GROUND TRANSPORTATION PLANNING IMPLICATIONS OF AIRLINE SHUTTLE PASSENGERS

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The authors have researched ground transportation characteristics of passengers using the Air-Shuttle services provided at LaGuardia Airport by Eastern Airlines, Inc. The research establishes relationships between characteristics of shuttle passengers, comprising about 15 percent of all LaGuardia enplanements, and the other passengers using LaGuardia Airport and Eastern Airlines facilities. Because of the importance business travelers place on convenient scheduled service with minimum interruption from checking into and out of the system, it is anticipated that shuttle-type airline service concepts will emerge in the more heavily traveled air corridors in the future. Data from field surveys have been analyzed relative to the impacts that shuttle travelers at LaGuardia have on the road system, parking facilities, and curb frontages at terminal buildings. Results indicate that shuttle passengers have parking durations about 50 percent less than other terminal passengers and that their parking space demands are about 40 percent less than other system passengers. Other details as to arrival modes, parking durations, vehicle occupancy, duration of parking at curb frontages, and a profile of the shuttle passenger are given.

•PHENOMENAL increases in air travel have been experienced in the last 2 decades. This has revolutionized life styles and business practices by bringing together peoples of all nations and regions. It has further impacted land development and ground transportation travel patterns in many of our greater cities.

For a trip between 100 and 150 miles in length, modal choice is almost academic in that terminal times between origin and destination with automobile, bus, conventional rail, or air are comparable, depending on the trip. As travel distances increase beyond 150 miles, the air trip gains in popularity because of the time savings and the usual convenience experienced in selecting this mode.

Using this premise as a basis for further study of air travelers, one can recognize the important contribution that innovations have made to the treatment of passengers and visitors to airport terminals today. Among those that have been inaugurated in the recent past are computerized reservation systems, pre-ticketing concepts, and scheduled-sustained shuttle service between major airport hubs.

It has recently been determined, for example, that more than 90 percent of the enplaning passengers departing New York via JFK International Airport are pre-ticketed. This high number signifies the importance of minimizing delays and inconvenience.

The growth trend in U. S. air patronage is shown in Table 1. As indicated, the growth from 1963 has been relatively strong, with only the period between 1969 and 1971 showing a lesser rate. Forecasts for 1982 are for continued strong annual growth, increasing at a rate of almost 10 percent per year. These forecasts, however, do not reflect the energy crisis and its implications on less air travel.

THE SHUTTLE CONCEPT

Recognizing the attraction between major city pairs, Eastern Airlines inaugurated the Air-Shuttle service from LaGuardia Airport to Washington's National Airport and from

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Table 1. Air passenger traffic growth trends, scheduled carriers.

Fiscal Year	Total Passenger Enplanements	
	Millions of Passengers	Percent Increase
1963	70.7	—
1964	83.0	17.4
1965	94.6	14.0
1966	113.9	20.4
1967	126.4	11.0
1968	152.6	20.7
1969	168.0	10.1
1970	171.4	2.1
1971	170.0	-0.8
1972	182.9	7.6
1977[a]	286.5	56.6
1982[a]	442.0	54.3

Source: Ref. 1.

[a]Passenger forecast by FAA.

Table 2. Air-Shuttle traffic growth at LaGuardia.

