Layout and Design

A. Parking Lot Access

Properly designed parking lot access provides for safe and efficient movement of vehicles into and out of the parking lot. Refer to Chapter 5 - Roadway Design for additional information on access management and driveway design, spacing, and location selection.

The most efficient approach to designing parking lot access places a priority on moving inbound traffic from the public roadway into the facility. Entrances should be located on major streets, align with interior traffic lanes/aisles, and direct inbound traffic toward the destination. Traffic control within the lot should provide inbound traffic the right-of-way. Favoring inbound traffic expedites the rapid movement of vehicles from the street into the facility and prevents vehicles from lining up on public roadways. Where a high volume parking lot is adjacent to a high volume or high speed roadway, a dedicated deceleration/turning lane at the entrance helps eliminate rear-end accidents.

Exits should be located away from the destination point and discharge vehicles onto lower volume adjacent side streets if possible. Since exiting traffic tends to move more slowly, drivers can more comfortably navigate the turns required to reach the exit. Vehicles queued to exit the parking lot will stack up inside the lot and will not affect traffic on the public street.

Where separate entrances and exits cannot be provided, the driveway to the parking lot should be at least 24 feet wide to provide two 12 foot lanes.

Traffic studies may be required for entrances to large retail centers, event facilities, or businesses with large numbers of employees entering or exiting the lot at the beginning or end of a work day or shift.

B. Parking Lot Circulation

Off-street parking lots should be designed to accommodate traffic volumes and pedestrian circulation based on the land use served. The use of islands, medians, curbing, and landscaping is encouraged to separate parking spaces from traffic and pedestrian circulation areas.

Parking spaces at entrance and exit points should be terminated (except at one and two family dwelling units) to prevent conflict between vehicles attempting to enter or exit the parking space, and vehicles attempting to enter or exit the parking lot.

Access between adjacent commercial parking lots should be considered. This allows patrons to travel from one business to the adjacent business without entering the public street and then turning immediately into the next parking area. These types of movements can cause operational problems on the public street.

C. Parking Lot Dimensions

1. **Parking Spaces:** In order to determine parking space sizes, the design vehicle size must be defined. Since 1999, the size of the 85th percentile vehicle on the road has varied slightly, but has remained within an inch or two of 6 feet, 7 inches wide by 17 feet, 3 inches long.

   In addition to vehicle size, the designer must consider the intended function of the parking facility. For example, facilities with high turnover rates, such as convenience stores, should have greater clearances than those with low turnover rates. In addition, where a significant portion of users may be elderly, such as at hospitals, larger dimensions may be appropriate.

   Parking spaces that provide sufficient clearance for doors to be opened and occupants to enter and exit will also provide adequate width for maneuvering if the adjacent aisle is wide enough. Door opening clearances should range from 23 inches in low turnover facilities to 27 inches in high turnover facilities. Table 8B-1.01 lists recommended parking stall widths on the basis of turnover.

   Table 8B-1.01: Recommended Minimum Widths for Parking Stalls

Facility Type	Width
Low turnover (employees, students, etc)	8'-6"
Moderate to high turnover (retail, medical facilities, etc.)	9'-0"

   Source: Urban Land Institute, National Parking Association

   For stalls that are adjacent to walls, curbs, islands, or other obstructions, increase the stall width by at least 12 inches to allow for door opening and to reduce the risk of tripping.

   Unlike width, the length of a parking space is not affected by turnover rate or user type. The recommended length of a parking space is 18 feet. The length of the parking space may be modified up to 2 feet, if vehicle overhang is allowed. However, the designer should be aware that the aerodynamic design of many current vehicles often does not provide sufficient vertical clearance for vehicles to pull forward over the curb.

2. **Parking Module Design:** The drive aisle is the space between two parking stalls directly across from one another. The term "module" refers to the width of the drive aisle combined with the length of the parking stalls on one or both sides of the drive aisle. Table 8B-1.02 lists recommended minimum dimensions for parking facilities. Figure 8B-1.01 provides further definition of the terms used in Table 8B-1.02.

