Table 2.3.6 Scheduled Flights of Airports in Central Java and D.I. Yogyakarta

Airports	Air-lines	Route	Type of Aircraft	Weekly Movements
YOGYAKARTA	GARUDA	YOGYAKARTA - JAKARTA	DC - 9	50
	GARUDA	YOGYAKARTA - DENPASAR	DC - 9	42
	BOURAQ	YOGYAKARTA - BANDUNG	HS - 748	14
	BOURAQ	YOGYAKARTA - BANJARMASIN	HS - 748	14
	MERPATI	YOGYAKARTA - SURABAYA	F - 27	14
SURAKARTA	GARUDA	SURAKARTA - JAKARTA	F - 28	30
	GARUDA	SURAKARTA - SURABAYA	F - 28	14
SEMARANG	GARUDA	SEMARANG - JAKARTA	F - 28	98
	BOURAQ		HS748	14
	MANDALA		VC832	28
	GARUDA	SEMARANG - SURABAYA	F - 28	28
	MERPATI		F - 27	12
	MERPATI	SEMARANG - PANGKALANBUN	CASA	14
	MERPATI	SEMARANG - BANDUNG	F - 27	12
	BOURAQ	SEMARANG - BANJARMASIN	HS748	14
CILACAP	MERPATI	CILACAP - JAKARTA	DHC - 6	10

2.3.3 Airline Companies

There are 4 major airlines in Indonesia: GARUDA, MERPATI, MANDALA and BOURAQ as shown in Table 2.3.7. International services are operated only by GARUDA.

The domestic services and fleet possession by scheduled airlines are shown in Tables 2.3.8 and 2.3.9, respectively.

Table 2.3.7 List of Major Domestic Scheduled Airlines

Name of Airline	Home Base	Operation Area
Garuda Indonesian Airways	Jakarta	All Indonesia
Merpati Nusantara Airlines	Jakarta	All Indonesia
Bouraq Indonesia Airlines.	Balikpapan	Java, Kalimantan, Sulawesi
Mandala Airlines	Surabaya	Java, Sumatra, Kalimantan, Sulawesi, Maluku

Table 2.3.8 Operation of Scheduled Airlines (Domestic Scheduled Air Service) as of 1983

Description	Unit	GARUDA	MERPATI	MANDALA 1)	BOURAQ 2)
1. Aircraft KM	1,000	52,042	19,815	5,843	4,453
2. Aircraft Departure	Number	76,832	53,485	6,061	11,588
3. Aircraft Hours	Number	108,742	69,880	10,792	18,141
4. Passengers Carried	Number	3,740,252	779,299	325,703	154,521
5. Freight Carried	Ton	37,998	6,364	1,685	1,567
6. Passenger KM	1,000	2,944,219	448,912	346,580	103,359
7. Available Seats KM	1,000	5,982,231	787,859	427,790	170,381
8. Passenger Load Factor	%	49.2	56.9	81	61
9. Ton KM Performed	1,000	273,376	43,859	29,264	8,843
10. Available Ton KM	1,000	650,680	70,486	43,783	14,157
11. Weight Load Factor	%	42	62.2	67	62

Note: 1) Total 10 months only
2) Data from January to June only

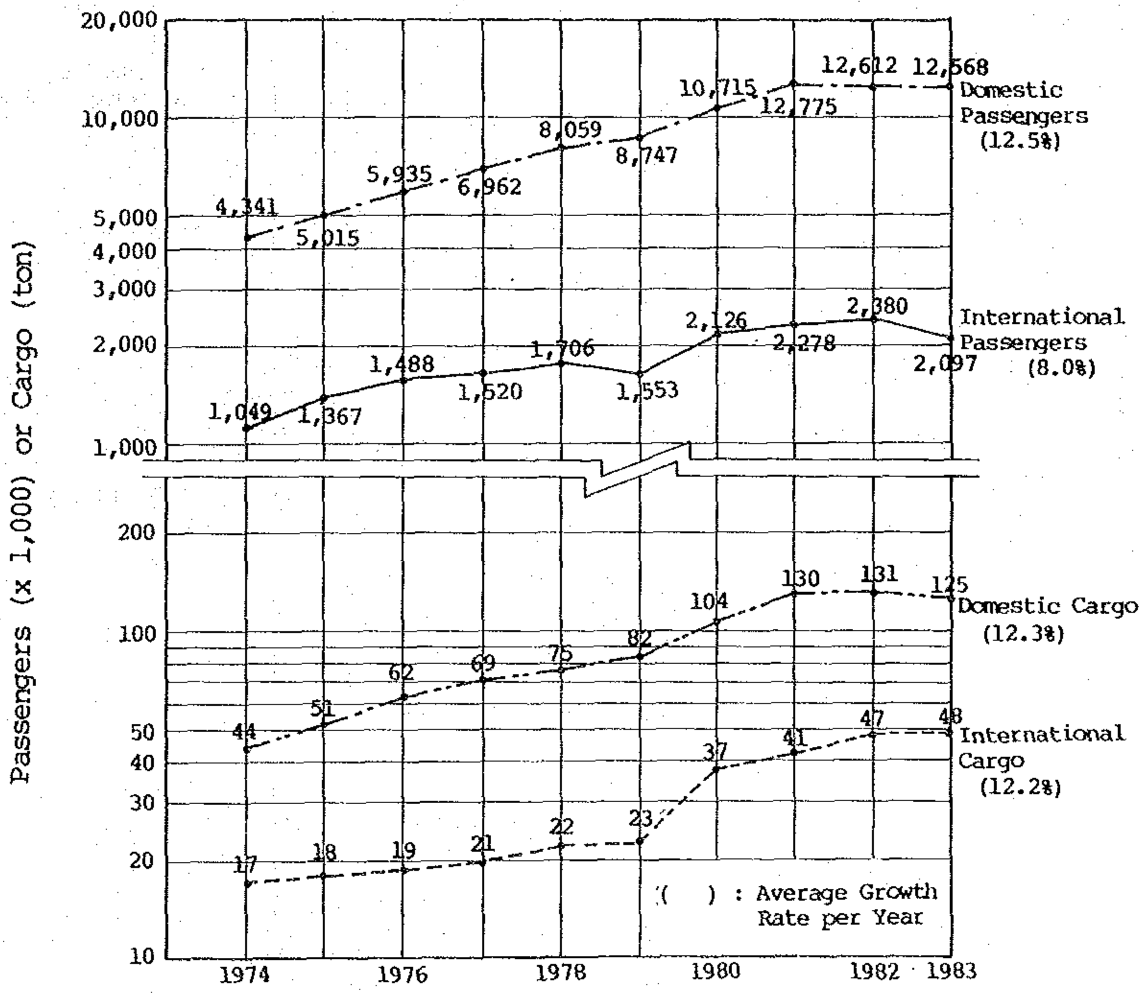
Table 2.3.9 Fleet Possession by Scheduled Airlines as of 1985

Aircraft \ Airline Company	GARUDA	MERPATI	MANDALA	BOURAQ	SEULAWAH	ZAMRUD	Total
B-747-2U3B	6						6
DC-10-30	6						6
A-300-B4	9						9
DC-9-32	19						19
F-28 MK-3000	6						6
F-28 MK-4000	28						28
F-27		14					14
DHC-6		17					17
CASA C-212		16		3			19
HAWKER SIDDELEY HS-748		2		16			18
DC-3				3	1	7	11
CONVAIR 600-240D					3		3
VICKERS VISCOUNT		2	2	4			8
VICKERS VANGUARD		1					1
LOCKHEED L-188			5				5
TOTAL	74	52	7	26	4	7	170

2.3.4 Air Traffic Volume

(1) Air Traffic Volume in Indonesia

Fig. 2.3.9 shows the actual record of total airport traffic in Indonesia by international/domestic and passengers/cargo, for the past 10 years from 1974 to 1983. It reveals that passengers volumes have increased with an average annual growth rate of 13 % for domestic, 8 % for international, respectively, while cargo volumes have been about 12 % for both domestic and international cargo.



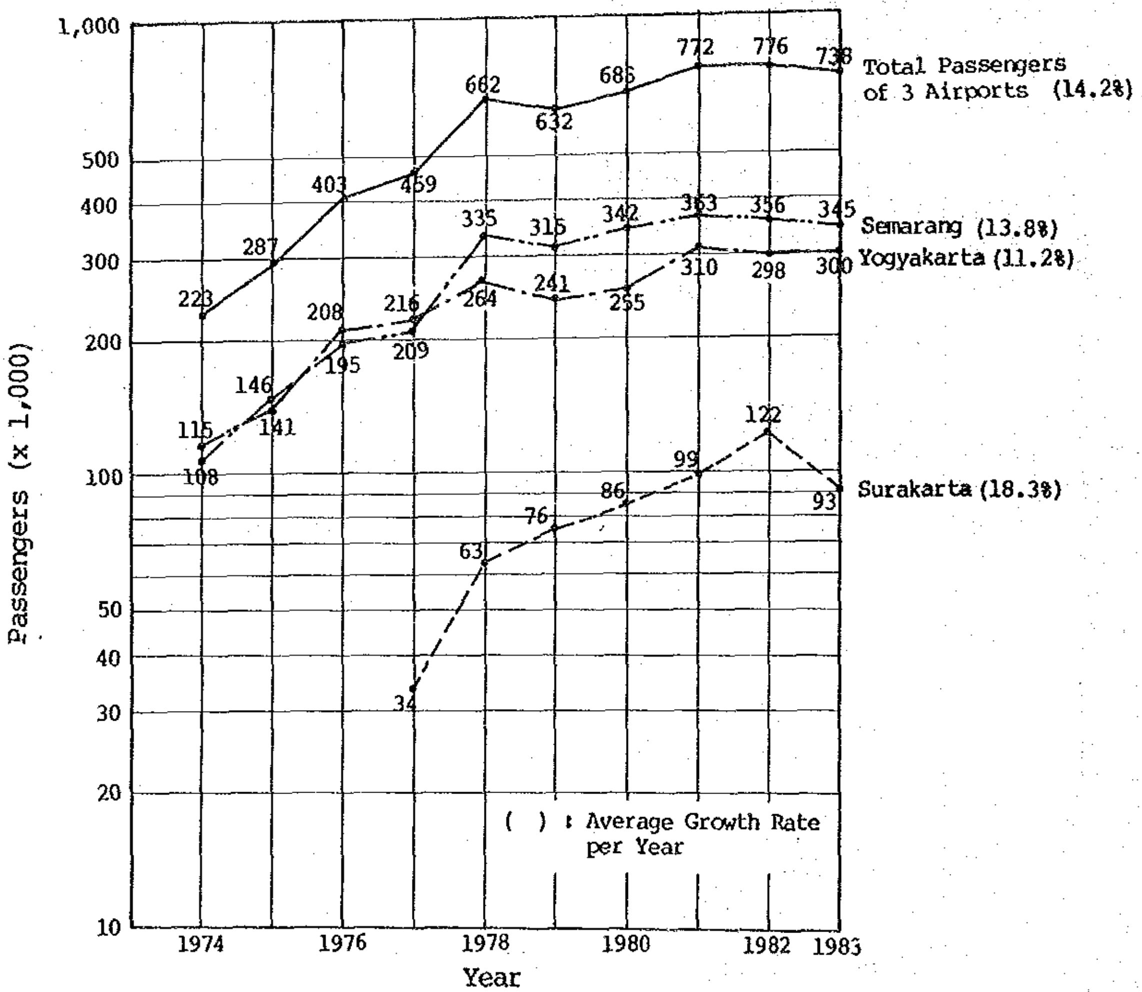
Note : Passengers are sum of arrivals and departures.

Fig. 2.3.9 Actual Records of Total Airport Traffic in Indonesia

(2) Air Traffic Volume in Central Java and D.I. Yogyakarta

Figs. 2.3.10 and 2.3.11 show the actual air passengers and cargo and total traffic handled at the said three airport, i.e., Yogyakarta, Surakarta and Semarang. It can be seen the annual growth rate of each airport is higher than that of the whole of Indonesia.

As for the Cilacap airstrip, actual air traffic volume since 1981 is shown in Table 2.3.10.



Note : Passengers are sum of arrivals and departures.