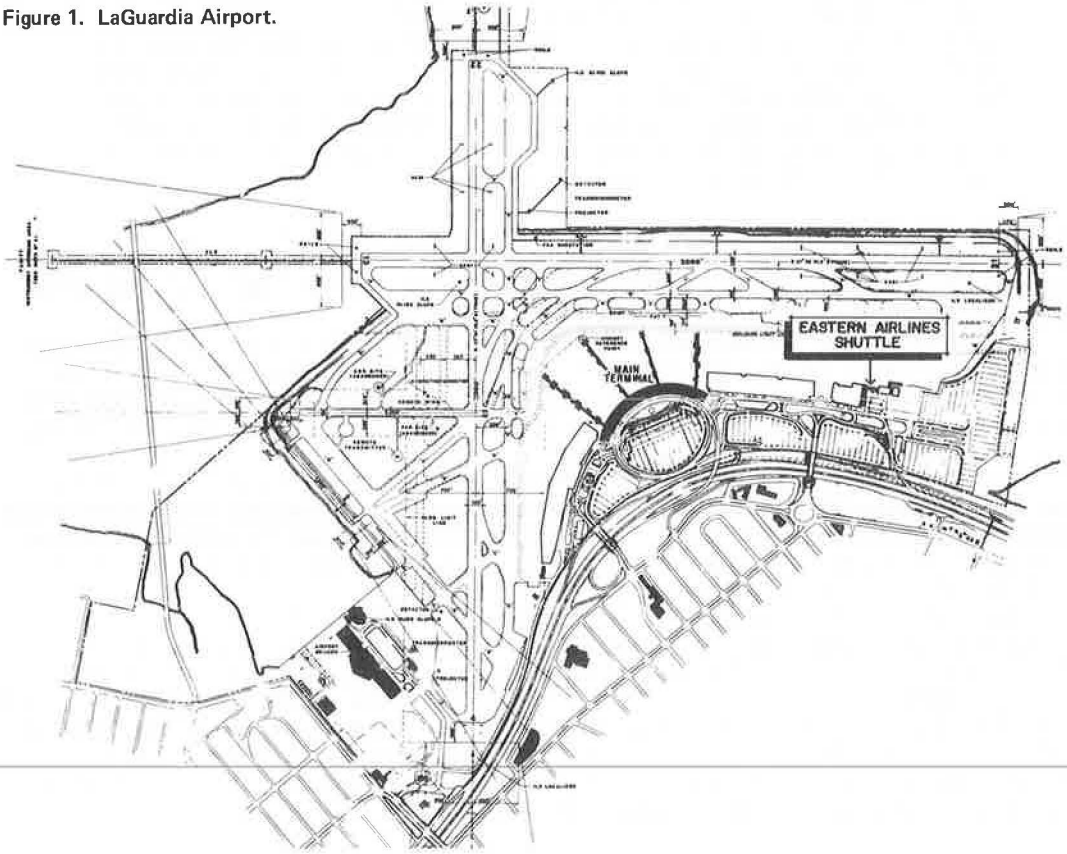
Year	Annual Shuttle Passengers[a]	
	Enplanements	Deplanements
1961[b]	250,559	239,633
1962	532,129	511,477
1963	835,801	826,557
1964	922,448	912,171
1965	950,956	946,513
1966	979,874	979,045
1967	1,139,387	1,118,300
1968	1,085,713	1,045,875
1969	1,142,452	1,112,312
1970	1,064,155	1,054,326
1971	974,319	949,336
1972	1,009,354	989,296

Source: Eastern Airlines.

[a]Passengers from LaGuardia Airport to Boston and Washington and return.

[b]Statistics from May 1961.

Figure 1. LaGuardia Airport.



LaGuardia to Logan International Airport in Boston in 1961. [Air-Shuttle is a trademark for service by Eastern Airlines, Inc.] The service was in response to marketing analyses of the traveler who desires scheduled and frequent service without fanfare and with minimum interruption in the terminal. All passengers are guaranteed a seat, assuming they arrive at the gate by departure time, which is scheduled on the hour, daily, between 7:00 a.m. and 10:00 p.m. between New York and Washington, New York and Boston, and vice versa. Tickets are issued in flight, and all baggage is loaded on the plane at the time passengers board. In the event the first section fills, it is dispatched to the destination city and a second plane is placed into service. Should other sections be required, the carrier will furnish them.

The concept has been expanded now to Montreal and from Newark to Washington and Boston on a 2-hour frequency daily. The hours of operation to Montreal are from 7:30 a.m. to 9:30 p.m.. and other cities are being considered for this service. [As a result of the energy crisis, Eastern Airlines has announced a reduction in shuttle services between New York and Montreal and flights from Newark Airport.]

American Airlines and United Air Lines offer similar but less frequent service to Washington and to Chicago from New York. Reservations are required in advance and ticketing at the gates is according to conventional practice.

Eastern's experience in public acceptance of the shuttle service has been quite favorable, as indicated by annual LaGuardia Airport patronage figures in Table 2. Since the service was inaugurated between New York and Washington and Boston, there has been an increase of almost 400 percent in annual patronage.

The concept, with variations, is being employed in other heavily traveled corridors on the West Coast and in the Midwest, and further studies are being made by industry to initiate similar service on the East Coast.

PROFILE OF SHUTTLE PASSENGERS

A study was made of ground transportation characteristics of Eastern Airlines shuttle passengers and Eastern Airlines main terminal passengers at LaGuardia (Fig. 1) for purposes of assessing ground transportation requirements and parking demands for an expanded terminal complex. Surveys were conducted during February and June 1973.

Eastern Airlines shuttle patronage totals 15 percent of all enplaning passengers at LaGuardia and represents 55 percent of all Eastern Airlines passengers being served at the airport. Some characteristics of shuttle passengers are as follows:

1. Business-oriented trips account for 65 percent of all shuttle users;
2. Passengers arrive by the quickest and most convenient means of transportation;
3. Over 20 percent of patrons fly twice a month;
4. Passengers create least impact on traffic of all passenger arrivals;
5. Minimal time is spent in the terminal building and at curb frontages by passengers;
6. Short-duration trips prevail, with over 55 percent of originating passengers returning the same day;
7. Least number of bags are carried, averaging 1.5 per person (predominantly carry-on brief cases); and
8. Average parking duration is approximately half of non-shuttle users (17 hours versus 37 hours).

In general, the shuttle passenger does not want to be hampered by schedules, desires service and frequency, and is the least burden on the carriers.

