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CHAPTER FIFTY-ONE

SPECIAL DESIGN ELEMENTS

51-1.0 ACCESSIBILITY FOR HANDICAPPED INDIVIDUALS

Many highway elements can affect the accessibility and mobility of handicapped individuals. These include sidewalks, parking lots, buildings at transportation facilities, overpasses, or underpasses. The Department's accessibility criteria comply with the 1990 *Americans with Disabilities Act* (ADA). The following provides accessibility criteria which are based on information presented in the *ADA Accessibility Guidelines for Buildings and Facilities* (ADA Guidelines). If local public agencies or local codes require standards which exceed the *ADA Guidelines*, the stricter criteria may be required. This will be determined as required.

51-1.01 Building

For interior accessibility criteria, the following will apply:

1. New. Each new building, airport terminal, rest area, weigh station, or transit station (e.g., station for rapid rail, light rail, commuter rail, intercity bus, intercity rail, high-speed rail, or other fixed guideway systems) shall meet the accessibility criteria set forth in the *ADA Guidelines*. The designer should review the *ADA Guidelines* to determine the appropriate accessibility requirements for the building interior, including rest rooms, drinking fountains, elevators, telephones, etc.

2. Existing. For alterations made to an existing building or facility, the design must meet the accessibility requirements for the alteration made to the facility, unless it is prohibitively expensive to do so. The designer should review the *ADA Guidelines* to determine the appropriate criteria and, if required, where exceptions may be permitted.

51-1.02 Bus Stop

The following accessibility criteria apply to the construction of a bus stop.

1. Bus-Stop Pad. A new bus-stop pad constructed to be used in conjunction with a lift or ramp should be in accordance with the following:

    a. A firm, stable surface must be provided.

b. It must have a minimum clear length of 8 ft measured from the curb or roadway edge, and a minimum clear width of 5 ft measured parallel to the roadway, depending on the legal or site constraints.

c. It must be connected to the street, sidewalk, or pedestrian path by at least one accessible route.

d. The slope of pad parallel to the roadway must be the same as that of the roadway to the maximum extent practical.

e. For drainage purposes, a maximum cross slope of 2% perpendicular to the roadway is allowable.

2. Bus Shelter. Where a new or replacement bus shelter is provided, it must be installed or positioned to permit a wheelchair user to enter from the public way and reach a location within the shelter having a minimum clear floor area of 2.5 ft by 4 ft. An accessible route shall be provided from the shelter to the boarding area.

3. Signage. Each new bus-route identification sign should be sized based on the maximum dimensions permitted by federal, State, or local regulations or ordinances. The sign shall have an eggshell, matte, or other non-glare finish. The characters or symbols shall contrast with the background (i.e., light characters on a dark background or dark characters on a light background).

51-1.03 Parking

51-1.03(01) Off-Street Parking

The following criteria apply to off-street handicapped-parking spaces.

1. Minimum Number. Figure 51-1A, Minimum Number of Accessible Spaces for Handicapped Users provides this criterion. A typical handicapped-user stall layout is shown in Figure 51-1B.

   One of every eight accessible spaces, but not less than one, shall have an access aisle of 8 ft wide and must be designated as van-accessible.

2. Location. Parking spaces for disabled individuals and an accessible passenger loading zone that serve a particular building should be the spaces or zone closest to the nearest accessible entrance on an accessible route. In a separate parking structure or lot that does not serve a

particular building, parking spaces for disabled individuals should be located on the shortest possible circulation route to an accessible pedestrian entrance of the parking facility. In a building with multiple access entrances with adjacent parking, accessible parking spaces shall be dispersed and located closest to the accessible entrances.

3. Signage. Each parking space for the handicapped should be designated with a sign with white lettering against a blue background. The sign should bear the international symbol of access (see the MUTCD). The sign should not be obscured by a vehicle parked in the space. A van-accessible space should have a supplemental "Van Accessible" sign below the symbol of accessibility.

4. Dimensions. Each parking space designated for the handicapped should be of 8 ft minimum width or 9 ft desirable width. It should include an additional access aisle of minimum width of 5 ft. For a van-accessible space, the access aisle should be of 8 ft width. Or, the space should be parallel to a public roadway's sidewalk (see Figure 51-1B). Each parking-access aisle should be part of an accessible route to the building or facility entrance. Overhangs on a parked vehicle should not reduce the clear width of an accessible circulation route. A parking space and its access aisle should be level, with surface slopes not exceeding 2% in all directions. A parking garage or terminal should have a 9.5 ft vertical clearance at its entrance, exit, and along the route to and from at least two parking spaces which have a 9.5 ft vertical clearance.

5. Passenger-Loading Zone. A passenger-loading zone should provide an access aisle at least 5 ft wide and 20 ft long, adjacent and parallel to the vehicular pull-up space. If there is a curb between the access aisle and the vehicular pull-up space, a curb ramp in accordance with Section 51-1.08 should be provided. A vehicular standing space and its access aisle should be level. Surface slopes should not exceed 2% in all directions.

51-1.03(02) On-Street Parking

Where new on-street paid or time-limited parking is provided and designated in an area zoned for business use, the on-street parking design shall be in accordance with the accessibility criteria as follows.

1. Minimum Number. Figure 51-1A provides the criteria for the minimum number of on-street accessibility spaces.

2. Location. On-street accessibility parking spaces should be dispersed throughout the project area. To the maximum extent feasible, accessible on-street parking should be located in a level area.

3. Dimensions. A parking space of minimum 8 ft width with an access aisle of 5 ft width should be provided. This is illustrated in Figure 51-1C, Handicapped On-Street Parking. The travel lane should not encroach into the access aisle.

4. Signage. Each parking area for the handicapped should be designated with a sign with white lettering against a blue background. The sign should bear the international symbol of access (see the MUTCD). The signs should be located to be visible from a driver's seat.

5. Curb Ramp. If there is a curb adjacent to an on-street handicapped-accessible parking space, a curb ramp in accordance with Section 51-1.08 should be provided. A parking space adjacent to an intersection may be served by the sidewalk curb ramp at the intersection, provided that the path of travel from the access aisle to the curb ramp is within the pedestrian crossing area.

6. Parking Meter. A firm, stable, and slip-resistant area of 2.5 ft by 4 ft, with the least possible slope, should be provided at the meter-controls location. It should be connected to the sidewalk with a continuous passage that is a minimum of 3 ft wide. The parking meter should be located at or near the head or foot of the parking space so that there is no interference with the operation of a vehicle side lift or a passenger-side transfer.

51-1.04 Accessible Route

An accessible route is a continuous, unobstructed path connecting all accessible elements and spaces in a building, facility, or site. A site is defined as a parcel of land bounded by a property line or a designated portion of a public right of way. A facility is defined as all portions of a building, structure, site improvement, complex, equipment, road, walk, passageway, parking lot, or other real or personal property on a site. An interior accessible route may include a corridor, floor, ramp, elevator, lift, or clear floor space at a fixture. An exterior accessible route may include parking access aisle, curb ramp, crosswalk at vehicular way, walk, ramp, or and lift.

An accessible route should be provided as follows.

1. At least one accessible route within the boundary of the site should be provided from each public-transportation stop, accessible parking, accessible passenger-loading zone, or public street or sidewalk to the accessible-building-entrance it serves. The accessible route should, to the maximum extent feasible, coincide with the route for the general public.

2. At least one accessible route should connect accessible buildings, facilities, elements, or spaces that are on the same site.

3. At least one accessible route should connect accessible buildings or facility entrances with all accessible spaces and elements and with all accessible dwelling units within each building or facility.

The application of the accessible-route criteria applies to definitive sites which are related to highway purposes. These include a rest area, recreational area, park-and-ride lot, etc. Sections 51-1.05 and 45-1.06 provide the accessibility requirements for a sidewalk.

51-1.05 Sidewalk

Each sidewalk must comply with the *ADA Guidelines* as described as follows..

51-1.05(01) Sidewalk on Accessible Route

1. Width. The minimum clear width should be 3 ft, except at a door, where the minimum width should be 5 ft.

2. Passing Space. If a sidewalk has less than 5 ft clear width, passing spaces of at least 5 ft by 5 ft should be located at an interval not to exceed 200 ft. A T-intersection between two walks is an acceptable passing space.

3. Surface. The sidewalk surface should be stable, firm, and slip-resistant. The longitudinal gradient should be flush and free of abrupt changes. However, a change in level of up to 1/4 in. may be vertical and without edge treatment. A change in level of 1/4 in. and 1/2 in. should be beveled with a slope not greater than 50%. A change in level of 1/2 in. or greater should be accommodated with a ramp (see Section 51-1.07).

   Gratings should not be placed within the walking surface. If, however, gratings are located in the walking surface, they should have openings of not greater than 1/2 in. in one direction. If gratings have elongated openings, they should be placed so that the long dimension is perpendicular to the dominant direction of travel.

4. Slope. The cross slope should not exceed 2%. If the longitudinal gradient exceeds 5%, the sidewalk must be in accordance with the accessibility criteria for a ramp (see Section 51-1.07).

5. Protruding Object. An object projecting from a wall (e.g., sign, telephone, canopy) with its leading edge between 2 ft and 6.5 ft above the finished sidewalk should not protrude more than 4 in. into any portion of the sidewalk. A freestanding object mounted on posts or pylons may overhang its mountings up to a maximum of 1 ft if located between 2 ft and 6.5

ft above the sidewalk or ground surface. An object of less than 2 ft or greater than 6.5 ft may protrude to any distance provided that the effective width of the sidewalk is maintained. Where the vertical clearance is less than 6.5 ft, a barrier should be provided to warn a visually-impaired person.

6. Separation. A sidewalk should be separated from roadways with a curb, planted parkway or other barrier, which should be continuous except where interrupted by a drive, alley, or connection to a handicapped-accessible element.

7. Bus Stop. Where a bus-passenger loading area or bus shelter is provided on or adjacent to a sidewalk, it should be in accordance with the criteria described in Section 51-1.02.

8. Curb Ramp. Each curb ramp on an accessible route should be in accordance with the criteria described in Section 51-1.08.

51-1.05(02) Sidewalk on Public Right of Way

Each such sidewalk should be in accordance with the criteria described in Section 51-1.05(01). However, the *ADA Guidelines* provide some flexibility to meet the adjacent roadway conditions and to provide a practical design. The criteria described in Section 51-1.05(01) should used, with the additional requirements as follows:

1. Slope. The flattest longitudinal slope practical should be provided. Preferably, the longitudinal slope should not be steeper than 8% or the longitudinal slope of the adjacent street. A sidewalk slope of 5% or flatter does not require the use of handrails as defined in Section 51-1.07.

2. Separation. A sidewalk adjacent to the curb or roadway may be offset to avoid a non-conforming cross slope at a drive apron by diverting the sidewalk around the apron.

3. Street Furniture. Street furniture such as a signal-controller cabinet, light standard, strain pole, utility pole, mailbox, sign support, etc., should not be placed within the required sidewalk width. In a location where it is impractical to provide the minimum sidewalk width, an accessible width of 3 ft should be maintained.

51-1.06 Stairway

A stairway should not be part of an exterior accessible route or a sidewalk on public right of way because it cannot be safely negotiated by an individual in a wheelchair. Where a stairway is used as part of an access route to a building or facility not subject to the ADA requirements, it should be

designed to be accessible by other handicapped individuals. Therefore, the design of a stairway should be in accordance with *ADA Guidelines* Section 4.9. This includes, for example, providing handrails. The designer should review the INDOT *Standard Drawings* for additional details on the design of a stairway.

51-1.07 Ramp

A part of an accessible route with a slope steeper than 5% should be considered a ramp and should be in accordance with the *ADA Guidelines*. This includes providing handrails. The following criteria apply to a ramp on an accessible route.

1. Slope and Rise. The flattest possible slope should be used. Figure 51-1D, Allowable Ramp Dimensions, New Construction, provides the maximum allowable ramp slope for new construction. A curb ramp or ramp to be constructed on an existing site or in an existing building or facility may have the slope and rise shown in Figure 51-1E, Allowable Ramp Dimensions for Existing Site, Building, or Facility, if space limitations prohibit the use of a slope of 8% or flatter.

2. Width. The minimum clear width should be 3 ft.

3. Landing. A ramp should have a level landing at the bottom and top of each run. A landing should be in accordance with the following.

    a. It should be at least as wide as the ramp run leading to it.

    b. The clear length should be a minimum of 5 ft.

    c. If a ramp changes direction at a landing, the minimum landing size should be 5 ft by 5 ft.

4. Handrail. If a ramp run has a rise greater than 0.5 ft or a horizontal projection greater than 6 ft, it should have handrails on both sides. A handrail is not required for a curb ramp. A handrail should be in accordance with the following.

    a. Handrails shall be provided along both sides of a ramp segment. The inside handrail on a switchback or dogleg ramp should be continuous.

    b. If a handrail is not continuous, it should extend at least 1 ft beyond the top and bottom of the ramp segment and should be parallel with the floor or ground surface.

    c. The clear space between the handrail and the wall should be 1½ in.

d. The gripping surface should be continuous.

e. The top of the gripping surface should be mounted between 2.8 ft and 3.2 ft above the ramp surface.

f. The end should be either rounded or returned smoothly to the floor, wall, or post.

g. A handrail should not rotate within its fittings.

5. Cross Slope and Surface. The cross slope of a ramp surface should not be steeper than 2%. The ramp surface should be in accordance with the sidewalk-surface criteria described in Section 51-1.05.

6. Edge Protection. A ramp or landing with a drop-off should have a curb, wall, railing, or projecting surface that prevents people from slipping off the ramp. A curb should be of minimum height of 2 in.

7. Outdoor Conditions. An outdoor ramp and its approaches should be designed so that water will not accumulate on the walking surface.

51-1.08 Sidewalk Curb Ramp

Highway or street resurface, rehabilitation, or improvement work in a suburban, intermediate, or urban (built-up) area in a city or town often requires the providing of adjacent curbs and sidewalks, or the repair or replacement of these facilities. In such an area, especially an urban (built-up) area, the faces of commercial or public buildings are often constructed on or in close proximity to the right-of-way or property line.

The Department, along with each local public agency, under Americans with Disabilities Act (ADA) Title II, is required to provide ADA-accessible facilities within the public right of way where a public facility such as a public building, curb and sidewalk, a rest area, a weigh station, etc., are currently located or are to be provided.

Each private business which is considered to be a place of public accommodation such as a retail business, restaurant, doctor's office, law office, etc., is required under ADA Act Title III to provide an ADA-accessible facility on its private property.

Curb or sidewalk repair or replacement may require a change in the sidewalk elevation within the public right of way. INDOT is responsible for ascertaining that ADA requirements are addressed on INDOT right of way. A business that serves the public and has a building with the

building face on or nearly on the right-of-way or property line is responsible for ensuring that each building entrance or walk, etc., is ADA-compliant and compatible with the adjacent public right-of-way sidewalk.

A project which includes curbs and sidewalks at pedestrian crosswalks will require sidewalk curb ramps to eliminate physical barriers for ease of access to such crosswalks. A pedestrian crosswalk is defined as the portion of a street ordinarily included within the prolongation or connection of lateral lines of sidewalks at an intersection. It also includes any portion of a highway or street distinctly indicated as a crossing for pedestrians by means of lines or other markings on the pavement surface.

A curb ramp provides a sloped area within a public sidewalk that allows pedestrians to accomplish a change from sidewalk level to street level. A curb ramp typically includes the ramp and flared sides and specific surface treatments, but does not include the landings at the top and bottom of the ramp.

A curb ramp should be placed at each crosswalk which extends from a paved sidewalk in each intersection with a curbed public roadway or curbed signalized commercial drive. A curb ramp should not be used at a private drive, alley, or unsignalized commercial drive. Instead, a sidewalk elevation transition as shown on the INDOT *Standard Drawings* should be placed. At a T-intersection, the designer should ensure that curb ramps are located on the side opposite the minor intersecting road if a sidewalk is present or is to be provided.

For a partial 3R project, curb ramps should be considered as described in Chapter Fifty-six. Curb ramps should not be considered for a signing, pavement marking, or roadway lighting project.

51-1.08(01) Location

In determining the location of a curb ramp, the designer should consider the following.

1. Curb ramps should be located directly opposite one another for each crosswalk, and should be placed within the transverse limits of crosswalk lines, where crosswalk lines are used.

   The placement of curb ramps affects the placement of crosswalk lines and vehicle stop lines. Conversely, the location of existing crosswalk lines and stop lines affect the placement of curb ramps. Some of the crosswalk-line constraints are shown in Figure 51-1F, Types of Curb Ramps at Marked Crossings, and on the INDOT *Standard Drawings*. The *Manual on Uniform Traffic Control Devices* contains additional constraints on crosswalk- and stop-line placement.

2. Each curb ramp should be designed and placed to provide continuity of the sidewalk corridor direction of travel while providing pedestrians the shortest but most direct route across a street.

3. The designer should ensure that the landing area at the bottom of each curb ramp does not encroach upon through-lane vehicle traffic which has the right of way at the same time a pedestrian is attempting to use the crosswalk parallel to it.

4. The curb ramp and associated landings should not be compromised by other highway features (e.g., guardrail, catch basin, utility pole, fire hydrant, sign or signal support, etc.).

5. There should be full continuity of use throughout. Opposing curb ramps should always be provided in all required intersection quadrants, including an intersection with some quadrants outside the project limits.

6. A curb ramp should be located or protected to prevent its obstruction by a parked vehicle.

7. Approval of a Level One waiver of the accessibility requirements for physically-impaired individuals is required for each location where there are valid reasons to restrict or prohibit pedestrian access. Such waiver is described in Section 40-8.04(01) Item 2.

8. The normal gutter flow line should be maintained through the curb-ramp area. Appropriate drainage structures should be placed as needed to intercept the flow prior to the curb-ramp area. Positive drainage should be provided to carry water away from the intersection of the curb ramp and the gutter line, thus minimizing the depth of flow across the crosswalk.

9. If modifications to the details shown on the INDOT *Standard Drawings* are required so that a curb ramp can be better accommodated, such details and the required pay quantities should be shown on the plans.

10. The impact of utility location on curb-ramp placement and construction should be minimized. The designer is responsible for being aware of potential utility conflicts. If utilities are present, coordination should be in accordance with Section 10-2.0.

51-1.08(02) Types of Sidewalk Curb Ramps

Details for placement of curb ramps and an illustration showing appropriate locations for each curb ramp type are shown on the INDOT *Standard Drawings*. Determining which curb ramp is most appropriate depends on the exact conditions of the site. Curb ramps are categorized below by their structural design and how they are positioned to the sidewalk or street.

