SUMMARY AND CONCLUSIONS

The opportunities for improved efficiency in the design and redesign of parking facilities appear certain to increase as the percentage of small cars increases. Our abilities to take advantage of these opportunities will vary by section of the country and type of parking facility in question. There is still considerable room for additional thought and effort in the classification of vehicles by size. The list referred to in this discussion of parking opportunities includes 1339 vehicles manufactured as 1976-1981 models, but it may not be comprehensive enough for many purposes.

With the wide range of existing dimensions and layouts of parking areas, criteria for redesign are difficult to recommend without detailed analysis of the special parking facility in question. However, by using a two-group classification of vehicles, a recommendation was made for small-car stall dimensions to be 16.5 ft long x 8.0 ft wide for 90-degree parking. Alternatives for the design of a new facility are to accommodate the present population of cars or to give more consideration to the inevitable increases in the number of small cars. A safe excess of large stalls is required because some small cars can be expected to park in large stalls, but large cars cannot park in reduced stalls. In addition, it is crucial that reduced stalls be located in a prime spot so that they will never be the last spaces to be filled.

Of the several types of parking facilities, those that have the greatest potential for redesign to accommodate small cars have rigid control over users. Included in this group are employee parking areas provided by employers and a variety of special-use parking areas. Many college and university campuses are particularly well-suited to small-car parking because of their high percentages of small cars, intense parking demand, and strict control over users.

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New Directions in Central Business District Parking Policies

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Several North American cities have recently adopted innovative approaches to central business district (CBD) parking requirements to manage the supply and location of downtown parking. Traditional zoning ordinances require sufficient parking in downtown developments to accommodate automobile access by building tenants and visitors. Some new approaches to parking involve the provision of an enhanced parking supply as an incentive to the economic development or redevelopment of an urban area; these approaches are generally being pursued in areas whose goals and objectives relate to economic development and new employment opportunities. Other new approaches to parking are directed at reducing the supply of downtown parking or redirecting new parking supply to the CBD periphery; these techniques generally are being pursued in areas where alternatives to automobile commuting exist or can be created. This paper reviews innovative parking policies in selected cities and describes and assesses the range of tactics for off-street parking supply that can be used in activity centers.

Policies to manage the supply and location of downtown parking are receiving renewed attention from many older cities that seek to revitalize their central business districts (CBDs) as well as from developing cities that are actively shaping their urban development. The traditional approach to CBD parking is a zoning requirement on developers to provide a minimum number of spaces, depending on the size of the building. However, limitations on the number of automobiles that can be accommodated in a CBD without serious congestion and pollution problems have prompted many cities to manage automobile use by controlling parking opportunities.

This paper examines the policies adopted by several North American cities to regulate the supply of CBD parking and, in some instances, to direct the construction of new spaces to areas on the CBD periphery. Most of the policies reviewed are directed at reducing the total available supply of CBD parking, although several cities are also pursuing programs to increase short-term parking opportunities and reduce long-term parking in the CBD. Efforts to reduce total available parking are most evident in cities where feasible alternatives to automobile commuting exist.

DOWNTOWN PARKING POLICIES IN SELECTED NORTH AMERICAN CITIES

Several cities in both Canada and the United States have implemented parking management policies to manage automobile access to their downtowns. These communities have adopted various zoning and related parking control measures that address their individual circumstances. The survey of downtown parking policies conducted in this study showed that no one approach to downtown parking will be universally successful (1). Parking is only one aspect of larger transportation management activities, and we must consider the other actions that the cities described below have taken to understand the framework for their parking policies.

In general, the surveyed communities have parking requirements in their zoning ordinances that range from 1 space/1000 gross ft² of development to 1 space/2500 gross ft². (Note: 1 net ft² is roughly equivalent to 0.85 gross ft².) Although zoning ordinances have traditionally specified the minimum amount of parking required, more and more communities are using the zoning requirement as a maximum limit as well as a means to control the growth in supply of downtown parking. Transit's role for downtown access is stressed in communities that seek to limit parking supply, and several cities reported that developers voluntarily built significantly fewer parking spaces than the maximum allowable in well-recognized transit corridors. Some communities interpreted this as the building industry's willingness to place the transportation burden on the public sector and there improve its return on investment. A developer's willingness to provide less than the allowable amount of parking space was dependent on the characteristics of the individual site; the survey of communities did not produce any conclusive generalizations about how much parking should be provided throughout a downtown area.

This paper reviews the parking policies in the following North American communities:

1. Calgary;
2. Chicago;
3. Denver;
4. Edmonton;
5. Los Angeles;
6. Montgomery County, Maryland;
7. Ottawa;
8. Portland, Oregon;
9. San Francisco;
10. Seattle;
11. St. Paul;
12. Toronto; and
13. Vancouver.

Table 1 summarizes the demographic, transportation, economic, and downtown parking characteristics of most of these cities.

Chicago

Chicago responded to its air quality problems by banning new parking structures in 1975 and by creating zoning incentives to reduce parking provided in new buildings. Ten percent reductions in the required parking are permitted for each of the following:

1. If parking is underground,
2. If the building has a good transit connection,
3. If the building has a pedestrianway connection, or
4. If the building is located in the CBD.

If fewer than a total of 50 spaces are required, the developer need not provide any parking. Experience suggests that developers will provide the least amount of parking possible. Fifty-story buildings typically have as few as 100 spaces, and some CBD office towers of more than 500 000 ft² are being built with as few as 80-100 stalls. Since the CBD work trip transit mode split is 80 percent, developers apparently are more concerned about avoiding costs than in providing parking.

