Chapter Thirty-one
SPECIAL DESIGN ELEMENTS

Table of Contents

Table of Contents
(Continued)

Chapter Thirty-one
SPECIAL DESIGN ELEMENTS

Chapter Thirty-one provides a discussion on several design elements including disabled accessibility requirements, two-way left-turn lanes, medians, on-street and off-street parking, railroads and snow fences.

31.1 ACCESSIBILITY FOR DISABLED INDIVIDUALS

Many highway elements can affect the accessibility and mobility of disabled individuals. These include sidewalks, parking lots, buildings at transportation facilities, overpasses and underpasses. The Department's accessibility criteria comply with the 1990 Americans with Disabilities Act (ADA). These criteria are presented in Chapter 18 of the Montana Road Design Manual. It presents accessibility criteria that are based on information presented in the ADA Accessibility Guidelines for Buildings and Facilities (ADA Guidelines). Designers are required to meet the criteria presented in the Montana Road Design Manual. Where other agencies or local codes require standards that exceed the ADA Guidelines, then the stricter criteria may be required. This will be determined on a case-by-case basis.

31.2 TWO-WAY LEFT-TURN LANES

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

31.2.1 Guidelines

The Traffic Engineering Section is responsible for determining the need for a TWLTL. 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 (e.g., 50 approaches total per mile (30 per km) on both sides);

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

   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 3-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.

31.2.2 Design Criteria

31.2.2.1 Lane Width

Widths for a TWLTL may vary from 14 ft (4.2 m) (rural) to 16 ft (4.8 m) (urban). In general, the desirable width should be used for facilities with higher volumes, higher speeds and/or in industrial areas. Chapter Twelve of the Montana Road Design Manual 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.

31.2.2.2 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 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 a 2-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 ft (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).

31.3 MEDIANS

31.3.1 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.

31.3.2 Median Types

Section 11.7 in the MDT Road Design Manual provides typical sections for various median types.

31.3.2.1 Flush Medians

Flush medians are often used on urban highways and streets. The typical width for a flush median ranges from 4 ft (1.2 m) to 16 ft (4.8 m). They are paved and striped for delineation. Flush medians are generally more 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 31.3.2.2.

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 31.2 provides information on design details for a TWLTL.

31.3.2.2 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 > 45 mph (70 km/h)).

<u>Advantages</u>

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.

<u>Disadvantages</u>

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. Sloping (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 ft (6.0 m) provides for:

   a. a 2 ft (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 ft (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 ft (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 ft (6.0 m) median is the minimum desirable width in which a left-turn lane can be developed with raised median. The 20 ft (6.0 m) width will provide for:

   a. a 14 ft (4.2 m) left-turn lane,

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

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

3. Surfacing. The raised portion of the median will be paved, typically with concrete.

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.

31.3.2.3 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 ft (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 ft (23.0 m). Beyond this, the two roadways of the divided facility are typically placed on independent alignment.

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

31.3.3 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 Section 28.8.

31.4 PARKING

31.4.1 On-Street Parking

31.4.1.1 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. The following factors will be evaluated:

1. prior crash 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 will apply.

31.4.1.2 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 parking,
   b. convert to parallel parking,
   c. change the angle of parking, 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.

