

PIARCO AIRPORT PASSENGER TERMINALS:
GROUND ACCESS AND VEHICLE PARKING

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SUMMARY

This paper presents the results of an interview survey and whole-day parking duration survey at Piarco Airport. Characteristics of access to and parking at the Airport are discussed in detail. Short-term projections of vehicle parking requirements are developed and planning ramifications are outlined.

1. INTRODUCTION

The growth of air travel worldwide has been quite extraordinary and almost all forecasts indicate continued rapid growth in the components of air transportation. Between 1960 and 1971, for example, air travel in the U.S.A., more than tripled¹. To and from Trinidad and Tobago, in the decade to 1977, the number of international passengers grew by a factor of 2.5 times² with the year 1977 witnessing the 1980 projection³ being surpassed. In a similar vein the 1977 figure⁴ for travel between the islands of Trinidad and Tobago surpassed the projection for the year 1983³.

In order to meet these growing demands public investment in airport infrastructure across the world has been running at a high level. To service the growing numbers of passengers requires a large capability in terms of ground access systems both for airline passenger conveyance and for the requirements of the airport as a major centre of employment. - An airport, as a major generator of ground traffic, is thus a most important element in the regional transportation planning process.

An airport passenger terminal can be thought of as the interface between the ground transport system and the air transport system as illustrated diagrammatically in Figure 1. This paper concerns itself with the ground system of access and parking in relation to Piarco International Airport, Trinidad. It is to be noted that the passenger terminals only were considered, the maintenance and cargo facilities being excluded. The results of interview and traffic counting surveys are reported and the terminal access and parking characteristics are discussed. Short-term projections and long-term planning ramifications are considered.

2. DATA COLLECTION

Data were collected relevant to ground access to the passenger terminals at Piarco Airport in four stages, namely:-

(i) Data concerning the numbers of airline passengers on international and domestic services were abstracted from International Travel Reports² and Quarterly Economic Reports⁴ of the Central Statistical Office.

(ii) A series of random checks was made on the number of vehicles parked at the terminals in order to determine the peak days of operation.

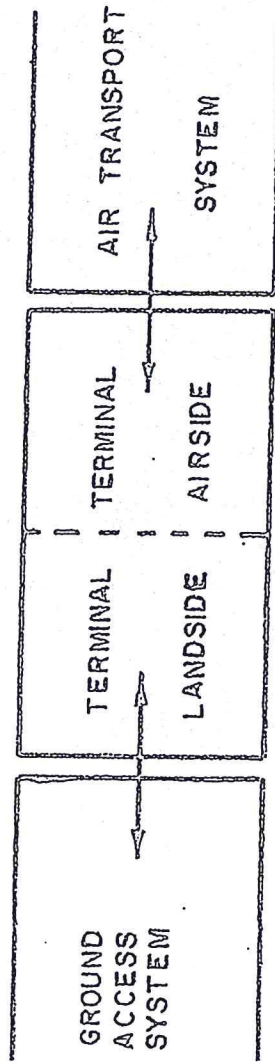


FIG. 1 SCHEMATIC FUNCTION OF AN AIRPORT.

- (iii) The peak days having been determined, a full-day (05.00h - 01.00h) traffic count was undertaken at the entry to and exit from the terminal compound.
- (iv) Interview surveys were carried out among persons using the terminal facilities, the information collected being as follows:-
 - (a) reason for visiting Airport.
 - (b) duration of parking/waiting.
 - (c) type of vehicle.
 - (d) origin of trip.
 - (e) time taken to reach Airport.

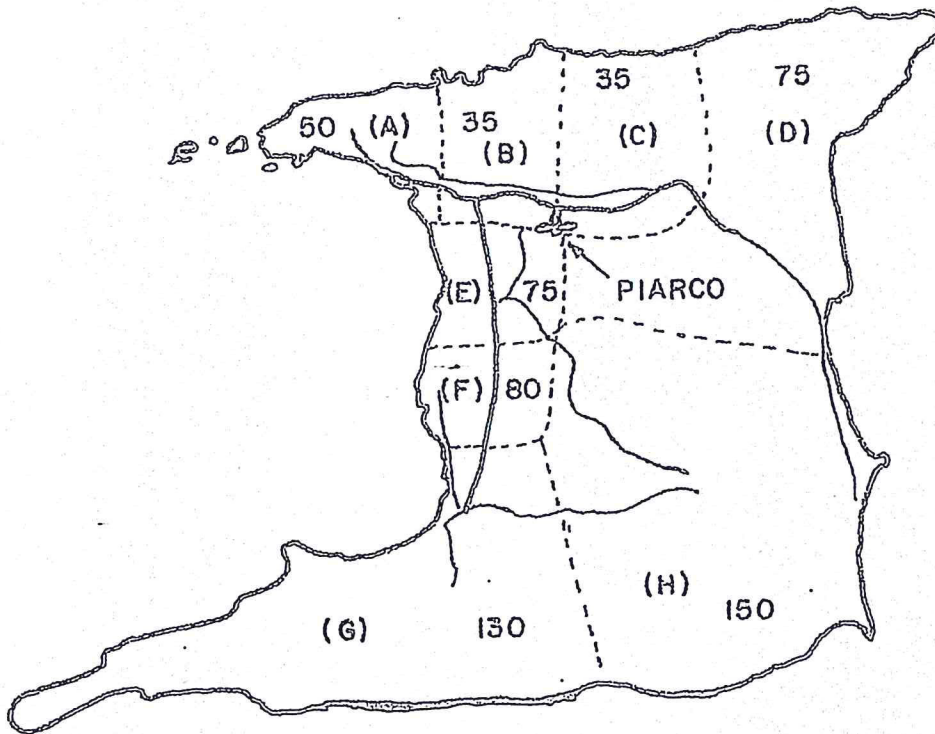
The nature of the surveys it was possible to undertake and the layout and functioning of the parking facilities imposed certain limitations upon the study. As mentioned above, only the passenger terminal compound was surveyed. The main shortcoming of the study is that since the two passenger terminals (international and domestic) do not have rigidly separate parking facilities it would not be possible to develop separate parking space relationships relating to the different trip characteristics associated with the two operations. It was, however, possible to develop separate parking duration relationships for the two types of air passenger.

