APPENDIX A

ULI SHARED PARKING REPORT SUMMARY

SHARED PARKING DEMAND FOR SELECTED LAND USES

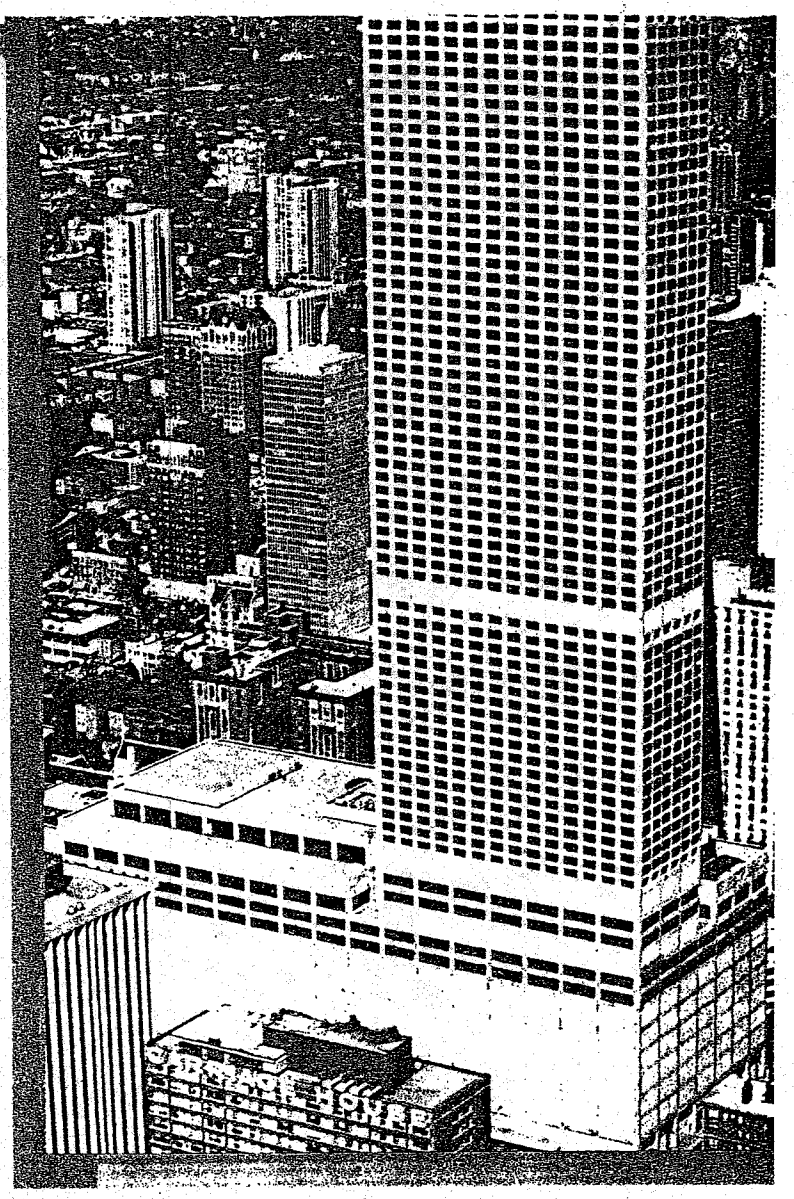
Barton-Aschman Associates, Inc.

In 1982–1983, ULI, with special funding from many sources, engaged Barton-Aschman Associates, Inc. to undertake a study of the shared parking phenomenon. This article summarizes the objectives, findings, and recommendations of the study. A published report and a computer program will be available later this fall. Richard J. Hocking, vice president, Neil S. Kenig, vice president, and John R. Wroble, associate, were project coordinators for Barton-Aschman, which is headquartered in Evanston, Illinois. —Editor

Shared parking is defined as parking space that can be used to serve two or more individual land uses without conflict or encroachment. The shared parking phenomenon has long been observed in central business districts, suburban communities, and other areas where land uses are combined. It is the result of two conditions:

- Variations in the peak accumulation of parked vehicles due to time differences in the activity patterns of adjacent or nearby land uses (by hour, by day, by season). For example, a parking facility can be used by office employees during the day and serve patrons of an adjacent theater at night.
- Relationships among land use activities that result in people being attracted to two or more land uses on a single auto trip to a given area or development.

