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MONTANA DEPARTMENT OF TRANSPORTATION

ROAD DESIGN MANUAL

Chapter Eleven
CROSS SECTION ELEMENTS

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Chapter Eleven
CROSS SECTION ELEMENTS

The highway cross section establishes the basic operational and safety features for the facility, and has a significant impact on the project cost, especially for earthwork. Most of the MDT design criteria for cross sections is contained in two chapters of the *Manual*. Chapter Twelve "Geometric Design Tables" provides numerical criteria for various cross section elements for Department projects. Chapter Eleven provides additional guidance which should be considered in the design of these cross section elements, including the roadway section, two-way left-turn lanes, curbs, sidewalks, medians, side slopes and right-of-way design. In addition, the independent design criteria of municipalities and local governments must be considered for urban projects. Chapter Eleven concludes with several typical sections for various highway types.

11.1 DEFINITIONS/NOMENCLATURE

Figures 11.1A, 11.1B and 11.1C provide the basic nomenclature for cross section elements for Interstates, rural highways and urban streets. The following definitions apply to the highway cross section:

1. Auxiliary Lane. The portion of the roadway adjoining the through traveled way for purposes supplementary to through traffic movement including parking, speed change, turning, storage for turning, weaving or truck climbing.

2. Back Slope. The side slope created by the connection of the ditch bottom, upward and outward, to the natural ground (often referred to as the cut slope).

3. Barrier Curb. A longitudinal element, typically concrete, placed at the roadway edge for delineation, to control drainage, to control access, etc. Barrier curbs may range in height between 6”(150 mm) and 12”(300 mm) with a face steeper than 1 horizontal to 3 vertical. This term has been replaced in AASHTO with the term “vertical curb”.

4. Buffer. Where used, the area or strip, also known as a boulevard, between the roadway and a sidewalk.

5. Cross Slope. The slope in the cross section view of the travel lanes, expressed as a percent based on the change in vertical compared to the change in horizontal.

6. Depressed Median. A median that is lower in elevation than the traveled way and designed to carry a certain portion of the roadway runoff.

7. Fill Slopes. Slopes extending outward and downward from the hinge point to intersect the natural ground line.

8. Flush Median. A paved median which is level with the surface of the adjacent roadway pavement.

9. Hinge Point (Freeways). The point from which the fill height and depth of cut are determined. For fills, the point is located at the intersection of the inslope extension and the fill slope. For cuts, the hinge point is located at the toe of the back slope.

10. Hinge Point (Non-Freeways). The point from which the fill height and depth of cut are determined. For fills, the point is located at the intersection of the subgrade cross slope and the fill slope for tangent sections and the low side of superelevated sections. On the high side of superelevated sections, the point is located on the fill slope at a distance from the centerline equal to the distance from the centerline to the hinge point on the tangent section. For cuts, the hinge point is located at the toe of the back slope.

11. Inslope. The side slope in a cut section created by connecting the subgrade shoulder to the ditch bottom, downward and outward.

12. Median. The portion of a divided highway separating the two traveled ways for traffic in opposite directions. The median width includes both inside shoulders.

13. Median Slope. The slope in the cross section view of a depressed median beyond the surfacing inslope, expressed as a ratio of the change in horizontal to the change in vertical.

14. Mountable Curb. A longitudinal element, typically concrete, placed at the roadway edge for delineation, to control drainage, to control access, etc. Mountable curbs typically have a height of 6"(150 mm) or less with a face no steeper than 1 horizontal to 3 vertical. This term has been replaced in AASHTO with the term "sloped curb".

15. Paved Walkway. That portion of the highway section constructed adjacent to facilities without curb and gutter, with a minimum of 3’ (1 m) buffer area, for use by pedestrians.

16. Raised Median. A median which contains a raised portion or island within its limits.

17. Roadside. A general term denoting the area adjoining the outer edge of the roadway.

18. Roadway Section. The combination of the traveled way, both shoulders and any auxiliary lanes on the highway mainline.

19. Shelf. On curbed urban facilities without sidewalks, the relatively flat area (2% slope) located between the back of the curb and the break for the fill slope or back slope.

20. Shoulder. The portion of the roadway contiguous to the traveled way for the accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses. On sections with curb and gutter, the shoulder extends to the face of the curb.

21. Shoulder Slope. The slope in the cross section view of the shoulders, expressed as a percent.

22. Shoulder Width. The width of the shoulder measured from the edge of the traveled way to the intersection of the shoulder slope and surfacing inslope planes. On curb and gutter sections, the width of the shoulder is measured from the edge of the traveled way to a point 0.5’ (0.15 m) in front of the back of curb.

23. Sidewalk. That portion of the highway section constructed for the use of pedestrians used in combination with curb and gutter.

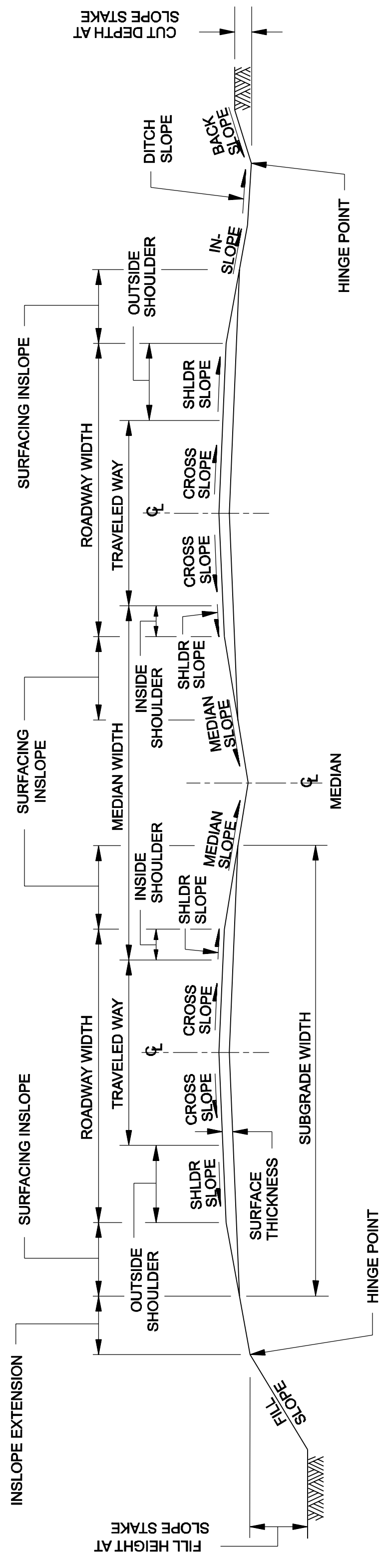
24. Slope Offset. On curbed facilities with sidewalks, the area between the back of the sidewalk and the break for the fill slope or back slope.

25. Surfacing Inslope. The slope extending from the edge of shoulder to the subgrade shoulder point, expressed as a ratio of the change in horizontal to the change in vertical.

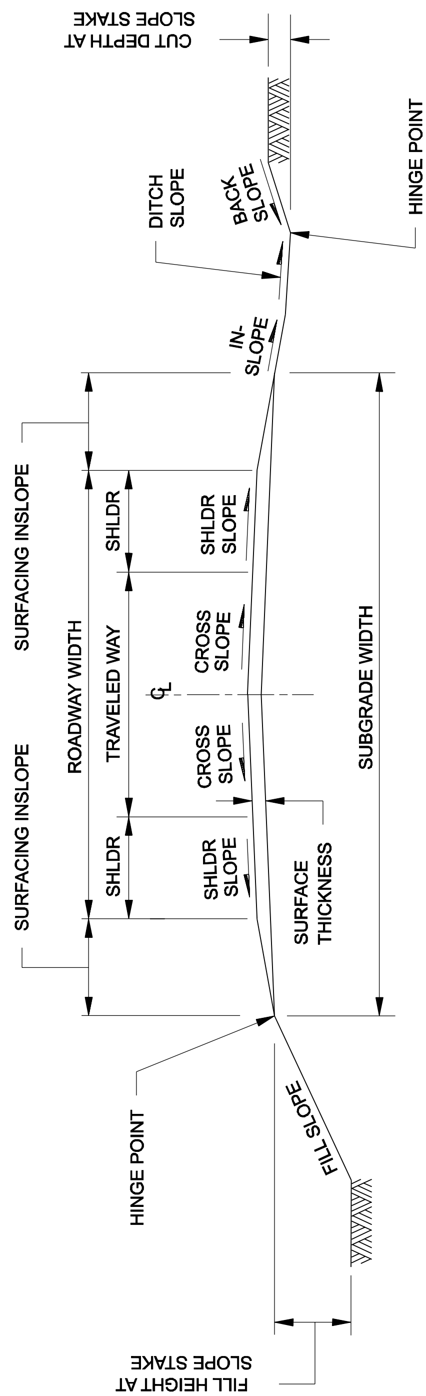
26. Toe of Slope. The intersection of the fill slope with the natural ground or the inslope with the ditch bottom.

27. Top of (Cut) Slope. The intersection of the back slope with the natural ground.

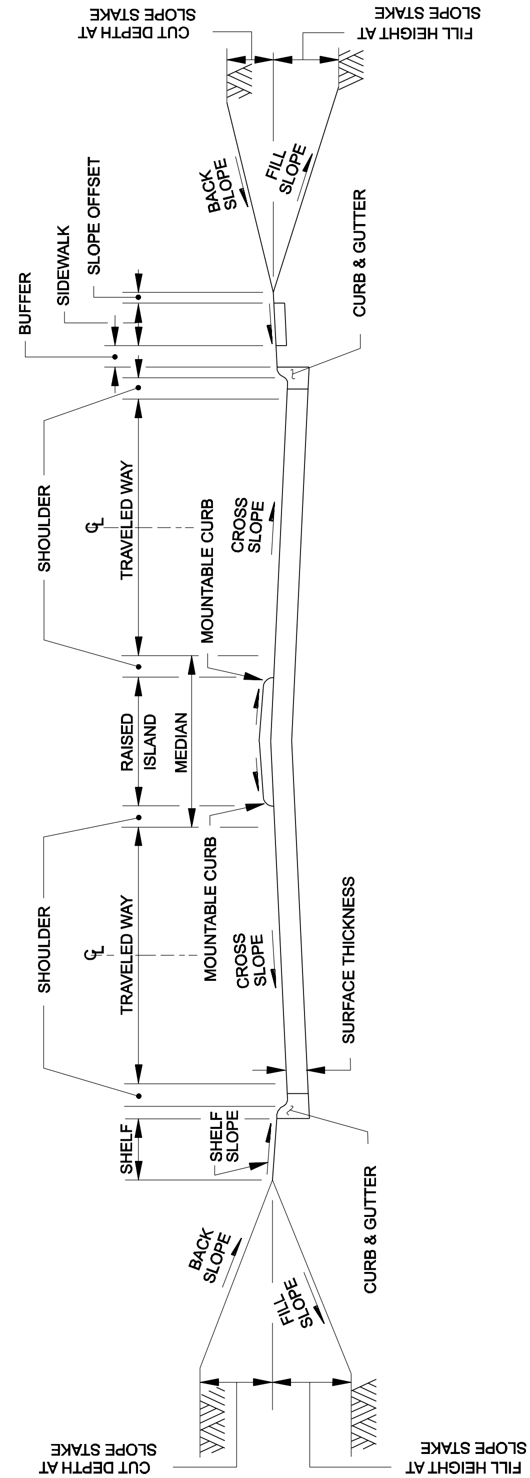
28. Traveled Way. The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.



FREEWAY NOMENCLATURE
Figure 11.1A



RURAL HIGHWAY NOMENCLATURE
(Non-Freeways)
Figure 11.1B



RURAL URBAN STREET NOMENCLATURE

Figure 11.1C

11.2 ROADWAY SECTION

11.2.1 Travel Lanes

11.2.1.1 Width

On State highways, travel lane widths are typically 12’ (3.6 m) for rural facilities. Lane widths on urban facilities may vary from 10’ (3.1 m) to 12’ (3.6m). On non-State highways, travel lane widths can vary between 10’ (3.0 m) and 12’ (3.6 m), depending upon traffic volumes, functional class and design speed. The tables in Chapter Twelve provide specific criteria for travel lane widths.

11.2.1.2 Surface Type

The following will apply to selecting the surface type for the traveled way:

1. Rural Arterials. All rural arterials will be paved.
2. Rural Collectors (State Highways). Normally, these will be paved. However, existing gravel roads may remain gravel. This decision will normally be made during the Preliminary Field Review.
3. Urban State Facilities. These will be paved.
4. Non-State Facilities. On projects where State and/or Federal funds are used on non-State facilities, the pavement surface type will normally be determined at the PFR.

11.2.1.3 Cross Slopes

Surface cross slopes are required for proper drainage of travel lanes on tangent sections. For tangent roadway sections, all pavement sections, with the exception of those having depressed medians, are crowned at the centerline of the roadway section. Sections having depressed medians are crowned at the centerlines of the individual traveled ways. The following will apply:

1. Paved (Uncurbed). The travel lane cross slope is typically 2%.

2. Curbed. On curbed facilities, the cross slope is typically 2%. Exceptions are allowed for any cross slope between 1% and 4%, depending on site conditions.

3. Gravel. The travel lane cross slope is typically 3%. At bridge ends the gravel lane cross slope must transition to match the bridge cross slopes which is generally 2%.

11.2.2 Shoulders

11.2.2.1 Functions

Shoulders serve many functions, and the wider the shoulder, the greater the benefits. Shoulder functions include:

1. providing structural support for the traveled way which prevents, for example, pavement edge dropoffs;
2. increasing highway capacity;
3. encouraging uniform travel speeds;
4. providing space for emergency and discretionary stops;
5. improving roadside safety by providing more recovery area for run-off-the-road vehicles;
6. providing a sense of openness;
7. improving sight distance around horizontal curves;
8. enhancing highway aesthetics;
9. facilitating maintenance operations;
10. providing additional lateral clearance to roadside appurtenances (e.g., guardrail, traffic signals);
11. facilitating pavement drainage;
12. providing space for pedestrian and bicycle use; and
13. providing space for bus stops.

11.2.2.2 Widths

Shoulder widths will vary according to functional classification, traffic volumes and urban/rural location. The tables in Chapter Twelve present the shoulder width criteria for the various conditions. In addition, consider the following:

1. Roadside Barriers. For roadway widths less than 28' (8.4 m), shoulder widths should be increased to 2' (0.6 m) when a roadside barrier is present. See Chapter Fourteen for more information on offsets to barriers.

2. Curb and Gutter. The minimum shoulder width adjacent to a curb is 2' (0.6 m) measured from the edge of the traveled way to a point 0.5' (0.15 m) from the back of curb.

3. Widening for Future Paving. For reconstruction and major widening projects provide 1.4' (0.4 m) of finished top width on each side of the roadway - 2.8' (0.8 m) total, in addition to what is required by the Route Segment Plan or Geometric Design Standards. This width is to accommodate a future 0.20' (60 mm) overlay. If the additional width cannot be provided, include documentation in the PFR or Scope of Work Report.

11.2.2.3 Surface Type

The type of surfacing used for the shoulder will match that used for the traveled way. See Section 11.2.2.6 for the use of rumble strips on shoulders.

11.2.2.4 Shoulder Slopes

The normal slope of the shoulder depends primarily on the surface type of the roadway section. The following summarizes MDT practices:

1. Paved. Except as noted in #2, all paved shoulders will have the same slope as the adjacent (paved) traveled way, typically 2%.

