Chapter 1103 Design Control Selection

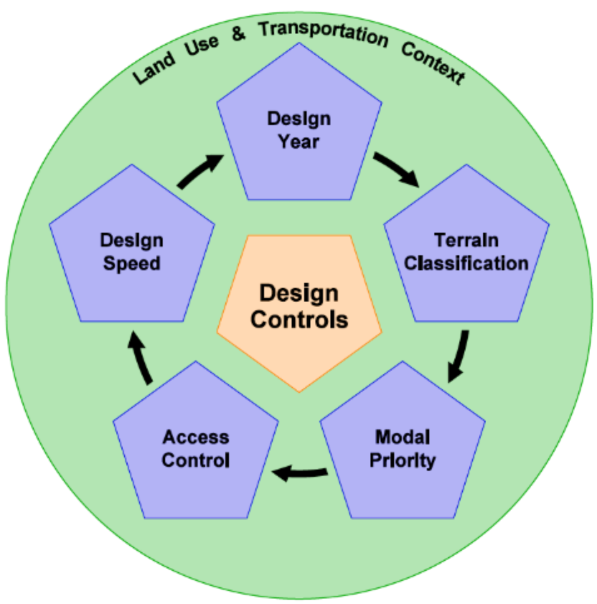
1103.01 General Overview

Design controls are specific factors that directly influence the selection of most design elements and their dimensions. Design controls establish fundamental boundaries for design alternatives. Selection of design controls is documented on the Basis of Design. This chapter provides guidance on the selection of design controls for state routes.

The five WSDOT design controls include:

- Design Year
- Modal Priority
- Access Control
- Design Speed
- Terrain Classification

Exhibit 1103-1 WSDOT Design Controls



Reciprocal connections between design controls and land use and transportation contexts

1103.02 Control: Design Year

Design year is the forecast year used for design. The year of opening is when the construction will be complete, and the project location is fully operational. Design year selection is dependent on a decision to design for the year of opening, or for a future year based on forecast or planned conditions. Design year has historically been associated with a 20-year vehicle traffic forecast used in development of large mobility and capacity expansion projects. This is the origin of the term **horizon year**. Horizon year is typically considered to be 20 years from the year construction is scheduled to begin.

WSDOT policy on design year is intentionally flexible. The design year can be any interim year selected between the project year of opening year and the horizon year. Many lower-cost projects result in immediate performance improvements when construction is completed. Safety projects are an example of this where the basis of design may show design year as the year of opening. Some projects may require horizon year analysis of an alternative regardless of the selected design year. A project may be required to evaluate alternatives based on the horizon year (20 years from the scheduled beginning of construction) if the project:

- Involves a federal nexus (federal funds involved, involves federal lands, or requires federal approvals or permits)
- Is a Project of Divisional Interest (See Chapter 300)
- Is a new/reconstruction project as defined in Chapter 300

Contact the region ASDE if there are questions.

1103.03 Control: Modal Priority

The concepts and method described in this section are adapted from National Cooperative Highway Research Program Report 855: "*An Expanded Functional Classification System for Highways and Streets"* (see www.trb.org/NCHRP/Blurbs/176004.aspx)

1103.03(1) Design Users

"Design users" refers to the modes that are legally permitted to use a facility. The intent in identifying design users is to highlight all user needs, recognize modal interactions, and develop an integrated system for all users. Identifying the design users is the first step in determining which modes to accommodate and prioritize. On the Basis of Design, list design users with sufficient descriptive detail. Include consideration for all ages and abilities.

Division III of the document *Understanding Flexibility in Transportation Design – Washington* is a key resource for understanding the needs and characteristics of various design users.

1103.03(2) Modal Accommodation

Modal accommodation refers to the level to which a travel mode will be addressed in the design. It is expressed on a scale of low, medium, and high, where a higher accommodation level is associated with the use of design features or criteria that tend to improve the performance of that mode compared to a lower level. Once established, the modal accommodation level is used to inform the decision on modal priority (See Section 1103.03(3)).

Complete Streets projects are not required to establish modal accommodation levels nor complete a Context and Modal Accommodation Report, as they are assumed to accommodate all modes.

For other projects, determine the modal accommodation level for both the current year (prior to opening) and the design year. These are referred to as existing and future conditions in the guidance that follows.