1. Perpendicular Curb Ramp. This curb ramp is perpendicular to the curb and requires a wide-enough sidewalk to provide an 8% running slope. This is the preferred design. The length of the ramp depends on the height of the curb where the ramp is to be located.

Details of a ramp with an integral curb and of a ramp with a separate curb are shown on the INDOT *Standard Drawings*. A landing should be provided at the top of the ramp. If site infeasibility precludes construction as shown on the INDOT *Standard Drawings*, the level landing width my be decreased from 4 ft to 3 ft, and the running slope may be steepened to 10% for a maximum 6-in. rise. New construction should provide adequate right of way for a perpendicular curb ramp. Some portion of the curb ramp, typically one of the flared sides, may appear within the curved intersection corner. See the INDOT *Standard Drawings* for details of improved access to a perpendicular curb ramp.

The standard perpendicular curb ramps are as follows:

a. Type A. This type should be specified where a curb ramp is required entirely within the pedestrian walkway. It is the preferred type where the sidewalk is adjacent to the curb.

b. Type C. This type should be specified where a curb ramp is required outside the pedestrian walkway, in the utility strip. It is the preferred type where there is a utility strip between the sidewalk and the curb.

c. Type D. This type should be specified where a curb ramp is required near an obstruction which can not be removed. It is the preferred type for this situation, and may be used with or without a utility strip present.

2. Diagonal Curb Ramp. A diagonal curb ramp is a single curb ramp that is located at the apex of the corner at an intersection, and serves two intersecting crossing directions. Since the ramp is diagonal to the path of travel, it is only accessible if level landing or maneuvering spaces are provided at both the top and bottom of the ramp. If creating a level landing is too difficult or a 4-ft clear space cannot be provided, a diagonal curb ramp should not be considered. If site infeasibility precludes construction as shown on the INDOT *Standard Drawings*, the landing width may be decreased from 4 ft to 3 ft and the running slope may be steepened to 10% for a maximum 6 in. rise.

A diagonal curb ramp should only be used where perpendicular or parallel curb ramps are infeasible and no other option is available, or if a field investigation warrants its use for alterations affecting existing sidewalks.

If a diagonal curb ramp is to be used, durable crosswalk markings are required on the street pavement. Specific constraints for crosswalk markings and stop-lines placement are shown on Figure 51-1F, Types of Curb Ramps at Marked Crossings. Each diagonal curb ramp should be wholly contained within the crosswalk lines, including any flared sides. There should be at least 4 ft between the gutter line and the corner of the two intersecting crosswalk

lines as delineated within the intersection pavement area. See Figure 51-1F for an illustration of these criteria.

The standard diagonal curb ramps are as follows:

a. Type B. This type should be specified where a curb ramp is required entirely within the pedestrian walkway, the corner radius is greater than 10 ft, and placement of a Type A ramp is infeasible. At the bottom of the ramp, the perimeter length is 8 ft, regardless of the corner radius.

b. Type E. This type should be specified where a curb ramp is required outside the pedestrian walkway in the utility strip, the corner radius is greater than 10 ft, and placement of a Type B ramp is infeasible.

This type should also be specified where a curb ramp is required outside the pedestrian walkway in the utility strip, the corner radius is greater than 10 ft, an obstruction which cannot be removed is present, and placement of a Type C ramp is infeasible.

At the bottom of the ramp, the perimeter length is 8 ft, regardless of the corner radius.

3. Parallel Curb Ramp. A parallel curb ramp has two ramps leading down towards a center level landing at the bottom between both ramps and has level landings at the top of each ramp. A parallel curb ramp may be specified for a narrow sidewalk, steep terrain, or at a location with a high curb, as the ramp can easily be lengthened to reduce the grades. A parallel curb ramp should not be installed where it is possible to install two perpendicular curb ramps. A wall or curb may be required along the back edge of the ramp as shown on the INDOT *Standard Drawings*. The designer should show details for such wall or curb on the plans and include a unique special provision.

A parallel curb ramp should only be used where a perpendicular curb ramp is infeasible and no other option is available.

The standard parallel curb ramp is type F. This type should be specified where the corner radius at least 15 ft but less than 25 ft, and only if a field investigation warrants its use for alterations affecting existing sidewalks.

4. Depressed-Corners Curb Ramp. Depressed corners gradually lower the level of the sidewalk to meet the grade of the road, street, or signalized approach. This curb ramp should be specified only at a corner where the sidewalk parallels only one of the intersecting roadways.

The standard depressed-corners curb ramps are as follows:

a. Type H. This type should be specified where the sidewalk is adjacent to the curb.

b. Type G. This type should be specified where there is a utility strip between the sidewalk and the curb.

5. Mid-Block Curb Ramp, Type K. This type should be specified at a mid-block location. It may be used where the sidewalk is adjacent to the curb or where there is a utility strip between the sidewalk and the curb.

6. Median Curb Ramp, Type L. This type should be specified where a raised paved or unpaved median of 8 ft or wider obstructs the crosswalk. Where the median is narrower than 8 ft, a detail should be shown on the plans.

51-1.08(03) Selection Guidelines

The following provides guidelines for selecting the appropriate curb ramp.

1. Sidewalk or Utility-Strip Width. The INDOT *Standard Drawings* show minimum sidewalk widths and utility-strip widths. These minimum widths are intended for new construction and reconstruction, typically to construct a perpendicular curb ramp. A parallel curb ramp type F may be used where an existing sidewalk cannot be widened to the minimum width.

2. Obstruction. It is desirable to move an obstruction wherever practical. Where it is not practical to move the obstruction, the direction of traffic relative to the placement of the curb ramp should be considered. It is important that drivers can see a physically-impaired person using a curb ramp. Where an obstruction is present, such as a signal controller box, planter, signal pole base, etc., a perpendicular curb ramp type D should be used. No obstruction should be permitted within flared paved curb-ramp sides.

3. Best Practices. The following should be considered.

a. A level maneuvering area or landing should be provided at the top of each curb ramp.

b. The ramp slope should be perpendicular to the curb, with a maximum steepness of 8.33%. Details regarding curb-ramp slope are shown on the INDOT *Standard Drawings*.

c. The counterslope of the gutter area or street at the flat of a curb ramp should be a 5% or flatter.

d. Curb-ramp geometrics to be used are summarized in Figure 51-1G.

51-1.08(04) Curb-Ramp Lengths and Slopes

A curb ramp should be designed with a steepest slope of 8.33%. See Figure 51-1H, Lengths of Perpendicular Curb Ramps, to determine the length of a curb ramp which is perpendicular to the curb. The figure assumes a 2% sidewalk cross slope and a level longitudinal grade.

For a curb ramp which is not perpendicular to the curb, the following formula should be used to determine its length. The formula assumes a 2% sidewalk cross slope and a level longitudinal grade.

$$L_{CR} = \frac{h}{\cos\theta\left(G_R - G_S\right)} \qquad \text{[Equation 51-1.1]}$$

Where:

L_{CR} = Curb-ramp length, ft

H = Change in elevation, ft

G_R = Curb ramp grade, % / 100

G_S = Sidewalk cross grade, % / 100

θ = Angle to which the curb ramp is out of perpendicular to the curb

51-1.08(05) Algebraic Difference Between Curb Ramp and Gutter Slope

The algebraic difference between a curb ramp slope and the gutter or pavement slope should be 11% or flatter. If this is not possible, a 2-ft wide level strip should be provided between the grades. See the INDOT *Standard Drawings*.

$$\Delta G = |G_R - G_G| \qquad \text{[Equation 51-1.2]}$$

Where:

ΔG = Algebraic grade difference, %

G_R = Ramp grade, %

G_G = Gutter grade, %

$|G_R - G_G|$ = Absolute value of grade difference, %

A level strip is required if ΔG is steeper than 11%.

51-1.08(06) Detectable Warning Device

Each sidewalk curb ramp is to include a detectable warning device. This consists of a standardized surface feature to warn people with vision impairments that they are approaching a street or drive. The color and texture of the device must contrast visually with adjoining surfaces. Details and explanations are shown on the INDOT *Standard Drawings* and the INDOT *Standard Specifications,* respectively.

51-1.08(07) Pedestrian Signal Control

If a pedestrian crosswalk and curb ramp are present at an intersection with a traffic signal that has pedestrian-signal-activating pushbuttons, the following will apply.

1. Location. A pushbutton control should be located as close as practical to the curb ramp and, to the maximum extent feasible, should permit operation from a level area immediately adjacent to the controls. The control should be placed so as not to create an obstruction to the curb ramp.

2. Surface. A sidewalk area of 4 ft by 4 ft should be provided to allow a forward or parallel approach to the control. In a restricted area, such sidewalk area may be reduced to 3 ft by 3 ft.

51-2.0 REST AREA

A rest area, information center, or scenic overlook is functional and desirable element of the complete highway development and is provided for the safety and convenience of the highway user. Many have been constructed along freeways and other major arterials. The location and design of a rest area is based on individual highway facility and site needs. The need for a new rest area will be determined by the Office of Environmental Services in conjunction with the district office.

51-2.01 Location

A rest area may be located on a freeway or other major arterial. Along a freeway, two are usually paired together (i.e., one on each side of the freeway). At a State line, only one rest area or welcome center for the incoming traffic may be provided. The following provides additional information in determining the need and location of a rest area.

51-2.01(01) Spacing on an Interstate Route

The recommended average spacing of rest areas is approximately one hour of driving time or 50 to 60 mi. It may be desirable to provide closer spacing for special conditions (e.g., scenic view, information center). Local conditions may warrant spacing which is greater than 50 to 60 mi (e.g., through a major metropolitan area).

51-2.01(02) Site Considerations

Once it has been determined that a rest area is required and the general area has been selected, the actual location of the rest area is selected based upon the following considerations.

1. Appeal. A rest area is a showplace for out-of-State visitors. If practical, it should be placed to take advantage of natural features (e.g., lakes, scenic views, points of special or historic interest).

2. Welcome Center. It is desirable to locate this facility close to a State line. This location provides the opportunity to personally present information on the State along with local attractions. A rest area located well within the State may only provide information racks for literature distribution.

3. Geometrics. The site should be located away from any other interference, such as an interchange or a bridge. The rest-area entrance should desirably be at least 3 miles from the nearest interchange.

4. Environmental Considerations. The site should be located or designed so that surface runoff or treatment-plant discharges will not adversely affect streams, lakes, wetlands, etc.

5. Median. A rest area should not be located in a median unless it can be serviced via a left-hand exit and entrance.

6. Size. The rest area should be large enough to provide sufficient parking capacity, needed facilities, picnic and stretch areas, and to retain existing landscaping features.

7. Right of Way. Right-of-way costs should be factored into the location decision. To allow for future expansion, a 40-year design life should be considered based on a straight-line traffic projection.

8. Topography. A rest area should be located where the natural topography is favorable to its development.

9. Development. A rest area should not be placed adjacent to or near an area which has been zoned as residential.

10. Emergency. The location choice should consider the proximity to emergency services.

11. Water and Sewer. The rest area should have an adequate water supply. Water availability should be determined during the site selection process prior to the development of plans. If a commercial sanitary-treatment plant is unavailable, the site must be large enough to provide for adequate sewage-treatment facilities. Recreational-vehicle dumping facilities may be provided.

12. Other Utilities. Other utilities, such as telephone and electricity, should always be provided.

51-2.02 Design

51-2.02(01) Exit and Entrance

The access to and from the rest area should be designed in accordance with Section 48-4.0. Reverse curves should not be used. If deemed necessary, they should be designed in accordance with Section 43-3.07. Full-depth shoulders should be provided along both exit and entrance ramps to the ramp extremities (i.e., the ends of the ramp tapers).

Adequate signing and pavement markings must be provided. These traffic-control devices should be placed in accordance with Part VII, the INDOT *Standard Drawings*, and the MUTCD.

51-2.02(02) Buffer Separation

The separation between the rest area facility and the highway mainline should be wide enough to discourage individuals from stopping on the mainline and crossing over to the facility. At a minimum, a 35-ft buffer area should be provided between the mainline pavement and parking areas.

A buffer separation of 175 ft or more is preferable. Fencing should be provided in the buffer area between the ramps and should desirably be located beyond the mainline clear zone.

51-2.02(03) Rest-Area Usage

Predicting rest area usage is the key factor in determining the location and sizing of a rest area. The designer must first determine the proportion of mainline traffic that will be using the rest area. This determination is dependent upon rest-area spacing, trip length, rest-area location, time of year, traffic composition, highway classification, etc. The designer should use data from nearby or similar rest areas to estimate the expected traffic entering the rest area. In the absence of historical data, Figure 51-2A, Design Guide for Rest-Area Facility (Interstate Route or Freeway), and the following may be used.

1. Design Year. The design year for traffic projection should be 20 years.

2. Highway Characteristics. A rest area on a highway that passes though recreational or historic areas tends to have fewer trucks and a higher percentage of passenger cars and RVs with trailers. Where the general purpose of the highway is to move commercial traffic between cities, a rest area tends to have a higher truck usage.

3. Trip Length. On a highway where the trip length is typically less than 100 mi (e.g., between two major cities), there is a significant reduction in the proportion of the passing traffic using the facility.

4. Temporal Factors. In a recreational area, rest-area usage is the highest during a summer weekend. During the day, passenger cars tend to make up a higher percentage of the rest-area usage. At night, trucks and RVs tend to make up the higher percentage of rest-area usage.

51-2.02(04) Parking

Rest-area parking capacity depends upon the type of usage expected for the rest area. Figure 51-2A, Design Guide for Freeway Rest-Area Facility, provides the formula and other factors to consider when determining the appropriate design hourly volume for passenger cars, passenger cars with trailers, and trucks. Consideration should be given to adding additional truck parking spaces if the rest area is located close to major delivery or distribution centers.

Parking areas for passenger cars and trucks should be separated from each other within the rest area. This should be accomplished by providing separate parking areas on opposite sides of the building. However, a separator (e.g., curbing) or pavement markings may be used in a restrictive location.

Figure 45-1B illustrates typical parking designs for a passenger car. Angular parking is preferred to parallel parking because it requires less time to enter and exit.

Figure 51-2B illustrates a typical angle-parking design for a truck or recreational vehicle. The design vehicle for angular truck parking is the WB-20 vehicle.

51-2.02(05) Pavement Design

Pavements for exit and entrance ramps, truck parking area, and truck connector roadway should be designed using a 14-in. portland cement concrete pavement on 3 in. of coarse aggregate No. 8 on 6 in. of compacted aggregate No. 53. The pavement area to be used only by passenger cars may be designed using a 10-in. portland cement concrete pavement on 3 in. of coarse aggregate No. 8 on 6 in. of compacted aggregate No. 53.

51-2.02(06) Cross Slopes

All ramps and connector routes should have a 2% cross slope. Parking areas typically should be designed with a 2% cross slope. A 5% maximum grade may be used. If practical, handicapped parking areas should not exceed 1%.

51-2.02(07) Facilities

A rest area provides a building with rest rooms and public information services, picnic tables and shelters, benches, sidewalks, drinking fountains, and trash collectors. It may also include vending machines, provided the machines are accessible from outside the building. The designer should ensure that sufficient facilities are available to accommodate the expected usage of the rest area. Figure 51-2A, Design Guide for Freeway Rest-Area Facility, provides the recommended total number of comfort facilities. Figure 51-2C, Guidelines for Comfort Facilities, should be used to determine the recommended number and types of fixtures. Dual men's and women's facilities (minimum of 2 each) should be provided to allow for cleaning, maintenance, etc. The total number of fixtures should be divided equally between the rest rooms. If practical, the designer should also consider providing exclusive unisex rest rooms for handicapped individuals. The building should be adequately sized to provide 120 ft^2 of floor area for each sanitary facility plus an additional 200 ft^2 of floor space. The rest-area building must be in accordance with all Indiana Department of Fire Prevention and Public Safety building codes.

51-2.02(08) Utilities

Where permanent facilities are provided, an adequate drinking-water supply, a wastewater disposal system, and a power supply will be required. These are required to bring the facilities into accordance with federal, Indiana Administrative Code (IAC), and Indiana Department of Environmental Management (IDEM) regulations, and local ordinances. Where practical, connection to existing wastewater treatment facilities and drinking-water supplies is the most desirable option.

A dedicated drinking-water treatment system will require a security system, ozone addition for deposition of iron, chlorine treatment, phosphate treatment, and backflow prevention to prevent contamination of the stored water and the water from the well. The drinking-water treatment system structure should be placed at least 4 ft horizontally clear of other structures. For a purchased-water system, automated chlorine testing and addition will also be required. Drinking-water treatment should otherwise be in accordance with IAC 327.

A dedicated wastewater disposal system will require a testing laboratory. Wastewater treatment units will require protection from exposure to direct sunlight, covers, or other means that prevent animals, bird feces, or external debris from entering the system, and shelter or other means that keeps the wastewater temperature within a specified range. A standby electric generator, surge control tank with dissolved oxygen sensor, trash collection tank, fixed film media filters, sand filters, ultraviolet disinfection, diffusers, and a splitter box are also required. The wastewater disposal system trash collection tank should be placed upstream of the surge control tank. Wastewater treatment should otherwise be in accordance with IAC 327 and 329.

A remote telemetry system will be required for the drinking-water and wastewater treatment facilities, lift stations, and locations where the water is purchased.

As a minimum, the telemetry system should include the following:

1. A portable laptop computer for data access and system interaction, including an operator training manual.

2. The computer software should be compatible with and be able to enter data onto IDEM's report forms. The forms are accessible through IDEM's website, at www.in.gov/idem/publications/forms/index.html#waterforms.

3. The interaction shall include an alarm to alert the plant operator (when the operator is both on-site and off-site) when the system's conditions are not within the required parameter limits.

4. A digital flow monitor.

5. The interaction shall include the ability to automatically add treatment chemicals.

The designer should develop appropriate specifications and call for appropriate pay items for this additional work. The specifications should comply with the Ten State Standards requirements. The Office of Environmental Services' Environmental Policy Team will review and approve the specifications.

The IDEM is responsible for approval of the final wastewater treatment and drinking-water supply options.

Telephones are usually also included. Proper lighting provides the patron an added sense of security and safety. Chapter Seventy-eight provides additional information on lighting design.

51-2.02(09) Landscaping

The rest area should be landscaped to take advantage of existing natural features and vegetation (see Section 51-8.0). Paths, sidewalks, and architectural style should fit naturally into the existing surroundings. The designer should coordinate the landscaping plan with the Services and Cultural Resources Team. A chain link fence should be placed between the parking areas and the adjacent roadway to enhance pedestrian safety.

