440.01 General

Full design level is the highest level of design and is used on new and reconstructed highways. These projects are designed to provide optimum mobility, safety, and efficiency of traffic movement. The overall objective is to move the greatest number of vehicles, at the highest allowable speed, and at optimum safety. Major design controls are: functional classification; terrain classification; urban or rural surroundings; traffic volume; traffic character and composition; design speed; and access control.

440.02 References

(1) Federal/State Laws and Codes

RCW 46.61.575, Additional parking regulations

RCW 47.05.021, Functional classification of highways

Chapter 47.24 RCW, City streets as part of state highways

WAC 468-18-040, Design standards for rearranged county roads, frontage roads, access roads, intersections, ramps and crossings

(2) Design Guidance

Local Agency Guidelines (LAG), M 36-63, WSDOT

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

(3) Supporting Information

A Policy on Design Standards – Interstate System, AASHTO, 2005

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

440.03 Definitions

collector system Routes that primarily serve the more important intercounty, intracounty, and intraurban travel corridors; collect traffic from the system of local access roads and convey it to the arterial system; and on which, regardless of traffic volume, the predominant travel distances are shorter than on arterial routes (RCW 47.05.021).

design speed The speed used to determine the various geometric design features of the roadway.

divided multilane A roadway with two or more through lanes in each direction and a median that physically or legally prohibits left turns, except at designated locations.

expressway A divided highway that has a minimum of two lanes in each direction for the exclusive use of traffic and that may or may not have grade separations at intersections.

freeway A divided highway that has a minimum of two lanes in each direction for the exclusive use of traffic and with full control of access.

frontage road A road that is a local road or street located parallel to a highway for service to abutting property and adjacent areas and for control of access.

functional classification The grouping of streets and highways according to the character of the service they are intended to provide.

high pavement type Portland cement concrete pavement or hot mix asphalt (HMA) pavement on a treated base.

highway A general term denoting a street, road, or public way for the purpose of vehicular travel, including the entire area within the right of way.

incorporated city or town A city or town operating under Title 35 or 35A RCW.

intermediate pavement type Hot mix asphalt pavement on an untreated base.

Interstate System A network of routes designated by the state and the Federal Highway Administration (FHWA) under terms of the federal-aid acts as being the most important to the development of a national system. The Interstate System is part of the principal arterial system.

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*. The width of an existing lane is measured from the edge of traveled way to the center of the lane line or between the centers of adjacent lane lines.

limited access highway All highways where the rights of direct access to or from abutting lands have been acquired from the abutting landowners.

low pavement type Bituminous surface treatment (BST).

managed access highway All highways where the rights of direct access to or from abutting lands have not been acquired from the abutting landowners.

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

minor arterial system A rural network of arterial routes linking cities and other activity centers that generate long distance travel and, with appropriate extensions into and through urban areas, form an integrated network providing interstate and interregional service (RCW 47.05.021).

National Highway System (NHS) An interconnected system of principal arterial routes that serves interstate and interregional travel; meets national defense requirements; and serves major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities, and other major travel destinations. The Interstate System is a part of the NHS.

operating speed The speed at which drivers are observed operating their vehicles during free-flow conditions. The 85th percentile of the distribution of observed speeds is most frequently used.

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 or collector-distributor (C-D) road.

posted speed The maximum legal speed as posted on a section of highway using regulatory signs.

principal arterial system A connected network of rural arterial routes with appropriate extensions into and through urban areas, including all routes designated as part of the Interstate System, that serves corridor movements with travel characteristics indicative of substantial statewide and interstate travel (RCW 47.05.021).

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

rural design area An area that meets none of the conditions to be an urban design area.

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.

shoulder width The lateral width of the shoulder, measured from the edge of traveled way to the edge of roadway or the face of curb.

suburban area A term for the area at the boundary of an urban design area. Suburban settings may combine higher speeds common in rural design areas with activities that are more common to urban settings.

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.

two-way left-turn lane (TWLTL) A lane, located between opposing lanes of traffic, to be used by vehicles making left turns from either direction, from or onto the roadway.

undivided multilane A roadway with two or more through lanes in each direction on which left turns are not controlled.

urban area An area designated by WSDOT in cooperation with the Transportation Improvement Board and Region transportation planning organizations, subject to the approval of the FHWA.

urban design area An area where urban design criteria are appropriate, that is defined by one or more of the following:

- An urban area.
- An area within the limits of an incorporated city or town.
- An area characterized by intensive use of the land for the location of structures, that receives such urban services as sewer, water, and other public utilities, as well as services normally associated with an incorporated city or town. This may include an urban growth area defined under the Growth Management Act (see Chapter 36.70A RCW, Growth management – planning by selected counties and cities), but outside the city limits.
- An area with not more than 25% undeveloped land.

urbanized area An urban area with a population of 50,000 or more.

usable shoulder The width of the shoulder that can be used by a vehicle for stopping.

440.04 Functional Classification

The state highway system is divided and classified according to the character and volume of traffic carried by the routes and distinguished by specific geometric design criteria (RCW 47.05.021). The functional classifications (from highest to lowest) used on highways are: Interstate, principal arterial, minor arterial, and collector. The higher functional classes give more priority to through traffic and less to local access. NHS routes are usually designed to a higher level of design than non-NHS routes.