2. Existing Roadways. Existing shoulder slopes on existing roadways may be variable. If the proposed pavement work is resurfacing, the existing slope may be retained. The decision to use the existing shoulder slope should be documented in the Scope of Work Report. If the proposed pavement work is full-depth reconstruction or major rehabilitation, the shoulder slope should match the cross slope of the traveled way, typically 2%.

3. Gravel. All gravel shoulders will have the same slope as the adjacent (gravel) traveled way, typically 3%.

11.2.2.5 Subgrade Slopes

The following will apply:

1. Tangent Sections. For tangent sections, the cross slope of the top of the subgrade will be the same as the cross slope of the paved surface.

2. Superelevated Sections. For superelevated sections, the cross slope of the top of subgrade will be the same as the cross slope of the paved surface from the subgrade shoulder (hinge point in fill sections) on the high side of the section to a point directly below the edge of the shoulder on the low side of the section. From this point to the subgrade shoulder on the low side, the subgrade cross slope will be 2%. This change in subgrade cross slope results in the subgrade shoulder at the inside of the superelevated section being the same distance from the centerline of the pavement as the subgrade shoulder of the tangent section. Maintaining a constant location of the subgrade shoulder on the low side of curves maintains the ditch offset distance, avoids depressions in the ditch grade, reduces surfacing material and aides in the staking of the subgrade.

3. Variable Surfacing Depths. Where adjoining typical sections have different surfacing depths, use a taper rate of 20:1 to transition between the subgrade widths. No transition is needed for the subgrade depth as the depth of surfacing will change abruptly.

See the typical section figures in Section 11.7 for an illustration of the subgrade slope on tangent and superelevated sections.

11.2.2.6 Rumble Strips

Guidelines/Location

Rumble strips on the shoulder can potentially prevent run-off-the-road accidents by alerting sleepy or inattentive drivers. However, other factors must be considered when using rumble strips, including:

1. use of the shoulder by bicyclists,

2. impact on pavement life,

3. impact on maintenance operations, and

4. initial construction costs.

The following summarizes MDT criteria for rumble strip guidelines and location on shoulders:

1. Interstates. Provide rumble strips on both the outside and inside shoulders of all Interstate projects unless there is a specific reason not to do so. The reason(s) should be documented in the Scope of Work Report. Typically, place the rumble strips 0.5’ (150 mm) outside of the shoulder stripe. At exit ramps, end the rumble strip 100’ (30 m) upstream of the ramp taper and begin again at the gore nose after the left shoulder stripe of the exit ramp. For entrance ramps, end the rumble strip at the gore nose and begin again at the end of the ramp taper.

2. Arterials. On arterials located within designated city or urban limits, the decision to install rumble strips will be determined on a case-by-case basis using engineering judgment. Guidelines for rumble strips on all other arterials are based on the shoulder width as follows:

   a. For shoulder widths equal to or greater than 4’ (1.2 m), provide rumble strips on the shoulders of all new construction, reconstruction and overlay arterial projects. Justification to not provide rumble strips will be based on corridor continuity, approach density, bicycle use and crash history. Document the decision and justification for not using rumble strips in the Scope of Work Report. Base the justification in part on corridor continuity, approach density, bicycle usage and crash history. Place the rumble strips 0.5’ (150 mm) from the shoulder stripe.

   b. For shoulder widths less than 4’ (1.2 m), do not use rumble strips. However, in cases where there is little bicycle usage and the incidence of run-off-the-road crashes is high, consider providing rumble strips. Document the decision and justification to use rumble strips in the Scope of Work Report.

   c. Where significant bicycle usage is documented or attested to by the District Administrator and the shoulder width is 4’ (1.2 m) or less, consider the following modifications:

      (1) The use of a 4”(100 mm) offset from the shoulder stripe.
      (2) The use of a 8”(200 mm) transverse rumble strip width.

3. Bridge Decks. Do not install rumble strips on bridge decks.

4. Approaches. Discontinue the use of rumble strips across the full width of all public and private approaches.

5. Turnouts. Continue the use of rumble strips along the full length of all turnouts, including tapers (e.g., mailbox turnouts, scenic and historic marker turnouts, chain-up turnouts).

6. Guardrail. Discontinue rumble strips on outside shoulders less than 6' (1.8 m) wide if guardrail is in place or will be installed.

7. Installation. Install rumble strips on the right shoulder on an 60' (18.3 m) cycle pattern consisting of a 48' (14.6 m) rumble strip and a 12' (3.7 m) gap. Eliminate the gap on the inside shoulder of multilane highways.

Design

For guidance on the configuration and design of rumble strips, see the *MDT Detailed Drawings.*

11.2.3 Auxiliary Lanes

Auxiliary lanes are any lanes beyond the basic through travel lanes, and they are intended for use by vehicular traffic for specific functions (e.g., two-way, left-turn lanes) TWLTL. The following will apply to the design of auxiliary lanes:

1. Width. With the exception of TWLTL, the width of an auxiliary lane is typically the same as that of the adjacent through lane. In rare cases, it may be justified to provide a narrower width (e.g., restricted right-of-way).

2. Shoulders. The designer should meet the following for shoulders adjacent to auxiliary lanes:

   a. On uncurbed facilities, the shoulder width adjacent to the auxiliary lane should be the same as the normal shoulder width for the approaching roadway. At a minimum, the width may be 4' (1.2 m), assuming the roadway has a shoulder width equal to or greater than 4' (1.2 m).

   b. On curbed facilities, the shoulder between the auxiliary lane and curb should be the same as that for the normal roadway section, typically 2' (0.6 m). At a minimum, the shoulder may be eliminated.

3. Cross Slope. The cross slope for an auxiliary lane will typically be the same as the adjacent through lane, typically 2%.

11.2.4 Two-Way Left-Turn Lanes (TWLTL)

Two-way left-turn lanes (TWLTL) are a cost-effective method to accommodate a continuous left-turn demand and to reduce delay and accidents.

11.2.4.1 Guidelines

The Traffic Engineering Section will determine where a TWLTL is necessary. The following provides guidance for where the TWLTL should be considered:

1. General. The physical conditions under which a TWLTL should be considered include:

    a. areas with a high number of approaches per mile (km) (e.g., 50 approaches per mile or 30 approaches total per km on both sides);

    b. areas of high-density, commercial development; and/or

    c. areas with a relatively continuous demand for mid-block left turns but where specific approaches do not have a heavy left-turn demand;

2. Functional Class. Undivided 2-lane and 4-lane urban or suburban arterials are the most common candidates for the implementation of a TWLTL. Once the TWLTL is used, these are commonly referred to as 3-lane and 5-lane facilities, respectively.

3. Traffic Volumes. Traffic volumes are a significant factor in the consideration of a TWLTL. If mid-block access is significant, then a TWLTL will be advantageous under any traffic volume level. The following are general guidelines where a TWLTL would be desirable based on volume:

    a. On existing 2-lane roadways, a TWLTL is desirable for AADT's greater than 5,000 vehicles per day (design year AADT).

    b. On existing 4-lane highways, a TWLTL is desirable for AADT's up to 30,000 vehicles per day (design year AADT).

4. Section Length. In rural areas, the section length and the number of through lanes are important considerations. Based on experience for rural and suburban

applications, only consider TWLTL where there are four or more through lanes. The application of short sections of three-lane facilities in rural areas will be determined on a site-by-site basis.

5. Crash History. On high-volume urban or suburban arterials, traffic conflicts often result because of a significant number of mid-block left turns combined with significant opposing traffic volumes. This may lead to a disproportionate number of mid-block, rear-end, left-turn and/or sideswipe crashes. A TWLTL is likely to reduce these types of crashes. The designer should review and evaluate the available crash data to determine if unusually high numbers of these crashes are occurring.

11.2.4.2 Design Criteria

Lane Width

The typical width for a TWLTL is 14’ (4.2 m). TWLTL widths may be less in urban areas. In general, the desirable width should be used for facilities with higher volumes, higher speeds and/or in industrial areas. Chapter Twelve presents specific TWLTL width criteria for specific functional classes.

Existing highways that require the installation of a TWLTL are often located in areas of restricted right-of-way, and conversion of the existing cross section may be difficult. To obtain the TWLTL width, the designer may have to consider several alternatives including:

1. acquiring additional right-of-way to expand the roadway width by the amount needed for the TWLTL,
2. eliminating existing buffer areas behind curbs and reconstructing curb and gutter and existing sidewalks,
3. eliminating existing parking lanes,
4. eliminating or reducing the width of existing shoulders and ditches,
5. reducing the width of existing through lanes, and/or
6. reducing the number of existing through lanes.

The designer will have to seriously evaluate the trade-offs between the benefits of the TWLTL and the negative impacts of eliminating or reducing the width of the existing cross section elements. This may involve a capacity analysis or an in-depth evaluation of the existing accident history.

Intersection Treatment

At all intersections with public roads, the TWLTL must either be terminated in advance of the intersection to allow the development of an exclusive left-turn lane or be extended up to the intersection. Where the TWLTL is extended up to the intersection, the pavement markings will switch from two opposing left-turn arrows to one left-turn arrow only, where justified by traffic volumes. When determining the intersection treatment, consider the following:

1. Signals. At signalized intersections, the TWLTL should be terminated because these intersections will typically warrant an exclusive left-turn lane. At unsignalized intersections, the TWLTL may be extended through the intersection if an exclusive left-turn lane is not justified.

2. Turning Volumes. The left-turn demand into the intersecting road is a factor in determining the proper intersection treatment. As general guidance, if the minimum storage length will govern, it will probably be preferable to extend the TWLTL up to the intersection (i.e., provide no exclusive left-turn lane). See Chapter Twenty-eight of the *Traffic Engineering Manual* for information on the design of exclusive left-turn lanes.

3. Length of TWLTL. The TWLTL should have sufficient length to operate properly. A TWLTL can be interrupted by the need to provide specific left-turn treatments at public intersections and high-volume approaches. This may still allow room to accommodate mid-block access between these left-turn treatments.

   In rural areas, the overall length must be given serious review. On two-lane roadway, a TWLTL may encourage inappropriate passing when carried for extensive distances.

4. Operational/Safety Factors. Extending the TWLTL up to an intersection could result in operational or safety problems. Some drivers may, for example, pass through the intersection in the TWLTL and turn left just beyond the intersection into an approach which is very close to the intersection (e.g., within 30’ (10 m)). If operational or safety problems are known or anticipated at an intersection, it may be preferable to remove the TWLTL prior to the intersection (i.e., provide an exclusive left-turn lane).

11.2.5 Parking Lanes (On-Street Parking)

11.2.5.1 Guidelines

Adjacent land use may create a demand for on-street parking along an urban street. Parking lanes provide convenient access for motorists to businesses and residences. However, on-street parking reduces capacity, impedes traffic flow and increases the crash potential. It may also produce undesirable traffic operations.

The decision to retain existing on-street parking or to introduce on-street parking will be based on a case-by-case assessment in cooperation with the local community. Evaluate the following factors:

1. prior accident experience or potential safety concerns;
2. impacts on the capacity of the facility;
3. current or predicted demand for parking;
4. actual needs versus existing number of spaces;
5. alternative parking options (e.g., off-street parking);
6. input from local businesses;
7. impacts on right-of-way;
8. impacts on bicyclists and pedestrians;
9. accessibility for disabled individuals;
10. construction costs; and
11. projected traffic volumes.

If parking is restricted, the criteria in Section 18.2.8 in Part III of the *Traffic Engineering Manual* will apply.

11.2.5.2 Types

The two basic types of on-street parking are parallel and angle parking. Parallel parking is the preferred arrangement when street space is limited and traffic capacity is a major factor. Angle parking provides more spaces per linear foot (meter) than parallel parking, but a greater cross street width is necessary for its design. The total entrance and exit time for parallel parking exceeds that required for angle parking. Parallel parking also requires a vehicle to stop in the travel lane and await an opportunity to back into the parking space. However, angle parking requires the vehicle to back into the lane of travel when sight distance may be restricted by adjacent parked vehicles and where this maneuver may surprise an approaching motorist.

The following summarizes MDT practice on the selection of parking lane type:

1. General. Parallel parking is preferred to angle parking.

2. Existing Angle Parking. The order of preference for treating existing angle parking is:

   a. eliminate,
   b. convert to parallel parking,
   c. change the angle, or
   d. leave as is.

   The Department will consult with the local community before selecting an option.

   A local authority may by ordinance permit angle parking on a roadway, except that angle parking will not be permitted on any Federal-aid or State highway unless the Department determines that the roadway is of sufficient width to permit angle parking without interfering with the free movement of traffic.

3. New Parking. Where on-street parking will be introduced, only parallel parking will be acceptable.

11.2.5.3 Design

The following summarizes MDT design criteria for on-street parking:

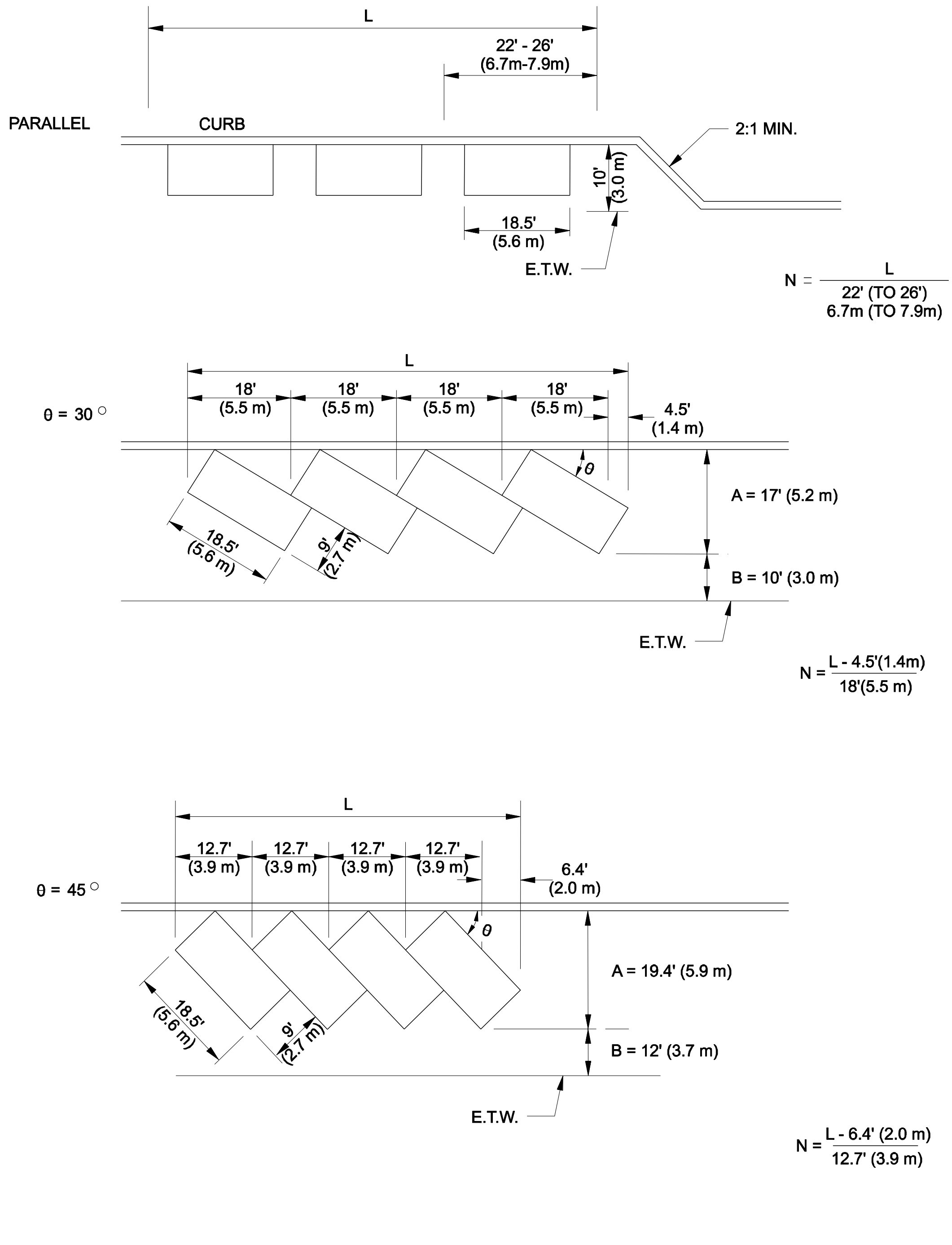
1. Stall Width. All parallel parking stalls will be 10' (3.0 m) wide. For parallel parking, stall widths are measured from the edge of traveled way to the face of curb. For angle parking, stall widths will generally be 9' (2.7 m).