51-2.02(10) Accessibility for the Handicapped

A rest area must be designed to properly accommodate physically handicapped individuals; including grounds, picnic areas, ramps to picnic areas, buildings, automatic door openers, sidewalk ramps, and signage. The designer must realize that an accessible route is required between the truck and RV parking area to the rest-area facilities. Section 51-1.0 provides the handicapped accessibility criteria for exterior features within a rest area. The *ADA Accessibility Guidelines for Buildings and Facilities* provides the handicapped-accessibility criteria for interior features.

51-3.0 WEIGH STATION

A truck weigh station installation is used to weigh trucks, to provide for vehicular safety inspection, or to provide a source of data for planning and research. The determination of the need for a truck weigh station is a combined effort of INDOT, the Indiana State Police, the Department of Revenue, and the Bureau of Motor Vehicles.

51-3.01 Location

Indiana has adopted the Point-of-Entry concept for locating a new weigh station. A weigh station is to be located only at or near a State line for inbound trucks on an Interstate route.

The actual selection of a truck weigh station site is controlled by right of way limitations and by geometric and topographic features (i.e., at the crest of a hill). It is desirable to select a site in a location where there is adequate right of way and where geometric, topographic, or environmental features lend themselves to the most economical development without undue site preparation and expense. The possibility of truck traffic circumventing the facility is also considered in locating the site of the weigh station.

51-3.02 Design

Figure 51-3A illustrates a typical truck weigh-station layout. In addition, the following should be considered.

1. Exit and Entrance Junctions. Desirably, the exit and entrance should be designed for large trucks. Section 48-4.0 provides design criteria for these elements, including truck acceleration and deceleration lengths.

2. Exit and Entrance Ramps. The minimum paved width is 28 ft, including a 4-ft left shoulder and 8-ft right shoulder. The shoulders should be designed with a full-depth pavement structure along both exit and entrance ramps to the ramp extremities (i.e., the ends of the ramp tapers). The cross slope will typically be 2% for the entire width, including shoulders.

3. Pavement Design. Pavements for ramps and the scale area should be designed using a 14-in. portland cement concrete pavement on 4 in. of coarse aggregate No. 8 on 3 in. of compacted aggregate No. 53. The parking area should have 12 in. portland cement concrete pavement on 4 in. of coarse aggregate No. 8 on 3 in. of compacted aggregate No. 53.

4. Geometrics. The weigh station area should be designed so that backing maneuvers are not required (e.g., pull-through parking). All pavement geometrics should be designed to accommodate off-tracking for a WB-20 design vehicle (Indiana Design Vehicle).

5. Maximum Grade. A short upgrade of as much as 5% does not unduly interfere with truck or bus operations. Consequently, for new construction it is desirable to limit the maximum grade to 5%. The grades across a weigh-in-motion scale must be 0% for 100 ft before and after the weigh-in-motion scale.

6. Buffer Separation. There should be a 30-ft minimum buffer strip between the weigh station facility and the mainline pavement. A wider separation is desirable.

7. Storage Length for Scale. There should be sufficient space to queue trucks waiting for the scale without backing up onto the mainline. This distance will be based on the number of trucks on the mainline, length of trucks, expected hours of operation, and time required for actual weighing. For design considerations, the design vehicle can be assumed to be the WB-20 truck. With the rapid advance in research on scales (e.g., weigh-in-motion), the designer should check with other Department entities or other agencies to determine the most appropriate time factor.

8. Safety Inspection. A weigh station will also be used by the Indiana State Police as a safety-inspection station. Therefore, a separate inspection building will be required. This building should be designed to accommodate a total of two WB-20 design vehicles, one in each of the adjacent bays.

9. Violation Storage. A space should be provided to store trucks that are either overweight or which have failed the safety inspection. These areas should be designed to accommodate the WB-20 design vehicle. Figure 51-2A, Design Guide for Freeway Rest-Area Facility, provides the design criteria for a WB-20 angular truck storage area.

10. Traffic Control Devices. Adequate signing and pavement markings should be provided prior to and at the truck weigh station. These traffic control devices should be designed and placed in accordance with the MUTCD and the INDOT *Standard Drawings*. The designer should contact the Production Management Division's Traffic Design Team for information regarding design for an electronic "Open / Closed" sign. Special signing will also be necessary for the internal traffic flow through the weigh station, such as at the weigh-control area and the inspection building.

11. Lighting. Chapter Seventy-eight provides information on lighting design.

12. Inspection Building. An inspection building should be designed for year-round use with sufficient space for computer operations, a service counter for permit issuances, and an emergency shower facility for hazardous-material removal. The inspection building should be in accordance with all local building codes and OSHA criteria.

13. Hazardous Materials. A 1600-gal. tank is required on site for the storage of hazardous materials from leaking or overflowing trucks. A detention basin with flow-release controls is required to contain surface runoff from the parking area.

14. Landscaping. The weigh station should be designed to minimize the effect on existing vegetation. The designer should also ensure that any new or existing plants will not affect the driver's sight distance to the weigh station or any critical point within the weigh station. Section 51-8.0 provides additional information on the Department's landscaping policy.

51-4.0 OFF-STREET PARKING

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

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.

The following provides criteria specifically for an off-street parking lot. Section 51-2.0 discusses that for a rest area.

51-4.01 Location of Park-and-Ride Lot

The Office of Environmental Services, in conjunction with the district office, determines the location of a park-and-ride lot during the planning stage. However, the designer usually has some control over the best placement of the lot when considering layout details, entrance and exit locations, and traffic flow patterns.

A park-and-ride lot should be located at a strategic point where transfers can conveniently be made from auto to carpooling or transit modes. Considerations that will affect the location of the parking facility are as follows.

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

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

3. Connections. There should be sufficient capacity on connections between the lot and the major commuting highway.

4. Design. The site location must be compatible with the design and construction of the lot. The designer should consider property costs, terrain, drainage, sub-grade soil conditions, and available space in relation to the required lot size, visibility, and access.

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

6. Size. The lot must be large enough to accommodate its expected usage. Studies by the Office of Environmental Services will determine the size of the lot and will determine the number of bus-loading areas.

51-4.02 Layout

The following should be considered when laying out a park-and-ride facility.

1. Entrances and Exits. Entrances and exits should be located to have the least disruption to existing traffic (e.g., away from intersections) and still provide the maximum storage space. A combined entrance and exit should preferably be as close to mid-block as practical. Where entrances and exits are separated, the entrance should be on the upstream side of the traffic flow nearest the lot and the exit on the downstream side. There should be at least one exit and entrance for each 500 spaces in a lot.

   Each entrance or exit should be designed as a commercial drive according to the design criteria described in Chapter Forty-six. The typical design vehicle will be a BUS or SU.

2. Drop-off and Pick-up Zone. Drop-off and pick-up zones for buses and autos should be clearly separated from each other and from the parking area to avoid as many internal traffic conflicts as possible. The bus loading and unloading zone should be serviced by the innermost parking lanes. Therefore this zone should be adjacent to the terminal loading and unloading area. Handicapped parking and the separate kiss-and-ride area should be serviced by the next closest parking lane. The number of parking spaces for a drop-off zone is between 20 and 60.

3. Traffic Circulation. Traffic circulation should be arranged to provide maximum visibility and minimum conflict between small vehicles (autos and taxis) and large vehicles (large vans and buses). Also, adequate maneuvering room must be provided for larger vehicles. A counterclockwise circulation of one-way traffic is preferred. This allows vehicles to unload from the right side.

4. Pedestrian and Bicyclist Considerations. The designer should consider pedestrian and bicycle routes when laying out a park-and-ride lot. Entrance and exit points in an area with high pedestrian volume should be avoided, if practical. Sidewalks should be provided between the parking area and the modal transfer points.

Crosswalks should be provided where necessary and clearly marked and signed. In a high-volume lot, fencing may be warranted to channel pedestrians to appropriate crossing points. A crossing at a major two-way traffic circulation lane should have a refuge island separating the travel directions.

A bicycle parking area should be provided with stalls that allow the use of locking devices. If a large volume of bicycle traffic is expected, a designated bicycle lane to and from the bicycle parking area should be provided.

5. Accessibility for Handicapped Individuals. Section 51-1.0 discusses the accessibility criteria for handicapped individuals, which also apply to a park-and-ride lot.

51-4.03 Design Elements

The following elements should be considered in the design of a park-and-ride facility.

1. Parking-Stall Dimensions. Parking-stall dimensions vary with the angle at which the stall is arranged relative to the aisle. Figure 51-4A, Parking-Stall Dimensions, provides the design dimensions for a 9 ft x 18 ft parking stall based on one-way circulation and angle parking. The typical stall width (measured perpendicular to the vehicle when parked) ranges from 8.5 ft to 9.5 ft. The recommended minimum stall width for self-parking of long-term duration is 8.5 ft. For higher-turnover self-parking, a stall width of 9 ft is recommended. Stall width at a supermarket or other similar parking facility, where large packages are prevalent, should desirably be 9.5 ft to 10 ft.

2. Bus Loading Area. A bus loading and unloading area should be designed to provide for continuous counterclockwise circulation and for curb parking without backing maneuvers. The traffic lanes and the curb loading area should each be 12-ft wide. Figure 51-4B provides criteria for the recommended length of a bus loading area.

3. Sidewalk Dimensions. The sidewalk should be at least 6 ft wide. In a loading area, the width should be at least 12 ft. The accessibility criteria for the handicapped must be met for a new lot (see Section 51-1.0).

4. Cross Slope. To provide proper drainage, the minimum cross slope on the parking lot should be 2%. The maximum, cross slope should not exceed 5%.

   The lot should be designed directing runoff into existing drainage systems. If water impoundment cannot be avoided along a pedestrian route, bicycle route, or standing area, drop inlets and underground drainage should be provided. In a parking area, drainage should

be designed to avoid standing water. Part IV provides additional information for the proper hydraulic design of drainage elements.

5. Pavement. A typical pavement design for the parking area is 3 in. of hot asphaltic concrete on 6 in. of aggregate base. For a bus route, the minimum pavement section should be 3½ in. of hot asphaltic concrete on 10 in. of aggregate base. For additional information on pavement design, see Chapter Fifty-two.

6. Lighting. The lot should be lighted for pedestrian safety and lot security. Chapter Seventy-eight provides information on lighting design.

7. Shelter. A pedestrian shelter is desirable if loading areas for buses or trains are provided. The shelter should provide approximately 5.5 ft^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. For handicapped-accessibility requirements, see Section 51-1.0.

8. Fencing. The need for fencing around a parking lot will be determined as required.

9. Signs. Signs should be provided to direct drivers and pedestrians to appropriate loading zones, parking areas, bicycle facilities, handicapped parking, or entrances and exits.

10. Landscaping. Landscaping may be provided to minimize the visual impact of the parking lot by providing a buffer zone around the perimeter of the lot or to improve the aesthetics of the lot itself. Space should be provided for a 10-ft to 20-ft buffer zone around the lot to accommodate vegetation screens. Traffic 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. For information on appropriate vegetation selections, the designer should contact the Services and Cultural Resources Team.

51-4.04 Maintenance Considerations

Maintenance should be considered in the design, including the following.

1. A 10-ft to 20-ft snow shelf should be provided around the perimeter of the lot, at least on two sides, to provide storage space during snow removal. This area can coincide with the buffer zone around the lot, provided that the entire area is not filled with shrubs or trees. Fencing should be placed outside the snow shelf.

2. Raised traffic islands should be kept to a minimum. Raised corrugated islands are preferred.

51-5.0 BUS STOP AND BUS TURNOUT

51-5.01 Location

51-5.01(01) Bus Stop

If local bus routes are located on an urban or suburban highway, the designer should consider their impact on normal traffic operations. The stop-and-go pattern of local buses will disrupt traffic flow, but certain measures can minimize this disruption. The location of a bus stop is particularly important. It is determined not only by convenience to patrons but also by the design and operational characteristics of the highway and the roadside environment. If the bus must make a left turn, for example, a bus stop should not be located in the block preceding the left turn. Common bus-stop locations are shown in Figure 51-5A, On-Street Bus Stop.

Some considerations in selecting an appropriate bus-stop location are as follows.

1. Far-Side Stop. The far side of an at-grade intersection is superior to a near-side or mid-block bus stop. A far-side stop produces fewer impediments to through and right-turning traffic, it does not interfere as much with intersection sight distance, and it lends itself better to a bus turnout.

2. Mid-Block Stop. A mid-block bus stop may be advantageous where the distance between intersections is large or where there is a fairly heavy and continuous transit demand throughout the block. It may be desirable if there is a high bus-stop demand located at mid-block. A mid-block bus stop may also be considered if right turns at an intersection are frequent (250 in peak hour) and a far-side stop is not practical.

3. Near-Side Stop. A near-side stop allows easier vehicle re-entry into the traffic stream where curb parking is allowed. At an intersection where there is a high volume of right-turning vehicles, a near-side stop can result in traffic conflicts and should be avoided. However, a near-side stop should be used where the bus will make a right turn at the intersection.

51-1.01(02) Bus Turnout

Interference between buses and other traffic can be reduced significantly by providing a bus turnout. A turnout helps remove stopped buses from the through lanes and provide a well-defined user area for a bus stop. A turnout should be considered under the following conditions.

1. The street provides arterial service with high traffic speeds and volumes and high-volume bus patronage.

2. Right-of-way width is sufficient to prevent adverse impact on sidewalk pedestrian movements.

3. Curb parking is permitted but is prohibited during peak hours.

4. There are at least 500 vehicles per hour in the curb lane during peak-hour traffic.

5. Bus volume does not justify an exclusive bus lane, but there are at least 100 buses per day and at least 10 to 15 buses during the peak hour.

6. The average bus dwell time exceeds 10 s per stop.

7. At a location where specially-equipped buses are used to load and unload handicapped individuals.

51-5.01(03) Selection

The Office of Environmental Services, in conjunction with the district office and the local transit agency, will determine the location of a bus stop or bus turnout. However, the designer usually has some control over the best placement of a bus stop or turnout location when considering layout details, intersection design, and traffic-flow patterns.

51-5.02 Design

51-5.02(01) Bus Stop

Figure 51-5A provides the recommended distance for the prohibition of on-street parking near a bus stop. Where articulated buses are expected to use a stop, an additional 20 ft should be added to this distance. An additional 50 ft of length should be provided for each additional bus expected to stop simultaneously at any given bus-stop area. This allows for the length of the extra bus (40 ft) plus 6 ft between buses. Changes in parking restrictions will require Official Action by INDOT.

51-5.02(02) Bus Turnout

The following design criteria will apply.

1. The desirable width is 12 ft, and the minimum width is 10 ft.

2. The full-width area of the turnout should be at least 50 ft long. Where articulated buses are expected, the turnout should be 70 ft. For a two-bus turnout, add 50 ft.

3. Figure 51-5B illustrates the design details for a bus turnout. In the transition areas, an entering taper not sharper than 5:1 and an exit taper not sharper than 3:1 should be provided. As an alternative, a horizontal curve of 100 ft radius may be used on the entry end and a horizontal curve of 50 ft to 100 ft radius may be used on the exit end. When a turnout is located at a far-side or near-side location, the cross-street area can be assumed to fulfill the need for the entry or exit area, whichever applies.

51-5.02(03) Bus-Stop Pad

Each new bus stop which is constructed for use with lifts or ramps must be in accordance with the handicapped-accessibility criteria set forth in Section 51-1.0.

51-5.02(04) Shelter

The need for a bus-stop shelter will be determined by the Office of Environmental Services in conjunction with the local transit agency. The designer should consider the following in the design of a shelter.

1. Visibility. To enhance passenger safety, the shelter sides should provide maximum transparency as practical. The shelter should not be placed such that it limits the general public's view of the shelter interior.

2. Selection. The local transit agency should be contacted to determine if it uses a standardized shelter design.

3. Appearance. The shelter should be pleasing and blend with its surroundings. The shelter should also be clearly identified with transit-company logo symbols.

4. Handicapped Accessibility. A new shelter must be designed to be in accordance with the accessibility criteria set forth in Section 51-1.02.

5. Placement. The shelter should not be placed where it will restrict vehicular sight distance, pedestrian flow, or handicapped accessibility. It should also be placed so that waste and debris are not able to accumulate around the shelter.

6. Responsibility. The local transit agency is responsible for providing and maintaining the shelter.

7. Capacity. The maximum shelter size is based upon the maximum expected passenger accumulation at a bus stop between bus runs. The designer can assume approximately 5.5 ft^2 per person to determine the appropriate shelter size. See Section 51-1.02 for minimum handicapped-accessibility requirements.

51-6.0 RECREATIONAL ROAD

Recreational-road design criteria are applicable to a road on a scenic drive or a Department of Natural Resources property such as a State park or other recreational area. The objective for this type of facility is to provide a safe highway and still retain the aesthetic, ecological, environmental, and cultural amenities of the area.

51-6.01 Functional Classification

A recreational road is functionally classified as a primary access road, circulation road, or area road. A primary access road provides access between a general-public-use highway and the recreational facility. A circulation road provides for the movement between activity sites within the recreational facility. An area road allows for the direct access to individual activity areas such as a campground, park area, boat-launching ramp, picnic area, scenic overlook, or historic site. Figure 51-6A illustrates a typical recreational-road functional-classification network.

51-6.02 Design

Strict adherence to highway criteria for this type of road is usually inappropriate and unwarranted. Design speed is usually low and driver expectancy is such that the reduction of design criteria does not produce serious safety concerns. Therefore, the designer should use engineering judgment to ensure that the design criteria fit the terrain and expected usage of the highway. Figure 51-6B provides the recommended geometric design criteria for a recreational road. However, for a primary access road which is a part of the county or State highway system, the geometric design criteria as described in Chapter Fifty-three or Fifty-five for the appropriate functional classification should be used. In addition to Figure 51-6B, the designer should consider the following.

51-6.02(01) Design Vehicle

Depending on the nature of the recreational area, the most common design vehicle may be a passenger car, passenger car with a travel trailer, passenger car with a boat trailer, motor home, a

motor home with a boat trailer, or possibly a bus. Where garbage pickup or other maintenance vehicles are required, an SU may be the most appropriate design vehicle.

The selected design vehicle should be used to determine lane widths, vertical clearances, intersection design, etc.

51-6.02(02) Stopping Sight Distance

Figure 51-6B provides the minimum stopping sight distances for a 2-lane or a 1-lane road. On a 2-directional 1-lane road, sufficient sight distance must be provided to allow one vehicle to reach a turnout or for both vehicles to stop before colliding. This distance is considered to be twice the stopping sight distance.

