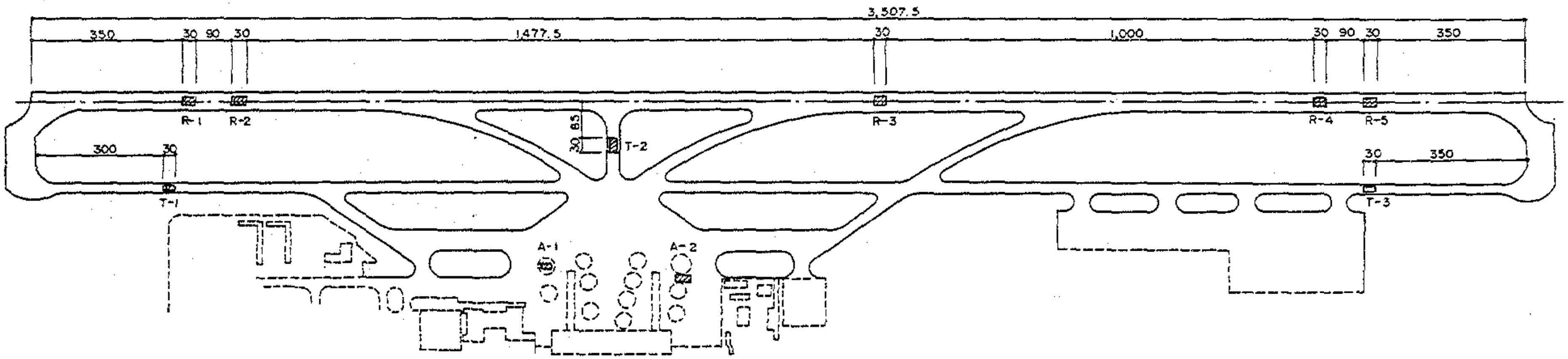
APPENDICES 3

APPENDIX 3-1(1) RESULT OF PAVEMENT SURFACE SURVEY

LOCATION OF SURVAY POINTS



DEGREE OF DETERIORATION OF PAVEMENTS

NUMBER OF DATA UNIT	DEGREE OF CRACKING (cm/m²)	PERCENTAGE OF CRACKING JOINT (%)	DEGREE OF STEPPING OF SLABS (m/m)	RANK OF PAVEMENT CONDITION
R - 1	23.7	2.6		C
R - 2	26.5	3.8		C
R - 3 *	RATE OF CRACKING 10.1 %	—	—	B
R - 4	22.6	1.3	0	C
R - 5	22.0	0	3	C
T - 1	29.0	0	0	C
T - 2	0	5.3	3	A
T - 3	24.4	1.6		B
A - 1	4.5	4.1	3	A
A - 2	1.2	10.4	3	B

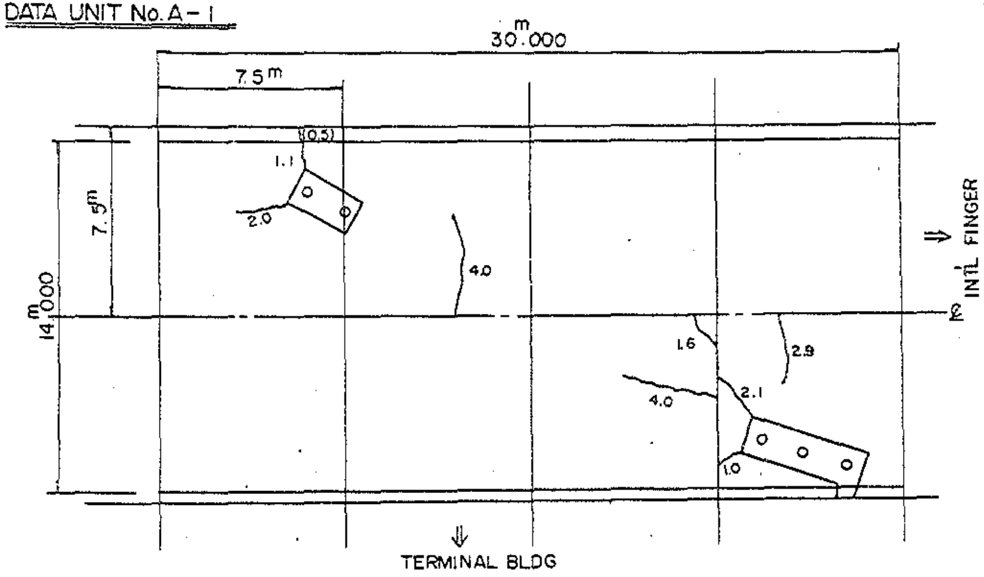
* Asphalt concrete overlay

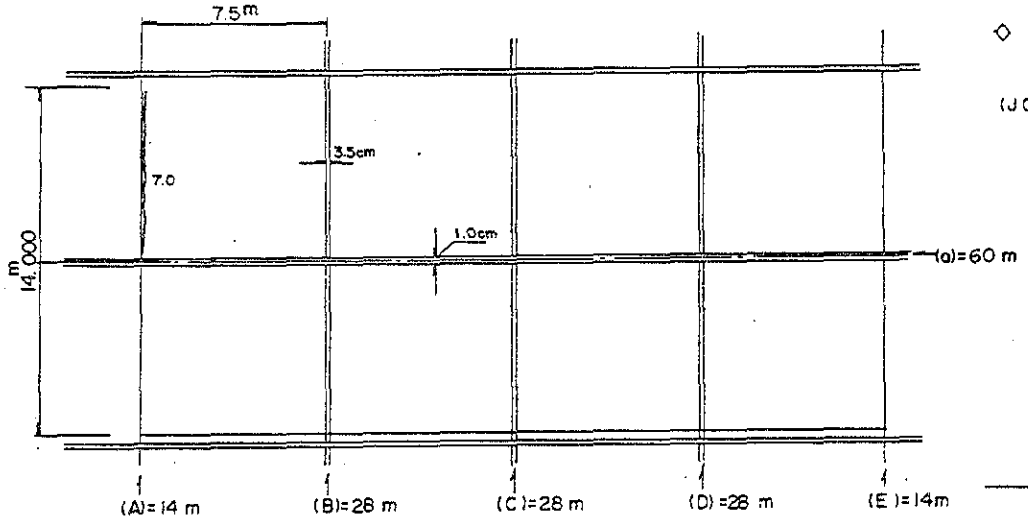
(Note)

A : No necessity of repairs
B : Repairs are necessary in near future
C : Repairs are necessary as soon as possible

DATA UNIT No. A-1

Date of Survey : Aug. 2. 1985





◇ Degree of cracking (cm/m²)

$$(CR) = \frac{\text{Length of cracks} \quad (cm)}{\text{Area of data unit} \quad (m^2)}$$

$$= \frac{①+②+③+\text{--------}+ⓝ}{14 \times 30}$$

$$= \frac{1870}{420}$$

$$= 4.5 \quad (cm/m^2)$$

◇ Percentage of cracking joints

$$(JC) = \frac{(\text{Length of damaged joints})}{(\text{Total length of joints})} \times 100$$

$$= \frac{(①+②+③+\text{------}+ⓝ)}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

$$= \frac{7.0}{172} \times 100$$

$$= 4.1 \quad (\%)$$

◇ Degree of stepping of slabs

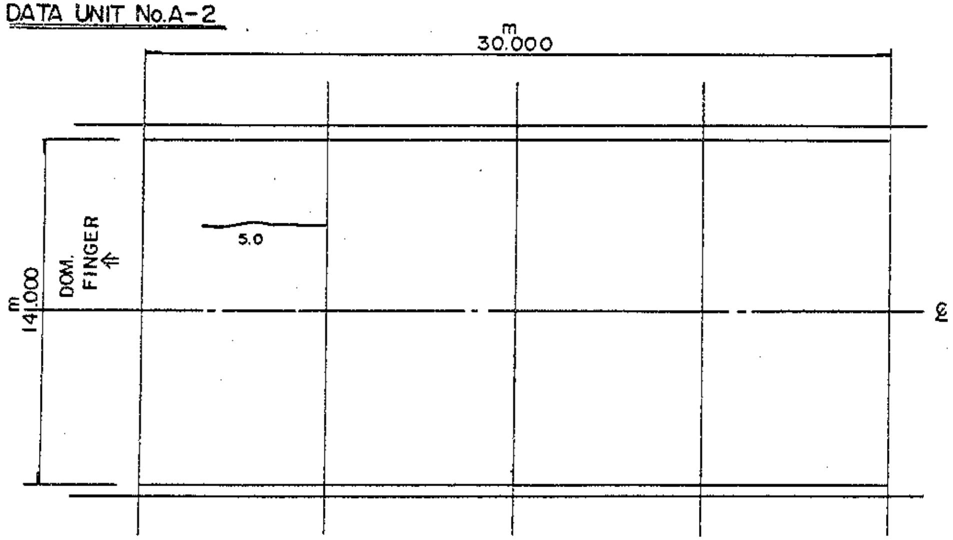
(SV) hmax = 3 m/m

◇ PRI = 10 − 0.290 x 4.5 − 0.296 x 4.1 − 0.535 x 3

= 5.9 —— Rank A

APPENDIX 3-1(2) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No.A-2



Date of Survey: Aug. 2. 1985

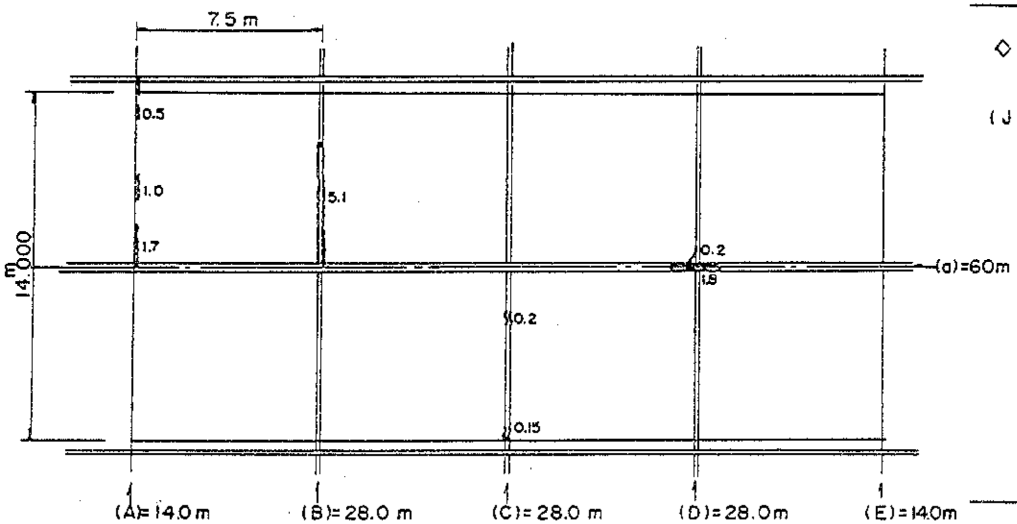
◇ Degree of cracking (cm/m²)

$$(CR) = \frac{\text{Length of cracks (cm)}}{\text{Area of data unit } (m^2)}$$

$$= \frac{①+②+③+\text{--------}+ⓝ}{14 \times 30}$$

$$= \frac{500}{420}$$

$$= 1.2 \quad (cm/m^2)$$



◇ Percentage of cracking joints

$$(JC) = \frac{\text{(Length of damaged joints)}}{\text{(Total length of joints)}} \times 100$$

$$= \frac{(①+②+③+\text{------}+ⓝ)}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

$$= \frac{17.9}{172} \times 100$$

$$= 10.4 \quad (\%)$$

◇ Degree of stepping of slabs

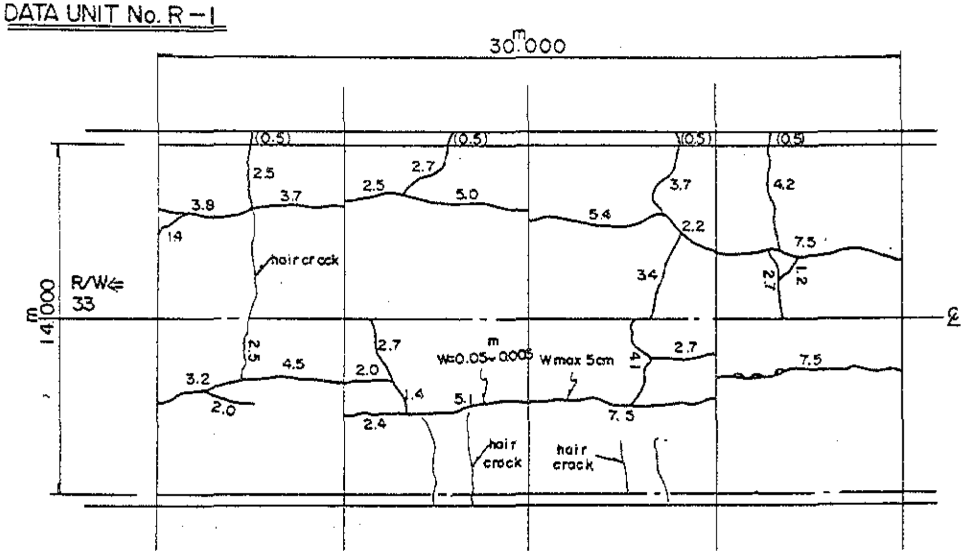
(SV) = h max= 3 m/m

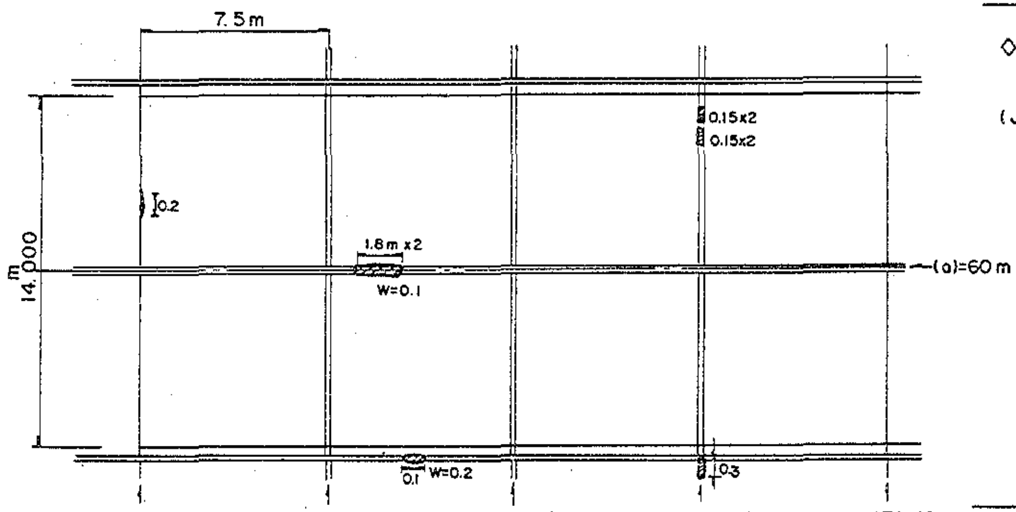
◇ PRI = 10 − 0.290 x 1.2 − 0.296 x 10.4 − 0.535 x 3

= 5.0 ——— Rank B

APPENDIX 3-1(3) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No. R-1





◇ PRI $= 10 - 0.290 \times 23.7 - 0.296 \times 2.6$

$= 2.4$ ——→ Rank C

Date of Survey : July.31. 1985

◇ Degree of cracking (cm/m²)

$$(CR) = \frac{\text{Length of cracks (cm)}}{\text{Area of data unit (m}^2)}$$

$$= \frac{①+②+③+\cdots\cdots+ⓝ}{14 \times 30}$$

$$= \frac{9950}{420}$$

$$= 23.7 \quad (cm/m^2)$$

◇ Percentage of cracking joints

$$(JC) = \frac{\text{(Length of damaged joints)}}{\text{(Total length of joints)}} \times 100$$

$$= \frac{(①+②+③+\cdots\cdots+ⓝ)}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

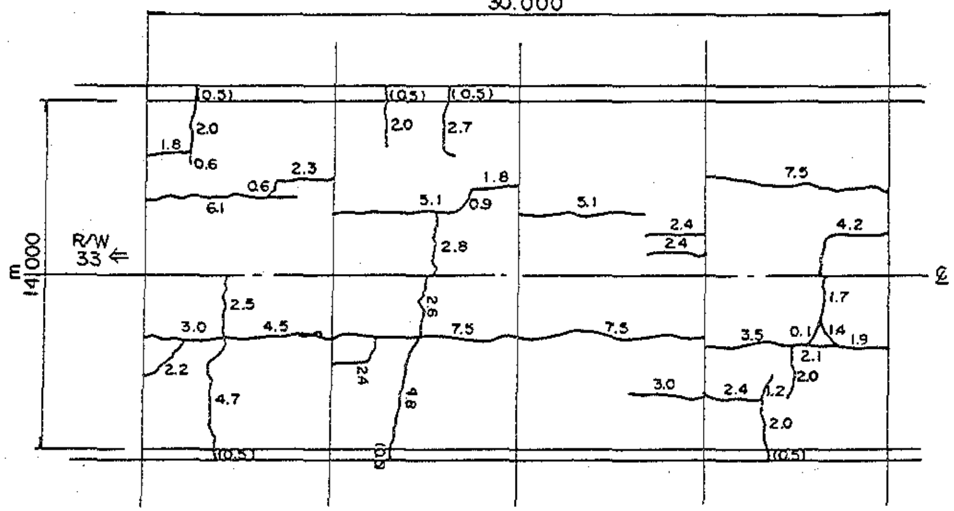
$$= \frac{4.4}{172} \times 100$$

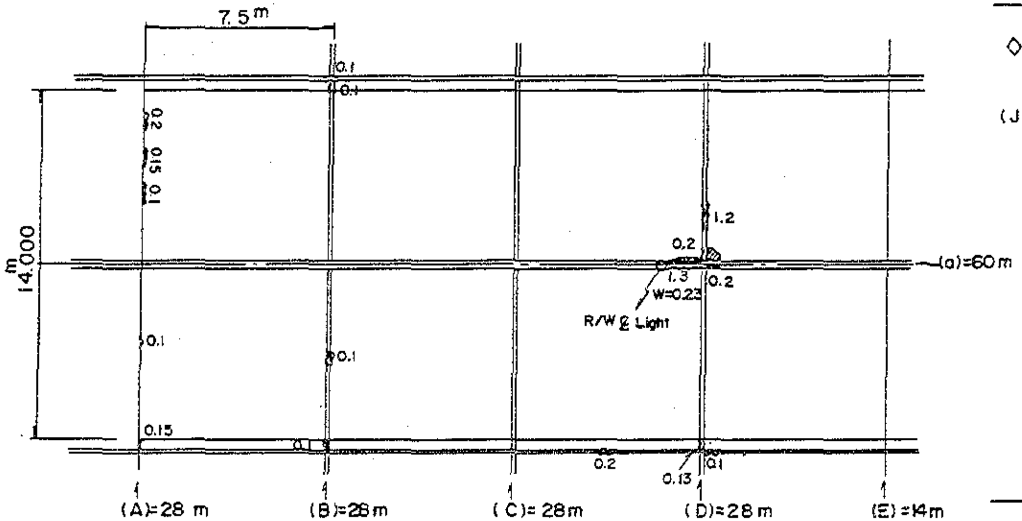
$$= 2.6 \quad (\%)$$

◇ Degree of stepping of slabs

APPENDIX 3-1(4) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No. R-2





◇ PRI = 10 − 0.290 x 26.5 − 0.296 x 3.8

= 1.2 —— Rank C

Date of Survey : July. 31. 1985

◇ Degree of cracking (cm/m²)

$$(CR) = \frac{\text{Length of cracks (cm)}}{\text{Area of data unit (m}^2\text{)}}$$

$$= \frac{①+②+③+\cdots\cdots+ⓝ}{14 \times 30}$$

$$= \frac{11140}{420}$$

$$= 26.5 \quad (\text{cm}/\text{m}^2)$$

◇ Percentage of cracking joints

$$(JC) = \frac{\text{(Length of damaged joints)}}{\text{(Total length of joints)}} \times 100$$

$$= \frac{(①+②+③+\cdots\cdots+ⓝ)}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

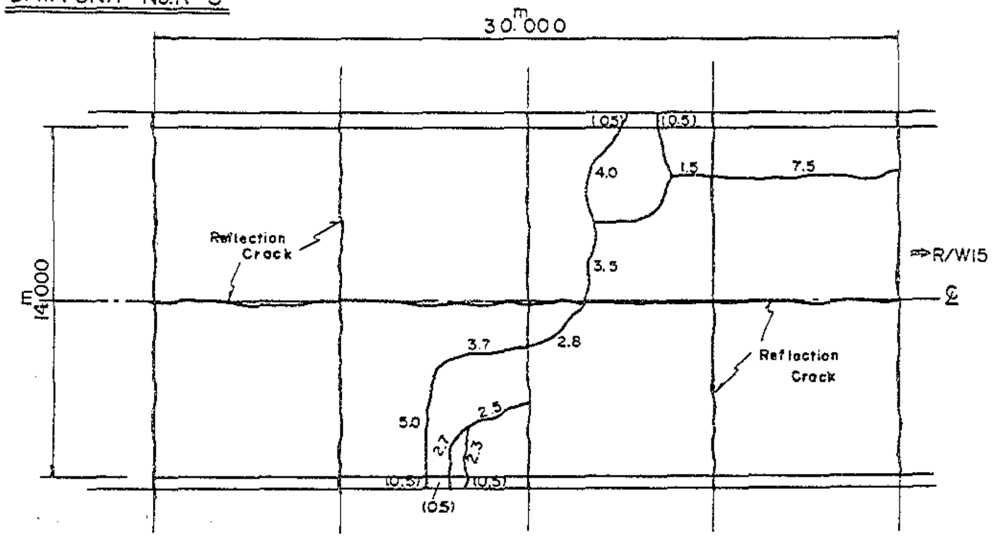
$$= \frac{6.55}{172} \times 100$$

$$= 3.8 \quad (\%)$$

◇ Degree of stepping of slabs

APPENDIX 3-1 (5) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No.R-3



Date of Survey : Aug. 1. 1985

◇ Ratio of cracking (%)

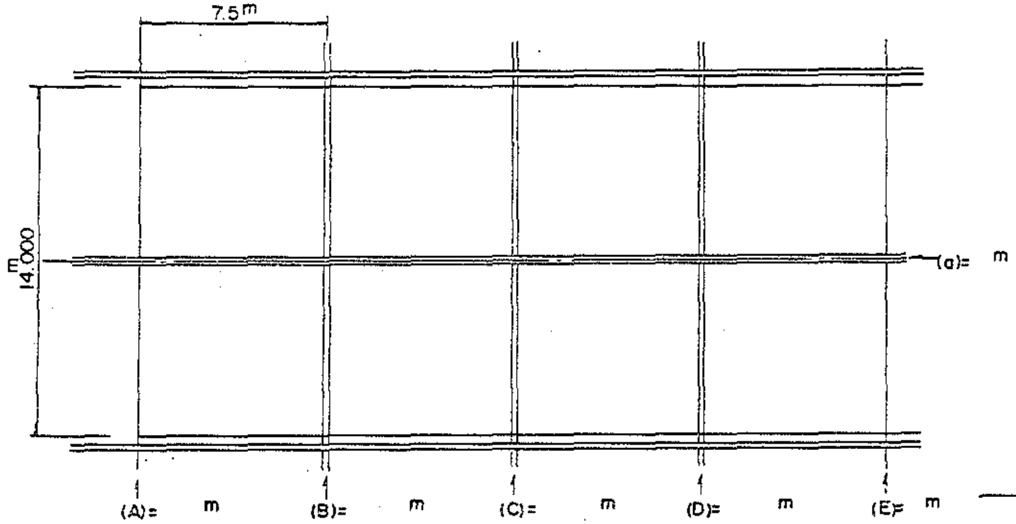
$$(CR) = \frac{\text{Area of cracks } (m^2)}{\text{Area of data unit } (m^2)} \times 100$$

$$= \frac{(40.7 + 100) \times 0.3}{14 \times 30} \times 100$$

$$= 10.1 \ (\%)$$

x) Area of Cracks = Length of Cracks (m) x 0.3 (m)

x) Length of reflection Cracks = 14x5+30 = 100m



$$= \frac{\text{(Length of damaged joints)}}{\text{(Total length of joints)}} \times 100$$

$$= \frac{(①+②+③+\cdots\cdots+ⓝ)}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

$$= \frac{\qquad}{\qquad} \times 100$$

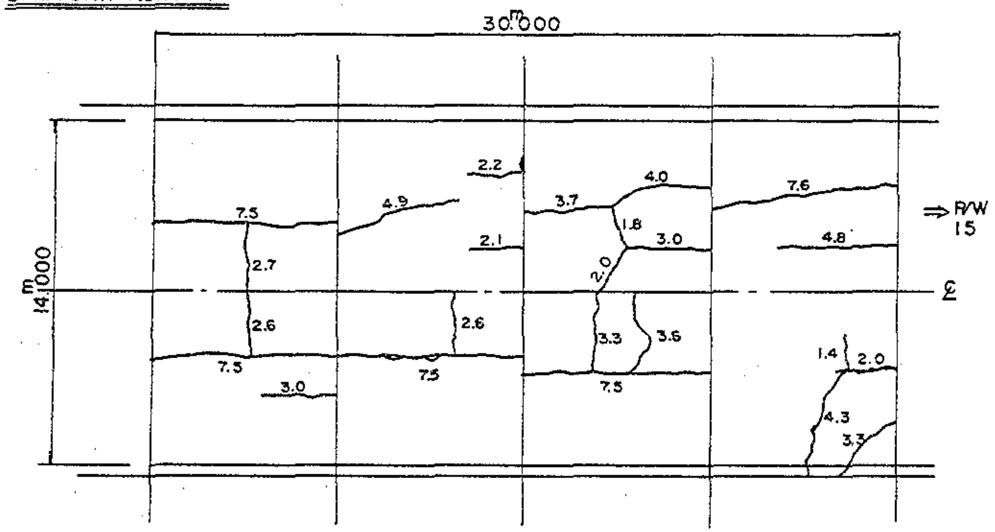
= (%)

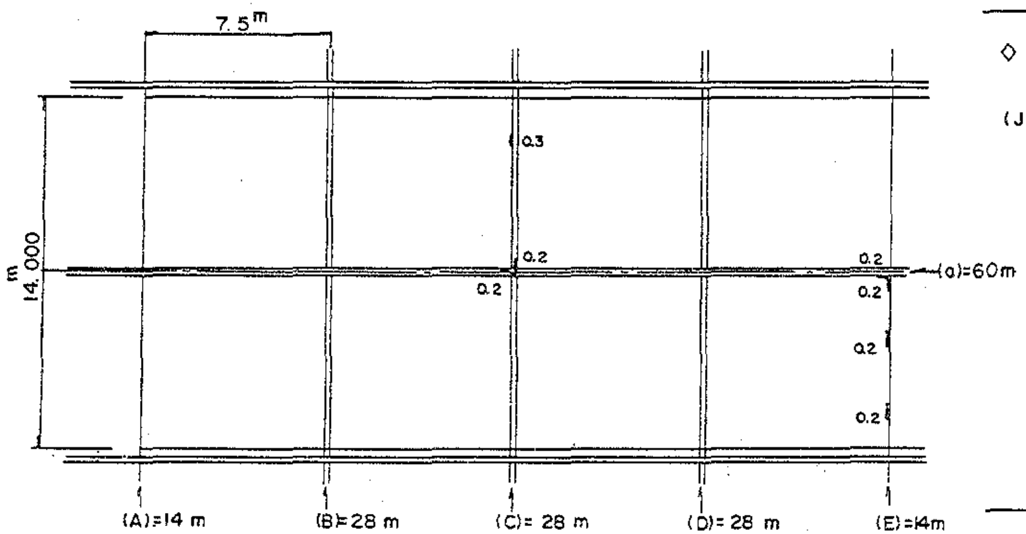
◇ PRI = 10 − 0.450 x 10.1

= 5.5 ——— Rank B

APPENDIX 3-1(6) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No.R-4





◇ PRI = 10 − 0.290 x 22.6 − 0.296 x 1.3

= 3.1 ——→ Rank C

Date of Survey : Aug. 2. 1985

◇ Degree of cracking (cm/m²)

$$(CR) = \frac{\text{Length of cracks (cm)}}{\text{Area of data unit } (m^2)}$$

$$= \frac{①+②+③+\cdots\cdots+ⓝ}{14 \times 30}$$

$$= \frac{9490}{420}$$

$$= 22.6 \quad (cm/m^2)$$

◇ Percentage of cracking joints

$$(JC) = \frac{\text{(Length of damaged joints)}}{\text{(Total length of joints)}} \times 100$$

$$= \frac{(①+②+③+\cdots\cdots+ⓝ)}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

$$= \frac{2.2}{172} \times 100$$

$$= 1.3 \quad (\%)$$

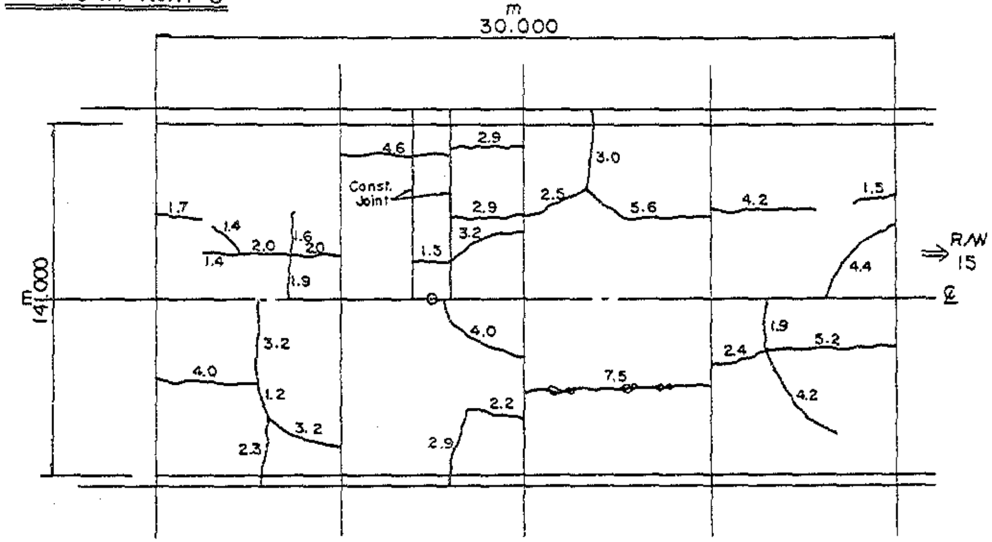
◇ Degree of stepping of slabs

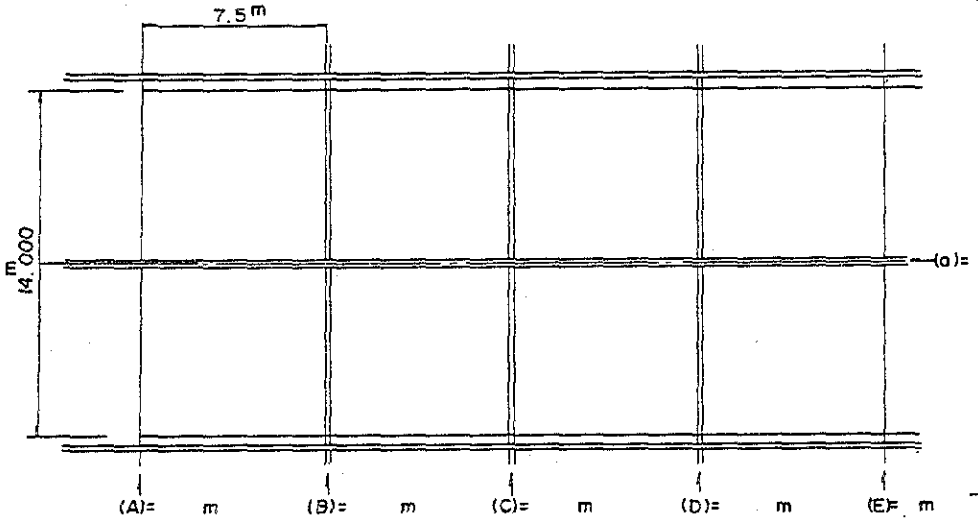
(SV) = hmax = 3 m/m

APPENDIX 3-1(7) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No.R-5

Date of Survey : Aug. 2. 1985





◇ Degree of cracking (cm/m²)

$$(CR) = \frac{\text{Length of cracks (cm)}}{\text{Area of data unit } (m^2)}$$

$$= \frac{①+②+③+\text{---------}+ⓝ}{14 \times 30}$$

$$= \frac{9250}{420}$$

$$= 22.0 \quad (cm/m^2)$$

◇ Percentage of cracking joints

$$(JC) = \frac{\text{(Length of damaged joints)}}{\text{(Total length of joints)}} \times 100$$

$$= \frac{(①+②+③+\text{------}+ⓝ)}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

$$= \frac{\qquad}{\qquad} \times 100$$

$= 0$ (%)

◇ Degree of stepping of slabs

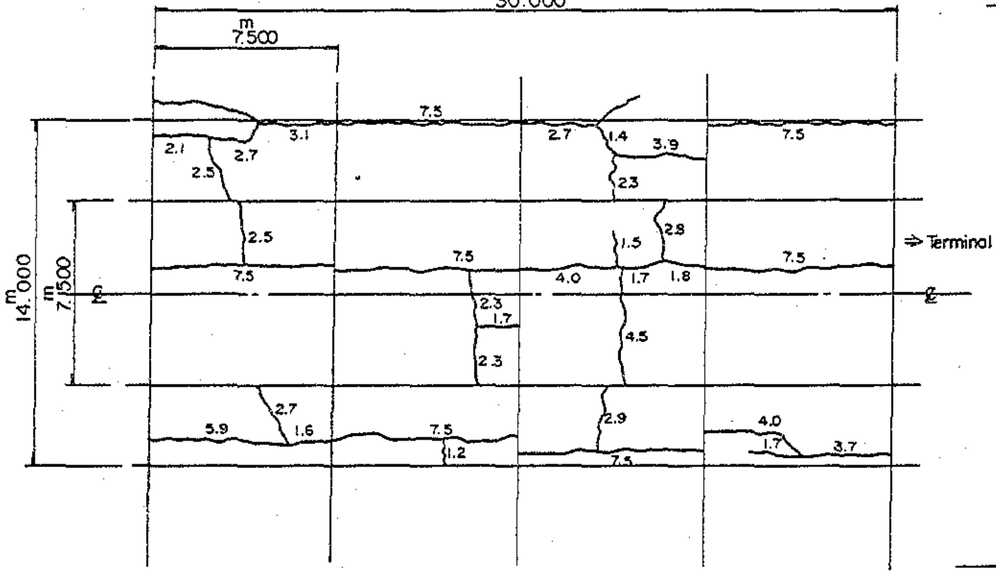
(SV) h max = 3 m/m

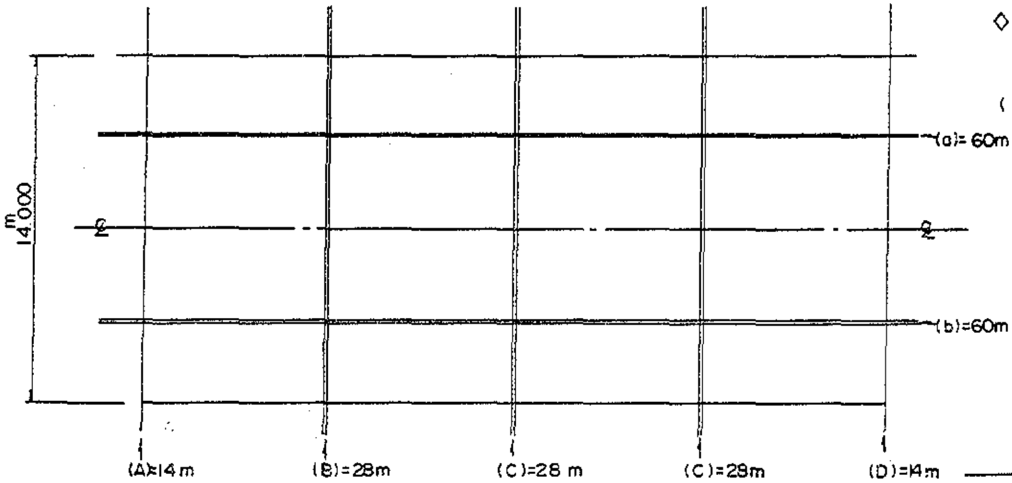
◇ PRI = 10 − 0.290 x 22.0 − 0.535 x 3.0

= 2.0 ——— Rank C

APPENDIX 3-1(8) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No. T-1





◇ PRI = 10 − 0.290 x 29.0

= 1.59 —— Rank C

Date of Survey : July. 31 1985

◇ Degree of cracking (cm/m²)

$$(CR) = \frac{(\text{Length of cracks})\ (cm)}{(\text{Area of data unit})\ (m^2)}$$

$$= \frac{①+②+③+\cdots+ⓝ}{14 \times 30}$$

$$= \frac{12200}{420}$$

$$= 29.0 \quad (cm/m^2)$$

◇ Percentage of cracking joints (%)

$$(JC) = \frac{(\text{Length of damaged joints})}{(\text{Total length of joints})} \times 100$$

$$= \frac{①+②+③+\cdots+ⓝ}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

$$= \frac{0}{232} \times 100$$

= D (%)