MODE OF ARRIVAL AT LAGUARDIA AND OTHER AIRPORTS

In the design of ground access/egress facilities, it is important to know passenger arrival patterns. Figure 2 shows that LaGuardia shuttle and system passengers make similar modal choices daily. Taxis comprise the primary mode, accounting for 42 percent of shuttle patrons and 46 percent of the total system passengers. The second most popular mode of arrival is the private automobile. Shuttle passenger use of the automobile is slightly higher (41 percent) than system passengers (38 percent). Bus and limousine modes are equal for both groups and represent about 16 percent.

Figure 2. Comparison of daily passenger arrivals by mode.

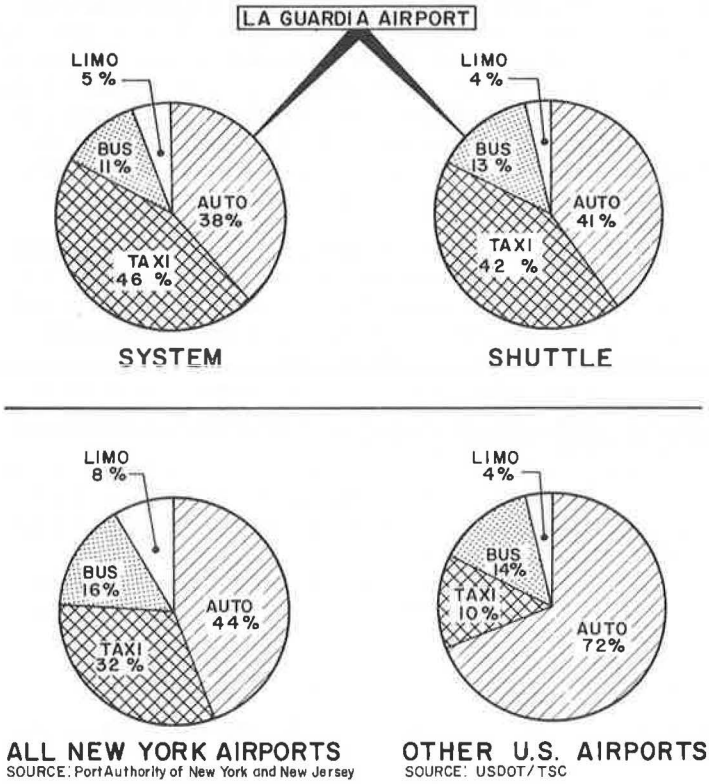
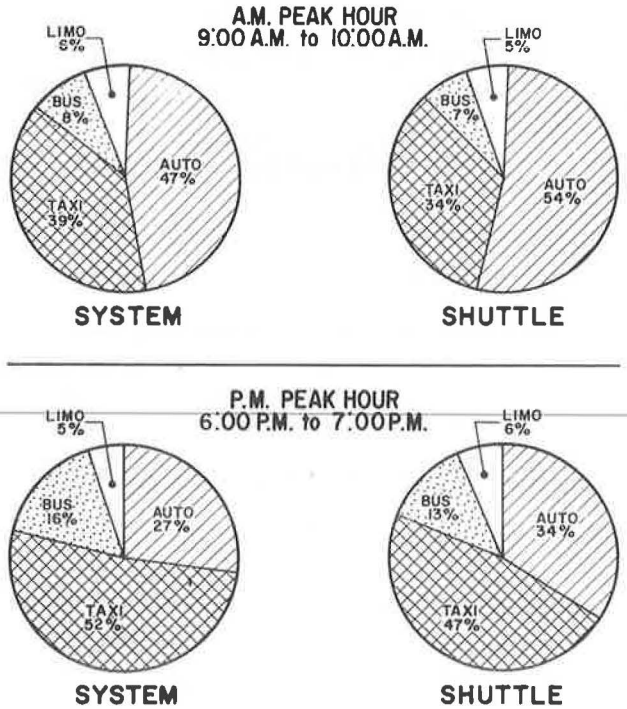


Figure 3. Comparison of peak-hour passenger arrivals by mode.



These proportions are representative of all New York airports. As shown in Figure 2, 44 percent of all passengers arrive by automobile and 32 percent by taxi. This differs from national trends, where 72 percent of all passengers arrive by automobile and 10 percent use taxis. The remaining 18 percent use transit or commercial vehicles.

PEAK-HOUR ARRIVAL AND DEPARTURE MODES

Peak-hour arrival modes, shown in Figure 3, reveal differences contrasted with daily figures. The peak hours are based on peak arrival times of enplaning passengers at the airport. In the morning peak hour, 9:00 a.m. to 10:00 a.m., 54 percent of all shuttle passengers arrive by automobile and 34 percent by taxi. The remaining 12 percent make use of buses and limousines. Corresponding values for system passengers are 47 percent auto and 39 percent taxi.