For functional classification maps and criteria see:
http://www.wsdot.wa.gov/mapsdata/tdo/functionalclass.htm

440.05 Terrain Classification

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

- **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.
- **Rolling**. Hills and foothills, with slopes that rise and fall gently; however, occasional steep slopes might offer some restriction to horizontal and vertical alignment.
- **Mountainous**. Rugged foothills; high, steep drainage divides; and mountain ranges.

Terrain classification pertains to the general character of the specific route corridor. Roads in valleys or passes of mountainous areas might have all the characteristics of roads traversing level or rolling terrain and are usually classified as level or rolling, rather than mountainous.

440.06 Geometric Design Data

(1) State Highway System

For projects on all highways in rural design areas and on limited access highways in urban design areas, the geometric design data is controlled by the functional class and traffic volume (see Figures 440-5 through 440-8). The urban managed access highway design class, based on traffic volume and design speed (see Figure 440-9), may be used on managed access highways in urban design areas, regardless of the functional class.

(2) City Streets as State Highways

When a state highway within an incorporated city or town is a portion of a city street, the design features must be developed in cooperation with the local agency. For facilities on the NHS, use *Design Manual* criteria as the minimum for the functional class of the route. For facilities not on the NHS, the *Local Agency Guidelines* may be used as the minimum design criteria; however, the use of *Design Manual* criteria is encouraged where feasible. On managed access highways within the limits of incorporated cities and towns, the cities or towns have full responsibility for design elements, including access, outside of curb, or outside the paved shoulder where no curb exists, using the *Local Agency Guidelines*.

(3) City Streets and County Roads

Plan and design facilities that cities or counties will be requested to accept as city streets or county roads according to the applicable design criteria shown in:

- WAC 468-18-040.
- *Local Agency Guidelines*.
- The standards of the local agency that will be requested to accept the facility.

440.07 Design Speed

Vertical and horizontal alignment, sight distance, and superelevation will vary with design speed. Such features as traveled way width, shoulder width, and lateral clearances are usually not affected. For the relationships between design speed, geometric plan elements, geometric profile elements, superelevation, and sight distance, see Chapters 620, 630, 642, 650, 910 and 940.

The choice of a design speed is primarily influenced by functional classification, posted speed, operating speed, terrain classification, traffic volumes, accident history, access control, and economic factors. A geometric design that adequately allows for future improvements is also a major criterion. Categorizing a highway by a terrain classification often results in arbitrary reductions of the design speed, when, in fact, the terrain would allow a higher design speed without materially affecting the cost of construction. Savings in vehicle operation and other costs alone might be sufficient to offset the increased cost of right of way and construction.

It is important to consider the geometric conditions of adjacent sections. Maintain a uniform design speed for a significant segment of highway.

For projects on all rural highways and limited access highways in urban design areas on new or reconstructed alignment (vertical or horizontal) or full width pavement reconstruction, the design speed for each design class is given in Figures 440-5 through 440-8.

For other projects, the desirable design speed is not less than that given in Figure 440-1. Do not select a design speed less than the posted speed.

When terrain or existing development limits the ability to achieve the design speed for the design class, use a corridor analysis to determine the appropriate design speed.

On urban managed access highways, the design speed is less critical to the operation of the facility. Closely spaced intersections and other operational constraints usually limit vehicular speeds more than the design speed.

For managed access facilities in urban design areas, select a design speed based on Figure 440-1. In cases where the Figure 440-1 design speed does not fit the conditions, use a corridor analysis to select a design speed. Select a design speed not less than the posted speed that is logical with respect to topography, operating speed (or anticipated operating speed for new alignment), adjacent land use, design traffic volume, accident history, access control, and the functional classification. Consider both year of construction and design year. Maintain continuity throughout the corridor, with changes (such as a change in roadside development) at logical points.

Route Type	Posted Speed	Desirable Design Speed
Freeways	All	10 mph over the posted speed
Nonfreeways	45 mph or less	Not less than the posted speed
	Over 45 mph	5 mph over the posted speed

Desirable Design Speed
Figure 440-1

440.08 Traffic Lanes

Lane width and condition influence safety and comfort. The minimum lane width is based on the highway design class, terrain type, and whether it is in a rural or urban design area. Lanes 12 feet wide provide desirable clearance between large vehicles where traffic volumes are high and sizable numbers of large vehicles are expected. The added cost for 12-foot lanes is offset, to some extent, by the reduction in shoulder maintenance costs due to the lessening of wheel load concentrations at the edge of the lane.

Highway capacity is also affected by the width of the lanes. With narrow lanes, drivers must operate their vehicles closer (laterally) to each other than they normally desire. To compensate, drivers increase the headway, which results in reduced capacity.

Figures 440-5 through 440-8 give the minimum lane widths for the various design classes for use on all rural highways and limited access highways in urban design areas. Figure 440-9 gives the minimum lane widths for urban managed access highways.

The roadway on a curve may need to be widened to make the operating conditions comparable to those on tangents. For guidance on width requirements on turning roadways, see Chapter 641.

440.09 Shoulders

Shoulder width is controlled by the functional classification of the roadway, the traffic volume, and the shoulder function.

The more important shoulder functions and the associated minimum widths are given in Figure 440-2. In addition to the functions in Figure 440-2, shoulders also:

- Provide space to escape potential accidents or reduce their severity.
- Provide a sense of openness, contributing to driver ease and freedom from strain.
- Reduce seepage adjacent to the traveled way by discharging stormwater farther away.

