FDM 11-20-1 Urban Dimensions and Design Classes

February 15, 2024

1.0 Introduction

This section contains design guidance for urban roadway projects.

1.0.1 Overview and Scope of Projects

Projects are intended to reconstruct or newly construct highway pavement structures, geometric, and cross-sectional features to meet service life cycles. A practical minimum design analysis period for projects is 20 years with many projects meeting a project service life cycle of more than 20 years.

Design of projects shall be in accordance with the Facilities Development Process described in Chapter 3 of the Facilities Development Manual (FDM Chapter 3).

1.0.2 Definitions

The purpose and need for projects should provide pavement structures, geometric, and cross-sectional features that will adequately meet the pavement, safety, and operational needs for full service life cycles of 20 or more years.

FDM 3-5-1 contains definitions for Highway Improvement work types, as well as other criteria, examples, and requirements.

WI Administrative Code Trans 209, Highway and Bridge Project Selection Process, is the basis for the definitions in FDM 3-5-1.

1.0.3 Safety and Traffic Operations

Safety and traffic operations, in addition to pavement structure, are equally important considerations to design for within the project service life cycle time frames. Safety and traffic operations will be addressed on these projects by applying the appropriate safety and operational analyses per the WisDOT Safety Certification Process (SCP) or Operations Certification Process (OCP) and associated Safety and Operations Certification Document (SOCD). See FDM 11-38 and FDM 11-52-15. If the project is a Modernization strategy, safety and operations will be addressed using design criteria per FDM 11-15-1.3.2. The SOCD, along with Design Justifications (DJs) in the Design Study Reports (DSRs) (see FDM 11-1-20 and FDM 11-4-10.4), when needed, are the mechanisms available to justify, document and approve the retention of existing geometric and cross-sectional features or to introduce new geometric or cross-sectional features outside of existing or new design criteria values when needed for situations in which reducing environmental impacts or excessive costs is justified. This FDM chapter will define the WisDOT policy on the proper application of these criteria and processes.

1.0.4 Design Criteria Application

Geometric and cross -sectional design criteria have been developed for improvement projects based on the following sources:

1. Interstate Highways - A Policy on Design Standards - Interstate System, 2016, AASHTO (see FHWA website, “Interstate System”, https://www.fhwa.dot.gov/programadmin/interstate.cfm, under “Interstate Design Standards”)
2. Non-Interstate Highways - A Policy on Geometric Design of Highways and Streets, 7th edition, AASHTO 2018 (see FHWA website, “Geometric Design”, http://www.fhwa.dot.gov/programadmin/standards.cfm, under “Information”)

Urban design criteria for various roadway systems are given in this procedure. Attachment 1.1 and Attachment 1.5 contain design criteria for urban highways.

The Safety Certification Process will be used in conjunction with this guidance to allow for the evaluation and potential utilization of existing geometric and cross-sectional features. Existing features not contributing to safety issues justify improvements using the lower end of the design criteria ranges and may with the addition of other factors (environmental, public involvement, significant costs, etc.) justify the use of existing feature values outside of the range of design criteria. The applications that WisDOT will use to apply these design criteria will be the defined guidance described as S-2 and S-3 Applications - see FDM 11-15-1. These applications will apply to both Federal-aid and State funded projects. See FDM 11-38 for Safety Certification Process (SCP) guidance. See FDM 11-1-10 for additional information regarding S-2 and S-3 Applications.

New Construction projects cannot use the Safety Certification Process (SCP) because no existing cross sectional, geometric features, or crash histories exist in which to analyze safety performance, however predictive safety benefit/cost analyses in conjunction with environmental process evaluations can be used to compare alternatives.

New Construction, reconstruction of an existing roadway with additional through lanes (expansion), or new bridge construction projects will use the S-3 Application as described in FDM 11-15-1.3.2. See FDM 11-15-1, FDM 11-4-10.4, FDM 11-1-20, and FDM 11-38 for further information on the S-2/S-3 Applications, Design Study Report (DSR), Design Justifications (DJs), and the SCP, respectively, for use on projects.

DJ approvals in the DSR are also available to use when needed to justify the preservation of existing features or the application of new cross sectional or geometric feature values outside of FDM design criteria values which are not initially recommended by the Safety and Operations Certification Document (SOCD) or other safety analyses. See FDM 11-1-20 and FDM 11-4-10.4 for information and guidance on the use of DSR DJs.

1.1 Cross Slopes

The pavements of urban roadways typically have crowns in the middle and slope downward towards both edges. The downward cross slopes should be in planes rather than curved (parabolic) sections. Table 1.1 shows the usual Lower and Upper cross slope rates to use:

Table 1.1 Cross Slope Rates for Urban Roadways

Lanes	Lower	Upper
Driving	2%	3%
Parking, Turning, etc.	2%	4%

Cross slope rates outside these ranges may be warranted in unique situations.

1.2 Curbs or Curb and Gutters

The designs of curbs are based on whether the improved roadways will be defined as “low speed urban,” “transitional,” or, “high speed urban.” Designers must therefore first determine the types of roadways, then use the guidelines for those roadway types to determine the curb designs that may be needed.

Roadways are defined as “low speed,” “transitional,” or, “high speed” based on two characteristics:

- Cross-sections
- Posted speeds (Regulatory speeds)

Generally, urban roadways are ones that control surface drainage using curbs and may have enclosed storm sewer systems that may discharge into open channels.

As Table 1.2 shows, roadways with urban cross sections and posted speeds of 40 mph or less are considered “Low Speed Urban,” whereas roadways with urban cross sections and posted speeds of 50 mph or greater are considered “High Speed Urban.” Other roadways are considered “Transitional.” Please note that the locations of roadways within the corporate limits of cities do not necessarily mean that the roadways have urban cross-sections.

Table 1.2 Matrix for Determining Roadway Types

Posted Speed	40 mph or less	45 mph	50 mph or greater
Urban Cross Section	Low Speed Urban Roadway	Transitional Roadway	High Speed Urban Roadway

Normally, the methods of handling drainage determine the cross section. Given the cross sections, designers then use the posted (regulatory) speeds or operating speeds to determine the types of roadways along with the information in the following paragraphs to select the appropriate curb designs.

When designing curbs for roadways, the expected posted speeds are used. The posted speed limits are not required to correspond to the design speeds or to individual design elements within the projects. Consult with region traffic engineers to determine the appropriate posted speeds that will be implemented following completion of improvement projects. (See Chapter 13 of the WisDOT Traffic Engineering Operation and Safety Manual[1] (TEOpS 13-5-12) for guidance relating to posted speed limits). In cases of local roadways or connecting highways, also consult with the local municipalities having jurisdiction over the roadways when determining the appropriate posted speed limits.

When determining the acceptability of given curb designs (heights and offsets), consider other characteristics of the roadway corridors. In addition to drainage and the posted speeds, consider:

- need to maximize capacity,
- degree of adjacent roadside property development,
- need for on-street parking
- need for sidewalks
- need for bicycle facility accommodations
- frequency of access points
- functional classification(s)
- availability and cost of right-of-way

Increases in any of these factors may make the character of the roadways more, low speed urban.

1.2.1 General Curb Design Information

Dimensions and details of recognized curb and gutter designs are on WisDOT's standard detail drawings web page (http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/rdwy/sdd.aspx). Curbs can be categorized as either vertical face or sloping face. Table 1.3 lists the standard WisDOT curbs shown in Chapter 16, and categorizes them as vertical face, 4-inch sloping face, or 6-inch sloping face.

Gutter width is the distance between the gutter flange line and the curb face. Gutter widths are considered part of the offsets from the edges of the traveled ways to the faces of curbs.

