REPUBLIC OF INDONESIA

FEASIBILITY STUDY FOR THE PADANG AIRPORT DEVELOPMENT

FINAL REPORT

APPENDIX

JANUARY 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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APPENDIX

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JAPAN INTERNATIONAL COOPERATION AGENCY

LIST OF APPENDICES

APPENDIX TO CHAPTER 1

APPENDIX 1.4.1 LIST OF INDONESIAN COUNTERPART TEAM

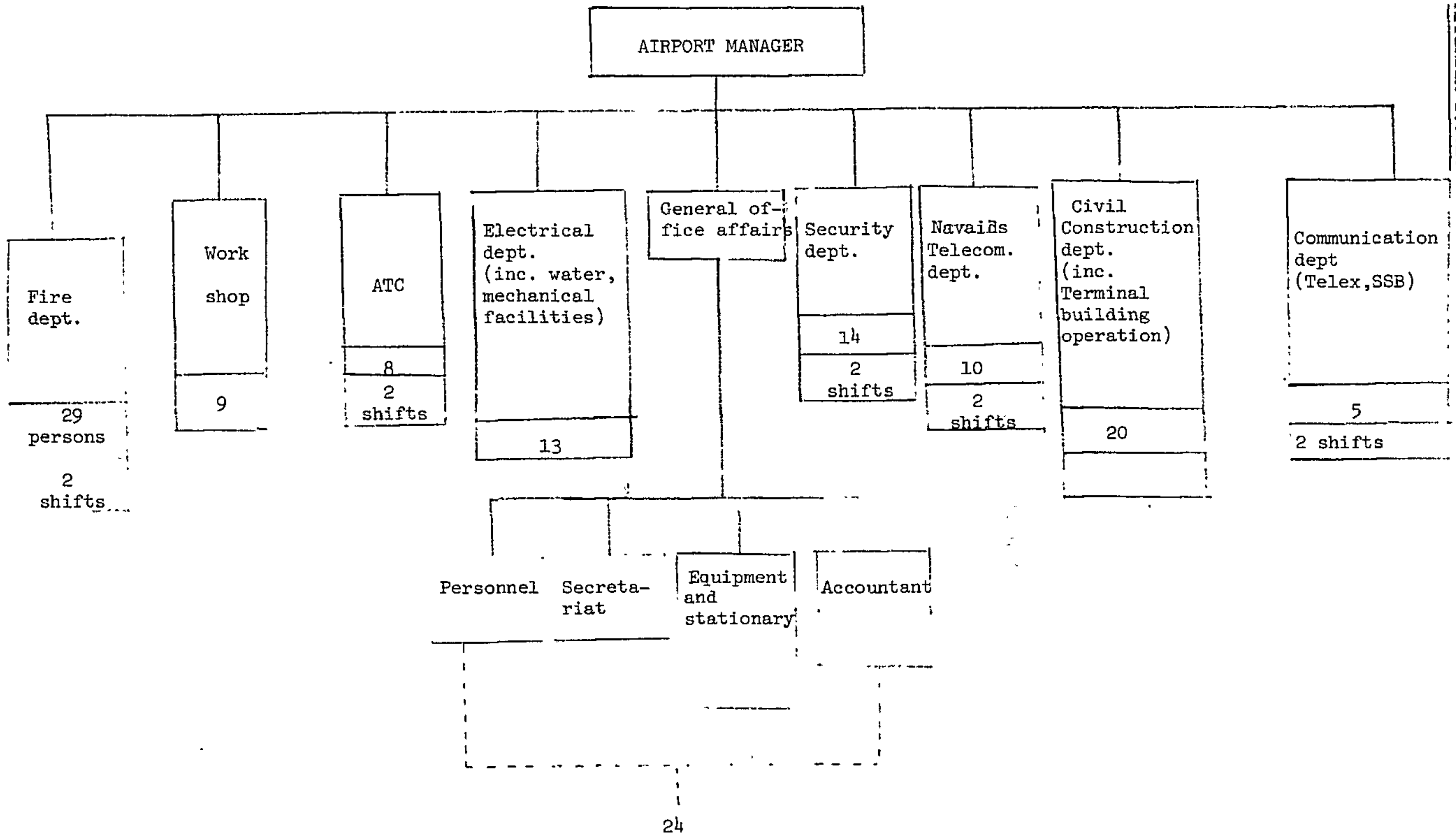
Mr. F.X. Margono	Head of Sub-Directorate of Airport Classification, Directrate of Airport Engineering	Chairman
Mr. Muchtar	Staff of Planning Branch	Secretary
Mr. Baroto	Staff of National Development Planning Agency	Member
Mr. Soekardi	Staff of Directorate General of Budgeting Department of Finance	Member
Mr. Suwardi	Staff of Planning Branch	Member
Mr. Martono	Head of Airport Terminal Planning Section, Directorate of Airport Engineering	Member
Mr. Bambang Tjahjono	Staff of Directorate of Airport Engineering	Member
Mr. A.T.E. Liando	Head of Sub-Directorate of Airways Operations	Member
Mr. Madijono	Head of Sub-Directorate of Flying Operations. Directorate of Aviation Safety	Member
Mr. Hadi Rachim	Head of Telecommunications, Navigation & Electrical Workshop Section	Member
Mr. Muchtar Usman	Head of Sub-Directorate of Domestic Air Transport.	Member
Mr. Djoko Suhadi	Head of Programming Division Aviation Research & Development Centre	Member
Mr. Bachtiar Motan	Staff of Planning Branch, Department of Communications	Member
Mr. Basuki	Staff Member of Indonesian Air Force	Member

APPENDIX 1.4.1 LIST OF JAPANESE STUDY TEAM

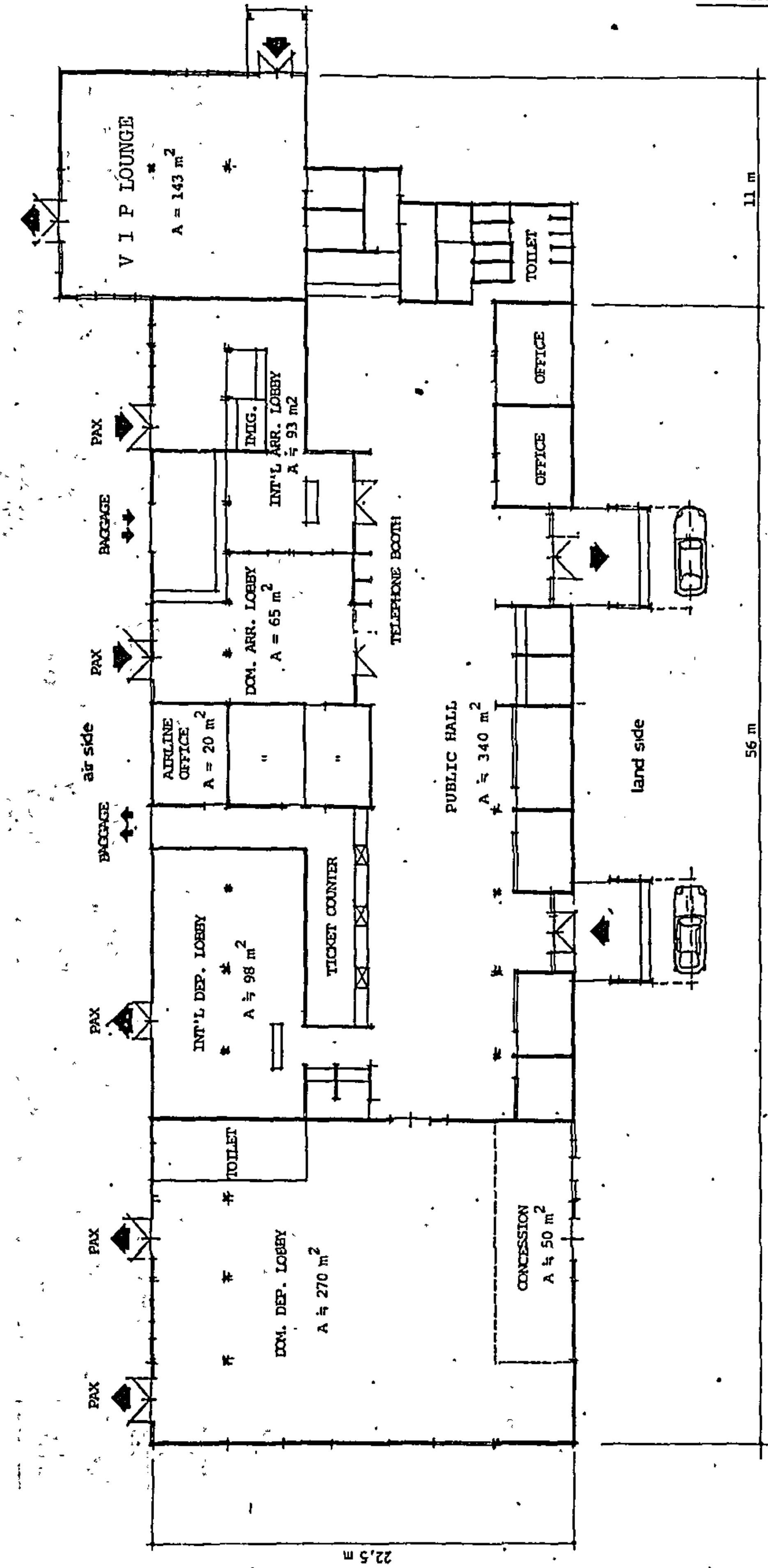
Mr. Tetsuya Shiraishi	Project Manager
Mr. Shota Morita	Deputy Project Manager/Airport Planning
Mr. Tadamitsu Itoh	Aircraft Operations and Navaids Planning
Mr. Hideki Murata	Airport Construction Planning
Mr. Takashi Miyawaki	Traffic Forecast and Economic/ Financial Analysis
Mr. Keiichi Takeda	Airport Planning (Utilities)
Mr. Kimihiro Maeta	Airport Planning (Civil)

APPENDIX TO CHAPTER 2

APPENDIX 2.3.1.



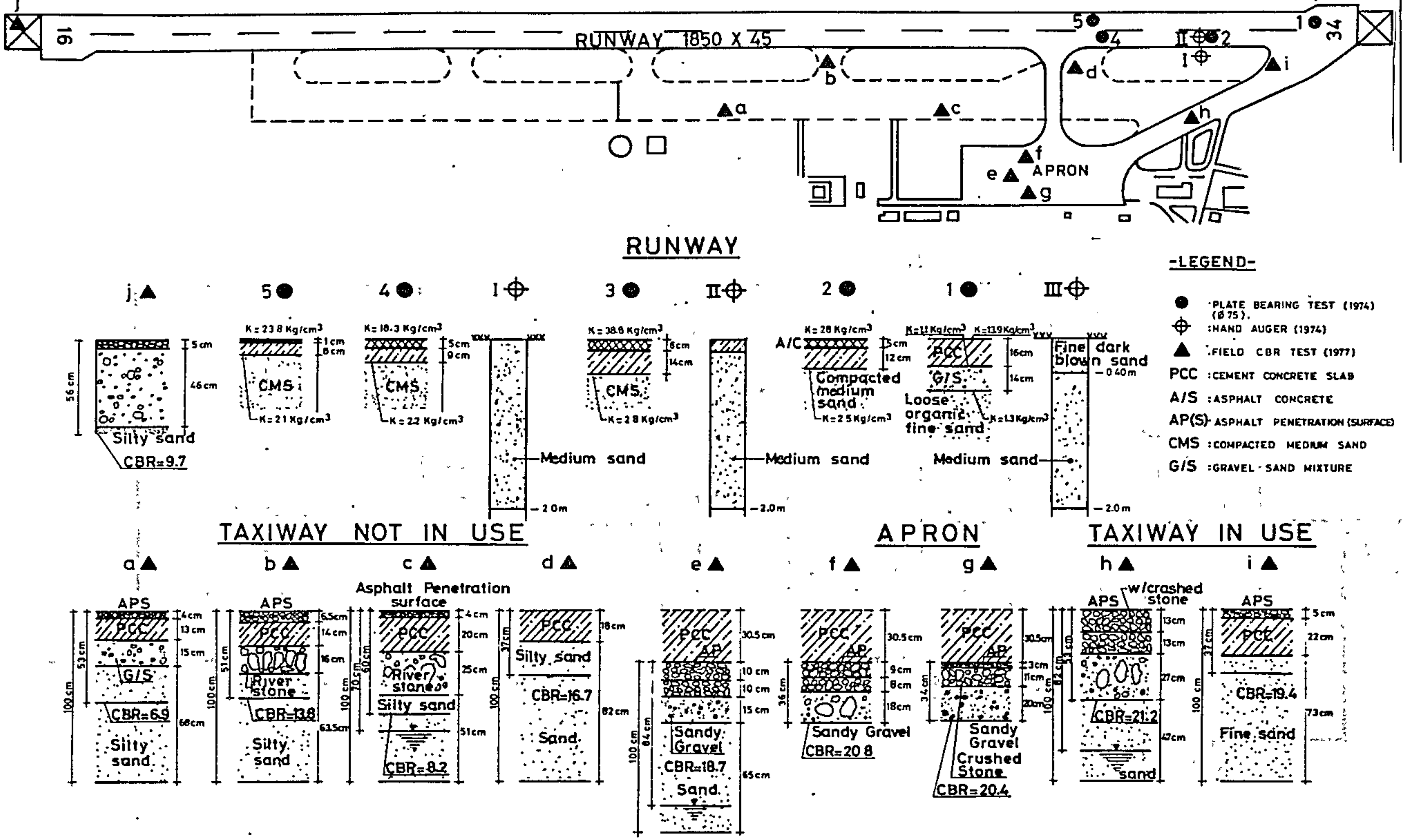
APPENDIX 2.3.1. ORGANIZATION CHART OF TABING AIRPORT



APPENDIX 2.3.2. PASSENGER TERMINAL BUILDING LAYOUT

APPENDIX 2.3.3.

SOURCE : LAPORAN PENYELIDIKAN PLATE BEARING TEST TABING AIRPORT, 1974 DAN PENELITIAN PENDATAAN UNTUK PEKERJAAN KONSTRUKSI PERANCANGAN TABING AIRPORT (1977)



APPENDIX 2.3.3 THE RESULTS OF THE PAST SOIL INVESTIGATIONS

APPENDIX 2.3.4. TABING AIRPORT - CONSTRUCTION HISTORY

1. 1969/1970 ;
   a. Temporary Apron Construction; 1975 M^2 (Area A), Sand & Crushed Stone/Gravel.

2. 1970/1971 :
   a. Temporary Apron Construction (Area B), Sand & Crushed Stone/Gravel.

3. 1971/1972 :
   a. Apron Expansion; 4300 M^2 (Area C & D), 100 + 150 cm Compacted Sand
      34 Cm. Compacted Local Material.
   b. Runway Construction; 200 M x 45 M.
      Constr: 30 Cm. Compacted Sand
      34 Cm. Compacted Local Material
      30,5 Cm. PC Concrete

4. 1972/1973 :
   a. Apron Expansion; 60 M x 66,5 M (Area E), 100+150 Cm. Compacted Sand
      34 Cm. Compacted Local Material.
   b. Runway Construction; 100 M x 45 M.
      Constr. : 30 Cm. Compacted Sand
      34 Cm. Compacted Local Material
      30,5 Cm. PC Concrete
   c. Runway Construction: 405 M x 45 M.
      Constr. : 30 Cm. Compacted Sand
      34 Cm. Compacted Local Material
      30.5 Cm. PC Concrete
   d. Taxiway Rehabilitation (be used for Temporary Runway); 1450 M x 30 M. plus Overrun, 2 x (100 M x 30 M).

5. 1973/1974 :
   a. Runway Construction ; 795 M x 45 M
      Constr. ; See 4 c)
   b. Leveling of Runway Edge ; 2x(1200 M x 7,5 M)
   c. Overrun Construction ; 2x(60 M x 45 M)
   d. Shoulder Work : 2x ((60 M + 160 M) x 52,5M)

6. 1974/1975 :
   a. Runway Construction : (300 M x 45 M)
      Constr. ; See 4 c)
   b. Extension Runway Construction; 50 M x 45 M
      Constr. ; See 4c)
   c. Turning Point Construction; 2 x 900 M^2
      Constr. ; See 4c)
   d. Leveling of Runway Edge; 2x(300 M x 7,5 M)

e. Shoulder Work ; 50 M x 52,5 M

7. 1975/1976 : a. Fillet Expansion ; 4800 M^2
Constr.: 70 Cm Compacted Soil
10 Cm Compacted Sand
20 Cm Paklaag (Large Size Crushed Stones)
20 Cm Aggregate Base
6 Cm Asph.Penetration

b. Overlayed Taxiway ; 800 M x 20 M , t= 3 in. with Asphalt Penetration.

c. Taxiway Rehabilitation & Reconstruction : 1000 M^2
Constr.: 50 Cm Compacted Soil
10 Cm Compacted Sand
20 Cm Paklaag
20 Cm Aggregate Base
2 Cm Seal Coating

d. Leveling of Fillets ; 4600 M^2 with Asphalt Penetration, t= 7,5 Cm

e. Subgrade Work, filling & compacting; 2497 M^2 prepared for Apron Expansion.
Constr.; 150 Cm Compacted Soil
30 Cm Aggregate Base
2 Cm Seal Coating

8. 1976/1977 : a. Apron Surface Construction with PC Concrete Area D & E ; 7000 M^2

b. Preparing Apron Expansion ; 3114 M^2
Constr.; See 7 e)

9. 1977/1978 : a. Taxiway Reconstruction ; 6500 M^2
Constr. ; See 7 a)

b. Preparing Apron Expansion ; 4500 M^2
Constr. ; See 7 e)

c. Apron Surface Construction with PC Concrete Area F & G ; 5600 M^2

d. Apron Edge, Filling & Compacting; 5000 M^2

10. 1978/1979 : a. Apron Surface Construction with PC Concrete Area H ; 3775 M^2

11. 1979/1980 :

APPENDIX TO CHAPTER 3

APPENDIX 3.4.2 AIR TRAFFIC DEMAND FORECAST

Air traffic demand projections at Padang were derived from the projected air traffic volume at the national level by utilizing the elasticity of an economic variable at West Sumatra (or Padang) with respect to the corresponding national variable.

If X_{WS} is a socio-economic variable of West Sumatra (or at Padang if it is available) and X_{INE} is the corresponding national socio-economic varialbe then. Elasticity e_X of X_{WS} with respect to X_{INE} is defined as

$$e_X = \left(\frac{d\,X_{WS}}{X_{WS}}\right) / \left(\frac{d\,X_{INE}}{X_{INE}}\right)$$

For various economic variables, this number based on the statistics in the past decade was estimated: resulting in a distribution mostly between 1.0 and 1.6. The conceptual distribution based on a subjective judgement is shown in Figure A3.4.1. This reflects the fast growth tendency in West Sumatra. While this tendency may somewhat decelerate in the coming decades, it is expected to still continue at a relatively high level. Hence for the projection of air traffic at Padang, the distribution of e_X is assumed to be as shown in Figure A3.4.1. Based on this, the medium projections for air traffic at Padang were made based on the growth rates which are 1.2 times (or 20 percent higher than) the projected national traffic growth rates; the low projections 1.0 times the national growth rates; and the high projections 1.4 times (or 40 percent higher than) the national growth rates.