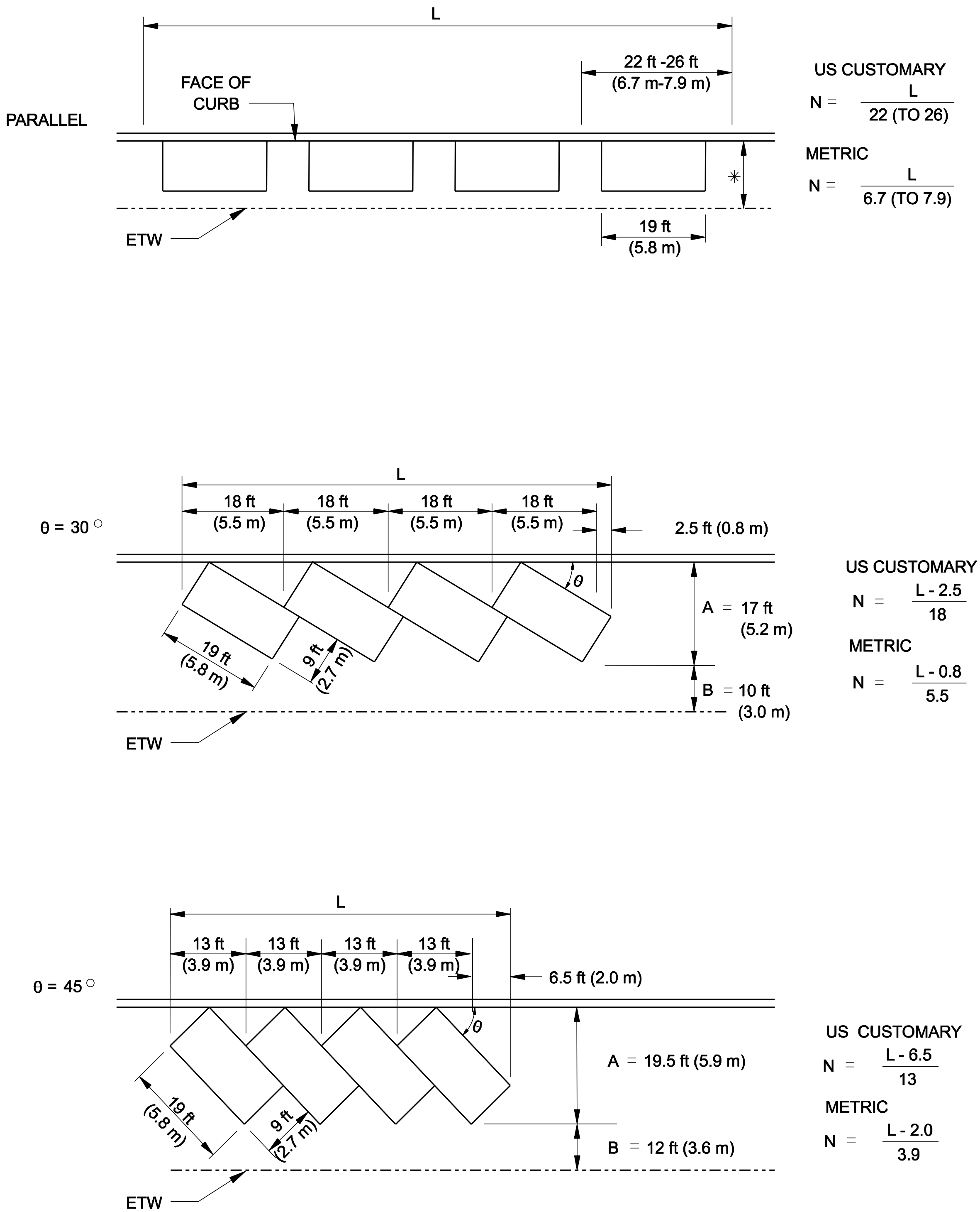
31.4.1.3 Design

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

1. Stall Width. All parallel parking stalls will be 10 ft (3.0 m) wide. For parallel parking, stall widths are measured from the edge of travel lane to the gutter line. For angle parking, stall widths will generally be 9 ft (2.7 m).

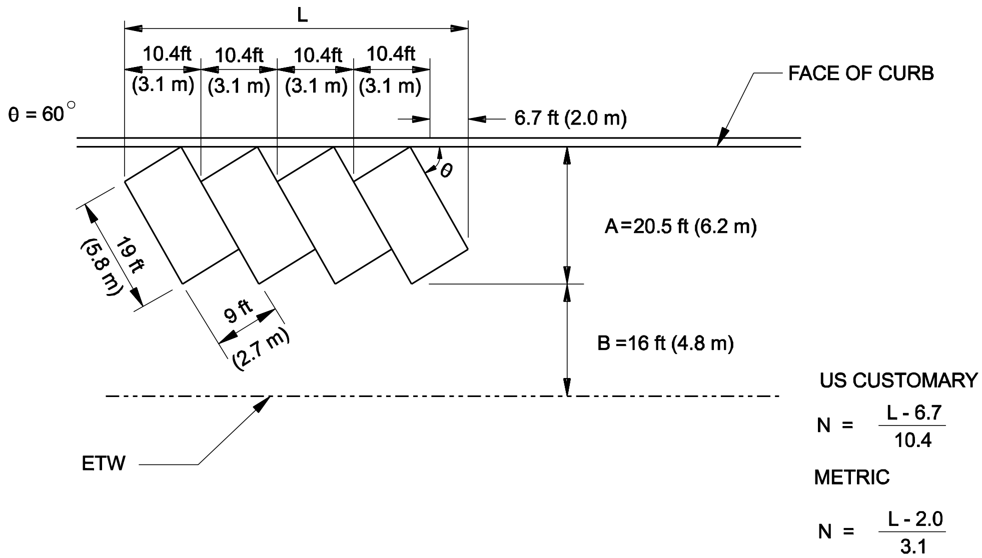
2. Stall Layout. Figure 31.4A provides the layout criteria for parking stalls for various configurations. The figure also indicates the number of stalls that can be provided for each parking configuration for a given curb length. For angle parking, desirably, the roadway width allocated to parking will be the sum of “A” and “B” as shown in Figure 31.4A 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.



