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301 ROADWAY CRITERIA

301.1 Pavement

301.1.1 General

This section will assist the designer in determining lane width and pavement cross slope. The number of lanes required is determined through the use of a capacity analysis. This process is explained in detail in the current Highway Capacity Manual, published by the Transportation Research Board. Figure 301-1 should be used as a guide for selection of design levels of service.

Pavement type is determined by the volume and composition of traffic, soil characteristics, performance of pavements in the area, availability of materials, initial cost, annual maintenance cost and service life cost. The determination of pavement type and structural design is included in the Pavement Design & Rehabilitation Manual published by the Office of Pavement Engineering.

301.1.1.1 Disposition of Pavement Required Due to Maintenance of Traffic

ODOT Policy 21-008(P) (and related Standard Procedure 123-001(SP)), Traffic Management in Work Zones, establishes criteria intended to eliminate or reduce traffic delays caused by work zones. Application of this policy to major rehabilitation projects typically results in the need for additional pavement to satisfy the policy. In some situations, this has caused debate on whether the additional pavement should be permanent, full depth design that would be opened to traffic upon completion of the project or a temporary, thinner design that would be removed after construction. The following is intended to provide guidance in making these decisions. This guidance should be considered during the earliest steps of the Project Development Process, and should not supersede any planning or PDP requirements.

The Districts should first request 20 year design traffic for the project and run capacity analyses to determine the need for future permanent lanes. According to Figure 301-1, the goal is to achieve level-of-service C or better depending on the terrain and locale. Typically, level-of-service C is considered satisfactory for all roadways due to budgetary constraints. However, this guideline has been slightly modified in urbanized areas to permit level-of-service D, if approved by the MPO. If the analyses indicate additional lanes will be needed within the next 20 years, the District should proceed with the environmental documentation required, including a Major Investment Study (MIS) in Metropolitan Planning Organization (MPO) areas. This may result in changing the original project classification from a minor project (major rehabilitation with no additional lanes) to a major project. If stream coordination, noise impacts, air quality and planning requirements can be addressed satisfactorily, FHWA will support further development of a project which includes additional permanent, full-depth pavement. Gap closure will not be accepted as the principal Purpose and Need for adding permanent lanes in the future if the capacity analysis does not indicate a need. Median treatments must also be analyzed to determine barrier requirements.

Projects which are approved for additional pavement that will be opened to traffic upon completion must be submitted to TRAC for their concurrence even if Major New funds are not being requested.

Due to the 1 mile signing requirements on freeways to warn motorists of a lane drop ahead, the additional lane/s which were permanently added should not be opened to traffic unless their total length is 5 miles.
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or greater if the adjoining pavement sections at either end of the project have not been widened to match.

Where the need for additional lanes has been determined, the Districts should also look at the need for modifying any existing interchanges which are in the project boundaries of the additional through lanes. Since approval for Interchange Justification Studies are based on not degrading the level-of-service of the Interstate or freeways from the no-build alternative to the build alternative, adding additional capacity to the roadway almost always permits existing interchanges to be expanded to handle additional traffic. Even if funding is not readily available for modifying interchanges at the time the additional through lanes are being added to the freeway, the District should still check the capacity need for modifying the existing interchanges. Many times auxiliary lanes are needed on the freeway from one interchange to another, and these lanes, along with bridge widening to accommodate these lanes could be performed at the same time the additional lanes are constructed.

If Districts determine additional capacity will not be needed within the next 20 years, the additional widening required to maintain traffic should be a temporary buildup sufficient for the duration of the construction project and then be removed upon completion of the project. It is not cost effective to construct full-depth pavement and open it to traffic at the conclusion of the project if the capacity is not required within a 20-year planning horizon.

301.1.2 Lane Width

Lane width in rural areas is dependent upon functional classification, traffic volumes and design speed and is shown in Figure 301-2. Figure 301-4 shows lane widths in urban areas based on functional classification and locale. See Section 105.3 for the National Network lane width requirements.

301.1.3 Traveled Way Widening on Highway Curves

Additional widening may be necessary on curves depending on the design speed, curvature and traveled way width. The Traveled Way Widening values Figure 301-5c are based on the WB-62 [WB-19] vehicle and are applicable to either one-way or two-way, two-lane traveled ways, and other similar type facilities. A WB-62 [WB-19] design vehicle is to be used on state maintained roadways. The design vehicle for other than state maintained roadways should be determined by the maintaining authority. Note that widening less than 2.0 ft. is not required.

Curve widening should be placed on the inside edge of the curve. Where spirals are used, the widening should begin at the TS and reach maximum width at the SC. On alignments without spirals, the widening should be developed over the same distance as the superelevation transition. See Section 202.4 and Figure 301-5a. The transition ends should be rounded to avoid an angular break at the traveled way edge and intermediate points should be widened proportionately. The longitudinal center joint and the centerline marking should be placed equidistant from the traveled way edges.

301.1.4 Pavement Transition/ Taper Rates

Where traveled way widths decrease, the length of transition should be calculated using the following:

Design Speed of 50 mph or more:
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\[ L = WS \]

Design Speed of less than 50 mph:
\[ L = W S^2 / 60 \]

Where: \( L \) = Taper length in feet
\( W \) = Offset width in feet
\( S \) = Design speed

The transition length for increases in traveled way width (diverging tapers) may be more abrupt, i.e. 5:1 ratio.

301.1.5 Pavement Cross Slope

Normal crowned pavements in Ohio are sloped at the rate of 0.016. There are occasions when, because of drainage or pavement type, this rate may be increased to 0.02. An increase in the 0.016 slope rate normally takes place on facilities maintained by local governmental agencies and usually at design speeds less than 50 mph.

Cross slope arrangements for normal crowned sections vary based on features such as the number of lanes, whether or not the highway is divided or undivided, the type and width of the median, and drainage. **Figure 301-6** shows examples normally used in Ohio. Generally the following are applicable on normal crowned pavements:

1. Crowns are to be located between lanes.
2. For three or four lane roadways, no more than two lanes should slope in the same direction.
3. When 3 or more lanes are sloped in the same direction on a high speed roadway (50 mph or greater), the first two lanes from the crown point should have the normal cross slope of 0.016 and any adjacent outside lanes may have an increased maximum cross slope of 0.02.
4. Undivided pavement sections are to be crowned at the middle when the number of lanes are even and at the edge of the center lane when there is an odd number of lanes. When possible, the majority of the pavement should slope to the side which will best accommodate the drainage.
5. Narrow raised median sections are crowned such that the majority of the pavement will drain toward the outside.
6. Pavement sections on either side of wide, depressed medians are to be treated similar to undivided pavement sections (See Item 3 above), with the majority of the pavement sloped to the outside.

Special conditions on individual projects may result in deviations from the above and from those examples shown in **Figure 301-6**.
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301.2 Shoulders

301.2.1 General

Shoulders are used to provide an area adjacent to the pavement to accommodate stopped vehicles, for emergency use, for use while maintaining traffic through construction work zones, for the lateral support of the pavement and to generally improve the safety of a highway. They are also available for the use of pedestrians and bicyclists. When discussing shoulders in this manual, the following meanings are applicable. (See Figure 301-7.)

Traveled Way - The portion of roadway used for the movement of vehicles, exclusive of shoulders and bicycle lanes.

Graded Shoulder Width - The width measured from the edge of the traveled way to the intersection of the shoulder slope and foreslope.

Treated Shoulder Width - The width of that portion of the graded shoulder improved with stabilized aggregate or better.

301.2.2 Shoulder Type

Four basic types of shoulders are used. These include paved, bituminous surface treated, stabilized aggregate, and turf. Structural design of shoulders and shoulder typical sections are covered in the Pavement Design & Rehabilitation Manual published by the Office of Pavement Engineering. Figures 301-3 and 301-4 show the type shoulder to use based on functional classification and traffic or locale.

301.2.3 Shoulder Width

Graded and treated shoulder widths vary depending on functional classification and traffic or locale. The criteria for graded and treated shoulder widths are shown in Figures 301-3 and 301-4. Consideration should be given to providing paved shoulders of sufficient width and strength to accommodate temporary traffic on Interstates, other freeways and expressways. Paved shoulder width reductions of less than 2’ at sign or luminaire foundations or bridge piers will not require a design exception. The 4’ minimum lateral clearance must still be provided.

301.2.3.1 Right Turn Lane Shoulder Width

Under normal roadway conditions, it is desirable to maintain the required mainline shoulder width throughout the length of the right turn lane. But for rare instances, where the roadway has constrained R/W limits and a low volume truck traffic, the width of the shoulder adjacent to the turn lane may be reduced, but to no less than 4 ft. paved and 6 ft. graded. The normal mainline shoulder width should still be maintained in advance of the diverging taper for the turn lane. The transition between the mainline shoulder width and the reduced shoulder width should take place during the span of the right turn taper. The reduced shoulder width may then be carried out throughout the length of the right turn lane. It should be noted that any shoulders or auxiliary lanes (i.e., right turn lanes) are considered part of the mainline clear zone.
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301.2.3.2 Shoulder Taper Rate

A 25:1 taper should be used to transition to a reduced shoulder width. The transition length for increases in shoulder width (diverging tapers) may be more abrupt, i.e. 5:1 ratio.

301.2.4 Shoulder Cross Slope

*Figures 301-8, 301-9 and 301-10* show cross slopes to be used depending on the shoulder type and pavement cross slope.

If the bridge shoulder cross slope is different than the approach roadway shoulder cross slope, then the shoulder cross slope shall be transitioned on the roadway section, off the bridge and approach slabs, within a distance of 100 feet.

301.2.5 Lateral Clearance

In general, roadside objects and barriers should be placed as far away from the traveled way as conditions permit. Proper lateral placement enhances a driver’s comfort level of the roadway, allows for a greater chance of recovery for errant vehicles, and provides for improved sight distance.

The distance from the edge of the traveled way, beyond which a roadside object will not be perceived as an obstacle and result in a motorist reducing speed or changing vehicle position on the roadway is called the shy line offset. As a minimum, the designer should provide a shy line offset of at least 4 ft. When an obstacle is placed too closely to the traveled way, it may interfere with the sight distance of the roadway.

302 BRIDGE CRITERIA

302.1 General

This section provides overall physical bridge dimensions such as width, lateral clearance at underpasses and vertical clearance over roadways. This information is given for New and Reconstructed Bridges in *Figure 302-1* and for Existing Interstate and Other Freeway Bridges to Remain in *Figure 302-2*. Similar information for existing non-freeway bridges that are to be left in place and not reconstructed is shown in *Figure 302-3*. For additional design information, including Minimum Design Loading, refer to the Bridge Design Manual, published by the Office of Structural Engineering.
303.1 General

An interchange is a system of interconnecting roadways, with one or more grade separations, used to efficiently manage traffic between different types and levels of highways. Interchanges are composed of various elements such as Acceleration-Deceleration Lanes, One and Two-lane Directional Roadways, and Ramps. Figure 303-1 shows information relating to the design of interchange elements including pavement and shoulder dimensions, as well as medians between adjacent ramps.

304 MEDIANs

304.1 General

A median is the portion of the highway separating opposing directions of the traveled way. Medians are highly desirable elements on all streets or roads with four or more lanes. This is especially true on rural arterials. All rural arterials, on new locations requiring four or more lanes, should be designed with a median.