Fig. 2.3.10 Actual Records of Air Passengers in Central Java and D.I. Yogyakarta

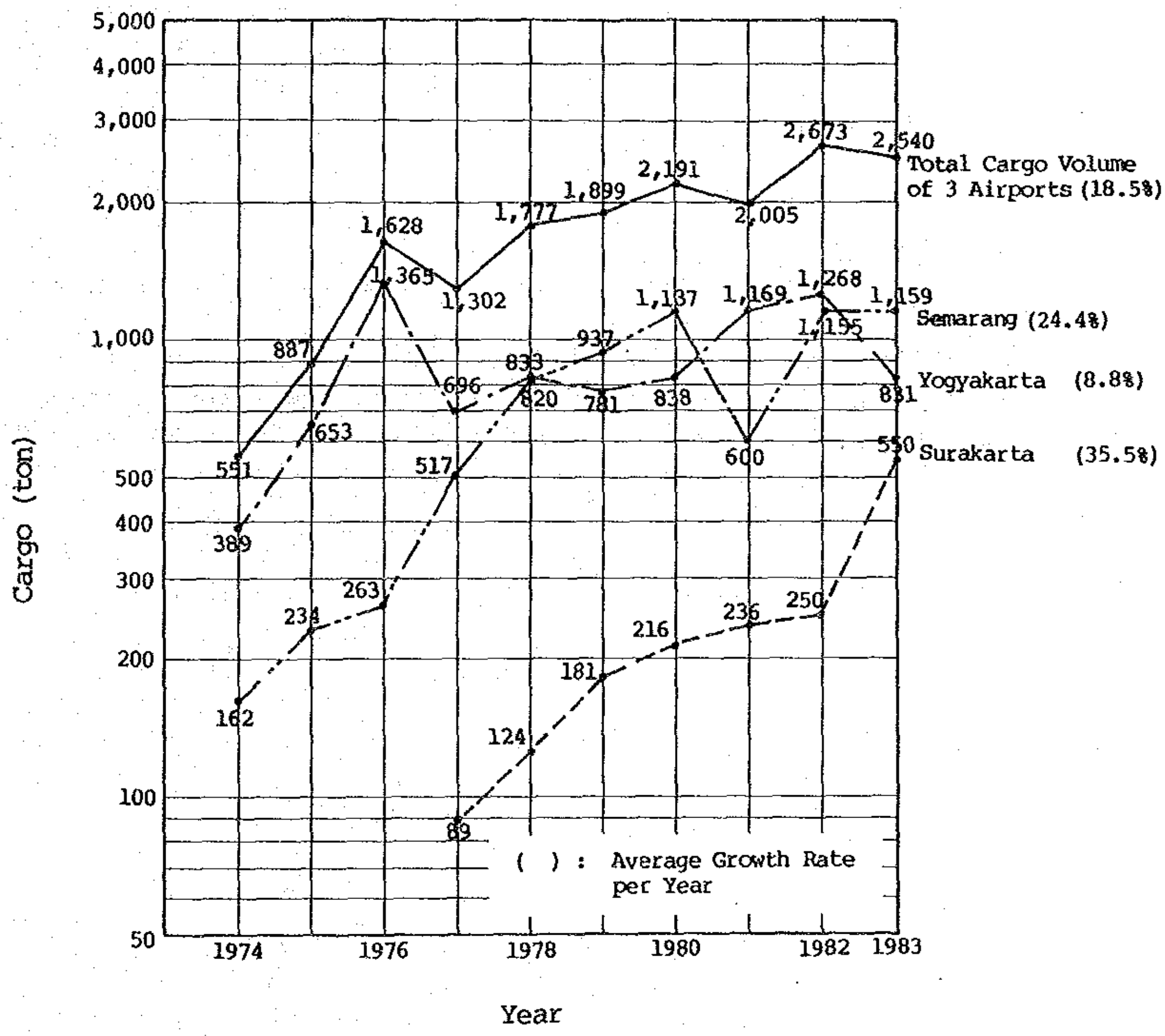


Fig. 2.3.11 Actual Records of Air Cargo in Central Java and D.I. Yogyakarta

Table 2.3.10 Air Traffic Volume in Cilacap Airstrip

Year	Aircraft Movements	Passengers	Baggage (kg)	Cargo (kg)
1981	125	7,057	7,057	162
1982	400	10,828	70,341	6,214
1983	426	10,190	70,359	7,935
1984	444	7,877	40,641	1,920

2.4 Other Transportation Systems

2.4.1 Roads

The development of road network in Indonesia shows a steady progress. As of December 1983, the total length of national road was 12,232 km. Those for provincial and regional roads were 35,239 km and 127,995 km, respectively.

The length of roads in Cental Java and Yogyakarta is as follows:

Central Java:

National Road	.....	416 km
Provincial Road	.....	1,890 km
Regional Road	.....	12,414 km
Total	.....	14,728 km

D.I. Yogyakarta:

National Road	.....	32 km
Provincial Road	.....	342 km
Regional Road	.....	4,697 km
Total	.....	5,071 km

2.4.2 Railways

The total length of railway operated by PJKA (National Railway Corporation) is 6,700 km, of which 70 % is in Java.

The railway passenger traffic shows a steady increase amounting to 44 million in 1982. On the other hand, cargo traffic decreased by 10 % annually, falling from 5.2 million tons in 1979 to 4.7 million tons in 1982 due to the diversion from railway to highway.

There are two trunk line railways connecting Jakarta and Surabaya running in Central Java and D.I. Yogyakarta. One is the northern coastal route via Semarang, and another the route via Yogyakarta and Surakarta.

Total passenger traffic in 1983 was 4.9 million and 0.7 million for Central Java and D.I. Yogyakarta, respectively.

2.4.3 Sea Transportation

According to DGSC (Directorate General of Sea Communications), the domestic sea traffic in 1983 was as follows:

Domestic Passengers	:	495,000 passengers
Domestic Loading Cargo	:	27,285 tons
Domestic Unloading Cargo	:	44,014 tons

The only port which handles passengers in Central Java and D.I. Yogyakarta is Semarang port. However, passengers are almost limited to transmigrants to Kalimantan and Sumatra.

CHAPTER 3 AIR TRAFFIC DEMAND FORECAST

CHAPTER 3 AIR TRAFFIC DEMAND FORECAST

3.1 Summary

This chapter sets forth the demand forecast of future air traffic in Central Java province and D.I. Yogyakarta.

As described in Chapter 2, there are three major airports: Yogyakarta, Surakarta and Semarang, and one airstrip, Cilacap in this Study area which are being operating for the scheduled civil air transport.

The future air traffic volume of passengers and cargo for these airports/airstrip were estimated up to year 2010 which is established as the design year for the long-term development, taking into consideration the past trends in air traffic, and the present socio-economic conditions and their future prospects.

In order to study the feasibility of the new local airport development as a commuter airport within the framework of future local air transport system, potential air traffic demands in-between the regions were also forecast.

The summary of forecast is shown in Fig. 3.1.1 and Table 3.1.1. As seen in Fig. 3.1.1, the estimated figures are considerably below the ones estimated in previous studies, reflecting the stagnation in the air traffic due to the national economic recession since 1981.

As for the internal passengers within the Study area, there seems no potential passengers other than the passengers on the Tegal-Pati route which may justify the new local airstrip development.

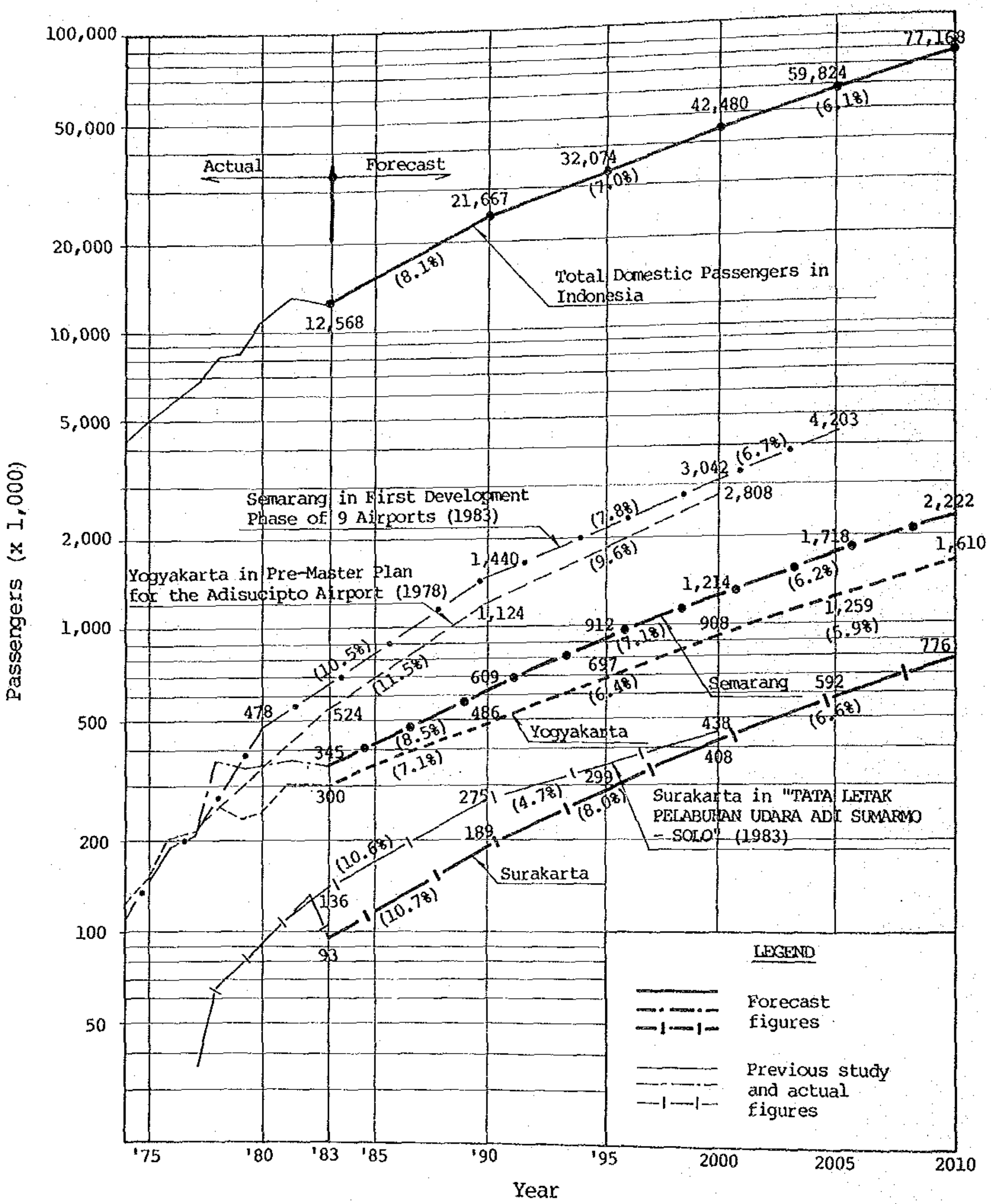


Fig. 3.1.1 Forecast of Air Passengers

Table 3.1.1 Actual Records and Forecast of Air Passengers and Cargo

	Year / Items	Actual										Forecast				
		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1990	1995	2000	2005	2010
Passengers (x 1,000)	Whole Indonesia	4,341	5,015	5,935	6,962	8,059	8,747	10,715	12,775	12,612	12,568	21,667	32,074	42,480	59,824	77,168
	Yogyakarta	115	141	208	216	264	241	255	310	298	300	486	697	908	1,259	1,610
	Surakarta	-	-	0	34	63	76	86	99	122	93	189	299	408	592	776
	Semarang	108	146	195	209	335	315	342	363	356	345	609	912	1,214	1,718	2,222
	Total of Three Airports	223	287	403	459	662	632	683	772	776	738	1,283	1,907	2,530	3,569	4,608
Cargo (x 1,000 ton)	Whole Indonesia	44	51	62	70	75	83	104	130	131	125	226	339	452	640	827
	Yogyakarta	0.39	0.65	1.37	0.70	0.83	0.78	0.84	1.17	1.27	0.83	1.25	1.73	2.21	3.02	3.82
	Surakarta	-	-	-	0.09	0.12	0.18	0.22	0.24	0.25	0.55	1.18	1.87	2.57	3.71	4.85
	Semarang	0.16	0.23	0.26	0.52	0.82	0.94	1.14	0.60	1.16	1.16	1.99	2.92	3.84	5.39	6.93
	Total of Three Airports	0.55	0.89	1.63	1.30	1.78	1.90	2.19	2.01	2.67	2.54	4.42	6.52	8.62	12.11	15.56

Source : 1. Past Domestic Passengers and Cargo for Whole Indonesia : Total Airport Traffic in "Statistical Yearbook of Indonesia"

2. Past Air Passengers and Cargo for the 3 Airports : Yogyakarta Airport, Surakarta Airport and Semarang Airport

3.2 Basic Considerations

As described in previous Chapter 2, highway and railway transportation are well developed in Central Java and D.I. Yogyakarta due to its geographical and historical conditions, when compared with other regions.

Air traffic demand will be essentially forecast with due consideration given to the modal split by transportation modes, where competitive conditions with other transportation modes exist.

In particular, as the economy develops, the time factor will become more crucial to the general economic activities, hence the share of air transportation will increase in proportion to the raise of per capita income.