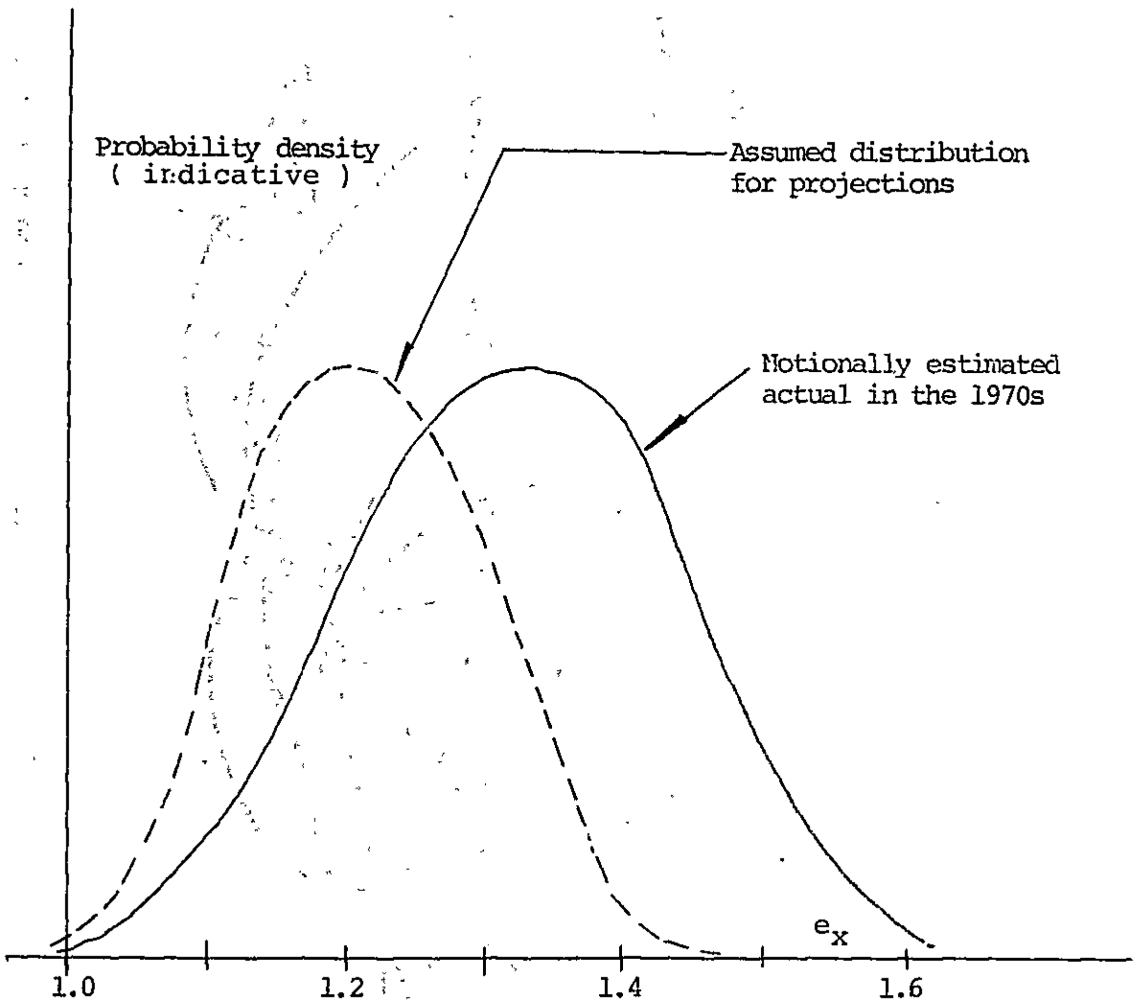
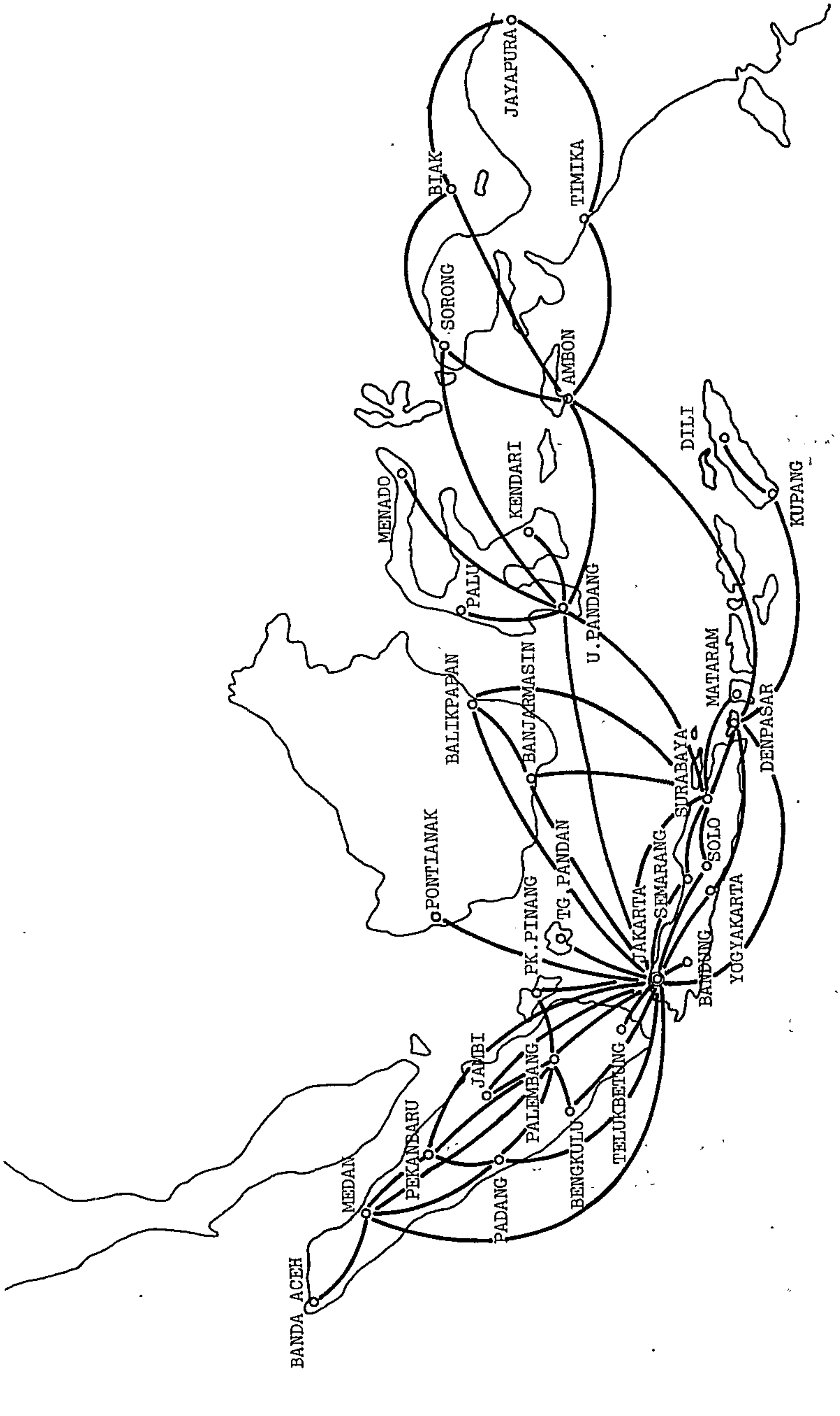
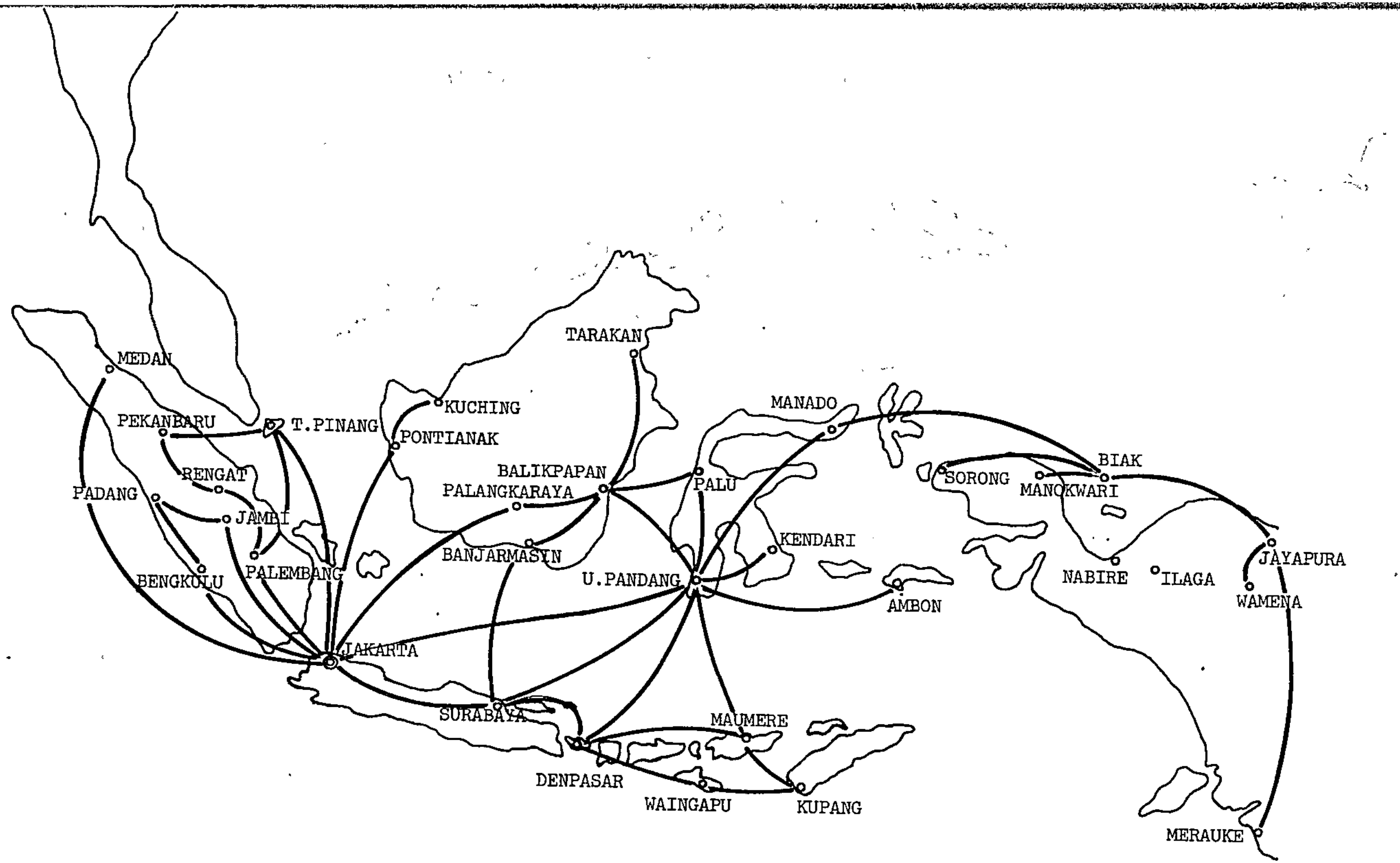


Figure A3.4.1 DISTRIBUTION OF ELASTICITY OF VARIOUS ECONOMIC VARIABLES FOR WEST SUMATRA WITH RESPECT TO ALL OF INDONESIA

APPENDIX 3.5.1.

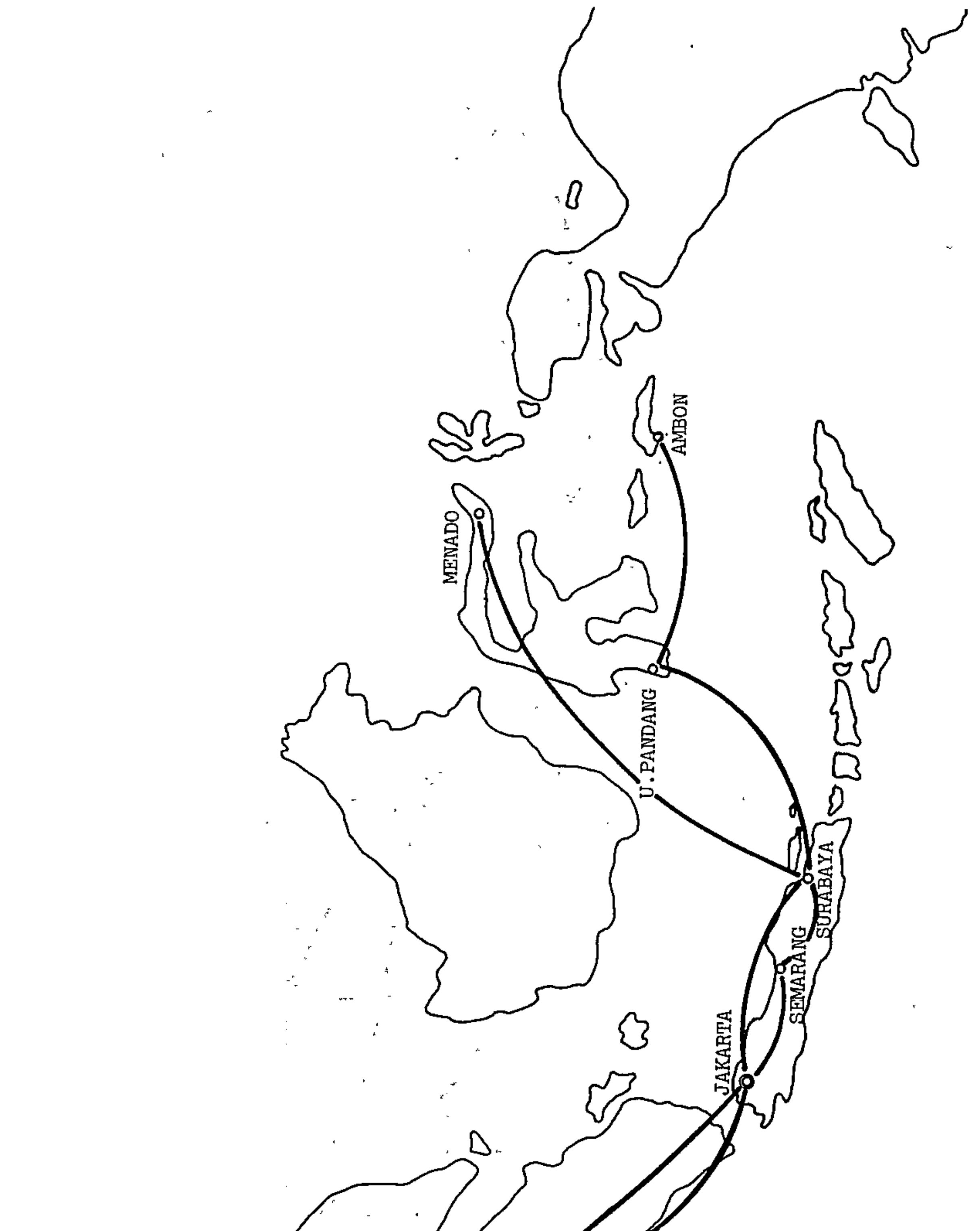


APPENDIX 3.5.1 PRESENT AIR ROUTE NETWORK (GARUDA)



APPENDIX 3.5.2 PRESENT AIR ROUTE NETWORK (MERPATI)

APPENDIX 3.5.3.



APPENDIX 3.5.3 PRESENT AIR ROUTE NETWORK (MANDALA)

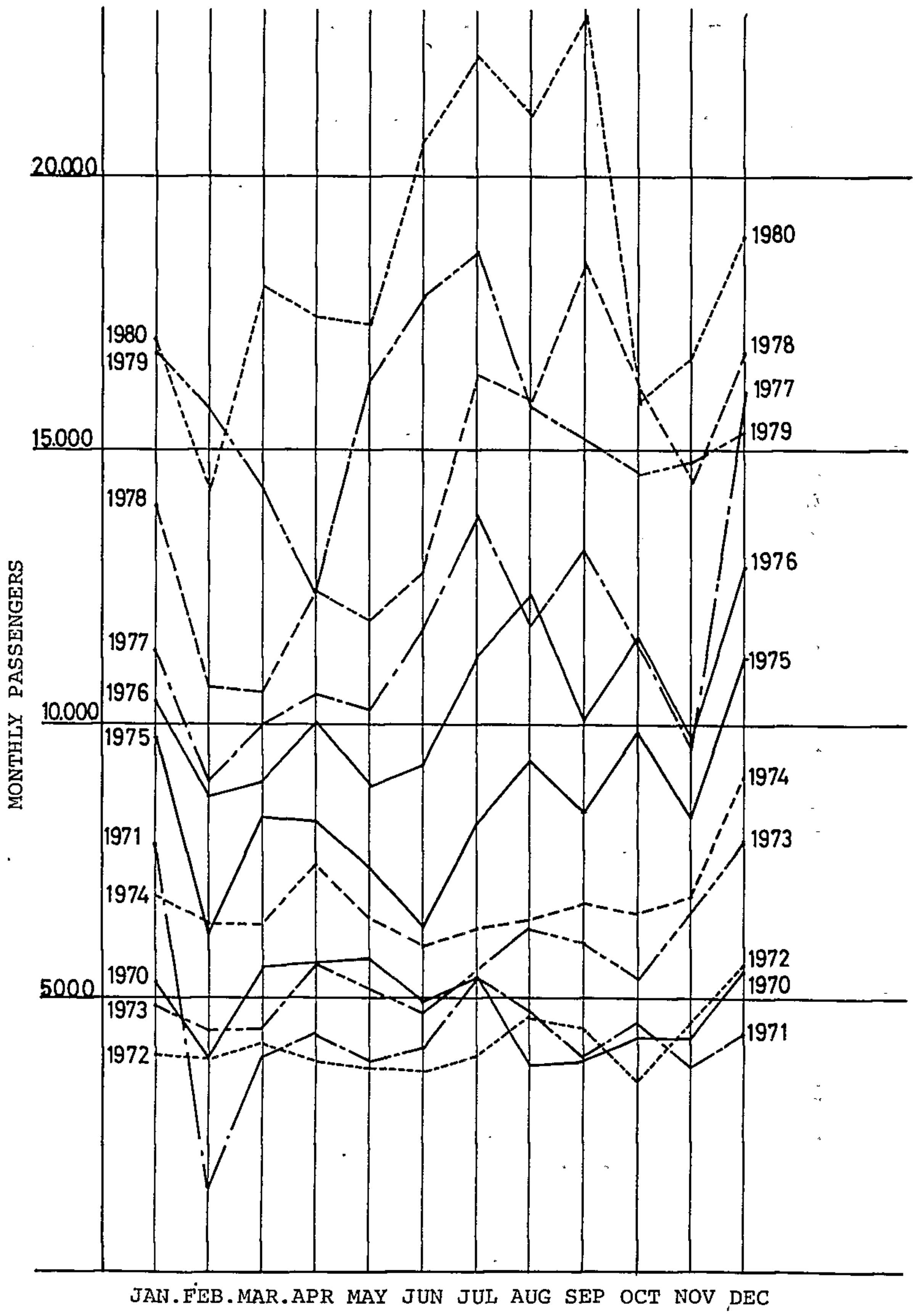
APPENDIX 3.5.4 : ANNUAL PASSENGER DISTRIBUTION BY ROUTE

Route \ Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Ave
PDG - JKT	18908 / 59.6%	23482 / 61.5%	28592 / 71.6%	36726 / N.A	51974 / 64.3%	67684 / 67.1%	84631 / 67 7%	102404 / 72.5%	84401 / N.A	N.A / N.A	158792 / 71.4%	67.0%
- MES	4660 / 14.7%	6370 / 16.7%	6853 / 17.2%	11734 / N.A	15248 / 18.9%	16707 / 16.6%	19262 / 15.4%	22546 / 16.0%	14502 / N.A	N.A / N.A	34774 / 15.6%	16.4%
- PKU	1436 / 4.5%	1463 / 3.8%	1127 / 2.8%	5894 / N.A	6748 / 8.4%	9310 / 9.2%	11347 / 9.1%	10870 / 7.7%	6568 / N.A	N.A / N.A	14473 / 6.5%	6.5%
- PLM	4460 / 14.1%	5212 / 13.7%	3375 / 8.4%	N.A / N.A	6806 / 8.4%	7139 / 7.1%	9742 / 7,8%	5412 / 3.8%	N.A / N.A	N.A / N.A	12906 / 5.8%	8.6%
OTHERS	2277 / 7.1%	1649 / 4.3%	0 / 0%	25 / N.A	0 / 0%	0 / 0%	0 / 0%	29 / 0%	N.A / N.A	N.A / N.A	1377 / 0.7%	1.5%
TOTAL	31741 / 100%	38176 / 100%	39947 / 100%	N.A / 100%	80776 / 100%	100840 / 100%	124982 / 100%	141261 / 100%	N.A / 100%	N.A / 100%	222322 / 100%	100%

SOURCE : AIR TRANSPORT STATISTICS ; BIRO PUSAT STATISTIK

NOTE :
1. As for total annual passengers, refer to APPENDIX 3.5.6.
(Total annual passengers in this Table do not meet APPENDIX 3.5.6.
2. The figures in the upper and the lower triangles indicate annual passengers of route and share to total annual passengers respectively.
3. N.A : Not Available.

APPENDIX 3.5.5.



APPENDIX 3.5.5 MONTHLY VARIATIONS IN NUMBER OF AIR PASSENGERS BETWEEN 1970 AND 1980

APPENDIX 3.5.6 PEAK MONTH CHARACTERISTIC

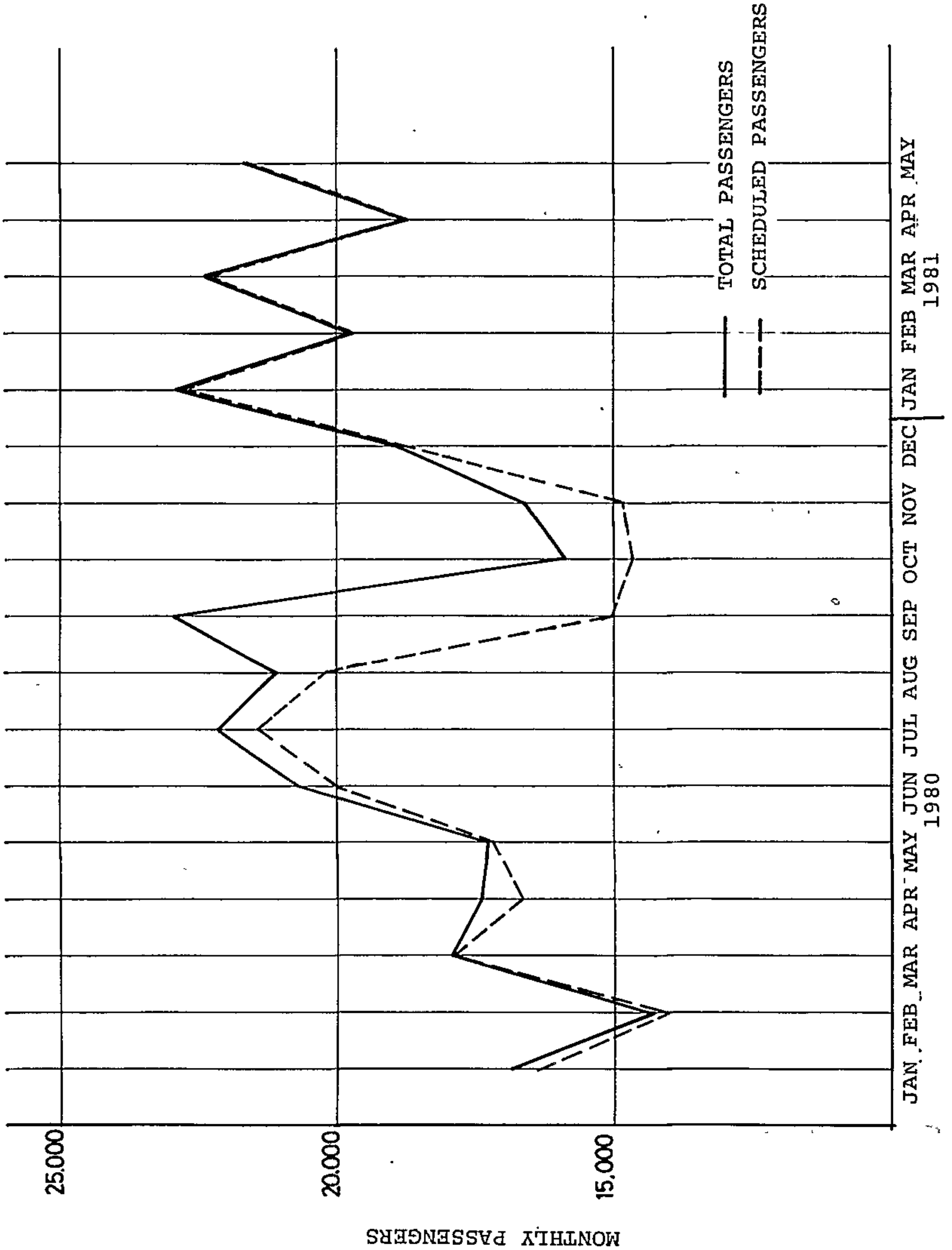
FOR THE YEARS 1970 TO 1980

ITEM / YEAR	ANNUAL PAX	GROWTH RATE (%)	PEAK MONTH PAX	PEAK MONTH RATIO	PEAK MONTH	HADJ DAY	REMARKS
1970	58,087	-	5,717	1/10.16	MAY	18/FEB	
1971	50,318	13.4	7,894	1/ 6.37	JAN	7/FEB	
1972	50,006	0.6	5,652	1/ 8.85	DEC	27/JAN	
1973	66,786	33.6	7,917	1/ 8.44	DEC	16/JAN	
1974	84,259	26.2	9,058	1/ 9.30	DEC	5/JAN 25/DEC	
1975	104,322	23.8	11,278	1/ 9.25	DEC	14/DEC	
1976	124,432	19.3	13,077	1/ 9.51	DEC	3/DEC	
1977	138,941	11.7	16,206	1/ 8.57	DEC	22/NOV	
1978	170,188	22.5	18,479	1/ 9.21	SEP	11/NOV	
1979	185,261	8.9	18,589	1/ 9.96	JUL	30/OCT	
1980	222,115	19,9	22,947	1/ 9.68	SEP	8/OCT	
Ave		15,2		1/ 9.4 *			

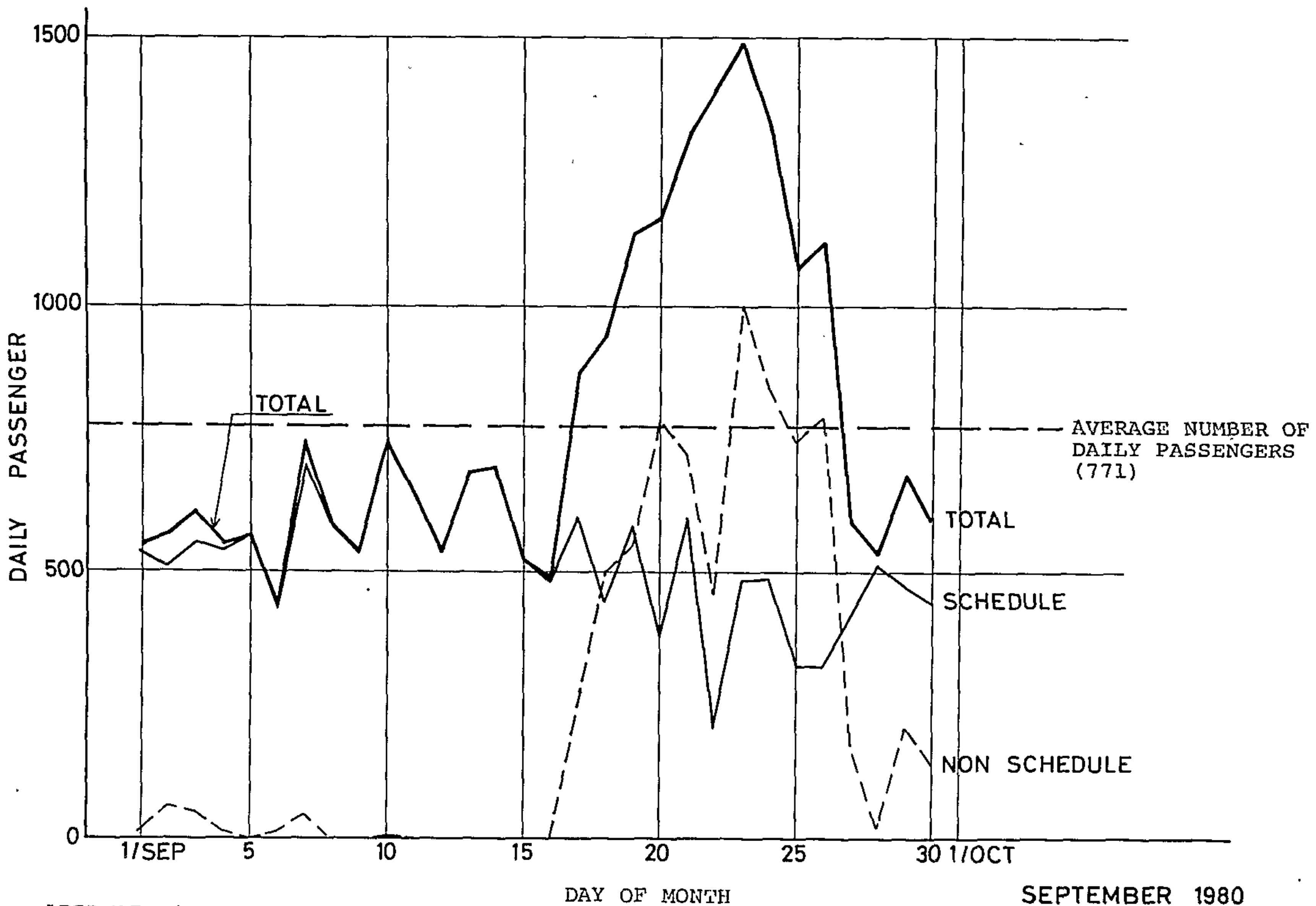
SOURCE : DATA LALU LINTAS ANGKUTAN UDARA ;
PELABUHAN UDARA TABING PADANG.