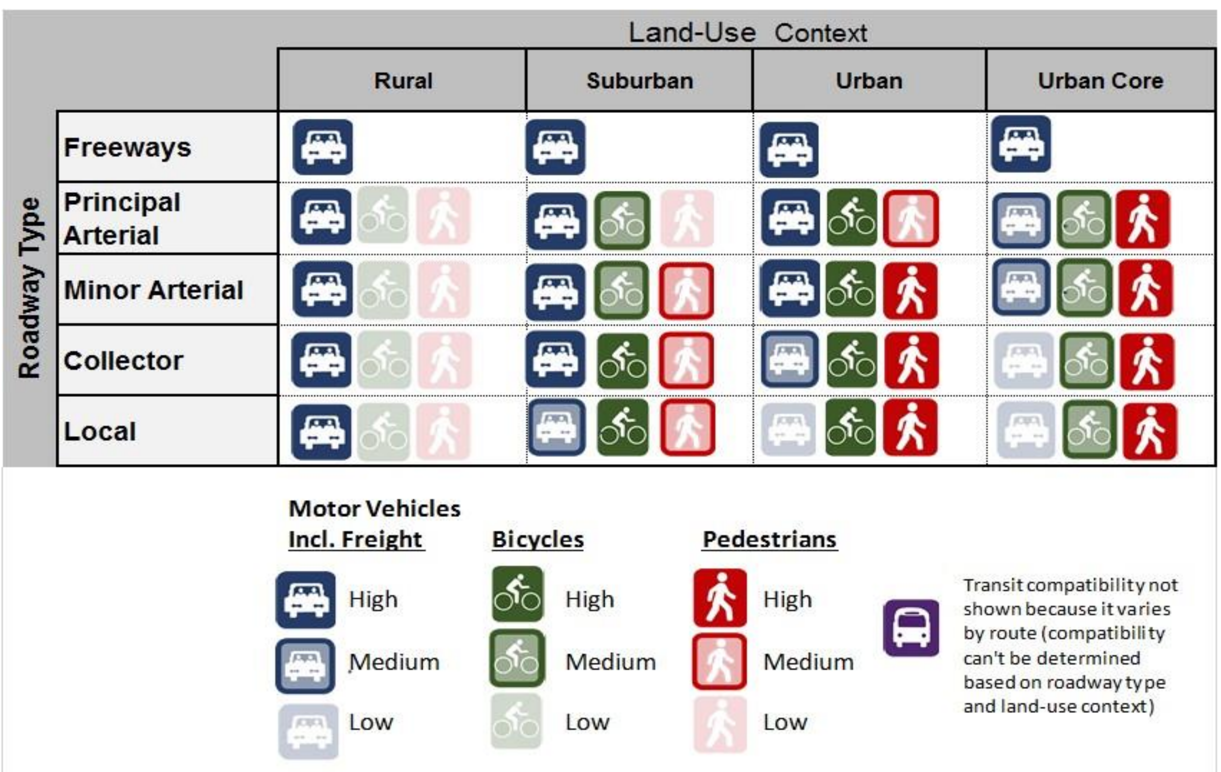
Note that in many cases, the planning documentation, data, or information in the project vicinity may not be available for the project's design year.

In those cases, identify the forecast or horizon year used by the local agency or planning organization in its work and planning products, and document the use of that year as the future year for purposes of determining the modal accommodation level.

1. An initial modal accommodation determination, for both the current and design years, are made using Exhibit 1103-2. The initial determination uses the roadway type and land use contexts that were determined earlier and documented in Section 2 of the Basis of Design (See Chapter 1102).
2. A final determination for both the current and design years is made using additional information and evidence to validate or modify the initial determination.

Make the final modal accommodation determination for each mode in consultation with the project advisory team and/or subject matter expert(s), as they may recommend modifications to the initial determinations (see Section 1100.04(2) for more information about working with the project advisory team). Exhibit 1103-3 provides examples of land-use and transportation characteristics that a project advisory team or subject matter expert(s) may consider in adjusting accommodation up or down for any particular travel mode. These characteristics can represent either the current suitability of a facility to accommodate a mode, or its future strategic role with respect to accommodating that mode. Note that the Context and Modal Accommodation Report provides a template for making and documenting decisions about modal accommodation.

