Feasibility of an Alternative Shuttle Bus System To Reduce Curbside Traffic Congestion at the Los Angeles International Airport

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The problem of traffic congestion within the Los Angeles International Airport's internal landside-access system was addressed. The study examined the feasibility of an alternative shuttle bus operation to serve 11 hotels near the airport. Improved utilization of shuttle vehicles (e.g., improving current service frequency, increasing load factors, and reducing overall fleet size) was expected to produce more efficient traffic flow within the airport's circulation system. Peak-hour observations of hotel courtesy van operations revealed arrivals of one van every 44 sec, but specific destinations were served on an average of only one van per 12 min. The inefficiency of the current system was characterized by an observed average peak-hour load factor of 0.26. An alternative pooled van system was developed using several criteria. Study results indicated that (a) service frequency nearly doubled to hotels in the airport vicinity, (b) airport boarding-passenger wait time was reduced from an average of 11.8 to 6.0 min, (c) average load factor was increased from .26 to .41 and provided comfortable service that allowed for peaking demand fluctuations, and (d) overall number of runs (hence generated traffic) was reduced by 35 percent.

Airport operations are significantly affected by the functioning of the landside ground access system. The importance of ground access is its potential to influence passenger choice, not only decisions among airports but also selection of travel mode.

A case study, which addressed crowded curbside-access conditions at the Los Angeles International Airport (LAX) and assessed the feasibility of an alternative shuttlebus system serving some airport-related industries, is reported in this paper. The project aimed at reducing ground-access traffic congestion through improved utilization of hotel courtesy vans. This approach is directly applicable to other public transportation systems serving airports.

Literature was reviewed to place the ground-access problem in an appropriate perspective. Although the curbside congestion problem is documented in the literature, suggested solutions (e.g., to segregate ground traffic, to modify air schedules) are costly, and these would tend to move the problem rather than eliminate it. Thus, the need for a low-cost solution aimed at reducing traffic generated in the airport's vicinity is evident.

Observations were conducted of shuttlebus operations during a peak period at LAX. These data led to the development of an alternative system, designed to provide equivalent or improved service, while reducing access congestion through improved efficiency. The new system would reduce curbside passenger wait time, provide more frequent service, and operate with a 35 percent reduction of total fleet size.

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LITERATURE REVIEW

Initial project activity was to conduct an extensive review of relevant background literature. An automated search of the following five data bases was performed: TRIS, NTIS, Engineering Index, Aerospace Database, and Prompt. The automated search yielded 175 items consisting of journal articles, research reports, and textbook citations. Although both U.S. and foreign items were listed, the majority of relevant work had been conducted in the United States. Of the 175 abstracts, many were not relevant to project objectives and hence were discarded.

The importance of proper ground-access planning was stressed in the publications. Airport access had been identified by some airport authorities as a potential threat to the growth of aviation (*1*). As a determinant of air passengers' choice of airport, ground accessibility plays a more significant role than air carrier level of service (*2*). Airport access systems have been defined in four categories as follows: (a) distribution within airports, (b) circulation within airport complexes and environs, (c) access to the airport complex from remote points, and (d) regional high-speed systems (*3*).

Access to airports from adjoining urban areas was addressed in the majority of papers, and its impact on overall demand for air transportation was stressed. Numerous models have been applied to predict airport access demand; typical of these is Skinner's (*2*) application of the logit model to passenger airport choice decisions.

A 1970 *Highway Research Record* contains a series of papers describing access to six major airports (i.e., Boston, Cleveland, London, Kansas City, Philadelphia, and Tokyo) (*4*). Yet, with the exception of Logan Airport's people-mover, no information on internal airport circulation was provided.

Although few items in the literature addressed internal landside access circulation, most of these pertained to operations at LAX. An economic incentive to reduce internal traffic congestion that was documented is low-rate off-airport parking with free tram service to terminal buildings (*5*). Additionally, the Schoenfeld work touted the Fly-Away bus, which offered free parking in Van Nuys.