However, irrespective of route distances, the share of air passengers in the Study area are extremely low at present as shown in Tables 3.2.1 and 3.2.2, meaning that the air transportation services are being limited to persons with high time value.

It is, furthermore, difficult to consider that those who utilize the railway and/or highway at present will largely transfer to air transport in future.

This Study, therefore, will provide a forecast of the air passengers with the exclusion of other transportation modes.

Air traffic volume is assumed to increase as the level of general economic activities increases. In the following, in order to forecast the future air traffic volume, it was assumed that air traffic volume is a function of Gross Domestic Product (GDP) or Gross Regional Domestic Product (GRDP). The functional model will be specified in the respective sections.

Table 3.2.1 O.D. MATRIX (1983)

(Unit: 1000)

Region	Mode \ Route	Jakarta	Pangka-lanbun	Surabaya	Banjar-masin	Bandung	Denpasar	Total
Yogyakarta	Airway	190	0	13	10	4	83	300 (2.3%)
	Highway	4,738	0	3,288	0	1,214	34	9,274 (71.0%)
	Railway	2,596	0	380	0	500	7	3,483 (26.7%)
	Ship	0	0	0	0	0	0	0 (0.0%)
	Total	7,524	0	3,681	10	1,718	124	13,057 (100.0%)
Surakarta	Airway	76	0	17	0	0	0	93 (1.0%)
	Highway	3,581	0	4,482	0	380	19	8,462 (93.7%)
	Railway	400	0	76	0	0	0	476 (5.3%)
	Ship	0	0	0	0	0	0	0 (0.0%)
	Total	4,057	0	4,575	0	380	19	9,031 (100.0%)
Semarang	Airway	265	15	49	10	6	0	345 (1.7%)
	Highway	7,861	0	9,836	0	834	41	18,572 (93.0%)
	Railway	878	0	168	0	0	0	1,046 (5.2%)
	Ship	0	12	0	1	0	0	13 (0.1%)
	Total	9,004	27	10,053	11	840	41	19,976 (100.0%)
Total	Airway	531	15	79	20	10	83	738 (1.8%)
	Highway	16,180	0	17,606	0	2,428	94	36,308 (86.3%)
	Railway	3,874	0	624	0	500	7	5,005 (11.9%)
	Ship	0	12	0	1	0	0	13 (0.0%)
	Total	20,585	27	18,309	21	2,938	184	42,064 (100.0%)

Source: Air Transport Statistic 1983
The feasibility Study on the Electrification Project of Main Line in Java
DGSC "ANGKUTAN PENUMPANG ANTAR DISTRIK TAHUN 1983"

Table 3.2.2 Transportation Mode by Route (1983)

Unit : %

Region	Mode	Jakarta	Pangka-lanbun	Surabaya	Banjar-masin	Bandung	Denpasar	Total
Yogyakarta	Airway	2.5	0.0	0.4	100.0	0.2	66.9	2.3
	Highway	63.0	0.0	89.3	0.0	70.7	27.4	71.0
	Railway	34.5	0.0	10.3	0.0	29.1	5.6	26.7
	Ship	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	100.0	0.0	100.0	100.0	100.0	100.0	100.0
Surakarta	Airway	1.9	0.0	0.4	0.0	0.0	0.0	1.0
	Highway	88.2	0.0	97.9	0.0	100.0	100.0	93.7
	Railway	9.9	0.0	1.7	0.0	0.0	0.0	5.3
	Ship	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	100.0	0.0	100.0	0.0	100.0	100.0	100.0
Semarang	Airway	2.9	55.6	0.5	90.9	0.7	0.0	1.7
	Highway	87.3	0.0	97.8	0.0	99.3	100.0	93.0
	Railway	9.8	0.0	1.7	0.0	0.0	0.0	5.2
	Ship	0.0	44.4	0.0	9.1	0.0	0.0	0.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total	Airway	2.6	55.6	0.4	95.2	0.3	45.1	1.8
	Highway	78.6	0.0	96.2	0.0	82.7	51.1	86.3
	Railway	18.8	0.0	3.4	0.0	17.0	3.8	11.9
	Ship	0.0	44.4	0.0	4.8	0.0	0.0	0.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

3.3 Air Traffic Demand Forecast for Indonesia

Future domestic air traffic demand for the whole of Indonesia was forecast for the purpose of cross-checking of the future air traffic demand in Central Java and D.I. Yogyakarta estimated in the following Section 3.4.

Following formula was used for the estimates.

$$TDP_t = TDP_{83} \times GR_t$$

Where;

TDP_t : Domestic traffic for the whole of Indonesia in year (t)

TDP_{83} : Domestic traffic in 1983 (actual traffic)

GR_t : Growth factor for domestic traffic (1983 = 1.00)

The growth factors (GR_t) were obtained from the growth rates shown in Table 3.3.1 which were reviewed in 1985 and approved by DGAC for the Bali International Airport Development Project, taking into consideration the stagnation in the national economy since 1981.

Table 3.3.1 Annual Growth Rate for Domestic Air Traffic

	1983 - 1990	1990 - 2000	2000 - 2010
Domestic Passengers	8.1 %	7.0 %	6.1 %
Domestic Cargo	8.8 %	7.2 %	6.2 %

Source: Bali International Airport Development Project, Review of Previous Feasibilty Study, 1985.

The results of the estimates are shown in Table 3.3.2.

Table 3.3.2 Air Traffic Demand for Whole Indonesia

Item / Year	Domestic Passengers		Domestic Cargo	
	1,000 pax.	Growth factor	1,000 ton	Growth factor
1974	4341	--	44	--
75	5015	--	51	--
76	5935	--	62	--
77	6962	--	70	--
78	8059	--	75	--
79	8747	--	83	--
80	10715	--	104	--
81	12775	--	130	--
82	12612	--	131	--
83	12568	1.00	125	1.00
1990	21667	1.72	226	1.81
95	32074	2.55	339	2.71
2000	42480	3.38	452	3.62
5	59824	4.76	640	5.12
10	77168	6.14	827	6.62

Note: Passengers are sum of arrivals and departures.
Source: Total Airport traffic in "Statistical Yearbook of Indonesia"

3.4 Passenger Traffic Demand Forecast for Central Java and D.I. Yogyakarta

3.4.1 Yogyakarta, Surakarta and Semarang Airports

(1) Basic Thinking

According to the results of passenger traffic flow survey executed by the Study Team during the four days from August 29 to September 1, 1986, the shares of foreign passengers to total passengers from/to these 3 airports were relatively high. In Yogyakarta airport especially, foreign passengers with the purpose of sightseeing occupied about 50 % of total passengers (For the details, refer to APPENDIX I-3).

Future passenger traffic at the 3 airports were, therefore, estimated seperately for foreign passengers and Indonesian passengers in accordance with the flowchart shown in Fig. 3.4.1.

$$DP_{it} = IP_{it} + FP_{it}$$

where;

DP_{it} : Domestic passengers of airport (i) in year (t)

IP_{it} : Indonesian passengers

FP_{it} : Foreign passengers

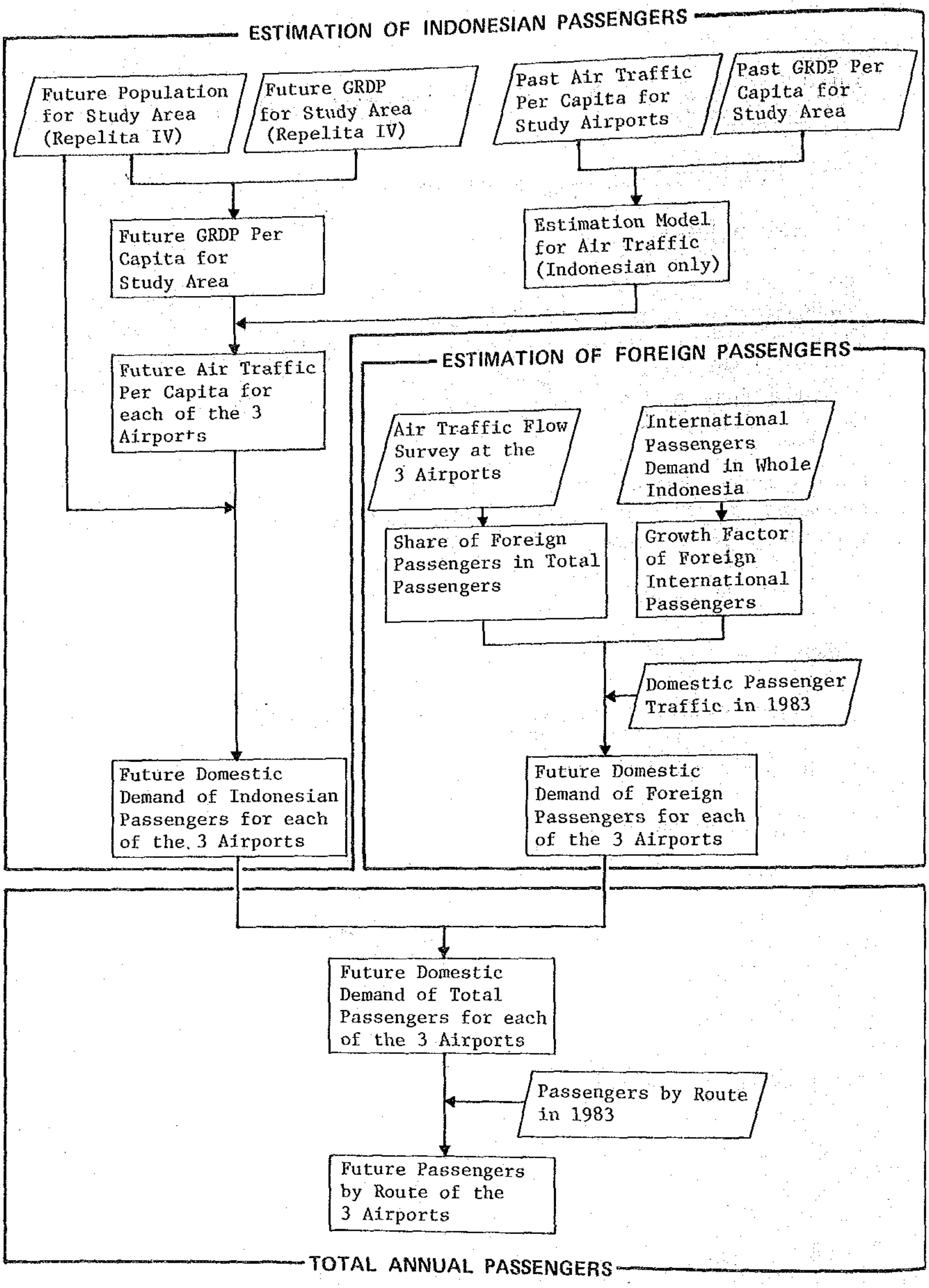


Fig. 3.4.1 Flowchart for Air Traffic Demand Forecast

(2) Foreign Passengers

Foreign passengers (FP) were estimated by using the following formula:

$$FP_{it} = DP83_i \times RF_i \times GFF_t$$

where;

$DP83_i$: Domestic passengers of airport (i) in 1983

RF_i : Share of foreign passengers in total passengers

GFF_t : Growth factor of foreign passengers at year (t)

The shares of foreign passengers to total passengers (RF) were established based on the results of the passenger flow survey and assuming that these shares will not change in future, as follows.

Yogyakarta	RF = 57 %
Surakarta	RF = 16 %
Semarang	RF = 30 %

The share for Yogyakarta airport (57 %) may be supported by the fact that the share of foreign guests is 51 % of the total guests stayed at high class hotels in Yogyakarta.

The growth factors of foreign passengers (GFF) were set as follows:

1983	GFF = 1.00
1990	GFF = 1.51
1995	GFF = 1.92
2000	GFF = 2.47
2005	GFF = 2.92
2010	GFF = 3.44

The above growth factors were obtained from the "Total" shown in Table 3.4.1, assuming that the growth factor for each airport is the same with that for the whole of Indonesia.