Exhibit 1103-2 Initial Modal Accommodation Level



Additional guidance on the use of the following criteria in determining final modal accommodation level is provided on the Design Support site: https://wsdot.wa.gov/engineering-standards/design-topics/design-tools-and-support#Tools

Exhibit 1103-3 Example Characteristics Related to Modal Accommodation

Land Use Characteristic	Increased Modal Accommodation Level
Close proximity to activity centers	Pedestrian, Transit, Bicycle
Industrial and commercial land uses in surrounding area	Auto, Freight
High densities of both residential and employment	Bicycle, Pedestrian, Transit
Minimal building setbacks adjacent to roadway	Bicycle, Pedestrian
Human scale architecture present	Bicycle, Pedestrian, Transit
Transportation Characteristic	Increased Modal Accommodation Level
Well-established grid network	Bicycle, Pedestrian, Transit, Auto
T-2 freight route	Auto, Freight
Streetside elements	Bicycle, Pedestrian, Transit
Frequent signalized intersections along route	Auto, Transit, Pedestrian, Bicycle

1103.03(2)(a) Vehicle modal accommodation level

Consider the vehicle modal accommodation level when making design decisions that address or affect needs associated with vehicle travel. Start with the initial modal accommodation level for motor vehicles per Exhibit 1103-2, and adjust it to establish the final level based on documented project specific conditions related to the quality of travel experience, and identified performance targets, that can be influenced by the project design, such as vehicle Level of Service, travel time, access classification, and other factors determined by subject matter experts or the project advisory team.

1103.03(2)(b) Bicycle modal accommodation level

Consider the bicycle modal accommodation level when making design decisions that address or affect needs associated with bicycle travel. Start with the initial modal accommodation level for bicycles per Exhibit 1103-2, and adjust it to establish the final level based on documented project specific conditions related to the quality of travel experience, and identified performance targets, that can be influenced by the project design, such as bicycle route type, efficiency of travel, range, bicyclist safety, route spacing, bicycle volumes, and other factors determined by subject matter experts or the project advisory team.

1103.03(2)(c) Pedestrian modal accommodation level

Consider the pedestrian modal accommodation level when making design decisions that address or affect needs associated with pedestrian travel. Start with the initial modal accommodation level for pedestrians per Exhibit 1103-2, and adjust it to establish the final level based on documented project specific conditions related to the quality of travel experience, and identified performance targets, that can be influenced by the project design, such as pedestrian route type, efficiency of travel, range, pedestrian safety, block length, and other factors determined by subject matter experts or the project advisory team.

1103.03(3) Modal Priority

Accommodate means that the roadway will be designed so that the chosen modes can use it, while **accommodation level** refers to the extent to which that accommodation may be required.

Priority refers to the decision to optimize the design based on the performance of one or more travel modes. Modal priority is used as input to choose the appropriate geometric cross section (see Chapter 1230).

Complete Streets projects are not required to establish modal priorities, as they are assumed to accommodate all modes, with none taking priority. For other projects, determine modal priority for all modes expected to use the facility using the accommodation level results, as well as other relevant information about freight, transit, and any other modes considered and documented in the Context and Modal Accommodation Report and Basis of Design. Engage the project advisory team as provided in Section 1100.04(2).

If the modal priority is inconsistent with assumptions made about the project during a planning or scoping phase, work with program management staff to consider the need for any changes to project scoping documentation, including scope, schedule, and budget.

Document the modal priority on the Basis of Design for both the current and future conditions.

1103.03(4) Intersection Design Vehicle

WSDOT policy provides flexibility when choosing the intersection design vehicle. The purpose for this policy is to balance user needs and avoid the unnecessary expense and increased active transportation user exposure associated with oversizing intersections. Considerations include frequency of the design vehicle and effects on other design users, specifically pedestrian crossing distance and times, and bicycle turning and through movements. Consider managing vehicle turning speeds and providing more protected intersection treatments for pedestrians and bicyclists to mitigate turning conflicts. Also consider implementing mountable truck aprons to encourage slow passenger vehicle turns while still accommodating larger vehicle.

An intersection design vehicle is a specific selection made at each intersection leg. Select a design vehicle that allows the largest vehicles commonly encountered to adequately complete a required turning maneuver. The objective is not necessarily to size the specific intersection curb radius (unless there is a baseline need associated with the larger vehicles), but rather to account for a reasonable path that allows the largest vehicle commonly encountered to turn without conflicts (see Chapter 1310). Use turn simulation software (such as AutoTURN®) to analyze turning movements. Select low turning speeds for turn speed simulation at locations where pedestrians and bicyclists may be present.

