CHAPTER 3 FORMATION OF THE AIRPORTS DEVELOPMENT CONCEPT

CHAPTER 3 FORMATION OF THE AIRPORTS DEVELOPMENT CONCEPT

3.1 Existing Airports and Evaluation Thereto

(1) Existing Airports

a) Yogyakarta Airport

The existing Yogyakarta airport is located 7.5 km east of the center of Yogyakarta city and jointly used by the civil and military sectors. Control agency of the airport is IAF. Layout plan and outline of the existing Yogyakarta airport are shown in Fig. 3.1 and Table 3.1, respectively.

Major problems of the existing airport are shown below:

- DC-9-32s are operated with weight restriction because of the insufficient runway length.
- Runway extension in any direction is difficult because of rivers crossing the extended runway center line.
- Width of runway strip does not meet the ICAO standard.
- There are many obstacles protruding upon the obstacle limitation surfaces.
- Expansion of a terminal area to cater for wide-body aircraft like A300 is difficult because of railway track and trunk road located close to the terminal area.

Improvements to solve the above problems will necessarily be large in scale and cost.

The existing facilities are estimated to reach their capacities around the year 1994 based on the assumptions that the maximum aircraft in service will be DC-9-32, same as present, and also that the existing facilities will not be redeveloped regardless of the demand increase.

Thus, it is recommended that the existing facilities be utilized with as little development as possible until long-term master plan established in this Study is commenced.

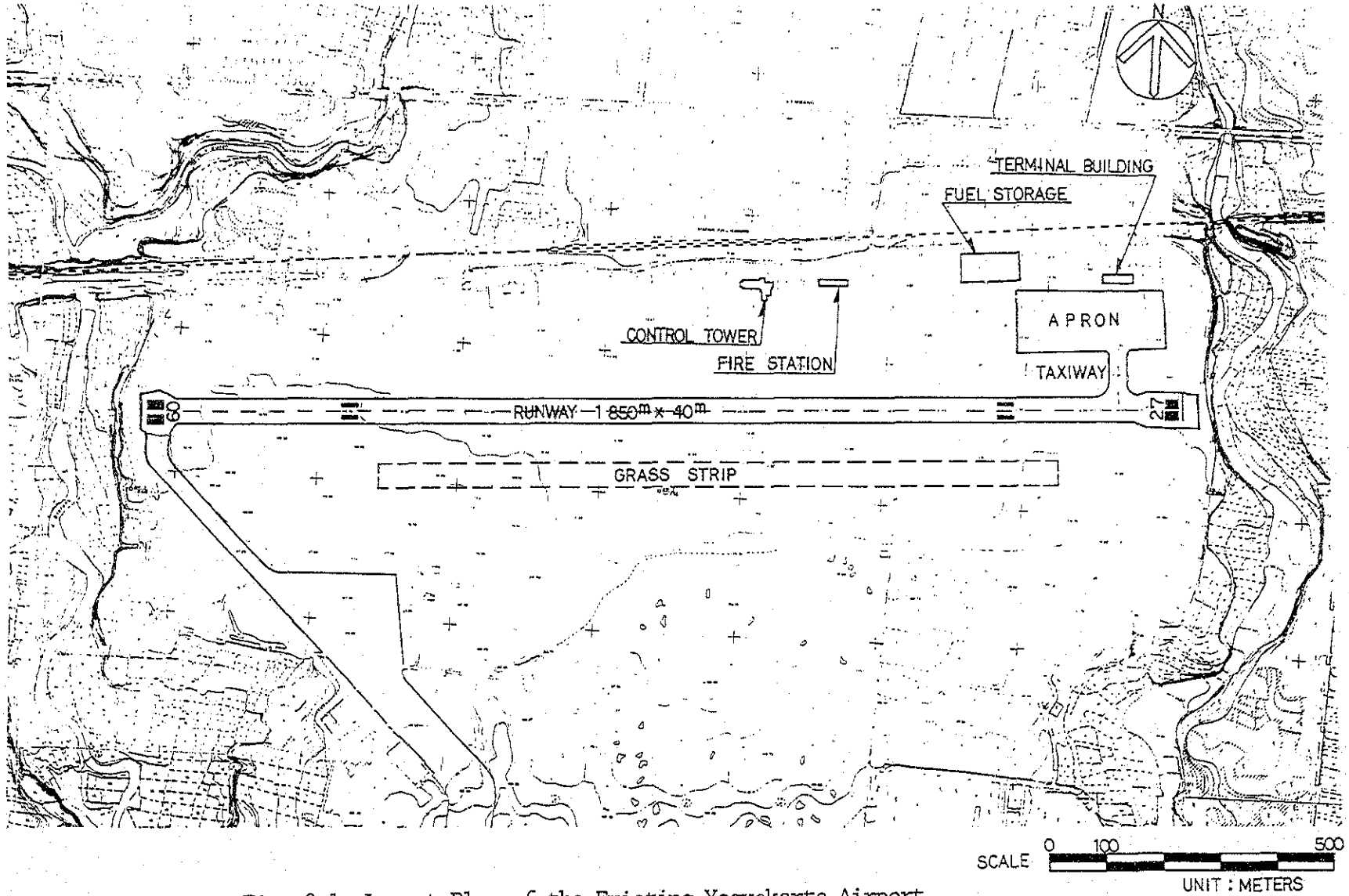

Fig. 3.1 Layout Plan of the Existing Yogyakarta Airport

Table 3.1 Outline of the Existing Yogyakarta Airport

Country	Name of Airport	INT'L/DOM ICAO CODE	Commencement of Services	Total Area of A/P	Aerodrome Ref. Point	A/P Elevation	R/W Bearing	Aerodrome Ref. Temperature	Operation Hours	Seasonal Availability	Note
Indonesia	Adisutjipto	DOM 4C	1952	-	07° 47' S 110° 26' E	350' (107m)	09-27	33.1°C	6-17 Local	All Seasons	Control Agency : IAF

City/Town Name	Population	Distance to A/P	Transportation Railway	Taxi	Bus	Wind Coverage	Minimum Meteorological Conditions (CIA Standard)	Runway	Approach Direction	Approach Procedure	Jet MDA	Jet Visual Range	Turboprop D/H	Turboprop Visual Range	Note
Yogyakarta	Yogya 404,000 DIY 2,900,000 as of 1983	7.5 km	-	Yes	Yes	98.0% (13 kt)		RWY 09/27	RWY 09	VOR	400	2,000m			
										CIRCLING	1050'	3,200m			