Contact the Region Maintenance Office to determine the shoulder width for maintenance operations. When shoulder widths wider than called for in Figures 440-5 through 440-9 are requested, compare the added cost of the wider shoulders to the added benefits to maintenance operations, as well as other benefits that may be derived. When the Maintenance Office requests a shoulder width different than the design class, justify the width selected.

Shoulder Function	Minimum Shoulder Width
Stopping out of the traffic lanes	8 ft
Minimum lateral clearance	2 ft[1]
Pedestrian or bicycle use	4 ft[2]
Large-vehicle off-tracking on curves	See Chapters 641 & 910
Maintenance operations	Varies[3]
Law enforcement	8 ft[4]
Bus stops	See Chapter 1060
Slow-vehicle turnouts and shoulder driving	See Chapter 1010
Ferry holding	8 ft[5]
For use as a lane during reconstruction of the through lanes	8 ft[5]
Structural support	2 ft
Improve sight distance in cut sections	See Chapter 650
Improve capacity	See Chapter 610

Notes:

[1] See Chapters 700 and 710.

[2] Minimum usable shoulder width for bicycles. For additional information, see Chapter 1020 for bicycles and Chapter 1025 for pedestrians.

[3] 10-ft usable width to park a maintenance truck out of the through lane; 12-ft clearance (14 ft preferred) for equipment with outriggers to work out of traffic.

[4] For additional information, see Chapters 1040 and 1050.

[5] Minimum usable shoulder width (10 ft preferred).

Minimum Shoulder Width
Figure 440-2

Minimum shoulder widths for use on all rural highways and limited access highways in urban design areas are based on functional classification and traffic volume (see Figures 440-5 through 440-8). Figure 440-9 gives the minimum shoulder widths for urban managed access highways without curb.

When curb with a height less than 24 inches is present on urban managed access highways, provide the minimum shoulder widths shown in Figure 440-3. For information on curbs, see 440.11.

When traffic barrier with a height of 2 feet or greater is used adjacent to the roadway, the minimum shoulder width from the edge of traveled way to the face of the traffic barrier is 4 feet. Additional width for traffic barrier shy distance (see Chapter 710) is normally not required on urban managed access highways.

Where there are no sidewalks, the minimum shoulder width is 4 feet. Shoulder widths less than 4 feet will require that wheelchairs using the roadway encroach on the through lane. For additional information and requirements regarding pedestrians and accessible routes, see Chapter 1025.

Lane Width	Posted Speed			
	>45 mph	≤45 mph	>45 mph	≤45 mph
	On Left		On Right[3]	
12 ft or wider	4 ft	[1][2]	4 ft	2 ft
11 ft	4 ft	[1][2]	4 ft	3 ft[4]

Notes:

[1] When mountable curb is used on routes with a posted speed of 35 mph or less, shoulder width is desirable; however, with justification, curb may be placed at the edge of traveled way.

[2] 1 ft for curbs with a height of 8 inches or less. 2 ft for curbs or barriers with a height between 8 and 24 inches.

[3] When the route has been identified as a local, state, or regional significant bike route, the minimum shoulder width is 4 ft or as indicated in Chapter 1020 for signed bike lanes.

[4] When bikes are not a consideration, width may be reduced to 2 ft with justification.

[5] Measured from the edge of traveled way to the face of curb.

Shoulder Width for Curbed Sections[5] in Urban Areas
Figure 440-3

The usable shoulder width is less than the constructed shoulder width when vertical features (such as traffic barrier or walls) are at the edge of the shoulder. This is because drivers tend to shy away from the vertical feature. For traffic barrier shy distance widening, see Chapter 710.

Shoulders on the left between 4 feet and 8 feet wide are less desirable. A shoulder in this width range might appear to a driver to be wide enough to stop out of the through traffic, when it is not. To reduce the occurrence of this situation, when the shoulder width and any added clearance result in a width in this range, consider increasing the width to 8 feet.

Provide a minimum clearance to roadside objects so that the shoulders do not require narrowing. At existing bridge piers and abutments, a shoulder less than full width to a minimum of 2 feet is a design exception. For Design Clear Zone and safety treatment requirements, see Chapter 700.

For routes identified as local, state, or regional significant bicycle routes, provide a minimum 4-foot shoulder. Maintain system continuity for the bicycle route, regardless of jurisdiction and functional class. For additional information on bicycle facilities, see Chapter 1020.

Shoulder widths greater than 10 feet may encourage use as a travel lane. Therefore, use shoulders wider than this only where required to meet one of the listed functions (see Figure 440-2).

When walls are placed adjacent to shoulders, see Chapter 1130 for barrier requirements.

440.10 Medians

Medians are either restrictive or nonrestrictive. Restrictive medians limit left turns, physically or legally, to defined locations. Nonrestrictive medians allow left turns at any point along the route. Consider restrictive medians on multilane limited access highways and multilane managed access highways when the design hourly volume (DHV) is over 2000.

The primary functions of a median are to:

- Separate opposing traffic.
- Provide for recovery of out-of-control vehicles.
- Reduce head-on accidents.
- Provide an area for emergency parking.
- Allow space for left-turn lanes.
- Minimize headlight glare.
- Allow for future widening.
- Control access.

Medians may be depressed, raised, or flush with the through lanes. For maximum efficiency, make medians highly visible both night and day.

The width of a median is measured from edge of traveled way to edge of traveled way and includes the shoulders. The desirable median width is given in Figure 440-4. The minimum width is the width required for shoulders and barrier (including required shy distance) or ditch.

