's Bridge Design Manual.

9.6.5 Traffic Control

All traffic control devices on the State Highway system and on all public roads shall conform to the Manual on Uniform Traffic Control Devices (MUTCD) and Oregon Supplement to the Manual on Uniform Traffic Control Devices. (23 CFR 655.603; ORS 810.200). In addition, when an LPA installs a traffic control device under interim approval by FHWA, the LPA must inform the statetraffic engineer's office in order to maintain a comprehensive list of such installations.

Once an interim approval device is installed, LPAs can report the installation through the Traffic Control Device Installation Report form onthe ODOT Engineering website. A list of devices that require reporting is located on the ODOT MUTCD web page. Traffic control poles and foundations should be checked by a professional engineer (with structural or geotechnical experience) or responsible manufacturer.

Critical required elements of temporary traffic control include safe bicycle, pedestrian, and ADA accommodations through or around work zones. These accommodations must be equal to or better than the existing level of accessibility prior to construction. Refer to Section 6D of the MUTCD for more information.

Additional guidance is also provided in ODOT's Technical Services Directive TSB17-01(D) entitled Temporary Pedestrian Accessible Route Plans Required for Work Zones.

9.6.6 Clear Zone

The clear zone is the unobstructed, traversable area beyond the edge of the traveled way that allows an errant driver to stop or regain control of a vehicle. See the AASHTO Roadside Design Guide and Part 400 of the ODOT HDM for further clear zone discussion.

Refer to the AASHTO Roadside Design Guide criteria for establishing clear zone distances, discussions of roadside features, and data on roadside barriers. If the guidelines in the Roadside Design Guide are not followed, the deviation process outlined in the Design Exceptions/Deviations section below shall be followed. The AASHTO Roadside Design Guide can be purchased at the AASHTO bookstore website.

9.6.7 Vertical Clearance

Refer to the appropriate section of AASHTO's *A Policy* on Geometric Design of Highways and Streets for the required vertical clearance for each functional classification of roadway. Vertical clearance on state highways must follow guidance and criteria established in the ODOT HDM.

As noted on page 7-13 of the Bicycle and Pedestrian Design Guide (HDM Appendix L), the standard vertical clearance of structures above multi-use paths and sidewalks is ten feet and under some circumstances, a minimum of eight feet may be allowable with good horizontal and verticalclearance, so users approaching the structure can see through to the other end.

9.6.8 Bridge Approach Railings

Approach guardrail is required at all bridge ends and shall be made structurally continuous with the bridge railing. For additional information regarding bridge railings, see Section C, Chapter 13 (Bridge) of this manual. Guardrail layouts have been developed for use when an intersecting roadway or private approach exists within the limit of the standard bridge approach guardrail.

See ODOT's Standard Drawings and Standard Details website for additional information.

9.6.9 Bridge Railings

Only bridge rail designs that have been successfully crash tested (or their equivalents) shall be used on federally funded new construction or reconstruction projects. ODOT's Bridge Design Manual contains guidelines and performance levels for bridge railing along with examples of bridge rail designs that have been crash tested.

9.6.10 Illumination

Consider roadway illumination for high activity pedestrian areas (bus stops, crosswalks, etc.), locations with a high number of night-time accidents, interchanges, etc. Low energy consumption designs should be considered as the maintenance and operation costs of illumination systems may exceed the installation costs. Lighting levels should be designed according to Illuminating Engineering Society Standards. Light poles and foundations should be checked by a structural engineer or responsible manufacturer.

9.6.11 Pedestrian Facilities

Refer to Part 800 and Appendix L in the ODOT HDM for design, traffic control and illumination standards, best practice recommendations, guidance,and information on pedestrian accommodation.

Sidewalks should be incorporated into reconstruction projects as required by law and into other projects where appropriate.

Refer to the Oregon Bicycle and Pedestrian Plan to ensure that projects conform to statewide goals, policies, and strategies for accommodating pedestrians. See also ODOT's Pedestrian and Bicycle Program website for information related to bicycle facility laws, standards, funding, contacts, etc. for design and traffic control standards, best practices, guidance, and information on pedestrian accommodation.

9.6.12 Bicycle Facilities

Refer to Part 900 and Appendix L in the ODOT HDM for design, traffic control, and illumination standards, best practice recommendations, guidance, and information on accommodating people on bicycles.

Bikeways should be incorporated into reconstruction projects as required by law and into projects where appropriate.

Refer to the Oregon Bicycle and Pedestrian Plan to ensure that projects conform to statewide goals, policies, and strategies for accommodating bicyclists. See also ODOT's Pedestrian and Bicycle website for information related to bicycle facility laws, standards, funding, contacts, etc.