Table 3.4.1 Annual International Foreign Passenger Demand for the Whole of Indonesia

Year	International Passengers (arrivals + departures) (x 1,000)							
	USA	United Kingdom	Malay-sia	Singa-pore	Aust-ralia	Japan	All Other Count-ries	Total
1980	100	77	90	115	154	117	403	1056
1981	96	91	81	129	176	124	413	1110
1982	94	99	81	137	157	132	368	1068
1983	103	101	94	172	152	154	380	1156
1990	124	115	139	347	170	271	580	1746
1995	131	119	169	463	181	340	811	2214
2000	143	127	213	618	203	438	1112	2854
2005	157	128	284	636	210	468	1490	3373
2010	175	129	362	672	223	509	1908	3978

Source: Air Transport Statistics, 1983
Bali Tourism Statistics, 1984

The following model, the so called logistic type model, was employed for the estimates of the international foreign passengers above, assuming that the international passengers per capita have a logical upper limit.

$$IP_{nt} = POP_{nt} \cdot UIP_{nt}$$

where;

IP_{nt} : International passengers (to/from Indonesia) of nation (n) in year (t)

POP_{nt} : Population of nation (n) in year (t)

UIP_{nt} : International passengers (to/from Indonesia) per capita of nation (n) in year (t)

$$UIP_{nt} = \frac{Kn}{1 + \alpha_n \cdot e^{-\beta n . UInt}}$$

where;

UI_{nt} : Per capita GNP of nation (n) in year (t)

K_n : Upper limit of per capita international passengers of nation (n)

$\alpha n, \beta n$: Parameters (shown in Table 3.4.2)

Table 3.4.2 Parameters, K, α and β

Nationality / Parameters	U S A	United Kingdom	Malaysia	Singa-pore	Aust-ralia	Japan
K	200	200	200	200	200	200
α	476.12	216.21	47.165	4265.8	39.99	354.85
β	-1.25055 E - 05	-4.06364 E - 04	-2.87356 E - 04	-1.09777 E - 03	-7.4607 E - 05	-1.14001 E - 04
Correlation Coefficient (R)	0.843	0.780	0.883	0.980	0.883	0.970

(3) Indonesian Passengers

The Indonesian passengers (IP) at each airport were estimated by using the following model defined as a function of the regional population and gross regional domestic product (GRDP).

$$IP_{it} = POP_{it} \cdot UDP_{it}$$

where;

IP_{it} : Indonesian passengers of airport (i) in year (t)

POP_{it} : Population of region (i) in year (t)

UDP_{it} : Domestic Indonesian passengers per capita of region (i) in year (t)

The per capita passenger (UDP) above was estimated by the formula indicated below. The formula adopted here is an expontential function model.

$$UDP_{it} = \alpha_i \cdot UI_{it}^{\beta_i}$$

where;

UI_{it} : GRDP per capita of region (i) in year (t)

α_i, β_i : Parameters (shown in Table 3.4.3)

Table 3.4.3 Parameters α and β and Correlation Coefficient R

Airport	α	β	R
Yogyakarta	0.000265	2.22433	0.84
Surakarta	0.00179	2.3048	0.97
Semarang	0.00588	2.00974	0.63

In the estimates of future population and GRDP in Table 3.4.4, the growth rates stated in REPELITA IV were applied as those growth rates have been estimated with due consideration of the various development plans in the Study area.

Table 3.4.4 Socio-Economic Indices in the Study Area

Year	Population (1,000)			GRDP (Billion Rp. in 1975 price)		
	Yogya-karta	Sura-karta	Sema-rang	Yogya-karta	Sura-karta	Sema-rang
1977	2,664	437	2,875	156	41.3	260
'78	2,691	444	2,942	164	45.5	279
'79	2,735	452	2,982	172	46.5	277
'80	2,761	459	3,051	187	50.0	323
'81	2,791	468	3,112	200	53.0	345
'82	2,821	478	3,169	208	55.0	359
1990	3,055	518	3,432	274	75	491
'95	3,211	544	3,607	325	92	598
2000	3,374	572	3,791	386	111	727
'05	3,546	601	3,984	459	136	885
'10	3,727	632	4,187	545	165	1,077

Note : Yogyakarta = D.I. Yogyakarta,
Surakarta = Kod. Surakarta,
Semarang = Kod. Semarang + Kab. Semarang + Kab. Kendal + Kab. Demak

Source : Jawa Tengah Salayang Pandang 1984,
Year Book of D.I. Yogyakarta 1983

(4) Cross Checking with the Total Passenger Demand in Indonesia

Table 3.4.5 shows the results of demand forecast for the 3 airports together with the total passenger demand in the whole of Indonesia.

As calculated from the table, the shares of total passengers of the three airports to total passengers in Indonesia generally showed a small variation with an average share of 6.4% for the past ten years. While, the shares in future based on the above-mentioned estimates showed a constant value of 6.0%.

It, therefore, can be understood that the forecasts made in the above section are much more reliable when compared with the demand on the national level.

Table 3.4.5 Annual Domestic Passenger Demand

(x 1000)

Year	Yogyakarta			Surakarta			Semarang			Total of the 3 Airports			Total Indonesia
	Foreigners	Indonesians	Total	Foreigners	Indonesians	Total	Foreignners	Indonesians	Total	Foreigners	Indonesians	Total	
1974	-	-	115	-	-	-	-	-	108	-	-	223	4,341
75	-	-	141	-	-	-	-	-	146	-	-	287	5,015
76	-	-	208	-	-	-	-	-	195	-	-	403	5,935
77	-	-	216	-	-	34	-	-	209	-	-	459	6,962
78	-	-	264	-	-	63	-	-	335	-	-	662	8,059
79	-	-	241	-	-	76	-	-	315	-	-	632	8,747
80	-	-	255	-	-	86	-	-	342	-	-	683	10,715
81	-	-	310	-	-	99	-	-	363	-	-	772	12,775
82	-	-	298	-	-	122	-	-	356	-	-	776	12,612
83	(170)	(130)	300	(15)	(78)	93	(36)	(309)	345	(221)	(517)	738	12,568
1990	257	229	486	23	166	189	54	555	609	334	949	1,283	21,667
95	326	371	697	29	270	299	69	843	912	424	1,483	1,907	32,074
2000	420	488	908	37	371	408	89	1,125	1,214	546	1,984	2,530	42,480
5	496	763	1,259	44	548	592	105	1,613	1,718	645	2,924	3,569	59,824
10	585	1,025	1,610	52	724	776	124	2,098	2,222	760	3,848	4,608	77,168

(5) Route Structure and Share of Passengers by Route

According to the results of passenger traffic flow survey, the originating points of passengers at Semarang airport are mainly from the northern part of the Central Java province, while the originating point at Yogyakarta and Surakarta airport are mostly from D.I. Yogyakarta and the southern part of the Central Java Province.

The originating points for the passengers at Yogyakarta and Surakarta airports are partly overlapped due to their proximity to each other.

Based on this existing condition, two alternatives for future airport layout were basically considered for establishing the route structures in the Study area:

a) One airport each for Yogyakarta, Surakarta, and Semarang, as well as the present situation.

b) One airport for Semarang, and another airport in the Yogyakarta and Surakarta region.

The results of forecast for annual passengers by route are summarized in Table 3.4.6.

Route structure and route share for each airport was made in consideration of the recent trend of passenger traffic.

In case that Yogyakarta and Surakarta airport will be combined into one airport, the number of passengers by routes is the total figures of both airports.

Table 3.4.6 Annual Passenger Demand by Routes

Unit : 1,000 Passengers

Route	Year	Share (%)	1990	1995	2000	2005	2010
YOGYAKARTA	Jakarta	65	316	453	591	818	1046
	Denpasar	26	126	181	236	327	419
	Surabaya	5	24	35	45	63	81
	Bandung	1	5	7	9	13	16
	Banjarmasin	3	15	21	27	38	48
	Total	100	486	697	908	1259	1610
SURAKARTA	Jakarta	83	157	248	339	491	644
	Surabaya	17	32	51	69	101	132
	Total	100	189	299	408	592	776
SEMARANG	Jakarta	76	463	693	922	1305	1688
	Surabaya	16	98	146	194	275	356
	Banjarmasin	4	24	36	49	69	89
	Pangkalanbun	4	24	36	49	69	89
	Total	100	609	911	1214	1718	2222
COMBINED CASE OF YOGYAKARTA AND SURAKARTA	Jakarta	70	473	701	930	1309	1690
	Denpasar	18	126	181	236	327	419
	Surabaya	9	56	86	114	164	213
	Bandung	1	5	7	9	13	16
	Banjarmasin	2	15	21	27	38	48
	Total	100	675	996	1316	1851	2386

3.4.2 Cilacap Airstrip

As described in Chapter 2 of this report, the existing route connecting Cilacap is only the Jakarta-Cilacap route, and future air passengers which may justify the new air transportation network within the Study area cannot be considered as stated hereafter.

Passenger traffic demand at Cilacap airport was, therefore, estimated for the passengers on the route between Jakarta and Cilacap by utilizing the average growth rate of the three airports.

The result of estimates is shown Table 3.4.7.

Table 3.4.7 Annual Passenger Demand at Cilacap Airstrip

Year	Passengers	Growth Factor
1981	2,280	-
1982	10,828	-
1983	10,190	-
1984	7,877	1.00
1990	13,100	1.66
1995	18,600	2.36
2000	26,300	3.34
2005	35,500	4.51
2010	48,000	6.09

3.4.3 Potential Air Traffic Demand within the Study Area

In order to study the feasibility of new local airport/airstrip development in the Study area, inter-regional passengers (potential air passengers) were estimated by an application of a functional model in which the share of air passengers to total inter-regional passengers is defined in relation to the highway distance.

The model utilized here is as follows:

$$AQ_{ij} = TQ_{ij} \cdot SA_{ij}$$

where;

TQ_{ij} : Air passenger traffic demand between zone (i) and (j)

TQ_{ij} : Total passenger traffic demand of (ij) (total of all transportaion mode)

SA_{ij} : The share of air passengers in total passengers

Total passenger traffic demand by all transportation modes is based on the study results of the "Electrification Project of Main Line in Java" executed by JICA, and the share of air passengers to total passengers is defined as follows.

$$SA_{ij} = \alpha \cdot D_{ij}^{\beta}$$

where;

D_{ij} : Distance between zone (i) and zone (j)

α, β : Parameters

$\alpha = 1.0E\text{-}9$, $\beta = 2.396$, $R = 0.78$

The above parameters were obtained by the regression analysis of the actual data shown in Table 3.4.8.

Table 3.4.8 Share of Air Passenger and Distance by Zonal Pair

Zonal Pair	The Share of Air Passengers in total Passengers (%)	Highway Distance (Km)
Yogyakarta - Jakarta	2.5	621
Yogyakarta - Surabaya	0.35	348
Yogyakarta - Bandung	0.23	441
Surakarta - Jakarta	1.87	646
Surakarta - Surabaya	0.37	284
Semarang - Jakarta	2.94	544
Semarang - Surabaya	0.49	305
Semarang - Bandung	0.71	364

As for the growth factors for the future projection, the same estimate for the three airports was applied.

The results of forecast are shown in Tables 3.4.9 through 3.4.12. The zoning of the study area was set the same as the zoning for the passenger traffic flow survey.

Table 3.4.9 Estimation of Air Passengers for Airstrips (Year 1983)

O.D. Matrix

Zone No.	Zone Center \ Zone No.	1	2	3	4	5	6	7	Total
	Zone Center	Cilacap	Magelang	Surakarta	Semarang	Pati	Tegal	Yogyakarta	
1	Cilacap		30	130	330	330	100	30	970
2	Magelang			30	30	100	430	0	630
3	Surakarta				70	100	770	0	1,100
4	Semarang					100	1,030	30	1,600
5	Pati						2,430	130	3,200
6	Tegal							470	5,200
7	Yogyakarta								670
	TOTAL								13,400

Table 3.4.10 Estimation of Air Passengers for Airstrips (Year 1990)

O.D. Matrix

Zone No.	Zone Center \ Zone No.	1	2	3	4	5	6	7	Total
	Zone Center	Cilacap	Magelang	Surakarta	Semarang	Pati	Tegal	Yogyakarta	
1	Cilacap		30	230	530	530	100	30	1,570
2	Magelang			70	70	170	700	0	1,030
3	Surakarta				130	200	1,530	0	2,200
4	Semarang					170	1,900	70	2,870
5	Pati						4,400	230	5,770
6	Tegal							730	9,430
7	Yogyakarta								1,070
	TOTAL								23,900

Table 3.4.11 Estimation of Air Passengers for Airstrips (Year 2000)

O.D. Matrix

Zone No.	Zone Center	1 Cilacap	2 Magelang	3 Surakarta	4 Semarang	5 Pati	6 Tegal	7 Yogyakarta	Total
1	Cilacap		70	1,000	1,000	1,000	270	100	2,930
2	Magelang			130	100	330	1,270	0	1,930
3	Surakarta				330	500	3,330	0	4,830
4	Semarang					400	3,630	100	5,630
5	Pati						8,570	470	11,270
6	Tegal							1,370	18,400
7	Yogyakarta								2,030
	TOTAL								47,000

Table 3.4.12 Estimation of Air Passengers for Airstrips (Year 2010)

O.D. Matrix

Zone No.	Zone Center	1 Cilacap	2 Magelang	3 Surakarta	4 Semarang	5 Pati	6 Tegal	7 Yogyakarta	Total
1	Cilacap		130	930	1,800	1,800	430	130	5,230
2	Magelang			270	200	600	2,200	0	3,430
3	Surakarta				670	1,000	6,300	0	9,130
4	Semarang					770	6,600	200	10,230
5	Pati						15,500	830	20,460
6	Tegal							2,430	33,500
7	Yogyakarta								3,600
	TOTAL								85,590

3.5 Cargo Traffic Demand Forecast for Central Java and D.I. Yogyakarta

The following model was used for the estimates of cargo volumes at the concerned 3 airports.

$$DC_{it} = A_i + B_i \cdot TDC_t$$

where;

DC_{it} : Domestic cargo of airport (i) in year (t)

TDC_t : Total domestic cargo of whole Indonesia in year (t)

A_i, B_i : Parameters (As shown in Table 3.5.1.)