While the existence of shared parking is recognized by developers and public officials, typical zoning codes do not explicitly provide for it. Instead, most zoning codes are expressed in terms of peak parking indices or ratios for major types of individual land uses. While the peak ratios reflect the differences in parking demand generated by separate land uses and under certain conditions, they do not reflect the fact that total or combined peak parking demand can be significantly less than the sum of the individual peak demand values.



Mixed-use developments, such as Water Tower Place in Chicago, highlight the need to plan for shared parking.

Study Objective

Even though the shared parking phenomenon commonly occurs in a number of specific cases, little literature is available that formally documents the circumstances of shared parking or provides guidelines for quantifying the extent of shared parking. There is no accepted method for predicting and quantifying shared parking opportunities under a wide range of possible conditions. Thus, research objectives were to:

- identify the primary independent variables affecting parking demand in shared parking situations (i.e., for developments involving two or more land uses);
- identify the relative effects and universality of those variables; and
- develop a standard methodology for analyzing shared parking.

Procedure

Parking demand can be observed at existing mixed-use developments. If such projects have their own parking facilities, it is possible to count the accumulation of parked vehicles and determine the peak parking demand. The latter would represent an aggregate value for all of the land uses in the development. The issue for research, however, was how this aggregate value compared to the sum of the peak parking demand for the individual land uses. That is, in order to study shared parking, it was necessary to study, independently, the parking space demand characteristics of each component of a mixed-use development and to estimate the effects on demand due to the combination of these uses.

Thus, the first step was to study the parking space demand generated by significant individual land uses in situations where unit peak parking demand would be at maximum levels. Typical freestanding suburban land uses produce maximum unit parking demand primarily because sufficient parking space is available and transit use is insignificant. By first identifying parking demand at such "unconstrained" freestanding single land uses, other effects such as transit use and captive market relationships could be isolated.

Analysis

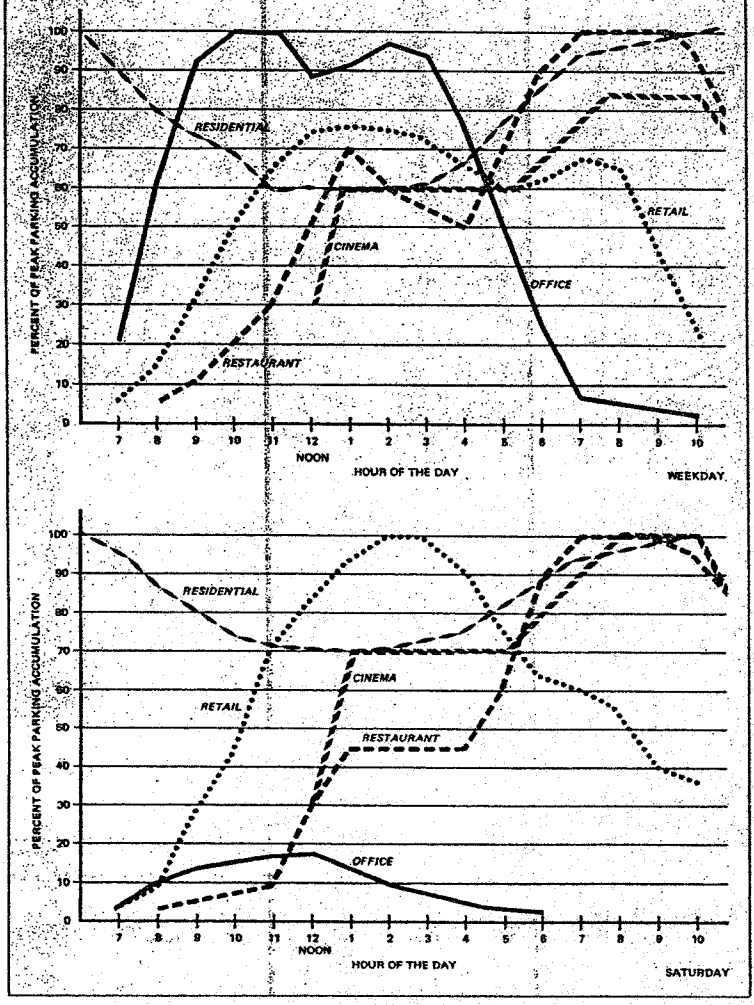
The results of the first step of the analysis established parking space demand characteristics at six single land uses, defined in terms of peak unit demand, hourly accumulation, and seasonal variation. Peak unit demands (see Figure 1) were developed on the basis of occupied land use units and negligible