CURB PARKING CONFIGURATIONS

Figure 31.4A



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 ft (0.4 m)
45°	2.0 ft (0.6 m)
60°	2.3 ft (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 31.4A

4. Accessibility for Disabled Individuals. A certain number of on-street parking spaces must be provided for accessibility for the disabled, and their design must meet the accessibility design criteria. See Chapter 18 of the Montana Road Design Manual for specific information.

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)) to properly negotiate the right turn. See Section 28.3 for specific information.

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

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

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

   c. Prohibit parking within 50 ft (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 of the Montana Road Design Manual.

   f. Prohibit parking within 30 ft (9 m) from end of curb return 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.

31.4.2 Off-Street Parking

A proposed highway project may incorporate some form of off-street parking. Typical applications may include:

1. providing off-street parking to replace on-street parking which will be removed as part of a proposed project;

2. the construction of a park-and-ride lot for commuters; or

3. the construction of a new rest area or improvement to an existing rest area. See Figure 31.4B for an example of a typical rest area parking layout.

31.4.2.1 Park-and-Ride Lots

Location

Park-and-ride lots may be located in either rural or urban areas to accommodate car-pooling or to provide access to transit terminals. By locating these lots outside of the downtown area, congestion is reduced, parking lot property costs are lowered and accessibility is improved. The general location and size of park-and-ride lots is normally determined during the Preliminary Field Review. Guidance for site selections can be found in the AASHTO Guide for the Design of Park-and-Ride Facilities. Some of the factors that will affect the location of the parking facility include:

1. Site Availability. Park-and-ride lots may consist of publicly owned property, excess State right-of-way or property used with the permission of private owners. When reviewing sites, consider the long-term availability of the lot.

2. Accessibility. The lot should be convenient to residential areas, bus and rail transit routes, and major highways used by commuters.