* AVERAGE OF 1976 TO 1980

APPENDIX 3.5.7.



APPENDIX 3.5.7. MONTHLY VARIATIONS IN NUMBER OF PASSENGERS FOR 1980 AND 1981



APPENDIX 3.5.8 DAILY VARIATIONS IN NUMBER OF SCHEDULED AND NON SCHEDULED PASSENGERS FOR PEAK MONTH

APPENDIX 3.5.9.

APPENDIX 3.5.9 AIRCRAFT IN SERVICE AT TABING AIRPORT AS OF 1981

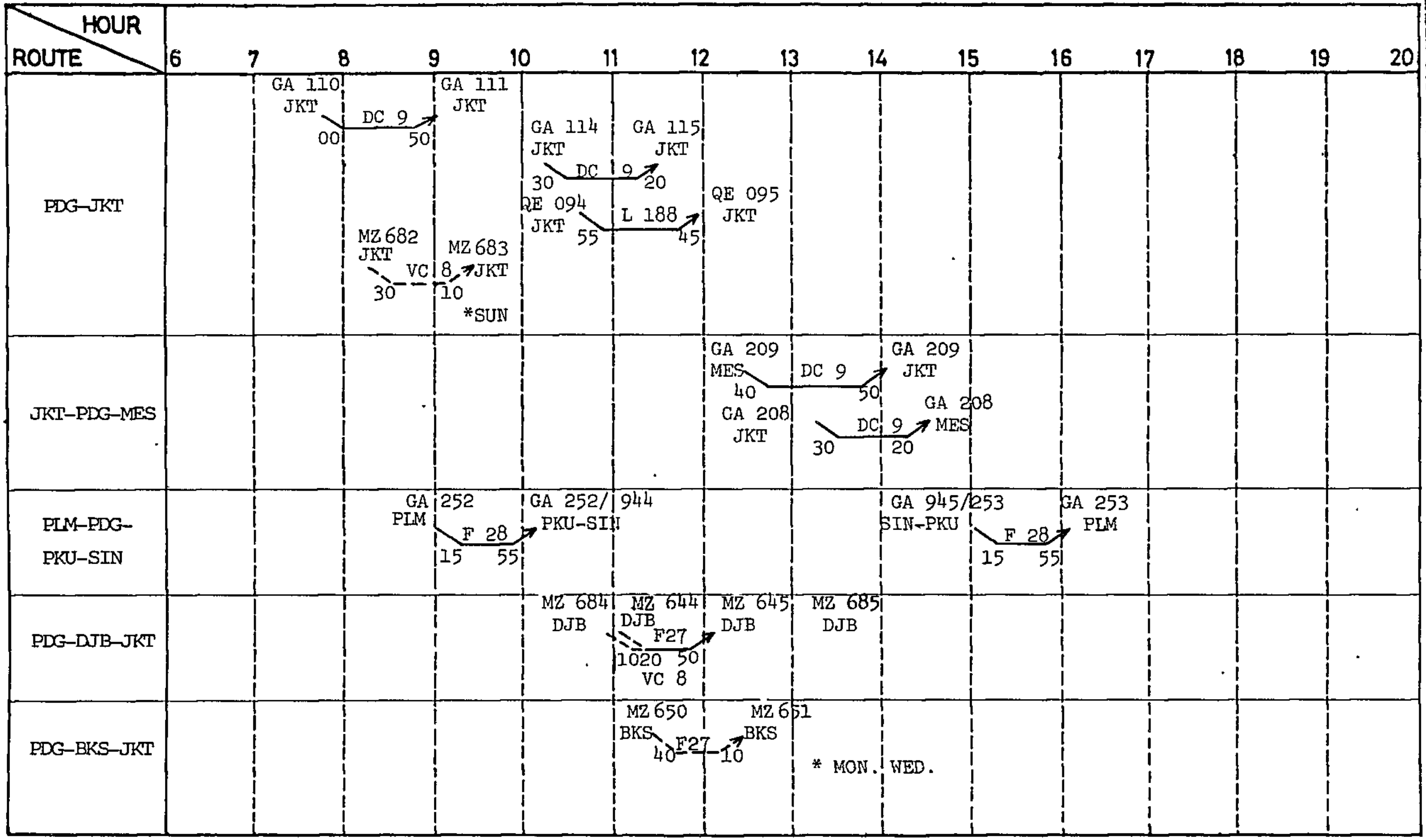
AIRCRAFT TYPE	SEATING CAPACITY	OPERATOR	ROUTE	REMARKS
DC-9	102	G I A	JKT-PDG JKT-PDG-MES	SCHEDULED
L-188	93	M D L	JKT-PDG	
F-28	85	G I A	PLM-PDG-PKU-SIN	
VC-8	68	M N A	JKT-PDG JKT-JMB-PDG	
F-27	44	M N A	JKT-JMB-PDG JKT-BKL-PDG	
BN-2A	10	I A T	PDG-PGI	NON SCHEDULED
		AIRFAST		
HS-748	48	AIRFAST		
DC-3	31	AIRFAST		
GRUMAN ALBATROS	20	AIRFAST		
BELL 206	8	AIRFAST		
PA-23	6	AIRFAST		
		MINANG AEROCLUB		
HERCULES	118	PELITA		
HS-125	8	PELITA		

APPENDIX 3.5.10 INCREASE IN FLEET SIZE FOR EACH TYPE OF AIRCRAFT

The Outline of PELITA III, issued in May 1978 by DGAC

NO.	TYPE OF AIRCRAFT	PELITA I					PELITA II					PELITA III				
		1969	70	71	72	73	74	75	76	77	78	79	80	81	82	83
1.	PILATUS PORTER PC - 6	9	9	9	9	9	9	9	9	9	9	9				
2.	DHC-3 OTTER AMPHIBIAN	1	1	1	1	1	-	-	-	-	-	-				
3.	DORNIER D-28-B-1	33	3	2	2	2	2	2	2	2	2	2				
4.	GRUMMAN G-21 A	-	-	-	-	-	-	-	-	1	1	1				
5.	DHC-6 TWIN OTTER/300	3	3	2	4	5	8	16	20	20	19	20				
6.	CASSA C-212	-	-	-	-	-	-	-	-	1	1	1				
7.	DC-3/C-47	37	31	29	29	29	21	20	20	20	20	20				
8.	HS-748	-	1	3	3	5	5	5	8	9	17	16				
9.	CONVAIR CV - 340	11	11	1	-	-	-	-	-	-	-	-				
10.	CONVAIR 600 - 240	-	3	3	3	3	3	3	3	3	3	3				
11.	LOOCHEED ELECTRA 1-188 C	2	2	2	2	-	-	-	-	-	-	-				
12.	YS - 11	-	1	4	5	6	5	5	4	1	-	-				
13.	VICKERS VISCOUNT 806/826	-	3	3	3	3	3	3	4	3	3	12				
14.	CONVAIR 990 A	2	2	-	-	-	-	-	-	-	-	-				
15.	VICKERS VANGUARD 951/953	-	-	-	2	2	3	4	4	4	4	4				
16.	FOKKER F - 27	8	11	11	10	9	9	9	9	4	5	5				
17.	FOKKER F - 28	-	-	3	6	10	11	17	23	26	28	30				
18.	DC - 9 - 32	2	2	3	5	6	9	12	18	18	18	25				
19.	DC - 8 - 55 / 53	-	-	-	-	1	3	3	3	3	3	2				
20.	DC - 10 - 30	-	-	-	-	-	-	-	2	3	4	6				
	TOTAL	78	87	79	87	84	96	101	112	134	147	160				

APPENDIX 3.5.11 FLIGHT SCHEDULE AT PADANG AIRPORT (APR. 1981)



APPENDIX 3.5.12 MONTHLY LOAD FACTOR

	SCHEDULED (%)	NONSCHEDULED (%)	AVERAGE (%)
80/NOV	72.2	6.1	55.7
/DEC	59.4	20.6	58.8
81/JAN	66.4	15.0	65.6
/FEB	43.2	18.7	43.0
/MAR	66.9	15.0	65.8
/APR	65.6	19.0	64.9
/MAY	70.8	20.7	70.6
AVE	63.5	16.4	60.6

APPENDIX TO CHAPTER 4

APPENDIX 4.3.1. A RUNWAY REQUIREMENTS (DC-9 TAKE-OFF)

ASSUMPTIONS

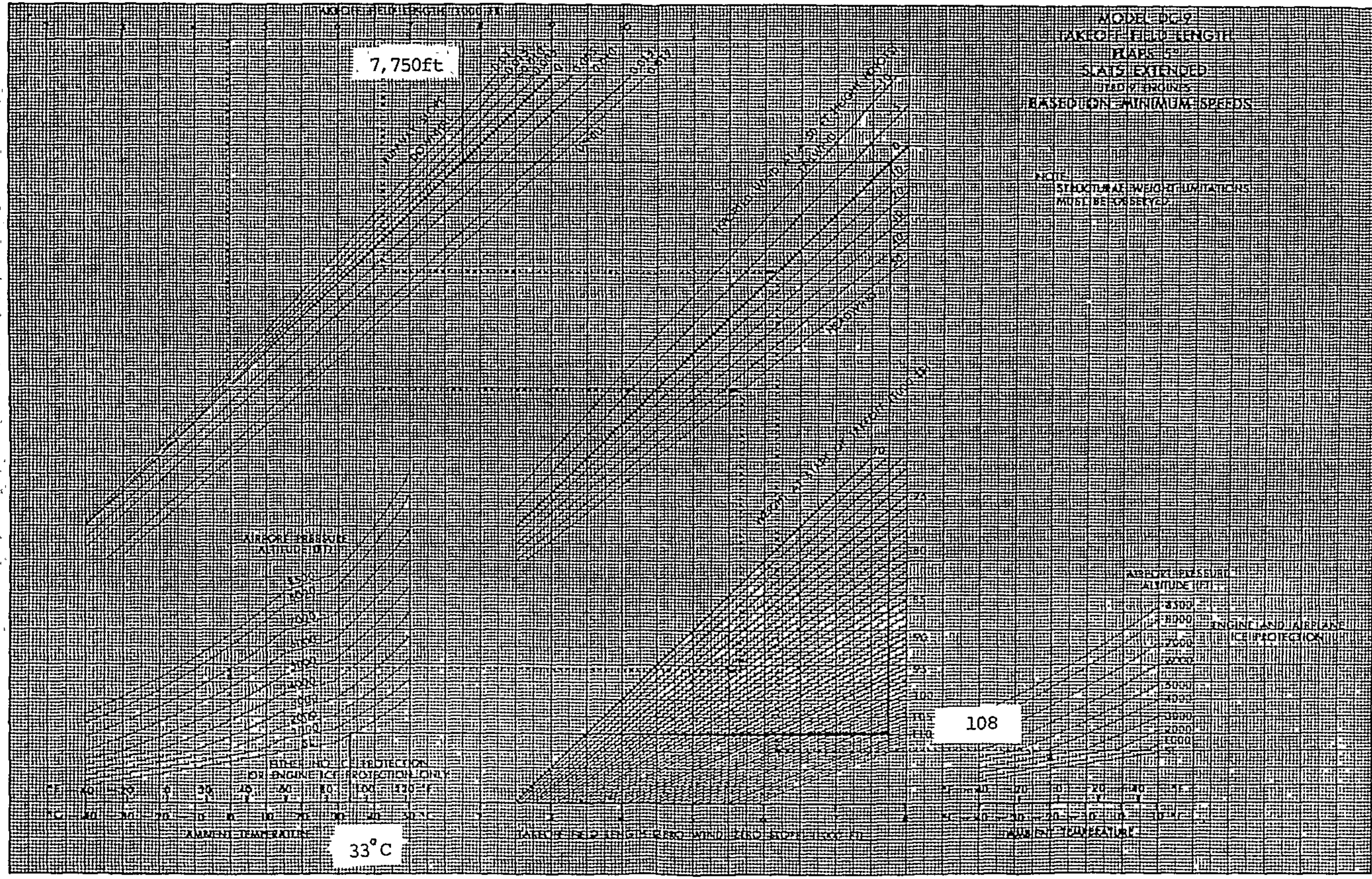
OAT	:	33° C (ISA + 18° C)	
Elevation	:	0 feet	
Slope	:	0 percent	
Procedure	:	Take-off	
Route	:	PDG ———— JTK - - - - - - - - SUB	
Distance	:	553 NM	382 NM
FL/Wind	:	-15Kt/FL 290	-20Kt/FL 290
Alternate	:	Surabaya	

TAKE-OFF WEIGHT	:	49,000	Kg	108,000	LBS
D.O.W	:	28,000	Kg		LBS
Fuel Carried.	:	9,535	Kg		LBS
Max. Payload	:	11,465	Kg		LBS

MONOGRAPH APPLIED :

RWY FIELD LENGTH REQUIRED : 2,370 m

(Flaps 5 °)
(Slats Extended)


MODEL DC-9
TAKEOFF FIELD LENGTH
FLAPS 5°
SLATS EXTENDED
BASED ON MINIMUM SPEEDS
NOTE:
STRUCTURAL WEIGHT LIMITATIONS
MUST BE OBSERVED
7,750ft
AIRPORT PRESSURE
ALTITUDE (FT)
AMBIENT TEMPERATURE
33°C
108
ENGINE AND AIRFRAME
ICE PROTECTION
EITHER NO ICE PROTECTION
OR ENGINE ICE PROTECTION ONLY

APPENDIX 4.3.2. A RUNWAY REQUIREMENTS (A-300 B4 TAKE-OFF)

ASSUMPTIONS

OAT	:	33° C (ISA + 18° C)
Elevation	:	0 feet
Slope	:	0 percent
Procedure	:	Take-off
Route	:	PDG ———— JTK - - - - - - - - SUB
Distance	:	553 NM 382 NM
FL/Wind	:	-15Kt/FL 290 -20Kt/FL 290
Alternate	:	Surabaya

TAKE-OFF WEIGHT	:	*143,000	Kg	*315,700	LBS
D.O.W	:	90,000	Kg		LBS
Fuel Carried	:	22,800	Kg		LBS
Max. Payload	:	30,500	Kg		LBS

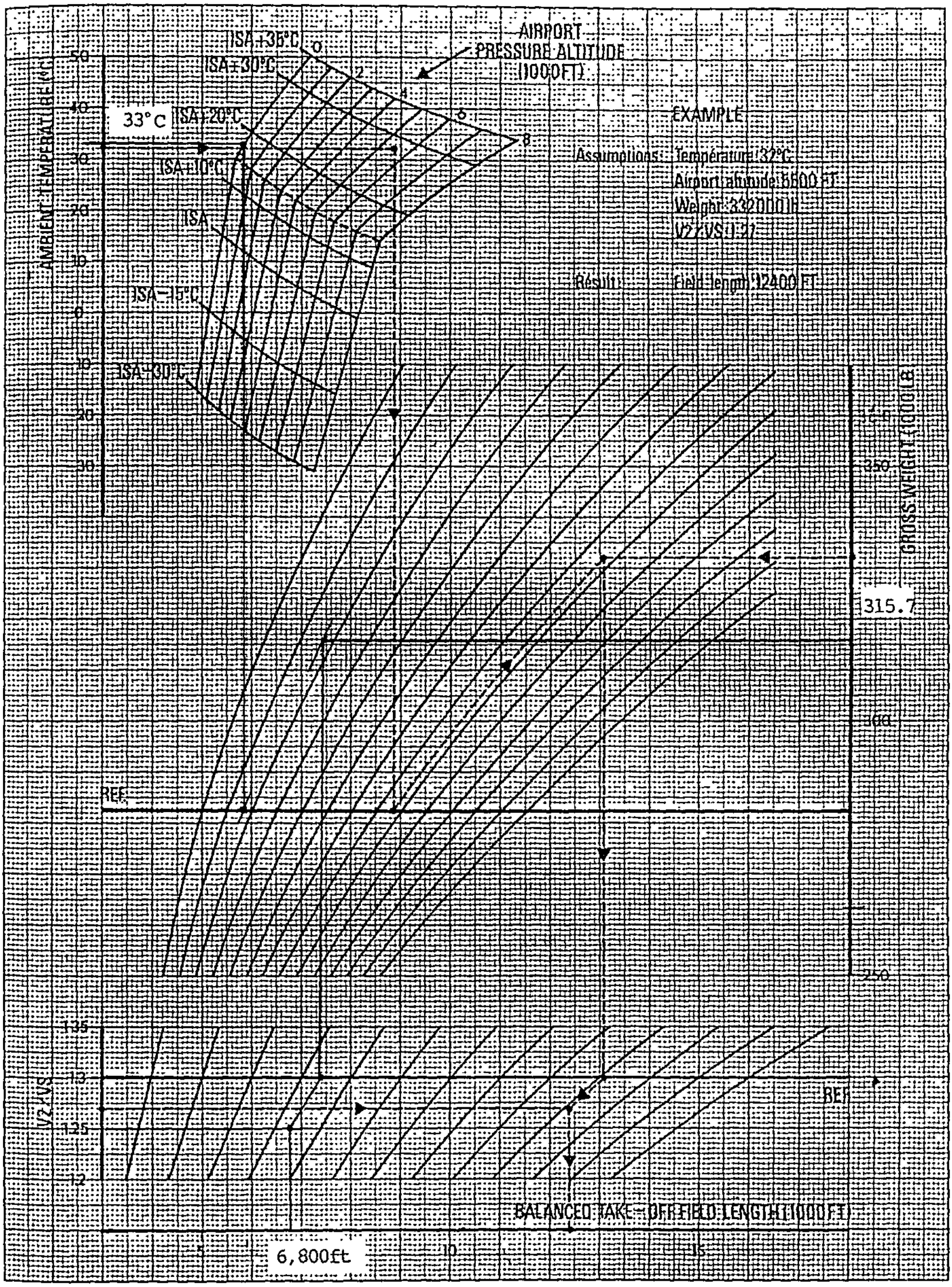
MONOGRAPH APPLIED :

RWY FIELD LENGTH REQUIRED : 2,080 m

(Flaps 8 °)
(Slats 16 °)

REMARKS : V2 / VS = 1.25

* If A-300-B4 would take off from Padang with the maximum take-off weight (324,000 LBS), the landing weight at Jakarta would exceed the maximum structural landing weight (295,000 LBS). Thus, the take off weight at Padang is restricted to 315,700 LBS.



A 300 B2 – 220
A 300 B4 – 120/220
(P&W JT9D–59A1)

BALANCED TAKE-OFF FIELD LENGTH
MAXIMUM RUNWAY LIMITING WEIGHT
SLATS 16° FLAPS 8°

SHEET 1.2.2
FEB. 1978

APPENDIX 4.3.2. B RUNWAY REQUIREMENTS (A-300 B4 LANDING)

ASSUMPTIONS

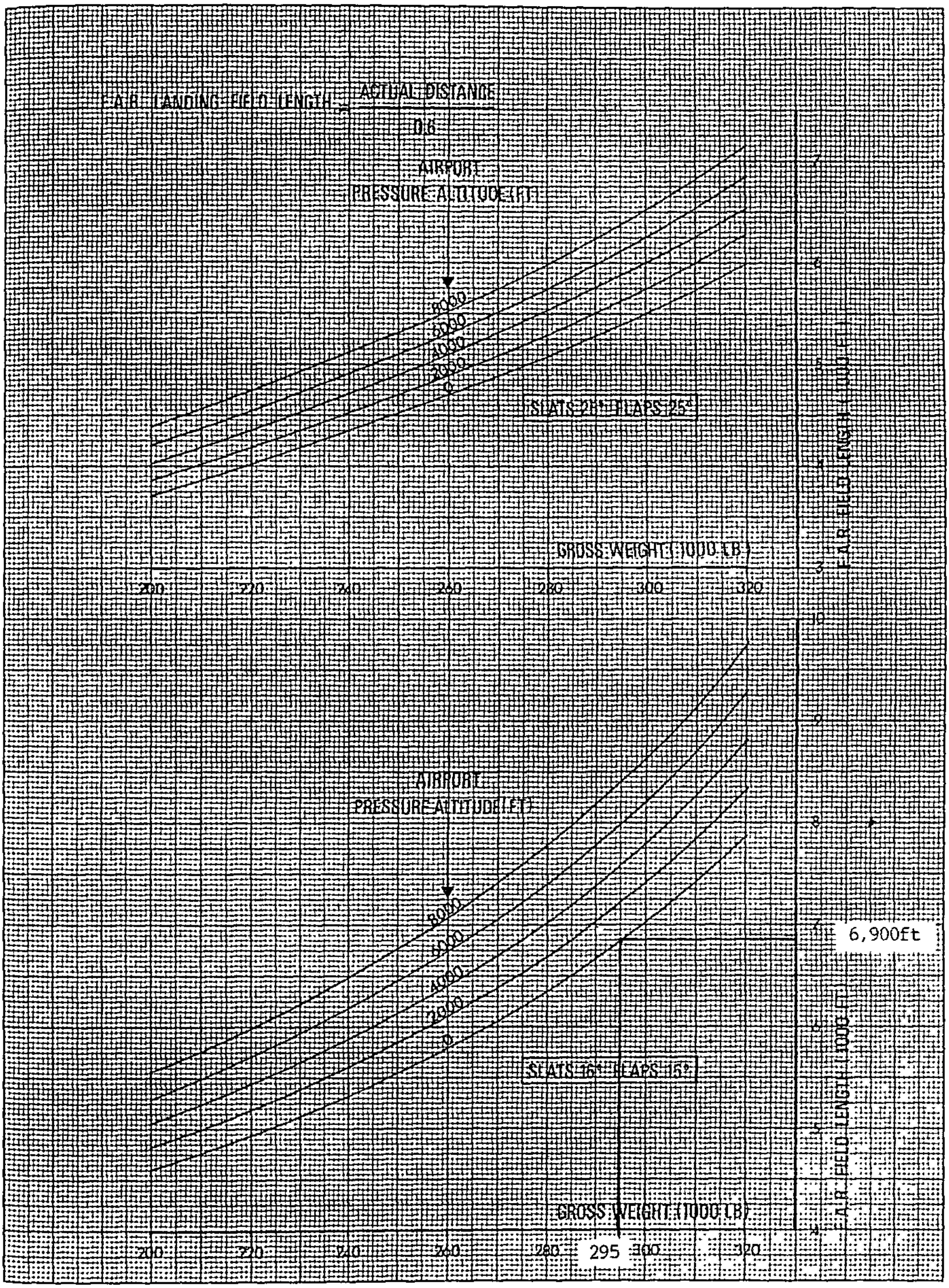
OAT	:	33° C (ISA + 18° C)
Elevation	:	0 feet
Slope	:	0 percent
Procedure	:	Landing
Route	:	JKT ——→ PDG ——→ MES
FL. /Wind	:	FL310 / + 5 Kt FL310/ + 5 Kt
Distance	:	530 NM 301 NM
Alternate	:	Medan