Example:

At an intersection with a pedestrian modal priority that experiences infrequent turning movements by a WB-67, a smaller curb radius would benefit pedestrians due to shorter crossing times and reduced exposure to vehicles. Using turn simulation software, a practicable path for the WB-67 can be identified, even though the vehicle's path may intrude into the second same direction lane may be necessary. Conversely, if the crossroad was identified as being within a Freight Economic Freight and Goods Transportation System Truck Corridor, with frequent turning movements from larger vehicles, it would be appropriate to size the intersection to prevent the second lane incursion. If there are pedestrians and cyclists present or latent demand at this same location, a mountable truck apron at the intersection may slow passenger vehicle turns while still accommodating larger vehicles.

Consider origins and destinations of large vehicles to understand their needs at specific intersection locations. Also, consider alternatives that may help lower turning speeds and minimize pedestrian exposure.

Work with stakeholders, businesses, and service providers to understand their needs (like transit, school bus and emergency vehicle movements) and define the frequency of use at specific intersections. Municipalities may have established truck routes or restrictions that govern local freight patterns.

1103.04 Control: Access Control

Access refers to the means of entering or leaving a public road, street, or highway by travelers with respect to property that abuts the facility, or by another public road, street, or highway. The regulation or control of this access (see Chapter 520) affects accessibility to the facility, and also impacts the types of activities and functions that can occur on a facility. Highway improvement projects consider the current and/or planned access control and classification in order to determine whether a change would support project baseline or contextual needs (see Chapter 1101).

During the original development of the state highway system, access management functioned to preserve the safety and efficiency of regional highways. However, the level of access management can also significantly affect accessibility to land uses, modal mobility needs and the economic vitality of a place.

Unless access control has already been acquired by the purchase of access rights, it is necessary to select the appropriate type of limited access control or managed access control during planning and design. Appropriate access control should be considered so as not to hinder bicycle and pedestrian accessibility, mobility, and safety.

A choice to change the current or planned access control is a major decision and is to be consistent with the context, desired performance targets, and modal priorities for a location.

Example: The area around a managed access Class 2 route has incurred significant development, increasing the number of local trips on a segment of the route. Over time, additional intersections and access connection permits have been granted. In this situation, it may be appropriate to consider selecting managed access Class 4 or 5 because of the changes in functions and activities along the segment over time.

Conversely, a route that does not contain bicyclist or pedestrian generators within it may have a need to improve motor vehicle travel time performance, and managed access Class 1 may be appropriate. A through route solution for active travelers, such as a shared use path, may still be needed for managed access Class 1 routes.

If an alteration to current or planned access is determined necessary, consult the Headquarters Access and Hearings Manager for preliminary approval for the selection, and document on the Basis of Design (see Chapter 1100). For additional information on access control and access management, see Chapter 520, Chapter 530, and Chapter 540.

1103.05 Control: Design Speed

WSDOT uses a target speed approach for determining design speed. The objective of the target speed approach is to establish the design speed at the desired operating speed. The target speed selection is derived from other design controls, as well as transportation and land use context characteristics.

Exhibit 1103-4 shows possible (planning level) target speeds for the various roadway types and land use contexts discussed in Chapter 1102. The target speeds shown in the exhibit are suggestions only, and the target speed for the specific location may vary from those shown in the exhibit.

Exhibit 1103-4 Target Speed Based on Land Use Context and Roadway Type

		Land-Use Context			
		Rural	Suburban	Urban	Urban Core
Roadway Type	Freeways	High (≥ 50 mph)	High (≥ 50 mph)	High (≥ 50 mph)	High (≥ 50 mph)
	Principal Arterial	High (≥ 50 mph)	Intermediate / High (≥ 40 mph)	Low / Intermediate (≤ 45 mph)	Low (≤ 35 mph)
	Minor Arterial	High (≥ 50 mph)	Low / Intermediate (≤ 45 mph)	Low / Intermediate (≤ 45 mph)	Low (≤ 35 mph)
	Collector	Low / Intermediate ≤ 45 mph	Low / Intermediate (≤ 45 mph)	Low (≤ 35 mph)	Low (≤ 35 mph)
	Local	Low / Intermediate (≤ 45 mph)	Low (≤ 35 mph)	Low (≤ 35 mph)	Low (≤ 35 mph)

Engage the public, local agency staff and officials, and transit agencies prior to selecting the target speed. Once the target speed has been selected, it becomes the design speed for the project. The goal of the target speed approach is that the speed ultimately posted on the completed project is the same as the design, and ultimately, the operating speed. In order to achieve this outcome, consider:

- The impact of existing or proposed contextual characteristics
- Modal priorities
- Access control selection
- Performance need(s)
- Contributing factors analyses that have been developed for the project

Lowering target speed: When selecting a target speed lower than the existing posted speed, or where excessive operating speeds were identified from contributing factors analysis of the baseline performance need, consider the use of roadway treatments that will help achieve the selected target speed (see Section 1103.05(2)) during alternatives formulation.