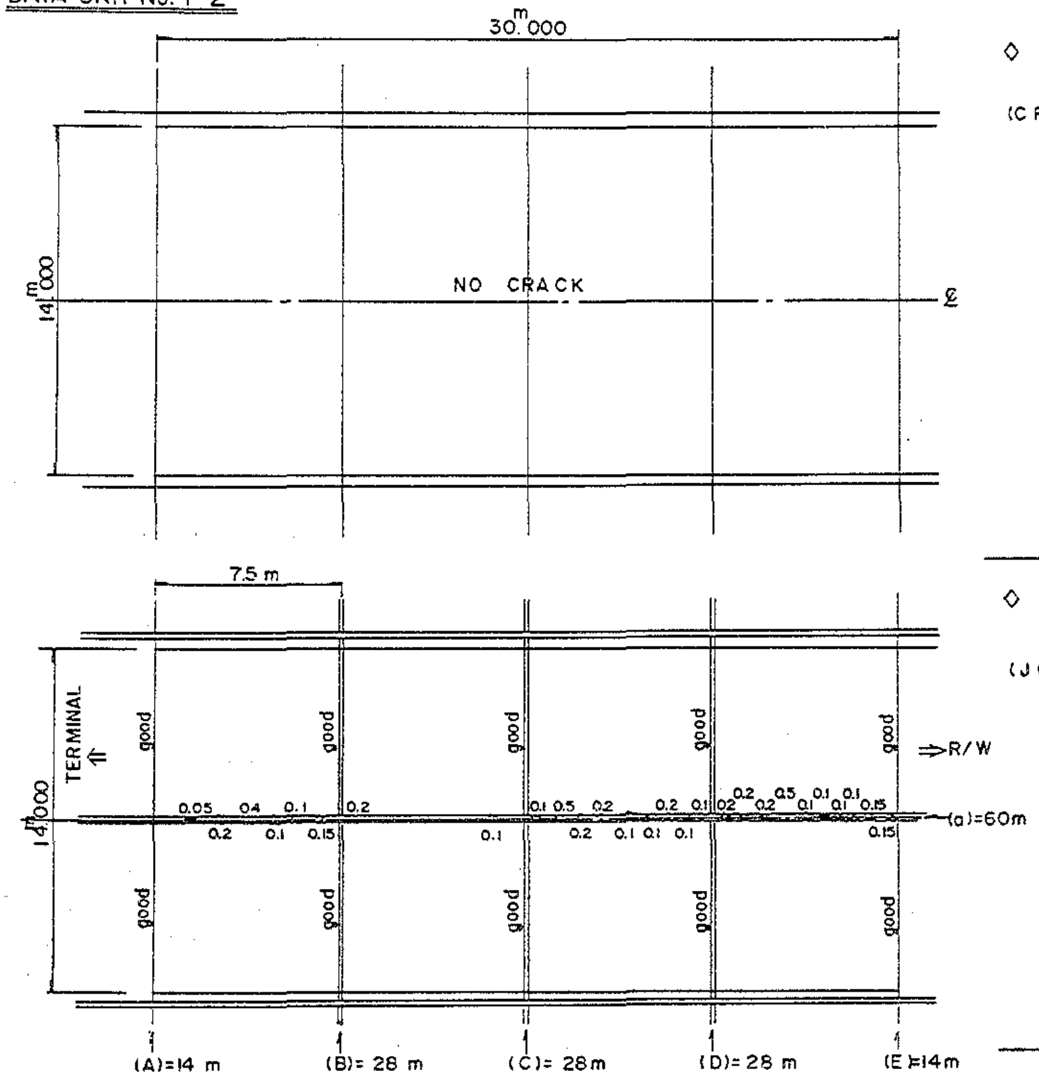
◇ Degree of stepping of slabs

(SV) = hmax = 0 m/m

APPENDIX 3-1(9) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No. T-2

Date of Survey : July.31.1985



◇ Degree of cracking (cm/m²)

$$(CR) = \frac{\text{Length of cracks (cm)}}{\text{Area of data unit (m}^2)}$$

$$= \frac{①+②+③+\cdots+ⓝ}{14 \times 30}$$

$$= \frac{0}{420}$$

$$= 0 \quad (cm/m^2)$$

◇ Percentage of cracking joints

$$(JC) = \frac{\text{(Length of damaged joints)}}{\text{(Total length of joints)}} \times 100$$

$$= \frac{(①+②+③+\cdots+ⓝ)}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

$$= \frac{9.4}{172} \times 100$$

$$= 5.5 \quad (\%)$$

◇ Degree of stepping of slabs

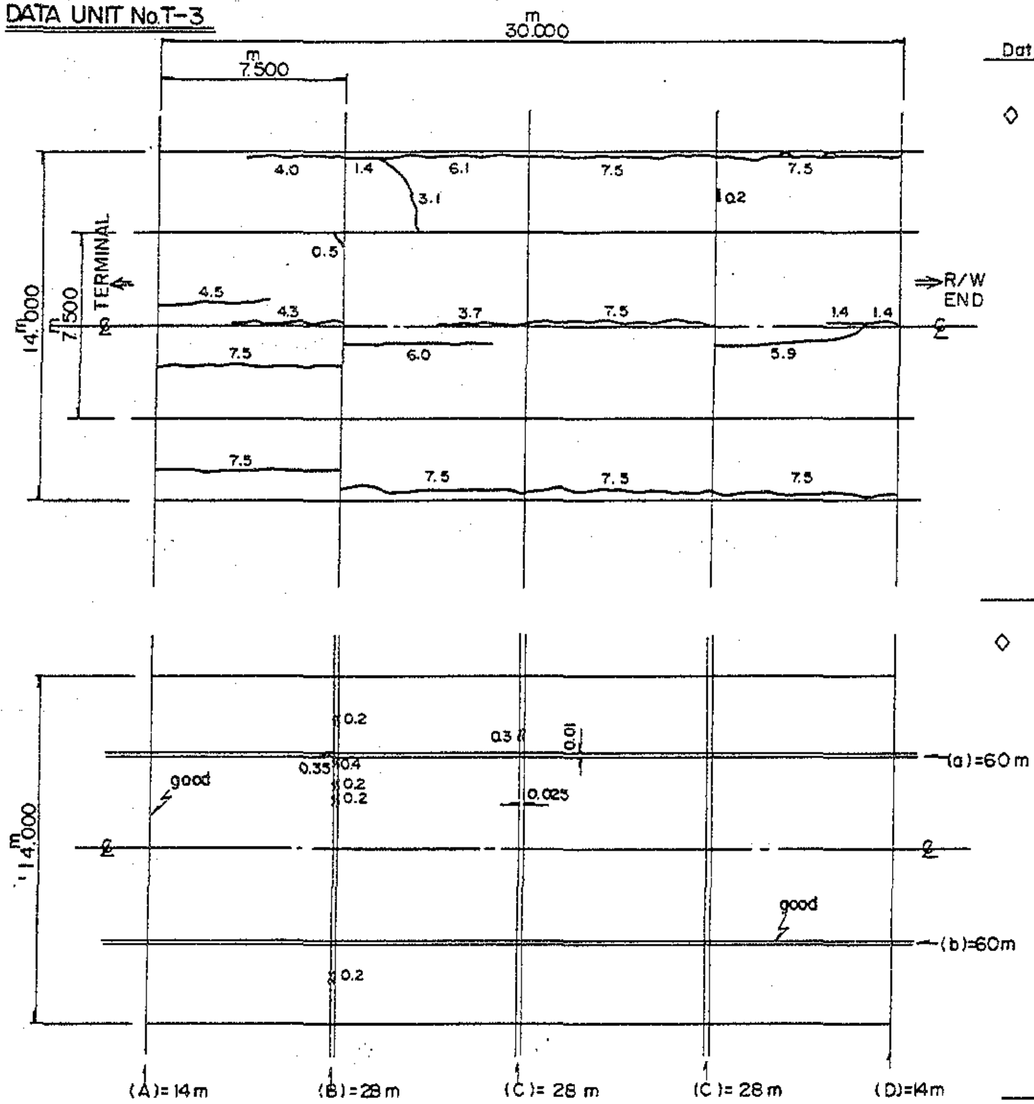
(SV) = h max = 3 m/m

◇ PRI = 10 − 0.290 x 0 − 0.296 x 5.47 − 0.535 x 3

= 6.8 —— Rank A

APPENDIX 3-1 (10) RESULT OF PAVEMENT SURFACE SURVEY

DATA UNIT No.T-3



Date of Survey: Aug. 1. 1985

◇ Degree of cracking (cm/m²)

$$= \frac{\text{(Length of cracks) (cm)}}{\text{(Area of data unit) (m}^2\text{)}}$$

$$= \frac{① + ② + ③ + \cdots + ⓝ}{14 \times 30}$$

$$= \frac{10\,250}{420}$$

$= 24.4$ (cm/m²)

◇ Percentage of cracking joints (%)

$$= \frac{\text{(Length of damaged joints)}}{\text{(Total length of joints)}} \times 100$$

$$= \frac{① + ② + ③ + \cdots + ⓝ}{(A)+(B)+(C)+(D)+(E)+(a)} \times 100$$

$$= \frac{3.7}{232} \times 100$$

$= 1.6$ (%)

◇ Degree of stepping of slabs

◇ PRI $= 10 - 0.290 \times 24.4 - 0.296 \times 1.6$

$= 2.5$ —— Rank B

APPENDIX 3-1 (11) RESULT OF PAVEMENT SURFACE SURVEY

APPENDIX 3-2 (I) RESULT OF PASSENGER FLOW SURVEY

Survey I International Arrival Passengers

Date, time 7 August 23:00 - 8 August 01:40

Check Point
- a Finger concourse (Arrival passenger only)
- b Immigration (Inspection Time)
- c Customs (Inspection Time)
- d Arrival Lobby (Arrival passengers only)

UNIT: Persons

min. / points	0- 5	5- 10	10- 15	15- 20	20- 25	25- 30	30- 35	35- 40	40- 45	45- 50
a	0	0	0	0	7	30	0	30	80	117
d	0	0	0	0	0	0	1	16	9	6

min. / points	50- 55	55- 60	60- 65	65- 70	70- 75	75- 80	80- 85	85- 90	90- 95	95-100
a	0	0	0	0	0	0	0	0	0	104
d	14	9	49	29	57	30	22	6	5	1

min. / points	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140	140-145	145-150
a	84	10	7	4	0	0	0	0	0	0
d	0	0	4	10	22	28	30	25	26	26

min. / points	150-155	155-160								
a	0	0								
d	8	6								

UNIT: Persons/5 minutes

b	11	5	3	4	8	4	7	5
	6	7	5	5	4	4	4	4
	5	5	5	4	–	–	–	–
c	3/7	3/9	4/9	3/5	2/7	4/–	3/–	4/–
	5/–	3/–	5/–	2/–	3/–	2/–		

APPENDIX 3-2 (2) RESULT OF PASSENGER FLOW SURVEY

Survey II Domestic Departure, Arrival Passengers

Date, time 10, August 12:30 - 10, August 15:30

Check point
- a Lobby Entrance
- b Lobby Exit
- c Departure Gate (Departure passengers only)
- d Finger (Arrival passengers only)
- e Arrival Gate (Arrival passengers only)

UNIT: Persons

points \ min.	0 – 30	30 – 60	60 – 90	90 – 120	120 – 150	150 – 180
a	564	668	762	608	725	749
b	622	1,032	655	403	647	681
c	24	4	54	99	74	134
d	366	140	44	27	36	263
e	146	378	73	35	32	205

APPENDIX 3-2 (3) RESULT OF PASSENGER FLOW SURVEY

Survey Ⅲ International Departure Passengers

Date, time 13 August 21:30 - 14 August 01:30

Check Point a Departure Wicket

b Immigration (Inspection Time)

c Finger (Departure passengers only)

d Lobby (Number of persons in the Lobby)

UNIT: Persons

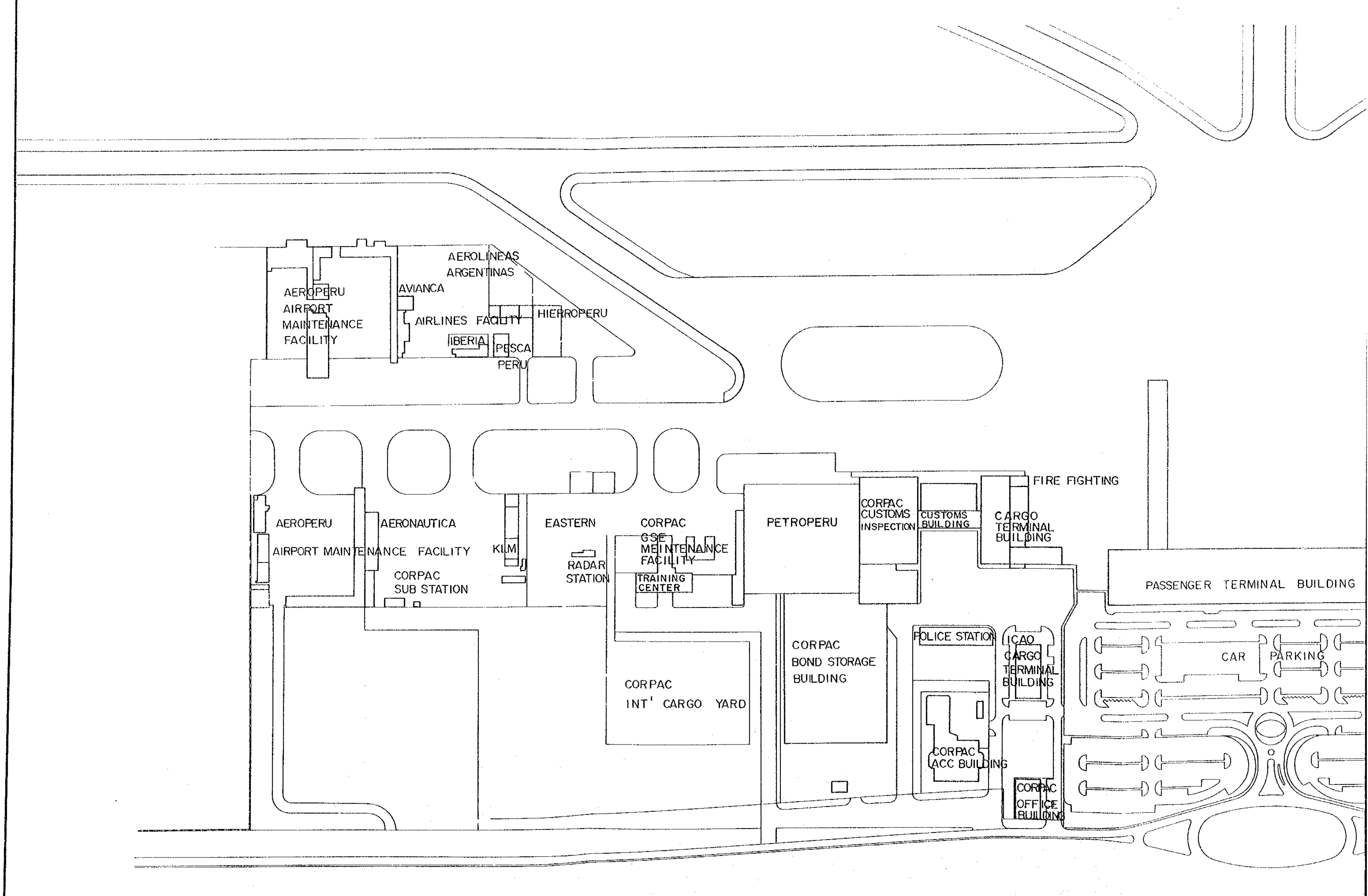
points \ min.	0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240
a	0	0	30	70	108	148	95	2
c	0	0	25	20	143	133	90	30

UNITS: second/person

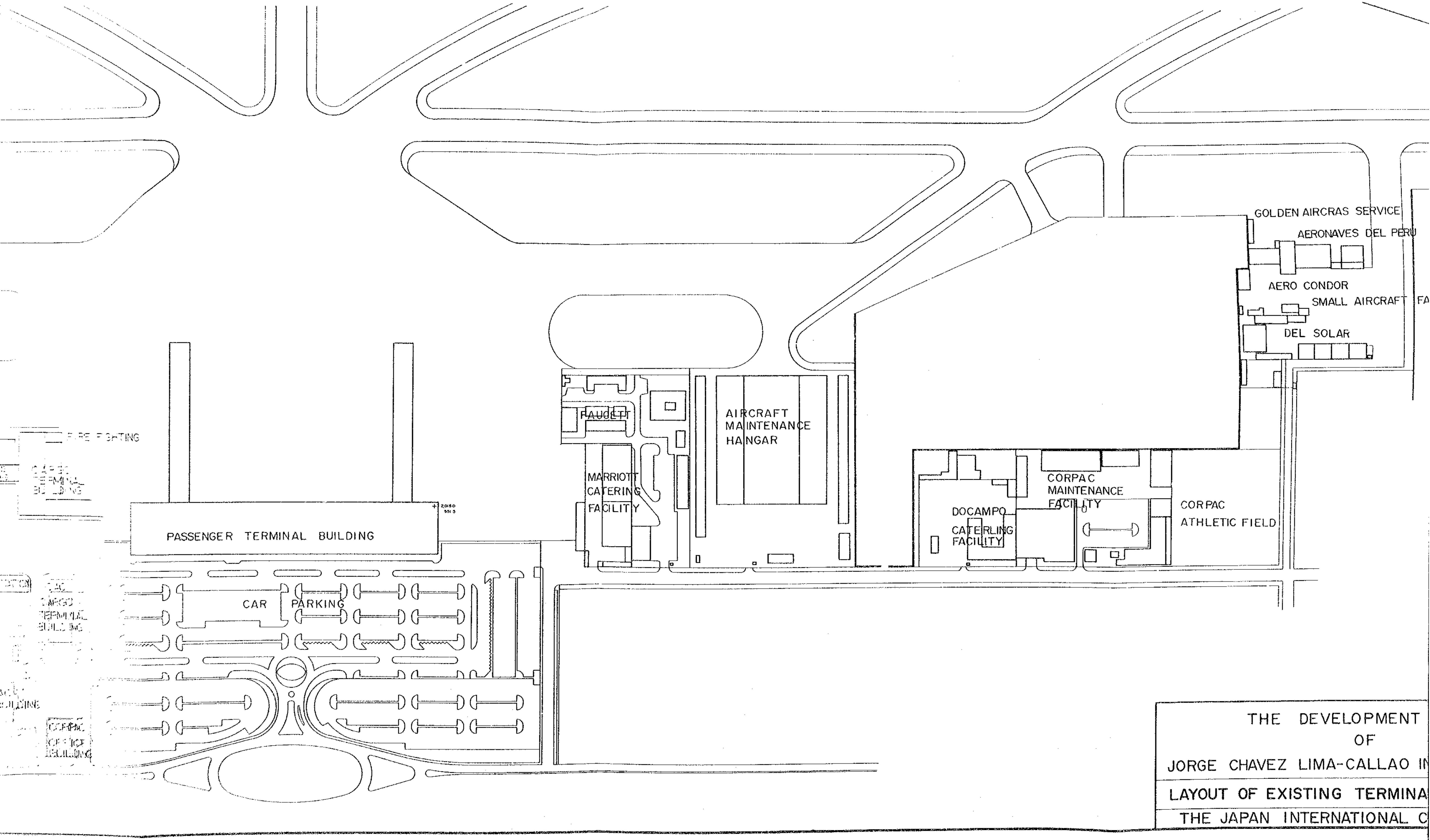
	83	56	10	250	25	50	27	88	102	35	70	70
	145	40	25	47	60	40	100	60	45	17	125	33
b	10	38	45	30	68	40	40	92	50	100	23	15
	55	15	80	27	40	40	15	15	50	23	20	77
	28	25	107	38	56	30	8	118	58	55	60	20
	56	37	25	38	15	18	7	12	40	7	105	40

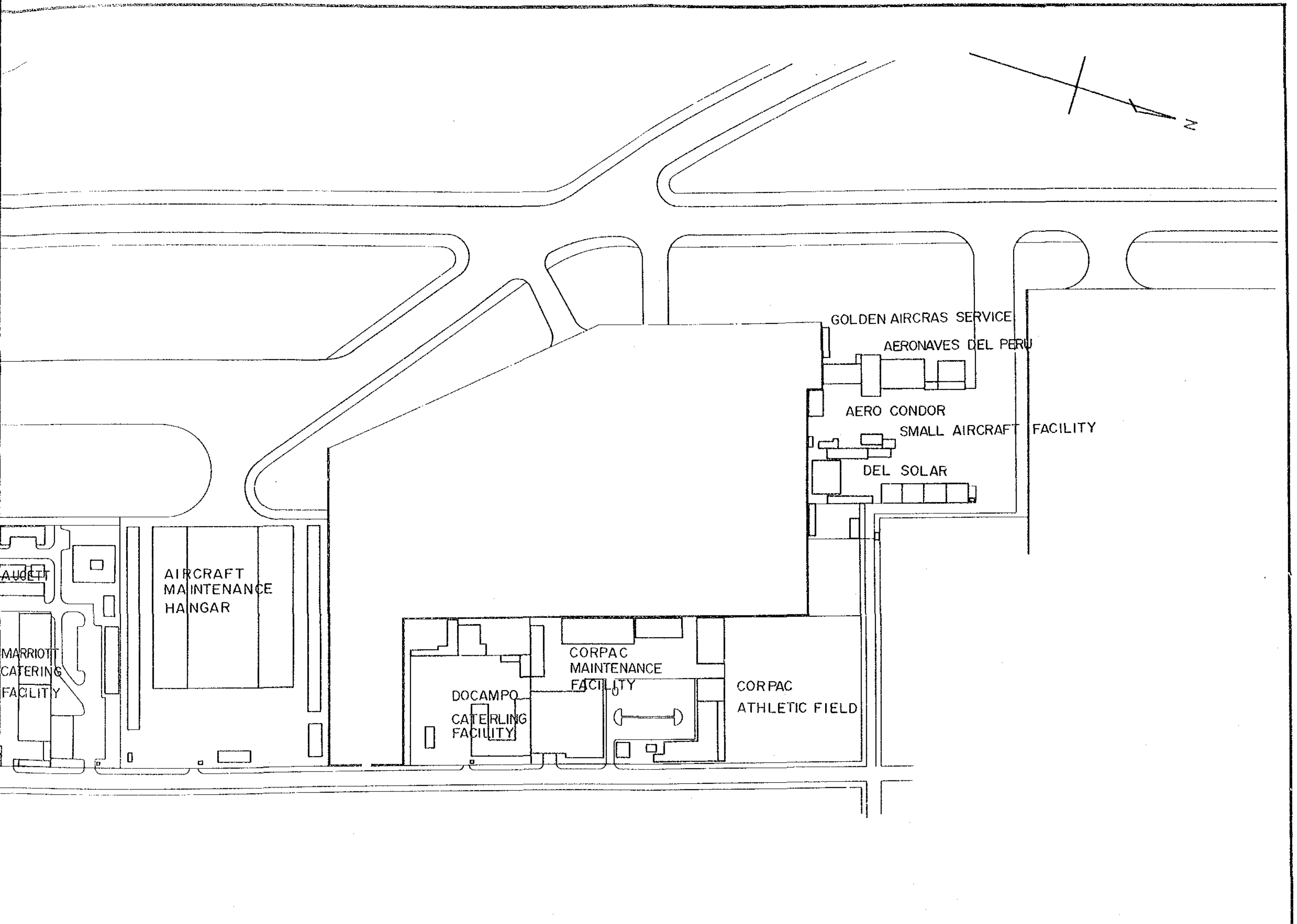
UNIT: Persons

point \ time	21:30	22:00	22:30	23:00	23:30	0:00	0:30	1:00
d	61	105	301	434	661	629	430	164


AEROLINEAS
ARGENTINAS
AEROPERU
AIRPORT
MAINTENANCE
FACILITY
AVIANCA
AIRLINES FACILITY
HIERROPERU
IBERIA
PESCA
PERU
FIRE FIGHTING
AEROPERU
AERONAUTICA
EASTERN
CORPAC
GSE
MEINTENANCE
FACILITY
PETROPERU
CORPAC
CUSTOMS
INSPECTION
CUSTOMS
BUILDING
CARGO
TERMINAL
BUILDING
AIRPORT MAINTENANCE FACILITY
KLM
RADAR
STATION
CORPAC
SUB STATION
TRAINING
CENTER
PASSENGER TERMINAL BUILDING
CORPAC
BOND STORAGE
BUILDING
POLICE STATION
ICAO
CARGO
TERMINAL
BUILDING
CAR PARKING
CORPAC
INT' CARGO YARD
CORPAC
ACC BUILDING
CORPAC
OFFICE
BUILDING

APPENDIX 3 - 3 LAYOUT OF EXISTING TERMINAL AREA FACILITIES

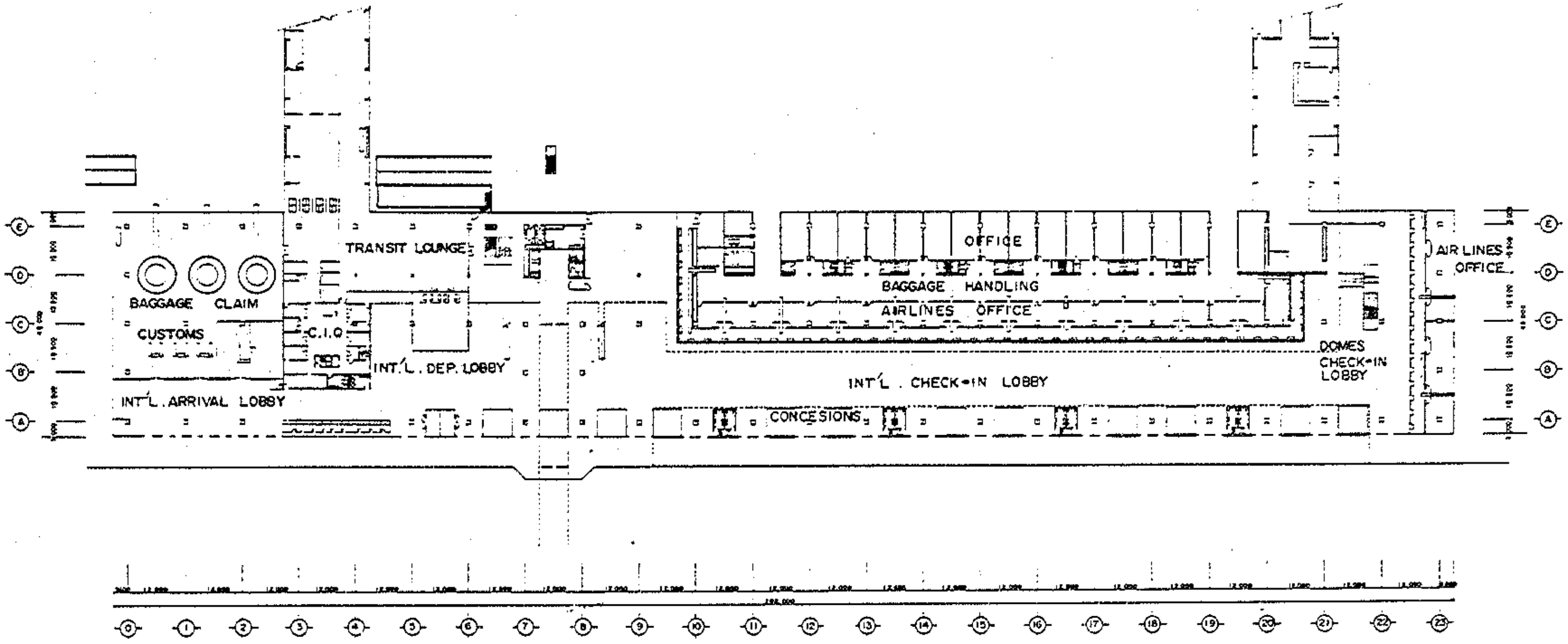




THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

LAYOUT OF EXISTING TERMINAL AREA FACILITIES

THE JAPAN INTERNATIONAL COOPERATION AGENCY

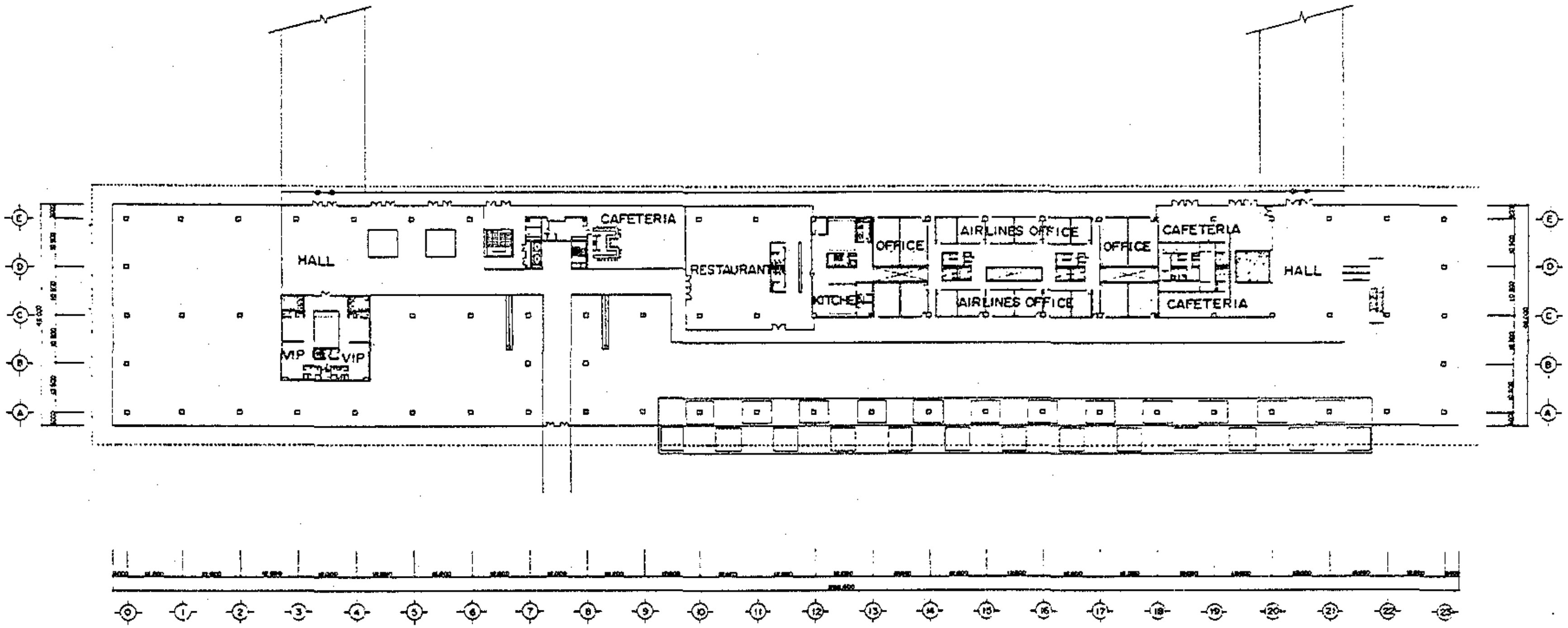


APPENDIX 3 - 4 (1) PLAN OF EXISTING TERMINAL BUILDING

THE DEVELOPMENT PROJECT OF JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

EXISTING PASSENGER TERMINAL BUILDING 1ST FLOOR PLAN

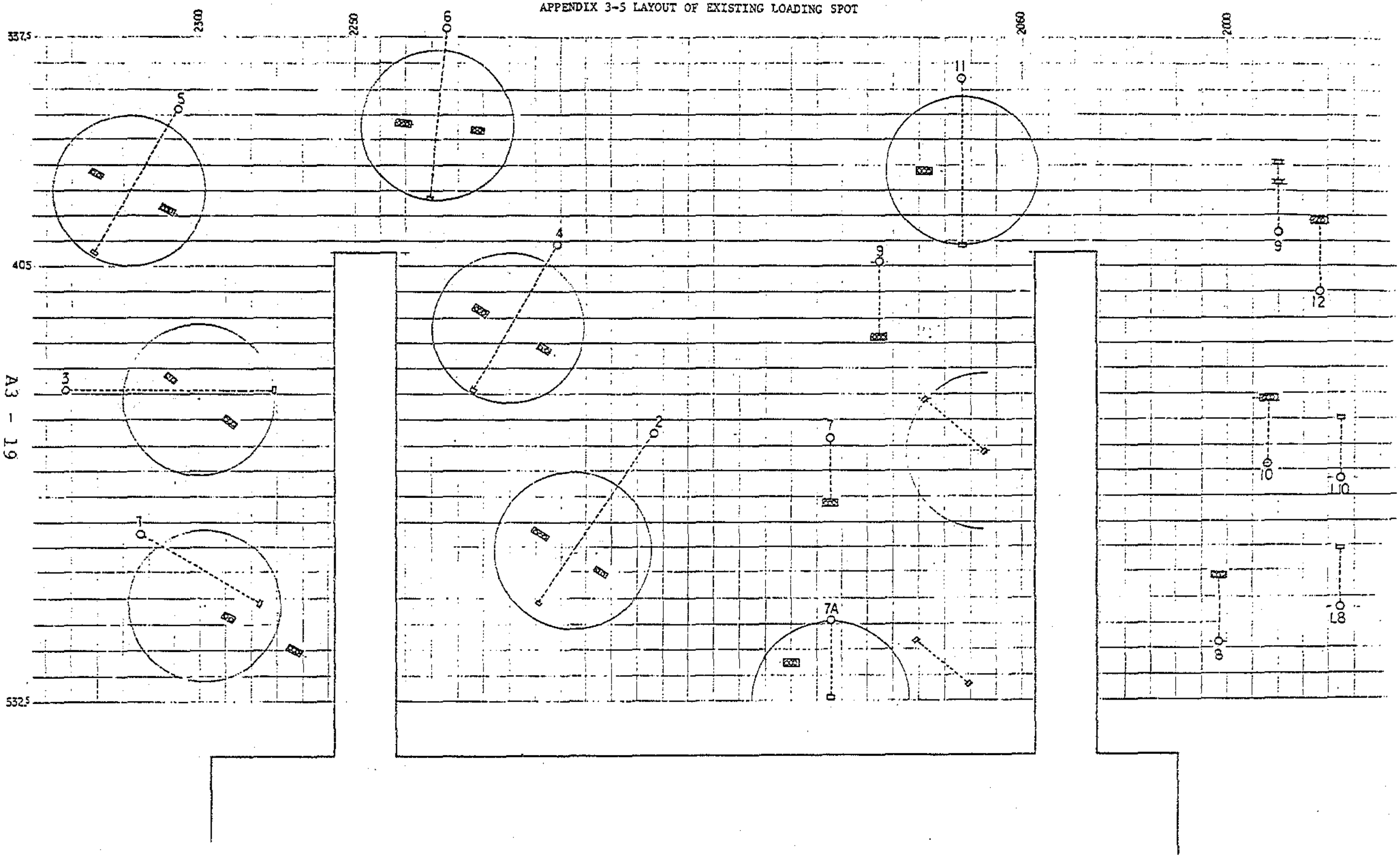
THE JAPAN INTERNATIONAL COOPERATION AGENCY



APPENDIX 3 - 4 (2) PLAN OF EXISTING TERMINAL BUILDING

THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT
EXISTING PASSENGER TERMINAL BUILDING 2ND FLOOR PLAN
THE JAPAN INTERNATIONAL COOPERATION AGENCY

APPENDIX 3-5 LAYOUT OF EXISTING LOADING SPOT



APPENDICES 4

APPENDIX 4-1 METHODOLOGY OF DEMAND FORECAST

1. Demand of International Air Transport

The forecasting procedure of international air transport demand for passengers and freight at Lima Airport is shown in Fig. 1-1.

1-1. International Passenger Demand

Step 1. Separate Peruvian and foreign passengers.
At first, the total passengers are devided into two groups: Peruvian and foreigners. The ratio of Peruvian to foreigners corresponds to that of departing Peruvians to arriving foreigners.

Step 2. Break down and forecast each group by area.
To obtain the approximate numbers of passengers by area, the total international passengers are devided into the following five areas:

(1) South America
(2) Central America and Mexico
(3) U.S.A. and Canada
(4) Europe
(5) Others

After Peruvian and foreign passengers have been estimated by area, an approximate number of total international passengers is estimated at the next step.