   The only dimension that varies by stall width is the interlock dimension. An interlock occurs with angled parking when two stalls in adjacent modules align. The overlap at the front of the stalls is the interlock dimension. When a parking facility is designed to take advantage of interlock, the effective width of the module may be reduced by the interlock dimension. For aisles with interlocking spaces on both sides, the effective width of the module may be reduced by two times the interlock distance. This approach can provide a more efficient parking lot facility and reduce the overall surface area required for the parking lot.

   Because snow can obscure pavement markings, vehicles will often pull too far into a parking space, which reduces the width of the aisle in the adjacent module. This has been taken into consideration in Table 8B-1.02. Therefore, when a curb, wall, or other physical restraint is provided for on at least 30% of the stalls, the aisle width (and therefore the overall module width) may be reduced by 1 foot.

Table 8B-1.02: Minimum Parking Dimensions

Parking Lot Dimension				Parking Angle (θ)				
				Two-way Aisle			One-way Aisle	
				90°	60°	45°	60°	45°
Stall Projection			SP	18'-0"	15'-7"	12'-9"	15'-7"	12'-9"
Aisle Width			A	24'-0"	25'-10"	29'-8"	20'-4"	21'-6"
Base Module			M_1	60'-0"	57'-0"	55'-2"	51'-6"	47'-0"
Single Loaded Module			M_2	42'-0"	39'-0"	37'-7"	32'-6"	29'-5"
Wall to Interlock			M_3	60'-0"	55'-10"	52'-2"	49'-4"	44'-0"
Interlock to Interlock			M_4	60'-0"	53'-8"	49'-2"	47'-2"	41'-0"
Overhang			o	2'-6"	2'-2"	1'-9"	2'-2"	1'-9"
Stall Width	*8'-6"*	Width Projection	WP	8'-6"	9'-10"	12'-0"	9'-10"	12'-0"
		Interlock	i	0'-0"	2'-2"	3'-0"	2'-2"	3'-0"
	9'-0"	Width Projection	WP	9'-0"	10'-5"	12'-9"	10'-5"	12'-9"
		Interlock	i	0'-0"	2'-3"	3'-2"	2'-3"	3'-2"

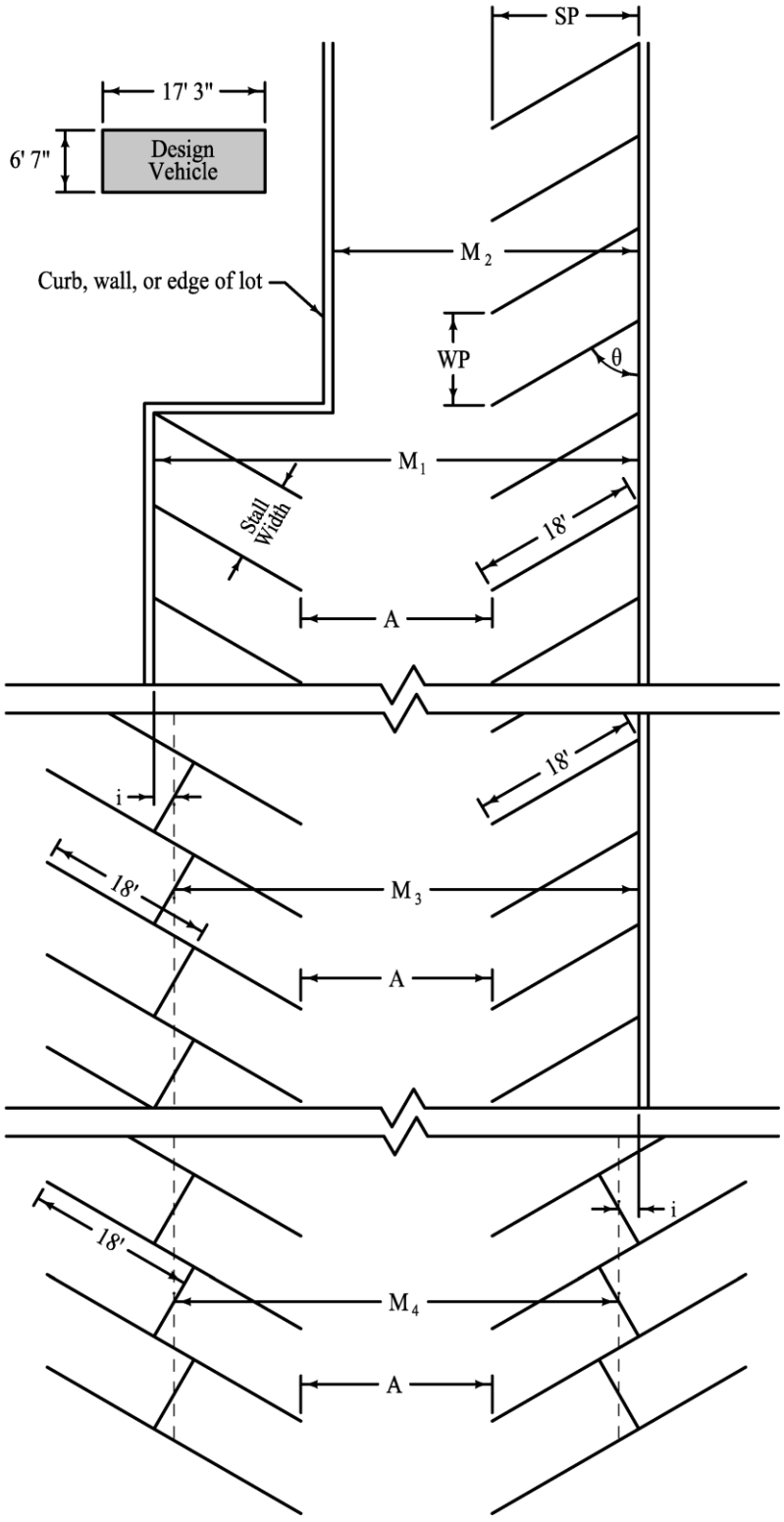
Notes:
1. Aisle width may be increased up to 3 feet to provide a higher level of comfort.
2. In lots where at least 30% of stalls have curbs, aisle width may be reduced by 1'-0".
3. Light poles and columns may protrude a maximum of 2 feet into a parking module as long as they do not encroach on more than 30% of the stalls. When more than 30% of the stalls are encroached, interlock reductions cannot be taken.
4. For additional parking angles, refer to The Dimensions of Parking, ULI, NPA