Denver

Denver does not require any parking in its downtown buildings, except in an urban renewal area where there is a requirement of 1 space/100 ft² (gross). The requirement in the urban renewal area was established in the 1960s, when a larger freeway system was envisioned. What is noteworthy about Denver is the actual rate at which parking is provided in the absence of any requirements. Denver city planning staff cited the following examples to support their belief that developers will try to avoid building parking to the maximum extent possible:

Parking Spaces	Building Size (gross ft²)	Parking Spaces
175	800 000	1 space/4571 gross ft²
400	630 000	1 space/1575 gross ft²
600	820 000	1 space/1367 gross ft²
325	421 000	1 space/1295 gross ft²
80	205 000	1 space/2563 gross ft²
100	157 000	1 space/1570 gross ft²
134	650 000	1 space/4851 gross ft²

Denver CBD office space increased by 40 percent between 1970 and 1980 to a total of 33 million ft² and is expected to further increase to 44 million ft² by 1985. Regional office and retail space has been growing at a slightly faster pace than the Denver CBD. A city official stated that recent CBD construction shows that parking in or next to buildings is not necessary to encourage development. Of the 60 000 parking spaces in the greater CBD area, 24 000 spaces are in fringe lots that serve long-term parkers. There are 1.5 parking stalls per employee in the greater CBD area.

Edmonton

The City of Edmonton has linked transportation access to its parking policies. The city's objective is to reduce the rate of growth of parking stalls in the CBD and to encourage alternative access modes. Edmonton has enacted an ordinance in its CBD that requires developers to provide 1 stall/1000 gross ft² either in the building or within 400 ft of the entrance. However, if the building has direct access to a pedestrianway, the requirement is to provide 1 stall/2000 gross ft². If there is direct access to the light rail transit (LRT), the requirement is reduced to 1 stall/25 000 gross ft².

Edmonton estimates its 1980 downtown employment at 54 000 and its total CBD parking inventory at 20 136, or an average of 1 stall/2.68 employees. The city thinks that it has maintained good rapport with the developers and there is not a widespread apprehension that these policies will create a parking shortage in the future. The Edmonton metropolitan population grew 12.2 percent from 1976 to 1980, and the city anticipates 80 000 CBD employees by 1986.

Los Angeles

Los Angeles is currently developing a parking management plan that will allow developers to provide transportation alternatives in lieu of providing parking. The municipal zoning ordinance currently requires 1 space/1000 ft² of development in the CBD and 1 space/500 ft² of development in other parts of the city. Under the proposed parking management plan, developers can reduce their parking construction if they are able to implement an effective transportation alternative to driving alone.

Three elements of the proposed parking management plan allow reductions in parking requirements:

1. Developer may provide alternatives to single-occupant automobile commuting (e.g., ridesharing promotion),
2. Park-and-ride program can be implemented to substitute off-site spaces for on-site requirements, and
3. Preferential parking can be designated on-site for high-occupancy vehicles (HOVs).

Table 1. Comparison of downtown parking in selected North American cities.

City	Regional Population	Employment		CBD Office Space (ft^2)		Downtown Parking Supply					CBD Work Trip Mode Split (% transit)	Zoning Bylaw
		Regional	CBD	Total	Growth	Total	Surface On-Street and Off-Street	Structure	Long Term	Short Term		
Calgary	583 100	231 920	72 675	14 200 000	16 400 000 additional by 1982	41 212	24 419	16 793	15 295	21 175	45	Minimum of 1 stall/1500 gross ft^2. If in the office core, 20 percent of requirement (or 50 stalls, whichever is greater) can be provided on site; balance will be provided by the city outside the office core by using developers' cash-in-lieu payments that are based on the minimum parking requirement
Denver	1 400 000	NA	93 000	33 000 000	11 000 000 additional by 1985	34 000 in CBD core; 60 000 in CBD core and fringe	36 000 in core and fringe	24 000 in core and fringe	NA	NA	24	No zoning bylaws govern parking except in an urban renewal area where 1 stall/1000 gross ft^2 is required
Edmonton	621 600	NA	54 000	NA	NA	20 100	NA	NA	6400	13 700	NA	Minimum of 1 stall/1000 gross ft^2. If direct access to pedway, 1 stall/2000 gross ft^2; if direct access in light rail transit, 1 stall/2500 gross ft^2. Parking must be provided within 400 ft
Ottawa	739 400	285 000	65 000	NA	None in the past 4 years	13 600 total off-street only; 7700 of this figure available to the public	1500 off-street only	12 100	NA	NA	66	No zoning bylaws govern parking for office development
Portland	1 200 000	575 000	80 000	13 500 000	1 000 000/year	33 000	NA	NA	23 000	15 000	35-40	Maximum of 1 stall/1000 gross ft^2 to 1 stall/1429 gross ft^2, depending on proximity to transit spine
Seattle	2 400 000	400 000	115 000	19 000 000	4 500 000 additional by 1982	43 700	NA	NA	NA	NA	45	Maximum of 1 space/1500 gross ft^2 for buildings in which at least 80 percent of gross floor area is office space; 1 space/1200 gross ft^2 for buildings in which less than 80 percent of gross floor area is office space; principal-use parking structures and surface lots are prohibited
St. Paul	2 500 000	1 500 000	62 000	8 000 000	150 000/year	30 000	10 000	20 000	NA	NA	35	No zoning bylaws govern parking for office development
Toronto	2 900 000	NA	185 600	NA	NA	35 800	18 000	17 800	NA	NA	80	Minimum of 1 stall/1668 net ft^2; maximum of 1 stall/1453 net ft^2
Vancouver	1 200 000	NA	125 000	NA	NA	41 600	20 000	21 600	NA	NA	50	Maximum may not be required; if required, 1 stall/1000 gross ft^2
Winnipeg	585 900	280 000	55 000	3 000 000	400 000/year	27 200	18 100	9 100	17 200	10 000	55	No zoning bylaws govern parking for office development in CBD

Note: NA = not readily available.