When selecting a median width, consider future needs such as wider left shoulders when widening from four to six lanes. A median width of 22 feet is desirable on a four-lane highway when additional lanes are anticipated. The minimum width required to provide additional lanes in the median, without widening to the outside, is 46 feet. On freeways or expressways requiring less than eight lanes within the 20-year design period, provide sufficient median or lateral clearance and right of way to permit the addition of a lane in each direction, if required by traffic increase after the 20-year period.

A two-way left-turn lane (TWLTL) may be used as a nonrestrictive median for an undivided managed access highway (see Figure 440-9). The desirable width of a TWLTL is 13 feet, with a minimum width of 11 feet. For more information on traffic volume limits for TWLTLs on managed access highways, see Chapter 1435. For additional information on TWLTL design, see Chapter 910.

A common form of restrictive median on urban managed access highways is the raised median. The width of a raised median can be minimized by using a dual-faced cement concrete traffic curb, a precast traffic curb, or an extruded curb. For more information on traffic volume limits for restrictive medians on managed access highways, see Chapter 1435.

Median Usage	Desirable Width (ft)[1]
Separate opposing traffic on freeways and expressways	
Rural	60[2]
Urban – 4-lane	18
Urban – 6 or more lanes	22
Allow for future widening	46[4]
Left-turn lanes[3]	13[2]
Control access on divided multilane urban managed access highways	
Design speed 45 mph or less with raised medians	3[5][6]
Design speed greater than 45 mph or barrier separated	10[6]

Notes:

[1] The minimum width is the width required for shoulders and barrier (including required shy distance) or ditch. For barrier requirements, see Chapter 710.

[2] Additional width required at rural expressway intersections for storage of vehicles crossing expressway or entering expressway with a left turn.

[3] For additional information, see Chapter 910.

[4] Narrower width will require widening to the outside for future lanes.

[5] Using a Dual-Faced Cement Concrete Traffic Curb 1 ft face of curb to face of curb.

[6] 12 ft preferred to allow for left-turn lanes.

Median Width
Figure 440-4

At locations where the median will be used to allow vehicles to make a U-turn, consider increasing the width to meet the needs of the vehicles making the U-turn. For information on U-turn locations, see Chapter 910.

Widen medians at intersections on rural divided multilane highways. Provide sufficient width to store vehicles crossing the expressway or entering the expressway with a left turn.

For undivided multilane highways, desirable median width is 4 feet in rural design areas and 2 feet in urban design areas. When signing is required in the median of six-lane undivided multilane highways, the minimum width is 6 feet. If barrier is to be installed at a future date, median widths for the ultimate divided highway are desirable.

When the median is to be landscaped or where rigid objects are to be placed in the median, see Chapter 700 for traffic barrier and clear zone requirements. When the median will include a left-turn lane, see Chapter 910 for left-turn lane design.

440.11 Curbs

(1) General

Curbs are designated as either *vertical* or *sloped*. Vertical curbs have a face batter not flatter than 1H:3V. Sloped curbs have a sloping face that is more readily traversed.

Curbs can also be classified as *mountable*. Mountable curbs are sloped curb with a height of 6 inches or less, preferably 4 inches or less. When the face slope is steeper than 1H:1V, the height of a mountable curb is limited to 4 inches or less.

Where curbing is to be provided, ensure that surface water that collects at the curb will drain and not pond or flow across the roadway.

For all existing curb, evaluate the continued need for the curb. Remove all curbing that is no longer needed.

When an overlay will reduce the height of a vertical curb, evaluate grinding to maintain curb height (or replacing the curb) versus the need to maintain the height of the curb.

Curbs can hamper snow-removal operations. The area Maintenance Superintendent's review and approval is required for the use of curbing in areas of heavy snowfall.

For curbs at traffic islands, see Chapter 910.

(2) Curb Usage

Curbing is used for the following purposes:

- Control drainage
- Delineate the roadway edge
- Delineate pedestrian walkways
- Delineate islands
- Reduce right of way
- Assist in access control
- Inhibit midblock left turns

Avoid using curbs if the same objective can be attained with pavement markings.

In general, curbs are not used on facilities with a posted speed greater than 45 mph. The exceptions are for urban design areas where sidewalks are provided or where traffic movements are to be restricted. Justify the use of curb when the posted speed is greater than 45 mph.

Do not use vertical curbs along freeways or other facilities with a posted speed greater than 45 mph. When curb is needed, use mountable curb with the height limited to 4 inches and located no closer to the traveled way than the outer edge of the shoulder. Provide sloping end treatments where the curb is introduced and terminated.

(a) Vertical curbs with a height of 6 inches or more are required:

- To inhibit or at least discourage vehicles from leaving the roadway.
- For walkway and pedestrian refuge separations.
- For raised islands on which a traffic signal or traffic signal hardware is located.

(b) Consider vertical curbs with a height of 6 inches or more:

- To inhibit midblock left turns.
- For divisional and channelizing islands.
- For landscaped islands.

(c) Provide mountable curbs where a curb is needed but higher vertical curb is not justified.

440.12 Parking

In urban design areas and rural communities, land use might require parking along the highway. In general, on-street parking decreases capacity, increases accidents, and impedes traffic flow; therefore, it is desirable to prohibit parking.