2. Stall Layout. Figure 11.2A provides the layout criteria for parking stalls for various configurations. The figure also indicates the number of stalls which can be provided for each parking configuration for a given curb length. For angle parking, desirably, the roadway width allocated to parking will be the sum of "A" and "B" as shown in Figure 11.2A exclusive of the through travel lane. Distance "B" is that width needed by a parked vehicle to back onto the street when exiting the stall. However, in restricted areas a portion of the "B" dimension may be required for the through travel lane, thereby reducing the roadway width allocated to angle parking.

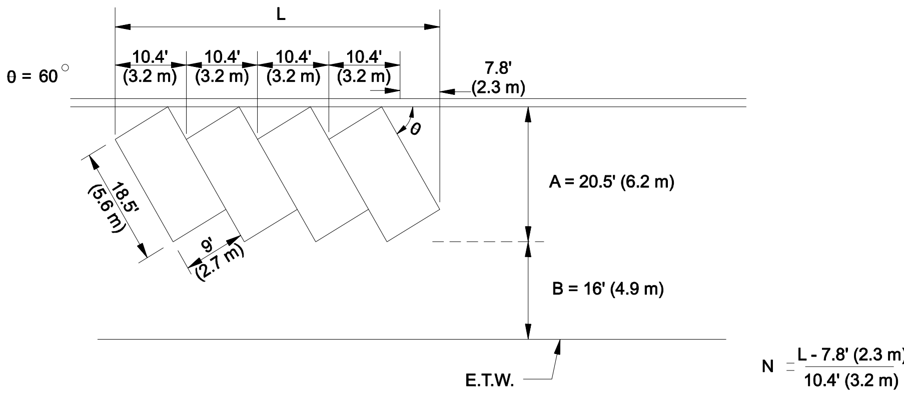
3. Cross Slope. The cross slope of the parking lane should match that of the adjacent through travel lane, typically 2%. However, exceptions are allowed for

cross slopes between 1% and 4% to fit actual field conditions. The slope of the parking lane may not be flatter than that of the adjacent through lane.

4. Accessibility for Disabled Individuals. Where on-street is permitted, a certain number of parking spaces must be provided for accessibility for the disabled, and their design must meet the accessibility design criteria. See Section 18.1 for specific information.



CURB PARKING CONFIGURATIONS
Figure 11.2A



Key: L = given curb length with parking spaces

N = number of parking spaces over distance L

A = required distance between face of curb and back of stall, assuming that bumper of parked car does not extend beyond curb face. In restricted locations, it can be assumed that the car will move forward until its tire contacts the curb. Ensure adequate sidewalk width is available for ADA requirements. In these cases, the "A" distances in the figure may be reduced as follows:

Angle of Parking	Reduction in "A"
30°	1.3’ (0.4 m)
45°	2.0’ (0.6 m)
60°	2.3’ (0.7 m)

B = minimum clear distance needed for a parked vehicle to back out of stall while just clearing adjacent parking vehicles.

E.T.W. = Edge of Traveled Way

CURB PARKING CONFIGURATIONS
(Continued)
Figure 11.2A

5. Intersection Curb Radii. Parking may need to be restricted a certain distance from intersections to allow the design vehicle (typically a WB-67(WB-20 metric)) to properly negotiate the right turn. See Section 28.3 of the *Traffic Engineering Manual* for specific information.

6. Location. For most sites, conduct a parking occupancy turnover study and a site distance evaluation. In addition to State and local regulations, when locating parking spaces consider the following:

   a. Prohibit parking within 20' (6 m) of any crosswalk.

   b. Prohibit parking at least 10' (3 m) from the beginning of the curb radius at mid-block approaches.

   c. Prohibit parking within 50' (15 m) of the nearest rail of a railroad/highway crossing.

   d. Prohibit parking from areas designated by local traffic and enforcement regulations (e.g., near school zones, fire hydrants). See local ordinances for additional information on parking restrictions.

   e. Prohibit parking near bus stops (see Chapter Eighteen).

   f. Prohibit parking within 30' (9 m) on the approach leg to any intersection with a flashing beacon, stop sign or traffic signal.

   g. Prohibit parking on bridges or within a highway tunnel.

   h. Eliminate parking across from a T- intersection.

11.2.5.4 Off-Street Parking

For design guidance of off-street parking, see Section 31.4.2 of the *Traffic Engineering Manual*.

11.2.6 Curbs and Curbed Sections

11.2.6.1 Usage

Curbs are often used on urban facilities to control drainage, delineate the pavement edge, channelize vehicular movements, control access, limit right-of-way needs, provide separation between vehicles and pedestrians and present an attractive appearance. Curbs are not used in rural areas. For urban and suburban areas, selecting a curbed section or uncurbed section depends upon many variables, and the decision will be made on a case-by-case basis. Evaluate the following factors to determine whether or not a curbed section is preferred:

1. local preference;
2. drainage impacts;
3. construction costs;
4. impacts on maintenance operations;
5. roadside safety impacts (see Chapter Fourteen);
6. sidewalk guidelines (see Section 11.2.7);
7. control of access to abutting properties;
8. impacts on traffic operations (e.g., vehicular channelization at intersections);
9. right-of-way restrictions; and
10. vehicular speeds (e.g., the use curbs is not preferred where V>45 mph (V>70 km/h)).

11.2.6.2 Curb Types/Details

Where a curbed section is required, the Department uses concrete curb exclusively. Typically, the curb will be a mountable sloped shape. This applies to both outside curbs and curbs used for raised medians. See the *MDT Detailed Drawings* for specific details of those curbs used by the Department.

11.2.6.3 Accessibility for the Disabled

Curbs must be designed with curb ramps at all pedestrian crosswalks to provide adequate access for the safe and convenient movement of physically disabled individuals. See Chapter Eighteen for details on the design and location of curb ramps.

11.2.7 <u>Sidewalks</u>

11.2.7.1 Guidelines

The following guidance will help determine the need for sidewalks in the project design:

1. <u>Sidewalks Currently Exist (Roadway or Bridge)</u>. Where sidewalks currently exist along a roadway, the sidewalk will normally be replaced. If a bridge with an

existing sidewalk is replaced or rehabilitated, the sidewalk will normally be replaced.

2. Sidewalks Currently Do Not Exist (Roadway). The need for sidewalks will be determined on a case-by-case basis in cooperation with the local community. In general, the designer should consider providing sidewalks along any roadway where pedestrians normally move or would be expected to move if they had a sidewalk available (i.e., a latent demand exists). In addition, sidewalks may be required at specific sites even if they are not needed along the entire length of the roadway. These include points of community development (e.g., schools), local businesses, shopping centers and industrial plants that result in pedestrian concentrations along the highway.

   If curb and gutter are included in the roadway section, the need for sidewalks should be evaluated. This evaluation is especially critical in developing transition areas between rural and urban areas. The decision and supporting rationale should be documented.

3. Bridge Without Sidewalk/Roadway With Sidewalk. If a bridge without a sidewalk will be replaced or rehabilitated and if existing sidewalks approach the bridge, a sidewalk will normally be included in the bridge project. Even if not currently on the approaching roadway, sidewalks may still be necessary on the bridge if the approach roadway is a candidate for future sidewalks according to the discussion in Comment # 2.

   As a more general statement of MDT policy, bridge projects within urban areas will have a sidewalk where pedestrians are legally allowed, unless there is a compelling reason not to provide a sidewalk. In addition, bridges at interchanges near urban areas should normally include sidewalks to accommodate the commercial development that typically occurs in the immediate vicinity of interchanges.

4. Sidewalks Currently Do Not Exist (Underpasses). An underpass may be within the limits of a project. If the approach roadway will have sidewalks, these will be provided through the underpass, unless this would involve unreasonable costs to relocate the bridge substructure.

   A bridge reconstruction project may involve major work on or the replacement of the bridge substructure. If the bridge passes over a roadway, the bridge should allow space for the future addition of sidewalks through the underpass based on the eventual need for sidewalks on the roadway approaching the underpass.

5. One Side vs. Two Sides. Sidewalk requirements for each side of the roadway or bridge will be evaluated individually; i.e., placing a sidewalk on each side will be based on the specific characteristics of that side.

6. Approval. For all projects in urban areas, the final decision on sidewalk requirements will be made by the Highways Engineer. This applies to the roadway, bridges and underpasses.

11.2.7.2 Sidewalk Design Criteria

In determining the sidewalk design, the designer should consider the following:

1. Typical Widths. The typical sidewalk width is 5' (1.6 m), as measured from the back of the curb. Also, carefully consider compatibility with local city and community criteria during design.

2. Appurtenances. The designer should also consider the impacts of roadside appurtenances within the sidewalk (e.g., fire hydrants, parking meters, utility poles, signs). These elements will reduce the effective width because they interfere with pedestrian activity. Preferably, place these appurtenances behind the sidewalk. If they are placed within the sidewalk, the sidewalk should have a minimum clear width of 3' (915 mm); desirably, a 5' (1500 mm) clear width will be available. The clear width will be measured from the edge of the appurtenance to the edge of the sidewalk. The 3' (915 mm) minimum is necessary to meet the disabled accessibility requirements (see Section 18.1).

3. Central Business District (CBD) Areas. The entire area between the curb and building is often fully used as a paved sidewalk. Check with local agencies for potential encroachments under sidewalks.

4. Cross Slope. The maximum cross slope on the sidewalk is 2% sloped towards the roadway.

5. Buffer Areas. If the available right-of-way is sufficient, buffer areas between the curb and sidewalk are desirable. The buffer area should be at least 2' (600 mm) wide to be effective and, if practical, wider.

6. Pavement Material. Sidewalks will be concrete.

7. Bridges. The Bridge Bureau is responsible for the dimensioning and structural design of all sidewalks on bridges.

11.2.7.3 Pedestrian Rails (on Bridges)

If a sidewalk is placed on a bridge, it may be warranted to provide the standard bridge rail to separate the vehicular traffic from pedestrians and then use a pedestrian rail on the outside edge of the sidewalk. Consider the need for a separate pedestrian rail on a case-by-case basis. Evaluate the following factors:

1. design speed;
2. pedestrian volumes;
3. traffic volumes;
4. accident history;
5. geometric impacts (e.g., sight distance);
6. practicality of providing proper end treatments;
7. construction costs; and
8. local preference.

If a bridge with a sidewalk is on a designated bike route or experiences heavy bicycle traffic, the railings, barriers, etc., must be a minimum of 4.5’ (1.4 m) high. In addition, barriers should have smooth rub rails at a 3.5’ (1.1 m) height. The Bridge Bureau will be responsible for the final decision on when to use a pedestrian rail in combination with the standard bridge rail. Due to the steepness of the roadway inslopes near the bridge ends we recommend that the pedestrian rail extend at least 25’ (7.5 m) beyond the end of the bridge. The need to extend the rail and the length of the extension should be determined at the Plan-in-Hand.

11.2.8 Paved Walkways

Paved walkways are typically constructed adjacent to facilities without curb and gutter, with a minimum 3’ (1 m) buffer area, for use by pedestrians. Paved walkways may be constructed in conjunction with a curb and gutter roadway section where the walkway is established for recreational use and is designed as part of the overall landscaping. Provide a buffer area of at least 3’ (1 m) wide between the walkway and the back of curb. The guidelines for paved walkways are the same as those for sidewalks (see Section 11.2.7.1). The following will apply to the design of paved walkways:

1. Typical Width. The minimum paved width is 6’ (2.0 m). A minimum 8’ (2.4 m) width is recommended if bicycle use is anticipated.

2. Appurtenances. Do not place appurtenances within a paved walkway.

3. Cross Slope. Slope the walkway at 2% to drain (i.e., it may be sloped in either direction as determined by field conditions).

4. Separation. The separation between the roadway and the paved walkway should be as wide as practical.

5. Pavement Material. Paved walkways will typically be bituminous.

6. Bridges. The paved walkway must be transitioned back to the bridge, unless a separate, adjacent bridge is provided. The Bridge Bureau is responsible for designing the bridge to accommodate the walkway across the bridge.

7. Bicycle Paths. Where walkways will be used as bicycle paths, see Section 18.2 and the *AASHTO Guide for the Development of Bicycle Facilities*.

11.3 MEDIANS

11.3.1 Functions

A median is defined as the portion of a divided highway separating the two traveled ways for traffic in opposing directions. The principal functions of a median are:

1. to provide separation from opposing traffic,
2. to prevent undesirable turning movements,
3. to provide an area for deceleration and storage of left-turning vehicles,
4. to provide an area for storage of vehicles for emergency stopping,
5. to facilitate drainage collection,
6. to provide a recovery area for run-off-the-road vehicles,
7. to provide an area for pedestrian refuge, and
8. to provide width for future lanes.

11.3.2 Median Types

Section 11.7 provides typical sections for various median types.

11.3.2.1 Flush Medians

Flush medians are often used on urban highways and streets. The typical width for a flush median ranges from 4' (1.2 m) to 16' (5.0 m). They are paved and striped for delineation. Flush medians are appropriate for traffic volumes less than 20,000 ADT and, under favorable conditions, can provide adequate service for traffic volumes up to 30,000 ADT.

To provide proper drainage, flush medians are typically crowned in the center with a cross slope of 2% in either direction.

One potential disadvantage of flush medians is that they do not effectively deter cross-median vehicular movements. If this is perceived as a problem, provide a raised median. See Section 11.3.2.2.

Two-way left-turn lanes (TWLTL) are also considered flush medians. Desirably, the roadway cross section with a flush median will allow ultimate development for a TWLTL in urban/suburban areas. Section 11.2.4 provides information on design details for a TWLTL.

11.3.2.2 Raised Medians

A median is defined as a raised median if it contains a raised portion within its limits. Raised medians may be used on urban and suburban highways and streets to control access and left turns. The use of raised medians is not recommended adjacent to high-speed lanes (V > 45mph(70 km/h)).

Advantages

When compared to flush medians, raised medians offer several advantages:

1. Mid-block left turns are controlled.
2. Left-turn channelization can be more effectively delineated.
3. A distinct location is available for traffic signs, signals and pedestrian refuge.
4. Limited physical separation is available.
5. Uncontrolled cross-traffic movements are prevented.
6. Reduce the potential for head-on collisions.

