630
Parking Area Design

General

Parking areas are an important component of many transportation facilities such as safety rest areas, park and ride lots, and viewpoints. The parking area is often the first thing users see upon entering the facility, creating an important first impression.

The optimum design for a parking area is not necessarily one that provides the maximum number of parking spaces. It is one that provides safe pedestrian and vehicular circulation, with ample stall and aisle widths, adequate turning radii, reasonable gradients, a pleasing appearance, visual access for law enforcement surveillance, provisions for handling and treating stormwater runoff, fits the site, is easy to maintain, and is in close proximity to the facility it serves. These elements illustrate the complexity of issues that must be addressed in parking area design.

Studies show that the use of shaded parking in hot weather can reduce noxious emissions by up to a ton a day for a municipality. The use of porous pavements for overflow parking areas can decrease the size of stormwater facilities needed.

Parking facilities must conform to local (city or county) regulations and zoning codes in addition to the guidelines outlined in this chapter.

References

Design Manual, WSDOT, M 22-01

Roadside Manual, WSDOT, M 25-30, Chapter 620 "Universal Access."

Standard Plans for Road, Bridge, and Municipal Construction, WSDOT, M 21-01.

Accessibility Design for All: An Illustrated Handbook, Washington State Regulations (WAC 51-40), by Barbara L. Allan and Frank C. Moffett, Olympia, Washington: A.I.A. Washington Council, 1998. Provides dimensions and slopes for accessibility in the state of Washington.

Guide for the Design of High Occupancy Vehicle and Public Transfer Facilities. AASHTO, 1983

Manual of Uniform Traffic Control Devices (MUTCD) for pavement markings and signing at http://mutcd.fhwa.dot.gov/

Resources

The region's Landscape Architect

Headquarters Roadside and Site Development Unit

Region or Environmental Affairs Office Water Quality Unit

The region's Hydraulics Engineer or the HQ Hydraulics Office

The region's Traffic Engineer, for signage, illumination, and traffic data.

Definitions

context sensitive design A collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic, and environmental resources, while maintaining safety and mobility. Context Sensitive Design is an approach that considers the total context within which a transportation improvement project will exist.[1]

facility All or any portion of buildings, structures, vehicles, equipment, roads, walks, parking lots, or other real or personal property or interest in such property.[2]

Planning

- When choosing locations for parking facilities consider impacts the facility will have on existing desirable vegetation, topography, and adjacent neighbors. For example if there are large trees, how can parking be sited to preserve these trees? How can the site design minimize grading?
- Encourage design and placement of facilities to provide for safety and access to services by many different types of transportation, such as car, bicycle, or pedestrian travel.
- Use context sensitive design principles in planning and funding of projects. See http://www.fhwa.dot.gov/csd/index.htm for more information on context sensitive design.
- Location of the parking facility in relation to the facility it serves should be carefully considered. Parking areas should not be the dominant visual element of the facility. Rather, the parking area design should direct the viewer to the main point of entry or attention.

[1] U.S. Department of Transportation, Federal Highway Administration. http://www.fhwa.dot.gov/csd/
[2] Subpart A, 49 CFR Part 27.

Design

- Adjust design to comply with local regulations and requirements.
- Design aisles and breaks in planting strips to provide for easy maintenance. Aisles should be wide enough to allow access by street sweepers. High points in corner areas will allow water to drain away from these locations so they do not collect water and leaves. Refer to planting area design later in this chapter for additional design considerations.
- Ensure environmental quality by addressing air, drinking water and noise concerns, watershed restoration, and preservation of habitats and public green spaces.
- Use transportation facilities to enhance community aesthetics by incorporating unique local features (scenic views, community neighborhoods, historic districts, cultural and natural resources, etc.) and providing focal points for communities through those facilities such as multimodal stations, pedestrian plazas, and parkways.

Pedestrian Safety

Security

Users of a facility should feel safe and not feel imprisoned or threatened. For example lighting, security cameras, emergency telephones, and appropriate vendors are preferable to fences and on-site security. Frequent removal of graffiti, broken glass, and trash is important when providing an environment that feels safe and secure to the user.[3] The perception of safety is as important as its reality.

In planting areas near conflicting traffic movement, such as backing vehicles or opposing traffic, select shrubs and groundcovers that grow no higher than 2 feet and keep trees limbed up to 8 feet above ground level to provide clear sight lines for safe traffic movement.[4]

Clear lines of vision are important so that police can provide surveillance within the site and surveillance from the street. Lighting is an important component in pedestrian and vehicle security and safety.

Sidewalks

Provide sidewalks near bus transfer areas or a scenic viewpoint with a minimum width of 10 feet. Provide 10 square feet per person for each user expected to be at the focal point at any one time:

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[3] Robert J. Spillar, P.E.. *Park-and-Ride Planning and Design Guidelines*. New York: Parsons Brinckerhoff Inc. 1997.
[4] *Design Manual,* Chapter 1025.07(2d).

Compare the density above with the following: Disneyland on a crowded summer day has a density of approximately 15 square feet per person. A crowded theater lobby has a density of approximately 5 square feet per person.[5]

Design slopes across access driveways so that cross slopes do not exceed 2 percent. This will allow safe crossing for people in wheelchairs or using strollers or walkers.