The developer is responsible for developing the transportation alternatives. Performance standards that are included in contractual agreements between developers and the city are an important part of the proposed plan. These performance requirements are intended to ensure adherence to the agreed on contractual agreement and may include on-site monitoring to ascertain whether solo driving has been reduced.

The city hopes that reducing the costs of providing parking facilities will act as the major incentive to encourage ridesharing programs that are operated by developers and employers. To date, this parking management plan has not been adopted by the city council.

Montgomery County, Maryland

Montgomery County, Maryland, is a suburban county located north of Washington, D.C.; its population is approximately 600 000. In response to a deficiency of shopper and employee parking, four parking lot districts were established that correspond to the county's business areas. The parking lot districts are economically self-sufficient units designed to meet the parking needs of the business areas.

Funding for the districts is provided by an ad valorem parking lot district tax on office developments that do not provide the 2 spaces/1000 ft^2 required by the zoning ordinance. The ad valorem tax is levied only against the value of the proportion of the building that is not used for parking. The county thinks that the ad valorem ordinance enhances development because it is cheaper for the developer to pay the tax than to build parking. Additional funding for the parking districts is obtained from parking fees, enforcement fines, and income from investments and bond issues.

Currently, a total of 2000 on-street and 1000 offstreet publicly owned spaces are provided. Most of the long-term parking is provided in off-street facilities; the short-term parker is served by on-street and off-street facilities. Each parking lot district is designed to be financially self-sufficient. Surplus funds are used for new programs and capital projects.

Ottawa

Four years ago the City of Ottawa commissioned a major parking study to develop parking control strategies to encourage transit use. As a result of the study, the city rescinded its zoning bylaw, which required office developers to provide 1 space/1000 ft^2 of office space, and currently there are no parking requirements. In an effort to discourage long-term parking and to ensure an adequate supply of short-term parking, the city also changed its pricing policy at municipal lots from day rates to higher hourly rates and built several short-term lots. In conjunction with these efforts, the city expanded and improved transit service. As a result, transit buses now serve 66 percent of the downtown work trips.

The development impacts of Ottawa's change in zoning requirements for parking cannot be determined yet as there has been little new office construction since the relocation of 15 000 federal employees from downtown Ottawa to Hull. The city currently expects several major office developments and anticipates that developers will provide parking to prevent a parking shortage. The amount of parking in buildings may be limited, however, by the expense of building on the bedrock that underlies the city. The amount of surface parking will be limited by the expense of providing lots, since the city assesses vacant lots at market rates that reflect their development potential. The anticipated completion of a transit mall by 1984 is another factor that may influence developers' decisions to provide parking.

Portland, Oregon

In response to federally mandated clean air requirements, Portland implemented coordinated transit and parking policies designed to discourage downtown automobile traffic and to promote transit use. The city is directing high-density development to its main transit corridor and freezing the number of parking spaces allowed downtown at the 1973 level of 38 870 (includes on-street and off-street parking).

Portland currently has 13.5 million ft^2 of downtown office space and the supply of office space is increasing at a rate of about 2 million ft^2/year. Downtown employment is about 80 000; therefore, Portland has 2.06 employees for each downtown parking space. Approximately 15 000 of the total of 38 870 spaces are short-term parking spaces (the city controls about 10 000 spaces), which reflects the city's policy of promoting short-term parking opportunities.

Portland's zoning ordinance sets a maximum limit on allowable parking that ranges from 1 space/1000 gross ft^2 to 1 space/1429 gross ft^2, depending on the proposed building's proximity to transit. The City Planning Department also reviews each application for its impacts on the parking freeze policy and the preservation of the ceiling. To date, the city believes that downtown development has not been deterred by these restrictions. CBD employment has increased by 10 000 since the program was adopted in 1975, and there has been a greater increase, proportionally, in CBD development than in suburban development. The lack of concern about the policy is apparently due to a doubling of transit ridership and the net contribution of usable spaces to the total number allowable. Parking that was previously in surface lots that no longer exist and on-street parking lost as a result of traffic improvements are both credited to the total allowable supply.

Initially, the parking management program encountered substantial resistance from developers. In a recent review of its policies, the city concluded that this resistance has largely dissipated as developers realized that they were being treated equitably and that the reduced parking requirements were saving them money. Developers are apprehensive about Portland's actions once the ceiling is reached, but they also recognize that the LRT scheduled to open in 1985 could be an important factor in reducing parking demand. A representative of the Portland Building Owners and Managers Association indicated that Portland's policies are successful so far, but the representative thought that a mechanism for change should be available if these policies create serious problems and dislocations in the future.