3. Visibility. The park-and-ride lot should be visible from the access road.

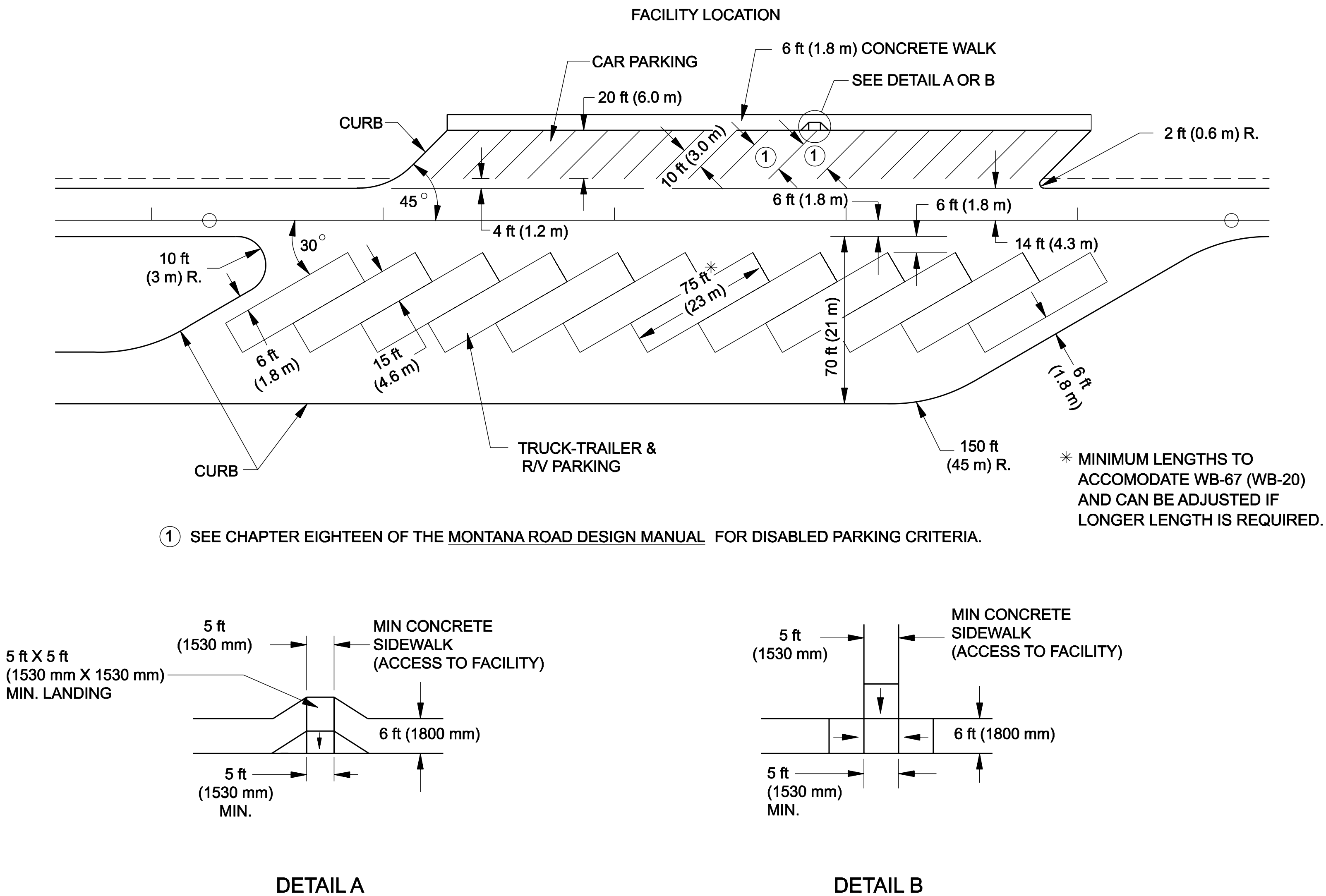
4. Demand. The lot must be large enough to accommodate the anticipated demand for parking spaces. In addition, sufficient transit service must be available to accommodate the anticipated demand.

5. Congestion. The location should precede any points of congestion on the major commuting highway to maximize its benefits.

6. Capacity. There should be sufficient capacity on connections between the lot and the major commuting highway.

7. Design. The site location must be compatible with the design and construction of the lot. Considerations will include property costs, terrain, drainage, subgrade soil conditions and available space in relation to the required lot size, visibility and access.

8. Land Use. The location of the lot should be consistent with the present and future adjacent land use. Consider the lot's visual and other impacts on surrounding areas. Where necessary, site sizing and design should allow for buffer landscaping to minimize the visual impact.



SAMPLE PARKING DESIGN FOR REST AREA PARKING

Figure 31.4B

Layout

Consider the following when laying out a park-and-ride facility:

1. Entrances and Exits. Locate entrances and exits so that they have the least disruption to existing traffic on the street, allow easy access to and from the lot and provide the maximum storage space within the lot. In addition, consider the following:

   a. Location. Provide separated entrances and exits whenever practical, preferably on two or more streets. The entrance should be on the "upstream" side of the traffic flow nearest the lot and the exit on the "downstream" side. If separation is not reasonable, the combined entry-exit point should be as close to mid-block as practical.

   b. Spacing. Separate entrances and exits should be at least 150 ft (45 m) apart and 150 ft (45 m) from a public road intersection. Desirably, these distances should be 350 ft (100 m). For lots with less than 150 spaces, these dimensions may be reduced to 100 ft (30 m).

   c. Traffic Signals. If a traffic signal is warranted or is expected in the future, the entrance should be more than 1300 ft (400 m) from an adjacent signal. Ensure that the traffic signal can be interconnected and/or coordinated with the other traffic signals to allow vehicular progression along the route.

   d. Storage. Ensure that there is sufficient storage on the mainline for entering the lot. This may require providing separate left- and/or right-turn lanes. Also, check the exiting traffic to ensure that the exiting queue will not adversely affect the traffic circulation in the lot itself.

   e. Design. Design all entrances and exits for capacity, sight distance, turning radii, acceleration and deceleration lanes, turn lanes, etc., according to the criteria in Chapter Twenty-eight. The typical design vehicle will be a BUS.