Source: Adapted from Urban Land Institute, National Parking Association

Perpendicular parking provides the greatest number of parking spaces for a given a length of aisle. One-way angled parking provides fewer spaces than perpendicular for the same length of aisle, but has the advantage of a narrower drive aisle. Because of this, the surface area per parking space for perpendicular and angled one-way parking is approximately equal.

Two-way angled parking is also allowable and can be useful in certain situations; however, it is a less efficient design than two-way perpendicular or one-way angled parking. Two-way angled parking cannot take full advantage of the narrower drive aisle, requiring approximately 10% to 15% more area per parking space than perpendicular or one-way angled parking.

Figure 8B-1.01: Parking Dimensions



SP	= Stall Projection	M_1 = Base Module	(2SP + A)
A	= Aisle Width	M_2 = Single Loaded Module	(SP + A)
WP	= Width Projection	M_3 = Wall to Interlock	(M_1 – i)
i	= Interlock	M_4 = Interlock to Interlock	(M_1 – 2i)

3. **Compact Parking:** It is no longer recommended that compact car only spaces be provided. At the time when compact car parking spaces were introduced, the mix of automobiles consisted of clearly defined very large and very small vehicles. As a result, the use of compact parking only was largely self enforcing; however, the current mix of automobile sizes is much more diverse. There is no longer a clear definition among the public of what constitutes a compact vehicle. In addition, if a compact car space is available in a convenient location, many drivers of intermediate and large vehicles will attempt to utilize the space, encroaching into the adjacent space. This creates a domino effect down the row and eventually renders a parking space unusable. For these reasons, compact car only spaces are not recommended.

D. Accessibility Requirements

Accessible parking spaces must be provided according to the 2010 ADA Standards for Accessible Design (2010 Standards). In addition, certain facilities are required to provide accessible passenger loading zones. The 2010 Standards identify both the minimum dimensions and the minimum number of accessible parking spaces and loading zones required. Refer to Parts 502 and 503 of the 2010 ADA Standards for additional information.