The principal functions of a median are to prevent interference of opposing traffic, to provide a recovery area for out-of-control vehicles, to provide areas for emergency stopping and left turn lanes, to minimize headlight glare and to provide width for future lanes. A median should be highly visible both day and night and in definite contrast to the roadway.

304.2 Width

The width of a median is the distance between the inside edges of the traveled way. See Figure 304-1. Width depends upon the type of facility, cost, topography and right-of-way.

304.2.1 Rural

In flat or rolling terrain, the desirable median width for rural freeways is 60 to 84 ft. The 84 foot wide median allows for a future 12 foot wide lane in each direction of travel, and the 60 ft. median. The minimum median width is normally 40 ft. However, in rugged terrain, narrower medians ranging from 10 to 30 ft. may be used. A constant width median is not necessary and independent profiles may be used for the two roadways. For narrower medians, see Section 601.2 for Median Barrier warrants.

304.2.2 Urban

Barrier medians are normally used in urban areas. The median width is dependent upon the width of the barrier and the shoulder width required in Figure 301-4. The minimum median width for a four-lane
urban freeway should be 10 ft. which provides for two 4 ft shoulders and a 2 ft median barrier. For freeways with six or more lanes, the minimum width should be 22 ft. The minimum median widths noted above do not take into account the extra width required if median piers are encountered. Where median piers are encountered either widen the median throughout or apply for a design exception. Preferably, use a 26 ft. wide median when the DDHV for truck traffic exceeds 250 vehicles per hour to provide a wider median shoulder to accommodate a truck.

304.3 Types

Medians are divided into types depending upon width and treatment of the median area and drainage arrangement. In general, raised or barrier medians are applicable to urban areas, while wide, depressed medians apply to rural areas. See Figure 304-1.

304.3.1 Rural

Medians in rural areas are normally depressed to a swale in the center and constructed without curbs.

304.3.2 Urban

There are various types of medians applicable to urban areas. The type selected depends upon the traffic volume, speed, degree of access and available right-of-way.

On major streets with numerous business drives, a median consisting of an additional lane, striped as a continuous two-way left turn lane is desirable.

The solid 6-inch high concrete median, at a minimum width of 4ft. (See Standard Construction Drawing RM-3.1) may be used where the design speed is less than 50 mph and where an all-paved section is appropriate and a wider median cannot be justified. Barrier medians, described in Section 601.2, are normally recommended for urban facilities where the design speed is 50 mph or greater. However, care must be exercised when barrier medians are used on expressways with unsignalized at-grade intersections because of sight distance limitations.

304.4 U-turn Median Openings

304.4.1 Purpose

U-turn median openings may be provided on expressways, freeways or interstate highways with non-barrier medians where space permits as outlined below and when needed for proper operation of police and emergency vehicles, as well as equipment engaged in physical maintenance, traffic service, and snow and ice control.

304.4.2 Location

U-turn crossings should not be constructed in barrier-type medians.

When U-turn median openings are required, they should be spaced as close to 3-mile intervals as possible.
Crossings should be located at points approximately 1,000 ft. beyond the end of each interchange speed change lane. Additional crossings may be constructed at maintenance borders, District borders, State lines and other desired locations in accordance with the 3-mile spacing interval requirement. Examples of the allowable number of crossings between interchanges, in addition to crossings provided at interchange speed change lanes, are shown below:

<table>
<thead>
<tr>
<th>Interchange Spacing</th>
<th>Number of Crossings</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 miles or less</td>
<td>None</td>
</tr>
<tr>
<td>3 to 6 miles</td>
<td>One</td>
</tr>
<tr>
<td>6 to 9 miles</td>
<td>Two</td>
</tr>
<tr>
<td>9 to 12 miles</td>
<td>Three</td>
</tr>
</tbody>
</table>

U-turn median crossings should be located to fit the median drainage pattern. Each should be placed either immediately downstream from a catch basin or on a crest. They should be located so that visibility is not restricted by structures, vertical curves or horizontal curves.

### 304.4.3 Design Details

Median crossings should be constructed as shown on Figure 304-2 which indicates geometric features applicable to the design of crossings located in medians of widths ranging from 40 to 84 ft. Tapers should be 200 ft. in length for all median widths. The profile grade line should normally be an extension of the cross slope of the shoulder paving, rounded at the lowest point.

### 305 CURBS

#### 305.1 General

The type of curb and its location affect driver behavior patterns which, in turn, affect the safety and utility of a road or street. Curbs, or curbs and gutters, are used mainly in low speed urban areas (See Section 305.3). Following are various reasons for justifying the use of curbs, or curbs and gutters:

1. Where required for drainage.
2. Where needed for channelization, delineation, control of access or other means of improving traffic flow and safety.
3. To control parking where applicable.
4. To reduce right-of-way requirements.
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Conventional concrete or bituminous curbs offer little visible contrast to the pavement surface, particularly during fog or at night when the surface is wet. The visibility of the curbs can be greatly enhanced with the use of reflectorized paints. Curb markings should be placed in accordance with OMUTCD.

305.2 Types and Uses

There are two general types of curbs; vertical curbs and sloped curbs. Vertical curbs are relatively high (6 inches or more) and steep-faced. Sloped curbs are 6 inches or less in height and have flatter, sloping faces so that vehicles can cross them with varying degrees of ease.

The curb sections detailed on Standard Construction Drawing BP-5.1 are approved types to be used as stated below:

Type 1 Curb (asphalt curb) is a sloping 6 inch curb used mostly for temporary situations, such as correcting special drainage problems.

Type 2, 2-A, and 2-B curbs are 6 inches high with a steep sloped face. They are widely used along the edges of traveled way in urban areas where design speeds are less than 50 mph. Type 2 curb is preferred to Type 6 curb to eliminate the joint between the curb and the gutter.

Types 3, 3-A, 3-B and Type 4, 4-A, 4-B and 4-C curbs are 4 inches high with a sloped face. They are used for channelizing islands and occasionally along medians and edges of traveled way. Type 3 is preferred for channelizing islands with the gutter sloped at the same rate as the adjacent pavement.

Type 6 Curb is a 6 inch high steep faced vertical curb. It is used in situations similar to Type 2 described above.

Type 7 Curb is a vertical type used in low speed areas (design speed of less than 50 mph) for protection at bridge approaches. It may also be used to control traffic in areas involving heavy trucks.

305.3 Position of Curb

305.3.1 Urban Areas (Design Speed less than 50 mph)

Curbs are normally used at the edge of traveled way on urban streets where the design speed is less than 50 mph. Curbs at the edge of traveled way have an effect on the lateral placement of moving vehicles. Drivers tend to shy away from them. Therefore, all curbs should be offset at least 1 foot and preferably 2 ft. from the edge of the traffic lane. Where curb and gutter is used, the standard gutter width is 2 ft.

305.3.2 Urban and Rural High Speed Areas

On roads where the design speed is 50 mph or greater, the use of curb should be avoided. Curbs should only be used in special cases. Special cases may include, but are not limited to, the use of curb to control surface drainage or to reduce right-of-way requirements in restricted areas. When it is necessary to use curbs on roads where the design speed is 50 mph or greater, they should not be closer to the traffic than 4 ft. or the edge of the treated shoulder, whichever is greater and their height should not exceed 4 inches.
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305.3.3 Curb/Guardrail Relationship
Refer to Section 602.1.5.

305.4 Curb Transitions
305.4.1 Curb Vertical Height Tapers
The approach and trailing ends of curb and raised medians should be tapered from the curb height to 0 in 10 ft.

305.4.2 Curbed to Uncurbed Transitions
When an urban type section with curbs at the edge of traveled way changes to a rural type section without curbs, the curb should be transitioned laterally at a 4:1 (longitudinal: lateral) rate to the outside edge of the treated shoulder or 3 ft., whichever is greater. See Figure 401-4b, Option 2.

305.4.3 Curbed Approach to Uncurbed Mainline
When a curbed side road intersects a mainline that is not curbed, the curb should be terminated no closer to the mainline edge of traveled way than 8 ft. or the edge of the treated shoulder, whichever is greater. See Figure 401-4a.

306 PEDESTRIAN FACILITIES

306.1 General
When pedestrians’ facilities are to be constructed or reconstructed as part of a project, the facilities shall be designed to accommodate persons with disabilities. The pedestrian environment must be designed to accommodate the needs of all users, some of whom have a broad range of mobility, physical and cognitive skills.


306.2 Sidewalk Design
306.2.1 Sidewalk and Shoulder Installation
Sidewalks are the principal improvements used to accommodate pedestrians, but it is recognized that wide shoulders and unpaved walkable space may be acceptable in some instances. Figure 306-1 provides July 2019
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A detailed listing of the recommended guidelines for the various roadway classifications for sidewalks/walkways.

While Figure 306-1 recommends when and where to install sidewalks, sidewalks should be considered on projects with curb-and-gutter installations and in areas where there is obvious pedestrian use (such as worn footpaths).

While no sidewalk requirements are specifically recommended for certain rural roadways, some residential areas should have a pedestrian connection to the rest of the rural community. A paved or unpaved shoulder should be provided as a minimum where it is impractical to provide a sidewalk along a paved rural road.

306.2.2 Sidewalk Widths

Minimum and desirable sidewalk widths are shown in Figure 306-2. The minimum recommended width is 5 ft. Under limited conditions, a 4 ft. sidewalk width can be tolerated, although this width does not provide adequate clearance room or mobility for pedestrians passing in opposite directions. A 4 ft. width can be accepted if there are 5 ft. wide by at least 5 ft. long passing sections at least every 200 ft.

306.2.3 Obstacles and Protruding Objects

The sidewalk widths shown in Figure 306-2 represent a clear or unobstructed pedestrian travel way. Still, be aware of the three dimensional corridor which makes up an accessible route and attempt to locate utilities, light poles, signs, fire hydrants, mail boxes, parking meters and street furniture (benches, shelters, bike racks, etc.) out of this sidewalk corridor. If unable to avoid keeping objects out of this space, then certain dimensional requirements must be maintained. See FHWA's Designing Sidewalks and Trails for Access, Part 2, Best Practices Design Guide, Section 4.1.3, for information.

Placement of utility covers, gratings and other covers should be off of the sidewalk to the maximum extent feasible.

306.2.4 Buffer Widths

A buffer width, also known as a tree lawn or planting strip, is the distance between the sidewalk and the adjacent roadway. Providing a buffer can improve pedestrian safety. The buffer width in a commercial area will be different than the buffer needs of a residential area. Buffer widths as measured from the face of curb are shown in Figure 306-2.

On-street parking or bike lanes can also act as a sidewalk buffer. In areas where there is no on-street parking or bike lane, the ideal width of a buffer is 6 ft.

If a buffer cannot be provided, then the curb-attached sidewalk width should be at least 7 ft. wide in residential areas. In commercial areas or along busy arterial streets, the minimum curb-attached sidewalk width should be 8 ft. to provide space for light poles and other street furniture. All roadways with curb attached sidewalks or buffers should be constructed with vertical curbing.
306.2.5 Grade and Cross Slope

Wherever possible, sidewalks and walkways should be designed with maximum grades of 5 percent. When the topography of an area leaves no other choice than to use a steeper grade, Table 306-1 provides a series of specific recommendations for each situation. The only exception to the recommendations is when the adjacent road grade is steeper than 5 percent and there is no other alternative alignment for the sidewalk.