Portland's experience since it adopted a maximum zoning ordinance indicates that most developers provide less than the allowable amount of parking. Outside the transit corridor, the maximum limit is 1 space/1000 ft^2; however, several buildings have provided 1 space/1200 ft^2, and one site provided 1 space/2000 ft^2. On the transit corridor, examples were cited of 1 space/2000 ft^2, another that has 1 space/2400 ft^2, and a third that has no parking at all. Exceptions to this trend are smaller projects farther away from transit where developers provide the maximum allowable parking.

San Francisco

San Francisco adopted a maximum allowable parking bylaw in 1968 in its core area to address air quality issues. The bylaw permits a maximum of 7 percent of a building's gross floor area to be used for parking without special approval. Assuming 300 ft^2 (gross) per stall (and ramps), this requirement equates to 1 stall/4285 ft^2 of office space. Parking has been growing at a rate of 1500 spaces/year outside of the core (mainly in parking structures) and office space has increased by approximately 2.0 million ft^2 to yield an estimated downtown incremental parking supply rate of 1 stall/1333 ft^2. San Francisco is concerned that its current policy is not achieving the objective of decreased automobile use and is now considering a cap on the total supply.

St. Paul

In an effort to promote downtown retail and commercial activity, St. Paul operates a program that allocates more than half of center-city parking to short-term use and provides fringe parking for long-term parkers. To achieve these objectives, the city uses pricing, a fringe-parking shuttle bus, and a skywalk system to create an integrated set of parking incentives and disincentives. St. Paul has no parking requirements in its zoning law nor does it limit the amount that a developer may provide.

To encourage short-term parking in the CBD, the city set the following rate structure at city-owned facilities and at private lots that participate in the city's program:

1. $0.25/0.5 h for the first 3 h,
2. Rate increases (increment depends on location) for parking after the first 3 h and the total daily rate may be as high as $8.00/day, and
3. Free parking during evening shopping hours.

Private operators participate on a voluntary basis, and the city reimburses them for their foregone parking fees. Under the program, private parking providers who participate in the program are still allowed to set special long-term rates; only the short-term fees are fixed. Several of the short-term structures are also connected to the skywalk system (which is the largest in the United States), and St. Paul thinks that the system has been well received and is well used.

Long-term parking is encouraged in the fringe lots through attractive long-term rates of $1/day or $20/month and by providing free shuttle-bus service during peak hours to the CBD at 5-min headways east-west and 10-min headways north-south. Most of the fringe lots are located on the vacant city-owned land. Two private lots are also used as fringe lots, and the city receives $0.25 from each $1.00 collected to help pay for the shuttle-bus service. The operations and capital expenses of the entire shuttle-bus and parking program is self-sufficient and is financed through the parking revenues and half of the meter receipts.

Developers initially opposed these policies but opposition has decreased over time as buildings have been successfully leased (the overall occupancy rate is 93 percent). The CBD has 62 000 employees and 30 000 total parking spaces, for an average rate of 2.06 employees/stall. Parking supply consists of 20 000 long-term parking spaces and 10 000 short-term spaces. Industry and warehousing are important functions in this city, and office space occupies only 8 million ft^2 in the downtown.

Seattle

Like Portland, Seattle adopted parking restrictions in response to federal clean air requirements. Seattle's zoning ordinance prohibits principal-use parking garages (i.e., a building dedicated to parking only) and parking lots in the downtown core. It also sets a maximum allowable rate of 1 space/1500 gross ft^2 for CBD developments when at least 80 percent of the gross floor area is office space. The maximum limit for CBD developments when less than 80 percent office space is 1 space/1200 gross ft^2. The city requires 30-40 percent of the allowable parking to be reserved for carpools and vanpools.

Allowable limits for the area that surrounds the office core are 1 space/1500 gross ft^2 if 80 percent of the gross floor area is office space, and 1 space /2000 gross ft^2 if less than 80 percent of the gross floor area is for office use. Principal-use parking garages and parking lots in the CBD periphery are allowed if the city determines that the additional automobiles attracted to these facilities will not adversely affect nearby traffic flow or exceed street capacity. The parking supply in recent developments indicates that parking is actually provided at a rate that is substantially lower than the amount allowed. Seattle estimates that 1 space/2500 gross ft^2 is actually being provided and developers are not anxious to provide more due to the economics of building parking. Developers have voiced strenuous objections to the 30-40 percent set aside for carpoolers; however, and argue that this does not reflect actual travel behavior and hurts their competitive position with older buildings that do not have similar restrictions.

The total CBD parking inventory in Seattle declined from 44 642 spaces in 1976 to 43 264 spaces in 1978, largely due to redevelopment activities and the ban on principal-use parking. Since CBD employment is approximately 114 200, this provides an average of 1 space/2.64 employees. Seattle expects an additional 4.5 million ft^2 of office development by 1982, for a total of 23.6 million ft^2.

Toronto

Within the past few years, Toronto has set minimum and maximum requirements on parking that enables them to better control the amount of parking constructed. The minimum amount of parking required is 1 space/1668 net ft^2, and the maximum is 1 space/1453 net ft^2. Previously there were no parking requirements.

CBD employment is 185 000 individuals and the downtown parking inventory is 35 800 spaces, so there are 5.2 employees/parking stall. However, 80 percent of Toronto's downtown work trips are made by transit. There has been an increase in the supply of downtown parking since the requirements took effect, but it is unclear whether new developments are providing more or less parking than older ones. Developers were surprised by the bylaws since previously there were none, but the city staff believes that these bylaws have not discouraged developers from investing in the downtown.

Vancouver

Vancouver, like Toronto, recently instituted a new parking bylaw. The new restriction allows a maximum of 1 space/1000 gross ft^2. This bylaw replaced a minimum of 1 space/4800 gross ft^2.

