3-1-2 Summary of Field Surveys

(1) Scope of field surveys

Based on the information collected by the advance mission of JICA, it was planned to conduct field survey covering the following items.

a. Pavement and geological survey

1. In-situ CBR, plate bearing test, soil sampling and laboratory tests, in order to ascertain the strength and characteristics of subgrade soil.

2. Sampling and strength tests of existing pavement.

3. Benkelman beam tests to observe the difference of flexibility on both sides of the undulation of RWY06/24.

4. Boring tests at the proposed borrow pit.

5. Visual observation of existing pavement.

b. Mapping and leveling

1. Topographic mapping.

2. Longitudinal and transversal leveling of airfield facilities.

3. Obstacle (trees) survey.

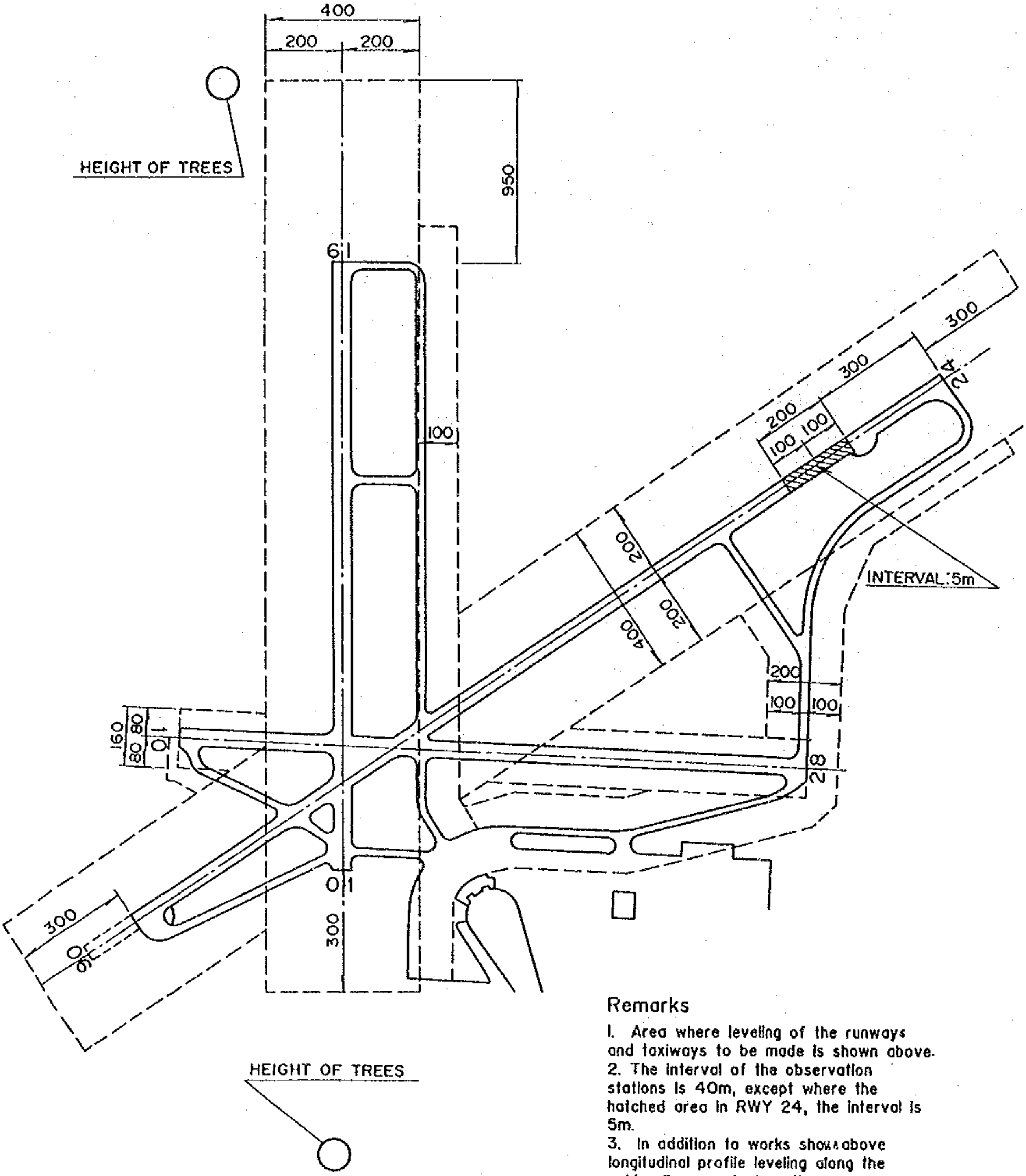
The field survey was carried out in 75 days. Further details of the field survey are described in Table 3-1.

It should be noted that strength tests of base and sub-base were not made because it was impracticable to remove a part of pavement for such tests, under operation.

Table 3-1 Scope of Supplementary Field Surveys

Item	Method	Location and Quantity	Remarks
Soil sampling, field CBR tests, groundwater level observations. Measurement of thickness of pavement	Test pit. Wet preparation of soils. Laboratory tests of soils	RWY06/24 x 3 RWY01/19 x 4 TWY-C x 2	Laboratory test. . CBR . Moisture density relations . Classification
Plate bearing test and groundwater level observation	Test pit.	APRON x 1	
Concrete core sampling and compressive strength tests	AASHTO T24 ASTM C-39	RWY06/24 x 3 RWY01/19 x 2 RWY10/28 x 3 APRON x 3	
Concrete beam sampling and flexural strength tests	AASHTO T24 ASTM C-78	RWY06/24 x 1 RWY01/19 x 1 RWY10/28 x 1 APRON x 2	
Asphalt core sampling and Marshall stability tests	ASTM D-1559	RWY06/24 x 6 RWY01/19 x 2 TWY-A x 1 TWY-B x 1 TWY-C x 2 APRON x 1	
Benkelman beam tests	AASHTO T-256	RWY06/24 x 10	
Boring	Percussion drilling	North of RWY01/19	
Pavement observation	Visual observation	Runways, taxiways and apron	
Topographic map	By analysis of aerial photographs	3 km x 3 km	Scale : 1/5,000
Longitudinal and transversal leveling	---	Runways, taxiways and apron	
Leveling of tree heights	---	North and south of RWY01/19	

Note: Location of tests are shown in Fig. 3-4 and Fig. 3-5.



Remarks

1. Area where leveling of the runways and taxiways to be made is shown above.
2. The interval of the observation stations is 40m, except where the hatched area in RWY 24, the interval is 5m.
3. In addition to works shown above longitudinal profile leveling along the guide-lines marked on the apron was made.

Fig. 3-4 LOCATIONS OF TOPOGRAPHIC FIELD SURVEYS

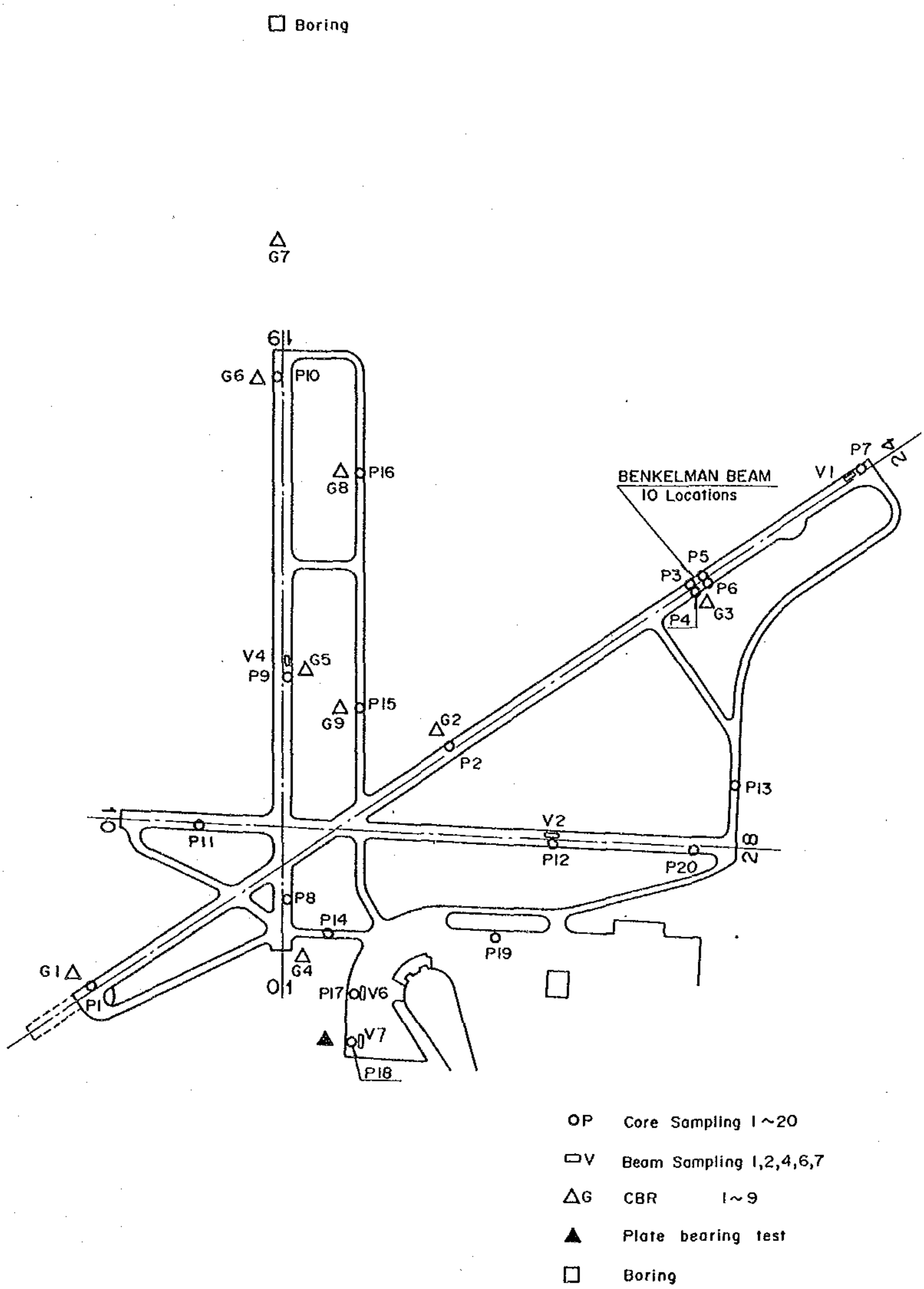


Fig. 3-5 LOCATIONS OF GEOLOGICAL AND PAVEMENT SURVEYS

(2) Results of field surveys

1) Geological surveys

a Design CBR of subgrade

Subgrade soil is fine-grained clay called "Formacion Libertad" and it is classified as CL or CH.

Through analysis of the observed CBR values, the design CBR is determined as follows.

· Observed values : X_i, n = 9

3.1	3.3	4.5	4.8	4.9
5.6	5.6	6.8	8.8	

· Average: $\bar{X}$ = 5.27
· Standard deviation : σ = 1.75
· Design CBR : $\bar{X} - \sigma$ = 3.52 ——> 3.5%

b Design K value of subgrade

According to the plate bearing test of 30 inches diameter made near apron, the K value is 1.75 kg/cm^3 (63 pci).

c Ground water level

In the pavement surveys conducted by JICA study team, no ground water was observed.

But it was reported that ground water was observed 2 to 3 m below ground level in the report of 「Estudio y Proyecto de Prolongacion y Refuerzo de la Pista 06-24」 conducted by D.G.I.A.

Fine-grained clay has very poor seepability and tends to hold water. Therefore, sufficient subgrade drainage is very important for protecting kneading effects.

2) Pavement surveys

The structure and the existing surface conditions of pavement are shown in Table 3-2 and Fig. 3-6.

The design flexural strength of existing cement concrete slabs is determined as follows.

Average: $\bar{X}$ = 52.9 kg/cm^2 (n = 12)
Standard deviation: σ = 5.6
Design strength : $\bar{X} - \sigma$ = 47.3 kg/cm^2
(670 psi)

Equivalency factor of the cement and asphalt concrete is set up as shown in Table 3-3 through consideration of the results of the strength tests and the surface conditions of the pavement.

General characteristics and equivalency factor of base and sub-base is shown in Table 3-4.

[Reference]

Recommended equivalency factor range stabilized sub-base

Material	Equivalency factor range
Bituminous surface course	1.7-2.3
Bituminous base course	1.7-2.3
Cold laid bituminous base course	1.5-1.7
Mixed in-place base course	1.5-1.7
Cement treated base course	1.6-2.3
Soil cement base course	1.5-2.0
Crushed aggregate base course	1.4-2.0
Gravel sub-base course	1.0

In establishing the equivalency factors shown above, the CBR of the gravel sub-base course was assumed to be 20.

Recommended equivalency factor range stabilized base

Material	Equivalency factor range
Bituminous surface course	1.2-1.6
Bituminous base course	1.2-1.6
Cold laid bituminous base course	1.0-1.2
Mixed in-place base course	1.0-1.2
Cement treated base course	1.2-1.6
Soil cement base course	N/A
Crushed aggregate base course	1.0
Sub-base course	N/A

The equivalency factors shown above assume a CBR value of 80 for crushed aggregate base course.

Source: Aerodrome Design Manual Part 3 Pavements Chapter 4.4
United States of America Practice.

Table. 3-2 Structure of pavement and existing surface conditions

Facilities	Location	Test point of field survey	Surface Layer						Second layer		Others		Total Thickness (cm)	Existing surface conditions			
			Material	Thickness (cm)	Marshall (kg)	Flow (mm)	Compressive Strength (kg/cm^2)	Flexural Strength (kg/cm^2)	Material	Thickness (cm)	Material (cm)	Thickness (cm)		Good	Fair	Poor	Very poor
RWY 06/24	OK000~1K722	P1-P2	Asphalt concrete (As. Con)	30	656 430	4.2 3.4	—	—	Cement concrete (Cem. Con.)	20	Sand	30	80			○	
	1K722~2K148	—	As. Con.	35.5	—	—	—	—	Macadam	23	Ballast	37	95.5			○	
	2K148~2K298	P3 P4	As. Con.	33	608 696	4.1 3.9	—	—	Bituminous base	10	Granular	55	98			○	
	2K298~2K448	P5 P6	As. Con.	20	738 665	4.6 4.5	—	—	※1 Cem. Con.	32	Granular	25	77		○		
	2K448~2K698	P7	Cem. Con.	35	—	—	450	58.1	Cement treated base	30	Tosca	30	95	○			
RWY 01/19	OK00~OK170	P8	As. Con.	5	242	4.6	—	—	Cem. Con.	20	Sand	30	55				○
	OK170~OK400	—	As. Con.	30	—	—	—	—	Cem. Con.	20	Sand	30	80			○	
	OK400~1K598	P9	Cem. Con.	20	—	—	588	53.9	Sand	30	—	—	50			○	
	1K598~1K748	P10	As. Con.	20	742	4.3	—	—	※1 Cem. Con.	20	Sand	30	70		○		
RWY 10/28	OK00~OK360	P11	Cem. Con.	20	—	—	542	—	Sand	30	—	—	50			○	
	OK360~OK725	—	As. Con.	30	—	—	—	—	Cem. Con.	20	Sand	30	80			○	
	OK725~1K715	P12 P13	Cem. Con.	20	—	—	516 603	52.5 —	Sand	30	—	—	50			○	
TWY-A	T1, T2 (Widened part)	P14	As. Con.	12	1,013	4.1	—	—	Sandy gravel	15	Tosca	52	79				○
	T1, (T2)	—	As. Con.	15 (20)	—	—	—	—	Cem. Con.	25	Sandy gravel	38	73 (83)				○
TWY-B	T5	P13	As. Con.	20	1,020	4.0	—	—	Gravel	20	Tosca	50	90			○	
	T6-1	—	As. Con.	33	—	—	—	—	Cem. Con.	25	Sand	30	88		○		
	T6-2	—	As. Con.	24	—	—	—	—	Macadam	20	Ballast	50	94		○		
	T7	—	Cem. Con.	35	—	—	—	—	Cement treated base	30	Tosca	30	95	○			
	T8	—	As. Con. Macadam	12 6	—	—	—	—	Aggregate Cem. Con.	8 25	Sand	30	81		○		
TWY-C	T4-1	P15 P16	As. Con.	15	1,092 407	5.6 4.1	—	—	well-graded aggregate	25	Sandy gravel	55	85				○
	T4-2	—	As. Con.	10	—	—	—	—	well-graded aggregate	25	Sandy gravel	55	90				○
TWY-D	—	—	As. Con.	15	—	—	—	—	Cem. Con.	20	Sand	30	65				○
TWY-E	T3-1	—	As. Con.	14	—	—	—	—	Cem. Con.	22	Sand	30	66			○	
	T3-2	—	Cem. Con.	22	—	—	—	—	Sand	30	—	—	52			○	
APRON	S-1	P18	Cem. Con.	35	—	—	391	48.2	Cement treated base	30	Tosca	30	95		○		
	S-2	—	Cem. Con.	35	—	—	—	—	Tosca	35	Soil	50	120		○		
	S-3	P17	Cem. Con.	15.5	—	—	586	56.2	Cem. Con.	20	Sand	30	65.5			○	
	S-4	—	As. Con. Macadam	6 6	—	—	—	—	Aggregate Cem. Con.	8 20	Sand	30	70				○
	S-5	—	As. Con.	7.5	—	—	—	—	Macadam	23	Aggregate	46	76.5				○
	S-6	P19	As. Con.	20	357	4.3	—	—	Cem. Con.	20	Sand	30	70		○		

※1 Compressive strength : P5=371kg/cm^2, P6=406kg/cm^2, P10=521kg/cm^2

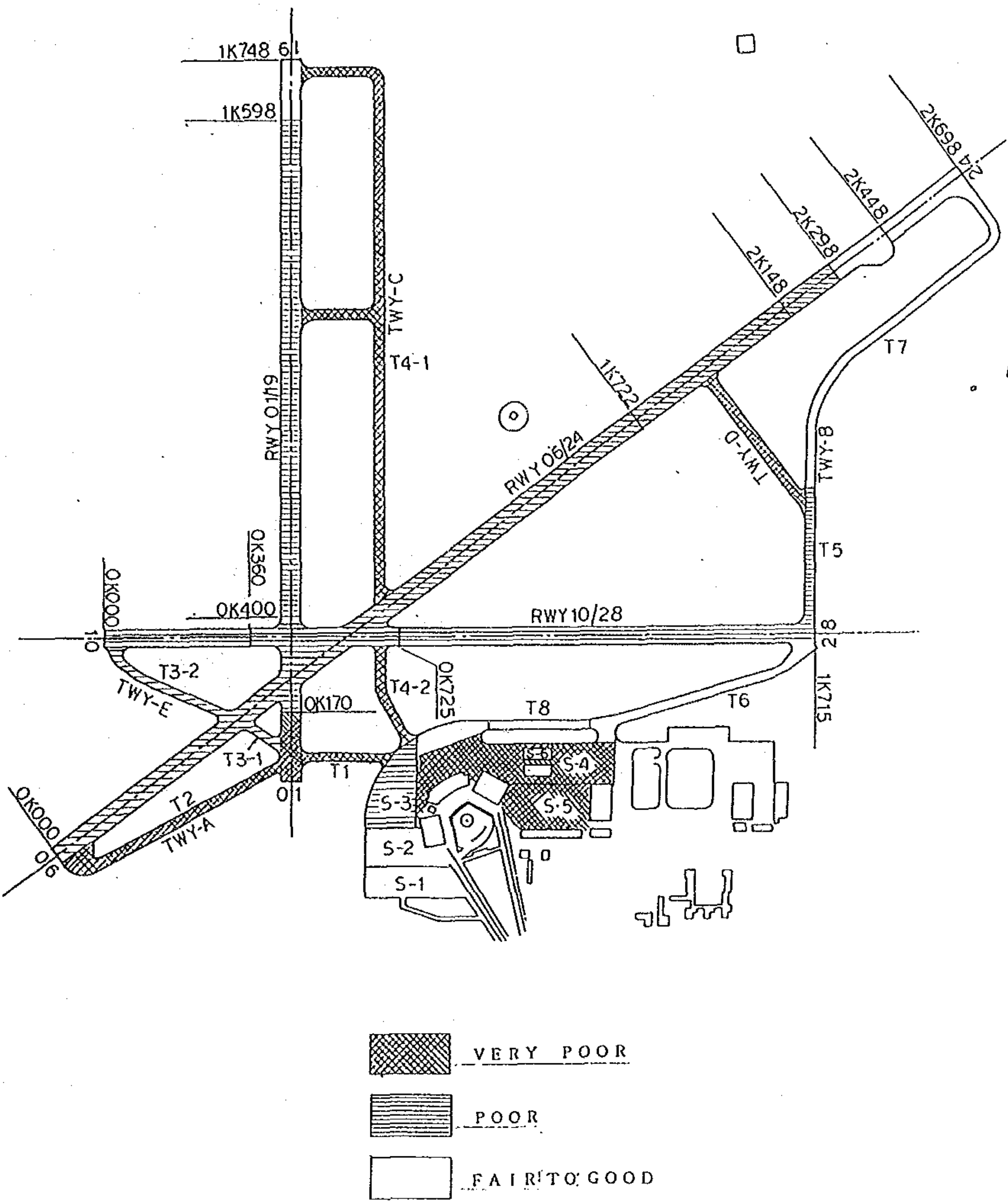


Fig. 3-6 SURFACE CONDITIONS OF PAVEMENT

Table 3-3 Equivalency Factor for Asphalt and Cement Concrete Layer

PAVEMENT TYPE	SURFACE CONDITION	LOCATION	EQUIVALENCY FACTOR	
			TO SUB-BASE	TO BASE
ASPHALT CONCRETE	FAIR TO GOOD	RWY06/24 2K298~2K448	2.0	1.4
		RWY01/19 1K598~1K748		
		TWY-B T6-1		
		TWY-B T6-2		
		TWY-B T8		
		APRON S - 6		
	POOR	RWY06/24 0K00 ~1K722	1.7	1.2
		RWY06/24 1K722~2k148		
		RWY06/24 2K148~2K298		
		RWY01/19 0K170~0K400		
		RWY10/28 0K360~0K725		
		TWY-B T5		
		TWY-E T3-1		
	VERY POOR	RWY01/19 0K000~0K170	1.0	To be replaced
		TWY-A T1		
		TWY-A T2		
		TWY-C T4-1		
		TWY-C T4-2		
		TWY-D		
		APRON S - 4		
		APRON S - 5		
CEMENT CONCRETE	FAIR TO GOOD	RWY06/24 2K448~2K698	2.0	1.4
		TWY-B T7		
		APRON S - 1		
		APRON S - 2		
	POOR	RWY01/19 0k400~1K598	1.7	1.2
		RWY10/28 0K000~0K360		
		RWY10/28 0K725~1K715		
		TWY-E		
		APRON S - 3		
	OTHER OLD SLABS(SECOND LAYERS)			
NEW MATERIAL			2.3	1.6

Table 3-4 General Characteristics and Evaluation of Base and Sub-Base

MATERIAL	GENERAL CHARACTERISTICS		ASSIGNMENT TO BASE OR SUB-BASE	EQUIVALENCY FACTOR FROM BASE TO SUB-BASE
	UNIFIED CLASSIFICATION	CBR (%)		
SAND (ARENA COMPACTADA)	SW	20	SUB-BASE	---
GRANULAR MATERIAL (BASE GRANULAR)	GW, GP, GM	40 ~ 70	SUB-BASE	---
TOSCA (TOSCA)	GW, GP, GM	40 ~ 70	SUB-BASE	---
BALLAST (BALASTO)	GW, GP, GM	40 ~ 70	SUB-BASE	---
AGGREGATE (SUB-BASE DE AGREGADOS)	GW, GP, GM	40 ~ 70	SUB-BASE	---
WELL-GRADED AGGREGATE (ROCA TRITURADA)	N.A.	100	BASE	1.4
SOIL (SUELO DE SUSTITUCION)	N.A.	N.A.	SUB-BASE	---
CEMENT TREATED BASE (PIEDRA CEMENT)	N.A.	N.A.	BASE	2.0
BITUMINOUS BASE (BASE BITUMINOSA)	N.A.	N.A.	BASE	1.6
MACADAM (MACADAM)	N.A.	N.A.	BASE	1.6

REMARKS: Above information about general characteristics of materials was provided by D.G.I.A.

3) Initial load-carrying capacity of existing pavement

The existing pavement is evaluated in accordance with "4.4 United States of America Practice" in Aerodrome Design Manual of ICAO.

Based on the data of subgrade strength and thickness of the pavement, initial load-carrying capacity when existing pavements was completed is computed through reversed procedures of pavement design as shown in Fig. 3-7.

The study is made under the following conditions:

. CBR of subgrade: 3.5 %

. K value of subgrage: 63 pci (1.75 kg/cm^3)

. Design aircraft or gear type

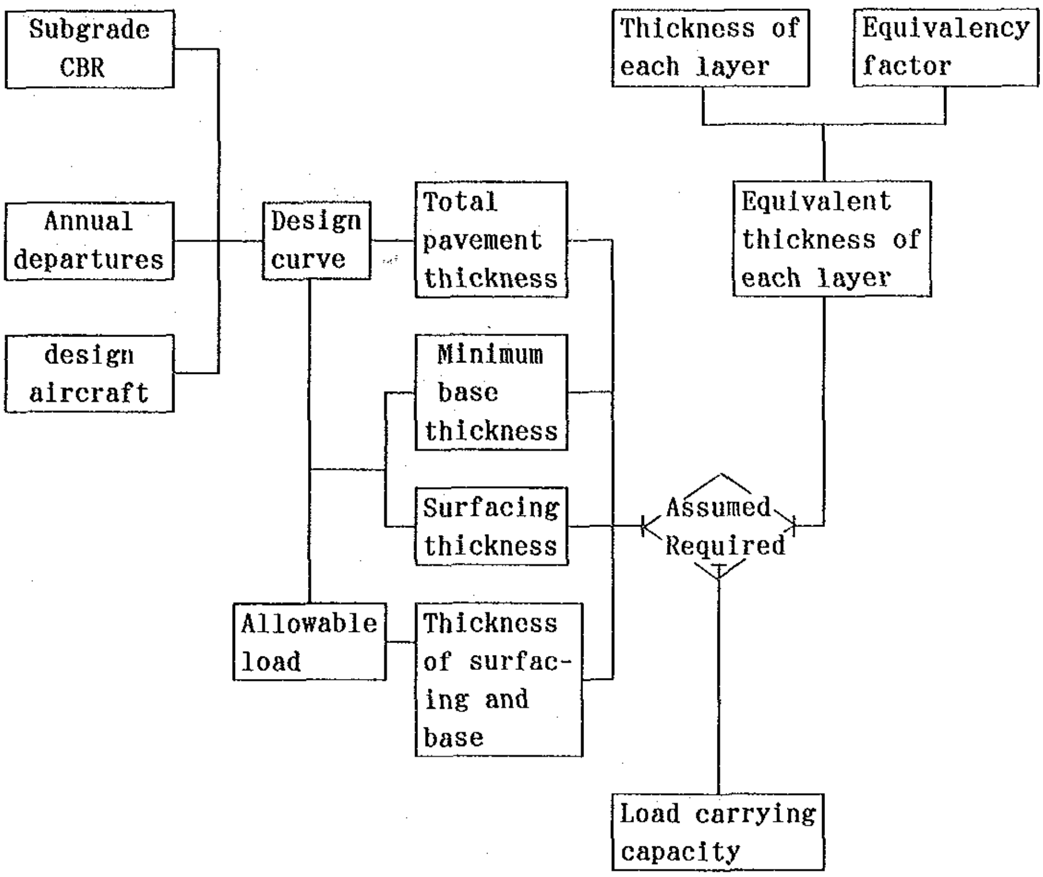
RWY06/24, TWY-A, TWY-B: APRON S-1, S-2, S-3 B-747-200B

Other facilities : Dual wheel (B-737, F-27, etc.)