51-6.02(03) Vertical Alignment

Figure 51-6B provides the recommended *K* values for vertical curves, maximum grades, and vertical clearances. Chapter Forty-four provides additional information on vertical-alignment design.

51-6.02(04) Horizontal Alignment

Straight tangent sections are often aesthetically undesirable and often physically impractical. Figure 51-6B provides the recommended minimum radius based on an e_{max} of 4%. However, on a primary access road, an e_{max} of 6% may be used. For a design speed of 20 mph or lower, superelevation is often unnecessary and impractical. Chapter Forty-three provides additional information on horizontal alignment for a paved roadway. An unpaved roadway is not superelevated.

For a narrow roadway with minimum radii, it may be necessary to provide travelway widening on the inside of a sharp curve. AASHTO *A Policy on Geometric Design of Highways and Streets* provides information for the design of pavement widening. The design vehicle for pavement widening will be the motor home with a boat trailer (MH/B).

51-6.02(05) Cross Section

Figure 51-6B provides the recommended cross-section widths for travel lanes, shoulders, and auxiliary lanes. The use of wider pavements is often aesthetically objectionable and often unwarranted. The designer must balance the safety benefits of a wider roadway with those of aesthetic and environmental concerns.

Where traffic volumes are less than 100 vehicles per day, it may be feasible to use a 2-directional, 1-lane roadway. This roadway type is often desirable from an economic and environmental standpoint. Where a 1-lane roadway with 2-directional traffic is used, turnouts for passing should be provided. Traffic convenience requires that such turnouts be intervisible, provided on each blind curves, and supplemented as necessary so that the maximum distance between turnouts is not more than 1000 ft. A turnout should be a minimum of 10 ft wide for a length of 50 ft and should have a 30-ft taper on each end. For an extra-long or extra-wide vehicle, these dimensions may need to be adjusted.

On a primary access road, the foreslopes and backslopes should be 4:1 or flatter. However, on a circulation or area road this criterion is often aesthetically undesirable. At a lower speed, steep slopes typically do not present a problem. However, maintenance operations may be better facilitated by the use of flatter slopes. The ditch section, typically a V ditch, should be deep enough to satisfactorily accommodate the expected design flow and provide for satisfactory drainage of the pavement base and sub base.

51-6.02(06) Roadside Safety

On a primary access road, an obstruction-free zone of 10 ft should be provided from the edge of the travel lane. However, use of a smaller width is appropriate where economic or environmental concerns dictate. The use of an obstruction-free zone on a circulation or area road is less critical due to its lower speed and traffic volume. Nevertheless, the designer should provide as wide an obstruction-free zone as practical where the accident potential is greater than normal (e.g., a sharp horizontal curve at the end of a long, steep downgrade). Section 55-5.0 provides additional information on the application of obstruction-free zone.

Roadside barriers should only be installed at points of unusual danger. Where barriers are installed, they should blend in naturally with the surrounding environment (e.g., wood rails on wood posts). For information on acceptable roadside barriers along a recreational road, the designer should contact the Indiana Department of Natural Resources' Engineering Division.

51-7.0 BIKEWAYS

The majority of bicycling will take place on public roads with no dedicated space for bicyclists. Bicyclists can be expected to ride on almost all roadways. Sometimes they use sidewalks as joint bicycle and pedestrian facilities, unless such usage is prohibited by local ordinance. This section primarily provides information on the development of new facilities to enhance and encourage safe bicycle travel.

51-7.01 Bikeway Classifications

The following bikeway definitions will apply.

1. Bikeway. Any road, path or way which in some manner is specifically designated as being open to bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or will be shared with other transportation modes.

2. Shared Roadway. Any roadway upon which a bicycle lane is not designated and which may be legally used by bicycles regardless of whether such facility is specifically designated as a bikeway.

3. Bicycle Path. A bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Bicycle paths may assume different forms, as conditions warrant. They may be 2-direction, multilane facilities or, where the path would parallel a roadway with limited right-of-way, a single lane on both sides of the road.

4. Bicycle Lane. A portion of a roadway which has been designated by striping, signing and pavement markings for the preferential or exclusive use of bicyclists. It is distinguished from the travel portion of the roadway by a physical or symbolic barrier. Bicycle lanes may also assume varying forms but are typically included in one of the following categories.

    a. bicycle lane between parking lane and travel lane, or

    b. bicycle lane between roadway edge and travel lane, where parking is prohibited.

51-7.02 Guidelines

Each type of facility has its own merits and disadvantages. Care must be exercised in choosing the appropriate type of facility for a given site. The following discussion and guidelines are offered to assist in making decisions regarding bikeway type. The use of definite, numerical limits for warrants should be avoided, and placing excess emphasis on any single concern should be avoided. Each route is unique and must be evaluated individually.

51-7.02(01) Bicycle Paths

Bicycle paths are normally constructed explicitly for use by bicycles. The cyclist is provided with a clear-cut route and is protected from many hazardous conflicts. However, bicycle paths are

extremely expensive to construct due to right-of-way and construction costs.

The following guidelines may be used to justify a bicycle path.

1. high vehicular speed on adjacent roadway;

2. high vehicular traffic volume on adjacent roadway;

3. high percentage of trucks on the adjacent roadway;

4. high bicycle traffic volume;

5. substantial anticipated increase in vehicular and/or bicycle traffic volume;

6. absence of suitable alternative routes;

7. demonstration that the facility would serve a definite purpose; and

8. reasonable indication that the bicycle path would be the safest and most economical method of providing a bicycle facility.

51-7.02(02) Bicycle Lanes

The occupation of a portion of a roadway by a bicycle lane implies a reasonable degree of safety for the cyclist. Conditions must be generally less severe than those which recommend a bicycle path. The use of a bicycle lane is normally restricted to bicycles, but exceptions may be made. Some sort of physical or symbolic barrier must be employed to delineate the bicycle portion of the roadway. Commonly, this is a painted stripe on the roadway surface.

The cost of installing a bicycle lane is normally a fraction of the expense associated with bicycle paths. Another advantage of bicycle lanes is the relatively minor land requirements. They can be installed in many areas where the construction of paths would be impractical. In practice, bicycle lanes, although not ideal, may be the most practical means of developing bikeways.

The following guidelines may be used to justify a bicycle lane.

1. moderate to low vehicular speed on adjacent roadway;

2. moderate to low vehicular traffic volume on adjacent roadway;

3. moderate bicycle traffic volume;

4. anticipated increase in bicycle traffic volume;

5. insufficient land to construct bicycle paths without major disruptions on the surroundings;

6. demonstration that the facility would serve a definite purpose; and

7. indication that the bicycle lane would be the safest and only feasible method of providing a bicycle facility.

51-7.02(03) Shared Roadway

Mixing bicycles and motor vehicles should generally be avoided. There are instances, however, where this is a practical method of establishing a bikeway. Because a shared roadway is designated only by bikeway signs, it is implied that the roadway provides safe conditions for both cyclist and motorist. Where some type of bikeway is warranted, shared roadways should be allowed only where the existing conditions either do not justify the greater expense of a higher type facility or prevent their installation.

The following guidelines may be used to justify a shared roadway.

1. low vehicular speed on roadway;

2. low vehicular traffic on roadway;

3. low percentage of trucks on roadway;

4. moderate bicycle traffic volume;

5. anticipated increase in bicycle traffic volume;

6. demonstration that the facility would serve a definite purpose;

7. indication that the shared roadway would be the safest and only feasible method of providing a bicycle facility; and

8. a higher grade facility not warranted.

51-7.03 Selection

Local governmental agencies will generally determine the bikeway type and location for the bicycle facility during the planning stages on most projects. If during the design of a project, it is determined that a bicycle facility is required, the designer should coordinate with these agencies to determine the most appropriate bikeway type.

51-7.04 Design

For design criteria of bicycle facilities, the designer is referred to the AASHTO publication *Guide for the Development of Bicycle Facilities*.

51-8.0 LANDSCAPING

51-8.01 General

Roadside landscaping can greatly enhance the aesthetic value of a highway. Landscaping treatments should be considered early in project development so that they can be easily and inexpensively incorporated into the project design. This may require the acquisition of additional right of way to implement these treatments.

Landscaping treatments are typically not included with other project types, but are generally completed as a separate project. Landscaping treatments will be considered on a project-by-project assessment.

51-8.01(01) Responsibility

The Production Management Division's Services and Cultural Resources Team has the primary responsibility for determining or reviewing landscaping treatment. During the final field check, a landscape architect will attend to determine the landscaping treatment. The Services and Cultural Resources Team or landscape consultant will submit recommendations and landscaping details to the designer for incorporation into the project design.

51-8.01(02) References

For information on landscaping procedures and plants, the designer should contact the Services and Cultural Resources Team for their expertise. The designer should review the INDOT *Standard Drawings*, the AASHTO *A Guide for Transportation Landscape and Environmental Design*, and the Team's reference library for more information on landscaping.

51-8.02 Benefits

Roadside landscaping can be designed advantageously to yield several benefits. The most important objective is to naturally fit the highway into the existing terrain. The existing landscape should be retained to the maximum extent practical. The following is a brief discussion of the benefits of proper landscaping.

1. Aesthetics. Gentle slopes, hills, parks, bodies of water and vegetation have an obvious aesthetic appeal to the highway user. Landscaping techniques can be used effectively to enhance the view from the highway. In a rural area, the landscaping should be natural and should eliminate construction scars. The planting shape and spacing should be irregular to avoid a cosmetic appearance.

   In an urban area, the smaller details of the landscape predominate and plantings become more formal. The interaction between the occupants of slow-moving vehicles and pedestrians with the landscape determines the scale of the aesthetic details. The designer may be able to provide walking areas, small parks, etc. Landscaping should be pleasant, neat, and sometimes ornamental, and it should require low maintenance.

2. Erosion. Landscaping and erosion control are strongly interrelated. Flat and rounded slopes and vegetation serve to both prevent erosion and provide aesthetic value. Chapter Thirty-seven provides additional information on erosion control.

3. Maintenance. Landscaping decisions will greatly affect roadside maintenance. Maintenance activities for mowing, fertilizing, or using herbicides should be considered when designing the roadside landscape. Involvement by other public or private groups (except on an Interstate route) should be encouraged to enhance the roadside landscape (e.g., Adopt-A-Highway Program).

4. Screening for Headlight Glare. Depending upon roadway alignment and the selected type of vegetation, landscaping features may be used to effectively screen headlight glare, for example, in a freeway median.

5. Screening for Noise Abatement. Although the effect may be more psychological than real, landscaping features may have some masking benefits to sensitive receptors.

6. Screening of Undesirable View. Screening of a junkyard or other undesirable view may be enhanced through the use of landscaping features.

7. Snow Drift. Landscaping features may assist in preventing snow from drifting and accumulating on the roadway.

51-8.03 Landscaping Considerations

All landscaping activities should be properly coordinated with other project design elements. The objectives are that other design elements should not be compromised by landscaping, and secondary benefits may be gained by the proper application of the landscaping features. Examples of coordination between landscaping and project design are briefly discussed below.

1. Geometric Design. On a new-construction or reconstruction project, the geometric design of the highway should be blended to fit the natural topography and landscaping features of the area. As practical, existing landscaping elements should be preserved and enhanced. The roadway alignment and cross-section design should be compatible with the landscaping objectives. The landscaping treatment should not be made to interfere with the driver's horizontal and intersection sight distances.

2. Roadside Safety. The introduction of landscaping features should not compromise the objectives of roadside safety. Chapter Forty-nine provides the Department's criteria for roadside-safety design. The most significant roadside-safety element relative to the use of landscaping features is the clear-zone concept. Roadside hazards should not be located within the designated clear zone. A tree is considered a roadside hazard.

3. Environmental. Every effort should be made to use vegetation that will survive in the area with minimum maintenance. The selection of the vegetation will depend upon the soil conditions, drainage, amount of sun exposure, diseases and insects, road deicing chemicals, temperature, and pollution.

4. Economics. Plant selection, availability, quantity, and size greatly affect the cost of landscaping. The selection of the plantings should be so as to provide a cost-effective design.

51-8.04 INDOT Landscaping Policy

51-8.04(01) Plant-Establishment Policy

A project which includes plantings may include a special provision which requires the contractor to be responsible for a plant-establishment period of at least one year. A longer establishment period may be required where survival is considered essential to the function of the plantings (e.g., junkyard screening, urban landscaping).

51-8.04(02) Protection of Existing Vegetation

Wherever practical, existing trees or other landscaping features should not be removed. This objective, however, must be compatible with other considerations such as roadside safety, geometric design, utilities, terrain, public acceptance, and costs. The plans should clearly designate all existing landscape features which will be retained. If the existing plant material conflicts with these considerations, where applicable, the plant material should be evaluated by a landscape architect for possible relocation to a more suitable portion of the right of way.

51-8.04(03) Disturbed Area

In an area disturbed by construction work, the designer should specify that the turf be reestablished. Turf establishment refers to the revegetation of a disturbed area. The designer should use the following guidance to determine the appropriate turf establishment, depending upon individual site conditions.

1. Topsoil. Topsoil is placed in a disturbed area to a depth of 6 in. or greater depending upon the underlying soil conditions.

2. Planting of Grass. Each area disturbed by construction, except exposed rock surfaces and areas to be sodded, should be seeded, fertilized, and mulched.

3. Sodding. Where developed properties or areas of intensive mowing abut the project, each areas disturbed by construction should be sodded and watered sufficiently to establish growth.

The INDOT *Standard Specifications* and Chapter Seventeen provide additional details on turf establishment.

51-8.04(04) Wildlife-Habitat Replacement

To some extent, existing wildlife habitat will be disturbed due to project work. Wildlife habitats may include woodlands, overgrown fields, and pastures and wetlands. The Department's policy is to replace any disturbed wetland. This will often require the purchase of additional right of way. To determine the project's effect on plants and animals, the designer should review the Design and Location Study Report or, where provided, the Environmental Impact Statement or Environmental Assessment. These reports may also provide recommendations on the type and quantities of habitat to be replaced.

The designer is responsible for incorporating the mitigation of the wildlife habitat into the plans. This may include revegetation with special grasses and woody species, wetlands grading, seed mixtures, etc. However, wetland revegetation with aquatic and woody species is usually administered in a separate contract once the plans have been completed. The Office of Environmental Services will assist in coordinating habitat types and quantities. The Services and Cultural Resources Team will assist in the development of plans and specifications.

51-9.0 SOUND BARRIER

A sound barrier is designed and erected to reduce the sound level of traffic adjacent to existing properties to an acceptable level as determined by Federal guidelines. A barrier is considered the most practical option to reduce sound when compared to other mitigating options (e.g., wider buffer zone, reducing speed, eliminating or restricting traffic or vehicular types). The Office of Environmental Services is responsible for determining the longitudinal limits of the barrier, the lateral location from the roadway, and the required height. The designer is responsible for the type selection, design of the sound barrier, and evaluating the impacts of the sound barrier on the highway design and complying with the project intent of the Office of Environmental Services.

51-9.01 Types

An absorptive or reflective sound barrier is effective in reducing the environmental impact of noise from the highway. The sound-barrier types that may be used are as follows.

1. Earth Berm. An earth berm is a graded mound of soil which redirects the highway sound from nearby sensitive areas.

2. Masonry Wall. A masonry wall is constructed from concrete blocks or bricks. Very pleasing architectural designs can be developed with this type of wall.

3. Concrete Wall. A concrete wall may be poured in place or precast. The advantage of s concrete wall is that decorative designs can be added to the face of the wall.

4. Wood Wall. A wood wall is less costly than a masonry or concrete wall and is often preferred by local residents. However, its life expectancy is typically less than that of a masonry or concrete wall.

5. Metal Wall. A metal wall is constructed using galvanized or treated steel panels. Concerns relative to cost and corrosion have generally limited the use of steel walls.

6. Other Materials. New sound barrier materials are continuously being developed, such as recycled plastic, fiberglass, composites, etc. Prior to their use, they should be reviewed by the New Products Evaluation Committee to ensure that each will meet INDOT criteria.

7. Combination Wall. This type uses a combination of an earth berm and one of the other material types. A combination wall is used to reduce the height of another wall type and for aesthetic purposes.

51-9.02 Design

1. Line of Sight. Noise waves travel in a straight line. A barrier which breaks the line of sight between the source and receiver will provide some attenuation. For roadway sources, the line of sight is drawn perpendicular to the roadway. The sound source for cars and medium-sized trucks is assumed to be the roadway surface and, for large trucks, it is 8 ft high. For the receiver, the line of sight is terminated at the expected ear height of the receiver (e.g., 8 ft). The designer must also consider that the receiver may be in a multi-storied building.

2. Structural Design. A sound barrier should either be in accordance with the AASHTO *Standard Specifications for Highway Bridges* or the AASHTO *Guide Specifications for Structural Design of Sound Barriers*. See Chapter Seventy-three.

3. Length. To block the roadway noise from the sides, the ends of the barrier should exceed the receiver by four times the distance from the barrier to the receiver; see Figure 51-9A, Sound-Barrier Placement , detail (a).

4. Location. Moving the barrier closer to the receiver or source will increase the effectiveness of the barrier.

5. Gap. A gap in the barrier for pedestrian access, cross-streets, or maintenance purposes can compromise the barrier performance. Where practical, the effects of a gap should be minimized by providing tight-fitting access doors, curving the ends of the barrier to shield nearby receivers, or overlapping sections of barrier. Figure 51-9A detail (b) illustrates the minimum distance required to maintain the acoustical effectiveness of the wall for overlapping barriers.

6. Right of Way. Additional right of way may be required for the installation and maintenance of the sound barrier.

7. Roadside Safety.

a. Clear Zone. Section 49-2.0 provides the Department's design criteria for clear zone. If practical, a sound barrier should be placed outside of the clear zone. If the barrier is within the clear zone, an integral concrete barrier shape or a metal barrier rail should be considered to shield a run-off-the-road vehicle from the barrier.

b. Terminal. A sound barrier should be terminated outside the clear zone. However, if the end of the barrier is within the clear zone, the designer should consider protecting the end with guardrail or an appropriate impact attenuator. Section 49-6.0 discusses the design of impact attenuators.

c. Traversability. If the sound barrier is an earth berm, the toe of the barrier should be traversable by a run-off-the-road vehicle (see Section 49-3.02).

d. Protrusion. A protrusion may become a safety hazard if it are struck or is dislodged by a vehicle. Figure 51-9B, Sound-Barrier Protrusions, illustrates the preferred practice for placing barrier protrusions and decorative facing.