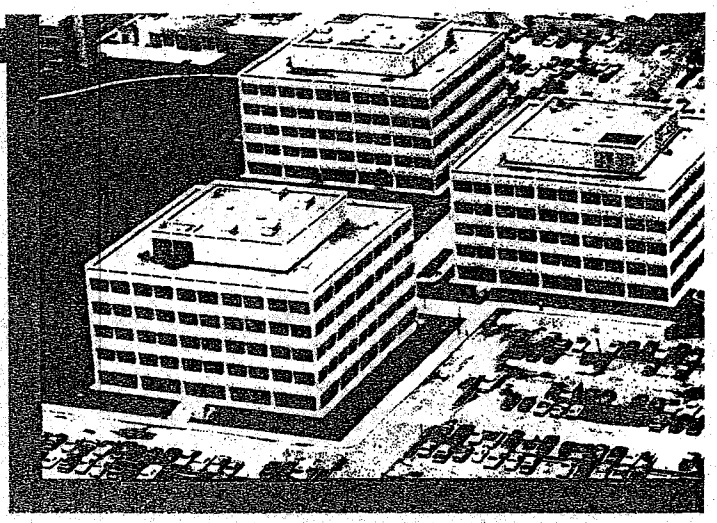
Figure 1
Representative Peak Parking Demand Factors

Land Use	Unit	Weekday	Saturday
Office	Parking spaces per 1,000 sq.ft. GLA	3.00	0.50
Retail (< 400,000 sq.ft.)	Parking spaces per 1,000 sq.ft. GLA	3.80	4.00
Retail (> 600,000 sq.ft.)	Parking spaces per 1,000 sq.ft. GLA	3.80	5.00
Restaurant	Parking spaces per 1,000 sq.ft. GLA	20.00	20.00
Cinema	Parking spaces per seat	0.25	0.30
Residential	Parking spaces per dwelling unit[1]	1.00	1.00
Hotel			
Guest Room	Parking spaces per room	1.25[2]	1.25[2]
Restaurant/Lounge	Parking spaces per 1,000 sq.ft. GLA	10.00	10.00
Conference Rooms	Parking spaces per seat[3]	0.50	0.50
Convention Area	Parking spaces per 1,000 sq.ft. GLA[3]	30.00	30.00

[1]Per one auto owned per dwelling unit.
[2]Factored up to 100 percent auto use from the 80 percent auto use value.
[3]Used by nonguests; the given rates, thus, are upper bounds that are very rarely achieved.

Figure 2
Hourly Parking Accumulation Curves for Individual Land-uses





Shared parking may occur in suburban developments if walking distances are not far and land uses are functionally related.

transit use, thus representing the maximum parking accumulation occurring on a given day. Hourly accumulation curves (developed from hourly counts at freestanding developments) for each individual land use (see Figure 2) indicate the variation in parking accumulation throughout a given day. Seasonal variation in parking demand at each land use (see Figure 3) was developed from management data supplied by developers and in-house historical data. The peak parking demands calculated from the parking demand factors in Figure 1 correspond to 100 percent of peak parking accumulation for each land use indicated on the hourly curves in Figure 2 and the monthly data in Figure 3.

By combining the results for single land uses with survey data for mixed-use developments, it was possible to document the effects of shared parking on total parking space requirements. This was shown in terms of the reduced number of parking spaces needed to serve peak activity periods.

The survey data also disclosed the potential for multiple "levels of reduction" in parking space based on the different impacts of time and inter–land use

Figure 3
Representative Monthly Variations as Percent of Peak Month

Month	Office	Retail	Restaurant	Cinema	Residential	Hotel Rooms Weekday	Hotel Rooms Saturday	Hotel Conference	Hotel Convention
January	100%	65%	80%	90%	100%	90%	65%	100%	20%
February	100	65	75	70	100	90	70	100	40
March	100	70	90	50	100	95	80	100	80
April	100	70	90	70	100	95	85	100	80
May	100	70	95	70	100	95	85	100	100
June	100	75	100	100	100	100	90	100	100
July	100	75	100	100	100	100	100	100	50
August	100	75	85	70	100	100	100	100	50
September	100	75	80	80	100	95	90	100	70
October	100	75	80	70	100	95	90	100	70
November	100	80	80	50	100	85	80	100	40
December	100	100	90	50	100	85	65	100	20