2. Drop-off/Pick-up Zones (Kiss-and-Ride). Drop-off and pick-up zones for buses and autos should be clearly separated from each other and from parking areas to avoid as many internal traffic conflicts as possible. Circulation for kiss-and-ride facilities should be one-way and adjacent to the terminal loading/unloading area. Angle the parking at 45 degrees towards the loading terminal to allow vehicles to pull through.

3. Traffic Circulation. Arrange the traffic circulation to provide maximum visibility and minimum conflict between small vehicles (e.g., autos, taxis) and large vehicles (e.g., large vans, buses). Locate major circulation routes at the

periphery of the lot to minimize vehicular-pedestrian conflicts. A counter-clockwise circulation of one-way traffic is preferred. This allows vehicles to unload from the right side.

4. Pedestrian and Bicyclist Considerations. Consider pedestrian and bicycle routes when laying out the commuter lot. Avoid entrance and exit points in areas with high-pedestrian volumes, if practical. Provide sidewalks between the parking areas and the modal transfer points. Locate passenger waiting areas in a central location or near the end of the facility. Maximum walking distances to any loading area should not exceed 1000 ft (300 m). Longer walking distances may require more than one loading area.

   Crosswalks should be provided where necessary and be clearly marked and signed. Include signing and pavement markings for pedestrian and bicycle paths to eliminate indiscriminate movements. In high-volume lots, lighting, fencing, barriers or landscaping may be warranted to channel pedestrians and bicyclists to appropriate crossing points.

   Include a bicycle parking area relatively close to the loading area. If a large volume of bicycle traffic is expected, provide a designated bicycle lane to and from the bicycle parking area.

5. Accessibility for Disabled Individuals. Chapter 18 of the Montana Road Design Manual discusses the accessibility criteria for disabled individuals, which also apply to park-and-ride lots.

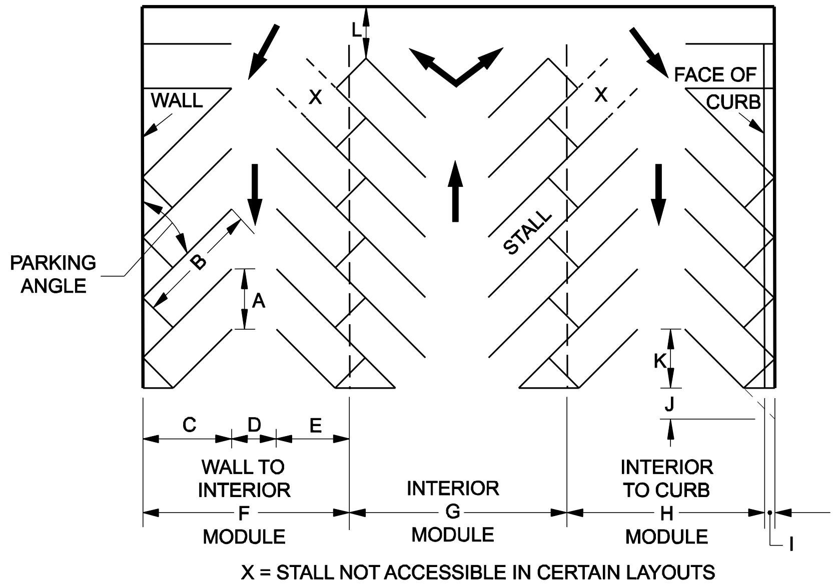
31.4.2.2 Design Elements

Consider the following elements in the design of off-street parking lots:

1. Parking Lot Dimensions. Parking stall dimensions vary with the angle at which the parking space is arranged relative to the aisle. Figure 31.4C provides the design dimensions for 9 ft x 18 ft (2.7 m x 5.5 m) parking stalls and shows how stalls may be combined into a parking lot. From a traffic operations standpoint, one-way aisles are desirable and should be designed to provide counterclockwise circulation. When determining parking stall widths, consider the following:

   a. Typical stall widths (measured perpendicular to the vehicle when parked) range from 9 ft to 9.5 ft (2.7 m to 2.9 m).

   b. The recommended minimum stall width for self-parking of long-term duration is 9 ft (2.7 m).