The equations for estimation of Peruvian passengers by area are formulated by the following variables:
(1) GDP of Peru
(2) Index of air fare
(3) Long-term foreign debt of Peru

The equations to estimate foreign passengers, on the other hand, consist of the following variables:
(1) GDP of each area
(2) Index of air fare
Both passengers are calculated by simulation analysis.

Step 3. Adjust approximate numbers by control total passenger.
Each number of passengers by area is adjusted by the total number of passengers, which has been obtained

at the second step. The equation (1) shows the procedure of control total.

$$Ti = T \times Ta,i/\sum Ta,i \quad \ldots\ldots\ (1)$$

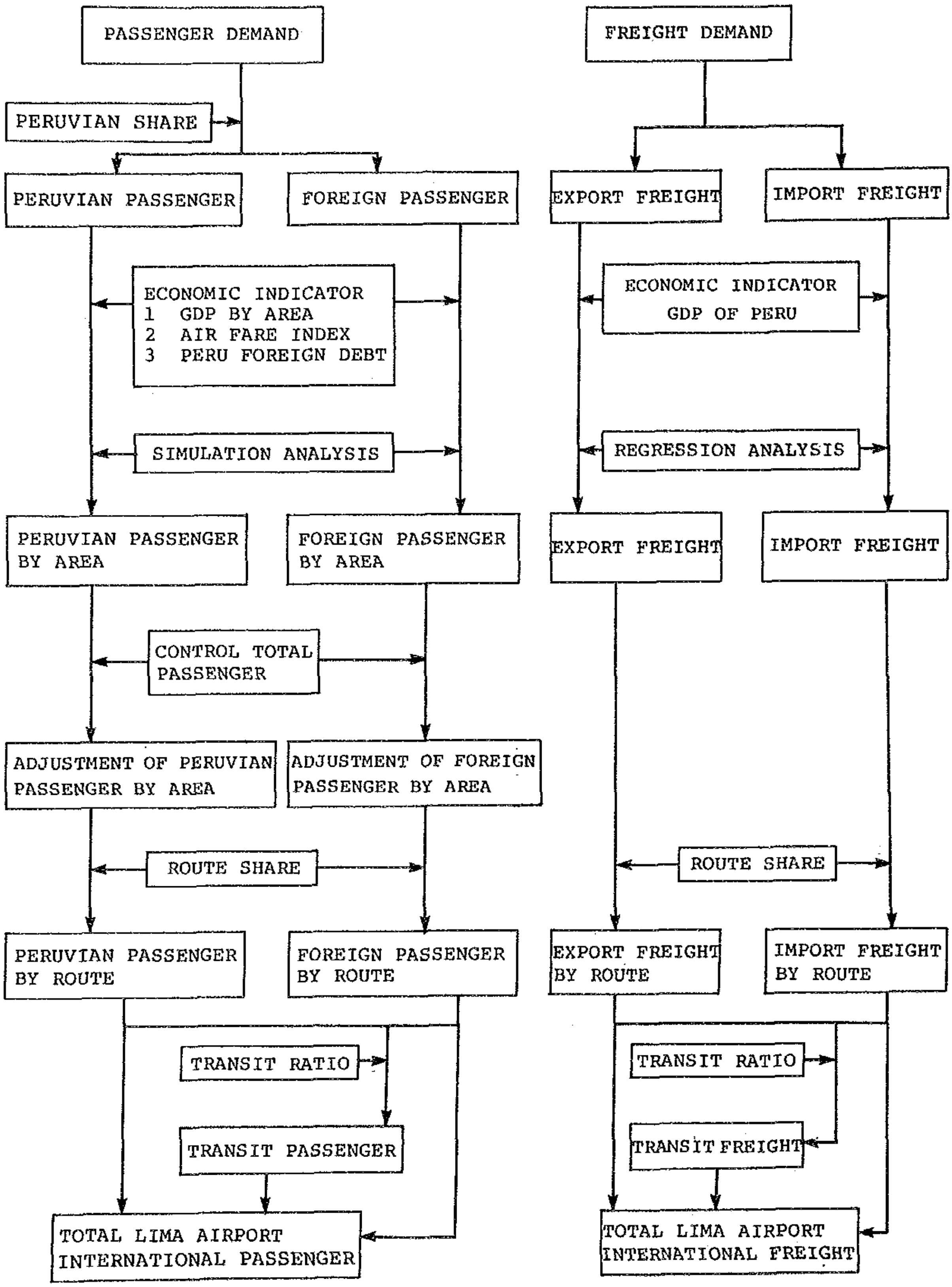
where

Ti is the adjusted demand of the i area

T is the total demand estimated as a control total

Ta,i is an approximate number of passengers by each area which is estimated at the second step.

Fig. 1-1 Flow Chart of International Air Transport Demand Forecast



Step 4. Estimate passengers by route.
According to the route share (1983), each adjusted number of passengers is broken down by route.

Step 5. Estimate the number of transit passengers.
The numbers of transit passengers are calculated by use of the transit ratio (the transit passengers/the total passengers). The average transit ratio for the recent three years was about 20%.

Step 6. Forecast the air passengers at Lima International Airport.
Finally, the number of passengers (embarking and disembarking passengers) at Lima International Airport are forecast. The time horizon of the forecasting is from 1985 to 2005 by each five years.

1-2. International Freight Demand

Step 1. Forecast export freight and import freight.
At first, the total international freight in Peru is forecast. The method of forecasting is the regression analysis whose explanatory variable is real GDP of Peru.

Step 2. Estimate international freight at Lima Airport.

The share of Lima international freight is 95.5% of the total Peru demand. Consequently, we estimate the freight demand at Lima Airport by multiplying the freight demand by 0.955, which has been obtained by the first step.

Step 3. Estimate freight by route.

According to the route share (1983), freight demand at Lima Airport is broken down by route.

Step 4. Estimate the transit freight.

The transit freight is calculated by use of the transit ratio. The average transit ratio for the recent three years was about 11%.

Step 5. Forecast the international freight at Lima International Airprot.

The international freight demand (export, import and transit) at Lima International Airport is forecast. The time horizon of the forecasting is from 1985 to 2005 by each five years.

2. Demand of Domestic Air Transport

The forecasting procedure of domestic air transport demand at Lima International Airport is shown in Fig. 1-2.

2-1. Domestic Passengers Demand

Step 1. Forecast total domestic passengers in Peru.

At first, we forecast the total passengers in Peru. Forecasting method is the regression analysis whose explanatory variables are Real GDP of Peru and oil crisis dummy.

dummy variable = 1 : before 1980

dummy variable = 0 : after 1981

Step 2. Estimate passengers between 21 airports in Peru.

In 1984, the domestic passengers between 21 airports (including Lima International Airprot) represented 95% of total domestic passengers; therefore, 95% of passengers forecast at Step 1 is the control total.

Step 3. Estimate passengers by route.

By FRATAR Method, we estimate domestic passengers by the existing 21 routes (from and to Lima). For this purpose, the passenger flow (origin and destination) is based on the 1984 CORPAC data. And the growth rate of passengers at each airport is considered proportional to the growth rate of income of that airport region.

Step 4. Estimate passengers by new route.

When the new Jaen Airport opens, the new route (Lima-Jaen) will be considered. The forecasting method of passengers of new route is as follows:

$$Yi = a + b \times Pi$$

where

Yi : passengers between i-airport and Lima

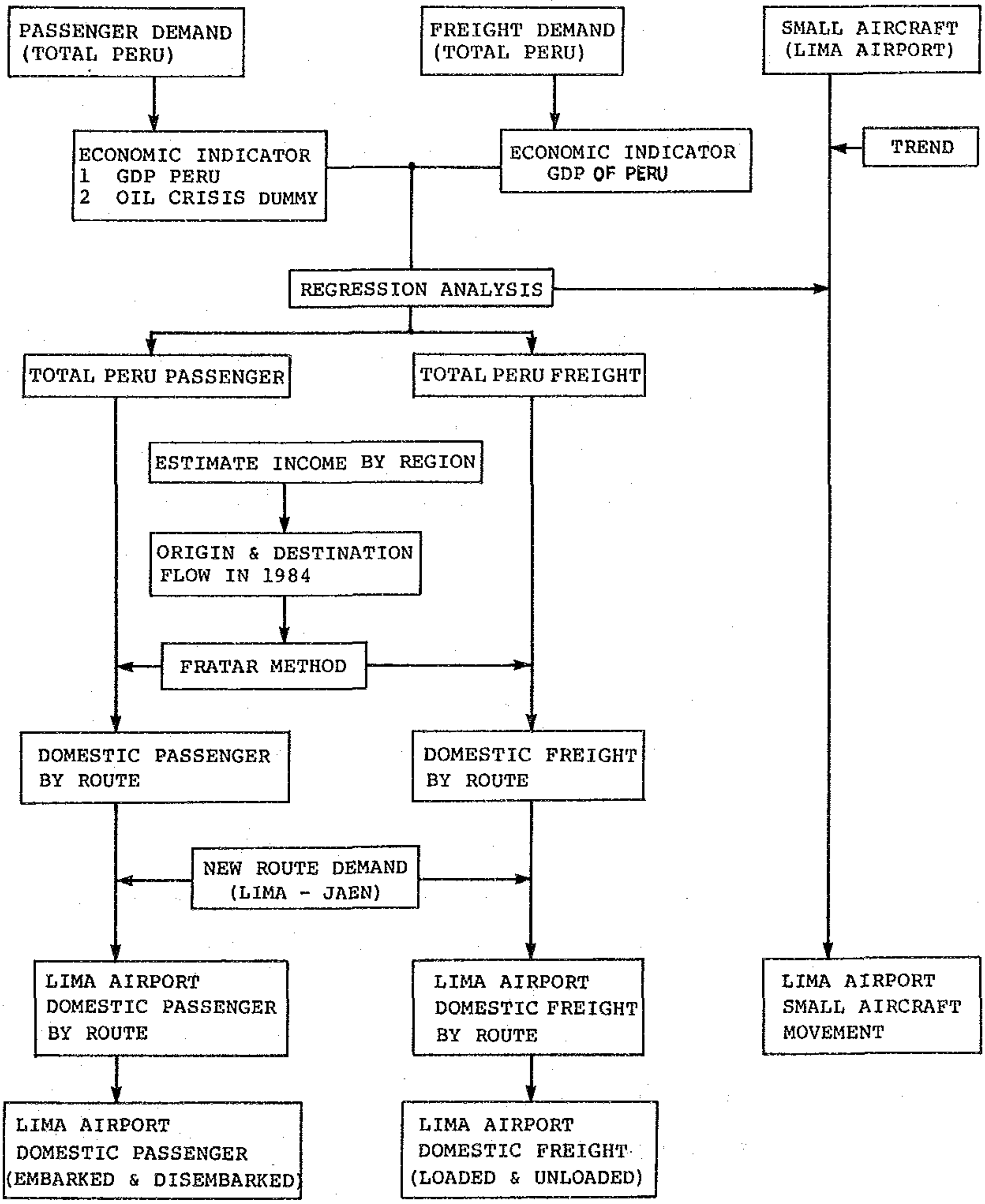
Pi : population of region i

a and b : estimated parameters

Step 5. Forecast the domestic passengers at Lima International Airport.

By Step 3 and Step 4, we estimate the number of domestic passengers (embarking and disembarking passengers) at Lima International Airport. The time horizon of the forecasting is from 1985 to 2005 by each five years.

Fig. 1-2 Flow Chart of Domestic Air Transport Demand Forecast



2-2. Domestic Freight Demand

Step 1. Forecast total domestic freight in Peru.

At first, we forecast the total freight in Peru. Forecasting method is the regression analysis whose explanatory variable is real GDP of Peru.

Step 2. Estimate freight between 21 airports in Peru.

In 1984, the domestic freight between 21 airports (including Lima International Airport) consisted of 75% of total domestic freight; therefore, 75% of the freight forecast in Step 1 is used as a control total.

Step 3. Estimate freight by route.

By FRATAR Method, we estimate domestic freight by the existing 21 routes (from and to Lima). For this purpose, the flow of freight (origin and destination) is based on the 1984 CORPAC Data. And the growth rate of freight at each airport is taken as proportional to the growth rate of income of the region in which the airport is located.

Step 4. Estimate freight by new route.

When the new Jaen Airport opens the new route

(Lima-Jaen) will be considered. The new route demand is estimated by the next formula:

$$Yi = a + b \times Pi$$

where

Yi : cargo between i-airport and Lima

Pi : freight between i-airport and Lima

a and b : estimated parameters

Step 5. Forecast the domestic freight at Lima International Airport.

By Step 3 and Step 4, we estimate the freight (loaded and unloaded) at Lima International Airport. The time horizon of the forecasting is from 1985 to 2005 by each five years.

2-3. Small Aircraft Movement

Forecast small aircraft movements at Lima Airport.

We forecast the small aircraft movements at Lima International Airport. Forecasting method is the regression analysis whose explanatory variable is year (time trend).

APPENDIX 4-2 AIR TRANSPORT DEMAND FORECAST FORMULA

1. Total Peru Domestic Air Passengers

$$P = 40.29 + 0.154G + 750Z \quad \ldots\ldots\ldots\ldots \quad (1)$$
$$(21.04) \quad (8.62) \quad R=0.938$$

P = Total Peru Domestic Air Passengers (unit = 1,000)

G = Peru GDP (unit = US$ million)

Z = 2nd oil crisis dummy

before 1980 .... Z=1

after 1981 .... Z=0

2. Total Peru Domestic Air Freight

$$C = 6237 + 4.325G \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$
$$(1.58) \quad R=0.672$$

C = Total Peru Domestic Air Freight (unit = ton, loaded and unloaded)

G = Peru GDP (unit = US$ million)

3. Peru Import Air Freight

$$M = -11609 + 1.407G \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$
$$(5.20) \quad R=0.944$$

M = Peru Total Import Air Freight (unit = ton)

G = Peru GDP (unit = US$ million)

4. Peru Export Air Freight

$$E = 2863 + 0.573G \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$
$$(3.05) \quad R=0.755$$

E = Peru Total Export Air Freight (unit = ton)

G = Peru GDP (unit = US$ million)

5. Lima Airport Small Aircraft Movement

$$Y = -416670 + 213.32t \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$
$$\qquad\qquad (2.77) \qquad\qquad R=0.723$$

Y = Lima Airport Small Aircraft Movement

t = Year

Note 1 : Above formulae are estimated by the regression analysis.

2 : Observation period = 1975 - 1983

3 : ( ) = t-Value and R = Correlation coefficient

6. Peru International Air Passengers

$$\Delta Yi/Yi = \alpha Gi/Gi + \beta P/P + \gamma L/L \quad \ldots\ldots \quad (6)$$

$\Delta Yi/Yi$ Growth-rate of i-area international air passenger

$\Delta Gi/Gi$ Growth-rate of i-area GDP

$\Delta P/P$ Change-rate of international air fare

$\Delta L/L$ Change-rate of Peru long term debt (public sector)

α GDP-Elasticity for air passenger of i-area

β Fare-Elasticity for air passenger of i-area

γ Loan-Elasticity for air passenger of i-area

Parameters α, β and γ are estimated by simulation method.

Table 1 Estimated Parameters

Peruvian International Air Passengers				
Area	α	β	γ	R
1. World (Total)	1.25	-1.40	-0.158	0.978
2. South America	1.10	-0.95	-0.125	0.911
3. Central America	1.35	-1.50	-0.043	0.619
4. U.S.A. and Canada	1.20	-1.45	-0.035	0.602
5. Europe	1.30	-1.50	-0.136	0.820
6. Other area	1.15	-1.40	-0.243	0.699
Foreign International Air Passengers				
Area	α	β	γ	R
1. World (Total)	1.35	-1.05	0	0.968
2. South America	1.15	-1.20	0	0.968
3. Central America	1.20	-1.35	0	0.943
4. U.S.A. and Canada	1.45	-1.05	0	0.931
5. Europe	1.60	-0.85	0	0.814
6. Other area	1.55	-1.20	0	0.623

Note 1 : R = Correlation coefficient

7. New Airport Jaen : Domestic Passenger

$$\dot{Y} = 15.43 + 0.024P$$
$$(1.04) \qquad R=0.601$$

$\dot{Y}$ = Domestic passenger (Lima - Jaen) (unit = 1,000)

P = Population (Jaen) (unit = 1,000)

8. New Airport (Jaen) : Domestic Freight

$$\bar{Y} = 92.35 + 7.316\ Pax$$
$$(9.58) \qquad R=0.960$$

$\bar{Y}$ = Domestic Freight (Lima - Jaen) (unit = ton)

Pax = Domestic Passenger (Jaen) (unit = 1,000)

APPENDIX 4-3 ESTIMATE OF EXPLANATORY VARIABLE USED IN AIR TANSPORT FORECAST

1. Annual growth rate of real GDP in Peru

Period	Low case	Main case	High case
1985-1995	2.5%	3.5%	4.5%
1995-2005	2.0%	3.0%	4.0%

2. Annual growth rate of real GDP in Main Areas

District	Low case	Main case	High case
World	2.7%	3.5%	3.9%
S. America	3.9	4.5	5.1
C. America	3.9	4.5	5.1
N. America	2.5	3.1	3.7
Europe	2.5	3.1	3.7
Others	3.6	4.3	5.0

3. Long term debt of Peru (public sector)

Unit=US$ million

Year	Low case	Main case	High case
1984	9,775	9,775	9,775
1990	13,502	13,640	13,775
1995	16,924	17,427	17,900
2000	21,197	22,479	23,647
2005	26,599	29,343	31,775

Note 1 : Peru Foreign Debt is estimated as follows:

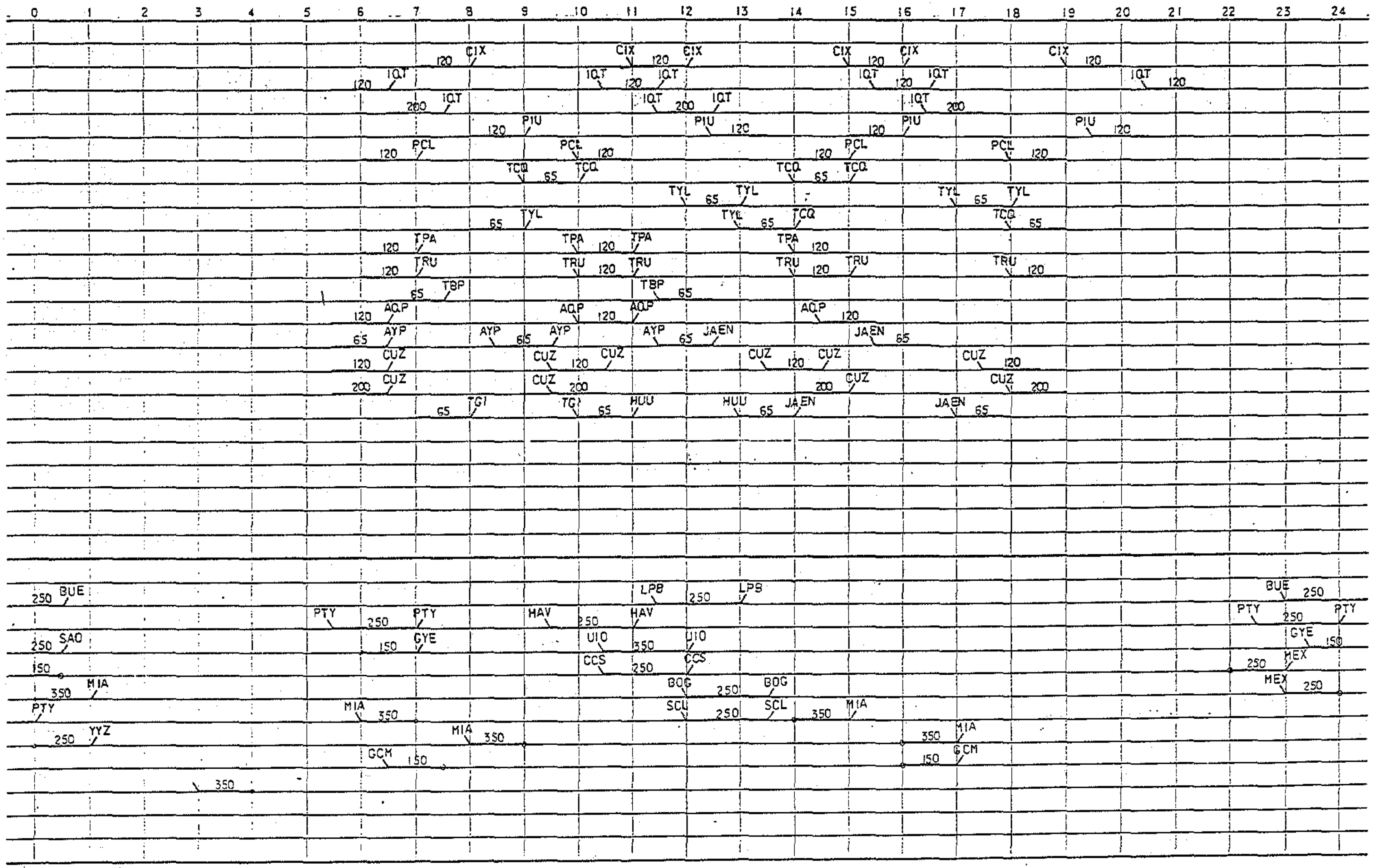
$$L(t) = L(t-1) + L(t-1) \times R - 0.1 \times E(t)$$

where L(t) : Foreign Debt year (t)

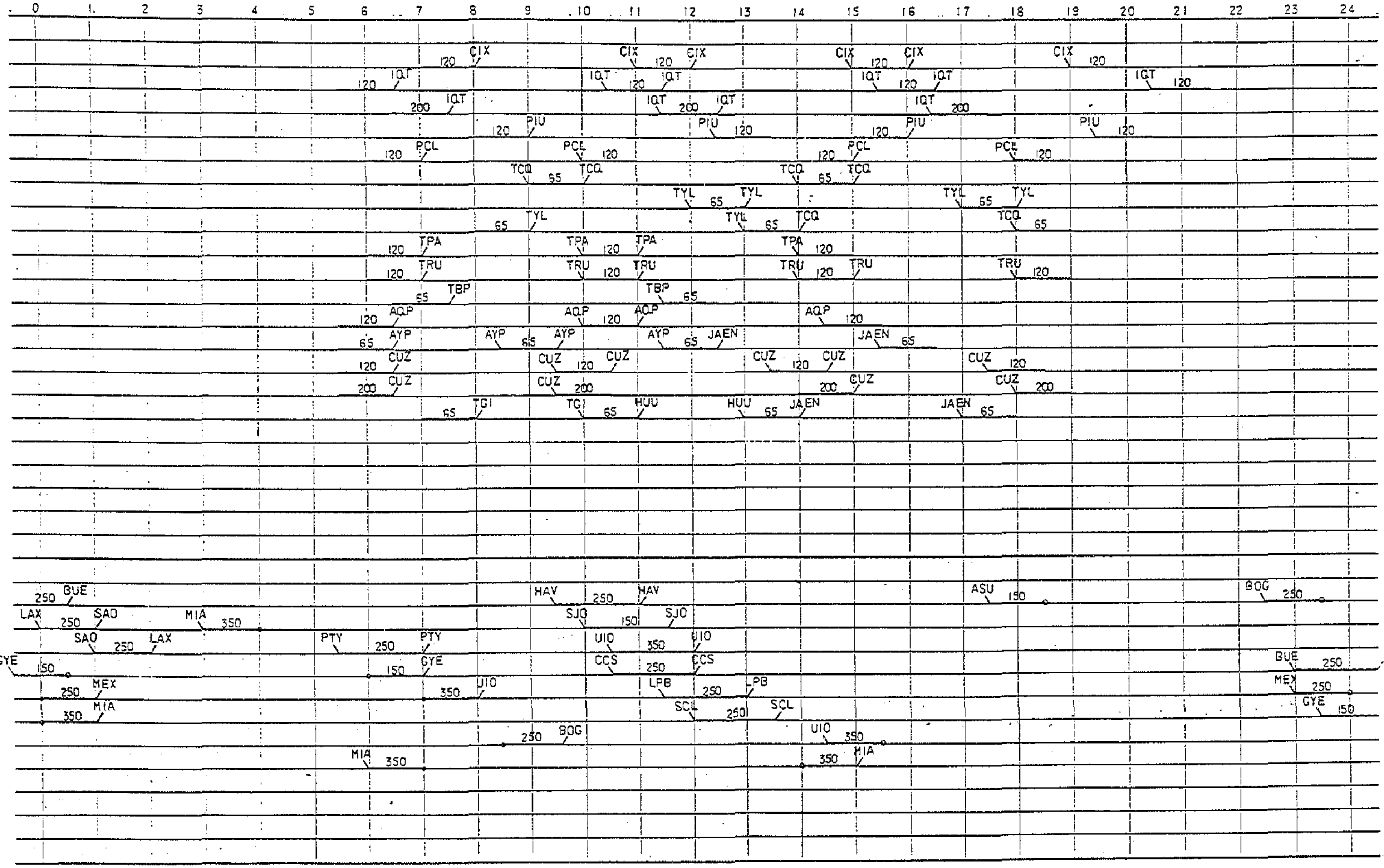
E(t) : Peru Export year (t)

R : Interest rate (8%)

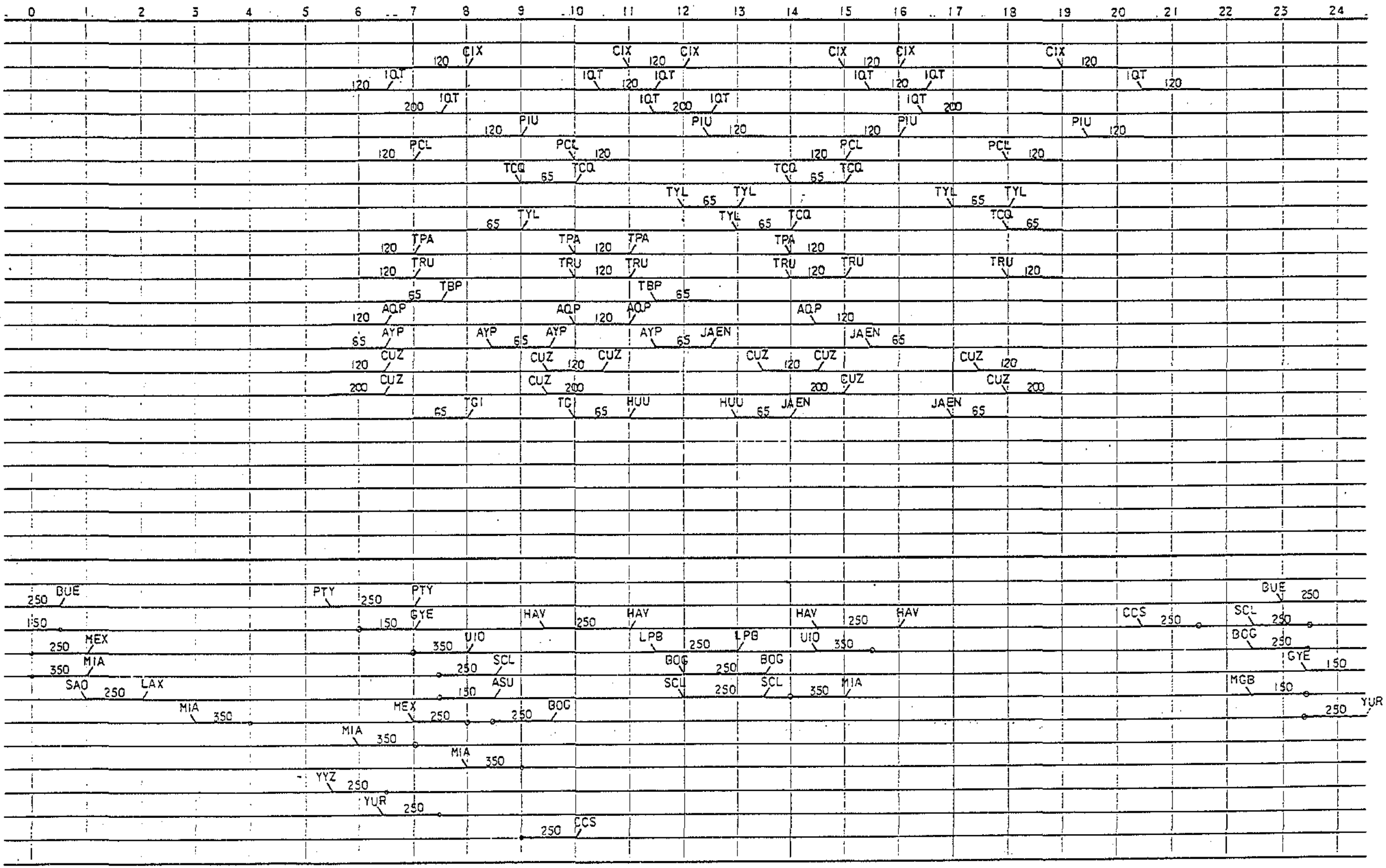
APPENDICES 5



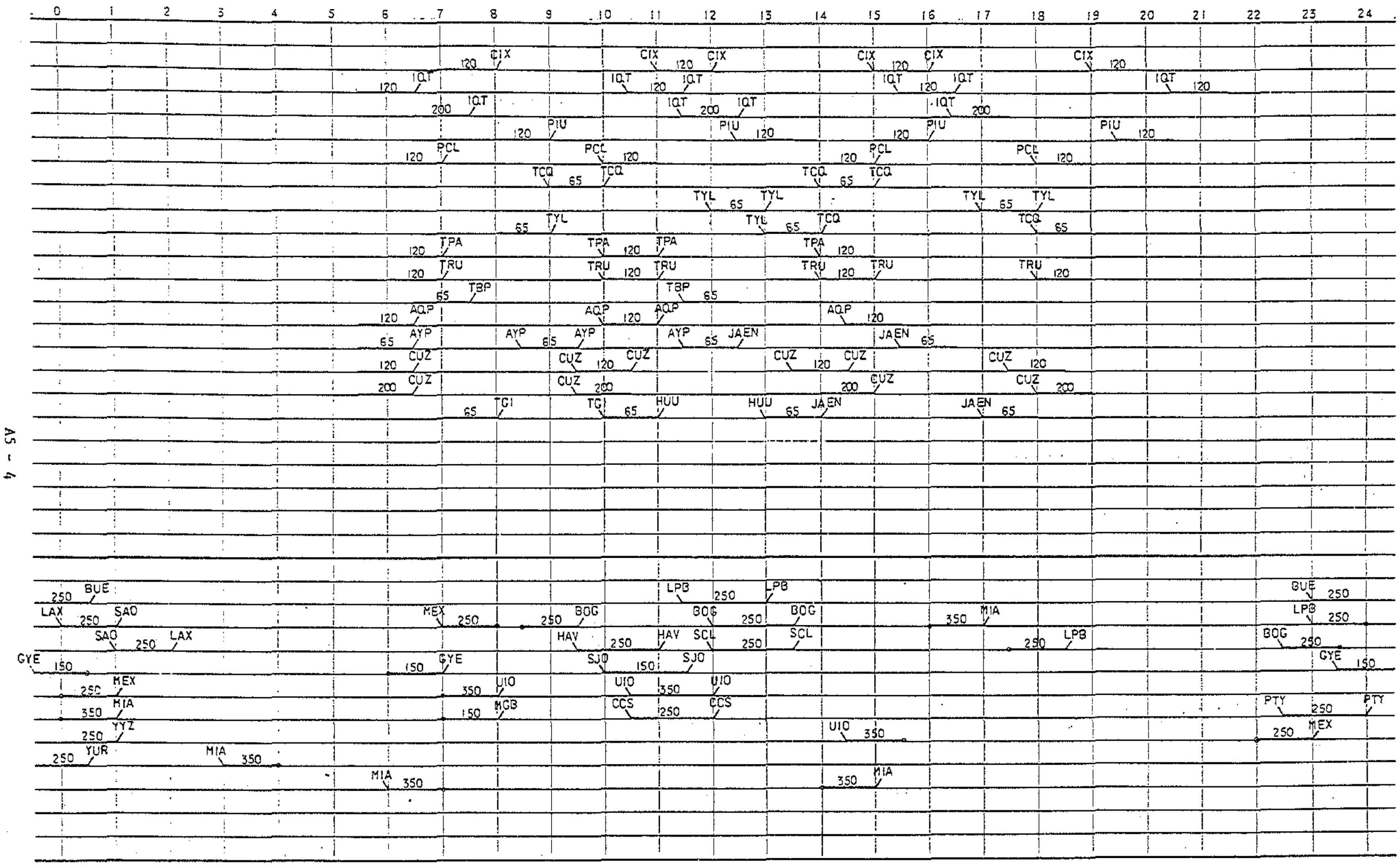
APPENDIX 5-1(1) SIMULATED FLIGHT SCHEDULE (1995 Sun.)



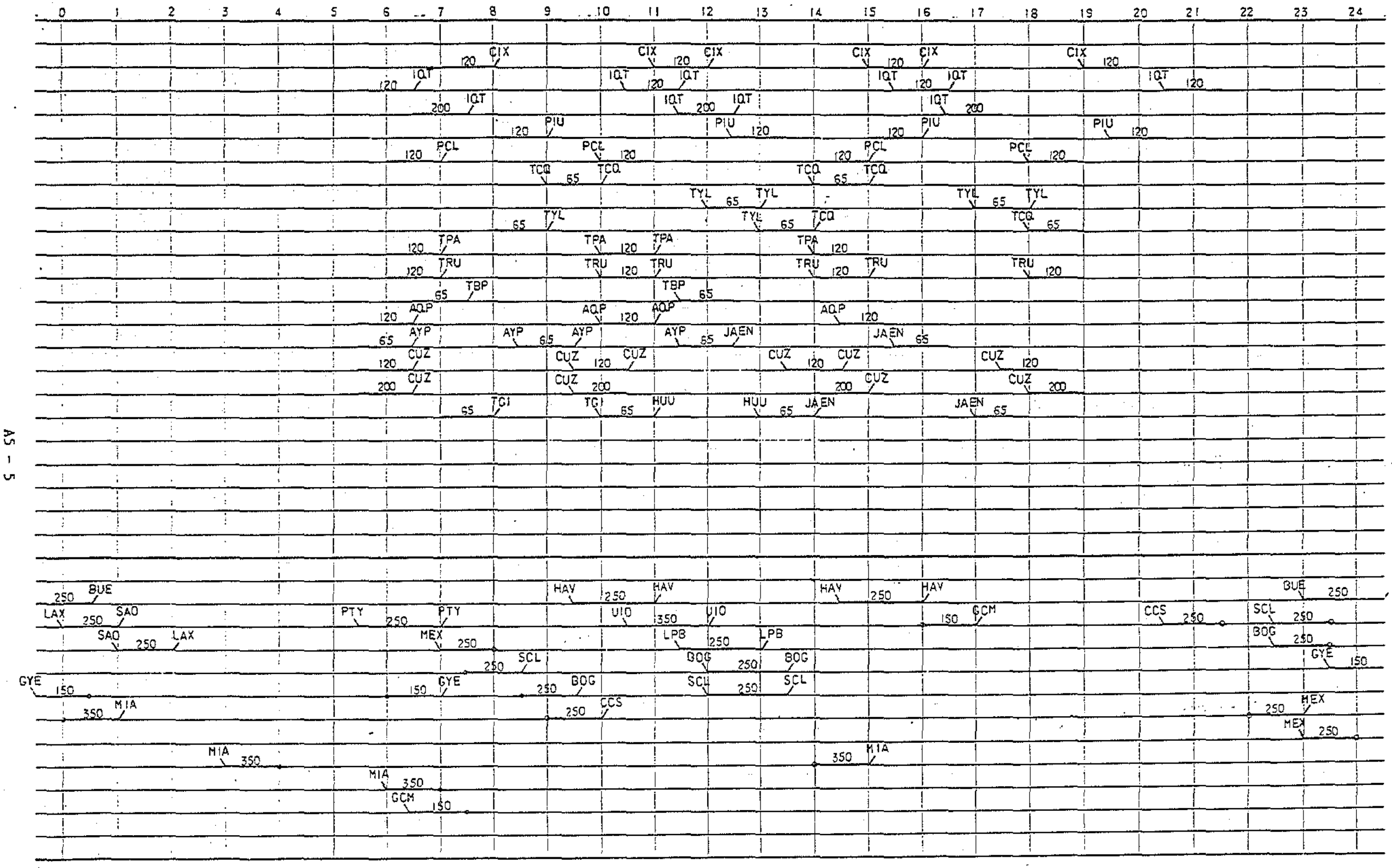
APPENDIX 5-1(2) SIMULATED FLIGHT SCHEDULE (1995 Mon.)