The random checks mentioned in (ii) above indicate that peak parking requirements (January 1978) occurred between 18.00h and 21.00h on Tuesdays and Saturdays. It should be noted that this corresponds to the arrival and departure of the Boeing 747 aircraft operated by British Airways. The detailed traffic count was, therefore, undertaken on a Tuesday.

3. ACCESS CHARACTERISTICS

A major feature of the study was the derivation of a geographical distribution for the trip origins. For this purpose, Trinidad was divided into eight zones intended, broadly speaking, to reflect the distribution of population in relation to access routes as shown on Figure 2. The mean reported travel times from zone to Airport are also reported on this diagram.

Table 1 shows the journey purpose of the persons interviewed. As would be expected most employees at the Airport have their trip origins within the Northern Urban Region, although it is noted that some do travel from the zones centred on Couva and San Fernando. Further, it is to be noted that approximately 60% of air travellers interviewed derived from the three North Urban zones. Also shown in Table 1 is the ratio of visitors



- KEY: A. Port of Spain
 B. Tunapuna
 C. Arima
 D. Sangre Grande
 E. Chaguanas
 F. Couva
 G. San Fernando
 H. Southeast

Numbers represent mean journey times.(minutes)

FIG. 2 ZONING ARRANGEMENTS FOR ACCESS AND PARKING STUDY.

Scale 1: 850,000

TABLE 1

JOURNEY PURPOSE AND ZONE OF ORIGIN OF THOSE RESPONDENTS TO THE PARKING INTERVIEW SURVEY

Zone of Origin	Type of Visitor to Airport					Well Wishers per traveller
	Employee	Business	Air Traveller	Well Wisher	Total	
Port-of-Spain	22	2	62	31	107	0.5
Tunapuna	15	2	18	45	80	2.5
Arima	10	1	17	21	49	1.2
Sangre Grande	9	-	12	29	50	2.4
Chaguanas	4	3	18	39	64	2.2
Couva	4	1	10	51	66	5.1
San Fernando	2	3	29	64	98	2.2
South East	-	-	1	2	3	2.0

and well-wishers to air travellers. The low ratio of 0.5 deriving from the Port-of-Spain zone presumably reflects the presence of foreign visitors and business travellers who would tend to have their origins in the Capital, this being the location of the vast majority of the hotel accommodation in Trinidad. The average number of visitors per air traveller for the rest of Trinidad was 2.4. The low value for the Arima zone and the high value for the zone centred on Couva cannot be accounted for although in the former case, the shortness of the access journey may be reflected.

The main mode of access to the Airport terminal is private car. The Airport is not served by a regular bus service so the available alternative access modes are route taxi and stand taxi. A route taxi service passes the Airport terminal running from Arouca where connections may be had by route taxi or bus in an easterly direction to Arima and Sangre Grande or a westerly direction to Tunapuna and Port-of-Spain. Stand taxis operate a conventional taxi service from the Airport and sixty-five vehicles are based at the Airport for this purpose. In addition, persons can travel to the Airport in taxis from other stands based mainly at the Port-of-Spain hotels. Most users of the stand taxi service are foreign visitors and business travellers and, consequently,

this is reflected in the access modal split for the Port-of-Spain zone. The zonal modal splits are given in Table 2. Outside the Capital it may

TABLE 2
ACCESS MODAL SPLIT OF AIRPORT USERS BY ZONE OF ORIGIN

Zone of Origin	Percentage Modal Split		
	Private Car	Route Taxi	Stand Taxi
Port-of-Spain	54	4	42
Tunapuna	85	7½	7½
Arima	90	10	-
Sangre Grande	86	14	-
Chaguanas	100	-	-
Couva	100	-	-
San Fernando	100	-	-
South East	100	-	-
All	86	4	10

be seen that private car travel to the Airport predominates, although there is some route taxi utilisation from Northern zones.