8. Emergency Access. Where sound barriers are placed relatively close to the roadway (e.g., at the edge of shoulder), sufficient escape routes must be provided in the wall to allow individuals to quickly leave the roadway in an emergency. These escape routes may be provided by inserting doors or overlapping walls. Item 5 above discusses the preferred methods for providing gaps in the barrier design. Where provided, access to fire hydrants should also be incorporated into the wall design.

9. Sight Distance.

a. At-Grade Intersection. A sound barrier should not be located in the triangle required for intersection sight distance. Section 46-10.0 provides the criteria to determine the required sight-distance triangle.

b. Entrance Ramp. A sound barrier should not block the line of sight between the vehicle on a ramp and an approaching vehicle on the major roadway. Therefore, a sound barrier should not be located in the gore area between an entrance ramp and freeway mainline.

c. Horizontal Sight Distance. A sound barrier can also restrict sight distance along the inside of a horizontal curve. Section 43-4.0 provides the criteria to determine the middle ordinate value which will yield the necessary sight distance. The location of the sound barrier should be outside this sight line.

10. Interference with Roadside Appurtenances. The proposed location of a sound barrier can interfere with proposed or existing roadside features, including signs, sign supports, utilities,

or lighting facilities. The designer must determine if these features are in conflict with the sound barrier.

11. Sound Considerations. The noise reduction provided by a barrier depends upon the diffraction of sound over the top and flanking around the sides of the barrier, the transmission of sound through the barrier, and the multiple reflection caused by double barriers. Some barrier types can absorb some of the sound energy. The contribution of this absorption depends on the barrier surface, shape, and material type. A hard, smooth surface will generally reflect the noise off the wall. If barriers are to be placed on both sides of the roadway, the designer also should consider the impact of the reflected noise on the receiver.

12. Drainage. Drainage may be accomplished by leaving a gap on the bottom and backfilling with gravel, by providing a hinged flap, by providing a closed drainage system, etc. The barrier's acoustical design should be maintained (i.e., no open holes in the wall).

13. Landscaping. Consideration should be given to providing landscaping treatments that will enhance the aesthetics and design of a sound barrier. Plantings should be provided, where practical, both in front of and behind the barrier. Low-maintenance plantings should be used behind the wall.

14. Aesthetics. Appearance plays a critical role in the acceptance of the sound barrier. The barrier should either be blended into the background or made aesthetically pleasing. Various types of materials, texture, and color should be considered. Smooth surfaces are not recommended.

    Due to the size of a sound barrier, the designer should strive to reduce the tunnel effect by using variations of form, wall types, and surface treatments.

    From both a visual and safety standpoint, a sound barrier should not begin or end abruptly. It should be transitioned from the ground line to its full height. This can be accomplished by using earth berms, curving the wall back, sloping the wall downward, or stepping the wall down.

15. Public Involvement. Early community participation in the selection of various sound barrier options is encouraged to ensure community acceptance of the wall.

16. Maintenance Considerations. The location and design of a sound barrier should reflect the following maintenance factors.

    a. The sound barrier must be located so maintenance crews can easily access the wall for routine repairs.

b. The sound barrier should be constructed of materials that discourage vandalism (e.g., graffiti) and allow for easy cleaning. The maintenance of barrier materials is less costly if unpainted surfaces such as weathering steel, concrete, pressure-treated wood, or naturally weathered cedar or redwood are used.

c. The sound barrier should be designed so that damage can be easily repaired. The barrier materials should be commercially available to reduce the need for keeping large stocks of material on hand.

d. The sound barrier should be located so that other maintenance operations can be reasonably performed (e.g., mowing, light-bulb replacement, sign cleaning, spraying). If the barrier is located near the shoulder, access for maintenance behind the wall should be provided from local streets or through overlapping gaps.

e. The sound barrier should be located so that it will not impact snow removal operations. A barrier located at the edge of the shoulder will require manual removal of snow from the roadway.

51-10.0 HAZARDOUS MATERIALS

Hazardous-waste sites can impact all phases of highway activities, including project development, design, right of way, construction, and maintenance. These impacts can increase costs and delay a highway project. Ownership of a site from which there has been a release, or threat of a release of a hazardous substance, may indicate liability whether the contamination is the result of the agency's actions or those of others.

51-10.01 Responsibility

The Office of Environmental Services is responsible for ensuring that the initial site assessment is performed during the environmental stage. If the initial site assessment and coordination with other agencies identifies the need for additional work, a consultant will be used to conduct a preliminary site assessment. The Production Management Division and Office of Real Estate will be provided with summaries or copies of the information gathered on hazardous waste by the Office of Environmental Services, typically at the time of environmental-document approval.

If high levels of contamination have been detected, the Office of Environmental Services will forward the initial site assessment and the preliminary site investigation to the appropriate section of the Indiana Department of Environmental Management (IDEM), and it will request that they become involved with the property owner to characterize the site and develop a remedial plan to

clean the site. This will be concurrent with the development of the preliminary plans. The Office of Environmental Services will monitor the progress of IDEM.

At the time of the preliminary field check, the Office of Environmental Services should be able to inform both the Production Management Division and Office of Real Estate on the status of the efforts of IDEM. At this stage, decisions can be made for the site. This may include redesigning the project to avoid the site, considering various land-acquisition strategies, or delaying or dropping the project from further development due to significant hazardous-waste considerations.

51-10.02 Location

Hazardous materials can emerge from almost anywhere. Common possible locations include abandoned or active storage tanks, oil lines, illegal dumping sites, abandoned chemical plants, service stations, paint companies, machine shops, metal processing plants, electronic facilities, dry cleaning establishments, old railroad yards, auto junkyards, landfills, or bridges with lead base paints. Early indicators of contamination include groundwater contamination of nearby wells, discarded barrels, soil discolorations, liquid discharges, odors, abnormalities in vegetation, and extensive filling and regrading. If there is a chance that a site may contain hazardous materials, the Office of Environmental Services should be contacted to determine if detailed testing of the site is warranted. If hazardous materials are suspected on a property, no attempt should be made to enter the property until the site has been cleared by IDEM.

51-10.03 Cleanup

Once the hazardous-material location is known, its location must be shown on the plans. The type of contamination, if known, must also be provided. The specifications or special provisions should include detailed instructions on the procedure for removing the material and properly disposing of the wastes. For example, on a bridge with lead-based paint, waste materials from sandblasting will not be permitted into the air or onto the ground, but instead must be collected and properly disposed.

Certain cleanup sites and materials may require a specialist contractor to determine the location and size of the contaminated site and to provide for the proper removal and disposal of the contaminated materials. The specialist contractor will be required to complete the cleanup prior to construction.

51-11.0 MAILBOXES

A mailbox or newspaper tube that is serviced by a carrier in a vehicle may constitute a safety hazard, depending upon its placement. Therefore, the designer should make every reasonable effort to replace all each non-conforming mailbox with one that is in accordance with the INDOT *Standard*

Drawings and the AASHTO *A Guide for Erecting Mailboxes on Highways*. Removal and replacement of a mailbox can be a sensitive issue and should be reviewed with the postage patron prior to its removal or replacement.

51-11.01 Location

A mailbox should be placed for maximum convenience to its patron, consistent with safety considerations for highway traffic, the carrier, and the patron. Consideration should be given to the minimum walking distance in advance of the mailbox site and possible restrictions to intersection sight distance at an intersection or drive entrance. A new installation should, where feasible, be located on the far right side of an intersection with a public road or drive entrance.

A box should be placed only on the right-hand side of the highway in the direction of travel of the carrier, except on a one-way street where it may be placed on the left-hand side. It is undesirable to require pedestrian travel along the shoulder. However, this may be the preferred solution for a distance of up to 200 ft when compared to constructing a turnout in a deep cut, placing a mailbox just beyond a sharp crest vertical curve with poor sight distance, or constructing two or more closely-spaced turnouts.

Placing a mailbox along a high-speed, high-volume highway should be avoided if other practical locations are available. A mailbox should not be located where access is from a freeway or where access, stopping, or parking is otherwise prohibited by law or regulation. A mailbox should not be at a location that would require a patron to cross the lanes of a divided highway to deposit or retrieve mail.

Placing a mail stop near an intersection will have an effect on the operation of the intersection. The nature and magnitude of this impact depends on traffic speed and volume on each of the intersecting roadways, the number of mailboxes at the stop, type of traffic control, how the stop is located relative to the traffic control, and the distance the stop is from the intersection. The INDOT *Standard Drawings* show the possible location of a mail stop at a rural intersection.

A mailbox should be located such that a vehicle stopped adjacent to it is clear of the adjacent traveled way. This need not apply to a low-volume, low-speed street or road. However, a vehicle stopped at a mailbox should be clear of the travelway. The higher the traffic volume or speed, the greater the clearance should be. Figure 51-11A provides guidelines for the lateral placement of a mailbox.

A turnout should be provided if a useable shoulder of 10 ft or wider is unavailable. The INDOT *Standard Drawings* provide additional details for the design of a turnout for a mail stop.

51-11.02 Design

The INDOT *Standard Drawings* provide the design criteria for the proper placement of a mailbox. The designer should also consider the following.

1. Height. A mailbox is located such that the bottom of the box is 3 ft to 4 ft above the mail-stop surface.

2. Multiple Mailboxes. To reduce the possibility of ramping, multiple mailboxes should be separated by a distance of at least three-fourths of their height above the ground.

4. Neighborhood Delivery and Collection Box Unit. This consists of a cluster of 8 to 16 locked boxes mounted on a pedestal or within a framework. One cluster can weigh from 100 lbs to 200 lbs and may be a roadside hazard. It should be located outside the clear zone or only on a low-speed curbed facility. It is located in a trailer park, apartment complex, or new residential subdivision.

Total No. of Parking Spaces	Minimum Number of Accessible Spaces
1 through 25	1
26 through 50	2
51 through 75	3
76 through 100	4
101 through 125	5
151 through 200	6
201 through 300	7
301 through 400	8
401 through 500	9
501 through 1000	2% of Total
1001 and Over	20 plus 1 for each 100 over 1000

Notes:

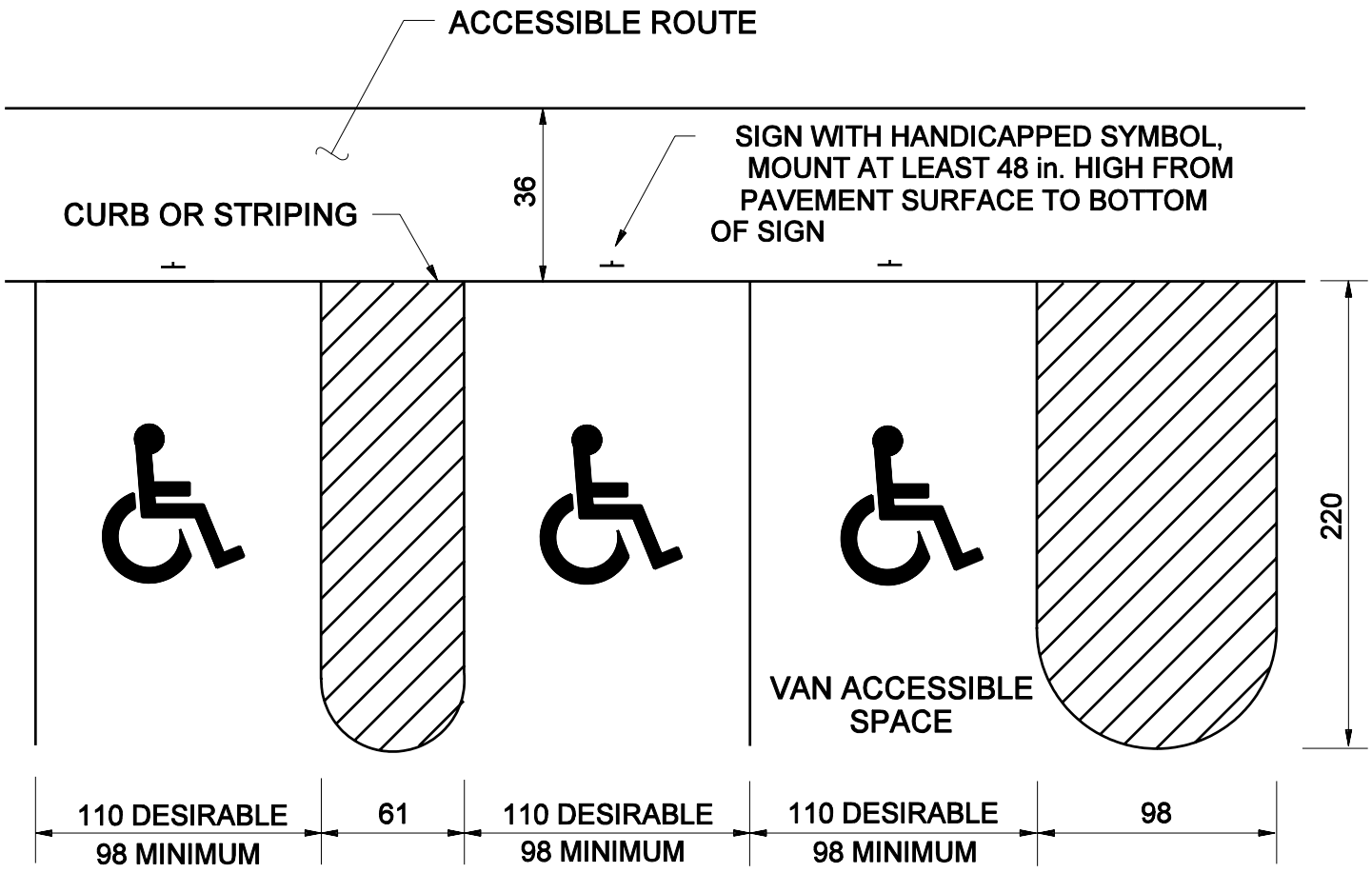
a. If one or more passenger loading zones are provided, then at least one passenger loading zone should comply with Section 51-1.03(01) Item 5.

b. Parking spaces for side-lift vans are accessible parking spaces and may be used to meet the requirements of Section 51-1.03(01).

c. The total number of accessible parking spaces may be distributed among closely spaced parking lots, if greater accessibility is achieved.

MINIMUM NUMBER OF ACCESSIBLE SPACES FOR PHYSICALLY-CHALLENGED USERS

Figure 51-1A

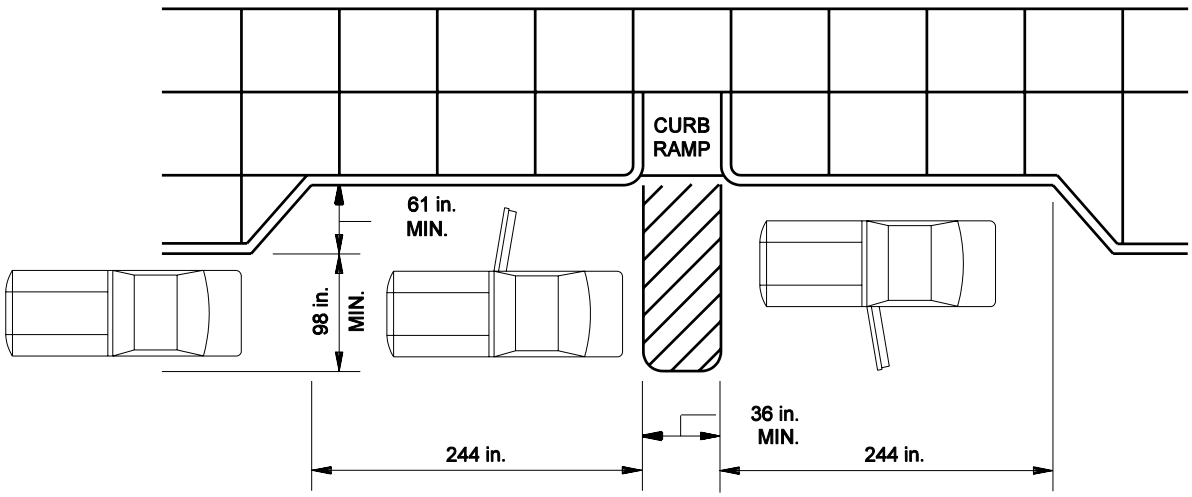


Notes: 1. All dimensions are in in.

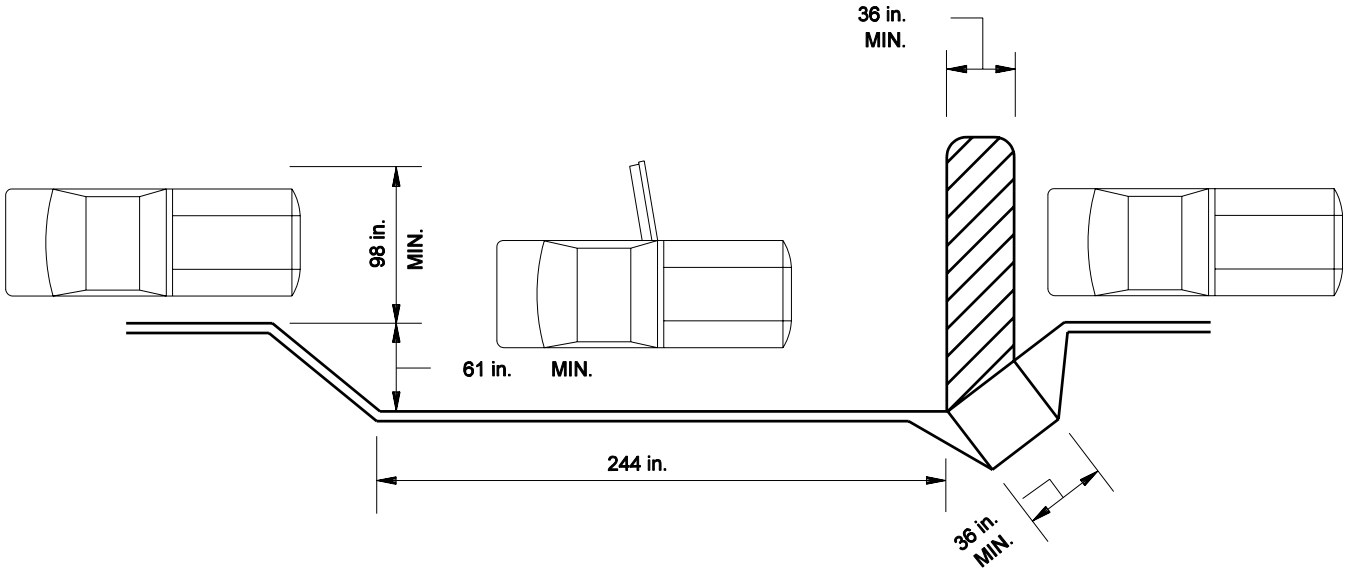
2. Two accessible parking spaces may share a common access aisle.