Sidewalks should be constructed with a maximum cross slope of 2 percent. The cross slope is the slope that is measured perpendicular to the direction of travel. A driveway crossing should maintain a level pedestrian zone (see Figure 803-3 for sidewalk design at drives).

| Table 306-1 |
| SIDEWALK GRADE RECOMMENDATIONS |
| Public Right of Way |
| Maximum Sidewalk Grade Adjacent to Roadway | No limit if it follows the grade of the street |
| Roadway |
| Maximum Cross slope | 0.02 |
| Accessible Routes Not Adjacent to Roadway |
| Max. Allowable Running Grade w/o Railings | 0.05 |
| Max. Ramp Grade w/ handrails and Landings | 0.083 |
| Landing Spacing |
| Landing intervals for Accessible Routes | If the slope of a ramp is between 1:12 and 1:16, the max. rise shall be 30 inches and the max. run shall be 30 ft. |
| If the slope of the ramp is between 1:16 and 1:20, the max. rise shall be 30 inches and the max. run shall be 40 ft. |
| Landing Dimensions | 5 ft. Length and Width |
306.2.6 Surface Treatments

The sidewalk surface treatment can have a significant impact on the overall accessibility and comfort level of the facility. The requirement is that the surface be stable, firm and slip resistant. There shall be an unobstructed reduced vibration zone within a pedestrian access route, this minimum width being 48 inches.

Concrete, asphalt or gravel walks may be specified according to the location and the particular need:

1. Concrete walks are the most widely used type. They should normally be 4 inches thick. The exception is at driveway locations where the thickness is increased to 6 inches, or drive thickness, whichever is greater.

2. Asphalt and gravel walks are used mostly in parks, rest areas, or for shared-use paths. Asphalt walks should be constructed of 2 inches of asphalt and 5 inches of aggregate base. Gravel walks should be constructed of 4 inches of compacted aggregate base. Increased thicknesses may be needed if maintenance or emergency vehicles will routinely use paths.

Specialty surface treatments are often desired for aesthetic reasons. But a disadvantage of either bricks or stamped concrete/brick decorative sidewalks is the problem seemingly small surface irregularities pose for certain wheelchair users. Designers should provide a zone of reduced vibration. It is possible to enhance sidewalk aesthetics while still providing a smooth walking surface by combining a smooth concrete walking area with a decorative edging. See FHWA’s Designing Sidewalks and Trails for Access, Part 2, Best Practices Design Guide for information.

306.3 Curb Ramps

306.3.1 Curb Ramp Locations

Section 729.12 of the Ohio Revised Code requires that all new or reconstructed curbs shall have curb ramps at each pedestrian crosswalk so that the sidewalk and street blend to a common level.

All newly constructed or modified curb ramps must be ADA compliant. Curb ramps shall be provided on all plans where curb and walks are being constructed, reconstructed or altered at intersections and other major points of pedestrian curb crossing such as mid-block crosswalks.

If a project has curbs and pedestrians are allowed, curb ramps need to be installed wherever sidewalks are present. In areas without sidewalks, pedestrian curb cuts as shown on Figure 306-4 are required if no curb ramps are provided.

Curb ramps are also to be installed in resurfacing projects as outlined in ODOT Policy 21-003(P) Curb Ramps Required in Resurfacing Plans.

It is desirable to provide a continuous path for the persons with disabilities. When a curb ramp is built on one side of a street, a companion curb ramp is required on the opposite side of the street. Therefore, when normal project or work limits end within an intersection, the work limits must be extended to allow construction of companion ramps. The basic requirement is that a crosswalk must be accessible via curb
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ramps from both ends, not one end only. In most cases, curb ramps will be installed in all quadrants of an intersection.

306.3.2 Design Considerations

Curb ramps should be designed to the least slope consistent with the curb height, available corner area and underlying topography. A level landing is necessary for turning, maneuvering or bypassing the sloped surface. Proper curb ramp design is important to users either continuing along a sidewalk path or attempting to cross the street.

306.3.3 Curb Ramps Components

The basic components to the standard curb ramp design are explained here and depicted on Figure 306-3.

1. **Ramps** - The grade of a ramp must not exceed 0.083. The cross slope must not be greater than 0.02. The recommended minimum width of a curb ramp is 4 ft.

2. **Gutters** - Gutters require a counter slope at the point at which the ramp meets the street for proper drainage. This counter slope may not exceed 0.05, and the change in angle must be flush, without a lip, raised joint or gap. Lips or gaps between the curb ramp slope and counter slope can arrest forward motion by catching caster wheels or crutch tips. The algebraic difference between the ramp slope and the gutter counter slope cannot exceed 11 percent, or a 24 inch level strip must be provided between the two slopes. See Figure 306-3.

3. **Landings** - Landings provide a level area (less than 2 percent slope in any direction) for wheelchair users to maneuver into or out of the curb ramp, or to simply bypass it. A level landing 5 ft. square is preferred. Level landings are required at the top and bottom of each ramp.

4. **Flares** - Curb ramp flares are graded transitions from a curb ramp to the surrounding sidewalk. Flares are not intended to be wheelchair routes, and may be one of the cues used to identify the presence of a curb ramp. Flares are only needed in locations where the ramp edge abuts pavement. A curb edge is used as a visual cue where the ramp edge abuts grass or landscaping.

306.3.4 Curb Ramp Types

Three types of ramps are currently used in street corner designs. In all cases curb ramps should be located entirely within the marked crosswalks (where they exist). Drainage grates or inlets should not be located within the crosswalk area, where wheelchair casters or canes tips may be caught. Nonetheless, curb ramps need to be adequately drained. See Figure 306-4 for a sketch of these types, and for details see Standard Construction Drawing BP-7.1.

**Perpendicular Curb Ramps** are generally perpendicular to the curb. Users will generally be traveling perpendicular to vehicular traffic when they enter the street at the bottom of the ramp. Advantages include providing a straight path of travel on tight radius corners at the expected crossing location for all pedestrians. Disadvantages are that they do not provide a straight path of travel on large radius corners and they require a level landing that takes up additional right-of-way. Perpendicular ramps are
generally the best design for pedestrians, provided that a minimum 4 foot landing is available for each approach.

Parallel Curb Ramps have two ramps leading down towards a center level landing at the bottom between both ramps, with a level landing at the top of each ramp. They can be installed where the available space between the curb and property line is too tight to permit the installation of both a ramp and a landing, and are effective on steep terrain or at locations with high curbs. Unfortunately, sidewalk users have to negotiate two ramp grades. Since the landing is depressed and level, drainage of the ramp landing at the street must be carefully designed.

Diagonal Curb Ramps are a single curb ramp that is located at the apex of the corner. Diagonal Curb Ramps are not acceptable designs for access to new sidewalks, but may be applied in retrofit locations where a pair of perpendicular ramps is not feasible due to existing site constraints. This design directs a visually impaired person away from the crosswalk and into traffic. Therefore when designed the entire lower landing area must fall within the crosswalk that the ramp serves and cannot be located in the traveled lane of opposing traffic.

306.3.5 Detectable Warnings

Detectable warnings are standardized surface features on walking surfaces to warn visually impaired people of the transition between the sidewalk and the street.

Truncated domes are specified as the detectable warnings to be used and are to be included in all connections to all street crossings to mark the street edge, where a sidewalk crosses a vehicular way. This includes islands and medians that are cut through level with the roadway.

Detectable Warnings should be used at the following locations:
- At the edge of depressed corners,
- At the border of raised crosswalks and raised intersections,
- At the base of curb ramps,
- At the border of median and islands,
- At street crossing for shared-use paths, and
- Where sidewalks cross railroad tracks.

Detectable Warnings are not needed where a sidewalk crosses an unsignalized driveway, nor where the sidewalk crosses an alley.

Truncated dome dimensions and alignment can be found on Standard Construction Drawing BP-7.1.

306.3.6 Curb Ramp Evaluation

Resurfacing is an alteration that triggers the requirement to add curb ramps if it involves work on a street or roadway spanning from one intersection to another, and includes overlays of additional material to the road surface, with or without milling. Examples include, but are not limited to the following treatments or their equivalents: addition of a new layer of asphalt, reconstruction, concrete pavement rehabilitation and reconstruction, open-graded surface course, micro-surfacing and thin lift overlays, cape seals and in-place asphalt recycling.
Projects classified as maintenance do not trigger an evaluation of existing curb ramps and the addition of new curb ramps. Maintenance treatments are those that serve solely to seal and protect the road surface, improve friction, and control splash and spray are considered to be maintenance because they do not significantly affect the public’s access to or usability of the road. Some examples of the types of treatments that would normally be considered maintenance are: painting or striping lanes, crack filling and sealing, surface sealing, chip seals, slurry seals, for seals, scrub sealing, joint crack seals, joint repairs, dowel bar retrofit, spot high-friction treatments, diamond grinding, and pavement patching. A curb ramp evaluation form is available on the Office of Roadway Engineering website.

306.3.7 Exception to Curb Ramp Replacement

Existing curb ramps in good repair (without spalling, cracking or uneven surfaces) may remain in place if they met the 1991 ADA standard at the time they were constructed. If no detectable warnings are present on an existing curb ramp constructed under the 1991 ADA standard, truncated domes should be added. The portion of the curb ramp not affected by the installation of the detectable warnings may remain in place.

306.4 Sidewalks for Highway Bridges/Underpasses

306.4.1 General

Provisions should always be made to include some type of walking facility as part of a vehicular bridge or underpass, if only as an emergency exit path. Wherever possible, sidewalk widths across bridges and through underpasses should be the same as the clear width of the existing connecting sidewalks.

306.4.2 Walks on Bridges

Walks should be provided on bridges located in urban or suburban areas having curbed typical sections under the following conditions:

1. Where there are existing walks on the bridge and/or bridge approaches, or

2. Where evidence can be shown through local planning processes, or similar justification, that walks will be required in the future (20 years). Anticipated pedestrian volumes of 50 per day would justify a walk on one side and 100 per day would justify walks on both sides.

Walks on bridges should preferably be 6 ft. in residential areas and 8 ft. in commercial areas measured from the face of curb to the face of parapet. The width should never be less than 5 ft.

In rural areas or other sites where flush shoulders approach a bridge and light pedestrian traffic is anticipated on the shoulders, the shoulder width should be continued across the bridge using the preferred lateral clearance from Figure 302-1, or greater if deemed appropriate. A raised walkway should not be used in these areas. Where an existing bridge has a safety curb (used as a walkway) and removal is not economically justified, the ends of the walkway should be shielded with a traffic barrier or ramped into the approach shoulder at a vertical transition rate of approximately 20:1.
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306.4.3 Walks under Bridges

The criteria for providing walks at underpasses are basically the same as described above for Walks on Bridges. An exception is in areas where there are no approach walks, space will be provided for future walks, but walks generally will not be constructed with the project unless there is concurrent approach walk construction.

Where the approach walks at underpasses include a tree lawn, the tree lawn width may be carried through the underpass wherever space permits.

306.5 Pedestrian Overpasses and Underpasses

306.5.1 General

Due to the high costs of constructing pedestrian-only structures, they should be considered only where other more standard and/or less costly solutions are not acceptable. Both pedestrian overpasses and underpasses need to meet ADA ramp criteria for maximum slopes (0.083), landings every 30 ft. of run, and handrails; or elevators.