Comparing these values to those of deplaning passengers, shown in Figure 4, indicates a lesser use of the automibile. Approximately 17 percent of the shuttle passengers make use of an automobile, supporting the heavy reliance on the taxi (59 percent) by businessmen destined for Manhattan and other central business districts. These are people from Boston or Washington on trips to the New York area.

Similarly, in the evening, an increase in the percentage of taxis related to enplaning shuttle passengers reflects the return of the businessmen to the airport. In this instance, 47 percent of the shuttle passengers and 52 percent of the system passengers select taxi as the mode for the trip to the airport.

As would be expected, automobile use for deplaning passengers increases in the peak evening hour (6:00 to 7:00 p.m.) and taxi use decreases. As shown in Figure 4, 48 and 53 percent for shuttle and system passengers respectively use automobiles when returning to New York after a day's work in other cities. Buses and limousines receive minimal use for deplaning passengers in the evening peak hour, comprising only 11 percent.

CURB USE CHARACTERISTICS

One of the most critical and noticeable areas of traffic congestion occurs at the curb frontage of the terminal buildings. In planning for curb frontage, characteristics of vehicle occupancy and durations of vehicles parked at the curbs are important considerations.

Vehicle occupancy ratios of shuttle passengers are almost identical to system passengers, as given in Table 3. Approximately 1.5 passengers per automobile (excluding drivers) were found at the curbs for both shuttle and system passengers daily. Occupancy rates for system passengers are identical for both taxi and automobile use at the enplaning and deplaning curbs. Shuttle passenger occupancy for the taxi is somewhat lower, with 1.2 and 1.3 passengers per vehicle for enplaning and deplaning curbs respectively.

Short trips, characterized by few bags, result in shorter durations of shuttle passenger vehicles at the enplaning and deplaning curbs. As indicated in Table 4, at the enplaning curb frontage, duration times for the automobile average 2 minutes less for shuttle passengers than for system passengers. Similarly, buses and limousines also take less time at the enplaning curb. The duration of taxi loading and unloading passengers remains relatively stable for both shuttle and system passengers, averaging approximately 1.5 minutes per vehicle.

Similar comparison of values is found at the deplaning curb, where in all instances a shuttle passenger requires less time than a system passenger. For taxis, the average time at the deplaning curb for a shuttle passenger is 1 minute, as contrasted with 3 minutes for system passengers. The same durations were found for automobiles. Buses exhibited the highest stopping duration of all—6 minutes for system passengers, including time consumed in boarding and alighting and sorting out baggage.

PARKER CHARACTERISTICS

Trip lengths do not necessarily reveal durations of parkers. At LaGuardia, a typical trip length for the average airport user is approximately 2.5 days. This does not compare with the average parking durations found in the parking lots. System passengers

Figure 4. Comparison of peak-hour passenger departures by mode.

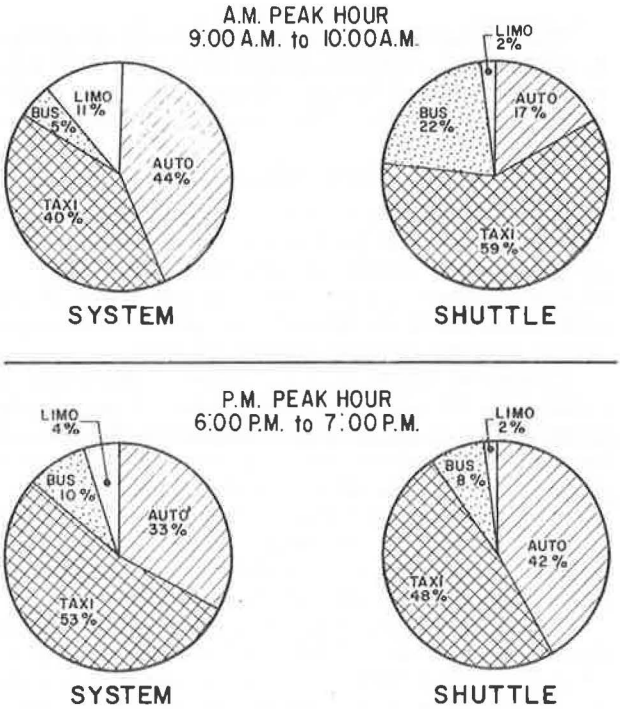


Table 3. Vehicle occupancy at the curb frontage.

	Vehicle Occupancy[a]			
	Enplaning		Deplaning	
Mode	Shuttle	System[b]	Shuttle	System[b]
Automobile	1.3	1.5	1.5	1.5
Taxi	1.2	1.5	1.3	1.5
Bus	3.5	8.0	5.5	7.0
Limousine	1.6	4.0	1.7	5.0

[a]Persons in vehicle excluding driver.
[b]All airlines located in main terminal building.

Table 4. Duration of vehicles at the curb frontage.