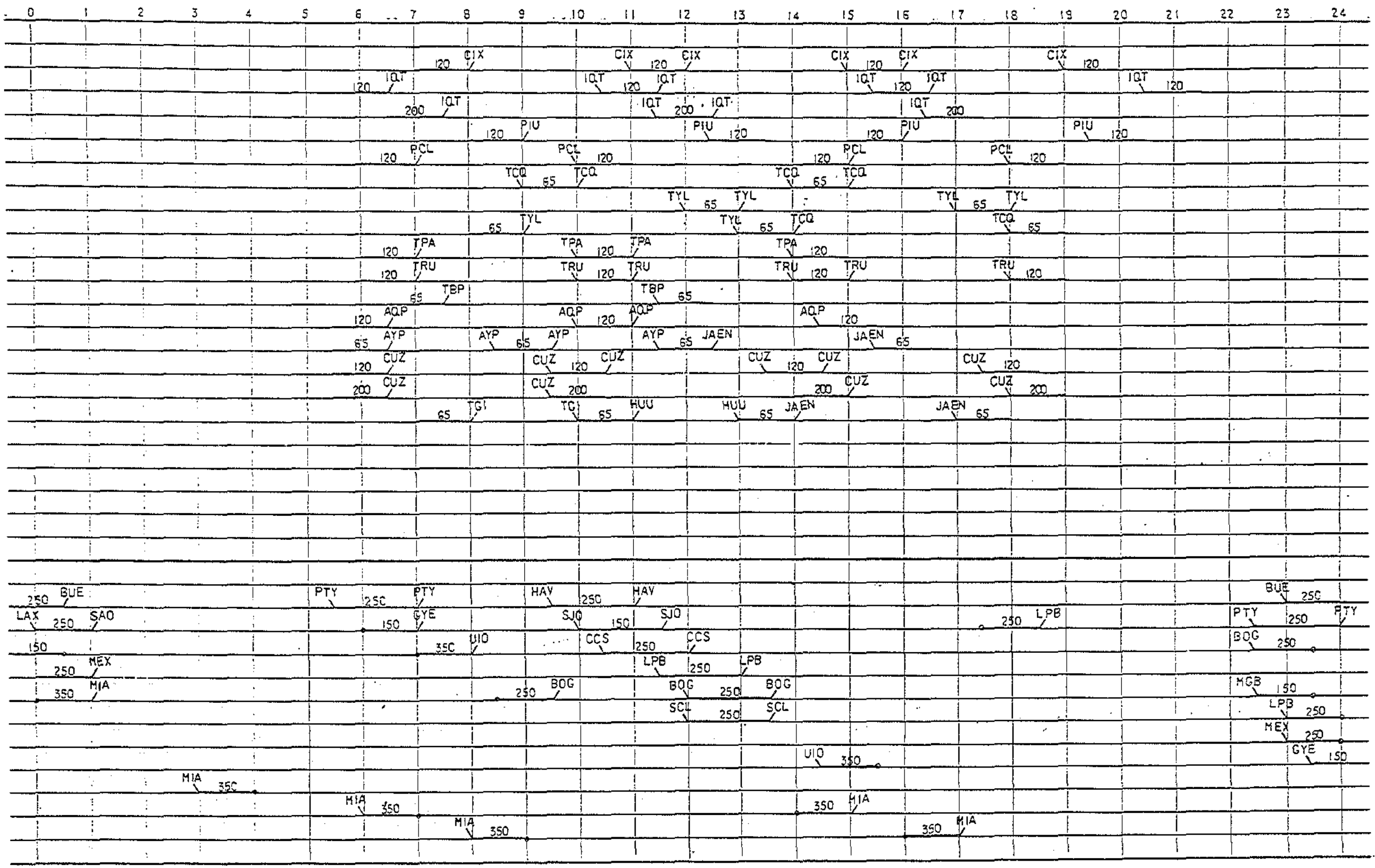
APPENDIX 5-1(3) SIMULATED FLIGHT SCHEDULE (1995 Tue.)



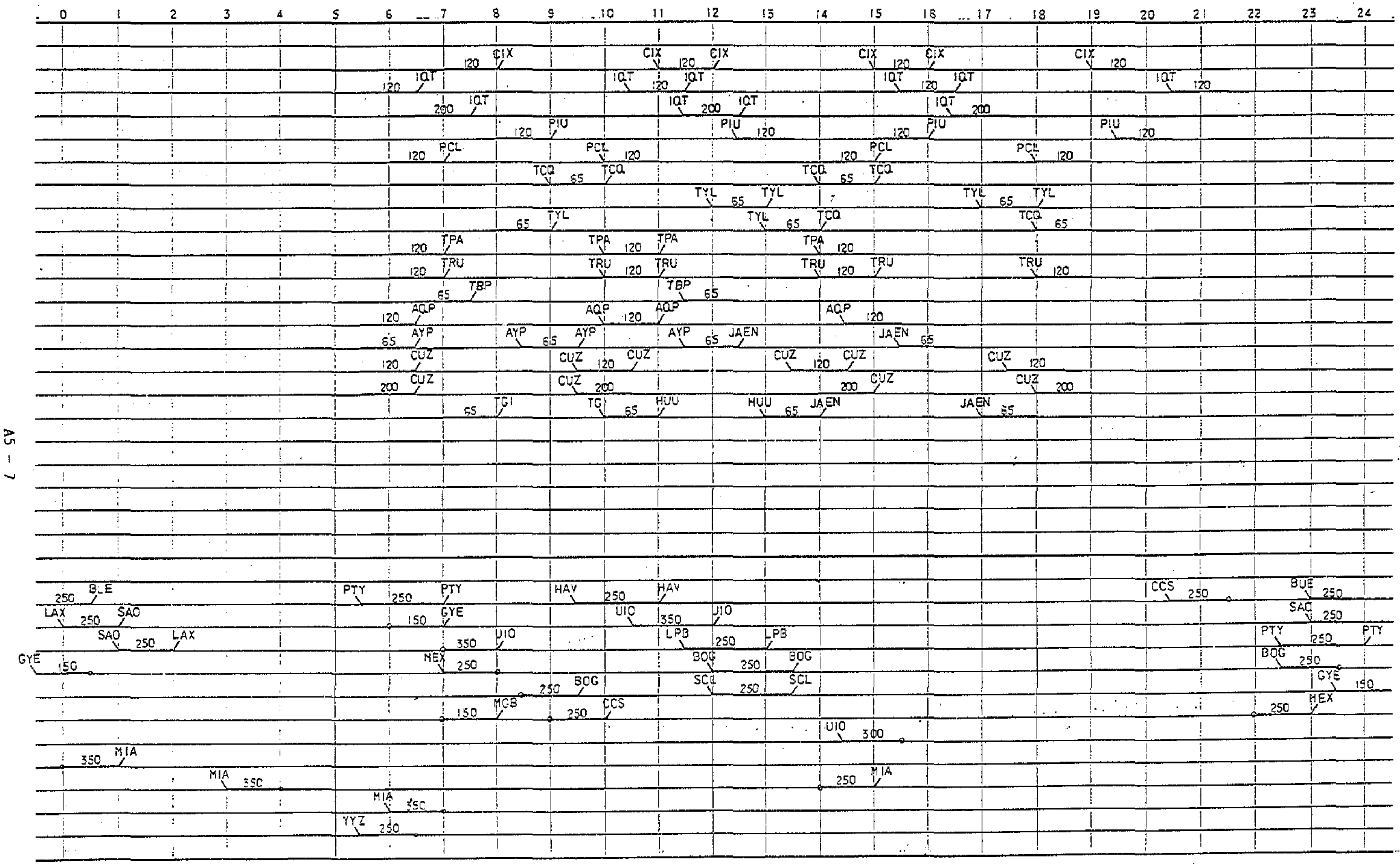
APPENDIX 5-1(4) SIMULATED FLIGHT SCHEDULE (1995 Wed.)



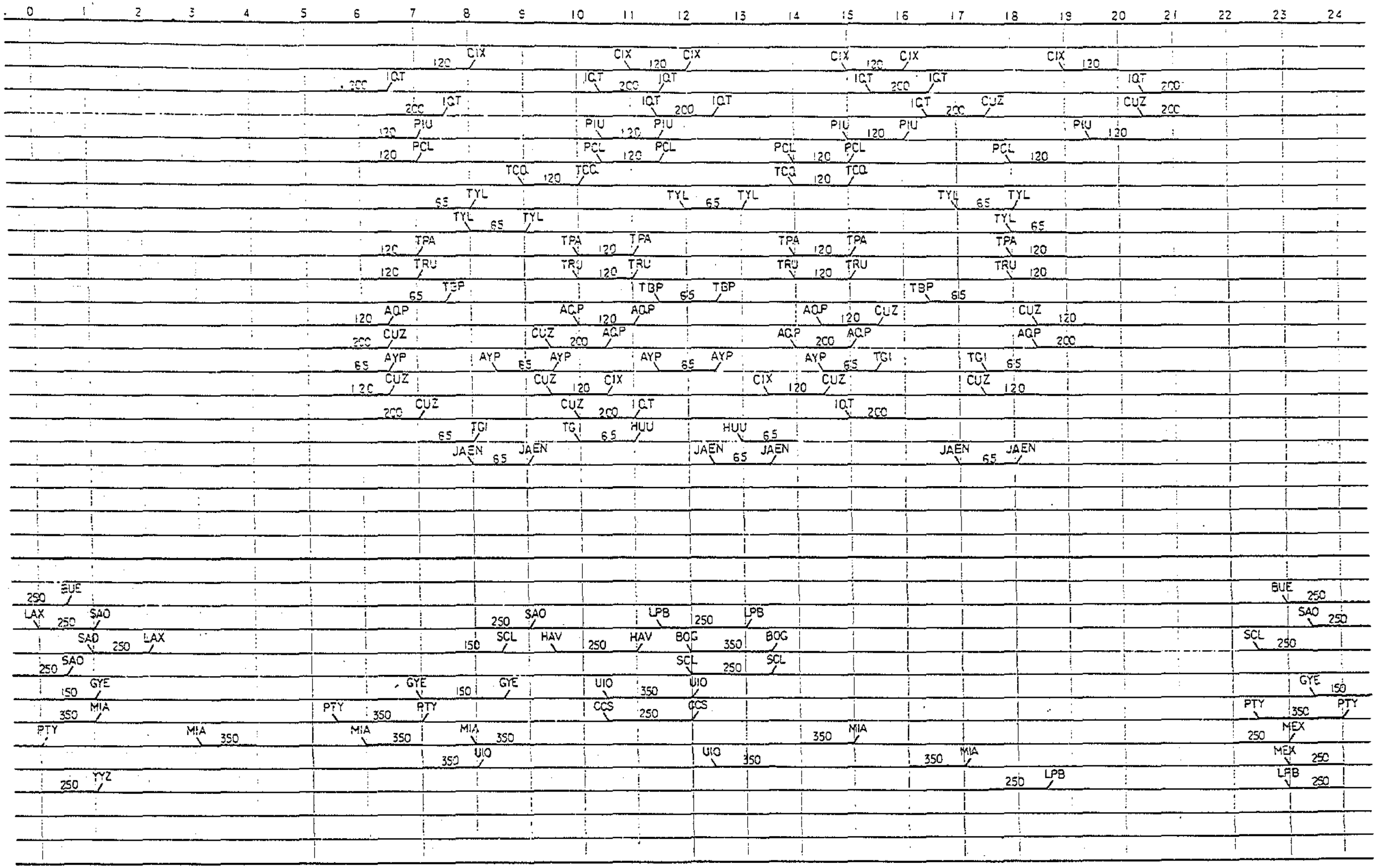
APPENDIX 5-1(5) SIMULATED FLIGHT SCHEDULE (1995 Thu.)



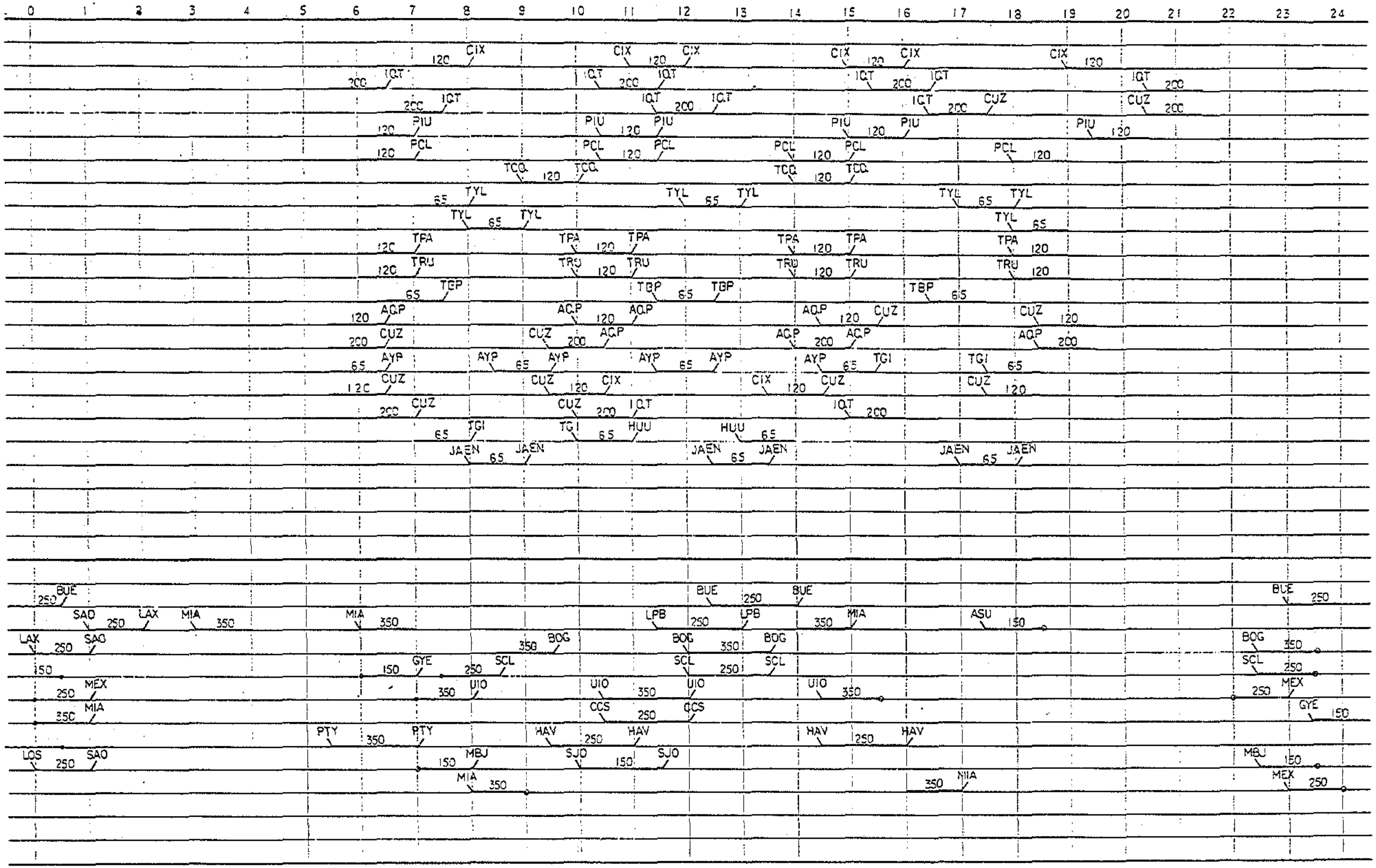
APPENDIX 5-1(6) SIMULATED FLIGHT SCHEDULE (1995 Fri.)



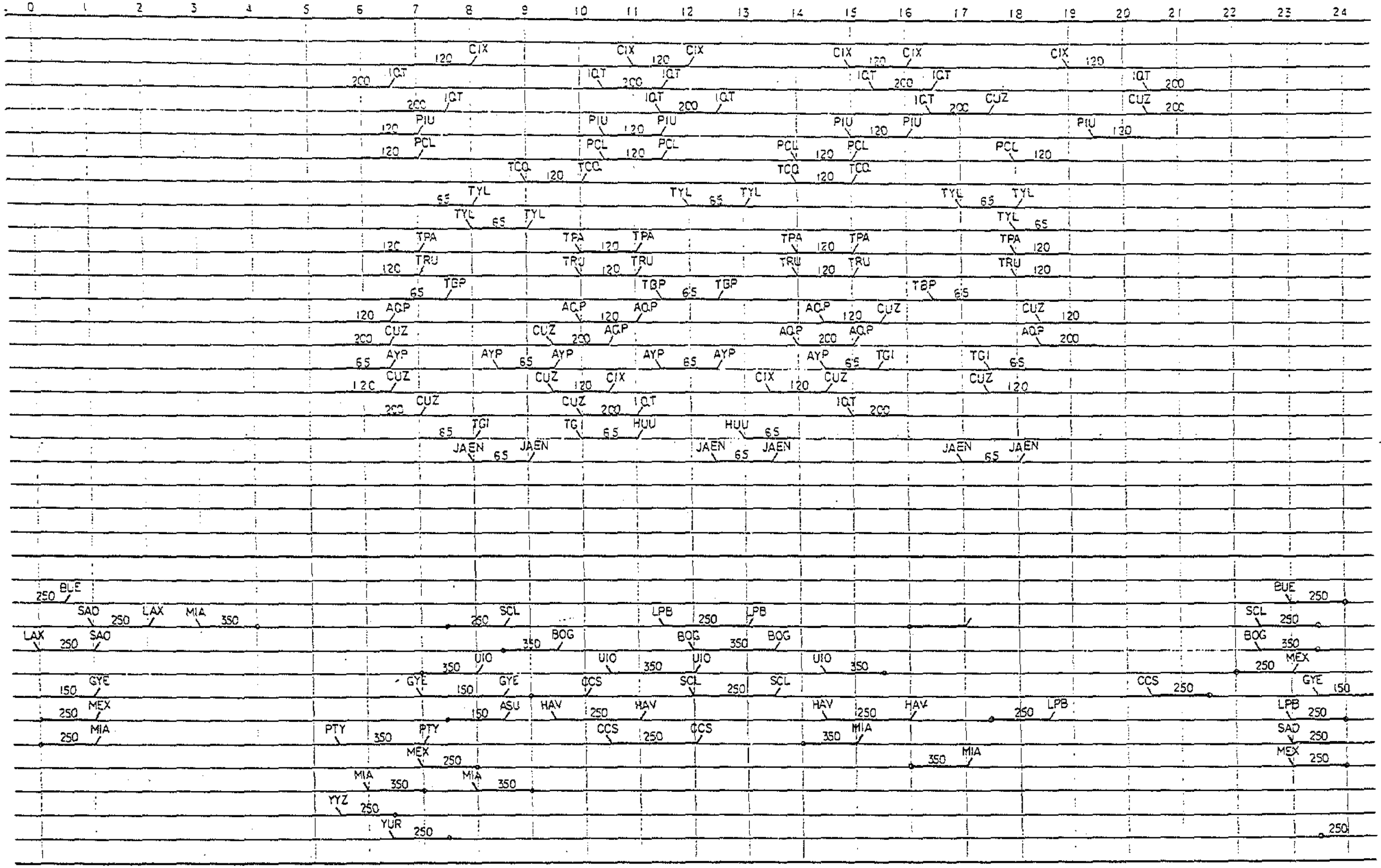
APPENDIX 5-1(7) SIMULATED FLIGHT SCHEDULE (1995 Sat.)



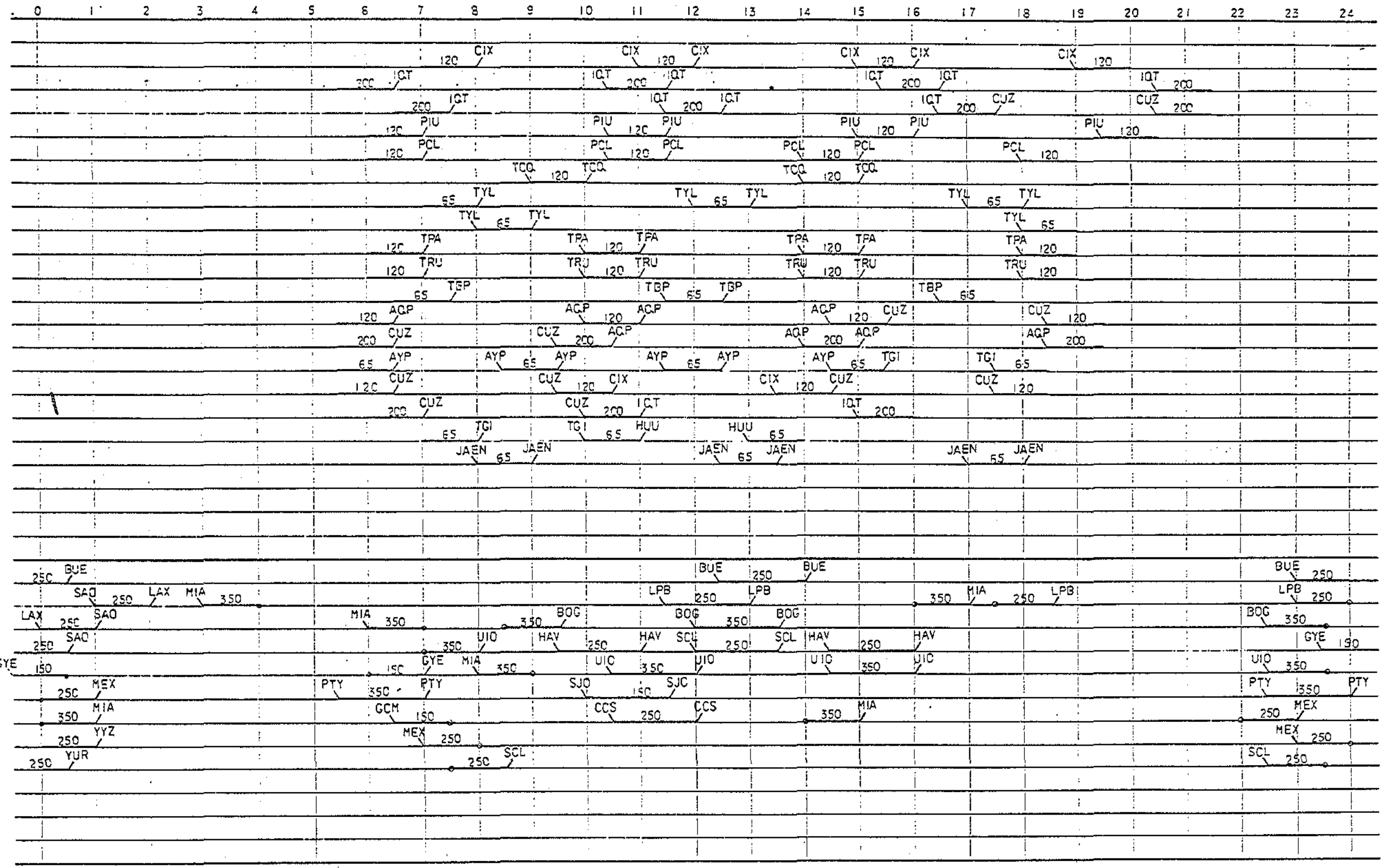
APPENDIX 5-1(8) SIMULATED FLIGHT SCHEDULE (2005 Sun.)



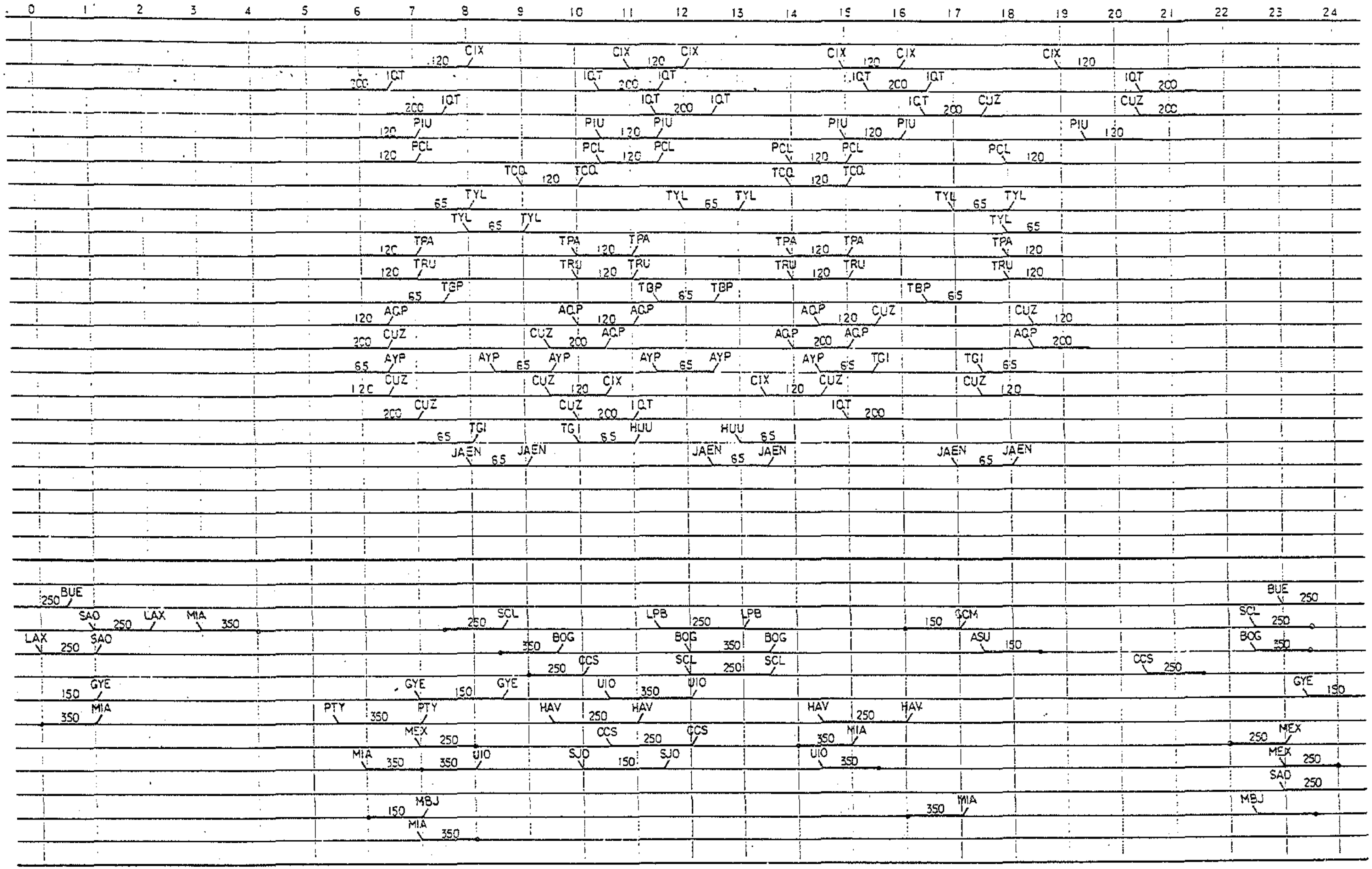
APPENDIX 5-1(3) SIMULATED FLIGHT SCHEDULE (2005 Mon.)



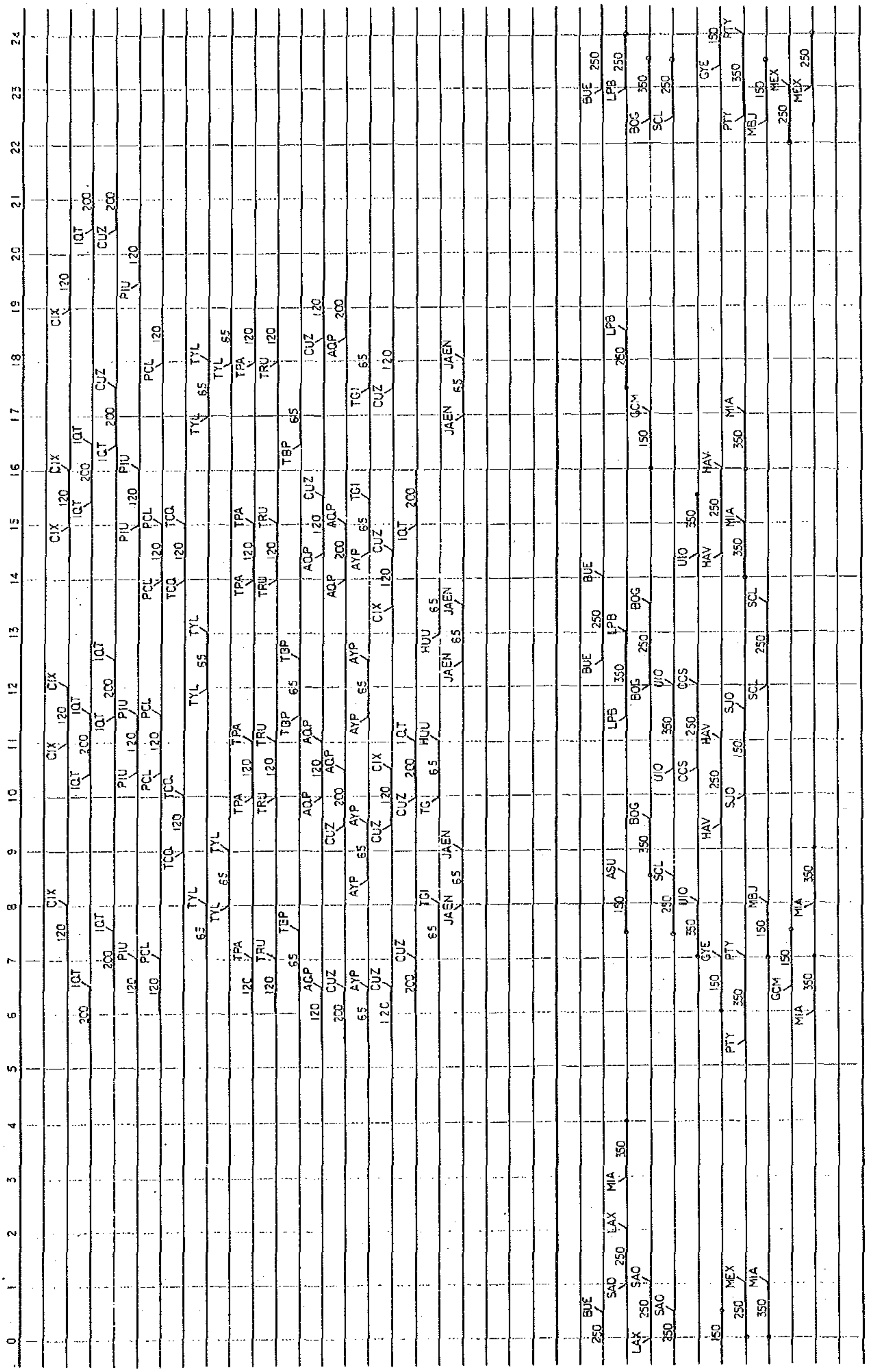
APPENDIX 5-1(10) SIMULATED FLIGHT SCHEDULE (2005 Tue.)



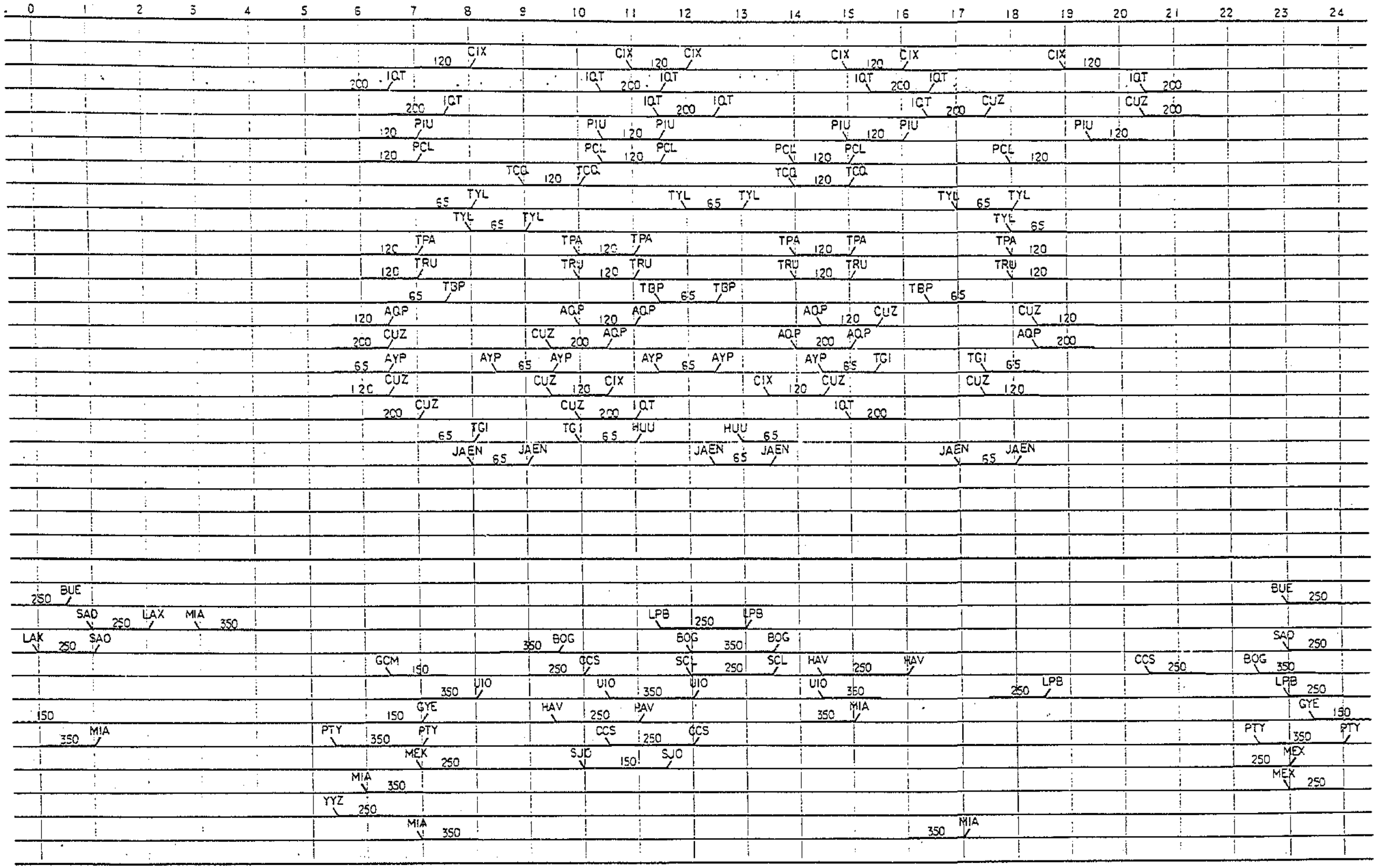
APPENDIX 5-1(11) SIMULATED FLIGHT SCHEDULE (2005 Wed.)



APPENDIX 5-1(12) SIMULATED FLIGHT SCHEDULE (2005 Thu.)



APPENDIX 5-1(13) SIMULATED FLIGHT SCHEDULE (2005 Fri.)



APPENDIX 5-1(14) SIMULATED FLIGHT SCHEDULE (2005 Sat.)