The circulation system within LAX includes reversible flow facilities, a metered parking lot, and illuminated tram stops (*6*); possible future improvements include an intra-airport tracked air vehicle access system (*7*). Innovative intra-airport circulation facilities at other locations include systems at Tampa and Seattle-Tacoma, Houston's underground transit system, and the AIRTRANS system at Dallas-Fort Worth (*8*).

An early examination of curbside space usage applied computer simulations of vehicle arrivals and dwell times to generate design requirements (*9*). More recent work cites causes of curbside congestion as follows (*10*):

1. Imbalances between the available capacity on the airside sector and the landside areas;
2. Surges due to the arrival or departure of passengers to and from high-capacity aircraft;
3. Uneven distribution of passenger loads along the curbs, due to the parking patterns of individual airlines;
4. Activity concentrations on terminal doors, curbside and baggage check-in locations, resulting in imbalances in available space and demand;
5. Lack of strict enforcement of parking duration restrictions along the curb, resulting in vehicles remaining at the curbs for longer periods than desirable; and,
6. Perceived difficulties in recirculating from the curb back to parking, from parking to curb or, when unable to find a curb space, back again to the curb.

The paper by Mandle et al. also developed level-of-service criteria for curbside operations and suggested strategies for operational improvements. However, improvement strategies included steps that were expensive (i.e., traffic segregation) or impractical (i.e., modification of airline schedules to reduce peak period demand).

An ameliorative strategy not cited in the literature is to charge a fee for vehicle use of circulation roads; this approach has recently been implemented at LAX. Another uncited operational improvement, implemented at Washington, D.C.'s National Airport, is the "Alexandria Express"—pooled service to a number of local hotels.

Critically inadequate curb frontage at John F. Kennedy Airport warranted extensive study and construction of a new internal circulation roadway (*11*). The high cost of this construction project included the loss of parking spaces.

Finally, the importance of recognizing and improving curbside operations is noted in a definitive Institute of Transportation Engineers statement of problems and solutions pertaining to airport access and circulation systems (*12*):

> The future will see little deviation from the highway as the primary form of ground access to airports. . . . Innovative airport access development will be concentrated on providing unique and ingenious intra-airport systems to interface with ground access to avoid choking curbside traffic.

BACKGROUND

The criticality of ground access to airports was demonstrated as posing a potential threat to the growth of aviation (*1*). Relatively little has yet been accomplished to ameliorate the problem of curbside congestion. Moreover, studies documenting causes of this problem have ignored trip-generation factors that affect airport internal ground-access circulation.

A major source of curbside congestion, which adversely affects the overall level of service of the ground-access system, is traffic generated by businesses in direct service of the airport. Shuttle buses offering regional transportation and courtesy vans operated by motel and rental car agencies are typical of this traffic. Because of frequent service redundancies (e.g., overlapping routes) and high exclusive exposure to potential customers (e.g., attempting to solicit business and ridership), these vehicles frequently operate at very low load factors. The result is congestion consisting of underused vehicles that greatly impedes traffic flow in the airport system. Figure 1 shows the current congestion situation at LAX.

A workable solution to this problem is to impose regulation that reduces congestion in the ground-access roadway system. A program recently implemented at LAX that charges commercial vans an access fee is a step in the right direction. However, an essential requirement for solving the congestion problem is increasing service vehicle utilization (e.g., higher passenger occupancy) as a means of maintaining service standards desired by airport-related industries.