Speed management treatments are used to achieve lower vehicle speeds. When speed management treatments are proposed to accomplish a desired target speed operation, obtain concurrence from the Region Traffic Engineer and the ASDE. When a design speed is proposed for a project that is lower than the existing posted speed, the approval of the State Transportation Operations Engineer is also required. See Section 1103.05(2) below for more on speed management.

Raising target speed: When selecting a target speed in excess of the existing posted speed, measures such as greater restriction of access control and segregation of modes may be necessary to reduce conflicts in activities and modal uses. Wider cross-sectional elements like lanes and shoulders are used with higher speed facilities. Careful consideration of other modal needs should be evaluated before raising target speeds.

Setting the posted speed: Use caution when basing a target speed on one or more contextual characteristics that are proposed to take place after project opening, as the goal of ending up with a posted speed equal to the design speed at opening may be jeopardized.

The Region Traffic Engineer is responsible for setting the posted speed on the highway once the project is completed. Target speed is only one of the considerations used when establishing posted speed. Engage and include the Region Traffic Engineer and the Region Transportation Operations Office staff in key decision-making that will affect the target, design, and operating speed selection. Incorporate consideration of traffic calming measures as needed.

1103.05(1) Low, Intermediate, and High Speeds

To provide a general basis of reference between target speed and geometric design, WSDOT policy provides three classifications of target speed as follows:

1. **Low Speed is 35 mph and below.** A low target speed is ideal for roadways with pedestrian and bicycle modal priorities. Locations that include frequent transit stops, intermodal connections, moderate to high intersection density, or moderate to high access densities may also benefit from lower speed environments. Low speed facilities in urban areas typically use narrower cross section elements.
2. **Intermediate Speeds are 40 mph and 45 mph.** An intermediate target speed is ideal for speed transitions between high and low target speed environments. Locations with low access densities and few at-grade intersections are also examples of where intermediate speed may be appropriate. In these locations consider a higher degree of separation between motor vehicles and bicycles and pedestrians.
3. **High Speed is 50 mph and above.** A high target speed is ideal for motor vehicle-oriented roadways such as freeways and highways, often serving regional or longer-distance local trips. Rural connector roadways with infrequent farm or residential accesses are also consistent with the use of high target speeds. In high target speed locations consider the highest degree of separation between motor vehicles and bicycles and pedestrians. Highways with high speeds are associated with wider cross section elements.

1103.05(2) Speed Management

In order to effectively achieve a target speed, a project needs to be designed to match the intended future land use context. It is usually not enough to change the operating speed of a corridor by simply changing the speed limit signs. The design of the corridor needs to match the target speed and thus match the regulatory speed (AKA speed limit). Physical changes to the characteristics of a corridor can help manage speed. When the characteristics of the corridor match with the target speed, then operating speeds are reduced to the regulatory speed. When target, operating, and regulatory speeds align, then the corridor can realize safety performance improvements and reduce the need for enforcement. The strategies presented in this section are called speed management strategies and can be deployed on a project to achieve a roadway that matches the intended context of the corridor, reduces speeds, and gets the three speed types to align.

Speed management has the potential to reduce the number and severity of crashes for all users. While there are not specific crash modification factors for every speed management strategy, it is reasonable to conclude that lower speed means less kinetic energy and that can equate to less severe injury in the event of a crash. Therefore, appropriately applying speed management strategies to encourage lower speeds, may improve safety performance of a roadway. In addition, lowering speeds will also decrease the design clear zone distance as noted in Section 1600.02.

Each speed management strategy (see Exhibit 1103-5) has varied effectiveness for lowering speed, while maintaining roadway function, depending on where they are installed and how they are installed. As a result, it may not be possible to say that one strategy works better than another. In addition, speed management efforts often follow an iterative approach as corridor designs evolve and some strategies work better than others at different stages of a roadway's progression toward achieving a target speed.

