



# Traffic Engineering & Highway Safety Bulletin



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Military Traffic Management Command Transportation Engineering Agency  
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## Parking

### PARKING

Is your installation giving parking the attention it deserves? Lack of adequate parking presents a significant problem at many installations. Poorly designed and maintained parking facilities frustrate drivers and increase crash potential.

There are two basic categories of parking: on-street and off-street. This bulletin will discuss common deficiencies with each and provide guidance on proper planning and design. ●

### COMMON DEFICIENCIES

The ten most common parking deficiencies are discussed below.

❖ *On-street parking creates conflicts with traffic flow* – Perpendicular parking in particular is a major hindrance to traffic flow as drivers must slowly back out their vehicles from the parking space.



❖ *Poor parking lot circulation pattern and layout* – Poorly designed lots create conflicts between vehicles and cause unnecessary travel within parking lots.

❖ *Incorrect parking lot dimensions* – Narrow parking spaces and aisle widths make entering and exiting stalls difficult.

❖ *Parking areas do not conform to ADA guidelines* – Islands without curb cuts lengthen routes for physically challenged users and force them to circulate with vehicles.

❖ *Parking lots not properly maintained* – Broken pavement and excessive vegetative growth discourage driver utilization.

❖ *Absence of markings in on- and off-street parking areas* – Without marked parking stalls, inefficient use of space results as motorists park in a chaotic fashion.

❖ *Lack of off-street parking areas* – When drivers cannot find an off-street parking space, they may park roadside and unknowingly become a hazard to other motorists.



❖ *Poor lighting in parking areas* – Without adequate lighting, some drivers feel insecure and will be discouraged from parking.

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❖ *Poor access design* – Unnecessary vehicular conflicts result when too many access points are provided. Conflicts between parking and circulation result.



❖ *Not enough buffer zone between parking lots and adjacent land uses* – Adequate buffer is necessary to provide room for landscaping. ●

## OFF-STREET PARKING FACILITIES

During the initial planning process, off-street parking should be selected over on-street parking because of the

lower crash rates associated with it. Also important is the assumption that people will not walk more than 1000 feet from their parking space to reach their destination.

## Demand

Future parking demand can be determined by developing parking generation rates. A parking generation rate equates parking demand to a predictable characteristic, such as population, number of employees, or floor space. These rates have been developed for many types of facilities, and are published in the Institute of Transportation Engineer's *Parking Generation*, 1987.

For existing facilities, demand can be measured by performing a parking utilization study. This study compares the highest number of vehicles parked at each facility to the available parking supply. The survey should be conducted at 10:00 a.m. and again at 2:00 p.m. for

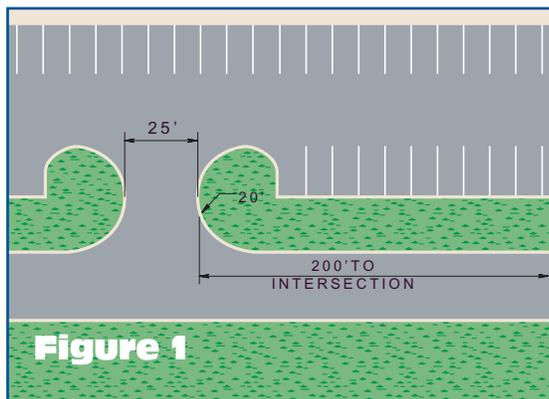
long-term parking; and every one to two hours for short-term parking. *MTMCTEA Pamphlet 55-8* provides more information on data collection procedures.

## Setbacks

Parking adjacent to buildings should be avoided to allow a buffer space for plantings and sidewalks. This space, or setback, should be a minimum of 20 feet between the parking area and adjacent buildings. In addition, provide a minimum of 20 feet for the buffer strip separating the parking area from the street. These setbacks, however, will likely be below what standards are in place for security requirements.

## Access Points

Factors such as pedestrians, traffic control, turning restrictions, and traffic volumes will affect the design of parking facilities, particularly in the location of entry and exit points (Figure 1 below).



Try to keep entry/exit points away from intersections; 200 feet or greater is desirable. A minimum driveway turning radius of 20 feet is recommended. A driveway width of

## What's Wrong With This Picture?

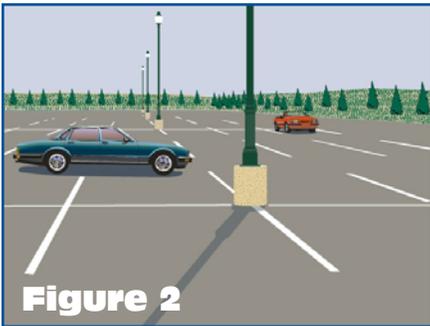


**Answers on Page 7**

25 feet is recommended for two-way traffic flow. A qualified engineer should determine the exact spacing and location of access points.