Table 3.5.1 Parameters A_i and B_i, and Correlation Coefficient R

	Yogyakarta	Surakarta	Semarang
A_i	0.123	-0.325	0.024
B_i	4.947 E - 03	0.007	9.467 E - 03
R	0.54	0.94	0.78

The results of estimates are summarized in Table 3.5.2 together with the cargo volume for the whole of Indonesia. As can be seen in Table 3.5.2, the drastic growth at Surakarta airport in the past 7 years is clearly reflected in the estimates.

Table 3.5.2 Annual Domestic Cargo Demand

(Unit: Ton)

Year	Yogyakarta	Surakarta	Semarang	Total Indonesia
1974	389	-	162	44,000
1975	653	-	234	51,000
1976	1,365	-	263	62,000
1977	696	89	517	70,000
1978	833	124	820	75,000
1979	781	181	937	83,000
1980	838	216	1,137	104,000
1981	1,169	236	600	130,000
1982	1,268	250	1,150	131,000
1983	831	550	1,159	125,000
1990	1,250	1,181	1,988	226,000
2000	2,212	2,566	3,844	452,000
2010	3,820	4,850	6,927	827,000

3.6 Air Traffic Breakdown for the Design Bases

3.6.1 Summary of the Air Traffic Breakdown

The annual traffic demands estimated in the previous sections were broken down into design bases to project the size of the airport.

The results are tabulated in the tables below.

(a) Table 3.6.1 Yogyakarta Airport
(b) Table 3.6.2 Surakarta Airport
(c) Table 3.6.3 Combined Case of Yogyakarta and Surakarta Airport
(d) Table 3.6.4 Semarang Airport

As for the Cilacap airstrip, present STOL aircraft will be substituted by F-27/HS748 class aircraft after the year 2000 in light of the design standard for aircraft introduction established as shown in Fig. 3.6.2.

With regards to the new local airstrip development, passengers on the Tegal-Pati route only will justify the introduction of STOL aircraft with a daily frequency of two movements after the year 2000 in the light of the same standard.

Table 3.6.1 Summary of the Air Traffic Demand Forecast for Yogyakarta Airport

Year	Items	Passengers	Aircraft Movements							Total
			J	WB	NMJ	MJ	SJ	SP	STOL	
1990	Annual	496,000				3,200	2,600	1,300	600	7,700
	Peak Month	51,700				310	240	120	60	730
	Design Day	1,690				10	8	4	2	24
	Peak Hour	480				2.8	2.3	1.1	0.6	6.8
	Heavy Direction Peak Hour	290								4.1
1995	Annual	697,000		1,300		3,900		1,300	600	7,100
	Peak Month	74,100		120		370		120	60	670
	Design Day	2,420		4		12		4	2	22
	Peak Hour	710		1.1		3.5		1.1	0.6	6.3
	Heavy Direction Peak Hour	430								3.8
2000	Annual	908,000		1,900		5,200		1,900	600	9,600
	Peak Month	96,600		180		490		180	60	910
	Design Day	3,160		6		16		6	2	30
	Peak Hour	800		1.5		4.0		1.5	0.5	7.5
	Heavy Direction Peak Hour	480								4.5
2010	Annual	1,610,000		4,500	2,600		1,300	1,300	1,300	11,000
	Peak Month	171,300		430	240		120	120	120	1,030
	Design Day	5,610		14	8		4	4	4	34
	Peak Hour	1,310		3.3	1.9		0.9	0.9	0.9	7.9
	Heavy Direction Peak Hour	790								4.7

Table 3.6.2 Summary of the Air Traffic Demand Forecast for Surakarta Airport

Year	Items	Passengers	Aircraft Movements							
			J	WB	NMJ	MJ	SJ	SP	STOL	Total
1990	Annual	189,000					3,800			3,800
	Peak Month	19,500					370			370
	Design Day	640					12			12
	Peak Hour	250					4.8			4.8
	Heavy Direction Peak Hour	150								2.9
1995	Annual	299,000				2,600	1,300			3,900
	Peak Month	30,800				240	120			360
	Design Day	1,010				8	4			12
	Peak Hour	400				3.2	1.6			4.8
	Heavy Direction Peak Hour	240								2.9
2000	Annual	408,000				3,200	1,300			4,500
	Peak Month	42,100				310	120			430
	Design Day	1,380				10	4			14
	Peak Hour	510				3.7	1.5			5.2
	Heavy Direction Peak Hour	310								3.1
2010	Annual	776,000			3,800	2,600				6,400
	Peak Month	80,000			370	240				610
	Design Day	2,630			12	8				20
	Peak Hour	810			3.7	2.5				6.2
	Heavy Direction Peak Hour	490								3.7

Table 3.6.3 Summary of the Air Traffic Demand Forecast for Combined Case of Yogyakarta and Surakarta Airports

Year	Items	Passengers	Aircraft Movements							
			J	WB	NMJ	MJ	SJ	SP	STOL	Total
1990	Annual	675,000		1,900		1,300	3,900	600	600	8,300
	Peak Month	71,100		180		120	370	60	60	690
	Design Day	2,320		6		4	12	2	2	26
	Peak Hour	630		1.6		1.1	3.3	0.5	0.5	7.0
	Heavy Direction Peak Hour	380								4.2
1995	Annual	996,000		3,900		1,900	1,900	600	600	8,900
	Peak Month	104,800		370		180	180	60	60	850
	Design Day	3,430		12		6	6	2	2	28
	Peak Hour	900		3.1		1.6	1.6	0.5	0.5	7.3
	Heavy Direction Peak Hour	540								4.4
2000	Annual	1,316,000		5,200		2,600	1,900	600	600	10,900
	Peak Month	138,500		490		240	180	60	60	1,030
	Design Day	4,530		16		8	6	2	2	34
	Peak Hour	1,070		3.8		1.9	1.4	0.5	0.5	8.1
	Heavy Direction Peak Hour	650								4.9
2010	Annual	2,386,000	5,200		2,600	2,600		1,300	1,300	13,000
	Peak Month	251,200	490		240	240		120	120	1,210
	Design Day	8,300	16		8	8		4	4	40
	Peak Hour	1,810	3.5		1.7	1.7		0.9	0.9	8.7
	Heavy Direction Peak Hour	1,090								5.2

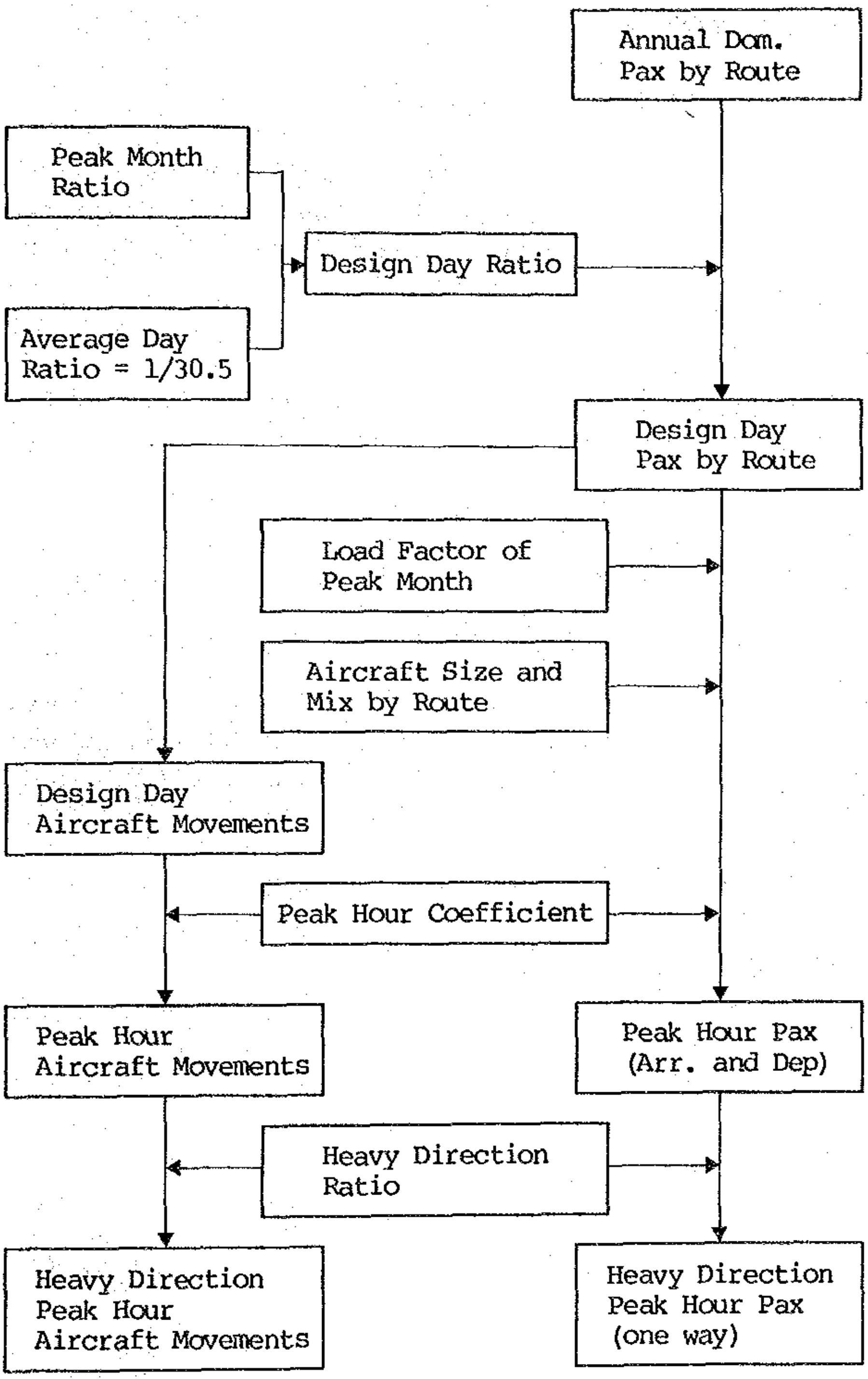
Table 3.6.4 Summary of the Air Traffic Demand Forecast for Semarang Airport

Year	Items	Passengers	Aircraft Movements							Total
			J	WB	NMJ	MJ	SJ	SP	STOL	
1990	Annual	609,000		1,300		2,000	2,000	1,300		6,600
	Peak Month	58,600		120		180	180	120		600
	Design Day	1,920		4		6	6	4		20
	Peak Hour	590		1.2		1.9	1.9	1.2		6.2
	Heavy Direction Peak Hour	350								3.7
1995	Annual	911,000		2,000		2,700	2,700	1,300		8,700
	Peak Month	87,600		180		240	240	120		780
	Design Day	2,870		6		8	8	4		26
	Peak Hour	780		1.6		2.2	2.2	1.1		7.1
	Heavy Direction Peak Hour	470								4.3
2000	Annual	1,214,000		4,700		2,000		2,700		9,400
	Peak Month	116,700		430		180		240		850
	Design Day	3,820		14		6		8		28
	Peak Hour	1,000		3.7		1.6		2.1		7.4
	Heavy Direction Peak Hour	600								4.4
2010	Annual	2,222,000	5,400			3,400	2,700			11,500
	Peak Month	213,700	400			310	240			1,040
	Design Day	7,000	16			10	8			34
	Peak Hour	1,660	3.8			2.4	1.9			8.1
	Heavy Direction Peak Hour	1,000								4.9

3.6.2 Methodology

Major airport facilities are to be designed based on the traffic volume of the peak hour of the average day of the peak month, i.e., the peak hour of the design day, in order not to cater unnecessarily to rare occurences.

In this section, the annual air traffic demands for the years 1990, 1995, 2000 and 2010 were broken down into daily and hourly bases as formulated in Fig. 3.6.1.



Note: Design bases are peak hour traffic of the average day of the peak month.

Fig. 3.6.1 Flowchart for Air Traffic Breakdown

3.6.3 Basic Assumptions

(1) Peak Month Ratio and Design Day Ratio

Peak month ratio, which indicates the degree of concentration of traffic at the peak month, was calculated based on the monthly statistics of the 3 airports as shown in Tables 3.6.5 and 3.6.6 for passenger traffic and for aircraft movements, respectively.

