Chapter 11

PARKING GEOMETRICS

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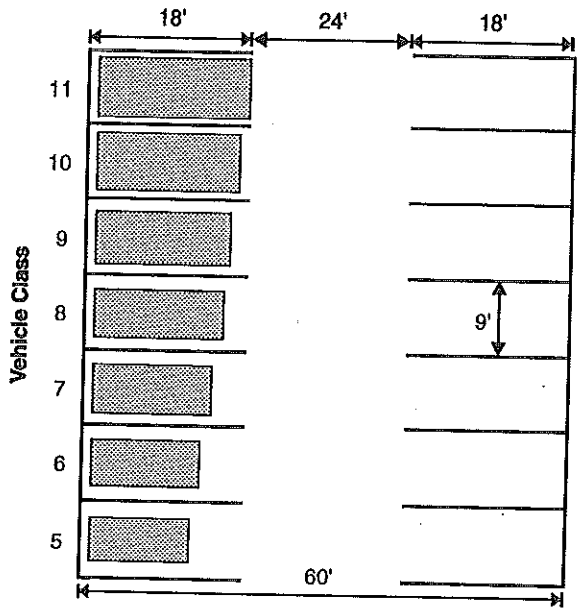
The size of the average car driven by Americans has shrunk dramatically since the early 1970s. Between 1973 and 1978, small-car sales only accounted for 14 to 25 percent of vehicles sold. Beginning in 1980, the percentage of small-car sales increased to almost 50 percent of the total. And between 1983 and 1990, small-car sales accounted for an average of 52 percent of annual sales in the United States.

This downsizing of the auto fleet was precipitated by the oil embargo of 1973 and the subsequent federal legislation mandating increasing fuel efficiency for new vehicles. Some of the gain in fuel efficiency has been achieved by reducing the size and weight of vehicles sold. As older, larger vehicles are scrapped and removed from the fleet, and as the number of smaller, newer vehicles increases, the average size of vehicles on the road decreases.

These changes have had a profound impact on parking dimensions. In the past, full-size parking stalls in some locations were 9 to 10 feet wide and 18 to 20 feet long. With smaller automobiles, an average width of 8.5 feet and a length of 16 to 17 feet is more appropriate for general use, with even smaller dimensions acceptable in some circumstances.

The purpose of this chapter is to address the questions and issues surrounding the geometric design of parking spaces for smaller cars. Constructing new parking lots or garages with tighter dimensions can reduce the overall construction cost and the land area required for parking. Existing parking facilities can also be altered; the restriping of garages and lots to accommodate smaller cars presents a low-cost alternative to adding parking capacity.

11-1 Parking Module



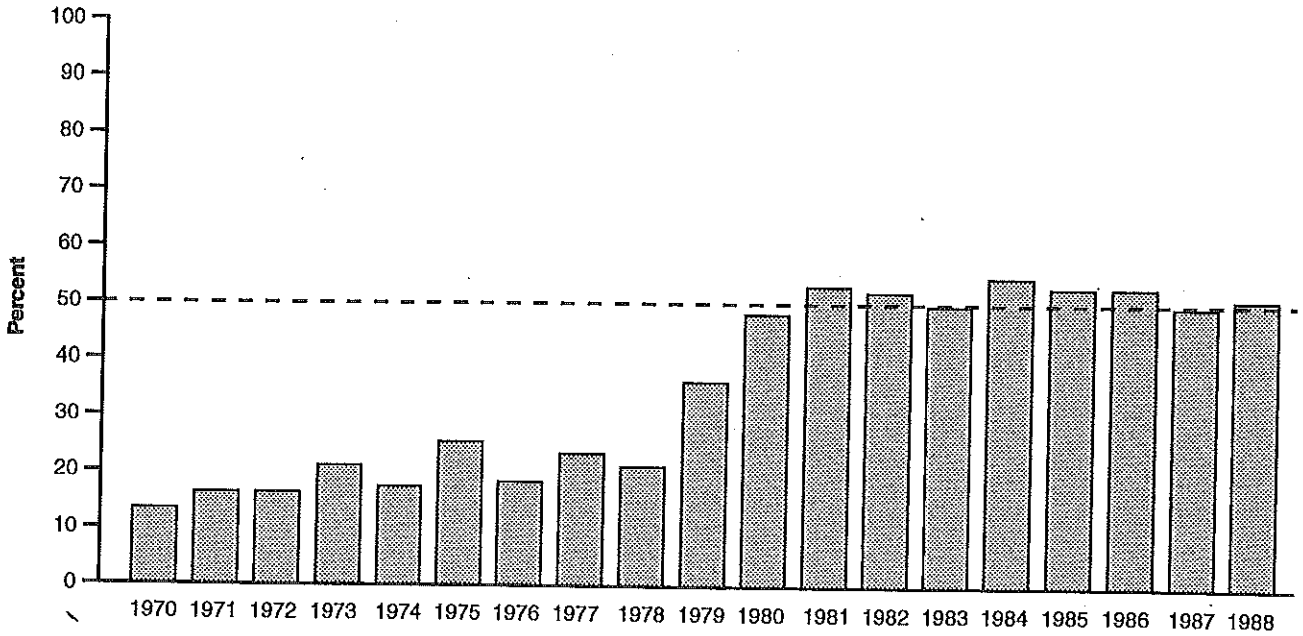
Source: Barton-Aschman Associates, Inc.

