CONSIDERATIONS IN THE DESIGN OF FRINGE PARKING FACILITIES

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The primary objective of this study was to develop a set of planning implications for the location, design, and service of transit provided at fringe parking facilities. These implications were developed through a detailed examination of five fringe parking programs currently in operation throughout the United States. The detailed case studies of the five fringe parking programs were presented in the final report for the project. This paper synthesizes the experience acquired from these five case studies and utilizes this experience to delineate the implications for the development of future fringe parking facilities.

•MANY urban transportation problems result from the temporal and geographical peaking of travel demand. Nowhere is this phenomenon more visible than during the so-called rush hours in the central business district (CBD) and the transportation corridors leading thereto. Several approaches have been used to reduce the problems affecting these highly congested areas. Most of the strategies followed by planners have a common thrust, namely, the reduction of the number of automobiles. One of these strategies is the use of fringe parking facilities located outside the CBD, with other transportation facilities being provided to the traveler to complete his trip to the CBD.

The term fringe parking refers to any parking facility located outside the CBD that serves travelers destined thereto. In this context, a wide spectrum of facilities, such as a lot in the vicinity of the CBD, a suburban shopping center, and a railroad station located many miles from the CBD, can be classified as fringe parking facilities.

The following fringe parking programs were investigated:

1. Atlanta, Georgia—Town Flyer bus service from fringe parking facilities located at the Atlanta Stadium and Civic Center;
2. Cleveland, Ohio—the Cleveland Transit System Loop Bus between the Lakeshore and St. Vincent fringe parking lots and the CBD;
3. Milwaukee, Wisconsin—Freeway Flyer express bus service between six suburban shopping centers and the CBD;
4. Philadelphia, Pennsylvania—the Lindenwold Hi-Speed Rail Line between the Philadelphia city center and six suburban fringe parking lots located in a New Jersey corridor; and
5. Seattle, Washington—Blue Streak express bus service (via an exclusive access ramp) between a fringe parking lot and the CBD.

A summary of the important physical and operational characteristics of the five fringe parking programs is given in Table 1. The transportation corridor fringe parking facilities are located between 6 and 14 miles from the CBD, whereas the CBD-peripheral fringe parking facilities are within 1 mile of the CBD. No parking fee is charged at transportation corridor facilities except for a low fee charged on the Lindenwold Hi-Speed Rail Line for those spaces that are close to the stations—about one-half of the total capacity. Parking rates for CBD-peripheral facilities (in Atlanta transit fare is included in the daily parking fee) are higher than those for the corridor facilities but lower than those for CBD facilities.

DEMAND FOR FRINGE PARKING

Characteristics of Fringe Parkers

Selected travel and socioeconomic characteristics of fringe parkers in each of the five cities are given in Table 2. Fringe parking facilities are used predominantly by travelers who work in the CBD and park all day in the fringe facilities. Therefore, the proportion of the facilities' capacities (measured in space-hours) used for work-related travel is even greater than the proportion of work-related trips, and there is little turnover associated with fringe parking facilities. Automobile occupancy at the fringe facilities ranges from 1.1 to 1.3; even the Atlanta pricing structure, designed to attract car pools, appears to have relatively little impact on automobile occupancy.

Because women constitute a significant proportion of the users, fringe parking facilities should be designed so that they are attractive to female patrons; thus, safety factors such as lighting and surveillance are particularly important. Fringe parking facilities attract users from all income categories; a majority of the users have annual household incomes greater than $10,000.

Factors Influencing Demand

Factors that influence travelers to choose fringe parking were determined by asking users in Atlanta and Cleveland to list the factors that influenced their choice of transportation mode. A free-form question (i.e., a question with no precoded responses) was used to avoid biasing the responses.

The results given in Table 3 suggest that fringe parking facilities and their associated transit service must offer significant cost and travel-time savings to the travelers. Further, the facilities must be convenient to use; that is, they must enable the traveler to avoid congested downtown streets, be easily accessible from high-speed arterials or freeways, and offer frequent transit service during peak periods. Finally, safety of the vehicle and the person may be an important factor—although this will depend on local conditions.

SUPPLY OF FRINGE PARKING

Historically, parking capacity in CBD's has been provided by municipal parking authorities, private enterprise, park-and-shop corporations, and benefit districts. In contrast, the momentum for all of the fringe parking facilities examined in this study emerged from the public transportation operator or the municipal government itself. Whether the case studies are indicative of an emerging pattern in the ownership and operation of fringe parking facilities can be determined first by examining the costs of the facilities.