Navigation Aids — Radio

	NDB	VOR	DME	TACAN	ILS	ASR	PAR	SSR	ARTS	ASDE	HF	VHF	UHF	ITS	DF	LTV	TTY	AFTN
Existing	Yes	Yes	Yes								Yes	Yes						Yes
Plan					(LLZ) YES													

Note: VOR/DME 7 miles from RWY 0 9 THR

Navigation Aids — Airfield Lighting

	ALS	SFL	SALS	ALB	AGL	CCL	VASIS	RAIL	RWL	RTL	REIL
Existing	Yes						RWY 09 RWY 27		Yes	RWY 09 RWY 27	09
Plan											

	RCLL	RTAL	OL	RDIL	TL	TCLL	TCL	AB	WDIL	AFL
Existing								Yes	Yes	Yes
Plan										

Meteorological Facilities

R/W Surface Sensors	Yes
Weather Facsimile	Yes
ART Receiver	
Radio Sonde	
Weather Radar	
VOLMET Broadcast	

Note: Aerodrome Comm. is made by IAF.

Basic Facilities

	Size	Pavement	Note
Runway Strip	1875m x 150m	Grass	Only 25m at Rwy 27
Runway	1850m x 40m	PCN 30	Rwy extension completed in 1976
Taxiway	80m x 30m	PCN 30	

Apron	Design Aircraft	No. of Stands	Pavement	Area(m^2)	Parking Configuration
247 x 86	DC-9	6	AS PCC	21242 m^2	Self-manuevering

Flight Services

INT'L /DOM	Major Air Route	Name of Airline	Type of Aircraft	No. of Flight/ Week	Note
DOM	YOG - DPS	CIA	DC-9	21	3/day
	YOG - JKT	CIA	DC-9	25	
DOM	YOG - BDO	BOURAQ	HS748	14	
DOM	BPN	Pelita	F-28	1	JKT - YOG - BPN
	JKT	"	"	1	BPN - YOG - JKT
DOM	YOG - SUB	Merpati	F-27	7	1/day SUB - YOG
				89 flts.	

General Note: Glider training

Other Facilities

	Size	Structure	Note
Roads	2 lane	AS.	
Vehicle Parking	50 lots	AS.	
Pax. T. Building	2,850 m^2		
Cargo T.Building	-		
Office Building	200 m^2		
Control Tower	14 m high		IAF
Fire Station		120m^2	IAF, DGAC
Fuel Supply			Pertamina
Power	317 (kw x 80%)		

Air Traffic Statistics

No. of Landings & Take-offs	6106	5566	4758	6246	5484
Annual Freight volume (ton)	821	878	954	1305	1320
No. of Annual Passengers	265,368	241,164	296,196	312,988	280,079
Year	1978	1979	1980	1981	1982

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b) Surakarta Airport

Surakarta airport, 14 km north of the center of Surakarta city, is a jointly used airport and controlled by IAF. Layout plan and outline of the existing Surakarta airport are shown in Fig. 3.2 and Table 3.2, respectively.

Major problems of the existing facilities are as follows:

- Width of runway strip does not meet the ICAO standard.
- Pavement strength is not sufficient for the introduction of MD-82 class aircraft.
- Passenger terminal building is too small to meet the facility requirements.
- Expansion of terminal area is restricted by a nearby river.

For the solution of these problems, large-scale redevelopment will be required, the same as at Yogyakarta airport.

The existing facilities are estimated to reach their capacities around the year 1993, assuming that no larger aircraft than F-28-4000 will be introduced, and that the existing facilities will not be redeveloped regardless of the increase in demand.

It is better to utilize the existing facilities, especially the terminal facilities, until the long-term master plan is commenced.