LANDING WEIGHT		134,000	Kg	295,000	LBS
D.O.W	:	90,000	Kg		LBS
Fuel left	:	9,800	Kg		LBS
Max.Payload	:	34,200	Kg		LBS

MONOGRAPH APPLIED :

RWY FIELD LENGTH REQUIRED : 2,420 m Wet 2,110 m Dry

(Flaps 15 °)
(Slats 16 °)



F.A.R. LANDING FIELD LENGTH
ALL AMBIENT TEMPERATURES

APPENDIX 4.3.3. A RUNWAY REQUIREMENTS (DC-10 TAKE-OFF)

ASSUMPTIONS

OAT	:	33° C (ISA + 18° C)
Elevation	:	0 feet
Slope	:	0 percent
Procedure	:	Take-off
Route	:	PDG ———— JTK – – – – – – – SUB
Distance	:	553 NM 382 NM
FL/Wind	:	-15Kt/FL 290 -20Kt/FL 290
Alternate	:	Surabaya

TAKE-OFF WEIGHT	:	192,700	Kg	425,500	LBS
D.O.W	:	124,000	Kg		LBS
Fuel Carried	:	25,700	Kg		LBS
Max. Payload	:	43,000	Kg		LBS

MONOGRAPH APPLIED :

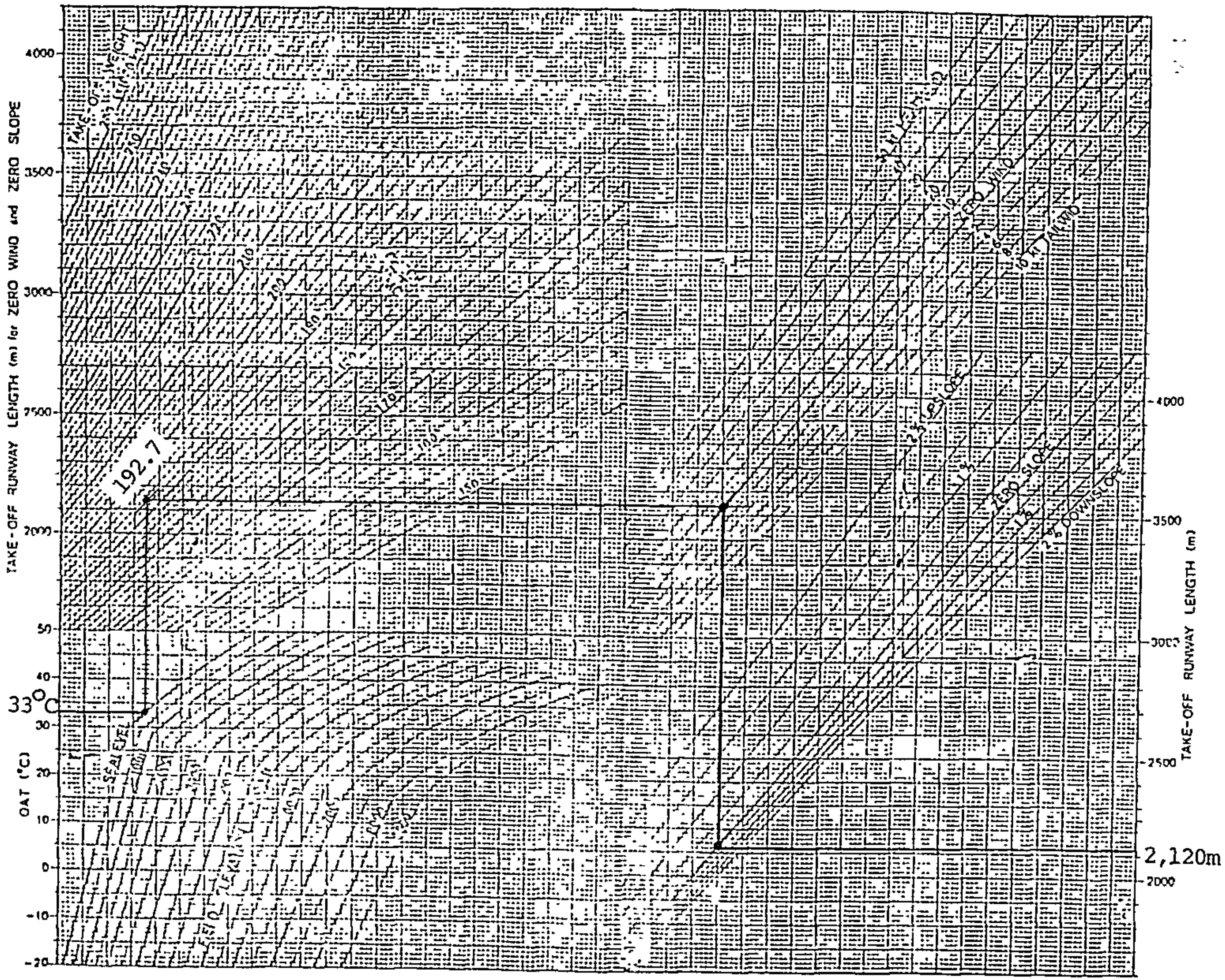
RWY FIELD LENGTH REQUIRED : 2,120 m

(Flaps 12 °)

12° FLAPS

Chart based on:
- No Engine bleed
- APU operating

CORRECTIONS:
- Engine Anti-Ice: SUBTRACT 1000 kg
- Engine bleed to Packs: SUBTRACT 2400 kg



APPENDIX 4.3.3. B RUNWAY REQUIREMENTS (DC-10 LANDING)

ASSUMPTIONS

OAT	:	33° C (ISA + 18° C)
Elevation	:	0 feet
Slope	:	0 percent
Procedure	:	Landing
Route	:	JKT ——→ PDG - - - - → MES
FL. /Wind	:	FL310 / + 5 Kt FL310/ + 5 Kt
Distance	:	530 NM 301 NM
Alternate	:	Medan

LANDING WEIGHT ____178,400____ Kg ____393,000____ LBS

D.O.W	:	124,000	Kg	LBS
Fuel left	:	11,400	Kg	LBS
Max.Payload	:	43,000	Kg	LBS

MONOGRAPH APPLIED :

RWY FIELD LENGTH REQUIRED : ____2,200____ m Wet ____1,910____ m Dry

(Flaps 35 °)

Chart ... Automatic
or Manual ... spoilers operation.

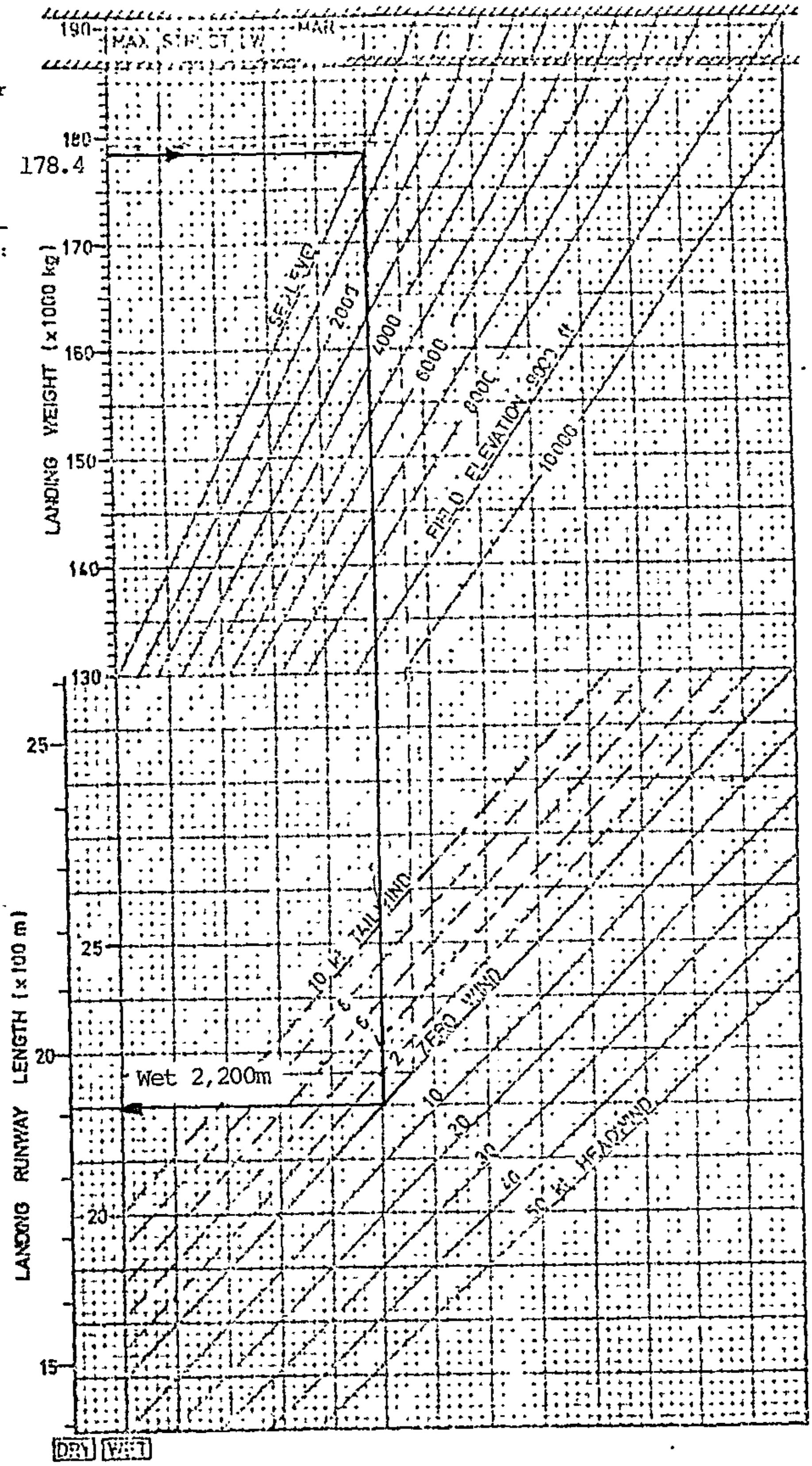
The Max. Landing Weight for DISPATCH is the lower of:

(i) Max. Structural LW
(ii) Landing RW length limited weight*)

*) (ii) is determined for:

- longest runway with zero wind
- most suitable runway with forecast wind

- using WET scale for DESTINATION (or DRY scale if forecast indicates dry, SCD)
- using DRY scale for ALTERNATE



APPENDIX 4.3.4. A RUNWAY REQUIREMENTS (B 747 TAKE-OFF)

ASSUMPTIONS

OAT	:	33° C (ISA + 18° C)	
Elevation	:	0 feet	
Slope	:	0 percent	
Procedure	:	Take-off	
Route	:	PDG ———— JTK – – – – – – SUB	
Distance	:	553 NM	382 NM
FL/Wind	:	-15Kt/FL 290	-20Kt/FL 290
Alternate	:	Surabaya	

TAKE-OFF WEIGHT	:	273,000	Kg	602,000	LBS
D.O.W	:	173,000	Kg		LBS
Fuel Carried	:	34,000	Kg		LBS
Max. Payload	:	66,000	Kg		LBS

MONOGRAPH APPLIED :

RWY FIELD LENGTH REQUIRED : 1,990 m

(Flaps 10 $^{\circ}$)

TABLE 54. AIRCRAFT PERFORMANCE, TAKEOFF (BOEING 747 SERIES) JT9D-7A ENGINE, 10° FLAPS

MAXIMUM ALLOWABLE TAKEOFF WEIGHT (1000 KG)

TEMP °C	0	500	1000	1500	2000	2500
	AIRPORT ELEVATION (METERS)					
10	356.0	356.0	343.5	327.4	310.8	294.6
12	356.0	356.0	343.5	327.4	310.8	294.6
14	356.0	356.0	343.5	327.4	310.8	294.6
16	356.0	356.0	343.5	327.4	310.8	291.9
18	356.0	356.0	343.5	327.4	309.2	289.0
20	356.0	356.0	343.5	327.4	306.2	286.3
22	356.0	356.0	343.5	323.8	303.0	283.4
24	356.0	356.0	342.0	320.2	299.6	280.2
26	356.0	356.0	338.0	316.4	296.1	277.0
28	356.0	356.0	333.9	312.5	292.4	273.6
30	356.0	352.0	329.7	308.6	288.7	270.1
32	356.0	347.5	325.5	304.6	284.9	266.6
34	356.0	343.0	321.3	300.6	281.2	263.1
36	356.0	338.6	317.1	296.7	277.5	259.7
38	356.0	334.2	313.0	292.8	273.9	256.3
40	351.8	329.9	309.0	289.1	270.5	253.1
42	347.4	325.7	305.1	285.6	267.2	250.1
44	343.1	321.7	301.4	282.2	264.2	247.2

REFERENCE FACTOR "R"

R= 74.3

TEMP °C	0	500	1000	1500	2000	2500
	AIRPORT ELEVATION (METERS)					
10	68.3	75.1	83.0	92.4	103.5	116.9
12	68.9	75.6	83.6	93.1	104.4	117.8
14	69.3	76.1	84.1	93.7	105.1	118.5
16	69.8	76.5	84.6	94.2	105.7	120.0
18	70.2	77.0	85.1	94.8	106.4	122.6
20	70.6	77.5	85.6	95.3	108.4	125.1
22	70.9	78.0	86.0	96.5	110.4	127.7
24	71.3	78.4	86.7	98.4	112.6	130.4
26	71.8	78.9	88.4	100.3	115.0	133.2
28	72.2	79.9	90.1	102.4	117.4	136.0
30	72.7	81.4	91.9	104.5	119.9	138.9
32	73.6	83.0	93.8	106.7	122.5	141.8
34	75.0	84.5	95.7	109.0	125.2	144.9
36	76.4	86.1	97.6	111.4	128.0	148.1
38	77.9	87.8	99.6	113.8	130.9	151.4
40	79.4	89.5	101.7	116.3	133.9	
42	81.1	91.2	103.7	118.9		
44	82.9	93.1	105.9	121.5		

RUNWAY LENGTH (METERS)

WEIGHT 1000 KG	60	70	80	90	100	110	120	130	140	150
	REFERENCE FACTOR "R"									
250	1355	1575	1790	1995	2195	2395	2590	2785	2975	3170
260	1455	1700	1935	2165	2390	2610	2830	3050	3265	3485
270	1565	1830	2090	2345	2595	2840	3085	3330	3575	3820
280	1685	1970	2255	2535	2815	3085	3360	3630	3905	4180
290	1810	2125	2435	2745	3050	3350	3655	3955	4260	4565
300	1945	2290	2625	2965	3300	3635	3970	4305	4640	4975
310	2090	2460	2830	3200	3570	3940	4310	4680	5050	
320	2245	2645	3050	3455	3860	4270	4680	5090		
330	2405	2840	3280	3725	4175	4625	5075			
340	2575	3050	3530	4015	4510	5005				
350	2750	3265	3790	4325	4865					
360	2930	3495	4070	4655						

273 1872 2140

R = 74.3 RWY = 1990m

APPENDIX 4.3.4.B RUNWAY REQUIREMENTS (B 747 LANDING)

ASSUMPTIONS

OAT	:	33° C (ISA + 18° C)
Elevation	:	0 feet
Slope	:	0 percent
Procedure	:	Landing
Route	:	JKT ——→ PDG ——→ MES
FL. /Wind	:	FL310 / + 5 Kt FL310/ + 5 Kt
Distance	:	530 NM 301 NM
Alternate	:	Medan.

LANDING WEIGHT	255,000	Kg	562,000	LBS
D.O.W :	173,000	Kg		LBS
Fuel left :	16,000	Kg		LBS
Max.Payload :	66,000	Kg		LBS

MONOGRAPH APPLIED :

RWY FIELD LENGTH REQUIRED : 2,480 m Wet 2,160 m Dry

(Flaps 25 °)

TABLE 52. AIRCRAFT PERFORMANCE, LANDING (BOEING 747 SERIES)
JT9D-7A ENGINE, 25° FLAPS

MAXIMUM ALLOWABLE LANDING WEIGHT (1000 KG)

TEMP °C	AIRPORT ELEVATION (METERS) 0	500	1000	1500	1500	2000	2500
10	285.7	285.7	285.7	285.7	285.7	285.7	285.7
12	285.7	285.7	285.7	285.7	285.7	285.7	285.4
14	285.7	285.7	285.7	285.7	285.7	285.7	282.3
16	285.7	285.7	285.7	285.7	285.7	285.7	279.2
18	285.7	285.7	285.7	285.7	285.7	285.7	276.3
20	285.7	285.7	285.7	285.7	285.7	285.7	273.3
22	285.7	285.7	285.7	285.7	285.7	285.7	270.3
24	285.7	285.7	285.7	285.7	285.7	284.4	267.4
26	285.7	285.7	285.7	285.7	285.7	281.3	264.4
28	285.7	285.7	285.7	285.7	285.7	278.1	261.5
30	285.7	285.7	285.7	285.7	285.7	274.9	258.4
32	285.7	285.7	285.7	285.7	285.7	271.6	255.4
34	285.7	285.7	285.7	282.5	285.2	268.2	252.3
36	285.7	285.7	285.7	278.7	281.5	264.8	249.1
38	285.7	285.7	285.7	274.9	277.8	261.3	245.8
40	285.7	285.7	285.7	271.1	273.9	257.7	242.4
42	285.7	285.7	284.5	267.3	269.9	254.0	238.9
44	275.1	282.5	280.4	263.6	265.8	250.2	235.2

RUNWAY LENGTH (METERS)

WEIGHT 1000 KG	AIRPORT ELEVATION (METERS) 0	500	1000	1500	2000	2500
205	2030	2110	2195	2285	2375	2480
210	2075	2155	2245	2335	2425	2535
215	2120	2205	2290	2385	2485	2590
220	2165	2250	2340	2435	2540	2645
225	2210	2295	2390	2485	2595	2705
230	2255	2345	2440	2540	2650	2760
235	2300	2390	2485	2590	2705	2820
240	2345	2435	2535	2645	2760	2880
245	2390	2480	2585	2695	2815	2935
250	2435	2530	2635	2750	2870	2995
255	2475	2580	2685	2800	2925	3055
260	2525	2630	2740	2855	2980	3115
265	2575	2680	2790	2910	3035	3170
270	2630	2735	2845	2960	3090	3230
275	2680	2785	2895	3015	3145	3290
280	2725	2835	2950	3070	3200	3345
285	2770	2885	3000	3125	3255	3405
290	2810	2930	3050	3175	3315	3460

APPENDIX 4.3.5 AIRCRAFT DATA

Aircraft	Wing Span (m)	Length (m)	Height (m)	Turn Radius (m)	Max T/o Weight (t)
(Jet)					
B-747-203B	59.64	68.63	19.58		371.9
DC-10-30	50.40	55.35	17.85		251.7
A-300 B4	44.8	53.6	16.5		150
B - 767	47.2	48.5	15.9		127
DC-9-80	32.85	45.02	9.04		63.5
DC-9-32	28.45	36.35	8.35		49.0
F-28-4000	25.07	29.60	8.47		32.2
(Prop)					
VC - 9					64.4
L - 188	29.91	31.88	10.26		51.4
VC - 8	28.57	25.83	8.15		33.0
F - 27	29.52	23.52	8.38		19.8
DC - 3	28.96	19.66	7.16		11.5
DHC - 6	19.8	15.5	5.65		5.67

APPENDIX 4.3.6 REQUIRED NUMBER OF AIRCRAFT STANDS

YEAR		AIRCRAFT CATEGORY				TOTAL
		A	B	C	D	
1985	Design Day A/C movement		2	20	6	28
	Peak hour A/C movement		0.4	4.0	1.2	5.6
	Heavy direction A/C movement		0.24	2.40	0.72	
	Stay time		70	55	50	
	Calculated number of A/C stand		0.28	2.2	0.6	3.08
	Required number of A/C stand		1	3		4
1990	Design Day A/C movement		12	24	4	40
	Peak hour A/C movement		2.2	4.4	0.7	7.3
	Heavy direction A/C movement		1.32	2.64	0.42	
	Stay time		70	55	50	
	Calculated number of A/C stand		1.54	2.42	0.35	4.31
	Required number of A/C stand		2+1=3	3		6
1995	Design Day A/C movement		22	18	6	46
	Peak hour A/C movement		3.9	3.2	1.1	8.2
	Heavy direction A/C movement		2.34	1.92	0.66	
	Stay time		70	55	50	
	Calculated number of A/C stand		2.73	1.76	0.55	5.0
	Required number of A/C stand		3+1=4	2	1	7
2000	Design Day A/C movement	8	14	18	8	48
	Peak hour A/C movement	1.4	2.5	3.2	1.4	8.5
	Heavy direction A/C movement	0.84	1.50	1.92	0.84	
	Stay time	70	70	55	50	
	Calculated number of A/C stand	0.98	1.75	1.76	0.70	5.19
	Required number of A/C stand	1+1=2	2	2	1	7
2005	Design Day A/C movement	12	16	26	12	66
	Pk. hr. A/C mov.	2.0	2.7	4.4	2.0	11.1
	Heavy direction A/C movement	1.2	1.62	2.64	1.2	
	Stay time	70	70	55	50	
	Calculated number of A/C stand	1.4	1.89	2.42	1.0	6.7
	Required number of A/C stand	2+1=3	2	2	1	8

APPENDIX 4.4.1. UNIT FLOOR AREA OF PASSENGER TERMINAL

1) Passenger terminal buildings in Japan

Although JCAB suggests 15 sq.m/peak hour passenger as a standard unit floor area for the passenger terminal building which is the actual average of average airport terminals in Japan, Japanese Airlines' Companies suggest 9 sq.m/peak hour passenger from the economical view point. It is considered that this 9 sq.m/peak hour passenger was derived from the guidelines of IATA. The values of 9 and 15 can be understood as the minimum and the maximum cases respectively under normal conditions.

2) Indonesian condition

The Indonesian terminal must accommodate a large number of visitors as compared with Japanese terminal. In Indonesia, 4 visitors for one passenger are considered for a terminal design while about 0.5 visitors for one passenger is the average greeter ratio of domestic air terminals in Japan.

This difference influences the size of the public lobby. The area of the public lobby is generally 30 percent of the total floor area of the terminal building.

Therefore, it is considered reasonable to assume from the following calculations that the unit floor area for the Indonesian terminal will be 65 percent larger than the Japanese standard.

The minimum case:

9 sq.m x 0.7 + 9 x 0.3 x 3.3 *
(30 percent)

= 15.21 = 15 sq.m/peak hour passenger

* = (1 + 4) – (1 + 0.5) = 3.3
pax. friends , pax. friends

The maximum case :

15 x 0,7 + 15 x 0.3 x 3.3

= 25 sq.m/peak hour passenger

However, 25 sq.m/peak hour passengers is considered too generous in any case as compared with other terminal buildings in other countries which also indicates the characteristics similar to Indonesia. Hence, in this Interim Report, a unit space requirement for the terminal building is estimated to be between 15 to 20 sq.m/peak hour passengers.