Parking Layout Dimension (in ft (m)) for 9 ft x 18 ft (2.7 m x 5.5 m) Stalls at Various Lengths

Design Feature	Notation	US Customary				Metric			
		Dimension (ft)				Dimension (m)			
		Parking Angle				Parking Angle			
		45°	60°	75°	90°	45°	60°	75°	90°
Stall width, parallel to aisle	A	12.7	10.4	9.3	9.0	3.9	3.2	2.8	2.7
Stall length of line	B	25.0	22.0	20.0	18.5	7.6	6.7	6.1	5.6
Stall depth to wall	C	17.5	19.0	19.5	18.5	5.3	5.8	5.9	5.6
Minimum aisle width between stall lines	D	12.0	16.0	23.0	26.0	3.7	4.9	7.0	7.9
Stall depth, interior	E	15.3	17.5	18.8	18.5	4.7	5.3	5.7	5.6
Module, wall to interior	F	44.8	52.5	61.3	63.0	13.7	16.0	18.7	19.2
Module, interior	G	42.6	51.0	61.0	63.0	13.0	15.5	18.6	19.2
Module, interior to curb face	H	42.8	50.2	58.8	60.5	13.1	15.3	17.9	18.4
Bumper overhang (typical)	I	2.0	2.3	2.5	2.5	0.6	0.7	0.8	0.8
Offset	J	6.3	2.7	0.5	0.0	1.9	0.8	0.2	0.0
Setback	K	11.0	8.3	5.0	0.0	3.4	2.5	1.5	0.0
Cross aisle, one-way	L	14.0	14.0	14.0	14.0	4.3	4.3	4.3	4.3
Cross aisle, two-way	—	24.0	24.0	24.0	24.0	7.3	7.3	7.3	7.3

Notes:

1. See Chapter 18 of the Montana Road Design Manual for criteria on the number and dimensions of parking spaces for disabled individuals.
2. If a special section is designated for subcompact vehicles, these stalls can be 8 ft x 15 ft (2.4 m x 4.5 m) for a 90° angle.
3. Stalls should be wider for commercial parking.
4. The designer should consider bumper overhang when placing lighting, railing, etc. Therefore, these appurtenances should be placed beyond dimension "I" in the figure.
5. Two-way traffic in aisles may only be used with a 90° parking angle. Use an aisle width of 26 ft (7.9 m).
6. Parking stalls for disabled individuals are not shown.

PARKING LOT LAYOUT DIMENSIONS
(9 ft x 18 ft (2.7 m x 5.5 m) Stalls)

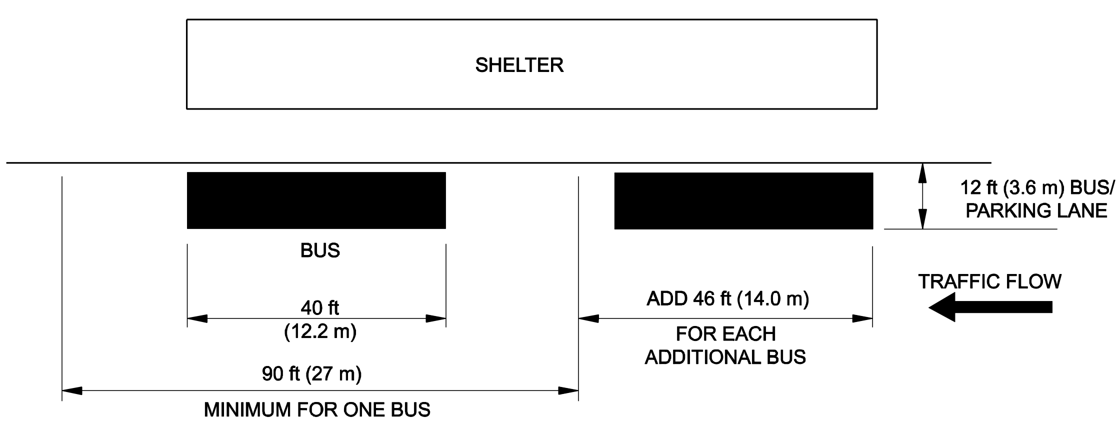
Figure 31.4C

c. For higher turnover self-parking, a stall width of 9.5 ft (2.9 m) is recommended.

2. Bus Loading Areas. Bus loading and unloading areas located adjacent to park-and-ride lots should be designed to provide for continuous counterclockwise circulation and for curb parking without backing maneuvers. The through traffic lanes and the curb loading area should each be 12 ft (3.6 m) wide. Figure 31.4D provides criteria for the recommended lengths of bus loading areas within park-and-ride lots. Figure 31.4E provides criteria for typical bus turnouts.