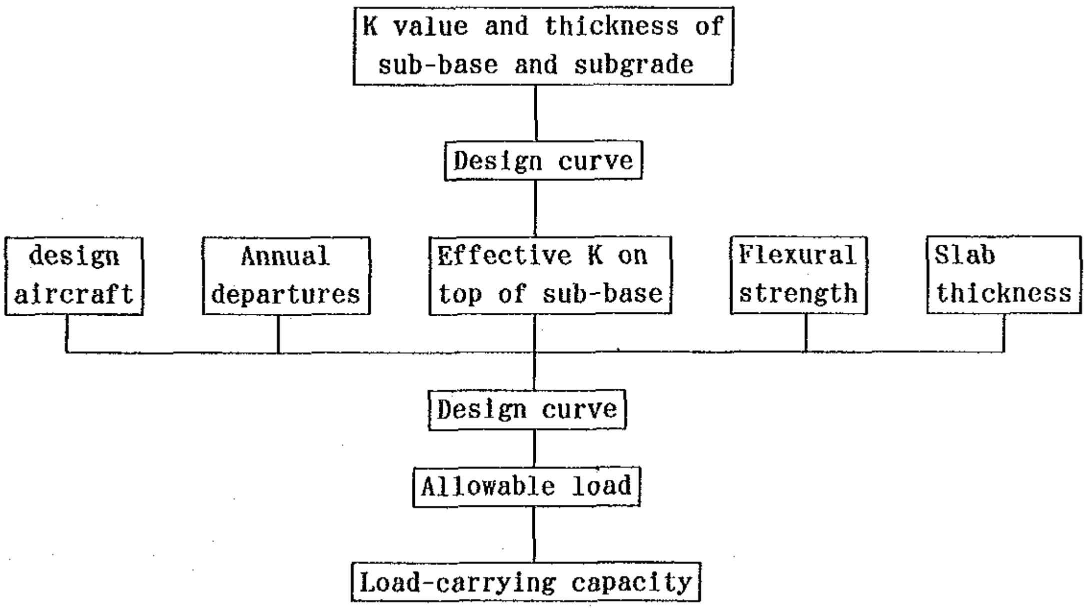
. Annual departures: 3,000

. Concrete flexural strength: 670 psi

The design aircraft and allowable load for each facility are shown in Table 3-5.



FLEXIBLE PAVEMENT



RIGID PAVEMENT

Fig. 3-7 PROCEDURES FOR ESTABLISHING LOAD-CARRYING CAPACITY OF EXISTING PAVEMENT

Table 3-5 Initial allowable load of existing pavement

FACILITY	LOCATION	DESIGN AIRCRAFT	ALLOWABLE LOAD (ton)	OPERATING WEIGHT (ton)	
				MAXIMUM RAMP	OPERATING EMPTY
RWY06/24	0K00 ~1K722	B-747-200B	181	353	173
	1K722~2K148		213		
	2K148~2K298		209		
	2K298~2K448		245		
	2K448~2K698		340		
RWY01/19	0K00 ~0K170	DUAL WHEEL	23	B-737-200 45	26
	0K170~0K400		68		
	0K400~1K598		23	F-27-MK500 20	12
	1K598~1K748		41		
RWY10/28	0K00 ~0K360	DUAL WHEEL	23	B-737-200 45	26
	0K360~0K725		68	F-27-MK500 20	12
	0K725~1K715		23		
TWY-A	T1	B-747-200B	159	353	173
	T2		168		
TWY-B	T5	B-747-200B	* N.A.	353	173
	T6-1		213		
	T6-2		191		
	T7		340		
	T8		168		
TWY-C	T4-1	DUAL WHEEL	59	B-737-200 45	26
	T4-2		45		
TWY-D	--	DUAL WHEEL	32	F-27-MK500 20	12
TWY-E	T3-1	DUAL WHEEL	33		
	T3-2		27		
APRON	S-1	B-747-200B	340	353	173
	S-2		281		
	S-3		191		
	* S-4	DUAL WHEEL	33	B-737-200 45	26
	* S-5		32	F-27-MK500 20	12
	S-6		42		

*Thickness of pavement T5 is too thin for B-747-200B.

4) Slopes on runways and taxiways

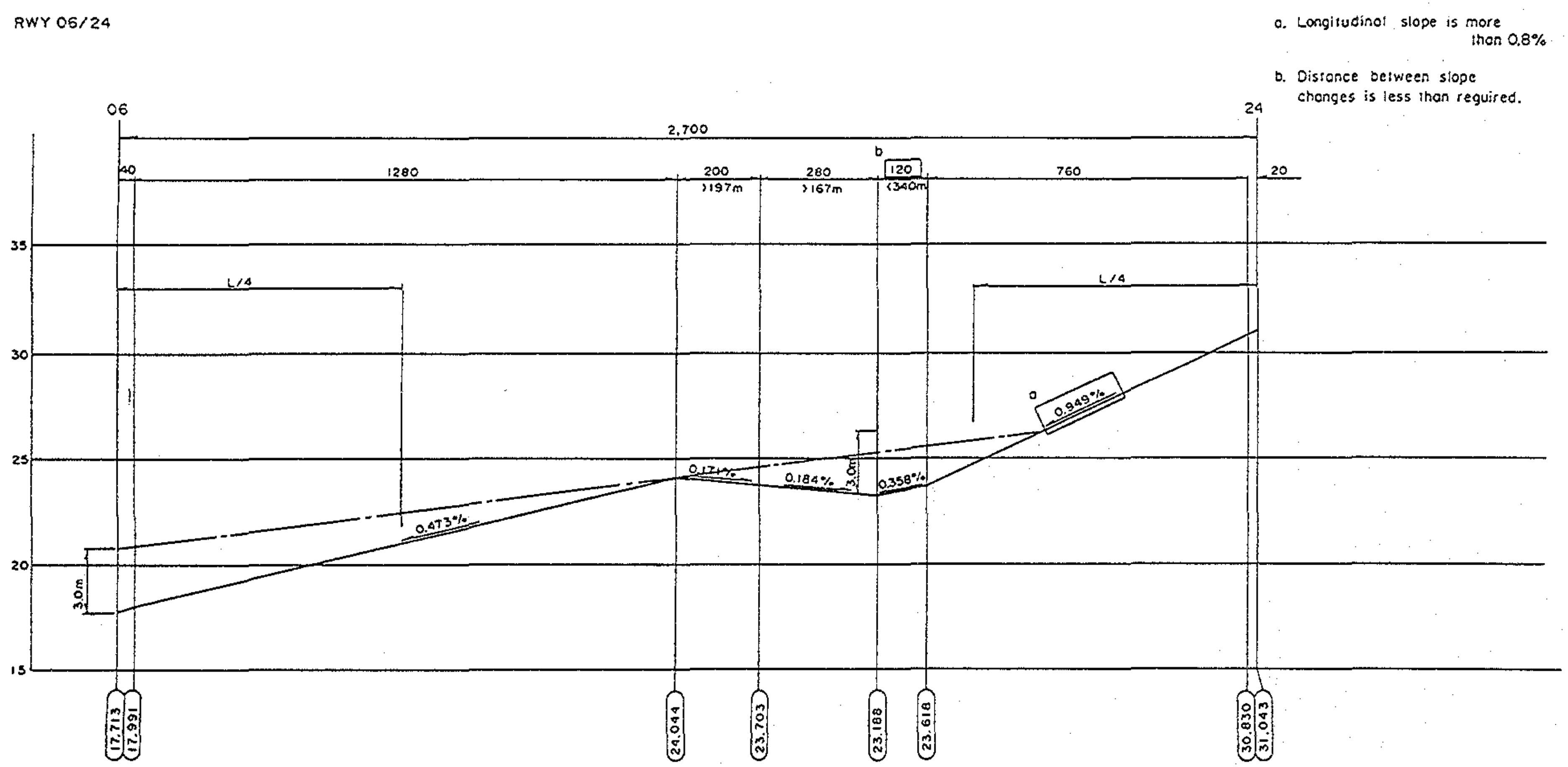
The problems of the slopes on the existing runways and taxiways are as shown in Table 3-6 .

Table 3-6 Problems of Slopes on Existing Runways and Taxiways

FACILITY	REFERENCE CODE		APPROACH PROCEDURE	PROBLEMS			REMARKS
	NUMBER	LETTER		LONGITU-DINAL SLOPE	DISTANCE BETWEEN SLOPE CHANGES	SIGHT DISTANCE	
RWY/06/24	4	E	Precision CAT - 1	a	b	-	-
RWY/01/19	3	C	Non-Precision	-	-	-	Longitudinal slope and distance between slope changes are out of requirement if code number is 4.
RWY/10/28	3	C	Non-Precision	-	-	-	ditto
TWY - A	4	E	Precision CAT - 1	-	-	c	-
TWY - C	3	C	Non-Precision	d	-	e	-

Note: 1. Requirements of slopes are based on ICAO 「ANNEX - 14」

2. Small letters, a, b, c, d, e are refered to succeeding drawings.

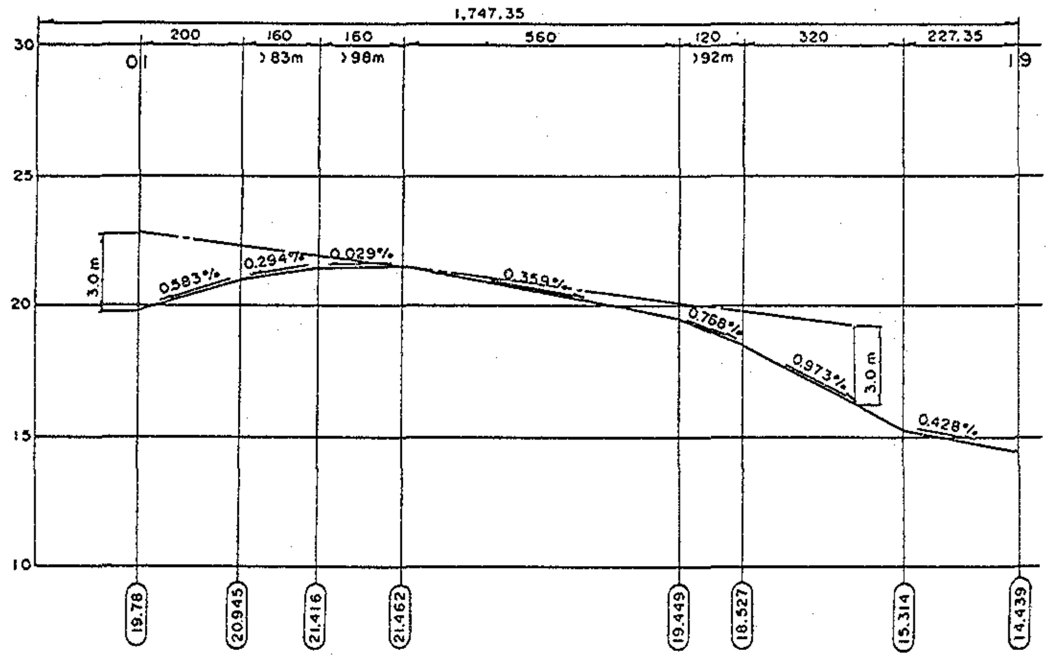


Code number : 4
Precision approach runway.

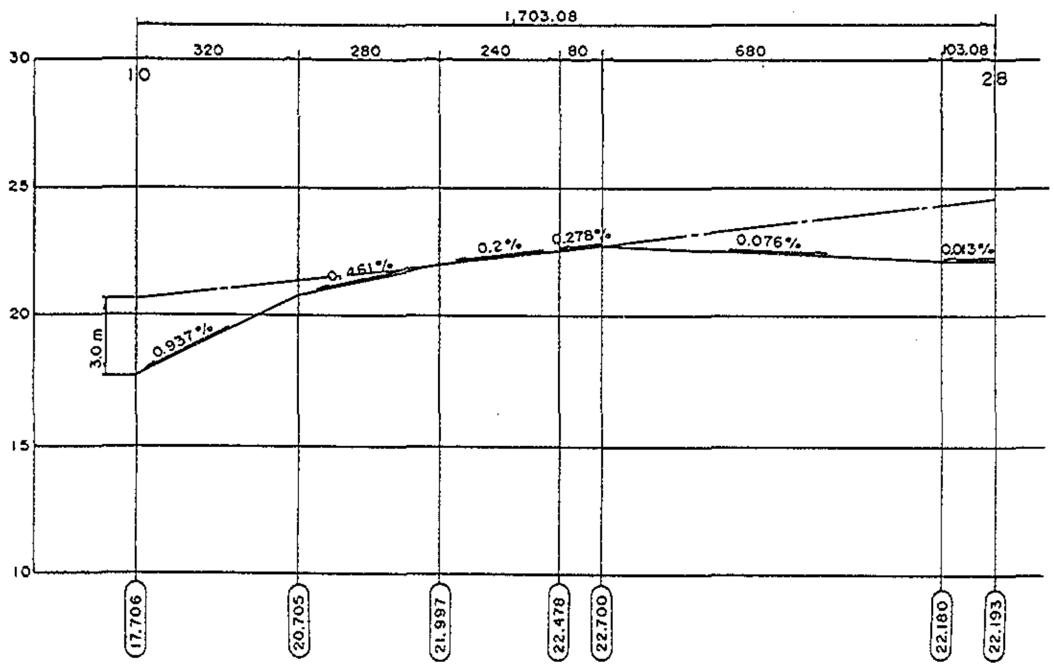
- Maximum slope
  First and last quarter : 0.8%
  Other part : 1.25%
- Longitudinal slope change : 1.5%
- Sight distance : above 3m
  half the length of RWY

Distance between slope changes : 30,000 X(|X − Y| + |Y − Z|)

RWY 01/19



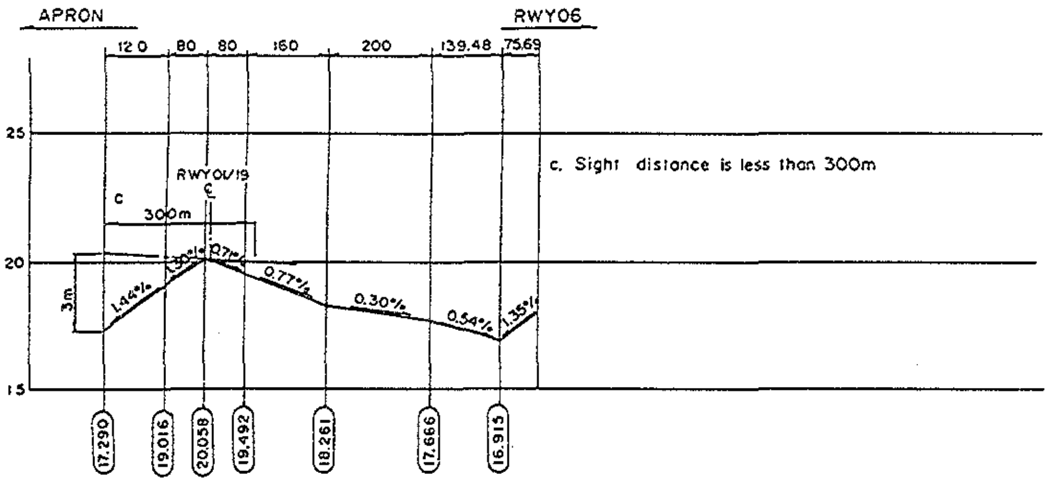
RWY 10/28



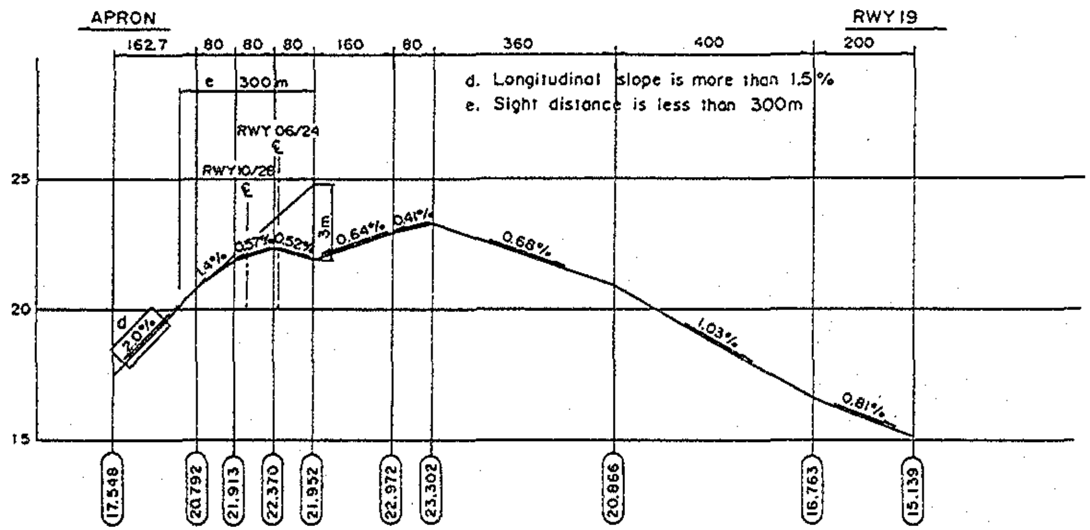
Code number : 3
Non-precision approach runway.

- Maximum slope : 1.5%
- Longitudinal slope change : 1.5%
- Sight distance : above 3m
  half the length of RWY
- Distance between slope changes :
  15,000m X(|X - Y| + |Y - Z|)

TWY-A
Code letter E

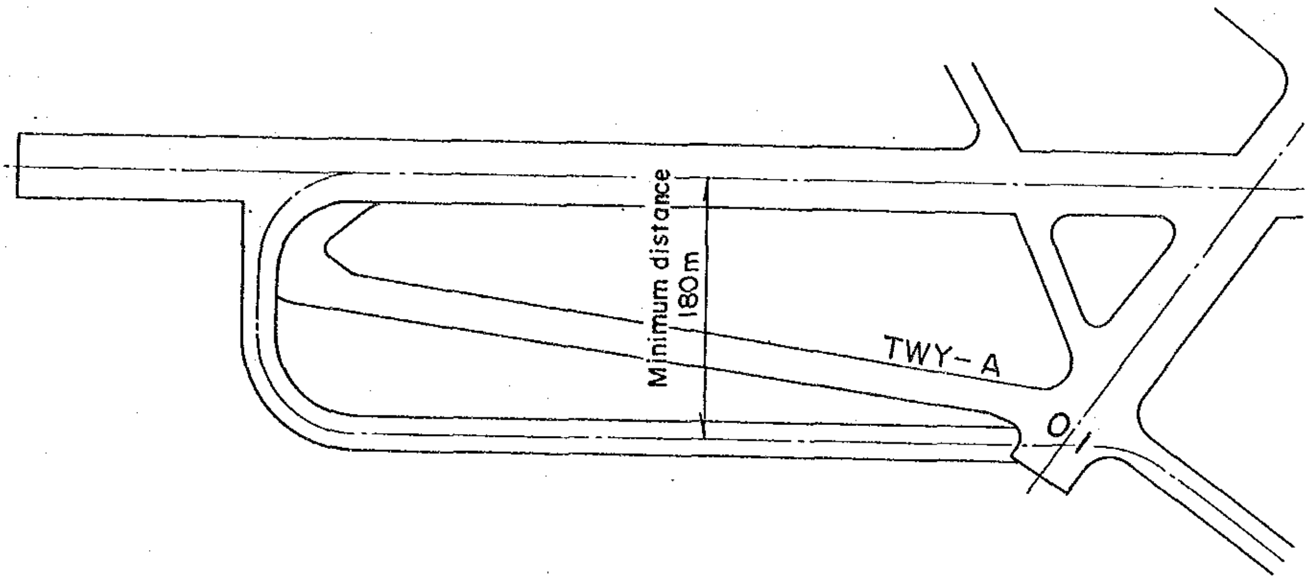


TWY-C
Code letter C



5) Minimum separation distance

A part of TWY-A from RWY01 to RWY06 does not meet the minimum separation requirement between centre line of runway and centre line of taxiway.



6) Obstacles

Following obstacles penetrate obstacle limitation surfaces of RWY01/19.

- Trees in north of RWY19
- Tail wings of B-747 parking on western apron

3-2. Terminal Area Facilities

3-2-1 Passenger Terminal Buildings

(1) Current situations

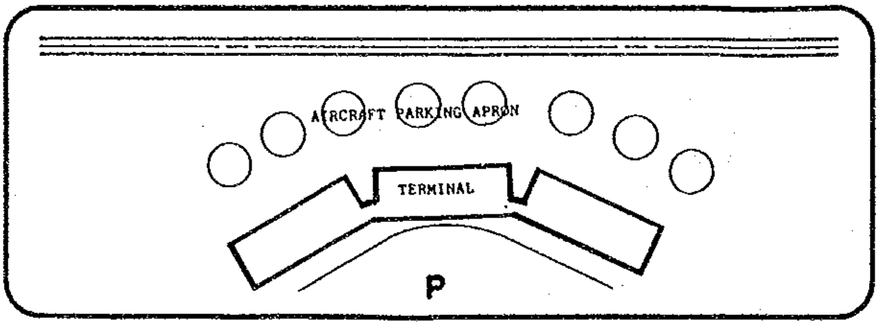
Passenger terminal buildings consist of three different buildings: central, arrival and departure terminals.

Of the three buildings, construction of the departure terminal has been completed in January 1990. Similarly, central terminal has been modified to cope with increasing demand of international passengers.

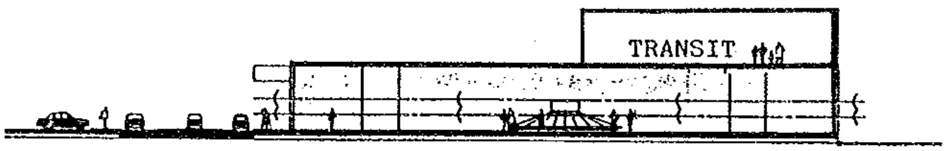
Central and departure terminals will be used for international departure passengers, and arrival terminal for international arrival passengers.

For domestic passengers, central terminal will be used.

Terminal is built on "semi-centralized and single-level terminal concept" with remote parking systems, thus disenabling installation of passenger boarding bridges. Following figure shows terminal concept of Carrasco Airport.



SEMI-CENTRALIZED CONCEPT



SINGLE LEVEL TERMINAL CONCEPT

Fig. 3-8 shows existing passenger flow, location of each facility and their functional relations in the three terminals.

(2) Actual capacity

Based on the result of survey on the existing terminal facilities, actual capacity has been analyzed.

Table 3-7 shows summary of building floor space and actual capacities of major terminal facilities related to passenger handling.

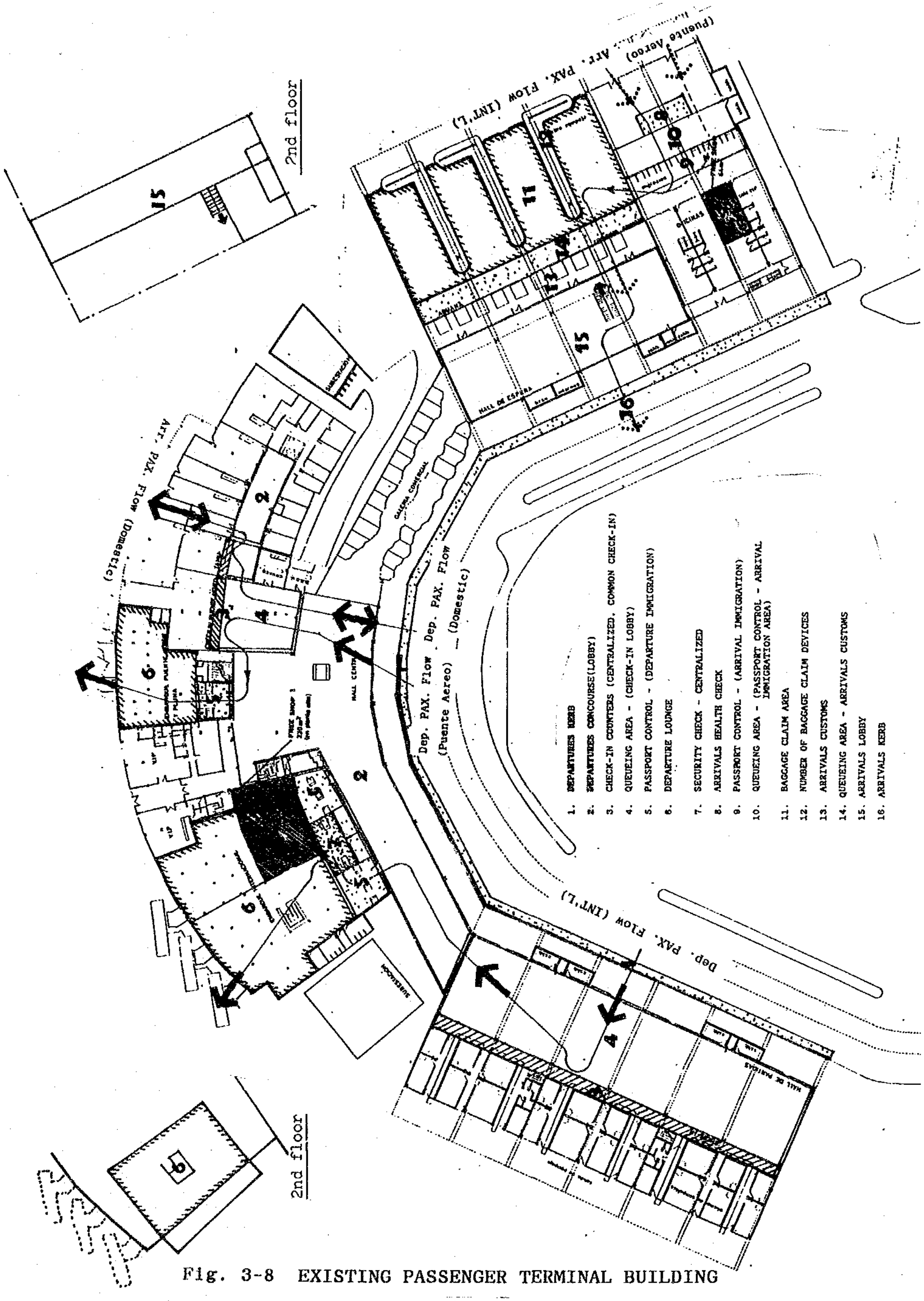


Fig. 3-8 EXISTING PASSENGER TERMINAL BUILDING

Table 3-7 Summary of building floor space and actual capacity of major terminal facilities

	① Central Terminal	② Departure Terminal	③ Arrival Terminal	Total actual eapacity by facility
A. Total Floor Space (approx)	7,700m^2	3,800m^2	4,500m^2	16,000m^2
B. Major Terminal - Public Area Facilities (Total)	(3,764m^2)	(1,814m^2)	(2,552m^2)	(8,130m^2)
1. DEPARTURES KERB	100m	—	—	100m
2. DEPARTURES CONCOURSE (LOBBY)	1,916m^2	—	—	1,916m^2
3. CHECK-IN COUNTERS (CENTRALIZED, COMMON CHECK-IN)	6× 30=180m^2	18×30=540m^2	—	24×30=720m^2
4. QUEUEING AREA- (CHECK-IN LOBBY)	170m^2	1,224m^2	—	1,394m^2
5. PASSPORT CONTROL- (DEPARTURE IMMIGRATION)	4×10=40m^2	5×10= 50m^2	—	9×10= 90m^2
6. DEPARTURE LOUNGE	1,438m^2	—	—	1,434m^2
7. SECURITY CHECK- CENTRALIZED	2×100=200m^2	—	—	2×100=200m^2
8. ARRIVALS HEALTH CHECK	—	—	2×60=120m^2	2×60=120m^2
9. PASSPORT CONTROL- (ARRIVAL IMMIGRATION)	—	—	8×20=160m^2	8×20=160m^2
10. QUEUEING AREA-(PASSPORT CONTROL-ARRIVAL IMMIGRATION AREA)	—	—	120m^2	120m^2
11. BAGGAGE CLAIM AREA	—	—	520m^2	520m^2
12. NUMBER OF BAGGAGE CLAIM DEVICES	—	—	3×40=120m^2	3×40=120m^2
13. ARRIVALS CUSTOMS	—	—	10×30=300m^2	10×30=300m^2
14. QUEUEING AREA-ARRIVALS CUSTOMS	—	—	192m^2	192m^2
15. ARRIVALS LOBBY	—	—	1,020m^2	1,020m^2
16. ARRIVALS KERB	—	—	100m	100m
C. Airline Offices	761m^2	1,540m^2	—	2,301m^2
D. Concessions	2,030m^2	—	405m^2	2,435m^2
E. Administrative and Technical	950m^2	—	670m^2	1,620m^2
F. Others	195m^2	446m^2	873m^2	1,514m^2

3-2-2 Cargo Terminal Facilities

Fig. 3-9 shows existing cargo terminal building and Fig. 3-10 shows schematic actual cargo flow. And result of survey and analysis of existing cargo terminal facilities shows Table 3-8.