4. PARKING

As described above, a parking accumulation survey was undertaken for a complete day. This was carried out by observing the entry and exit flows for the terminal compound and thus, having taken a reading of the number of vehicles within the compound at the beginning of the survey, the parking accumulation curve could be constructed. The entry and exit flows by time of day are shown on Figure 3 and the number of vehicles within the compound by time of day is shown in Figure 4. On the day of the survey, on Tuesday 25th April 1978, the maximum parking requirement

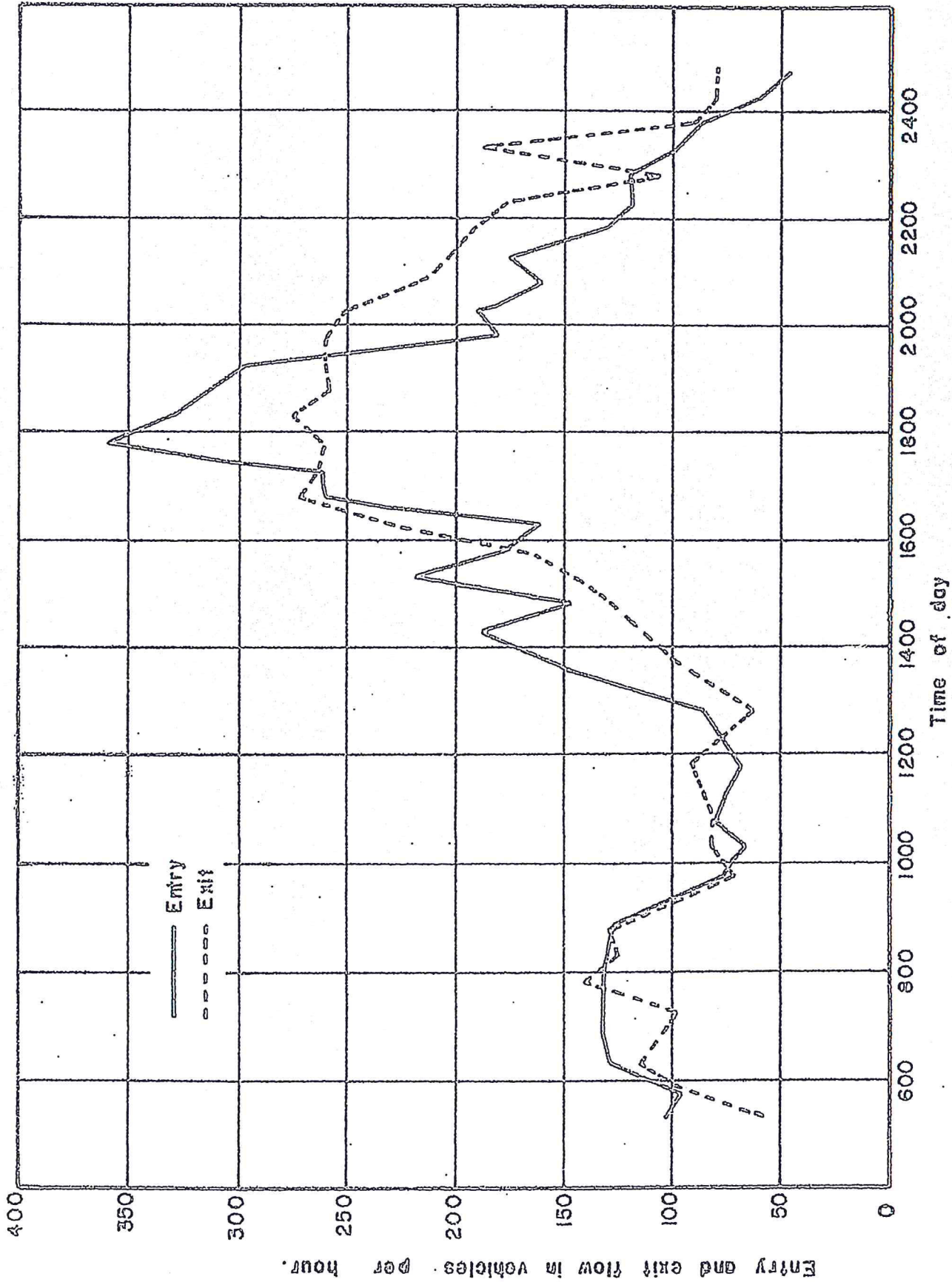


FIG. 3 TERMINAL COMPOUND ENTRY AND EXIT FLOWS BY TIME OF DAY

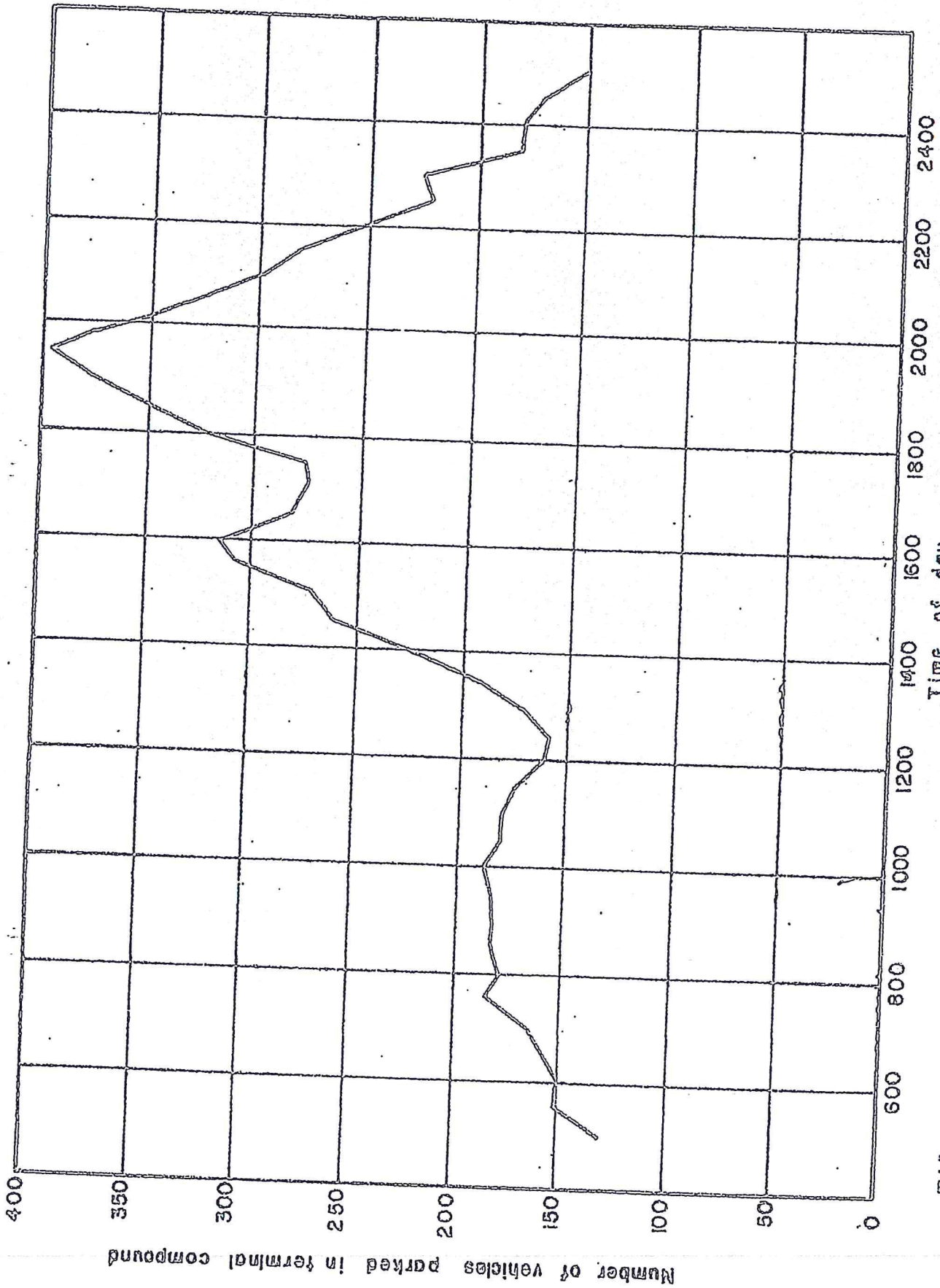


FIG. 4 NUMBER OF VEHICLES PARKED IN TERMINAL COMPOUND BY TIME OF DAY. (TUESDAY IN APRIL)

Number of vehicles parked in terminal compound

is seen to be approximately 400 vehicles occurring at 19.30h. This high requirement in the late evening, of course, corresponds to the presence of a Boeing 747 aircraft unloading and then loading at the Airport.

Parking facilities at the Airport, as illustrated in Figure 5, consist of the following:-