Speed management strategies applied independently, in combination, or in series may be beneficial depending on the type and use of the strategies. Many speed management strategies have demonstrated varied effectiveness for single applications, however multiple strategies in series and parallel that build upon the context are more effective. Though not fundamentally speed management devices, crosswalk enhancements and bicycle strategies can help create the desired environment to achieve lower speeds based upon the contextual cues they offer to drivers. However, the speed reduction benefits of crosswalk or bicycle improvements are secondary. It should be recognized that there are usually multiple goals for improving multimodal travel on a given corridor, with speed management being one. Other goals may involve increasing vulnerable user conspicuity, providing mode specific travel space, and reducing crash exposure. Many speed management tools can address more than one goal, and lowered speeds can reduce the complexity and cost of other safety and mobility strategies for vulnerable users. For this reason, it is important to consider the final multimodal function of each corridor.

The effective use of speed management strategies requires extensive collaboration with stakeholders inside and outside the WSDOT. These may include individuals from headquarters, regions, local agencies, community group, and business groups. Changes to posted speed limits require the approval of the State Transportation Operations Engineer.

Reducing the speed of a corridor can have the side effect of diverting traffic off the street where the speed management has been deployed. As a result, many agencies apply speed management across broader areas. When deploying a strategy on a state highway, coordinate with adjacent local agencies to evaluate the traffic network as a whole and to consider the possibility of traffic diversion and ways to mitigate it.

Several speed management strategies are listed in Exhibit 1103-5. Each strategy has information about the typical application. Designers should consider each strategy uniquely for their project and match the strategy with the desired context. Do not apply speed management strategies as a one-size-fits-all approach. Each corridor has unique needs and therefore will deploy different strategies. Experts in other fields of study like Active Transportation, Transportation Operations, and Maintenance should be consulted for input. The selection of a strategy should be documented in the Basis of Design (BOD) as a baseline or contextual need. In the alternatives section of the BOD, describe the strategies considered and why they were selected for the project.

Some of the most effective self-enforcing speed management strategies present concerns on roads where vehicle speeds are already high. An example is a speed hump which is highly effective at lowering speed, but can create other unintended effects, like damage to a vehicle, if used where motorists are driving at higher speeds. In those locations use an iterative approach where one speed management strategy is used to begin lowering speeds and as speeds go down other strategies are used to continue lowering speeds until eventually the desired target speed is achieved.

The strategies in Exhibit 1103-5 are typically highway strategies. In areas not on the state highway system, there are other strategies that can be deployed that are not listed in this exhibit. Ideas for these locations can be found in the resources listed at the end of this chapter.

The strategies in Exhibit 1103-5 are grouped into categories (e.g., delineation, horizontal deflection, pinch points) and further described by their attributes. Each strategy group is explained as follows:

- Delineation: These speed management strategies can add or change roadway delineation. They can be paint or plastic markings and may include raised pavement markings or tubular markers/flexible bollards. These strategies do not modify the pavement. When stripes are reapplied, consider the use of a wide line to add emphasis to the strategy.

- Horizontal Deflections: These strategies may be achieved with curbed features, planter strips, pavement markings, or with additional fixed delineators. These strategies are more appropriate on intermediate speed or low speed facilities. When introducing this strategy on high-speed facilities, the strategy should utilize paint striping, in addition to using other strategies preceding the deflection, rather than constructing hardscape features. Horizontal deflections are commonly installed at the entrance to roundabouts.
- Vertical Deflections: This speed management strategies change the roadway elevation. They are designed to meet the target speed. The Institute of Transportation Engineers have written a recommended practice on speed humps, see A Guide to Speed Reduction Techniques, Planning and Design of Speed Humps, Speed Tables, and Other Related Measures (Institute of Transportation Engineers, 2022). Raised crosswalks and intersections are where the crosswalk or the entire intersection is raised. Vertical deflections are not appropriate for high-speed segments.
- Pinch Points: This strategy uses striping, roadside features, or curb extensions to temporarily narrow the vehicle lane. Pinch points are commonly applied at intersections as bulb-outs. Gateways can be installed along a corridor to introduce a change in context.
- Circular Intersections: Roundabouts (compact, mini, and modern) are designed to a particular circulatory speed and have warning signs that indicates this speed. Because of their low circulatory speed, they can have speed management effects on the corridor in proximity of the roundabout. They can be applied in a variety of locations and a variety of speeds. Design criteria for roundabouts are contained in Chapter 1320. The neighborhood traffic circle is a small island in the center of an intersection. As the name implies, these are intended for neighborhoods and are not applicable on state highways.
- ITS: Intelligent Transportation Systems (ITS) uses technology for transportation applications. Some ITS can affect drivers' travel speed choices. They can be applied in various speed situations and in various contexts. Application of ITS for speed management should be coordinated with your Region Transportation Operation Office.
- Streetscape: Streetscapes can be installed on the side of the street or in the median. Streetscapes encourage lower speeds by emphasizing a multimodal context and creating a feeling of confinement for drivers. There is a lot of variety in what constitutes a streetscape, including the non-transportation functions they perform. Streetscapes are often created in collaboration with a local agency, citizens group, or business district. They may require a lot of maintenance to remain effective. Work with the partners who help design the streetscape to determine who will be responsible for maintenance. Streetscapes are typically applied in low-speed environments. Deploying streetscapes in intermediate or high-speed roadways may require barrier protection and as such will not have as significant of a speed management effect.
- Roadway Reallocation: Roadway reallocation means to change the roadway surface to dedicate some of the surface to other modes, parking, or traffic movements. Each of these speed management measures repurpose the road to give less priority to the through vehicle. The action of vehicles slowing to turn, or park, causes "friction" with the through vehicles which cause the drivers to adjust their speed accordingly. The design criteria are found in other chapters of the Design Manual based upon the