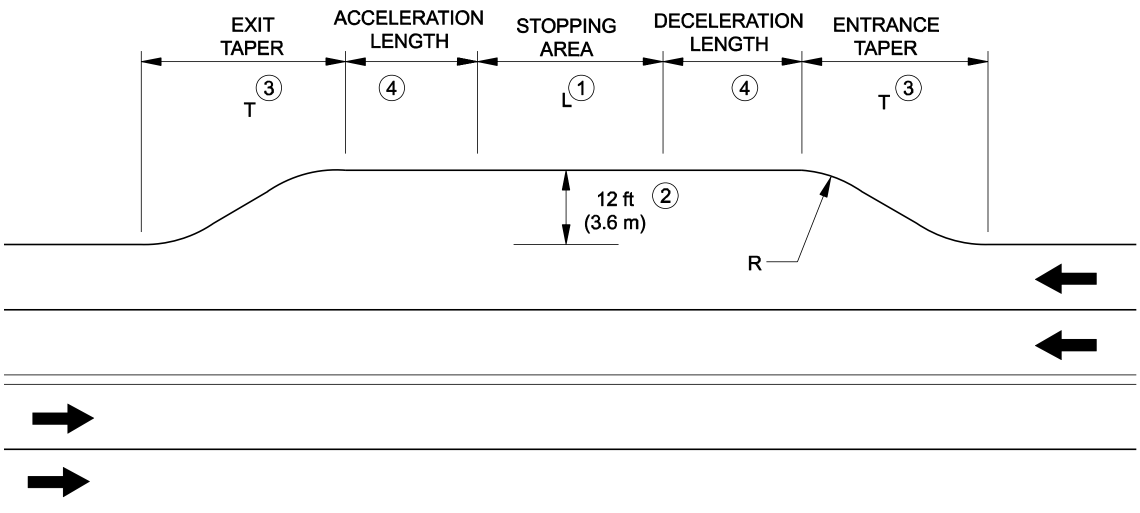
3. Sidewalk Dimensions. All sidewalks should be at least 5 ft (1.5 m) wide. In loading areas, the width should be 12 ft (3.6 m) or the adjacent sidewalk width plus 7 ft (2.1 m), whichever is greater. The accessibility criteria for the disabled must be met for all new lots; see Chapter 18 of the Montana Road Design Manual.

4. Cross Slope. To provide proper drainage, the minimum cross slope on a parking lot should be 1%. As a maximum, the cross slope should not exceed 5%. Desirably, design the lot to direct the drainage runoff into existing drainage systems. If water impoundment cannot be avoided along pedestrian routes, bicycle routes and standing areas, provide drop inlets and underground drainage. In parking areas, design the drainage to avoid standing water. The detailed drainage design for the lot should be prepared using the Department's Drainage Manual to determine design frequency, pavement discharge and capacity of drainage inlets.



RECOMMENDED LENGTHS FOR BUS-LOADING AREAS
(Park-and-Ride Lots)

Figure 31.4D



Notes:

① *Stopping area length consists of 50 ft (15 m) for each standard 40 ft (12 m) bus and 70 ft (21 m) for each 60 ft (18 m) articulated bus expected to be at the stop simultaneously.*

② *Bus turnout width is desirably 12 ft (3.6 m). For traffic speeds under 30 mph (50 km/h), a 10 ft (3.0 m) minimum bay width is acceptable. These dimensions do not include gutter width.*

③ *Suggested taper lengths are listed below. A minimum taper of 5:1 may be used for an entrance taper from the street for a bus turnout while the merging or re-entry taper should not be sharper than 3:1. Desirable taper length = VW (US Customary) (0.6 VW (metric)).*

V = design speed, mph (km/h)
W = width of turn bay, ft (m)

④ *The minimum design for a bus turnout does not include acceleration or deceleration lengths. Recommended acceleration and deceleration lengths are listed below.*

Design Speed	Entering Speed*	Acceleration Lengths	Deceleration Lengths	Suggested Taper Lengths
US CUSTOMARY				
35 mph	25 mph	250 ft	185 ft	170 ft
40 mph	30 mph	400 ft	265 ft	190 ft
45 mph	35 mph	700 ft	360 ft	210 ft
50 mph	40 mph	975 ft	470 ft	230 ft
METRIC				
50 km/h	35 km/h	60 m	45 m	45 m
60 km/h	45 km/h	105 m	70 m	50 m
70 km/h	55 km/h	200 m	105 m	60 m
80 km/h	65 km/h	310 m	145 m	70 m