Although design data for parking lanes are included in Figures 440-6 through 440-9, consider them only in cooperation with the municipality involved. The lane widths given are the minimum for parking; provide wider widths when feasible.

Angle parking is not permitted on any state route without WSDOT approval (RCW 46.61.575). This approval is delegated to the State Traffic Engineer. Angle parking approval is to be requested through the Headquarters (HQ) Design Office. Provide an engineering study, approved by the Region Traffic Engineer, with the request documenting that the parking will not unduly reduce safety and that the roadway is of sufficient width that the parking will not interfere with the normal movement of traffic.

440.13 Pavement Type

The pavement types given in Figures 440-5 through 440-8 are those recommended for each design class. (See Chapter 520 for information on pavement type selection.) When a roadway is to be widened and the existing pavement will remain, the new pavement type may be the same as the existing without a pavement type determination.

440.14 Structure Width

Provide a clear width between curbs on a structure not less than the approach roadway width (lanes plus shoulders). The structure widths given in Figures 440-5 through 440-9 are the minimum structure widths for each design class.

Additional width for barriers is not normally added to the roadway width on structures. When a structure is in a run of roadside barrier with the added width, consider adding the width on shorter structures to prevent narrowing the roadway.

440.15 Right of Way Width

Right of way width must be sufficient to accommodate all roadway elements and required appurtenances necessary for the current design and known future improvements. To allow for construction and maintenance activities, provide 10 feet desirable, 5 feet minimum, wider than the slope stake for fill and slope treatment for cut. For slope treatment information, see Chapter 640 and the *Standard Plans*.

The right of way widths given in Figures 440-5 through 440-8 are desirable minimums for new alignment requiring purchase of new right of way. For additional information and consideration on right of way acquisition, see Chapter 1410.

440.16 Grades

Grades can have a pronounced effect on the operating characteristics of the vehicles negotiating them. Generally, passenger cars can readily negotiate grades as steep as 5% without appreciable loss of speed from that maintained on level highways. Trucks, however, travel at the average speed of passenger cars on the level roadway but display up to a 5% increase in speed on downgrades and a 7% or greater decrease in speed on upgrades (depending on length and steepness of grade as well as weight-to-horsepower ratio).

The maximum grades for the various functional classes and terrain conditions are shown in Figures 440-5 through 440-8. For the effects of these grades on the design of a roadway, see Chapters 630, 650, 910, 940, and 1010.

440.17 Fencing

Remove rigid top rails and brace rails from existing fencing and retrofit with a tension wire design. For information on fencing, see Chapter 1460.

440.18 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/

Divided Multilane		
Design Class	I-1	
Design Year	[1]	
Access Control[2]	Full	
Separate Cross Traffic		
Highways	All	
Railroads	All	
Design Speed (mph)[3]		
Rural	80[4]	
Urbanized	70[5]	
Traffic Lanes		
Number	4 or more divided	
Width (ft)	12	
Median Width (ft)[6]	Minimum width is as required for shoulders and barrier (including required shy distance) or ditch (see 440.10).	
Shoulder Width (ft)[7]	4 lanes	6 or more lanes
Right of Traffic	10[8]	10[8]
Left of Traffic	4	10[8][9]
Pavement Type[10]	High	
Right of Way[11]		
Rural – Width (ft)	63 from edge of traveled way	
Urban – Width (ft)	As required[12]	
Structures Width (ft)[13]	Full roadway width each direction[14]	

Type of Terrain	Design Speed (mph)						
	50	55	60	65	70	75	80
	Grades (%)[15]						
Level	4	4	3	3	3	3	3
Rolling	5	5	4	4	4	4	4
Mountainous	6	6	6	6	5	5	5

Interstate Notes:

[1] The design year is 20 years after the year the construction is scheduled to begin.

[2] For access control requirements, see Chapter 1430.

[3] For existing roadways, see 440.07.

[4] 80 mph is the desirable design speed; with a corridor analysis, the design speed may be reduced to 60 mph in mountainous terrain and 70 mph in rolling terrain. Do not select a design speed that is less than the posted speed.

[5] 70 mph is the desirable design speed; with a corridor analysis, the design speed may be reduced to 50 mph. Do not select a design speed that is less than the posted speed.

[6] Independent alignment and grade are desirable in all rural areas and where terrain and development permit in urban areas.

[7] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by up to 4 inches.

[8] 12-ft shoulders are desirable when the truck DDHV is 250 or greater.

[9] For existing 6-lane roadways, an existing 6-ft left shoulder is a design exception when the shoulder is not being reconstructed and no other widening is required.

[10] For pavement type determination, see Chapter 520.

[11] Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut (see 440.15).

[12] In urban areas, make right of way widths not less than those required for necessary cross section elements.

[13] For minimum vertical clearance, see Chapter 1120.

[14] For median widths 26 ft or less, address bridge(s) in accordance with Chapter 1120.

[15] Grades 1% steeper may be provided in urban areas and mountainous terrain with critical right of way controls.