Accessibility

All pedestrian facilities must be designed to meet standards set by the Americans with Disabilities Act. See Chapter 620 of this manual for these guidelines. Accessible parking spaces must be located nearest to the destination point, such as a rest room or bus stop. The number of accessible parking spaces shall be provided according to Figure 630.1[6]:

Total Number of Spaces in Lot or Garage	Minimum Number of Accessible Spaces
1-25	1
26-50	2
51-75	3
76-100	4
101-150	5
150-200	6
201-300	7
301-400	8
401-500	9
501-999	2% of total spaces
Over 1000	20 spaces, plus 1 space for every 100 spaces, or fraction thereof, over 1000[7]

Figure 630.1 Ratio of handicap parking stalls to total stall numbers.

[5] Abbaté, Mike. "Pedestrian Density:" GreenWorks, PC * Landscape Architecture * Environmental Design.

[6] Accessible Design For All, Appendix A, p. 23. WAC 51-40-1103.

[7] Accessibility Design for All. Appendix A, p. 33.

Accessible Parking Space Dimensions					
Cars			Vans		
Stall Width	Access Ramp	Slope	Stall Width	Accesss Ramp	Slope
8 feet	5 feet	2%	11 feet	5 feet	2%

Figure 630.2 Dimensions for Accessible Parking Spaces

Two parking stalls can share the same access aisle. These wider spaces allow people to move from the car into a wheelchair or to use van lifts. Because of the need for stability for these maneuvers, slopes in accessible parking areas may not slope more than 1V: 48H (approximately 2%) in any direction.[8] See Chapter 620 of this manual for more information on Universal Access issues.

Detectable warning strips on walking surfaces help to warn visually impaired pedestrians of a hazard. Truncated domes are specified by the Access Board's ADA Accessibility Guidelines. Examples are seen in Figure 630.3 and 630.4.

Lighting

- Provide illumination as per the *Design Manual* Chapter 840 on Illumination.
- Consider adjacent land uses when designing the illumination plan. Using trees and tall shrubs to screen the parking facility's vehicle activity and lighting from adjoining residential land use can be effective and may be required by county or local code in many locations.
- Pay particular attention to the scale of lighting fixtures in pedestrian areas. Standard heights for roadway lighting are not appropriate for pedestrians.
- Ensure that lighting illuminates pedestrian pathways, not just the roadway.
- Lighting maintenance requires set-up room for the man-lift truck to change lights. Replacement of lights can occur during midday or off peak hours, but must be taken into consideration during the design of the facility.
- Junction boxes and hand-hole access at the poles must be accessible for servicing and not covered with vegetation.

[8] Accessibility Design for All. P 22.

Pedestrian Circulation

See the *Design Manual*, Chapter 1025 on Pedestrian Design Considerations and the *MUTCD* (http://mutcd.fhwa.dot.gov) for pavement markings and signing.

Clear separation of pedestrian and vehicle circulation will increase safety in parking facilities. Once people leave their vehicles, lines of approach to the bus stop or toilets should be obvious. People will take the shortest, most direct route to their destination.

For park and ride lots, aisle lengths should not exceed 400 feet if possible.[9]

Minimize pedestrian crossings in front of moving vehicles. When this is necessary, especially in safety rest areas, provide cues to the drivers before pedestrian crossings. Cues can include items such as:

- signing
- painted crosswalks
- rumble strips in advance of a stopping or slowing condition
- speed bumps
- raised crosswalks
- embedded lights in pavement

Parking areas may require more aggressive delineation than typical roadway applications to indicate pedestrian paths and vehicular channelization. Using planting islands to direct pedestrian and vehicular traffic can be effective.

Vehicular Circulation

Separate vehicle circulation from pedestrian circulation as much as possible.

In two-way vehicular circulation patterns, minimize left hand turns when entering the lot to minimize traffic delays.

The most desirable direction for internal circulation within the parking area is clockwise. This is because it follows the normal pattern of driving to the right.

Locate the vehicle entrance and exit far from the major pedestrian circulation area. For example, locate the entrances as far from the bus stop as possible.

[9] AASHTO. *Guide for the Design of High Occupancy Vehicle and Public Transfer Facilities. 1983. p. 24.*

In large multi-aisle parking lots, consider two-lane vehicular cross aisles to facilitate circulation. These cross aisles can be located when each row exceeds 25 stalls.

Allow enough length and slope on driveways to provide access for large vehicles (such as trucks, busses, and motor homes) so that the back bumpers do not drag on curb cuts. See the Road Approaches chapter in the *Design Manual.*

Circulation within the parking lot should be clearly indicated by planting beds or islands and differences in paving patterns. Excessive use of pavement markings is difficult to maintain.

For small parking lots with uncontrolled or stop-controlled driveway intersections on one-way streets, it is desirable to utilize separate entry and exit points to avoid left-turn conflicts with outbound traffic. The inbound lane can be on one side of the lot and the outbound on the other, or the lanes can be separated by a wide divider.

Transit Movement

Separate bus loading and unloading areas from auto and pedestrian travel ways.