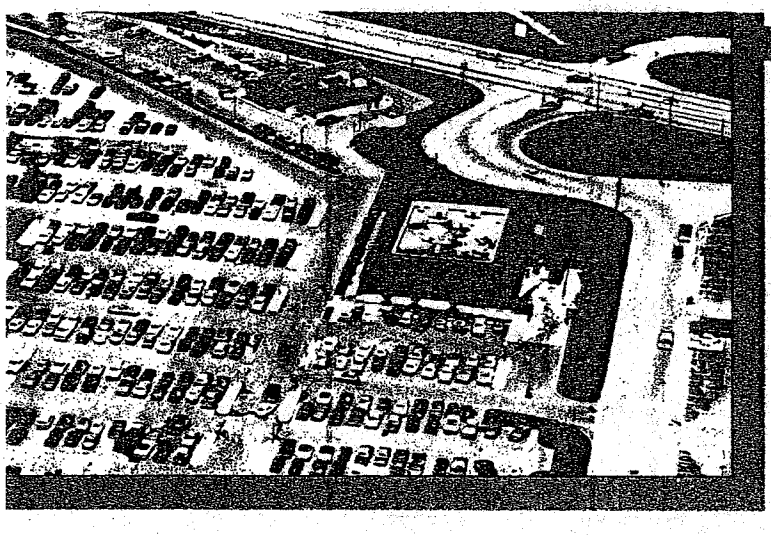


Figure 4
Captive Market Effects—Percent of Employees Who Are Also Patrons In Same Or Nearby Development

	CBD Site	Range	Non-CBD Site	Range
Single-Use Sites	29%	0–76%	19%	0–78%
Mixed-Use Sites	61	22–85	28	0–83
All Sites	43	0–85	24	0–83

relationships. Depending on the particular land uses involved and other site-specific characteristics, parking space reductions resulted from one or more of the effects of (1) hourly, daily, and seasonal offsets in parking accumulation patterns of individual land uses and (2) relationships among land use activities that resulted in people using more than one land use on a single auto trip, i.e., captive market effects. The captive market effect on parking demand at a particular mixed-use development was dependent upon specific market conditions. The range of possible market conditions was reflected in the data obtained from survey questionnaires. Aggregate results of employee surveys indicated that the percentage of all employees who were also patrons at a particular development ranged from 0 to 85 percent. However, on the average, there was a significant increase in employee patrons in central business district (CBD) developments relative to non-CBD developments and in combined-use developments relative to single-use developments. These results are summarized in Figure 4.

Using the single-use analysis results, Figure 5, for example, illustrates the impact of time offsets in parking demand when 400,000 square feet (GLA occupied) of office space and 1.2 million square feet (GLA occupied) of retail space are combined. On weekdays, retail parking demand is lower than Saturday, but competes with office parking demand. The opportunity for shared parking results from having to provide the peak weekend retail parking demand for the development as a whole and when the office parking demand is at its lowest.

In order to demonstrate the potential magnitude of shared parking effects, the parking demand findings for individual land uses were used to estimate demand for mixed-use developments. These results were compared to the actual peak parking accumulation counts to identify the difference. This test involved three steps as follows:

- Compute gross peak parking demand.
- Compute shared parking demand.
- Compare results to actual parking demand.

Figure 5
Office/Retail Parking Accumulations (400,000 sq. ft. office and 1,200,000 sq. ft. retail)