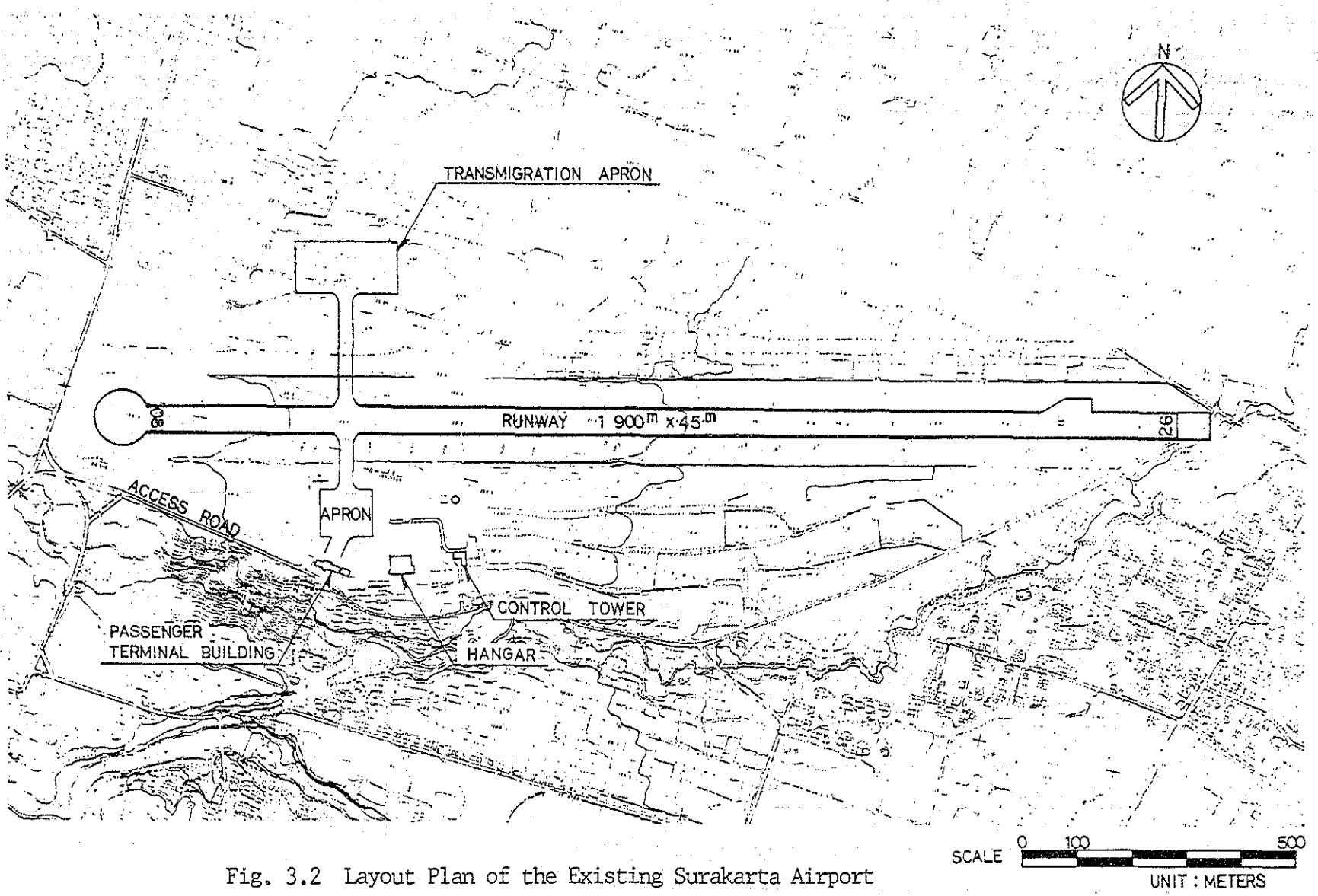

Fig. 3.2 Layout Plan of the Existing Surakarta Airport

Table 3.2 Outline of the Existing Surakarta Airport

Country	Name of Airport	INT'L/DOM ICAO CODE	Commencement of Services	Total Area of A/P	Aerodrome Ref. Point	A/P Elevation	R/W Bearing	Aerodrome Ref. Temperature	Operation Hours	Seasonal Availability
Indonesia	Adi Sumarmo Solo	DOM / 3C	1945 as IAF base 1974 as Civil Traffic	-	07. 31S 110. 45E	347 Ft (106m)	08 - 26	34.7°c	7-17 Local	all seasons

Note: Control Agency: IAF

City/Town Name	Population	Distance to A/P	Transportation: Railway	Taxi	Bus	Wind Coverage	Minimum Meteorological Conditions
Surakarta	470,000 (1980)	14 km to N.W.	-	Yes	Yes	98.4% (13kt)	

Runway	Approach Direction	Approach Procedure	Jet: MDA	Jet: Visual Range	Turboprop: D/H	Turboprop: Visual Range
RWY 08/26	RWY 26	NDB	769'	2,000m		
		Circling	1,048'	3,200m		

Note:

Navigation Aids — Radio

	NDB	VOR	DME	TACAN	ILS	ASR	PAR	SSR	ARTS	ASDE	HF	VHF	UHF	ITS	DF	ITV	TTY	AFTN
Existing	Yes	Yes	Yes								Yes	Yes						
Plan																		

Note: VOR/DME under construction

Navigation Aids — Airfield Lighting

	ALS	SFL	SALS	ALB	AGL	CGL	VASIS	RAIL	RWL	RTL	REIL
Existing			Rwy 26				Yes		Yes	Yes	Yes
Plan											

	RCLL	RTAL	OL	RDIL	TL	TCLL	TGL	AB	WDIL	AFL
Existing			Yes		Yes			Yes	Yes	Yes
Plan										

Meteorological Facilities

R/W Surface Sensors
Weather Facsimile
ART Receiver
Radio Sonde
Weather Radar
VOLMET Broadcast

Note:

Basic Facilities

	Size	Pavement	Note
Runway Strip	2020 x 150	Grass	
Runway	1900 x 45	AS. PCN 27	
Taxiway	100 x 23	AS.	

Apron 97m x 83m: Design Aircraft	No. of Stands	Pavement	Area(m^2)	Parking Configuration
F-28	2	AS.	8,051m^2	self-maneuvering
C 130	1			
Skyvan	1			

Flight Services

INT'L /DOM	Major Air Route	Name of Airline	Type of Aircraft	No. of Flight/ Week	Note
DOM	SOC - JKT	GIA	F-28	15	2flts/day, 1 flts on Sunday.
DOM	SOC SUB -	GIA	F-28	7	1flt/day
				22 flts	

General Note: Air Force uses this airport for primary training of pilots.

There is a road crossing the extended runway center, a graveyard and a depression of about 20m on runway 08 side.

Other Facilities

	Size	Structure	Note
Roads	2 lane		
Vehicle Parking	50 lots		estimate
Pax. T. Building	670m^2		1974 & 1981
Cargo T.Building	-		
Office Building	50 m2		1979
Control Tower	270 m^2		completed 1976 service started 1977
Fire Station	200 m^2		1978
Fuel Supply	-		

Air Traffic Statistics

No. of Landings & Take-offs	2,444	2,270	3,382	3,388	-
Annual Freight volume (ton)	250	285	310	618	409
No. of Annual Passengers	86,062	98,509	122,221	92,745	97,746
Year	1980	1981	1982	1983	1984

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c) Semarang Airport

Semarang airport, located near the coast, 3 km west of the center of Semarang city, capital of the Central Java province, is also jointly utilized by the civil and military sectors. The Indonesian Army is in control of the airport.

Layout plan and outline of the existing Semarang airport are shown in Fig. 3.3 and Table 3.3, respectively.