## Lighting

Locate parking lot light fixtures away from traffic aisles and parking stalls. Light poles are ideally located in center or side islands, and protected by raised curbs. When light poles are within parking rows, locate the poles at the junctions of adjacent stalls (Figure 2).



Poles and fixtures should be in scale, and accommodating to, the setting and surrounding area, while providing the desired level of nighttime illumination.

Mounting height and spacing of luminaires should be sufficient to distribute the desired lighting intensity to the entire parking area. A normal lighting level is from 1.0 to 2.0 foot-candles.

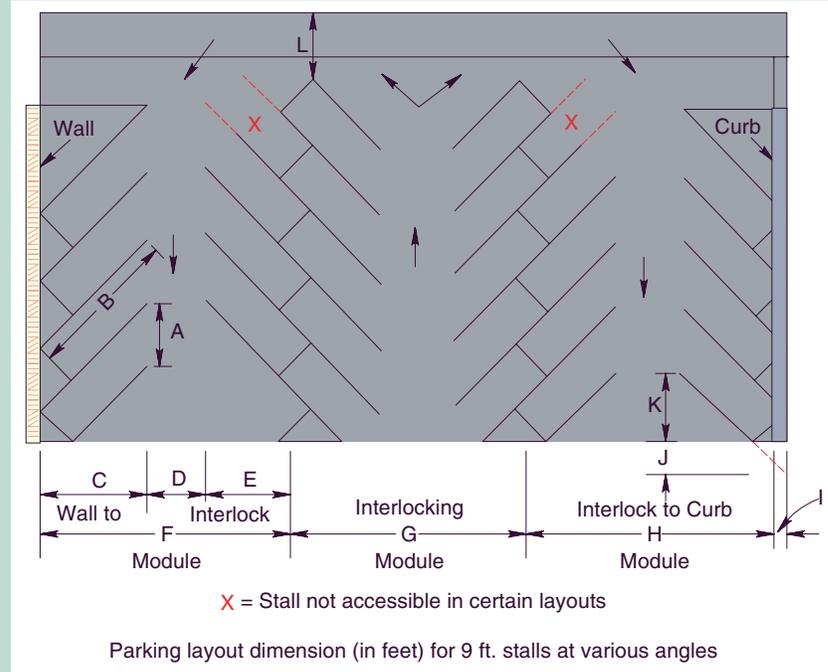
## Layout of Stalls

Ideally, parking lots should be rectangular with parking on both sides of access aisles. For two-way traffic flow, parking spaces perpendicular (90°) to the aisles provide the most efficient design. The efficiency decreases as the parking angle decreases.

Where a fast turnover rate is expected or where site limitations dictate, 60-degree- or 45-degree-angle parking with one-way aisles may be used. However, the advantage of easy pull-in and pull-out that angle parking provides is often offset

by the inconvenience of one-way aisles, and the tendency of motorists to attempt to pull into a space from the wrong direction. Figure 3 provides layout dimensions with the recommended minimum 9-foot-wide stall.

**Figure 3**



Dimension	On Diagram	Angle			
		45°	60°	75°	90°
Stall width, parallel to aisle	A	12.7	10.4	9.3	9.0
Stall length of line	B	27.5	23.7	20.9	18.5
Stall depth to wall	C	19.5	20.5	20.0	18.5
Aisle width between stall lines	D	12.0	16.0	23.0	26.0
Stall depth, interlock	E	16.5	18.5	18.5	18.5
Module, wall to interlock	F	48.0	55.0	62.0	63.0
Module, interlocking	G	45.0	53.0	61.0	63.0
Module interlock to curb face	H	46.0	53.2	59.5	60.5
Bumper overhang (typical)	I	2.0	2.3	2.5	2.5
Offset	J	6.4	2.6	0.6	0.0
Setback	K	13.1	9.3	4.8	0.0
Cross aisle, one-way	L	14.0	14.0	14.0	14.0
Cross aisle, two-way	-	24.0	24.0	24.0	24.0

## **OTHER OFF-STREET PARKING DESIGN CONSIDERATIONS**

### **A - Accessible Parking**

The Americans with Disabilities Act (ADA) requires that a certain number of parking spaces be set aside for accessible parking. Generally, this amounts to about 4 percent of the total number of spaces within a lot for the first 100 spaces; 3 percent for 101-200 spaces; and 2 percent for 200 or more spaces. Medical facilities require additional accessible parking.