Provide covered, enclosed areas for pedestrians to wait for buses.

At transit stops truncated domes are required[10] at loading areas. Figures 630.3 and 630.4 show views of truncated domes.

Figure 630.3 Truncated Domes under construction at transit stop

[10] *Design Manual*, Chapter 1025 and *Standard Plans*.

Figure 630.4 Close-up of truncated domes with pen for scale

The truncated domes are available in several different materials: metal plates, concrete paving tiles, polymer concrete appliqués, or stamped concrete.

Stormwater Treatment and Detention

Biofiltration Swales

Integrate vegetated swales into the facility to collect and detain stormwater. These can be designed within planting islands and around the perimeter. These swales also serve as water quality filtration strips and can be an amenity on the site.

Long, linear swales break up the large expanse of pavement, collect stormwater, and allow for tree planting. A minimum width is 10 feet for these planted swales.

Use on-site stormwater drainage to provide water for plants. For example, plant trees on the edges of swales in parking islands. Trees should be spaced a minimum of every 75 feet on center within the parking lot, and aligned with stall lines.

Figure 630.5 Vegetated bioswale in parking lot

If curbing is used around swales, regular gaps in the curbing must be provided to allow stormwater runoff to drain into the swale. The elevation of the swale in relation to the pavement should be low enough for water and debris to drain into the swale without continuous maintenance. However, these locations will require periodic maintenance to clear debris build-up.

Figure 630.6 Curb interruption to facilitate drainage into bioswale

If curbing is not placed around the swale, stop blocks must be used for each parking space surrounding the swale to prevent vehicles from entering the swale.

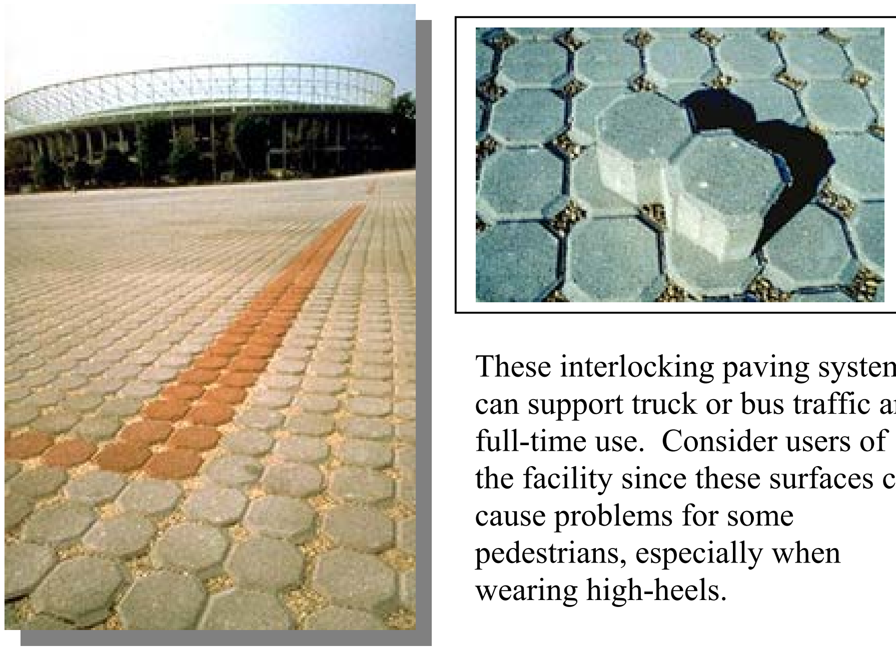
Compacted soils resist infiltration of water. Rip soils in planting islands before adding soil amendments and plant materials. These planting islands can require subsurface drainage.

Figure 630.7 Inlet for subsurface drainage

Permeable Pavements

Consider vegetated pervious open grid-type parking stalls to allow infiltration of stormwater. These are most effective for peripheral or overflow parking. Consult with the region, or state Materials, or Hydraulics office to select an appropriate pavement type.

An alternative modular paving system that can support long-term parking is available.



These interlocking paving systems can support truck or bus traffic and full-time use. Consider users of the facility since these surfaces can cause problems for some pedestrians, especially when wearing high-heels.

Figure 630.8   Permeable Paving Systems

Porous Concrete Pavement

No-fines porous concrete pavement is an emerging technology in our area that has been used in the eastern United States and in Europe for years. Costs are slightly higher (approximately 25% more) than that of conventional Portland cement concrete pavement. However, because porous concrete pavement infiltrates water at 270 to 450 inches per hour per square foot (3-5 gallons per minute per square foot), stormwater detention facilities are usually not needed to mitigate those surfaces, thereby reducing costs for stormwater mitigation.

Figure 630.9   Porous concrete sidewalk cross-section, in Olympia

Porous concrete pavement uses large aggregate and Portland cement with an additive to slow the rate of evaporation of the mix during placement. The thickness of the pavement is greater than conventional concrete to provide structural stability and is laid over an aggregate subbase. Because of the large pore spaces (15 to 25% of the total volume), porous concrete pavement is more resistant to frost heave than conventional concrete pavement. With regular (4 times per year) vacuuming or blowing to remove fine materials that can clog the pore spaces, these systems can continue to infiltrate stormwater and last as long as conventional concrete pavement systems. Higher installation and maintenance costs might be balanced by savings in stormwater storage and treatment costs.