Table 3.6.5 Peak Month Ratio and Design Day Ratio for Passenger Traffic

Airport / Year	Yogyakarta	Surakarta	Semarang
1981	1/9.6 (Aug.)	1/10.3 (Dec.)	1/9.8 (Jun.)
1982	1/9.6 (Aug.)	1/9.6 (Jul.)	1/10.4 (Jul.)
1983	1/9.3 (Aug.)	1/9.5 (Jul.)	1/10.9 (Jul.)
1984	1/9.1 (Jul.)	1/9.2 (Jul.)	1/10.5 (Jul.)
Adopted Peak Month Ratio	1/9.4	1/9.7	1/10.4
Adopted Design Day Ratio	1/287	1/296	1/317

Table 3.6.6 Peak Month Ratio and Design Day Ratio for Aircraft Movements

Year \ Airport	Yogyakarta	Surakarta	Semarang
1981 1982 1983 1984	1/11.0 (Aug.) 1/10.7 (Aug.) 1/10.3 (Dec.) 1/10.5 (Jul.)	1/9.9 (Jan.) 1/10.7 (Jul.) 1/10.0 (Jul.) 1/11.3 (Jun.)	1/10.8 (Aug.) 1/10.7 (Dec.) 1/11.0 (May) 1/11.3 (Dec.)
Adopted Peak Month Ratio	1/10.6	1/10.5	1/11.0
Adopted Design Day Ratio	1/323	1/320	1/336

Peak month traffic was occured in July and August due school vacations and religious events, i.e., Idul Fitri.

The higher peak month ratio for passengers of Yogyakarta airport in Table 3.6.5 indicates a characteristic of this airport which serves many tourists. On the other hand, the lower peak month ratio of Semarang airport can be explained by the high percentage of business passengers which was observed during the traffic flow survey.

Peak month ratio for aircraft movements shows lower figures. This indicates the load factor increases during the peak month.

These peak month characteristics are not considered to change greatly even if the annual passengers increase.

Therefore, an average ratio for the recent four years was adopted for the design basis.

The design day ratio was obtained as a product of the peak month ratio and average day ratio of 1/30.5.

(2) Aircraft Classification and Planning Standard for Aircraft Introduction

a) Aircraft Classification and Seat Capacity

Aircraft seat capacity by aircraft category was set as shown in Table 3.6.7 taking into account the present aircraft types owned by Indonesian airline companies, REPELITA IV and future plans of aircraft manufacturers.

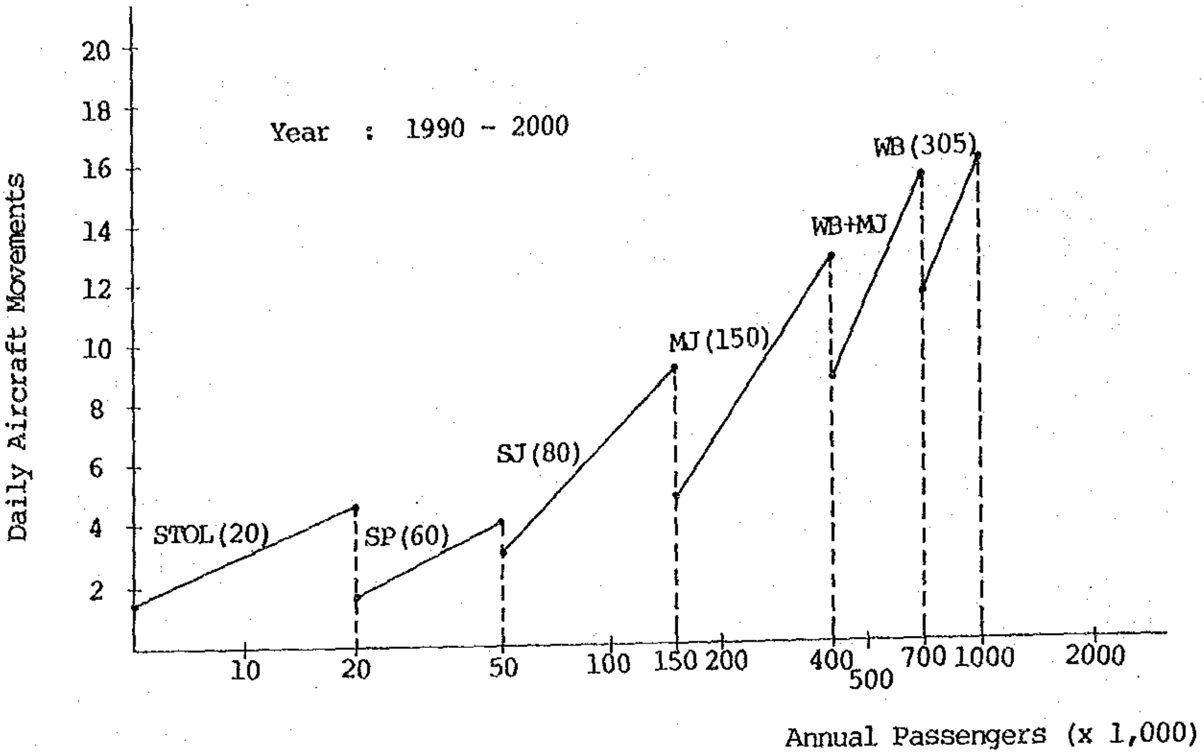
In REPELITA IV, the aircraft types are categorized into B-747, A300/DC-10, DC-9, F-28, F-27 and CS212 and the improvement and construction of runways are targeted in accordance with this categorization. However, B-767/A310 class aircraft, which require the same runway length as DC-9, are considered to be introduced after the year 2000 in order to fill the gap between A300/DC-10 and DC-9 aircraft from the viewpoint of operational economy.

Table 3.6.7 Aircraft Classification and Seat Capacity

Aircraft Category	Type of Aircraft	Seat Capacity 1990 -2000	Seat Capacity 2001 -2010	Remarks
J	B-747	500	500	. A300 class aircraft is assumed to be enlarged in the future.
WB	A300 DC-10	305	350	
NMJ	B-767 A310	--	260	. B-767 class aircraft will fill the gap between WB and MJ for economical operation.
MJ	MD-82 A320	150	150	. MD-82 class aircraft will replace DC-9-32s.
SJ	F-28	80	80	
SP	F-27 HS748	60	60	
STOL	DHC-6 CS2	20	20	

b) Planning Standard for Aircraft Introduction

Planning standard for aircraft introduction was established as shown in Fig 3.6.2 taking into account the current situation of aircraft assignment by route, economical operations of aircraft and convenience of passengers.



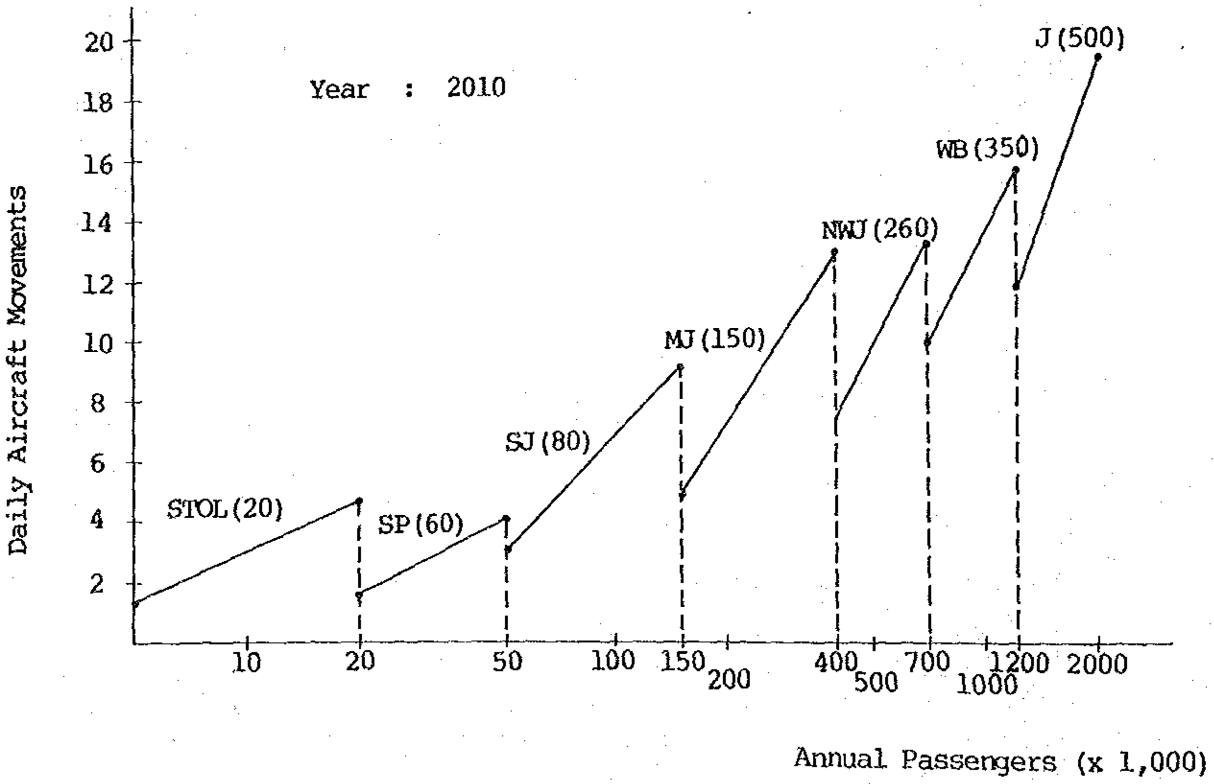


Fig 3.6.2 Design Standard for Aircraft Introduction

(3) Load Factor

According to the past five year statistics for each airport, the load factor by route was relatively low except for the route from/to Jakarta.

In this study, the load factor was set at 70 percent which is adopted generally as the planning value for the domestic routes.

(4) Peak Hour Coefficient

Peak hour coefficient is defined as the ratio of peak hour aircraft movements to daily aircraft movements. Based on the present aircraft movements at various Indonesian airports, the formula of the relation between daily aircraft movements and peak hour coefficient was derived as follows: (refer to Fig. 3.6.3)

$$Cp = 1.38 \ / \sqrt{Md} \quad (Md \leq 200)$$

Where; Cp : Peak hour coefficient
Md : Daily aircraft movements

(5) Heavy Direction Ratio

Heavy direction ratio is defined as the ratio of the aircraft movements of the heavier direction (arrival or departure) divided by total peak hour movements, and generally is situated between 0.6 and 0.7.

It is observed from the timetables of several Indonesian airports that heavy direction ratio is about 0.6 on the average.