Handicapped spaces should be located immediately adjacent to the nearest building entrance or exit of the lot or garage. Provide a 60-inch access aisle and a ramp. Display the handicapped symbol on a signpost at the head of the stall.

### **B - Aisles**

The most efficient arrangement is usually for aisles to be parallel to the longest side of the lot. This results in a 20 percent increase in lot capacity. Cross aisles are necessary in large parking areas. Generally, provide a cross aisle for every 30 spaces.

### **C - Employee Parking**

Providing a separate parking area for employees of a facility helps to avoid a mixture of all-day parking with customer parking, which has a fast turnover rate. The employee parking area should be separated from the main parking area.

### **D - Entrances and Exits**

Design entrances and exits to serve as a continuation of traffic aisles. Avoid sharp turns whenever possible. Another good practice is to prohibit stalls so close to the entry/exit point that parking maneuvers would obstruct traffic flow.

### **D - Rows**

Parking rows should be perpendicular to buildings for the safety and convenience of pedestrians; however, perpendicular rows less than 130 feet long are not practical. In this case, rows parallel to the front of buildings are recommended.

### **E - Pavement Markings**

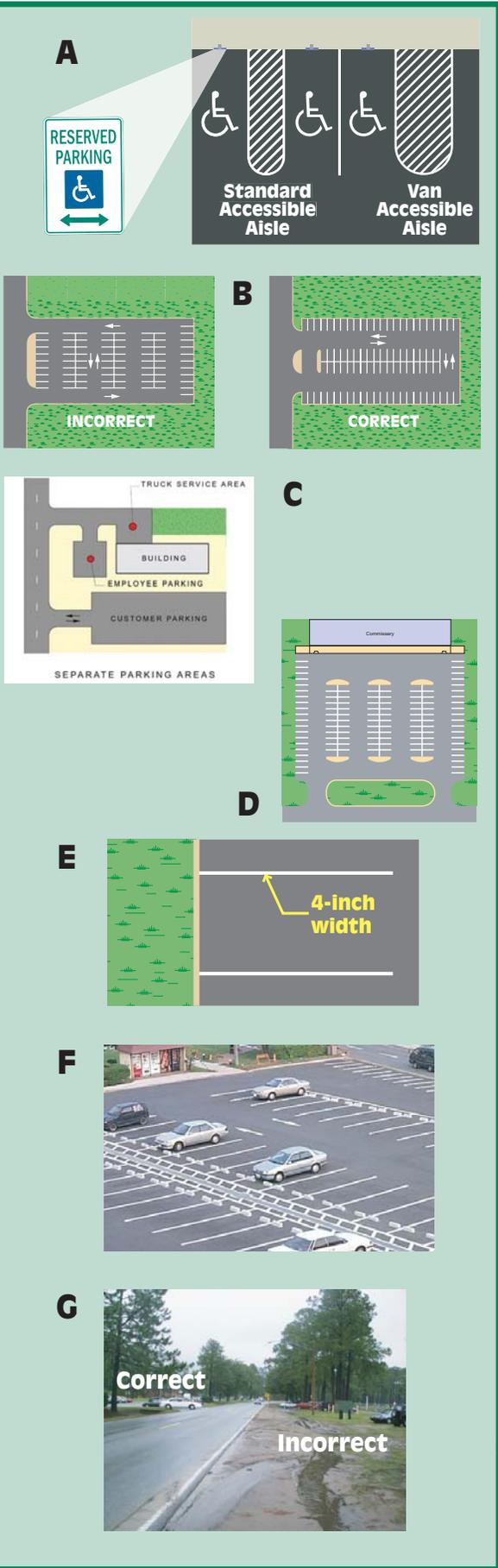
White is normally the best color for marking stall lines. All lines should be 4 inches wide.

### **F - Wheelstops**

Are often used along the site boundaries of uncurbed lots, where large landscaped areas extend beyond the edge of pavement. Wheelstops in the interior of a parking lot have a few disadvantages: they may hinder people walking between cars; are often a hazard when hidden from view by parked cars; and they also tend to trap blowing debris.