Disadvantages

The disadvantages of raised medians when compared to flush medians are:

1. Access for emergency vehicles (e.g., fire, ambulance) may be more difficult.
2. Prohibiting mid-block left turns may overload street intersections and may increase the number of U-turns. They also may impact other streets in the corridor.
3. They may need greater roadway widths to serve the same function (e.g., left-turn lanes at intersections) because of the raised island and offset between curb and travel lane.
4. Curbs may result in adverse vehicular behavior upon impact.
5. They are more expensive to construct and more difficult to maintain.
6. Prohibiting mid-block left-turns causes drivers to take alternative access routes to and from adjacent properties.

Design

If a raised median will be used, consider the following in the design of the median:

1. Curb Type. Mountable concrete curbs are used for raised medians.

2. Width. The width of a raised median is measured from the two inside edges of the traveled ways and, therefore, includes the median shoulders. The typical median width of 20’ (6.0 m) provides for:

    a. a 2’ (0.6 m) offset from the through lane edge to face of curb on each side of the raised median (median shoulder), and

    b. a 16’ (4.8 m) raised median from face to face of curb.

    The width of the median should be of sufficient width to allow for the development of a channelized left-turn lane. Where the raised median exceeds 16’ (4.8 m), the designer should center the opposing lanes about each other or, if practical, provide offset left-turn lanes. This will enhance the ability of a left-turning vehicle to see around the opposing left-turning vehicle.

    A 20’ (6.0 m) median is the minimum desirable width in which a left-turn lane can be developed with raised median. See Chapter 12 for absolute minimum dimensions. The 20’ (6.0 m) width will provide for:

    a. a 12’ (3.6 m) left-turn lane,

    b. a minimum 4’ (1.2 m) raised portion of the median, and

    c. a 2’ (0.6 m) offset between the opposing traveled way and the raised portion of the median.

3. Surfacing. The raised portion of the median is usually paved with concrete. Alternate treatments such as landscaping should be determined at or before the plan-in–hand.

4. Lighting. Where raised medians are used, the roadway must be lighted and the medians must be delineated.

Existing

Evaluate all existing raised medians within the project limits for their current appropriateness. The existing configuration of the raised median should be evaluated with its consistency to the existing geometric needs. This includes sight distance for the left-turn bays, storage lengths and turning paths for vehicles entering and exiting the roadway.

11.3.2.3 Depressed Medians

A depressed median is typically used on freeways and other divided rural arterials. Depressed medians typically have good drainage characteristics and, therefore, are preferred on major highways.

Depressed medians should be as wide as practical to allow for the addition of future travel lanes on the inside while maintaining a sufficient future median width. The minimum width is 36’ (11.0 m). This allows the development of a depressed median with 6:1 side slopes and a ditch with sufficient depth to accommodate the water runoff. The maximum width for a depressed median is approximately 75’ (23.0 m). Beyond this, the two roadways of the divided facility are typically placed on independent alignments.

The center longitudinal slope of a depressed median should be a minimum of 0.2%.

11.3.3 Median Openings

The evaluation for median openings in raised medians should be based on the type of intersecting facility and design considerations at the candidate site. These are discussed in the following sections.

11.3.3.1 Intersecting Facility

Median openings are provided on all divided highways with partial control of access or control by regulation provided that the openings are sufficiently spaced. Median openings are appropriate:

1. at most dedicated public streets (site specific),
2. for U-turn movements on long sections of a continuous raised median, or
3. at approaches serving major traffic generators.

Examples of major traffic generators include major shopping centers and special event facilities with several events per month. Small shopping plazas or single businesses are not considered major traffic generators.

11.3.3.2 Design Considerations

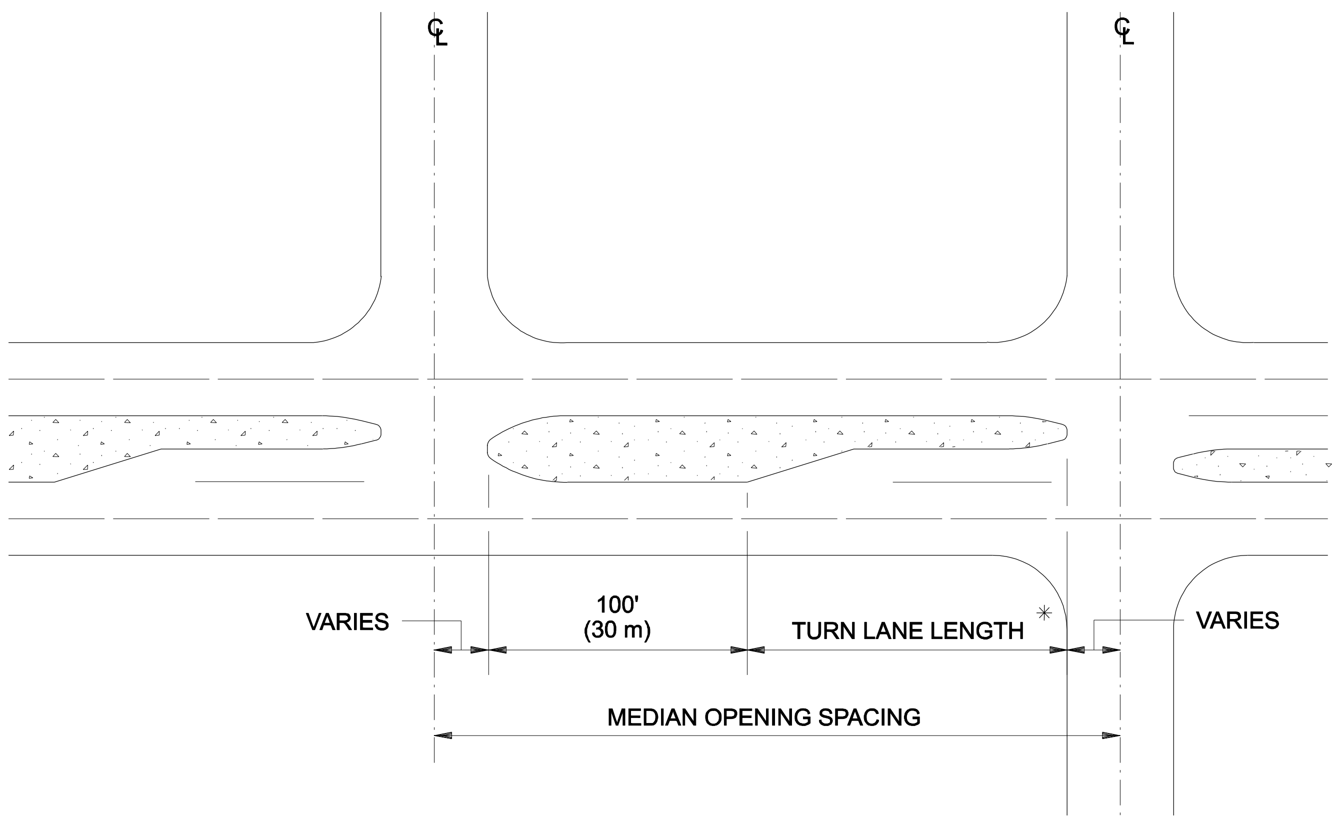
Median openings should be consistent with the following design considerations:

1. Signal Coordination. Median openings (both signalized and unsignalized) must not impair the traffic signal coordination of the overall facility.

2. Sight Distance. Do not locate median openings in areas of restricted sight distance (e.g., on a horizontal curve or near the apex of a crest vertical curve). Section 13.4 discusses the minimum intersection sight distances that should be available at a median opening.

3. Turn-Lane Length. Median openings should only be provided if the full length of a left-turn lane can be provided and if the beginning of the turn lane taper is at least 100’ (30 m) from the median nose of the previous intersection. See the schematic in Figure 11.3A. The length of the left-turn lane will be determined by the criteria in Section 28.4.2 of the *Traffic Engineering Manual*.

4. Minimum Spacing. In no case may the number of median openings exceed three per 1000’ (300 m).



* See Chapter Twenty-eight of the *Traffic Engineering Manual* for turn-lane lengths.

RECOMMENDED MEDIAN OPENING SPACING
(Raised Medians)
Figure 11.3A

11.4 SIDE SLOPES

Section 11.7 presents typical sections for side slopes for various highway types. Chapter Twelve presents specific criteria for fill slopes and ditch configurations in earth cuts. The following briefly discusses side slopes in general.

11.4.1 Fill Slopes

Fill slopes are the slopes extending outward and downward from the hinge point to intersect the natural ground line. The slope criteria depend upon the functional classification, fill height, urban/rural location and the presence of curbs. Although Chapter Twelve provides typical criteria for fill slopes, the designer must also consider right-of-way restrictions, utility considerations, roadside safety and roadside development in determining the appropriate fill slope for the site conditions.

11.4.1.1 Barn-Roof Sections

A barn-roof slope will provide a slope 4:1 or flatter (6:1 or flatter is desirable) to the clear zone distance. A steeper fill slope will be constructed from the edge of the clear zone to the intersection with natural ground. The barn-roof section can be used to avoid conflicts with natural or man-made features and to reduce the amount of right-of-way acquisition. However, the use of a barn roof section will require a design exception unless both slopes are equal to or flatter than the required slope for the given fill height.

11.4.1.2 Maximum Fill Slope

As indicated in Chapter Twelve, the maximum fill slope should in general be 3:1 for fill heights less than 30’ (9 m). A 3:1 slope is a practical maximum when considering maintenance operations (e.g., mowing), erosion control and roadside safety. A slope steeper than 3:1 may require a roadside barrier (see Chapter Fourteen).

11.4.2 Cut Slopes

11.4.2.1 Earth Cuts

In earth cuts on facilities without curbs, roadside ditches are provided to control drainage. The ditch section includes the inslope, ditch width and back slope as appropriate for the facility type. On facilities with curbs and no sidewalks, a shelf (3’ (1

m) typical measured from the back of curb) is provided, and the back slope is located beyond the shelf. See the typical sections in Section 11.7.

The following will apply to earth cuts:

1. Snow Drifting. One of the following two methods can be used to control snow drifting in cuts.

    a. Design the back slope so that an imaginary line between the finished shoulder and the top of the cut (intersection with natural ground) has a slope of 11:1 or flatter.

    b. Increase the width of the flat-bottomed ditch to provide additional snow storage. Used the method described in the Strategic Highway Research Program's *Design Guidelines for the Control of Blowing and Drifting Snow* to determine the necessary width of the ditch.

2. Superelevated Sections. On superelevated sections, a 6:1 side slope on the high side of the section will extend outward and downward from the subgrade shoulder a sufficient distance such that the distance from the centerline of the pavement (or traveled way for sections with depressed medians) to the end of the 6:1 side slope is the same as the distance from the centerline of the pavement to the subgrade shoulder on the tangent section. As with the break in the subgrade cross slope, the use of the extended 6:1 slope will maintain the ditch offset distance, avoid depressions in ditch grades and aid in the field staking of the subgrade. See the typical sections in Section 11.7 for an illustration.

3. Daylighting. Daylighting slopes can provide several benefits, including:

    a. enhancing aesthetics,
    b. enhancing roadside safety,
    c. providing needed fill material,
    d. removing undesirable features,
    e. obliterating existing roadbeds, and
    f. providing convenient outfall points for roadside drainage.

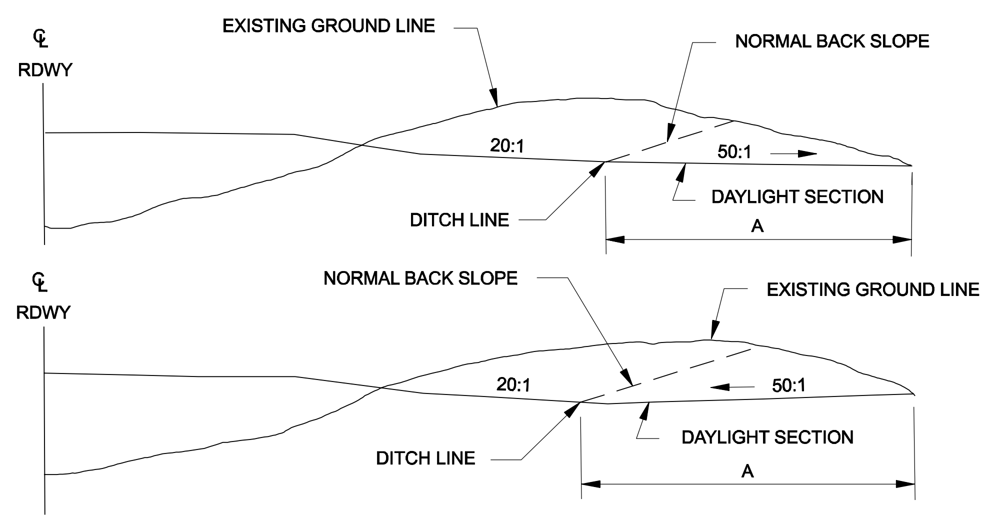
    Figure 11.4A illustrates how to daylight slopes. A 50:1 slope is typically used either away from or towards the ditch line, as appropriate. The dimension "A" in the figure refers to the lateral distance needed to excavate to daylight a slope. Whether a given site should be daylighted, based on "A", will be determined on a case-by-case basis.

Note that daylighting should not be used if it results in the need for a traffic barrier.

4. Back Slope Rounding. Utilize the standard back slope rounding detail that results in a construction limit that is 2 meters beyond the back slope catch point regardless of the back slope. Back slope rounding is not measured for payment. The cost of the rounding is included in the unit price bid for Unclassified Excavation. The rounding will be shown on the final cross sections.

   If it is determined that additional R/W is needed to accommodate utilities or furrow ditches or to address slope stability, a formal request to increase the R/W width at the top of specific cuts needs to be submitted to the Right-of-Way Bureau after the Plan-in-Hand review has been held and before the submission of final construction limits.

5. Geotechnical Investigations. Back slopes steeper than 3:1 should be reviewed for stability by the Geotechnical Section.



DAYLIGHTING
Figure 11.4A

11.4.2.2 Rock Cuts (Back Slopes)

The back slope through rock cut sections will be determined by the Geotechnical Section based on its field investigation. At a maximum, the back slope typically will not exceed 0.25:1. For large cuts, benching of the back slope may be required.

11.4.2.3 Roadside Safety

To safely accommodate a run-off-the-road vehicle, the slopes of the ditches should be as flat as practical. Chapter Fourteen presents specific criteria to determine the necessary inslope and back slope combinations which are traversable. In general, if the back slope of a non-traversable ditch section is within the clear zone, a roadside barrier will be warranted.

11.5 BRIDGE AND UNDERPASS CROSS SECTIONS

The roadway cross section must be carried over and under bridges, which often requires special considerations because of the confining nature of bridges and their high unit costs.

11.5.1 Bridges

Coordinate with the Bridge Bureau to determine widths on new and reconstructed bridges and on existing bridges to remain in place.

11.5.2 Underpasses

The approaching roadway cross section, including any auxiliary lanes, should be carried through the underpass. Sidewalks may also be necessary through the underpass. See Section 11.2.

When determining the cross section width of an underpass, the designer should also consider the likelihood of future roadway widening. Widening an existing underpass in the future can be extremely expensive and difficult. If the potential for future traffic growth and roadway expansion exists, the designer should evaluate the possibility providing additional width for the underpass. If appropriate, a reasonable allowance for future widening may be to provide sufficient lateral clearance for one additional lane in each direction.