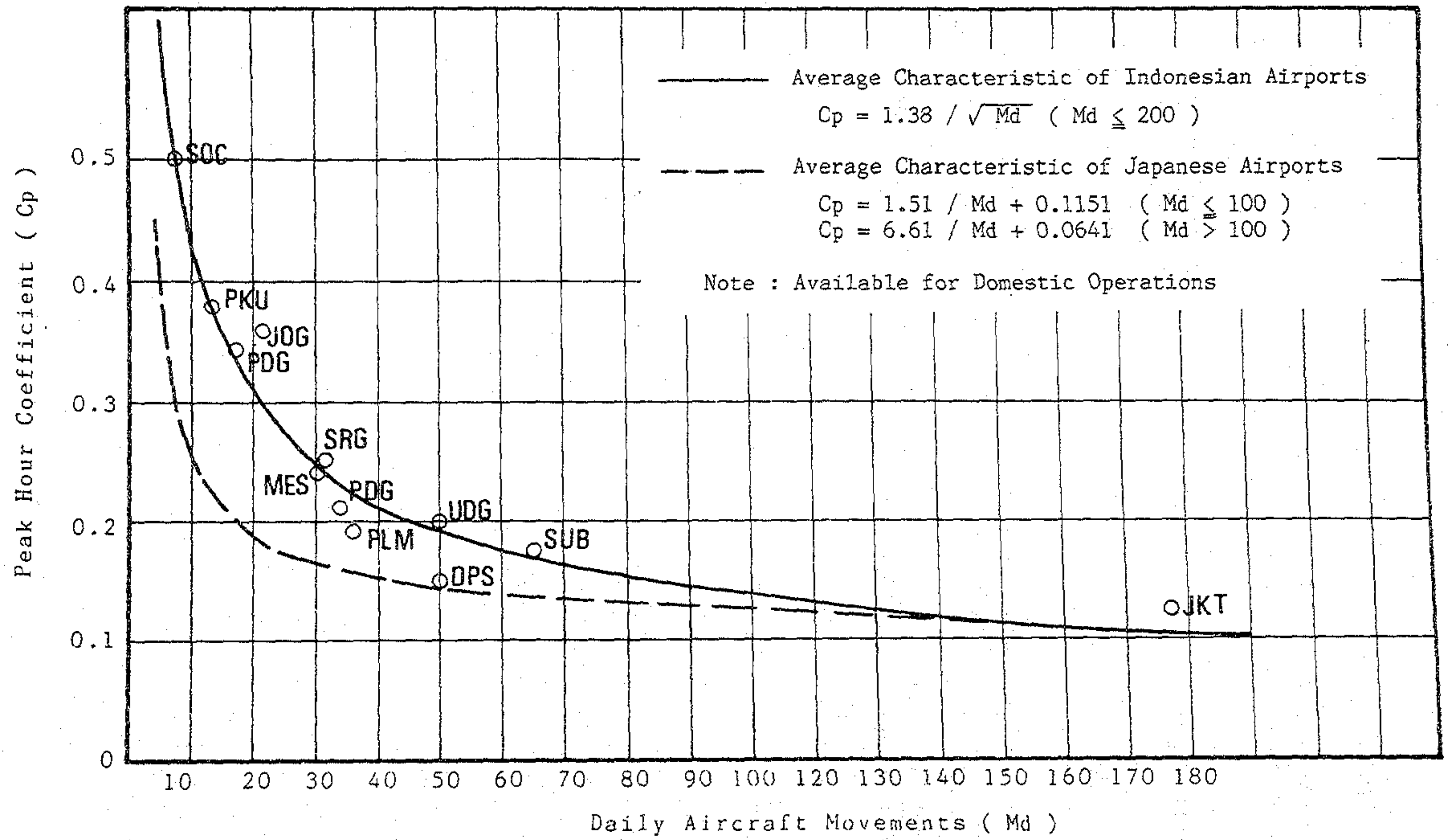


Fig. 3.6.3 Daily Aircraft Movements and Peak Hour Coefficient

CHAPTER 4 AIRPORT FACILITY REQUIREMENTS ANALYSIS

CHAPTER 4 AIRPORT FACILITY REQUIREMENTS ANALYSIS

4.1 Summary

This chapter sets forth the major airport facility requirements necessary for the purpose of studying the alternative airports development concepts, which are estimated based on the air traffic demand forecast and in compliance with the relevant standards, recommended practices and/or regulations of ICAO (International Civil Aviation Organization), JCAB (Civil Aviation Bureau of Japan) and FAA (Federal Aviation Administration of the United States).

The results are summarized in Table 4.1.1.

Table 4.1.1 Summary of Preliminary Facility Requirements

	ITEMS \ AIRPORT / YEAR	YOGYAKARTA AIRPORT					SURAKARTA AIRPORT				
		Present Condition (as of 1984)	1990	1995	2000 (Phase I)	2010 (Phase II)	Present Condition (as of 1984)	1990	1995	2000 (Phase I)	2010 (Phase II)
AIR TRAFFIC DEMAND	1. Annual Passengers	290,279	486,000	697,000	908,000	1,610,000	97,746	189,000	299,000	408,000	776,000
	2. Annual Cargo (ton)	830	1,250	1,730	2,210	3,820	550	1,180	1,870	2,570	4,850
	3. Annual Aircraft Movements	6,336	7,700	7,100	9,600	11,000	3,193	3,800	3,900	4,500	6,400
	4. Peak Hour Passengers (Arr. + Dep.)	300*1	480	710	800	1,310	180*1	250	400	510	810
	5. Peak Hour Aircraft Movements (one way)	4	4.1	3.8	4.5	4.7	2	2.9	2.9	3.1	3.7
	6. Largest Aircraft in Service	DC-9-32	MD-82/A320	A300/DC-10			F-28-4000	F-28-4000	MD-82/A320		B-767/A310
FACILITY REQUIREMENTS	7. Runway (m x m)	1,850 x 40	2,150 x 45	2,500 x 45			1,900*3 x 45	1,800 x 45	2,150 x 45		
	8. Runway Strip (m x m)	1,970 x 150	2,270 x 300	2,620 x 300			2,020 x 150	1,920 x 300	2,270 x 300		
	9. Taxiway	-	Parallel Taxiway Justified				-	Parallel Taxiway Not Necessary			
	10. Passenger Terminal Apron (stands)	DC-9 : 6	MJ : 4 SP : 1 STOL : 1	WB : 2 MJ : 2 SP : 1 STOL : 1	WB : 2 MJ : 3 SP : 1 STOL : 1	WB/NMJ : 5 SJ : 1 SP : 1 STOL : 1	F28 : 4	SJ : 4	MJ : 3 SJ : 1	MJ : 3 SJ : 1	NMJ : 4 SJ : 2
	11. Passenger Terminal Building	2,850*2	7,200	10,700	12,000	19,700	670	3,800	6,000	7,700	12,200
	12. Air Navigation Systems	Instrument, Non-Precision	Precision Approach Category-I				Instrument, Non-Precision	Precision Approach Category-I			

Note *1 : Estimated figure
*2 : Expansion works was completed in 1985.
*3 : Runway extension work was completed in 1986.

Aircraft Category

WB : A300/DC-10 class
NMJ: B-767/A310 class
MJ : MD-82/A320 class
SJ : F-28 class
SP : F27/HS784 class
STOL: DHC-6/CS2 class

Table 4.1.1 (Cont'd)

	ITEMS \ AIRPORT / YEAR	Combined Case of Yogyakarta and Surakarta Airports: Present Condition (as of 1984)	1990	1995	2000 (Phase I)	2010 (Phase II)	Semarang Airport: Present Condition (as of 1984)	1990	1995	2000 (Phase I)	2010 (Phase II)
AIR TRAFFIC DEMAND	1. Annual Passengers	388,025 *1	675,000	996,000	1,316,000	2,386,000	344,422	609,000	911,000	1,214,000	2,222,000
	2. Annual Cargo (ton)	1,380 *1	2,430	3,600	4,780	8,670	1,159	1,990	2,920	3,840	6,930
	3. Annual Aircraft Movements	9,529 *1	8,300	8,900	10,900	13,000	10,221	6,600	8,700	9,400	11,500
	4. Peak Hour Passengers (Arr. + Dep.)	-	630	900	1,070	1,810	300 *2	590	780	1,000	1,660
	5. Peak Hour Aircraft Movements (one way)	-	4.2	4.4	4.9	5.2	4	3.7	4.3	4.4	4.9
	6. Largest Aircraft in Service	-	A300/DC-10			B-747	F-28-4000	A300/DC-10			B-747
FACILITY REQUIREMENTS	7. Runway (m x m)	-	2,500 x 45				1,650 *3 x 45	2,500 x 45			
	8. Runway Strip (m x m)	-	2,620 x 300				1,770 x 150	2,620 x 300			
	9. Taxiway	-	Parallel Taxiway Justified				-	-	Parallel Taxiway Not Necessary		
	10. Passenger Loading Apron (stands)	-	WB : 2 MJ : 1 SJ : 2 SP : 1 STOL : 1	WB : 4 MJ : 1 SJ : 1 SP : 1 STOL : 1	WB : 4 MJ : 1 SJ : 1 SP : 1 STOL : 1	J : 4 NWJ : 2 MJ : 1 SP : 1 STOL : 1	F28 : 4	WB : 2 MJ : 1 SJ : 1 SP : 1	WB : 2 MJ : 2 SJ : 1 SP : 1	WB : 4 MJ : 1 SP : 1	J : 4 MJ : 2 SJ : 1
	11. Passenger Terminal Building	-	9,500	13,500	16,100	27,200	1,540	8,900	11,700	15,000	24,900
	12. Air Navigation Systems	-	Precision Approach Category-I				Instrument, Non-Precision	Precision Approach Category-I			

Note *1 : Total of Yogyakarta and Surakarta airports
*2 : Estimated figure
*3 : Runway extension work was completed in 1985.

Aircraft Category

J : B-747 class
WB : A300/DC10 class
NWJ : B-767/A310 class
MJ : MD-82/A320 class
SJ : F-28 class
SP : F-27/HS784 class
STOL: DHC-6/CS2 class

4.2 Aerodrome Reference Code and Operational Requirements

The aerodrome reference code will be established in accordance with the characteristics of the aircraft to be introduced as shown in Table 4.2.1.

Table 4.2.1 Aerodrome Reference Code

Airport \ Year	1990	1995	2000	2010
Yogyakarta	4C	4D	4D	4D
Surakarta	3C	4C	4C	4D
Combined Case of JOG and SOC	4D	4D	4D	4E
Semarang	4D	4D	4D	4E

Note: JOG = Yogyakarta, SOC = Surakarta

The operational category of the runway should be precision approach runway Category-I.

4.3 Runway Length and Width

Runway length was calculated for the 4 cases for the maximum payloads and for the longest domestic route. The conditions of the calculation and the required length of the runway are summarized hereafter for each aircraft.

The width of runway should be 45 m with 7.5 m shoulders on each side where the code number and letter of the airports are 4C, 4D or 4E.

a) Yogyakarta Airport

1. Study Route (stretch) : Yogyakarta - Denpasar
2. Distance : 348 NM
3. Alternate Airport : Surabaya
4. Airport Altitude : 107 meter
5. Surface Wind : 0 kt
6. Runway Slope : 0 percent
7. Runway Surface Condition : Wet condition
8. Temperature : 33 ^{o}C

Aircraft	FAR Take-off Runway Length (m)	Remarks
MD-82	2,150	* Landing is the critical phase
A320	2,100	** Garuda performance
B-767-200	2,100	
A310	2,150	
A300-B4	2,200 (2,500*) **	
DC-10-30	2,200 (2,300*) **	

b) Surakarta Airport

1. Study Route (stretch) : Surakarta - Jakarta
2. Distance : 295 NM
3. Alternate Airport : Palembang
4. Airport Altitude : 106 meter
5. Surface Wind : 0 kt
6. Runway Slope : 0 percent
7. Runway Surface Condition : Wet condition
8. Temperature : 33 ^{o}C

Aircraft	FAR Take-off Runway Length (m)
F-28	1,800
MD-82	2,150
A320	2,100
B-767-200	2,100
A310	2,150

c) Combined Case of Yogyakarta and Surakarta Airport

1. Study Route (stretch) : Yogyakarta - Denpasar
2. Distance : 348 NM
3. Alternate Airport : Surabaya
4. Airport Altitude : 107 meter
5. Surface Wind : 0 kt
6. Runway Slope : 0 percent
7. Runway Surface Condition : Wet condition
8. Temperature : 33 °C

Aircraft	FAR Take-off Runway Length (m)	Remarks
B-767-200	2,100	* Landing is the critical phase
A310	2,150	** Garuda performance
A300-B4	2,200 (2,500*) **	
DC-10-30	2,200 (2,300*) **	
B-747-200B	2,200 (2,500*) **	

d) Semarang Airport

1. Study Route (stretch) : Semarang - Jakarta
2. Distance : 224 NM
3. Alternate Airport : Surabaya
4. Airport Altitude : Sea level
5. Surface Wind : 0 kt
6. Runway Slope : 0 percent
7. Runway Surface Condition : Wet condition
8. Temperature : 33 °C

Aircraft	FAR Take-off Runway Length (m)	Remarks
A300-B4	2,100 (2,500*) **	* Landing is the critical phase
DC-10-30	2,100 (2,300*) **	
B-747-200B	2,100 (2,500*) **	** Garuda performance

4.4 Runway Strip

The runway strip should be of the following dimensions based on the runway length and operational category of precision approach Category-I.

Table 4.4.1 Runway Strip

Airports \ Year	1990	1995	2000	2010
Yogyakarta	2,270 m x 300 m	2,620 m x 300 m		
Surakarta	1,920 m x 300 m	2,270 m x 300 m		
Combined Case of JOG and SOC	2,620 m x 300 m			
Semarang	2,620 m x 300 m			

4.5 Obstacle Limitation Requirements

The requirements of the obstacle limitation surfaces for the runway with precision approach Category-I are summarized in Figs. 4.5.1 and 4.5.2, and Tables 4.5.1 and 4.5.2 for the aerodrome reference code numbers 3 and 4.