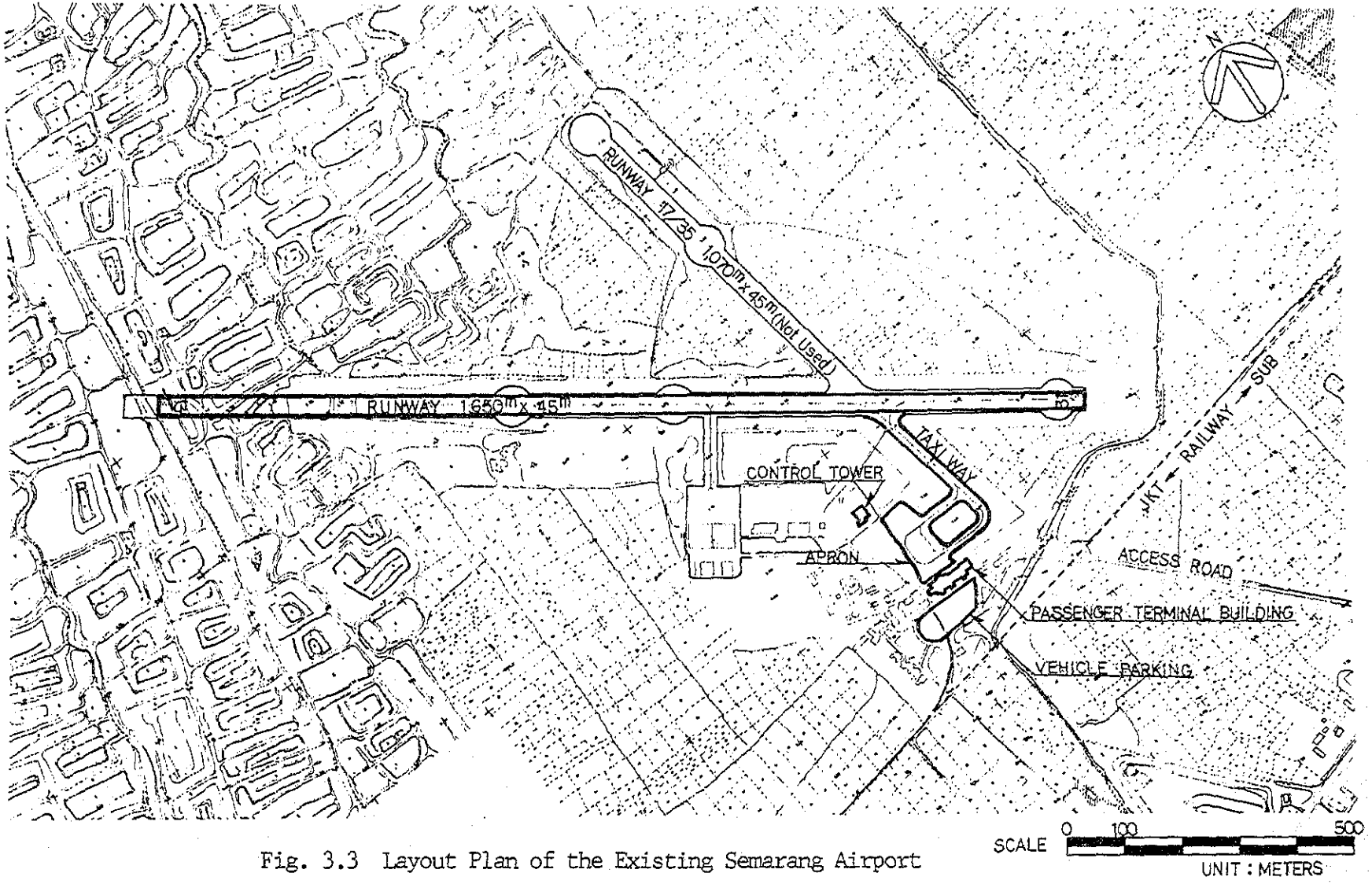

Fig. 3.3 Layout Plan of the Existing Semarang Airport

Table 3.3 Outline of the Existing Semarang Airport

Country	Name of Airport	INT'L/DOM ICAO CODE	Commencement of Services	Total Area of A/P	Aerodrome Ref. Point	A/P Elevation	R/W Bearing	Aerodrome Ref. Temperature	Operation Hours	Seasonal Availability
Indonesia	Acmad-Yani	DOM 3C	Before 1950 as Civil, 1966 Army	-	06.59S 110.23E	10' (3m)	13 - 31	34.3°c	6-19 Local	all seasons

Note: Control Agency: Indonesian Army

City/Town			Transportation			Wind Coverage	Minimum Meteorological Conditions
Name	Population	Distance to A/P	Railway	Taxi	Bus		
Semarang	1 million (1980)	3 km	-	Yes	Yes	RWY 13/31 99.6% (13kt)	

Runway	Approach Direction	Approach Procedure	Jet MDA	Jet Visual Range	Turboprop D/H	Turboprop Visual Range
RWY 13		NDB	500'	2,800m		
		Circling	900'	3,200m		

Note:

Navigation Aids

Radio

	NDB	VOR	DME	TACAN	ILS	ASR	PAR	SSR	ARTS	ASDE	HF	VHF	UHF	ITS	DF	ITV	TTY	AFTN
Existing	Yes	Yes	Yes					Yes			Yes	Yes						Yes
Plan																		

Airfield Lighting

	ALS	SFL	SALS	ALB	AGL	CGL	VASIS	RAIL	RWL	RTL	REIL
Existing	RWY 31						Yes		Yes		Yes
Plan											

	RCLL		OL	RDIL	TL	TCLL	TGL	AB	WDIL	AFL	
Existing					Yes			Yes	Yes	Yes	
Plan											

Meteorological Facilities

R/W Surface Sensors
Weather Facsimile
ART Receiver
Radio Sonde
Weather Radar
VOLMET Broadcast

Note: SSR, VOR/DME outside the airport

Note: According to wind direction, Rwy 13 is mostly used for 6-12 hr. Rwy 31 is mostly used in the afternoon.

Basic Facilities

	Size	Pavement	Note
Runway Strip	1770m x 150m	Grass	
Runway	1650m x 45m	AS. 58,000 lb	Rwy 17 - 35 is not active
Taxiway	69.2 x 14.8m 69.1 x 18.4m	AS. 25,000 lb	

Apron	Design Aircraft	No. of Stand	Pavement	Area(m^2)	Parking Configuration
143m x 56.7m	F-28	4	AS. 25,000 lb	8108 m^2	self-maneuvering

Flight Services

INT'L /DOM	Major Air Route	Name of Airline	Type of Aircraft	No. of Flight/ Week	Note
DOM	SRG - JKT	GA	F-28	49	7 flts/day
	SRG - SUB	GA	F-28	14	2 "
DOM	SRG - PKN	Merpati	CS2	7	
	SRG - SUB	"	F-27	6	} BDO - SRG - SUB
	SRG - BDO	"	F-27	6	
DOM	SRG - JKT	Mandala	YCV	14	
DOM	SRG - JKT	Bouraq	HS748	7	} JKT -SRG - BDJ
	SRG - BDJ	"	"	7	
				110/Week	

Other Facilities

	Size	Structure	Note
Roads	2 lane	AS.	
Vehicle Parking	App. 150 lots	AS.	
Pax. T. Building	1544 m^2		1100 m^2 for pax processing
Cargo T.Building	5 m^2		
Office Building			
Control Tower	192 m^2		since 1950
Fire Station	198 m^2		since 1950
Fuel Supply			

Air Traffic Statistics

Year	1980	1981	1982	1983	1984
No. of Landings & Take-offs	9,897	9,805	10,523	10,968	10,231
Annual Freight volume (ton)	1,102	710	1,364	1,156	1,395
No. of Annual Passengers	342,014	365,539	361,094	347,995	353,244

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In order to cope with the future increase in traffic demand, DGAC carried out a feasibility study in "Studies for the Improvement of Seven Domestic Airports" in 1981, and completed the master plan and detailed design in "First Development Phase of 9 Airports" in 1984. These two stidies were financed by Asian Development Bank.