Freeways should not have pedestrian crossings at-grade and may require the occasional use of separate pedestrian structures.

Underpasses that are below grade should provide clear sight distances to and through the underpass. A minimum width of 14-16 ft. is desirable, but longer tunnels need to be wider for security. Likewise, vertical clearance of 8 ft. is sufficient for short tunnels, but longer ones may need 10 ft. Heights of maintenance and emergency vehicles need to be addressed. Drainage must be carefully considered.

Both pedestrian overpasses and underpasses should be adequately illuminated.

306.5.2 Guidelines

Experience has shown that the primary location for pedestrian overpass/underpass is an urban area outside the central business district. Such a pedestrian crossing may be considered when the following conditions exist:

1. The community has expressed a strong desire for a pedestrian crossing.
2. A reasonable alternate route for pedestrian is not available.
3. There is no signal, stop intersection, or pedestrian crossing available within 660 ft. of the proposed location.
4. Pedestrians can be prevented from crossing at grade.
5. Physical conditions permit construction.
6. The traffic volume and pedestrian volume are above those required to warrant the installation of pedestrian signals as stated in the Ohio Manual of Uniform Traffic Control Devices for Streets and Highways (OMUTCD). This stipulation can be waived in special cases such as when sight distances are limited.
7. Where there are a large number of pedestrians who must regularly cross a high-speed, high volume roadway.
307 GRADING AND SIDESLOPES

307.1 General

This section is concerned with the design of slopes, ditches, parallel channels and interchange grading. It incorporates into the roadside design, the concepts of vehicular safety developed through dynamic testing. Designers are urged to consider flat foreslopes and backslopes, wide gentle ditch sections and elimination of barriers in their initial design approach.

307.2 Slopes

307.2.1 Roadside Grading

There are several combinations of slopes and ditch sections that may be used in the grading of a project. Details and use of these combinations are discussed in subsequent paragraphs. In general, slopes should be made as flat as possible to minimize the necessity for barrier protection and to maximize the opportunity for a driver to recover control of a vehicle after leaving the traveled way. Regardless of the type of grading used, projects should be examined in an effort to obtain flat slopes at low costs. For instance, fill slopes can be flattened with material which otherwise might be wasted and backslopes can be flattened to reduce borrow.

ODOT does not allow non-ODOT agencies to use ODOT right of way for the purpose of locating stormwater Best Management Practices (BMPs).

In order to more fully understand the discussions on the various types of grading, the designer should become familiar with the need for barrier protection and the clear zone concept covered in Section 600.

Safety grading is the shaping of the roadside using 6:1 or flatter slopes within the clear zone area (Section 600.2) and 3:1 or flatter foreslopes and recoverable ditches extending beyond the clear zone. Safety grading is used on Interstate, other freeways and expressways. Figures 307-1 and 307-2 show many of these details.

Clear zone grading is the shaping of the roadside using 4:1 or flatter foreslopes and traversable ditches within the clear zone area. Foreslopes of 3:1 may be used, but are not measured as part of the clear zone distance. Clear zone grading is recommended for undivided rural facilities where the design speed is 50 mph or greater, the design hourly volume is 100 or greater, and when at least one of the following conditions exists:

1. The wider cross section is consistent with present or future planning for the facility.
2. The project is new construction or major reconstruction involving significant length.
3. The wider cross section can be provided at little or no additional cost.

Figure 307-3 shows examples of clear zone grading and traversable ditches.
Common grading is the shaping of the roadside using 3:1 or flatter foreslopes and normal ditches. It is used on undivided facilities where the conditions for the use of safety grading or clear zone grading do not exist. The designer should ensure that all obstacles within the clear zone receive proper consideration. Figure 307-4 shows examples of common grading and normal ditches.

Barrier grading is the shaping of the roadside when barrier is required for slope protection. Normally 2:1 foreslopes and normal ditch sections are used. Figure 307-4 gives an example of barrier grading.

307.2.2 Slope Transitions

When clear zone grading is used to eliminate the need for barrier protection of a fixed object, the length of slope transition should be determined using the length of need concept described in Section 602.1. The clear zone measurement should be used for the Lateral Extent of the Hazard (“LH”). Clear Zone grading should not be utilized unless the required lane and shoulder widths are present.

As shown in these conditions, Clear Zone grading is desirable throughout a roadway corridor. It does little to increase the safety of a roadway if Clear Zone grading is only done on spot projects such as culvert replacements, if the rest of the corridor will be maintained with common grading.

307.2.3 Rounding of Slopes

Slopes should be rounded at the break points and at the intersection with the existing ground line to reduce the chance of a vehicle becoming airborne and to harmonize with the existing topography. Recommended rounding at the edge of the graded shoulder is shown in Figure 301-3. Rounding at other locations is shown in Figures 307-1, 307-3 and 307-4.

307.2.4 Special Median Grading

Figure 307-5 shows some examples of median grading when separate roadway profiles are used.

307.2.5 Rock Slopes (See Figure 307-5)

In rock cuts, determine the cut slope angle(s) and necessary slope benches using design guidance presented in Geotechnical Bulletin 3, “Rock Cut Slope and Catchment Design”. The designer should examine the project to ascertain whether flatter slopes could be used to the advantage of reducing borrow within a reasonable haul distance. Such a situation should also be discussed with the Office of Geotechnical Engineering.

307.2.6 Curbed Streets

The slope treatment adjacent to curbed streets is shown on Figure 307-6.
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307.2.7 Driveways and Cross Roads

At driveways or crossroads, where the roadside ditch is within the clear zone distance and where clear zone grading can be obtained, the ditch and pipe should be located as shown on Figure 307-7.

Requirements for pipe location should be applied to all new construction, reconstruction, widening and resurfacing projects if regrading of the roadsides to safety or clear zone grading is included in the work. New driveways constructed by permit should also conform to the above if other such installations on the route conform, otherwise the new driveway pipe may be located in the existing roadside ditch.

307.3 Ditches

When the depth or velocity of the design discharge accumulating in a roadside or median ditch exceeds the desirable maximum established for the various highway classifications, a storm sewer will be required to intercept the flow and carry it to a satisfactory outlet. If right-of-way and earth work considerations are favorable, a deep parallel side ditch (see Figure 307-5) may be more practical and should be considered instead of a storm sewer.

In some cases where large areas contribute flow to a highly erodible soil cut, an intercepting ditch may be considered near the top of the cut to intercept the flow from the outside and thereby relieve the roadside ditch.

Constant depth ditches (usually 18 inches deep) are desirable. Where used, the minimum pavement profile grades should be 0.24% to 0.48%. Where flatter pavement grades are necessary, separate ditch profiles are developed and the ditch flow line elevations are shown on each cross section.

307.4 Parallel Channels

Where it is desirable that a stream intercepted by the improvement be relocated parallel to the roadway, the channel should be located beyond the limited access line in a channel easement. This does not apply to conventional intercepting erosion control ditches located at the top of cut slopes in rolling terrain. This arrangement locates the channel beyond the right-of-way fence. See Figure 307-5.

In areas of low fill and shallow cut, protection along a channel by a wide bench is usually provided. Fill slopes should not exceed 6:1 when this design is used and the maximum height from shoulder edge to bench should generally not exceed 10 ft. If it should become necessary to use slopes steeper than 6:1, guardrail may be necessary and fill slopes as steep as 2:1 may be used.

In cut sections 5 ft. or more in depth, earth barrier protection can be provided. Where very deep channels are constructed, this design probably affords greater protection and requires less excavation. See Figure 307-5. Where the sections alternate between cut and fill and it is desired to use a single design, earth barrier protection would be less costly if waste is a problem. Likewise, bench protection would be less costly if borrow is needed.

Earth bench or earth barrier protection provided adjacent to parallel channels should not be breached for any reason other than to provide an opening for a natural or relocated stream requiring a drainage
structure larger than 42 inches in rise. Outlet pipes from median drains or side ditches shall discharge directly into the parallel channel.

Channels and toe-of-slope ditches, used in connection with steep fill slopes, should be removed from the normal roadside section by benches. The designer shall establish control offsets to the center of each channel or ditch at appropriate points which will govern their alignment so they will flow in the best and most direct course to the outlet. Bench width shall be varied as necessary (See Figure 307-5).

### 307.5 Interchange Grading

Interchange interiors should be contour graded so the least amount of guardrail is required and so maximum safety is provided with corresponding ease of maintenance. Sight distance is critical for passenger vehicles on ramps as they approach entrance or merge areas, especially if barrier is erected on the merging side of the vehicle. Therefore, sight distance shall be unobstructed by landscaping, earth mounds or other barriers.

#### 307.5.1 Crossroads

At a road crossing within an interchange area, bridge spill-through slopes should be 2:1, unless otherwise required by structure design. They should be flattened to 3:1 or flatter in each corner cone and maintained at 3:1 or flatter if within the interior of an interchange. Elsewhere in interchange interiors, fill slopes should not exceed 3:1.

#### 307.5.2 Ramps

Roadside design for ramps should be based on the mainline grading concept.

#### 307.5.3 Gore Area (See Figure 307-8)

Gore areas of trumpets, diamonds and exteriors of loops adjacent to the exit point, should be graded to obtain slopes (6:1 or flatter) which will not endanger a vehicle which is unable to negotiate the curvature because of excessive speed.

#### 307.5.4 Trumpet Interiors (See Figure 307-8)

Interior areas of trumpets should be graded to slopes not in excess of 8:1, sloping downward from each side of the triangle to a single rounded low point. Roadside ditches should not be used. Exteriors should be graded in accordance with the mainline or ramp standards.

#### 307.5.5 Loop Interiors (See Figure 307-9)

In cut, the interior should be graded to form a normal ditch section adjacent to the lower part of the loop and the backslope should be extended to intersect the opposite shoulder of the upper part of the loop, unless the character and the amount of material or the adjacent earth work balances indicate that...
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the cost would be prohibitive. Roadside cleanup and landscaping should be provided in undisturbed areas of loop interiors.
If channels are permitted to cross the loop interior, slopes should not be steeper than 4:1.

307.5.6 Diamonds

If the location of the ramp intersection at the crossroad is relatively near to the main facility, a continuous slope between the upper roadway shoulder and the lower roadway ditch will provide the best and most pleasing design.

If the ramp intersection at the crossroad is located a considerable distance from the main facility, then both ramp and mainline roadsides should have independent designs, until the slopes merge near the gore. If the quadrant is entirely, or nearly so, in cut, it is suggested that the combination of a 3:1 backslope at the low roadway ditch and a gentle downslope from the high roadway shoulder will provide the best design in the wide portion of the quadrant. Approaching the gore, the slopes should transition to continuous 4:1 and 6:1 or flatter slopes.

Quadrants located entirely in fill areas should have independently designed roadways for ramp, mainline and crossroad. Each should be provided with normal slopes not greater than 3:1, with the otherwise ungraded areas sloped to drain without using ditches.

If the quadrant is located partially in cut and partially in fill, the best design would feature a gentle fill slope at the upper roadway and a gentle backslope at the lower roadway joined to a bench at the existing ground level which is sloped to drain.

The combination of a long diamond ramp having gentle alignment with a loop ramp in the same interchange quadrant is not to be treated as a trumpet. Each ramp should be designed independently of the other in accordance with the suggested details set forth above.