	Duration of Vehicles Parking at Enplaning and Deplaning Curbs (minutes)			
	Enplaning		Deplaning	
Mode	Shuttle	System[a]	Shuttle	System[a]
Automobile	1.0	3.0	1.0	3.0
Taxi	1.5	1.5	1.0	3.0
Bus	1.5	3.5	1.5	6.0
Limousine	1.0	2.0	1.0	2.0

[a]All airlines located in the main terminal building.

Table 5. Duration of air passenger parkers.

	Type of Passenger			
Duration Parked (hours)	Shuttle		System[a]	
	Number	Percent	Number	Percent
0 to 12	230	63.7	345	27.8
12 to 24	58	16.1	225	18.1
24 to 36	33	9.1	207	16.6
36 to 48	13	3.6	97	7.8
48 to 60	12	3.3	139	11.1
60 to 72	7	1.9	47	3.8
72 to 84	3	0.8	55	4.5
84 to 96	2	0.6	36	2.9
96 to 120	1	0.3	50	4.0
120 to 144	1	0.3	22	1.8
Over 144	1	0.3	20	1.6
Total	361	100.0	1,243	100.0
Average duration (hours)	17		37	

[a]All airlines located in the main terminal building.

average 37 hours parked (1.6 days), as given in Table 5. The difference in duration parked from duration of trips by air can be attributed to the parking cost for more than 24 hours. When the convenience cost of using the automobile appreciably exceeds the passengers' desired cost, another means of transportation will likely be selected.

The shuttle passenger average parking duration of 17 hours is less than half of that of the system passenger.

Another aspect of parking duration depends on the time the vehicle is parked. Figure 5 shows duration patterns of shuttle passenger parkers. As depicted, of those persons who park after 4:00 p.m., 50 percent remain for at least 24 hours. Of those who park before 10:00 a.m. and between 10:00 a.m. and 4:00 p.m., 50 percent stay for less than 10 hours.

Similar analyses have been made for system passenger parkers as shown in Figure 6. In this instance, duration of time parked is much longer. For those parkers who park after 4:00 p.m., 50 percent park less than 54 hours, as compared with 24 hours for the shuttle patrons. For those who park before 10:00 a.m., 50 percent stay less than 13 hours, and, for midday parkers, 50 percent park less than 29 hours.

Other data indicate that, of all passengers arriving by automobile, 53 percent utilize the enplaning curb and 47 percent the deplaning curb. The remaining passengers go directly to parking without stopping at the curb. Also, of all passengers parking, 55 percent park for the duration of their flight and 45 percent are driven to the airport.

LOCATION OF PARKING

Figures 7 and 8 show that parkers always prefer a space most convenient to their destination. Of those destined for the shuttle, 97 percent park in Lots 4 and 5. The majority of parkers destined for the main terminal building park in Lots 1, 2, and 3 and account for almost 82 percent of all parkers destined for this terminal.

CURB FRONTAGE DEMAND

The amount of curb frontage at a terminal directly affects the convenience of arriving and departing passengers and is a major contributor to congestion on terminal roadways. It is particularly critical to the overall trip because this area is the major interface between passengers and their vehicles.

An analysis of curb frontage requirements for the two passenger types (shuttle and system) was performed. Existing conditions indicate that the greatest impact at the curbs would occur during the evening peak hour. At the enplaning curb, 53 percent of the passengers arriving by automobile will utilize the curb, as compared with 47 percent at the deplaning curb. If it is assumed that 500 shuttle and system passengers will arrive and depart, the number of vehicles expected at the curb during the peak hour is determined as given in Table 6. Involved is the application of percent modal splits for arriving and departing passengers and vehicle occupancy factors to the total number of passengers. The total number of spaces for each mode is determined by applying these values to the duration of vehicles parked at the curb.

The results indicate that, during the evening peak hour, system passengers require a total of 720 linear feet at enplaning and deplaning curbs. This compares with 540 linear feet for shuttle passengers, which represents a reduction of 25 percent in curb frontage requirements. Similar results were found throughout the day.

PARKING DEMAND RELATIONSHIPS

Parking demands at airports fluctuate according to the type of facility. Airports such as Chicago's O'Hare and Atlanta, with many interline transfers, have fewer unit space demands for enplaning passengers than Washington's National or LaGuardia. As many as 50 percent of the total passenger movements through O'Hare never use the ground transportation system.

Some years back the Federal Aviation Administration established approximate ratios of unit parking demands as related to enplaning passengers varying between 900 and 1,200 spaces of parking to be provided for each million annual enplaning passengers. This converts to about one parking space per thousand annual enplaning passengers. The

Figure 5. Parking duration patterns of shuttle passengers.