The large pore spaces may cause problems with people in spiked heels, or people with pointed-tip canes. For this reason the use of this system may be more appropriate on outlying areas.

Regional water quality engineers can provide assistance in calculating water storage and infiltration needs with porous concrete systems.

Because these systems infiltrate water at high rates, they are not appropriate where pollutants, such as fluid drips are likely to occur and where ground water tables are close to the surface. See the region water quality engineer for appropriate locations.

Information on pavements can be found at:
http://www.wsdot.wa.gov/fasc/engineeringpublications/Manuals/Volume1.pdf

Planting Area Design

Tree shading for emissions reduction

While cars sit in the sun, gasoline evaporates from fuel tanks and worn hoses. These evaporated materials are principle components of smog. In 1999, the United States Forest Service and the University of California at Davis completed a pilot study to measure the difference in parking lot microclimate and parked vehicle emissions resulting from the presence or absence of shade tree cover. Results indicate that shade tree cover in parking lots reduces motor-vehicle hydrocarbon and nitrogen oxide emissions from cars parked in those lots.

In this study, conducted in Sacramento California, interior vehicle temperatures averaged 45ºF cooler in the tree-shaded vehicle when compared with temperatures inside unshaded vehicles. Increasing parking lot canopy cover from 8% to 50% would reduce total vehicle-generated hydrocarbon emissions by two percent and nitrogen oxide emissions by just under 1% in similar climates. In addition, this study noted that there was a user preference for shaded parking spaces. [11] (Shade also extends the life of asphalt pavement.)

Trees in parking areas provide shade, visually reduce the impact of large pavement areas, and reduce heat gain.

- Use perimeter trees and shrubs to screen the parking area from nearby residential uses, while allowing for visibility by security personnel.

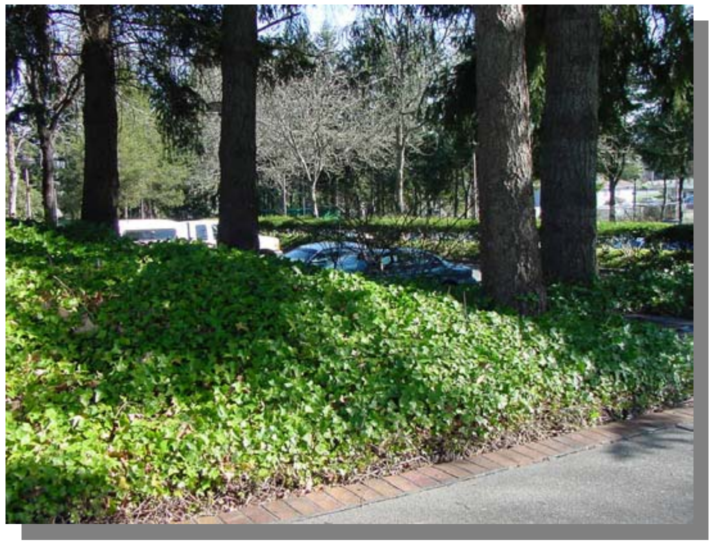


Figure 630.10 Use of berms and vegetation to screen parking from residential area

- Design for a minimum of 50% canopy cover over parking areas.
- Select tree species that do not drip pitch or attract aphids.
- Where trees are planted near a bus route, or bus parking, limb up trees to eight (8) feet above the ground.
- Use planting areas to divide paved surfaces into smaller, more defined parking areas.
- Consider end islands to delineate aisles and intersections and to protect the end vehicles. End islands should have raised curbs.

[11] Klaus I. Scott, James R. Simpson, and E. Gregory McPherson. "Effects of Tree Cover on Parking Lot Microclimate and Vehicle Emissions. *Journal of Arboriculture* 25(3): May 1999. pp. 129-142. http://wcufre.ucdavis.edu/research/air.html

Figure 630.11 Raised curbs around end island

- An alternative to planting in linear parking islands is the design of large concentrated planting islands within parking lots. This can allow plant communities to establish in these islands. They can also be stormwater infiltration areas.
- Keep landscaping as low-maintenance as reasonably possible.

Figure 630.12 Large, concentrated planting island

- In high snow load areas, end islands may cause difficulties with snow removal. In these areas, large central planting islands may be more appropriate. Consider snow storage needs and adjacent vegetation in high snow load areas.

- In arid climates, irrigation may be necessary for plant survival. These areas benefit most from tree shading of parking stalls in the summer due to higher temperatures.
- Consider the use of structural soils[12] under paved surfaces to allow root penetration without damage to the pavement and to retain parking spaces while increasing soil volume for trees in parking islands. This will benefit both the tree and long-term maintenance of the parking lot. Additional information can be found at: http://www.hort.cornell.edu/department/faculty/bassuk/uhi/pubs.html
- Interior planting islands should have drainage provided and depth to allow tree root growth at least 3 feet deeper than paving grade.
- Plant trees to align with the parking stall lines to prevent their damage by car bumpers, as shown in Figure 630.13 and 630.14.