HANDICAPPED PARKING STALL DIMENSIONS
(Off-Street Parking)

Figure 51-1B



(a) TWO ACCESSIBLE PARALLEL PARKING SPACES IN SERIES, SEPARATED BY AN ACCESSIBLE AISLE, WITH BOTH DRIVER-SIDE AND PASSENGER-SIDE ACCESS DEMONSTRATED.



(b) SINGLE ACCESSIBLE PARALLEL PARKING SPACE WITH DRIVER-SIDE ACCESS DEMONSTRATED; PASSENGER SIDE ACCESS CAN BE PROVIDED BY PARKING IN LINE WITH STANDARD ON-STREET SPACES.

HANDICAPPED PARKING
(On-Street Parking)

Figure 51-1C

Slope	Maximum	Maximum Run
Steeper than 16:1 but not steeper than 12:1	30 in.	30 ft
Steeper than 20:1 but not steeper than 16:1	30 in.	40 ft

Note: A slope steeper than 12:1 is not permitted.

ALLOWABLE RAMP DIMENSIONS
(New Construction)

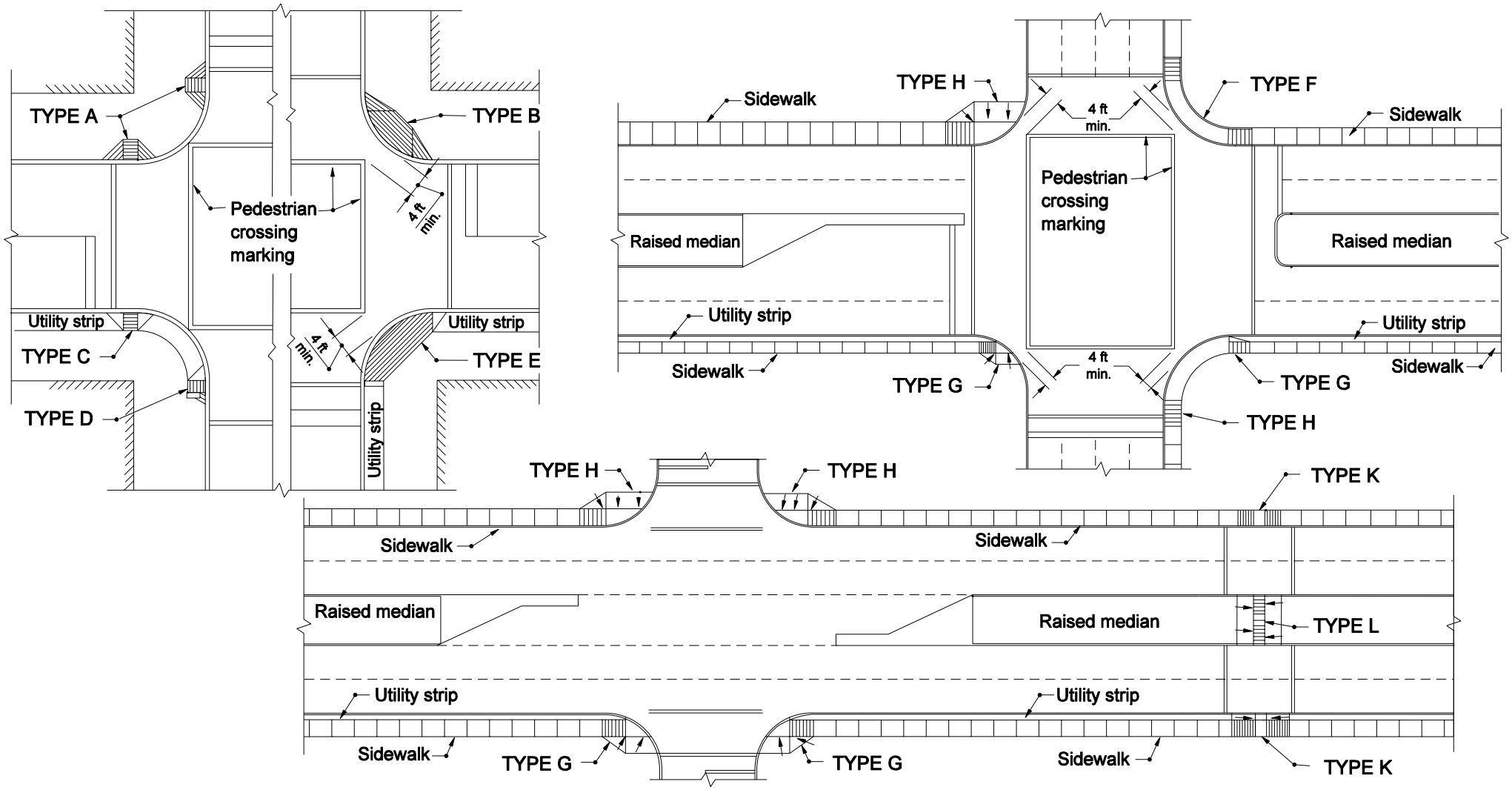
Figure 51-1D

Slope	Maximum Rise	Maximum Run
Steeper than 10:1 but not steeper than 8:1	3 in.	24 in.
Steeper than 12:1 but not steeper than 10:1	6 in.	60 in.

Note: A slope steeper than 12.5% is not allowed.

ALLOWABLE RAMP DIMENSIONS
(Existing Sites, Buildings, and Facilities)

Figure 51-1E



TYPES OF CURB RAMPS AT MARKED CROSSINGS

Figure 51-1F

Type	Ramp Width (ft)	Ramp Slope	Landing Width (ft)	Landing Depth (ft)	Flare Slope	Clear Space (ft)
PERPENDICULAR						
A	4 [1]	12:1 [2]	4	4 [1]	12:1, Pvmt.	n/a
C	4 [1]	12:1 [2]	4	4 [1]	12:1, Pvmt.	n/a
D	4 [1]	12:1 [2]	4	4 [1]	12:1, Pvmt.	n/a
DIAGONAL						
B	4 [1] to 8	12:1 [2]	n/a	4 top & bot	12:1, Pvmt.	4
E	5.5 to Vari.	12:1 [2]	0 to 5.5	4	12:1, Sod	4
PARALLEL						
F	Sdwk.	12:1	Sdwk.	4	n/a	4
DEPRESSED-CORNERS						
H	6	12:1	6	6	12:1, Sod [3]	4
G	5	12:1	5	5	12:1, Sod [3]	4
MID-BLOCK						
K	4	12:1	4 [1]	Sdwk.	n/a	n/a
MEDIAN						
L	5.25	50:1	5.25	n/a	12:1, MM [4]	n/a

[1] If 4-ft width or depth is site-infeasible, it may be reduced to 3 ft.

[2] If 12:1 slope is site-infeasible, it may be steepened to 10:1 for a rise of not more than 6 in.

[3] If 6-ft depth is site-infeasible, it may be steepened or replaced with a vertical curb.

[4] MM = median material.

5. The landing cross slope shall be 50:1, but if it is site-infeasible, it may be steepened.

6. The landing slope should be 50:1, the maximum longitudinal gutter slope should be 20:1, and the width of the area with detectable warning devices should be 2 ft.

SUMMARY OF CURB RAMP GEOMETRICS

Figure 51-1G

Change in Elevation, in.	Ramp Length, ft
4	5.5
5	6.5
6	8.0
7	9.0
8	11.0

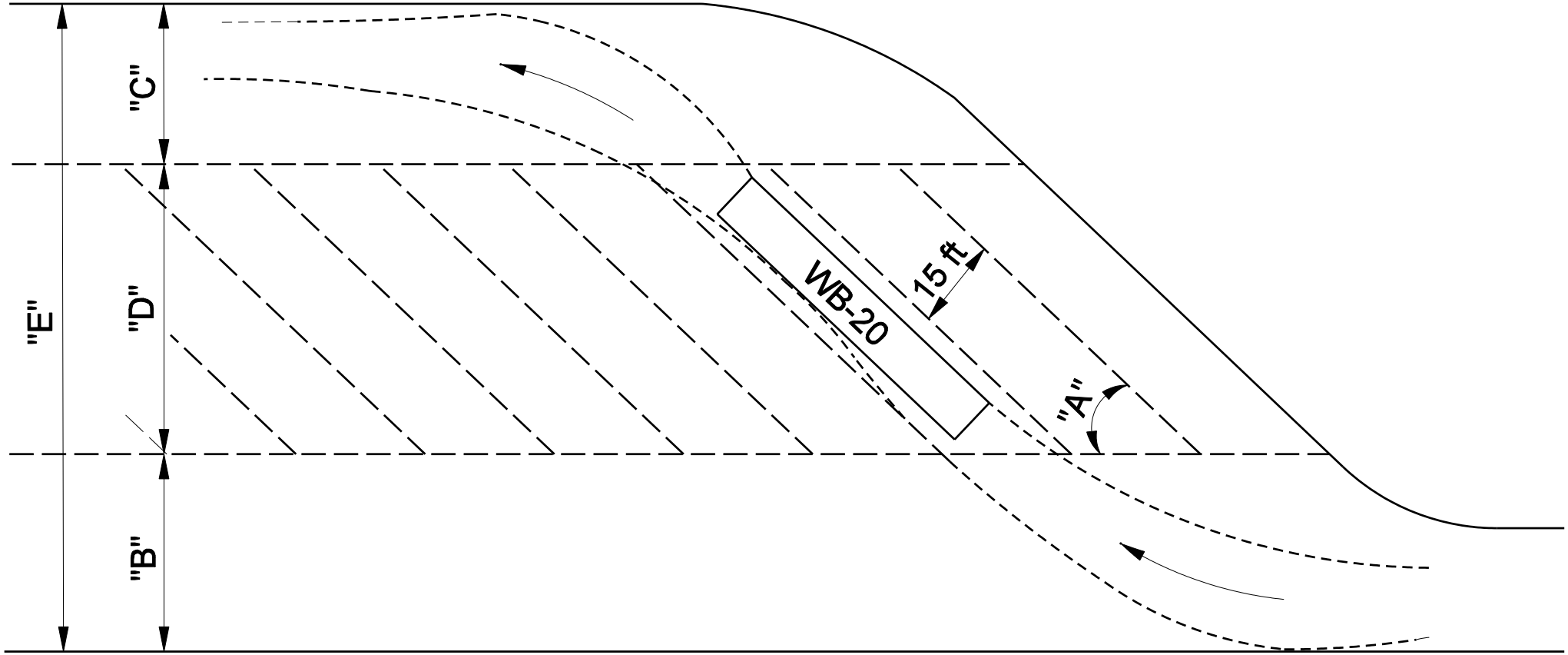
LENGTHS OF PERPENDICULAR CURB RAMPS

Figure 51-1H

Design Element	Factor	Cars	Cars/ Trailers	Trucks	Total
Mainline Traffic Data					
20 Year ADT (A)					
20 Year ADT, Directional (B)	A x 0.60				
DHV, Directional (DHV)	B x 0.135 (1)				
Traffic Composition (20-year projected) Cars (D_1) …… 1-(D_2+D_3) Cars/Trailers (D_2)……..….. 5% Trucks (D_3)……...……. %	*(D_1)* ___ Cars *(D_2)* ___ Cars/Trailers *(D_3)* ___ Trucks	C_1=DHV x D_1	C_2=DHV x D_2	C_3=DHV x D_3	C=C_1+C_2 + C_3
Vehicles Per Hour @ Rest Area (VPH)					
Cars Stopping (E_1) Normal Routes……...…… .09 Tourist Routes……..… .13 Information & Welcome Centers ……..…. .15 Cars/Trailers (E_2) Normal Stopping ……..…. .15 Trucks (E_3) Normal Stopping ……..…. .15	*(E_1)* ___ Cars *(E_2)* ___ Cars/Trailers *(E_3)* ___ Trucks	VPH_1=E_1 x C_1	VPH_2=E_2 x C_2	VPH_3=E_3 x C_3	VHP=VHP_1+ VHP_2 + VHP_3
Parking Spaces					
Cars (T_1) – Average Stop …….. .25 to .33 hr. @ info. centers … .33 to .50 hr. Cars/Trailers (T_2)….. .50 hr. Trucks (T_3) (2)…….. .50 hr.	*(T_1)* ___ Cars *(T_2)* ___ Cars/Trailers *(T_3)* ___ Trucks	P_1=VPH_1 x T_1	P_2=VPH_2 x T_2	P_3=VPH_3 x T_3	P=P_1+P_2 + P_3
Rest Room Requirements					
Persons/Hour (PH)	VPH x 3.0 occupancy x .75 use				
Number of Comfort Facilities – Men's Room (M)	PH x 0.5				
Number of Comfort Facilities – Women's Room (W)	PH x 0.5				

(1) Assume 13.5% or the 20-year projected DHV, whichever is greater.
(2) Maximum of 80 truck and recreational vehicle parking spaces.

DESIGN GUIDE FOR REST AREA FACILITIES
(Interstates and Freeways)
Figure 51-2A



DESIGNS FOR ANGLE PARKING
(Based on WB-20 Design Vehicle)

Figure 51-2B

(M) Persons/Hour Using Rest Room During Design Hours (1)	Number of Facilities – Men's Room (2)			
	Urinals (3)	Toilets (3)	Wash Basins (3)	Hand Air Dryers (3)
0-105	2	2	2	2
106-225	4	4	4	4
226-315	6	6	6	6
316-375	8	6	6	6
376-435	10	6	8	8
436-500	12	8	10	10

(W) Persons/Hour Using Rest Room During Design Hours (1)	Number of Facilities – Women's Room (2)		
	Toilets (3)	Wash Basins (3)	Hand Air Dryers (3)
0-105	6	4	4
106-225	10	6	6
226-315	14	8	8
316-375	18	10	10
376-435	20	12	12
436-500	24	14	14

Notes:

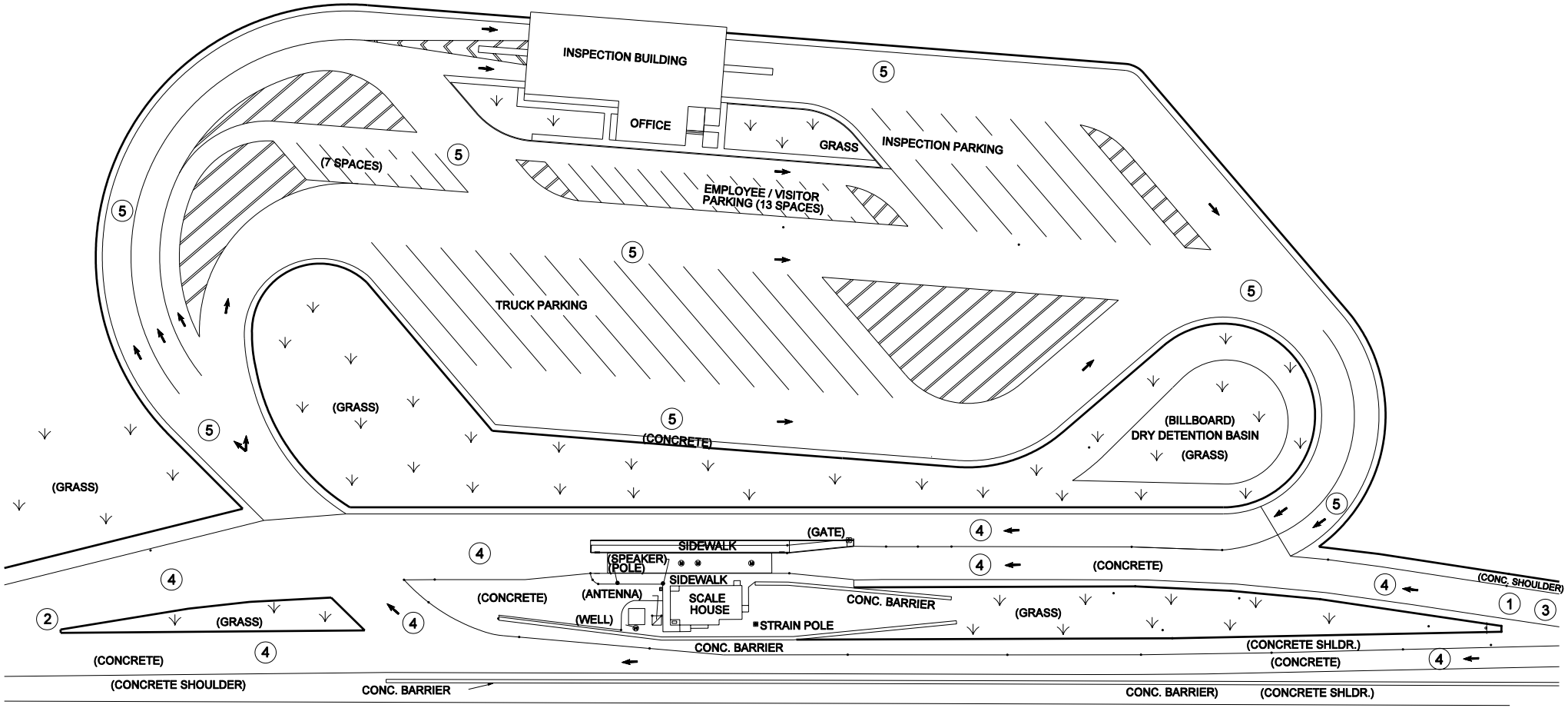
(1) See Figure 51-2A to determine the number of persons/hours.

(2) Dual men's/women's facilities (minimum of 2 each) should be provided. The number of fixtures should be divided equally among the rest rooms.

(3) At least one fixture should be handicapped accessible in each rest room provided. For additional criteria, see ADA Guidelines.