[1] WisDOT Traffic Engineering Operations and Safety Manual: http://wisconsindot.gov/Pages/doing-bus/local-gov/traffic-ops/manuals-and-standards/teops/default.aspx

Table 1.3 ***Curb, Curb & Gutter, and Inlet Covers per FDM Chapter 16***

	Curb type	Inlet Covers *
Vertical Face	Type A curb	A, A-S, H, H-S, WM, S, V, Z
	Type A, 18-inch	Z
	Type A, 30-inch	A, A-S, H, H-S, WM, Z
	Type D curb	A, A-S, H, H-S, WM, S, V, Z
	Type D, 18-inch	Z
	Type D, 30-inch	A, A-S, H, H-S, WM, Z
	Type K, 30-inch	A, A-S, H, H-S, WM, Z
	Type L, 30-inch	A, A-S, H, H-S, WM, Z
	Milwaukee: 18-inch	
	Milwaukee: 22-inch	
	Milwaukee: 31-inch	R, W
4-inch Sloping Face	Type A, 36-inch	HM, HM-S
	Type D, 36-inch	HM, HM-S
	Type G, 30-inch	HM-GJ, HM-GJ-S
	Type J, 30-inch	HM-GJ, HM-GJ-S
	Type T, 36-inch	T
	Type R, 36-inch	T
6-inch Sloping Face	Type A, 36-inch	F, HM, HM-S
	Type D, 36-inch	F, HM, HM-S
	Type G curb	HM-GJ, HM-GJ-S, S, V
	Type G, 30-inch	HM-GJ, HM-GJ-S
	Type J curb	HM-GJ, HM-GJ-S, S, V
	Type J, 30-inch	HM-GJ, HM-GJ-S

* *Inlet covers can fit curb heights and curb and gutter widths. Some adjustments may be required. Also, check hydraulic capacities and the safety for bicycles, pedestrians, and disabled users.*

Another approach is to widen the gutters at the inlet locations. This can be done by either flaring back the curb faces or flaring in the gutter flags.

Use of non-standard curb designs is discouraged but may be necessary where site conditions dictate. Prior to inclusion in project plans, alternate designs should be discussed in the SOCDs or DSR DJs.

Curb types and placements near traffic barriers (guardrails, etc.) and crash cushions is important because there is the potential for errant vehicles to vault. High speed impacts to curbs can cause vehicle damage leading to loss of vehicle control.

Evaluate whether roadway tapers or curb cuts (driveway entrance curbs) need to be provided at the approach ends of traffic barrier end treatments or crash cushions to minimize any adverse effects on traffic barrier or crash cushion performance. Base these decisions on the types of end treatments, drainage requirements, roadway cross-sections and available right-of-way.

Further guidance on curb placements around traffic barriers and crash cushions can be found in the Roadside Design Guide (AASHTO RDG, 2011[2]).

1.2.1.1 Gutter Cross Slopes

A 4% gutter cross slope is the design criteria slope. Consider on-road bicycle accommodations, including concrete bike lanes, in gutter slope selections. A 2% gutter slope may be appropriate for these conditions.

Refer to FDM 11-46-10.3 for gutter cross slope design guidance with curb ramp applications. Provide inlet spacings per FDM 13-25-15 for the selected gutter slope designs.

Label any non-standard (i.e. other than 4%) gutter cross slope locations within the plans. At a minimum, include gutter cross slope labels or notes within the contract typical cross sections and miscellaneous quantities. Include additional labels or notes within contract construction details and cross sections for all gutter cross slopes as needed and to provide further clarity.

1.2.2 Low Speed Urban Roadways

- Use 6-inch vertical curbs to control both surface drainage and access.
- For raised median curbs, designers may use either 1 or 2-foot offsets from the edges of the traveled ways to the faces of curbs. (1 - 2-foot gutter sections will meet design criteria).
- For outside curbs, designers may use either 1 or 2-foot offsets from the edges of the traveled ways to the faces of curbs. (1 - 2-foot gutter sections will meet design criteria)
- Typically, match island curbs to the curb designs used on the roadway sections unless the roadway environment or maintenance activities dictate different approaches such as traffic pavement markings or alternative curb designs. Coordinate the designs with region or municipal operations and maintenance staffs. - Certain characteristics of roadway corridors may limit the ability to offset the curbs by the 1-foot minimum from the edges of the traveled ways. In these situations, the median curbs and curbs on the outside edges of the roadways may have offsets less than 1-foot. However, the reasoning for the reduced offsets are to be justified in the SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4). (To mitigate for the reduced offsets, sloping curbs may be needed)
- Further guidance on curb types and placements can be found in Section 4.7, pages 4-19 thru 4-23 of the 2018 GDHS and the Roadside Design Guide (AASHTO RDG, 2011[2]). (GDHS hyperlink is only available to WisDOT staff.)

1.2.3 Transitional Roadways

- If posted speeds are greater than 40 mph, eliminate curbs when possible.
- If curbs are required to control drainage, use 6-inch sloping curbs rather than 4-inch sloping.
- In limited situations where the access points are not clearly delineated and cannot be controlled by other means, 6-inch vertical curbs may be used. Document the justifications for using the vertical curbs in the SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4).
- Curbs and Curb Offsets - Consult region planning and traffic personnel, local municipalities, regional planning organizations, or County planning departments to determine the nature and extent of existing or planned developments surrounding or impacting the proposed roadway corridors. To qualify projects as being in developing areas; written documentation is needed from either the local municipalities, regional planning organizations or county planning departments verifying current or future zoning and other long-range planning goals. In addition to reviewing the nature and extent of existing or planned developments, consider the roadway's functional classification and frequency of access points.

1.2.3.1 Undeveloped Areas:

- Use 6-inch sloping curbs.
- Offset both median curbs and outside curbs to the edges of normal-width shoulders. (See FDM 11-15 Attachment 1.1 - 1.4 and FDM 11-15 Attachment 1.17 - 1.19).
- Median curbs and curbs on the outside edges of the roadways with offsets less than the normal-width shoulders will require justification and approval in the SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4).

1.2.3.2 Developing Areas:

- Use 6-inch sloping curbs.
- Offset both median curbs and outside curbs to the edges of normal-width shoulders. (See FDM 11-15

[2] Roadside Design Guide, 4th edition. AASHTO, Washington, DC, 2011

Attachment 1.1 - 1.4 and FDM 11-15 Attachment 1.17 - 1.19)

- Certain characteristics of the roadway corridors may limit the ability to offset the curbs by the normal width shoulders. In those situations, the median curbs and curbs on the outside edges of the roadways may have reduced offsets, down to minimum 1.8-foot offsets, from the edges of traveled ways to faces of curbs, but reasoning shall be justified and approved in the SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4).
- Median curbs and curbs on the outside edges of the roadways with offsets less than the 1.8-foot minimum require justification in the SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4).

1.2.3.3 Developed Areas:

- Use 6-inch sloping curbs.
- Offset both median curbs and outside curbs to the edges of normal-width shoulders. (See FDM 11-15 Attachment 1.1 - 1.4 and FDM 11-15 Attachment 1.17 - 1.19).
- Certain roadway characteristics may limit the ability to offset the curbs by the normal width shoulders. Minimum offsets of 1-1.8 feet may be used but shall be justified and approved in the SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4).
- Offsets of less than 1-foot may be considered in unique circumstances but require justification in the SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4).

1.2.4 High Speed Urban Roadways

- In general, neither vertical nor sloping curbs are ideal for use on high-speed roadways. Therefore, eliminate curbs on urban high-speed roadways, where it is practical to do so.
- When curbs are used, 4-inch sloping curb designs are preferable. However, 6-inch sloping curb designs may be used when required for drainage or access control considerations.
- Shoulder width offsets from the traveled ways to the faces of median curbs and from the traveled ways to the outside edges of the roadways are required (See Attachment 1.5). However, in special cases, when justified and approved in the SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4), minimum offsets of 1.8 feet to the faces of curbs may be acceptable.

1.3 Design Criteria Guidance

The FDM design criteria tables show ranges of design criteria values based on design speeds, lane widths, parking lane widths and roadway widths (faces of curbs to faces of curbs) including widths for providing bicycle accommodations/lanes.

- For New Construction projects (new alignment or capacity expansions), since there are no existing geometric features and crash histories to evaluate, start with the upper ranges of FDM values as the starting points for evaluating alternatives in conjunction with predictive safety benefit/cost analyses (such as HSM) as needed to meet the project purpose and need.
- In addition to the safety benefit/cost analyses evaluations, appropriate environmental impact evaluations need to be completed and documented in the project environmental documents when selecting final design alternatives. Justifications for the use of design criteria outside of the values given in this chapter need to be documented and approved in the project SOCDs and DSR DJs (See FDM 11-38, FDM 11-1-20 and FDM 11-4-10.4).

1.3.1 Low Speed Urban Roadways

In low-speed urban areas with restricted space or historically sensitive resources, lower range design criteria alternatives need to be evaluated during the environmental analysis processes. Evaluation of lower range design criteria on urban streets can help to reduce impacts to the surrounding developed environment, reduce pedestrian crossing distances, allow for on-street bike provisions, parking and transit stops, or enable development of left turn lanes for safety. An important factor to be aware of when considering the use of lower range design criteria is that narrower travel lanes reduce the distances separating various transportation users sharing the same roadway space. Careful review of existing or predictive crash analyses can give an indication as to how existing or proposed narrower lane widths are or may operate into the future. Selections of design vehicles are also an important consideration when evaluating the use of lower range design criteria because heavy trucks require more room to maneuver, both along the roadways and at intersections.