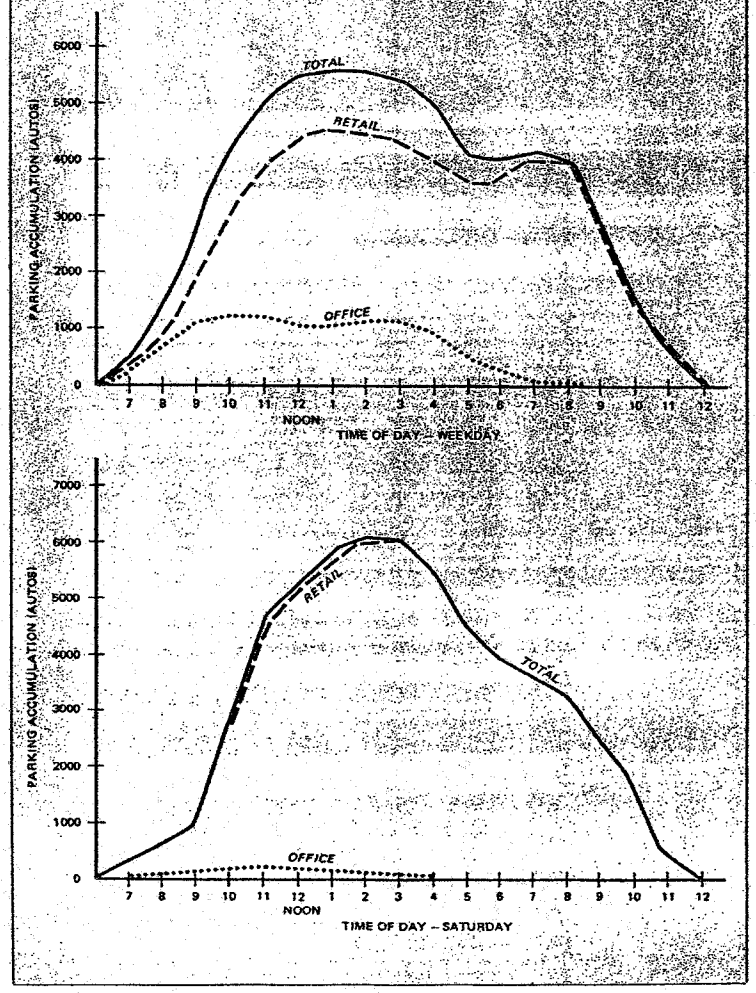


Figure 6 summarizes the results of the test. An important qualification to the results is that the observed parking count (Column 4) does not necessarily represent a "design value" for the development. It is not known if each project was operating at maximum levels of trip generation or if business volumes were significantly lower for the project due to the slow economy or other factors. Specifically, it is known that those projects exhibiting an unusually low actual accumulation were being affected by site factors. Projects 10, 11, 13, 16, and 17 were experiencing lower occupancy at hotel components. This is significant since the values in Column 3 were computed assuming 100 percent occupancy. Further, some projects were surveyed assuming that all parking demand was being served by on-site facilities. Projects 13 and 15, however, may reflect a different situation, since there is a substantial amount of "other" parking space available. For Project 13, it is known that such parking is used significantly by employees.

Findings

With the above qualifications in mind, Figure 6 indicates:

- The parking demand estimated by adding the individual peaks produced results that were consistently high.
- Estimating shared parking demand using time differentials will, if properly constructed, be more reliable than estimating gross parking demand.
- When conservative values are used for peak parking and hourly factors, estimated shared parking demand will be higher than actual parking accumulation. In addition, there often times are other relationships, such as captive market effects, which lower aggregate parking demand.

Figure 6
Results of Test Cases

Mixed-Use Project Type	1 Estimated Single-Use Gross Peak Accumulation (spaces)	2 Typical Zoning Code[1] Requirement (spaces)	3 Estimated Shared Parking Peak Accumulation (spaces)	4 Observed Actual Peak Accumulation (spaces)	5 Percent of Overestimation Gross Peak to Actual	6 Shared[2] Parking Peak to Actual	7 Savings Gross Peak to Shared Peak
1. Office/Retail	5,749	5.858	5,229	5,570	3%	−6%	9%
2. Office/Retail	2,936	3,744	2,788	2,352	25	19	6
3. Office/Retail	772	900	617	633	22	−3	25
4. Office/Retail	2,814	3,048	2,291	2,592	9	−12	21
5. Office/Retail	162	196	154	154	5	0	5
6. Office/Entertainment	1,458	1,879	1,326	1,163	25	14	11
7. Office/Entertainment	812	1,016	714	464	75	54	21
8. Office/Entertainment	1,724	2,112	1,501	614	181	144	37
9. Office/Hotel	1,145	1,399	1,006	882	30	14	16
10. Office/Hotel/ Entertainment	1,627	1,933	1,323	725	124	82	42
11. Office/Hotel/ Entertainment	1,236	1,452	990	525	135	89	46
12. Office/Hotel/ Entertainment	784	862	659	809	−3	−19	—
13. Office/Retail/Hotel/ Entertainment	8,316	9,610	4,242	2,287	264	85	179
14. Office/Retail/ Entertainment	869	1,094	754	600	45	26	19
15. Office/Retail/ Entertainment	5,099	5,157	3,755	2,869	78	31	47
16. Office/Hotel/ Entertainment	2,588	3,188	2,183	1,498	73	46	27
17. Office/Hotel	1,125	1,346	743	594	89	25	64

[1]For this calculation, the following code standards were used: Office = 4.0 spaces per 1,000 square feet of GLA; retail = 4.0 or 5.0 spaces per 1,000 feet of GLA (function of size); restaurant = 20.0 spaces per 1,000 square feet of GLA; residential = 1.0 spaces per dwelling unit; hotel = 1.0 spaces per room, with conference rooms at 0.5 spaces per seat.
[2]Using results from Column 3.