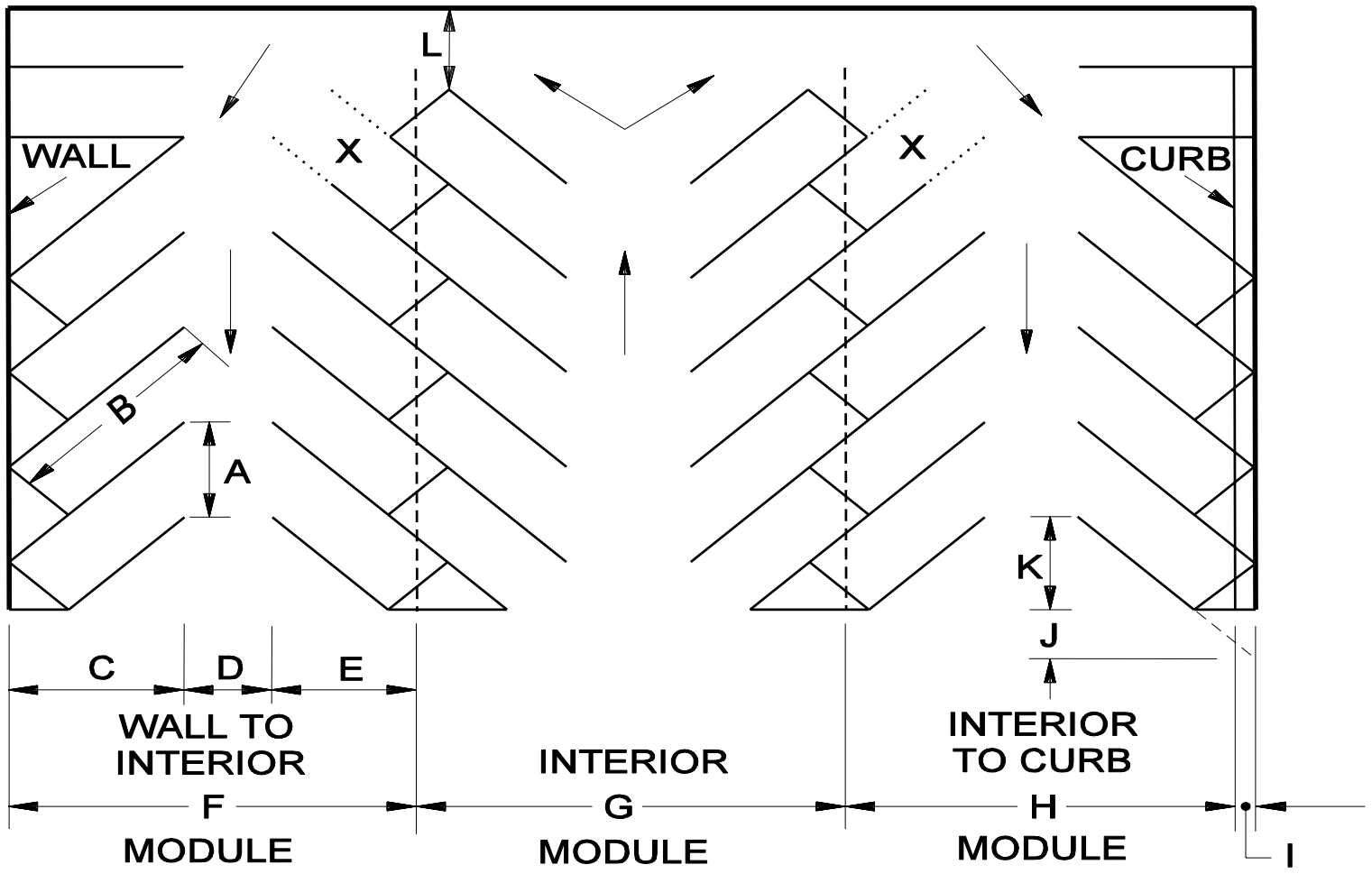
GUIDELINES FOR COMFORT FACILITIES

Figure 51-2C



TYPICAL TRUCK WEIGH STATION

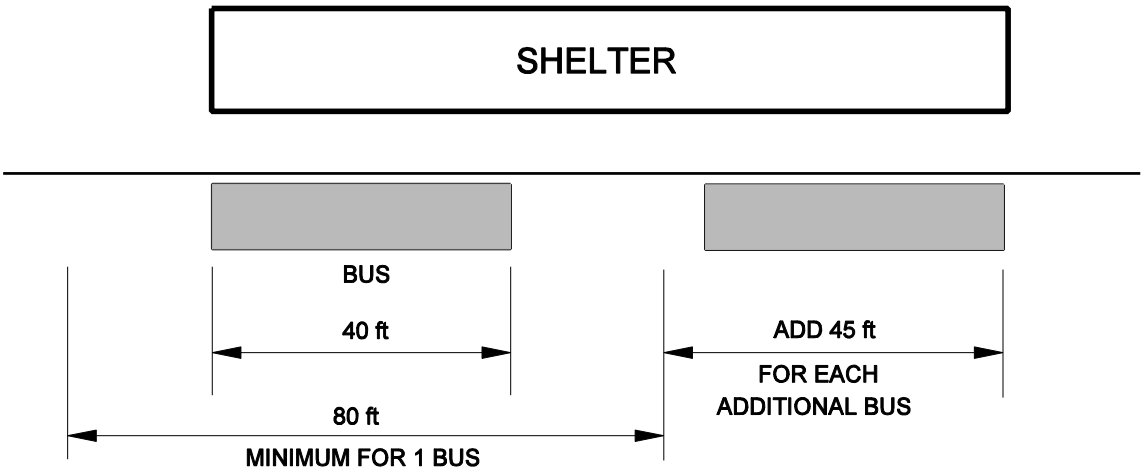
Figure 51-3A



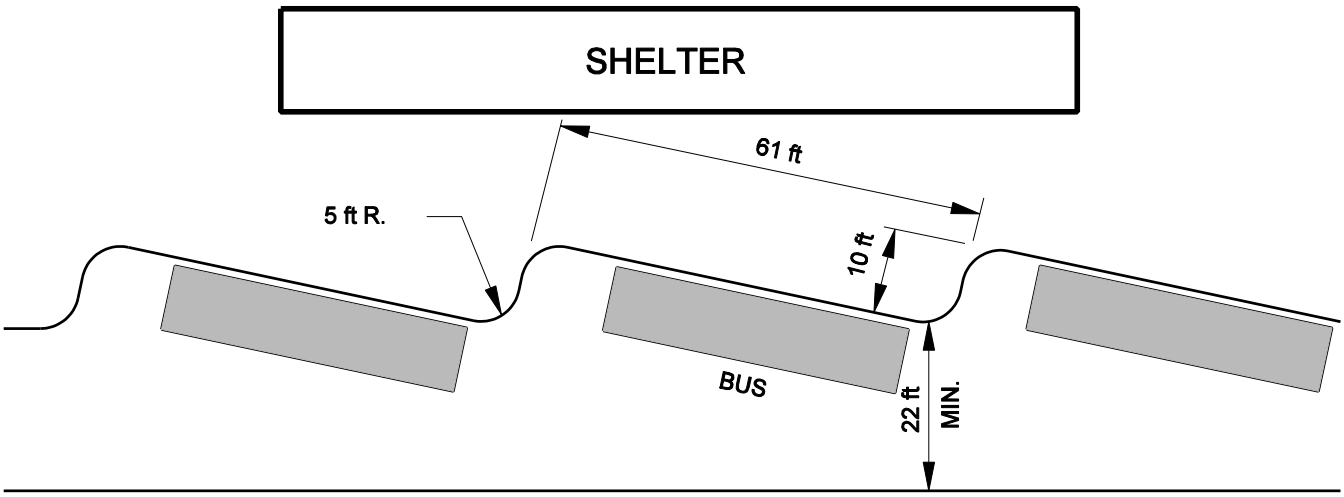
X = STALL NOT ACCESSIBLE IN CERTAIN LAYOUTS

PARKING STALL DIMENSIONS

Figure 51-4A



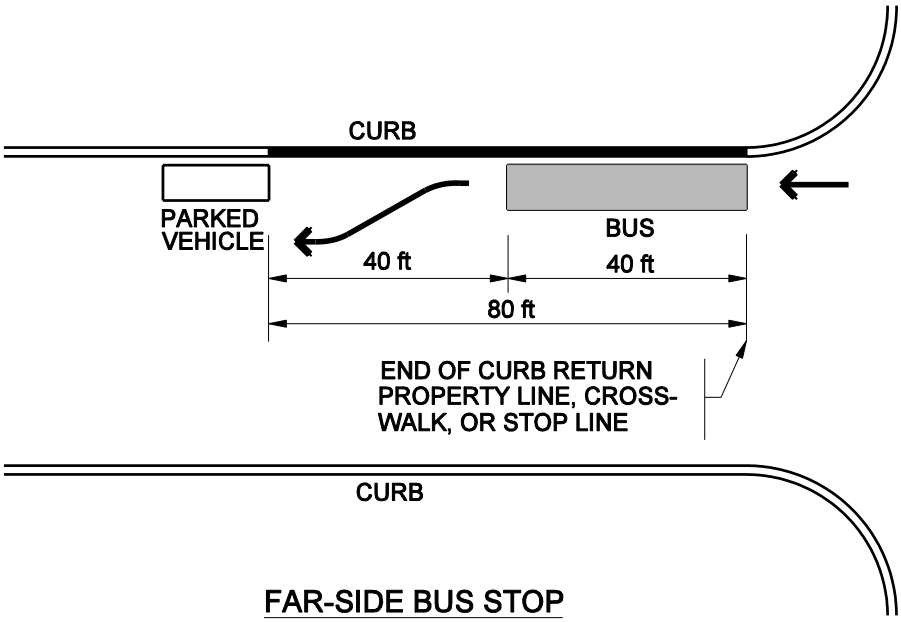
PARALLEL PARKING



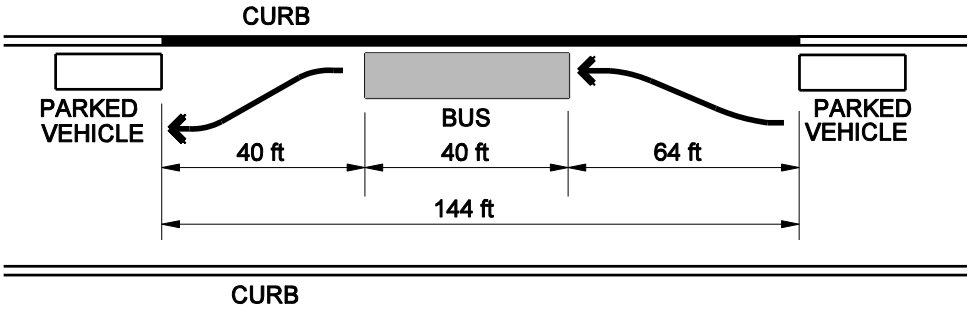
SHALLOW SAWTOOTH PARKING

RECMMENDED LENGTHS FOR BUS-LOADING AREAS
(Parking-and-Ride Lots)

