Chapter 1106 Design Element Dimensions

When choosing any dimension, read the guidance for the specific facility type (for example, for ramps see Chapter 1360) and also read the guidance for the specific element (for example for side slopes see Chapter 1239).
When a range of dimensions is given, consider modal needs, required function, and desired performance (Section 1106.03) and, where possible, use quantitative tools to help choose a dimension within the range.

1106.01 General

Practical design resolves the project need with the least investment. Flexibility in the choice of design element dimensions helps accomplish this.

For guidance related to geometric cross-section elements, first see Chapter 1230. For guidance related to all other design elements, see the appropriate chapter.

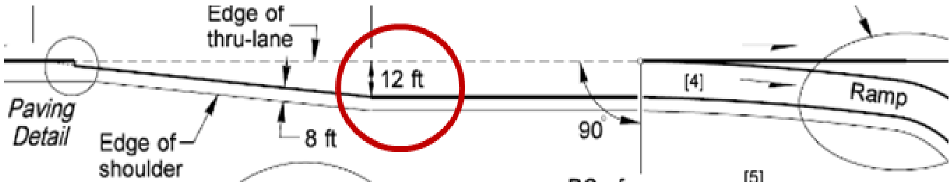
1106.02 Choosing Dimensions

Depending on the facility type, *Design Manual* guidance may come in the form of a single dimension or a range of dimensions to choose from. See Exhibit 1106-1.

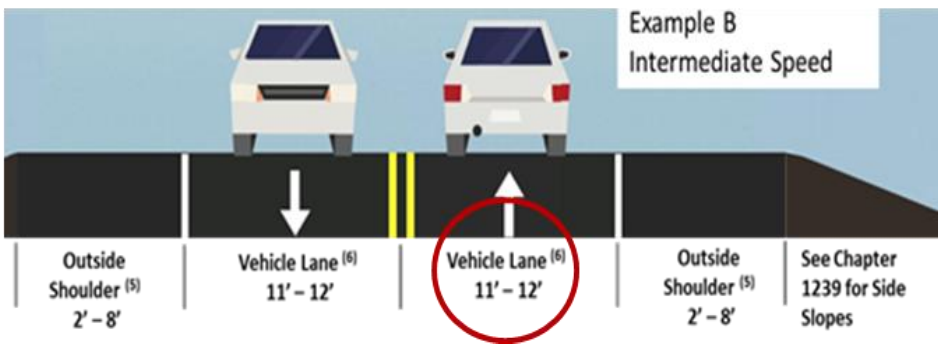
For some roadways, the optimum solution is very dependent on the location (context) of the roadway. In these cases, you will likely see a range of widths to choose from. For example, the geometric cross section guidance chapters for highways (Chapter 1231) and freeways (Chapter 1232) show cross-sections that list ranges to choose from for lane and shoulder widths.

The **mode/function/performance approach** described in Section 1106.03 is the tool to be used to choose the appropriate width from the range given.

Exhibit 1106-1 Dimensioning Guidance Variations



Example: Exhibit 1360-21 calls out one specific dimension for the lane width of this section of a parallel off connection.



Example: Exhibit 1231-2 calls out a range of dimensions for the lane width.

When a single dimension is given: If the decision is to use the dimension shown, no further evaluation is needed; just document the dimension choice on the Design Parameter Sheets.

If a particular roadway warrants use of a dimension that is different than the value given, the mode/function/performance approach described in Section 1106.03 can be used to determine the appropriate dimension. Results will need to be documented in a Design Analysis.

When a range of widths is given: Understand any width considerations specific to the design element (for example, lane width considerations are described in Chapter 1231). Use the mode/function/performance approach described in Section 1106.03 to choose the appropriate value within the range. If the dimension chosen is within the range given in the Design Manual, document the reasoning in the Design Parameter Sheets. If the value chosen is outside of the given range, document the decision in a Design Analysis.