(1) Export facilities

The freight airlines have their offices along the main road. They are nineteen in number.

Goods for export, (such as wool, leather and articles derived from leather and fabrics) are unloaded at a dock and stored on the warehouse floor only a few hours before aircraft departure. Customs control is made while loading, along with documentation control and sampling. Then they are gathered either in structural containers or in an igloo, depending on the gauge of the plane into which they will be loaded.

Pallet build-up operations are carried out at the place where goods are loaded. So, when preparing for several flights, the moving of trucks and pallets requires a lot of space.

Cargo traffic is divided into two parts: 50% on cargo flights, 50% on passenger flights. The regular cargo flights are as follows:

LAN CHILE	once a week
FASTAIR	twice a week
LUFTHANSA	once a week
AIR BOLIVIANO	once a week

(2) Import Cargo Facilities

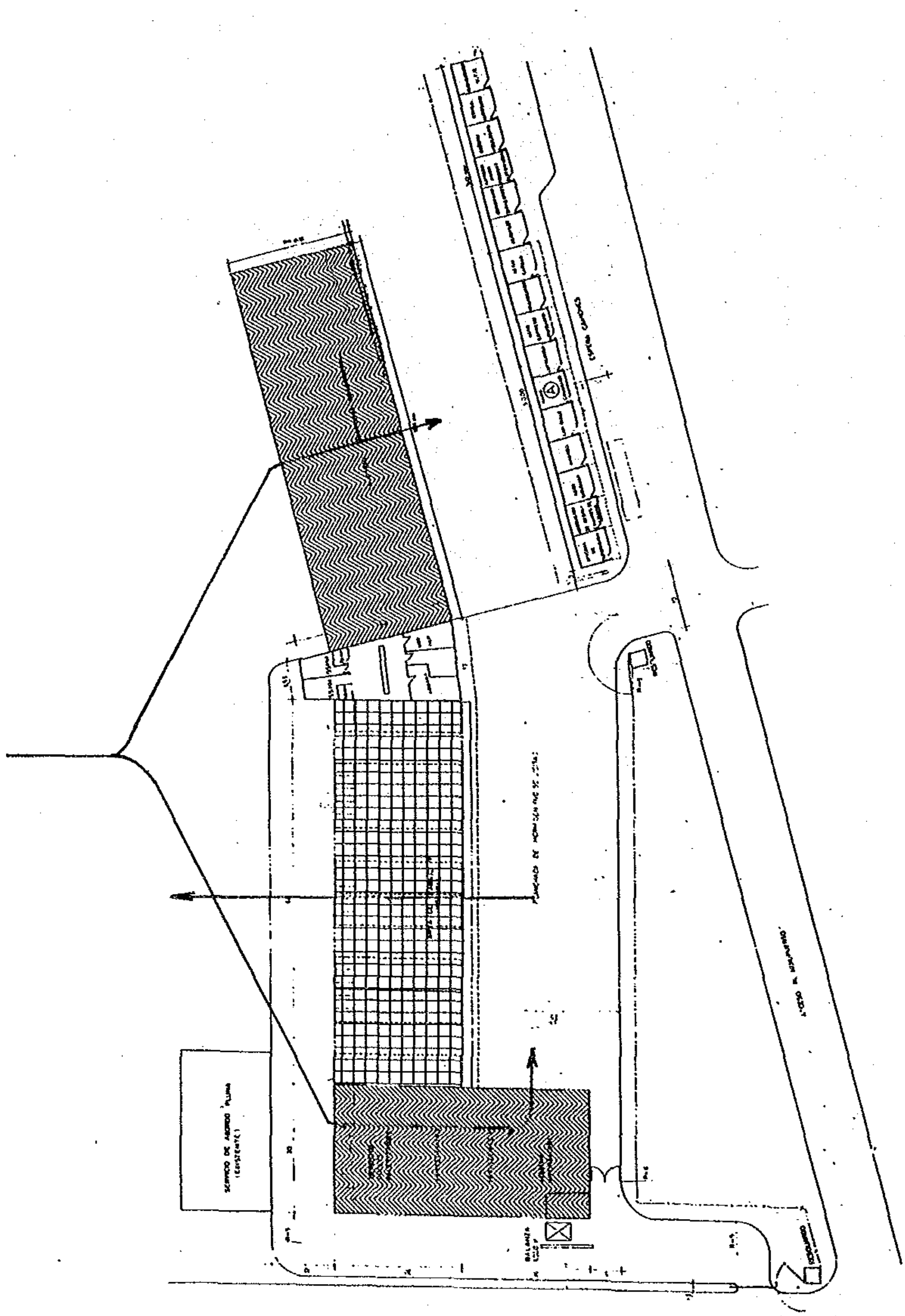
The import cargo building is divided into three areas:

Reception area (25 x 13 m) where goods are controlled by Customs, DGIA and airlines.

Storage area (55 x 25 m) where goods are stored.
Clearing through customs control area (20 x 12 m).

At the present time, according to the person in charge of cargo facility, 50% of goods would be loaded within one week, about 48% within a period of 15 to 20 days and a small part may stay as long as 6 months. Customers have to pay a tax if they want to keep their goods more than 120 days before taking them out.

Fig. 3-11 shows average stored period after import cargo arrival at the airport.



EXPORT AREA

IMPORT AREA

Fig.3-9 Existing Cargo Terminal Building

Fig. 3-10 SCHEMATIC ACTUAL CARGO FLOW

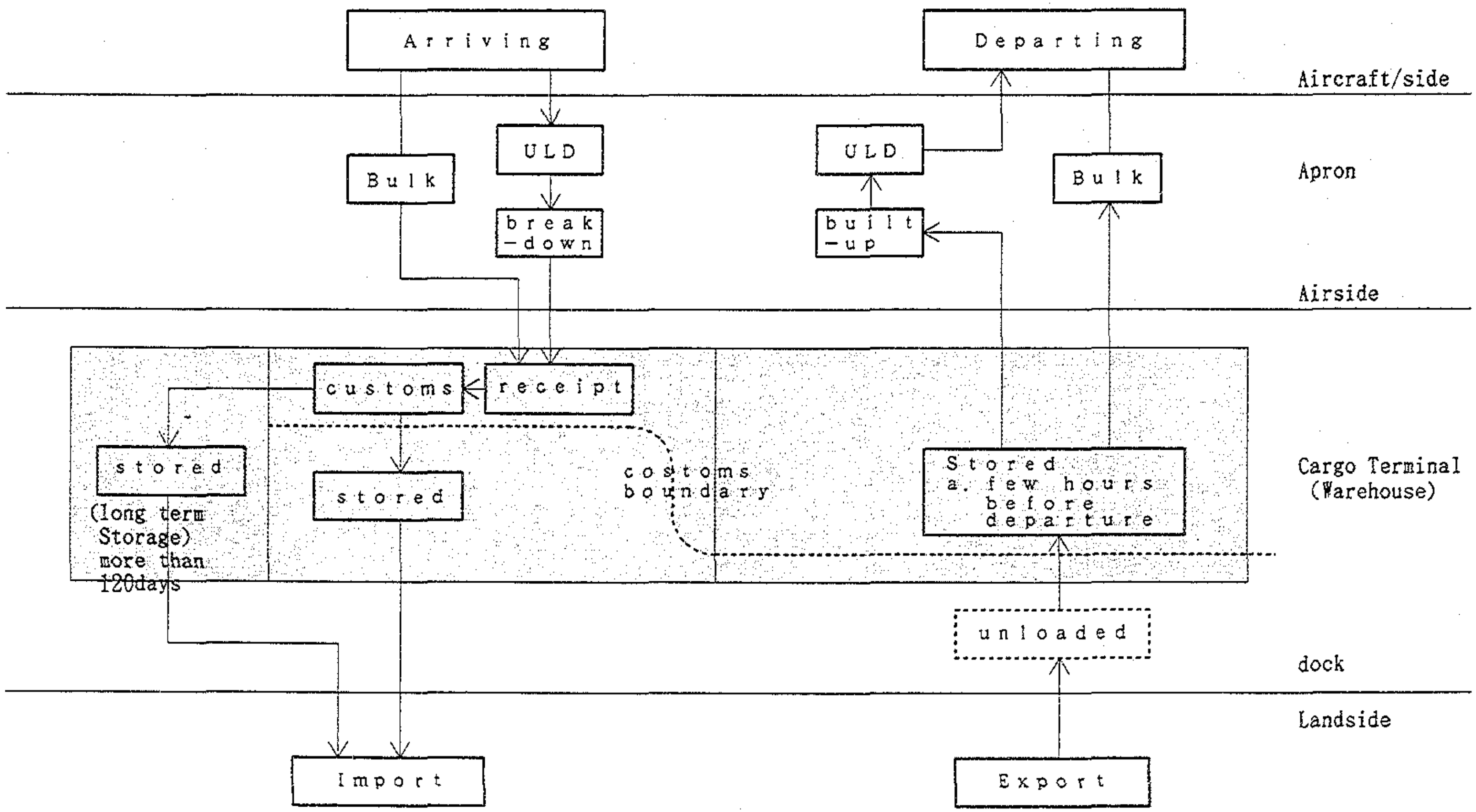


Fig. 3-11 ACTUAL STORED PERIOD OF IMPORT CARGO

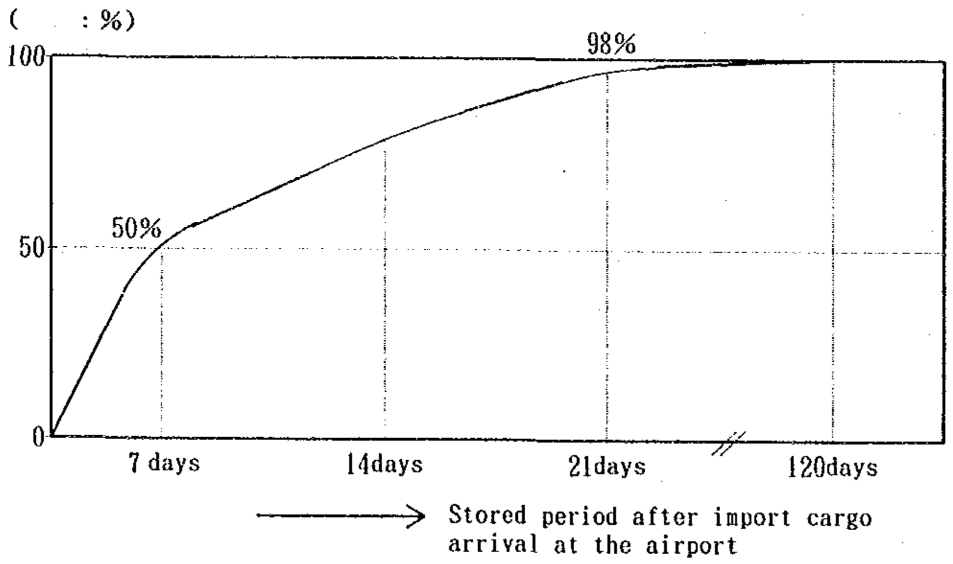


Table 3-8 summary of existing situation on the cargo facilities

Name of Facilities	Dimension and area (floor space)	Observations	Output rate of facility
Cargo Apron			
Export Cargo Facilities	Depth x Width 20 M x 60 M 1,220 M^2	Actually warehouse has been used only a few hours before departure	5.8 ton/m^2 per year
Import Cargo Facilities	Depth x Width 15 M x 77.6 M 1,940 M^2	receipt area 325 m^2 stored 1,375 m^2 customs 240 m^2	2.0 ton/m^2 per year
	20 M x 40 M 800 M^2	long term storage (more than 120 days)	
Airline Offices	400 M^2	19 cargo airlines	
Customs Offices	260 M^2		

3-2-3 Car Parks

(1) Current situations

Car Parks in the passenger terminal area consist of following blocks;

1) Administration block for D.G.I.A. and PLUNA
2) Public block for private cars
3) Taxi waiting block

Of these blocks, public block is divided into pay parking lot and free parking lot. Fig. 3-12 shows existing car flow and layout of car parks.

(2) Actual capacity

Based on the result of survey on the existing car parks, actual capacity has been analyzed.

Table 3-9 shows actual parking spaces and capacities of car parks related to passenger handling.

Table 3-9 Actual Parking Spaces and Capacities

	Actual Space (M^2)	Actual Capacity number of parking lot	Note
1. Administration Block			
a. D.G.I.A.	930	930 ÷ 20 = 46	
b. PLUNA	1,400	1,400 ÷ 20 = 70	
2. Public Block			*effective factor using
a. Pay parking lot	3,000	(3,000 x 0.7)* ÷ 20 =105	for parking space
b. Free parking lot	A 3,800	(7,200 x 0.7)* ÷ 20 =252	
	B 3,400	Total 357	
3. Taxi Waiting Block	---	---	

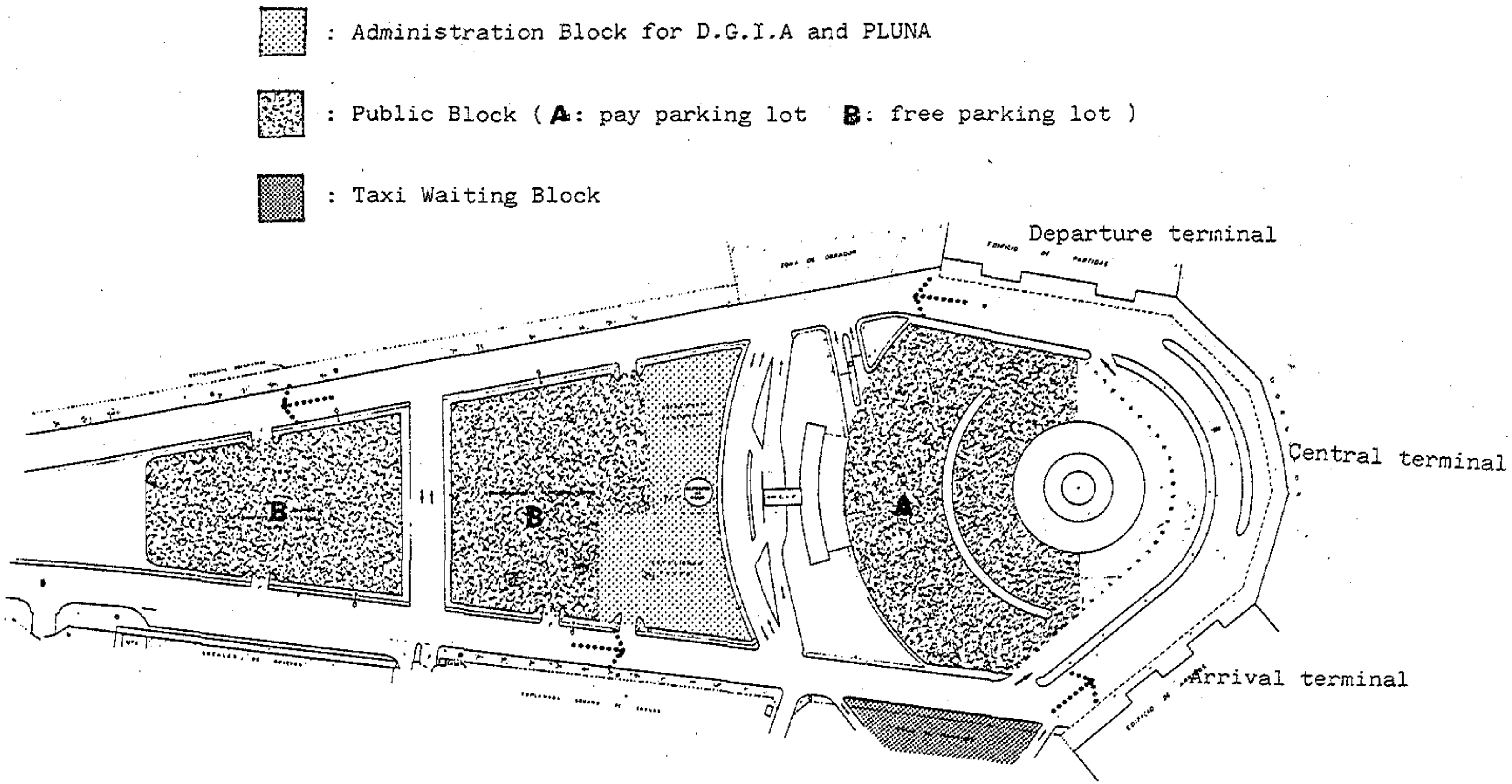


Fig. 3-12 EXISTING CAR FLOW AND LAYOUT OF CAR PARKS

3-2-4 Rescue and Fire-Fighting Facility

(1) Airport Category

This airport falls in Category 8 Airport in accordance with ICAO Airport Service Manual (Doc 9137).

(2) Fire-Fighting Vehicles

The airport fire brigade has following fire-fighting vehicles and meets the ICAO requirement for Category 8 Airport;

VEHICLE NO.	MAKER	YEAR	WATER CAPACITY	FOAM CAPACITY
501	DODGE	1988	1.2 M^3	0.14 M^3
502	M. BENZ	1989	10.0 M^3	1.2 M^3
503	M. BENZ	1989	10.0 M^3	1.2 M^3
221	M. BENZ	1987	10.0 M^3	
124	M. BENZ	1951	10.0 M^3	
161	M. BENZ	1972	10.0 M^3	
204	M. BENZ	1987	2.5 M^3	0.5 M^3
120	CHEVOLET	1976	AMBULANCE	
124	CHEVOLET	1976	AMBULANCE	

(3) Problems

In the fire brigade, there is no elevated water tank or similar facility to supply water to the fire-fighting vehicles in emergency.

3-2-5 Fuel Oil Facility

(1) Operation

The supply of the fuel oil in the airport to the airlines is performed by three oil companies; ANCAP, ESSO and SHELL. Each company has its own fuel depot and operates independently. ANCAP is a national company and supplys fuels to other oil companies exclusively. The fuels are delivered to each oil depot by tank tracks and supplied to aircraft by refuellers. There is no hydrant system. Each airline has a contract with one of the three oil companies for supply of the fuels.

(2) Oil Facility

Fig. 3-13 shows the existing fuel oil facilities.

The fuel oil facilities were constructed in 1947 and since then there is no basical modification nor renewals.

The capacity of oil depot of each oil company is as follows;

ANCAP:	seven 90KL tanks	630KL
ESSO:	three 100KL tanks	300KL
SHELL:	four 90KL tanks	360KL
	Total	1,290KL

(3) Fuel Oil Supply Volume

The supply record of JET A-1 in the past three years is as follows;

1986	29,534KL
1987	34,915KL
1988	32,136KL

Each oil company's share was almost one third.

(4) Problems

ESSO and SHELL oil depots have no oil-water separators for storage tank yards and oil handling areas. In ANCAP's facility, there is no oil-water separator in oil handling area.

All depots should have pressurized air foam fire-fighting systems and fire water main.

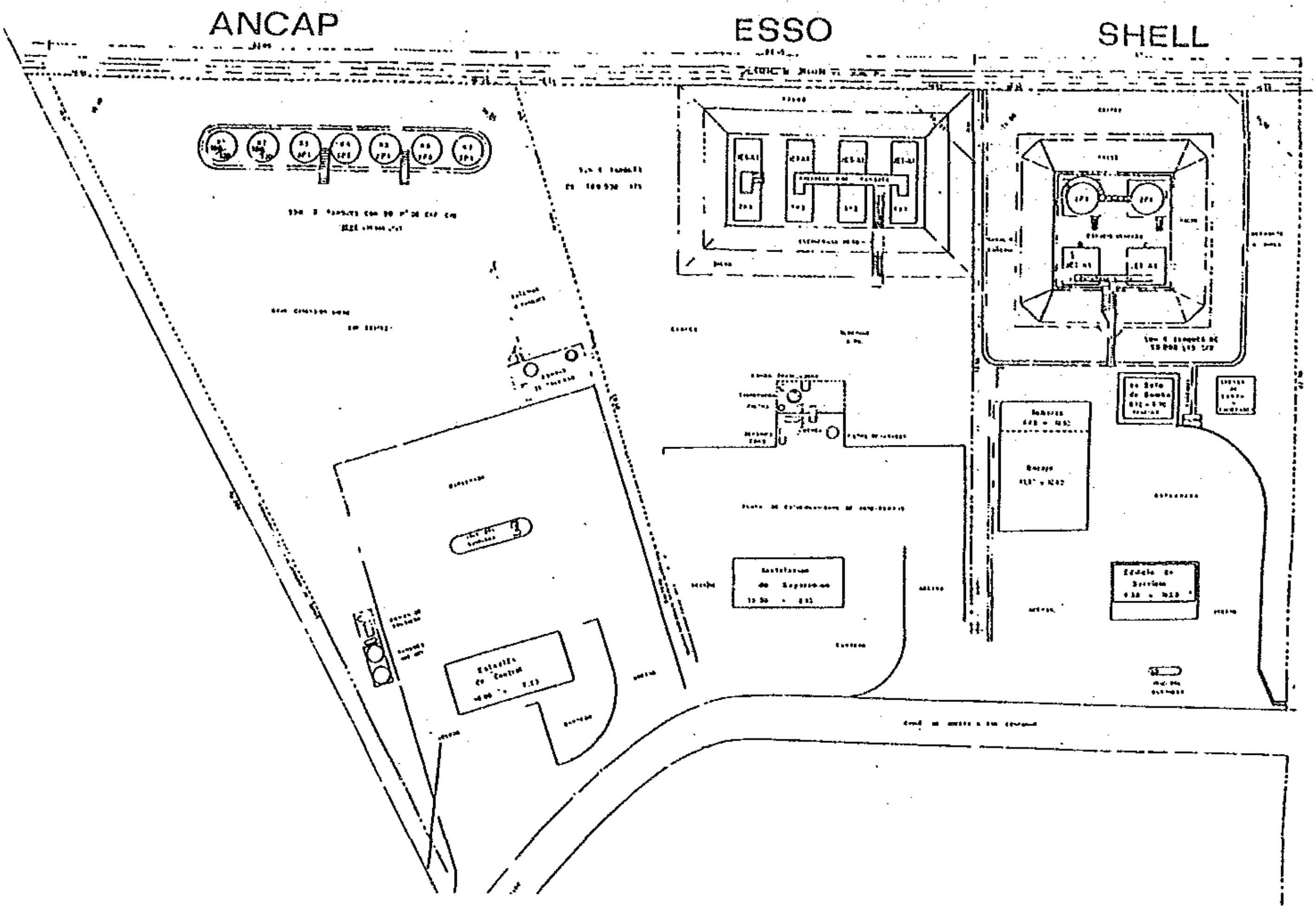


Fig. 3-13 EXISTING FUEL SUPPLY FACILITIES
(located at military area)

3-2-6 Water Supply Facility

(1) Facility

Public water is received by a 75 M^3 water tank which is located in the parking area in front of the airport terminal building and constructed in 1979. From this tank, water is sent by pumps through 75 MM pipe to the 58 m^3 water tank, which is a part of the control tower of the airport terminal building. From the latter tank, water is distributed by gravity.

(2) Water Consumption

The monthly water consumption in the terminal building in the last year was as follows;

Average:(February to December)5,714 m^3(190 m^3/day)

Minimum:(July) 4,954 m^3(160 m^3/day)

Maximum:(May) 6,560 m^3(212 m^3/day)

(3) Water for Airport Fire Brigade

The 75 m^3 water tank is supplying water to the airport fire-fighting vehicles.

(4) Problems

Capacity of water tanks are too small. To secure stable water supply, two days water reserve should be required.

3-2-7 Sewage Facility

(1) Facility

The plant was constructed in 1981 to treat 15,000 liters of sewage from airplanes, the terminal building and other facilities within the airport boundary. The sewage is treated biologically by injecting air into the oxidation pond. The sewage from the terminal building and other facilities is sent to the pond through underground pipes by gravity. The sewage from the airplanes is collected by a sewage tank car and dumped to the pond directly.

(2) Improvement of Underground Pipes

The underground sewage pipe from the terminal building runs through the apron yard. Because of the difficulty in maintenance, D.G.I.A. is planning to construct a new underground piping system in which forced flow method by pumps are considered. This plan will be materialized by D.G.I.A. in near future.