APPENDIX 5－2 CAPACITY OF EXISTING RUNWAY

1. Capacity Assumptions

1)	Runway use	Optimum	
		• Orientation of active RWY	(RWY 15)
		• Type and direction of operation	(RWY 15)
		• Equipped with ILS	(Yes)
		• Radar environment	(Yes)
2)	% of Arrival		(50%)
3)	% of T & G		(2%)
4)	Taxiway	• Full length parallel taxiway	(Yes)
		• Ample entrance/ exist Taxiway	(Yes)
		• No taxiing crossing active runway	(No)
5)	Air Space	• No airspace limitation	(No)
		• Ample protection for MSAP in IFR WX	(Yes)

2. Runway Capacity

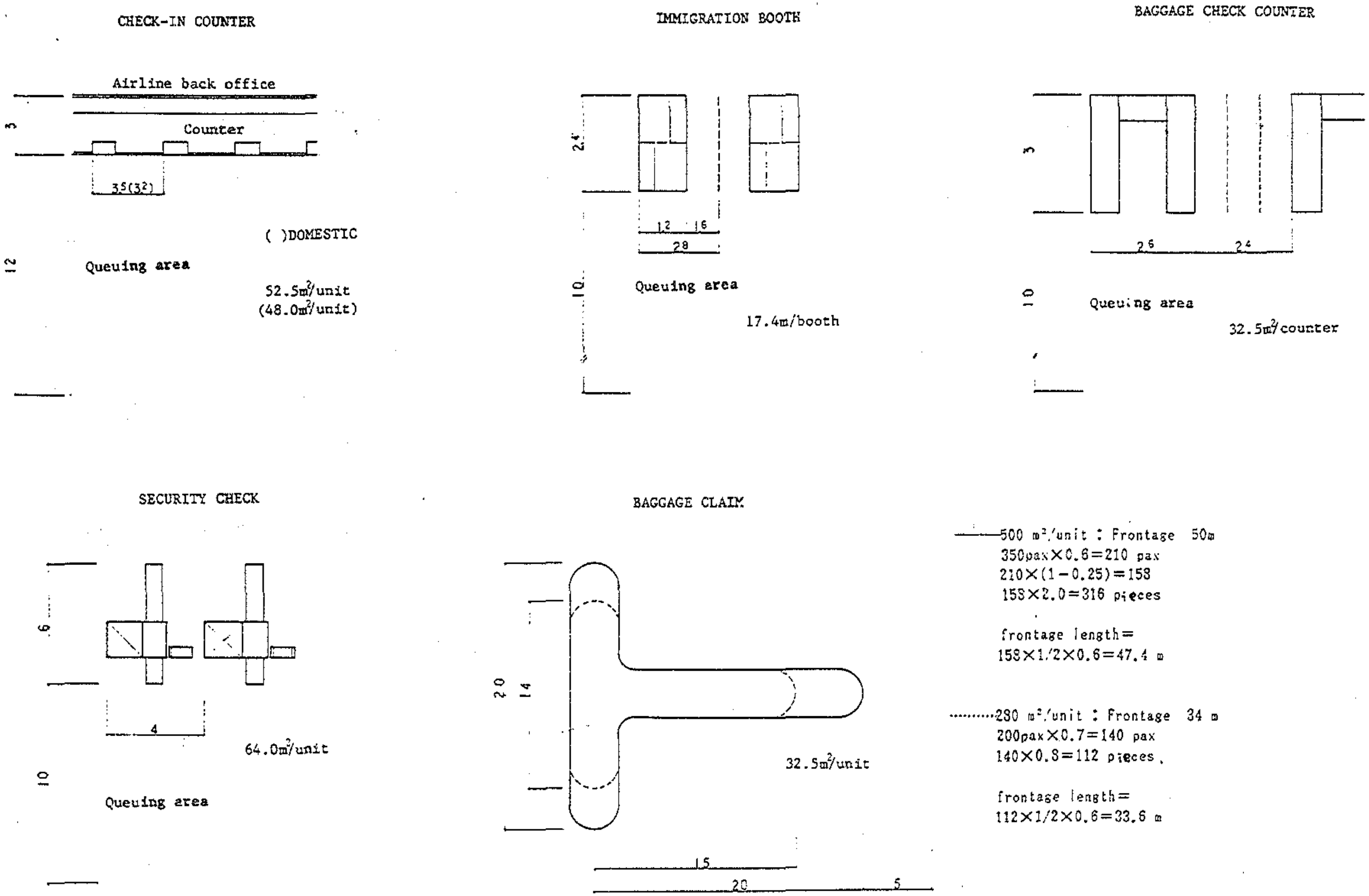
1) Hourly capacity = 47 operations

2) Annual capacity = 160,000 operations

Note: Based on "FAA AC 150/5060-5"

APPENDIX 5-3 BASIC DATA FOR PASSENGER PROCESSING AREA CAPACITY REQUIREMENTS

Items		Description
Check-in service time		
	International	2.0 min/person
	Domestic	1.0 min/person
Number of well-wishers		
	International	5.2 persons/dep.pax. 1.0 persons/arr.pax.
	Domestic	0.8 persons/pax.
Departure public lobby area		
	International	1.2 m²/person
	Domestic	1.2 m²/person
Security check service time		
	International	0.2 min/person
	Domestic	0.2 min/person
Departure lounge area		
	International	2.0 m²/person
	Domestic	2.0 m²/person
Baggage claim service time		
	International	30 min/system, flight
	Domestic	20 min/system, flight
Number of baggages received		
	International	2 pieces/person
	Domestic	0.8 pieces/person
Arrival lobby area		
	International	1.2 m²/person
	Domestic	1.2 m²/person
Immigration service time for international passengers		
	Departing	0.8 min/pax.
	Arriving	1.0 min/pax.
Baggage check service time for International Passengers		1.5 min/pax.



APPENDIX 5 - 4 UNIT SPACES OF PASSENGER PROCESSING FACILITIES

APPENDIX 5-5 BASIC DATA FOR CALCULATION OF FLOOR AREA OF CARGO TERMINAL BUILDING

Items		Description
Busiest month peaking coefficent		
	International	0.11
	Domestic	0.10
Average stay time		
	Int. outbound cargo	1 week
	Int. inbound cargo	2 weeks
	Domestic	2 days
Storage area		
	Int. Dom.	5 m^2/ton

APPENDIX 5－6 BASIC DATA FOR AIRCRAFT MAINTENANCE HANGAR

Item		1995－M	2005－M
Number of aircraft required for Peruvian airlines	International	6	8
	Domestic	17	18

Note : Number of days required for maintenance per year

(1) International services = 6 weeks per aircraft

(2) Domestic services = 4 weeks per aircraft

Appendix 5-7(1) THE AMOUNT OF AVIATION FUEL SUPPLY PER DAY

(1995 International)

Air Route	Aircraft Type	Stage Length (km)	Fuel Consumption (L/km)	Fuelling Quantity (kL)
BUE	250seater	3151	17.4	55
SAO	〃 〃	3397	〃	59
MIA	350 〃	4215	23.1	73
YYZ	250 〃	6195	17.4	108
LPB	〃 〃	1081	〃	19
GYE	150 〃	1135	11.3	13
HAV	250 〃	3935	17.4	69
LPB	〃 〃	1081	〃	19
UIO	350 〃	1329	23.1	31
CCS	250 〃	2751	17.4	48
BOG	〃 〃	1888	〃	33
SCL	〃 〃	2459	〃	43
MIA	350 〃	4215	23.1	73
MIA	350 〃	4215	23.1	73
MGB	150 〃	3400	11.3	38
PTY	250 〃	2351	17.4	41
MEX	〃 〃	4241	〃	74
LAX	〃 〃	6716	〃	117
YUR	〃 〃	8154	〃	142
SJO	150 〃	3098	11.3	35
UIO	350 〃	1329	23.1	31
BOG	250 〃	1888	17.4	33
MEX	250 〃	4241	17.4	74
				1301

Appendix 5－7(2)　THE AMOUNT OF AVIATION FUEL SUPPLY PER DAY

(1995　Domestic)

Air Route		Aircraft Type	Stage Length (km)	Fuel Consumption (L/km)	Fuelling Quantity (kL)
CIX	×3	120seater	657	8.6	17.0
IQT	×3	〃 〃	1017	〃	26.2
〃	×2	200 〃	〃	11.3	23.0
＊PLC	×2	120 〃	490	8.6	16.9
PIU	×2	〃 〃	850	〃	14.6
TCQ	×2	65 〃	997	5.7	11.4
TYL	×3	〃 〃	945	〃	16.2
TPA	×2	120 〃	618	8.6	10.6
＊TRU	×3	〃 〃	491	〃	25.3
TBP		65 〃	1010	5.7	5.8
AQP	×2	120 〃	768	8.6	13.2
AYP	×2	65 〃	337	5.7	3.8
JAEN		〃 〃	850	〃	4.8
CUZ	×3	120 〃	590	8.6	15.2
〃	×2	200 〃	〃	11.3	13.3
＊TGI		65 〃	330	5.7	3.8
HUU		〃 〃	250	〃	1.4
JAEN		〃 〃	850	5.7	4.8
TCQ		〃 〃	997	〃	5.7
					233.0

＊No Fuelling Service Airport

Appendix 5−7(3)　THE AMOUNT OF AVIATION FUEL SUPPLY PER DAY

(2005 . International)

Air Route	Aircraft Type	Stage Length (km)	Fuel Consumption (L/km)	Fuelling Quantity (kL)
BUE	250seater	3151	17.4	55
SAO	〃 〃	3397	〃	59
LAX	〃 〃	6716	〃	117
SAO	〃 〃	3397	〃	59
SJO	150 〃	3098	11.3	35
MIA	350 〃	4215	23.1	73
YYZ	250 〃	6195	17.4	108
YUR	〃 〃	8154	〃	142
SCL	150 〃	2459	11.3	28
GYE	〃 〃	1135	11.3	13
PTY	350 〃	2357	23.1	54
UIO	〃 〃	1329	〃	31
HAV	250 〃	3935	17.4	69
UIO	350 〃	1329	23.1	31
CCS	250 〃	2751	17.4	48
LPB	〃 〃	1081	〃	19
BOG	350 〃	1888	23.1	44
SCL	250 〃	2459	17.4	43
MIA	350 〃	4215	23.1	73
〃	〃 〃	〃	〃	〃
LPB	250 〃	1081	17.4	19
PTY	350 〃	2357	23.1	54
MEX	250 〃	4241	17.4	74
BOG	350 〃	1888	23.1	44
BUE	250 〃	3151	17.4	55
HAV	〃 〃	3935	17.4	69
UIO	350 〃	1329	23.1	31
MEX	250 〃	4241	17.4	74
				1594

Appendix 5－7(4)　THE AMOUNT OF AVIATION FUEL SUPPLY PER DAY

(2005 Domestic)

Air Route		Aircraft Type	Stage Length (km)	Fuel Consumption (L/km)	Fuelling Quantity (kL)
CIX	×3	120Seater	657	8.6	17.0
IQT	×5	200 〃	1017	11.3	57.5
PIU	×3	120 〃	850	8.6	21.9
*PCL	×3	120 〃	490	8.6	25.3
TCQ	×2	120 〃	997	〃	17.1
TYL	×4	65 〃	945	5.7	21.5
TPA	×3	120 〃	618	8.6	15.9
*TRU	×3	〃 〃	491	〃	25.3
TBP	×2	65 〃	1010	5.7	11.5
AQP	×2	120 〃	768	8.6	13.2
CUZ	×3	200 〃	590	11.3	20.0
〃	×3	120 〃	〃	8.6	15.2
*TGI		65 〃	330	5.7	3.8
HUU		〃 〃	250	〃	1.4
JAE	×3	〃 〃	850	〃	14.5
AQP	×2	200 〃	768	11.3	17.4
AYP	×2	65 〃	337	5.7	3.8
CIX		120 〃	657	8.6	5.7
IQT		200 〃	1017	11.3	11.5
HUU		65 〃	250	5.7	1.4
*TGI		〃 〃	330	〃	3.8
AYP		〃 〃	337	〃	1.9
					225.2

*No Fuelling Service Airport

APPENDIX 5－8　RESULT OF CAR PARKING SURVEY

(Unit : Car)

Time	Number of parked cars	
	Passenger	Employee
5:30	105	210
6:30	232	210
7:30	266	218
8:30	261	390
9:30	345	428
10:30	430	575
11:30	344	567
12:30	323	535

(1) *Peak hour of parking (Passenger)* 9:30～10:30

(2) Number of Passengers at peak－hour 1,380

(3) Peak hour of parking (Employee) 9:30～10:30

(4) Number of employees at peak－hour 6,016

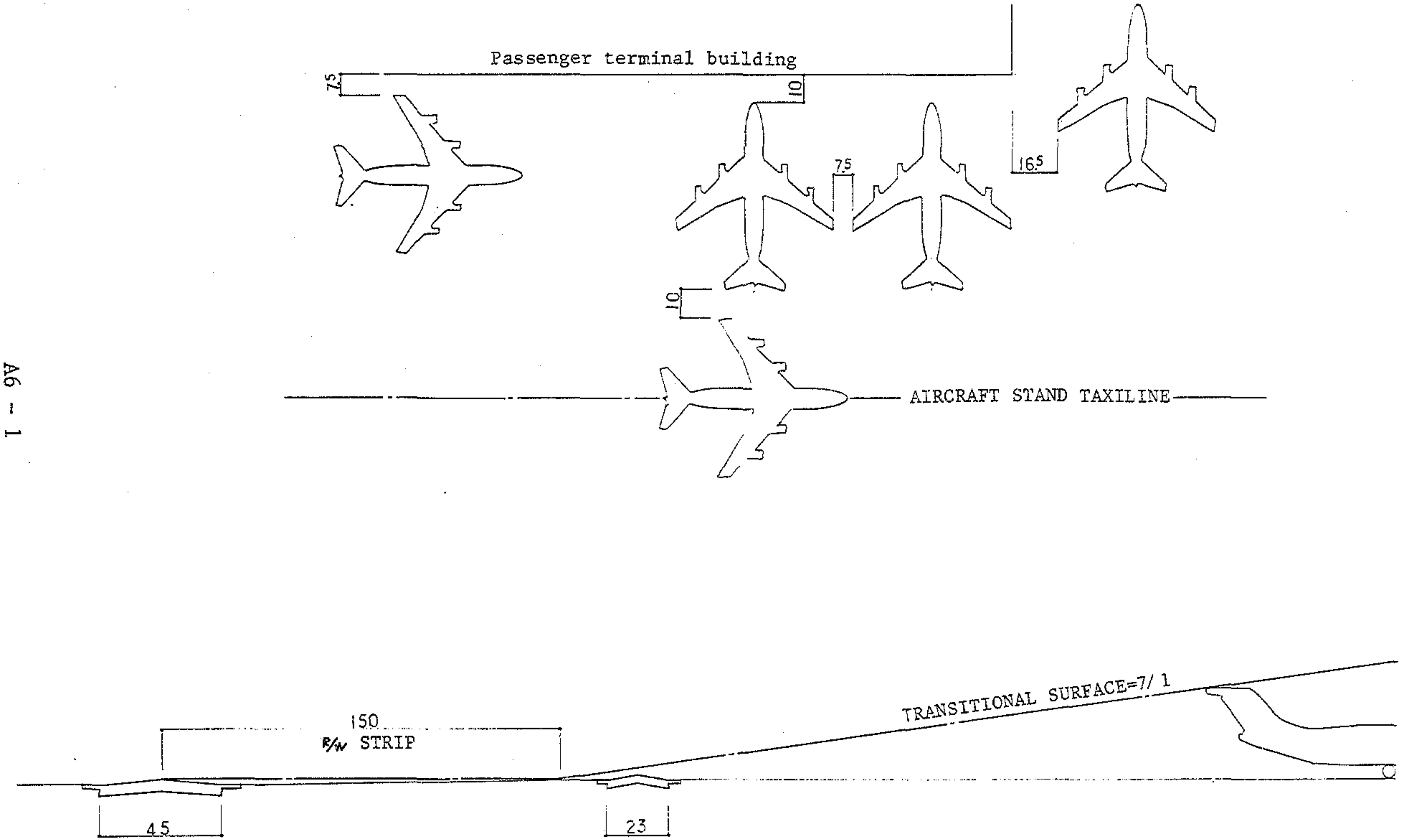
Item	1995	2005
Number of Passengers at peak－hour	2,400	3,000
Number of employees	7,250	8,290

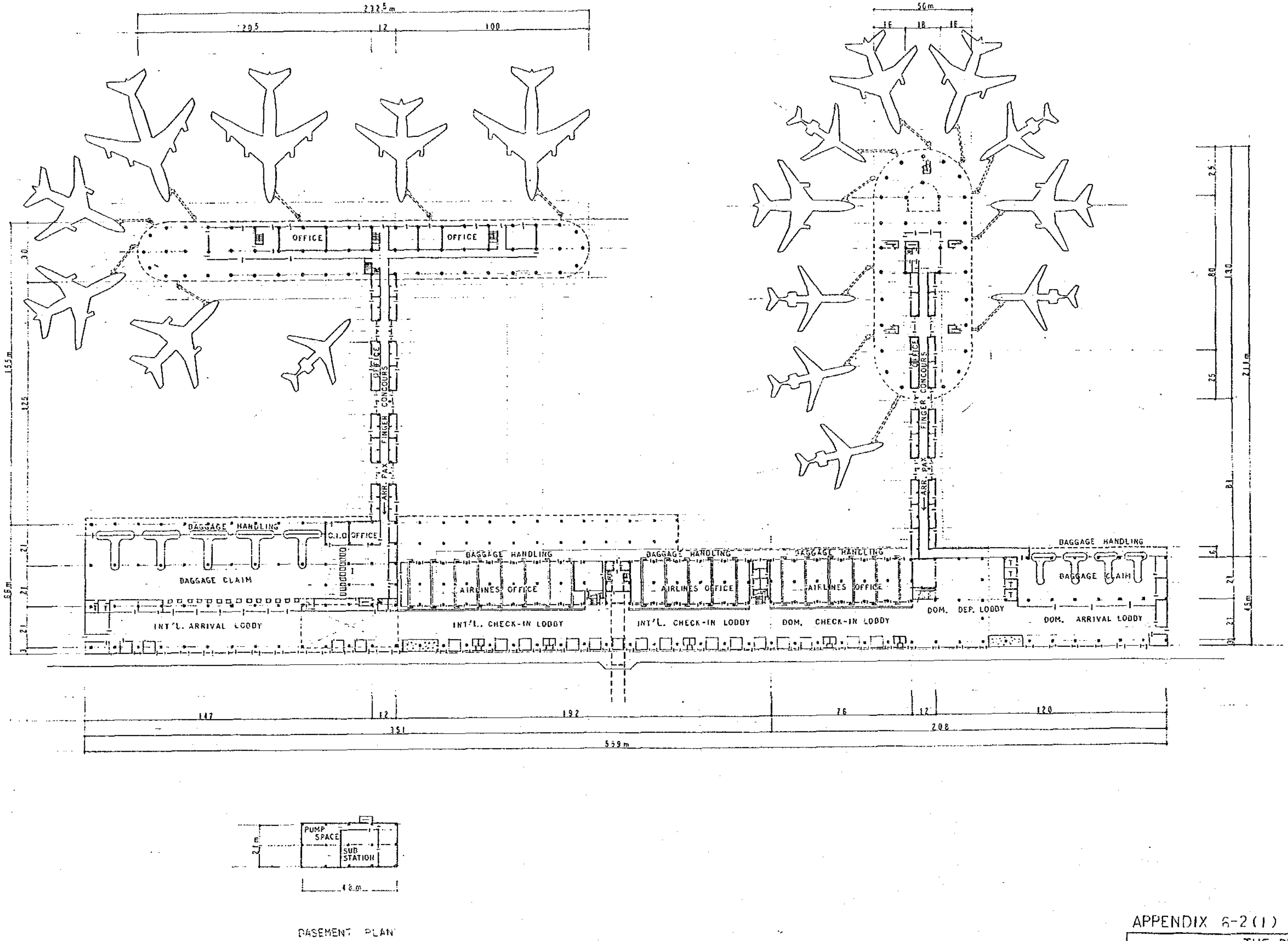
APPENDIX 5-9 FORECAST OF NUMBER OF AIRPORT EMPLOYEES

Item	Existing	1995	2005
CORPAC	3,122	3,650	4,060
C.I.Q.	554	860	1,190
Others	2,340	2,740	3,040
Total	6,016	7,250	8,290

APPENDICES 6

APPENDIX 6-1 BASIC DATA FOR AIRCRAFT STAND LAYOUT



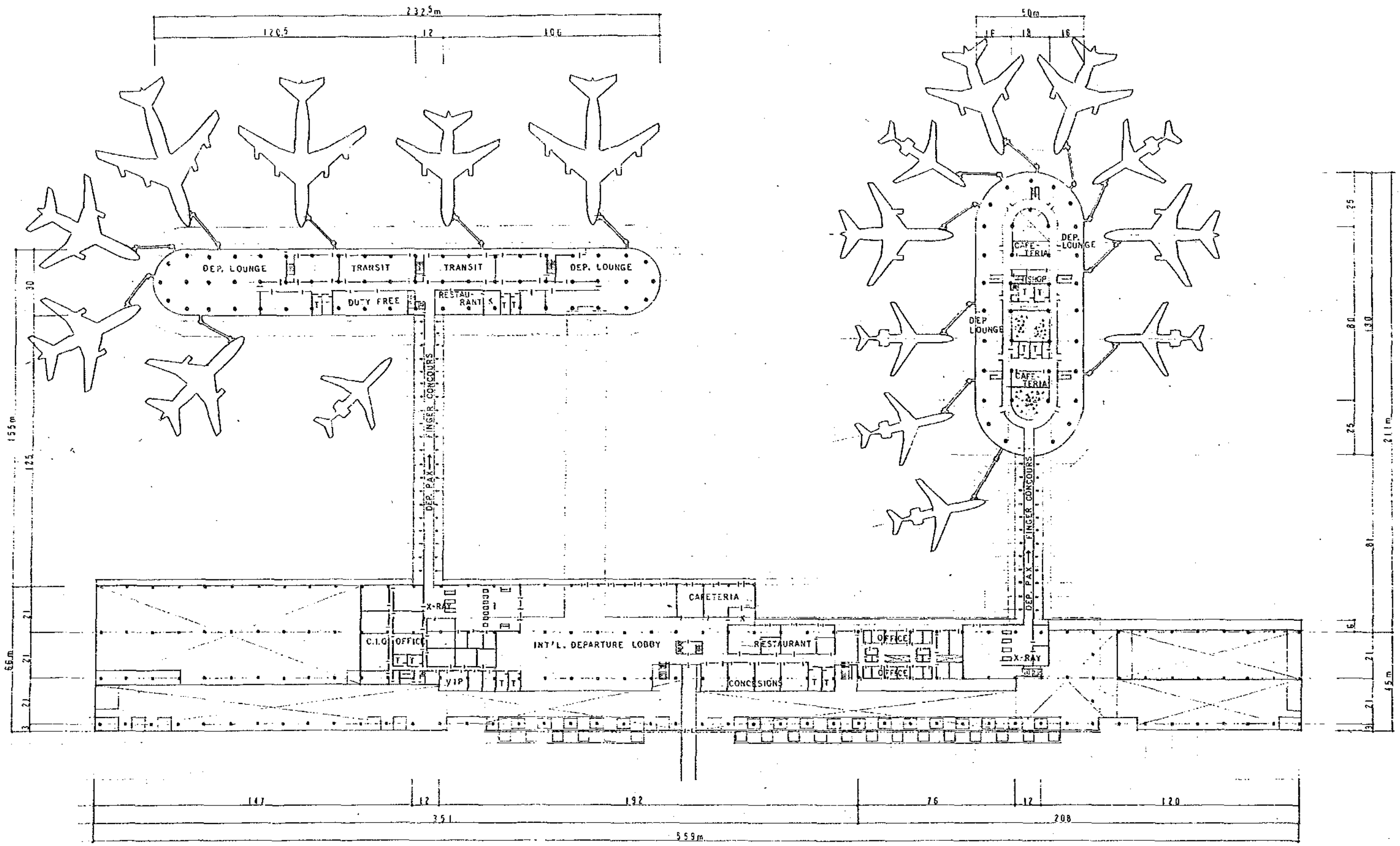


APPENDIX 6-2(1)

THE DEVELOPMENT PROJECT OF JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

PASSENGER TERMINAL BUILDING(MASTER PLAN) 1ST FLOOR PLAN

THE JAPAN INTERNATIONAL COOPERATION AGENCY



APPENDIX 6-2(2)

THE DEVELOPMENT PROJECT OF JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

PASSENGER TERMINAL BUILDING(MASTER PLAN) 2ND FLOOR PLAN

THE JAPAN INTERNATIONAL COOPERATION AGENCY

APPENDIX 6-3 FLOOR AREA REQUIREMENTS OF PASSENGER TERMINAL BUILDING

Facilityies	Area (m^2)	Remarks
International		
Check-in Lobby Departure Lobby	6,900m^2	Counter unit 44
Departure Inspection Area	360m^2	Immigration booth 12
Security Inspection Area	220m^2	X-Ray, metal detector unit 3
Depature Lounge	7,000m^2	
Arrival Inspection Area	350m^2	Immigration booth 17
Baggage Claim Area	3,600m^2	Turntable 5
Baggage Inspection Area	900m^2	Customs Counter 25
Arrival Lobby	2,800m^2	
V.I.P. Room	450m^2	
Domestic		
Check-in Lobby Depature Lobby	3,100m^2	Counter unit 22
Security Insoection Area	300m^2	X-Ray, Metal detector unit 4
Depature Lounge	3,300m^2	
Baggage Claim Area	1,500m^2	Turntable 4
Arrival Lobby	1,400m^2	
Office		
C.I.Q., Security and CORPAC	7,200m^2	
Airlines	5,600m^2	
Others	14,820m^2	
TOTAL	59,800m^2	

APPENDIX 6-4 BASIC DATA FOR CALCULATION OF WECPNL CONTOUR

1. Airport altitude : 66 ft above mean sea level

2. Ambient temperature : 18°C

3. Runway Utilization : - Landing (R/W 15) = 85%

   (R/W 33) = 15%

   - Take-off (R/W 15) = 80%

   (R/W 33) = 20%

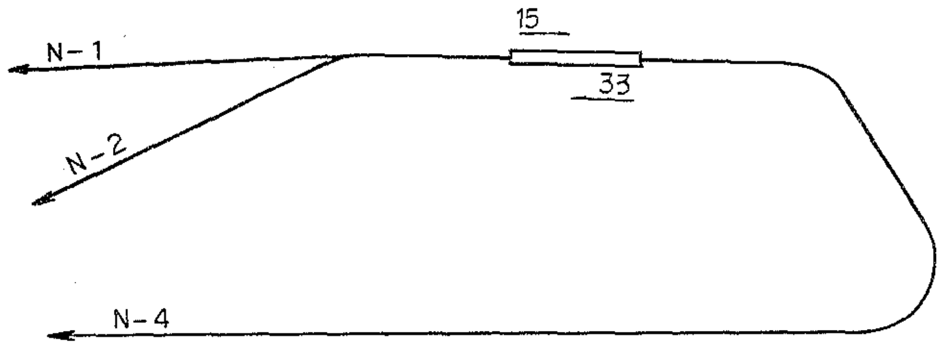
4. Track Figuration : (North) see Fig. 6-1

   (South) see Fig. 6-2

   (East) see Fig. 6-3

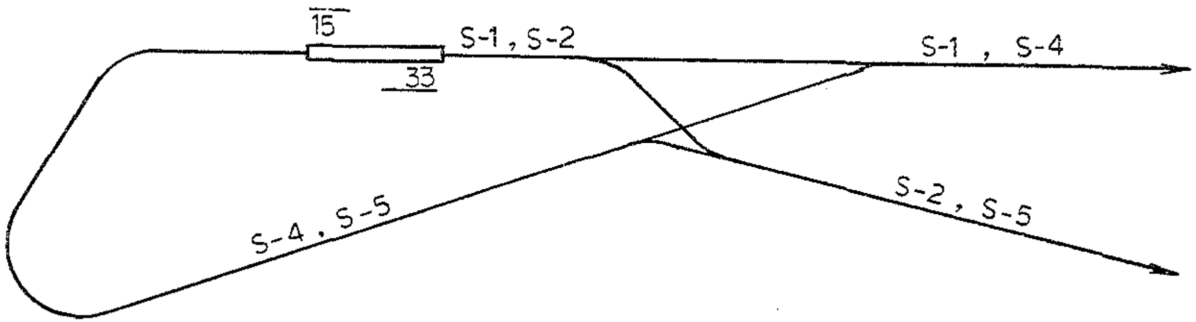
5. Aircraft Noise Model for Calculation of WECPNL Contour

Aircraft Category	Aircraft Noise Model (1985)	Aircraft Noise Model (2005)
350 Seater Jet	B-747-200	B-747-200
250 Seater Jet	DC-10-30	DC-10-30
200 Seater Jet	DC-8-55	A-300
150 Seater Jet	B-727-200	A-300
120 Seater Jet	B-727-100	A-300
65 Seater Jet	F-28-2000	F-28-2000
General Aviation	MTEP 10Q	MTEP 10Q
Military	C-130 E	C-130 E



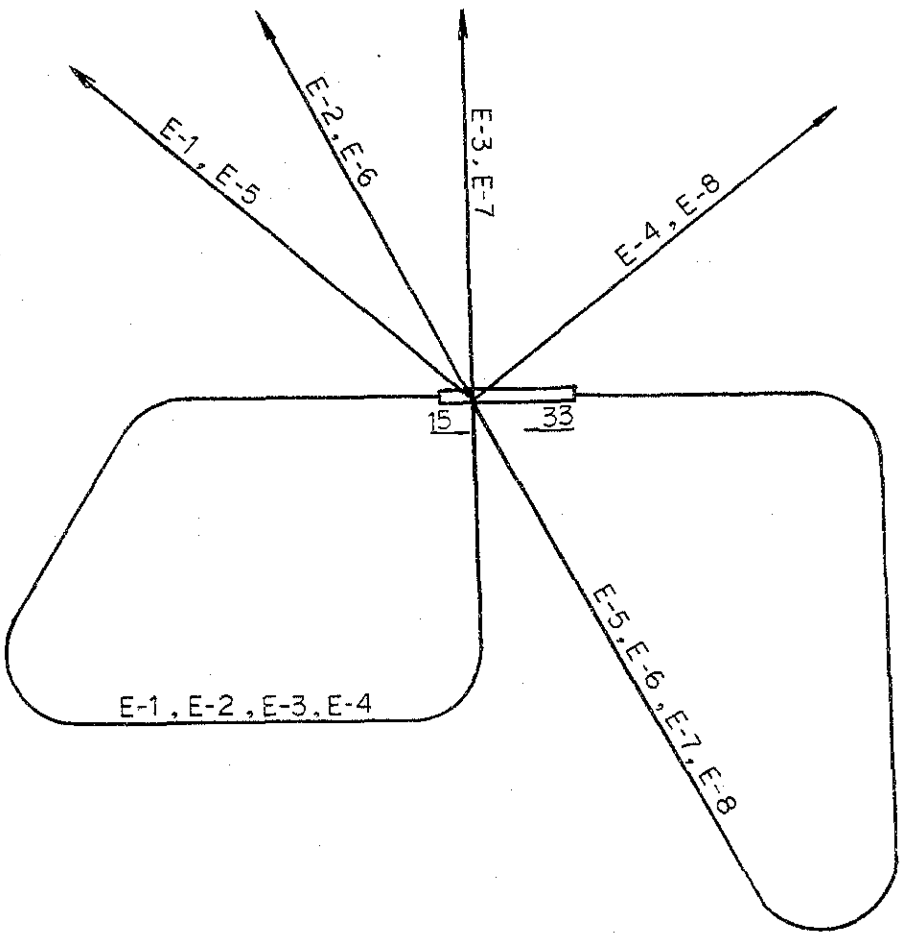
TRACK	DESTINATION
N-1 N-2 N-4	UIO, GYE, BOG, PTY, HAV, SJO, MBJ, GCM, MEX, MIA, YYZ, LAX YVR
	TBP, TYL, PIU, CIX TRU

FIG. 6 - 1 TRACK FIGURATION (NORTH) S= 1: 100,000



TRACK	DESTINATION
S - 1 S - 2	LPB , SCL , BUE ASU , SAO
S - 4 S - 5	TCQ , AQP

FIG. 6 - 2 TRACK FIGURATION (SOUTH) S = 1:100,000



TRACK	DESTINATION
E-1 E-5	TPA, JAEN
E-2 E-6	IQT, TGI, PCL HUU
E-3 E-7	CCS, G.A., MIL
E-4 E-8	AYP, CUZ

FIG. 6-3 TRACK FIGURATION (EAST) S = 1:100,000

TABLE 6-1 <u>AIRCRAFT MOVEMENTS BY TYPE PER DAY (1985)</u>

FEDERAL AVIATION ADMINISTRATION INTEGRATED NOISE MODEL 2. 6
NOISE CONTOUR -LIMA INTERNATIONAL AIRPORT : 1985 -

A/C	A/C NAME		NC		ARRIVALS		0- 500		500-1000		1000-1500		1500-2500		2500-3500		3500-4500		4500- UP
5	3E N3TF	727-200	8	D	1.1	18	0.0	20	.5	20	.3	20	.3	0	0.0	0	0.0	0	0.0
				E	.2		0.0		.2		0.0		0.0		0.0		0.0		0.0
				N	1.0		0.0		0.0		.1		.9		0.0		0.0		0.0
6		727-100	8	D	6.9	17	6.9	18	0.0	19	0.0	20	0.0	0	0.0	0	0.0	0	0.0
				E	1.6		1.1		.5		0.0		0.0		0.0		0.0		0.0
				N	3.1		3.1		0.0		0.0		0.0		0.0		0.0		0.0
10		DC-8-55	11	D	3.5	27	2.5	28	1.0	29	0.0	31	0.0	34	0.0	36	0.0	36	0.0
				E	.5		0.0		.5		0.0		0.0		0.0		0.0		0.0
				N	.9		.5		.4		0.0		0.0		0.0		0.0		0.0
18	STOL	F-28-2000	1	D	6.1	61	4.9	62	1.3	62	0.0	0	0.0	0	0.0	0	0.0	0	0.0
				E	1.6		1.5		.1		0.0		0.0		0.0		0.0		0.0
				N	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
23	3E LR WB	DC-10-30	14	D	1.4	56	0.0	56	.4	57	.6	58	.4	59	0.0	60	0.0	60	0.0
				E	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
				N	2.3		0.0		.1		.4		.9		.3		.3		.3
25	4 ENG WB	747-200	16	D	4.8	6	0.0	7	1.4	8	1.6	9	1.7	10	0.0	11	0.0	11	0.0
				E	.1		0.0		.1		0.0		0.0		0.0		0.0		0.0
				N	3.1		0.0		1.2		.5		1.4		0.0		0.0		0.0
44	MTEP100	GA	27	D	7.8	92	7.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
				E	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
				N	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
55	C-130E	MIL	38	D	19.2	103	19.2	103	0.0	103	0.0	103	0.0	103	0.0	0	0.0	0	0.0
				E	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
				N	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0

TABLE 6-2 <u>AIRCRAFT MOVEMENTS BY TYPE PER DAY (2005)</u>

FEDERAL AVIATION ADMINISTRATION INTEGRATED NOISE MODEL 2. 6
NOISE CONTOUR -LIMA INTERNATIONAL AIRPORT : 2005

A/C	A/C NAME	NC		ARRIVALS		0- 500		500-1000		1000-1500		1500-2500		2500-3500		3500-4500		4500- UP
18	STOL F-28-2000	1	D	11.3	61	6.6	62	4.7	62	0.0	0	0.0	0	0.0	0	0.0	0	0.0
			E	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
			N	0.0		.5		0.0		0.0		0.0		0.0		0.0		0.0
20	2EWB A300 AIRBUS	13	D	27.1	50	19.2	51	6.6	51	0.0	52	1.2	53	0.0	0	0.0	0	0.0
			E	2.0		1.5		.5		0.0		0.0		0.0		0.0		0.0
			N	2.3		1.5		.8		0.0		0.0		0.0		0.0		0.0
23	3E LR WB DC-10-30	14	D	6.1	56	0.0	56	1.4	57	1.5	58	3.2	59	0.0	60	0.0	60	0.0
			E	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
			N	4.3		0.0		0.0		0.0		3.2		.2		.8		.1
25	4 ENG WB 747-200	16	D	4.7	6	0.0	7	1.7	8	1.2	9	1.8	10	0.0	11	0.0	11	0.0
			E	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
			N	2.4		0.0		0.0		1.5		1.0		0.0		0.0		0.0
44	MTEP10Q GA	27	D	15.5	92	15.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
			E	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
			N	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
55	C-130E MIL	38	D	27.4	103	27.4	103	0.0	103	0.0	103	0.0	103	0.0	0	0.0	0	0.0
			E	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
			N	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0

APPENDICES 7

APPENDIX 7-1 DESIGN OF PAVEMENTS

1. Determination of Design Aircraft

Pavement thickness is determined for each aircraft in the forecast using the appropriate design curves. In this study the DC-10-30 requires the greatest pavement thickness and is thus the design aircraft as shown in Table 7-1.

Table 7-1 Determination of Design Aircraft

Aircraft type	Gear type	Forecast annual departures	Maximum take-off weight (kg)	Required slab thickness (cm)
350 Seater (B 747-200)	double dual tandem	1,120	352,893	25.5
250 Seater (DC-10-30)	double dual tandem	3,477	253,105	31.3
200 Seater (B-767)	dual tandem	1,500	136,984	26.8
150 Seater (B-727-200)	dual	574	78,471	28.0
120 Seater (B-737)	dual	5,820	45,722	25.0
65 Seater (F-28)	dual	3,440	29,484	18.0

2. Equivalent Annual Departures of the Design Aircraft

Since the traffic forecast is a mixture of a variety of aircraft having different landing gear types and different weights, the effects of all traffic must be accounted for items of design aircraft.

First all aircraft have been converted to the same landing gear type as the design aircraft using following factors.

To convert from	To	Multiply departures by
dual wheel	dual tandem	0.6
double dual tandem	dual tandem	1.0

Secondly, after the aircraft have been grouped into the same landing gear configuration, the conversion to equivalent annual departures of the design aircraft are determined as shown in Table 7-2 by the following formula:

$$\log R1 = \log R2\left(\frac{W2}{W1}\right)^{\frac{1}{2}}$$

where R1 = equivalent annual departures by the design aircraft

R2 = annual departures expressed in design aircraft landing gear

W1 = wheel load of design aircraft

W2 = wheel load of the aircraft in question

Table 7-2 Equivalent Annual Departures of Design Aircraft

Aircraft	Dual tandem gear departures	Wheel load	Wheel load of design aircraft (kg)	Equivalent annual departures of design aircraft
B-747-200	1,120	16,160*	16,160	1,120
DC-10-30	3,477	16,160*	16,160	3,477
B-767	1,500	16,740	16,160	1,708
B-727-200	344	17,240	16,160	417
B-737	3,492	12,440	16,160	1,284
F-28	2,064	7,200	16,160	163
Total				8,169

* Wheel loads for wide body aircraft will be taken as the wheel load for a 300,000 lb (136,100 kg) aircraft for equivalent annual departure calculations.