In these studies and designs, a new 2,500 m runway will be constructed on the northeast side of and in parallel with the existing runway with a separation of 273 m. Terminal area will also be constructed on the northeast side of the new runway. Fig. 3.4 shows the airport layout plan of the Phase I development in the design year of 1992.

However, according to the review in our study, demand forecast made in the above master plan should be lowered to 40 - 50 % of the original value. Consequently, the facility requirements should be modified as shown below:

	Master Plan	Preliminary Review
- Runway (Phases I,II,III)	2,500 m x 45 m	2,500 m x 45 m
- Apron Area		
(Phase I)	50,000 m^2 (100%)	38,000 m^2 (75%)
(Phase II)	75,000 m^2 (100%)	41,000 m^2 (55%)
(Phase III)	78,000 m^2 (100%)	50,000 m^2 (64%)
- Terminal Building		
(Phase I)	18,900 m^2 (100%)	11,700 m^2 (62%)
(Phase II)	20,900 m^2 (100%)	15,000 m^2 (72%)
(Phase III)	29,500 m^2 (100%)	24,900 m^2 (84%)

As for the apron area, it can be constructed step by step in accordance with the reviewed required number of gate positions, but, as for the passenger terminal building, there are two solutions:

i) to modify the terminal building layout plan completely before tendering, or

ii) to adjust the area to be constructed by the Construction Management (CM) service team.

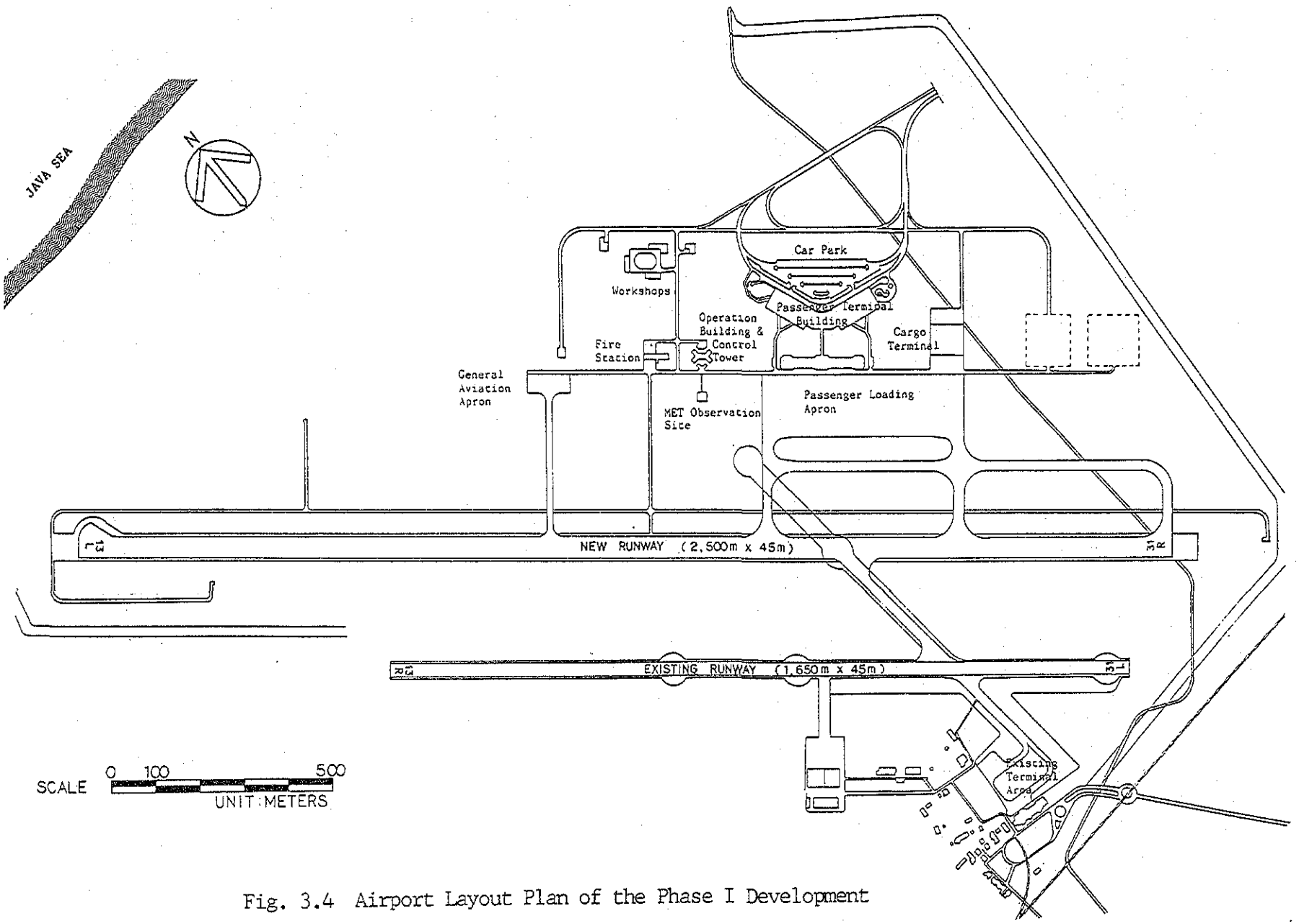


Fig. 3.4 Airport Layout Plan of the Phase I Development

(2) Existing Airstrips

a) Cilacap Airstrip

Cilacap airstrip which is owned and operated by PERTAMINA is located 14 km north of Cilacap city. Other than PERTAMINA's flight operation, 10 regular flights between Cilacap and Jakarta are operated weekly using CS212 and DHC-6 aircraft of the Merpati Nusantara Airlines. The existing runway length is 660 m.

Passenger demand for the Cilacap area is expected to be 48,000 passengers in the year 2010, and this requires that it be served by F-27/HS748 class aircraft, which needs a 1,800 m long runway.