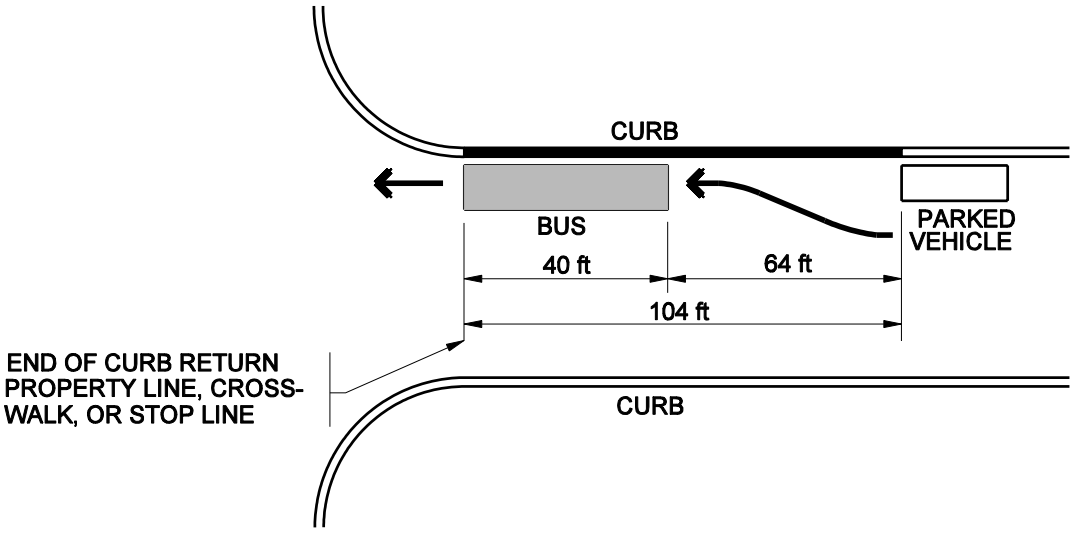
Figure 51-4B



FAR-SIDE BUS STOP



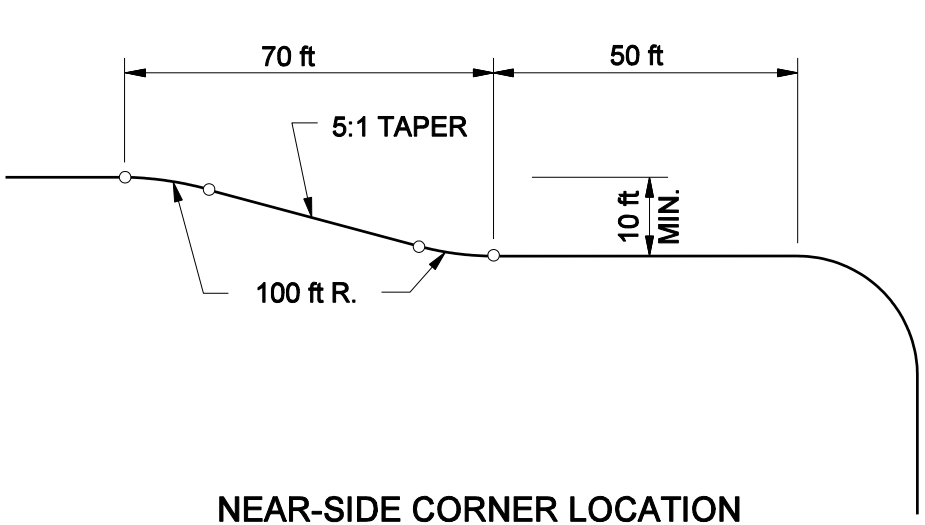
MID-BLOCK BUS STOP



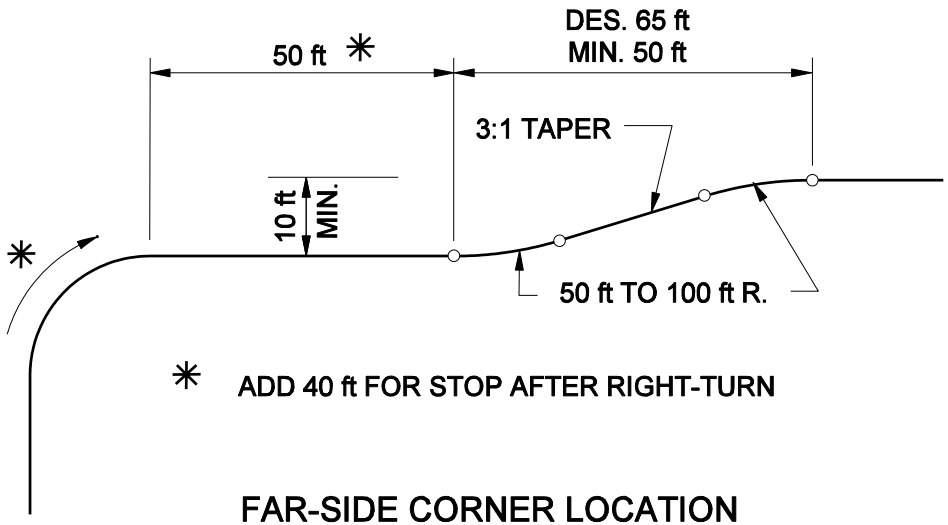
NEAR-SIDE BUS STOP

ON-STREET BUS STOPS

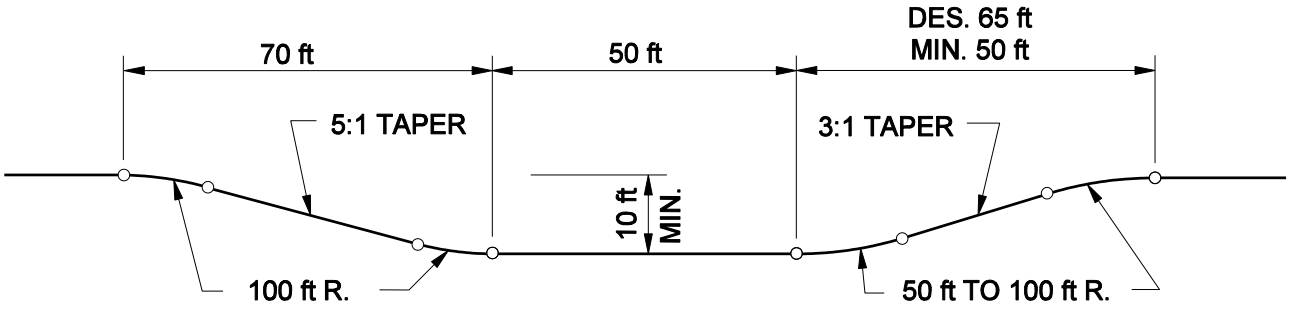
Figure 51-5A



NEAR-SIDE CORNER LOCATION



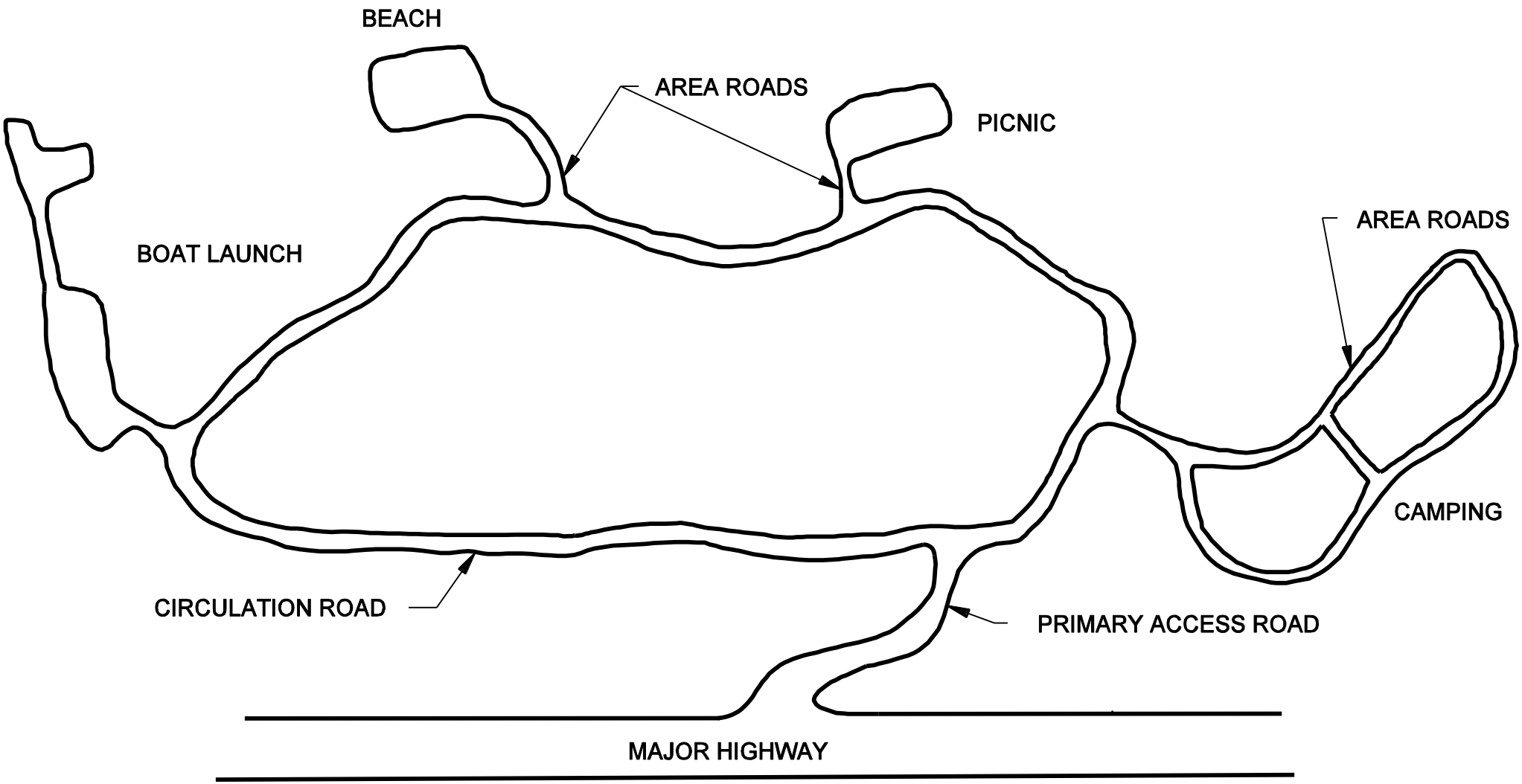
FAR-SIDE CORNER LOCATION



MID-BLOCK LOCATION

BUS TURNOUT DESIGNS

Figure 51-5B



RECREATIONAL ROAD NETWORK

Figure 51-6A

Design Element				Manual Section	Area Road		Circulation Road	Primary Access Road
					1-Lane (1a)	2-Lanes (1b)	2-Lanes (1b)	2-Lanes (1b)
Design Controls	Design Year Traffic (Current AADT)			40-2.0	< 100	≥ 100	≥ 100	≥ 100
	Design Forecast Year			40-2.0	Current			
	Design Speed (mph)			40-3.0	10-20	10-20	25-35	30-45
	Access Control			40-5.0	None (2)			
	Level of Service			40-2.0	Desirable: B; Minimum: D			
Cross-Section Elements	Travel Lane	Width		51-6.02(05), 45-1.0	12 to 14 ft	9 to 12 ft	10 or 11 ft	11 or 12 ft
		Typical Surface Type			HMA / Aggregate		HMA	HMA
	Shoulder	Width (4)		51-6.02(05), 45-1.0	1 ft	2 ft	2 to 4 ft	2 to 4 ft
		Typical Surface Type			Aggregate/Earth			
	Cross Slopes	Travel Lane		45-1.0	2% if HMA; 6% if Aggregate			
		Shoulder			6% if Aggregrate; 8% if Earth			
	Auxillary Lanes	Lane Width		51-6.02(05), 45-1.0	Desirable: 10 ft			
		Shoulder Width			Desirable: 2 ft; Minimum: 1 ft			
	Obstruction Free Zone (5)			51-6.02(06)	Desirable: 3 ft		Desirable: 6.5 ft	Desirable: 10 ft
	Side Slopes	Cut	Foreslope	51-6.02(05), 45-3.0	Desirable: 4.1; Maximum: 1½:1			
			Ditch Width		Minimum: 0 ft (V-Ditch)			
			Baclslope		Desirable: 4:1; Maximum: 1½:1			
		Fill			Desirable: 4:1; Maximum: 1½:1			
Bridges	New or Reconstructed Bridge	Structural Capacity		Part VI	HS-20			
		Clear Roadway Width		45-4.0	Travelway + 5 ft			Travelway + Shoulders
	Existing Bridge to Remain in Place	Structural Capacity		Part VI	HS-15			
		Clear Roadway Width		45-4.0	Minimum: Travelway			
	Vertical Clearance (Recreational Road Under)	New or Replaced Overpassing Bridge		44-4.0	15 ft			
		Existing Overpassing Bridge			14.5 ft			
	Vertical Clearance (Recreational Road Over Railroad) (6)			Ch. 69	23 ft			

GEOMETRIC DESIGN CRITERIA FOR RECREATIONAL ROAD

Figure 51-6B

Design Element			Manual Section	15 mph	20 mph	25 mph	30 mph	40 mph	50 mph
Alignment Elements	Stopping Sight Distance	2-Lane (1b)	51-6.02(02), 42-1.0	80 ft	115 ft	155 ft	200 ft	250 ft	305 ft
		1-Lane (1a)		160 ft	230 ft	n/a	n/a	n/a	n/a
	Passing Sight Distance		42-3.0	n/a	n/a	n/a	1090 ft	1470 ft	1835 ft
	Intersection Sight Distance		46-10.0	170 ft	225 ft	280 ft	335 ft	445 ft	555 ft
	Minimum Radius (e=4%)		51-6.02(04), 43-2.0	70 ft	125 ft	205 ft	300 ft	565 ft	930 ft
	Superelevation Rate		51-6.02(04), 43-3.0	n/a	e_{max} = 4%				
	Horizontal Sight Distance		51-6.02(04), 43-4.0	(7)					
	Vertical Curvature (K-values)	Crest 2-Lane (1b)	44-3.0	3	7	12	9	16	25
		Crest 1-Lane (1a)		12	25	n/a	n/a	n/a	n/a
		Sag 2-Lane (1b)		10	17	26	37	49	64
		Sag 1-Lane (1a)		27	44	n/a	n/a	n/a	n/a
	Maximum Grade	Level	44-1.02	8%	8%	7%	7%	7%	7%
		Rolling		12%	11%	10%	10%	9%	8.5%
	Minimum Grade		44-1.03	Desirable: 0.5%; Minimum: 0.0%					

GEOMETRIC DESIGN CRITERIA FOR RECREATIONAL ROAD

Figure 51-6B (Continued)

GEOMETRIC DESIGN CRITERIA FOR RECREATIONAL ROAD
Footnotes to Figure 51-6B

1. 1-Lane/2-Lanes. For Section 51-6.0 only, the following will apply:

   a. The criteria for one-lane refer to two-directional traffic on a one-lane road.

   b. The criteria for two-lanes refer to two-lane roads or a one-way roadway with either one or two lanes.

2. Access Control. Generally, access to private individuals is not provided within the recreational area. However, access may be provided on the primary access road.

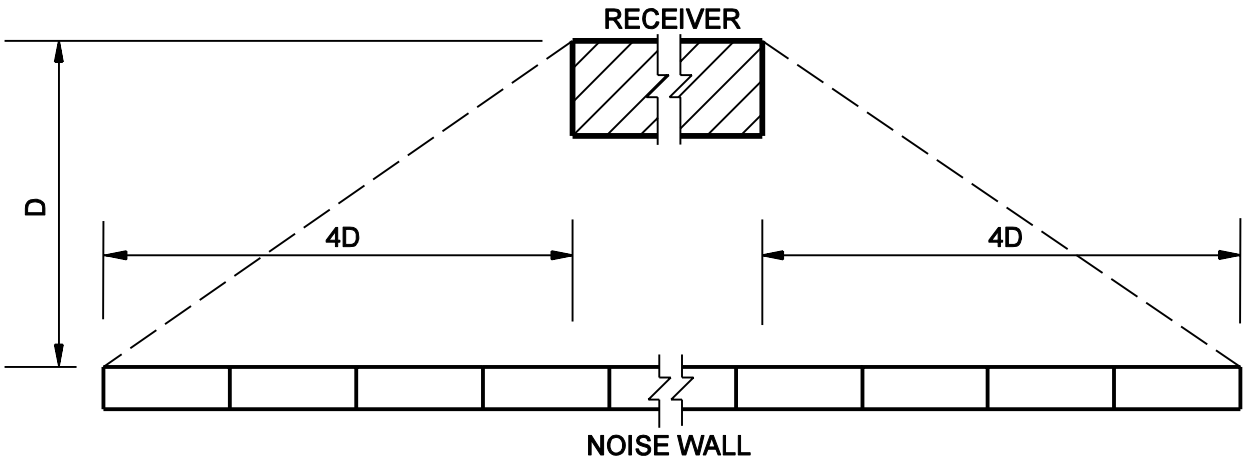
3. Travel Lane Width. A total roadway width greater than 14 ft is not recommended for a one-lane road. For a one-lane road, the travel lane width is predicated upon the type of vehicle expected to use the facility.

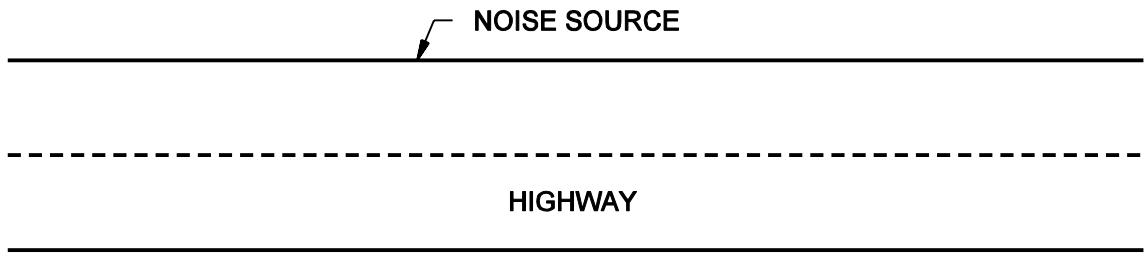
4. Shoulder Width. Where a barrier is used, the graded width of shoulder should desirably be increased by 2 ft.

5. Obstruction-Free Zone. The minimum obstruction-free zone will be the shoulder width.

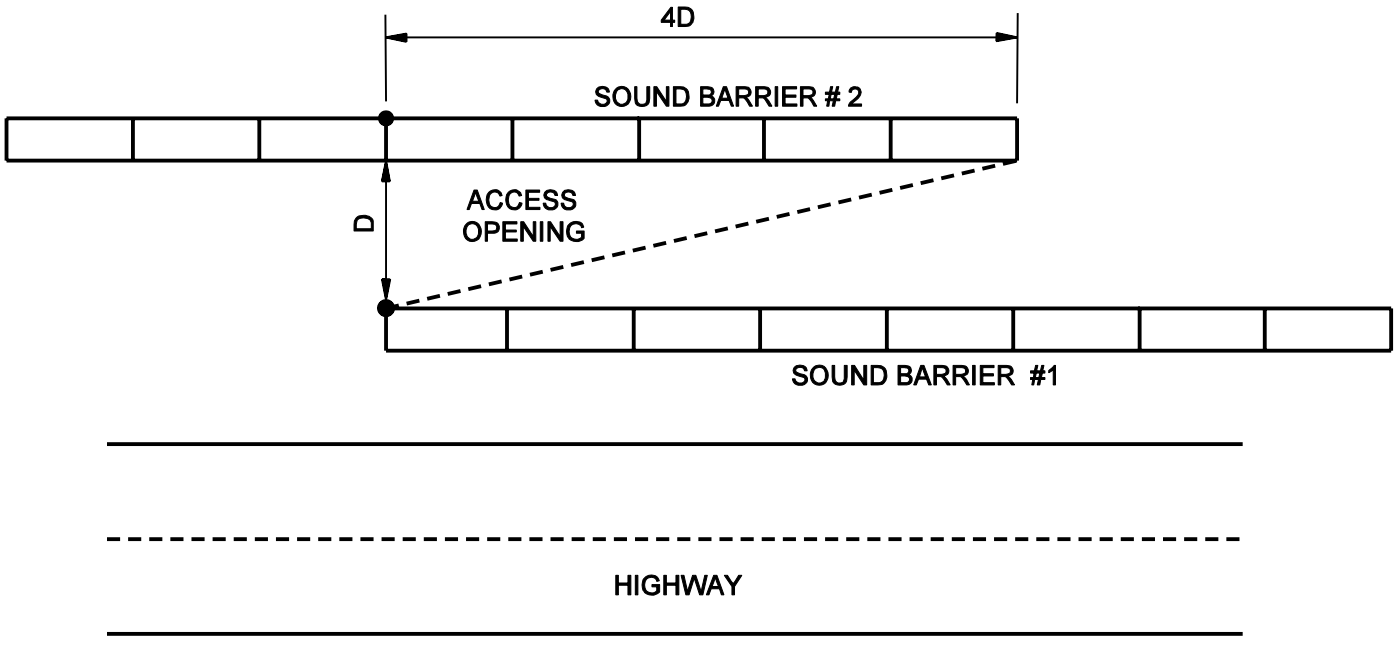
6. Vertical Clearance (Recreational Road Over Railroad). See Chapter Sixty-nine for additional information on railroad clearance under a highway.

7. Horizontal Sight Distance. For a given design speed, the necessary middle ordinate will be determined by the minimum radius and the stopping sight distance which applies at the site.





(a) MINIMUM LENGTH REQUIRED



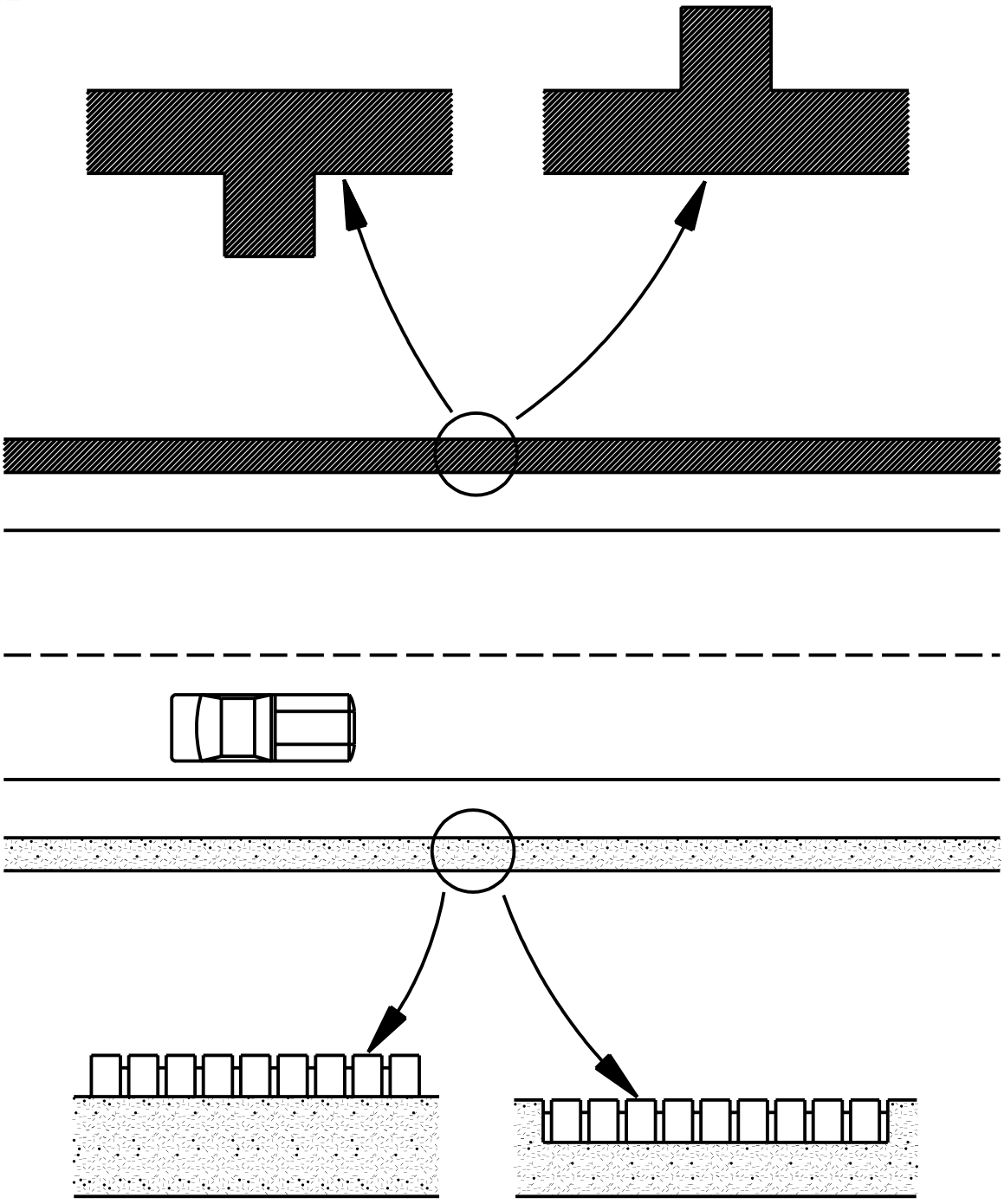
(b) MINIMUM OVERLAP REQUIRED

SOUND BARRIER PLACEMENT

Figure 51-9A

AVOID LARGE COLUMN PROTRUSIONS ON WALL ADJACENT TO TRAFFI C LANE

ACCEPTABLE



AVOID FACING WHICH MAY BECOME SAFETY HAZARDS WHEN HIT

FACING SET INTO RECESS

SOUND BARRIER PROTUSIONS

Figure 51-9B

Highway Type and Traffic Conditions	Width, *W*, of All-Weather Surface of Turnout or Available Shoulder at Mailbox (ft)		Distance Roadside Face of Mailbox is to be Offset Behind Edge of Turnout or Usable Shoulder (in.)	
	Preferred	Minimum	Preferred	Minimum
Rural highway AADT >10,000	> 12	12	8 to 12	0
Rural highway 1,500 < AADT ≤ 10,000	12	10		
Rural highway 400 < AADT ≤ 1500	10	8		
Rural road AADT ≤ 400	8	6		
Residential street without curb or all-weather shoulder	6	0		8 *
Curbed residential street	Not Applicable		8 to 12 Behind Traffic Face of Curb	6 Behind Traffic Face of Curb

AADT = Average Annual Daily Traffic vpd = vehicles per day

* If a turnout is provided, this may be reduced to zero.

SUGGESTED GUIDELINES FOR LATERAL PLACEMENT OF MAILBOXES

Figure 51-11A