Geometric Design Data: Interstate

Figure 440-5

Design Class	Divided Multilane				Two-Lane						Undivided Multilane	
	P-1		P-2		P-3		P-4		P-5		P-6[1]	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year[2] NHS Non-NHS	Over 1500		Over 700[3]		Over 201[4] Over 301		61–200 101–300		60 and Under 100 and Under		Over 700[3]	
Access Control[5]	Full		Partial[6]									
Separate Cross Traffic Highways Railroads[7]	 All All		 Where Justified All		 Where Justified All[8]		 Where Justified Where Justified[9]		 Where Justified Where Justified[9]		 Where Justified Where Justified[9]	
Design Speed (mph)[10] Desirable[11] Minimum[12]	 80 60[13]		 70 50[14]		 70 50	 60 40[14]	 70 50	 60 40[14]	 60 40	 60 30[14]	 70 40	 60 30[14]
Traffic Lanes Number Width (ft)	 4 or more divided 12		 4 or 6 divided 12		 2 12		 2 12		 2 12		 4 12	 4 or 6 11[15]
Shoulder Width (ft)[16] Right of Traffic Left of Traffic	 10[17] Variable[19][20]		 10 Variable[19][20]		 8		 6		 4		 8	 8[18]
Median Width (ft)	Minimum width is as required for shoulders and barrier (including required shy distance) or ditch. (See 440.10.)										(See 440.10)	
Parking Lanes Width (ft) – Minimum	None		None		None		None	10	None	10	None	10[21]
Pavement Type[22]	High				High or Intermediate							
Right of Way[23] – Width (ft)	[24]	[25]	[24]	[25]	120	80	120	80	100	80	150	80
Structures Width (ft)[26]	Full Roadway Width[27]				40		40		32		Full Roadway Width	
Other Design Considerations–Urban					[28]		[28]		[28]		[28]	

Type of Terrain	Rural – Design Speed (mph)									Urban – Design Speed (mph)						
	40	45	50	55	60	65	70	75	80	30	35	40	45	50	55	60[29]
	Grades (%)[30]															
Level	5	5	4	4	3	3	3	3	3	8	7	7	6	6	5	5
Rolling	6	6	5	5	4	4	4	4	4	9	8	8	7	7	6	6
Mountainous	8	7	7	6	6	5	5	5	5	11	10	10	9	9	8	8

Geometric Design Data: Principal Arterial

Figure 440-6

Principal Arterial Notes:

[1] Justify the selection of a P-6 design class on limited access highways.

[2] The design year is 20 years after the year the construction is scheduled to begin.

[3] When considering a multilane highway, perform an investigation to determine whether a truck-climbing lane or passing lane will satisfy the need (see Chapter 1010).

[4] Where DHV exceeds 700, consider 4 lanes. When the volume/capacity ratio is equal to or exceeds 0.75, consider the needs for a future 4-lane facility. When considering truck-climbing lanes on a P-3 design class highway, perform an investigation to determine whether a P-2 design class highway is justified.

[5] For access control requirements, see Chapters 1430 and 1435 and the Master Plan for Limited Access Highways. Contact the HQ Design Office Access & Hearings Unit for additional information.

[6] Full or modified access control may also be used.

[7] Contact the Rail Office of the Public Transportation and Rail Division for input on railroad needs.

[8] All main line and major spur railroad tracks will be separated. Consider allowing at-grade crossings at minor spur railroad tracks.

[9] Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the hazard potential. Provide justification for railroad gradeseparations.

[10] For existing roadways, see 440.07.

[11] These are the design speeds for level and rolling terrain in rural design areas. They are the preferred design speeds for mountainous terrain and urban design areas. Higher design speeds may be selected, with justification.

[12] These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

[13] In urbanized areas, with a corridor analysis, 50 mph may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

[14] In urban design areas, with a corridor analysis, these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

[15] 12-ft lanes are required when the truck DDHV is 150 or greater.

[16] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by 4 inches.

[17] 12-ft shoulders are desirable when the truck DDHV is 250 or greater.

[18] When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

[19] Minimum left shoulder width is to be as follows: 4 lanes – 4 ft: 6 or more lanes – 10 ft. Consider 12-ft shoulders on facilities with 6 or more lanes and a truck DDHV of 250 or greater.

[20] For existing 6-lane roadways, an existing 6-ft left shoulder is a design exception when the shoulder is not being reconstructed and no other widening is required

[21] Restrict parking when DHV is over 1500.

[22] For pavement type determination, see Chapter 520.

[23] Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut (see 440.15).

[24] 63 ft from edge of traveled way.

[25] Make right of way widths not less than those required for necessary cross section elements.

[26] For the minimum vertical clearance, see Chapter 1120.

[27] For median widths 26 ft or less, address bridges in accordance with Chapter 1120.

[28] For bicycle requirements, see Chapter 1020. For pedestrian and sidewalk requirements, see Chapter 1025. Curb requirements are in 440.11. Lateral clearances from the face of curb to obstruction are in Chapter 700.

[29] For grades at design speeds greater than 60 mph in urban design areas, use rural criteria.

[30] Grades 1% steeper may be used in urban design areas and mountainous terrain with critical right of way controls.