(3) Sewage Volume

Available data for daily sewage volume is only for 19 days in February in 1980 and it shows;

Average	187 m^3/day
Minimum	90 m^3/day
Maximum	250 m^3/day

(4) Problems

Effluent water from the sewage treatment plant should be regulary checked to avoid public polution.

3-2-8 Garbage Handling Facility

(1) Present Situation

At present, there is no garbage handling facility such as an incinerator in the airport except a four ton track which collects eight or nine garbage every day from airport facilities and airplanes and dump it to a wasteland outside the airport.

(2) Problems

Incinerator plant should be required.

3-3. Air Navigation Facilities

3-3-1 Radio navigation aids

Location of radio navigation aids are shown in Fig. 3-14 and Fig. 3-15.

(1) ILS

Category I ILS is installed to serve aircraft landing on the runway 24. The ILS comprises localizer (LLZ), glide slope (GS), middle marker (MM) and outer marker (OM). All the equipment were initially installed in 1970, and modulators of LLZ and GS were modified in 1980.

The equipment, except the modulators of LLZ and GS, are aged and out-of-date.

Major data on the ILS are shown below.

- Frequencies:	LLZ 109.9 MHz
	GS 333.8 MHz
- GS Angle:	2.8
- RDH:	21.10 m

(2) VOR/DME

VOR was installed in 1968 and DME in 1973. The facilities are operated in normal condition, however, the equipment become aged and out-of-date.

Frequency and output power of the VOR/DME are shown below.

	VOR	DME
- Frequency	116.9 MHz	116 X
- Output Power	100 W	3 kW

(3) NDB

Two sets of NDB, "CAR" and "CRO", and three locators, "AR" "CA" and "BC" are installed in the airport. The NDB and locators, except "CAR" NDB, were installed in 1980 and the "CAR" NDB in 1971. All the facilities are operated in good condition.

Major data on the NDBs and locators are shown below.

	Frequency	Coverage	Location
- "CAR" NDB	380 kHz	489 km	8 km north from RWY19 end and on the extended centerline of the RWY.
- "CRO" NDB	305 kHz	25 km	940 m north from RWY19 and on the extended center-line of the RWY
- "AR" Locator	260 kHz	25 km	Co-located with MM of RWY24 ILS
- "CA" Locator	280 kHz	25 km	Co-located with OM of RWY24 ILS
- "BC" Locator	298 kHz	25 km	8 km west from R/W 06 end and on the extended centerline of the RWY.

3-3-2 Air Traffic Control Facilities

Area control, approach control (or IFR control) and aerodrome control (or VFR control) services are provided, and in near future radar control services will be introduced to the area control as well as to the IFR control.

Location of air traffic control (ATC) facilities for these services are shown in Fig. 3-14.

3-3-3 Communications

Following services are provided:

- Tele-typewriter communications via AFTN
- ATS direct speech circuit
- HF en-route radio telephony networks
- Airport telephone system

Existing AFTN system configuration is shown in Fig. 3-16, and Direct speech system configuration is shown in Fig. 3-17.

3-3-4 Meteorological observations

Following items are observed at meteorological station:

- Wind direction
- Temperature
- Atmospheric pressure
- Rainfall
- Visibility (Without RVR)
- Ceiling

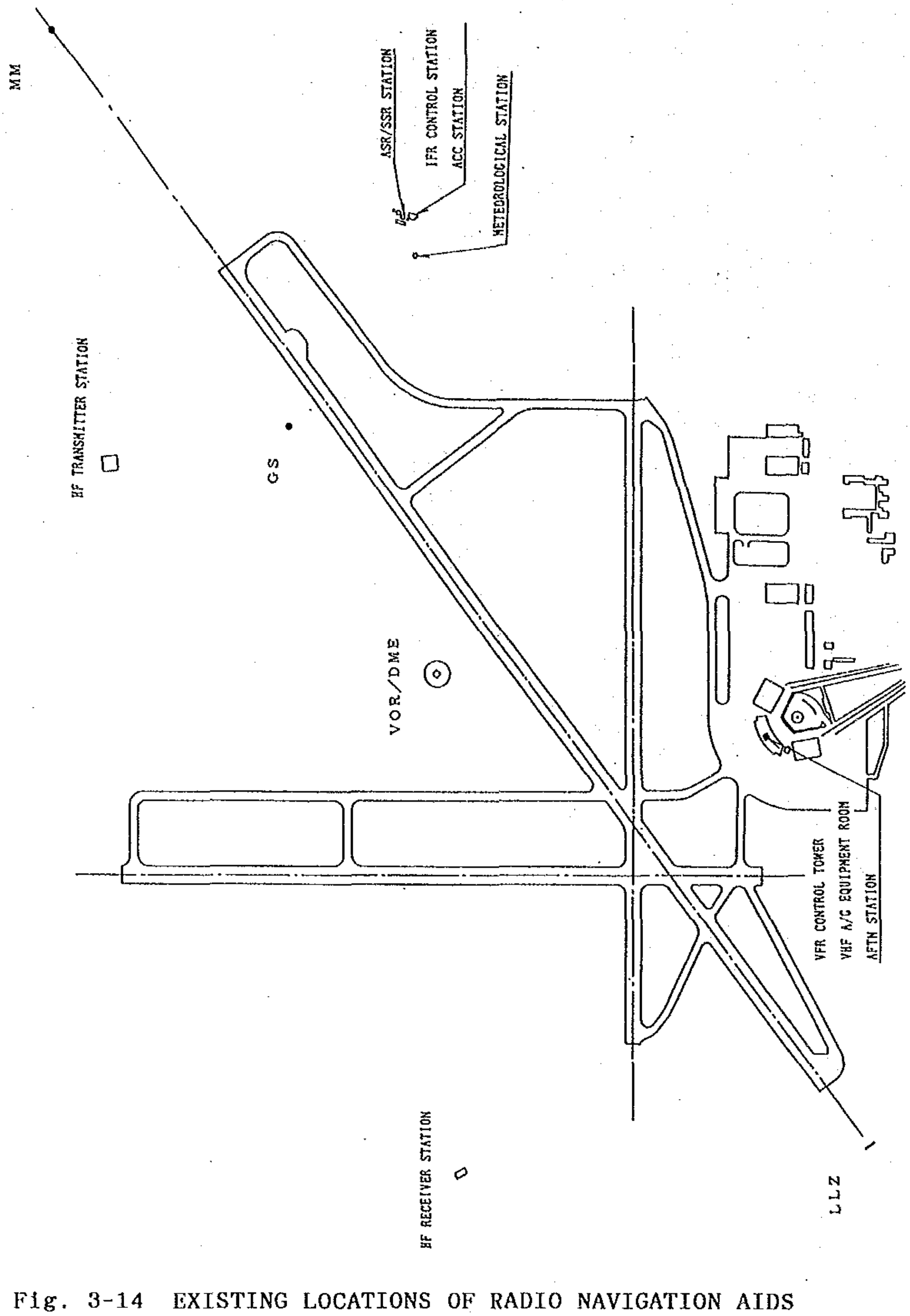


Fig. 3-14 EXISTING LOCATIONS OF RADIO NAVIGATION AIDS INSIDE THE AIRPORT

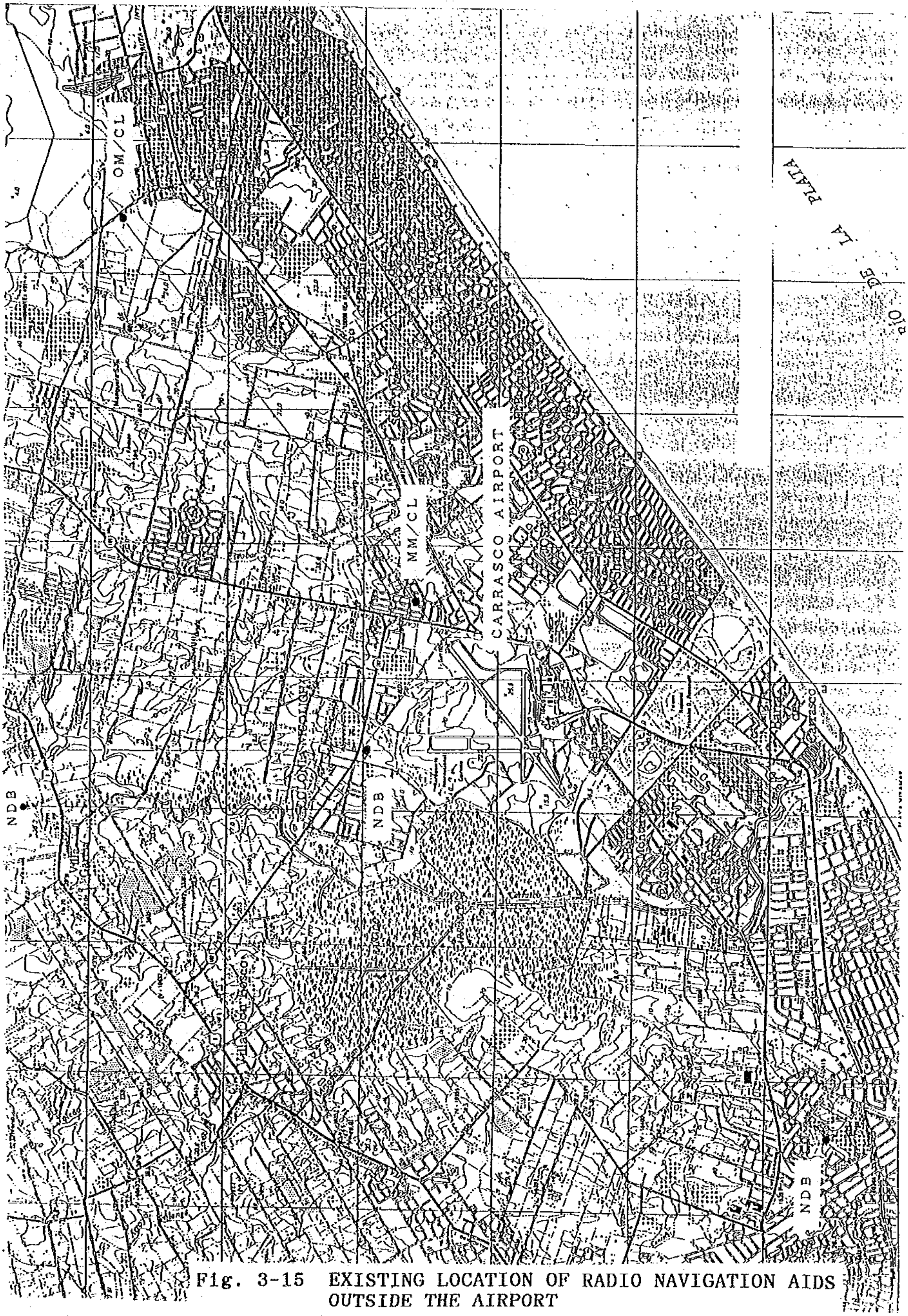


Fig. 3-15 EXISTING LOCATION OF RADIO NAVIGATION AIDS
OUTSIDE THE AIRPORT

AFTN SYSTEM CONFIGURATION

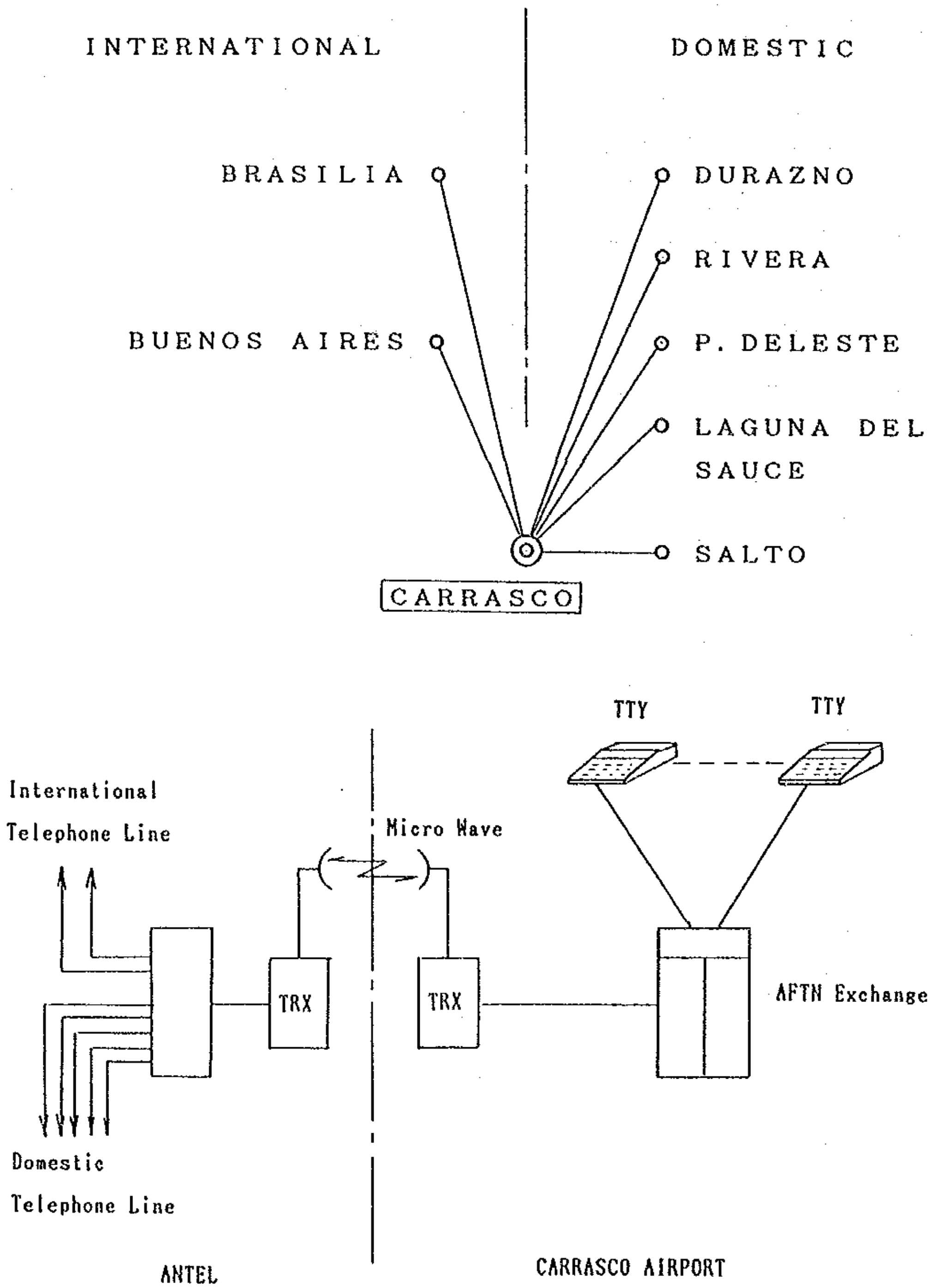


Fig. 3-16 EXISTING AFTN SYSTEM CONFIGURATION

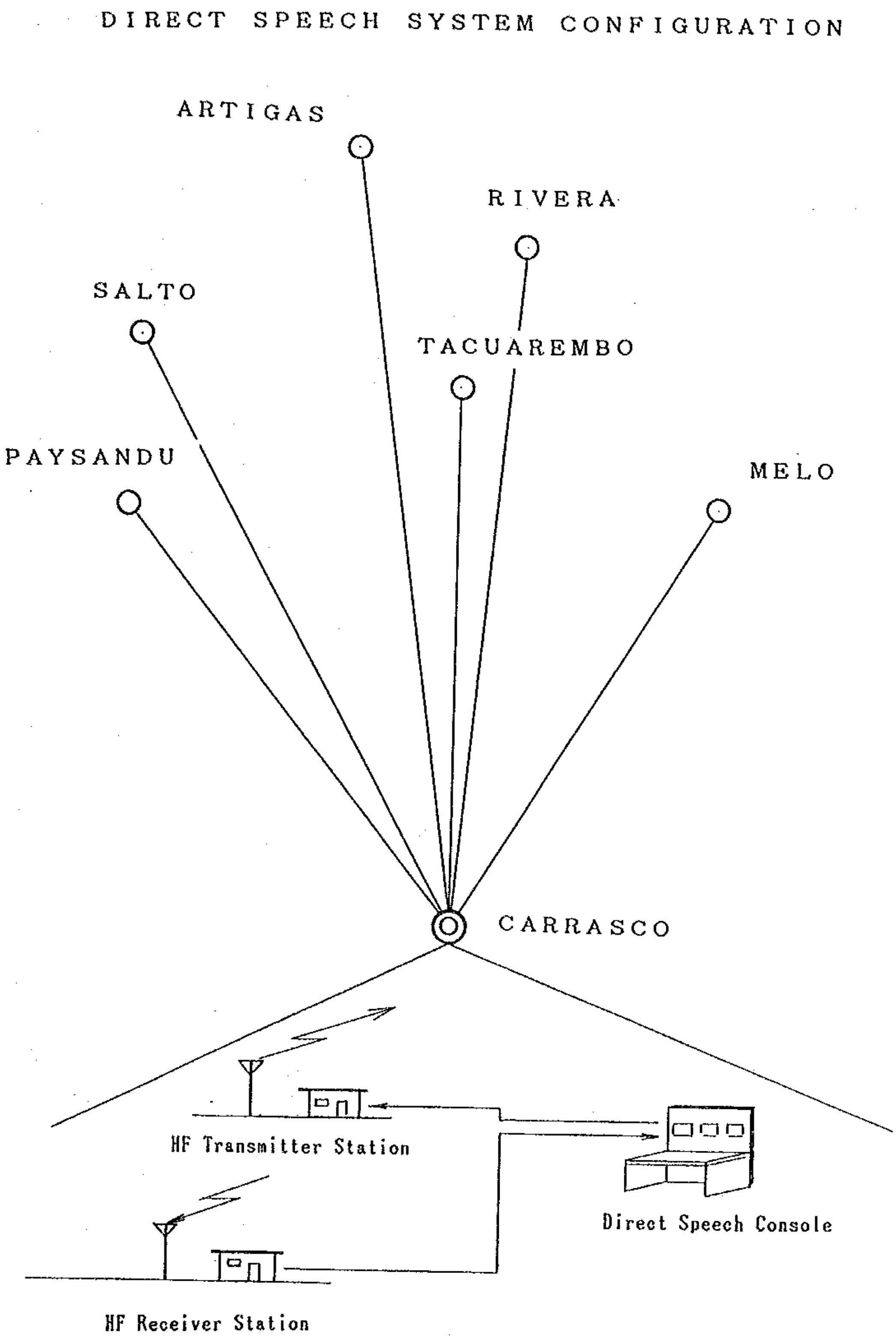


Fig. 3-17 EXISTING DIRECT SPEECH SYSTEM CONFIGURATION

3-3-5 Visual Aids

Existing conditions of visual aids are shown below.

Facility		Lighting equipment	Year of installation	Dimension	Operating conditions
RWY06/24	RWY24	Simple Approach Lighting System (SALS)	1977	Length: 330 m Interval: 30 m	Lamp intensity is not suitable for ICAO standards.
		Sequenced Flashing Lights (SFL)	1977	Length: 300 m Interval: 60 m	Lamps are damaged and out of service.
	RWY06	Runway End Identification Lights (REIL)	1977	--	Out of service
		VASIS	1975	3-bar VASIS	Under normal operation
	RWY06/24	Runway Edge Lights	1971	Interval: 60 m	Under normal operation
		Runway Center Line Lights	1981	Interval: 30 m	
		Runway Threshould and End Lights	1970	--	Some lights are out of service.
		Wingbar Lights	1970	--	Some lights lost.
	RWY24	Runway Touch Down Lights	1981	--	Out of service.

Facility		Lighting equipment	Year of installation	Dimension	Operating conditions
RWY01/19	RWY19	Simple Approach Lighting System	1977	Length: 300 m Interval: 30 m	Lamp intensity is not suitable for ICAO standards.
		VASIS	1972	2-bar VASIS	Under operation
	RWY01	Runway End Identification Lights	1977	--	Under operation
	RWY01/19	Runway Edge Lights	1972	Interval: 60 m	Under operation
		Runway Threshould and End Lights	1980	--	Under operation
TWY - A TWY - B TWY - D		Taxiway Edge Lights	1971 Extended part of TWY-B 1980.	--	Under operation
Apron		Apron Flood Lights	14 lights in 1970 and 4 lights in 1988	--	Brightness is not enough.
		Aerodrome Beacon	1970	--	Under operation

FACILITY	SYMBOL	NOTE
APPROACH LIGHTING SYSTEM	⊂⊂⊃⊃	
SEQUENCED FLASHING LIGHT	⊠	Out of service
RUNWAY THRESHOLD INDENTIFICATION LIGHT	◘	
VISUAL APPROACH SLOPE INDICATOR SYSTEM	○○□	
RUNWAY EDGE LIGHT	○ ◐	
RUNWAY THRESHOLD LIGHT, END LIGHT	◒◒◒◒	
WINGBAR LIGHT	●●●	
RUNWAY CENTER LINE LIGHT	○ ○	
RUNWAY TOUCHDOWN ZONE LIGHT	▭▭	Out of service
TAXIWAY EDGE LIGHT	◦	
AERODROME BEACON	⊕	
APRON FLOOD LIGHT	▽	

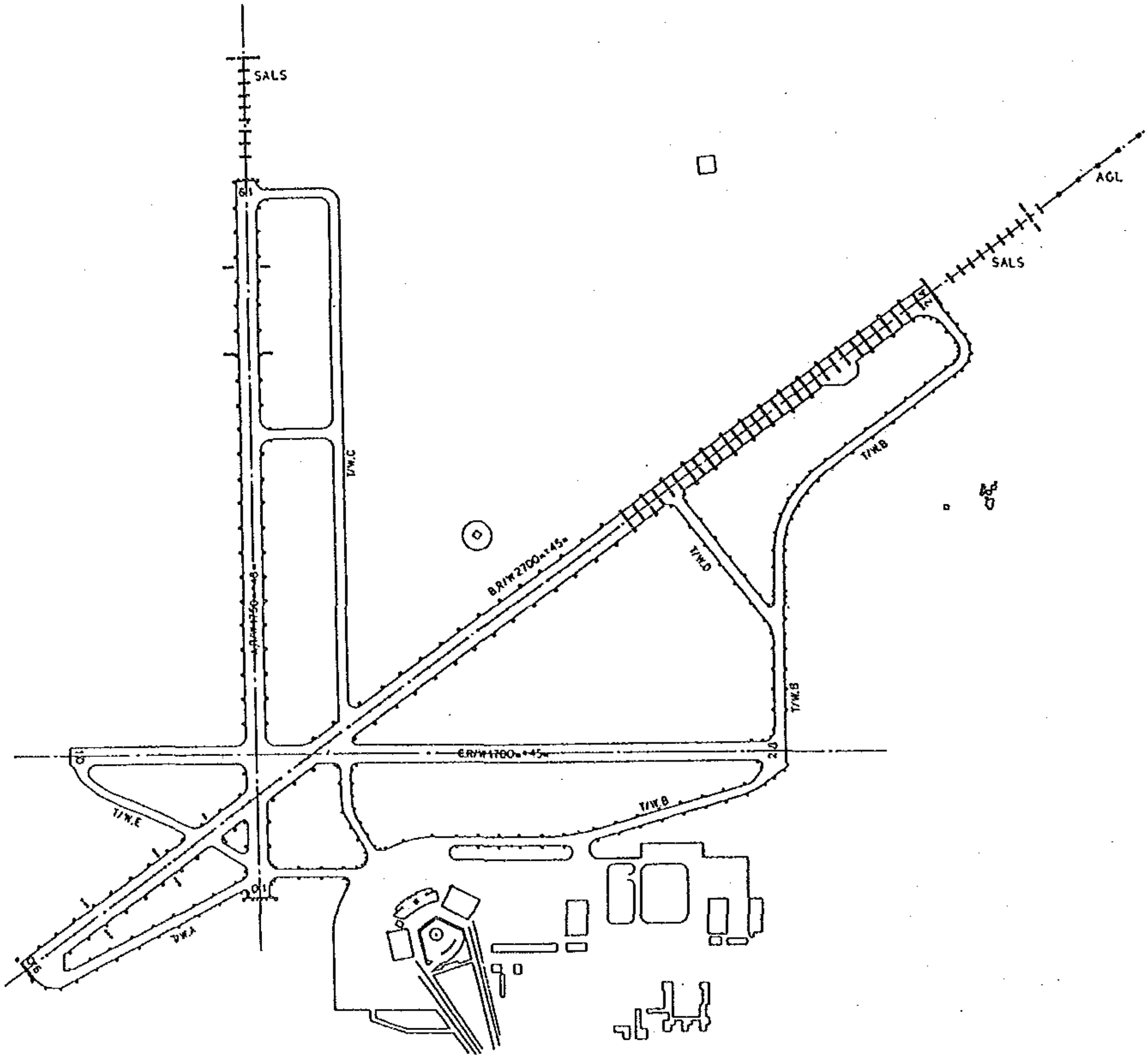


Fig. 3-18 EXISTING LAYOUT OF VISUAL AIDS

3-3-6 Electrical Power Supply

There are three main substations and two small substations in the airport.

The three main substations are located in the terminal area. One small substation located, in the HF transmitting station and other one is in the HF receiving station.

The configuration diagram of three main substations is shown on Fig. 3-19.

(1) SUBSTATION-1

Substation-1 is located in basement of the terminal building. It was installed in 1943. The substation-1 equipped two engine generators and one power distribution panel.

Those facilities are barely operated by good maintenance work.

(2) SUBSTATION-2

Substation-2 is located at east side of the terminal building. It was installed in 1985. The substation-2 equipped two engine generators and one power distribution panel.

Those facilities has good operation condition and enough capacity.

(3) SUBSTATION-3

Substation-3 is located at the west side of the Terminal building. It was installed in 1970.

The substation-3 equipped one engine generator, one transformer (for VOR/DME.ILS) and five constant current regulator (CCR) in the station.

The power source for this substation is supplied from substation-1. Those facilities operate in good condition.

(4) SMALL SUBSTATIONS

Facilities are still operated but already aged.