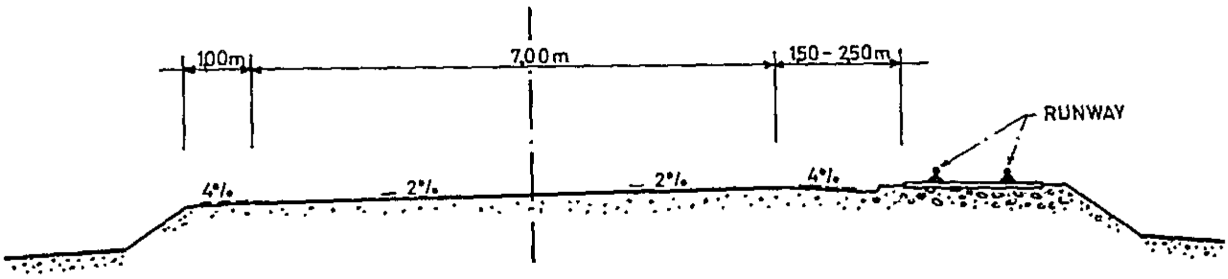
APPENDIX TO CHAPTER 5

APPENDIX 5.1.1. THE CAPACITY OF THE EXISTING HIGHWAY

1. Capacity of the existing coastal highway

The cross section is composed of 2 lanes (3.5m each) for 2 ways with 1m to 2.5m wide shoulder on each side as indicated in the sketch below.

TYPICAL CROSS SECTION OF
THE EXISTING HIGHWAY



The capacity of the existing highway is calculated to be 1420 VPH based on Japanese geometric design standards of road as follows :

Capacity = A x a x b x c x d x e

Where : A : 2500 VPH for both ways

a thru e : reduction coefficient of capacity

a : 1.0 for roadway of 3.5 m

b : 0.96 for average lateral clearance of 1.5 m

c : 0.74 for 35 % of trucks

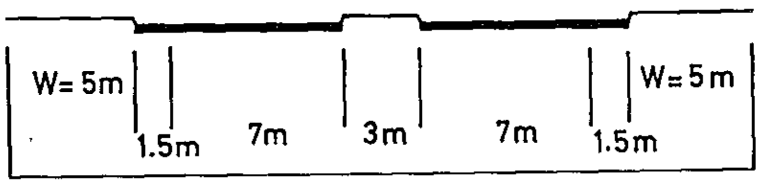
d : 0.8 for road side condition (within town)

Capacity = 1420 VPH

2. Capacity of Padang bypass toll road

The cross section is composed of 2 lanes of 3.5m each with shoulder of 1.5m on each way.

TYPICAL CROSS SECTION OF PADANG BYPASS TOLL ROAD



The capacity is calculated to be 1615 VPH per lane as follows :

Capacity = A x a x b x c x d x e

Where :
- A : Basis capacity of 2500 VPH per lane
- a : 1.0
- b : 0.97 for average lateral clearance of 1.0m (1.5 + 0.5) - 2
- c : 0.74 for 35% of trucks
- d : 0.9 for road side condition (toll road)

Capacity = 1615 VPh / lane

3. Traffic Volume of the existing highway

The result of the traffic survey carried out by DG of Bina Marga in 1979 is as follows :

Padang - Lubuk Buaya

Passengers Cars	Bus	Trucks	Total
1150 VPD	516 VPD	812 VPD	2478 VPD
115 VPD	52 VPD	81 VPD	248 VPD

(VPh is setimated to be 10% of VPD)

The future hourly traffic volumes for this road anticipating airport access traffic are estimated by assuming an average annual growth rate to be 10 percent which was forecast for the future traffic volume of Padang toll road by DGBM.

The airport access traffic access volumes were estimated and are shown in Table 4.7.1. The sum of the both hourly traffic volumes is tabulated as follows.

Year	1990	1995	2000	2005
Airport access	450	765	1170	1620
Other traffic	710	1140	1830	2950
	1160	1905	3000	4570
		1335*	2085*	3095*

* : These figures are calculated based on the assumption that half of the other traffic will utilize the bypass road.

4. Traffic volume of Padang toll road

The future traffic volumes of this road were forecast by DGBM and the results are tabulated in the following Table.

Future Traffic Volume of Padang Toll Road

Year	1990	1995	2000	2005
VPD	7284	12599	21266	32576
VPh	728	1260	2130	3258

Note 1 : The proportion of truck and bus is about 35 percent of the total.

2 : The average annual growth rate is about 10 percent.

From the above traffic volume, which is larger than the future traffic volume for the existing highway, it is suggested that this forecast was based on the assumption that most of the inter-regional traffic will utilize the new bypass road instead of the existing highway.

5. Assessment

The traffic volume of the existing highway anticipated in 1995 is 1335 VPH. This volume is less than the capacity of 1420 VPH. Therefore, the existing highway will be sufficient in terms of capacity up to 1955 if Padang bypass road will be completed before 1992. After 1995, the widening of the road will be necessary.

APPENDIX 5.3.1 PAYLOAD REDUCTION OF A-300-B4

This Appendix explains the weight restriction for A-300 aircraft, when it will be introduced to the 2,150m runway after the completion of 300m runway extension now under construction.

LANDING: Although there will be no weight restriction in the non-economical operations of slats 25° and flaps 25°, a weight reduction of 23,000 Lbs (10442 kg) from the payload will be needed in GARUDA's standard operations of slats 16° and flaps 15°. In this case, the weight reduction is 31 percent from the maximum payload. However, 250 passengers could be carried without any cargo payload.

Landing (Slats 16°, Flaps 15° —— Standard Operation)

RWY 2,500m : Landing Weight = 295,000 Lbs
RWY 2,150m : Restricted
(1,870m Dry Condition) Landing Weight = 272,000 Lbs

Payload Reduction = 23,000Lbs (10,442 kg)

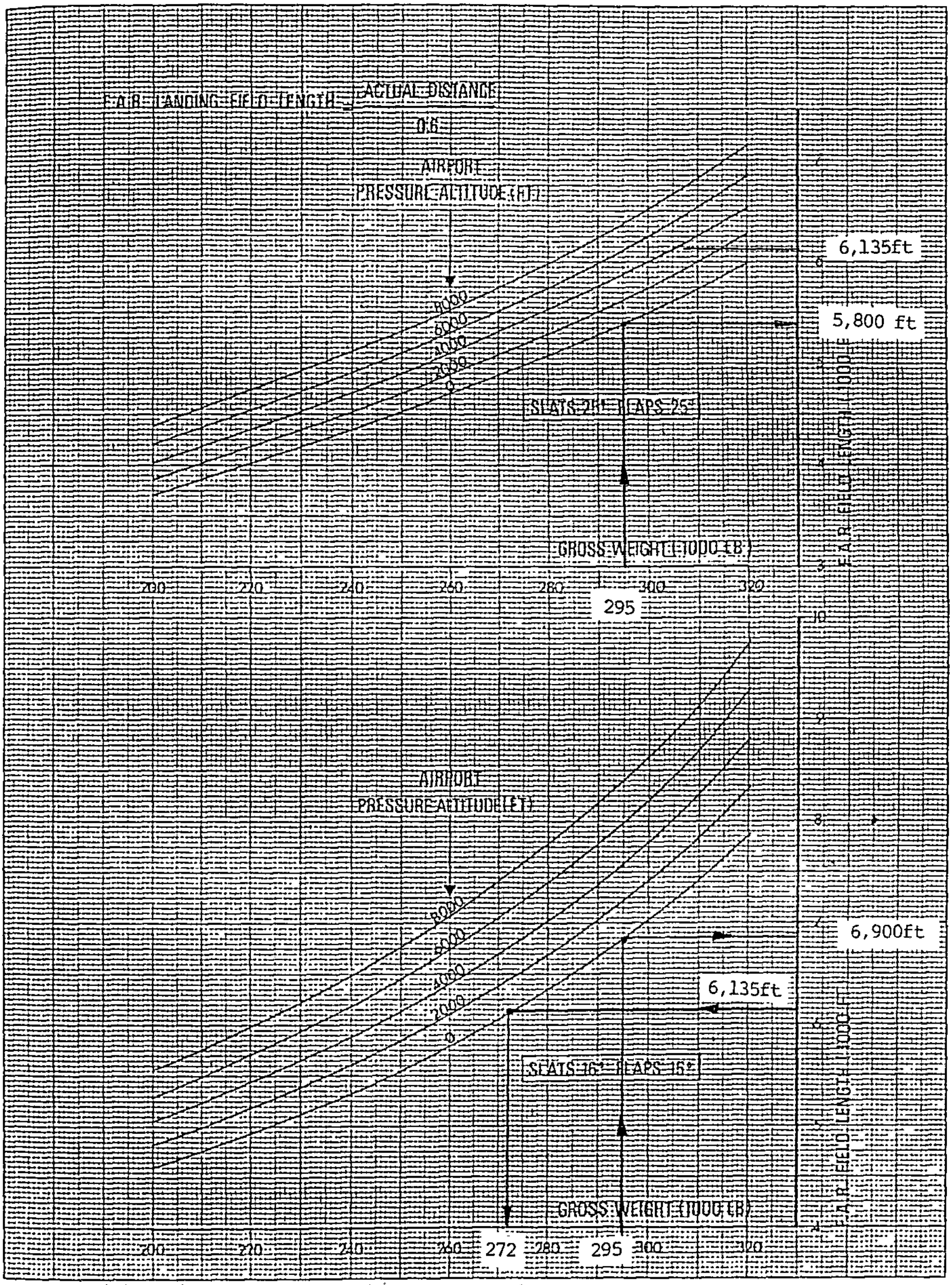
Payload Reduction ; 10,442/34,200 kg = 0,305 (31%)

No. of seats allowed ; $\frac{34,200 \text{ kg} - 10,442 \text{ kg}}{95 \text{ kg}}$ = 250 seats (52 seats reduction)
(No cargo)

Landing (Slats 25°, Flaps 25°)

RWY 2,500m : Landing Weight = 295,000 Lbs
RWY 2,150m : Landing Weight = more than
(1,870m Dry) 295,000 Lbs

No Restriction



A300 B2 _ 220 F.A.R. LANDING FIELD LENGTH SHEET 1.5.2
A300 B4 _ 120/220 ALL AMBIENT TEMPERATURES FEB. 1978

Take - Off : No weight reduction will be needed for RWY 34 take-off. This is because the landing weight at Jakarta exceeds the maximum structural landing weight if A-300- B4 takes-off Padang with the maximum take-off weight. Thus, the maximum take-off weight At Padang is restricted to 315,700 LBS. On the other hand, the take-off weight allowed by the 2,150m RWY is 317,000 LBS. Thus no restriction is necessary. As for RWY 16 take-off, 7,540 LBS (3,423 kg) of payload reduction will be necessary due to the ob - struction (Sarit and Pangilun hills).

Take-off RWY 34 (Slats 16°, Flaps 8°)

RWY 2,500m :	* Take off weight at Padang	= 315,700 LBS
RWY 2,150m :	Take off weight by the runway length	= 317,000 LBS
		No Restriction

* Structural take-off weight (324,000 LBS) at Padang is restricted to 315,700 LBS because the landing weight at Jakarta exceeds the maximum landing weight (295,000 LBS).

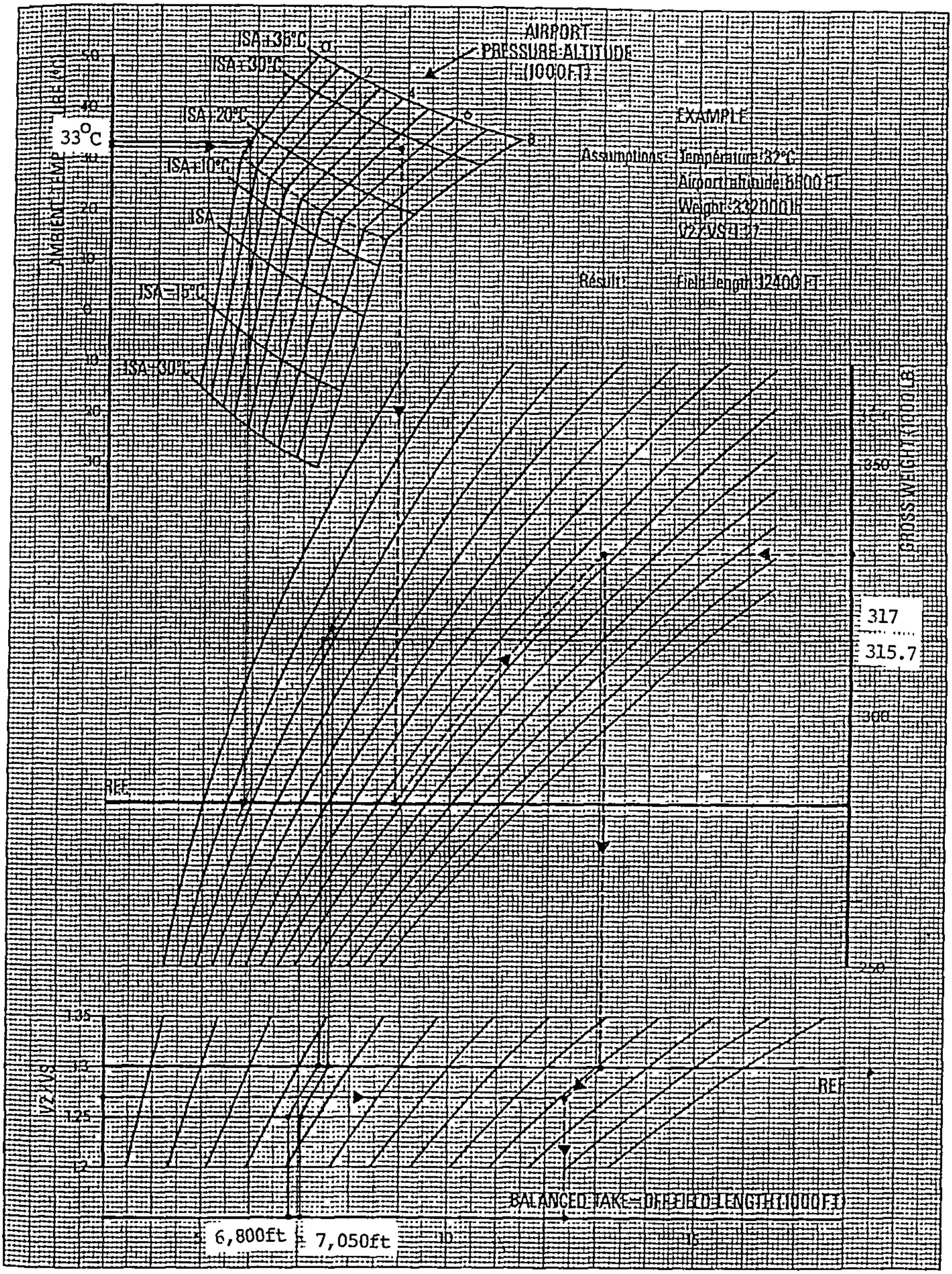
Take-off RWY 16 (Slats 16°, Flaps 8°)

RWY 2,500m :	Take off weight at Padang	= 315,700 LBS
RWY 2,150m :	Take off weight by the runway length	= 317,000 LBS
Obstruction:	Restricted Take off weight by hills	= 308,160 LBS
	Payload Reduction	= 7,540 LBS (3,423 Kg)

Payload REduction : 3423kg/ 30500kg = 0.112

No. of seat allowed : $\frac{30,500 \text{ kg} - 3,423 \text{ kg}}{95 \text{ kg}}$ = 285 seats
(No cargo)

(17 seats reduction)

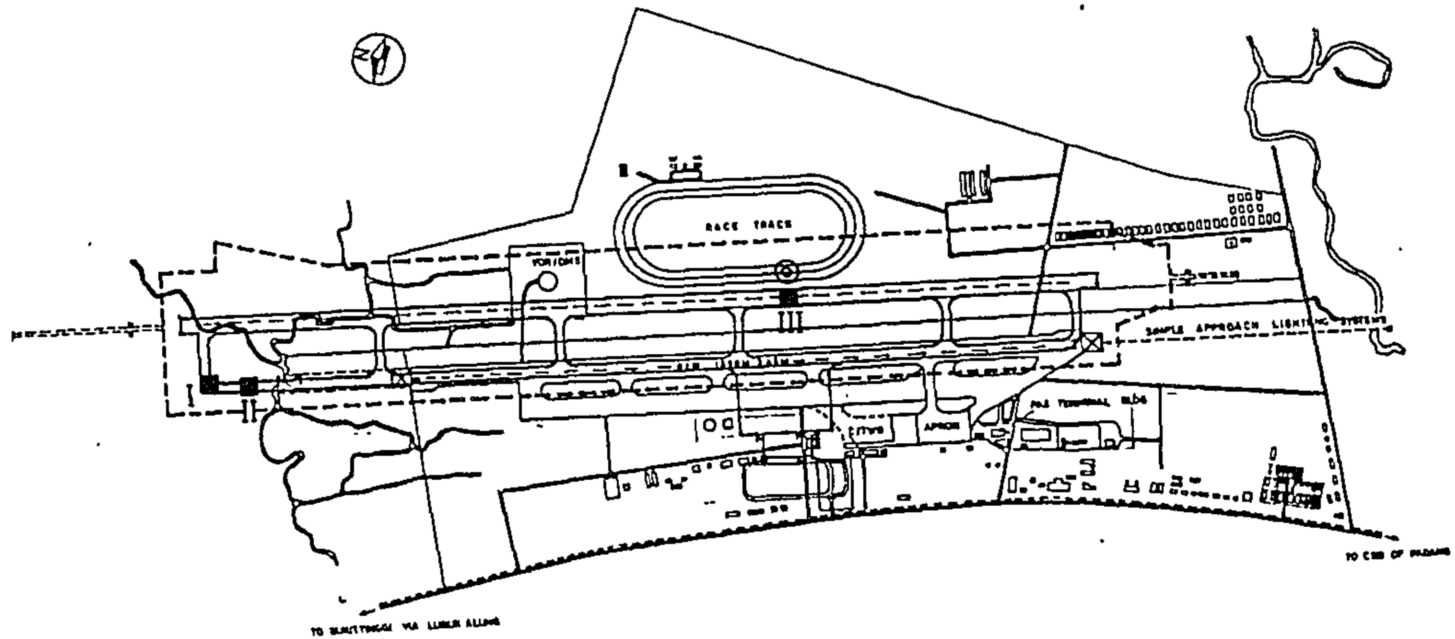


A 300 B2 – 220
A 300 B4 – 120/220
(P&W JT9D–59A1)

BALANCED TAKE-OFF FIELD LENGTH
MAXIMUM RUNWAY LIMITING WEIGHT
SLATS 16° FLAPS 8°

SHEET 1.2.2
FEB. 1978

APPENDIX TO CHAPTER 8



Legend

■ Test Pit

◎ Mechanical Boring

APPENDIX 8.2.1 LOCATION OF SOIL INVESTIGATION AT TABING

DINAS PEKERJAAN UMUM PROP. DAERAH TK. I SUMATERA BARAT
LABORATORIUM. PENYELIDIKAN TANAH DAN JALAN
SOIL INVESTIGATION SUMMARY

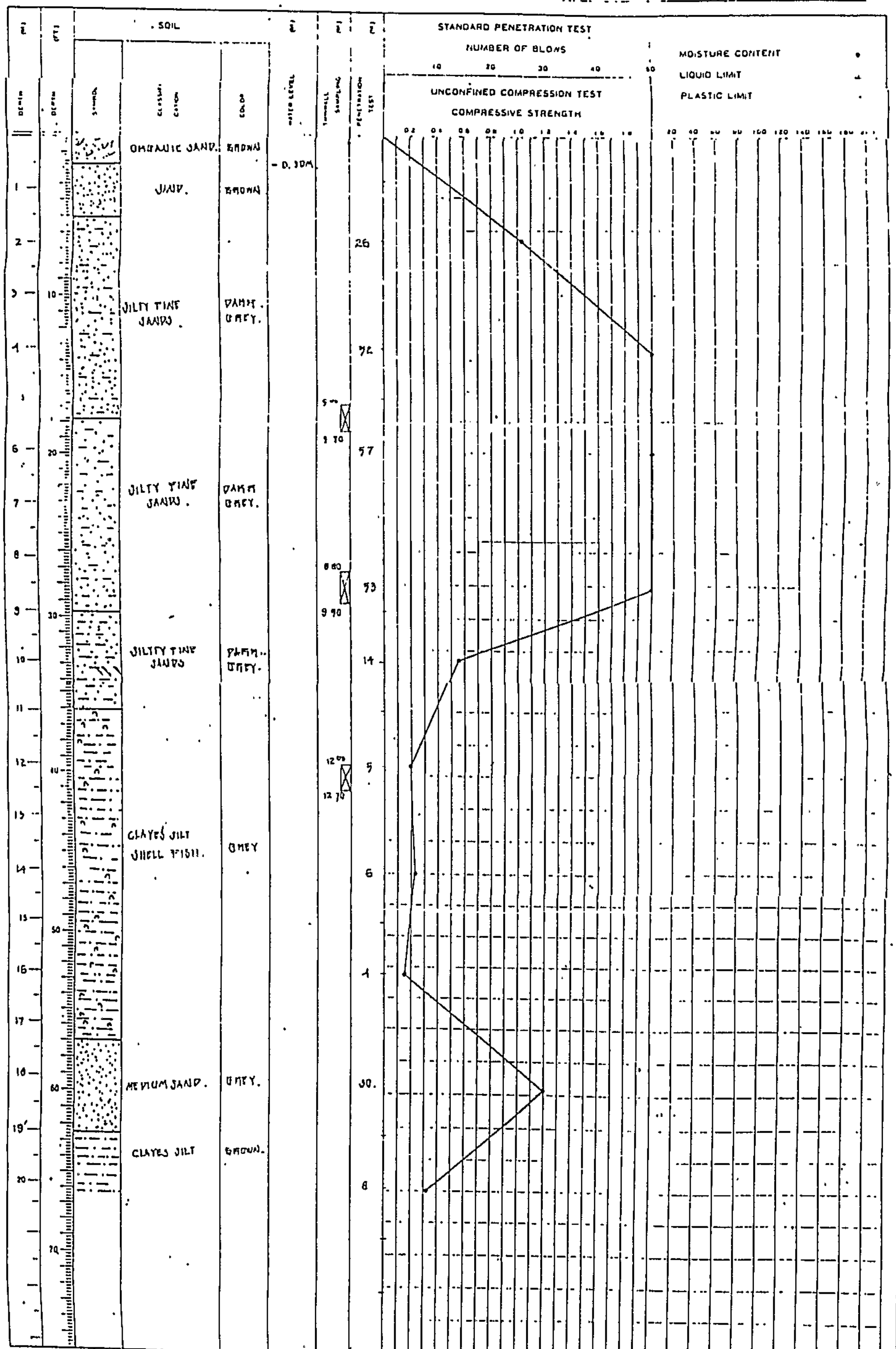
LOCATION : Tabing
PROVINCE : West Sumatra
DATE :
TESTED BY :

BORING NO.	DEPTH (m).	Atterberg Limits LL %	PL %	PI %	GRAIN SIZE ANALYSIS PERCENT FINER THAN ASTM SIEVES 10	20	40	80	100	200	Unit Weight V	Water Content W	Specific Gravity Gs	Void Ratio e	Porosity n	Degree of saturation % SR	Shear Strength Kg/cm2 Su	Cohesion Kg/m2 C	Angle of int. Friction Q	Unconf. comp. strength Kg/m2 Qu	Soil Classification Usc	Hrb	Gt	Relative Density % Dr	Coef of Permeability Cm/Su K	Compression index Cc	Coef of Compressibility Av	Coef of Consolidation Cv	Sensitiviti	DESCRIPTION
Test Pit																														
I	0.50	N.P	N.P	-	23	15.7	7.3	2.0	1.6	0.7		10.3	2.78																	
	1.00	N.P	N.P	-	20.5	10.9	6.2	2.93	1.3	0.4		8.5	2.86																	
	1.50	N.P	N.P	-	49	27.5	11.0	3.1	2.6	1.61		6.8	2.75																	
II	0.50	76.6	41.6	30	99.9	99.8	99.6	98.2	97.9	93.8		57.5	2.63																	
	1.00	68.4	45.7	22.7	99.8	99.5	98.6	96.8	96.3	91.9		67.2	2.63																	
	1.50	62.6	36.9	25.7	99.92	99.88	99.78	97.9	96.8	86.68		59.2	2.67																	
III	0.00	N.P	N.P	-	99.9	98.6	85.5	19.1	12.9	4.0		36.7	2.43																	
	1.00	N.P	N.P	-	99.88	98.37	82.3	18.96	11.2	5.73		38.1	2.72																	
	1.50	N.P	N.P	-	99.88	97.65	78.2	17.8	14.0	7.1		44.4	2.68																	
Mechanical Boring																														
I/1	1.55	NP	NP		98.5	94.2	80.9	21.4	15.8	5.2		29.1	2.77																	
I/3	5.00 5.70	NP	NP		99.61	98.9	98.4	97.6	97.0	72.0		34.1	2.77																	
I/6	8.85 - 9.50	NP	NP		98.5	97.1	96.4	94.2	93.5	57.6		47.1	2.67																	
I/9	12.00 ~ 12.70	58.9	41.6	17.3	99.5	99.0	99.6	97.2	97.0	95.8		66.5	2.68																	
I/10	13.55 ~ 14.00	65.2	46.5	18.7	99.5	99.0	98.6	97.3	97.0	93.8		56.2	2.69																	
I/12	18.15 ~ 19.55	N.P	N.P		99.96	99.39	92.15	40.54	33.98	13.61		36.6	2.78																	

APPENDIX 8.2.3 SOIL PROFILE AT TABING

SOIL PROFILE

PROJECT: AIR PORT
LOCATION: TABING.
BOREHOLE NO: I
BORING DEPTH (M): 20 M
TEST METHOD: ROTARY DRILLING.
TYPE OF MACHINE: ACKER.
COMPLETED DATE:
SOILS AND MATERIALS ENGINEER: UEDI MAKSADI
TECHNICIAN: MUAR MUKTAR.