1.3.2 Transitional and High-Speed Urban Roadways

Careful reviews of existing and predictive crash analysis results are even more important when evaluating the use of narrower lane width alternatives on Transitional and High-Speed Urban Roadways because of their higher operating speeds. Reduced separation between transportation users, when operating speeds are higher, make the interactions between various users even more complicated with increased risk of higher severity type crashes. However, use of narrower lane widths can be evaluated when looking to better allocate roadway space for multi- transportation modes, improving operations within narrower urbanized roadway corridors or reducing the roadways impacts on natural or societal resources with or without considerations for operational improvements. Selections of design vehicles are even more important in these situations because heavy trucks operating at higher speeds require more room to maneuver, both along the roadways and at intersections.

At the same time, use of upper range design criteria values may contribute to higher vehicle operating speeds than would otherwise occur if lower range design criteria were used. In situations where it is desirable to lower vehicle operating speeds, consider using pavement markings, small plantings and other traversable features to visually narrow lanes and shoulder/curb offset widths and lateral clearances, rather than physically reducing their dimensions. Physical reductions in lanes, shoulder/curb offsets and lateral clearance widths can be accomplished by either moving curb and gutters in or allowing small, non-hazardous plantings to be placed closer to the traveled ways. However, careful evaluations are needed when considering such physical reductions. As mentioned elsewhere in this procedure, curbing has no re-directive capability at medium and high speeds (45 mph or greater) and can destabilize vehicles or cause them to vault traffic barriers.

1.4 Medians

Types of medians and their recommended designs are addressed below and in Section 7.3.3.1, Pages 7-39 thru 7-49, 2018 GDHS.

Medians for urban streets are designated as either curbed or flush.

Except at intersections, obstacles in medians that cannot be installed with breakaway supports, such as bridge piers, should be either shielded with attenuators or traffic barriers, or be removed.

For guidance on median openings and median widths where left-turn bays will be installed, refer to FDM 11-25 particularly FDM 11-25-2, "Design Criteria and Guidelines", FDM 11-25-5, "Left-Turn Lanes" and FDM 11-25-20, "Median Opening". The minimum median widths required for U-turns are shown in Table 9-28, Page 9-140, 2018 GDHS.

Indicated widths of medians referred to in this procedure are based on the definition appearing on page 4-38, Section 4.11, 2018 GDHS, which is "expressed as the dimension between the edges of the traveled way for the roadways in the opposing directions of travel, including the width of the left shoulders, if any. "

1.4.1 Curbed Medians

The median edges usually consist of 1 to 2-foot gutters and six-inch high vertical or sloped face curbs (see SDD for curb and gutter details).

Several choices are available as to the treatment of the median areas between the curbs. They can be raised or depressed and covered with grass, artificial turf, gravel, paved with asphaltic or P.C. concrete, etc. Selected treatments will vary depending primarily on drainage considerations and pavement slopes, with secondary consideration of aesthetics, plantings, etc. In-lay bricks between the medians is not allowed on the state highway system; bricks are strongly discouraged on municipal projects. During a statewide investigation into curb shearing, the in-lay brick medians displayed greater curb shear damage than other impervious median options. The shifting and movement of the bricks during freeze/thaw events are increasing the stress on the back of the curb leading to premature failures. Lastly, in-lay bricks cause difficulties and increased maintenance with snow removal due to frost heaving. It is recommended that communities wanting a brick aesthetic should consider stamped and/or colored concrete for the median surface treatment.

If the median areas are crowned, low-side median curb and gutters (gutters slope toward curbs) are generally used. These assume that the roadways are also crowned and the driving lanes adjacent to the medians drain toward the medians. Use low-side curb and gutters in super-elevated areas, also.

For projects where all roadway lanes pitch to the outsides, use depressed medians and high-side curb and gutters (gutters slope away from curbs).

Designs utilizing low-side curb and gutters are best as they tend to minimize the wet and slippery conditions caused by snow melt.

1.4.2 Flush Medians

Two types of flush medians are available:

1. The first is truly flush with the edges of driving lanes on either side (Figure 7-4 B, page 7-24, 2018 GDHS). They are delineated by either painting or paving with contrasting types of pavement.
2. The second types of flush medians consist of slightly raised pavements, normally having corrugated

surfaces.

On streets with numerous businesses, raised medians restrict access and force drivers to make U-turns at median openings to reach their destinations. With flush medians, the center lanes can be reserved for vehicles making left turns from both directions. For more information on two-way left-turn lanes refer to FDM 11-25-5.

1.4.3 Low Speed Urban Roadways

Medians are included on two-way streets in Design Classes 4 and 5 (see Attachment 1.2 and Attachment 1.3). Curbed medians are to be as wide as practical, with 30 feet normally being the upper width. When crossing traffic is a factor, curbed medians should not be less than 24 feet. Lesser widths down to 14 feet are appropriate when there are predominantly left-turning movements and few cross-traffic vehicles. Curbed median widths less than 14 feet are adequate to provide for separation and prevent conflicts between vehicles traveling in opposite directions.

1.4.4 Transitional and High Speed Urban Roadways

Medians are included on two-way streets in Design Classes UCL5 and UA3 (see Attachment 1.6). The narrowest median widths provided on these roadways should be 30 feet for the following reasons:

- Provides minimal clear zone in one direction for up to 60 mph design speeds
- Provides the narrowest widths needed to meet the operational requirements of cable-guard and other median roadside safety barriers that may be needed to prevent or eliminate cross over crashes.
- Provides reasonable widths for semi-trailer trucks to safely cross medians in single crossing maneuvers (includes crossing the adjacent traffic lanes, medians and either into or across the far side traffic lanes). For semi-trailer trucks to cross in multiple stages by storing in the medians, requires median storage widths of 80 feet or greater.

1.5 Travel Lanes

The number and width of travel lanes for each design class are shown in Attachment 1.1 and Attachment 1.5. For low-speed urban roadways (Attachment 1.1) threshold traffic volumes are given in the tables for LOS C, D and middle E for typical "worst case" and typical "best case" scenarios and for transitional and high speed urban roadways (Attachment 1.5) threshold traffic volumes are given based on the FDM 11-5-3 level of service triggers.

The intent of the threshold volumes is to indicate when incremental improvements or capacity improvements might need to be considered. For the low-speed urban roadways, the "worst case" and "best case" thresholds provide a range of capacities based on a range of possible geometric and operational features.

The "worst case" scenario thresholds are based on roadways that contain typically the worst, capacity-reducing features such as narrow lanes, high turnover parking stalls, no exclusive turn lanes, poor access control, poor signal timing and coordination, etc. The "best case" scenario thresholds are based on roadways containing typically the best, capacity increasing features such as wide lanes, no parking stalls, exclusive turn lanes, good access control, good signal timing and coordination, etc.

If the projected traffic volumes are below the "worst case" thresholds, then the highways will most likely operate sufficiently under their current configurations; if the projected traffic volumes are above the "best case" thresholds, then additional lanes or other major improvements are most likely needed; and if the projected traffic volumes fall between the "worst case" and "best case" thresholds, then traffic analyses are needed to individually evaluate each project's capacity, level of service and necessary incremental improvements. See FDM 11-5-3 for use of meta-manager data or whether project specific traffic analyses need to be completed.

For transitional and high speed urban roadways, the thresholds are based on typical geometric and operational features. When the thresholds for transitional and high-speed urban roadways are exceeded, consider adding travel lanes or other improvements such as passing lanes or climbing lanes.

Consider the use of physically narrower lanes where no safety issues exist and where limitations are imposed by topography, right-of-way, social/environmental impacts or when costs significantly outweigh benefits; but only when appropriate analyses have been completed on the effects on traffic safety and capacity.

Lane widths for Federally Designated Long Truck (i.e. the "National Network" as defined in 23 CFR Part 658) routes are 12-foot (11-foot minimum), but there shall be at least one 12-foot lane in each direction. Lane widths for NHS Routes and Arterials and Collectors that are not Federally Designated truck routes are 12-foot (11-foot minimum if truck and bus volumes exceed an average of 200/lane/day for undivided roadways and 300/lane/day for divided roadways) (e.g., the threshold for urban design class 3 (4-lane undivided) is 4 x 200 = 800 trucks per day; the threshold for urban design class 4 (4-lane divided) is 4 x 300 = 1,200 trucks per day).