9.6.13 Accessibility Features

Every service or facility provided in a project must be accessible and usable to people with disabilities in accordance with the Americans with Disabilities Act (ADA). For example, where sidewalks are provided, the sidewalks, curb ramps, and driveways shall meet the accessibility requirements of the ADA.

Note: Most Certified LPAs have an ADA Title II Transition Plan that identifies the priorities with respect to ensuring accessibility. See Section B of this manual.

Refer to ODOT's Engineering for Accessibility website for information about curb ramps, traffic signals, parking, accommodation in work zones, crosswalks and for ADA requirements.

Reference ODOT's Standard Drawings for additional guidance.

For projects on or along state highways, ODOT's Curb Ramp Process policy and procedures for the design and construction of sidewalks and ramps shall be followed, including the use of all ODOT forms. For projects on a local facility, ODOT's process must be followed unless the LPA has ODOT-approved ADA design, design exception, and inspection processes in place.

9.6.14 Drainage and Hydraulic Design

Refer to the ODOT Hydraulics Manual or other ODOT approved manuals.

9.6.15 Construction Specifications

Unless otherwise agreed upon, all federally funded certified LPA projects shall be constructed in conformance with the currentedition of the Oregon Standard Specifications for Construction as modified by the LPA and approved by ODOT.

Refer to Section B and Section C, Chapter 11 of this manual for additional information.

9.7 DESIGN EXCEPTIONS/DEVIATIONS

Certified LPAs are required to have a documented design exception process and shall document project design exceptions and the reasons for deviation from standards. Each documented design exception should include a description of the problem, its proposed solution, and any other information that may be helpful as a future reference.

For ADA-related design exceptions, the design exception should describe how it has ensured adherence to ADA standards to the maximum extent feasible.

LPAs are authorized to design projects to the standards referenced in this chapter, following the warrants and qualifying statements given. In the event all minimum recommendations cannot be incorporated into the design, the LPA shall obtain exception/deviation approval as applicable.

- Design exceptions shall be documented and approved by the appropriate authority prior to the LPA's completion of PS&E documents. Approval of any design exception is a prerequisite for PS&E approval.
- Roadway design exceptions for work on a local facility are processed and approved by the LPA.
- Design exceptions for work on or along the state highway system requires approval from ODOT of a Design Exception Request. To obtain ODOT approval, the LPA must submit a completed ODOT Design Exception Request form and supporting documentation to the ODOT project contact for processing. For more information, see ODOT HDM sections 1003.5, 1004 and 1006.1.
- All bridge design deviations must be approved by ODOT (and FHWA if necessary) if the bridge is on the National Bridge Inventory (NBI). For locally owned bridges not on the NBI, the LPA has approval authority.

For additional information, see the Approval Authority Matrix along with other resources below.

9.8 RESOURCES

For questions not covered here, contact the ODOT project contact.

Provider	Resource Title	Description	Link
AASHTO	AASHTO Bookstore	Webpage (transportation resources for purchase)	https://transportation.org/store/
eCFR	Value Engineering Title 23 Part 627	Webpage	https://ecfr.io/Title-23/cfr627_main
FHWA	Highway Functional Classification	Concepts, criteria and procedures	https://www.fhwa.dot.gov/policyinformation/hpms/hfcccp.cfm
ODOT	Curb Ramp Process	Webpage	https://www.oregon.gov/odot/ADA/Pages/Curb-Ramp-Engineering.aspx
ODOT	Engineering Guidance	Webpage (provides links to manuals, forms, design exceptions, ADA accessibility requirements, standard specifications and drawings)	https://www.oregon.gov/odot/engineering/pages/eng-guidance.aspx
ODOT	Implementing Uniform Traffic Control Devices	Webpage (links to applicable FHWA MUTCD, the Oregon Supplement to the MUTCD, and FHWA Interim Approvals)	https://www.oregon.gov/ODOT/Engineering/Pages/MUTCD.aspx
ODOT	Pedestrian and Bicycle Program	Webpage (includes plan and design)	https://www.oregon.gov/odot/programs/pages/bikeped.aspx
ODOT	Project Risk Management, Value Engineering and Constructability Reviews	Webpage	https://www.oregon.gov/ODOT/Engineering/Pages/VE-RM.aspx
ODOT	Transportation and Growth Management Program	Webpage (for Joint program of DLCD and ODOT)	https://www.oregon.gov/LCD/TGM/pages/index.aspx
OR DFR	File Complaint or Check License	Webpage	https://dfr.oregon.gov/help/complaints-licenses/Pages/check-license.aspx
OR SOS	Business Name Search	Webpage	https://sos.oregon.gov/business/pages/find.aspx
US DOJ	Americans with Disabilities Act	Webpage	https://www.ada.gov/