General cost estimates for fringe parking facilities were developed from an analysis of self-service surface lots in a number of metropolitan areas. All of the fringe parking facilities examined in this study are self-park surface lots that require about 330 ft^2 per vehicle. Examination of investment costs, exclusive of land, for self-park surface lots with capacities ranging from 250 to 2,000 automobiles suggests that the average investment of $265 per space is essentially constant for all capacities.

Because investment cost per space is essentially dependent on the size of the facility, the remainder of the discussion is based specifically on a facility with a capacity of 500 vehicles. An interest rate of 5 percent and amortization periods of 25 years and 10 years for the land and improvements were assumed respectively for a publicly owned facility. Similarly, a land value yield of 10 percent, an interest rate of 7 percent, and an amortization period of 10 years for the improvements and equipment were assumed for privately owned parking facilities. For both public and private operation, it was assumed that operations were fully automated, and no attendants were on duty.

The case studies indicated that turnover was relatively low at fringe parking facilities and that they were not heavily used on weekends. In this sense, the use of the fringe parking facilities is similar to that of public transportation in urban areas. For this reason, it was assumed that each space would be used by about 280 vehicles per year and that the facility would be at capacity each working day. This annualization

Table 1. Summary of operational characteristics of fringe parking facilities.

Characteristic	Type of Facility: Transportation Corridor			CBD-Peripheral	
	Milwaukee	Seattle	Philadelphia	Atlanta	Cleveland
Number of parking spaces	800	475	8,200	1,250	4,100
Number of automobiles parked	400	475	6,600	400	4,100
Number of facilities	6	1	6	2	2
Distance to CBD (miles)	10 to 14	9	6 to 14	1	1
Daily parking fee (cents)	0	0	0 to 25	75[a]	50
One-way transit fare	50 to 55	35	40 to 60	75[a]	25
Self-parking	Yes	Yes	Yes	Yes	Yes
Attendant on duty	No	No	No	Yes	Yes
Paving	Yes	Yes	Yes	Yes	Yes
Lighting	Yes	Yes	Yes	Yes	Yes
Shelter	Yes	Yes	Yes	No	Yes

[a]Parking fee and two-way fare for all automobile occupants.

Table 2. Selected characteristics of fringe parkers.

Characteristic	Type of Facility: Transportation Corridor			CBD-Peripheral	
	Milwaukee	Seattle	Philadelphia	Atlanta	Cleveland
Trip purpose					
Work (percent)	99[a]	85[b]	89[c]	98[a]	95[a]
Other (percent)	1	15	11	2	5
Parking duration					
Less than 8 hours	1[a]	N/A	N/A	11[a]	2[a]
More than 8 hours	99	N/A	N/A	89	98
Occupancy of parked automobiles	1.20[a]	1.06[b]	1.16[c]	1.30[a]	1.35[a]
Sex					
Male (percent)	52[a]	N/A	60[c]	40[a]	68[a]
Female (percent)	48	N/A	40	60	32
Annual household income					
Less than $10,000 (percent)	20[a]	N/A	N/A	35[a]	53[a]
More than $10,000 (percent)	80	N/A	N/A	65	47
Travel alternative or prior mode					
Automobile (percent)	57[a]	70[b]	36 to 60[c]	81[a]	65[a]
Transit (percent)	43	30	64 to 40	19	35

[a]Data derived from Peat, Marwick, Mitchell and Company surveys, 1971.
[b]Data derived from Seattle Transit System survey, 1970.
[c]Data derived from Delaware River Port Authority surveys, 1969-1970.

Table 3. Factors influencing fringe parking.

Factor	Atlanta		Cleveland	
	Number of Responses	Percentage of Respondents	Number of Responses	Percentage of Respondents
Cost	103	74	181	70
Convenience	18	56	151	58
Travel time	15	11	62	24
Avoidance of downtown traffic	59	42	8	3
Safety	28	20	19	7
Availability of public transportation	11	8	15	6
Ecological considerations	2	1	1	—
Exercise associated with walking	—	—	16	6
Total number of responses	296	—	453	—
Total number of respondents	139	—	262	—
Average responses per respondent	2.1	—	1.7	—

factor corresponds to the one used for public transportation systems. Thus, annual costs must be allocated to 140,000 vehicles each year, yielding daily costs of $0.49 per vehicle for a land value of $2.50/ft^3 for a publicly owned facility and $0.81 for a privately owned facility (Table 4). Hence, for the lowest land value considered, daily costs at a publicly owned facility are essentially equivalent to the highest daily parking fee for any of the fringe parking facilities considered in the study. In Atlanta, the $0.75 fee per vehicle per day also includes the transit fare for all occupants of the vehicle. Clearly, exceptions could be found to each of the assumptions underlying the foregoing analysis. Nonetheless, the results of the analysis suggest that, in the context of the current situation, revenues that could reasonably be derived from fringe parking facilities will, in most cases, not meet the fully allocated costs of constructing and operating such facilities even if they are publicly owned. If the facilities are privately owned or the cost of the land is greater than $2.50/ft^2, the difference between potential revenues and the average daily costs will become even greater.