Geometric Design Data: Principal Arterial
Figure 440-6 (continued)

Design Class	Divided Multilane		Two-Lane						Undivided Multilane	
	M-1		M-2		M-3		M-4		M-5[1]	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year[2] NHS	Over 700[3]		Over 201[4]		61–200		60 and Under		Over 700[3]	
Non-NHS			Over 401		201–400		200 and Under			
Access Control[5]	Partial[6]									
Separate Cross Traffic										
Highways	Where Justified		Where Justified		Where Justified		Where Justified		Where Justified	
Railroads[7]	All		All[8]		Where Justified[9]		Where Justified[9]		Where Justified[9]	
Design Speed (mph)[10]										
Desirable[11]	70		70	60	70	60	60	60	70	60
Minimum[12][13]	50		50	40	50	40	40	30	40	30
Traffic Lanes										
Number	4 or 6 divided		2		2		2		4	4 or 6
Width (ft)	12		12		12		12		12	11[14]
Shoulder Width (ft)[15]										
Right of Traffic	10		8		6		4		8	8[16]
Left of Traffic	Variable[17][18]									
Median Width (ft)	[19]								[19]	
Parking Lanes Width (ft) – Minimum	None		None		None	10	None	10	None	10[20]
Pavement Type[21]	High		As Required						High or Intermediate	
Right of Way[22] – Width (ft)	[23]	[24]	120	80	120	80	100	80	150	80
Structures Width (ft)[25]	Full Roadway Width[26]		40		40		32		Full Roadway Width	
Other Design Considerations–Urban			[27]		[27]		[27]		[27]	

Type of Terrain	Rural – Design Speed (mph)									Urban – Design Speed (mph)						
	40	45	50	55	60	65	70	75	80	30	35	40	45	50	55	60[28]
	Grades (%)[29]															
Level	5	5	4	4	3	3	3	3	3	8	7	7	6	6	5	5
Rolling	6	6	5	5	4	4	4	4	4	9	8	8	7	7	6	6
Mountainous	8	7	7	6	6	5	5	5	5	11	10	10	9	9	8	8

Geometric Design Data: Minor Arterial
Figure 440-7

Minor Arterial Notes:

[1] Justify the selection of an M-5 design class on limited access highways.

[2] The design year is 20 years after the year the construction is scheduled to begin.

[3] When considering a multilane highway, perform an investigation to determine whether a truck-climbing lane or passing lane will satisfy the need (see Chapter 1010).

[4] Where DHV exceeds 700, consider 4 lanes. When the volume/capacity ratio is equal to or exceeds 0.75, consider the needs for a future 4-lane facility. When considering truck-climbing lanes on an M-2 design class highway, perform an investigation to determine whether an M-1 design class highway is justified.

[5] For access control requirements, see Chapters 1430 and 1435 and the Master Plan for Limited Access Highways. Contact the HQ Design Office Access & Hearings Unit for additional information.

[6] Full or modified access control may also be used.

[7] Contact the Rail Office of the Public Transportation and Rail Division for input on railroad needs.

[8] All main line and major spur railroad tracks will be separated. Consider allowing at-grade crossings at minor spur railroad tracks.

[9] Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the hazard potential. Provide justification for railroad grade separations.

[10] For existing roadways, see 440.07.

[11] These are the design speeds for level and rolling terrain in rural design areas. They are the preferred design speeds for mountainous terrain and urban design areas. Higher design speeds may be selected, with justification.

[12] In urban design areas, with a corridor analysis, these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

[13] These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

[14] When the truck DDHV is 150 or greater, consider 12-ft lanes.

[15] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by 4 inches.

[16] When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

[17] The minimum left shoulder width is 4 ft for 4 lanes and 10 ft for 6 or more lanes.

[18] For existing 6-lane roadways, an existing 6 ft left shoulder is a design exception when the shoulder is not being reconstructed and no other widening is required.

[19] Minimum median width is as required for shoulders and barrier (including required shy distance) or ditch (see 440.10).

[20] Restrict parking when DHV is over 1500.

[21] For pavement type determination, see Chapter 520.

[22] Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut (see 440.15).

[23] 63 ft from edge of traveled way.

[24] Make right of way widths not less than those required for necessary cross section elements.

[25] For the minimum vertical clearance, see Chapter 1120.

[26] For median widths 26 ft or less, address bridges in accordance with Chapter 1120.

[27] For bicycle requirements, see Chapter 1020. For pedestrian and sidewalk requirements, see Chapter 1025. Curb requirements are in 440.11. Lateral clearances from the face of curb to obstruction are in Chapter 700.

[28] For grades at design speeds greater than 60 mph in urban design areas, use rural criteria.

[29] Grades 1% steeper may be used in urban design areas and mountainous terrain with critical right of way controls.

Geometric Design Data: Minor Arterial
Figure 440-7 (continued)

Design Class	Undivided Multilane		Two-Lane					
	C-1		C-2		C-3		C-4	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year[1] NHS	Over 900[2]		Over 301[3]		201–300		200 and Under	
Non-NHS			Over 501		301–500		300 and Under	
Access Control	[4]		[4]		[4]		[4]	
Separate Cross Traffic								
Highways	Where Justified		Where Justified		Where Justified		Where Justified	
Railroads[5]	Where Justified[6]		All[6]		Where Justified[6]		Where Justified[6]	
Design Speed (mph)[7]								
Desirable[8]	70	60	70	60	70	60	60	60
Minimum[9][10]	40	30	50	40	50	40	40	30
Traffic Lanes								
Number	4	4 or 6	2		2		2	
Width (ft)	12	11[11]	12		12		12	
Shoulder Width (ft)[12]	8	8[13]	8		6		4	
Median Width (ft)	[14]							
Parking Lane Width (ft) – Minimum	None	10	None		None	10	None	10
Pavement Type[15]	High or Intermediate		As Required					
Right of Way (ft)[16]	150	80	120	80	120	80	100	80
Structures Width (ft)[17]	Full Roadway Width		40		40		32	
Other Design Considerations – Urban	[18]		[18]		[18]		[18]	

Type of Terrain	Rural – Design Speed (mph)										Urban – Design Speed (mph)								
	25	30	35	40	45	50	55	60	65	70	20	25	30	35	40	45	50	55	60[19]
	Grades (%)[20]																		
Level	7	7	7	7	7	6	6	5	5	4	9	9	9	9	9	8	7	7	6
Rolling	10	9	9	8	8	7	7	6	6	5	12	12	11	10	10	9	8	8	7
Mountainous	11	10	10	10	10	9	9	8	8	6	14	13	12	12	12	11	10	10	9

Geometric Design Data: Collector
Figure 440-8

Collector Notes:

[1] The design year is 20 years after the year the construction is scheduled to begin.