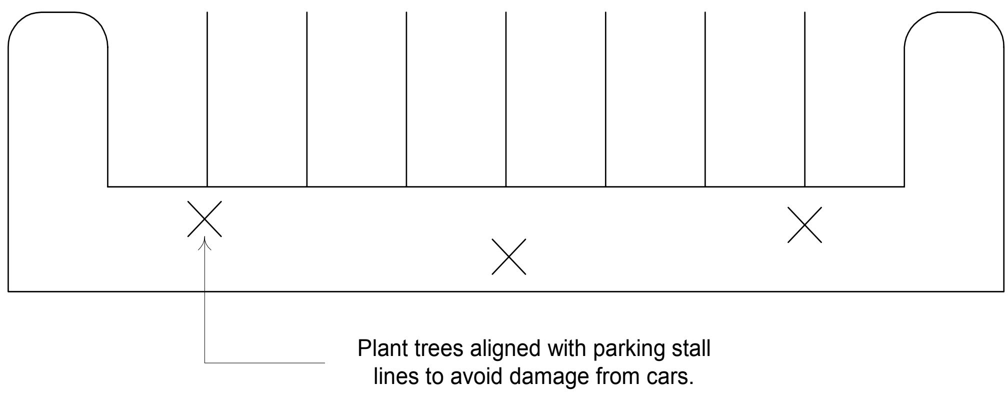


Figure 630.13 Locating trees in line with stall lines

[12] See chapter 700 in this manual for a description of this mix.

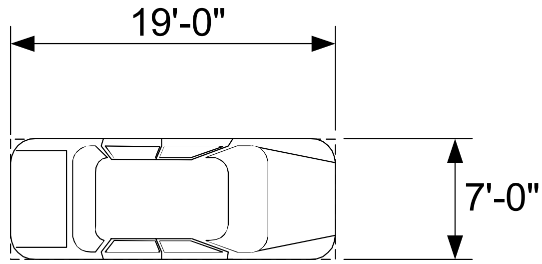
Figure 630.14 Align trees with parking stall lines to minimize bumper damage to trees

Stall Layout and Size

Good parking area design is easy to understand and convenient for the user and it uses the site efficiently.

- Provide wider stalls for short-term users (turnover of five or more cars per day), and narrower stalls for long-term users (turnover of one or two cars per day).
- Provide 10 feet wide stall widths in safety rest areas. Stall widths of 9 ft may be justified if 60 degree angle parking is used.
- Provide a minimum of 8.5 feet wide stalls in park and ride lots. Wider stalls are easier to park in and exit from.
- Efficient layouts provide parking around the periphery of the site and orient the stalls to the longest dimension of the site.

The large AASHTO design passenger car has the following dimensions:



AASHTO Passenger Car

A large number of sport utility vehicles (SUVs) and trucks on the road have these dimensions.

Orientation of Aisles to Destination

Aligning the parking stalls perpendicular to the focus of a facility allows pedestrians to reach their goal without having to cut between parked cars, cross vehicular traffic, or cut across stormwater swales. This is shown in Figure 630.15.

Figure 630.15 Aisles oriented perpendicular to destination – note bumper overhang

Car bumpers overhang tire stops and curbs. Consideration must be made in the design of sidewalks and planting areas for this overhang.

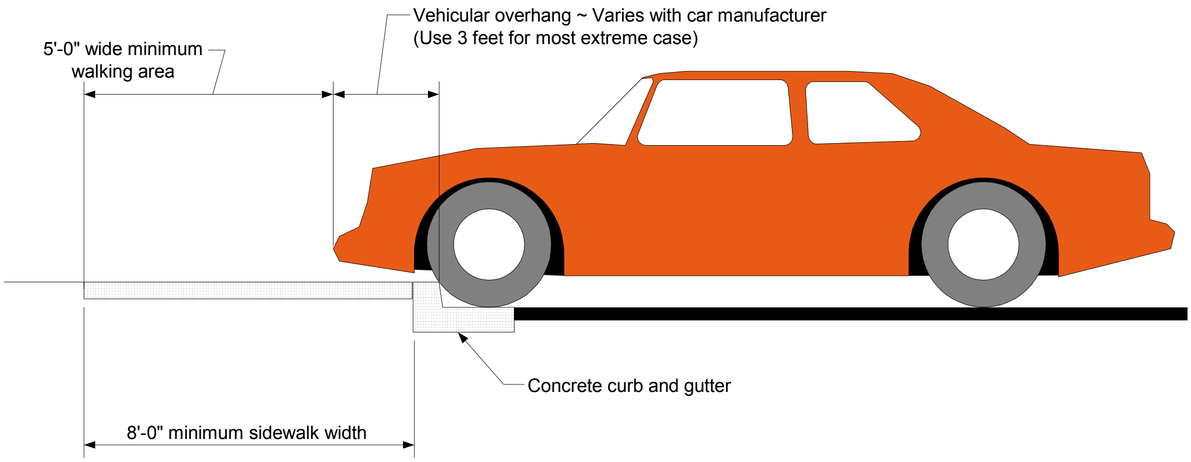


Figure 16 Car bumper overhang

Parking Angle

The decision to use angle or perpendicular parking should consider all factors. Some considerations are listed below:

Angle Parking (most often 60 degrees)

- One-way aisles are used.
- Most drivers find angled-in parking easier to use.
- It is appropriate for short stays with high turnover, such as those in safety rest areas.
- Angled parking generally takes more space than perpendicular parking.
- Angled parking has been used successfully in oddly dimensioned sites to achieve layout efficiency.
- Planting areas are easier to provide.