The capacity increase that can be achieved through the application of smaller standards to new construction, or through the restriping and changing of geometrics in an existing parking facility, usually ranges between 5 and 10 percent. The exact gain will depend on the original geometrics, the intended use of the facility (whether for long-term employee parking or short-term parking), and the mix of vehicles using the facility.

Size Definitions

What is a small car or a large car? In a discussion of the continued trend toward smaller cars, many terms are used without being precisely defined or understood: "large," "medium," "small," "full-size," "standard-size," "compact," "subcompact," and so forth. The classification of automobile sizes can be made either on the basis of the inertial weight of the vehicle or on the basis of the area it occupies. For parking facility design, the latter classification is more useful. With this system, the length and width of the vehicle, measured in meters, are multiplied to give the area covered by the vehicle in square meters. The convention is to drop the decimal parts of the measurement and use only the integer for the classification. For example, a Ford Escort covers an area of 5.7 square meters. It would be considered a Class 5 vehicle. By comparison, a 1990 Lincoln Town

11-2 Annual Small-Car Sales in the United States, 1970–1990



Source: Automotive News: Market Data Book, issues 1970–1990.

Car covers a total area of 11.08 square meters and would be considered a Class 11 vehicle.

The cars in use today generally fall into the range of Class 5 through Class 12 (no models in Class 12 or larger have been built since 1981). The following list gives examples of the 1990 model cars in each class size:

Class 5 Ford Festiva
Class 6 Geo Metro
Class 7 Plymouth Horizon, Dodge Colt, Ford Mustang, Pontiac Grand Am
Class 8 Buick Century, Chevrolet Celebrity, Ford Thunderbird
Class 9 Buick Regal, Oldsmobile Cutlass
Class 10 Chevrolet Caprice, Cadillac Brougham
Class 11 Lincoln Town Car, Ford Grand Marquis

Classes 5 through 7 are considered small cars; Classes 8 and above, large cars. Figure 11-1 shows how vehicles ranging from Class 5 through Class 11 fit into a typical full-size parking module of 60 feet with stalls that are 9 feet wide. Clearly, a module of this size is overdesigned for vehicles of Class 8 or smaller.

Vehicle Size Changes

The percentage of small cars sold (area less than 8 square meters) increased dramatically in 1979 and 1980 and has since stabilized at about 52 percent of the vehicles sold each year. Figure 11-2 graphically shows this change. As the automobile fleet ages, more of the older large vehicles will be retired, further reducing the overall fleet dimensions.

It should be noted that the ratio of small cars to large cars will vary by region. On the East or West Coasts, with a higher percentage of small cars, the ratio will be higher. It will also usually be higher on college and university campuses and at many hospitals and medical centers. In smaller cities and towns, the percentage of large cars is likely to be higher due to a higher percentage of older domestic cars in the fleet, as well as to the tendency to use full-size pickup trucks.

Changes in Parking Dimensions

A parking module consists of two rows of parking, one on each side of an access or driving aisle. The stall width selected depends on the type of use or turnover that will prevail at a parking lot or garage. The typical bay width for 90-degree parking used to be 60 to 62 feet, using a stall width of 9 feet. Many zoning codes incorporated this module or an even larger module, with a stall size of 10 feet by 20 feet. As the average car size has decreased, there have been significant opportunities to decrease the dimensions of the parking module.