[2] When considering a multilane highway, perform an investigation to determine whether a truck-climbing lane or passing lane will satisfy the need (see Chapter 1010).

[3] Where DHV exceeds 900, consider 4 lanes. When the volume/capacity ratio is equal to or exceeds 0.85, consider the needs for a future 4-lane facility. When considering truck-climbing lanes on a C-2 design class highway, perform an investigation to determine whether a C-1 design class highway is justified.

[4] For access control requirements, see Chapters 1430 and 1435 and the Master Plan for Limited Access Highways. Contact the HQ Design Office Access & Hearings Unit for additional information.

[5] Contact the Rail Office of the Public Transportation and Rail Division for input on railroad needs.

[6] Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the hazard potential. Provide justification for railroad grade separations.

[7] For existing roadways, see 440.07.

[8] These are the design speeds for level and rolling terrain in rural design areas. They are the preferred design speeds for mountainous terrain and urban design areas. Higher design speeds may be selected, with justification. Do not select a design speed that is less than the posted speed.

[9] In urban design areas, with a corridor analysis, these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

[10] These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

[11] Consider 12-ft lanes when the truck DDHV is 200 or greater.

[12] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by 4 inches.

[13] When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

[14] Minimum median width is as required for shoulders and barrier (including required shy distance) or ditch (see 440.10).

[15] For pavement type determination, see Chapter 520.

[16] Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut (see 440.15).

[17] For the minimum vertical clearance, see Chapter 1120.

[18] For bicycle requirements, see Chapter 1020. For pedestrian and sidewalk requirements, see Chapter 1025. Curb requirements are in 440.11. Lateral clearances from the face of curb to obstruction are in with Chapter 700.

[19] For grades at design speeds greater than 60 mph in urban design areas, use rural criteria.

[20] Grades 1% steeper may be used in urban design areas and mountainous terrain with critical right of way controls.

Geometric Design Data: Collector
Figure 440-8 (continued)

Design Class	Divided Multilane		Undivided Multilane		Two-Lane	
	$U_{M/A}$-1	$U_{M/A}$-2	$U_{M/A}$-3	$U_{M/A}$-4	$U_{M/A}$-5	$U_{M/A}$-6
DHV in Design Year[1]	Over 700	Over 700	700–2,500	Over 700	All	All
Design Speed (mph)	Greater than 45	45 or less	35 to 45	30 or less	Greater than 45	45 or less
Access	[2]	[2]	[2]	[2]	[2]	[2]
Traffic Lanes						
Number	4 or more	4 or more	4 or more	4 or more	2	2
Width (ft) NHS	12[3][4]	12[3]	12[3]	12[3]	12[3][6]	12[3]
Non-NHS	11[4]	11[5]	11[5]	11[5]	11[6]	11[7]
Shoulder Width (ft)[8]						
Right of Traffic[9]	10	10	8	8	8[10]	4
Left of Traffic	4	4				
Median Width (ft)[11]			[12]	[12]		
Parking Lane Width (ft)	None	10[13]	10[13]	8[14]	10[15]	8[14]
Structures Width (ft)[16]	Full Roadway Width[17]		Full Roadway Width		32	30
Other Design Considerations	[18]	[18]	[18]	[18]	[18]	[18]

Urban Managed Access Highways Notes:

[1] The design year is 20 years after the year the construction is scheduled to begin.

[2] The urban managed access highway design is only used on managed access highways (see Chapter 1435).

[3] May be reduced to 11 ft, with justification.

[4] Provide 12-ft lanes when truck DDHV is 200 or greater.

[5] Consider 12-ft lanes when truck DDHV is 200 or greater.

[6] Provide 12-ft lanes when truck DHV is 100 or greater.

[7] Consider 12-ft lanes when truck DHV is 100 or greater.

[8] When curb section is used, see Figure 440-3.

[9] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by 4 inches.

[10] When DHV is 200 or less, may be reduced to 4 ft.

[11] Minimum width is as required for shoulders and barrier or ditch (see 440.10).

[12] 2 ft desirable. When a TWLTL is present, 13 ft is desirable, 11 ft is minimum.

[13] Prohibit parking when DHV is over 1500.

[14] 10 ft is desirable.

[15] Prohibit parking when DHV is over 500.

[16] For minimum vertical clearance, see Chapter 1120.

[17] For median requirements, see Chapter 1120.

[18] For bicycle requirements, see Chapter 1020. For pedestrian and sidewalk requirements, see Chapter 1025. Lateral clearances from face of curb to obstruction are in Chapter 700. For railroad and other roadway grade separation, maximum grade, and pavement type for the functional class, see Figures 440-6 through 440-8. Make right of way widths not less than required for necessary cross section elements.

Geometric Design Data: Urban Managed Access Highways

Figure 440-9