11.5.3 Travelway Width Reductions

When approaching a narrow bridge or underpass, the travelway width may need to be reduced to allow the roadway to pass over or under a bridge. These travelway reduction transitions should be designed using the taper rates in Figure 11.5A.

The transition should be completed prior to the beginning of the approach rail, particularly when the approach rail consists of a bridge approach section and an optional terminal end section. For long runs of approach rail, the designer must determine if the length of rail can be reduced by locating the transition closer to the bridge.

Design Speed		Taper Rate
mph	km/m	
20	30	10:1
25	40	15:1
30	50	20:1
35	60	25:1
45	70	45:1
50	80	50:1
55	90	55:1
60	100	60:1
70	110	70:1
75	120	75:1

Note: Taper Length (L) = Taper Rate x Offset Distance

TAPER RATES FOR WIDTH REDUCTIONS
Figure 11.5A

11.6 RIGHT-OF-WAY

11.6.1 Definitions

The following definitions will apply:

1. Permanent R/W. Highway R/W acquired for permanent ownership by the State for activities which are the responsibility of the State for an indefinite period of time. The State obtains fee title to the property. Permanent R/W is typically acquired for the construction and maintenance of roads.

2. Permanent R/W Easements. A right for a specific purpose acquired by the State for the limited usage of property not owned by the State. Types of R/W easements include:

   a. maintenance easements,
   b. utility easements,
   c. storm sewer easements, and
   d. roadway easements.

3. Construction Permit. Temporary legal access acquired by the State, outside the permanent R/W boundaries, to construct the highway project according to its proper design but on property which is not owned by the State. See Section 11.6.4 for examples of construction permits. MDT will relinquish all rights to the permit upon completion of the contract.

4. Temporary Easement. R/W acquired for the legal right of usage by the State to serve a specific purpose for construction operations (e.g., storage of equipment). Once construction is completed, the State yields its legal right of usage and returns the land to its original condition as close as practical. If necessary, MDT has the authority to condemn property for a temporary easement.

5. Limited Access Control. Limiting access to a highway is used to maintain and protect the safety and operating capacity of the facility. It is accomplished by limiting the number of public and private approaches and allowing them only at certain locations along a given section of highway.

11.6.2 R/W Width (Typical MDT Policy)

11.6.2.1 General

The basic policy of the Department is to acquire right-of-way (R/W) of sufficient, but not excessive, width to accommodate construction and maintenance operations. Except as noted for overlay projects and construction permits, the minimum right-of-way width for all facilities will be the sum of the travel lanes, outside shoulders and median width (if applicable) plus the necessary width for fill and cut slopes or for roadside clear zones, whichever is greater, plus a border strip. See the following sections for specific criteria. Desirably, the R/W width will accommodate the anticipated ultimate development of the highway facility, if known.

The R/W width should be uniform, where practical. In urban areas, variable widths may be necessary due to existing development; varying side slopes and embankment heights may make it desirable to vary the R/W width; and, R/W limits will likely need to be adjusted at intersections and freeway interchanges. Other special R/W controls should be considered and should be coordinated between the R/W Design and Plans Section and the Road Design Section. These include:

1. In areas where the necessary R/W widths cannot be reasonably obtained, the designer may consider the advisability of using steeper slopes, revising grades or using retaining structures.

2. At horizontal curves and intersections, additional R/W may be warranted to ensure that the necessary sight distances are available in the future.

The designer will coordinate with the Right-of-Way Bureau on the design of R/W for highway projects.

11.6.2.2 Rural Areas

The following will apply to R/W widths in rural areas:

1. Application. These criteria apply to highways through low and medium value farm land, grazing land, forest land, etc. Areas of extremely high R/W costs, major improvements, historic sites, etc., must be analyzed individually and exceptions made where appropriate.

2. General. Except as noted in Sections 11.6.3 and 11.6.4, the permanent R/W in rural areas should be wide enough to include all elements of the highway cross

section plus an additional border strip from 10’ (3.0 m) to 20’ (6.0 m) in width to accommodate construction and maintenance equipment.

3. Minimum Widths. The minimum R/W width is 10’ (3 m) beyond the construction limits. The following standard R/W widths have been established as general criteria for rural areas when extremely high R/W cost is not a significant controlling factor:

   a. Interstate Projects. Facilities without frontage roads will have 80’ (25 m) minimum from the centerline of the nearest main roadway to the R/W line. Facilities with frontage roads or ramp roads will have 60’ (20 m) minimum from the center of the nearest roadway to the R/W line.

   b. Arterial Projects. These facilities will have 80’ (25 m) from the centerline of the nearest roadway to the R/W line or to the construction limits plus 10’ (3 m), whichever is greater.

   c. Collector Projects. These facilities will have 60’ (20 m) from the centerline of the nearest roadway to the R/W line or to the construction limits plus 10’ (3 m), whichever is greater.

4. Changes in Right-of-Way Widths (R/W Breaks). The following will apply:

   a. Except at property ownership lines, changes in R/W widths are typically made on a taper. Changes of 25’ (8 m) or less should be on a longitudinal transition taper of 4:1. A steeper taper may be used on width changes in excess of 25’ (8 m) or where special circumstances warrant.

   b. R/W widths should not be changed at property ownership lines unless the property line has been located and adequately tied to the highway survey such that its location is definite and defensible.

   c. The distance between R/W breaks should be a minimum of 500’ (150 m) unless it is entirely impractical to provide a uniform R/W width for this distance. The reasons for utilizing a shorter distance between breaks should be documented.

11.6.2.3 Urban Areas

Because of the restrictive conditions often encountered in urban areas, no rigid R/W widths can be established. Sound engineering judgment must be applied to obtain a logical balance among R/W costs, R/W impacts and R/W widths. Where practical, the following should be met:

1. Curbs. Urban R/W must be wide enough to accommodate the curb-to-curb width of the street plus a border strip on each side. Each border strip must be at least 8' (2.4 m) and, preferably, should be 12' (3.6 m) or more. The border strip is defined as the area between the curb and the R/W line.

2. Sidewalks. If a sidewalk will be constructed, the R/W limit should be at least 3' (1 m) beyond the sidewalk.

3. Construction Limits. In most cases, the minimum R/W width is to the construction limits plus 3' (1 m). Curb and gutter sections and the toe of fill slopes often use permits for construction.

4. Exceptions. As in rural areas, extremely high R/W costs, major improvements, historic sites, etc., may require exceptions.

11.6.3 Overlay and Widening Projects

Projects involving overlay and widening are constructed over the existing highway alignment, and construction limits normally will remain within the existing R/W. Where widening dictates the need for additional permanent R/W, the widths in Section 11.6.2 may be waived, and the minimum amount of new R/W needed may be acquired in fee. Where a minor amount of work must be accomplished outside the existing R/W, construction permits may be used as discussed in Section 11.6.4. The use of this approach is a subjective decision which should be addressed in the preparation of the scope of work and again at the preliminary field review.

11.6.4 Construction Permits

As land becomes more valuable and public criticism of land acquisition becomes more vocal, especially for the acquisition of cultivated lands, it is important to consider reasonable deviations from MDT typical procedure. However, the R/W will be designed showing the acquisition of all land within the construction limits. The decision to obtain a construction permit rather than acquire the property in fee will be made during the R/W negotiations process. In general, the following guidelines will apply to construction permits:

1. Approaches. Construction permits are required for the construction of approaches only if the work extends more than 50’ (15 m) beyond the permanent R/W.

2. Drainage. Construction permits may be used where inlet and outlet ditches from culverts or minor channel changes extend beyond the R/W width necessary to accommodate adjacent fill or cut slopes.

3. Non-Applicability. Culvert pipes, major structures, paved portions of roadways or streets, and other permanent roadway elements which will be maintained in connection with the roadway should be located on property on which the State has a permanent property right. Therefore, do not use construction permits for these permanent elements. In general, the permit areas should contain only the flattened cut and fill slope areas.

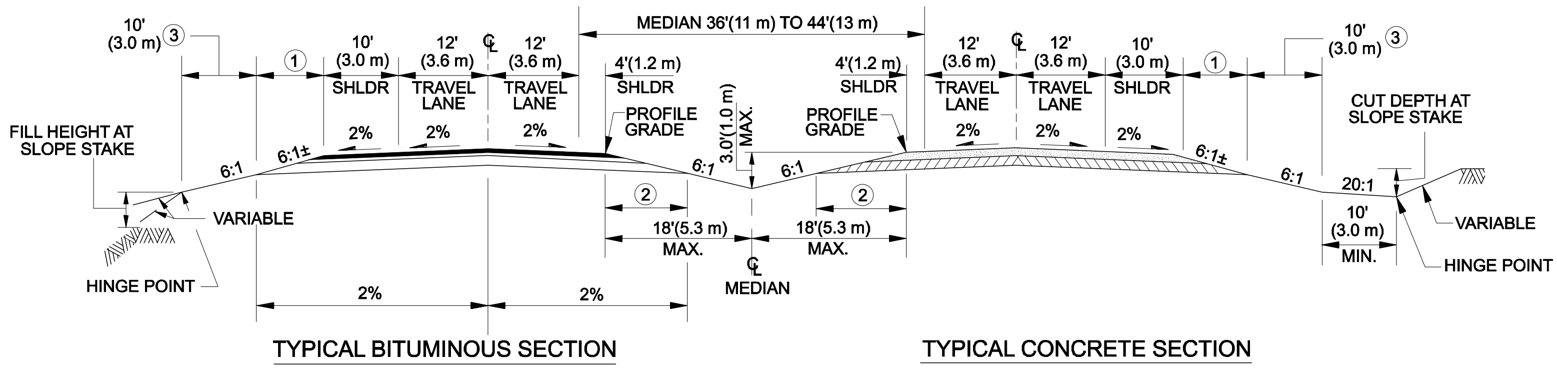
4. Fences. Because of the presence of livestock, a parcel may need to be fenced during construction. Acquisition in fee is preferred over construction permits because the cost of constructing a fence twice is typically greater than the value of the land.

5. Condemnation. MDT does not have the authority to condemn property for a construction permit. Therefore, if condemnation is required, areas covered by temporary construction permits must be changed to temporary easements.

11.7 TYPICAL SECTIONS

The following figures present typical sections which will apply to all projects. Chapter Twelve presents specific criteria which apply to various conditions. The typical section figures are:

1. Figure 11.7A"Typical Freeway Depressed Median Section (Tangent Section) (Medians 36' to 44' (11 m to 13 m))."
2. Figure 11.7B"Typical Freeway Depressed Median Section (Superelevated Section) (Medians 36' to 44' (11 m to 13 m))."
3. Figure 11.7C"Typical Freeway Depressed Median Section (Tangent Section) (Medians 44' to 76' (13 m to 23 m))."
4. Figure 11.7D"Typical Freeway Depressed Median Section (Superelevated Section) (Medians 44' to 76' (13 m to 23 m))."
5. Figure 11.7E"Typical Freeway Depressed Median Section (Tangent Section) (Medians 76' (23 m) and Over)."
6. Figure 11.7F"Typical Freeway Depressed Median Section (Superelevated Section) (Medians 76' (23 m) and Over)."
7. Figure 11.7G"Typical Freeway Flush Median Section (Tangent Section)."
8. Figure 11.7H"Typical Freeway Flush Median Section (Superelevated Section)."
9. Figure 11.7I"Typical Non-Freeway Flush Median Section (Tangent Section)."
10. Figure 11.7J"Typical Non-Freeway Flush Median Section (Superelevated Section)."
11. Figure 11.7K"Typical Raised Median Section (Tangent Section)."
12. Figure 11.7L"Typical Raised Median Section (Superelevated Section)."
13. Figure11.7M"Typical Two-Lane Rural Highway (Tangent Section)."
14. Figure 11.7N"Typical Two-Lane Rural Highway (Superelevated Section)."
15. Figure 11.7O"Typical Curbed Urban Street (Tangent Section)."
16. Figure 11.7P"Typical Curbed Urban Street (Superelevated Section)."
17. Figure 11.7Q"Off-System Rural Road (Tangent Section). "
18. Figure 11.7R"Off-System Rural Road (Superelevation Section)."



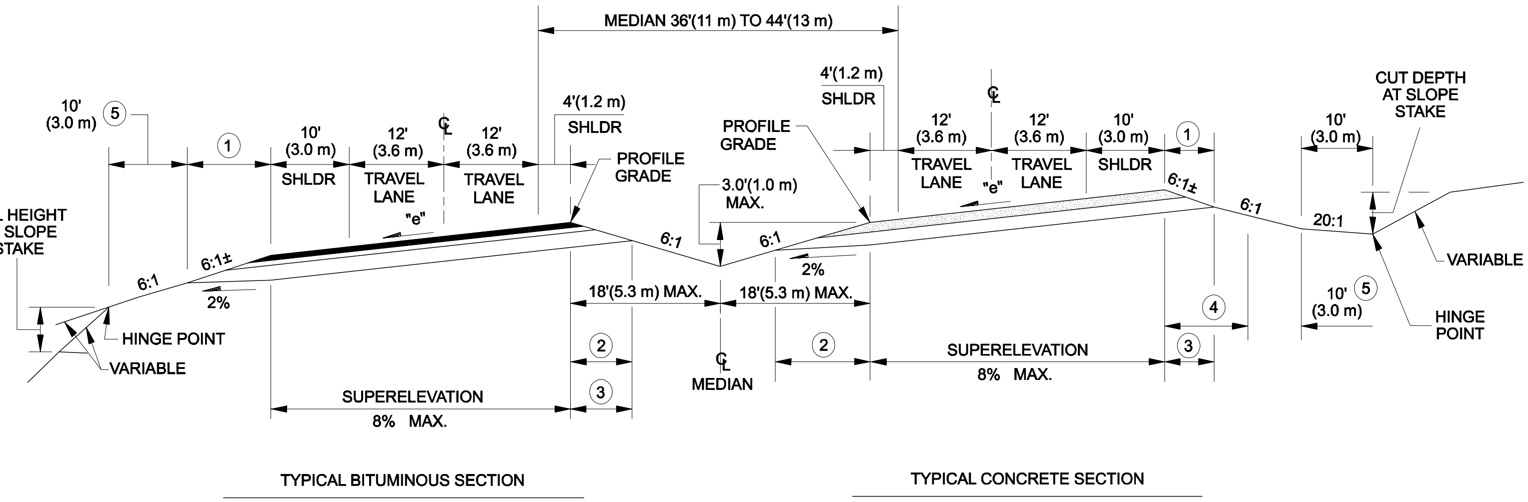
GENERAL NOTE: Dimensions in figure will typically apply. See Figure 12-2 "Geometric Design Criteria for Freeways" for specific cross section criteria for various conditions (e.g., for cut and fill slopes).

① Compute total width to nearest foot(0.1 meter). Compute intermediate surfacing widths to nearest 0.1 foot(0.01 meter).

② Compute distance to nearest 0.1foot(0.01 meter) based on a true 6:1 slope.

③ For rehabilitation projects, an existing 6' (1.8 m) width may be retained with documentation.

TYPICAL FREEWAY DEPRESSED MEDIAN SECTION (Tangent Section)
(Medians 36' (11 m) to 44' (13 m))
Figure 11.7A



GENERAL NOTE: Dimensions in figure will typically apply. See Figure 12-2 "Geometric Design Criteria for Freeways" for specific cross section criteria for various conditions (e.g., for cut and fill slopes). See Chapter Nine for details on superelevation.