PROJECT OBJECTIVE

The objective of this project was to examine the feasibility of an alternative shuttle bus system to reduce traffic congestion

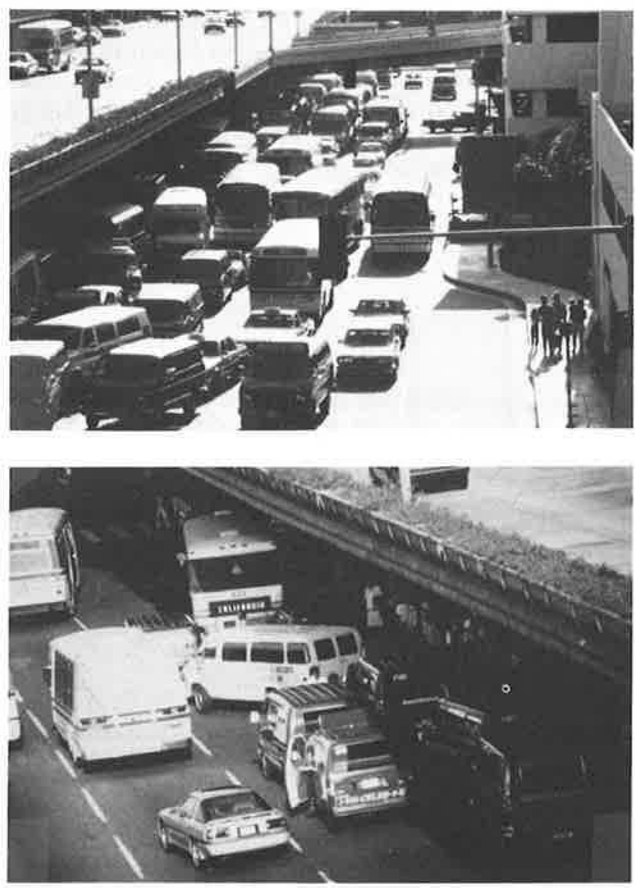

FIGURE 1 Sunday afternoon peak at LAX. *Top*: Internal access congestion on lower level. *Bottom*: Delayed van departure resulting from congestion.

within the LAX landside internal access system. The targeted congestion reduction was to be achieved by increasing shuttle bus efficiency by improving services, increasing load factors, and reducing overall fleet size.

PROJECT SCOPE

Although a variety of vehicles operate in the LAX ground-access system roadway, project resources precluded observations of all vehicle classes. Service vehicles amenable to study included car rental agency courtesy buses, local shuttle buses (e.g., serving fringe-area parking, nearby communities, and etc.), and hotel-motel vans. Although this study was limited to hotel courtesy vans, the methodology is applicable to other vehicle classes operating within the airport ground-access roadway system.

STUDY METHODOLOGY

Observations were conducted on hotel courtesy van operations on the lower (deplaning) level at LAX. The terminal access circulation pattern at LAX is shown in Figure 2.

Manually recorded measures were vehicle arrival time, hotel destination, and load factor (visual estimation of passenger occupancy as a percentage of available capacity) on a vehicle-by-vehicle basis. Figure 3 is a sample data collection form (headway observations are those for specific hotels). Operations were observed for about 4 hr, from 6:00 to 10:00 p.m. on Sunday. This observation period represented peak-period conditions. Selection of the observation point, Terminal 7, ensured that observed load factors represented actual loading upon departure from the airport.

The analysis involved calculating average headways and passenger loading for vans serving specific hotels in the LAX vicinity. These data were combined over specific routes, whereby each van served a maximum of three destinations. This alternative routing scheme offered greater efficiency than the observed practice (each van serving a single destination).

Operational criteria were established for designating the alterative routing system. These requirements specified improved service in concert with an overall reduction in generated traffic volume. Following development of the alternative bus system, benefits were assessed and its feasibility was evaluated.

CURRENT HOTEL COURTESY VAN OPERATIONS

During the nearly 4-hr study period, 311 courtesy vans were observed; 253 of these served 11 hotels in LAX's immediate vicinity. Figure 4 is a map (not to scale) showing the location of each hotel in relation to the airport property. Also shown are hotel groupings suggested for service by individual pooled vans designated in the alternative shuttle bus system.