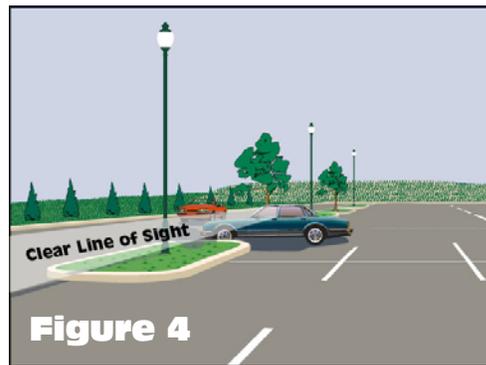
### **G - Surface Treatment**

Paved parking areas are desirable for many reasons including controlling drainage, reducing mud and dust, improving walking surfaces, reducing maintenance costs, and providing a pleasing appearance. Paved parking lots should be marked to provide safe, efficient, and enforceable parking lot operations.



## End Islands

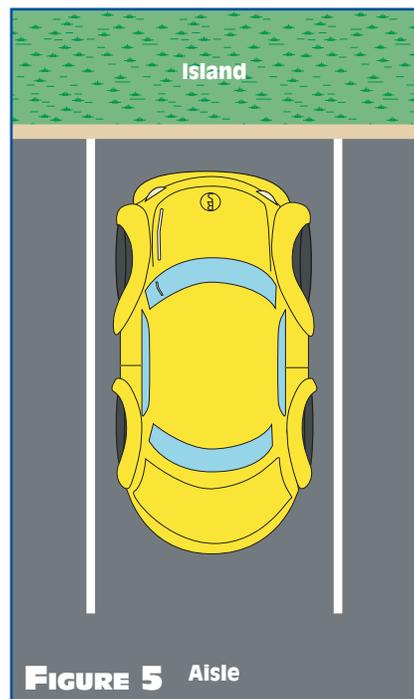
Space at the end of each aisle should be kept clear of parked vehicles to allow turning motorists a clear view down the cross aisle (Figure 4). Mark this area with either white paint or a raised traffic island. Islands should be designed to accommodate the turning maneuvers of vehicles in the parking lot. A passenger car requires a right-turning radius of 18 feet.



Raised end islands can provide a location for signs and light fixtures. They also provide an aesthetic function by breaking up the “sea of pavement” as well as providing a place for plantings. While these other functions are useful, adequate sight distance for motorists using the parking lot must be maintained.

## Site Characteristics

Site dimensions, topography, and vehicle type affect the design of parking lots. As a general rule, about 350 square feet is required per car to account for traffic aisles, space between adjacent cars, and entrance and exit lanes (Figure 5).



## Landscaping

The objective of parking lot landscaping is to enhance the lot, provide a buffer zone between adjacent land uses, and to subdivide large parking areas. Landscaping should never obstruct the view of motorists in a parking facility, or interfere with the parking function.

Be sure to provide sufficient setbacks for all plants, so that the front or rear overhangs of parked vehicles do not damage or destroy them. Ensure that placing and maintaining shrubbery or other plants near entrances and exits does not restrict sight distance. Also consider the growth pattern of the plant, so that a small plant will not develop into a major sight restriction in the future.

## Drainage

Provide adequate grading of surface lots to minimize the possibility of low or flat spots. Accumulation of standing water in a parking lot is a hazard for both vehicle and pedestrian movements, particularly in cold climates where freezing may lead to icy spots. Recommended minimum grades are 1.0 percent for asphalt surfaces and 0.5 percent for Portland cement surfaces.



are designed to move high traffic volumes at moderate or high speeds. On lower speed roadways, such as residential streets, on-street parking is acceptable because it “calms” traffic and thus reduces vehicle speeds.

## Angle Versus Parallel Parking

Angle on-street parking provides more parking per unit of curb length than parallel parking. However, angle parking increases the hazard of starting, stopping, and turning in moving traffic, and therefore, is discouraged.

The principal hazard of angle parking is the driver’s lack of adequate visibility during backing maneuvers.

Because empty parking stalls are difficult to see with angle parking, motorists who are seeking a place to park create another hazard. They must either proceed slowly in order to find an empty stall, or stop abruptly when they come to an empty stall. Angle parking is generally unsafe and its use should be discouraged.

## Layout of On-Street Parking Stalls

There are two types of stalls to consider when designing on-street parallel parking: the end stall and the interior stall.