3. Design of the Rigid Pavement for Apron

1) Design Conditions

a)	Design aircraft	DC-10-30 (253,105 kg)
b)	Equivalent annual departure of design aircraft	8,200 times
c)	Subgrade strength	$k = 7\ kg/cm^3$ (253 pci)
d)	Pavement type	rigid pavement
e)	Subbase strength	k = 325 pci
f)	Subbase thickness	t = 30 cm
g)	Flexural strength of concrete slab (90 days)	$= 55\ kg/cm^2$ (782 psi)

2) Pavement Thickness

Using Fig. 7-1 the thickness of concrete slub can be obtained as 33.0 cm. Pavement structure is shown below:

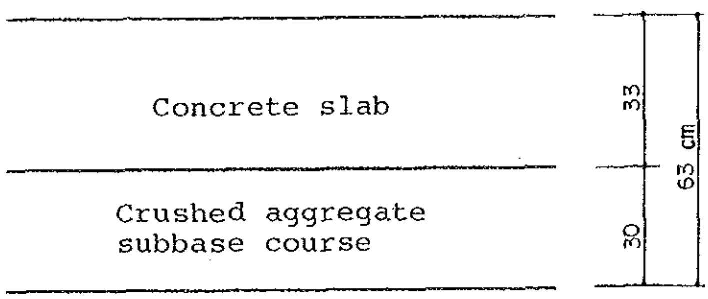
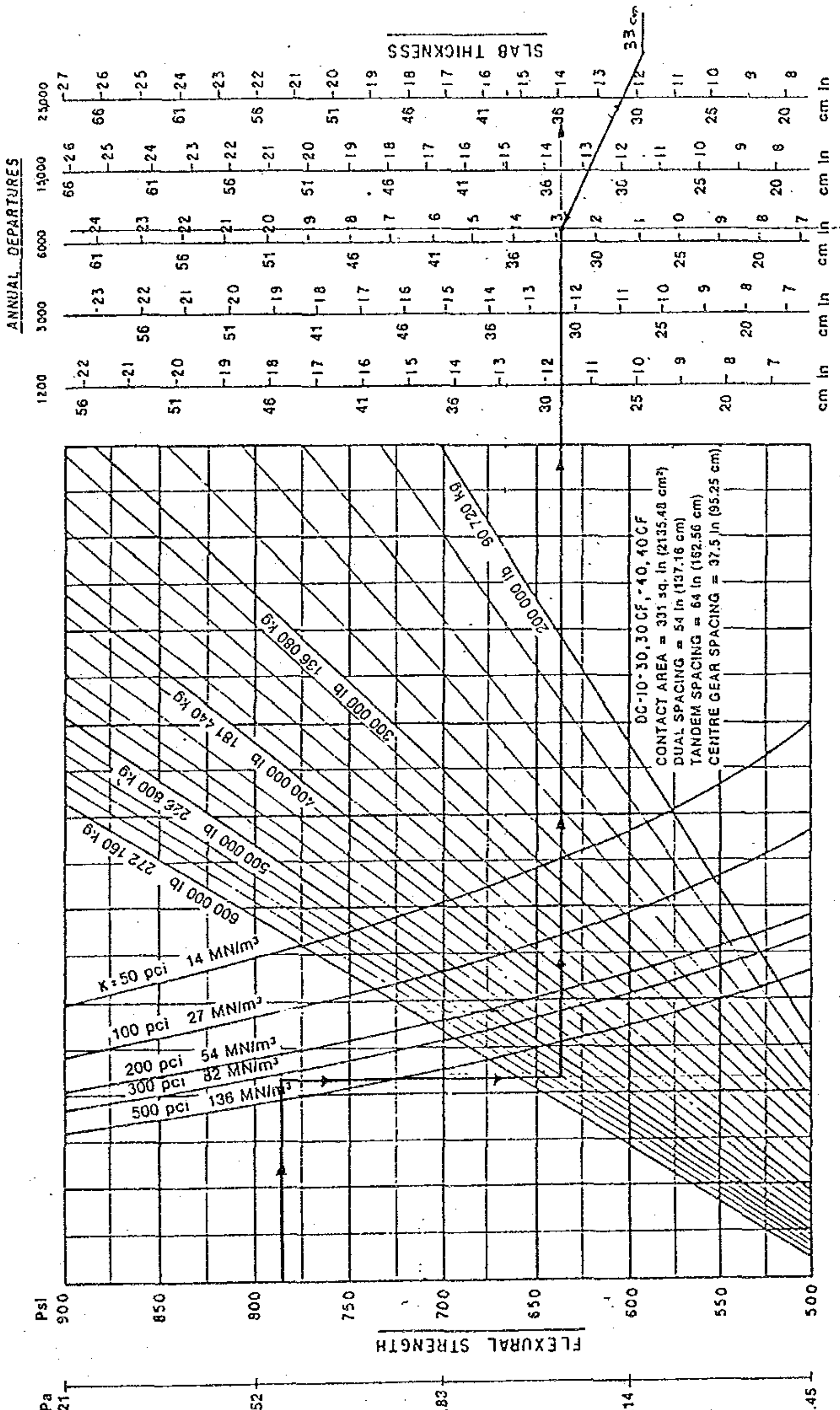


Fig. 7-1 Rigid Pavement Design Curves - DC-10-30, 30CF, 40, 40CF



4. Design of the Flexible Pavement for High Speed Exit Taxiway

1) Design Condition

a)	Design aircraft	DC-10-30 (253,105 kg)
b)	Equivalent annual departures of design aircraft	8,200 times
c)	Subgrade strength	CBR = 21%
d)	Pavement type	Flexible pavements

2) Pavement Thickness

Using Fig. 7-2 the total thickness and the thickness of bituminous surface can be obtained as 46 cm and 13 cm respectively.

Using Fig. 7-3 the minimum base course thickness can be obtained as 38 cm. Therefore, the total thickness becomes 13 cm + 38 cm = 51 cm. Pavement structure is shown below:

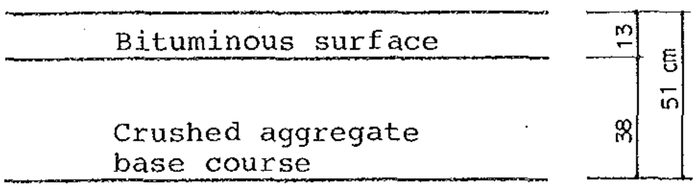


Fig. 7-2 Flexible Pavement Design Curves for Critical Areas

DC-10-30, 30CF, 40, 40CF

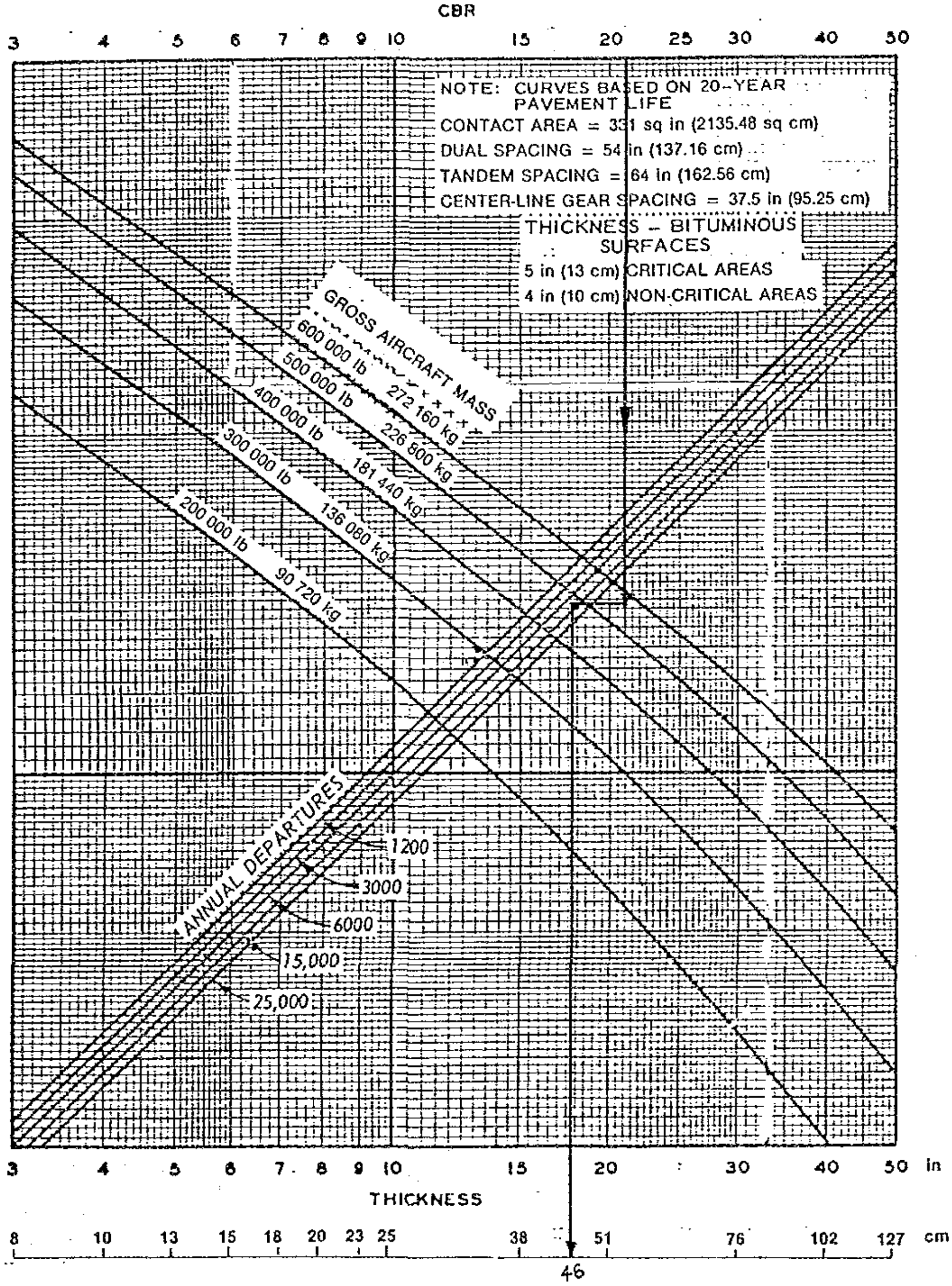
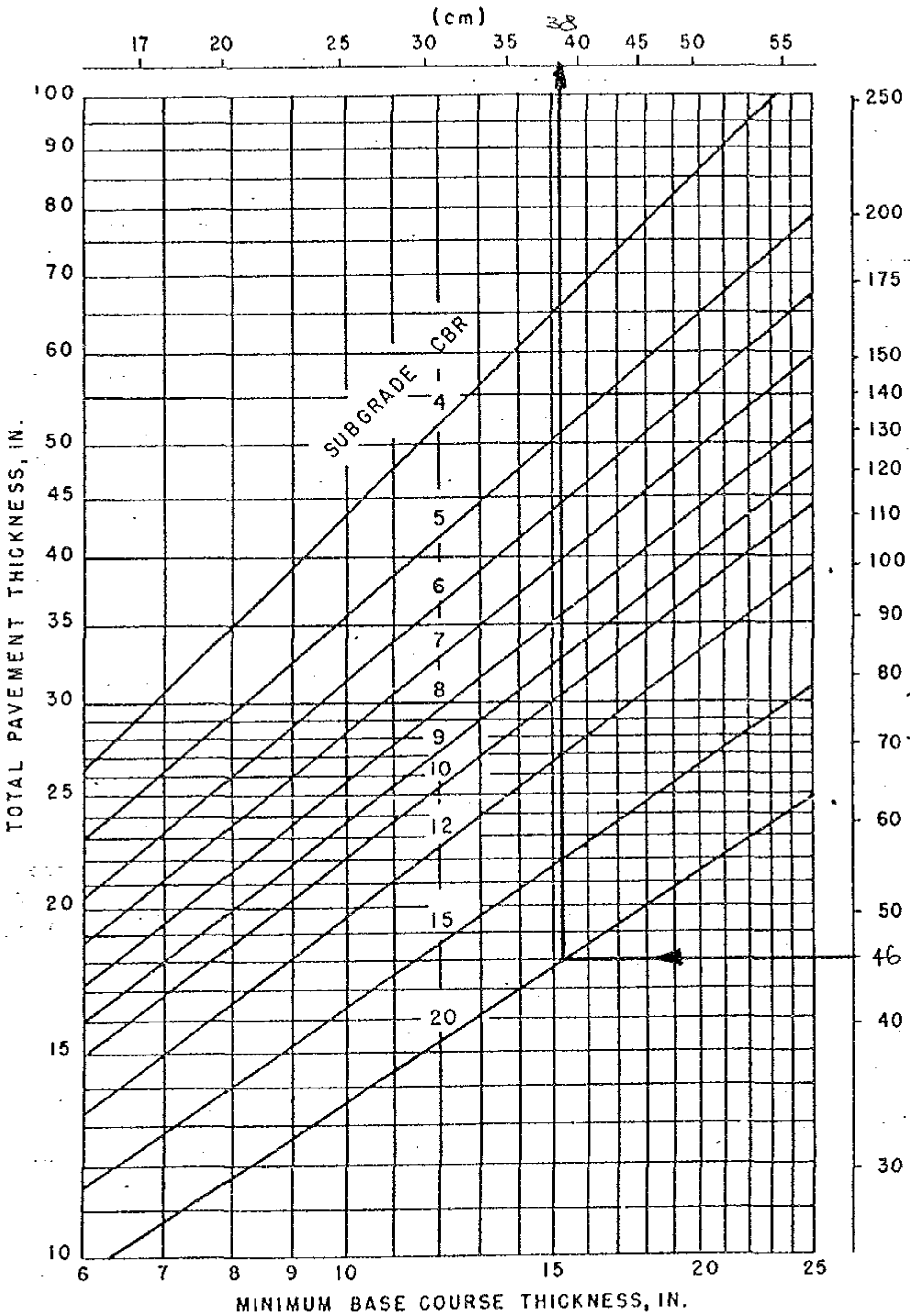


Fig. 7-3 Minimum Base Course Thickness Requirements



5. Design of Bituminous Overlay on Existing Rigid Pavement for Runway

1) Design Conditions

a)	Design aircraft	DC-10-30 (253,105 kg)
b)	Equivalent annual departures of design aircraft	8,200 times
c)	Subgrade strength	$k = 7\ kg/cm^3$ (253 pci)
d)	Subbase thickness	$t = 30$ cm
e)	Subbase strength	$k = 325$ pci
f)	Flexural strength of concrete slab (90 days)	$\sigma = 55\ kg/cm^2$ (782 psi)

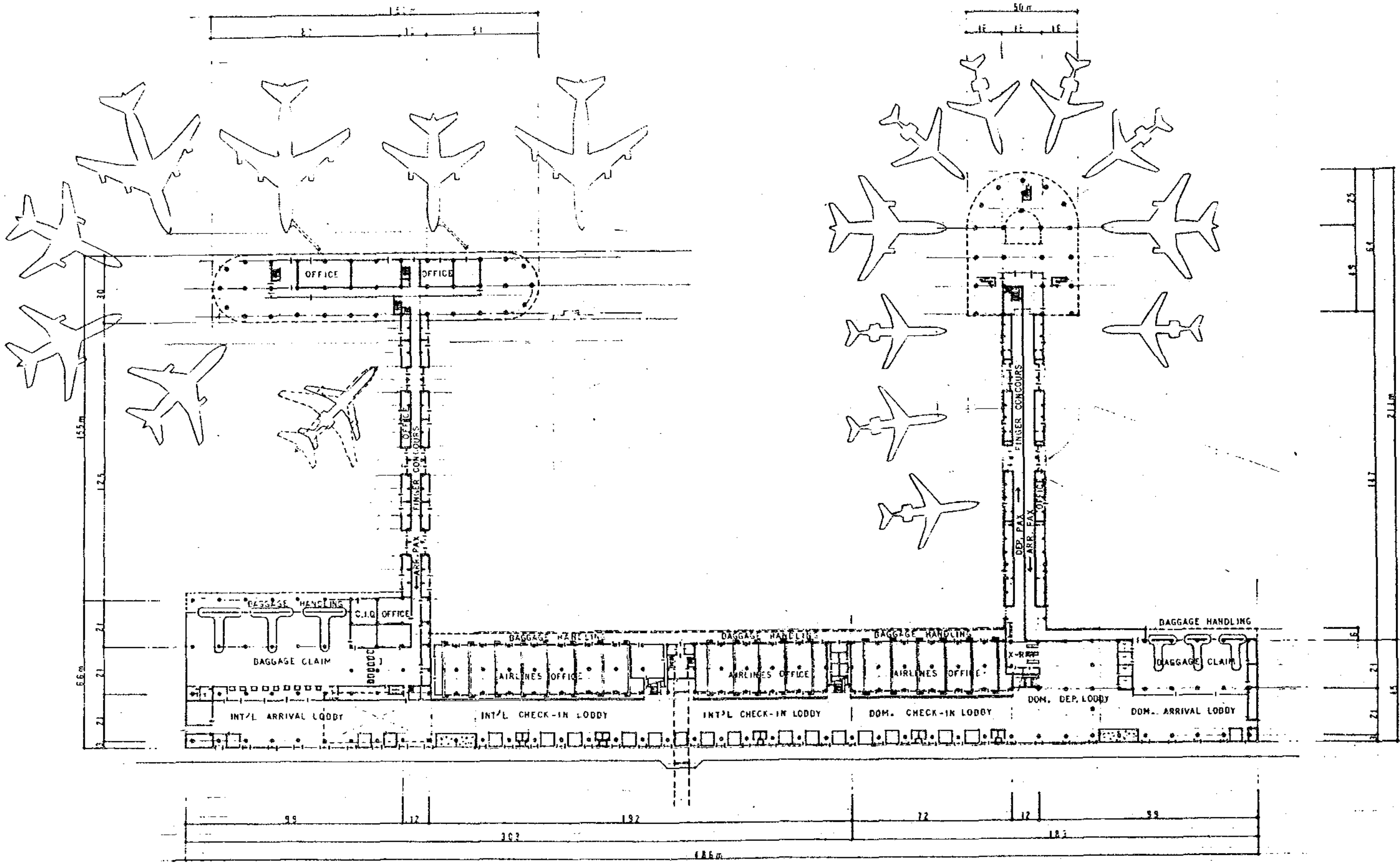
2) Thickness of Bituminous Overlay

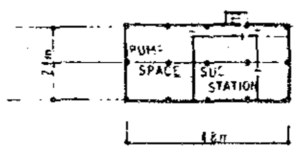
To establish the required thickness of bituminous overlay for the existing rigid pavement, it is first necessary to determine the single thickness of rigid pavement required to satisfy the design conditions. The single thickness of rigid pavement has been calculated to be 33 cm from Fig. 7-1.

After the single thickness of rigid pavement has been calculated, the thickness of the bituminous overlay is computed to be 11 cm from the following formula:

$$t = 6.3\ (F \times h - Cb \times he) = 6.3\ (0.95 \times 33 - 0.9 \times 33) = 11\ \text{cm}$$

where
- t = Thickness of bituminous overlay, centimetres
- F = Factor which controls the degree of cracking in the base pavement
- h = Single thickness of rigid pavement required for design condition, centimetres
- Cb = Condition factor for base pavement
- he = Thickness of existing rigid pavement, centimetres





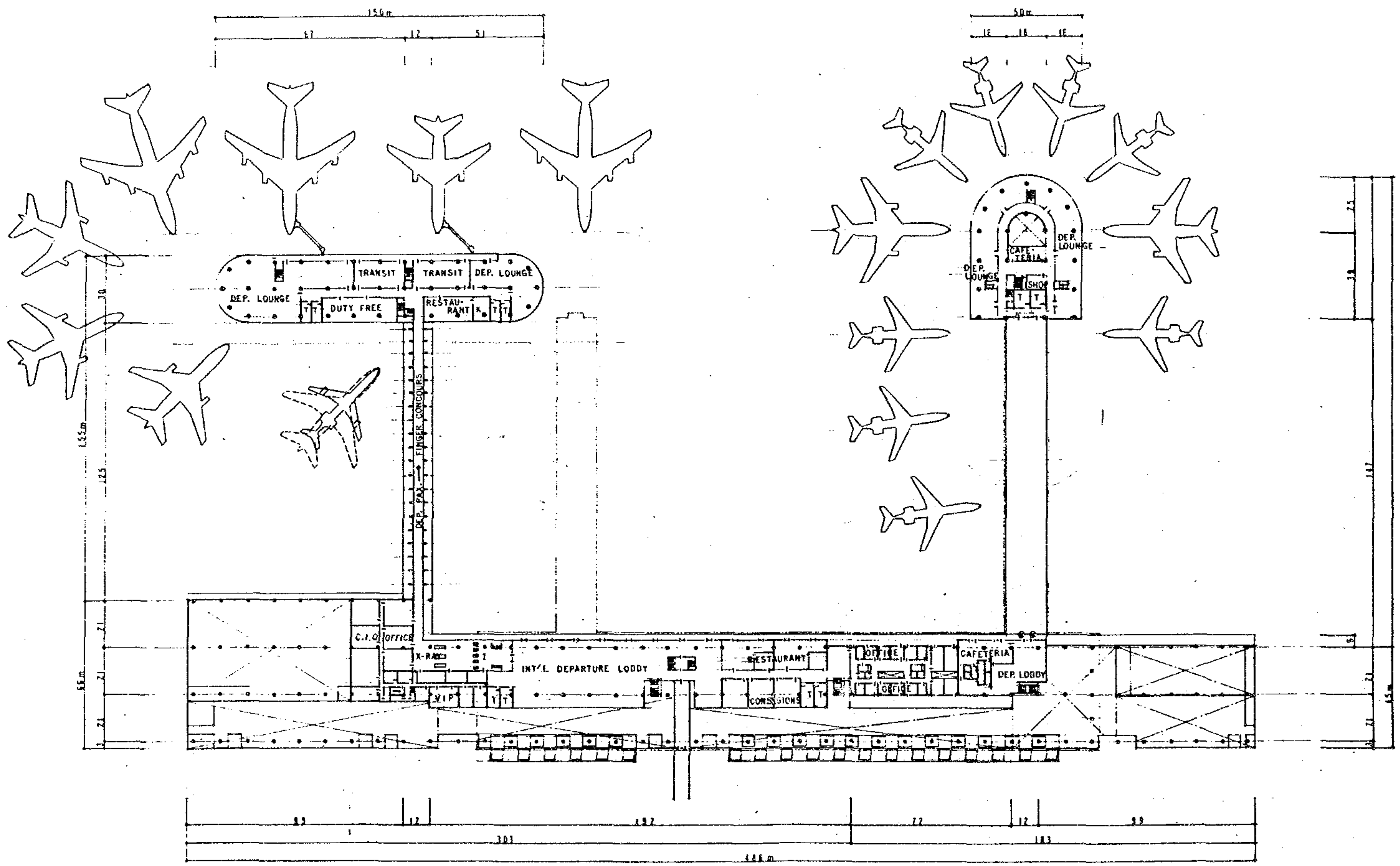
BASEMENT PLAN

APPENDIX 7 -2 (1)

THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

PASSENGER TERMINAL BUILDING (SHORT TERM) 1ST FLOOR PLAN

THE JAPAN INTERNATIONAL COOPERATION AGENCY

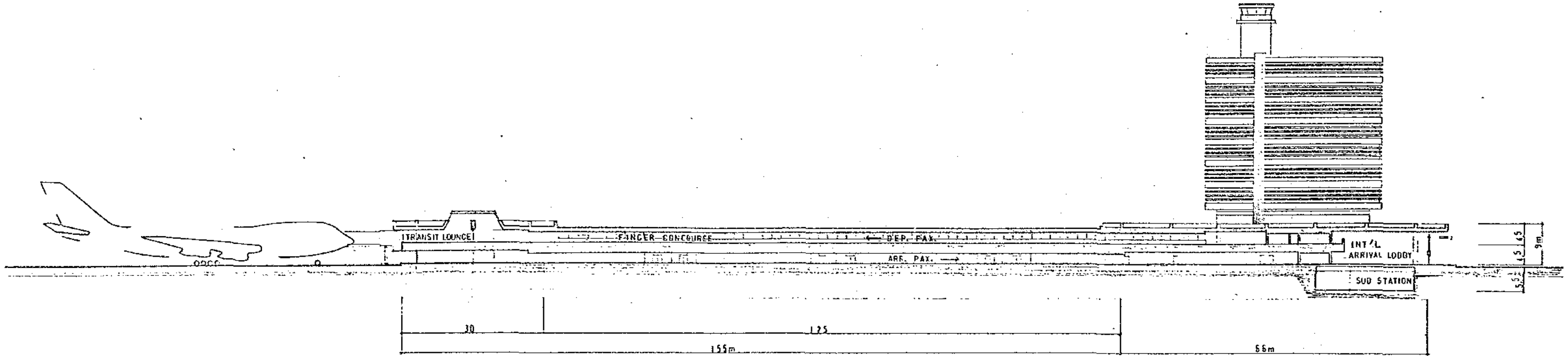


APPENDIX 7-2 (2)

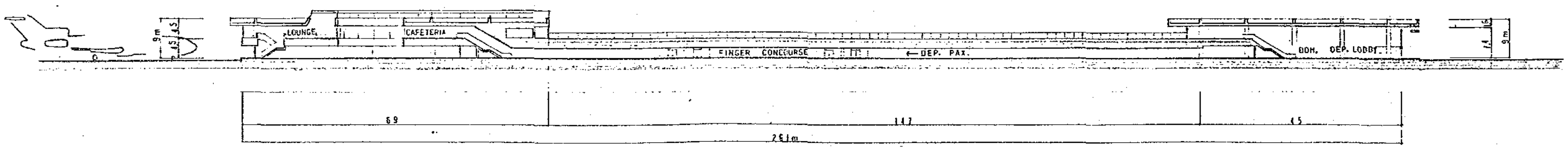
THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

PASSENGER TERMINAL BUILDING (SHORT TERM) 2ND FLOOR PLAN.

THE JAPAN INTERNATIONAL COOPERATION AGENCY



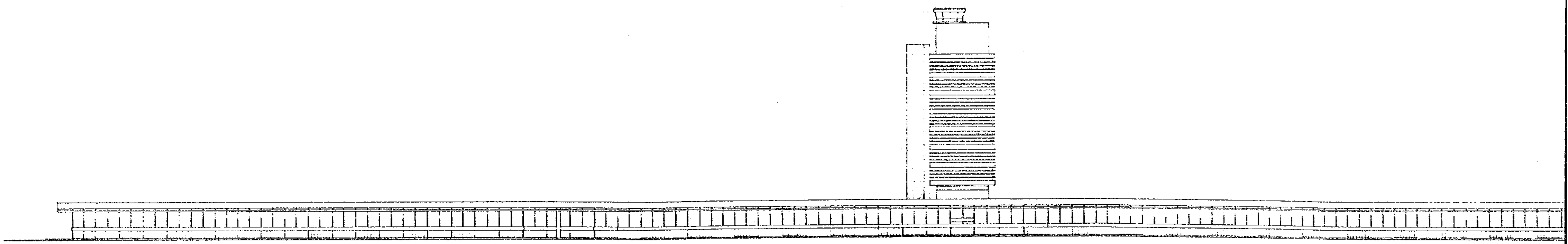
SECTION THROUGH INTERNATIONAL FINGER CONCOURSE



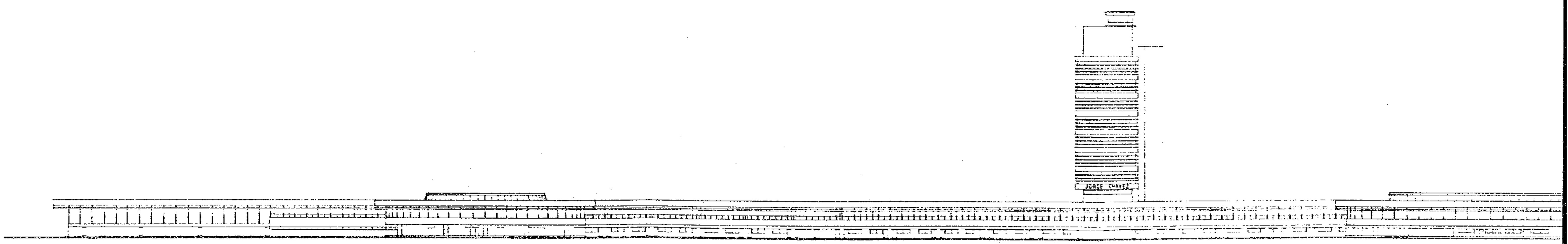
SECTION THROUGH DOMESTIC FINGER CONCOURSE

APPENDIX 7-2 (3)

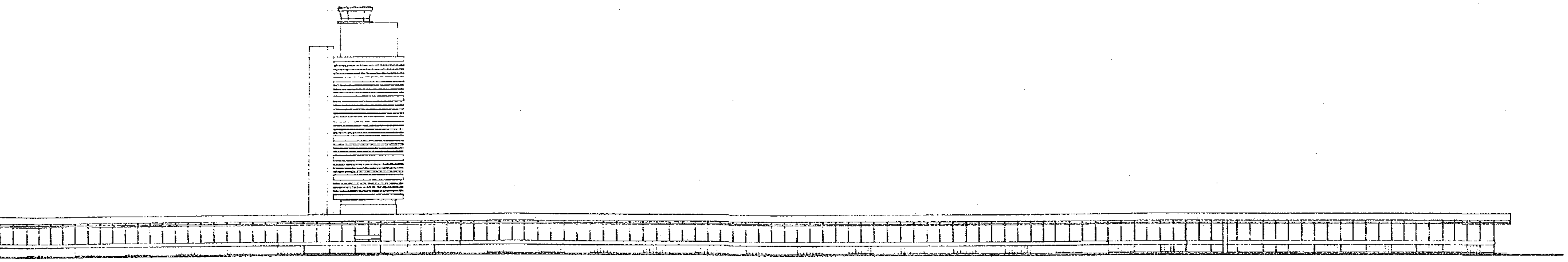
THE DEVELOPMENT PROJECT OF JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT
PASSENGER TERMINAL BUILDING(SHORT TERM) SECTION
THE JAPAN INTERNATIONAL COOPERATION AGENCY



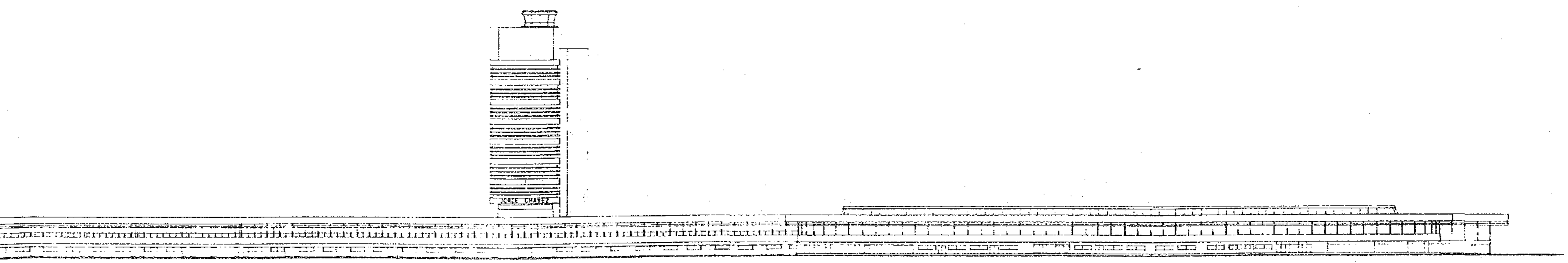
EAST ELEVATION



WEST ELEVATION



EAST ELEVATION



WEST ELEVATION

APPENDIX 7-2 (4)

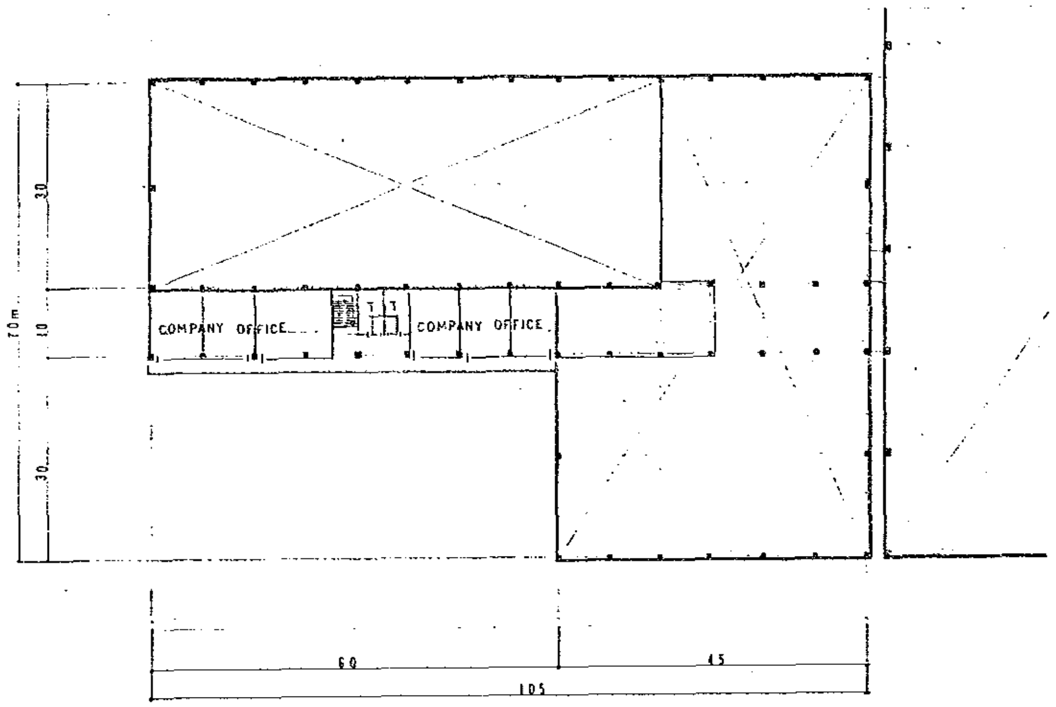
THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

PASSENGER TERMINAL BUILDING(SHORT TERM) EAST · WEST ELEVATION

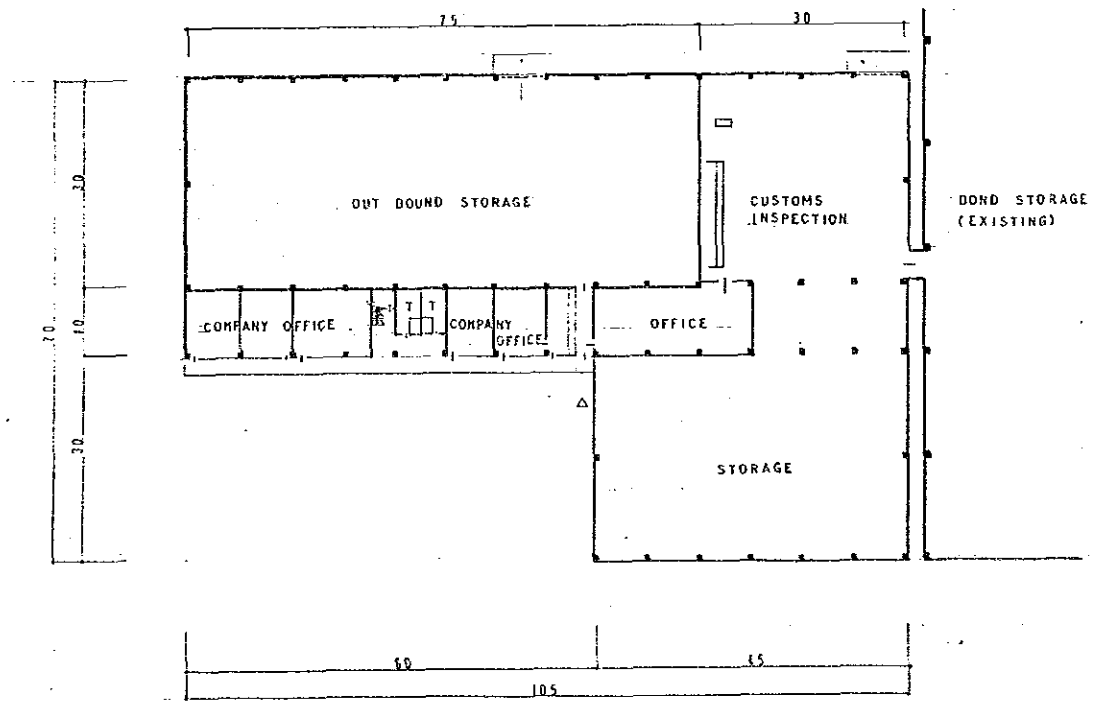
THE JAPAN INTERNATIONAL COOPERATION AGENCY