307.6 Disposal of Construction Debris and Waste Material within ODOT R/W

All projects with pavement removal, particularly non-recyclable concrete pavement, or an excess of excavation should be evaluated for acceptable disposal areas within the state right-of-way. This material cannot be arbitrarily dumped within the limits of state right-of-way. If improperly placed, the material may interfere with adequate sight distance and may create an unnecessary hazard.

Acceptable disposal areas would preferably enhance highway operations and should not in any way reduce safety. Instead of hauling the material offsite or improperly placing the material, the excess fill may be used throughout the state right-of-way limits to improve grading and general roadside safety. For example, all interstate and interstate look-alike systems should use safety grading. If safety grading currently exists, consider extending it to the right-of-way limit. If clear zone grading currently exists, consider using safety grading or extend the clear zone grading to the right-of-way limit. Each barrier location should be evaluated to see if the application of safety grading, or at a minimum clear zone grading, would eliminate the need for barrier. Adjustments to drainage or drainage structures may also be required.
The determination as to whether or not to allow the disposal of waste material within the right-of-way of a project should be made as soon as possible in the project development process. Possible waste areas within the project right-of-way limits should be identified during the field review prior to final scope preparation. Areas deemed acceptable should be identified accordingly in the construction plans. If none of the areas are considered acceptable, this should also be clearly noted in the construction plans in the form of a plan note.

For the full text of the guidelines see Guidelines for Identifying Acceptable Locations for the Disposal of Waste Material and Construction Debris or the Excavation of Borrow Material within ODOT Right-of-Way located in the Reference section of this manual.

307.6.1 Exit Ramps

Fill material may be placed in the infield areas of exit ramps as long as the decision sight distance is provided and 6:1 or flatter slopes are provided in the gore areas. Decision sight distances, Avoidance Maneuver A or B, as per Figure 201-6 should be provided for the design speed of the ramp. Also note that with respect to a diamond interchange, the placement of the fill material in the infield should not be such that it interferes with the intersection sight distance at the intersection of the crossroad and the exit ramp.

307.6.2 Entrance Ramps

Excess or disposable fill material should not be placed adjacent to an entrance ramp such that it interferes with the available sight distance. Decision sight distance, Avoidance Maneuver C or E, as per Figure 201-6 should be provided for the design speed of the ramp. The decision sight distance is measured from a point on the ramp where the driver, on the ramp, has an unobstructed view of the mainline to where the lane width becomes less than 10 ft. and the driver must merge. This is the distance that the driver merging from the ramp has to decide where he can safely merge into the mainline traffic. This distance should also be unobstructed for the mainline driver to react to the ramp vehicle by either a lane or speed change.

307.6.3 Loop Ramps

In general, the infield of loop ramps should not be filled unless it is to eliminate barrier or provide safety graded slopes. Filling these areas may decrease sight distance and diminish the driver’s ability to anticipate the sharpness and total path of the ramp. It is important to have an unobstructed view of the ramp in order that driver may have adequate time to react to possible obstructions and delays ahead. Loop ramps are more susceptible to run off the road accidents due to the sharp curvature and high speeds.

If a designer chooses to fill the infield, as a minimum, the decision sight distance, Avoidance Maneuver A or B, as per Figure 201-6, using the ramp design speed, should be provided for the exit portion of the ramp. Likewise, Avoidance C or E, using the ramp design speed, should be provided for the entrance portion of the ramp. The fill height should not exceed 20 ft. in height or as determined by the Office of Geotechnical Engineering. Slopes should not exceed 4:1 for ease of maintenance.
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307.6.4 Adjacent to Noise Sensitive Areas

Excess or disposable fill material may be placed adjacent to a noise sensitive area via the construction of a small height berm. Consult with the Office of Environmental Services-Policy Section-Noise Unit regarding opportunities. A minimum 3’-6” tall berm height is recommended. Consult with the Office of Geotechnical Engineering regarding taller berm heights. Designer must adhere to clear zone requirements in LDM Vol 1 Section 600 and grading requirements in LDM Section 307. The designer must consider issues including but not limited to underground utilities, tower lighting, signage, landfills, floodplains, utility markers, valve boxes, manholes, hydrants, exposed conduits, drainage concerns, tree removal, ecological items, etc.

308 ON-ROAD BICYCLE FACILITIES

308.1 General

This section provides an overview of designs that facilitate safe, efficient and convenient travel for bicyclists on roadways. Bicyclists often have to share these roadways with motorized vehicles as they travel.

308.2 Design

Generally, the basic geometric design guidelines for motor vehicles will result in a facility that will provide a safe accommodation for on-street bicyclists. If properly designed for motor vehicles, roadway design elements such as stopping sight distance, horizontal and vertical alignment, grades and cross slopes will meet or exceed the minimum design standards applicable to bicyclists. See AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition for additional information regarding the design of On-Road Bicycle Facilities.

308.3 Shared Lanes

Bicycles may be operated on all roadways except where prohibited by statute or regulation. Shared lanes where bicyclists and motor vehicles share the same travel lanes exist everywhere; on local neighborhood streets, on city streets, and urban, suburban and rural highways. There are no bicycle-specific designs or dimensions for shared lanes or roadways, but various design features can make shared lanes more compatible with bicycling, such as adequate sight distance and roadway designs that encourage lower speeds.

308.3.1 Shared Lanes on Major Roadways (Wide Curb/Outside Lanes)

Motor vehicles will begin encroaching at least part way into the next lane for lane widths of 13 ft. or less to pass a bicyclist. Lane widths of 14 ft. or greater will allow motorists to pass bicyclists without encroaching into the adjacent lane. For additional information on shared lane widths see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.
### 308.4 Paved Shoulders

Bicyclist accommodations on roadways with higher speeds or traffic volumes can be greatly improved by adding, improving or expanding paved shoulders.

Paved shoulders are different from bicycle lanes, in that at intersection approaches paved shoulders are placed to the right of the right-turn lanes and bike lanes are placed on the left side of right-turn lanes since they are intended to serve the through movements by bicyclists. Through moving bicyclists should normally be to the left of right-turning motor vehicles to avoid conflicts. On roadways with paved shoulders that approach right-turn lanes, some jurisdictions introduce a bike lane only at the intersections, and then transition back to a paved shoulder. For more information on paved shoulders see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.

For uncurbed roadways with no vertical obstructions immediately adjacent to the roadway, paved shoulders should be at least 4 ft. wide to accommodate bicycle travel. A shoulder width of at least 5 ft. is recommended from the face of any vertical obstruction such as guardrail, curb, or other roadside barrier since bicyclists generally shy away from a vertical face. It is desirable to increase the width of shoulders where any of the following conditions exist: high bicycle usage is expected, motor vehicle speeds exceed 50 mph, use by heavy trucks, buses, or recreational vehicles is considerable or static obstructions exist at the right side of the roadway.

On two-way roads it is preferable to provide paved shoulders on both sides; however, in constrained locations where pavement width is limited, it may be preferable to provide a wider shoulder on only one side of the roadway, rather than to provide a narrow shoulder on both sides. This approach may prove beneficial in the following situations:

1. On uphill roadway sections, a shoulder may be provided to give slow-moving bicyclists additional maneuvering space, thereby reducing conflicts with faster moving motor vehicle traffic.

2. On roadway sections with vertical or horizontal curves that limit sight distance, it can be helpful to provide shoulders over the crest and on the downgrade of a vertical curve, and on the inside of a horizontal curve.


### 308.5 Bicycle Lanes

#### 308.5.1 General Considerations

Bicycle lanes are one-way facilities designated for preferential use by bicyclists that typically carry bicycle traffic in the same direction as adjacent motor vehicle traffic. Bike lanes are the appropriate and preferred bicycle facility for thoroughfares in both urban and suburban areas. Where there is a high potential for bicycle use, bike lanes may be provided on rural roadways near urban areas. Paved shoulders may be designated as bike lanes by installing bike lane symbol markings.
308.5.2 Bicycle Lanes on Two-Way Streets

Bike lanes should be provided on both sides of two-way streets since a bike lane provided on only one side may invite wrong-way use. For additional information on bicycle lanes on two-way streets see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.

308.5.3 Bicycle Lanes on One-Way Streets

On one-way streets the bike lane should be on the right-hand side of the roadway. If there are a significant number of left turning bicyclists or if a left-side bike lane decreases conflicts resulting from heavy bus traffic, heavy right-turn movements (including double right-turn lanes), deliveries, or on-street parking a bike lane may be placed on the left side of the roadway.

Bike lanes should typically be provided on both streets of a one-way couplet in order to provide facilities in both directions and discourage wrong-way riding. If width constraints or other conditions make it impractical to provide bike lanes on both streets, shared-lane markings should be considered on the constrained street. This provides a more complete network and encourages bicyclists to travel with the flow of the other traffic.

308.5.4 Bicycle Lane Widths

Bicycle lane widths should be determined based on the speed, volume, and type of vehicles in adjacent lanes since these factors significantly affect bicyclists’ comfort and desire for lateral separation from other vehicles. Also, the appropriate width should take into account design features at the right edge of the bicycle lane, such as the curb, gutter, on-street parking lane, guardrail or other roadside barrier.

The preferred operating bicycle lane width is 5 ft. Wider bicycle lanes may be desirable under the following conditions:

- Adjacent to a parking lane (7 ft.) with a high turnover (such as those servicing restaurants, shops, or entertainment venues), a wider bicycle lane (6-7 ft.) provides more operating space for bicyclists to ride out of the area of opening vehicle doors.
- In areas with high bicycle use and without on-street parking, a bicycle lane width of 6 to 8 ft. makes it possible for bicyclists to ride side-by-side or pass each other without leaving the lane.
- On high-speed (greater than 45 mph) and high-volume roadways, or where there is a substantial volume of heavy vehicles, a wide bicycle lane provides additional lateral separation between motor vehicles and bicycles to minimize wind blast and other effects.

The minimum width of a bicycle lane is 4 ft. for roadways with no curb and gutter and no on-street parking. For roadways where the bike lane is immediately adjacent to the curb, guardrails or other vertical surface, the minimum bike lane width is 5 ft., measured from the face of a curb or vertical surface to the center of the bike lane line. There are two exceptions to this:

- Where a 2-ft. wide gutter is used, the preferred bike lane width is 6 to 7 ft. inclusive of the gutter. Gutters with longitudinal seams running parallel to bicycle travel can pose a potential...
300 Cross Section Design

- crash hazard due to deterioration between the asphalt and concrete surfaces or any unevenness at the edges due to resurfacing.

- On extremely constrained, low-speed roadways with curbs but no gutter, where the preferred bike lane width cannot be achieved despite narrowing all other travel lanes to their minimum widths, a 4-ft. wide bike lane can be used.

For additional information or design considerations concerning bicycle lanes widths see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.

308.5.5 Bicycle Lanes and On-Street Parking

Where on-street parking is permitted, the bike lane should be located between the parking lane and the travel lane. The recommended bike lane width in these locations is 6 ft. and the minimum width is 5 ft.

Bike lanes should not be placed between the parking lane and the curb. Such placement reduces visibility at driveways and intersections, increases conflicts with opening car doors, complicates maintenance, and prevents bike lane users from making convenient left turns.