APPENDIX 8.2.4 RESULT OF CBR TEST

CALIFORNIA BEARING RATIO | DATE | TESTED BY Nerinas

PROJECT Airport | SAMPLING LOCATION Tabing | SAMPLE NO. I / 2 / 1.00 m

MOLD NO.		11	
SAMPLE CONDITION	DISTURBED	DISTURBED	DISTURBED
NUMBER OF LAYERS		5	5
NUMBER OF BLOWS PER LAYER		56	56
MAXIMUM PARTICLE SIZE (mm)		19.05	19.05
WEIGHT OF SAMPLE + MOLD (g)		11618	11618
WEIGHT OF MOLD (g)		7306	7306
WEIGHT OF SAMPLE (g)		4317	4312
VOLUME OF MOLD (cm³)		2060	2060
WET DENSITY γt (g/cm³)		2,093	2.093
DRY DENSITY γd (g/cm³)		1.84	1.84

INITIAL WATER CONTENT			
MOLD NO		11	
TARE NO.		010	
WEIGHT OF TARE + WET SOIL (g)		112.80	
WEIGHT OF TARE + DRY SOIL (g)		101.80	
WEIGHT OF TARE (g)		26.61	
WEIGHT OF WATER (g)		10.28	
WEIGHT OF DRY SOIL (g)		75.19	
WATER CONTENT (%)		13.80	

AVERAGE W = ...%

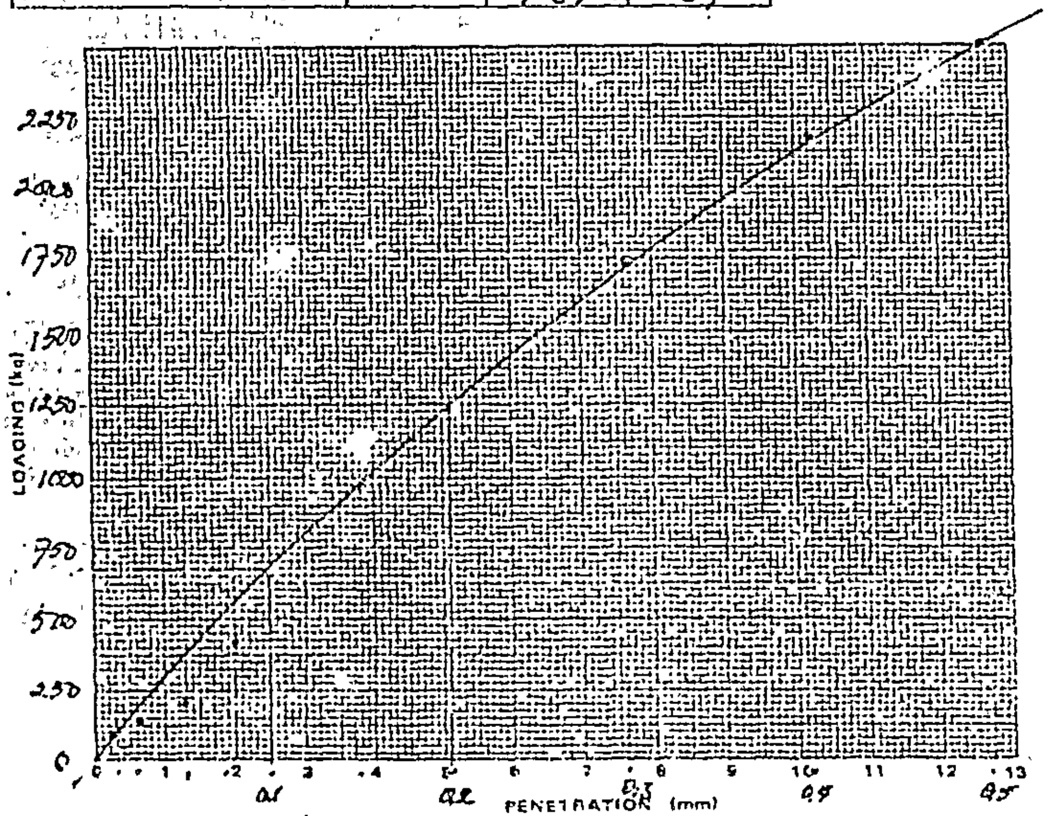
SOAKED TIME	MOLD NO.	SWELLED Lo (mm)	SWELLED δ e (%)
95			
HOURS (4 DAYS)	11	0,102	0,09

AFTER SWELL			
MOLD NO		11	
WEIGHT OF SAMPLE + MOLD (g)		11918	
WEIGHT OF SAMPLE (g)		4612	
VOLUME OF SAMPLE (cm³)		2060	
WET DENSITY γt (g/cm³)		2.239	
DRY DENSITY γd (g/cm³)		1.84	
WATER CONTENT w (%)		22.76	

PENETRATION	2.5 mm	5.0 mm	CORRECTED LOAD 2.5 mm	CORRECTED LOAD 5.0 mm
LOADING (kg) MOLD NO. 11				
MOLD NO.	675	1250		
MOLD NO.				

CBR (%)	PENETRATION 2.5 mm	PENETRATION 5.0 mm
MOLD NO. 11		
MOLD NO.	22.5	27.8
MOLD NO.		

STANDARD LOAD (2.5 mm) 1370 kg
AVERAGE CBR = 22.5 %
STANDARD LOAD (5.0 mm) 2030 kg
AVERAGE CBR = 27.8 %



FINAL WATER CONTENT			
MOLD NO.		11	AVERAGE OF WATER CONTENT
TARE NO.		19	
WEIGHT OF TARE + WET SOIL		156.65	
WEIGHT OF TARE + DRY SOIL		132.52	
WEIGHT OF TARE		26.48	
WEIGHT OF WATER		24.13	w = 22.76
WEIGHT OF DRY SOIL		106.04	
WATER CONTENT		22.76	

CALIFORNIA BEARING RATIO

DATE

TESTED BY Erman

PROJECT Airport

SAMPLING LOCATION Tobing

SAMPLE NO. II/2/1.00

MOLD NO		27	
SAMPLE CONDITION	DISTURBED	DISTURBED	DISTURBED
NUMBER OF LAYERS		5	
NUMBER OF BLOWS PER LAYER		56	
MAXIMUM PARTICLE SIZE (mm)		4.75	
WEIGHT OF SAMPLE + MOLD (g)		10532	
WEIGHT OF MOLD (g)		6875	
WEIGHT OF SAMPLE (g)		3657	
VOLUME OF MOLD (cm³)		2060	
WET DENSITY γ_t (g/cm³)		1.775	
DRY DENSITY γ_d (g/cm³)		1.33	

INITIAL WATER CONTENT			
MOLD NO.		27	
TARE NO.		84	
WEIGHT OF TARE + WET SOIL (g)		85.49	
WEIGHT OF TARE + DRY SOIL (g)		70.56	
WEIGHT OF TARE (g)		26.55	
WEIGHT OF WATER (g)		14.73	
WEIGHT OF DRY SOIL (g)		44.0	
WATER CONTENT (%)		33.47	

AVERAGE W = 33.47

SOAKED TIME	MOLD NO.	SWELLED Lc (mm)	SWELLED δ = (%)
95 HOURS (4 DAYS)	27	0.179	0.15

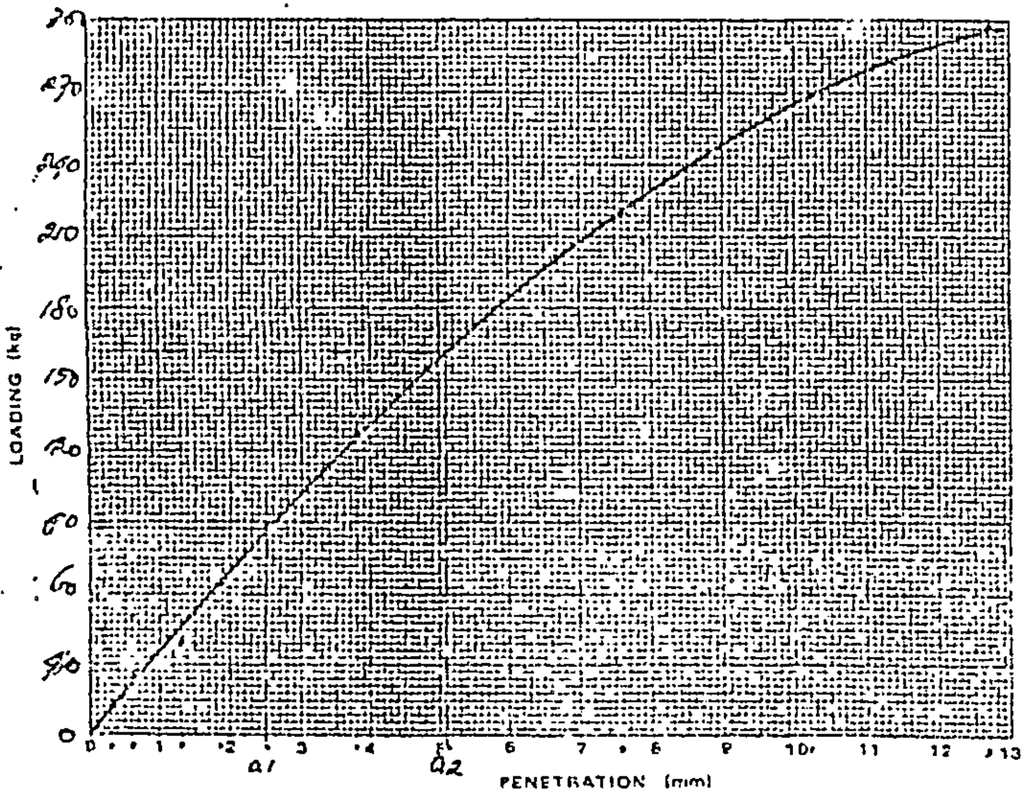
AFTER SWELL			
MOLD NO.		27	
WEIGHT OF SAMPLE+MOLD (g)		10387	
WEIGHT OF SAMPLE (g)		3512	
VOLUME OF SAMPLE (cm³)		2060	
WET DENSITY γ_t' (g/cm³)		1.894	
DRY DENSITY γ_d' (g/cm³)		1.30	
WATER CONTENT w' (%)		45.58	

LOADING (kg) PENETRATION	2.5 mm	5.0 mm	CORRECTED LOAD 2.5 mm	CORRECTED LOAD 5.0 mm
MOLD NO.				
MOLD NO. 27	87	162		
MOLD NO.				

CBR (%)	PENETRATION 2.5 mm	PENETRATION 5.0 mm
MOLD NO.		
MOLD NO. 27	2.9	8.6
MOLD NO		

STANDARD LOAD (2.5 mm) 1370 kg
AVERAGE CBR = 2.9 %
STANDARD LOAD (5.0 mm) 2030 kg
AVERAGE CBR = 3.6 %

FINAL WATER CONTENT				AVERAGE OF WATER CONTENT
MOLD NO.		27		
TARE NO.		TE		
WEIGHT OF TARE+WET SOIL		67.1		
WEIGHT OF TARE+DRY SOIL		54.42		
WEIGHT OF TARE		26.60		45.58
WEIGHT OF WATER		12.68		
WEIGHT OF DRY SOIL		27.82		
WATER CONTENT		45.58		



CALIFORNIA BEARING RATIO

DATE		TESTED BY	Remikos
PROJECT Air port	SAMPLING LOCATION Tabing	SAMPLE NO. III - 2 / 000 - 100	

MOLD NO		47	
SAMPLE CONDITION	UNDISTURBED DISTURBED	UNDISTURBED DISTURBED	UNDISTURBED DISTURBED
NUMBER OF LAYERS		5	
NUMBER OF BLOWS PER LAYER		56	
MAXIMUM PARTICLE SIZE (mm)		4.75	
WEIGHT OF SAMPLE + MOLD (g)		10666	
WEIGHT OF MOLD (g)		6797	
WEIGHT OF SAMPLE (g)		3869	
VOLUME OF MOLD (cm³)		2060	
WET DENSITY γ_t (g/cm³)		1.878	
DRY DENSITY γ_d (g/cm³)		1.55	

INITIAL WATER CONTENT			
MOLD NO.		47	
TARE NO.		4	
WEIGHT OF TARE + WET SOIL (g)		100.38	
WEIGHT OF TARE + DRY SOIL (g)		87.46	
WEIGHT OF TARE (g)		26.27	
WEIGHT OF WATER (g)		12.92	
WEIGHT OF DRY SOIL (g)		61.19	
WATER CONTENT (%)		21.13	

AVERAGE W = 21.13 %

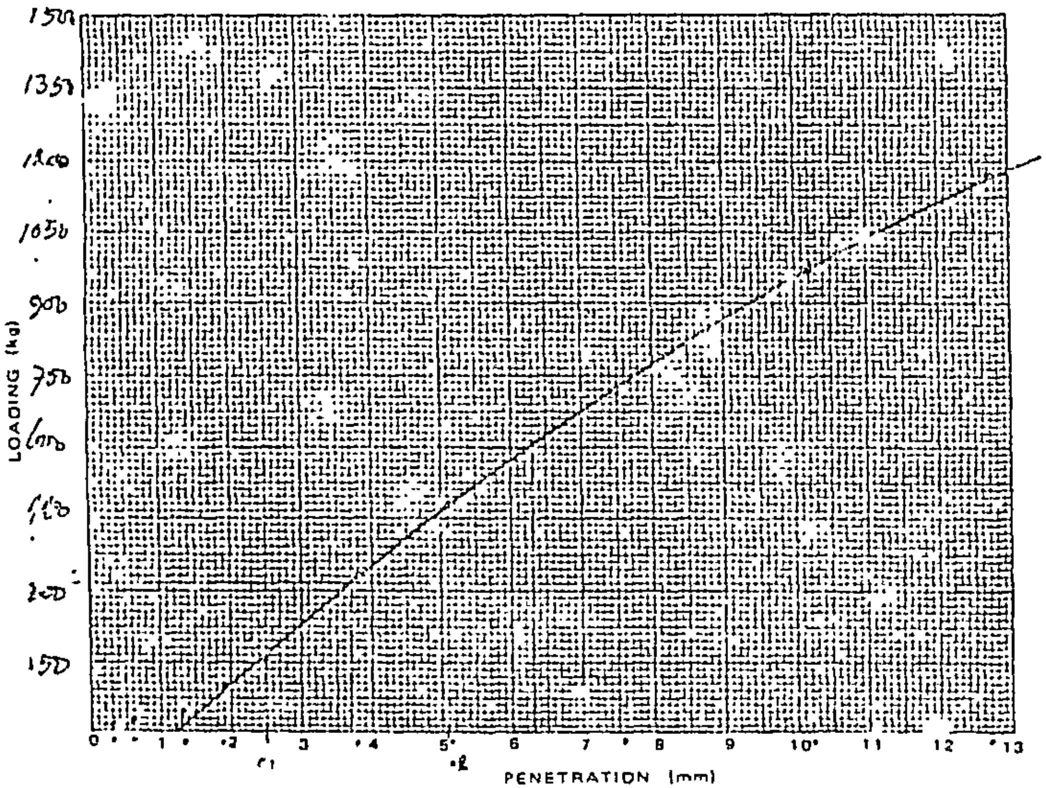
SOAKED TIME	MOLD NO.	SWELLED Le (mm)	SWELLED δ = (%)
95 HOURS (4 DAYS)	47	0.076	0.06

AFTER SWELL			
MOLD NO.		47	
WEIGHT OF SAMPLE + MOLD (g)		10 938	
WEIGHT OF SAMPLE (g)		4191	
VOLUME OF SAMPLE (cm³)		2060	
WET DENSITY γ_t' (g/cm³)		2,010	
DRY DENSITY γ_d' (g/cm³)		1.52	
WATER CONTENT w (%)		32.23	

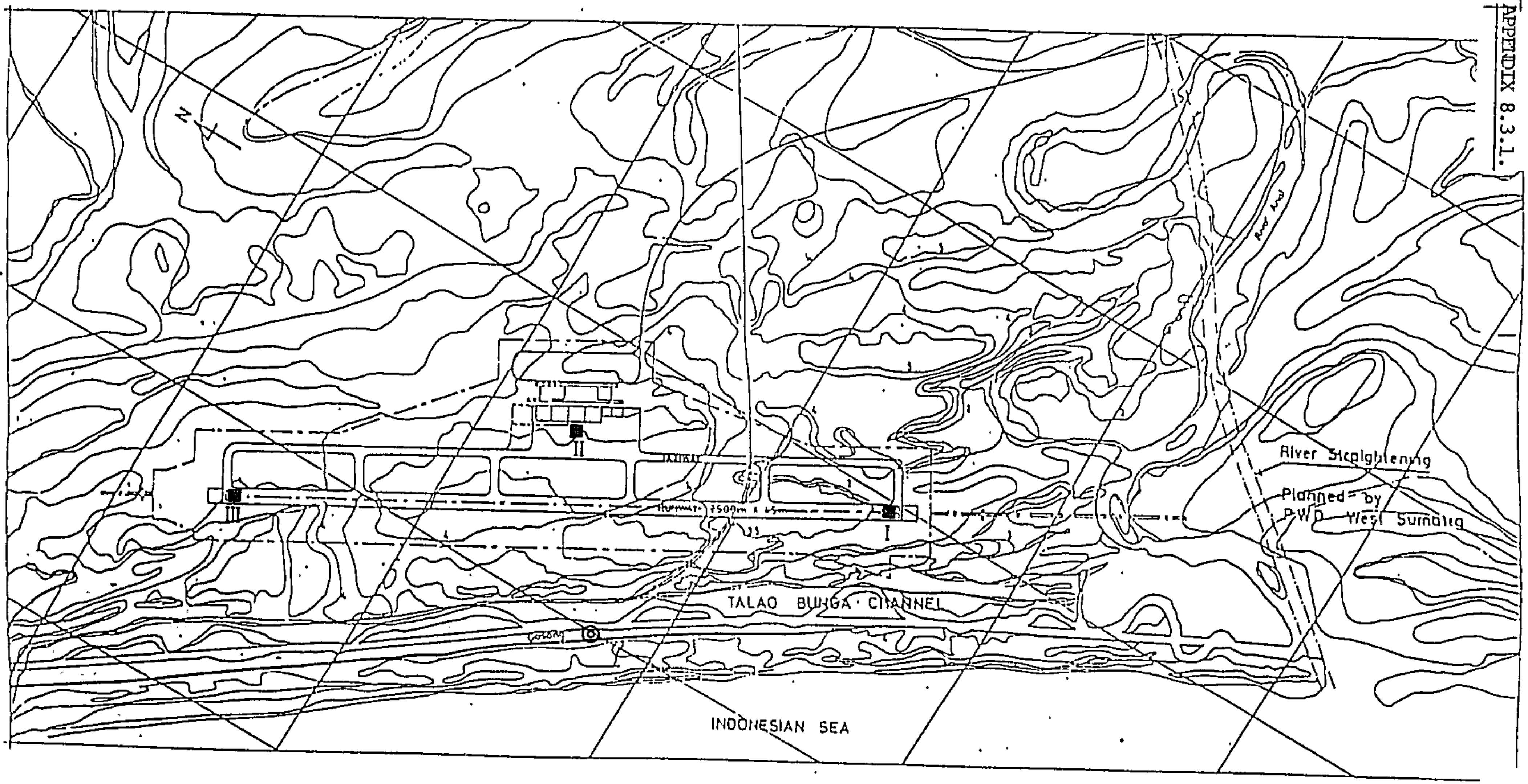
PENETRATION	2.5 mm	5.0 mm	CORRECTED LOAD 2.5 mm	CORRECTED LOAD 5.0 mm
LOADING (kg) MOLD NO.				
MOLD NO. 47	315	600		
MOLD NO.				