Figure 630.17 shows the minimum aisle width and turning radius needed for angled parking.

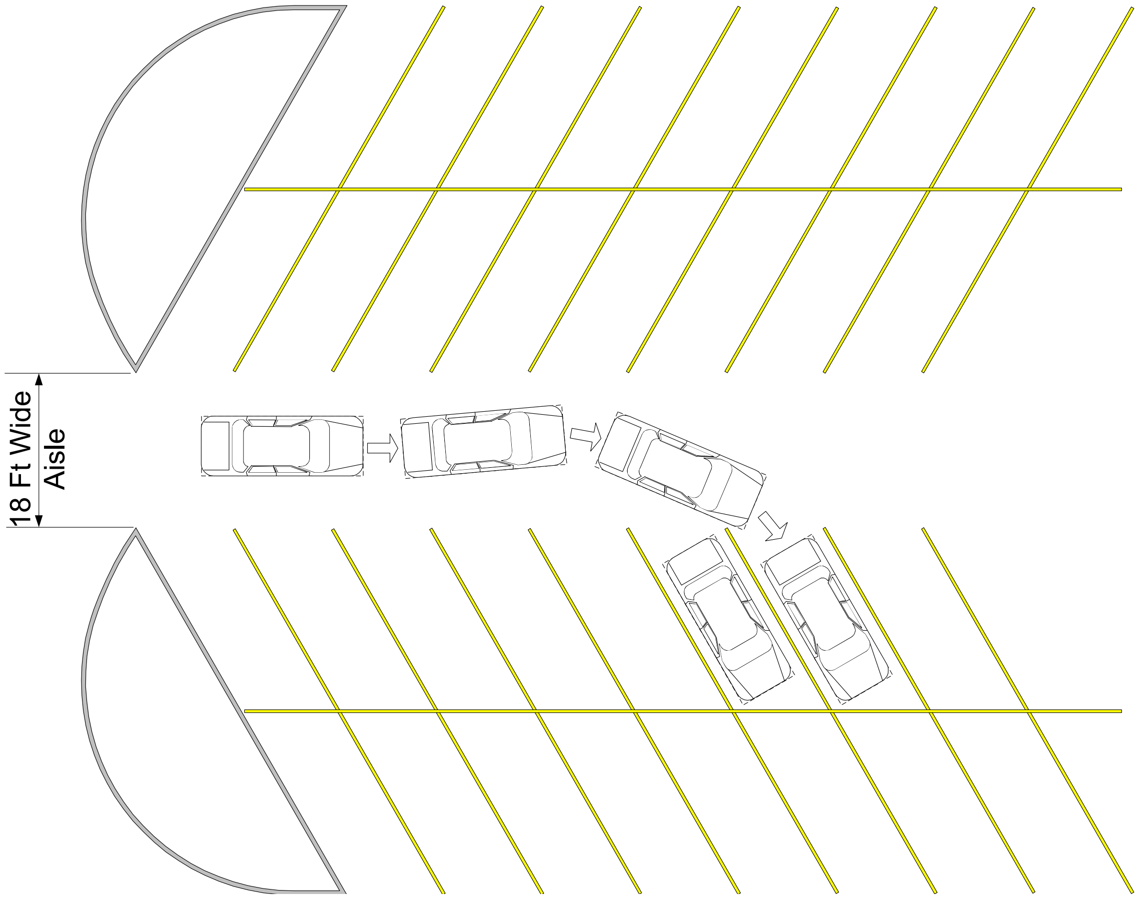


Figure 630.17 Angled Parking

Perpendicular Parking (90 degree)

- Perpendicular parking requires less knowledge of the circulation pattern because two-way aisles are used.
- Wider aisle widths are necessary to allow for two-way traffic and to allow drivers to pass a waiting vehicle.
- A slightly higher number of stalls can be accommodated in a rectangular lot when compared to angle parking layouts.

Figure 630.18 shows the wider aisles and necessary turning radius needed when parking and perpendicular stalls and the minimum aisle width.