As the extension of the existing runway is estimated to be very expensive due to the geographical conditions, a new airport replacing the existing one is considered necessary in order to introduce larger type aircraft and meet the future demands.

Upgrading of Wirasaba grass strip which is used as military strip at present may be included in one of the alternative sites for the new airport.

b) Other Airstrips

With regard to the new local airstrip development, passenger demand on the Tegal-Pati route only justifies the introduction of STOL aircraft with a daily frequency of 2 movements after the year 2000.

3.2 Redevelopment Plans of the Existing Airports

Redevelopment plans were studied for Yogyakarta and Surakarta airports. As for Semarang airport, it is assumed that the airport development will be implemented based on the master plan with a review on its facility requirements.

(1) Yogyakarta Airport

Alternatives for redevelopment plan for this airport include alternatives of the runway extension and those of the construction of a new runway near the existing site.

Four alternatives shown in Fig 3.5 were selected for comparison. The outline of each alternative is as follows.

In alternatives Y1 and Y2, which are the alternatives for the runway extension, it is necessary to demolish or relocate many existing IAF facilities, and the mountain to the east of the airport protrudes upon the obstacle limitation surface. Moreover, construction costs of these alternatives are as expensive as that for alternative Y4 with a new runway, though the existing runway and property area can be utilized. For these reasons, alternatives Y1 and Y2 are considered unsuitable as a long-term master plan.

Alternative Y3 has an advantage of being the lowest as regards construction cost among four alternatives. However, this is omitted because of the following reasons: the new runway overlaps existing facilities such as a grass strip and the future extension area of air force facilities, and the new runway is too close to the holy tomb of the Sultan prince.

On the other hand, alternative Y4 is located outside of the existing airport property area, and civil aviation facilities can be completely separated from military facilities. Moreover, construction cost is nearly the same as alternative Y1, and there are not so many disadvantages.

As a result, alternative Y4 is selected as the most suitable alternative for the long-term master plan for the redevelopment of Yogyakarta airport.

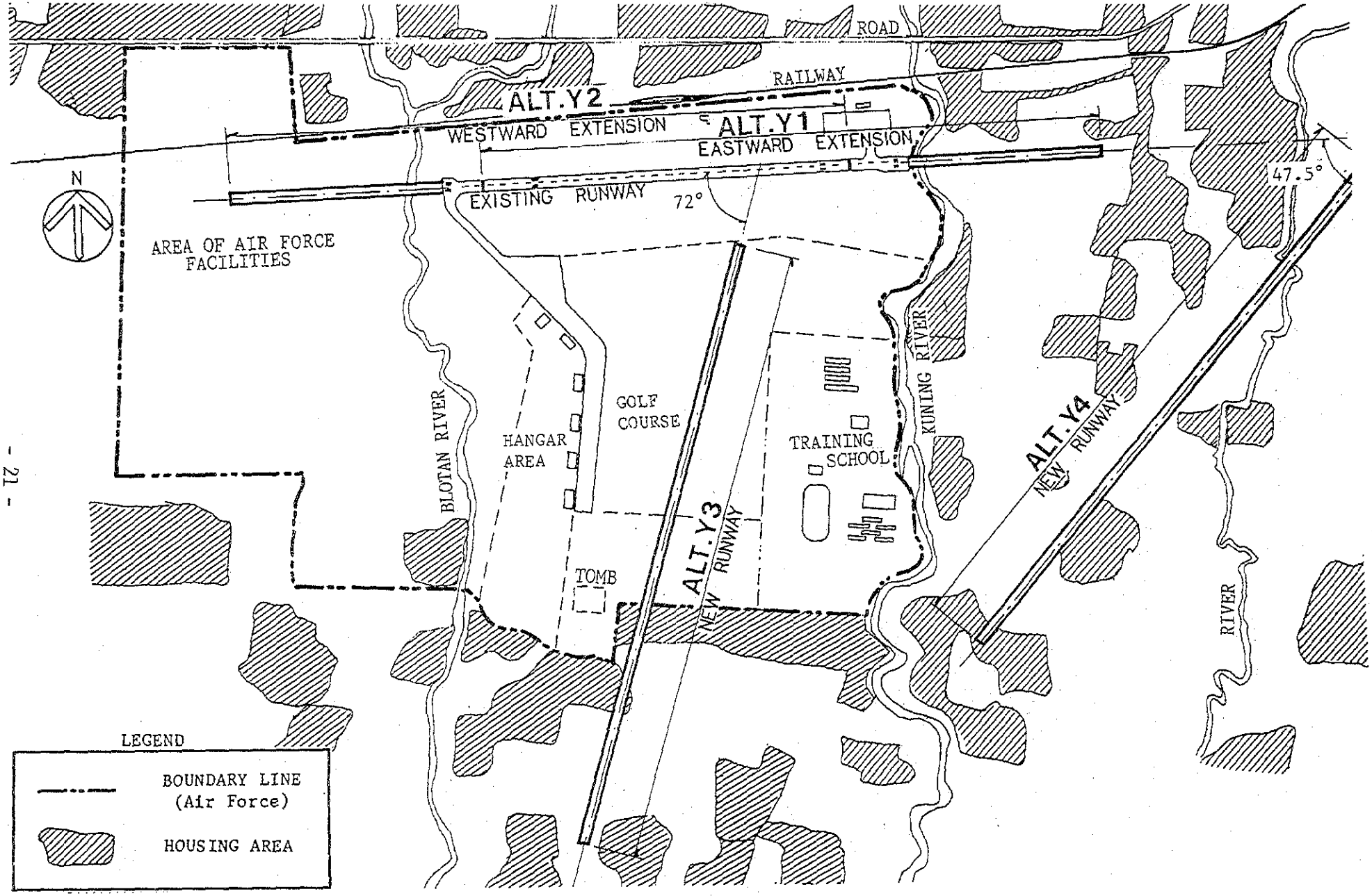


Fig. 3.5 Alternative Redevelopment Schemes for Yogyakarta Airport

(2) Surakarta Airport

In Surakarta airport, there are no significant obstructions to aircraft operations in the airport vicinity area, and little conflict with the existing military facilities, so it is possible to carry out the redevelopment without having any severe restrictions.

Three alternatives shown in Fig. 3.6 were studied for the long-term master plan. Alternatives S1 and S2, which are redevelopment using the existing runway were proved to be feasible without difficulty. Alternative S3 was excluded because the construction cost including a new runway is the highest.