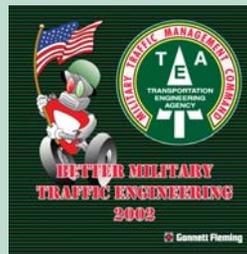
An end stall is used where a vehicle can be driven directly into or out of the parking space. End stalls require a length sufficient enough to accom-

## Maintenance

For good visibility, repaint markings as needed, and replace old signs. Clean light fixtures at least annually, and replace bulbs before burnouts occur. A properly designed lot is great, but a good maintenance plan is necessary to keep it that way! ●

## ON-STREET PARKING

About 20 percent of all crashes in built-up areas involve vehicles parked along the roadway. On-street parking is not desirable on arterial or collector roads that



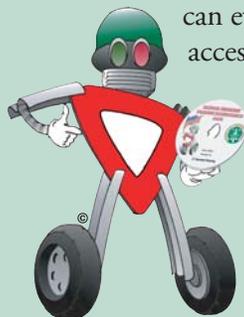
## THE BETTER MILITARY TRAFFIC ENGINEERING 2002 CD-ROM Now Available from MTMCTEA

The CD is designed to function as an instructional tool to train personnel on the proper installation and use of traffic control and safety devices. It is divided into six traffic engineering topics:

- ❖ Signs and pavement markings
- ❖ Parking
- ❖ Traffic signals
- ❖ Roadside safety
- ❖ Gates
- ❖ Intersections

The CD is extremely easy to use and provides animation, graphics, and illustrations to inform the user. It includes 17 calculators that use graphic displays that provide answers to many traffic engineering calculations. The calculators, as well as the CD can even be downloaded and installed on your computer for improved accessibility. Go to <http://www.tea.army.mil/cdrom/default.htm> to obtain

further information about the CD. Copies of the CD can be obtained free of charge by calling Janie Campbell at (757) 599-1591.



modate a passenger car, typically 20 feet. Maintain a minimum of 20 feet between an end stall and a curb opening or intersection.

An interior stall requires room for maneuvering into and out of the space. A 22-foot-long stall is recommended.

## On-Street Delineation

Parallel parking stalls should be defined by white lines extending perpendicular from the curb, for a distance of 7 feet. Generally, end stall lines are L-shaped and interior stall lines are T-shaped.

### MTMCTEA Can Help!

MTMCTEA highway engineers stand ready to help installations with their traffic engineering concerns—especially those involving high crash locations or access control. We perform many types of studies with an emphasis on low-cost improvements that are immediate or short-term and yield high benefits to their implementation costs. Generally, the studies conducted include:

- ❖ Access control
- ❖ Access roads
- ❖ Fatal crash analysis
- ❖ Force protection
- ❖ High crash locations
- ❖ Safety audits
- ❖ Signal operations
- ❖ Traffic calming evaluations
- ❖ Traffic engineering
- ❖ Traffic impact (such as BRAC)

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## Parking Restrictions

Control of on-street parking is accomplished through signing, markings, and enforcement. Signing and marking regulations are discussed in the *MUTCD*. Standard parking restrictions are set forth in the *National Uniform Vehicle Code*. Some common parking restrictions are:

- ❖ In front of a public or private driveway.
- ❖ Within an intersection.
- ❖ Within 15 feet of a fire hydrant.
- ❖ Within 20 feet of a crosswalk at an intersection.
- ❖ Within 50 feet on the approach to any flashing beacon, STOP sign, or traffic control signal located at the side of a roadway.
- ❖ Within 50 feet of the nearest rail of a railroad crossing.
- ❖ On any bridge or other elevated structure on a highway. ●

### Answer from Page 2

1. Parking adjacent to the travelway creates conflicts with traffic flow.
2. Because this area is unmarked, poor circulation of vehicles is likely.
3. Vehicles are parked in a disorderly fashion resulting in the inefficient use of space.
4. Since vehicles are parked in an area not designated for such a use, it is likely that there is a shortage of parking at this installation.



## Reference List

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- ❖ Urban Land Institute. *Dimensions of Parking*. Washington, D.C. 2000.
- ❖ U.S. Department of Transportation, Federal Highway Administration. *Manual on Uniform Traffic Control Devices, Millennium Edition*. Washington, D.C. 2001.
- ❖ [www.tea.army.mil](http://www.tea.army.mil)



## Training

Continuing Education	Phone	Web Site
<b>Penn State University; The Penn Transportation Institute</b>	(814) 865-4700	www.pti.psu.edu
<b>University of Maryland; Md. Transportation Technology Transfer Center</b>	(301) 403-4623	www.encc.umd.edu/ttcc
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<b>Northwestern University Center for Public Safety</b>	(800) 323-4011	www.northwestern.edu/nucps/index.htm
<b>Texas A&amp;M University</b>	(979) 845-3211	www.tamu.edu
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