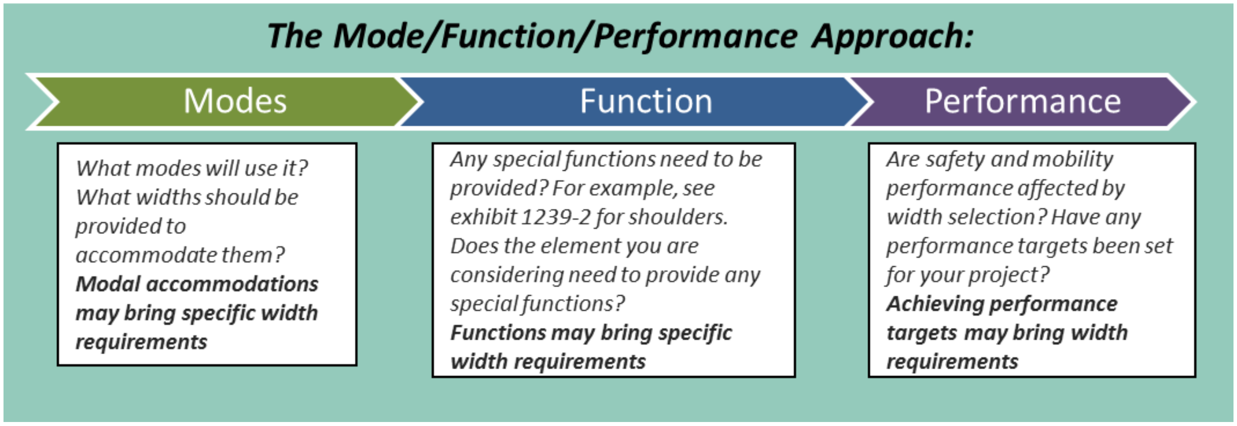
Some dimension choices can be complex, and involve trade-off evaluations, including comparisons of alternatives, benefit/cost analysis, etc. In these instances, it may be appropriate to record the dimension choice on the Design Parameter Sheets and reference any related documents that support the dimension choice.

1106.03 The Mode/Function/Performance Approach

The mode/function/performance approach is the primary methodology to apply when a range of dimensions is given. Utilizing this approach ensures that modal needs, the function of the design element, and safety and mobility performance have all been considered. For example, lanes and shoulders have to accommodate the modes that use the roadway, provide functions that are appropriate for the specific roadway, and provide appropriate safety and mobility performance.

Modes, function and performance overlap and are interrelated. These considerations are part of a tradeoffs discussion. Cost is always a consideration in a tradeoffs discussion. Engineering judgment and stakeholder involvement will be required.

Exhibit 1106-2 Mode/Function/Performance Approach



Modal accommodation: It is important to understand the modal needs for a roadway. Accommodating a specific mode (or modes) may influence the dimension choice.

For example, it is important to understand the vehicle mix that will be using the lanes and to understand the modes that will be using the shoulder. For lanes, a significant number of trucks and oversized vehicles may affect the lane width choice, especially if the alignment is not tangent. Read Chapter 1231 when choosing lane widths.

For shoulders, it is important to understand bicyclist and pedestrian use. The width requirements that come with accommodating various modes are discussed in Chapter 1239.

Function(s): Function is closely related to modal accommodation. Providing a specific function may drive the dimension choice.

For example, the shoulder width requirements that come with providing various functions bring a wide range of associated widths (see Exhibit 1239-2, Shoulder Function & Modal Accommodation Width Considerations).

Performance: When choosing a dimension from a range of possible choices, consider safety performance and mobility performance. Meeting safety or mobility performance targets may drive the dimension choice.

When evaluating performance, the use of quantitative engineering methods and tools is encouraged whenever possible. See Section 1106.05 for more information on quantitative tools and methodology for evaluating safety and mobility performance.

An important consideration of performance evaluation is whether or not the project has an identified baseline (or contextual) safety need. If safety need has been identified, performance metrics and targets may play a major role in choosing dimensions. See Chapter 1101.