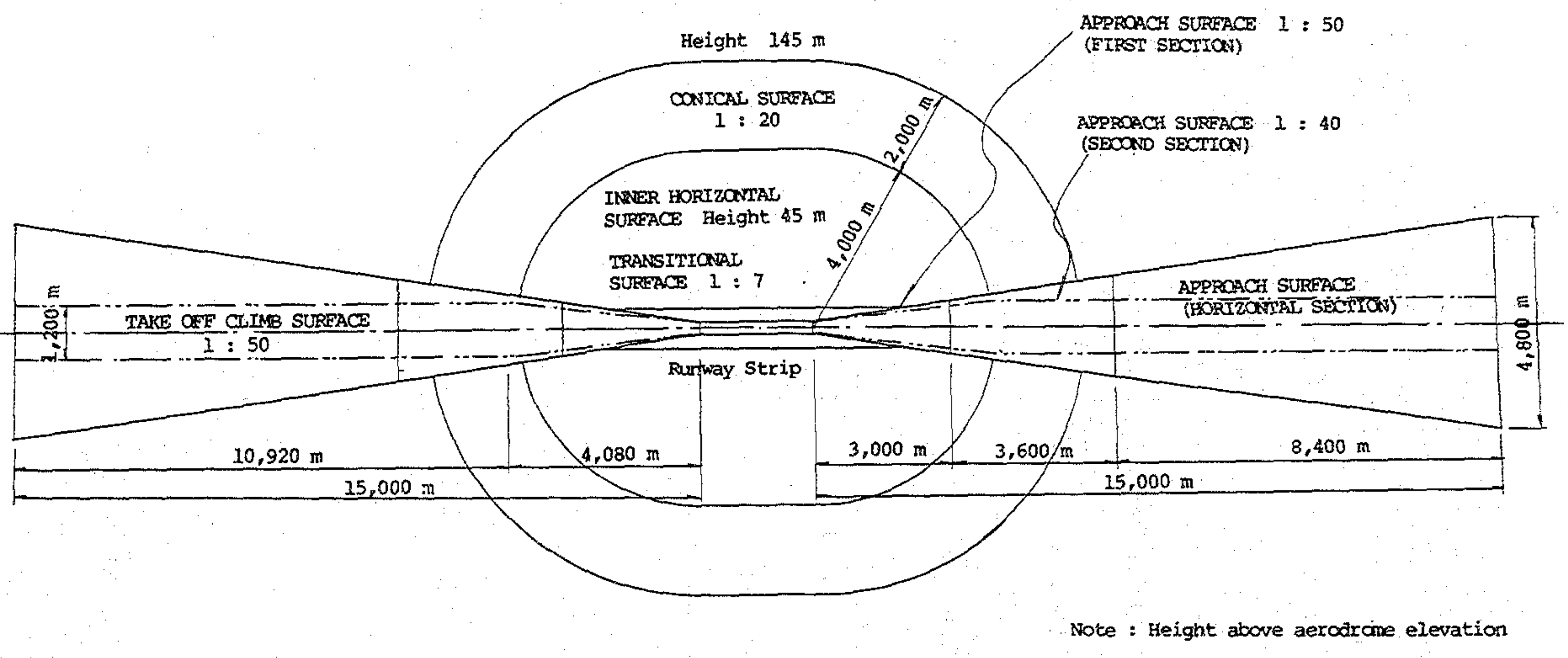


Fig. 4.5.1 Obstacle Limitation Surfaces (1)

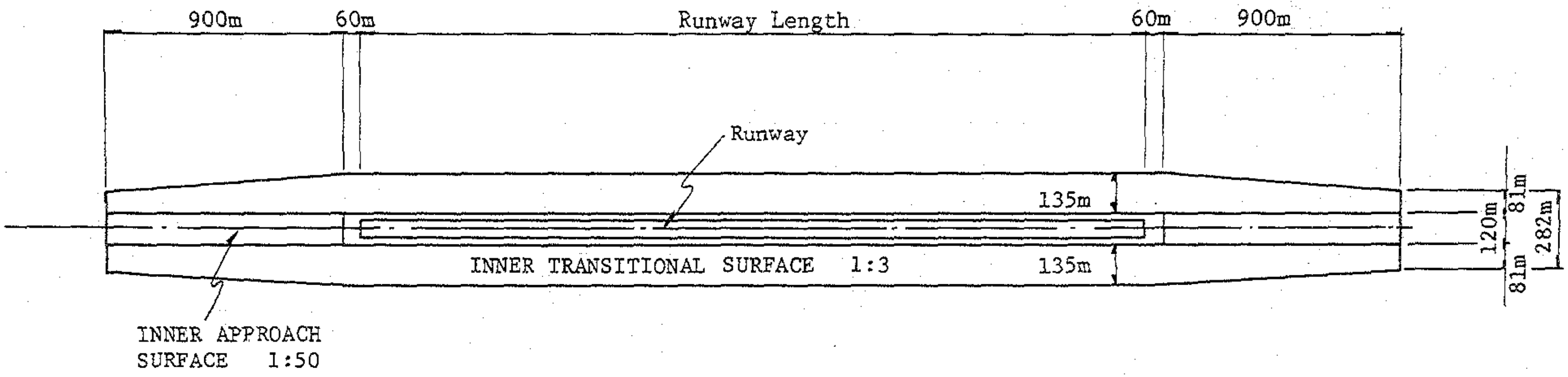


Fig. 4.5.2 Obstacle Limitation Surfaces (2)

Table 4.5.1 Dimensions and Slopes of Obstacle Limitation Surfaces (1)

APPROACH RUNWAYS

	Runway classification									
	Non-instrument				Non-precision approach			Precision approach category		
								I		II or III
	Code number				Code number			Code number		Code number
Surface and dimensions[a]	1	2	3	4	1,2	3	4	1,2	3,4	3,4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2 000 m	2 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m
INNER APPROACH										
Width	-	-	-	-	-	-	-	90 m	120 m	120 m
Distance from threshold	-	-	-	-	-	-	-	60 m	60 m	60 m
Length	-	-	-	-	-	-	-	900 m	900 m	900 m
Slope								2.5%	2%	2%
APPROACH										
Length of inner edge	60 m	80 m	150 m	150 m	150 m	300 m	300 m	150 m	300 m	300 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	-	-	-	-	-	3 600 m[b]	3 600 m[b]	12 000 m	3 600 m[b]	3 600 m[b]
Slope	-	-	-	-	-	2.5%	2.5%	3%	2.5%	2.5%
Horizontal section										
Length	-	-	-	-	-	8 400 m[b]	8 400 m[b]	-	8 400 m[b]	8 400 m[b]
Total length	-	-	-	-	-	15 000 m	15 000 m	15 000 m	15 000 m	15 000 m
TRANSITIONAL										
Slope	20%	20%	14.3%	14.3%	20%	14.3%	14.3%	14.3%	14.3%	14.3%
INNER TRANSITIONAL										
Slope	-	-	-	-	-	-	-	40%	33.3%	33.3%
BALKED LANDING SURFACE										
Length of inner edge	-	-	-	-	-	-	-	90 m	120 m	120 m
Distance from threshold	-	-	-	-	-	-	-	d	1 800 m[c]	1 800 m[c]
Divergence (each side)	-	-	-	-	-	-	-	10%	10%	10%
Slope	-	-	-	-	-	-	-	4%	3.33%	3.33%

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (see 4.2.9 or 4.2.17).
c. Or end of runway whichever is less.
d. Distance to the end of strip.

Source: Annex 14 - Aerodrome, ICAO

Table 4.5.2 Dimensions and Slopes of Obstacle Limitation Surfaces (2)

TAKE-OFF RUNWAYS

Surface and dimensions[a]	Code number		
	1	2	3 or 4
(1)	(2)	(3)	(4)
TAKE-OFF CLIMB			
Length of inner edge	60 m	80 m	180 m
Distance from runway end[b]	30 m	60 m	60 m
Divergence (each side)	10%	10%	12.5%
Final width	380 m	580 m	1 200 m 1 800 m[c]
Length	1 600 m	2 500 m	15 000 m
Slope	5%	4%	2%[d]

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
d. See 4.2.24 and 4.2.26.

Source: Annex 14 - Aerodrome, ICAO

4.6 Taxiway

A complete parallel taxiway with perpendicular exits will be justified if considered economically feasible, when the number of instrument approaches exceeds 4 instrument approaches during the peak hour and the operation of wide-body jet aircraft becomes frequent.

Table 4.6.1 Parallel Taxiway

Airports \ Year	1990	1995	2000	2010
Yogyakarta	Parallel Taxiway Justified			
Surakarta	-	-	-	-
Combined Case of JOG and SOC	Parallel Taxiway Justified			
Semarang	-	Parallel Taxiway Justified		

4.7 Passenger Terminal Apron

4.7.1 Calculation Method for Required Number of Aircraft Stands

The following formula was used to obtain the required aircraft stands for the future key years.

$$S = \sum_{i}^{n} \left(\frac{Ti}{60} \times Ni \right) + a$$

Where ;

S : Required number of aircraft stands
Ti: Gate occupancy time of aircraft of category (i) in minutes
Ni: Number of arriving aircraft of category (i) during peak hour
a : One extra stand for the largest aircraft of the planning year for an unexpected peak occasion. (1 extra for each 10 stands)

4.7.2 Classification of Aircraft

Apart from the aircraft classification by seat capacity, the classification as shown in Table 4.7.1 was made for the planning of aircraft stands taking into account the wing span, overall length, etc., of aircraft. (Refer to Table 4.7.2)

Table 4.7.1 Aircraft Classifications for Apron

Aircraft Category	Type of Aircraft	Design Aircraft	Wing Span (m)	Clearance (m)
J	B-747	B-747	60	7.5
WB/NMJ	A300/DC-10 B-767/A310	DC-10	50.5	7.5
MJ	MD-82/A320	A320	34.5	4.5
SJ	F-28	F-28	25.1	4.5
SP	F-27/HS748	HS748	30	4.5
STOL	DHC-6	DHC-6	20	3.0

Note*: Clearance between adjacent aircraft stands

Table 4.7.2 Size of Aircraft

Aircraft Model	Wing Span (m)	Overall Length (m)	Height (m)
B-747-200B	59.6	70.5	19.3
DC-10-30	50.4	55.5	17.4
A300-B4	44.8	53.6	16.7
B-767-200	47.2	48.5	15.9
A310-200	43.9	46.7	15.8
MD-82	32.9	45.0	9.2
A320	34.5	37.4	11.8
DC-9-32	28.5	36.4	8.4
F-28-4000	25.1	29.1	8.5
F-27	29.0	25.5	8.4
HS748	30.0	20.4	7.6
DHC-6	19.8	15.8	5.7
CS212	19.0	15.2	6.3

4.7.3 Gate Occupancy Time

Gate occupancy time for each aircraft category was set as tabulated in Table 4.7.3 taking into consideration the present parking time according to the timetables, with a margin for delay.

Table 4.7.3 Gate Occupancy Time

Aircraft Category	Actual Gate Occupancy Time (Minutes)	Gate Occupancy Time for Planning (Minutes)
J	60	70
WB/NMJ	60	70
MJ	45	55
SJ	45	55
SP	30 - 40	45
STOL	30	45

4.7.4 Required Number of Aircraft Stands

Number of required aircraft stands was calculated based on the aforementioned assumptions and summarized in Table 4.7.4 for respective airports.

Table 4.7.4 Required Number of Aircraft Stands

a) Yogyakarta Airport

Aircraft Category	1990	1995	2000	2010
WB/NMJ	-	2	2	5
MJ	4	2	3	-
SJ	-	-	-	1
SP	1	1	1	1
STOL	1	1	1	1
Total	6	6	7	8

b) Surakarta Airport

Aircraft Category	1990	1995	2000	2010
WB/NMJ	-	-	-	4
MJ	-	3	3	-
SJ	4	1	1	2
Total	4	4	4	6

c) Combined Case of Yogyakarta and Surakarta Airports

Aircraft Category	1990	1995	2000	2010
J	-	-	-	4
WB/NMJ	2	4	4	2
MJ	1	1	1	1
SJ	2	1	1	-
SP	1	1	1	1
STOL	1	1	1	1
Total	7	8	8	9

d) Semarang Airport

Aircraft Category	1990	1995	2000	2010
J	-	-	-	4
WB/NMJ	2	2	4	-
MJ	1	2	1	2
SJ	1	1	-	1
SP	1	1	1	-
Total	5	6	6	7

4.7.5 Parking Space Requirements

The dimensions of the parking space for aircraft types were planned as indicated in Table 4.7.5 taking into consideration that the linear parking configuration will be adopted for the terminal judging from the number of stands required for the year 2010.

Table 4.7.5 Parking Space Requirements

Aircraft Category	Tractor Associated	Self-Maneuvering
J	68 m x 190 m	-
WB/NMJ	58 m x 160 m	-
MJ	39 m x 105 m	-
SJ	30 m x 105 m	-
SP	-	50 m x 90 m
STOL	-	30 m x 80 m

4.8 Passenger Terminal Building

The floor area required for the passenger terminal building is calculated by multiflying the number of peak hour passengers by the unit floor area.

Unit floor area of 15 sq.m per peak hour passengers (2 ways) was adopted for the planning basis.

Table 4.8.1 Floor Area Requirement for the Passenger Terminal Building

(sq.m)

Airport \ Year	1990	1995	2000	2010
Yogyakarta	7,200	10,700	12,000	19,700
Surakarta	3,800	6,000	7,700	12,200
Combined Case of JOG and SOC	9,500	13,500	16,100	27,200
Semarang	8,900	11,700	15,000	24,900