Table 1 summarizes operations, giving the number of observed runs for each hotel, average headways, and load factors. Hotel destinations are ordered with the most distant at the top. The four groups shown are those designated in the pooled (alternative) shuttle bus system. An interesting trend is evident from these data. Average headways decrease for each hotel group; the closer the group is to the airport, the shorter the average headway. It is not surprising that more frequent shuttle service was observed for hotels closer to the airport. Also, as expected, the number of observed runs is approximately proportional to the size of the hotel.

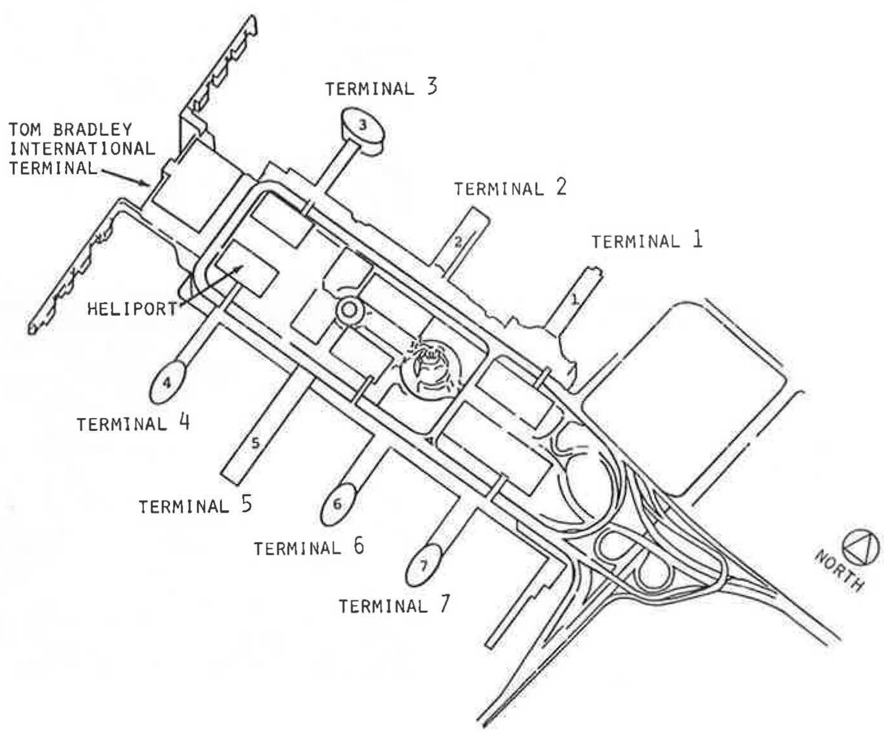

FIGURE 2 LAX terminal arrangement and circulation pattern.

LOS ANGELES INTERNATIONAL AIRPORT
Curbside Congestion Study

Date: 4-17-88 Sheet No.

Arrival Time	Destination	Occupancy	Headway	Comment
6:31	Marriott	.15	18.6	
:35.4	C. Plaza	.2	9.1	
:35.1	Hilton	.1	6.9	
:35.5	Hilton	0	.4	
36.2	Tivoli	.1	32.7	
37.2	Amfac	0	19.8	
:38.7	Hacienda	.4	18.7	
:38.	A Park	0	16.4	
:41.5	Sheraton	.6	22.3	
41.3	Viscount	0	12.9	
42.	Trade Wind	0	11.1	
43.4	Viscount	0	2.1	
43.3	Amf.	.1	6.1	
43.3	Days Inn	0	20.2	
43.7	C. Plaza	—	7.9	
44.3	Holiday Inn	0	10.9	
45.2	Hyatt	–	16.7	
45.8	Stouffer	.2	13.1	
47.2	Marriott	0	13.2	
48.	C. Plaza		4.7	
49.4	Hyatt	0	4.2	
53.3	Sheraton	.7	11.8	

FIGURE 3 Sample data collection form.