For some projects, modal accommodation needs may drive lane and shoulder width decisions. In other cases, the need to provide a specific function may drive width decisions. And, in some cases, meeting established performance targets may drive width decisions. Regardless of whether modal accommodation, function, or performance drives the dimension choice, the effect of the decision on mobility and safety performance has to be considered.

Accommodating modal needs, providing specific functions, or achieving specific performance targets may require widths that can bring significant investments. Consider the cost and associated trade-offs, and document why it is worthy of the associated investment.

In addition to being the primary method to choose a dimension when a range of dimensions is given, the mode/function/performance approach can also be used in support of a Design Analysis.

1106.04 Design up Method

When a range of dimensions is given, guidance may specifically require a "design up" approach. For example, Chapter 1231 requires a design up approach for state highways other than freeways.

Design up means considering the smallest dimension first. Increasing dimensions are then considered until the smallest dimension is identified that accommodates modal needs, provides the desired functions, and provides appropriate safety and mobility performance. Using the mode/function/performance approach described in Section 1106.03 is an important part of design up.

1106.05 Quantitative Analysis Methods and Tools

Currently, two primary tools exist to quantitatively evaluate performance; the *Highway Safety Manual* (HSM) for evaluating modal safety performance and the *Highway Capacity Manual* (HCM) for evaluating traffic operational mobility performance.

1106.05(1) Highway Safety Manual and Safety Modeling

Safety is and always has been a primary performance category for WSDOT. Past design policy relied on the assumption that the application of design criteria equated to a desired level of safety performance for the expenditure. This assumption may not have always been true for all locations given their operational and geometric characteristics. The strict application of criteria to achieve safety performance is known as "nominal safety." To achieve a more reliable safety performance, scientific estimation of crashes using site conditions is necessary and is termed "substantive safety." A new understanding of safety performance, crash modification factors, and roadway functions has led to a growing body of knowledge about the relationship between roadway characteristics and safety performance.

The application of the *Highway Safety Manual* (HSM) and its companion tools provides an understanding of how a particular design can perform with respect to safety. This enables analysis of safety-specific performance metrics that may be more critical to address. The HSM covers multiple transportation road types and can be a valuable tool to analyze various geometric alternatives in any program type.

For guidance regarding whether or not to include a baseline safety need see Chapter 1101. For more information on sustainable highway safety tools and analysis, see Chapter 321.

1106.05(2) Highway Capacity Manual and Traffic Modeling

The *Highway Capacity Manual* (HCM) provides quantitative methods for evaluating mobility operational performance. However, some quantitative outputs from some HCM methods are specific to free-flow speed operations or level of service, and may not be appropriate for use given the baseline mobility performance metric selected for a specific location. Traffic modeling software provides a more relevant method for understanding the mobility operational performance; however, the reliability of the outputs varies given the traffic forecasting for design years further in the future. Utilize traffic modeling to ascertain potential mobility operational performance whenever feasible.

1106.06 Documenting Dimensions

While a primary function of the Basis of Design is to document the design elements selected to be included in a project, another primary function of the Design Parameter Sheets is to document the dimensions chosen for the various design elements included in a project.

Important Note: If the dimension for an existing design element does not change, no documentation is required on the Design Parameter sheets. A Design Parameter Sheet entry left blank means that the element was not selected to be included in the project. (See Chapter 1105 for design element selection guidance.) A Design Parameter Sheet template can be found here: https://wsdot.wa.gov/engineering-standards/design-topics/design-tools-and-support#Tools.

1106.07 Design Analysis

A Design Analysis is required when a dimension chosen does not meet the value, or fall within the range of values, provided for that element in the Design Manual (see Chapter 300.) The considerations described in Section 1106.03 may be useful when completing a Design Analysis.

1106.08 References

Highway Capacity Manual (HCM), latest edition, Transportation Research Board, National Research Council

Highway Safety Manual (HSM), AASHTO

Washington State's Target Zero Strategic Safety Plan https://wsdot.wa.gov/construction-planning/statewide-plans/strategic-highway-safety-plan-target-zero