Wide curb lanes (aka "wide outside lanes" or "wide outside thru lanes") are outside curb lanes that are wider than 12-feet. The widths of wide curb lanes are equal to the lesser of the distances from the lane lines to the curb flange lines or from the lane lines to 1-foot inside the curb faces. The outside thru travel lanes are part of the wide curb lanes (travel lane widths do not exceed 12-feet). The use of wide curb lanes as bicycle accommodations is discussed in FDM 11-46-15.3.3 and in the Wisconsin Bicycle Facility Design Handbook[3].

If there is room for single lanes in the center of undivided two-way streets, then they may be:

1. Marked for traffic in one direction if the volumes are always heavier in that direction. These would be considered travel lanes.
2. Marked as reverse flow lanes if the heavy direction of flow changes during the day. These would be considered travel lanes.
3. Used for left-turn storage and paved with contrasting materials or conspicuously marked if there is a large percentage of turns at many intersections. These would *not* be considered travel lanes. (Note: two-way left-turn-lanes (TWLTLs) need to be 14-16 feet wide - see FDM 11-25-5).

Reverse flow lanes can generally be considered when right-of-way is restrictive, and more than two-thirds of the peak-hour traffic flows are in opposite directions daily. More than one lane may be designed to carry reverse flow traffic if needed (refer to pages 7-60 thru 7-62, 2018 GDHS).

1.6 Auxiliary and Parking Lanes

Urban roadway widths over and above that required for traffic lanes (typically 36 feet Fc - Fc) are frequently necessary (or useful) to accomplish the following urban needs:

1. Enable two-way arterial traffic to bypass disabled vehicles.
2. Allow for safer entrances and exits from intersections and driveways.
3. Maintain greater separation between pedestrians and moving vehicles when sidewalks abut curbs.
4. Maintain greater separation between bicyclists and moving vehicles.
5. Enable turning movements to be accomplished by trucks or buses minimizing or eliminating encroachments on opposing traffic lanes.
6. Provide temporary storage areas for snow.
7. Provide storage spaces for turning vehicles.
8. Provide for parking.

When parking must be accommodated, the additional roadway widths required for this purpose more than suffice for all the other items in the preceding listing. Designs that include parking lanes are typically discouraged. It is preferable that street widths be selected such that design year traffic volumes will justify all lanes to function as live traffic lanes. Parking can then be permitted until the lanes are needed for traffic.

Parallel parking is an added benefit for adjacent businesses, but results in reductions in capacity, especially during peak traffic times. Studies of street capacity have found that curb parking reduces capacity by 1/4 - 1/3 or more on typical streets. The areas occupied by parked vehicles are not available for traffic movements. The effect on capacity and service volumes is thus equivalent to reductions in effective widths of at least 8 feet. Additionally, in areas of heavy parking turnover, sporadic interruptions in the adjacent lanes will result from vehicles entering or leaving parking spaces. When capacity problems exist, consider removing all on-street parking, when possible. Parking can interfere with emergency and service vehicles such as: police, fire, ambulance, trash collection and water utilities. On-street parking can also be a major contributing factor to traffic crashes because of improperly or illegally parked vehicles and pedestrians entering streets from between parked vehicles.

In the cases of arterials, design year traffic volumes may be high enough to require the parking lanes to ultimately act as live traffic lanes on either a part-time or full-time basis. If parking lanes are used as travel lanes, then the widths of these travel lanes do not include the gutter widths. These travel lanes become the outside travel lanes and their outside edges are considered the edges of the traveled ways.

Regardless of whether the anticipated ultimate uses are for parking or driving, wider parking lanes are desirable in commercial areas. See Table 1.4 below.

[3] Wisconsin Bicycle Facility Design Handbook:
http://wisconsindot.gov/Documents/projects/multimodal/bike/facility.pdf

***Table 1.4* Parking Lane Widths to Accommodate Parallel Parking**

Roadway Type	(Width Including Gutter)	
	Upper	**Lower***
Arterial Street (or Collector in commercial area)	12 feet	7 feet
Collector (non-commercial area)	8-10 feet	7 feet
Local Street	8 feet	7 feet

* *See FDM 11-46-15.3 for bicycle accommodations with parking.*

Consider restricting parking near intersections for the purposes of:

- increasing sight distances, both for vehicles and pedestrians (see FDM 11-10-5.1.4.1.3 and FDM 11-10 Figure 5.3)
- reducing conflicts for turning traffic,
- providing bus storage or loading zones, and
- Complying with state and local regulations.

See pages 7-58 and 9-66, 2018 GDHS for parking restrictions at intersections.

1.6.1 Angle Parking

Various studies have shown that angle parking is particularly unsafe and is to be replaced with parallel parking, if possible. Angle parking presents problems because of the varying lengths of vehicles and the sight distance problems associated with vans and recreational vehicles.

Angle parking requires much wider parking lanes than parallel parking. Lane widths of 15 to 20 feet are required depending on the degrees of angles used.

Do not use angle parking, except in the following situations.

1. On low-volume local streets which have adequate widths to safely accommodate this type of parking
2. The additional parking is absolutely needed for the economic stability of the local communities.

Typical situations when angle parking may become an issue is when street improvements are planned and angle parking already exists. In these cases, review crash records to assess the safety impacts of this type of parking before allowing it to continue.

When angle parking is determined to be required, treat it as a Design Justification and document it accordingly. Documentation is to include crash analyses, posted speeds, street widths, traffic volumes and discussions of why the parking is necessary to the economic stability of the communities to retain it.

1.6.2 No Parking

When provisions for parking are unnecessary, use the roadway widths for the no-parking conditions given in Attachment 1.1. However, if the roadways are two-lane STHs or Connecting Highways, and no provisions for parking are to be made, total widths of 36 feet from faces to faces of curbs are recommended. These widths will provide all the needs previously listed under the Auxiliary and Parking Lanes section, except parking. If parking is to be permitted on one side only, consider providing total widths greater than 36 feet only when there are reasonable chances of needing additional traffic lanes within the foreseeable future.

1.7 Border Area and Curb Extensions

1.7.1 Border Area

A border area is the area adjacent to an urban street, measured from the face of curb to one-foot behind the back edge of the sidewalk – typically the right-of-way line. Border areas typically include the curb head, the terrace, the sidewalk, and clearance area behind the sidewalk especially where businesses front the sidewalk. See FDM 11-46-5.2.

1.7.2 Curb Extensions[4]

Curb extensions (also known as bump-outs or bulb-outs) visually and physically narrow the roadway. They may be implemented on downtown, neighborhood, and residential streets. Curb extensions have multiple applications ranging from traffic calming (speed management) to bus bulbs and midblock crossings. Curb extensions increase the overall visibility of pedestrians by aligning them with the traffic side of the parking lane.[5]

Curb extensions:

- Reduce pedestrian crossing distances and exposure.
- Create additional space for curb ramps and landings where walkway space is narrow.
- Delineate on-street parking areas effectively.
- Reduces the likelihood that motorists will use the parking lane as a travel lane.
- Restricts drivers from encroaching into crosswalks or intersections when parking their cars.
- Improve sight distance and sight lines for both pedestrians and motorists by:
    - making the pedestrians waiting at the corner more visible to drivers on roadways with on-street parking; and,
    - giving the pedestrian a better view of oncoming traffic without having to step into the roadway.

General considerations:

- Before installing curb extensions on the National Highway System (NHS) and State Trunk Highway (STH) network, consult with the region bicycle/pedestrian coordinator, the Bureau of Project Development (BPD) Region Design Oversight Engineer, and the municipality to determine if curb extensions are appropriate for a given project.
- In cases of local roadways, consult with the region's bicycle/pedestrian coordinator and the municipality having jurisdiction over the roadway to determine if curb extensions are appropriate for the project.
- May be used on projects with existing or proposed parking lanes.
- In constrained conditions, a curb extension can facilitate vertical tie-ins and ADA compliant curb ramps. The extra space may make a more desirable ramp type feasible. See FDM 11-46-10.6.2.