design elements that you are modifying. Roadway reallocation is usually done by changing the striping, however sometimes you can change curbing or install physical separation.

The list of strategies in Exhibit 1103-5 is not an all-encompassing list. There may be new and emerging strategies that can be applied on a project as a trial or pilot study.

When new strategies are applied, it is important to communicate and collaborate with the fields of expertise like Active Transportation, Region Transportation Operations, HQ Transportation Operations, HQ Design, and Maintenance.

Each strategy is described with respect to a series of attributes that are the headers along the top of Exhibit 1103-5. These attributes can help a designer understand more about the strategy and whether it would be beneficial (or appropriate) on their project. These attributes are guidelines and engineering judgment must be applied when a strategy is selected for inclusion in a project.

The attributes shown in the headers across the top of Exhibit 1103-5 can be described as follows:

- Speed: These are the speeds for which the strategy is typically applied. The definition of these speeds is found in Section 1103.05(1).
- Land Use: The land use context describes where the strategy is typically applied and reflects the future land use context. To successfully change context requires partnering with the stakeholders. For further information on land use context, see Chapter 1102.
- Hard/Soft Infrastructure: Hard infrastructure is a physical change that is relatively permanent. Soft infrastructure are items that can be easily changed or removed. Some items that are listed as soft can also be hard but are usually deployed as soft due to cost.
- Cost: Initial cost is what the items typically cost when first installed. The ongoing cost is what it would cost on an annual basis for maintenance. Ongoing cost does not cover if the item is damaged, vandalized, or stolen. These numbers should be adjusted for your location because project specific issues can impact the cost. Partners can contribute to either initial or ongoing maintenance cost through written agreements.
- Maintainability: The maintainability rating is based upon a scale of easy to hard and reflects the ease to conduct maintenance such as snow plowing, weed control, sweeping, restriping, setting up traffic control, and landscaping. Some of this work can be done by local agencies or private entities through written agreement. Consult with the people who will be conducting the maintenance to determine if there are design options that can decrease the need for maintenance.