① Compute total width to nearest foot(0.1 meter). Compute intermediate surfacing widths to nearest 0.1 foot (0.01 meter).

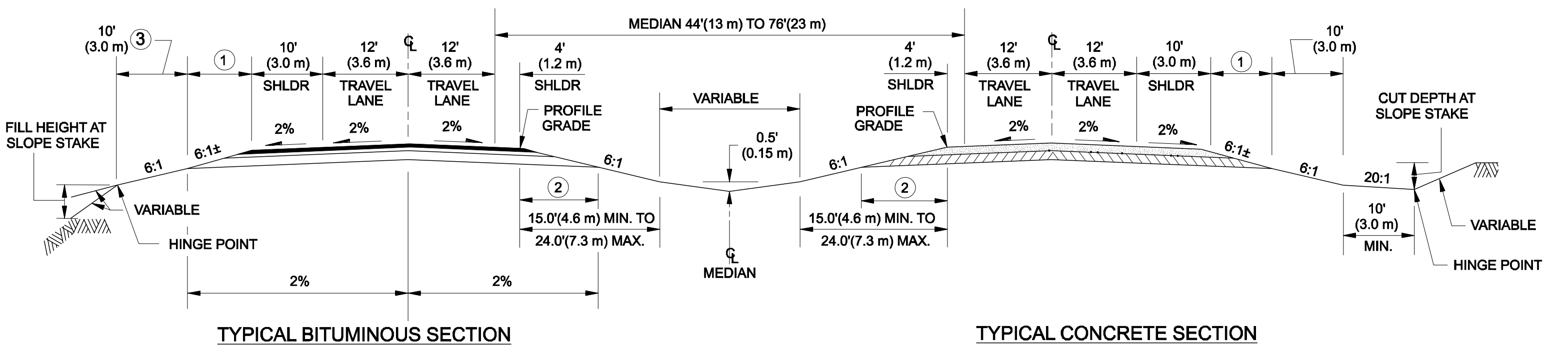
② Compute distance to nearest 0.1 foot(0.01 meter) based on a true 6:1 slope.

③ Compute distance for each superelevation on the project.

④ This distance will be equal to the ① distance on the tangent section (Figure 11.7A).

⑤ For rehabilitation projects, an existing 6’ (1.8 m) width may be retained with documentation.

TYPICAL FREEWAY DEPRESSED MEDIAN SECTION (Superelevated Section)
(Medians 36’ (11 m) to 44’ (13 m))
Figure 11.7B



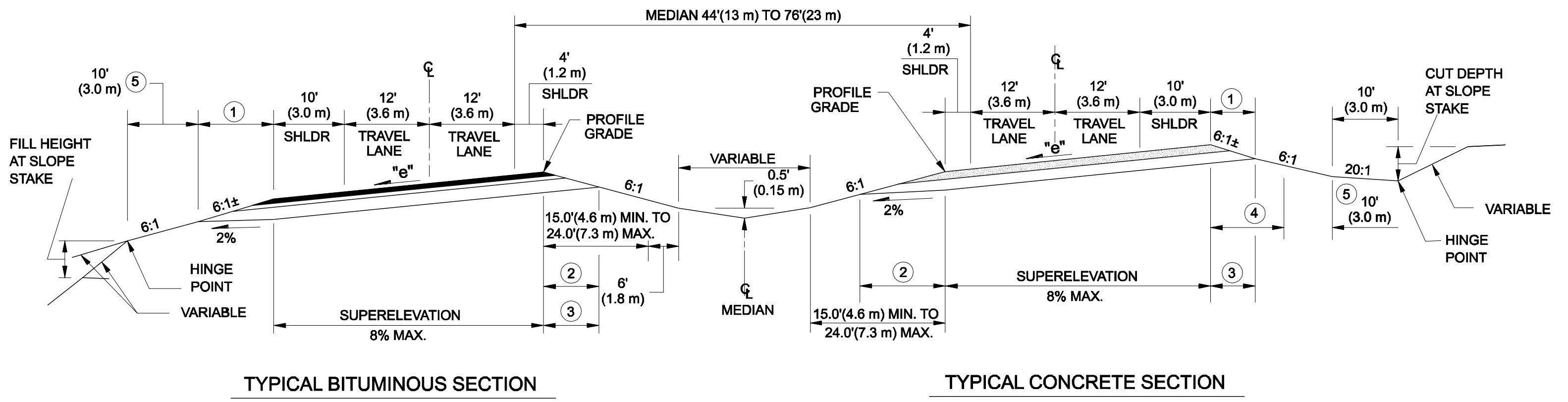
GENERAL NOTE: Dimensions in figure will typically apply. See Figure 12-2 "Geometric Design Criteria for Freeways" for specific cross section criteria for various conditions (e.g., for cut and fill slopes).

① Compute total width to nearest foot(0.1 meter). Compute intermediate surfacing widths to nearest 0.1 foot(0.01 meter).

② Compute distance to nearest 0.1 foot(0.01 meter) based on a true 6:1 slope.

③ For rehabilitation projects, an existing 6' (1.8 m)width may be retained with documentation.

TYPICAL FREEWAY DEPRESSED MEDIAN SECTION (Tangent Section)
(Medians 44' (13 m) to 76' (23 m))
Figure 11.7C



GENERAL NOTE: Dimensions in figure will typically apply. See Figure 12-2 "Geometric Design Criteria for Freeways" for specific cross section criteria for various conditions (e.g., for cut and fill slopes). See Chapter Nine for details on superelevation.

① Compute total width to nearest foot (0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot(0.01 meter).

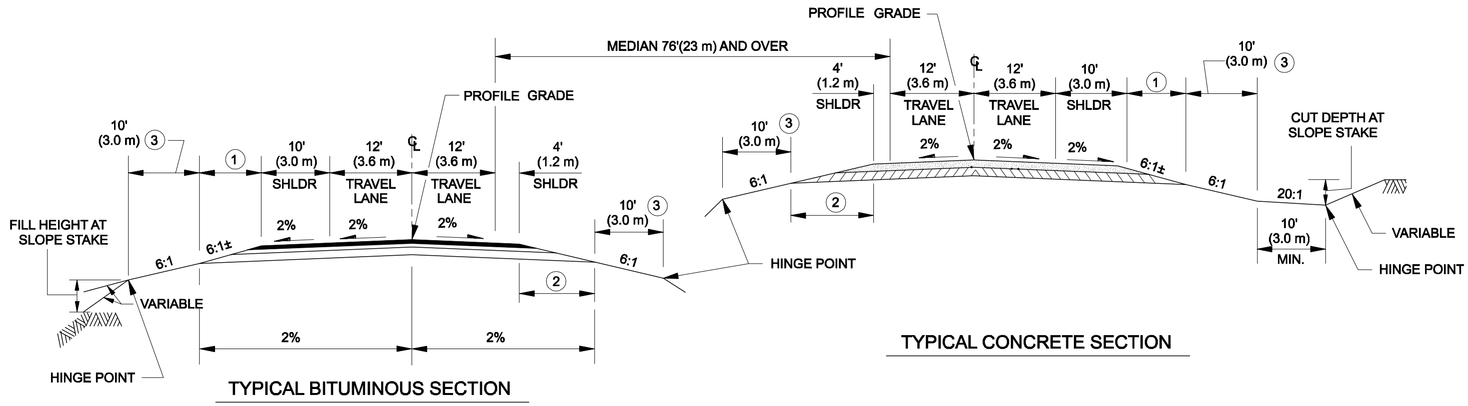
② Compute distance to nearest 0.1 foot (0.01 meter) based on a true 6:1 slope.

③ Compute distance for each superelevation on the project.

④ This distance will be equal to the ① distance on the tangent section (Figure 11.7C).

⑤ For rehabilitation projects, an existing 6’ (1.8 m) width may be retained with documentation.

TYPICAL FREEWAY DEPRESSED MEDIAN SECTION (Superelevated Section)
(Medians 44’ (13 m) to 76’ (23 m))
Figure 11.7D



GENERAL NOTES:

1. Dimensions in figure will typically apply. See Figure 12-2 "Geometric Design Criteria for Freeways" for specific cross section criteria for various conditions (e.g., for cut and fill slopes).

2. Generally, this typical section will be used only where terrain warrants the use of independent grade lines. Median slope intersections will be determined by the designer to meet individual conditions. In cases where median widths vary (from 36’ (11 m) to 76’ (23 m) and over) within a given project, the profile grade will be carried on the finished median shoulder.

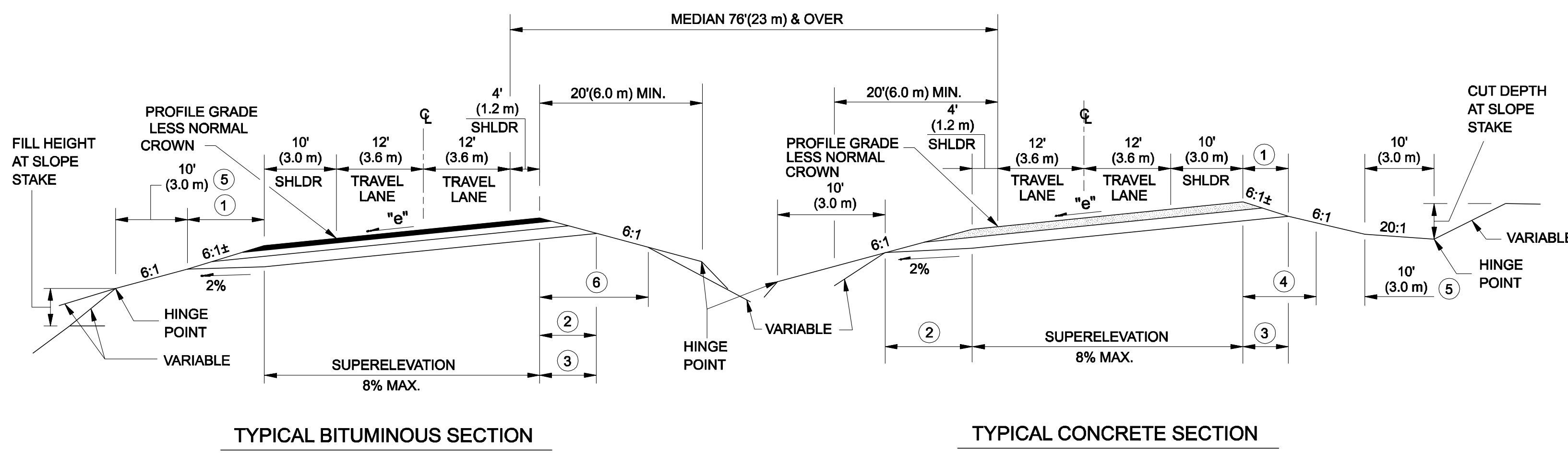
3. Where practical, natural growth in place between roadways should be preserved.

① Compute total width to nearest foot(0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot(0.01 meter).

② Compute distance to nearest 0.1 foot(0.01 meter) based on a true 6:1 slope.

③ For rehabilitation projects, an existing 6’ (1.8 m) width may be retained with documentation.

TYPICAL FREEWAY DEPRESSED MEDIAN SECTION (Tangent Section)
(Medians 76’ (23 m) and Over)
Figure 11.7E



GENERAL NOTE: Dimensions in figure will typically apply. See Figure 12-2 "Geometric Design Criteria for Freeways" for specific cross section criteria for various conditions (e.g., for cut and fill slopes). See Chapter Nine for details on superelevation.

① Compute total width to nearest foot (0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot(0.01 meter).

② Compute distance to nearest 0.1 foot (0.01 meter) based on a true 6:1 slope.

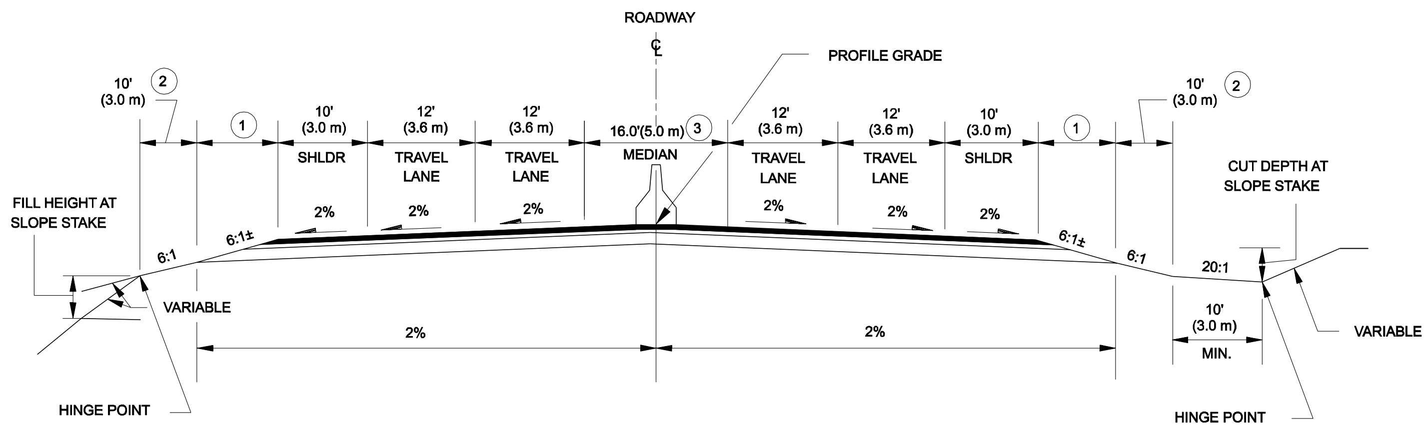
③ Compute distance for each superelevation on the project.

④ This distance will be equal to the ① distance on the tangent section (Figure 11.7E).

⑤ For rehabilitation projects, an existing 6' (1.8 m) width may be retained with documentation.

⑥ This distance will be equal to the ②,distance on the tangent section plus 10' (3.0 m).

TYPICAL FREEWAY DEPRESSED MEDIAN SECTION (Superelevated Section)
(Medians 76' (23 m) and Over)
Figure 11.7F



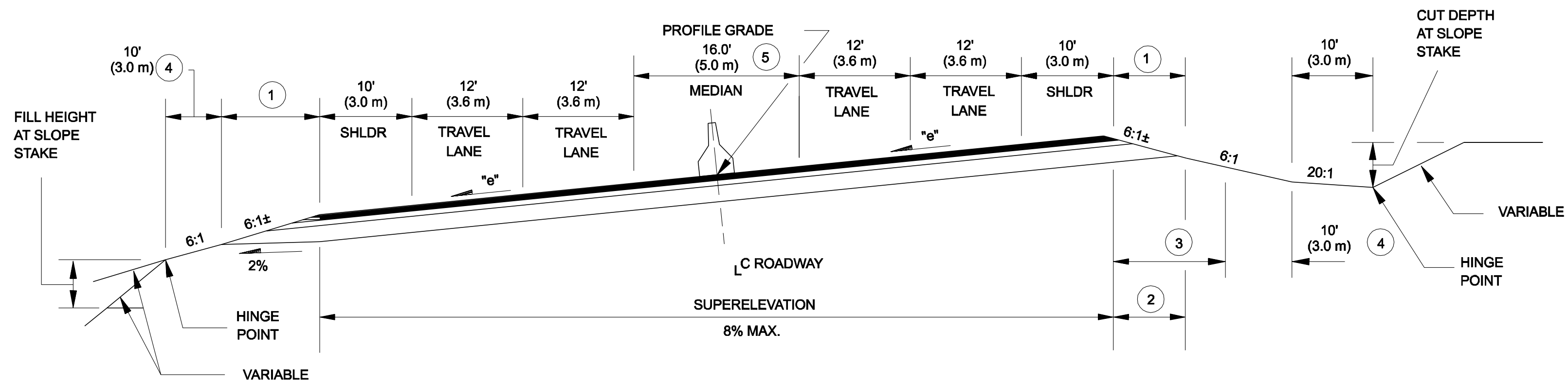
GENERAL NOTE: Dimensions in figure will typically apply. See Figure 12-2 "Geometric Design Criteria for Freeways" for specific cross section criteria for various conditions (e.g., for cut and fill slopes).