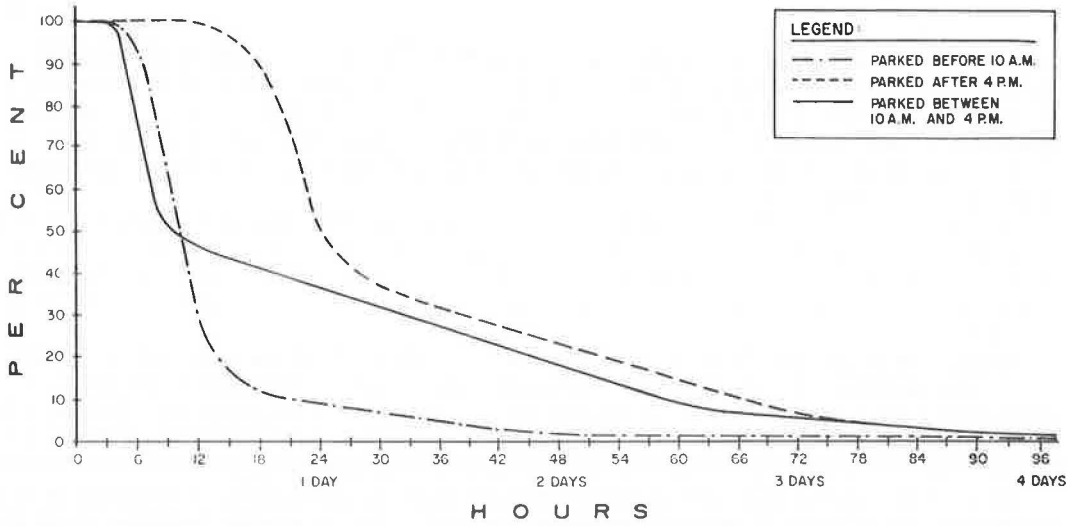


Figure 6. Parking duration patterns of system passengers.

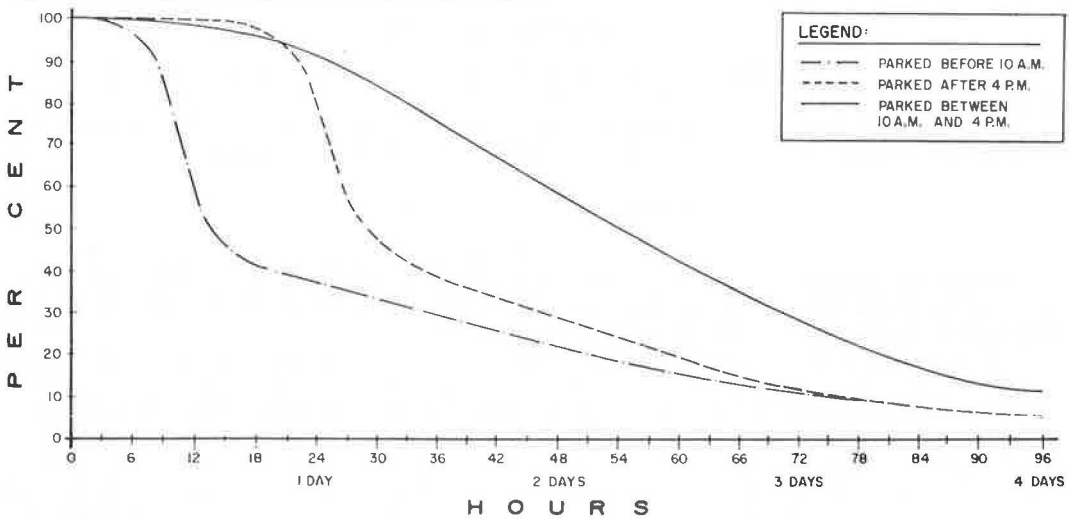


Figure 7. Location of parkers destined to shuttle terminal.