- (i) A public car park to the south of the terminal building able to accommodate about 130 cars.
- (ii) A public car park to the east of the terminal building able to accommodate about 240 cars.
- (iii) On-street parking for setting down passengers and taxi parking.

In addition, "illegal" kerbside parking appears to be permitted. At the time of peak demand, vehicles within the compound were arranged as shown in Table 3, where, in addition, the peak occupancy rates for the two

TABLE 3
OCCUPANCY OF VEHICLE PARKING AREAS AT PEAK TIME

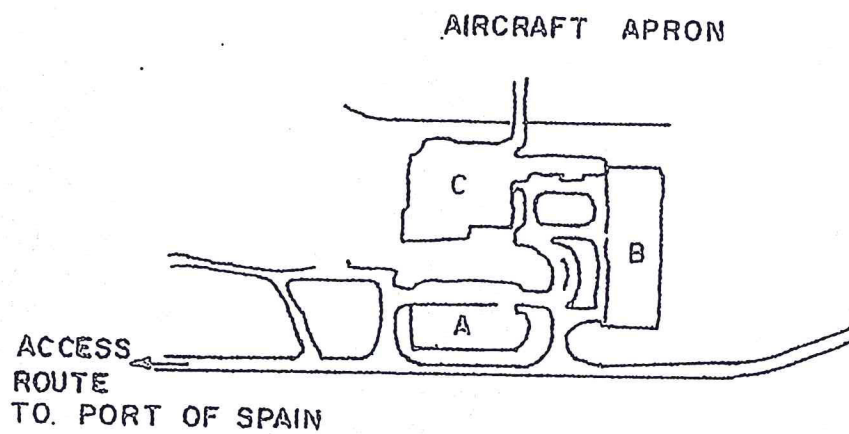
Parking Area	Legal Capacity	No. Parked at Peak	Percent Occupancy
South Car Park	130	138	106
East Car Park	240	141	59
On-Street	60 ^(a)	117 ^(b)	195
Total	430	396	93

(a) spaces for taxis and setting down

(b) including illegal street parking and parking on grassed areas

car parks are shown. Three features are obviously apparent from Table 3, namely:-

- (i) The high occupancy of the South Car Park



- KEY : A South Car Park
B. East Car Park
C. Terminal Buildings

FIG. 5 LOCATION OF CARPARKS AT TERMINAL FACILITY.