Comparing alternatives S1 with S2, S1 was considered to be better, because construction cost of S1 is lower than S2. There are not so many differences regarding the other items of comparison.

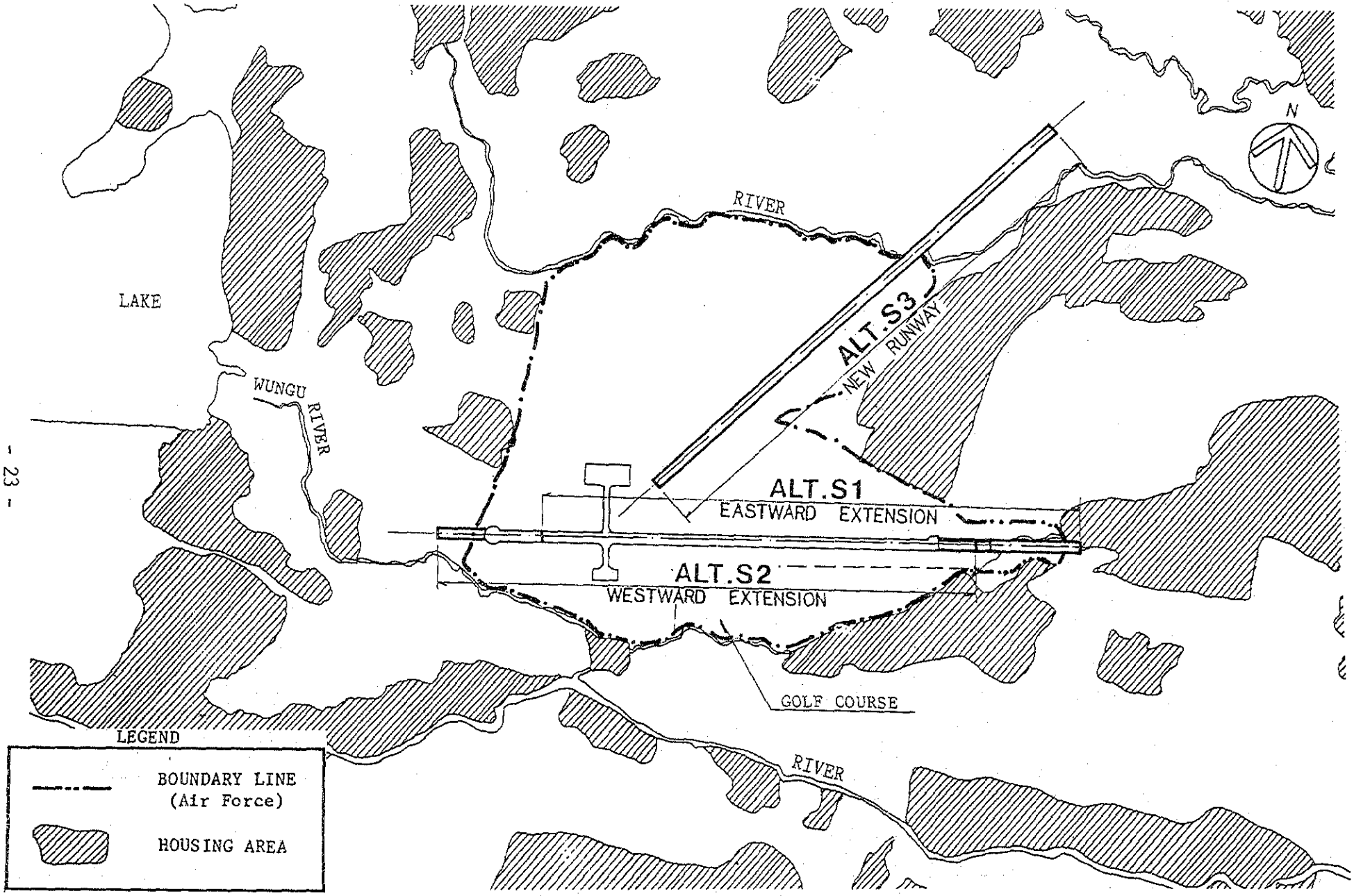


Fig. 3.6 Alternative Redevelopment Schemes for Surakarta Airport

3.3 Site Selection of the New Airports

Site selection is made for a new airport which replaces the existing Yogyakarta airport and for one which combines the airport functions of both existing Yogyakarta and Surakarta into one airport. A new airport to replace the existing Surakarta airport was not considered, because the existing airport can be redeveloped without any major difficulty and great cost.

(1) New Airport Site for Yogyakarta Airport

Three sites, W1, W2 and W3 in the Wonosari area, and 2 sites, B1 and B2 in the Bantul area were selected as possible new airport sites for Yogyakarta airport as shown in Fig. 3.7.

Each site is located within one hour distance from the center of Yogyakarta city. It is, especially, noted that only 15 or 30 minutes are required to reach the sites in the Bantul area.

However, sites B1 and B2 lie on the hills composed mainly of limestone and require a large amount of earthwork of approximately 3.5 million cu.m. The construction costs of both sites are, consequently, about Rp. 13 billion higher than that of W1 which is the cheapest among the 5 said sites. Sites B1 and B2 are, therefore, considered inadequate from the viewpoint of construction costs.

Meanwhile, site W1 is the nearest to Yogyakarta city (approx. 40 min.) and the most economical among the 3 sites in the Wonosari area, and has no problem regarding the airport planning considerations. Site W1 has, accordingly, been selected for the new airport site to replace the existing Yogyakarta airport.

(2) New Airport Site for Combined Case

Three sites, K1, K2 and K3, were selected for possible new airport sites to combine both the existing Yogyakarta and Surakarta airports, from the Klaten area in-between both cities as shown in Fig. 3.7. With regard to the safe aircraft operation, the circling approaches to sites K2 and K3 will be limited to the northside only because the southern mountainous terrain infringes the inner horizontal surface. The construction costs of K2 and K3 are respectively Rp. 3.0 billion and Rp. 4.0 billion higher than that of K1.

The main disadvantage of K1 is poor accessibility caused by its location (approx. 47 km from Yogyakarta); however, other requirements for a new airport site are almost satisfied.

As a result, site K1 was selected for the new airport site to combine both the existing Yogyakarta and Surakarta airports.