CBR (%)	PENETRATION 2.5 mm	PENETRATION 5.0 mm
MOLD NO.		
MOLD NO. 47	10.5	13.3
MOLD NO		

STANDARD LOAD (2.5 mm) 1370 kg
AVERAGE CBR = ... 10.5 %
STANDARD LOAD (5.0 mm) 2030 kg
AVERAGE CBR = 13.3 %



FINAL WATER CONTENT				
MOLD NO		47		AVERAGE OF WATER CONTENT
TARE NO.		136		
WEIGHT OF TARE + WET SOIL		111.18		
WEIGHT OF TARE + DRY SOIL		90.59		
WEIGHT OF TARE		26.69		w = 32.23 %
WEIGHT OF WATER		20.59		
WEIGHT OF DRY SOIL		63.85		
WATER CONTENT		32.23		



APPENDIX 8.3.1 LOCATION OF SOIL INVESTIGATION AT KETAPING

APPENDIX 8.3.2 SOIL INVESTIGATION SUMMARY AT KETAPING

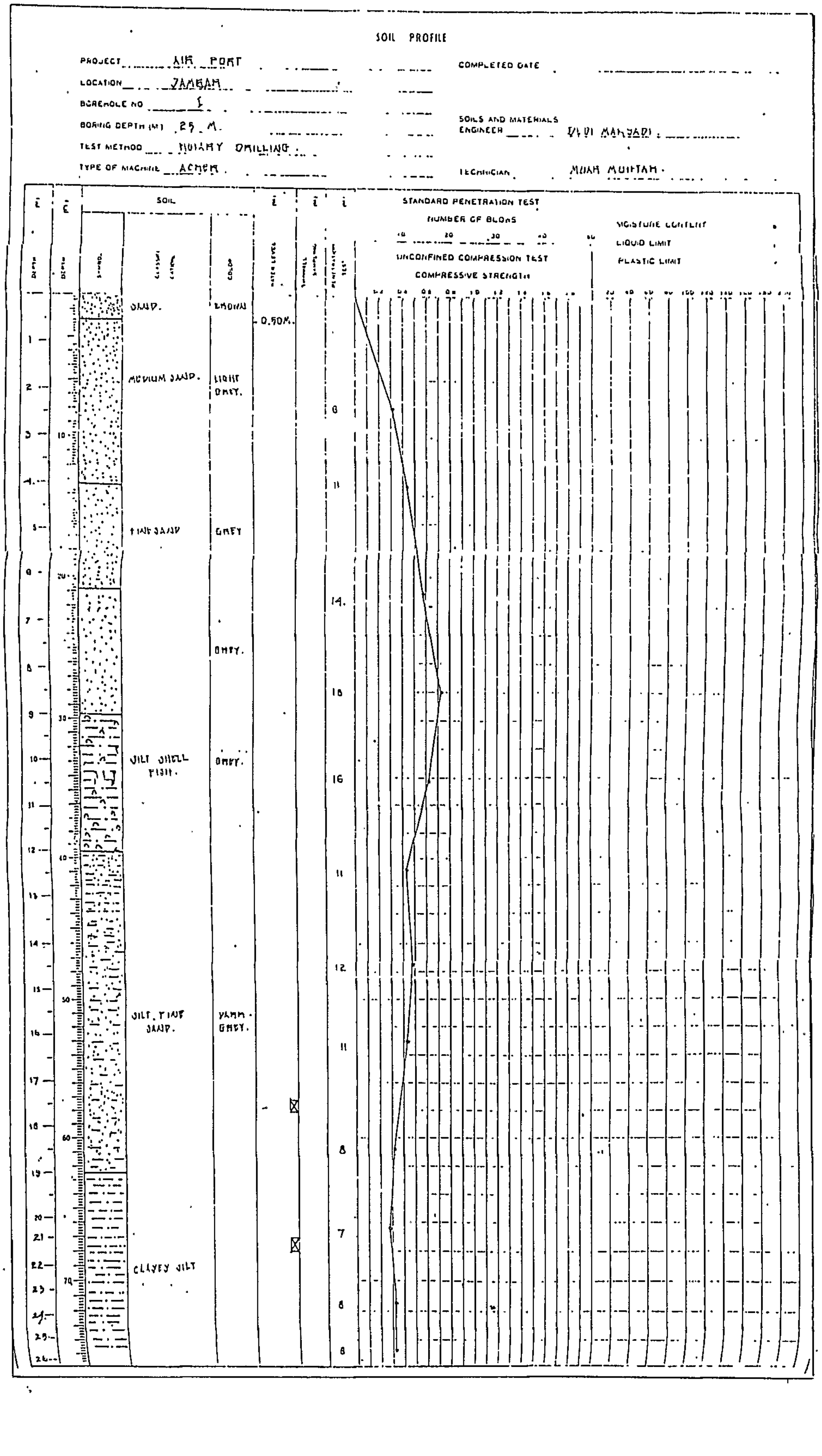
DINAS PEKERJAAN UMUM PROP. DAERAH TK. I SUMATERA BARAT
LABORATORIUM PENYELIDIKAN TANAH DAN JALAN
SOIL INVESTIGATION SUMMARY

LOCATION : Jombak
PROVINCE : West Sumatra
DATE :
TESTED BY :

BORING NO.	DEPTH (m).	Atterberg Limits LL	PL	PI	GRAIN SIZE ANALYSIS PERCENT FINER THAN, ASTM SIEVES 10	20	40	80	100	200	Unit Weight	Water Content	Specific Gravity	Void Ratio	Porosity	Degree of Saturation %	Shear Strength Kg/cm2	Cohesion Kg/m2	Angle of int. Friction	Unconf. comp. strength Kg/m2	Soil Classification			Relative Density %	Coef of Permeability Cm/Sn	Compression index	Coef of Compressibility	Coef of Consolidation	Sensitivity	DESCRIPTION
		%	%	%							V	W	Gs	e	n	SR	Su	C	Q	Qu	Usc	Hrb	Gt	Dr	K	Cc	Av	Cv		
Test Pit I	0.50	N.P	N.P		99.3	90.68	47.8	6.5	42	2.1		7.3	2.78																	
	1.00	---	---		99.0	87.7	87.2	51.8	503	48.7		6.7	2.79																	
	1.50	---	---		98.96	97.9	69.7	16.8	4.0	3.3		8.9	2.76																	
II	0.50	N.P	N.P		99.81	90.69	41.76	3.94	2.48	0.87		36.9	2.57																	
	1.00	---	---		99.8	90.8	42.3	5.3	4	2.3		30.3	2.73																	
	1.50	---	---		99.83	92.8	47.7	3.82	2.3	1.0		17.4	2.80																	
III	0.50	N.P	N.P		99.85	86.80	30.10	2.42	1.87	1.46		9.2	2.76																	
	1.00	---	---		99.8	86.4	30.6	3.1	2.5	1.9		8.9	2.71																	
	1.50	---	---		99.9	95.2	53.8	5.10	40	3.2		8.7	2.81																	
Mechanical Boring I/1	0.50 ~ 2.00	N.P	NP		96.9	79.6	42.4	5.4	4.6	3.6		2.86	2.66																	
I/2	2.45 ~ 3.50	---	---		99.1	93.7	66.4	8.3	6.8	5.2		21.9	2.67																	
I/5	6.00 ~ 6.45	---	---		62.2	38.6	32.0	25.8	23.8	5.5		54.2	2.71																	
I/8	12.00 ~ 12.45	49.4	35.6	13.8	99.9	99.8	99.7	99.5	99.4	98.2		42.7	2.61								[illegible]									
I/11	17.30 ~ 18.00	57.0	42.2	11.8	99.92	99.86	99.74	99.44	99.42	98.88		53.4	2.65																	
I/14	21.00 ~ 21.70	65.0	36.4	28.8	91.98	99.94	99.74	99.56	99.48	99.14		60.8	2.61																	
I/16	25.00 ~ 25.45	54.2	33.7	20.5	99.96	99.80	99.5	98.64	98.54	97.76		70.1	2.65																	

note: N.P (non Plastic)

APPENDIX 8.3.3 SOIL PROFILE AT KETAPING



APPENDIX 8.3.4 RESULT OF CBR TEST

CALIFORNIA BEARING RATIO

DATE		TESTED BY	Erman.
PROJECT	AIRport	SAMPLING LOCATION	Jambak
SAMPLE NO.	I/2 /100 m		

MOLD NO.		86	
SAMPLE CONDITION	[illegible] DISTURBED	[illegible] DISTURBED	[illegible] DISTURBED
NUMBER OF LAYERS		5	
NUMBER OF BLOWS PER LAYER		56	
MAXIMUM PARTICLE SIZE (mm)		4.75	
WEIGHT OF SAMPLE + MOLD (g)		11546	
WEIGHT OF MOLD (g)		7250	
WEIGHT OF SAMPLE (g)		4296	
VOLUME OF MOLD (cm³)		2060	
WET DENSITY γ_t (g/cm³)		2.085	
DRY DENSITY γ_d (g/cm³)		1.79	

INITIAL WATER CONTENT			
MOLD NO.		86	
TARE NO.		AE	
WEIGHT OF TARE + WET SOIL (g)		107.61	
WEIGHT OF TARE + DRY SOIL (g)		96.13	
WEIGHT OF TARE (g)		26.60	
WEIGHT OF WATER (g)		11.48	
WEIGHT OF DRY SOIL (g)		69.53	
WATER CONTENT (%)		16.51	

AVERAGE W = 16.51 %

SOAKED TIME	MOLD NO.	SWELLED Le (mm)	SWELLED γ_s (%)
95 HOURS (4 DAYS)	86	0.102	0.09

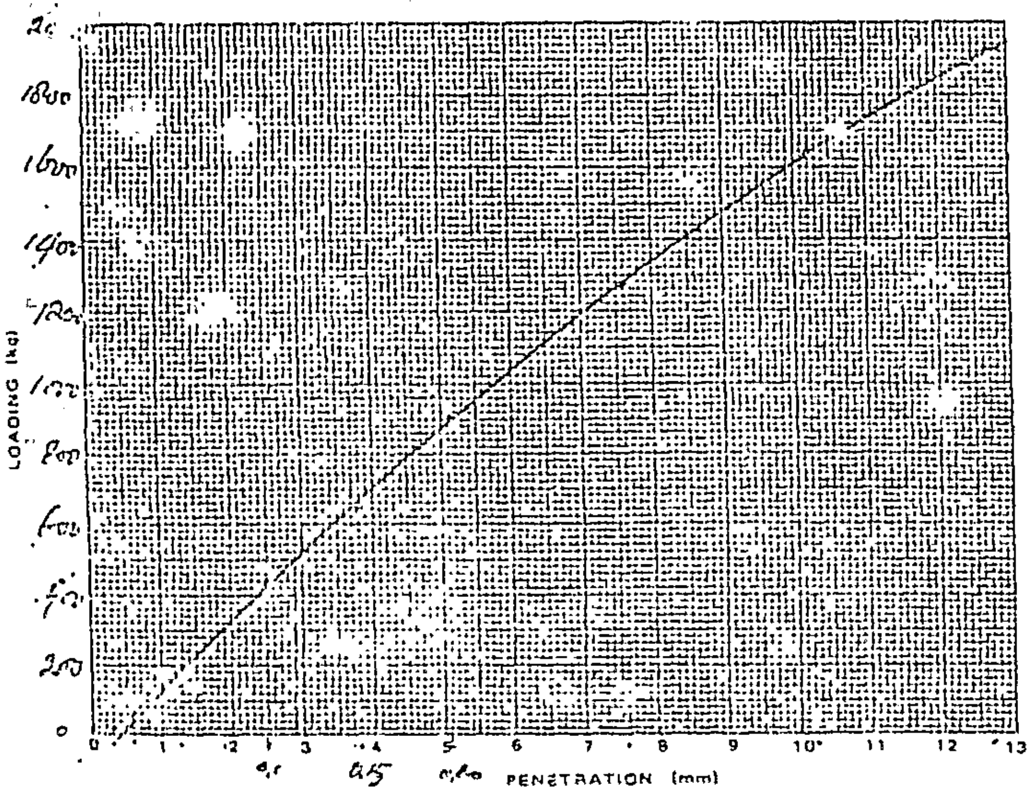
AFTER SWELL			
MOLD NO.		86	
WEIGHT OF SAMPLE + MOLD (g)		11656	
WEIGHT OF SAMPLE (g)		4406	
VOLUME OF SAMPLE (cm³)		2060	
WET DENSITY γ_t' (g/cm³)		2.139	
DRY DENSITY γ_d' (g/cm³)		1.76	
WATER CONTENT w (%)		21.72	

PENETRATION	2.5 mm	5.0 mm	CORRECTED LOAD 2.5 mm	CORRECTED LOAD 5.0 mm
LOADING (kg) MOLD NO.				
MOLD NO. 86	500	960		
MOLD NO.				

CBR (%)	PENETRATION 2.5 mm	PENETRATION 5.0 mm
MOLD NO.		
MOLD NO. 86	16.7	21.3
MOLD NO.		

STANDARD LOAD (2.5 mm) 1370 kg
AVERAGE CBR = 16.7 %
STANDARD LOAD (5.0 mm) 2030 kg
AVERAGE CBR = 21.3 %

FINAL WATER CONTENT				
MOLD NO		86		AVERAGE OF WATER CONTENT
TARE NO		33		
WEIGHT OF TARE + WET SOIL		165.21		
WEIGHT OF TARE + DRY SOIL		140.90		
WEIGHT OF TARE		26.46		w 21.72 %
WEIGHT OF WATER		24.31		
WEIGHT OF DRY SOIL		113.99		
WATER CONTENT		21.72		



CALIFORNIA BEARING RATIO

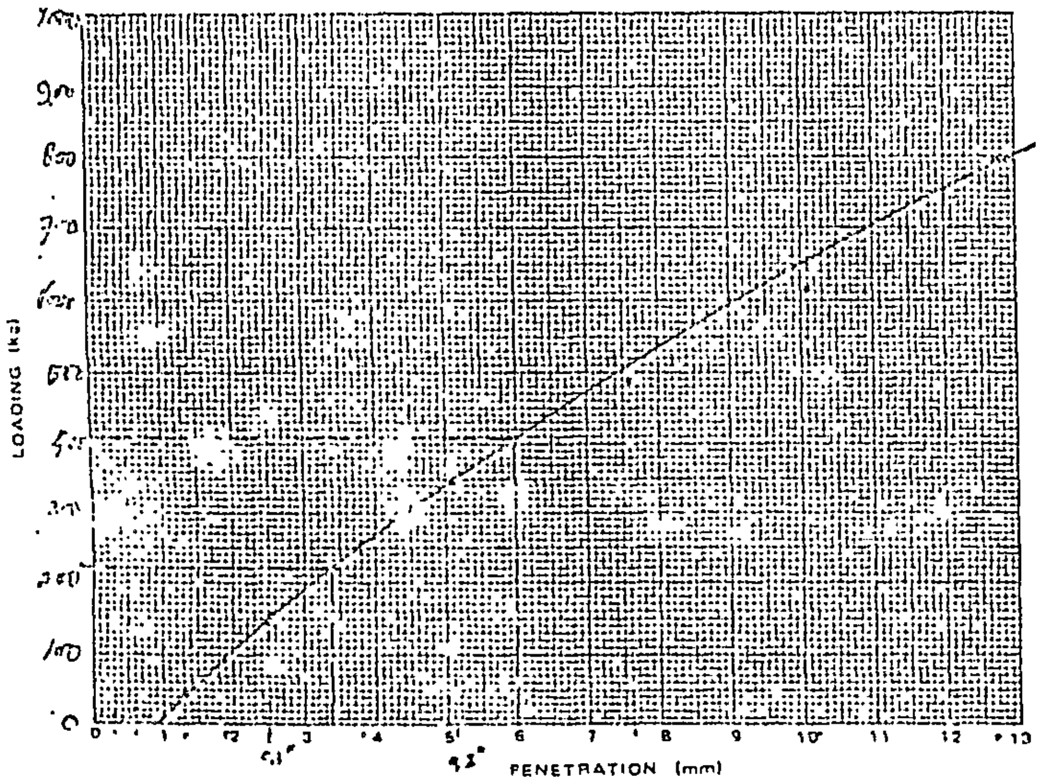
DATE		TESTED BY	Nenirlas
PROJECT	AIRPORT	SAMPLING LOCATION	JAMBAR
SAMPLE NO.	II-2 1000-1100		

MOLD NO.		12	
SAMPLE CONDITION	DISTURBED	DISTURBED	DISTURBED
NUMBER OF LAYERS		5	
NUMBER OF BLOWS PER LAYER		56	
MAXIMUM PARTICLE SIZE (mm)		4.75	
WEIGHT OF SAMPLE + MOLD (g)		10630	
WEIGHT OF MOLD (g)		6988	
WEIGHT OF SAMPLE (g)		3842	
VOLUME OF MOLD (cm³)		2060	
WET DENSITY γ_t (g/cm³)		1.865	
DRY DENSITY γ_d (g/cm³)		1.61	

INITIAL WATER CONTENT			
MOLD NO		12	
TARE NO		D11	
WEIGHT OF TARE + WET SOIL (g)		107.08	
WEIGHT OF TARE + DRY SOIL (g)		96.10	
WEIGHT OF TARE (g)		26.73	
WEIGHT OF WATER (g)		10.98	
WEIGHT OF DRY SOIL (g)		69.37	
WATER CONTENT (%)		15.83	

AVERAGE W = 15.83 %

SOAKED TIME	MOLD NO.	SWELLED	
		Ls (mm)	δs (%)
95 HOURS (4 DAYS)	56	0.02	0.09



AFTER SWELL			
MOLD NO.		12	
WEIGHT OF SAMPLE + MOLD (g)		11070	
WEIGHT OF SAMPLE (g)		4082	
VOLUME OF SAMPLE (cm³)		2060	
WET DENSITY γ_t (g/cm³)		1.982	
DRY DENSITY γ_d (g/cm³)		1.57	
WATER CONTENT w (%)		25.52	

PENETRATION	2.5 mm	5.0 mm	CORRECTED LOAD 2.5 mm	CORRECTED LOAD 5.0 mm
LOADING (kg) MOLD NO.				
MOLD NO 12	220	910		
MOLD NO.				

CBR (%)	PENETRATION 2.5 mm	PENETRATION 5.0 mm
MOLD NO.		
MOLD NO. 12	2.3	9.1
MOLD NO.		

STANDARD LOAD (2.5 mm) 1370 kg
AVERAGE CBR = 2.2 %
STANDARD LOAD (5.0 mm) 2030 kg
AVERAGE CBR = 9.0 %

FINAL WATER CONTENT				AVERAGE OF WATER CONTENT
MOLD NO		12		
TARE NO.		50		
WEIGHT OF TARE + WET SOIL		137.21		
WEIGHT OF TARE + DRY SOIL		114.95		
WEIGHT OF TARE		27.95		
WEIGHT OF WARER		22.81		w = 25.92 %
WEIGHT OF DRY SOIL		88		
WATER CONTENT		25.92		

CALIFORNIA BEARING RATIO

DATE		TESTED BY	Ermon

PROJECT: Air Port | SAMPLING LOCATION: Jambak | SAMPLE NO. III - 2 / 000 - 100

MOLD NO.		22	
SAMPLE CONDITION	DISTURBED	DISTURBED	DISTURBED
NUMBER OF LAYERS		5	
NUMBER OF BLOWS PER LAYER		56	
MAXIMUM PARTICLE SIZE (mm)		4.75	
WEIGHT OF SAMPLE + MOLD (g)		11178	
WEIGHT OF MOLD (g)		7149	
WEIGHT OF SAMPLE (g)		4029	
VOLUME OF MOLD (cm³)		2060	
WET DENSITY γ_t (g/cm³)		1.956	
DRY DENSITY γ_d (g/cm³)		1.65	

INITIAL WATER CONTENT			
MOLD NO		22	
TARE NO.		216	
WEIGHT OF TARE + WET SOIL (g)		69.82	
WEIGHT OF TARE + DRY SOIL (g)		62.09	
WEIGHT OF TARE (g)		26.51	
WEIGHT OF WATER (g)		7.73	
WEIGHT OF DRY SOIL (g)		36.53	
WATER CONTENT (%)		18.56	

AVERAGE W = 18.56%

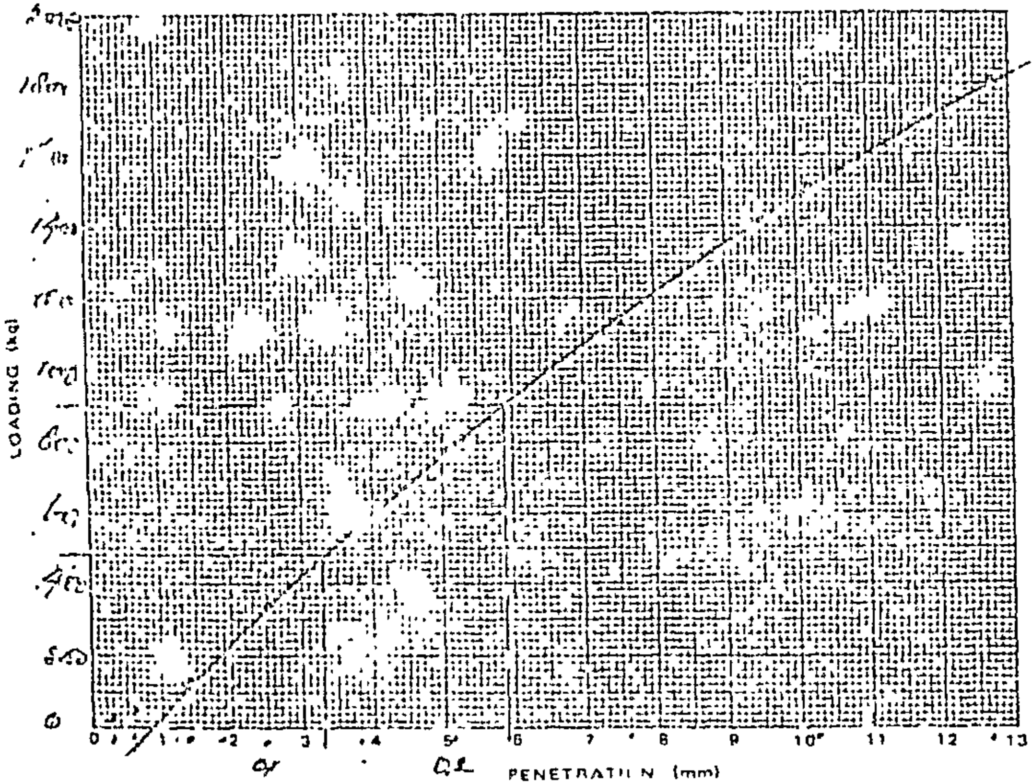
SOAKED TIME	MOLD NO.	SWELLED Le (mm)	SWELLED δ = (%)
35 HOURS (4 DAYS)	22	0.152	0.09

AFTER SWELL			
MOLD NO.		22	
WEIGHT OF SAMPLE + MOLD (g)		11318	
WEIGHT OF SAMPLE (g)		4169	
VOLUME OF SAMPLE (cm³)		2060	
WET DENSITY γ_t (g/cm³)		2.023	
DRY DENSITY γ_d (g/cm³)		1.56	
WATER CONTENT w (%)		29.59	

PENETRATION	2.5 mm	5.0 mm	CORRECTED LOAD 2.5 mm	CORRECTED LOAD 5.0 mm
LOADING (kg) MOLD NO.				
MOLD NO 22	180	400		
MOLD NO.				

CBR (%)	PENETRATION 2.5 mm	PENETRATION 5.0 mm
MOLD NO.		
MOLD NO 22	16	20
MOLD NO.		

STANDARD LOAD (2.5 mm) 1370 kg
AVERAGE CBR = 16 %
STANDARD LOAD (5.0 mm) 2030 kg
AVERAGE CBR = 20 %



FINAL WATER CONTENT				AVERAGE OF WATER CONTENT
MOLD NO		22		
TARE NO.		010		
WEIGHT OF TARE + WET SOIL		175.83		
WEIGHT OF TARE + DRY SOIL		141.76		
WEIGHT OF TARE		26.61		w = 29.59%
WEIGHT OF WATER		34.07		
WEIGHT OF DRY SOIL		115.15		
WATER CONTENT		29.59		

APPENDIX TO CHAPTER 11

APPENDIX 11
ECONOMIC ANALYSIS OF PROJECT

1. Basic Concept

A project is series of economic activities consisting of investment and other input costs which will produce a variety of outputs (benefit), some are tangible such as goods and services, and some are not tangible such as convenience etc., all of them beneficial to the society. It may also often produce output which may not be beneficial to the society. There are termed disbenefits and consist of such outcome as pollution and destruction of natural landscapes.

The objective of economic analysis is to assess economic contribution of such project to the national economy. To do so, the economic analysis should :

1) identify and measure economic cost and benefits arising from the project; and
2) compare them to assess the economic profitability of the project.

Shadow Prices : Economic cost and benefit should be valued at economic prices, which may be different from financial or actually prevailing market prices. If there is a high rate of unemployment in the economy, wages to value the unskilled labor cost should be adjusted from the actual market wages to such a price as reflects this fact. Normally the economic wages should be lower than the market wage. Hence a project which hires more unskilled labor will have lower labor cost than other projects and consequently is considered contributing more to the economy as it creates more jobs. Similarly when a country has foreign exhange difficulty, then the exchange rate should be adjusted so that it reflect the scarecity of foreign exchange. In such a case, a project which utilizes more domestic resources, or produces more exportable goods is judged to be contributing more to the economy than the one which utilized more imported goods. These economic prices, different from the market prices when a free market competition is hampered for some reasons are called shadow prices.

With and without the project : Economic analysis of a project is to measure net contribution of the project to the economy. To do so, it is necessary to compare the situations with the project and without the project. Investment is normally net input to the economy. On the other hand, a part of economic benefit which accrues to the project may be realized without the project. An irrigation project may increase rice production, which is a major part of economic benefits to the irrigation project. But rice could be produced without the irrigation. Hence it is necessary to measure the incremental rice production due to the investment, then to attribute it to the project as its benefits. To do this, both cost and benefits should be measured "with" and "without" the project, then their differences are the incremental cost and benefit attributable to the project.