(Scale 1:5000)

- (ii) The low occupancy of the East Car Park
- (iii) The high number of vehicles parked on the compound roads and grassed areas.

In total, there was not a net shortfall of parking spaces, although an overall occupancy of 93% on the total available legal spaces indicates in itself the need for expansion.

The fact that the East car park is under-utilised may be explained as follows:-

- (i) Longer walking distances when compared to the available alternatives.
- (ii) A 50 cent parking fee is payable whereas "Street" parking is free.
- (iii) Non-enforcement of the parking regulations.
- (iv) Lack of sign-posting.

In the vicinity of the South car park an impression of congestion is gained. This results from the following features:-

- (i) Vehicles waiting in the access road for entry to South car park.
- (ii) Illegal parkers on the road causing taxis and others setting down passengers to perform their operations in such a position that the access road is blocked.

It is felt that, despite the limited land area available, the congestion problem could be relieved to some extent by the relocation of the taxi and setting down area to a position south of the present Tobago terminal and east of the International terminal, by a re-arrangement of the compound roads, by an extension eastwards of the East car park and by adequate sign-posting. In addition, the traffic regulations need to be vigorously enforced.

At the interviews stage, a parking duration survey was carried out and the cumulative percentage of parking durations for the various types of airport users was as shown in Figure 6. Generally, the expected patterns emerge. Business users tend to have short parking durations with a median value of about 50 mins. Employees at the terminals who arrive by private car have parking durations in excess of four hours or merely a few minutes, indicating being dropped by family or friends.

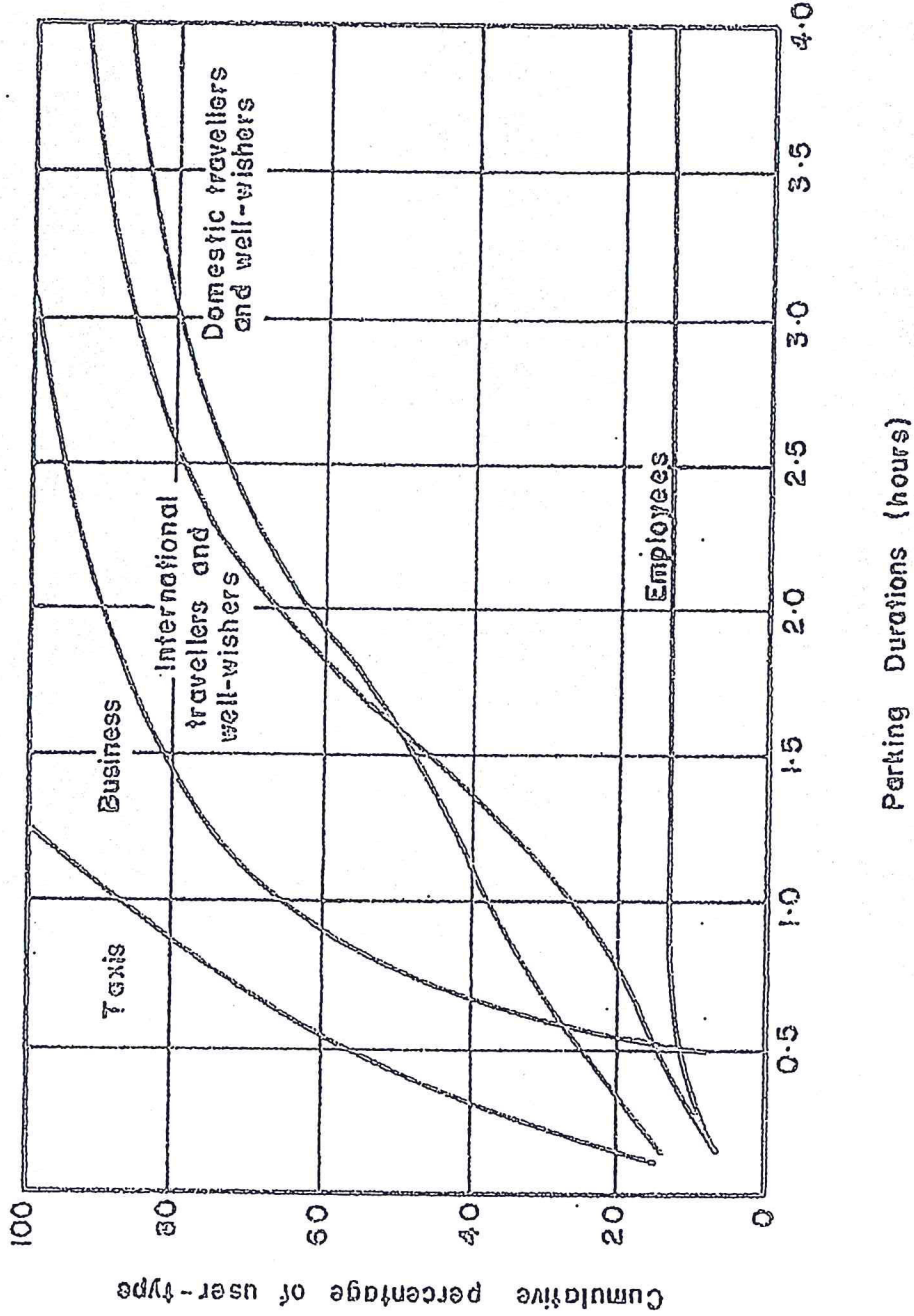


FIG. 5 PARKING DURATION CURVES FOR VARIOUS TYPES OF AIRPORT USER.