If this conclusion and the assumptions on which it is founded are correct, traditional approaches for implementing parking in the CBD will be inappropriate for fringe parking. In the absence of profit, not to say sufficient net revenues to amortize bonds, it is difficult to envision that private enterprise or parking authorities would construct new facilities. Although park-and-shop corporations, benefit districts, and, occasionally, municipal parking authorities have allocated the deficits of parking facilities to merchants or property owners benefiting from the projects, this approach would not necessarily be valid for fringe parking facilities. First, these arrangements are generally oriented to shoppers, whereas the case studies strongly established that fringe parking facilities are primarily used by all-day workers. Second, the benefits from fringe parking are so diffuse that it is difficult to assess specific merchants or property owners for the costs of such facilities. Thus, the organizational and financial structures under which fringe parking programs are sponsored must be such that their fully allocated costs are not borne solely by the users of the facilities.

The case studies suggest two approaches for implementing fringe parking programs: utilization of parking facilities constructed as part of other public or private projects and assumption of the investment and, in some cases, operating costs by a public agency. Fringe parking facilities have been implemented at shopping centers in conjunction with bus programs in Milwaukee, Miami, and Washington, D.C. In most urban areas, other sites, such as civic centers and stadiums, are also available. For fringe parking to be truly effective, however, it must provide the user with good service, express bus or rail, to the CBD.

In the case of the Lindenwold Hi-Speed Line and the Seattle Transit System, fringe parking facilities were provided as part of an overall transit program. In effect, the transit operators recognized that, under certain circumstances, fringe parking was the most cost-effective means of carrying out the residential collection and distribution function. Because bus service has traditionally been more ubiquitous than rail rapid service, there have been greater opportunities for "informal" fringe parking on streets adjacent to bus lines. However, in order to increase the attractiveness of bus service by providing express service at acceptable headways on exclusive freeway lanes or ramps, it is necessary to "concentrate" bus patrons at a relatively few sites appropriately located with respect to the freeway or exclusive lane facilities to the CBD.

IMPACTS

If we consider the five operations examined in this study, it would appear that, with the possible exception of Cleveland, revenues derived from the facilities are not sufficient to meet the fully allocated costs of constructing and operating these facilities. The incentive to develop fringe parking facilities is, therefore, not necessarily financial; rather, it underscores the belief that the environmental, social, and economic benefits of the facilities are such that the general community should contribute to their development and support.

User Impacts

Fringe parking facilities offer cost savings to those who would otherwise drive and park in the CBD and travel-time savings to those who would otherwise use public transportation (Table 5). Aside from Lindenwold and possibly Cleveland, it cannot be asserted that the fringe parking program at its current scale has a measurable impact on travel congestion in the corridor served by the fringe parking facility. This assertion is not meant to be detrimental to the potential role of fringe parking. Rather, it implies that fringe parking must divert a significant portion of the home-to-work travel market to meaningfully improve travel service for those who drive to the CBD.

Impacts at the Regional Level

Insofar as it expands the market of public transportation beyond the limits set by acceptable walking distances, fringe parking facilitates the integration of fixed-route public transportation with a suburban life-style. As such, fringe parking has implications within the complex relation between a region's development pattern and the accessibility provided by a region's transportation system. Although factors other than accessibility to the CBD shape the development of a metropolitan area, particularly in multinucleated developments, there is reason to believe that differential accessibility to the CBD influences regional patterns with high-density land uses clustering along highly accessible corridors.

Because their function is to attract CBD-oriented home-to-work drivers, fringe parking facilities and their associated public transportation service can result in a measurable reduction in the vehicle-miles of travel and, consequently, air and noise pollution. For example, it has been estimated that the Lindenwold Hi-Speed Line has removed nearly 29 million vehicle-miles of travel per year, most of which is fairly peaked both temporally (i.e., during rush hours) and spatially (i.e., oriented to the CBD).

Impacts on Neighborhoods

Fringe parking facilities are less compatible with residential than nonresidential land uses; a "sea of asphalt" is not aesthetic, and entering and exiting traffic may disturb the character of residential streets. Careful attention in the design phases to issues such as drainage, lighting, landscaping, and access roads enhances the land-use compatibility of fringe parking facilities.