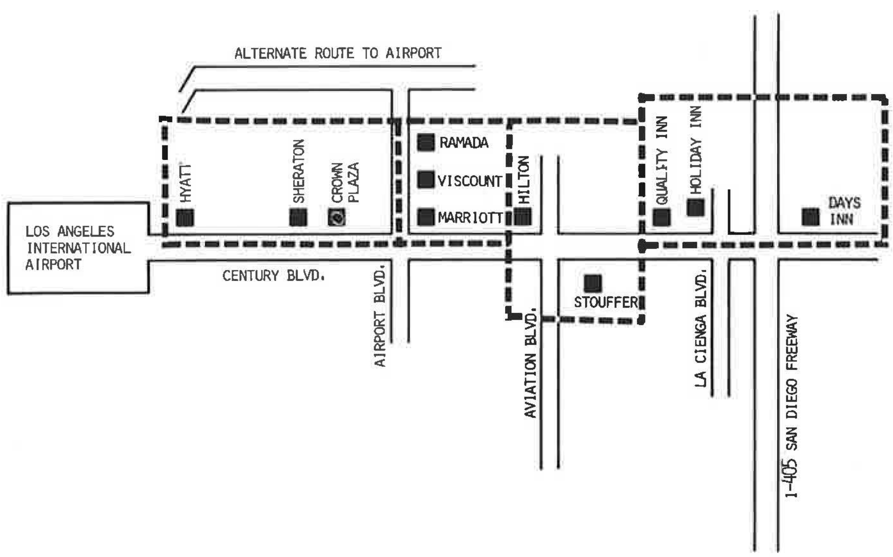

FIGURE 4 Hotels near LAX and designated groupings for alternative courtesy van system.

TABLE 1 HOTEL COURTESY VAN OPERATIONS, HEADWAYS, AND LOAD FACTORS BY DESTINATION

Group	Destination	Number of Runs	Average Headway (Minutes)	Average Load Factor
1	Days Inn	10	23.0	.19
	Holiday Inn	19	12.1	.21
	Quality Inn	8	28.8	.28
			21.3	.23
2	Stouffer Inn	20	11.5	.26
	Hilton	29	12.1	.21
			11.8	.24
3	Marriott	26	8.8	.48
	Viscount	17	13.5	.47
	Ramada Inn	24	9.6	.16
			10.6	.37
4	Crown Plaza	30	7.7	.30
	Sheraton	24	9.6	.30
	Hyatt	29	7.9	.20*
			8.4	.27

* Hyatt load factor estimated on partial sample; tinted van windows obscured observations.

The average observed headway for courtesy vans serving all local hotels (including some not shown in Table 1) was one van every 44.4 sec; however, the average wait time for any one LAX area hotel was 11.8 min. The average load factor was .26 (i.e., vans were loaded only to 26 percent of their capacity, on average) on the basis of 240 observations. This final statistic points out that if a bus system provided service to hotels with 100 percent efficiency, nearly three-fourths of the hotel courtesy van traffic could be eliminated.

DEVELOPMENT OF ALTERNATIVE BUS SYSTEM

Planning criteria for the alternative bus system was developed and applied as follows:

1. *Political considerations*—For the pooled system to work, it must be acceptable to participating hotels and businesses. Priority should thus be given to (a) exposure to arriving passengers, and (b) maintenance of high service frequency.
2. *Maximum number of hotels per pool*—In order to provide suitable exposure (e.g., advertisement logos on van), a maximum of three hotels would be served by one van.
3. *Service frequency*—In order for the system to be accepted, service improvement over the existing system is required. Thus, runs between the airport and hotel groups are provided at twice the current frequency.
4. *Total fleet size reduction*—In order to ease congestion, the improved service must be accompanied by a substantial reduction in fleet size. The service level just specified can be met by a 35 percent reduction in overall number of runs.

Operational characteristics for the new system are presented in Table 2.