Exhibit 1103-5 Speed Management Strategies

Strategy Category	Strategy	Speed			Hard/ Soft	Land Use				Cost		Maintain-ability
		L	I	H		R	SU	U	UC	Initial	Ongoing	
Circular Intersections	Neighborhood Traffic Circle	✓			Hard				*	Low	Low	◕
	Mini Roundabouts	✓			Hard		✓	✓	✓	Low	Low	◑
	Compact Roundabouts	✓	✓	✓	Hard	✓	✓	✓	✓	Medium	Low-Med	◑
	Modern Roundabouts	✓	✓	✓	Hard	✓	✓	✓	✓	High	Medium	◑
Delineation	Lane Narrowing	✓	✓	✓	Either	✓	✓	✓	✓	Low	None	●
	Optical Speed Markings		✓	✓	Soft	✓	✓			Low	Low	◔
	Pavement Markings: Longitudinal	✓	✓		Soft	✓	✓	✓	✓	Low-Med	None	●
	Pavement Markings: Transverse	✓	✓	✓	Soft	✓	✓	✓	✓	Low	Low	◔
	Transverse Rumble Strips	✓	✓	✓	Either	✓	✓	✓	✓	Low	None	◑
Horizontal Deflections	Lane Shifts	✓	✓	✓	Either	✓	✓	✓	✓	Low-Med	None	◕
	Chicanes	✓	✓	✓	Hard	✓	✓	✓	✓	Medium	None	◕
Intersection Geometry	Reduced Turn Radii	✓	✓	✓	Hard	✓	✓	✓	✓	Med-High	None	◕
	Removing Right Turn Lanes	✓	✓		Hard		✓	✓	✓	Medium	None	●
	Protected Intersections	✓			Hard			✓	✓	High	Low	◔
ITS	Photo Enforcement	✓	✓	✓	Soft	✓	✓	✓	✓	Low-Med	None	N/A
	Signal progression	✓	✓	✓	Soft			✓	✓	Low	Low-Med	◑
	Speed Feedback Signs	✓	✓	✓	Soft	✓	✓	✓	✓	Low-Med	Low-Med	◑
Pinch Points	Bulb-Outs	✓			Hard		✓	✓	✓	Med-High	Low	◔
	Gateways	✓	✓	✓	Hard		✓	✓	✓	Medium	Low	◔
	Refuge Islands	✓	✓	✓	Hard		✓	✓	✓	Medium	Low	◑
Roadway Section Reallocation	Roadway Section Reallocation	✓	✓		Soft		✓	✓	✓	Medium	None	◕
	On-Street Parking	✓			Soft		✓	✓	✓	Low	None	◑
Streetscape	Landscaping	✓	✓		Hard		✓	✓	✓	High	High	○
	Public Art	✓			Hard	✓	✓	✓	✓	Low	Low	◑
	Street furniture	✓			Hard				✓	Low	Low	N/A
Vertical Deflections	Raised Crosswalks	✓			Hard			✓	✓	Medium	None	◑
	Raised Intersections	✓			Hard			✓	✓	High	None	◑
	Speed Humps/Tables/Cushions	✓			Hard			✓	✓	Low	None	◑

* Not to be installed on state highways

L = low
I = Intermediate
H = High

R = Rural
SU = Suburban
U = Urban
UC = Urban Core

○ = Very Hard
◔ = Hard
◑ = Neutral
◕ = Easy
● = Very Easy

1103.05(2)(a) References

The following list of references are specific to speed management and were utilized to create the content for this section. There are many references outside of this list that can provide useful information for speed management.

"Guidelines for Selection of Speed Reduction Treatments at High-Speed Intersections," NCHRP 613. Washington, DC, Transportation Research Board, 2008.

"Guidance to Improve Pedestrian and Bicyclist Safety at Intersections," NCHRP 926. Washington, DC, Transportation Research Board, 2020.

"Review of Engineering Speed Management Countermeasures." FHWA. Accessed May 25, 2022. https://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_speed.cfm.

"Traffic Calming ePrimer | FHWA (dot.gov)." 2017. Dot.gov. 2017. https://highways.dot.gov/safety/speed-management/traffic-calming-eprimer

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1103.06 Control: Terrain Classification

Terrain may limit operational and safety performance for particular modes. While terrain impacts may be addressed at specific locations, it is not cost beneficial to modify terrain continually throughout a corridor. The type of terrain, context, and speed influence the potential operating conditions of the highway and should be a consideration when selecting mobility performance targets (See Chapter 1101). For more information on grades, see Chapter 1220.

To provide a general reference between terrain and geometric design, three classifications of terrain have been established:

1. **Level:** Level to moderately rolling, this terrain offers few or no obstacles to the construction of a highway having continuously unrestricted horizontal and vertical alignment.
2. **Rolling:** Hills and foothills, with slopes that rise and fall gently; however, occasional steep slopes might offer some restriction to horizontal and vertical alignment.
3. **Mountainous:** Rugged foothills; high, steep drainage divides; and mountain ranges.

Designate terrain as it pertains to the general character along the alignment of a corridor. Roadways in valleys or passes in mountainous areas might have the characteristics of roads traversing level or rolling terrain and are usually classified as level or rolling, rather than mountainous. See the *Highway Log* for terrain classification.

1103.07 Documentation

Document selections for design controls in Section 3 of the Basis of Design.

1103.08 References

1103.08(1) Federal/State Directives, Laws, and Codes

Secretary's Executive Order 1090 – Moving Washington Forward: Practical Solutions

1103.08(2) Supporting Information

Design Support website to download the Basis of Design and Context and Modal Accommodation Report: https://wsdot.wa.gov/engineering-standards/design-topics/design-tools-and-support#Tools

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