Parallel Parking

Where bike lanes are installed adjacent to parallel parking, the recommended width of a marked parking lane is 8 ft., and the minimum width is 7 ft. Where parallel parking is permitted but a parking lane line or stall markings are not utilized, the recommended width of the shared bicycle and parking lane is 13 ft. If parking usage is low and turnover is infrequent a minimum width of 12 ft. may be satisfactory.

Diagonal Parking

Bike lanes should normally not be placed adjacent to conventional front-in diagonal parking, since drivers backing out of parking spaces have poor visibility of bicyclists in the bike lane.

The use of back-in diagonal parking can help mitigate the conflicts normally associated with bike lanes adjacent to angled parking. For additional information on the benefits of back-in diagonal parking see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.

308.5.6 Bicycle Lanes at Intersections

Intersections and driveways present the increased likelihood for conflicts between bicyclists and motor vehicles.


308.6 Retrofitting Bicycle Facilities on Existing Streets and Highways

Existing streets and highways can be retrofitted to improve bicycle accommodations by either widening the roadway or by reconfiguring the existing roadway. Paved shoulders can be added to improve mobility.
and comfort for bicyclists and reduce bicycle related crashes on busier or higher-speed rural roads. It may be possible to accommodate bike lanes on urban (curbed) roadways by reconfiguring travel lanes or make other adjustments that better accommodate bicyclists where reconfiguration of the lanes is not practical.

When retrofitting roads for bicycle facilities, the width guidelines for bike lanes and paved shoulders (see Sections 308.4 and 308.5.4) should be applied. For additional information on retrofitting bicycle facilities on existing streets and highways see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.

Retrofitting bicycle facilities on bridges presents special challenges because it may be impractical to widen an existing bridge. The guidance in Section 308.6.2 for retrofitting bicycle facilities without roadway widening is applicable to existing bridges. Further guidance on accommodating bicyclists on bridges is presented in Section 308.8.2.

308.6.1 Retrofitting Bicycle Facilities by Widening the Roadway

Where right-of-way is adequate, or where additional right-of-way can be obtained, roads can be widened to provide wide outside lanes, paved shoulders, or bike lanes. Widening must be weighed against the possibility that vehicle speeds will increase, which may adversely impact bicyclists and pedestrians.

308.6.2 Retrofitting Bicycle Facilities without Roadway Widening

In many areas, especially built-out urban and suburban areas, physical widening is impractical, and bicycle facility retrofits have to be done within the existing paved width. There are three methods of modifying the allocation of roadway space to improve bicyclist accommodation:

1. Reduce or reallocate the width used by travel lanes.
2. Reduce the number of travel lanes.
3. Reconfigure or reduce on-street parking.

In most cases, travel lane widths can be reduced without any significant changes in levels of service for motorists. Before a reduction or reallocation in the number of travel lanes or their widths shall be considered, an operational study should be performed to evaluate the impact of the proposed changes on the level of service of the facility. One benefit is that bicycle LOS will be improved. Creating shoulders or bike lanes on roadways can improve pedestrian conditions as well by providing a buffer between the sidewalk and the roadway.

Reducing Travel Lane Width

In some cases, the width needed for bike lanes or paved shoulders can be obtained by narrowing travel lanes. Lane widths on many roads are greater than the minimum values shown in Figures 301-2a and 301-4a and, depending on condition, may be candidates for narrowing.

For additional information concerning the reduction of the travel lane widths see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.
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Reducing the Number of Travel Lanes

One method that can be used to integrate bike lanes on existing roadways is reducing the number of travel lanes which is often referred to as a “road diet”. This strategy can be used on streets with excess capacity (more travel lanes than needed to accommodate the existing or projected traffic volumes), especially between intersections.

A traffic study should be conducted to evaluate potential reductions in crash frequency and severity, to evaluate motor vehicle capacity and level of service, to evaluate bicycle LOS, and to identify appropriate signalization modifications and lane assignment at intersections before implementing a road diet.

Road diets have many benefits, often reducing crashes; improving operations; and improving livability for pedestrians, bicyclists, adjacent residents, businesses, and motorists.

For additional information concerning the reduction in the number of travel lanes see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.

Reconfiguring or Reducing On-Street Parking

For additional information concerning reconfiguring or reducing on-street parking see AASHTO’s Guide for the Development of Bicycle Facilities 2012 Fourth Edition.

308.8 Other Roadway Design Considerations

Bicycle travel should be safely accommodated at railroad crossings, drainage grates, bridges, viaducts, tunnels, traffic signals, interchanges and roundabouts.

Exclusive bicycle lanes should not be provided through the roundabout but rather should be terminated upstream of the entrance line. Bicyclists have the option to either merge into the travel lanes navigating the roundabout in the same fashion as a motorized vehicle since bicycle speeds are in the range of the motorized vehicles or the bicyclist can dismount and walk their bicycle on the sidewalks.

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</tr>
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* Note: For the design criteria pertaining to Collectors and Local Roads with ADT < 400 or less, refer to the AASHTO Publication - Guidelines for Geometric Design of Very Low-Volume Local Roads ADT < 400)
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**LEVELS OF SERVICE**

A - Free flow, with low volumes and high speeds.
B - Stable flow, speeds beginning to be restricted by traffic conditions.
C - In stable flow zone, but most drivers are restricted in freedom to select own speed.
D - Approaching unstable flow; drivers have little freedom to maneuver.
E - Unstable flow, may be short stoppages.
F - Forced or breakdown flow.

* This table should be used as guidance. The designer should use judgment to choose a design level of service that is practical for each location.
### RURAL LANE WIDTHS (A)

#### Functional Classification

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#### NOTES:

(A) There may be some rural locations that are urban in character. An example would be a village where adjacent development and other conditions resemble an urban area. In such cases, urban design criteria (Figure 301-4) may be used.

(B) The number of lanes should be determined by a capacity analysis.

(C) An 11 ft. lane width may be retained on reconstructed highways if the alignment and safety records are satisfactory.

(D) For National Network lane width requirements, see Section 105.3.

Note: For the design criteria pertaining to Collectors and Local Roads with ADT’s of 400 or less, refer to the AASHTO Publication - Guidelines for Geometric Design of Very Low-Volume Local Roads ADT ≤ 400.)
### RURAL SHOULDER CRITERIA (A)

**REFERENCE SECTIONS**
301.2.2, 301.2.3, 307.2.3 & 602.1.1

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See following sheet for corresponding notes.

Note: For the design criteria pertaining to Collectors and Local Roads with ADT≤400, refer to the AASHTO Publication - Guidelines for Geometric Design of Very Low-Volume Local Roads ADT≤400).

July 2019
Notes to Figure 301-3: Rural Shoulder Criteria

(A) There may be rural locations that are urban in character. An example would be a village where adjacent development and other conditions resemble an urban area. In such cases, urban design criteria (Figure 301-4) may be used.

(B) If 6 or more lanes, use 15 ft.

(C) Where truck traffic exceeds 250 DDHV, additional shoulder width may be beneficial. If the treated shoulder width is increased then the graded shoulder width should be increased by the same amount.

(D) If 6 or more lanes, use 10 ft. See Note (R).

(E) A 6 ft. turf shoulder may be used with a 4:1 or flatter foreslope.

(F) See AASHTO=S Guidelines for Geometric Design for Very Low-Volume Local Roads for values.

(G) Concrete barrier may be placed at the edge of treated shoulder when used in lieu of guardrail.

(H) An 8 ft. graded shoulder may be used with a 4:1 or flatter foreslope.

(I) Turf shoulders may be used on non-state maintained roads at option of local government if current year ADT includes less than 250 B and C trucks. Turf shoulders are not to be used on State maintained roads.

(J) Stabilized aggregate may be used on State maintained roads if the design year ADT includes less than 250 B and C truck units. Paved shoulders are recommended if the design year ADT includes over 1000 B and C truck units.

(K) Rounding should be 4 ft. where the foreslope begins beyond the clear zone or where guardrail is installed and foreslope is steeper than 6:1. No rounding is required when the foreslope is 6:1 or flatter.

(L) Guardrail offset is treated width plus 2 ft.

(M) Whenever a design exception is approved for graded shoulder width, the guardrail offset may be reduced but shall not be less than 4 ft.

(N) The median and right shoulder width criteria for Interstates, other freeways and expressways shall apply to the shoulders of divided arterials and divided collectors.

(O) A fully paved shoulder is preferred, but may not be economically feasible. Therefore, a minimum 2 ft. of the treated shoulder should be paved. The remainder of the treated shoulder may be either stabilized aggregate or bituminous surface treated material according to the criteria stipulated in Note (J).

(P) Total Graded Width may be reduced as much as 3 ft. where MGS guardrail with the longer posts is used. See Section 603.1.2 and SCD MGS-1.1 for post length and position details.

(Q) Paved shoulder width reductions of less than 2’ at sign or luminaire foundations or bridge piers will not require a design exception. The 4’ minimum lateral clearance must still be provided.

(R) Prior to the January 2017 update of L&D Manual Vol. I a 12 ft. shoulder width was the standard. A 12 ft. shoulder width may be retained or perpetuated, if desired.
# Urban Roadway Criteria

## Lane & Shoulder Widths

### Functional Classification

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<th>Minimum Curbed Shoulder Width (ft.)</th>
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<td>1-2 Paved</td>
</tr>
<tr>
<td><strong>Local Streets (I)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial / Industrial</td>
<td>11</td>
<td>1-2 Paved</td>
</tr>
<tr>
<td>Residential</td>
<td>10 (C)</td>
<td>1-2 Paved</td>
</tr>
</tbody>
</table>

### Notes:

(A) Use rural criteria (Figure 301-3) for uncurbed shoulders. Rural functional classification should be determined after checking the urban route extension into a rural area.

(B) On all Federal Aid Primary (FAP) roadways at least one 12 ft. lane in each direction is required. FAP listings may be obtained from Office of Technical Services' Roadway inventory reports. See Section 105.3 for more information on the lane width requirements for the FAP and National Network.

(C) Lane width may be 9 ft. where right-of-way is limited and current ADT is less than 250.

(D) Use 10 ft. median shoulder on facilities with 6 or more lanes.

(E) Use minimum lane width if, in the foreseeable future, the parking lane will be used for through traffic during peak hours or continuously.

(F) See Sections 305.3.2 and 305.3.3 for use of curbs and Section 602.1.5 for curb/guardrail relationships.

(G) The median and right shoulder width for divided arterials shall follow the shoulder criteria for Interstates, other Freeways and Expressways.

(H) Where truck traffic exceeds 250 DDHV, additional shoulder width may be beneficial.

(I) The AASHTO Publication – Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400) may be used for the design criteria of Collector and Local Streets with ADT’s of 400 or less.

(J) Paved shoulder width reductions of less than 2’ will not require a design exception at sign or luminaire foundations or bridge piers. The minimum 4’ lateral clearance must still be provided.

July 2018
LOCATION OF TRAVELED WAY TRANSITION IN RELATIONSHIP TO THE SUPERELEVATION TRANSITION

Traveled Way Widening for a Simple Curve:

The Centerline Marking is to be placed at the actual center of the traveled way width.

Traveled Way Widening for a Spiral Curve:

The Centerline Marking is to be placed at the actual center of the traveled way width.