Travellers and visitors parking at the terminals exhibit a wide range of parked times, the median value being approximately 100 minutes.

The volume of enplaned and deplaned passengers is, of course, the most important factor affecting parking at an airport¹. Indeed, parking for employees, rental cars and casual visitors is generally proportional to the amount of passenger traffic. The relationship between passenger numbers and motor vehicle generation depends upon the particular traveller characteristics at individual airports, particularly upon the ground public transit access facilities and upon the relative numbers transferring from one air journey to another. For example, a study carried out in U.S.A.⁵ indicated a wide range of values for various airports (from 180 to 630 vehicles per 1000 departing air passengers).

A further influence upon the maximum number of vehicle parking spaces required is the degree of peaking in air transport demand over the year. It is assumed that the peak for the month of April was isolated and in addition, that the demand for spaces in the peak month would be in the same proportion to the demand for air passenger movements. The monthly variations in air passenger movements are shown on a percentage basis in Figure 7.

Using the 1977 passenger returns based on total arrivals plus total departures on both domestic and international flights a factor of 1.55 between the peak month (August) and the study month (April) is developed. This leads to a present peak requirement of 620 parking spaces which, in terms of annual passenger departures by air is approximately 900 per million. This is a comparatively high requirement (see for example a paper by T.C. Albouy⁶) which is thought to result from a number of possible factors:-

- (i) The high ratio of visitors/airline passengers, a value of 1.7:1 being observed in the interview study. It is noted that this feature was also observed by Phelps et al³. By comparison, the U.S. Federal Aviation Administration recommends a 1:1 ratio for design purposes⁷.
- (ii) Relatively poor accessibility to the Airport by public transit facilities.
- (iii) Relatively long average parking duration for those visitors to the Airport for the purpose of well-wishing travellers by comparison⁸ with other airports.