1. **Accessible Parking Spaces:** The 2010 Standards identify two types of accessible parking spaces for vehicles - car and van-accessible parking spaces. The minimum dimensions and common requirements for each are provided below and in Figure 8B-1.02.

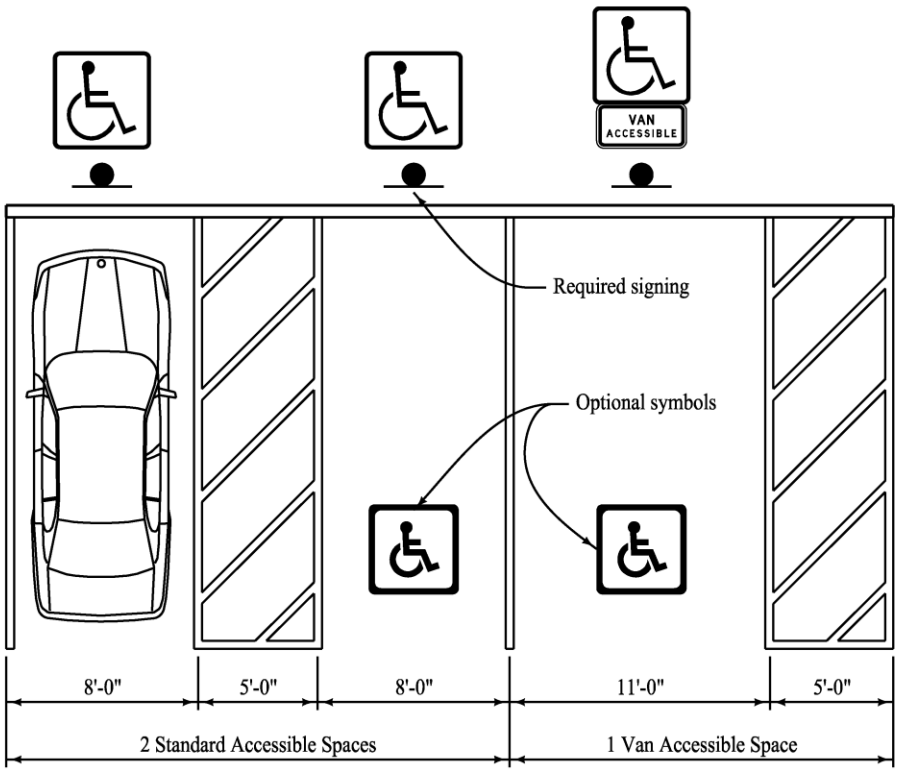
    a. **Car Accessible Spaces:** Minimum width of 96 inches (8 feet 0 inches)

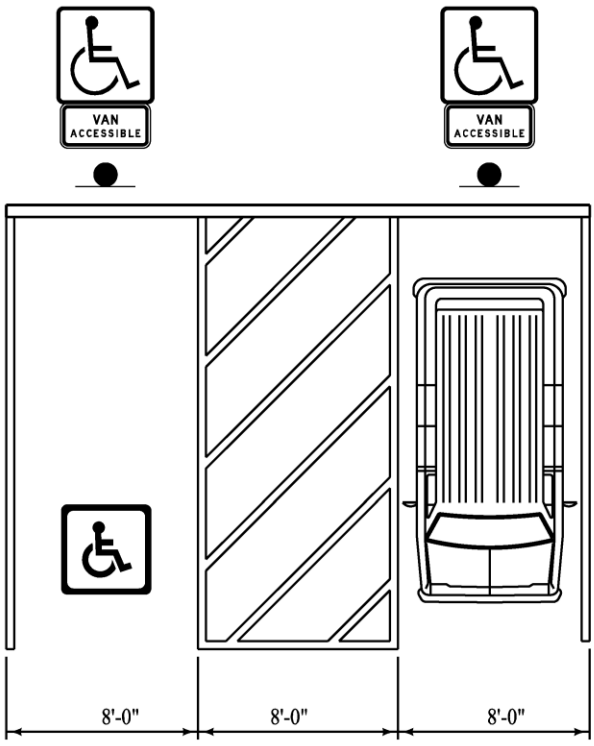
    b. **Van-accessible Spaces:** Minimum width of 132 inches (11 feet 0 inches)