Curb extension general design parameters:

- Use on low-speed urban roadways (posted speed 35 MPH or lower).
- Accommodate large turning vehicles without encroachment on sidewalk. Discuss with the Regional Freight Coordinator prior to implementing on freight routes - Oversized Overweight (OSOW) truck routes, High Clearance routes (OSOW-HC), and Wind Tower corridors (OSOW-WT) – see FDM 11-25.
- When a bike accommodation is not included in the proposed (finished) typical section, provide an area to be clear for bicyclist who may be sharing the travel lane, 5-foot typical/4-foot minimum, from the parking lane to accommodate bikes at the intersection. Extend curbs to the point where the gutter flange would be aligned 5-foot typical/4-foot minimum from the edge of the traveled way (see Figure 1, below).
- When the design includes a bike lane or bike accommodation, extend curbs to the point where the gutter flange would end at the edge of the parking (see Figure 2, below).
- Drainage around the curb extension needs to be addressed. Additional inlets and storm sewer may be needed or moved accordingly – see FDM 13-25.
- Tapered sections should be designed to accommodate snow removal per recommendation from maintaining authority.
    - flexible delineators post with reflective sheeting are recommended to delineate oncoming tapers (see SDD).

Document curb extensions in the Design Study Report - see FDM 11-4-10.

[4] Adapted from: Federal Highway Administration Highway Safety Programs/Designing a Road Diet & Minnesota Department of Transportation Facility Design Guide
[5] National Association of City Transportation Officials, Urban Street Design Guide https://nacto.org/publication/urban-street-design-guide/street-design-elements/curb-extensions/

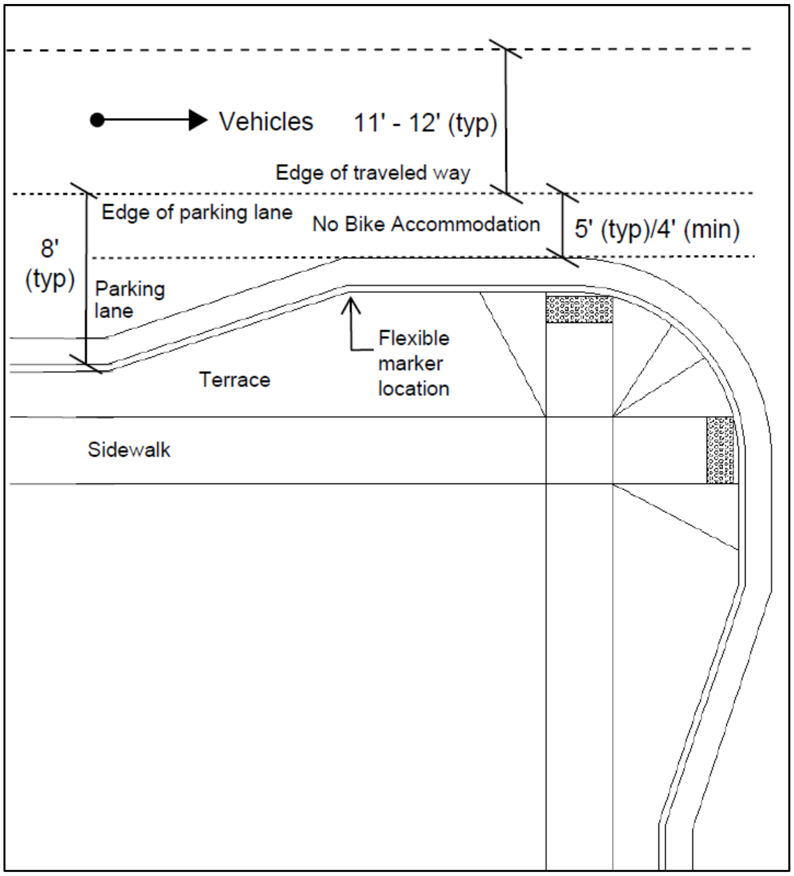

Figure 1 – No Bike Accommodation

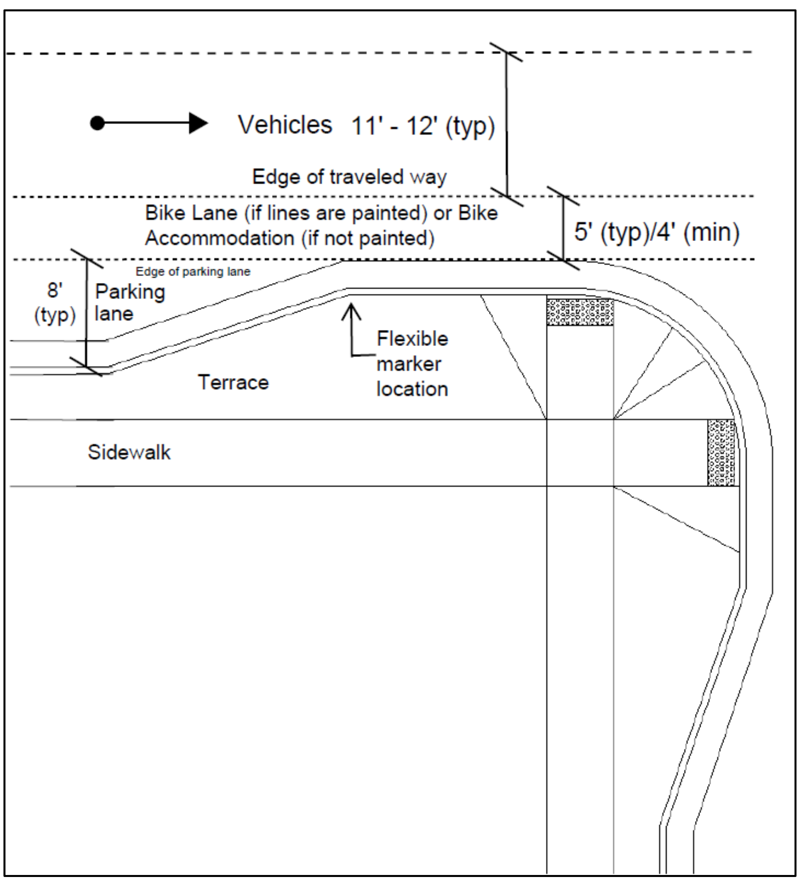

Figure 2 – Bike Lane or Accommodation

1.8 Slopes and Ditches

In urban areas where roadways are designed to match the existing properties at the street right-of-way, slopes (widths) are usually kept to minimums. If the roadways do not match abutting properties, the choices are to acquire permanent right-of-way (acquire in fees or easements), or temporary construction permits, or build retaining walls when close structures do not permit the use of adequate slopes. See page 8-14, 2018 GDHS and the Wisconsin LRFD Bridge Manual[6] for guidance in the use of retaining walls.

When the depths of cuts or fills are about 5 feet or above, permanent right-of-way (acquired in fees or easements) are typically required to have permanent rights to maintain the slopes. For lesser heights where it is only necessary to construct the slopes and "dress up" the adjacent lands, temporary limited easements are obtained.

Flatten and shape slopes to fit the existing topography, and to provide pleasing, natural appearances consistent with effective erosion control and adequate drainage.

Generally, ditches that are parallel to streets (roadside ditches) are not required in urban areas. However, if ponding is anticipated adjacent to fill sections, or if the natural sheet flows are interrupted because of the streets, place inlets in the ponded areas, or construct roadside ditches to drain the ponded areas (use longitudinal ditch slopes of 0.5% or steeper).

1.9 Clearances for Urban Roadways

Definitions and guidance for Lateral Clearances and Clear Zones can be found in FDM 11-15-1. As mentioned there, the distinction between lateral clearance and clear zone is that lateral clearance is for the benefit of vehicles on the roadway, and clear zone is for the benefit of vehicles that errantly leave the roadway.

The Department has adopted OSOW High Clearance Routes with the objective of minimizing overhead constraints for OSOW vehicles along these routes. OSOW High Clearance Routes may traverse through communities. Refer to FDM 11-10-5.4.3 for further vertical clearance guidance along the high clearance routes. See FDM 11-20-1.9.5 for guidance applying to traffic signal supports. See FDM 11-25-40.1 for guidance applying to railroad signals.

1.9.1 Lateral Clearance for Urban Roadways

Lateral clearances are important to provide on all roadways. On urban roadways without roadside barriers, lateral clearances should be provided from the edges of driving lanes to at least a small distance behind the faces of curbs. On urban roadways with roadside barriers, provide the required lateral clearances between the edges of driving lanes and the faces of the barriers. Table 1.5 and Attachment 1.7 show lateral clearance design criteria.