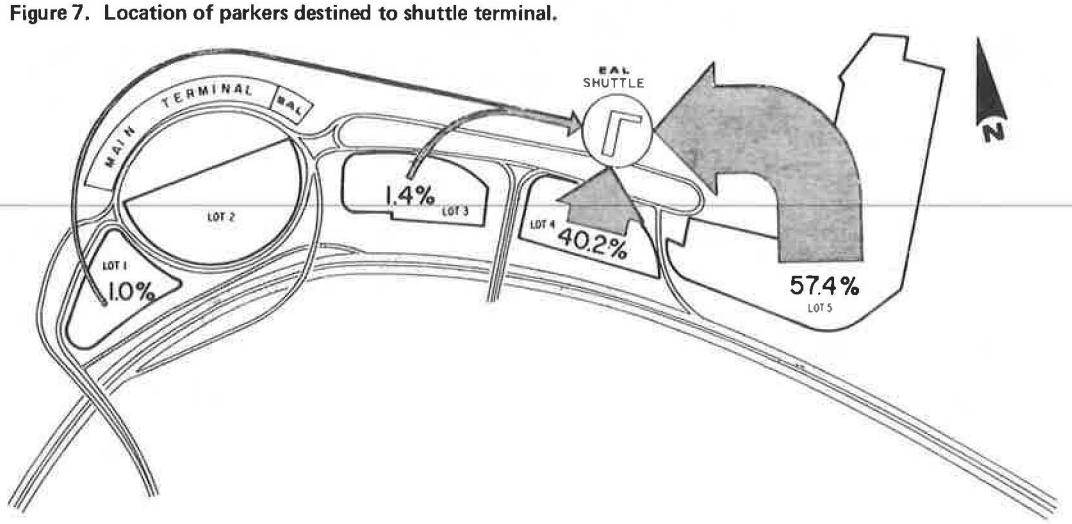


Figure 8. Location of parkers destined to main terminal.

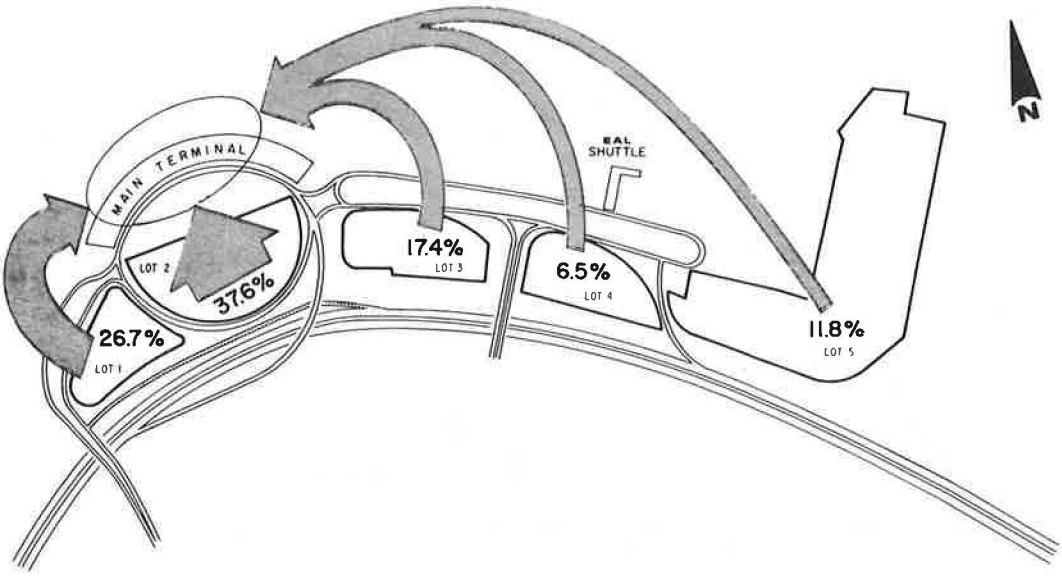


Table 6. Comparison of evening peak-hour curb frontage demands.

Type of Vehicle	Number of Vehicles Using Curb		Duration of Vehicles at Curb (minutes)		Number of Required Spaces		Length of Spaces (feet)[a]	Total Lineal Feet of Curb Required	
	Enplaning	Deplaning	Enplaning	Deplaning	Enplaning	Deplaning		Enplaning	Deplaning
Automobile									
System	50	60	3.0	3.0	3	3	30	90	90
Shuttle	(70)	(75)	(1.0)	(1.0)	(2)	(2)		(60)	(60)
Taxi									
System	175	175	1.5	3.0	5	9	24	120	216
Shuttle	(195)	(185)	(1.5)	(1.0)	5	(4)		(120)	(96)
Bus									
System	10	8	3.5	6.0	1	1	60	60	60
Shuttle	(19)	(8)	(1.5)	(1.5)	1	1		(60)	(60)
Limousine									
System	7	4	2.0	2.0	1	1	42	42	42
Shuttle	(19)	(6)	(1.0)	(1.0)	1	1		(42)	(42)
Total								312	408
								(282)	(258)
Combined total								720	
								(540)	

[a]Includes an allowance for inefficiency in curb use.

Figure 9. Accumulation of parkers.