July 2012
## TRAVELED WAY WIDENING ON OPEN HIGHWAY CURVES FOR WB-62 DESIGN VEHICLES

<table>
<thead>
<tr>
<th>RADIUS</th>
<th>Design Speed (mph)</th>
<th>Design Speed (mph)</th>
<th>Design Speed (mph)</th>
<th>Design Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 to 39</td>
<td>40 to 49</td>
<td>50 to 59</td>
<td>60 to 69</td>
</tr>
<tr>
<td>1°00'</td>
<td>5730'</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2°00'</td>
<td>2865'</td>
<td>0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>3°00'</td>
<td>1910'</td>
<td>1.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>4°00'</td>
<td>1432'</td>
<td>1.5</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>5°00'</td>
<td>1146'</td>
<td>2.0</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>6°00'</td>
<td>955'</td>
<td>2.5</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>7°00'</td>
<td>819'</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>8°00'</td>
<td>716'</td>
<td>3.5</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>9°00'</td>
<td>637'</td>
<td>4.0</td>
<td>4.0</td>
<td>4.5</td>
</tr>
<tr>
<td>10°00'</td>
<td>573'</td>
<td>4.0</td>
<td>4.5</td>
<td>5.0</td>
</tr>
<tr>
<td>11°00'</td>
<td>521'</td>
<td>5.0</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td>12°00'</td>
<td>477'</td>
<td>5.5</td>
<td>5.5</td>
<td>6.5</td>
</tr>
<tr>
<td>13°00'</td>
<td>441'</td>
<td>5.5</td>
<td>5.5</td>
<td>6.5</td>
</tr>
<tr>
<td>14°00'</td>
<td>409'</td>
<td>6.0</td>
<td>6.0</td>
<td>7.0</td>
</tr>
<tr>
<td>14°30'</td>
<td>395'</td>
<td>6.0</td>
<td>6.5</td>
<td>7.0</td>
</tr>
<tr>
<td>15°00'</td>
<td>382'</td>
<td>6.5</td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td>18°00'</td>
<td>318'</td>
<td>7.5</td>
<td>9.0</td>
<td>9.0</td>
</tr>
<tr>
<td>19°00'</td>
<td>300'</td>
<td>8.0</td>
<td>9.0</td>
<td>9.0</td>
</tr>
<tr>
<td>21°00'</td>
<td>265'</td>
<td>9.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>22°00'</td>
<td>260'</td>
<td>9.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>25°00'</td>
<td>229'</td>
<td>10.5</td>
<td>11.5</td>
<td>11.5</td>
</tr>
<tr>
<td>26°00'</td>
<td>223'</td>
<td>10.5</td>
<td>11.5</td>
<td>11.5</td>
</tr>
<tr>
<td>26°30'</td>
<td>219'</td>
<td>11.0</td>
<td>12.0</td>
<td>12.0</td>
</tr>
</tbody>
</table>

**NOTE:** Values are for two-lane highways, one-way or two-way. Values less than 1.0 ft. per lane may be disregarded. Multiply table values by 1.5 for 3-lanes and by 2.0 for 4-lanes. For traveled way widening for other design vehicles, refer to the AASHTO “Green Book”.

July 2012
NORMAL CROSS SLOPE ARRANGEMENTS

301.1.5

UNDIVIDED

2-LANE

3-LANE

5-LANE

DIVIDED (RAISED MEDIAN)

4-LANE

6-LANE

8-LANE

DIVIDED (DEPRESSED MEDIAN)

4-LANE

6-LANE

6-LANE

8-LANE

Note: All grade breaks should not exceed 0.032.

November 2002
See Figure 301-3 for recommended dimensions.

**WITH BARRIER OR FORESLOPE STEEPER THAN 6:1**

**WITHOUT BARRIER AND FORESLOPE 6:1 OR FLATTER**

**NOTES:**

(A) The "Treated Width" is that portion of the shoulder improved with stabilized aggregate or better.

(B) See Figure 603-2 for minimum barrier clearance.

(D) Concrete barrier may be placed at the edge of treated shoulder when used in lieu of guardrail.

(E) Treated shoulder width may equal graded shoulder width in some cases.
NORMAL AND LOW SIDE OF SUPERELEVATED SECTIONS

CURBED-HIGH SIDE OF SUPERELEVATED SECTIONS

UNCURBED-HIGH SIDE OF SUPERELEVATED SECTIONS
NORMAL AND LOW SIDE OF SUPERELEVATED SECTIONS

- or rate of super if greater

HIGH SIDE OF SUPERELEVATED SECTIONS

November 2002
NORMAL AND LOW SIDE (INNER SIDE) SUPERELEVATED SECTIONS

- or rate of super

RISING SIDE (OUTER SIDE) OF SUPERELEVATED SECTIONS IN TRANSITION

From 0.016 to 0.01

0.07 max. break

HIGH SIDE OF SUPERELEVATED SECTIONS

From > 0.01 to 0.08

Pavement slope

The break at the edge of the traveled way shall not exceed 0.07.

November 2002
# DESIGN CRITERIA
## NEW AND RECONSTRUCTED (J) BRIDGES

### Functional Classification

<table>
<thead>
<tr>
<th>Traffic</th>
<th>Lateral Clearance</th>
<th>Vertical Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On Bridge (A)</td>
<td>Under Bridge (F)</td>
</tr>
<tr>
<td></td>
<td>Rural (B)</td>
<td>Urban (D)</td>
</tr>
<tr>
<td></td>
<td>Min.</td>
<td>Min.</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>Minimum</td>
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</tbody>
</table>

### Design Year ADT

<table>
<thead>
<tr>
<th></th>
<th>10’ Rtl. (B)(D)</th>
<th>4’ Lt. (E)(B)</th>
<th>16.5’ (I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstates, Other Freeways &amp; Expressways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 2000</td>
<td>8’ (B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1501 – 2000</td>
<td>6’ (B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>400 – 1500</td>
<td>6’ (B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 400</td>
<td>4’</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Arterial

<table>
<thead>
<tr>
<th></th>
<th>4’</th>
<th>16.5’ (I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1501 – 2000</td>
<td>4’</td>
<td>(G)</td>
</tr>
<tr>
<td>400 – 1500</td>
<td>4’</td>
<td></td>
</tr>
<tr>
<td>&lt; 400</td>
<td>(C)</td>
<td></td>
</tr>
</tbody>
</table>

### Collector

<table>
<thead>
<tr>
<th></th>
<th>4’</th>
<th>14.5’</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 2000</td>
<td></td>
<td>(G)</td>
</tr>
<tr>
<td>1501 – 2000</td>
<td>4’</td>
<td></td>
</tr>
<tr>
<td>400 – 1500</td>
<td>4’</td>
<td></td>
</tr>
<tr>
<td>&lt; 400</td>
<td>(C)</td>
<td></td>
</tr>
</tbody>
</table>

### Local

<table>
<thead>
<tr>
<th></th>
<th>4’</th>
<th>14.5’</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 2000</td>
<td></td>
<td>(G)</td>
</tr>
<tr>
<td>1501-2000</td>
<td>4’</td>
<td></td>
</tr>
<tr>
<td>400 – 1500</td>
<td>4’</td>
<td></td>
</tr>
<tr>
<td>&lt; 400</td>
<td>(C)</td>
<td></td>
</tr>
</tbody>
</table>

For structure design criteria not contained in this table such as minimum design loading, refer to the Bridge Design Manual from the Office of Structural Engineering.

WHERE THE APPROACH ROADWAY WIDTH (TRAVELED WAY PLUS SHOULDERS) IS SURFACED, AT A MINIMUM, THAT SURFACE WIDTH SHOULD BE CARRIED ACROSS THE STRUCTURE.

January 2017
A. Lateral Clearance is the distance measured from the edge of the traveled lane to the face of curb (or railing if no curb is present).

B. If bridge is considered to be a major structure having a length of 200 ft. or more, the width may be reduced, subject to economic studies, but not less than a lateral clearance of 4 ft.

C. See AASHTO’s Guidelines for Geometric Design for Very Low-Volume Local Roads (ADT ≤ 400) for values.

D. Where truck traffic exceeds 250 DDHV, additional shoulder width may be beneficial.

E. If 6 or more lanes, provide 10 ft. width.

F. Distance measured from the edge of the traveled lane to the face of walls of abutments and piers.

G. May be reduced to a clearance of 2 ft. plus barrier clearance (Figure 603-2) on urban streets with restricted right-of-way and a design speed less than 50 mph.

H. The minimum vertical clearance includes an allowance for future resurfacing equal to 0.5 ft. Sign supports and pedestrian structures shall have a 1 ft. additional clearance. Clearances shown shall be over paved shoulder as well as traveled way width.

I. A 15.5 ft. minimum clearance may be used in highly developed urban areas if attainment of 16.5 ft. clearance would be unreasonably costly and if there is an alternate freeway route or bypass which provides a minimum 16.5 ft. vertical clearance.

J. A reconstructed bridge is any improvement to an existing bridge involving the replacement of the bridge deck or more.
<table>
<thead>
<tr>
<th>Functional Classification</th>
<th>Design Year ADT</th>
<th>Minimum Lateral Clearance</th>
<th>Minimum Vertical Clearance (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>On Bridge (A)</td>
<td>Under Bridge (C)</td>
</tr>
<tr>
<td>Urban Interstate</td>
<td>All</td>
<td>10' Rt. (B) 3.5' Lt.</td>
<td>Curbed or Treated Shoulder Width Plus Barrier Clearance (D)</td>
</tr>
<tr>
<td>Rural Interstate</td>
<td>All</td>
<td>10' Rt. (B) 3.5' Lt.</td>
<td>16.0'</td>
</tr>
<tr>
<td>Other Freeways</td>
<td>All</td>
<td>10' Rt. (B) 3.5' Lt.</td>
<td>14.5'</td>
</tr>
</tbody>
</table>

This table is applicable to all bridges except those classified as new or reconstructed. (See Figure 302-1.)

For structural criteria not contained in this table, including Minimum Design Loading, see Structural Engineering’s Bridge Design Manual.

**NOTES:**

(A) Distance measured to curb or railing, whichever is less, in no case shall the minimum width be less than the approach roadway (traveled way plus shoulders).

(B) On mainline bridges that are 200 ft. long or longer, the minimum may be reduced to 3.5 ft. for Interstate and 3 ft. for other freeways.

(C) Distance measured to face of walls, abutments or piers.

(D) See Figure 603-2 for minimum barrier clearance.

(E) Includes height over shoulders

(F) Minimum vertical clearance is 16 ft. if there is no alternative Interstate routing with the minimum 16 ft. vertical clearance.

November 2002
### CRITERIA FOR EXISTING NON-FREWAY BRIDGES TO REMAIN

<table>
<thead>
<tr>
<th>Functional Classification</th>
<th>Design Year ADT</th>
<th>Minimum Lateral Clearance (A)</th>
<th>Minimum Vertical Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>On Bridge (B)</td>
<td>Under Bridge (E)</td>
</tr>
<tr>
<td><strong>Expressways and Arterials</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 4000</td>
<td>6 ft. (C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 4000</td>
<td>3 ft.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Collector</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 4000</td>
<td>6 ft. (C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001-4000</td>
<td>3 ft.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1001-2000</td>
<td>2 ft.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>400-1000</td>
<td>2 ft.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 400</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Local</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 4000</td>
<td>6 ft. (C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001-4000</td>
<td>3 ft.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1001-2000</td>
<td>2 ft.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>400-1000</td>
<td>2 ft. (D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 400</td>
<td>0 (D)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table is applicable to all non-freeway bridges except those classified as new or reconstructed.