Street parking may be unrestricted, restricted, or prohibited. On streets with prohibited or restricted parking, the outer lanes are available to carry moving traffic.

On streets with unrestricted parking, the driving lanes will have sufficient lateral clearances because they are offset from the faces of curbs by the widths of the parking lanes. However, lateral clearance offsets must still be provided behind the faces of curbs to reduce interference with parked vehicles.

Do not place roadside barriers adjacent to parking lanes. Install roadside barriers so they meet the lateral clearance design criteria and the guidance in FDM 11-15-1.13.1.3, i.e. the curb faces are either flush with or behind the faces of beam guard railings.

[6] WisDOT LRFD Bridge Manual: http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/bridge-manual.aspx

Table 1.5 Lateral Clearance from Edge of Driving Lane of Urban Streets [A]

Parking Condition	Urban Roadway Type	WITHOUT roadside barrier [B]	WITH roadside barrier at curb face[C]
With Parking	ALL	**Parking lane width + 4-feet [D]** (Lower Value) (Parking lane width + 2 feet [D])	**Should not allow parking where roadside barrier is used**
Without Parking	HIGH SPEED and TRANSITIONAL	**The Larger of** **6 feet** ***OR*** **the offset from edge of driving lane to face of curb + 4 feet [E]** (Lower Value) (The offset from edge of driving lane to face of curb + 2 feet [E])	**The Larger of** **6 feet** ***OR*** **the offset from edge of driving lane to face of curb[E]** (Lower Value) (The GREATER of 1.8 feet *OR* the offset from edge of driving lane to face of curb[E])
	LOW SPEED AND TURNING LANES	**The Larger of** **4 feet** ***OR*** **the offset from edge of driving lane to face of curb + 2 feet [E]** (Lower Value) (The offset from edge of driving lane to face of curb + 2 feet [E])	**The Larger of** **4 feet** ***OR*** **the offset from edge of driving lane to face of curb[E]** (Lower Value) (The GREATER of 1.8 feet *OR* the offset from edge of driving lane to face of curb[E])

A. Applies to all fixed objects other than mailboxes. Clearances to mailboxes are based on the guidelines from Chapter 11 of the 2011 AASHTO Roadside Design Guide[7], titled "Erecting Mailboxes on Streets and Highways."

B. Lateral clearances extend behind the curb faces.

C. Lateral Clearances should be provided to the faces of barriers, but do not extend behind them. Other offsets behind barriers or curb faces may apply. Also, consider the potential deflections of the roadside barriers (see FDM 11-45).

D. Parking lane widths include gutter widths.

E. Include gutter widths - see this Procedure for guidance on offsets from edges of driving lanes to faces of curbs.

1.9.2 Clear Zones for Urban Roadways

Clear zones are important in urban and transitional roadways. Nationally in 2010, 42% of fixed object fatalities occurred in urban areas (Insurance Institute for Highway Safety). In another study, 48% of run off the road fatalities, occurred at speeds less than 50 mph.

[7] Roadside Design Guide, 4th edition. AASHTO, Washington, DC, 2011

Because of this, clear zones on urban roadways are important. However, there may be trees, utility poles, utility cabinets, or other fixed objects within the clear zones, which are impractical to remove or shield. That, along with limited right-of-way, generally makes it more difficult to provide clear zones on urban roadways than on rural roadways.

The 2018 GDHS indicates the following:

- "Where establishing a full-width clear zone in an urban area is not practical due to right-of-way constraints, consideration should be given to establishing a reduced clear zone or incorporating as many clear-zone concepts as practical, such as removing roadside objects or making them crashworthy." (page 4-17, 2018 GDHS).
- "On curbed facilities located in transition areas between rural and urban settings there may be an opportunity to provide greater lateral offset in the location of fixed objects." (page 7-49, 2018 GDHS).

In the past, there has been much confusion over what clear zones are required for urban or transitional roadways. The 2011 AASHTO Roadside Design Guide[2] has provided the following clarifications:

- "This minimum lateral offset was never intended to represent an acceptable safety design criteria, though sometimes it has been misinterpreted as such. In a constrained urban environment, there is still a need to position rigid objects as far away from the active traveled way as possible."

A common misconception about urban roadways is that curbs act as barriers that help prevent vehicles from leaving the roadways. Slope faced curbs have no re-directional capabilities and vertical faced curbs have only limited re-directional capabilities and only at low speeds (approximately 25 mph or lower).

***Table 1.6* Recommended Clear Zone of Urban**

Low Speed (40 mph posted speed or less)	Transitional (45 mph posted speed) - (By Level Of Development)			**High Speed (50-55 mph posted speed)**
	Developed	Developing	Undeveloped	
Provide clear zones to the extent practical	Provide clear zones to the extent practical	Provide rural clear zones until developments occur. See FDM 11-15 Attachment 1.9 and FDM 11-15 Attachment 1.10	Provide rural clear zones. See FDM 11-15 Attachment 1.9 and FDM 11-15 Attachment 1.10	Provide rural clear zones. See FDM 11-15 Attachment 1.9 and FDM 11-15 Attachment 1.10

Practical clear zones can depend on many different variables. Review FDM 11-45-20, and FDM 11-45-30 for additional discussion.

1.9.3 Additional Guidance for Treatment of Fixed Objects - Low Speed Urban (40 mph posted speed or less), With or Without Parking

Place light poles beyond the lateral clearances. Breakaway light poles are generally the preferred light pole installation in developed areas. However, non-breakaway light poles are acceptable to install in the following situations.

- Downtown streets with commercial buildings behind sidewalks.
- Where there is a preponderance of other non-breakaway features such as trees, or street furniture.
- Where ornamental poles are used which cannot be made breakaway.
- At locations that are frequented by high concentrations of pedestrians, and where the likelihood of poles coming down on pedestrians is high, e.g. bus stops.
- Playgrounds.

1.9.4 Additional Guidance for Treatment of Fixed Objects - Transitional (45 mph posted speed) and High-Speed Urban (50 mph posted speed or greater)

Curbs are ineffective at redirecting errant vehicles at these speeds. Therefore, providing clear zones are more important in transitional and high-speed urban areas than in low-speed urban areas. Guidance for choosing the location of various fixed objects is provided below,

- Utility poles. The most desirable treatments are to bury utilities, or install on poles at, or as close as practical to the right-of-way line. Make accommodations in accordance with the WisDOT Utility

Accommodation Policy Manual, Chapter 96 of the State Highway Maintenance Manual[8].

- Utility junction boxes, pedestals, cabinets, and other above ground facilities. It is undesirable to locate these on the right-of-way. However, when above ground facilities are allowed on the right-of-way, place these at locations that are not vulnerable to errant vehicles and at, or as near to, the right-of-way line as practical.
- Trees. Generally, do not allow trees on constricted right-of-way. Plant trees beyond sidewalks or arrange for special treatments.
- Overhead sign supports, non-breakaway. Individual attention must be given to look for locations which may give adequate offsets. If the horizontal clearances must be less than the values prescribed in FDM 11-15-1 or if located on substantial curves, then shield with guardrail or crash cushions. Shielding may be unnecessary or undesirable under the following conditions:
  - Buildings, walls or drop-offs near curbs.
  - Interference with pedestrian movements, or potential driveway developments.
  - Sight obstructions may result.
  - Shielding themselves may be hazards.
- Light poles. State-owned light poles, and those under permits, shall comply with the lateral offset criteria in Section 11-10-1 of the Traffic Engineering operations and Safety Manual[1]. For convenience, a portion of that information is provided in Table 1.7 below.

***Table 1.7* Light Pole Lateral Offsets for Transitional and High-Speed Urban**

Posted Speed (MPH)	Traffic Volume (ADT)	Minimum Offset* For Rigid	Minimum Offset for Breakaway
45-50	0 - 1,500	20 Feet	**
	1,500 - 6,000	26 Feet	**
	over 6,000	28 Feet	**
55 and over	0 - 1,500	24 Feet	**
	1,500 - 6,000	30 Feet	**
	over 6,000	30 Feet	**

* *Offset distances are measured from the adjacent edges of traveled ways (through lanes), to the faces of the poles.*

** *Breakaway poles should be a minimum of 12-feet as measured from the adjacent edges of traveled ways (through lanes) in rural cross-sections. Breakaway poles should be at least 2-feet from faces of vertical curbs, or flow lines of sloping curbs, in urban cross-sections.*

1.9.5 Traffic Signal Supports

See section 6-1-3 of the Traffic Signal Design Manual (TSDM)[9] for guidance on offsets. Breakaway installations are not required per the 2011 AASHTO Roadside Design Guide[10]. Non-breakaway traffic signal supports are allowed within the clear zones. Shielding may be necessary at some locations. Consult with the Region Traffic Signal Design Engineer.