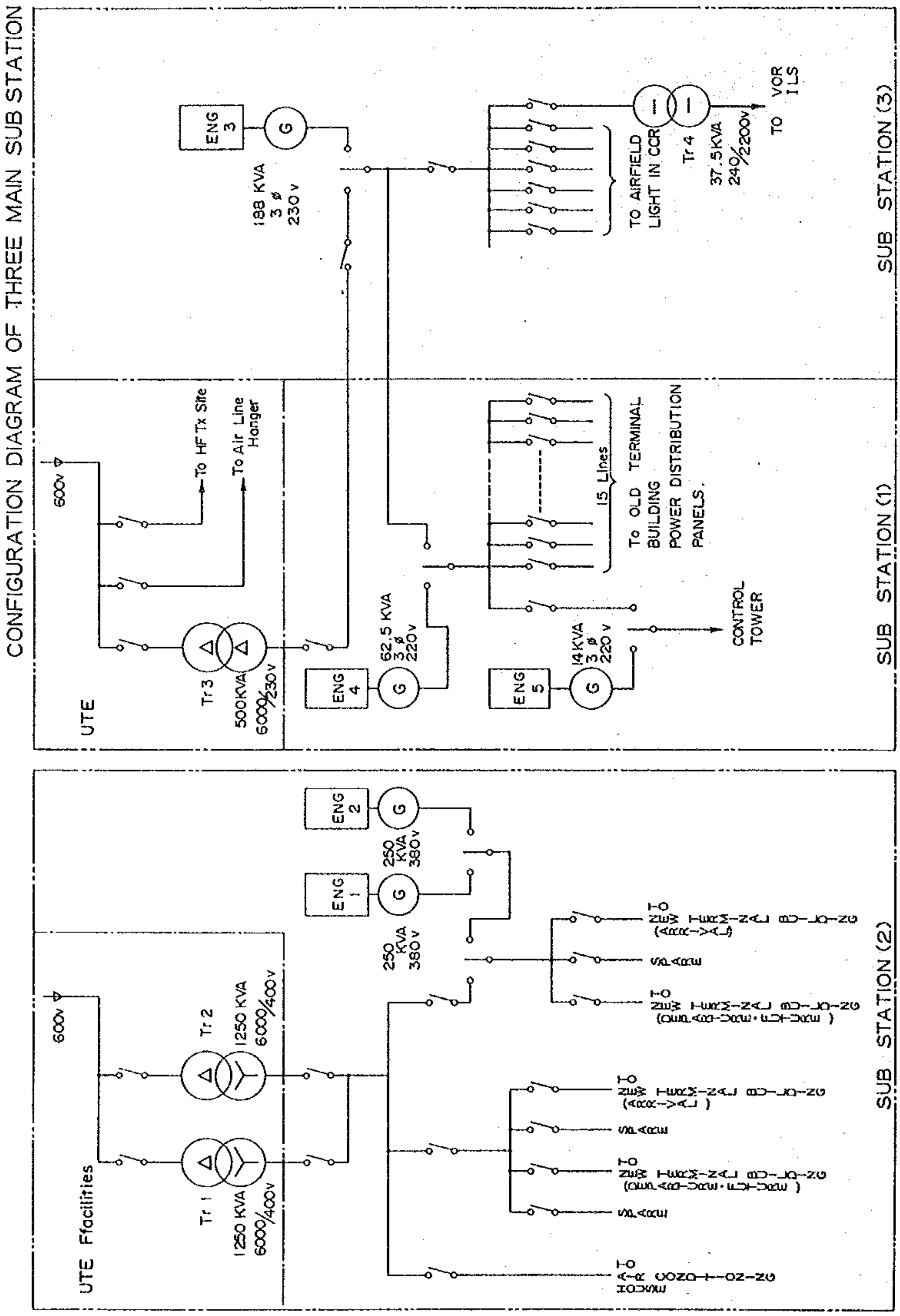


Fig. 3-19 DIAGRAM OF EXISTING MAIN SUBSTATIONS

3-3-7 Air space operational conditions

Radar facilities were installed in 1987 and radar control procedures will be commenced in the near future.

As the result of the survey for the air traffic control services and the airspace utilizations, major problems have been summarized as follows:

- Size of the terminal approach control area (now about 30nm radius from Carrasco) is small for the establishment of arrival routes.
- Restricted area R3, R4, R5 prohibited area P9, P20 and DEC 152/972 hinder for the establishment of instrument approach and departure procedures defined by ICAO standard.
- Also standard traffic pattern at the east side of the Artigas aerodrome are contiguous by the ILS final approach on RWY24.

While being not described on AIP, operators are requested to adopt noise abatement operating procedure (steepest climb procedure) when aircraft take off by SARGO 1 DEP (CRR R263) and KORVA 1 A (CRR R253) DEP.

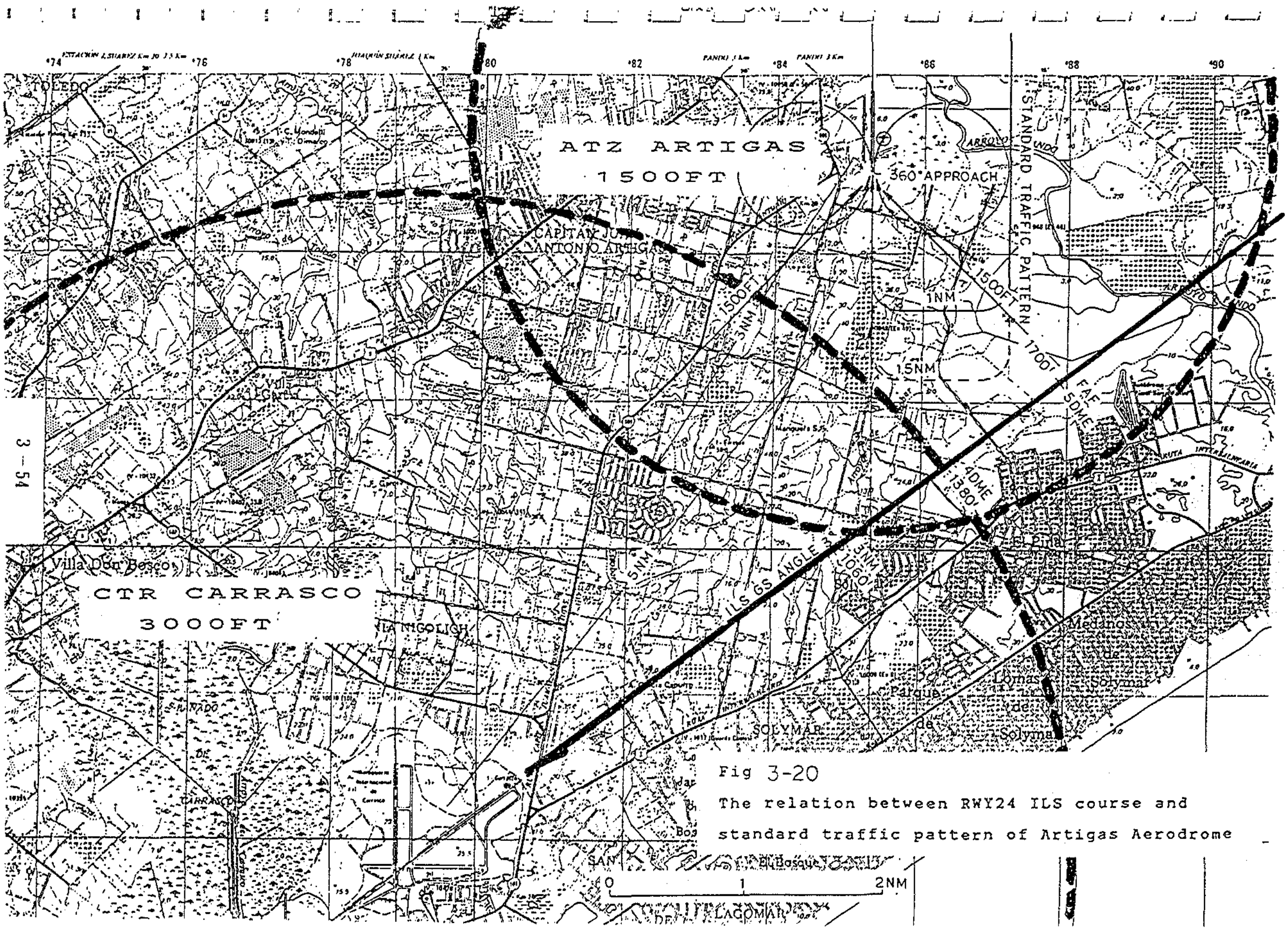
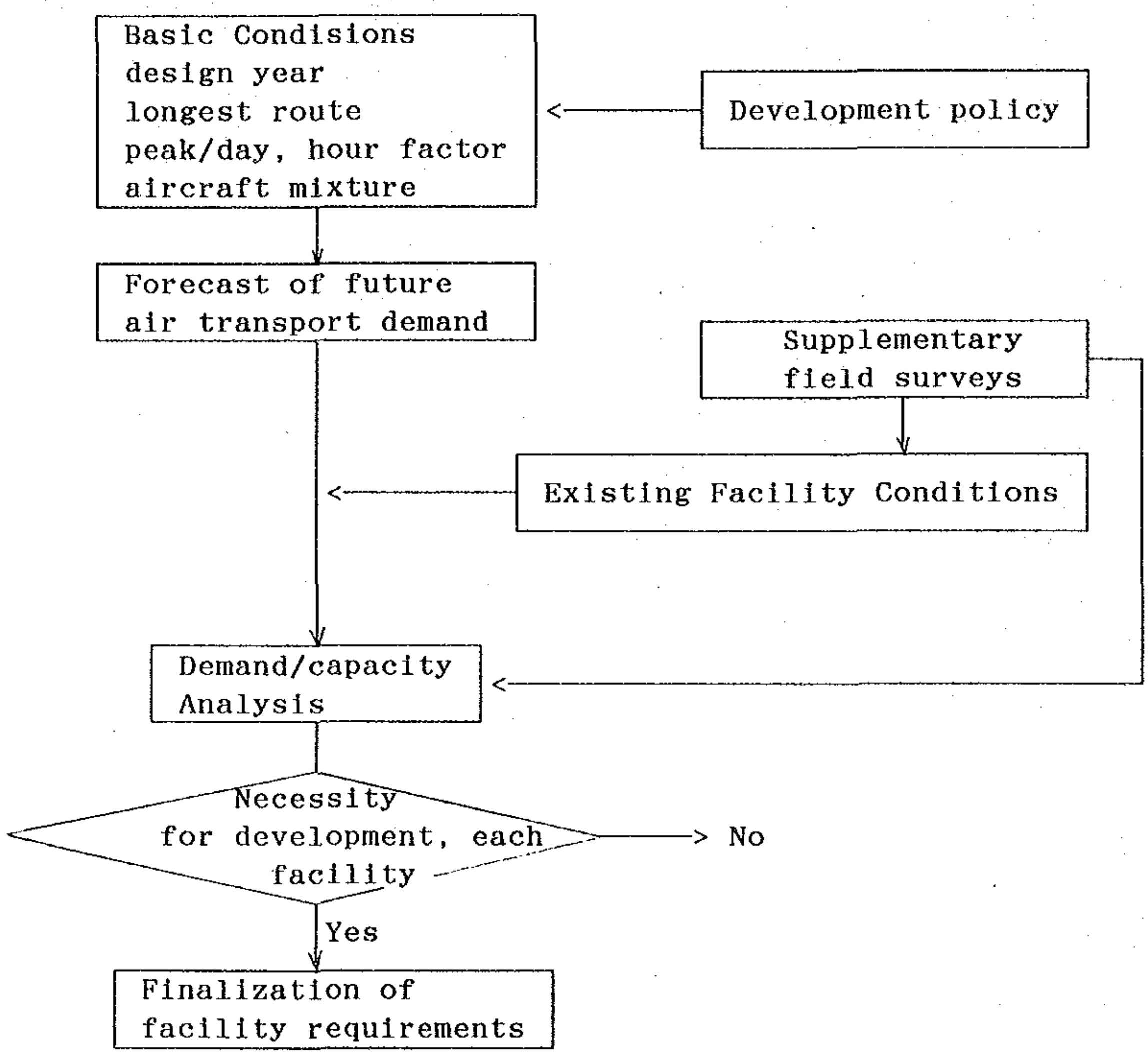


Fig 3-20
The relation between RWY24 ILS course and standard traffic pattern of Artigas Aerodrome

CHAPTER 4

FACILITY REQUIREMENTS

Requirements for airport facilities are established through demand/capacity and facility requirement analysis, basen on the following sequence.



4-1. Basic Contiditons

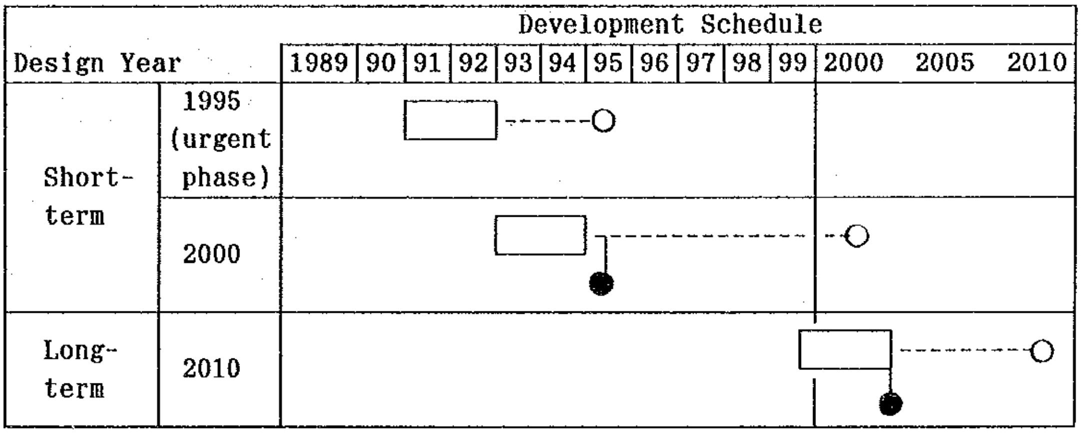
4-1-1 Design Years

For the purpose of the present feasibility study, design years of development are set at 2000 for Short-term Development, and 2010 for Long-term Development.

However, in order to cope with urgent requirements for runway improvement, Short-term Development will be divided into two phases: Phase 1 for urgent development set at 1995 and Phase 2 set at 2000.

For the sake of optimizing investment effects, relation between design year and its expected completion date should be as shown Table 4-1.

Table 4-1 Development Schedule



● : Completion of Development

○ : Desigh Year

▭ : Duration of the Development
(Design and Construction)

4-1-2 Longest Direct Route in Each Design Year

According to the air transport forecast, number of regional International passengers will increase to 276,000 in 2000 from 157,000 in 1988.

Therefore, direct flight to major cities of regional area will be required, and Rio De Janeiro is selected as the farthest direct destination in design year 2000.

In design year 2010, no further direct destination will be required, according to analysis of air transport forecast.

However, it will be desirable to improve airport facilities accommodating the longest route in South America.

In this case, Caracas is selected as the farthest direct destination in design year 2010.

4-1-3 Peak-day and Peak-hour Movement

(1) General

In accordance with the result of survey on the existing airport situation and airport facilities, and on analysis of transport demand forecast, the following two factors in the years 1995, 2000 and 2010 are established as the "basic design data" for the calculation of facility requirements and demand/ capacity analysis.

1) aircraft mixture
2) peak-day and peak-hour aircraft, passenger and cargo movements

(2) Aircraft Mixture

The following table shows the actual aircraft mixture and average number of seats per flight at Carrasco Airport.

Table 4-2

Route		Aircraft (% share)	Average number of seats per flight
INT'L	International	B747(15), DC-10(17), B707(16), B767 (7), B727(12), B737 (31), Others(2).	194
	Puente Aereo	B737 (100)	122
DOMESTIC		F27, C95, CS12	15

As for the international route except Puente Aereo (air shuttle), wide-body aircraft are used only for less than one-third of the total flights, reflecting the general South-American tendency of slow fleet modernization due to economic difficulties encountered.

As for the Puente Aereo route, B737 seems to fit ideally for the service.

The future aircraft mixture is established on the basis of the survey of existing situation including hearings from airlines, and on the following technical assumptions:

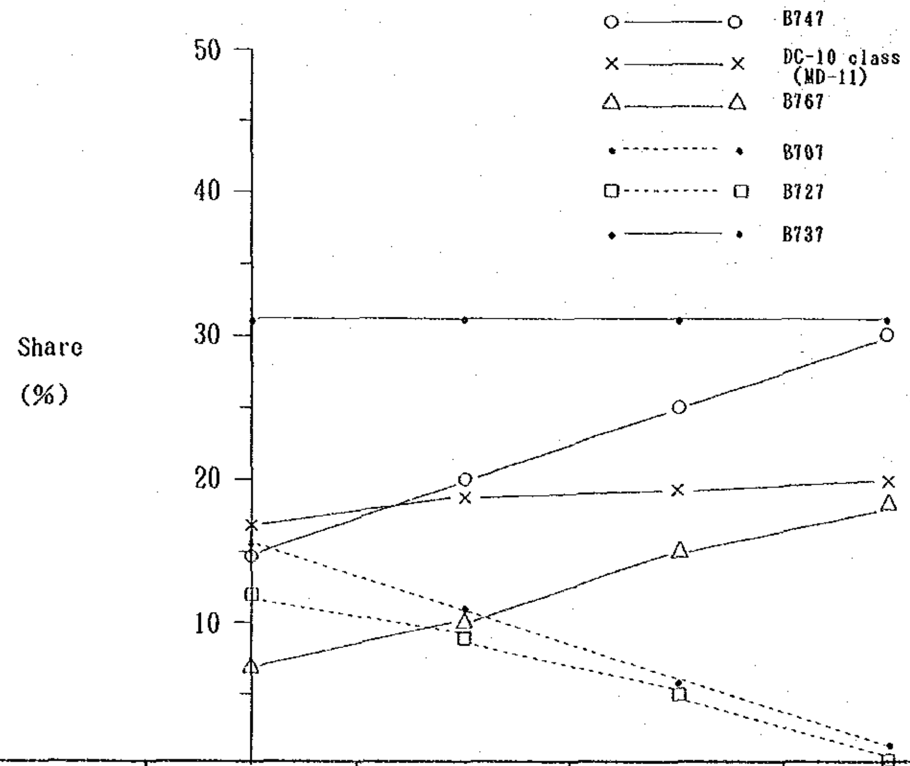
a) Both international and Puente Aereo flights will maintain reasonable load factors at the level of international average. Actual average load factor of Puente Aereo is 64%. In the same way, the actual average load factor of international flight except Puente Aereo is 33% because most of these flights are like "transit flights" to and from Buenos Aires, and also to and from Brazil. Thus, the load factor cannot be expected to increase very much, and it is assumed to be 33% in 1995 and 2000, and 40% in 2010.

b) B707 and B727 will retire progressively and will completely retire in the year 2010.

c) B767 will gradually replace B707 and B727,

d) B737 for the Puente Aereo flight will operate continuously up to the year 2000, when MD-81 class will take over.

Table 4-3 shows established aircraft mixture and average number of seats per flight on the international flight except Puente Aereo.



aircraft mixture and average number of seats per flight	design year	1989 (actual)		1995		2000		2010	
	B747 (363)120	15	194	20	211	25	218	30	240
	DC-10 class (239) 79	17		20		20		20	
	B707 (167) 55	16		10		5		–	
	B767 class (212) 70	7		10		15		20	
	B727 (134) 45	12		10		5			
	B737 (130) 43	31		30		30		30	
	SF=340A (34)	2							

Table 4-3 Aircraft mixture and average number of seats per flight by design year (other international flight)

(3) Aircraft movement

1) Peak-day movement

Aircraft movement is established, using the established aircraft mixture, load factor and peak-day factor.

Actual peak-day factor of Puente Aereo flight is estimated to be 1.2 on Friday; in the same way,that of international flight is estimated to be 1.28 on Friday. The peak-day factor in future is not expected to change, because flight on Friday is convenient for business passengers as well as for international tourists. Thus, the future peak-day factor is assumed to be almost the same as the actual number, namely, 1.2 for Puente Aereo and 1.3 for other international for each target year.

Table 4-4 shows peak-day aircraft movement.

2) Peak-hour movement

Simulated flight schedule is established, using the result of peak-day movement calculation, the actual flight schedule, and the following assumptions:

<u>International flight except Puente Aereo</u>

a. Actual flight schedule of each airline will remain virtually the same.
b. Number of air routes is not expected to increase in the years 1995 and 2000.
c. When new flight has to be introduced, it is assumed that this will be accomplished by changing the non-daily flight to daily flight.

<u>Puente Aereo</u>

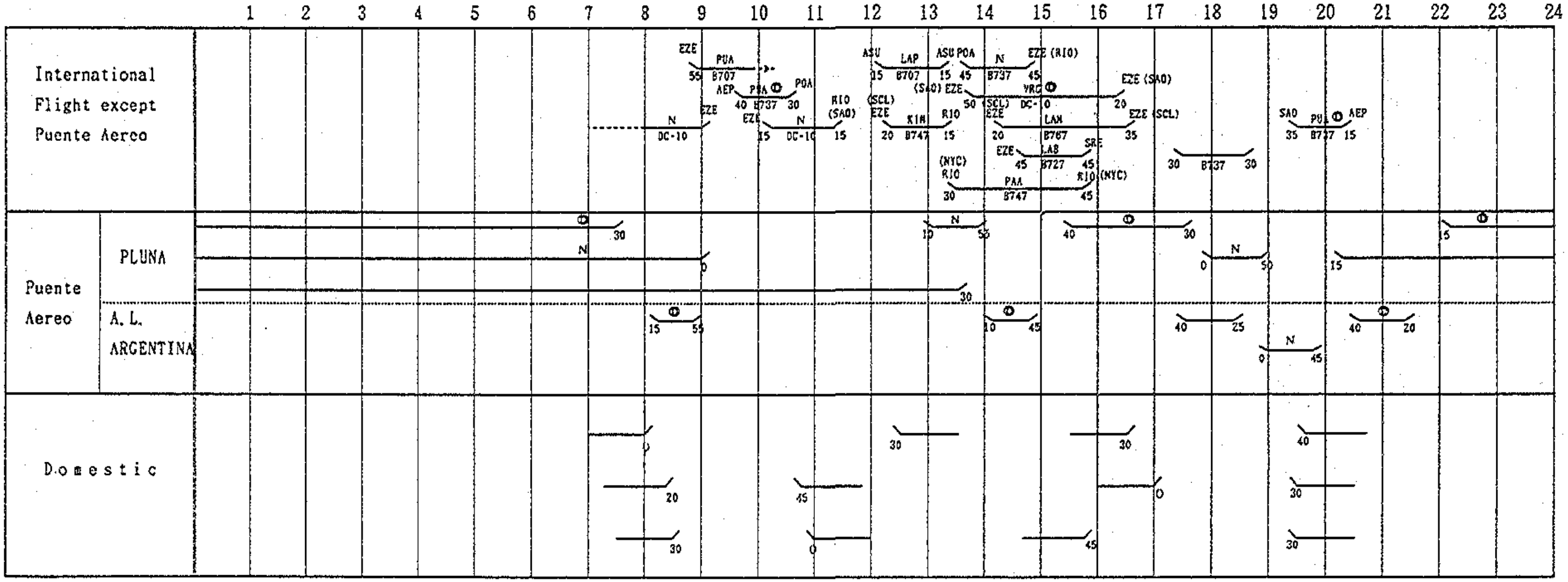
This air shuttle flight is expected to increase in frequency at regular interval, to achieve optimum aircraft operation and enhanced convenience for passengers.

Figs. 4-1 ~ 4-3 show simulated flight schedule in the years 1995, 2000 and 2010.

Table 4－4 Peak－Day Aircraft Movement (Peak－day flight)

				Annual Pax×1,000	Average number of seats per flight		Load factor (LF) %	Peak－day flight: Annual flight / Peak－day factor	April 89
1989 (actual)		INT	P/A	337	122	B737 (100%)	64	4,320／365×1.2≒15	(16)
			O/INT	301	194	Shown in Table C-3	33	4,700／365×1.3≒17	(15)
		Domes		43	15	F27, C95, CS12	—	2,870／365×1.2≒10	
Short-term	1995	INT	P/A	498	122	B737	64	6,385／365×1.2≒21	
			O/INT	448	211	Shown in Table C-3	33	6,400／365×1.3≒23	
		Domes		48	15	F27, C95, CS12	—	3,200／365×1.2＝12	
	2000	INT	P/A	572	122	B737	64	7,330／365×1.2≒24	
			O/INT	604	218	Shown in Table C-3	33	8,390／365×1.3≒30	
		Domes		50	15	To be assigned	—	3,335／365×1.2≒12	
Long-term	2010	INT	P/A	752	146	MD-81	64	8,000／365×1.2≒27	
			O/INT	1,098	240	Shown on Table C-3	40	11,437／365×1.3≒41	
		Domes		55	17	To be assigned	—	3,240／365×1.2≒12	

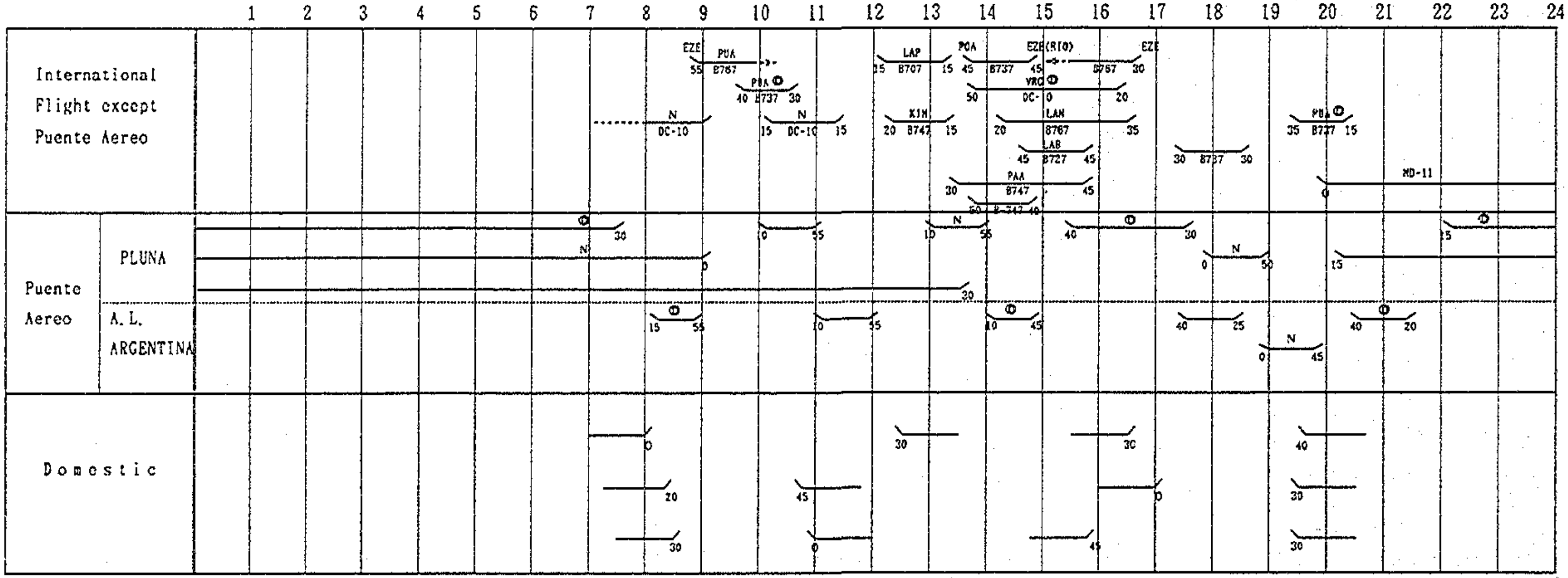
Fig. 4-1 Simulated Flight Schedule (year 1995)