For structural criteria not contained in this table, including Minimum Design Loading, see Structural Engineering’s Bridge Design Manual.

**NOTES:**

(A) Divided facilities shall have a minimum of 3 ft. lateral clearance on the median side.
(B) Distance measured to curb or railing, whichever is less. In no case shall the minimum width be less than the approach roadway (traveled way plus shoulders).
(C) On mainline bridges having a length of 100 ft. or more, the minimum may be reduced to 3 ft.
(D) One lane bridges have a total minimum width of 18 ft.
(E) Distance measured to face of walls, abutments or piers.
(F) See Figure 603-2 for minimum barrier clearance.

Note: For the design criteria pertaining to Collectors and Local Roads with ADT’s of 400 or less, refer to the AASHTO Publication - Guidelines for Geometric Design of Very Low-Volume Local Roads ADT ≤ 400.

November 2002
## Interchange Elements - Traveled Way, Shoulders and Medians

### Reference Sections
- 303.1

<table>
<thead>
<tr>
<th>Interchange Elements</th>
<th>Total Traveled Way Width</th>
<th>Graded Shoulder Width</th>
<th>Paved Shoulder Width</th>
<th>Normal Rounding (E)</th>
<th>Guardrail Offset (From Traveled Way) (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>Right</td>
<td>LT</td>
<td>RT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With Barrier or</td>
<td>w/o Barrier</td>
<td>LT</td>
<td>RT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foreslope steeper</td>
<td>slopes 6:1 or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>than 6:1</td>
<td>flatter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>w/Barrier or</td>
<td>With Barrier or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foreslope steeper</td>
<td>Foreslope</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>than 6:1</td>
<td>steeper than 6:1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>w/o Barrier</td>
<td>w/o Barrier</td>
<td>LT</td>
<td>RT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>slopes 6:1 or</td>
<td>slopes 6:1 or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>flatter</td>
<td>flatter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
- **A** Use 18 ft. when inside traveled way edge radius is less than 200 ft.
- **B** For 2-lane directional roadways and 2-lane multilane ramps, the traveled way width shall be 24 ft.
- **C** May be reduced 1 ft. if the face of the mainline barrier is 2 ft. from the outside edge of the graded shoulder.
- **D** Or match mainline dimension if lesser.
- **E** Rounding is 4 ft. when barrier is used. No rounding is required when foreslope is 6:1 or flatter.
- **F** Match Multilane Ramp dimensions when used with Multilane Ramps.
- **G** Concrete barrier may be placed at the edge of the paved shoulder when used in lieu of guardrail, but no closer than 4'.
- **H** For 3 or more lanes, use right side widths or dimensions.

### Diagrams:
- **Two-Way Ramp Median**
- **Minimum Two-Way Ramp - Concrete Median**
- **Minimum Two-Way Ramp - Concrete Barrier Median**
Crossover pavement slope same as mainline profile.

"D" (Below)-Profile Grade Line at Location Point.

The values shown do not reflect values needed for CAD accuracy.
<table>
<thead>
<tr>
<th>ROADWAY CLASSIFICATION &amp; LAND USE</th>
<th>SIDEWALK/WALKWAY</th>
<th>FUTURE PHASING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Highways (&lt;2,000 ADT)</td>
<td>See AASHTO’s A Policy on Geometric Design of Highway and Streets for combined traveled way and shoulder widths for local roads, collectors and arterials</td>
<td>----</td>
</tr>
<tr>
<td>Rural/suburban highways (ADT &gt; 2,000 and less than 1 dwelling unit per acre)</td>
<td>Minimum 8 ft. shoulders recommended</td>
<td>Secure/preserve ROW for future sidewalks</td>
</tr>
<tr>
<td>Suburban Highway (1 to 4 dwelling units per acre)</td>
<td>Sidewalks on both sides recommended</td>
<td>----</td>
</tr>
<tr>
<td>Local Urban Street (Residential - 1 to 4 dwelling units per acre)</td>
<td>Sidewalks on both sides preferred, min. of 8 ft. shoulders recommended</td>
<td>Secure/preserve ROW for future sidewalks</td>
</tr>
<tr>
<td>Local Urban Street (Residential - 1 to 4 dwelling units per acre)</td>
<td>Sidewalks on both sides recommended</td>
<td>----</td>
</tr>
<tr>
<td>Local Urban Street (Residential - more than 4 dwelling units per acre)</td>
<td>Sidewalks on both sides recommended</td>
<td>----</td>
</tr>
<tr>
<td>Urban Collector and Minor Arterial (residential)</td>
<td>Sidewalks on both sides recommended</td>
<td>----</td>
</tr>
<tr>
<td>Major Urban Arterial (residential)</td>
<td>Sidewalks on both sides recommended</td>
<td>----</td>
</tr>
<tr>
<td>All Commercial/Urban Streets</td>
<td>Sidewalks on both sides recommended</td>
<td>----</td>
</tr>
<tr>
<td>All Industrial Streets</td>
<td>Sidewalks on both sides preferred, sidewalk on one side and min. of 5 ft. shoulder recommended</td>
<td>----</td>
</tr>
</tbody>
</table>
WALK DESIGNS

REFERENCE SECTION
306.2.2. 306.2.4

WALK WITH BUFFER

2 ft. Minimum
6 ft. Residential
8 ft. Commercial

Variable 0.04 to 0.08
Buffer

5 ft. Min.
Residential
6 ft. Min.
Commercial

2 ft. R/W

0.02
Walk

WALK-NO BUFFER

7 ft. Min.
Residential
8 ft. Min.
Commercial

2 ft. R/W

0.02
Walk

WALK-CENTRAL BUSINESS DISTRICT

Residential: 8 ft. Min. 14 ft. Desirable
Commercial: 10 ft. Min. 16 ft. Desirable

R/W

0.04

BORDER-NO WALK

November 2002
CURB RAMP COMPONENTS

306-3
REFERENCE SECTION
306.3.3

CURB RAMP TERMS

Change in angle must be flush without a lip, raised joint or gap.

Algebraic difference greater than 11% is not permitted.

Provide 24 inch level strip if algebraic difference exceeds 11%.

COUNTER SLOPE

November 2002
CURB RAMP TYPES AND PEDESTRIAN CURB CUTS

PERPENDICULAR

Curb Ramps

Crosswalk

Sidewalk

PARALLEL

Curb Ramps

Crosswalk

Sidewalk

DIAGONAL

Curb Ramp

Sidewalk

Crosswalk

PEDESTRIAN CURB CUT

Unpaved Area

Roadway

October 2010
TRUNCATED DOMES

50% to 65% of base diameter

0.2" min. 0.9" max.

HEIGHT AND DIAMETER

1.6" min.
1.4 max.

0.9 min.
2.4" max.

SQUARE PATTERN, PARALLEL ALIGNMENT

0.9 min.
2.4 max.

Direction of Ramp

1.6" min.
2.4 max.

RADIAL ALIGNMENT

DOME HEIGHT AND SPACING

Sidewalk

Perpendicular

Flared Side

Curb ramp with truncated domes

24"

Slope down

Level

Slope down

Sidewalk

Truncated domes

Curb

Parallel

Curb ramp with truncated domes

Flared Side

24"

Medians

At-grade pedestrian refuge with 24" strip of truncated domes

Ramped pedestrian refuge with 24" strip of truncated domes

Passage at street level with 24" deep truncated domes

At Curb Ramps

AT CURB RAMPS

October 2010
CUT SECTION
RURAL INTERSTATE

8:1 slope may be used with horizontal distance remaining the same to increase the ditch depth.

CUT SECTION
URBAN INTERSTATE, OTHER FREeways AND EXPRESSWAYS

If backslope is greater than 3:1, use 40’ radius as shown above.

Approximate guide for cut depth.

SHALLOW CUT OR LOW FILL

Slope transition between low fill design and medium fill design should be such that the flowline of the roadside ditch does not turn towards the roadway.

MEDIUM FILL

Application of these sections may vary to avoid frequent slope changes and to maintain reasonably straight ditches.

NOTES:

(A) 6:1 slope may be used with horizontal distance remaining the same to increase the ditch depth.

(B) 6:1 slope may be used

(C) 4’ Rounding

(D) See Fig. 307-2 for ditch sections to be used with safety grading

January 2005
CUT SECTION

Clear Zone (See Note A)

Preferred Ditch (See Figures 307-10 & II)

FILL SECTIONS (B)

Clear Zone (See Note A)

Preferred Ditch (See Figures 307-10 & II)

Normal Ditch (See Figure 307-4)

NOTES:

(A) See Figure 600-1 for Clear Zone widths.

(B) For fill heights over 16 ft., use barrier grading (See Figure 307-4)

(C) 4 ft. Rounding

November 2002
COMMON AND BARRIER GRADING SECTIONS

COMMON GRADING

CUT

FILL

BARRIER GRADING

NORMAL DITCH SECTIONS

CUT

FILL

NOTES: (A) 4’ Rounding

January 2007
DESIGNS FOR ROCK CUTS WITH SAFETY GRADING
REFERENCE SECTION 307.2.5

Clear Zone *
See Fig. 307-1 for radius (R) R

*If safety graded cross sections according to section 307.2.1 can not be obtained install guardrail or Type D concrete barrier

DESIGNS FOR DEEP PARALLEL SIDE DITCHES
REFERENCE SECTIONS 307.3 & 307.4

EARTH BARRIER PROTECTION

CHANNEL EASEMENT

MEDIUM FILL

LOW FILL

BENCH PROTECTION

*6:1 Slope may be used

ALTERNATE MEDIAN DESIGNS-SEPARATE PROFILES
REFERENCE SECTION 307.2.4

\[ \frac{V}{2} \text{ Normal median width} \]

Variable slope 2:1 max.

Rounding

Variable slope steeper than 3:1

* 6:1 Slope may be used
The 4% to 8% slopes in the top detail were extended to the R/W line to prevent runoff from the right-of-way entering private property. This slope may be broken if the highway runoff can be maintained within the highway right-of-way.
SLOPES AND DITCHES AT
DRIVEWAYS AND CROSSROADS
IN CUT OR LOW FILL

307-7
REFERENCE SECTIONS
307.2.7

November 2002
PREFERRED CROSS SECTIONS FOR DITCHES WITH ABRUPT SLOPE CHANGES

This chart is applicable to vee ditches, rounded ditches with bottom widths less than 8'-0", and trapezoidal ditches with bottom widths less than 4'-0".

Ditch sections that fall within the shaded areas of the figure above are considered traversable and are preferred for use within the Clear Zone. Ditch sections that fall outside the shaded areas are considered non-traversable and should generally be located outside the Clear Zone.

November 2002
Preferred Cross Sections for Ditches with Gradual Slope Changes

Foreslope = $b_1/a_1$

Backslope = $b_2/a_2$

This chart is applicable to rounded ditches with bottom widths of 8'-0" or more, and to trapezoidal ditches with bottom widths equal to or greater than 4'-0".

Ditch sections that fall within the shaded areas of the figure above are considered traversable and are preferred for use within the Clear Zone. Ditch sections that fall outside the shaded areas are considered non-traversable and should generally be located outside the Clear Zone.

November 2002