APPENDIX 7-3 FLOOR AREA REQUIREMENTS OF PASSENGER TERMINAL BUILDING

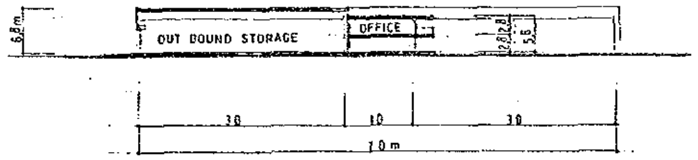
Facilities	Area (m^2)	Remarks
International		
Check-in Lobby Departure Lobby	5,500m^2	Counter unit 44
Departure Inspection Area	250m^2	Immigration booth 10
Security Inspection Area	220m^2	X-Ray, metal detector unit 3
Departure Lounge	2,800m^2	
Arrival Inspection Area	200m^2	Immigration booth 12
Baggage Claim Area	2,200m^2	Turntable 3
Baggage Inspection Area	570m^2	Customs Counter 18
Arrival Lobby	1,800m^2	
V.I.P. Room	280m^2	
Domestic		
Check-in Lobby Departure Lobby	3,100m^2	Counter unit 22
Security Insoection Area	190m^2	X-Ray, Metal detector unit 3
Departure Lounge	1,700m^2	
Baggage Claim Area	1,200m^2	Turntable 3
Arrival Lobby	1,100m^2	
Office		
C.I.Q., Security and CORPAC	6,500m^2	
Airlines	5,600m^2	
Others	14,090m^2	
TOTAL	47,300m^2	



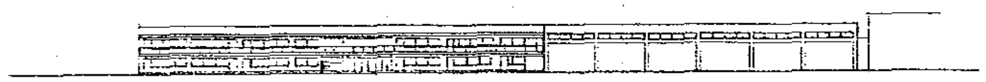
PLAN 2ND FLOOR



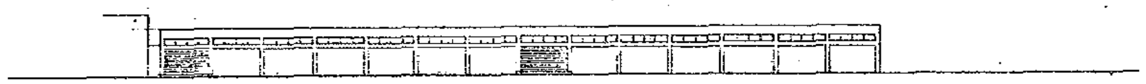
PLAN 1ST FLOOR



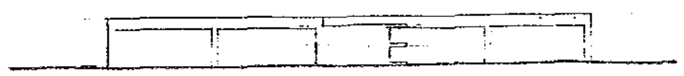
SECTION



EAST ELEVATION



WEST ELEVATION



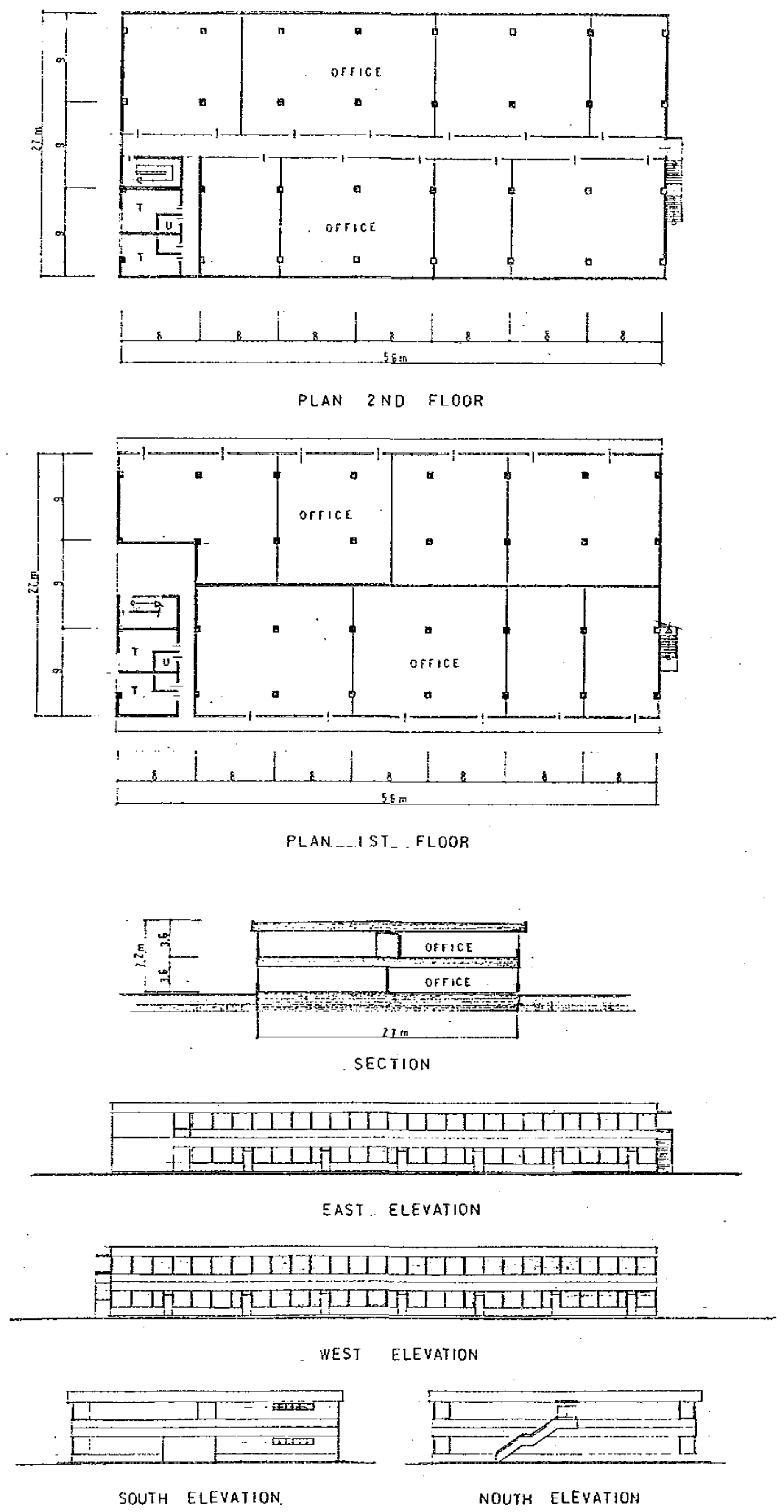
SOUTH ELEVATION

APPENDIX 7 - 4

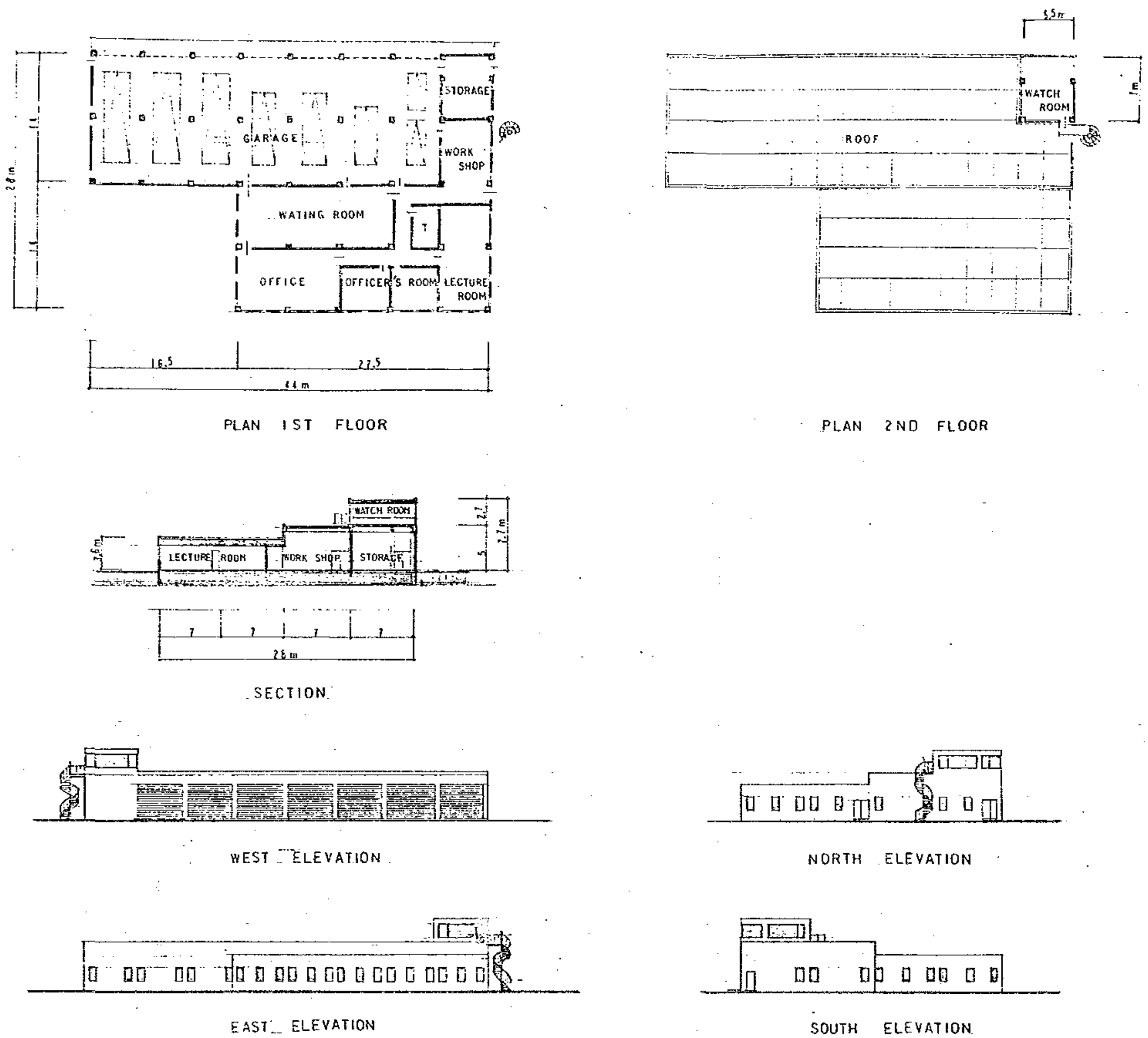
THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

IMPORT CARGO BUILDING PLAN/SECTION/ELEVATION

THE JAPAN INTERNATIONAL COOPERATION AGENCY



CUSTOMS BUILDING



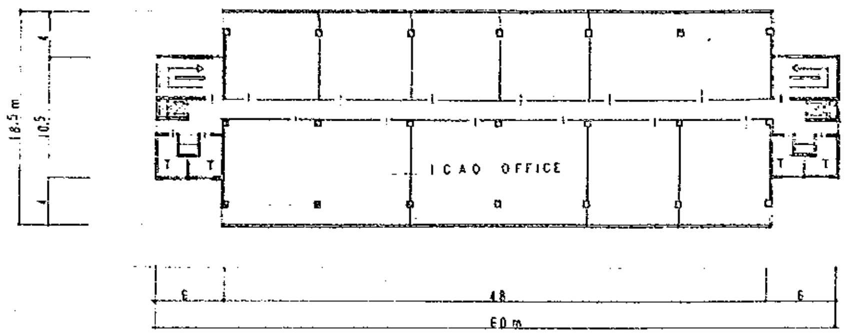
FIRE STATION

APPENDIX 7-5

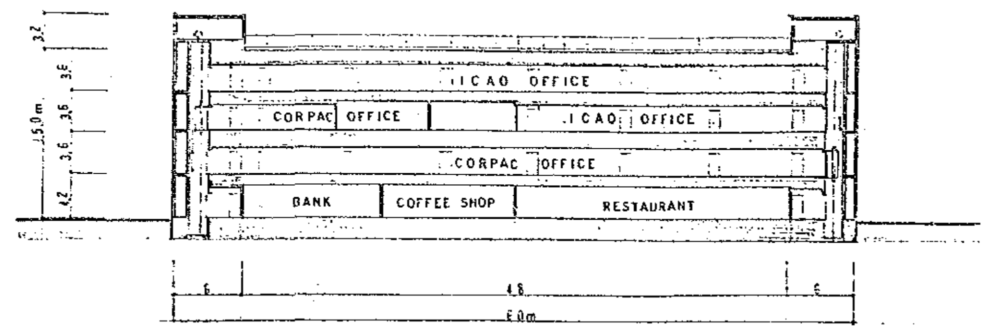
THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

CUSTOMS BUILDING & FIRE STATION
PLAN/SECTION/ELEVATION

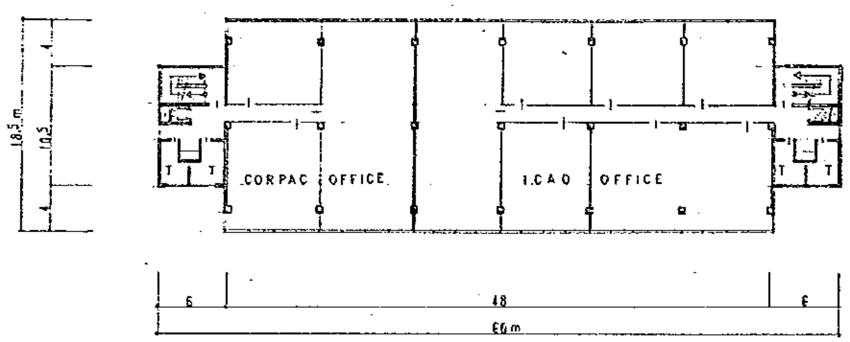
THE JAPAN INTERNATIONAL COOPERATION AGENCY



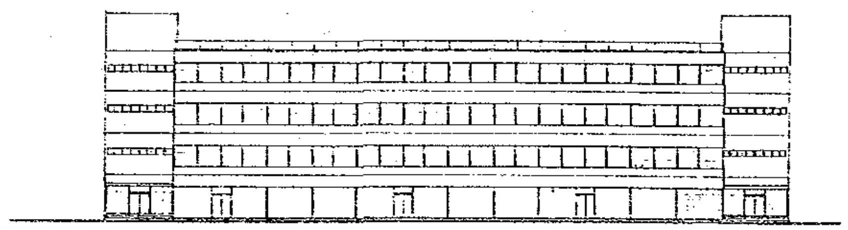
PLAN 4TH FLOOR



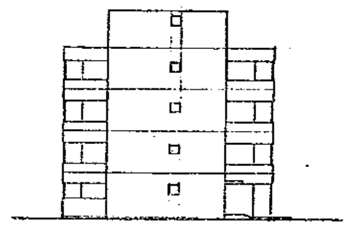
SECTION



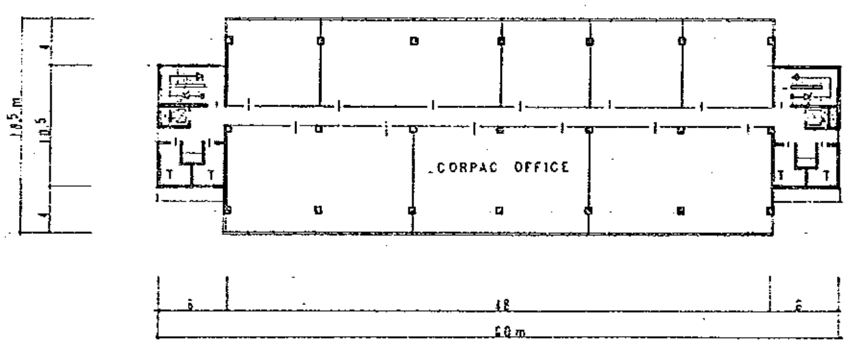
PLAN 3TH FLOOR



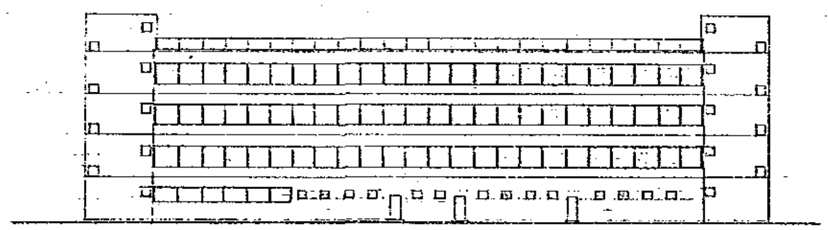
NORTH ELEVATION



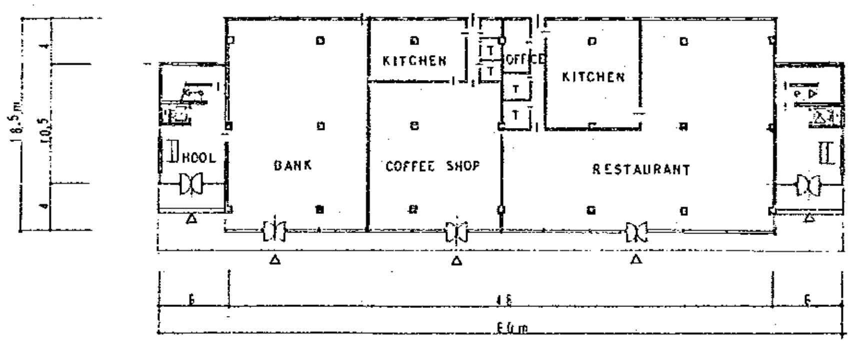
EAST ELEVATION



PLAN 2ND FLOOR



SOUTH ELEVATION



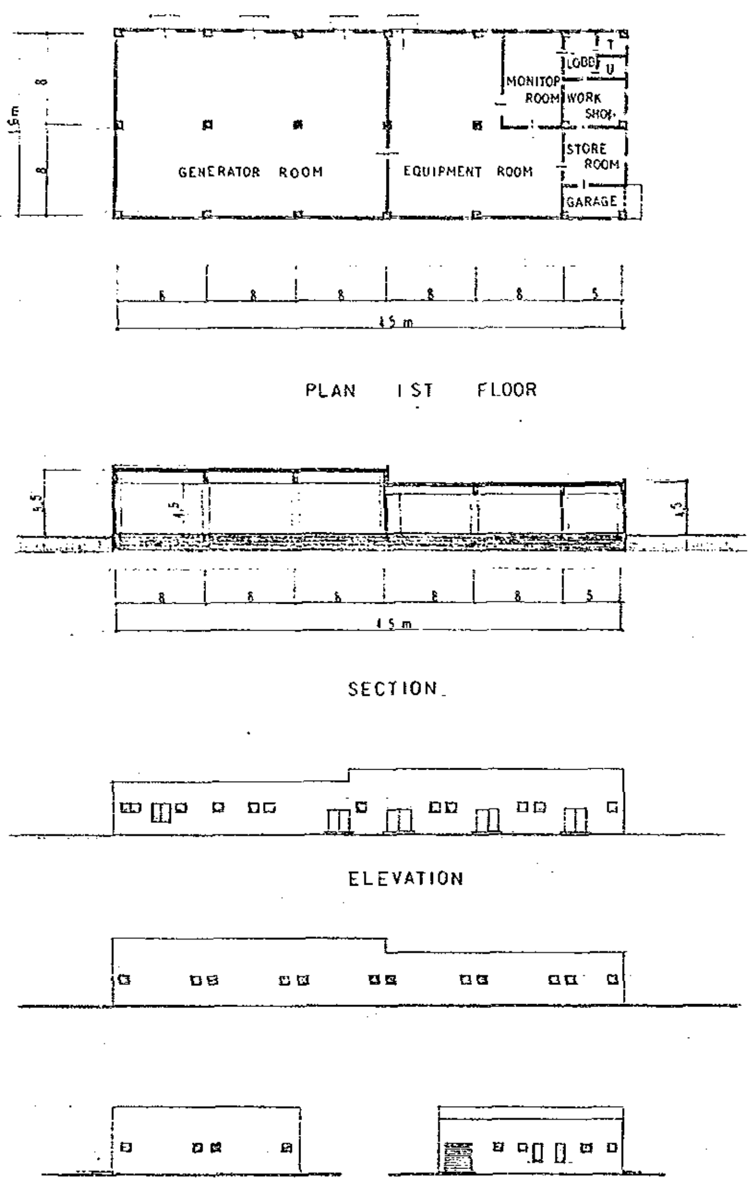
PLAN 1ST FLOOR

APPENDIX 7-6 A7-18

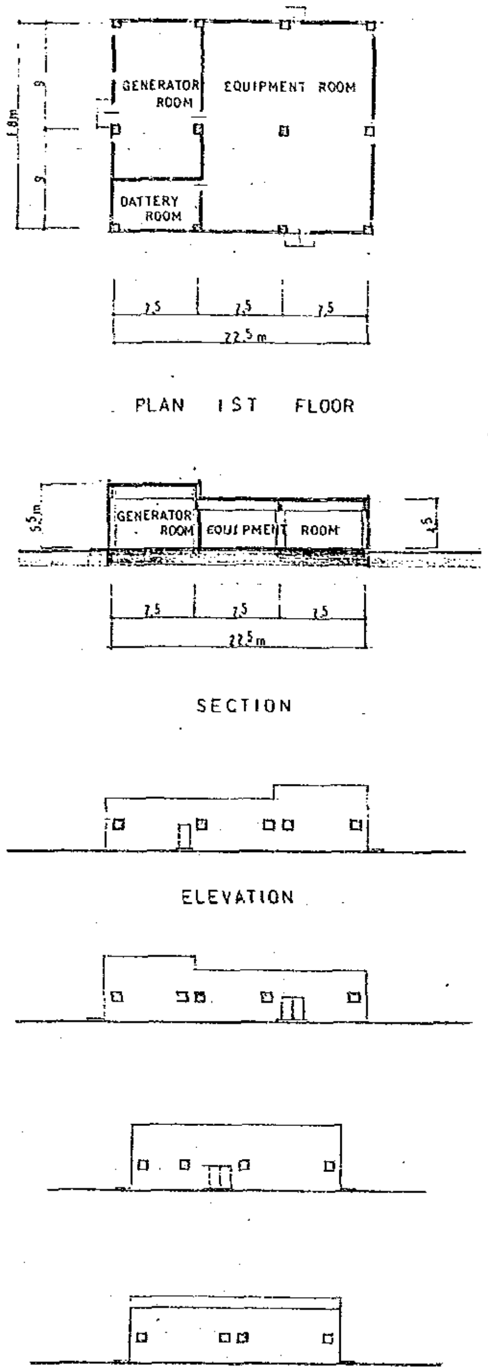
THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

ADMINISTRATION BUILDING PLAN/SECTION/ELEVATION

THE JAPAN INTERNATIONAL COOPERATION AGENCY



MAIN SUBSTATION



RW 15 · RW 33 SUBSTATION

APPENDIX 7-7

THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

MAIN SUBSTATION/RW15-RW33 SUBSTATION
PLAN/SECTION/ELEVATION

THE JAPAN INTERNATIONAL COOPERATION AGENCY

APPENDIX 7-8 BRIGHT DISPLAY (BD) EQUIPMENT

It is recommended to install the Bright Display Equipment (BD) in the control tower for the following reasons:

1. Bounds of Aerodrome Control
   As shown in Fig. 7-4, the dimension of Lima control zone is 10 NM wide and approximately 30 NM long. The contorl tower manages not only VFR traffic in the control zone but also IFR traffic which are to be transferred to and from the Lima ACC.

2. Weather Condition and Traffic Mix
   According to statistics, IMC-VMC ratio at the Lima International Airport is 25:75 in five year average, the same in the winter season is 32:67 (see Table 7-3 and 7-5). IFR/VFR ratio is 86:14 (see Table 7-7), the percentage of VFR traffic is much more greater in day time because VFR operation is prohibited during the hours of darkness.

3. Coordination Problem
   It is often the case that many portions of the control zone, that is to say many of traffic to be controlled are not visible from the tower due to reduced visibility. These conditions lead to impose heavy burden on the controller in exercising inter-facility (ACC-Tower) coordination.

4. Recommendation

The radar display, if installed in the control tower, would help greatly in reducing coordination load as it will enable the controller to recognize on-time relative position of traffic under his control. The installation of the Bright Display Equipment is therefore recommended to realize practical use of radar information in the control tower.

ZONA DE CONTROL Y ZONA DE TRANSITO DE AERODROMO — LIMA - CALLAO/INT JORGE CHAVEZ

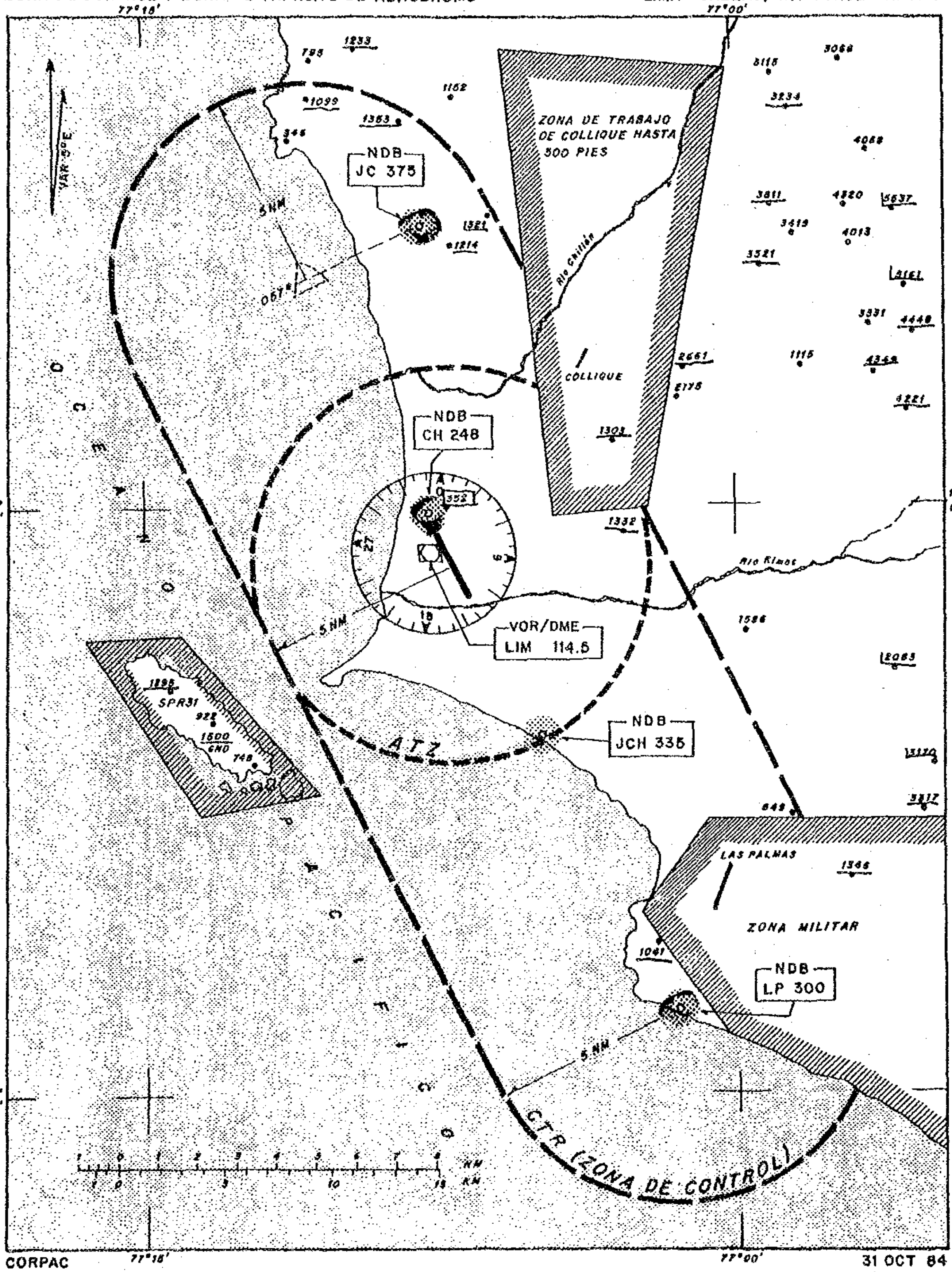


Table 7-3 CEILING and VISIBILITY

LIMA INTERNATIONAL AIRPORT

1981,82 and 84 (Total Obs. 26304)*

m / km	<30	>30	>60	>90	>120	>150	>180	>240	>300	>450	Ulmt	TTL
<0.4	16	1	2									19
>0.4	8		1									9
>0.5	6		3		1							10
>0.6			3	1								4
>0.7		1	3									4
>0.8	1	7	5	12	3	3						31
>1.2		2	17	15	9	1						44
>1.6			12	23	11	9	10	3				68
>2.4			4	12	33	17	42	11	10			129
>3.2				22	44	65	261	196	305	56		949
>8.0				9	29	57	336	573	4353	7087		12444
Ulmt											12593	12593
TTL	31	11	50	94	130	152	649	783	4668	7143	12593	26304

*Data for the year of 1983 are not included in this table as they are considered to be anomalous for unknown reasons.

INTERPRETATION

%VMC - 19680/26304.....................74.8%
%IMC - 6624/26304......................25.2%
%PVC - 320.................1.2%(4.8% of IMC)
Cat-I Coverage - 264.......1.0%(82.5% of PVC)
Cat-II Coverage - 286.......1.1%(89.4% of PVC)

Rmks: %VMC - Percentage of Visual Meteorological Condition. CIG 450m or more, VSBY 8km or more.

%IMC - Percentage of Instrument Meteorological Condition. CIG below 450m, VSBY below 8km.

%PVC - Percentage of Poor Visibility Condition. CIG below 150m and/or VSBY below 1.6km.

Cat-I Coverage - Percentage of adverse weather which may be relieved by CAT-I Precision Approach Aids.

CAT-II Coverage -Percentage of adverse weather which may be relieved by CAT-II Precision Approach Aids.

Table 7-4 CEILING and VISIBILITY
LIMA INTERNATIONAL AIRPORT
SUMMER SEASON (Dec-May)

m / km	<30	>30	>60	>90	>120	>150	>180	>240	>300	>450	Ulmt	TTL
<0.4	16	1	2									19
>0.4	8		1									9
>0.5	6		3		1							10
>0.6			3	1								4
>0.7		1	3									4
>0.8	1	7	5	12	3	3						31
>1.2		2	17	15	6	1						41
>1.6			11	22	6	4	4					47
>2.4			4	9	29	11	24	1	6			84
>3.2				20	37	59	159	87	102	11		475
>8.0				9	29	52	233	329	993	1295		2940
Ulmt											9464	9464
TTL	31	11	49	88	111	130	420	417	1001	1306	9464	13128

%VMC - 10759/13128......................82.0%
%IMC - 2369/13128......................18.0%
%PVC - 294...............2.24%(12.4% of IMC)
Cat-I Coverage - 238......1.8% (81.0% of PVC)
Cat-II Coverage - 260......2.0% (88.4% of PVC)

Table 7-5 CEILING and VISIBILITY
LIMA INTERNATIONAL AIRPORT
WINTER SEASON (Jun-Nov)

m / km	<30	>30	>60	>90	>120	>150	>180	>240	>300	>450	Ulmt	TTL
<0.4												
>0.4												
>0.5												
>0.6												
>0.7												
>0.8												
>1.2					3							3
>1.6			1	1	5	5	6	3				21
>2.4				3	4	6	18	10	4			45
>3.2				2	7	6	102	109	203	45		474
>8.0						5	103	244	3360	5792		9504
Ulmt											3129	3129
TTL			1	6	19	22	229	366	3567	5837	3129	13176

%VMC - 8921/13176................67.7%
%IMC - 4225/13176................32.3%
%PVC - 26..........0.2%(0.6% of IMC)
Cat-I Coverage - 26..............100%
Cat-II Coverage - 26..............100%

TABLE 7-6 AIRCRAFT MOVEMENT

LIMA INTERNATIONAL AIRPORT 1980-1984

year / TFC*	1980	1981	1982	1983	1984
IFR(ttl)	42110	42485	40371	49317	41774
(civil)	33505	33800	33901	34856	30991
(military)	8605	8685	6470	14461	10783
VFR(ttl)	6243	6303	5595	8713	8104
(civil)	3235	3337	2810	4423	4745
(military)	3008	2966	2785	4290	3359
A/D(ttl)	48353	48788	45966	58030	49878
(civil)	36740	37137	36711	39279	35736
(military)	11613	11651	9255	18751	14142
T and G	931	920	863	1330	1043
Grand TTL	49284	49708	46829	59360	50921

* IFR(ttl)-total number of IFR arrivals and departures
VFR(ttl)-total number of VFR arrivals and departures
A/D(ttl)-total number of arrivals and departures
T and G - total number of touch and go landings
Grand TTL-Total number of operations including T and G

TABLE 7-7 AIRCRAFT MOVEMENT STATISTICS

LIMA INTERNATIONAL AIRPORT 1980-1984

	1980	1981	1982	1983	1984	(Rmks)
Peak Day Tfc I+V	240	260	277	284	234	
IFR Peak Day Tfc	180	190	130	190	171	
VFR Peak Day Tfc	60	70	150	94	80	
Peak Day Avrg	215.0	212.3	184.0	240.8	206.5	Note-1
(I F R)	163,8	162.2	123.9	164.8	148.7	
(V F R)	51.2	50.1	60.1	76.1	57.8	
Peak Hour Trc I+V	35	37	38	42	34	
IFR Peak Hour Tfc	26	26	25	28	25	
VFR Peak Hour Trc	14	13	13	14	19	
Peak Hour Avrg	31.3	31.9	31.9	34.4	28.5	Note-2
(I F R)	21.3	21.8	22.0	22.9	19.3	
(V F R)	10.0	10.1	9.9	11.5	9.2	
Max Daily Demand	141.6	149.4	136.3	179.6	147.9	Note-3
Daily Demand Avrg	132.1	133.7	125.9	159.0	139.1	Note-4
(civil)	100.4	101.8	100.6	107.6	97.7	
(military)	31.7	31.9	25.3	51.4	38.6	
IFR-VFR Ratio	85:15	85:15	86:14	83:17	82:18	Avrg.84:16
(civil)	90:10	90:10	92:8	87:13	85:15	Avrg.89:11
(military)	65:35	66:34	57:43	70:30	69:31	Avrg.65:35
Civ-Mil Ratio	76:24	76:24	80:20	68:32	72:28	Avrg.74:26
(I F R)	80:20	80:20	84:16	71:29	74:26	Avrg.78:22
(V F R)	52:48	53:47	50:50	51:49	59:41	Avrg.53:47
% Arrival	50.1	49.9	49.9	49.8	50.4	Avrg.50%
% Civ IFR Tfc	68	68	72	59	61	Avrg.66%
% Civ VFR Tfc	7	7	6	8	9	Avrg. 7%
% Mil IFR Tfc	17	17	14	24	21	Avrg.19%
% Mil VFR Tfc	6	6	6	7	7	Avrg. 6%
% Touch & Go's	1.9	1.9	1.8	2.2	2.1	Avrg. 2%

Note-1-Average of peak day's traffic of every month.
Note-2-Average of peak hour's traffic of every month.
Note-3-Average daily demand of the busiest month.
Note-4-Average daily demand of the year.

APPENDIX 7-9 ADDITION OF DISTANCE MEASURING EQUIPMENT (DME)

1. Existing Ingress/Egress Fix to The TMA Lima

At present, Salinas VOR (SLS), 51 NM northwest of Lima is being used as ingress/egress fix to the TMA Lima, and also outer fix for approach to the Lima International Airport from the north and northeast. Eight air routes converge at SLS and minimum enroute altitude (MEA's) north of SLS are relatively high as shown in Fig. 7-5 due to lack of coverage at lower airspace. Inbound traffic via UG431, UL305 and UG426 have to maintain FL250 until reaching SLS while those coming in via other air routes, FL200. MEA's are too high for inbound aircraft to cross the outer fix located 51 NM north. Appropriate crossing altitude for inbound aircraft would be FL140 when considering flight distance between SLS and the approach gate (Siella Point -37 NM). Those situations can be said to be bottleneck in actual operation of ATC.

2. Implementation Plan

The CORPAC plans to install two additional VOR stations in the TMA Lima, one at Medio Mundo, approximately 35 NM north of Salinas VOR (SLS) and the other at Cenizal, approximately 10 NM southeast of SLS. The purpose of new VOR at Medio Mundo is to provide better coverage for traffic coming in from the north while the other one for traffic coming in from northeast. Lower MEA's for inbounds are expected and two more fixes would be made available, thus, the installation of new VOR's would serve in relieving traffic congestion.

3. Further Improvement

DME information a used together with the azimuth information of VOR is quite useful for both air navigation and ATC. Continuous information on exact position is given to the pilot and optional fixes are formed and utilized by ATC, for example, more than twenty DME fixed are established in TMA Lima (see Fig. 7-5). It is therefore recommended to add DME's to be co-located with VOR's which are to be installed in the near future. By doing this, expedited descent and more orderly flow of traffic can be attained.