Vancouver's downtown employment is 125 000, and there are 41 600 parking spaces. Of the total num-

ber of parking spaces, 20 000 are curb or surface-lot spaces and the remainder are in parking structures. Even though the total parking supply in Vancouver's CBD has been growing slowly in the past few years, the number of surface spaces is decreasing. There are 3 workers/parking stall.

The new bylaw has not altered radically the number of spaces that developers provide. In 1973, before the current bylaw was instituted, developers provided between 1 space/1000 ft² and 1 space/5000 ft². Currently, two new developments provide 1 space/1500 ft² and 1 space/4500 ft². A third major development is providing 1 space/1250 ft² and the developer said he would like to provide more. Developers generally have accepted Vancouver's new zoning restrictions.

PLANNING AND IMPLEMENTING OFF-STREET SUPPLY TACTICS

The types of tactics of particular interest to cities are as follows:

1. Changes in zoning requirements for parking (e.g., minimum space requirements, maximum space requirements, joint use of parking, and reduced requirements for developments near transit facilities);
2. Constraints on the growth in parking supply (e.g., ceilings on supply, reductions in parking requirements through HOV and transit incentives, and restrictions on principal-use parking facilities);
3. Preferential parking for HOVs, handicapped, and small vehicles in off-street parking facilities; and
4. Construction and management of peripheral parking to reduce long-term parking demand in the CBD.

The private sector typically builds, owns, and operates most of the off-street parking facilities in activity centers (e.g., CBDs and office parks), although some jurisdictions are notable exceptions to this. Consequently, the role of government agencies in providing such parking is predominantly one of developing and applying rules and standards to regulate the amount, location, and type (e.g., lot or garage) of parking and amenities and facilities to be provided to protect public health and welfare (e.g., lighting, ventilation, and fire protection).

Assessment of Existing Parking System

Some of the off-street supply tactics, particularly those that involve parking ceilings or freezes or major changes in zoning requirements, may generate considerable controversy. Experience with such tactics is limited, and it is difficult to accurately predict their economic, development, environmental, and transportation impacts.

Most communities are concerned as to how changes in parking policies will affect the economic feasibility and the development potential of activity centers such as the CBD or major office and retail areas outside the CBD. The feasibility of such centers is important to the tax base of a community and, therefore, proposed government policies that will affect such activity centers should be analyzed carefully and objectively. Consequently, it is important to comprehensively, even if qualitatively, analyze and evaluate such tactics and to address important issues raised by affected interests.

In many jurisdictions in which zoning and supply constraint tactics have been implemented, broad-based community sentiment favored reduced traffic congestion, improved transit ridership, reduced air pollution and other undesirable environmental impacts, and promotion of an economically and culturally strong downtown.

A basic step that should be taken in evaluating changes in off-street parking policies (e.g., zoning changes and freezes) is determination of the characteristics and adequacy of the existing parking system and the likely characteristics and adequacy of the future system under current parking policies. This should include compilation of accurate information on the existing supply, location, type (e.g., ownership), use, and prices of parking within activity centers. Specific types of data of interest and sources of such information are shown in Table 2 (2-4). These data should be used to identify existing parking problems such as inadequate short- or long-term parking supply or an oversupply of parking. Such information is necessary (a) to demonstrate an understanding of the parking system and (b) to provide a basis for assessing the impacts of changes in off-street parking policies on the activity center.

Existing parking policies should also be reviewed in terms of their long-range implications. For example, future parking demand should be estimated based on land use and employment projections, planned highway and transit improvements, and other factors (e.g., price of gasoline and transit fares). This information is available from the urban transportation planning agency in each urban area. Parking demand forecasts should be compared with existing and future parking supply to identify potential parking problems and requirements. In some jurisdictions this information is available from activity center parking studies.

Selection of Tactics

Based on the results of the problem assessment described above, planners should be able to identify changes to existing off-street parking supply programs or new tactics to promote activity center development and economic objectives. Table 3 shows the applicability of selected off-street parking supply tactics to alleviate activity center problems. The advantages and disadvantages of selected off-street parking supply tactics are described below and summarized in Table 4.

Minimum and Maximum Parking Requirements

Most communities have zoning codes that specify the number of parking spaces to be provided per unit (e.g., 1000 ft² of development, dwelling unit) and type (e.g., office, retail, hotel, or industrial) of development. Some communities specify the minimum number of spaces required, and others specify the maximum number per unit of development. The use of minimums or maximums is important from the perspective of controlling the off-street supply of parking. If a community wishes to constrain supply, it can set maximum (i.e., build no more than) parking requirements at a low level that achieves this objective. Alternatively, if inadequate parking supply is available for certain uses (e.g., retail), minimum (i.e., build at least) parking space requirements can be set at a high level to promote additional supply.

Aside from specifying parking requirements in terms of minimums and maximums, many jurisdictions should review their zoning requirements for parking space in light of public transit, carpool or vanpool, and other transportation programs designed to increase modal split and vehicle occupancies, particularly for work trips. Zoning requirements can be set to restrict parking supply, which will likely increase the price of parking. Both of these ef-

Table 2. Potential sources of data for planning off-street parking management tactics.