The first developmental step involved designating service frequencies (operational headways) for each motel grouping. Taking one-half of the current operating value and rounding, the following headways would be applied: Group 1, 10 min; Group 2, 6 min; Group 3, 5 min; and Group 4, 4 min. Because 5 min is a reasonable minimum, and to avoid favoring Group 4, 5 min was assigned to both Groups 3 and 4. Therefore, the average wait time for arriving passengers, based on current demand, is reduced from 11.8 min for current operations to 6 min for the alternative system operations.

Projected load factors presented in Table 2 were computed assuming the same passenger loading for each hotel grouping. These load factors were slightly higher than the currently observed load factors, therefore characterizing a more efficient system. Projected loading, however, would still allow for passenger comfort and accommodate load fluctuations because of peaking.

A substantial benefit of the new system is the 35 percent overall reduction in the number of runs required for the designated service level. For example, for the observed 230-min operation, 37 runs were generated by Group 1 hotels. By using the alternative pooled operation, the number would be reduced to 23—a 38 percent reduction in required runs. At the same time, average headways for Group 1 hotels would be reduced from 21.3 to 10 min.

Four routes would be designated for the hotel groupings. Airport-return passengers would be taken to their terminals on the upper level. The van would then pass all terminals on the lower level for pick-ups to the hotels within each group.

TABLE 2 OPERATIONAL CHARACTERISTICS OF ALTERNATIVE HOTEL VAN SYSTEM

Group	Participating Hotel	New Headway (Minutes)	Projected Load Factor	Benefit (Reduced Runs)
1	Days Inn Holiday Inn Quality Inn	10	.32	38%
2	Stoffer Inn Hilton	6	.24	22%
3	Marriott Viscount Ramada Inn	5	.52	31%
4	Crown Plaza Sheraton Hyatt	5	.48	45%

A number of operational features are desirable to render this shuttle bus system acceptable to participating hotels. A demand-response feature is suggested to facilitate airport returns. Each van would be equipped with either a two-way radio or beeper device to flag an airport return. This feature would eliminate the unattractive necessity of stopping at all hotels within the group on the run to the airport. Because most vans are currently equipped with two-way radios, this demand-response feature would not entail an additional expense.

SUMMARY OF RESULTS

Peak-hour observations of 311 hotel courtesy van operations revealed arrivals of one van every 44.4 sec, yet specific destinations were served on an average of only one van per 11.8 min. The inefficiency of the current system was characterized by an observed average peak-hour load factor of .26 (26 percent utilization of available passenger-carrying capacity).

A suggested alternative pooled van system was developed to serve groupings of two or three hotels each. This system provides service twice as frequently and operates with a substantially reduced fleet size.

Study results, based on equal passenger loads, indicated benefits of the alternative system as follows:

1. Service frequency is nearly doubled to hotels in the airport vicinity.
2. Airport boarding-passenger wait time is reduced from an average of 11.8 to 6.0 min.
3. Average load factor is increased from .26 to .41. This level still provides comfortable service and allows for peaking demand fluctuations.
4. The overall number of runs (hence generated traffic) is reduced by 35 percent.

FUTURE STUDY REQUIREMENTS

The development of an alternative ground transportation system to reduce curbside congestion must consider elements in addition to local hotel courtesy vans treated in this paper. However, the approach used here is applicable to other vehicle classes, including charter-party carriers and passenger-stage corporation vehicles.

Data on courtesy van operations reported in this paper address peak-hour conditions. Additional study is required for schedule and routing modifications applicable to off-peak conditions.

CONCLUSION

Airport area hotel courtesy vans are but one traffic component contributing to the curbside congestion problem within the LAX ground-access system. Yet this study has analytically demonstrated the effectiveness of improved vehicle utilization and systematic scheduling to reduce overall traffic while increasing service frequency.

A significant lesson can be learned by contrasting the approach applied in this study to curbside congestion reduction strategies suggested in the literature. Two approaches (air schedule modifications and traffic separation) pose practical and financial problems. The alternative solution of more efficient vehicle utilization is not only easier to implement from the airport landside operations standpoint, but also offers additional cost-saving benefits to local bus system operations.

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