① Compute total width to nearest foot (0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot (0.01 meter).

② For rehabilitation projects, an existing 6’ (1.8 m) width may be retained with documentation.

③ A reduced median width may be used; see Chapter Twelve.

TYPICAL FREEWAY FLUSH MEDIAN SECTION (Tangent Section)
Figure 11.7G



GENERAL NOTE: Dimensions in figure will typically apply. See Figure 12-2 "Geometric Design Criteria for Freeways" for specific cross section criteria for various conditions (e.g., for cut and fill slopes). See Chapter Nine for details on superelevation.

① Compute total width to nearest foot (0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot (0.01 meter).

② Compute distance for each superelevation on the project.

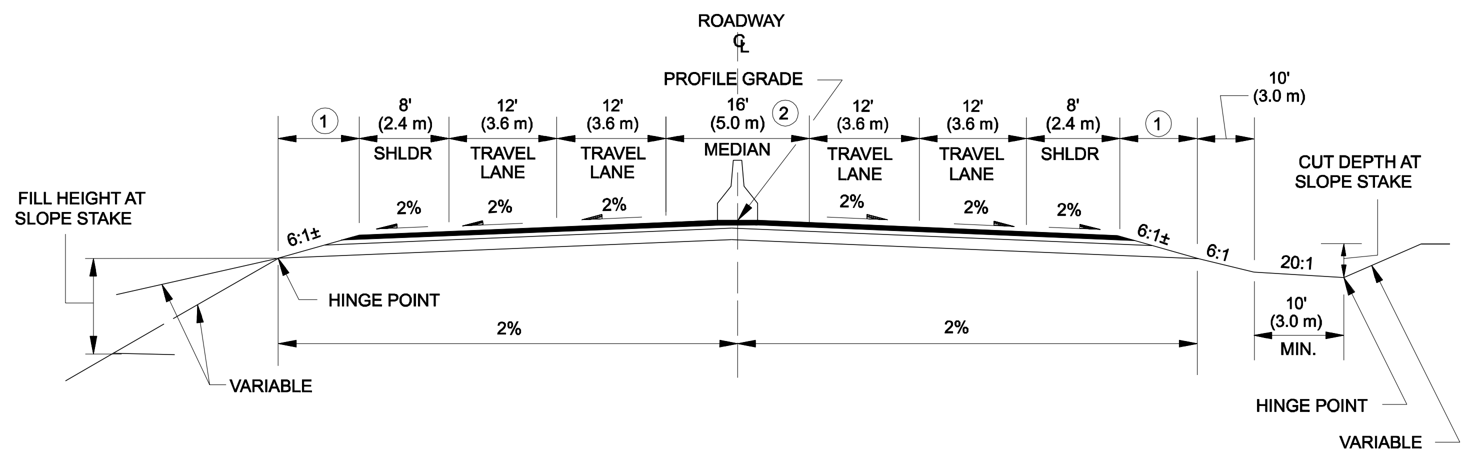
③ This distance will be equal to the ① distance on the tangent section (Figure 11.7G).

④ For rehabilitation projects, an existing 6' (1.8 m) width may be retained with documentation.

⑤ A reduced median width may be used; see Chapter Twelve.

TYPICAL FREEWAY FLUSH MEDIAN SECTION (Superelevated Section)

Figure 11.7H



GENERAL NOTES:

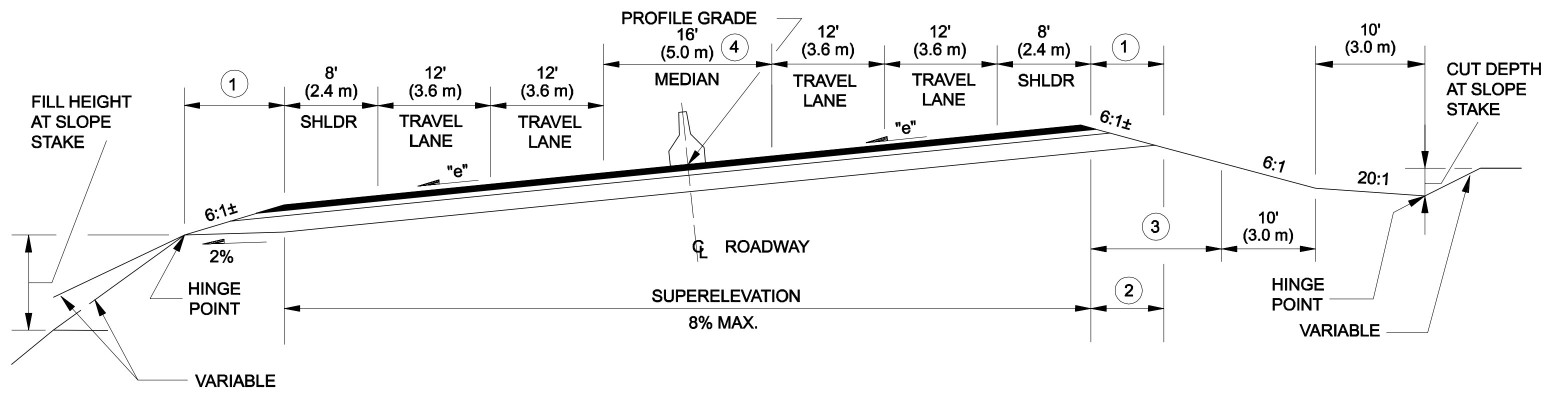
1. Dimensions in figure will typically apply. See applicable figure in Chapter Twelve for specific cross section criteria for various conditions (e.g., for cut and fill slopes).

2. The need for a median barrier will be determined on a case-by-case basis.

① Compute total width to nearest foot(0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot(0.01 meter).

② A reduced median width may be used; see Chapter Twelve.

TYPICAL NON-FREEWAY FLUSH MEDIAN SECTION (Tangent Section)
Figure 11.7I



GENERAL NOTE: Dimensions in figure will typically apply. See applicable figure in Chapter Twelve for specific cross section criteria for various conditions (e.g., for cut and fill slopes). See Chapter Nine for details on superelevation.

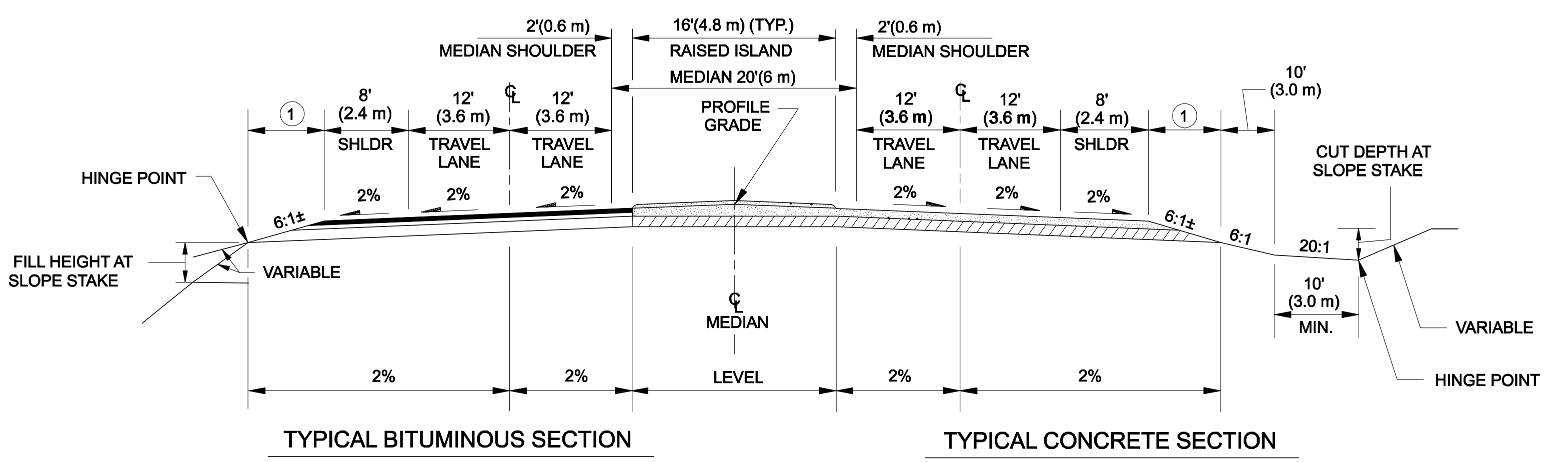
① Compute total width to nearest foot(0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot(0.01 meter).

② Compute distance for each superelevation on the project.

③ This distance will be equal to the ① distance on the tangent section (Figure 11.7I).

④ A reduced median width may be used; see Chapter Twelve.

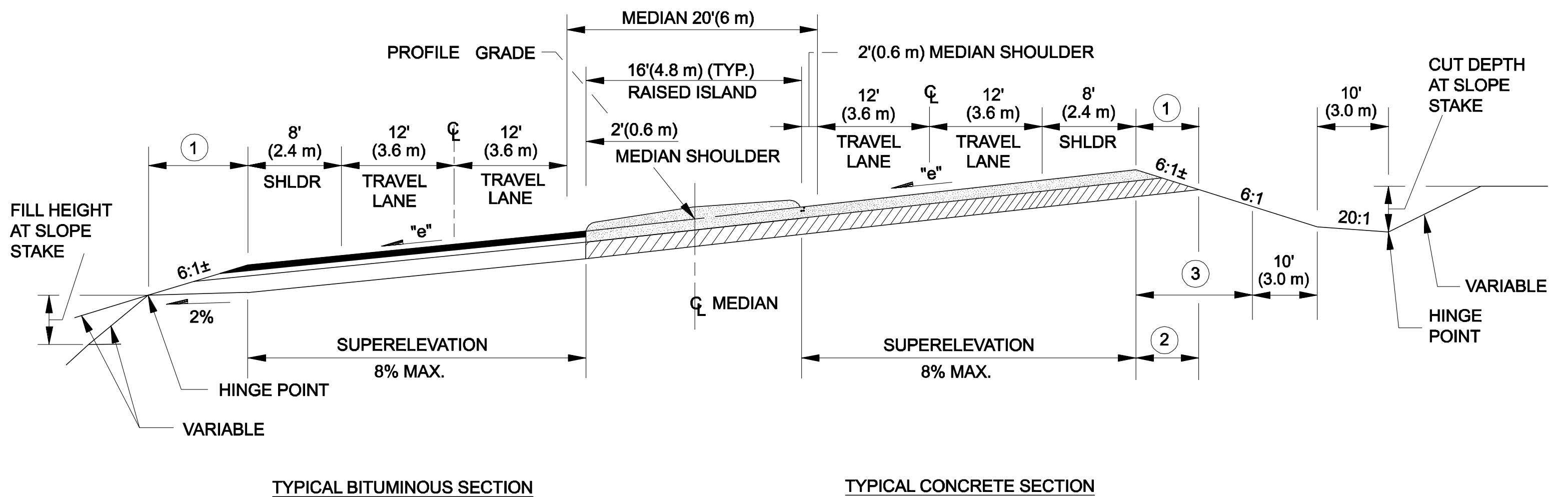
TYPICAL NON-FREEWAY FLUSH MEDIAN SECTION (Superelevated Section)
Figure 11.7J



GENERAL NOTE: Dimensions in figure will typically apply. See applicable figure in Chapter Twelve for specific cross section criteria for various conditions (e.g., for cut and fill slopes).

① Compute total width to nearest foot(0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot (0.01 meter).

TYPICAL RAISED MEDIAN SECTION (Tangent Section)
Figure 11.7K



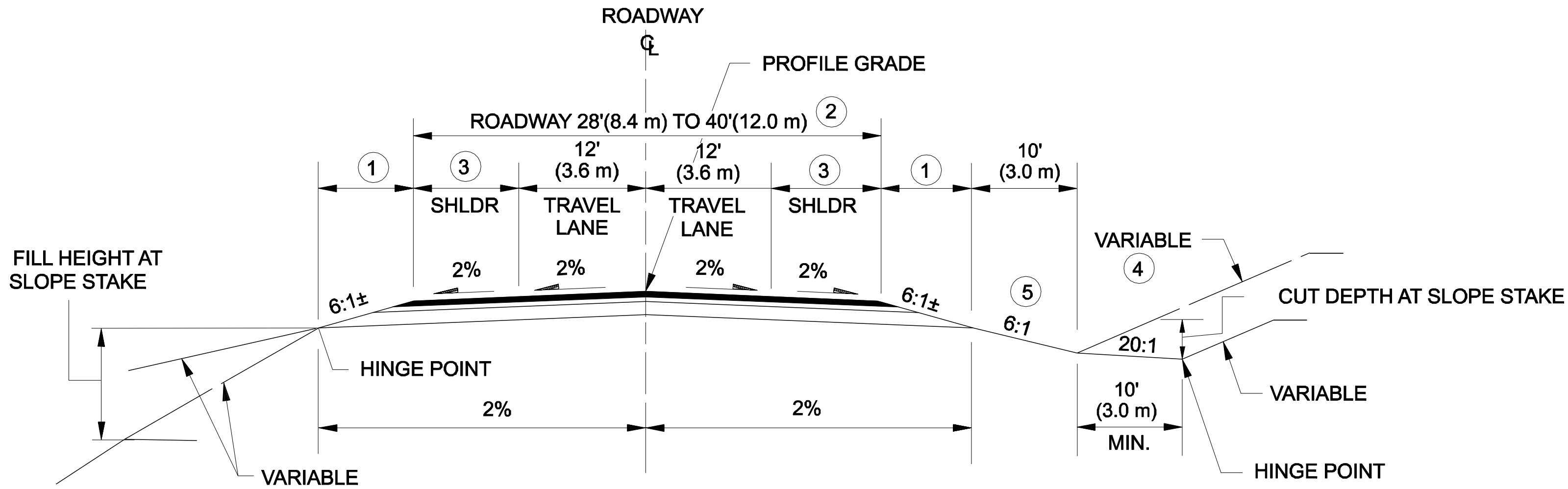
GENERAL NOTE: Dimensions in figure will typically apply. See applicable figure in Chapter Twelve for specific cross section criteria for various conditions (e.g., for cut and fill slopes). See Chapter Nine for details on superelevation.

① Compute total width to nearest foot (0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot (0.01 meter).

② Compute distance for each superelevation on the project.

③ This distance will be equal to the ① distance on the tangent section (Figure 11.7K).

TYPICAL RAISED MEDIAN SECTION (Superelevated Section)
Figure 11.7L



GENERAL NOTE: Dimensions in figure will typically apply. See applicable figure in Chapter Twelve for specific cross section criteria for various conditions (e.g., for cut and fill slopes).