2. Theoretical Framework

This section sets up the theoretical framework of economic analysis for an airport project. Macroeconomic framework of economic analysis is described. Then the economic activites surrounding an airport and their relation to the macroeconomic variables are defined. Finally, an multisectoral model for an airport project will be discussed.

2.1. Macroeconomic Model

The macroeconomic framework for economic analysis of project is first set up. The next is the well-known material balance equation.

(2.1) $X = Q + C + G + I + J + E - M,$

where X = total gross production,
Q = intermediate input,
C = private consumption expenditures,
G = public consumption expenditures,

I = fixed capital formation,

J = changes in stocks,

E = exports, and

M = imports.

All of these variables can be interpreted as scalar variables which represent aggregates of each activity or vector variables whose dimension represents of the number of sectors. This equation can be interpreted as representing the ex-post equilibrium of two equations, namely,

(2.2) Supply of goods = X + M , and

(2.3) Demand for goods = Q + C + G + I + J + E.

It is also noted that

(2.4) GDP = X - Q

Economic analysis of a project analyzes changes in variables in equation (2.1) "with" and "without" the project. As defined earlier , a project produces a series of benefits to the society, by utilizing economic resources consisting of capital, labor, and materials inputs.

Pure theoretical approach to the project analysis first defines the welfare function of the society and analyse the cost of resource utilization and compare them with the realized welfare increase.

First define the production function as :

(2.5) X = F (K , L , Q)

where K = capital stock,

L = labor, and

Q = intermediate inputs.

Assume that this function F satisfies normal regularity conditions on the production function. Next define the social welfare function.

(2.6) $W = W (Y_1 , \ldots , Y_m)$,

where W = the social welfare, and

$Y_1 , \ldots , Y_m$ = all relevant economic variables

With these equations defined, project analysis is more formally defined.

Definition 1 : A project is an economic activity which utilizes investment (i), labor input (l), and raw materials (q) to produce goods and services. i, l, and g are called inputs to the project and are increments to K, L, and Q in (2.5).

Through the relation (2.5), a project will change $Y_1 , \ldots , Y_m$, hence W. The project analysis may be now redefined.

Definition 2 : Net increment of an economic variable due to a project whose input are i, l, and q is defined as difference between the value of the variable with i, l, and q and that with i, l, q = 0. A project analysis compares the economic value of l, l, q with ΔW.

Theoretically and ideally, benefits ought to be measured as increases in the social welfare. However, the social welfare function may not be uniquely defined. If the objectives of a country are clearly defined and an agreement among members of the society concerning the objectives and means to accomplish them is reached, the social welfare may be defined uniquely as an ideal means of measuring benefits of a project. It would measure a contribution of the project to enhance the welfare, hence the extent to which project help achieve the national objectives. However, the social welfare may not be easy to define uniquely. Agreements among the members of the society may not be easily reached. There are infinately many ways to transform a vector ($Y_1 , \ldots , Y_m$) to W.

As an alternative to using social welfare staightforwardly Gross Domestic Product (GDP) or consumption based on a system of national accounts may be used as a proxy of the social welfare. GDP measures goods and services produced in the country, which are used for consumption, invesment (disregarding trades for the moment).

The larger the GDP is, the greater the availibility of goods and ser - vices to the population becomes. However, this may not measure the actual comfort or standard of living enjoyed by the people, as a substantial part of GDP may be used for investment. Although investment in - creases the future availibility of goods and services to the economy, it may reduce the level of comforts currently enjoyed by the people. Even though a country produces lots of goods and services, the prople may not enjoy the higher level of life if they can consume only the small part of those goods and services. An extreme case is the exploitation by foreign countries in the colonial days.

Consumption on the other hand measures the total of goods and services consumed by the people. The more the people can consume goods (not "bads"), the better off their lives become. A higher level of consumption in general brings a more comfortable, healthier and happier life, hence a higher level of the social welfare.

In the following economic benefit to the airport project is primarily measured as increases in private consumption, and then measured as reduction in input costs of other sectors than the one for the project. (in the present case, an airport)

2.2. Economic Relations surrounding an Airport

In order to make a systematic economic analysis on an airport project, it is necessary to clarify the economic relations surrounding the airport. Figure 2.1 summarize these relations.

Major participants to the economic activities surrounding the airport are : the airport authority; consumers, i.e., passengers and cargo dispatchers; airlines; other industries which provide services to the airport; and the surrounding communities.

The airport is an entity which provides consumers and airlines with airport services. Both consumers and airlines buy airport services from the airport which facilitates transactions between consumer and airline.

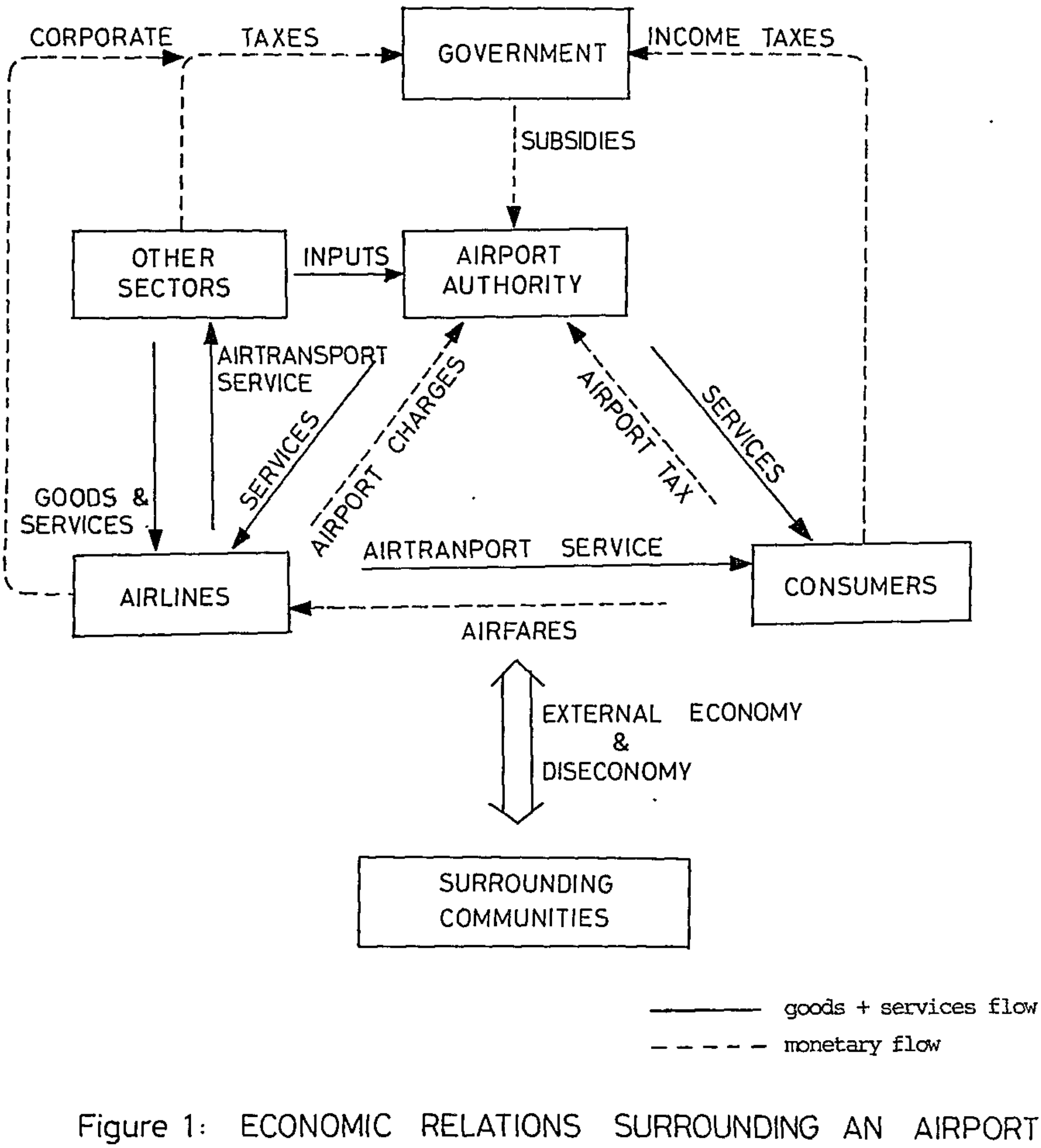


Figure 1: ECONOMIC RELATIONS SURROUNDING AN AIRPORT

An airport is thus a market place forthese transactions : for consumer to buy air transport services from airlines; and for airlines to pro - vide air transport services to consumers.

Consumers buy air transport services from airlines as either final consumers (personal trip passengers), or intermediate consumers (business travellers and cargo shippers).

Airlines provide air transport services to consumers. To do so, airlines may have to buy goods and services from other sectors (such as fuel, communication services, etc), and airport services from the airport.

Other sectors of economy provide various goods and services both to the airport and to airlines. They supply utilities, goods and services to the airport ; and fuels, foods, and other services to airlines.

The surrounding communities get in touch with the airport in various ways. They derive both benefits and disbenefits. These are called externalities, since there is no direct compensations from the project for the benefits or disbenefits. They may enjoy the convenience close to the airport. Business may flourish as many travellers go through the area. Extra employment may be generated as the airport and airlines buy goods and services from the area. They may also enjoy the convenience of highways which are built primarily to serve the airport (external economies). On the other hand, people in the communities may suffer from noise and air pollutions from the airport (external diseconomies).

2.3. Multi-sectoral Analysis

In order to analyze the project systematically and theoretically, a multi-sectoral model is defined which combines the analysis in the privious two sections. It is systematic, because it can avoid the double counting, and because it can measure all the impacts of a project on the whole economy.

Sectoral definitions : The economy is divided into four economic sectors.

i) Airlines are those which serve the project airport.

ii) The airport sector represents economic activities related to the project airport. Other airports should be included in the other government sector.

iii) Other government consists of all government activities except the project airport.

iv) Other sectors are all other economic sectors not included above. They are normally agriculture, mining and manufacturing, construction, electricity, gas and water, transportation and communication excluding those airlines in (ii), trade, banking and financing, ownership of dwellings, and other services.

This sector specification is designed to analyse the present airport project at Padang. There may be other ways of specifying sectors. The analyst may want to see the impacts of an airport project on other transportation sector. He may even have a specific transportation route. In such a case, these sectors may be singled out in the above sector specification.

On the basis of this sector specification, an input - output model will be next formulated.

Table 2.1. represents the relationship of various economic activities surrounding an airport project and other variable. This is a modified version of an input-output table. It singles out the particular airport currently studied as one sector, and airlines services to the airport as another. It clarifies inputs used to produce airport and air transport services, and how their products (i.e. services) are consumed by other sectors, including the final consumption.

Each component in the table represents inflow of goods and service from the row sectors to the coloumn sectors. Airlines buy airport service from the airport and fuels and other goods and services from other sectors. The airport buys materials and utilities from other sectors.

Table 2.1. INPUT OUTPUT TABLE AND AIRPORT PROJECT

	Airlines	Airport	Other Government	Other Sectors	Private Consump.	Public Consump.	Investment by sources	Changes in stock	Exports	Imports (m.p)	Imports (c.i.f)	Gross Output	Investment by destination
Airlines			Postal service	Air services - passengers (business) - cargoes	Air transport - passengers (private) (incl. airp. tax)				National carrier used by foreign residents	Foreign carrier used by domestic residents		X 1	- aircraft - air hangar
Airport	Airport services (landing fee, air nav.aid charge, parking fee)				(Airport services)				To foreign Carr.	From foreign airports		X 2	- runway - buildings - air nav. equip. - fire engines etc
Other Government						G			0	0		X 3	- construction - equipments
Other Sectors	Fuels Food catering Materials Advertising	materials utilities	materials utilities	intermediate goods+services	-food -clothings -housing utilit. -oth. transport -oth services		- construction - equipments	inventories	Fuels, mat. & services sold to foreign carries	Fuels, mat & services bought by national carr from for. airp.		X 4	- construction - equipments
Total intermediate inputs	T 1	T 2	T 3	T 4	0	0	0						
(of which imported)	fuels & food catering, oth. mat. & serv. imported			imported raw materials	imported consumer goods		imported capital goods	Imported goods					
Indirect taxes - subsidies	- airport tax	- subsidies		- excise tax - subsidies									
Wages & Salaries	salaries administrative flight crews others	Personnel cost	Salaries & wag.	Salaries & wag.									
Operating surplus	Return to capital	0	0	Return to capital									
Value added	Y 1	Y 2	Y 3	Y 4	C	G	IS	J	E	M*	M	GDP (Gross Domestic Product)	I
Gross Output	X 1	X 2	X 3	X 4									

Same for the other government sector.

Note that in this table, passenger charges collected at airport are classified as indirect tax charged to the air transport services. Hence in this table, consumers do not buy airport services for final consumption. They buy air transport services in which airport charges are included as a part of cost.

Based on this table, the impact of an airport project to the national economy can be systematically analyzed. Cost of the project is the monetary value of i,l,q as defined earlier. Net economic benefit consists of net increase in private consumption expenditures, and net reduction in intermediate inputs. Increases in foreign exchange earnings is also considered tradionally as benefits. This is a benefit to the economy since it will increase the import capacity of the economy, hence supply of goods which cannot be produced in a country. Consequently it increases goods available for consumption.

Ideally the whole table should be estimated for the "with the project" case and the "without the project case" and their benefits should be compared. Incremental benefits with the project will then be compared against the cost, to complete the cost-benefit analysis. This is theoretically necessary for the complete project analysis. If there is a new airport, it will reduce the transportation cost to business travellers, hence will increase the corporate and consequently income paid to employees. This will then increase private consumption. These secondary, tertiary, and ultimate efferts of the project can be only estimated by completing the whole table.

Unfortunately completing the whole table is costly and cumbersome. In most cases, lack of data makes such estimation impossible. Therefore in the following, only the immediate impacts of the project on the economy will be counted and measured.

To compare the national economic situations "with" and "without" the project by utilizing the table discussed, it must be remembered that the price sturcture also may differ from each other. "Without" the project, supply of the particular commodity (in the present case, air transport service) will be lower than the "with" case, while the potential demand exists. Hence there is excess demand for the "without case", and a consequent higher price for the commodity. However, it is assumed in the present analysis that the project is very small in the economy, hence its price impact can be ignored.

2.4. Economic Benefits to an Airport Project

The first immediate impact of an airport project will be an increase in the air transportation services to the region it serves. This will be consumed as a final consumption and intermediate consumption as shown in Table 2.1. Transportation consumed by consumers will increase final consumption, which is a part of benefits. Business travellers and cargo shippers can reduce their transportation cost by utilizing air transport. This is a net reduction in intermediate inputs and adds to the total benefit. The second immediate impact will be a reduction of operating cost at the airport. A new airport may reduce waiting and holding time for landing and take-off of airplanes, and loading or unloading time at the airport.

Indirect benefits comprise increases in output of other sectors and increase in foreign exchange. The increase in consumption or increase in business income due to the airport project will raise effective demand, hence, through multiplier effects, increase production and income in the region.

There are other benefits or disbenefits which are not represented in this table. Most of them are related to external conomy or diseconomy. They are called "external", because no compensating monetary transfer will take place to meet these beneficial or non beneficial economic factors which occur to the society. Business flourishes in the area where the new airport is opened. But the people in the area may suffer from air, and noise pollution. Enhancement of regional or national prestige by having a new airport is another factor which may constitute an important part of national objectives but could not be easily quantified.

3. Estimating Cost and Benefit of the Project

Based on the theoretical framework described in the previous sections, this section describes the actual ertimation procedure of each component of cost and benefit.

3.1. Economic Cost

Economic cost as described earlier consists of (i) investment cost, (ii) labor cost, and (iii) materials and other services inputs cost. These items can be easily identifed with the project construction, and operating and maintenance cost.

The important issue concerning the cost estimation is what prices should be used to evaluate it.. As noted earlier, different pricing from the actual market prices may be necessary to evaluate the economic cost of project. Such prices are called shadow prices and reflect the real economic cost to the economy.

Items which are normally shadow priced are unskilled labor, foreign exchange, and interest rate.

Shadow prices are also applied to valuing economic benefits. However most of the benefit items do not contain unskilled labor, foreign exchange, and capital goods.

3.4. Economic Benefit

Economic benefits items are identified and explained in Section 2.4. Their actual estimation procedures are presented in the following.

The overflowing traffic is defined as the difference between the forecast traffic and the traffic "without" the project. For this, it is necessary to estimate and determine the capacity of the existing airport "without" the project. This will be used to compare the benefits "with" the project.

3.4.1. Benefits to the accommodated overflowing traffic

Air transport consumption is divided into passenger and cargo transportation. Passengers transportation is divided into final consumption (personal trips) and intermediate consumption (business trips).

i) Passengers traffic

It is assumed that 75 percent of passengers are personal trip passengers and 25 percent business trip passengers. This proportion is assumed to be the same for the overflowing passengers.

a) Personal Trip Passengers

The overflowing passenger may either give up the trip at all or may use other mode of traffic. For personal trip passengers, the benefits to them are measured by additional consumption made possible by the project. For the overflowing passengers who give up trips, the benefit is equal to the consumption spent of the traffic made possible by the project. For those who take other mode of transportation, it equals to the difference between consumption on the air transport and on other modes of transportation.

It is assumed that 80 percent of the personal trip passengers would give up their trips if there should be no project. The remaining 20 percent would take other modes of the transportation. Airfares and other alternative transportation fares are calculated as follows. They are summarized in Table 3.1.

Average Airfare : Average airfare to and from Padang is calculated as an weighted average of airfares of routes through Padang based on the route structure assumed in Chapter 3.

Average Alternative Transportation Fares : For the overalow passengers, an average alternative transportation cost between Padang and other cities are estimated as an weighted average of alternative transportation fares using the same route structure.

Benefit to an average personal trip passenger is estimated to be Rp 42,900.

Table 3.1. AVERAGE AIRFARE AND ALTERATIVE TRANSPORTATION

Route	Air transportation			Alternative transportation	
	Weight	Fare	Time (hrs) 4/	Fare	Time (hrs)
PDG - JKT	0.690	53,600	3	21,000 1/	72
PDG - MES	0.165	34,000	2	4,000 2/	18
PDG - PKU	0.065	15,000	2	1,000 2/	8
PDG - PLM	0,085	34,000	2	6,000 3/	36
Weighted Average	0,985	46,000		15,500	

1/ Boat trip Class II deck
2/ Bus trip
3/ Combination bus and taxi trip
4/ Includes waiting time at the airport

Source : Ministry of Transportation

b) Business Trip Passengers

For business trip passengers, benefit are measured differently from personnal trip passengers. Transportation for business passengers is essential input to produce other goods, and is not the final consumption. It is assumed here that business passengers will not give up the trip even if air transport is not available. They always have to take other modes of transportation. Hence benefit which would arise to the overflow business passenger if air transportation should become available can be measured by reduction in travel cost resulted from taking other modes to air transportation. Travel cost here should include both transportation fares and time values of the passengers.

The benefits to the overflow business passengers are expressed as follows.

$$B = N_B \; (F + V \, . \, T),$$

Where B = benefits to the overflow business passengers

N_B = number of the overflow business passengers,

F = average net reduction (or increase) in transportation fares between air transport and other modes,

V = average time value of a business passenger (Rp/hour), and

T = average reduction in travel time (in hours).

Among the variables,those which require estimation are explained as follows; The average fare difference is the difference between the average air fare and other transport fare. Average time difference between air transport and other modes of transportation is similarly calculated. They are listed in Table 3.1.

Time value of a business passenger is equal to the average value added of workers in industry and service sectors per hour. It is estimated by dividing the estimated 1981 GDP excluding agriculture by the estimated 1981 labor force in the same sectors; then by dividing it by 300 work days and 6 hours per work day.

Table 3.2. ESTIATED TIME VALUE OF PASSENGERS

	Unit	Total	Industry and Services
GDP in 1981	Rp billion	59,905	42,119
Labor force in 1981	thousand	-	15,771
Population in 1981	thousand	150,424	-
Per capita value added	Rp	-	2,670,660
Per capita GDP	Rp	389,240	-
Time value of business pax 1/	Rp	-	1,483
Time value of personal trip pax 2/	Rp	182 2/	-

1/ Per capita value added - (300 days x 6 hours)

2/ Per capita GDP - (365 days x 6 hours)

Average benefit to a business passenger is estimated to be Rp 48,680.

ii) Cargo Traffic

Air cargo traffic serves to meet the specific purpose : speed. Many air cargoes may not be moved at all if there is no air transportation. They are high valued fresh foods or fresh flowers. They can not be transported on other modes of transportation.

Because they are mostly consumed, and hence consumption will be increased by at least the cost of transportation if air transport becomes available, their benefits may be measured in a similar way to the overflow personnal trip passenger, namely air cargo fare as a measurement of the benefit.

There are other commodities which are carried by air transport, but could not be carried by other means of transportation in the absence of air transport. They are for example high value machinery and equipment. They are carried by air transport if it is available because it is cheaper.

It is difficult to estimate the cost of transportation of these goods when air transport is not available : a delay in delivering such goods may increase operation costs of a factory; land transportation of sensitive machinery may damage it beyond repair. Thses costs however cannot be assessed in a general way.

In the present study, it is assumed that all cargoes are high value perishables or high technology consumer goods.

3.4.3. Benefits to Airlines

As a new airport opens, the procedual improvement at the airport may reduce operating cost of airline.

i) Fuel cost saved may arise become of the impovement in air approach procedure.

ii) Waiting time at the airport may be reduced, resulting in better usage of aircraft, and cost savings in personnel time.

Table 3.3 AIR CARGO FARE

Route	Cargo Fare
PDG - JKT	Rp 295 / kg
PDG - MES	Rp 150 / kg
PDG - PKU	Rp 135 / kg
PDG - PLM	Rp 150 / kg

iii) Load-factor may be improved which will increase the output capital ratio.

3.4.4. Other Benefits to Passengers

Other benefits to passengers may include **time saved at the airport.** Since the new airport will reduce the crowded conditions at the airport, hence waiting time. This could be considered additional benefits by both personal and business trip passengers. They are evaluated as the time saved value for each passenger who could take air transport in the "without" case. This benefit will not arise to the overflowing passengers as they do not use air transport in the "without" case.

If there is difference in access time between the two cases, they have also to be evaluated for passengers of the "without" case. It may result in either benefits (reduction in access time and cost) or dis - benefits (increases in them).

3.4.5. Benefits to the Regional and National Economy

i) Tangible benefits

Foreign exchange revenues may increase as a result of increase in tourism, including airport taxes. Additional foreign exchange may be earned from foreign airlines as increased airport charges.

ii) Intangible benefits

A new airport may increase the air safety. It may also enhance regional and national prestige.

iii) Intangible disbenefits

Air or noise pollution may be increased or descreased by a new project.

APPENDIX TO CHAPTER 16

APPENDIX 16.3.1 FUNCTION OF DGAC ORGANIZATION

This Appendix explains the major function of each section contained in the airport organization.

Section	Function
General Affairs Section	- General Administration of the airport organization
Personnel Section	- Personnel planning, administration and welfares
Accounting Section	- Accounting and property custody
Security Section	- Security control and guard
Business Section	- Operation of terminal buildings
Fire Fighting Section	- Fire fighting and rescue
Dispensary	- Medical care for passengers and employees
Civil and Architectural Section	- Maintenance of airport civil and architectural facilities
Electrical Section	- Operation and maintenance of electric power supply system - Maintenance of aeronautical ground lights
Mechanical Section	- Operation and maintenance of mechanical facilities and vehicles

Terminal Maintenance Section	- Maintenance of terminal buildings
Flight Operation Section	- Approving flight plans, providing aeronautical information and telecommunication services
Air Traffic Control Section	- Air traffic control
Navaid Section	- Operation and maintenance of radio navigational aids
Communications Section	- Operation and maintenance of aeronautical telecommunications facilities