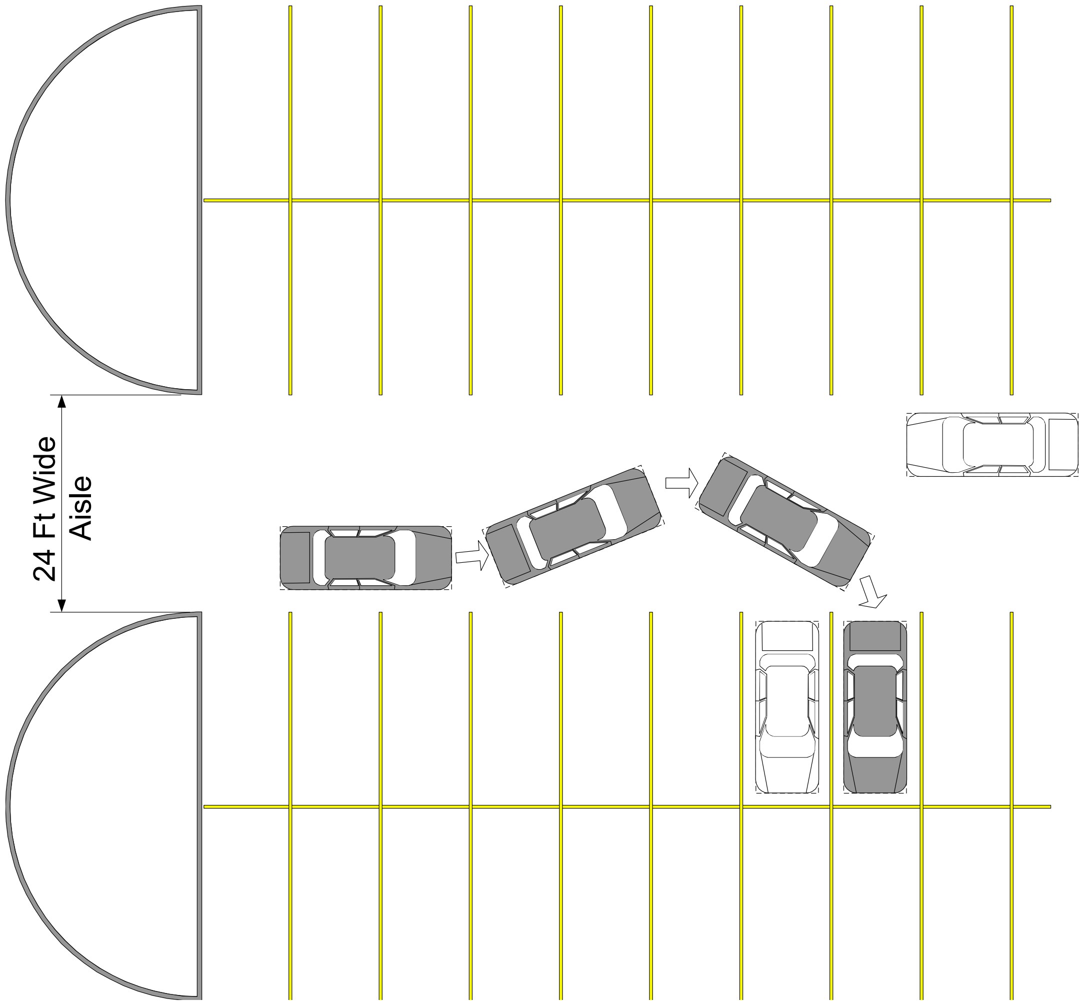


Figure 630.18 Perpendicular parking

Figure 630.19 shows a comparison between angle and perpendicular parking stalls.