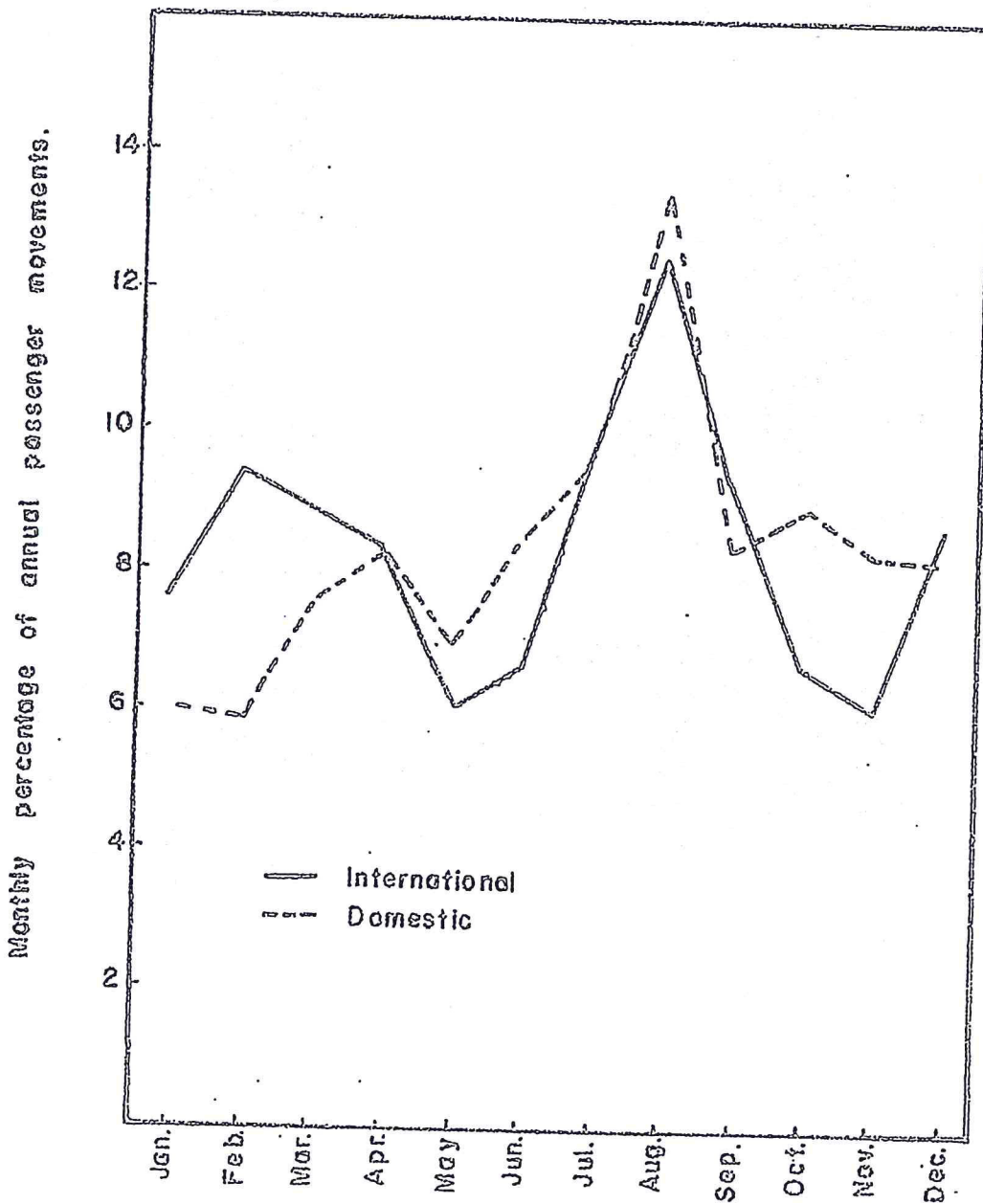


FIG. 7 VARIATION OF AIR PASSENGER VOLUMES BY TIME OF YEAR AT PIARCO AIRPORT.

- (iv) Comparatively low numbers of hotel holiday tourists and overseas business visitors. These make up about 13% of International travellers and approximately 9% of total passenger movements.

5. SHORT-TERM PROJECTIONS

In the development of short-term (less than, say, five years) projections of parking requirements, it is probably valid to utilise extrapolative growth factor methods, so as an exercise it was decided to develop projections for the year 1982. It should be noted that both airport and airline development strategy in Trinidad and Tobago are presently in the "melting pot" so it would certainly be invalid to use growth factor methods for the development of medium and long-term requirements.

Growth in vehicle ownership would, of course, tend to increase the demand for Airport parking but it is felt that, in general, those who travel by air are at present likely to have access to private cars as a result of their socio-economic status. Increasing car-ownership is a reflection of the nation's growth in wealth and, consequently, is subject to similar influences which determine the general level of air transport demand. It is thus considered that car ownership need not be taken into account, in the short-term, as an independent influencing variable.

The demand for vehicle parking spaces has been considered as directly proportional to the number of air passenger movements. Implicit in this assumption is the further assumption that the general pattern of ground access will remain constant, particularly that the present social pattern which generates a high well-wisher/traveller ratio will continue. The growth in passenger movements in recent years is shown in Figure 8. From Figure 8, it may be deduced that the demand for International travel has experienced a growth rate of the order of 10% per annum and that the demand for Domestic travel has been growing much faster, with range from 20% to 50% in a year. Clearly, the higher end of the Domestic growth rate is unlikely to be maintained. A range of overall growth rates from 1.0% to 18% have been used and projections made on this basis. The formula used is the standard "compound interest" formula:-

$$D_d = D_p (1 + g)^n \quad (1)$$

where D_d = demand in the design year.

D_p = present demand.

g = growth rate.

n = number of years.

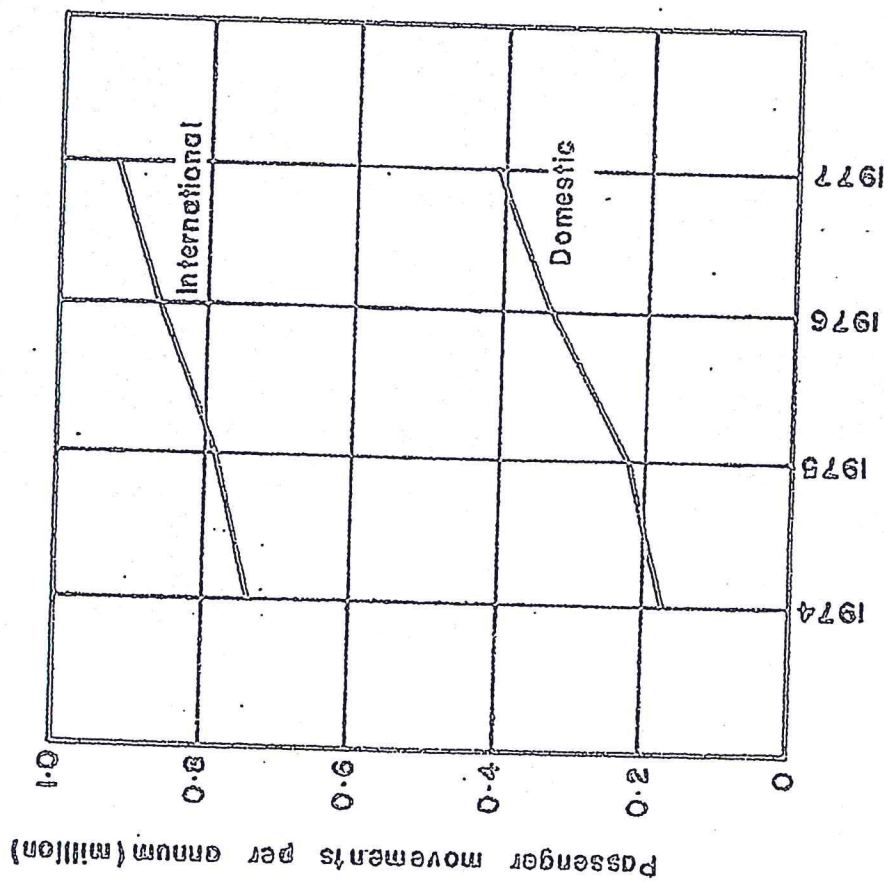


FIG. 8 AIR PASSENGER TRAFFIC GROWTH AT PIARCO AIRPORT.