The issue of compatibility with adjacent land uses becomes more critical as the scale of the fringe parking facilities increases. If a highly differentiated transit service is offered, significant development pressures may occur near the transfer location. In this context, either vertically or horizontally integrated joint-use activities may provide a mechanism for allowing valuable sites within walking distances of stations to be used for fringe parking and other joint-use activities (Fig. 1). With appropriate design, such an approach can contribute significantly to ensuring that the transfer location is compatible with adjacent land uses. Staged development programs could be visualized in which transportation centers are initially exclusively oriented to fringe parking facilities and other uses are developed according to market requirements.

PLANNING IMPLICATIONS

The following locational factors should be considered in the design of fringe parking facilities:

1. Fringe parking facilities should be located in transportation corridors so that they intercept home-to-work trips destined to the CBD at a point where there is a sufficient density of transit demand that high-quality transit service may be offered.
2. To the maximum extent feasible, facilities should be located on land that is already used for parking or in a low-grade nonresidential use.
3. Fringe parking facilities should be located on sites compatible with land uses and activities in the immediately adjacent area.
4. Potential joint-use aspects of a fringe parking facility should be considered during

Table 4. Annual operational cost of 500-vehicle, self-park surface lot.

Cost Factor	Public Ownership (in dollars)	Private Ownership (in dollars)
Amortization		
Land at $2.50/ft^2	29,000	41,300
Land at $5.00/ft^2	58,500	82,500
Land at $7.50/ft^2	88,500	124,000
Land at $10.00/ft^2	117,500	165,000
Land at $12.50/ft^2	145,500	206,000
Improvements and equipment	17,500	18,100
Operating costs	22,500	22,500
Taxes	—	32,000
Total annual cost		
Land at $2.50/ft^2	69,000	113,900
Land at $5.00/ft^2	98,500	155,100
Land at $7.50/ft^2	128,500	196,600
Land at $10.00/ft^2	157,500	237,600
Land at $12.50/ft^2	185,500	278,600
Daily cost per vehicle parked[a]		
Land at $2.50/ft^2	0.49	0.81
Land at $5.00/ft^2	0.70	1.11
Land at $7.50/ft^2	0.92	1.40
Land at $10.00/ft^2	1.13	1.70
Land at $12.50/ft^2	1.32	1.99

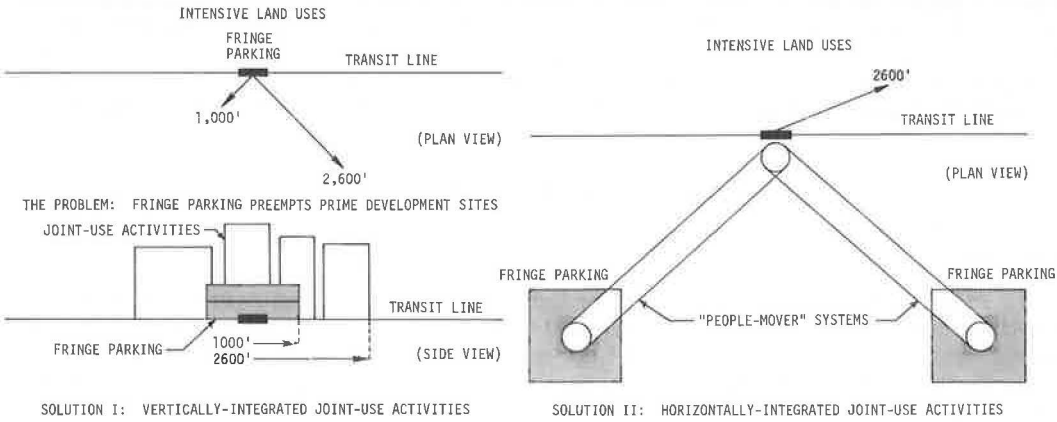
[a]At-capacity operation for 280 days per year.

Table 5. Time and cost savings accruing to fringe parkers.

Fringe Parking Transit	Cost Savings if Alternative Is Driving to the CBD (dollars/day)	Time Savings if Alternative Is Public Transportation (min/day)	Number of Automobiles per Day Parked in all Fringe Parking Facilities
Milwaukee Freeway Flyer	1.25	50	400
Seattle Blue Streak	1.05	N/A	475
Atlanta Town Flyer	0.53	22	400
Cleveland Loop Bus	1.00	20	4,100
Philadelphia-Lindenwold Hi-Speed Rail Line	2.30[a]	35[b]	6,800

[a]Assuming tolls of 50 cents and parking of $1.75 per day. [b]Estimated time savings for all users of the Lindenwold line.