Item	Applicable Data for Problem Assessment	Potential Sources of Data
Parking inventory	Number of spaces by type, location of spaces, applicable parking rates, restrictions and use of facility, hours of operation, and ownership	Parking inventory; records of local transportation, parking authority, or planning department
Parking use data	Maximum parking accumulation, number of parkers by parking duration, parking turnover, and trip purpose, residence, number of occupants, and destination of parker	Use survey, records of local transportation department or parking authority, and parker survey
Existing and projected land use, employment, and economic data		Local and regional planning agencies, chambers of commerce, and universities
Existing and projected travel by mode and purpose		Local, regional, and state transportation planning agencies and transit operators
Existing and projected transportation system characteristics		Local, regional, and state transportation planning agencies; transit operators; and parking authority

Table 3. Applicability of off-street supply tactics to selected problems in major activity centers.

Objective	Tactics for Off-Street Parking Supply in Activity Centers	Selected Problems					
		Provide Adequate Supply of Short-Term Parking	Provide Adequate Supply of Long-Term Parking	Encourage Efficient Use of Existing Supply	Reduce Highway Congestion in Peak Periods	Promote Economic Development	Conserve Energy and Reduce Air Pollution
Expand or restrict off-street supply in CBD and activity centers	Zoning requirements						
	Minimum requirements				X	X	X
	Maximum requirements				X	X	X
	Joint use			X		X	
Constrain normal growth in supply	Maximum ceiling (i.e., freeze) on CBD spaces				X		X
	Reduced minimum parking requirements through HOV and transit incentives				X	X	X
	Restricted principal-use parking facilities				X		X
Construct new lots and garages		X					
Change mix of short- and long-term parking		X	X	X	X	X	X
Restrict parking before or during selected hours of the day		X			X		X
Preferential parking	Carpool and vanpool parking, handicapped parking, spaces for small vehicles			X	X		X

Table 4. Characteristics of selected off-street parking management tactics.

Tactic	Jurisdiction	Agency	Area	Operating Characteristics	Compliance	Impacts
Expand or restrict supply in CBD and activity centers						
Zoning requirements						
Maximum and no minimum parking requirements	Portland, OR	Planning commission	CBD	No minimum required parking, maximum allowed parking for retail or office development is 1 space/1000 ft^2	Development review process	This action in conjunction with other tactics has resulted in 1 space/1350 ft^2 being provided for new developments
	San Francisco	City planning commission	CBD	No minimum required parking, limits parking to 7 percent of the gross floor area	Development review process	Moderate growth in private off-street parking has occurred in contrast to high growth in downtown office and retail space
	Seattle	Department of buildings	CBD	No minimum required parking, depending on the zone and use; maximum allowed parking ranges from 1 space/1000 ft^2 to 1 space/2000 ft^2	Environmental impact statement review	Parking supply is growing in areas farther from the retail core and decreasing closer in
Joint use	Los Angeles	Planning commission	Entire city	Would allow developments within 1500 ft to share parking if demand patterns do not conflict	Land convenant and performance bond	Proposed action
	Montgomery County, MD	Division of parking	Suburban CBD	Spaces rented by local college for use by students	Parking patrol checks for valid stickers	Student parking impacts have been reduced
	Portland, OR	Planning commission	CBD	City has agreed to increase number of short-term spaces in city garage if developer reduces number of off-street spaces provided; code allows developers to share parking	Development review process	Development under construction
Constrain normal growth in supply	Palo Alto, CA	Department of planning and community environment	Entire city	Allows reductions of up to 20 percent for developers without conflicting demand patterns	Development review process	
Maximum ceiling (i.e., freeze) on CBD supply	Boston	Boston air pollution control commission	CBD	Limit on total number of allowable commercial spaces; freeze does not apply to free employee and customer parking	Development review process	Development has not been hindered
	Portland, OR	Planning commission	CBD	Limit on total number of allowable parking spaces by sector	Development review process	Ceiling has not been reached; tactic has encouraged parking in desired sectors; development has not been hindered
Reduced minimum parking requirements through HOV and transit incentives	Arlington, VA	Zoning administration	Entire county	Developers located near rail rapid transit station may provide approximately 70 percent of required parking	Development review process	Should reduce commuter parking impacts
	Chicago	Zoning administration	CBD	Required parking reduced if developer meets certain conditions concerning transit stations	Development review process	There are 1000 fewer spaces in CBD since 1975; a 110-story building (Sears Tower) constructed with only 150 spaces
	Los Angeles	Planning commission	Entire city	Parking requirements would be reduced if developer provides HOV and transit incentives; developer would be allowed to substitute on-site spaces for off-site park-and-ride spaces; developer would be able to reduce required parking by 1.5 space for each space reserved for HOVs	Land covenant, development review process, developer would contribute money for park-and-ride facility development and transit shuttle services	Proposed actions

Table 4 (Continued).