    c. **Access Aisle:** An adjacent access aisle is required for both car and van-accessible spaces. Two parking spaces may share an individual access aisle.
        1) **Width:** The minimum width of the access aisle is 60 inches (5 feet 0 inches). If the width of the access aisle is increased to 96 inches, the width of an adjacent van-accessible parking space may be reduced from 132 inches to 96 inches. With proper layout, this allows for a reduction in the total width consumed by two adjacent van-accessible spaces.
        2) **Length:** The access aisle must extend the full length of the parking spaces they serve.
        3) **Marking:** The access aisle must be marked; however, the 2010 Standards do not indicate the type of pavement marking required. Typically, the aisle is striped at an angle. While not required, the adjacent stalls may be painted with the international symbol of accessibility (wheelchair symbol) to aid motorist in identifying the space as being reserved.

    d. **Signing:** Accessible parking spaces must be designated with signs showing the international symbol of accessibility. Signs for van accessible spaces should also contain the designation "van accessible." Signs must be installed a minimum of 60 inches from the bottom of the sign to the ground surface. Additional signage related to enforcement or parking fines is not required by ADA.

Figure 8B-1.02: Accessible Space Dimensions



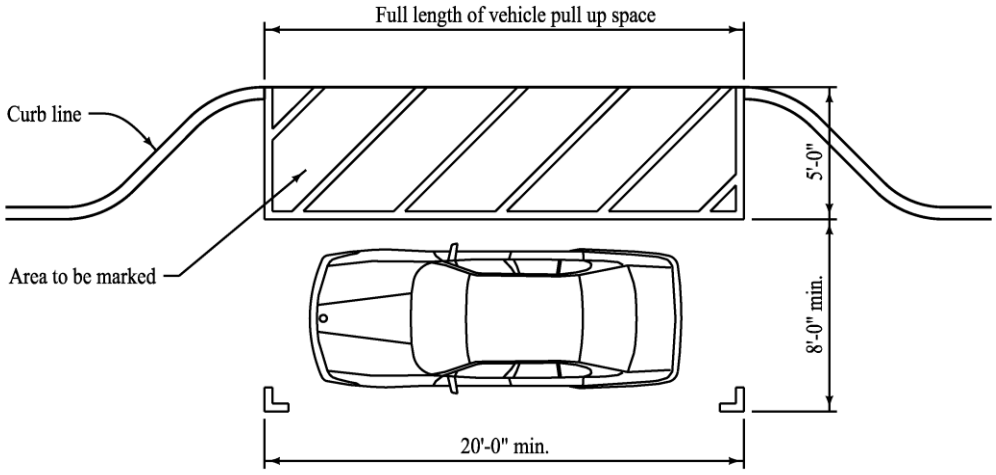


Alternate Van Accessible Parking Dimensions

2. **Passenger Loading Zone:** The 2010 ADA Standards require passenger loading zones only at licensed medical care and long-term care facilities (where the period of stay exceeds 24 hours). At other locations, the provision of passenger loading zones is optional; however, when they are provided, a portion of the loading zone must be accessible. At least one accessible passenger loading zone must be provided for every 100 continuous linear feet of loading zone space.

   Passenger loading zones must have a minimum pull-up length of 20 feet and a width of 96 inches. An access aisle adjacent to the loading zone must extend the full width of the vehicle pull up space they serve and have a minimum width of 60 inches. The access aisle must be at the same elevation as the vehicle pull-up spaces that serve them. The loading zone cannot discharge to a sidewalk on top of a curb. In addition, the access aisle must be marked to discourage parking. This is typically accomplished by striping at an angle.

Figure 8B-1.03: Passenger Loading Zone Dimensions



3. **Access Routes:** At least one accessible route must connect the building or destination with each accessible parking space or loading zone. To the maximum extent possible, the accessible route should coincide with the route for the general public. Like accessible off-street parking spaces and loading zones, accessible routes are covered by the 2010 ADA Standards. The basic requirements that apply to new construction for accessibility from a parking lot to a building or other destination are summarized in Chapter 4 of the 2010 Standards.

4. **On-Street Parking:** For requirements on accessibility for on-street marked or metered parking spaces, see Section 12A-2.