Table 4 shows the likely magnitude of the peak vehicle parking

TABLE 4

PROJECTED NUMBER OF VEHICLE PARKING SPACES IN 1982 FOR A RANGE OF AIR
TRANSPORT GROWTH RATES

Growth rate in air passengers (%p.a.)	10	12	14	16	18
No. vehicle parking spaces in 1982	900	960	1040	1110	1200

requirements in the year 1982 for various annual growth rates in the total number of air passenger movements.

Utilising the existing car parks to full capacity and allowing full use of the access roads for parking it is possible that about 600 vehicles can be accommodated within the compound. It can, therefore, be seen clearly that unless extended facilities are made available congestion is likely to become a serious problem. The most obvious recommendation is that the East car park be extended further East where land presently undeveloped appears to be available.

6. PLANNING RAMIFICATIONS

It is evident that the single most important aspect of medium and long term planning of ground access facilities to airports is the determination of future numbers of air passenger movements. As in the case of other transportation studies⁹ it is unlikely that methods based on growth factors would yield satisfactory long-term projections. A more realistic approach would be based upon causal relationships between air transport demand and those factors which tend to promote or impede travel. Extension of preliminary work which has already been carried out¹⁰ tends to indicate a model of the general form:-

$$D = K f(A, P, I, F) \quad (2)$$

where

- D = air passenger movements
- K = constant
- A = mutual attractiveness of origin and destination
- P = population
- I = income
- F = airfare

In regard to the assessment of Domestic air transport demand, of course, a projection of the air versus ship modal split would have to be undertaken. Once these future projections have been carried out, the scale of ground access activity can then be designed for.

The public roads in the vicinity of Piarco Airport appear to be adequate to cater for present traffic demands although there are four features which indicate a remodelling to be desirable at some future date:-

- (i) The scale of activity at the Airport is likely to increase rapidly.
- (ii) Some delays do occur at Oropuna to the north of the Airport.
- (iii) There is a drainage problem under heavy rainfall conditions.
- (iv) The lateral separation of the public access road and the west end of the Airport runway does not meet standard requirements.

The major ground access problem, however, from the journey times reported by the interview respondents appears to be the slowness of the journey speed between origin and Airport when approaching from the West. This is, of course, a common problem in any major urban area. As a consequence of this, many urban planning authorities have turned their attention to the development of efficient transport links between an Airport and city centres such that the advantage of high speed air travel between airports is not lost as a result of excessive journey times between airport and cityll.

As the volume of air passenger traffic increases and the level of urban congestion is not improved, segregated track public transit links become attractive for the city centre to airport journey on the condition that the volume of air traffic having its origin or destination in the city centre is sufficient to justify their operation. In the case of Piarco Airport, the planned construction of a busway from Port-of-Spain to Arouca and the corridor pattern of urban development east from Port-of-Spain invite the opportunity to investigate the feasibility of a bus transit link. There are two major possibilities namely:-

- (i) A city-centre to airport express service operating at a high speed and aimed almost exclusively at the city centre originating air traveller.

- (ii) A stopping service, operating on the busway, at a lower journey speed but aimed at airport users from intermediate locations as well as those from the city centre.

Both of the above need to be thoroughly evaluated in order to determine their viability. Qualitative arguments for one or other approach at the present time are subject to doubt, but the likely number of users on an express service, it is thought, would not justify its provision mainly on grounds of the likely concentration of final trip ends in the central area of Port-of-Spain especially in view of likely decentralisation in the future.

As described above, the ultimate vehicle parking capacity is likely to be reached shortly. Car park extensions and adjustments to the terminal compound circulatory system are indicated. In the medium and long-term, it is likely that further infrastructural investment would be needed. The type of provision would obviously depend upon decisions regarding the future development of facilities at Piarco. If it were decided to retain the present location of the passenger terminals then a multi-storey parking garage solution would be indicated. If a decision is made to construct completely new terminal facilities, then surface car parking would be possible although a multi-storey solution may be preferred on grounds of overall convenience.

7. CONCLUSIONS

Following a parking interview survey and numerical traffic counts, the access characteristics and parking behaviour at Piarco Airport have been presented. In access characteristics, the private car plays the major role in transporting people to the Airport, the modal split being 54% to private car from Port-of-Spain and 94% for the rest of Trinidad. Approximately 60% of air travellers have their trip origin in urban North Trinidad. Large numbers of well-wishers visit the Airport the average being 1.7 per traveller. Stand taxis play an important role in transporting persons from Port-of-Spain to Piarco.

Parking behaviour reflects a desire to minimise walking distance, indicated by the low utilisation of the East car park. Maximum demand for parking at the present time is about 620 spaces in total which is much in excess of the actual provision, the shortfall being made up by illegal street parking and parking on grassed areas. Parking duration for travellers and visitors has a median value of about 100 minutes. Short term projections indicate the imminence of a serious deficiency of parking spaces.

Planning ramifications have been discussed and it is recommended that the potential for a regular transit service be investigated.

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