Tactic	Jurisdiction	Agency	Area	Operating Characteristics	Compliance	Impacts
Reduced minimum parking requirements through HOV and transit incentives	Palo Alto, CA	Department of planning and community environment	Entire city	Allows up to 20 percent reduction in required parking if transit and HOV incentives are employed	Development review process, legal agreements	Several new developments have agreed to institute HOV incentives
Restrict principal-use parking facilities	Chicago	Zoning administration	CBD	Prohibits construction of principal-use parking facilities	Development review process	Number of parking spaces has decreased by 1000 since 1975; number of long-term parkers has increased
	San Francisco	Planning commission	CBD	New principal-use parking facilities require conditional use review	Development review process	
	Seattle	Department of buildings	CBD	New parking lots prohibited; new parking structures prohibited in most of CBD	Development review process	No new principal-use facilities have been built since 1976, economics is major factor
Construct new municipally owned parking facilities						
CBD	Baltimore, MD	Baltimore City	CBD	New facilities for tourists and shoppers in capital improvement plan	NA	Facilities planned and under construction
	Montgomery County, MD	Division of parking	Suburban CBDs	New parking structures have been constructed to meet long-term and short-term demand	NA	Employers and shoppers are encouraged to work and shop in these suburban CBDs
	Portland, OR	Downtown development commission	Retail core of CBD	Recently completed 492-space garage with a 752-space garage under construction; designated for short-term use only; $0.60/h, merchant stamp program	NA	Merchants pleased by increased supply of short-term parking
Neighborhood shopping districts	Los Angeles	City transportation department	Various neighborhoods	More than 7000 spaces in more than 100 facilities have been provided	NA	Program has increased attractiveness of shopping districts
	San Francisco	Parking authority	Various neighborhoods	Began program to increase number of available short-term spaces	NA	Merchants are supportive; made less impact on surrounding neighborhoods
Carpool and vanpool preferential parking	Alexandria, VA	Alexandria	CBD	Reserved spaces for city employee carpools of three or more persons; city vehicles are also available to carpools	Applications are cross checked	15 pools in program
	Los Angeles	City of Los Angeles	City facilities	Free reserved spaces are proposed for city employees		Proposed action
	Montgomery County, MD	Division of parking	Suburban CBDs	55 spaces reserved for carpooling of three or more; cost is $16/month versus normal fee of $24/month	Vehicles must arrive with three or more occupants	48 pools in program
	San Francisco	California Department of Transportation	Fringe of CBD	40 percent of under freeway lots reserved for vanpools; fee is $10/month versus normal fee of $60/month	Vanpools are certified	Program just beginning
	Seattle	Commuter pool	CBD and fringe of CBD	219 spaces under freeway reserved for 3 + carpools at $5/month; 1000 spaces in stadium lot available to poolers of 3+ for free	Carpools must be certified and are audited	Freeway lot is full; stadium lot has low utilization; 40 percent of carpoolers formerly used transit

Note: NA = not applicable.

fects may encourage transit ridership, carpooling, and vanpooling. Gasoline price increases and possibly its availability also may cause reductions in parking demand over time. Changing parking requirements in a zoning code are likely to have long-range rather than short-range impacts on supply. Such impacts would occur as new developments or redevelopment occurs over time.

Joint Use of Parking Facilities

This tactic is intended to lessen the duplication and improve the use of existing and new parking facilities. Two or more nearby developments would be able to meet local zoning requirements by constructing fewer total parking spaces (probably in a single facility) than would normally be required if each development were treated separately. Several conditions typically must be met for this tactic to be feasible:

1. The proposed joint parking facility should be in close proximity (e.g., within 1500 ft) of each participating development,
2. The time periods during which each development would use the parking facility should not overlap or be in conflict, and
3. There should be a legally enforceable agreement between each participating developer to ensure that the parking facility is built and operated in accordance with local zoning requirements.

For example, a joint-use parking facility may be feasible in settings where theaters or sports arenas, which attract evening and weekend travel, are built near an office development that experiences its peak parking demands on weekdays between 8:00 a.m. and 6:00 p.m. The key element of this example is that the temporal distribution of parking demand for these developments would not overlap, and consequently, the parking supply in the joint-use facility could serve both developments. This would eliminate the need for duplicating parking supply.

This tactic provides an incentive to developers to reduce their costs associated with meeting municipal parking requirements and allows the development of more revenue-producing space in their projects. Duplicative parking can eliminate spaces that serve travelers who have different temporal parking patterns (e.g., daily work-trip parkers versus evening theater or sports parking). The land freed by such a tactic can be developed for employment and revenue-producing purposes that benefit citizens and municipalities. Further, the tactic might encourage multipurpose projects and increase activities during the evening hours in downtown areas that are oriented to office buildings.

This tactic has limitations. In relatively few instances do no conflicts exist in the hours of parking for two or more developments. The developments must be in close proximity; otherwise, the long walking distance to one or both developments may inconvenience parkers. The enforcement of the joint-use agreement through a land convenant or a performance bond may discourage the execution of such an agreement. This tactic can be implemented through a revision of the zoning code. However, in order for it to be effective, considerable care must be exercised in defining the criteria where joint use will be permitted and in specifying the legal and financial mechanisms to be followed by developers to enforce the agreement over time. If either or both of these items are perceived by developers and others as being too rigid, use of this tactic may be undermined.

Ceiling and Freeze on Parking Supply

Ceilings and freezes are major actions taken to control parking supply. A ceiling sets an upper limit on the parking supply within a geographic area. The supply ceiling could be equal to or larger than the existing parking supply. Conversely, a parking freeze would limit future parking supply in a geographic area to the number of spaces available for use at the time the freeze is put into effect.

Several significant factors must be considered in planning and implementing a ceiling or a freeze on parking:

1. Types of parking to be covered,
2. Geographic area to be affected,
3. Provisions for review and approval of proposed parking facilities, and
4. Provisions for banking parking that is converted to other uses.

Reduce Parking Requirements Through HOV and Transit Incentives

This tactic is intended to reduce vehicular travel to and congestion in major activity centers by encouraging travelers to park at remote locations and use carpools, vanpools, and transit to reach their place of employment. This tactic differs from conventional park-and-ride tactics in several important respects. The affected municipality would construct park-and-ride facilities in suburban parts of the municipality. The municipality would then encourage developers and employers to purchase such spaces as an alternative to building spaces within major activity centers. The developers and employers would be charged the unit development cost per space to acquire the remote parking supply. Regulations that govern this tactic should be documented in a municipality's zoning code.