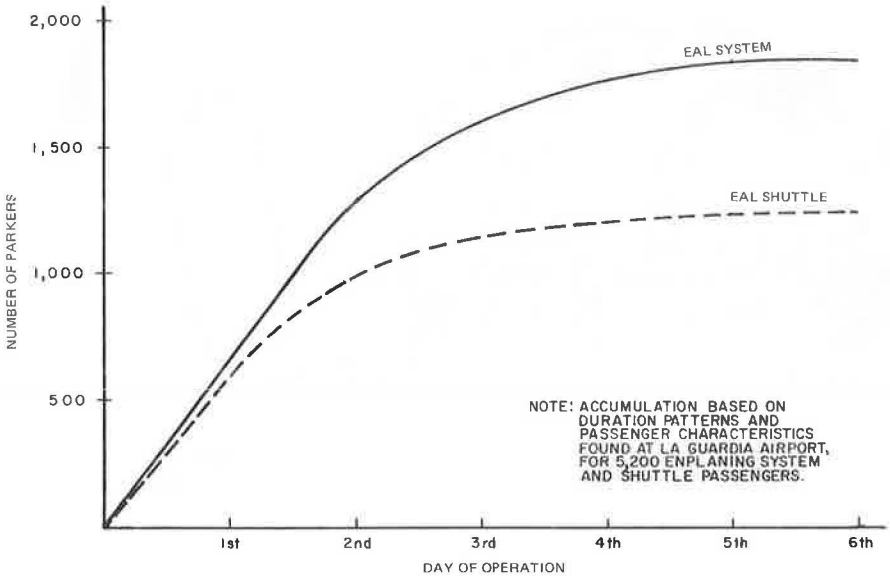
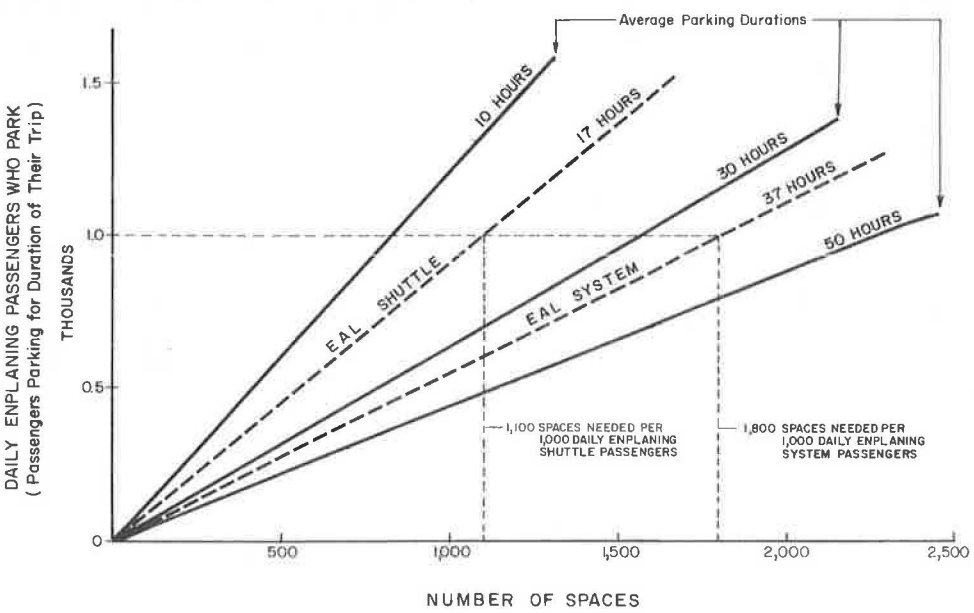


Figure 10. Parking space requirements for passengers.



type of airport and the type of user may alter this figure substantially, which accentuates the importance of studying each individual airport and using rules of thumb for guideline planning purposes.

In computing the parking space demands, a vehicle accumulation matrix was developed in which the number of vehicles parked (and remaining) after each successive day was plotted.

Of 5,200 daily enplaning system passengers, 38 percent, or 2,000 persons, will arrive by automobile, resulting in 1,275 arriving vehicles. Of these, 50 percent, or 635 vehicles, will be parked and left at the airport for the duration of the trip. Similarly, of 5,200 daily enplaning shuttle passengers, 700 automobiles will be parked for the duration of their trip. Using duration factors for parking passengers extrapolated from Figures 5 and 6, peak vehicle accumulation occurs after the fifth day and remains stable thereafter, as shown in Figure 9.

As noted, shuttle passenger parkers require 40 percent less spaces than do system passengers. On a unit basis, for 1,000 enplaning passengers who park for the duration of their trip, 1,100 parking spaces are required for the shuttle passenger, with an average duration of 17 hours. System passenger parkers, however, will require 1,800 parking spaces with an average duration of 37 hours, as shown in Figure 10.

The FAA parking guidelines suggest provision of 300 to 400 spaces per 1,000 daily enplanements. On this basis, 5,200 enplaning system passengers would require 1,600 to 2,100 spaces. The requirement of 1,800 system spaces falls within this range, indicating that the system conforms with existing trends.

CONCLUSIONS

It can be concluded that the shuttle concept, where feasible from a market point of view, is a positive and efficient innovation in serving air travel needs in heavy travel corridors. The user of the shuttle service is usually a repeat passenger who knows the highway system and the functions of the airport and airline and therefore has less negative impact on ground transportation facilities than other air passengers. More enplaning shuttle passengers use private modes and park for durations substantially less than the average system travelers, thereby imposing fewer demands on terminal curb frontages and parking facilities—up to 40 percent less than the system users. Every effort should be given to implementing this concept at other areas in the United States and abroad where markets warrant.

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