① Compute total width to nearest foot (0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot (0.01 meter).

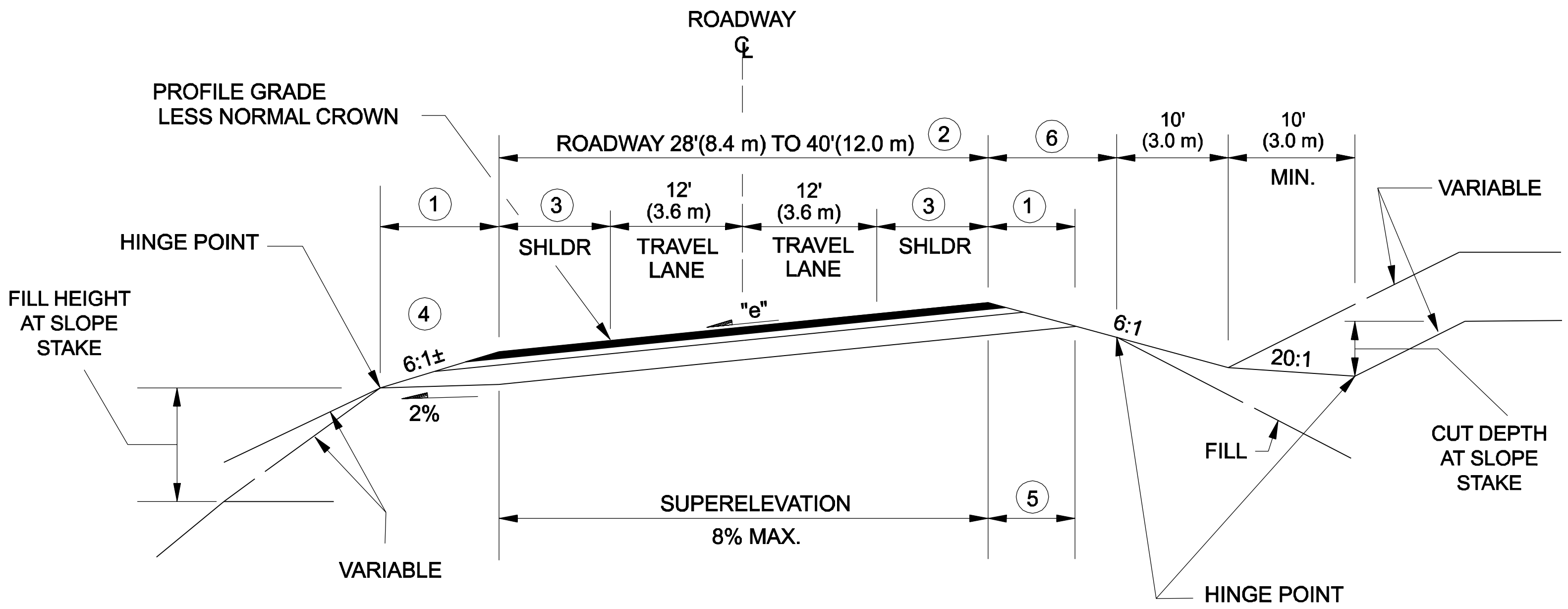
② Roadway width will vary. See Chapter Twelve for specific criteria.

③ Shoulder width will vary. See Chapter Twelve for specific criteria. New projects should include full-depth shoulders.

④ V-ditches may be used in special cases. Check Chapter Fourteen for traversability criteria for roadside ditches.

⑤ The inslope may be 4:1 for some major collectors; see Chapter Twelve for specific criteria.

TYPICAL TWO-LANE RURAL HIGHWAY (Tangent Section)
Figure 11.7M



GENERAL NOTE: Dimensions in figure will typically apply. See applicable figure in Chapter Twelve for specific cross section criteria for various conditions (e.g., for cut and fill slopes). See Chapter Nine for details on superelevation.

① Compute total width to nearest foot (0.01 meter). Compute intermediate surfacing widths to nearest 0.1 foot (0.01 meter).

② Roadway width will vary. See Chapter Twelve for specific criteria.

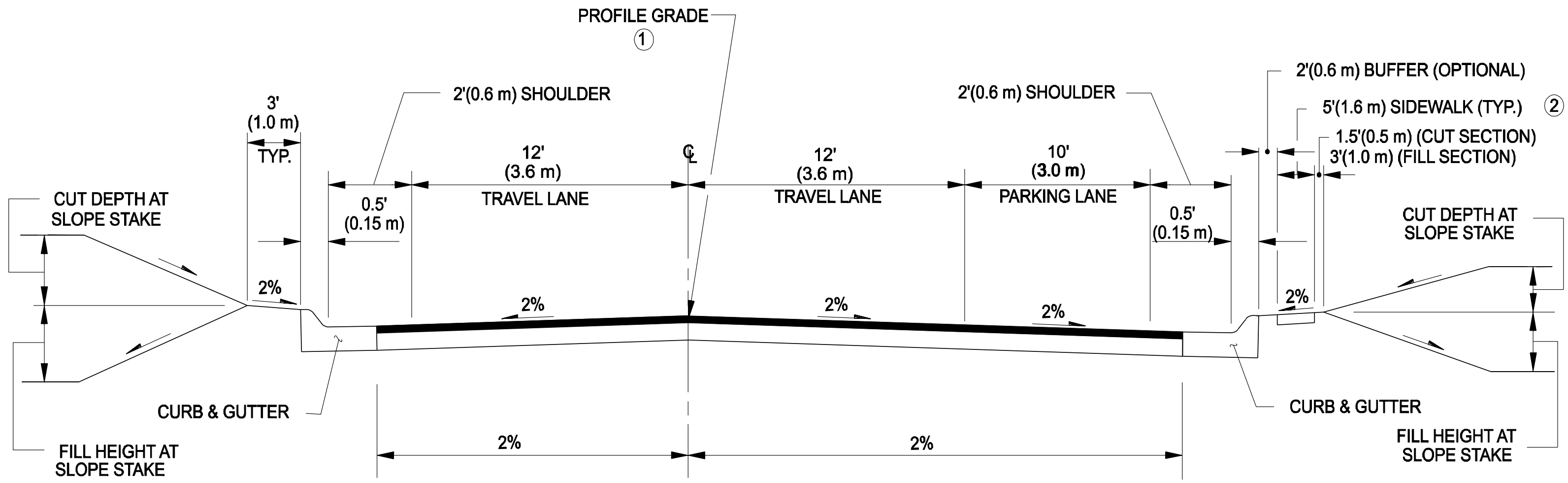
③ Shoulder width will vary. See Chapter Twelve for specific criteria. New projects should include full-depth shoulders.

④ See Chapter Five for method of computing intermediate thicknesses on low side of curves.

⑤ Compute distance for each superelevation on the project.

⑥ This distance will be equal to the ① distance on the tangent section (Figure 11.7M).

TYPICAL TWO-LANE RURAL HIGHWAY (Superelevated Section)
Figure 11.7N

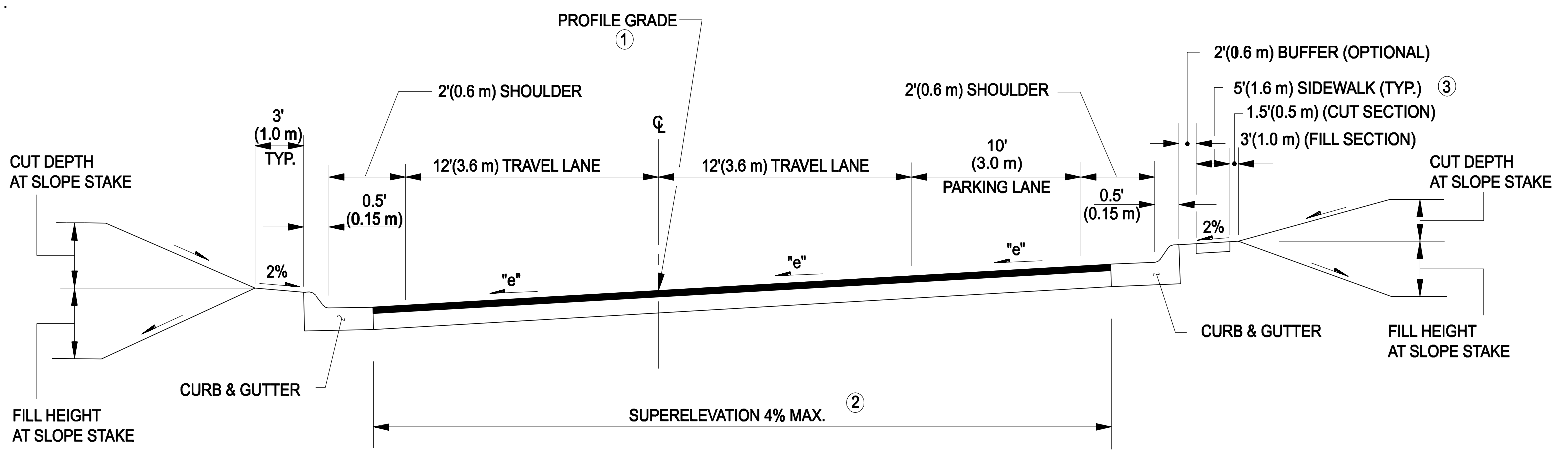


GENERAL NOTE: Dimensions in figure will typically apply. See applicable figure in Chapter Twelve for specific cross section criteria for various conditions (e.g., for cut and fill slopes).

① It may be necessary to use separate profiles at the top back of curb to promote positive drainage and to match existing development.

② See Section 11.2 for sidewalk design criteria.

TYPICAL CURBED URBAN STREET (Tangent Section)
Figure 11.7O



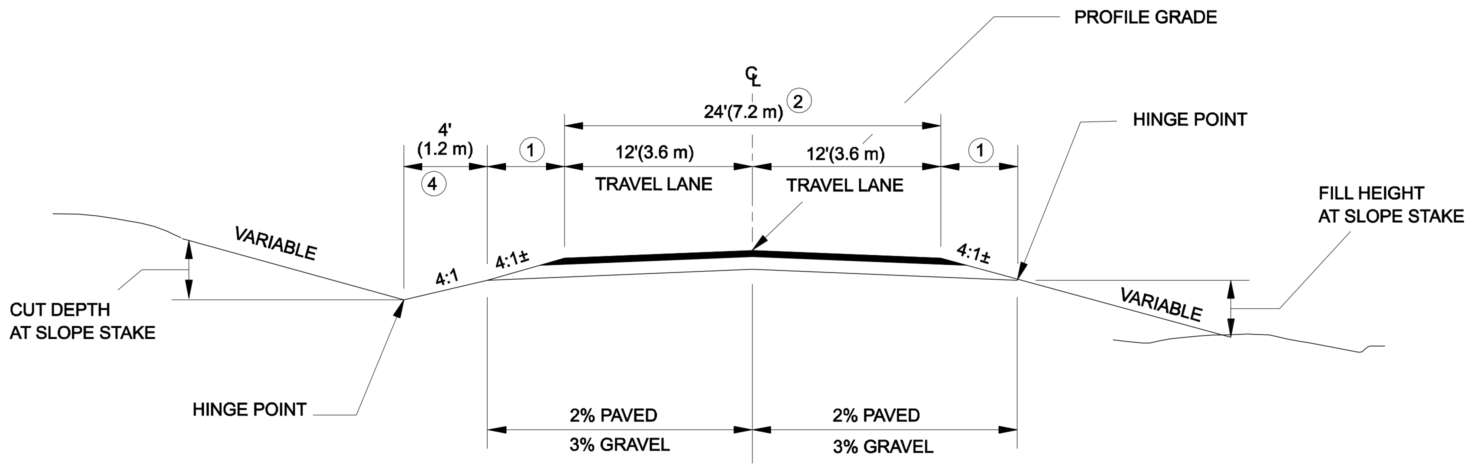
GENERAL NOTE: Dimensions in figure will typically apply. See applicable figure in Chapter Twelve for specific cross section criteria for various conditions (e.g., for cut and fill slopes). See Chapter Nine for details on superelevation.

① It may be necessary to use separate profiles at the top back of curb to promote positive drainage and to match existing development.

② Applies to low-speed urban streets V ≤ 45 mph (V ≤ 70 km/h).

③ See Section 11.2 for sidewalk design criteria.

TYPICAL CURBED URBAN STREET (Superelevated Section)
Figure 11.7P



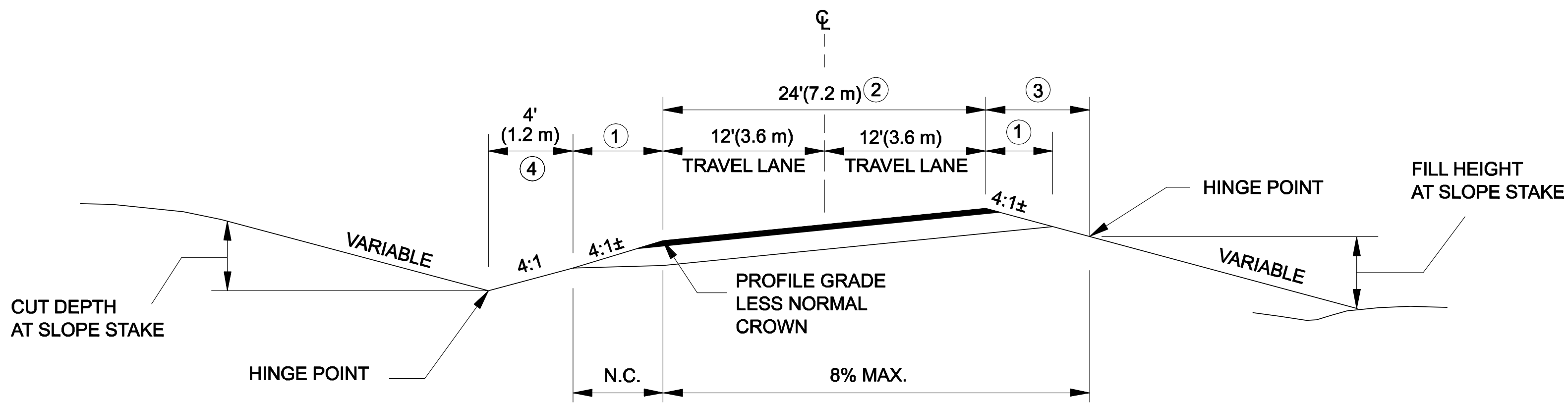
① Compute total width to nearest foot (0.1 m). Compute intermediate widths to nearest 0.1 foot (0.01 m).

② Roadway width may vary; see Chapter Twelve.

③ For ADT > 300, use the criteria for a major collector.

④ Check Chapter Fourteen for traversable requirements. For non-traversable ditches, place the toe of the ditch outside the clear zone.

OFF-SYSTEM RURAL ROAD
(Tangent Section)
Figure 11.7Q



① Compute total width to nearest foot (0.1 m). Compute intermediate widths to nearest 0.1 foot (0.01 m).

② Roadway width may vary; see Chapter Twelve.

③ This distance will be equal to the ① distance on the tangent section (Figure 11.7Q).

④ Check Chapter Fourteen for traversable requirements. For non-traversable ditches, place the toe of the ditch outside the clear zone.

OFF-SYSTEM RURAL ROAD
(Superelevated Section)
Figure 11.7R