Developers and employers who participate in this proposal would be required to support transportation services (e.g., carpools, vanpools, and public transit) to link the lots with the places of employment. To ensure that all elements of this agreement are adhered to, performance bonds may be required or covenants may be executed on the property in question.

The provision of remote parking for transit, carpools, and vanpools would promote HOV travel, particularly among single-occupant automobile drivers, and may reduce congestion. The developer can use more of the project for office, retail, or other purposes that could increase the profitability of the project. Developers will also save capital costs of constructing parking facilities.

Selection of sites for such park-and-ride lots, operation of the lots, and support for transit services must be done with extreme care. Lots must be located to serve commuting patterns of employees for specific firms that have purchased spaces in a park-and-ride lot. Clearly, commuting patterns may change over time for a given employer. Facility locations must be selected in locations where a stable market of employees is likely to be found.

Keys to developer and employer participation in this type of effort are likely to include (a) the role and cost to the developer or employer in promoting and supporting carpool, vanpool, and transit service programs; (b) the type of legal agreements (e.g., performance bonds or land convenants) required by the municipality; (c) the savings in parking facility capital costs to the developer; and (d) the ease of leasing space under the provisions of the parking substitution program. These questions are difficult to answer; however, they are critical to the overall success of the project.

A particularly important municipal responsibility in this tactic is the timely and cost-effective

development of park-and-ride facilities that can be acquired by the private sector. If the planning and construction of such spaces are not in phase with private sector schedules, the results of this tactic may be jeopardized. Municipal staff and capital and operating budgets will have to be structured to meet this need.

Restrict Principal-Use Parking Facilities

A number of cities such as Chicago, San Francisco, and Seattle have implemented restrictions on the development of principal-use (i.e., stand alone) parking facilities. Both Chicago and Seattle have prohibited the development of principal-use parking facilities in all or most of their CBDs. In San Francisco, proposed new principal-use parking facilities must undergo a conditional use review.

These restrictions generally have been implemented to restrict the growth in parking supply, especially that which is not a part of a development project within these cities.

Note that this tactic may not be applicable in many jurisdictions that have inadequate parking or that must rely heavily on the private parking industry to build and operate such facilities.

Preferential Parking

Considerable interest has been generated in providing preferential parking in off-street parking facilities to promote certain social, energy conservation, and other objectives. A growing practice in many parts of the country is to reserve convenient parking spaces for the handicapped.

Increasingly, government and private employers are providing preferential parking for carpools and vanpools. This traffic compliments carpool and vanpool programs that are sponsored by such employers.

There is little evidence that the private parking industry has implemented preferential parking tactics for carpools and vanpools. Several factors may contribute to this. Reservation of spaces for carpools and vanpools may cause a loss in revenues if the spaces are not fully used, and such spaces may require additional supervision and rules to identify carpools. These types of problems are likely to be overcome through proper coordination between the public sector and the private parking industry.

CONSIDERATIONS IN APPLYING OFF-STREET SUPPLY TACTICS

Several factors should be considered in using off-street parking as a tactic in managing the supply of parking. First, parking management tactics can be effective in alleviating certain types of transportation problems within individual municipalities and an overall urban area. Such tactics frequently should be planned and implemented in conjunction with other transportation system management tactics to help achieve local, regional, and national transportation, energy, economic, environmental, and related objectives. Note that parking management tactics are not limited to actions that restrict the use of passenger vehicles. Rather, they include many actions that are intended to use roadway capacity more effectively, to manage parking supply, and to encourage the economic growth of activity centers while promoting transportation, environmental, energy conservation and other community objectives.

Parking management tactics frequently can be implemented quickly and inexpensively, which is an important concern to local governments. Many of the on-street, off-street, pricing, marketing, and enforcement tactics involve development of new ordinances (e.g., zoning and enforcement) or modification of existing ordinances to implement tactics and do not entail large increases in staffing or costs.

Frequently, parking management tactics are planned, implemented, and operated by local governments or transit authorities and state departments of transportation. In many situations, local governments are the lead agencies because of the highly localized and frequently politically sensitive impacts of such tactics. Nevertheless, such planning needs to be supportive of adopted regional transportation plans and policies and the transportation improvement program of the affected metropolitan planning organization (MPO). MPOs play an important role in the identification and promotion of the use of parking management tactics and programs to encourage the urban area's goals and objectives.

The highly localized and potentially significant nature of the impacts associated with many tactics makes it extremely important (a) to encourage residential, business, governmental, and other interests to participate in the planning of such tactics and (b) to use accurate, current data on parking demand and supply for the study area in question. If either of these items is lacking, the credibility of the recommended parking management program can be jeopardized. Another potentially serious constraint in the planning and implementation of parking management tactics is institutional conflict between various local, regional, and state agencies. These conflicts are common and should be accounted for in the planning, implementation, and operation of such tactics.

An often overlooked, but critical, element that affects the successful operation of parking management tactics is an effective parking enforcement program. On-street parking tactics require strict enforcement if they are to be successful.

Although this paper has endeavored to present best current practice, it does have several important limitations. Most importantly, the suggested procedures and practices should be tailored to the needs of each urban area, municipality, and problem. Unless this is done, strict adherence to procedures described may undermine the success of the parking management program.

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