Along the Department's adopted OSOW High Clearance Routes, design traffic signals that provide minimum 20'-0" vertical clearances. Coordinate with the Region and State Traffic Signal Design Engineers during the design process.

---

[8] WisDOT Highway Maintenance Manual: http://wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/mntc-manual/default.aspx

[9] WisDOT Traffic Signal Design Manual: http://wisconsindot.gov/Pages/doing-bus/local-gov/traffic-ops/manuals-and-standards/tsdm/tsdm.aspx

[10] Roadside Design Guide, 4th edition. AASHTO, Washington, DC, 2011

1.9.6 Railroad Warning Signs and Signals

See FDM 17-60-20 and Part 8 of the WisDOT MUTCD[11] for guidance. Consult with the Region Railroad Coordinator.

Refer to FDM 11-25-40.1 for guidance on railroad signal vertical clearances along OSOW High Clearance Routes.

LIST OF ATTACHMENTS

Attachment 1.1	Urban Streets Roadway Criteria for Posted Speed Limits of 40 mph or less
Attachment 1.2	Typical Street Cross Sections, Classes 1b, 2a, 2b & 3
Attachment 1.3	Typical Street Cross Sections, Class 4 and Class 5
Attachment 1.4	Factors Used for Highway Capacity Manual LOS Thresholds
Attachment 1.5	Transitional and High Speed Urban Roadway Criteria For Posted Speed Limits of 45 - 55 mph
Attachment 1.6	Typical Transitional / High-Speed Urban Street Cross Sections
Attachment 1.7	Lateral Clearance Criteria
Attachment 1.8	Run off the Road Frequency Calculator

FDM 11-20-5 One-Way Streets *May 15, 2019*

5.1 Guidelines

Designs for one-way operations are recommended when geometrically feasible and economically justifiable. These should normally be applied when adjacent streets can be paired to carry traffic in both directions. One-way operations are most applicable when two-way operations would cause problems with heavy turning movements, when closely spaced signals make progressive signalization difficult on two-way facilities, or when directional distributions are well balanced throughout the entire day. Also, one-way pairs can sometimes be used to good advantage to provide the desired capacities through corridors without requiring extensive street reconstructions or property damage.

With the exceptions listed below, all guidelines pertaining to two-way street operations should also apply to one-way streets.

A table of roadway characteristics has not been prepared for one-way streets as was done for two-way streets; therefore, design classes, normal traffic volume ranges, and functional classifications have not been assigned. However, two-, three-, and four-lane facilities can be taken to be roughly equivalent to design classes 1, 2, and 3, respectively, as shown in FDM 11-20 Attachment 1.1 for two-way streets. Attainable traffic volumes should be computed using procedures shown in the Highway Capacity Manual (see FDM 11-5-3). Medians should not be used on one-way streets, and because of this, typical cross sections should not include more than four driving and two parking lanes.

One significant difference between one-way and two-way streets is that two adjacent lanes may be used as turning lanes in the same direction of travel from one-way streets. Before this is done, however, the following conditions should exist:

1. The movements should be onto other facilities with more than one lane operating in the directions of the completed turns.
2. The roadway cross sections beyond the intersections should be reduced in widths so that the outer lanes do not continue through the intersections. The streets beyond the intersections could be the same widths if the outer lanes are parking lanes. Preferably, the intersections should also mark the ends of the major streets.
3. Turning lanes should be well marked and lane lines should carry completely through the turning areas.
4. The movements should be adequately signed, signalized, or a combination of both.
5. Adequate lane widths should be provided throughout the radius areas of the turns to prevent lateral

[11] WisDOT Manual on Uniform Traffic Control Devices, Chapter 8: http://wisconsindot.gov/Pages/doing-bus/local-gov/traffic-ops/manuals-and-standards/wmutcd/wmutcd.aspx

encroachments upon other lanes by the largest vehicle classes upon which the designs are based.

FDM 11-20-10 Driveways February 15, 2024

10.1 Introduction

The purpose of this section is to provide guidance on the design and construction of driveways.

There are four types of driveways outlined in the Wisconsin Administrative Code TRANS 231:

- Commercial rural
- Commercial urban
- Non-commercial rural
- Non-commercial urban

TRANS 231 specifies maximum widths for urban driveways, but not minimum widths.

10.2 Driveways for Parcels

Each parcel on a highway project must be evaluated for access controls, restrictions, permits, and related items before determining the number, location, and designs of the driveways. The responsibility for this rests with the Region's Access Management (AM) Engineer or Coordinator. The project manager needs to work closely with AM staff to see that all design issues are considered during this phase of project development.

Where properties are served by single driveways that provide the only reasonable accesses to the highway system, WisDOT typically replaces the existing driveways in kind. For access management purposes, the locations of entrances may be moved or combined with neighboring property entrances. Where more than one driveway exists, or reasonable access is available from lower tier roads, the access coordinator's input should be sought regarding the possibility of closing or combining driveways to improve safety and mobility on the state highways or higher tier roads.

Additional driveways between state highways and parcels should not be added without evaluations from the Region's AM staff. Each driveway contributes to additional conflict points and may decrease mobility. TRANS 231.03(2) generally does not warrant multiple driveway entrances on state highways.

10.2.1 Access Control and Right of Way Considerations

Review existing right of way plats and real estate records to determine whether parcels are access restricted from prior acquisitions of highway access rights. It is possible that the Real Estate section may have agreed to access related matters such as driveway removals, relocations, or eliminations in the negotiations and acquisition processes.

On streets and highways with controlled access, driveways may only be located at points shown on the right of way plats, and to widths that correspond to openings in the access controls. Site topography may also influence the placements of driveways relative to horizontal and vertical criteria. Temporary limited easements (TLE) may be required to perform grading operations outside the right of way, to fit the driveway(s) to the site(s). The project manager and project engineer should perform the work and research associated with development of the right of way plats or transportation project plats.

10.2.2 Driveways at Intersections

For parcels at intersections between state highways and local roads, one driveway may be provided on each frontage of the lots, for a total of two driveways. However, if only one driveway is needed, preference should be given to locating the driveways on the side streets. The driveways provided should follow the guidance on marginal corner clearances (see FDM 11-25-2 Figure 2.10, and Table 2-7). At high traffic intersections, it may be required to limit traffic movements to right-in and right-out, by constructing raised medians. Evaluate driveways for stopping sight distances.

On corner lots, access for the properties should be obtained from the lower tier facilities. TRANS 231.03(2) limits the number of driveways serving single parcels to the minimum necessary for reasonable service to the parcels without undue impairment of safety, convenience, and utility of the highways. If reasonable service is obtained via driveways from the intersecting facilities and without driveways directly onto state highways, no driveways may be permitted or constructed on the state highways.

There are circumstances where second driveways may be appropriate, such as where the nature of traffic at the sites make it impossible to provide reasonable service with single entrances. In such cases, second entrances may be constructed, preferably onto the lower tier roads, but onto the higher tier highways, if necessary. Such occurrences may be gasoline stations.

Attention should be given to throat capacities for any proposed driveways onto state trunk highways. Any entrances should have sufficient throats to accommodate expected traffic from the state highways so that vehicles do not stop on the highways to wait for internal traffic or parking on the parcels. Consideration may also be given to limiting the direction of traffic, noted above regarding right-in, right-out driveways. Median installations and signing may also be used to restrict turns or prevent left turning maneuvers at the entrances. Turn lanes may be required or constructed where warranted by expected traffic (trips per day).

10.3 Design Criteria

Geometric elements of driveways include:

- Cross slopes
    - ADA requirements where driveways cross sidewalks
- Vertical alignments
    - Grades
    - ADA requirements where driveways cross sidewalks
    - Break-over angles
    - Vertical curves
    - Drainage considerations
- Widths
- Driveway (intersection) sight distances
- Skew angles

Urban driveways are typically relatively short with straight horizontal alignments.