Hour			4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Number of Loading Stands (apron) required	International	B747 DC-10 MD-11 class	1	1	1	1	1	1	1	1	1	(3)	2	2	1							
		B707 B767 class					1	1	1		1	1	(1)	1	1							
	B737 class	B727						1	1			1	(2)	1		1	1	1	1			
	Puente Aereo	B737 MD-81 class	3	3	3	3	(3)	1	1	1	1	2	1	1	1	2	2	1	2	2	2	2
	Domestic		3	3	3	3	3	1	2	2	3	3	3	3	3	1	0	3	3			

( ) : Including reserved spot to cope with flight delay, Ⓓ : Daily Flight, ——— : Actual flight, —N— : Newly will be operated

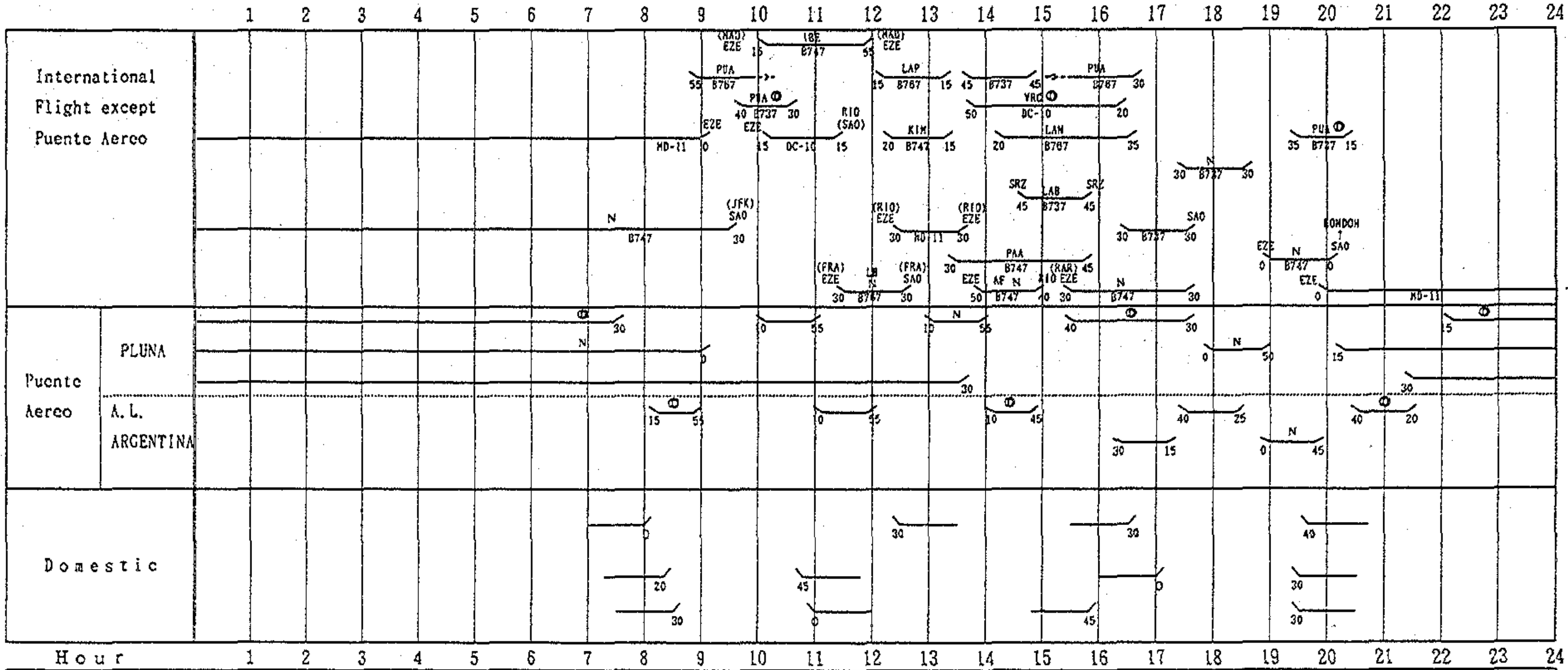
Fig. 4-2 Simulated Flight Schedule (year 2000)



Number of Loading Stands (apron) required		Hour: 4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	17–18	18–19	19–20	20–21	21–22	22–23	23–24
International	B747 DC-10 MD-11 class	1	1	1	1	1	1	2	2	1	(4)	2	2	1			1	1	1	1	1
International	B707 B767 class					1	1	1		1	1		(2)	2							
International	B727 B737 class						1	1			1	(2)			1	1	1	1			
Puente Aereo	B737 MD-81 class	3	3	3	3	3	1	2	2	2	1	2	1	1	2	2	1	2	2	2	2
Domestic		3	3	3	3	3	1	2	2	3	3	3	3	3	1	0	4	3			

( ) : Including reserved spot to cope with flight delay, Ⓓ : Daily Flight, ⌣ : Actual flight, ⌣N : Newly will be operated

Fig. 4-3 Simulated Flight Schedule (year 2010)



Number of Loading Stands (apron) required

		4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	17–18	18–19	19–20	20–21	21–22	22–23	23–24
International	B747 DC-10 MD-11 class	2	2	2	2	2	2	2	2	2	(5)	3	3	2	1		1	1			
	B767 class						1		1	2	1	1	(2)	2							
	B737 class						1	1			1	(2)	1	1	2	1	1	1			
Puente Aereo	B737 MD-81 class	3	3	3	3	3	1	2	2	1	2	1	1	2	3	2	1	2	3	3	3
Domestic		3	3	3	3	3	1	2	2	3	3	3	3	3	1	0	4	3			

( ) : Including reserved spot to cope with flight delay, Ⓓ : Daily Flight, ⌣ : Actual flight, ⌣N : Newly will be operated

(4) Passenger Movement

1) Peak-day passenger movement

Peak-day passenger movement is estimated, using the peak-day aircraft movement and average number of passengers per flight as shown in Table 4-5.

Table 4-5 Peak-day passenger movement

(person)

	Design		1995	2000	2010
INT'L	P/A	Departure	858	1014	1316
		Arrival	780	858	1220
	INT'L	Departure	840	1008	1680
		Arrival	840	936	1600
	TOTAL	Departure	1698	2022	2996
		Arrival	1620	1794	2820
DOMESTIC		Departure	90	90	90
		Arrival	90	90	90

2) Peak-hour passenger movement

Passenger movement is divided into two categories: departures and arrivals.

Peak-hour movement of departure passengers is estimated, using the simulated flight schedule and hourly inflow distribution of passengers from outside into airport.

Peak-hour movement of arrival passengers is estimated, assuming that they will be in the arrivals hall within 30 minutes after arrival time.

Figs. 4-4 and 4-5 show actual and assumed distribution of passengers entering the airport.

Table 4-6 shows peak-hour passenger movement.

Fig. 4－4 Cumulative curve of passengers per flight entering the Carrasco Airport prior to departure flight (Puente aereo)

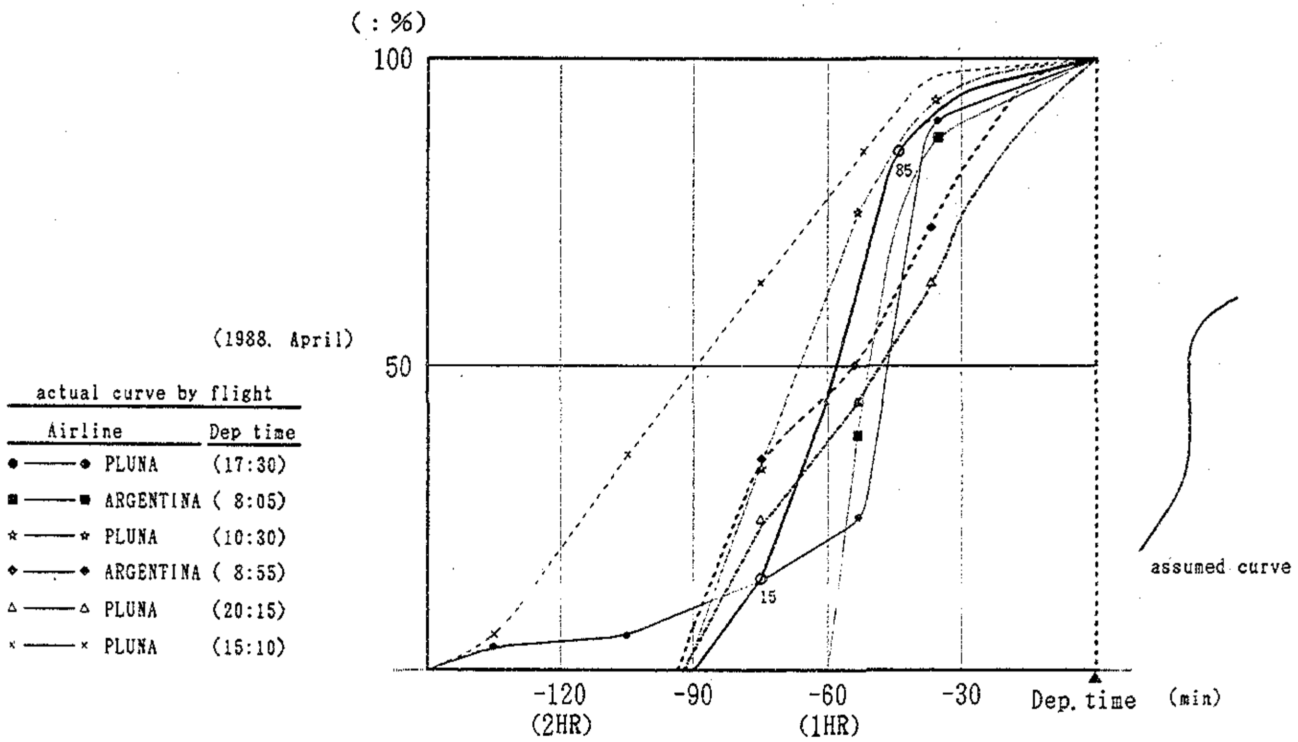


Fig. 4－5 Cumulative curve of passengers per flight entering the Carrasco Airport prior to departure flight (International flight)

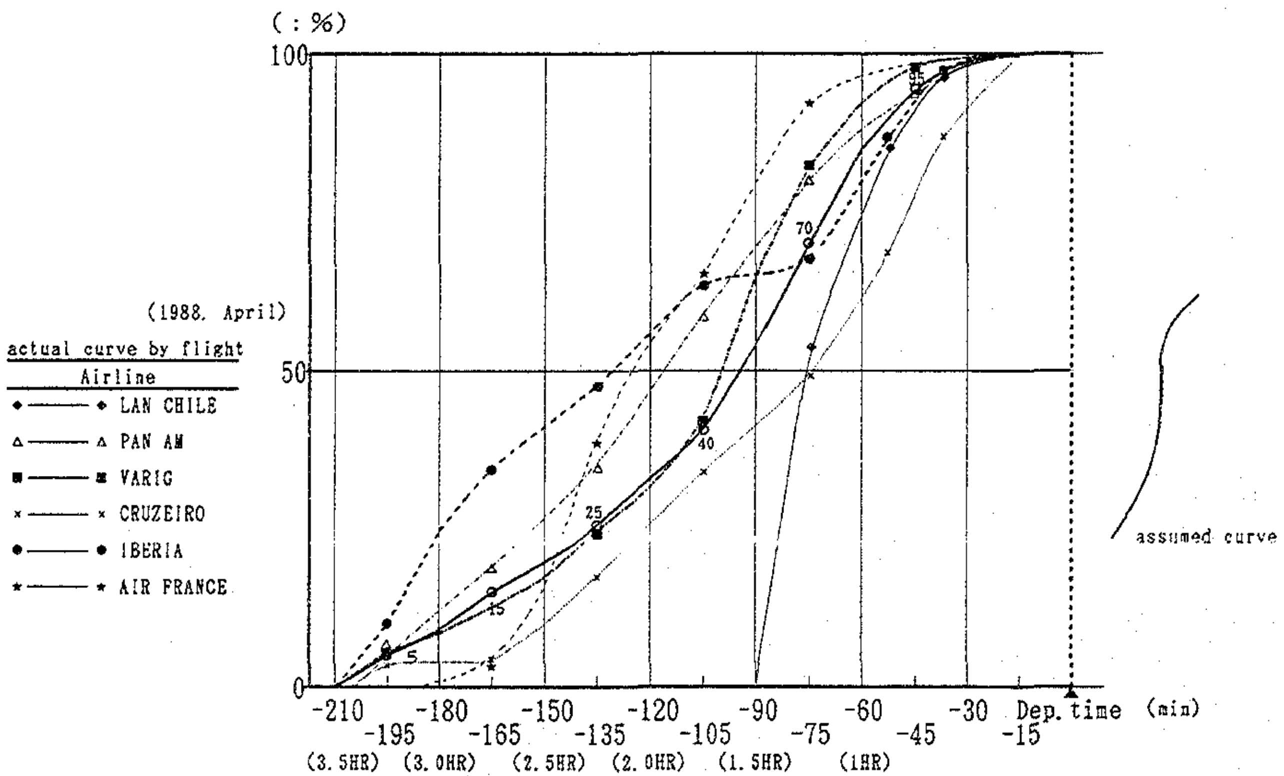


Table. 4-6 Peak-Hour Passenger Movement

Design Year			1989	1995	2000	2010
Departure	Int'l	Int'l	276 15:00~16:00	276 15:00~16:00	328 15:00~16:00	367 15:00~16:00
		Puente Aereo	74 14:00~15:00	138 8:00~ 9:00	138 8:00~ 9:00	176 16:30~17:30
		Total	(350) 276 15:00~16:00	(414) 307 12:30~13:30	(466) 328 15:00~16:00	(543) 464 12:30~13:30
	Domestic		45 19:00~20:00	45 19:00~20:00	60 19:00~20:00	68 19:00~20:00
	G. Total		321	352	388	532
Arrival	Int'l	Int'l	269 13:30~14:30	312 13:30~14:30	312 13:30~14:30	432 13:30~14:30
		Puente Aereo	156 20:00~21:00	156 20:00~21:00	156 20:00~21:00	188 20:00~21:00
		Total	(425) 341 13:30~14:30	(468) 400 13:30~14:30	(468) 400 13:30~14:30	(620) 526 13:30~14:30
	Domestic		45 16:00~17:00	45 16:00~17:00	60 16:00~17:00	68 16:00~17:00
	G. Total		396	445	460	594

(5) Cargo Movement

Assumed peak-day international cargo volume by design year is shown in Table 4-7.

Table 4-7 Peak-day cargo volume

Design Year	Annual Volume (t)	Peak-day Factor	Peak-day Volume (t)
1988	Export 7,042 Import 5,263	$\frac{1}{270}$	Export 26 Import 20
1995	Export 10,843 Import 10,522	$\frac{1}{270}$	Export 41 Import 39
2000	Export 14,310 Import 16,127	$\frac{1}{270}$	Export 53 Import 60
2010	Export 24.925 Import 37.887	$\frac{1}{270}$	Export 93 Import 140

Air cargo has to be carried in passenger aircraft as its belly cargo up to reasonable capacity; Primarily, air cargo exceeding this capacity will be carried by cargo freighter.

Estimated distribution of international air cargo between passenger aircraft and cargo freighter in each design year is shown in Table 4-8.

Table 4-8 Estimated distribution of International air cargo between passenger aircraft and cargo freighter

Year & Aircraft			Number of peak-day flight		(A) Peak-day cargo volume (ton)	Volume of cargo that can be loaded on passenger flight	(B) Peak-day cargo volume can be loaded on passenger flight		(C) Assumed load factor of belly cargo (%)		(D) Peak-day cargo volume handled by passenger flight $(D)=(B)\times\frac{(C)}{100}$ (ton)		(E) Peak-day cargo that should be handled by cargo flighter $(E)=(A)-(D)$ (ton)	
			D	A			E	I	E	I	E	I	E	I
1988	INT	B747	2	2	Export 26	*1 10								
		DC-10	1	1		9								
		B707	1	2		} 7								
		B767	1	1	Import 20		48	55	27	18	13	10	13	10
		B727	1	1		2								
		B737	2	2		1.5								
	P/A	B737	7	7	46	*2 3.5								
1995	INT	B747	2	2	Export 41	*1 10								
		DC-10	3	2		9								
		(MD-11)												
		B707	1	2	Import 39	7	69	67	50	50	34	34	7	5
		B767	1	1		7								
		B727	1	1		2								
		B737	4	4		1.5								
	P/A	B737	11	10	80	*2 3.5								
2000	INT	B747	3	3	Export 53	*1 10								
		DC-10	3	2		9								
		(MD-11)												
		B707	1	1	Import 60	7	76	67	50	50	38	34	15	10
		B767	2	2		7								
		B727	1	1		2								
		B737	4	4		1.5								
	P/A	B737	13	11	113	*2 3.5								
2010	INT	B747	8	7	Export 93	*1 10								
		DC-10	4	4		9								
		(MD-11)					144.5	136	50	50	72	68	21	72
		B767	3	3	Import 140	7								
		B737	6	6		1.5								
	P/A	MD-81	14	13	233	*2 3.5								

* 1 : Max. Capacity×0.7×0.5   D : Departure   E : Export Cargo

* 2 : Max. Capacity×0.7   A : Arrival   I : Import Cargo

4-2. Airfield Facilities (mainly runways)

4-2-1 Number of runways

Runway capacity is defined as the maximum number of aircraft operations which can be accommodated on the runway within one hour.

Runway capacity varies with the following conditions:

- number of runways
- weather conditions (VFR or IFR conditions)
- aircraft mix (aircraft class)
- percent of arrivals
- exit factor (type and position of exit taxiway)
- touch-and-go factor

The capacity of single runway is about 47 operations/ hour according to FAA method in the following conditions:

- single runway
- IFR weather condition
- mix index is 180% (large and heavy aircraft)
- 50% arrivals (thus 50% departures)
- exit factor is 0.96 (RWY 24 operation)
- touch-and-go factor is 1.0

hourly capacity = C x T x E
= 47 operations/hour

where C: hourly capacity base (49 operations/hour)
T: touch-and-go factor (1.0)
E: exit factor (0.96)
(See Fig. 4-6)

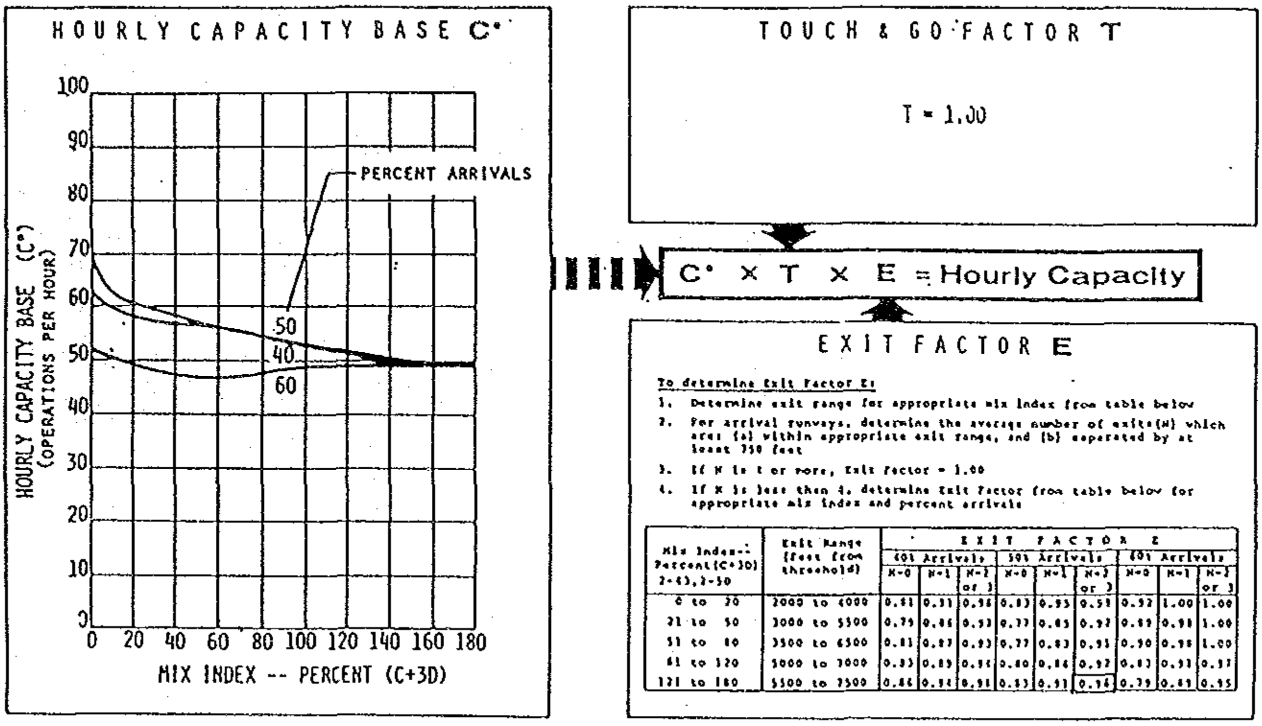
Reference: Airport capacity and delay AC 150/5060-5, FAA, US DOT

Peak-day aircraft movement of scheduled flights in 2010 will be around 80.

Therefore, number of runways required is one from view point of runway capacity, unless general aviation movement will increase significantly.

Of existing three runways, RWY06/24 should be able to continue to serve as the primary runway.

The other runway, RWY01/19 or RWY10/28, should be maintained as the secondary runway.



Mix Index-- Percent (C+3D)	Exit Range (feet from threshold)	EXIT FACTOR E								
		40% Arrivals			50% Arrivals			60% Arrivals		
		N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3
0 to 20	2000 to 4000	0.81	0.91	0.96	0.83	0.93	0.97	0.92	1.00	1.00
21 to 50	3000 to 5500	0.75	0.85	0.93	0.77	0.85	0.92	0.89	0.98	1.00
51 to 80	3500 to 6500	0.81	0.87	0.93	0.77	0.83	0.93	0.90	0.98	1.00
81 to 120	5000 to 7000	0.83	0.85	0.96	0.80	0.86	0.97	0.83	0.93	0.97
121 to 180	5500 to 7500	0.86	0.94	0.98	0.83	0.93	0.96	0.79	0.89	0.95

Fig. 4-6 HOURLY CAPACITY OF RUNWAY USE DIAGRAM NOS. 1,54
FOR IFR CONDITIONS

Source: Airport Capacity and Delay AC150/5060-5, FAA, US DOT.

4-2-2 Runway length requirement

Required runway lengths for operation of B-747-300 for Carrasco/Rio de Janeiro and Carrasco/Caracas routes shown in Table 4-9.

The present RWY06/24 length of 2,700 m is sufficient for direct flight of B747 to Rio de Janeiro.

In the Long-term development, RWY06/24 should be extended to 3,100 m, to enable direct flight to Caracas.

Table 4-9 Required Runway Length

Route	Approx Distance (km)	Required Runway Length (m)	Criterion
MVD(AIC)/Rio	2,010	2,050*	Max. landing weight at Rio plus burn-off fuel
MVD(AIC)/Caracas (Longest route in South America region)	6,200	3,100	Max. take off weight at flap 20 degrees

*As the reference for this calculation, Varig airlines officially gave us their comments that 1900 m is sufficient for B747-300.

As for the secondary runway, the present length of 1,700 m or 1,750 m is adequate for F27 operations.

For B737, reduction of allowable cabin load to approximately 24,000 lb will be required, but it is practically acceptable.

Therefore, extension of secondary runway will not be required.

4-2-3 Runway Orientation

Based on wind data from 1979 to 1984 at Carrasco International Airport, calculation of wind coverage is made as shown in Table 4-10.

In case of cross wind limitation at 20 kt, direction of N050E and N060E is optimum.

In case of cross wind limitation at 13 kt, direction of N010E and N180E is optimum.

Of the existing three runways, the optimum is RWY06/24 for jet aircraft operations, and RWY01/19 for smaller aircraft operations.

Table 4-10 Wind Coverage at Carrasco

RWY DIR.	Cross wind 20 kt	Cross wind 13 kt
N 010 E	98.16	90.02
020	98.29	89.43
030	98.37	88.79
040	98.40	88.20
050	98.43	87.64
060	98.42	87.13
070	98.31	86.67
080	98.11	86.34
090	97.87	85.95
100	97.64	85.52
110	97.47	85.28
120	97.36	85.55
130	97.31	86.20
140	97.36	87.11
150	97.52	88.10
160	97.70	89.07
170	97.85	89.86
180	98.00	90.26

4-2-4 Classification of runways for operation of Aircraft

Relation between weather minima and operation probability is shown in Table 4-11.

In case of VOR approach only, the average probability will be 93.6%, which is less than ICAO Recommendation of Minimum 95%.

In case of ILS CAT-I approach, the probability will be 95.2%.

Therefore, the main runway, RWY06/24, should meet ILS CAT-I requirement.

Secondary runway should be non-precision but instrument approach runway.

Table 4-11 The Probability with the Wx minima

(unit %)

WX minima	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average
take off 0m/400m	99.9	100.0	99.9	99.8	98.6	97.0	97.2	97.3	99.6	99.4	100.0	99.8	99.0
ILS CAT-I 60m/800m	99.4	99.4	98.4	94.3	94.1	87.9	89.1	90.1	95.3	96.2	98.7	98.9	95.2
VOR approach 100m/1600m	99.3	99.2	98.3	93.7	93.0	84.6	85.3	87.7	91.9	93.5	97.8	98.5	93.6

Remarks: Wx minima are ceiling/visibility.

Source: Relation entre la visibilidad horizontal y la altus de la nubosidad baja para el aeropuerto internacional de Carrasco. (1976 - 1980)

4-2-5 Summary of facility requirements

Recommended facility requirements of runways for airport development plan are summarized below.

a. Number and orientation of runways

- Primary runway:	RWY06/24
- Secondary runway:	RWY01/19 or RWY10/28

b. Design aircraft

-Primary runway:	B747-400
- Secondary runway:	B737 or F27

c. Runway lengths

	Short-term	Long-term
- Primary runway:	2,700 m	3,100 m
- Secondary runway		
RWY01/19:	1,750 m	1,750 m
RWY10/28:	1,700 m	1,700 m

d. Type of runways for operation of aircraft

- Primary runway:	Precision approach CAT-I
- Secondary runway:	Non-precision approach

4-3. Terminal Area Facilities

4-3-1 Calculation of Facility Requirements

(1) Apron

Based on the simulated flight schedule set out in Fig. 4-1 ~ 4-3, and taking into consideration the following conditions, number of aircraft parking aprons by aircraft type for each design year is estimated.

Table 4-12 shows required number of aircraft parking aprons.

1) Apron occupancy time is actual apron parking time, plus 20 minutes before arriving time as well as 20 minutes after departing time, to take care of possible flight delay.