There is a definite relationship between the allowable width of a parking stall and the width of the aisle that serves the space. As the aisle width increases, the stall width can be made smaller and still provide ample room for the driver to enter the space. The stall width is usually based on the door-opening clearance, which in turn is based on the turnover or type of parking. Spaces with high turnover rates, such as convenience stores or retail centers, require more door clearance than low-turnover situations, such as long-term employee parking. Door-opening standards should range from 20 inches for small cars in low-turnover situations to 28 inches for large cars in high-turnover applications. When combined with a design vehicle width of 5 feet 8 inches for small cars and 6 feet 6 inches for large cars, these dimensions result in the minimum range of stall and module widths that is shown in Figure 11-3.

11-3 Recommended Minimum Stall and Module Dimensions for Parking Facility Design

Type of User	Minimum Stall Width: Small Car	Minimum Stall Width: Large Car
All-Day Parker (employee, resident, etc.)	7′-4″	8′-2″
Visitor (hospital, CBD)	7′-8″	8′-6″
High-Turnover Parker (shopping, bank, etc.)	8′-0″	8′-10″

Angle	Wall-to-Wall Module Dimension: Small Car	Wall-to-Wall Module Dimension: Large Car
45°	42′-0″	49′-0″
50°	43′-6″	51′-0″
55°	45′-0″	53′-0″
60°	46′-0″	55′-0″
65°	47′-0″	56′-6″
70°	48′-0″	58′-0″
75°	49′-0″	59′-6″
90°	51′-0″	62′-0″

Adjustments to Modules:

1. If a curb, wheelstop, wall, or other vehicle restraint is placed at every parking stall, the modules above can be reduced by 1 foot.
2. For each 1 inch of additional stall width, the module may be reduced 3 inches to maintain the same level of comfort.

Source: Parking Consultants Council, National Parking Association, *Recommended Guidelines for Parking Geometrics* (Washington, D.C.: NPA, 1989).

Parking Design Standards

Figure 11-4 shows recommended parking design standards for large and small cars. This exhibit has been adapted from the National Parking Association's 1989 *Recommended Guidelines for Parking Geometrics*, but it generally agrees with the dimensions established by the Institute of Transportation Engineers in its 1990 guidelines.[1] The primary differences are that the ITE

1. See References 4 and 2, respectively, at the end of this chapter.

11-4 Typical Parking Dimensions

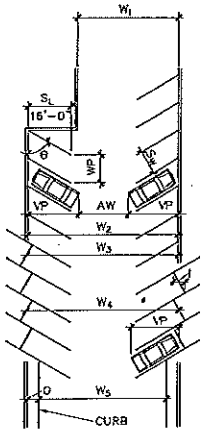
Small Cars

Angle	Interlock Reduction i	Overhang o	Vehicle Projection VP	Aisle Width AW	Module Widths W_1	W_2	W_3	W_4	W_5
45°	2′-0″	1′-5″	15′-3″	11′-6″	26′-9″	42′-0″	40′-0″	38′-0″	39′-2″
50°	1′-10″	1′-6″	15′-9″	12′-0″	27′-9″	43′-6″	41′-8″	39′-10″	40′-6″
55°	1′-8″	1′-8″	16′-1″	12′-10″	28′-11″	45′-0″	43′-4″	41′-8″	41′-8″
60°	1′-5″	1′-9″	16′-4″	13′-4″	29′-8″	46′-0″	44′-7″	43′-2″	42′-6″
65°	1′-2″	1′-10″	16′-6″	14′-0″	30′-6″	47′-0″	45′-10″	44′-8″	43′-4″
70°	1′-0″	1′-11″	16′-7″	14′-10″	31′-5″	48′-0″	47′-0″	46′-0″	44′-2″
75°	0′-9″	1′-11″	16′-6″	16′-0″	32′-6″	49′-0″	48′-3″	47′-6″	45′-2″
90°	0′-0″	2′-0″	15′-6″	20′-0″	35′-6″	51′-0″	51′-0″	51′-0″	47′-2″