Recommended Shared Parking Method

Based upon survey findings, a methodology was developed to determine parking demand under mixed-use development conditions. This methodology is universal in its application and flexible enough to incorporate adjustment factors as necessary to suit specific policies, programs, and market conditions. It involves four basic steps that may be applied, with appropriate background information, to an existing or proposed project. Figure 7 illustrates the organization and flow of work.

The four basic steps are:

Step 1: *Initial Project Review*—involves the sizing and functional relationship of project land uses based upon market research, site constraints, etc.

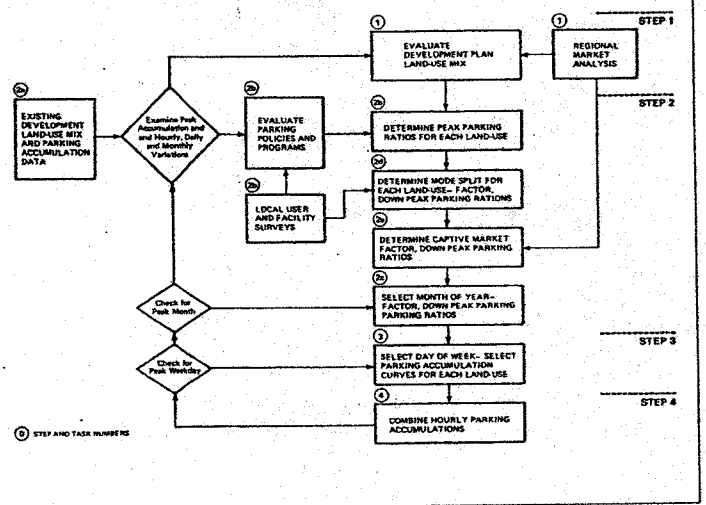
Step 2: *Peak Parking Factor Adjustments*—involves the selection of appropriate peak parking accumulation factors for each land use, and the adjustment of each factor to reflect site-specific factors such as transit use and captive markets.

Step 3: *Hourly Accumulation Analysis*—involves the hourly, daily, and seasonal estimation of parking accumulation for each component land use.

Step 4: *Shared Parking Estimation*—involves the hourly, daily, and seasonal estimation of parking accumulation for the entire project.

The method can use factors and relationships developed by this research or input from other analyses. The latter could include data to modify unit parking factors or other characteristics and market analyses. The method is designed to be sequential, but it can be used in an iterative fashion to test the impact of alternative development plans, assumptions, or policies.

Figure 7
Shared Parking Method



Implementing Shared Parking

A number of factors must be considered in order to insure efficient design, operation, and management of shared parking facilities. The research also examined these factors in detail and identified guidelines for implementing shared parking as follows:

- Each parking space should be usable by all parkers, i.e., no restrictions.
- The facility will have significant inbound and outbound traffic flow at one or more periods of the day. Therefore, the design of the access and circulation system must accommodate bi-directional movement without significant conflict. Also, the circulation concept should be easy to use and understand in order to minimize confusion and inefficient driving maneuvers.
- The facility would tend to operate 24 hours, seven days per week. Thus, safe day and night operation would be a significant characteristic.
- Because of the multiple land uses that would be served, involving a variety of types of parkers (e.g., business, daily versus infrequent, shoppers, visitors, recreational, etc.), the facility will be more sensitive to effective signing, markings, and other communication systems.
- Thought needs to be given to enforcement of parking for on-site visits, since the facility will be more sensitive to encroachment (i.e., less typically vacant space).
- A strategy for the use of the facility needs to be developed in order to guide parkers to the most optimum space. The strategy would consider:
  a. Achieving maximum separation of those parkers who tend to compete for space, i.e., being present at the same time (e.g., shoppers and cinema patrons attending matinees).
  b. Achieving minimum walking distance to those land uses having captive market relationships.
  c. Achieving minimum separation of those parkers not competing for space.
- The data collected in the survey was sufficiently consistent to indicate that a quantitative basis for estimating shared parking demand does exist. Since the shared parking methodology estimates potential parking requirements for specific mixed-use or multiuse developments, it can be used as evidence for a zoning procedure and as a development design tool. Use in zoning procedures is significant because of the parking standards currently used in most urban areas. In many cases, the shared parking analysis will indicate lower parking requirements. ■