2) There should be the following four types of parking aprons:
Category 1: B747, DC-10 (MD-11) class
Category 2: B767, B707 class
Category 3: B727, B737, (MD81) class
Category 4: F27 class for domestic flight

Table 4-12 Required number of aircraft parking aprons

Category / year	1 B747 DC-10 (MD-11)	2 B707 B767	3 B727 (MO-81) B737	4 F27 class	5 Cargo freighter B707
1989 actual capacity	4	2	2	2	1
1995	3	1	3	3	1
2000	4	2	2	3	1
2010	5	2	2	3	1 1 B747

(2) Passenger Terminal and Cargo Terminal Buildings

Based on the established design data set out in 4-1, and calculation formulae attached hereto, entire facility requirements for each design year are calculated.

The calculation formulae are mainly in accordance with IATA Capacity Calculation Formulae.

Tables 4-13 and 4-14 show estimated total facility requirements.

Table 4-13 Estimated Total Facility Requirements for Passenger Terminal Building (in m^2)

Facility / Design year	Actual Capacity in 1989	Short-term Development 1995	Short-term Development 2000	Long-term Development 2010
1) Public Area	8,130	6,955	7,590	9,065
2) Concessions: Annual PAX (10,000) x 20 m^2	2,435	1,934	2,236	3,862
- Non Public Area -				
3) Airline Offices	2,301	1) x 0.8	1) x 0.9	1) x 1.0
4) Administrative and Technical Area	1,620	=	=	=
5) Others	1,514 1) x (0.7)	5,564	6,831	9,065
Total	16,000	14,453	16,657	21,992

Table 4-14 Estimated Total Facility Requirements for Cargo Terminal Building

(in m^2)

Facility / Design year	Actual Capacity in 1989	Short-term Development 1995	Short-term Development 2000	Long-term Development 2010
1) Export Cargo Facilities	1,220	515	590	890
2) Import Cargo Facilities	2,740	1,330	1,450	3,060
3) Airline Offices	400	235	500	1,385
4) Customs Offices	260			
Sub-total	4,620	2,080	2,540	5,335
5) Work Station (Export)		(2) 180	(2) 180	(5) 450
6) Work Station (Import)	0	(2) 180	(2) 180	(7) 630
Total	4,620	2,440	2,900	6,415

4-3-2 Demand/Capacity Analysis and Facility Requirements

Comparison between actual and required capacities of major terminal area facilities in each target year shown in Figs. 4-7 ~ and 4-8.

The following facilities require reconstruction, expansion or modification, from the functional and physical points of view:

(1) Apron

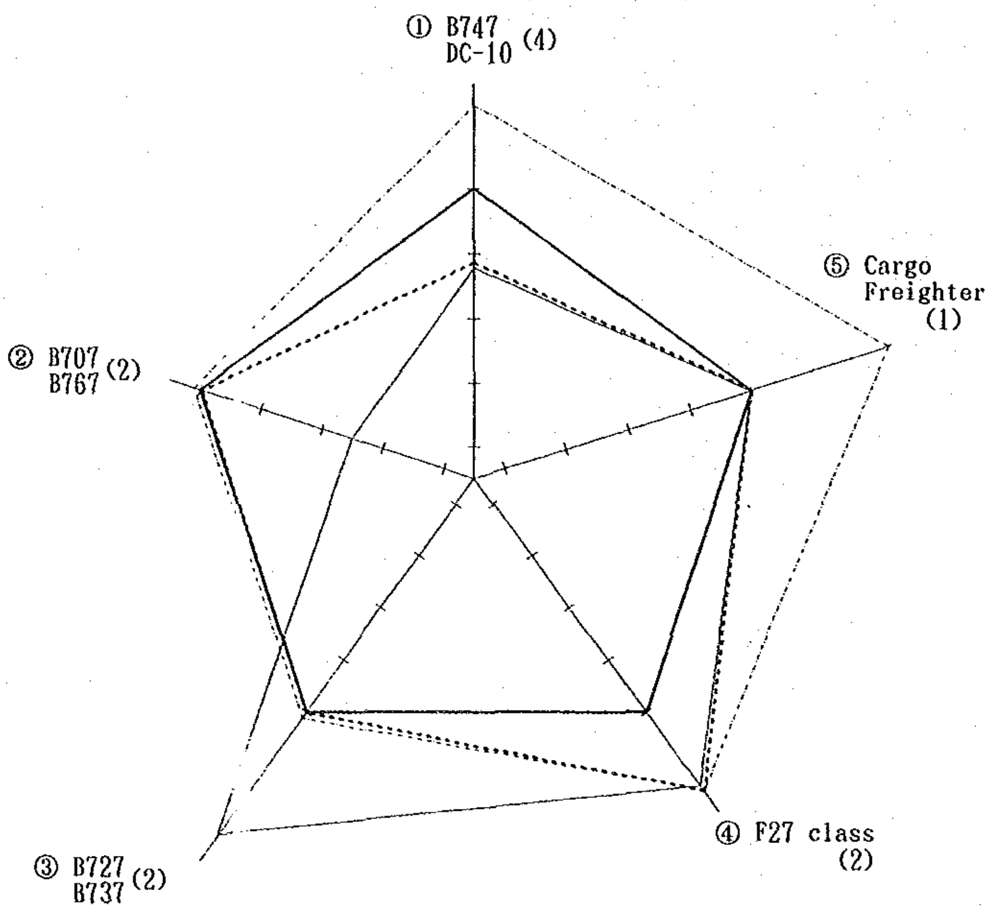
The present apron area will be almost sufficient for the requirement in the short-term development.

However, aircraft parking concept should be modified to accommodate required aircraft mix, and to meet obstacle clearance requirement of RWY01/19.

In the long-term development, additional area of 22,000 m^2 will be required.

Aircraft parking concept should be changed to taxi-in and push-out concept.

The present terminal area permits such expansion and modification to be made.



Actual Capacity

Required Capacity, 1995

Required Capacity, 2000

Required Capacity, 2010

( ) : Actual Capacity

Fig.4-7 Comparison between actual and required capacities (Apron)

(2) Passenger terminal area and facilities

Capacity of existing terminal building will be almost sufficient in the Short-term Development, though some modification of the central and arrival buildings will be required.

In the Long-term Development, reconstruction or expansion of the central and arrival buildings will be required.

Such reconstruction or expansion can be made within the existing passenger terminal area.

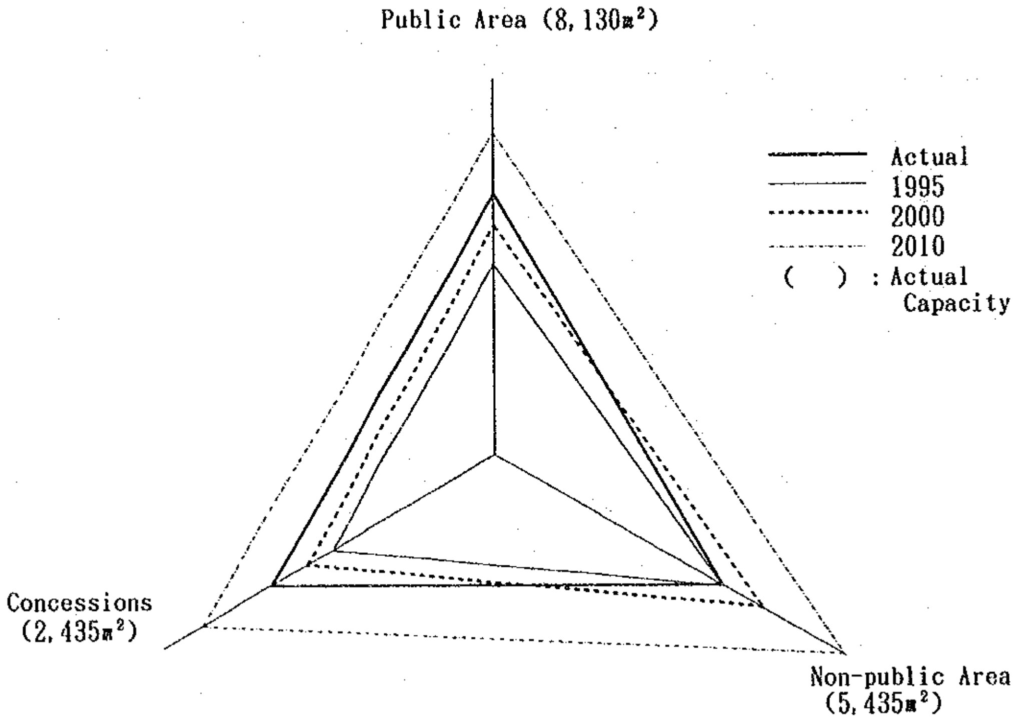


Fig 4-8 Comparison between actual and required capacities (Passenger Terminal)

(3) Cargo terminal area and facilities

Some modification of warehouse and installation of equipment will be required in the Short-term Development.

In the Long-term Development, expansion of cargo handling area will be required.

Such modifications and expansion can be made within the existing cargo terminal area.

(4) Conclusions of demand/capacity analysis

Modification, reconstruction and expansion of terminal area facilities will be required to meet demand of the Short-term and Long-term Developments.

The present terminal area can adequately provide for the above-mentioned developments to be made.

4-4. Recommended Facility Requirements

Overall facility requirements recommended by the study team are shown in Tables 4-14 ~ 4-16.

Table 4-14 Recommended Facility Requirements of Airfield Facilities

Facility	1995	2000	2010
Primary runway (RWY06/24)	1. Longitudinal slope of RWY24 should be corrected. 2. Width of runway strip should be extended to 300 m. 3. Pavement should be reinforced to accommodate Short-term traffic with design life of 10 years. 4. Shoulders should be reconstructed.	---	1. Runway length should be extended to 3,100 m. 2. Pavement should be reinforced to accommodate future traffic.
TWY - A	1. Part from RWY01 to RWY06 should be reconstructed as parallel taxiway. 2. Pavement should be reinforced to accommodate short term traffic with design life of 10 years.	---	1. Pavement should be reinforced to accommodate future traffic.
TWY - B	1. Pavement should be reinforced to accommodate short term traffic with design life of 10 years.	---	1. Pavement should be reinforced to accommodate future traffic.

Facility	1995	2000	2010
TWY - D	1. Pavement should be reinforced to accommodate Short-term traffic with design life of 10 years.	---	1. Pavement should be reinforced to accommodate future traffic.
RWY01/19 and TWY - C	1. Pavement should be reinforced to accommodate B737 or F27, operations with design life of 10 years.	---	1. Pavement should be reinforced to accommodate future traffic.

Table 4-15 Recommended Facility Requirements of Terminal Area Facilities

Facility	1995	2000	2010
1. Apron	1. Reconstruction of areas S-4, S-5 and S-6 should be made to accommodate Long-term traffic with design life of 20 years. 2. Repairs of areas S-1, S-2 and S-3 should be made to prevent further deterioration.	1. Reinforcement of area S-3 should be made to accommodate Long-term traffic with design life of 20 years.	1. Reinforcement of areas S-1 and S-2 should be made to accommodate future traffic.
2. Passenger Terminal Central Terminal Departure Terminal Arrival Terminal	As is	Central Terminal will be modified to provide: 1. 300 m^2 for departure concourse and departure lounge; 2. 300 m^2 for security check area with three (3) X-ray detectors, two for international and one for domestic; 3. 105 m^2 for domestic baggage claim area with one baggage claim device. Arrival Terminal will be modified to provide: 1. 120 m^2 for arrival health check area	Central Terminal; Demolish the existing central terminal and newly construct departure concourse, departure lounge concession area and administrative area, with new control tower and ATC facilities. Departure concourse 2,400 m^2 Departure lounge 1,760 m^2 Concessions 3,450 m^2 Administrative area 5,550 m^2 Total 13,160 m^2 Arrival Terminal; Existing arrival terminal will be expanded by 12 m(one span) x 45 m. Install one baggage claim device for wide-body and two claim devices for narrow-body aircraft.

Facility	1995	2000	2010
3. Cargo Terminal	Warehouse: As is, with "open shed" to be provided.	1. Four(4) work stations will be installed at "open shed", whose area will be 360 m^2 2. Rack system will be provided inside of warehouse, covering area of 1080 m^2. 3. Modify existing warehouse for bulk cargo handling area. 4. Provide cold storage (125 m^2 in area) insede the existing warehouse.	1. The "open shed" will be doubled in size, to 720 m^2 in area and eight(8) work stations. 2. Import storage area and office area will expand, expanded area will be 320 m^2 and 725 m^2 3. Expand cold storage, by 135 m^2 in area.
4. Car Parks	As is	As is	Add space for 200 cars.
5. Fuel	Major facilities: As is. Oil-water separaters will be required for ESSO and SHELL	Reconstruct to provide three 600-kl tanks, complete with supporting facilities.	Add one 600-kl tank (tank only)
6. Water Supply	Add one 600-m^3 tank	Add one 600-m^3 tank	---
7. Sewage	As is	Add 15 m^3/hr plant.	---

Facility	1995	2000	2010
8. Rescue and Fire Fighting	Add one 30 m^3 elevated tank.	---	---
9. Garbage disposal	Provide two 5-tons day incinerators.	Add one more 5-tons/day incinerator.	---
10. GSE maintenance shop and airline offices located near the hangar	As is	As is	Half of existing building will be demolished, and new building (floor area: 1,500 m^2)will be constructed along the east boundary of terminal area.

Table 4-16 Recommended Facility Requirements of Air Navigation Facilities

Design year / Facility	1995	2000	2010
1. Radio Navigational Aids	1. ILS equipment of RWY24 should be renewed. 2. Terminal VOR/DME should be renewed.	1. Two sets of VOR/DME and one set of NDB should be installed. 2. MLS equipment for RWY24 should be installed.	---
2. Air Traffic Control Facilities	1. VFR equipment should be renewed. 2. VHF Air-to-Ground communication equipment should be renewed. 3. Tape recorder should be renewed.	---	1. ASR/SSR should be renewed. 2. ACC facilities should be newly constructed. 3. New IFR equipment should be installed. 4. New VHF equipment should be installed.
3. Communications Facilities	1. Following equipment or facilities should be renewed: - ATS direct speech equipment - HF receiving station - HF transmitting station	---	1. Following equipment should be newly installed: - AFTN - ATS direct speech equipment - Telephone

Design year / Facility	1995	2000	2010
4. Meteorological equipment	1. Equipment should be renewed. 2. RVR system should be installed.	---	---
5. Electrical power supply	1. New station and equipment should be provided.	---	1. New substation and equipment should be provided.
6. Visual Aids	1. RWY06/24 1) Existing approach lights and sequenced flashing lights of RWY24 should be changed to meet ALS requirement. 2) Following lights should be installed. - SALS for RWY06 - Two sets of PAPI - Stopway lights 3) Following lights should be renewed: - RWY edge lights and End lights. - Wingbar lights for RWY24 - RWY threshold lights - Touch down zone lights. - RWY centerline lights.	1. RWY06/24 1) Additional approach lights should be installed to meet ICAO recommendation	

Design year / Facility	1995	2000	2010
	2. TWY-A, TWY-B and TWY-D 1)Taxiway-edge lights should be renewed. 2)Taxiing guidance lights should be installed.		
	3. RWY01/19 and TWY-C 1)Following lights should be installed: -SALS for RWY19 -Two sets of PAPI -TWY dege lights -Taxiing guidance light 2)Following lights should be renewed: -RWY edge lights -RWY threshold lights and End lights -REIL for RWY01		
	4. Aerodrome beacon should be renewed.		
	5. Apron flood-lights should be renewed.		

CHAPTER 5

AIRPORT MASTER PLAN

5-1. Airport Layout Plan

5-1-1 Preparation of Alternative Airport Layout Plans

Conceptual airport layout plans have been prepared, taking into due consideration of the following points:

- Smooth and economical development (runway improvement, expansion of terminal area facilities, and installation of air navigation facilities).
- Harmonious inter-relation between facilities
- Efficient land use
- Accessibility of ground traffic (air side and land side)
- Safe aircraft operation

Three conceptual airport layout plans, A-1 through A-3, have been prepared, combining the main runway 06/24, and secondary runway 01/19, and terminal area alternatives.

Required conditions of terminal area alternatives are as follows;

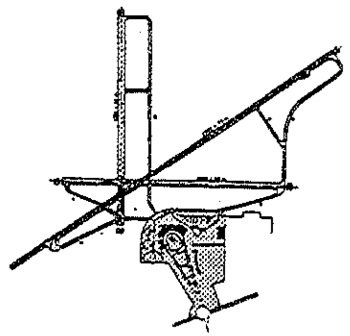
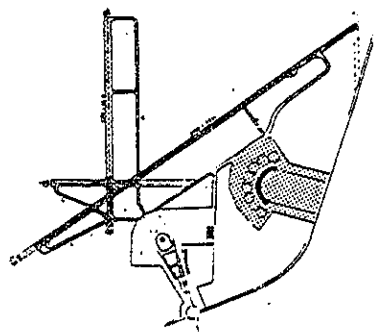
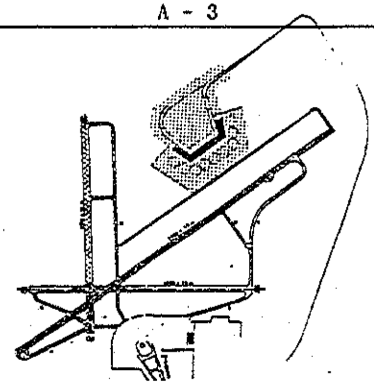
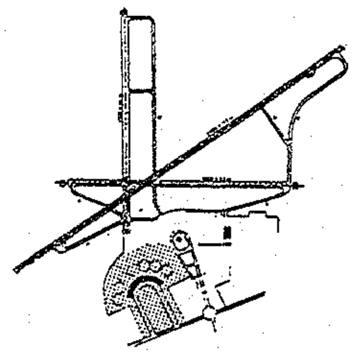
- Area should have enough space required for Long-term development.
- Access road between route 101 or 10 and terminal area should be connected directly.
- Area should be cleared from flight obstacles.

In addition, based on the comments and mutual agreement on Progress Report, conceptual airport layout plan B has been prepared, combining the main runway 06/24 and runway 10/28, and new terminal area proposed by D.G.I.A.

Table 5-1 shows the four conceptual airport layout plans: their basic conditions and comparison.

As a result of evaluation, A-1 and B are selected as the candidate alternative airport layout plans.

Table 5-1 Conceptual Airport Layout Plans

	A			B
	A - 1	A - 2	A - 3	
				
<u>Basic Conditions</u> 1) Main Runway Runway strip Direction of extension	06/24 300 m West ward	06/24 300 m East ward, crossing over Route 102	06/24 300 m West ward	06/24 300 m West ward
2) Secondary Runway for B 737	01/19	01/19	01/19	10/28
3) Terminal Area	As is	Relocate to east side of air base.	Relocate to opposite side of Runway 06/24.	Expand west ward of existing terminal.
4) Access Road	As is	Connecting road required.	New access required.	Connecting road required.

***: excellent
**: good
*: fair

	A			B
	A - 1	A - 2	A - 3	
Evaluation factors				
1) Smooth and economical development				
a. Runway, taxiway and apron improvement	***	* New long taxiway and apron are required.	* Completely new parallel taxiway and apron are required.	** New passenger loading apron is required.
b. Expandability of terminal area	***	*	*	**
c. Installation of air navigation facilities	***	Phased expansion is impracticable.	Phased expansion is impracticable.	***
2) Harmonious interrelation between facilities	***	**	***	***
3) Efficient land use	***	**	* Large-scale earth-work is required.	**
4) Accessibility of ground traffic				
a. Air side R/W --- Apron	***	***	***	***
b. Land side Route 101 --- access road	***	**	* New access road is required.	**
5) Safe aircraft operation	***	***	***	***

5-1-2 Evaluation of Airport Layout Plans

Alternative Airport Plans A (corresponding to the conceptual airport layout plan A-1) and B have been prepared, based on the evaluation of conceptual airport layout plans.

Figs. 5-1 and 5-2 show Alternative Airport Layout Plans A and B.

The alternative airport layout plans in the year 2010 have been evaluated in the light of the following criteria:

- Functional features
- Easy and economical operation
- Reasonable and economical improvement

Table 5-2 shows summary results of evaluation on the two Alternative Airport Layout Plans.

Alternative A has been selected as a result of this evaluation, mainly from the viewpoints of functional features and economical improvement.

Alternative A is recommended particularly as a result of comparative analysis on the secondary runway between 01/19 and 10/28, shown in Attachment 8, since it gives better wind coverage for smaller aircraft operations.

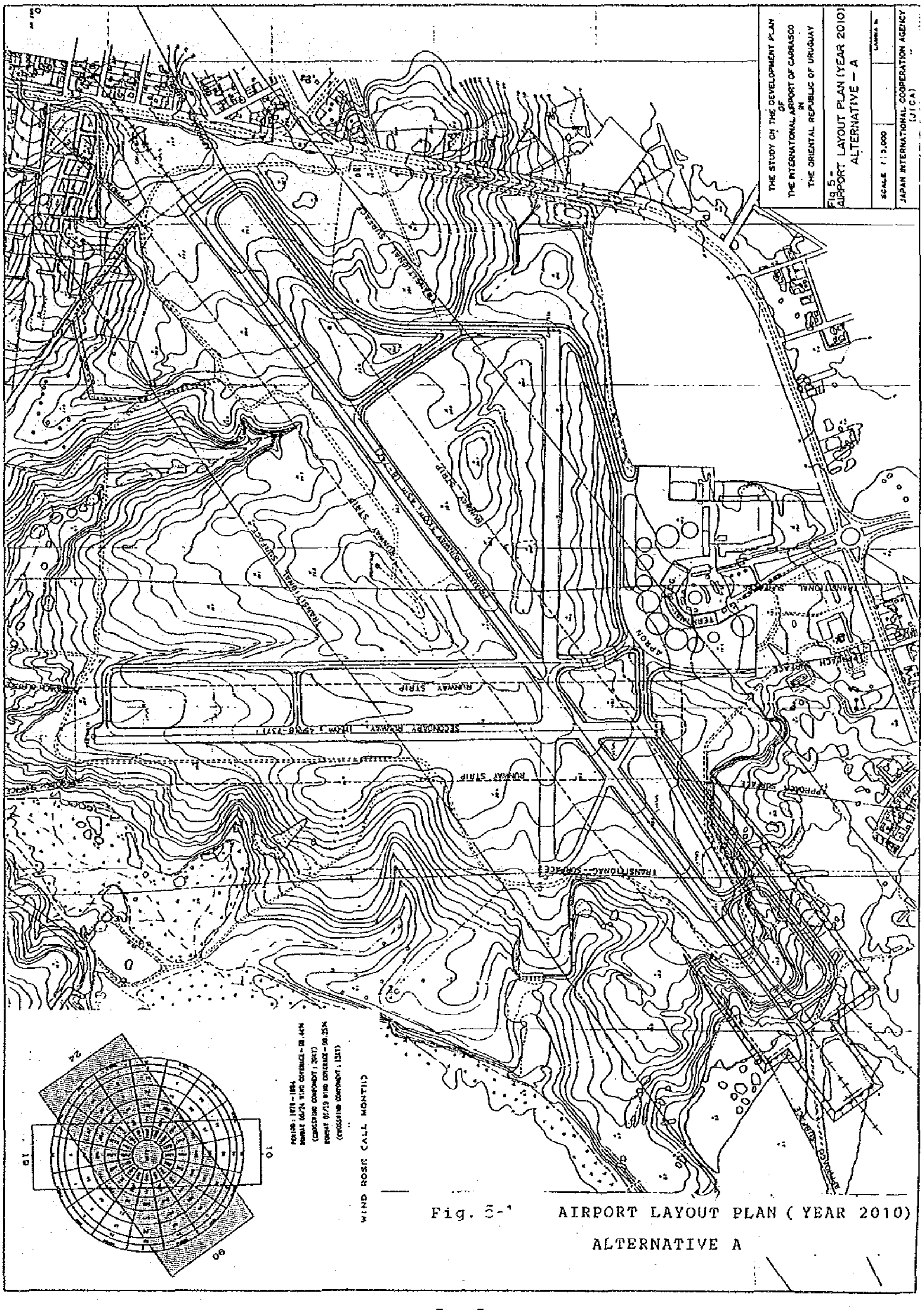


Fig. 5-1 AIRPORT LAYOUT PLAN (YEAR 2010)

ALTERNATIVE A

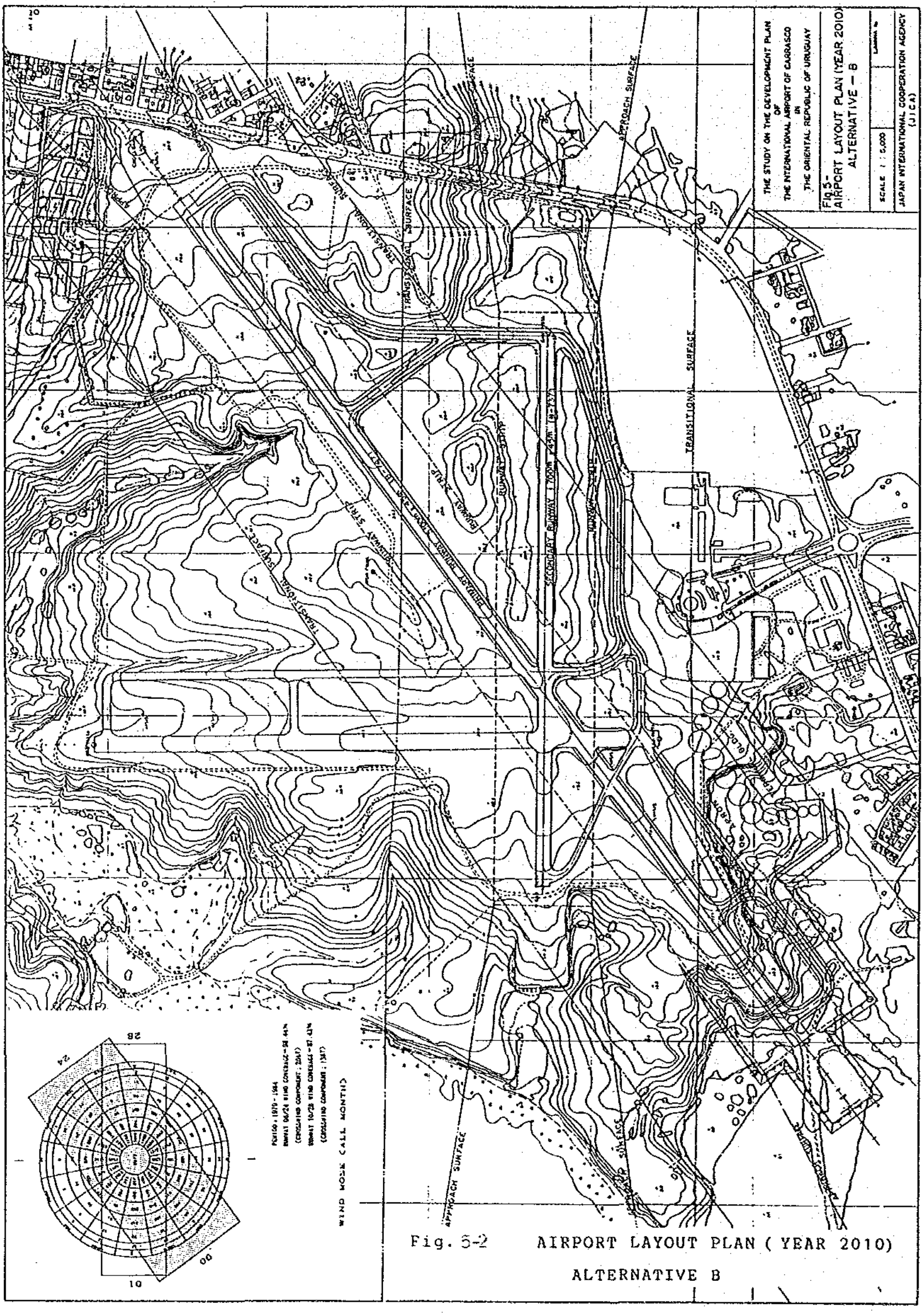
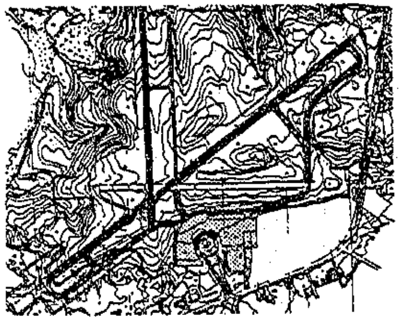
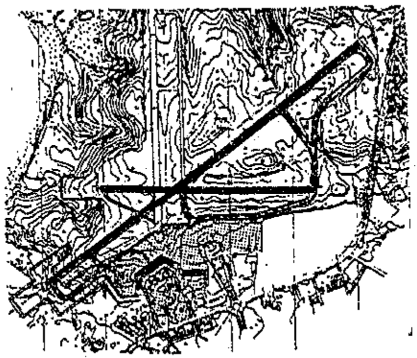


Fig. 5-2　AIRPORT LAYOUT PLAN (YEAR 2010)

ALTERNATIVE B

Table 5-2 Summary of Evaluation on the Alternative Airport Layout Plans in the year 2010

Alternatives / Criteria	1 Functional Features	2 Easy Operation	3 Reasonable and Economical Improvement
A 06/24 01/19 	1) Wind coverage : excellent (see Table 4-10.) 2) Aircraft ground access between 06/24 and apron : excellent because existing apron is located at center part of RWY 06/24. 3) Obstacles : none only a few trees, which can be removed.	1) Aircraft manoeuvring : easy taxi-in, push-out 2) Air traffic control : easy	1) Expandability : excellent Phased development is feasible. 2) Economical improvement : excellent Most of existing apron and terminal buildings can be utilized. 3) Development cost : economical (cost: US$15,000,000 - 20,000,000 only terminal area)
B 06/24 10/28 	1) Wind coverage : fair (see Table 4-10.) 2) Aircraft ground access between 06/24 and apron : good because new apron will be located at west side of RWY 06/24. 3) Obstacles : none only a few trees, which can be removed.	1) Aircraft manoeuvring : easy taxi-in, push-out 2) Air traffic control : easy	1) Expandability : excellent 2) Economical improvement : fair Most of required facilities should be newly constructed 3) Development cost : expensive (cost: US$40,000,000 - 50,000,000 only terminal area)

5-2. Airport Master Plan, Finalized Facility Requirements and Airport Development Plan for Feasibility Study

5-2-1 Airport Master Plan

As for the selected Airport Layout Plan, D.G.I.A. has requested to include extension of RWY01/19 and construction of new passenger loading apron in Short-term Airport Development Plan to cope with emergency operation and charter and non-scheduled flights in future.