Large Cars

Angle	Interlock Reduction i	Overhang o	Vehicle Projection VP	Aisle Width AW	Module Widths W_1	W_2	W_3	W_4	W_5
45°	2′-4″	2′-1″	18′-0″	13′-0″	31′-0″	49′-0″	46′-8″	44′-4″	44′-10″
50°	2′-1″	2′-4″	18′-8″	13′-8″	32′-4″	51′-0″	48′-11″	46′-10″	46′-4″
55°	1′-10″	2′-5″	19′-2″	14′-8″	23′-10″	53′-0″	51′-2″	49′-4″	48′-2″
60°	1′-8″	2′-7″	19′-6″	16′-0″	35′-6″	55′-0″	53′-4″	51′-8″	49′-10″
65°	1′-4″	2′-9″	19′-9″	17′-0″	36′-9″	56′-6″	55′-2″	53′-10″	51′-0″
70°	1′-1″	2′-10″	19′-10″	18′-4″	38′-2″	58′-0″	56′-11″	55′-10″	52′-4″
75°	0′-10″	2′-11″	19′-9″	20′-0″	39′-9″	59′-6″	58′-8″	57′-10″	53′-8″
90°	0′-0″	3′-0″	18′-8″	24′-8″	43′-4″	62′-0″	62′-0″	62′-0″	56′-0″

θ Parking angle
W_1 Parking module width (wall to wall), single-loaded aisle
W_2 Parking module width (wall to wall), double-loaded aisle
W_3 Parking module width (wall to interlock), double-loaded aisle
W_4 Parking module width (interlock to interlock), double-loaded aisle
W_5 Parking module width (curb to curb), double-loaded aisle
AW Aisle width
WP Stall width parallel to aisle
VP Projected vehicle length, measured perpendicular to aisle
S_L Stall length
S_W Stall width
o Overhang clearance
i Interlock reduction



Source: Parking Consultants Council, National Parking Association, *Recommended Guidelines for Parking Geometrics* (Washington, D.C.: NPA, 1989).

wall-to-wall module is 1 foot smaller for the 90- and 45-degree stalls for large cars. Otherwise, the parking module dimensions are identical.

In practicality, the vehicles using a parking facility will be a mix of large and small cars. The large-car spaces will be too generous for the small cars, and the small-car space dimensions will be inadequate to accommodate the larger cars. A more realistic approach would be to design the facility with a single composite or average dimension that will adequately accommodate the expected vehicle mix. "One-size-fits-all" is an approach preferred by some designers for this reason. That is, an average size is selected for the particular use and vehicle mix. The extent to which this approach can be used will depend on local ordinances.[2]

Designated Small-Car Spaces

Often, a zoning ordinance will allow the designation of a parking area for small cars that is separated from the large-car area. In this situation, small cars can fit into the large-car spaces, but large cars cannot easily fit into the small-car spaces. One-size-fits-all designs are easier to execute for several reasons: 1) most drivers do not know the size of their vehicle or whether it is a large or small car; 2) most drivers take the first available space regardless of size; and 3) large cars parked in small-car spaces create problems by encroaching on adjacent spaces and possibly on the adjoining aisles.

The use of spaces designated for small-car use is recommended in parking structures in the odd locations where a full-sized space cannot fit and the alternative would be to eliminate a parking space. The use of an area designated for small-car use can also be effective in controlled situations, such as a parking facility used by a single employer or a college or university campus. In the case of a university, because there is a control mechanism (issuance of parking permits), vehicles may be assigned to specific locations by size.

2. A more detailed explanation of this method is presented in reference 3.

Summary

The size of the average car driven in the United States has been dramatically reduced since the early 1970s because of an increase in the number of small cars sold. Total small-car sales now account for more than half the cars sold. The reduction in vehicle dimensions has also reduced the size requirements of the average parking space. Instead of a parking stall being 9 feet wide, it can be as narrow as 8 feet wide for very low-turnover situations; a stall width of 8 feet 6 inches is satisfactory for most higher-turnover applications. Further reductions in stall width can be achieved in situations in which most of the vehicles using the facility are small cars. In any case, more efficient, cost-effective parking facilities can be designed by carefully considering the type of patron or use and the actual mix of vehicles expected to park.

References

1. Weant, Robert, and Herbert Levinson. *Parking.* Westport, Conn.: Eno Foundation, 1990.

2. Institute of Transportation Engineers. "A Summary Report: Guidelines for Parking Facility Location and Design." *Journal* (April 1990).

3. Parking Consultants Council, National Parking Association. *Parking Space Standards Report.* Washington, D.C.: NPA, 1985.

4. Parking Consultants Council, National Parking Association. *Recommended Guidelines for Parking Geometrics.* Washington, D.C.: NPA, 1989.

5. Smith, Mary. "Parking Standards." *Parking* 24 (July–August 1985): 55–60.

6. Weant, Robert. *The Influence of Smaller Cars on Parking Geometry.* Westport, Conn.: Eno Foundation, 1984.