Figure 1. Fringe parking and joint-use activities.



the location process. If planners believe that joint use could be envisioned within the foreseeable future, sufficient land should be acquired so that a staged development program can be implemented.

5. Trade-offs implicit in the scale of the fringe parking facility, namely, the level of transit service as opposed to its neighborhood impacts and the ease of using the facility, should be considered.

Design considerations for fringe parking facilities are as follows:

1. To the maximum possible extent, fringe parking facilities should be designed to minimize potential impacts on the neighborhood. Areas of particular concern include the following: Available rainfall data should be used to estimate runoff and sufficient drainage should be provided, the lighting provided should not intrude on the adjacent land uses, due consideration should be given to the aesthetics of the facility, and walkways and bikeways should be developed within the facility if it interferes with established patterns of community interaction.
2. Care should be taken to ensure that access traffic to fringe parking does not overwhelm the character of residential neighborhoods. To this end, direct links should be provided, where feasible, from large facilities to high-speed roads.
3. Fringe parking facilities should be paved and lighted. Appropriate shelters should be provided so that patrons may wait comfortably for transit in those areas of the country in which adverse weather conditions may be anticipated for a significant proportion of the year. Other amenities enhancing the utility of even a small facility include telephones and newspaper stands.
4. Fringe lots should be designed to minimize labor costs required to operate these facilities, unless the intensity of use and revenues derived from these facilities are substantially different from those observed in the case studies. To this end, fringe parking facilities should be self-parking and automatic fare-collection equipment should be used.
5. Access-egress facilities and fare-collection procedures should be carefully designed to accommodate peaking.
6. As the scale of surface lots increases, care should be taken to ensure that walking distances do not become excessive. Although the definition of excessive is, to some extent, subjective and related to local conditions, it would appear that parkers having to walk more than 1,500 to 2,000 ft from their automobiles to the transit boarding point might be discouraged from using the facility. To this end, transit boarding points should be located in the center of the fringe parking facility rather than on the periphery; multiple boarding points should be used, if feasible, and, in the extreme, multilevel parking or internal people-mover systems should be considered.
7. Potential joint-use activities should be considered during the design of the facility to ensure effective integration of transportation and other functions. For example, care should be taken so that parking spaces available for transportation and other functions do not preempt one another and that the access facilities are not overburdened. Joint-use facilities should be designed to ensure that they effectively integrate the transfer location with the neighborhood. Such integration may require that additional local supportive systems be constructed in the neighborhood, e.g., walkways or bikeways.

The following fringe parking service factors should be considered:

1. High-level transit service should be provided from the fringe parking facility to the CBD. For buses, quality implies express operations, use of reserved facilities on those segments of the route on which traffic congestion would be encountered, and acceptable frequencies during the peak hours. For rail, it implies low travel times and headways during peak hours. Further, careful attention must be devoted to ensuring that an effective CBD distribution system is developed. Finally, off-peak transit service should be provided to the fringe parking locations.
2. Pricing of the fringe parking transit service should be carefully considered during the planning phases to ensure its competitiveness. Thus, the trade-off between the community objective of maximizing patronage of fringe parking and the financial objective of maximizing revenues should be carefully considered.

3. To increase neighborhood compatibility, all-day parking on adjacent streets should be discouraged. Such a policy should be implemented at the inception of fringe parking service—before such activity is observed.

SUMMARY

In the past two decades, there has been a direct correlation between the increasing dispersion of land use in urban areas and the general decline of fixed-route and -schedule public transportation. As low-density, residential areas were constructed, it would have been necessary for transit operators to extensively expand their routes to provide service within walking distance. It was economically infeasible, however, for the public transportation operator to expand service to keep pace with the expansion in the low-density residential areas.

Planners have noted that the person-carrying capacity of an exclusive bus lane or a single track of rail transit is significantly greater than that of a single freeway lane used by automobiles with typical home-to-work occupancies. On the other hand, the cost per passenger-mile of using fixed-route and -schedule modes to perform the residential collection and distribution function in less densely settled suburban areas is relatively high. The private automobile is a relatively effective means for performing the residential collection and distribution function. In this context, fringe parking can be a key component of an integrated transportation system, in which each of the modes is used most advantageously. In this sense, fringe parking has positive impacts at the individual and regional levels, and the justification to develop a fringe parking program stems from its contribution to the overall development of the community's objectives, not from a profit-making motive. On the other hand, unless care is taken in locating and designing large-scale fringe parking facilities, they could have adverse impacts on the proximate environment, i.e., the neighborhood.

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