D.G.I.A. also decided that the longitudinal slope of RWY24 should be retained as is, and layout of TWY-A should be corrected in the Long-term Development.

On the basis of the revised facility requirements in full conformity with the projected size and volume of facilities thus redefined, Airport Master Plan has been prepared , as shown in Fig. 5-3.

Layout plans of apron and passenger terminal building, in the Long-term development, are given in Attachment.

5-2-2 Possibility of Nighttime Construction for Urgent Development in 1995

In order to ensure feasibility of the urgent development plan, Study Team carefully considered the possibility of the pavement improvement works of main runway 06/24 during off-peak hours, mostly in nighttime periods, reopening to operations the next morning, without causing loss of revenues, inconvenience to passengers or delays to the air traffic.

Such nighttime construction work has successfully been carried out at many airports in Japan, U.S.A. and U.K., and has been used extensively in runway overlay projects throughout the Caribbean and Latin America. As part of this study, two Uruguayan counterparts visited Osaka International Airport to join and observe nighttime overlay work for its main runway, which was successfully made.

As a result of these considerations, Study Team decided that "nighttime construction work" is most reasonable and practicable for urgent development of Carrasco Airport. In this connection, IATA's working group published "OFF-PEAK (nighttime work) CONSTRUCTION PRACTICES". For reference, Study Team did consider secondary runway development, either runway 01/19 or 10/28, prior to the main runway development, in case that it is impossible to carry out the "nighttime construction work" without interruption of air traffic operations. This study led to the conclusion that total development cost would be much higher than that resulting from "nighttime construction work". Furthermore, completion date of main runway development would be delayed. Incremental costs are as follows:

- If RWY01/19 is developed US$19,500,000
- If RWY10/28 is developed US$15,520,000

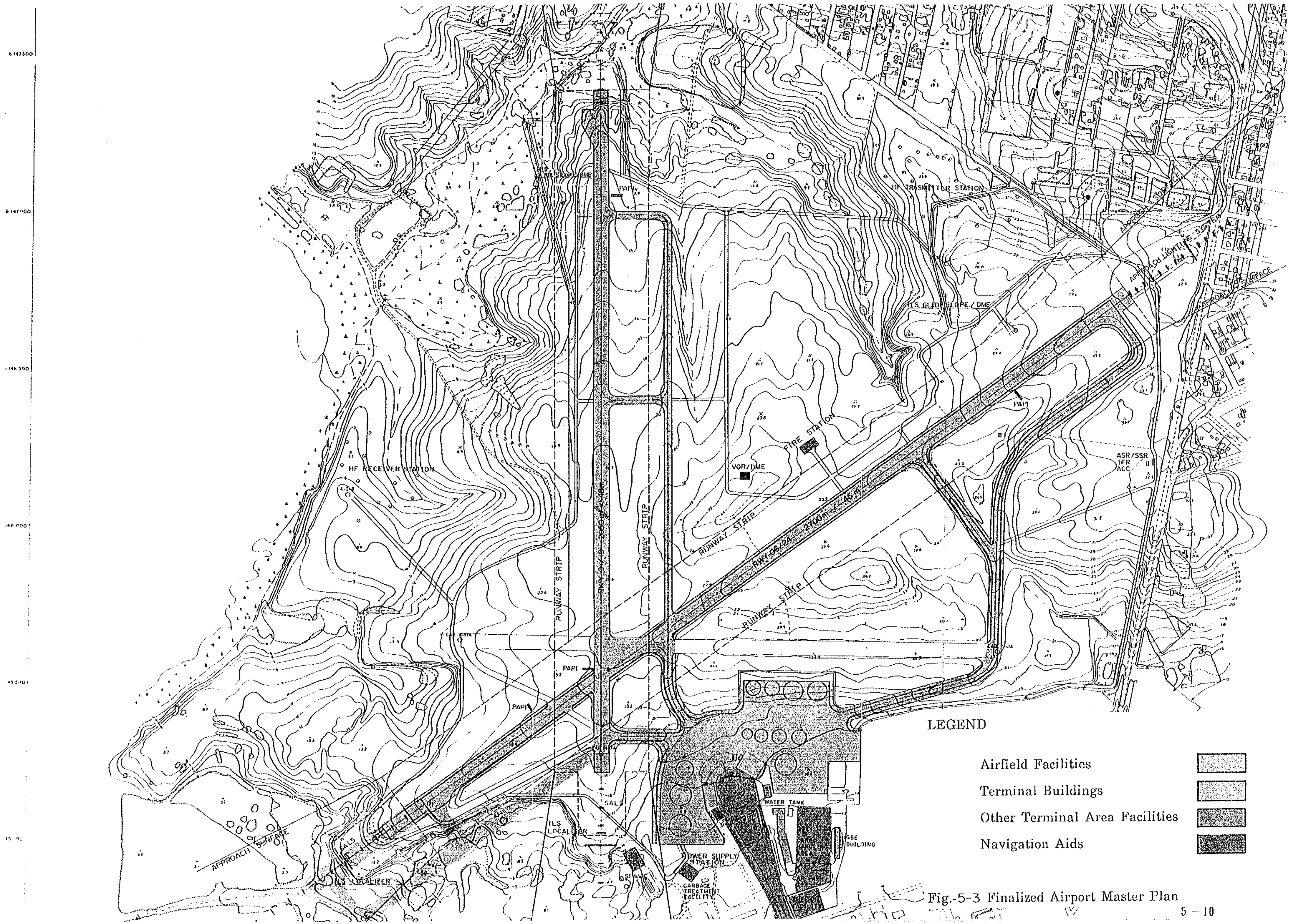


Fig.-5-3 Finalized Airport Master Plan

5-2-3 Finalized Facility Requirements and Airport Development Plan for Feasibility Study

On the basis of prepared Airport Master Plan, both parties agreed that the finalized facility requirements and Short-term airport development plan for Feasibility Study should be revised as follows:

(1) Airfield facilities

1) RWY06/24 (Primary runway)

The problems with, width of runway strip, strength of pavement and shoulders should be resolved to meet the ICAO recommendations for target year 1995.

Pavement should be reinforced to accommodate short-term traffic with design life of 10 years.

Design aircraft should be B747-400.

2) TWY-A

Reinforcement of pavement should be made in the same manner as RWY06/24.

3) TWY-B

Reinforcement of pavement should be made in the same manner as RWY06/24.

4) TWY-D

Reinforcement of pavement should be made in the same manner as RWY06/24.

5) RWY01/19

Pavement should be reinforced to accommodate B737 operations (Puente Aereo).

Design life in target year 1995 should be 10 years.

6) TWY-C

A part from RWY06/24 to RWY19 should be maintained as is.

For the other part, pavement should be reinforced in the same manner as RWY06/24.

Table 5-3 Finalized Facility Requirements for Airfield Facilities

Facility	1995	Additional Requirements and Descriptions
1. Primary runway (RWY06/24)	1. Width of runway strip should be extended to 300 m. 2. Pavement should be reinforced to accommodate Short-term traffic with design life of 10 years. 3. Shoulders should be reconstructed.	1. Pavement work will be made at off-peak hours (night time). 2. Design aircraft is B747-400 with weight of 625,000 lbs. Design curve of B747-200B will be applied. 3. D.G.I.A. will construct rigid paved shoulder with width of 3.5 m, this year or next year. Additional width of 4 m outside the paved shoulder (3.5 m) will be reviewed in this study.
2. TWY - A	1. Pavement should be reinforced to accommodate Short-term traffic with design life of 10 years.	1. Design aircraft is B747-400 with weight of 625,000 lbs. Design curve of B747-200B will be used applied. 2. Shoulders should be constructed (width: 10.5 m).
3. TWY - B	1. Pavement should be reinforced to accommodate Short-term traffic with design life of 10 years.	- ditto -
4. TWY - D	1. Pavement should be reinforced to accommodate Short-term traffic with design life of 10 years.	- ditto -
5. RWY01/19	1. Pavement should be reinforced to accommodate B737 operations with design life of 10 years.	1. Design weight of B737 is 109,000 lbs. (maximum take-off weight).
6. TWY-C	A part from RWY06/24 to apron should be reinforced in the same manner as RWY06/24.	

Table 5-3 Finalized Facility Requirements for Airfield Facilities

Facility	2000	Additional Requirements and Descriptions
1. Primary runway (RWY06/24)	----	
2. TWY - A	----	
3. TWY - B	----	
4. TWY - D	----	
5. RWY01/19	----	1. Runway length will be extended to 2050 m. 2. RWY19 will be upgraded to precision approach runway CAT-1. 3. Glide slope area and localizer area should be graded. 4. Provide B747 turning area at northern end of RWY01/19.
6. TWY-C	----	

(2) Terminal Area Facilities

1) Apron

Pavement should be reinforced in the whole area to accommodate B747 operations with design life of 20 years.

The reinforcement should be made in the following two stages:

Target year 1995: Construction of new apron and reconstruction of S-4, S-5 and S-6 to accommodate long-term traffic with design life of 20 years.

Repairs of S-1, S-2 and S-3.

Target year 2000: Reinforcement of S-3 to accommodate long-term traffic with design year of 20 years.

In the target year 2000, taxi-in & push-out concept will partially replace the present taxi-in & taxi-out concept.

2) Passenger Terminal Buildings, Cargo Terminal Buildings and Other Terminal Area Facilities

Table 5-4 shows finalized facility requirements for each facility.

Table 5-4 Finalized Facility Requirements for Terminal Area Facilities

Facility	1995	Additional Requirements and Descriptions
1. Apron	1. Reconstruction of areas S-4, S-5 and S-6 should be made to accommodate Long-term traffic with design life of 20 years. 2. Repairs of areas S-1, S-2 and S-3 should be made to prevent further deterioration.	1. Taxi-in and taxi-out concept will be maintained. 2. Following aircraft parking positions will be added at north-east side of existing apron: - two B747-400 - two B707
2. Passenger Terminal Central Terminal Departure Terminal Arrival Terminal	1. An area of 300 m^2 will be allocated as security check area, with three(3) X-ray detectors, two for international and one for domestic.	
3. Cargo Terminal	1. Warehouse: As is, with "open shed" to be provided. 2. Cargo and G.S.E. handling area will be provided.	

Facility	1995	Additional Requirements and Descriptions
4. Car Parks	1. Add space for 100 cars including cargo trucks at the cargo terminal area.	
5. Fuel	Major facilities: As is. Oil-water separaters will be required for ESSO and SHELL	
6. Water Supply	Add one 600-m^3 tank	
7. Sewage	As is.	
8. Rescue and Fire Fighting	1. Demolish the existing building and construct new building. 2. Construct one 30 m^3 elevated tank.	
9. Garbage disposal	Provide one 2 - 4 tons/day incinerator.	
10. GSE maintenance shop and airline offices located near the hangar	1. Existing building will be demolished, and new building (floor area: 3,000 m^2) will be constructed along the east boundary of terminal area.	

Table5-4 Finalized Facility Requirements for Terminal Area Facilities

Facility	2000	Additional Requirements and Descriptions
1. Apron	1. Reinforcement of area S-3 should be made to accommodate Long-term traffic with design life of 20 years.	1. Taxi-in and push-out concept will be partially introduced.
2. Passenger Terminal Central Terminal Departure Terminal Arrival Terminal	Central Terminal will be modified to provide: 1. Area of 300 m^2 for departure concourse and departure lounge: 2. Area of 105 m^2 for domestic baggage claim area with one baggage claim device.	
3. Cargo Terminal	1. Four(4) work stations will be installed at "open shed", whose area will be 360 m^2. 2. Rack system will be provided inside of warehouse, covering area of 1080 m^2. 3. Modify existing warehouse for bulk cargo handling. 4. Provide cold storage (125 m^2 in area) inside the existing warehouse.	

Facility	2000	Additional Requirements and Descriptions
4. Car Parks	----	
5. Fuel	Reconstruct to provide three 600-kl tanks, complete with related facilities.	
6. Water Supply	Add one 600-m^3 tank	
7. Sewage	Add 15 m^3/hr plant.	
8. Rescue and Fire Fighting	----	
9. Garbage disposal	Add one more 5 tons/day incinerator.	
10. GSE maintenance shop and airline offices located near the hangar	----	

(3) Air Navigation Facilities

1) Radio navigational aids

In the target year 1995, ILS equipment for RWY24 and Terminal VOR/DME should be renewed.

In the target year 2000, two sets of VOR/DME and one set of NDB should be additionally installed outside the airport.

ILS equipment for RWY19 should also be installed.

2) Approach lighting system

In order to meet ILS CAT-1 requirement, existing SALS of RWY24 should be changed to ALS.

In the target year 1995, new approach lights meeting ALS requirement should be installed in place of the existing SALS and sequenced flashing lights.

In the target year 2000, additional approach lights should be installed, to shorten interval of barrettes to 30 m and to extend total length of ALS as much as practicable.

For RWY01/19, approach lights should be installed in the following two steps:

Target year 1995: SALS for RWY19
Target year 2000: ALS for RWY19 and SLAS for RWY01

3) Other facilities and equipment

Table 5-5 shows finalized requirements.

Table 5-5 Finalized Facility Requirements for Air Navigation Facilities

Facility	1995	Additional Requirements and Desciptions
1. Radio Navigational Aids	1. ILS (CAT-1) equipment for RWY24 should be renewed. 2. Terminal VOR/DME should be renewed.	
2. Air Traffic Control Facilities	1. VFR equipment should be renewed. 2. VHF Air-to-Ground communication equipment for VFR should be renewed. 3. Tape recorder should be renewed.	
3. Communications Facilities	1. Following equipment or facilities should be renewed: - ATS direct speech equipment - HF receiving station - HF transmitting station	
4. Meteorological equipment	1. Equipment should be renewed. 2. RVR system should be installed.	
5. Electrical power supply	1. New station and equipment should be provided.	
6. Visual Aids	1. RWY06/24 1) Existing approach lights and sequenced flashing lights of RWY24 should be changed to meet ALS requirement.	

Note: MLS will be installed when its practicability and adaptability has been firmly confirmed.

Facility	1995	Additional Requirements and Descriptions
	2) Following lights should be installed: - SALS for RWY06 - Two sets of PAPI - Stopway lights 3) Following lights should be renewed: - RWY edge lights and end lights. - Wingbar lights for RWY24 - RWY threshold lights - Touchdown zone lights - RWY centerline lights	
	2. TWY-A, TWY-B and TWY-D 1) Taxiway edge lights should be renewed. 2) Taxiing guidance lights should be installed.	
	3. RWY01/19 and TWY-C 1) Following lights should be installed: - SALS for RWY19 - Two sets of PAPI - TWY edge lights - Taxiing guidance light 2) Following lights should be renewed: - RWY edge lights - RWY threshold lights and end lights - REIL for RWY01	
	4. Aerodrome beacon should be renewed.	
	5. Apron flood-lights should be renewed.	

Table5-5 Finalized Facility Requirements for Air Navigation Facilities

Facility	2000	Additional Requirements and Descriptions
1. Radio Navigational Aids	1. Two sets of VOR/DME and one set of NDB should be installed.	1. Glide slope/DME, localizer and middle marker will be installed for RWY19 ILS (CAT-1) approach.
2. Air Traffic Control Facilities	----	
3. Communications Facilities	----	
4. Meteorological equipment	----	
5. Electrical power supply	----	
6. Visual Aids	1. RWY06/24 1) Additional approach lights should be installed to meet ICAO recommendation.	

Note: MLS will be installed when its practicability and adaptability has been firmly confirmed.

Facility	2000	Additional Requirements and Descriptions
	2. RWY01/19	1. RWY19 SALS will be changed to ALS. 2. SALS for RWY01 will be installed. 3. Wingbar lights for RWY19 will be installed. 4. Following lights for RWY19 will be moved to appropriate locations; - PAPI - RWY threshold lights and end lights. 5. RWY edge lights will be added for extended part of runway. 6. REIL of RWY01 will be taken away.

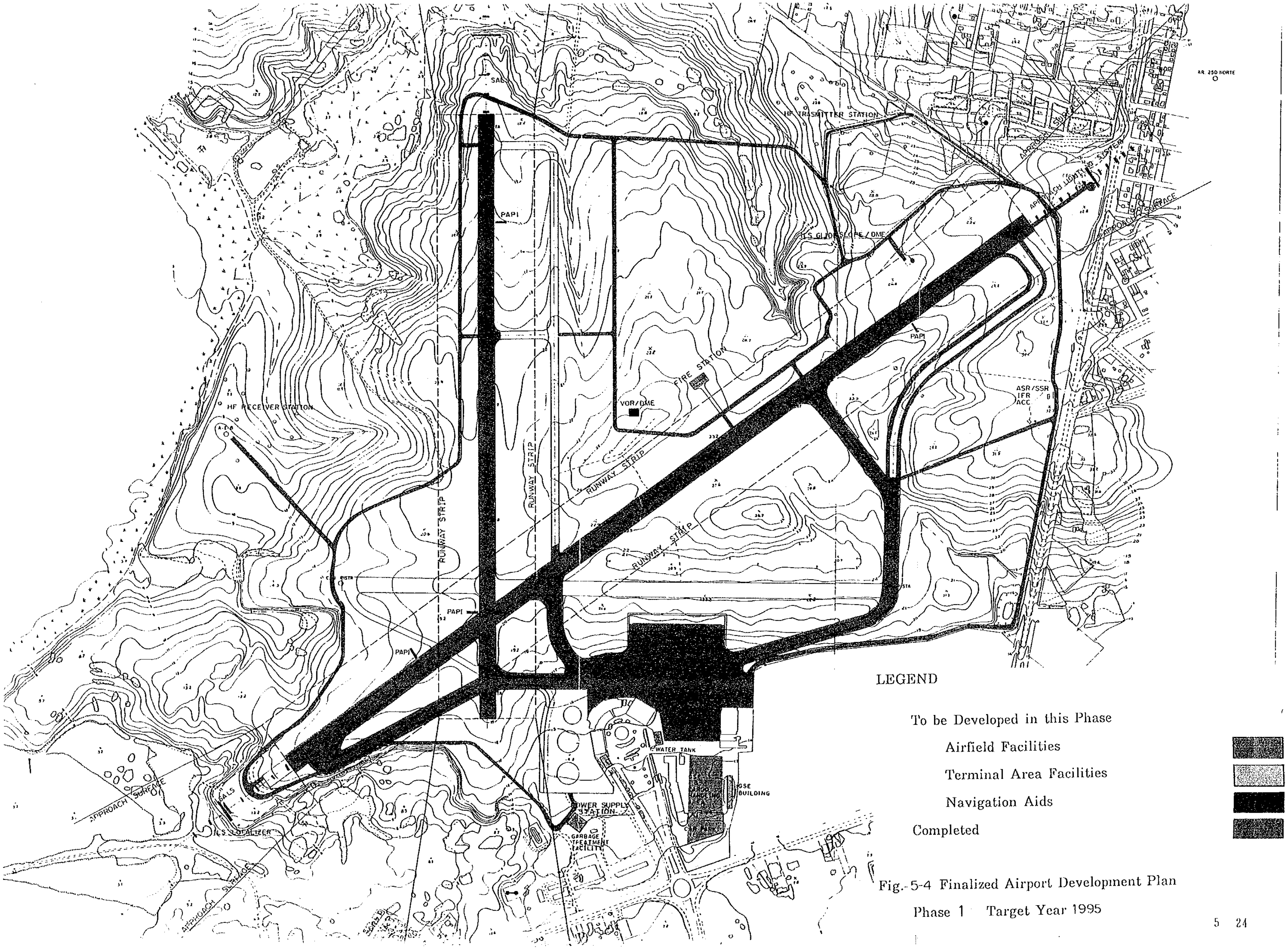


Fig. 5-4 Finalized Airport Development Plan

Phase 1 Target Year 1995

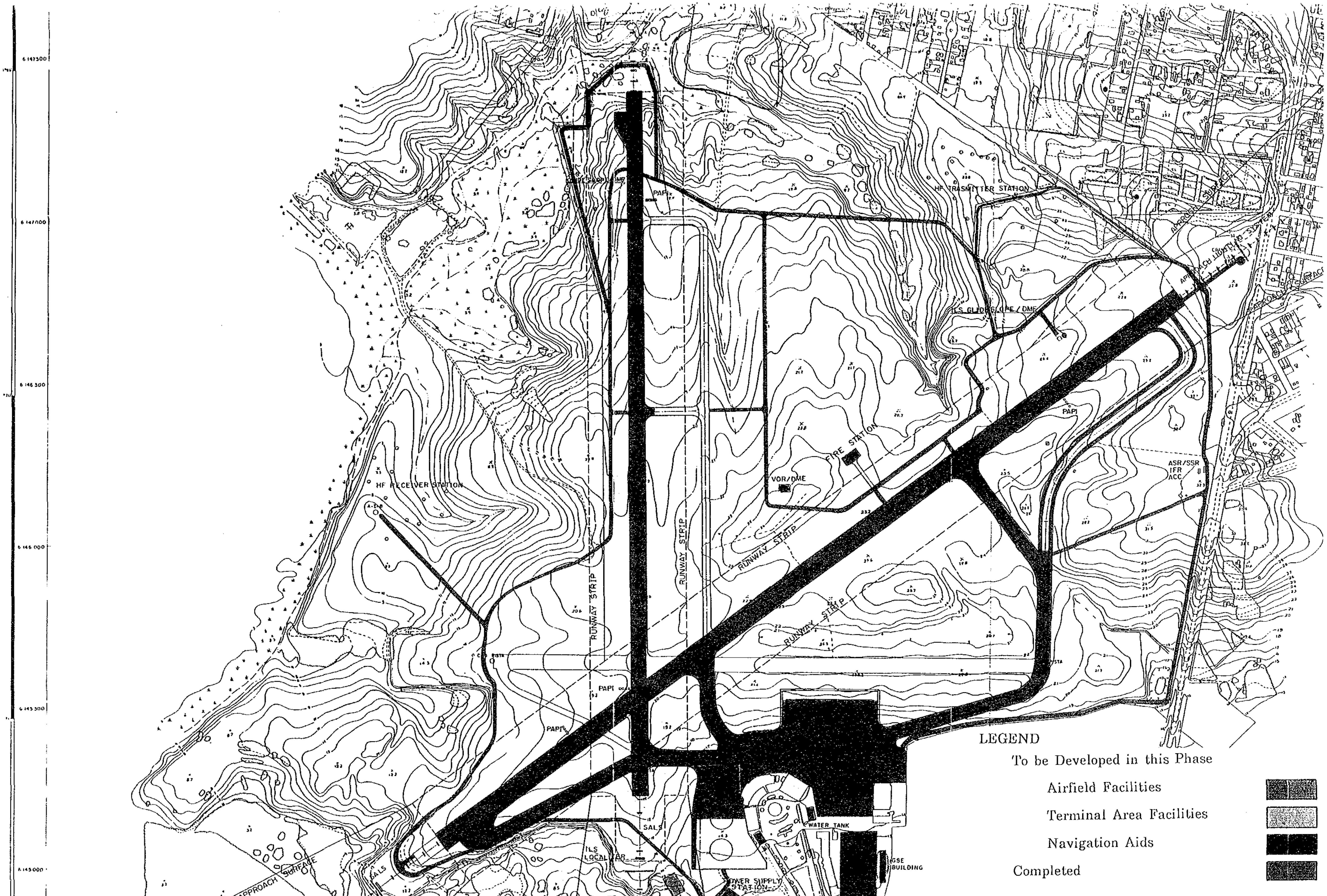


Fig. 5-5 Finalized Airport Development Plan

Phase 2 Target Year 2000