10.3.1 Cross Slope and Vertical Alignment

One reference on driveways is the Guide for the Geometric Design of Driveways, NCHRP Report 659 (GGDD). This is the successor to the TRB publication Access Management Manual (AMM). Twelve (12) percent should usually be the maximum slopes of residential driveways in some references. The absolute maximum is 15 percent for residential driveways and 10 percent for commercial driveways in GGDD (Exhibit 5-67, Page 70). When the driveways have sidewalk cross slopes of 1.5 percent, the maximum slopes for the driveways beyond the sidewalks is 11.5 percent based on the 10 percent rollover / break-over criteria for crests. The range of such driveway slopes are shown in Table Z of SDD 8d19. The lower limits range from 5 to 9 percent in order to drain the adjoining terraces toward the streets.

The recommended maximum rollovers / break-overs are 9 percent for sag points (curves) in the profiles and 10 percent for crest points (curves) in profiles. These criteria are set in Exhibit 5-68 (Page 71) and Exhibit 5-75 (Page 74) of the GGDD. Rollover limits for other situations are also presented in these exhibits, depending on the types of vehicles under consideration. It should be noted that using the 9 percent criteria for sag points (curves) with gutter cross slopes of 6.25 percent, the resulting maximum upslopes are 2.75 percent for the depressed curb heads and the initial slopes of the driveway aprons (see SDD 8d18 and SDD 8d19). Correspondingly, the maximum upslopes are 5 percent with gutter cross slopes of 4 percent.

One additional slope related criterion is the use of 1.5-inch lips in the curb and gutters at points where the curbs tie into driveway aprons. This condition is constructed for drainage purposes of the design flows. These lips are generally okay for vehicles, but not where bicycles and wheel chairs use the driveways for access to buildings or sidewalks. The wheel chairs can tip over if the 1.5-inch lips are encountered. Bicycles may also have similar problems with vertical lips. The lips are also a problem for snowplows. As such, it is recommended that the lips not be vertical, but rather be transitioned at 2.75 percent over the 6-inch depressed curb heads. This is shown on SDD 8d19.

10.3.1.1 Cross Slope and Vertical Alignment - ADA

Restrictions on driveways include those related to the Americans with Disabilities Act (ADA) and the Public Right of Way Accessibility Guidelines (PROWAG). They cover the interactions of street cross slopes and sidewalk cross slopes with driveway profiles, all being along the same alignments. The maximum sidewalk cross slope according to these laws and regulations is 2 percent. For construction administration purposes, WisDOT has set the sidewalk cross slope limit to be 1.5 percent with a construction tolerance of 0.5 percent, plus or minus. This is set to avoid the situations where the constructed cross slopes do not comply with the PROWAG maximums of 2 percent.

For driveways with crossing sidewalks, the maximum sidewalk ramp slope tying into driveways (in line with the sidewalk profile alignments and perpendicular to the driveway cross slopes) is set as 8.33 percent (12 to 1). According to PROWAG, this applies for maximum distances of 15 feet. This information is shown on the Type X and Type Y driveway details included in SDD 8d18. When applying the 15-foot criteria, the running profile slopes of the sidewalks should be as flat as feasible and not exceed the longitudinal profile grades of the streets or highways. This is to avoid chasing steep slopes indefinitely when fitting the sidewalks to the sites. The Type X detail is for driveways with sidewalks directly abutting the curb and gutters, and Type Y is for driveways with narrow terraces, of 4 to 6 feet. SDD 8d19 shows a Type Z driveway with a wider terrace, of 7 to 12 feet.

10.3.2 Width of Driveways

Provide 12-foot lower minimum widths for non-commercial, residential and field driveways and 16-foot lower minimum for commercial even if the existing driveways are narrower beyond the right of way lines. Do not provide more than 24-foot for non-commercial, residential and field driveways or 35-foot commercial driveways even if the existing driveways are wider.

There are exceptions. For example, it may not be practical to provide 12-foot wide driveways for narrow cemetery entrances. In addition, driveway aprons for buildings housing fire departments or combined EMS facilities may require larger widths to accommodate all the bays.

10.3.3 Driveway Sight Distance

Sight distances should be checked using intersection sight distance (ISD) criteria found in FDM 11-10-5.1.4. The presence of parking needs to be taken into consideration as well.

10.3.4 Driveway Skew

The range of allowable skews is recommended to be the same as for intersections. This is shown in SDD 8d20. The allowable ranges are from 70 degrees to 110 degrees, with respect to the centerlines of the streets or highways.

10.4 Driveway Pavement Materials

There are three material types typically used for driveways and field entrances:

- non-reinforced Portland cement concrete,
- asphaltic surface, or
- aggregate.

Paving driveways within the right of way is done to limit the tracking of soil and loose materials onto the lanes and shoulders of the roadways.

For urban driveways, Portland cement concrete pavements (hereafter referred to as concrete pavements) are typically used for constructing the portions of driveways within the right of way. Asphaltic surfaces are acceptable, except for the portions of the driveways that are considered parts of the sidewalks, which should be concrete. Beyond the right of way lines, match the types of materials in the existing driveways.

The lower minimum thicknesses of concrete driveways are 6 inches, with 6-inch base aggregate courses. The bid items used can be dense or open graded, depending on the types of bases used on the mainlines. If the mainline pavements are 9 to 12 inches, calculate the pavement thicknesses for the driveways using WisPave and site-specific soil conditions, as well as delivery traffic information from the land owners, store owners, or developers.

The lower minimum thicknesses of asphaltic surfaces on driveways and field entrances should be 2 to 3 inches, with a lower minimum of 6 inches of base aggregate (dense or open graded). The lower minimum thicknesses of aggregate surfaces on driveways is 6 inches. For heavy trucks, these thicknesses may need to be increased per WisPave. They also may need to be increased for clay subgrades and other low strength soils. Confirm any increases with the regional pavement engineer.

10.5 Plan Preparation

Evaluate driveway profiles using the vertical concepts shown on Attachment 10.1. Driveway concepts for Type X, Type Y, and Type Z are presented in Attachment 10.2.

Label driveway profiles on the cross sections in the plan sets, showing the percent slopes and segment lengths. Also show the spot elevations at the edges of pavements, low points, break points, high points, the right of way lines, and TLEs.

In Attachment 10.1, typical driveways are shown with curb and gutter (urban typical) and without curb and gutter (rural typical). They are shown for the cases with an upgrade driveway and a downgrade driveway. The details show driveways with sidewalk directly abutting the curb and gutter, as well as with a driveway apron and terrace. The driveways may be composed of segments; however, vertical curves are recommended when the break-overs exceed 6 percent. Sidewalks at driveways are generally five feet wide, except where the sidewalks abut the curb and gutters. In that case, the lower minimum width of sidewalk is six feet. Driveways and shared use trails (typically 10 feet in width) can be designed and constructed with the same guidelines as 5-foot sidewalks. If the driveways have curb and gutter returns, detectable warning fields should be used where sidewalks cross the curb and gutters.

Plan preparation is required for all projects. One cross section is required for each driveway, except where the driveways are 24 feet or wider, where two cross sections should be shown. The driveway slopes should be labeled on the cross sections, and widths should be shown on the plan and profile sheets, and the miscellaneous quantity sheets. Stations and offsets should be labeled on the plan and profile sheets along with the abbreviations of PE, FE or CE (private entrances, field entrances, or commercial entrances).

SDD 8d20 shows driveways with concrete curb and gutter (i.e. urban driveways), as referenced in TRANS 231. SDD 8d20 shows driveways with acceptable skews between 70 degrees and 110 degrees. Also shown are driveways near an intersecting street and with two entrances close to each other.

SDD 8d21 shows details for driveways without concrete curb and gutter (i.e. rural driveways).

SDD 8d22 shows aggregate and asphaltic surfaced driveways on asphaltic concrete resurfacing projects, without curb and gutter.

Minimum island requirements between driveways on adjacent parcels are prescribed in TRANS 231.06. For urban commercial connections, when sidewalks are adjacent to the curbs, islands of intact curbs with lower minimum lengths of 6 feet, measured along the curb lines, are required between each entrance to state highways. When there are terraces between the sidewalks and the curbs, islands with lower minimum lengths of 10 feet measured along the right of way lines must be maintained between each entrance (see SDD 8d20). Where driveway entrances are near property lines, at least 3 feet of curbs must be left undisturbed adjacent to the property lines to serve as island areas should the adjoining property owners request permits for entrances. See TRANS 231.06 for minimum requirements for non-commercial and rural commercial connections.

LIST OF ATTACHMENTS

Attachment 10.1	Conceptual Driveway Profiles
Attachment 10.2	Driveway Design Concepts for Type X, Type Y, and Type Z