E. Drainage

Internal parking lot drainage should be designed according to Chapter 2 - Stormwater.

Stormwater runoff from parking lots serving other than single and two family dwellings should not be discharged directly into the street; such runoff should be collected internally or discharged to an adjacent drainage way. After providing detention, when required, the collected stormwater may be discharged to the public storm sewer, ditch, or other conveyance. Stormwater runoff discharged to the street over the back of the curb or through a parking lot entrance, should be minimized. Check with the local jurisdiction for their stormwater requirements.

Where narrow (less than 10 feet wide) raised islands are provided, their presence should generally be disregarded when determining the runoff coefficient or curve number for the parking lot as they provide little benefit in reducing runoff. Wider islands, or islands that are depressed to collect stormwater runoff, are encouraged and may be taken into consideration when determining the runoff potential.

Pavement slopes of 1.5% should be provided to ensure proper drainage and eliminate standing water and icy conditions. Minimum pavement slopes of 0.6% may be used, however since the potential for flat areas is greater, additional measures to address drainage, such as slotted drains or pervious pavement, may be necessary. Slopes greater than 2% in areas between the parking lot destination and the accessible parking stalls should be avoided as they create a situation where constructing an accessible route is difficult. Slopes greater than 5% are discouraged.

F. Pavement Design

Any off-street parking area should be surfaced with a flexible or rigid pavement. Check with the local jurisdiction to determine the requirements for paving parking lots. If no local requirements are stipulated, the pavement thickness for parking areas occupied by cars and small trucks for rigid and flexible pavements (see Chapter 5 - Roadway Design for mix designs) should be designed according to the following tables. It should be noted that the layer of aggregate used as the subbase needs to be drainable.

Parking lots should be designed for a minimum 20 year design life. If a design life of greater or less than 20 years is desired, see Chapter 5 - Roadway Design for pavement thickness determination. In addition, for pavements less than the recommended thickness, a pavement thickness determination should be completed to match the pavement structure with the needs of the project.

The subgrade should be designed according to Section 6E-1. If soils tests are not available to determine the CBR value and uniformity of the soil (before and after construction), a CBR value of 3 and a non-uniform subgrade should be assumed.

Table 8B-1.03: Pavement Thickness for Light Loads
(Parking lots with 200 or less cars/day and/or 2 or less trucks/day or equivalent axle loads)

Subgrade CBR	**Surface Material**	**On 12"of Prepared Subgrade**		**On 12" of Prepared Subgrade with 4" Granular Subbase**	
		Minimum	***Desirable***	***Minimum***	***Desirable***
9	Rigid	5"	6"	4"	5"
	Flexible	5"	6"	4"	5"
6	Rigid	5"	6"	4"	5"
	Flexible	5"	6"	4"	5"
3	Rigid	5"	6"	4"	5"
	Flexible	6"	6"	5"	5"

Table 8B-1.04: Pavement Thickness for Moderate Loads
(Parking areas, entrances, perimeter travel lanes, and frontage roads subject to 201 to 700 cars/day and/or 3 to 50 trucks/day or equivalent axle loads)

Subgrade CBR	Surface Material	On 12"of Prepared Subgrade		On 12" of Prepared Subgrade with Granular Subbase		
		Minimum	***Desirable***	***Thickness of Granular Subbase***	***Minimum***	***Desirable***
9	Rigid	5"	6"	4"	4"	5"
	Flexible	5"	6"	6"	4"	5"
6	Rigid	5"	6"	6"	4.5"	5"
	Flexible	6"	6"	8"	5"	5"
3	Rigid	5.5"	6"	6"	5"	5"
	Flexible	6"	7"	8"	6"	6"

The portions of the parking facility serving truck traffic such as entrances, perimeter travel lanes, trash dumpster sites, and delivery truck routes must be designed to accommodate heavier loads. The number, type, and weight of delivery vehicles can usually be predicted with a fair level of accuracy. With this information, ESAL values and pavement thicknesses can be determined using the methodology described in Chapter 5 - Roadway Design.

If the parking lot is to service an industrial area, such as a truck stop or manufacturing facility, the volume of truck traffic and the associated ESALs should be determined and an independent pavement thickness determination completed to ensure meeting the 20 year design life needs of the project.