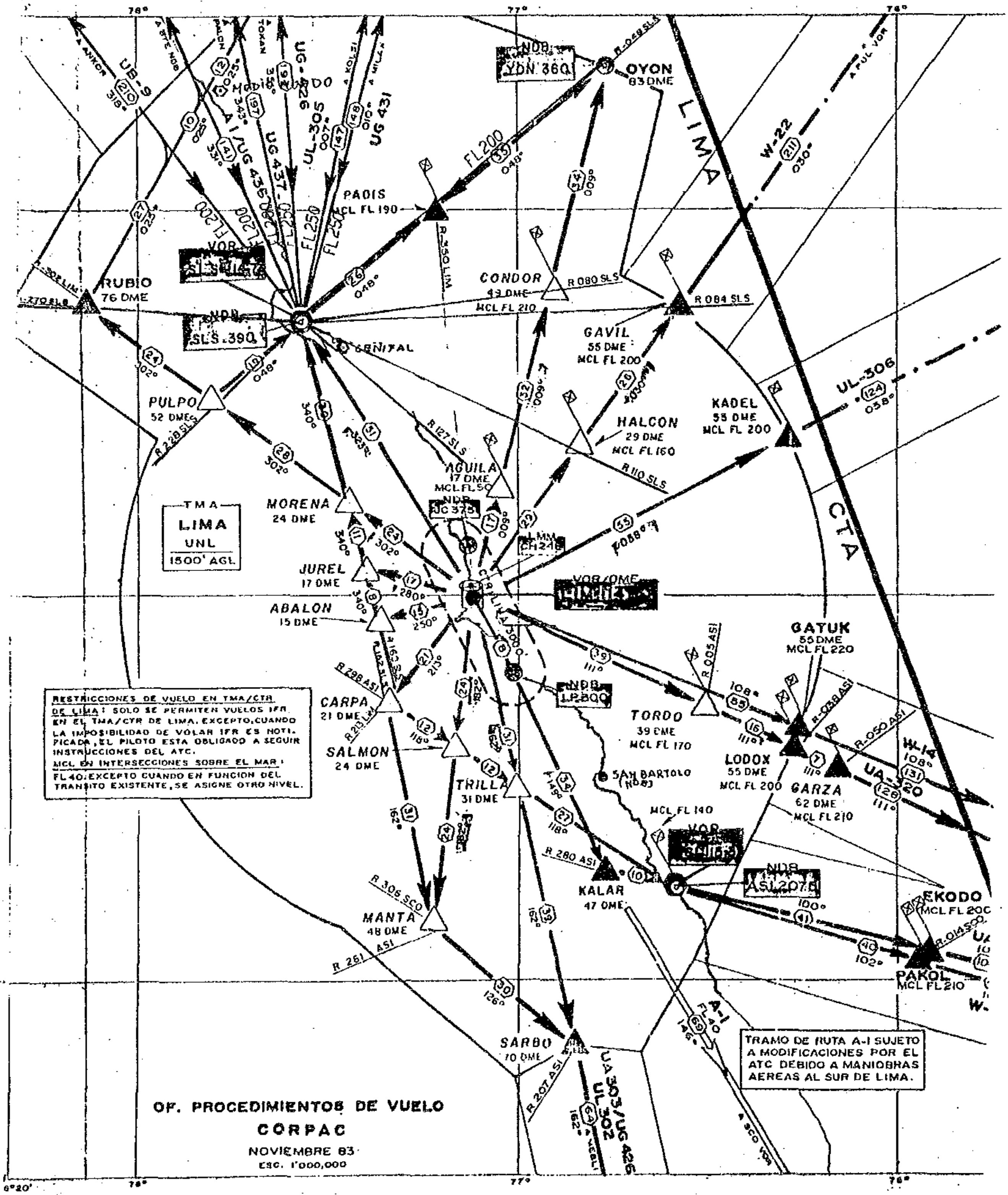

78°
77°
76°
6°20'
OYON
83 DME
LIMA
CTA
W-22
UL-306
UB-9
UG 431
UL-305
UG 437
PADIS
MCL FL 190
FL 200
FL 250
RUBIO
76 DME
CONDOR
43 DME
MCL FL 210
GAVIL
55 DME
MCL FL 200
KADEL
55 DME
MCL FL 200
HALCON
29 DME
MCL FL 160
PULPO
52 DME
AGUILA
17 DME
MCL FL 50
MORENA
24 DME
TMA
LIMA
UNL
1500' AGL
JUREL
17 DME
ABALON
15 DME
GATUK
55 DME
MCL FL 220
CARPA
21 DME
TORDO
39 DME
MCL FL 170
SALMON
24 DME
LODOX
55 DME
MCL FL 200
GARZA
62 DME
MCL FL 210
TRILLA
31 DME
SAN BARTOLO
KALAR
47 DME
EKODO
PAKOL
MCL FL 210
MANTA
48 DME
SARBO
10 DME
UA 303/UG 426
UL 302
A-1
FL 40
RESTRICCIONES DE VUELO EN TMA/CTR DE LIMA: SOLO SE PERMITEN VUELOS IFR EN EL TMA/CTR DE LIMA, EXCEPTO, CUANDO LA IMPOSIBILIDAD DE VOLAR IFR ES NOTIFICADA, EL PILOTO ESTA OBLIGADO A SEGUIR INSTRUCCIONES DEL ATC.
MCL EN INTERSECCIONES SOBRE EL MAR: FL 40, EXCEPTO CUANDO EN FUNCION DEL TRANSITO EXISTENTE, SE ASIGNE OTRO NIVEL.
TRAMO DE RUTA A-1 SUJETO A MODIFICACIONES POR EL ATC DEBIDO A MANIOBRAS AEREAS AL SUR DE LIMA.
OF. PROCEDIMIENTOS DE VUELO
CORPAC
NOVIEMBRE 83
ESC. 1'000,000

Fig. 7-5

APPENDIX 7-10 PRELIMINARY STUDY ON ILS APPROACH PROCEDURE LIMA INTERNATIONAL AIRPORT

1. General

Preliminary study on the Cat-II ILS approach procedure for the Lima International Airport has been made in accordance with the applicable portions of the ICAO criteria (PANS-OPS Doc 8161-OPS/611).

The purpose of this study is to identify firstly the known obstacles within the essential portion of the approach surfaces i.e., the precision segment including the final approach and initial/intermediate missed approach, and secondly, the area within which a complete survey should be made on all natural and man-made obstacles clarifying major obstacles beneath the approach and missed approach surfaces.

This study however does not intend to bind the actual establishment of the operational procedures of the airport for which the Peruvian Authority shall be responsible.

2. Assumptions

This study is based on the following assumptions:

2.1 Aerodrome Details

a)	ILS Runway Number	15*
b)	Direction of Runway	154 degree (True)
c)	Runway Dimension	3,507.5 m x 45 m
d)	Threshold Elevation	13.86 m (Runway 15)

* See Table 7 for wind data

2.2 ILS Parameters

a)	Glide Path Angle	3.0 degree
b)	LLZ-THR Distance	3,800 m**
c)	ILS Reference Datum	15 m***
d)	ILS Sector Width	210 m at THR

** Datum used to select OAS table

*** Height of an imaginary glide path directly over the runway threshold

2.3 Missed Approach

a)	Climb Gradient	2.5%
b)	Turning Point	at a specified point

2.4 Aircraft Parameters

a)	Aircraft Category	"D"
b)	Wheel Height	6 m or less*
c)	Wing Span	30 m or less Semi Span

* Vertical distance between the flight path of the wheels and glide path antenna.

2.5 Charting Accuracy

a) Chart used to plot ILS surfaces** — 1:10,000 and 1:100,000 topographical chart

** The actual height of plants and man-made obstacles in the vicinity of the airport as well as those on the surrounding hills are unknown.

3. Construction of Final and Missed Approach Segments

An approach procedure may have five separate segments. They are the arrival, initial, intermediate, final and missed approach segments. Only those segments which are required by local conditions need be implemented in the procedure.

The final approach segment should be identified first because it is the least flexible and most critical of all, and in the case of this study, the missed approach segment including initial and intermediate phases are of same significance as they have direct concern to the OCA/H calculation.

3.1 Precision Segment

a) Precision segment begins at final approach point (FAP)* and terminates at a turning point where the final phase of missed approach segment begins or where the missed approach surface "Z" reaches a height of 300 m above threshold level, whichever is lower.

b) Precision segment containes the final approach, the initial and intermediate phase of missed approach. (See Fig. 1)

* The final approach point (FAP) is an intersection of the nominal glide path and the minimum altitude specified for intermediate approach segment.

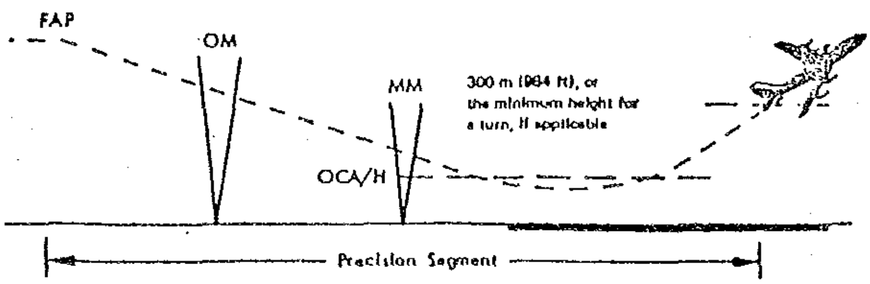


Fig. 1 Precision Segment

3.2 Fixes on Final Approach Track

a) Descent Fix

A descent fix may be located at the FAP. When so located, it becomes final approach fix (FAF) linking MOC in the intermediate approach segment smoothly with the precision surfaces.

b) Outer Marker (OM) Fix

An outer marker fix should be installed so as to permit comparison between the glide path indication and altimeter information.

c) DME Fix

The GP/DME may be used to identify the fixes. The maximum fix tolerance for OM fix and descent fixes are 0.9 km (0.5 NM).

3.3 Basic ILS Surfaces

a) The area required for precision segment is bounded overall by the basic ILS surfaces shown in Fig. 2. There is no restriction on object beneath the surfaces. Objects penetrate these surfaces must be either:

- minimum mass and frangible, or
- taken into account in the calculation of the OCA/H

Object which may be ignored in OCA/H calculation are listed in Table 1.

Table 1 Objects which may be ignored in OCA/H Calculation

	Max. Height above THR	Min. Distance from CLR*
GP antenna	17 m (55 ft)	120 m
ACFT taxiing	22 m (72 ft)	150 m
ACFT in holding bay or taxi holding position at a range between THR and -250 m	22 m (72 ft)	120 m

* Centre line of Runway

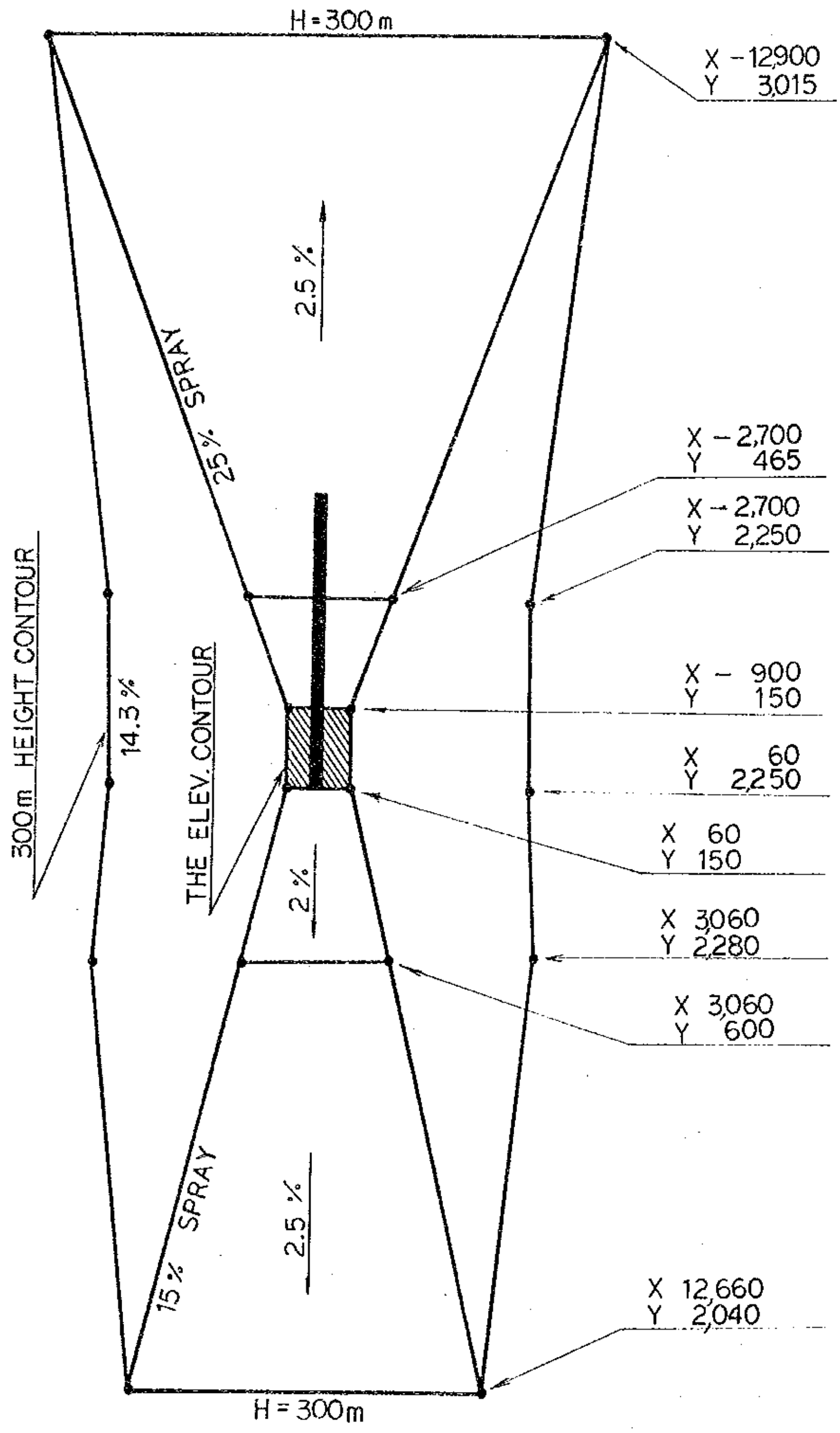


FIG. 2 BASIC ILS SURFACES

b) If the basic ILS surfaces are penetrated by objects other than those tabulated in Table 1, the OCA/H may calculated directly by applying height loss/altimeter margins (Table 2) to obstacles. Alternatively, the Obstacle Assessment Surface (OAS) criteria must be applied.

Table 2 Height Loss/Altimeter Margin (Aircraft Category "D")

Aircraft Speed (Vat)	Margin Using* Radio Altimeter		Margin Using Pressure Altimeter	
	Metres	Feet	Metres	Feet
165 kt	26	85	49	161

Note: In this study, points on the ILS surfaces and positions of obstacles are indicated in relation to the centre point of runway 15 threshold and in the form of x, y co-ordinates as shown in Fig. 3.

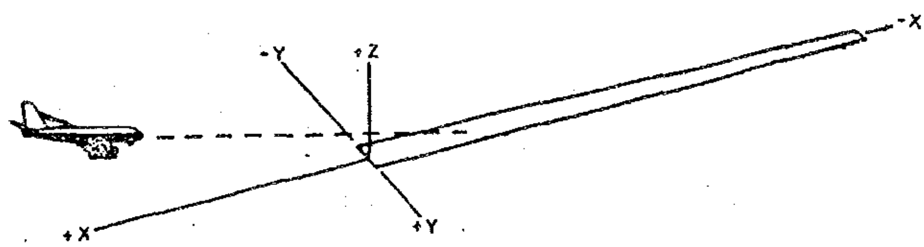


Fig. 3 System of X, Y Co-ordinates

3.4 Obstacles Outside the Airport

The basic ILS surface plotted on 1:100,000 topographic map is shown in Fig. 4. Major obstacles found on the map are:

A. Peak of a hill approximately 1.7 km north of the airport, elevation 112.2 m, co-ordinates x=1,585 y=910.

B. Peak of a hill approximately 6.8 km southeast of the airport, elevation 87.7 m, co-ordinates x=6,830 y=960.

Comparison between the height of obstacles above runway threshold level and the height of ILS surfaces are shown in the following table. As far as Obstacle A and B are concerned, there will be no restriction assuming that any plant and/or man-made object on peak A is no higher than 8.37 m above the ground, and for peak B, no higher than 74.41 m.

Table 3 Height of Basic ILS Surfaces at the Position of Major Obstacles Outside the Airport

Obstacle	Obs. height M.L.S.	Obs. height above THR	Basic ILS surface	Penetration YES/NO
A	112.2	98.34	106.47	NO*
B	87.7	73.84	170.75	NO**

* Provided no plant/man-made objects exceeds 8.37 m AGL

** Provided no plant/man-made objects exceeds 74.41 m AGL

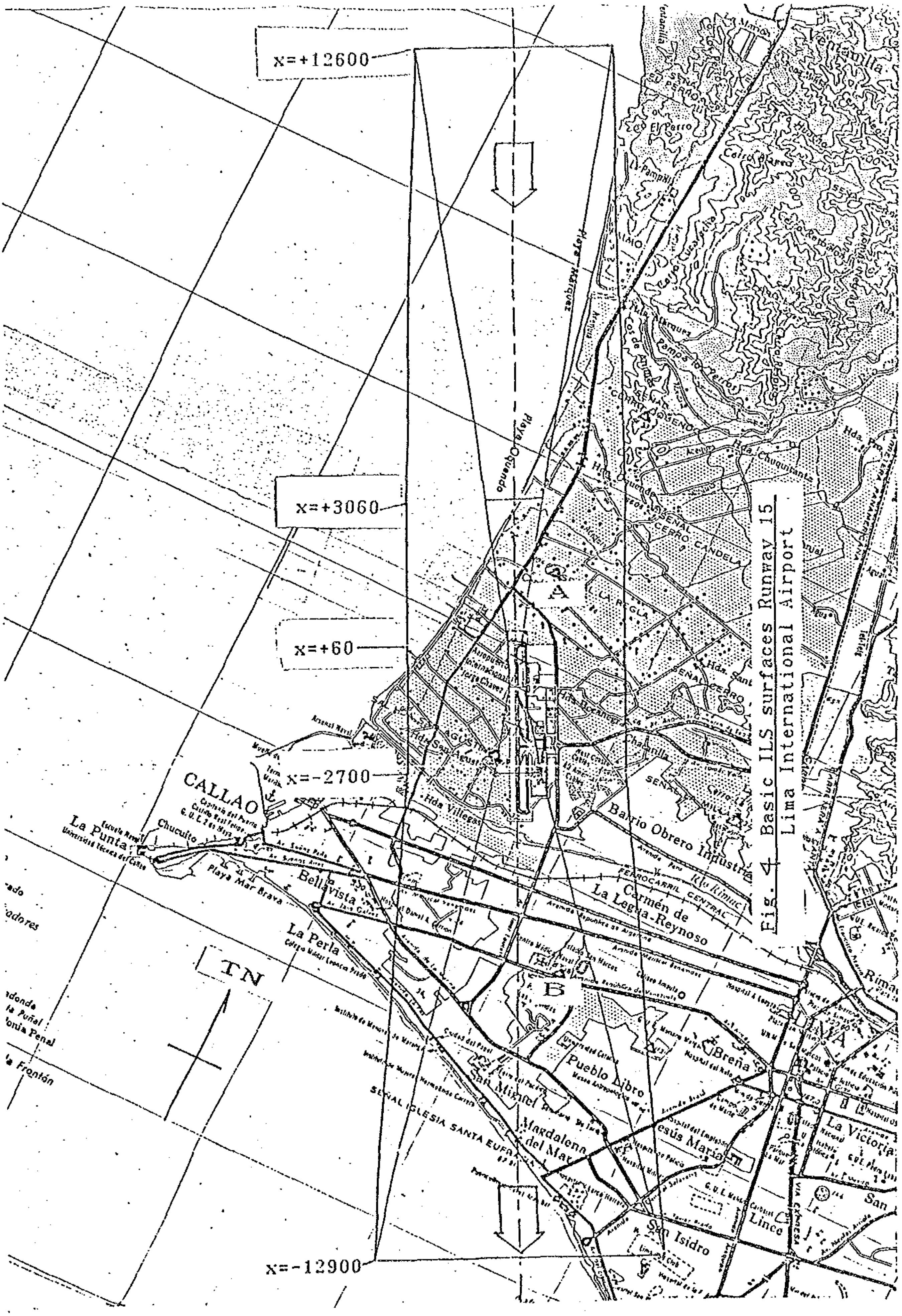


Fig. 4 Basic ILS surfaces Runway 15
Lima International Airport

3.5 Obstacles within Airport

The obstacles within the airport is plotted on 1:10,000 topographical map (see Fig. 5). The heights of obstacles are related to runway 15 threshold level. The comparison between the basic ILS surfaces and the height of obstacles above the threshold are shown in Table 4.

Obstacle 1 (aerodrom control tower) penetrates the ILS surface by 16.2 m, Obstacle 9, by 3.6 m and Obstacle 10, by 2.6 m. Obstacles 9 and 10 are both lighting poles.

Table 4 Heights of Obstacles within Airport

Obstacle	Obs. height M.L.S.	Obs. height above THR	Basic ILS surface	Penetration YES/NO
1	87.3	73.7	57.1	YES
2	41.8	27.8	65.1	NO
3	41.7	27.7	62.5	NO
4	40.7	26.7	60.5	NO
5	39.7	25.7	57.8	NO
6	44.0	30.0	56.9	NO
7	41.3	27.3	50.5	NO
8	45.5	31.5	46.8	NO
9	54.2	40.2	36.6	YES
10	53.2	39.2	36.6	YES
11	48.9	34.9	39.1	NO
12	31.6	17.6	21.9	NO
13	43.6	29.6	30.6	NO
14	26.6	12.6	17.2	NO
15	31.0	17.0	21.5	NO
16	23.3	9.3	14.8	NO
17	33.9	19.5	31.2	NO
18	26.0	12.0	16.3	NO

Note: Ground level (presumed) is added onto the height of obstacle above ground.

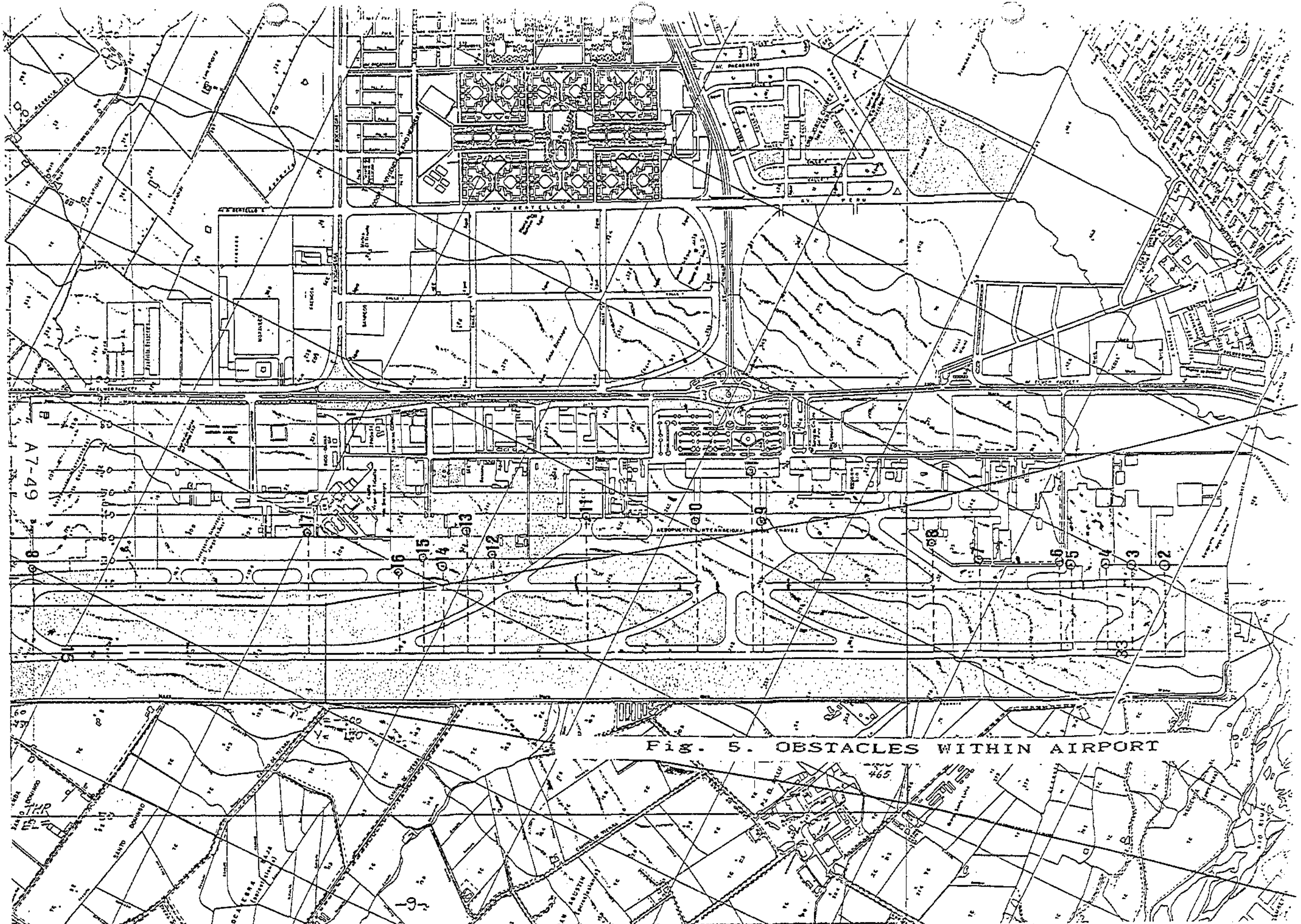


Fig. 5. OBSTACLES WITHIN AIRPORT

4. Obstacle Assessment Surface (OAS)

a) The dimensions of the OAS are related to the ILS geometry (LLZ-THR distance, GP angle), and the Category of ILS operation. Additional materials are included in the ICAO criteria to enable appropriate authority to assess realistic benefits for claims of improved performance and associated conditions. For example, the missed approach climb gradient of more than 2.5% may be applied.

b) It should be noted that the OAS are not intended to replace basic ILS surfaces as planning surfaces for unrestricted growth of obstacle. The obstacle density between the basic surfaces and OAS must be accounted for.

c) OAS template coordinates and OAS constants applicable to Cat. II operation are shown in Table 5. (See also Fig. 6 and 7).

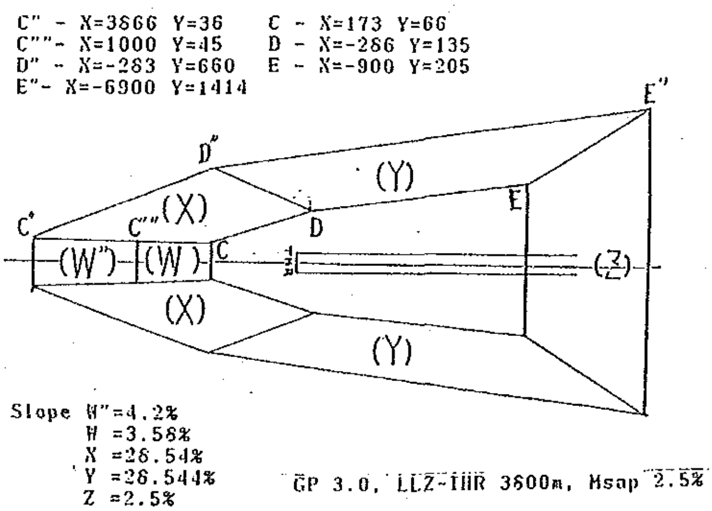


Fig. 6 OAS (Cat. II with Autopilot)

Table 5. OAS coordinates and constants

(GP 3.00 LLZ/THR dist 3800)

OAS TEMPLATE COORDINATE CAT II			
THRESHOLD ELEVATION			
	X	Y	
C	173	66	3-1
D	-286	135	
E 3%	-900	198	
E 2.5%	-900	205	
150m HEIGHT			
	X	Y	
C"	4362	65	
D"3%	2576	334	3-2
E"	-5900	1203	
D"2.5%	2576	334	
E"	-6900	1414	
CAT II AUTOPILOT			
	X	Y	
C"	3866	36	
C""	1000	45	
D"3%	399	557	3-3
E"	-5900	1203	
D"2.5%	-283	660	
E"	-6900	1414	

NOTE: C"" *coordinates apply to template at 29.6m height.*

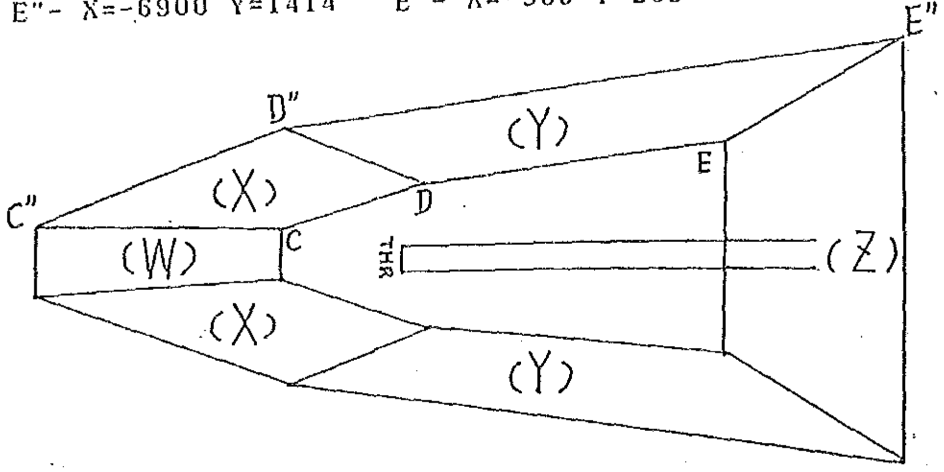
OAS CONSTANTS CAT II				
	A	B	C	
W	.035800	.000000	-6.19	
X	.035823	.238300	-21.93	
Y 3%	.031227	.304338	-32.15	3-4
Z	-.030000	.000000	-27.00	
Y2.5%	.032542	.285440	-29.23	
Z	-.025000	.000000	-22.50	
CAT II AUTOPILOT				
	A	B	C	
W	.035800	.000000	-6.19	
W*	.042000	.000000	-12.39	
X	.042903	.285400	-26.26	3-5
Y 3%	.031227	.304338	-32.15	
Z	-.030000	.000000	-27.00	
Y2.5%	.032542	.285440	-29.23	
Z	-.025000	.000000	-22.50	

NOTE:
3-1,3-2 and 3-4 apply to Cat II operation without autopilot.
3-1,3-3 and 3-5 apply to Cat II operation with autopilot.

Fig. 7 OAS (Cat. II without Autopilot)

C" - X=4362 Y=65
D" - X=2576 Y=334
E" - X=-6900 Y=1414

C - X=173 Y=66
D - X=-286 Y=135
E - X=-900 Y=205



Slope W=3.58%
X=23.83%
Y=28.544%
Z=2.5%

GP 3.0, LLZ-THR 3800m, Msap 2.5%

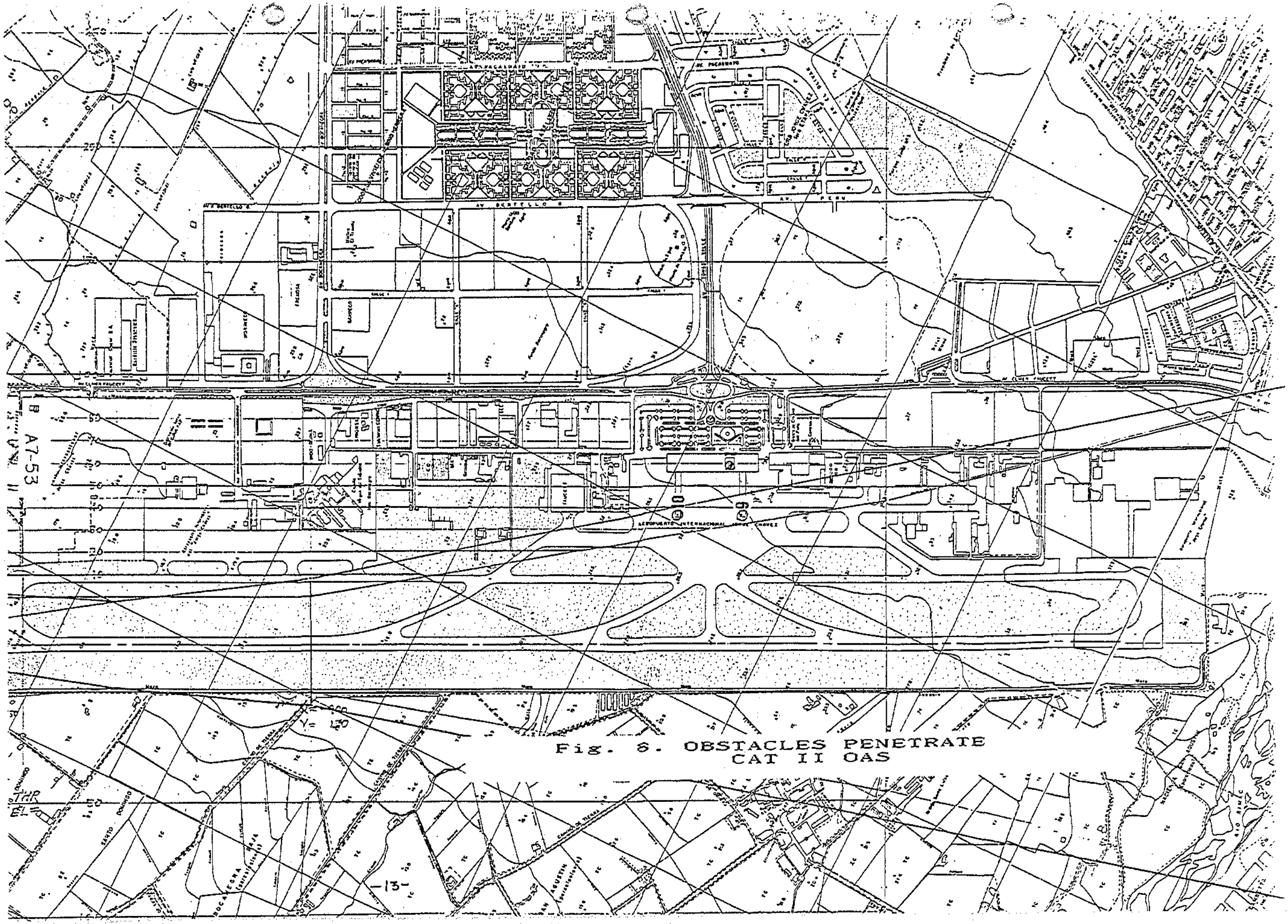


Fig. 8. OBSTACLES PENETRATE CAT II OAS

d) Obstacle within Airport

For Obstacle 1, 9 and 10, cross-reference is made to Cat. II OAS (Fig. 7). Those obstacles still penetrate the ILS surfaces. (See Table 6 and Fig. 8).

Table 6 Height of Major Obstacles within Airport

Obstacle	Obs. height above THR	Cat. II surface	Penetration
1	73.7	55.51	YES
9	40.2	33.68	YES
10	39.2	28.62	YES

5. Recommendation

a) Obstacle Survey

A complete survey on the obstacles within the area in question is needed to enable further detail study on Cat. II ILS approach procedures.

b) Remaining portions of ILS approach segment should also be studied in accordance with the ICAO criteria, Doc, 8168-OPS/611 Vol. II Second Edition which was revised completely in 1982.

c) Re-construction of Non-precision Approach

Other types of approach procedure i.e., VOR, ADF, etc., should also be re-constructed in accordance with the ICAO criteria as well.

d) Landing Minimums

Minimums for each approach procedure should be promulgated in the form of OCA/H for each type of aircraft.

Table 7 Wind Direction and Velocity

Lima International Airport

Frequency of Wind Direction and Velocity (Hourly Obs. 1981-1984)

	5-10 kt	11-13 kt	14-20 kt	Over 20 kt	Freq.	Percentage
N	14	-	-	-	14	-
NNE	14	-	-	-	14	-
NE	11	-	-	-	11	-
ENE	30	-	-	-	30	0.1
E	9	3	-	-	12	-
ESE	102	-	-	-	102	0.3
SE	843	187	49	-	1,079	3.1
SSE	5,743	2,146	1,323	12	9,224	26.3
S	9,580	2,066	1,292	19	12,957	37.0
SSW	1,510	149	54	-	1,713	4.9
SW	465	43	6	-	514	1.5
WSW	980	59	9	-	1,048	3.0
W	1,145	43	4	-	1,192	3.4
WNW	723	18	3	-	744	2.1
NW	125	2	2	-	129	0.4
NNW	136	-	-	-	136	0.4
Subtotal	21,430	4,716	2,742	31	28,919	
%	61.1	13.5	7.8	0.1		82.5
Calm					6,145	17.5
Total					35,064	100.0

Remarks: Calm = 4 kt or less