* *Desirably, the bus speed at the end of taper should be within 10 mph (15 km/h) of the design speed of the traveled way.*

TYPICAL BUS TURNOUT DIMENSIONS

Figure 31.4E

5. Pavements. Minimum pavement design for parking areas in a park-and-ride lot is 3.5 in (90 mm) of bituminous concrete on 8 in (200 mm) of aggregate base. For bus routes, the minimum pavement design should be 9 in (125 mm) of bituminous concrete on 10 in (250 mm) of aggregate base. Based on site specific needs, a Portland cement concrete pavement may be considered.

6. Lighting. Desirably, the lot should be lighted for pedestrian safety and lot security. Ensure provisions are considered for lighting supports and power lines. Chapter Thirteen provides information on the design of lighting.

7. Shelters. Pedestrian shelters are desirable when loading areas for buses are provided. Their inclusion will be determined on a case-by-case basis. The shelter should provide approximately 5 ft^2 (0.5 m^2) of covered area per person. As a minimum, the shelter should provide lighting, benches and trash receptacles. Routing information signs and a telephone should also be considered.

8. Bicycle and Motorcycle Storage. Provide bicycle stalls that allow the use of locking devices. Bicycle stalls are typically 2 ft by 6 ft (0.6 m by 1.8 m). Motorcycle stalls are 3 ft by 6 ft (1 m by 1.8 m).

9. Traffic Control Devices. Provides signs and pavement markings to direct drivers and pedestrians to appropriate loading zones, parking areas, bicycle facilities, disabled parking entrances and exits. Coordinate the use of traffic devices with the Signing Unit.

10. Fencing. The need for fencing around a parking lot will be determined on a case-by-case basis.

11. Landscaping. In some locations, consider landscaping to minimize the visual impact of the parking lot. This may include providing a buffer zone around the perimeter of the lot or improving the aesthetics of the lot itself. Desirably, include a 10 ft to 20 ft (3.0 m to 6.0 m) buffer zone around the lot to accommodate vegetation screens. Also, raised islands and parking lot separators provide suitable locations for shrubs and trees. Landscaping should include low-maintenance vegetation which does not cause visibility or security problems.

12. Snow Removal. To assist with snow removal and storage, the design should include a 10 ft to 20 ft (3.0 m to 6.0 m) snow shelf around the perimeter of the lot on at least two sides. This area can coincide with the buffer zone around the lot, provided that the entire area is not filled with shrubs or trees. Place any fencing outside the area of the snow shelf. Providing painted islands rather than raised islands can also make it easier to plow snow from the parking lot.

31.5 RAILROAD/HIGHWAY GRADE CROSSING

In general, the following will apply where there is a highway/railroad grade crossing:

1. Design. The road designer is responsible for coordinating with the Utilities Section to provide the necessary information on the proposed project to the affected railroads. The road designer is also responsible for incorporating, as necessary, the information from the railroad company into the design plans.

2. Agreements. The Utilities Section in the Right-of-Way Bureau is responsible for contacting the railroad company and negotiating all agreements with the railroad companies. The Contract Plans Bureau is responsible for preparing the maintenance agreement for signing and other related items if the facility is maintained by some other entity (e.g., State Secondary Route maintained by a county).

3. Signing and Pavement Markings. The Signing and Pavement Marking Unit in the Traffic Engineering Section is responsible for the signing and pavement markings on the approach to the railroad crossing. The railroad company will be responsible for the traffic control devices at the crossing.

4. Electrical. The Electrical Unit in the Traffic Engineering Section is responsible for working with the railroad to coordinate nearby traffic signals and active traffic crossing controls.

31.6 SNOW FENCES

Snow fences should be provided along portions of the roadway experiencing problems with blowing and drifting snow. Snow fences improve driver visibility and reduce the accumulation of snow and ice on the roadway. See Section 18.3 in the Montana Road Design Manual for design and placement of snow fences.

31.7 SCHOOL BUS PULLOUTS AND TURNAROUNDS

The Traffic Engineering Section is responsible for determining the need for deploying school bus pullouts and turnarounds, as well as their location, design and operation. The design of these elements will be site-specific, based upon site geometrics, available right-of-way, traffic volumes, types of design vehicle, etc. For specific information on the operation of school bus pullouts and turnarounds, see MCA 61-8-351.