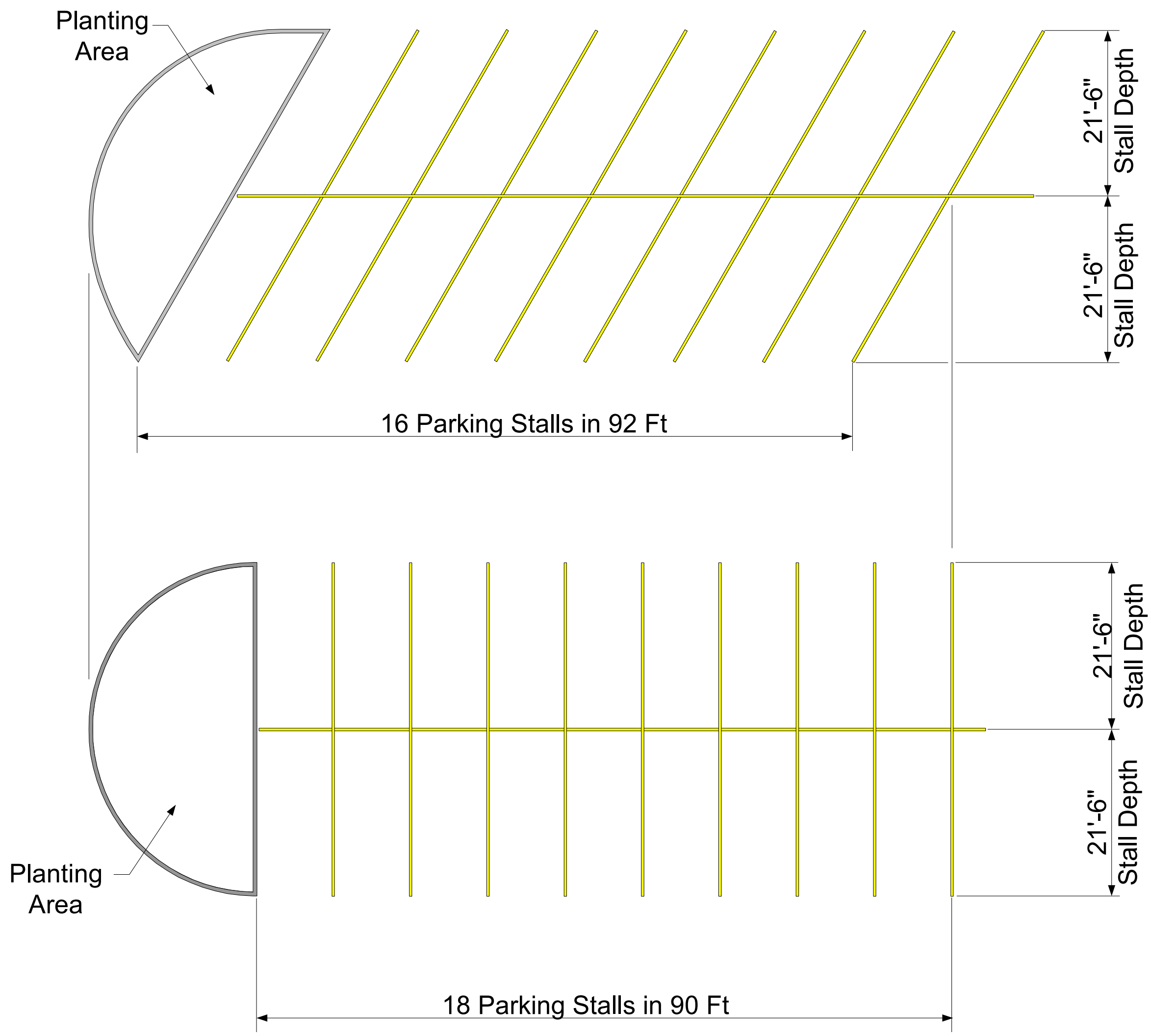


Figure 630.19 Comparison between dimensions in angle and perpendicular parking layout

Note that as stall width decreases, aisle width increases. Perpendicular parking is more difficult when aisle widths are not wide enough.

Driver and pedestrian safety and the flow of traffic must be considered when determining the number of spaces in a parking lot. Efficiency and convenience must be in balance.

Other stall angles are used less commonly. For example, a 45-degree angle can provide stall space in a narrow lot because stall-to-curb dimensions and aisle widths decrease with angle of stall.

Motorcycle and Bicycle Parking

Motorcycle Parking

Provide for motorcycle parking. A good place for this is at the end of rows where insufficient room remains for a full car width. Mark motorcycle stalls individually, as with car stalls, and mark clearly for "Motorcycle Parking Only" to prevent cars from occupying an area that may be big enough for several motorcycles. Generally, it is appropriate to include one motorcycle stall for every 100 car stalls. Motorcycle stalls should be at least 4'-9" wide and 9'-0" long at a 60 degree angle.

Consider providing racks to secure motorcycles for long-term parking areas. Embed these racks in concrete and use steel tubing or reinforced concrete. Placing high-tensile strength wire cable (1/3" diameter) loosely inside the steel tubing and securing each end can provide additional security since, as it moves within the tube, it is difficult to cut with a hacksaw. A preservative wax or grease can also be used to coat the wire cable to allow it to move more freely within the tube. Place the attachment area a minimum of 1 foot above the ground. To address theft and safety concerns due to the higher exposure of motorcycles and their users, it is desirable to provide adequate lighting at the location of the racks.

Bicycle Parking

Provide bicycle racks and/or storage units near the pedestrian waiting areas in park and ride lots. Storage units are preferable to racks to keep bicycles out of the weather and provide extra security. Some municipalities rent the storage units for a nominal fee to help pay for the extra cost. Maintenance of these units must be included in budget provisions. The designer should coordinate with the agency that will maintain the park and ride facility.

Locate the bicycle racks so they are accessible to bicyclists without conflicting with major pedestrian or vehicular paths of travel. For areas with high bicycle use, some separation between bicycle racks is desirable to prevent concentration of all users at one point.

Consider bicycle use at safety rest areas and viewpoints where bicycles are permitted, and provide racks as appropriate.

Bicycle racks should support the frame of the bike, allow at least one wheel to be locked to the frame, allow the use of different kinds of bicycle locks, and be durable and easy to use. To address theft and safety concerns due to the higher exposure of bicycles and their users, it is desirable to provide adequate lighting at the location of the racks.

See the Bicycle Facilities chapter of the *Design Manual* for further information.

Construction

When constructing parking facilities, avoid compaction of soil within planting strips. This can alleviate the need to rip the soil before planting. Avoid impacts to plants that will remain after construction. See Chapter 800 of this manual for more information on mitigating impacts to vegetation.

Maintenance

Adequate funding for maintenance must be provided to maintain public safety. Clean facilities provide the perception of safety and discourage vandalism. Immediate removal of graffiti and litter removal are necessary.

Consult Maintenance personnel during the design phase of any parking facility to determine their concerns and respond to their suggestions.

Additional Sources of Information

Linda S. Glisson, ed. *The Parking Handbook for Small Communities*. National Mainstreet Center: Washington D.C. 1994.

http://www.epa.gov/owow/nps/bioretention.pdf Information on design of planting islands within parking areas.