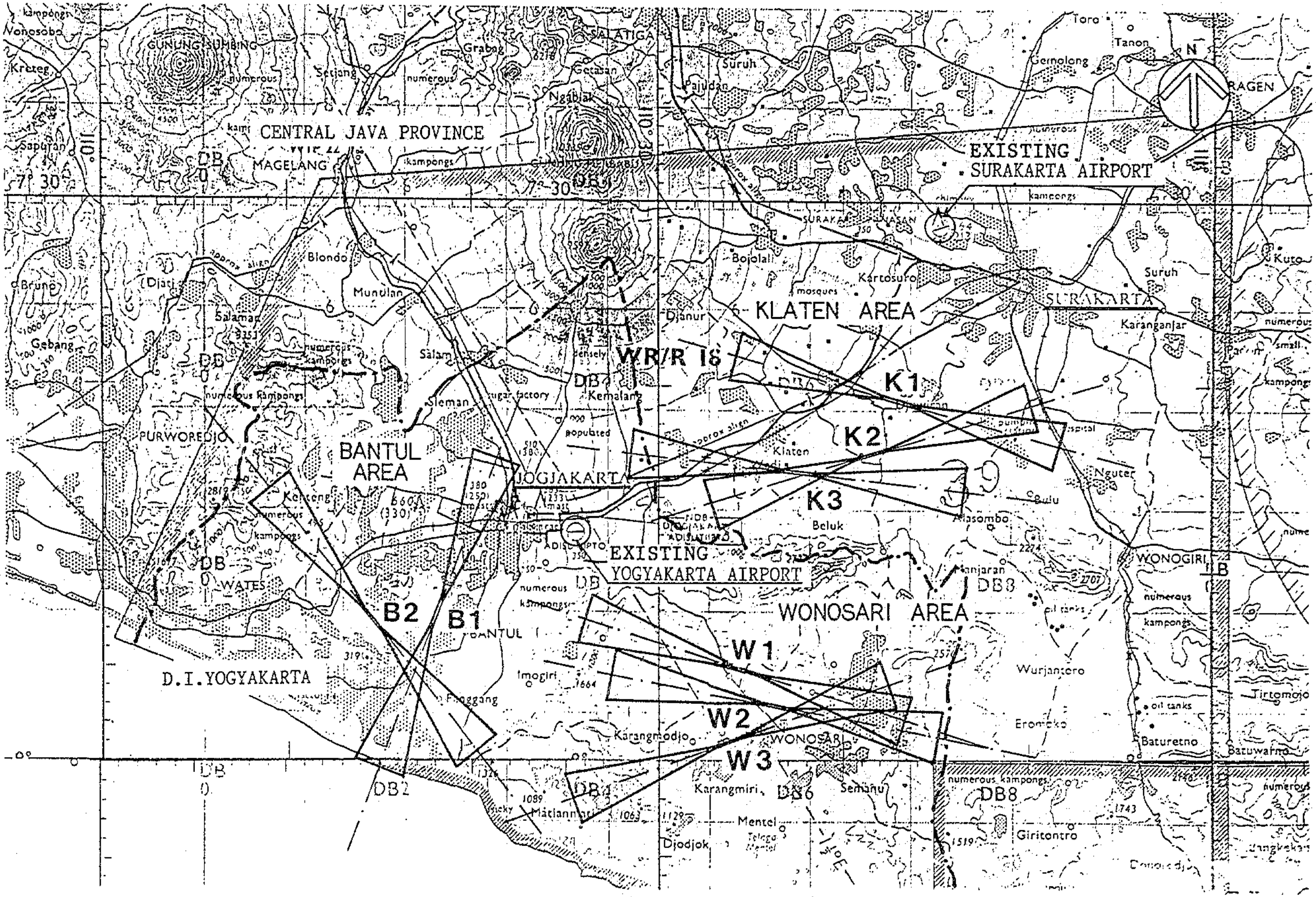


Fig. 3.7 Location of Possible New Airport Sites

3.4 Establishment of Alternative Concepts for Airports Development

As the alternative concepts of airports development in the Central Java and D.I. Yogyakarta areas, possible combinations of redevelopment of the existing airport and new airport development are listed in Table 3.4. In this table, Semarang airport is assumed to be developed based on the implementation program of DGAC.

Table 3.4 Alternative Concepts of Airports Development

	Development Concept \ Airport	Yogyakarta		Surakarta		Semarang
		Redeve-lopment	New Airport	New Airport	Redeve-lopment	Redeve-lopment
3-Airport Concept	Concept - A	X			X	X
	Concept - B	X		X		X
	Concept - C		X		X	X
	Concept - D		X	X		X
2-Airport Concept	Concept - E	X				X
	Concept - F			X		X
	Concept - G				X	X

Note: "X" indicates development policy in each concept.

Among the 7 concepts shown in Table 3.4, Concepts B, D and G were screened out prior to further evaluation because of the following reasons.

a) From the study results of "Evaluation of the Existing Airport" and "Redevelopment Plans of the Existing Airports", it was revealed that the existing Surakarta airport can easily be redeveloped without any major problems; thus, the new airport to replace the existing airport is not considered necessary.

   Therefore, Concepts B and D which involve the new airport for Surakarta are considered inadequate.

b) Concept-E, in which all airport functions relating to civil aviation at the existing Surakarta airport will be transferred to the existing Yogyakarta airport, is considered neither economical due to the easy expansibility of Surakarta airport, nor preferable to the passengers who utilize the existing Surakarta airport at present.

c) Concept-G is the opposite of Concept-E. All of the airport functions at Yogyakarta airport relating to civil aviation will be transferred to the existing Surakarta airport. This Concept is also considered inadequate for further study, because the air traffic demand as well as the potential as a tourist resort obviously centers on Yogyakarta city.

Table 3.5 indicates the remaining 3 concepts which will be examined in the succeeding comparative evaluation.

Table 3.5 Selected Alternative Concepts of the Airports Development for Detailed Study

Development Concept \ Airport		Yogyakarta		Surakarta		Semarang
		Redeve-lopment	New Airport	New Airport	Redeve-lopment	Redeve-lopment
3-Airport Concept	Concept - A	X (Y4)			X (S1)	X
	Concept - C		X (W1) Wonosari Area		X (S1)	X
2-Airport Concept	Concept - F	X (K1) Klaten Area				X

Note: "X" indicates development policy in each concept.

Location of Airports in respective airports development concepts is shown in Fig. 3.8.

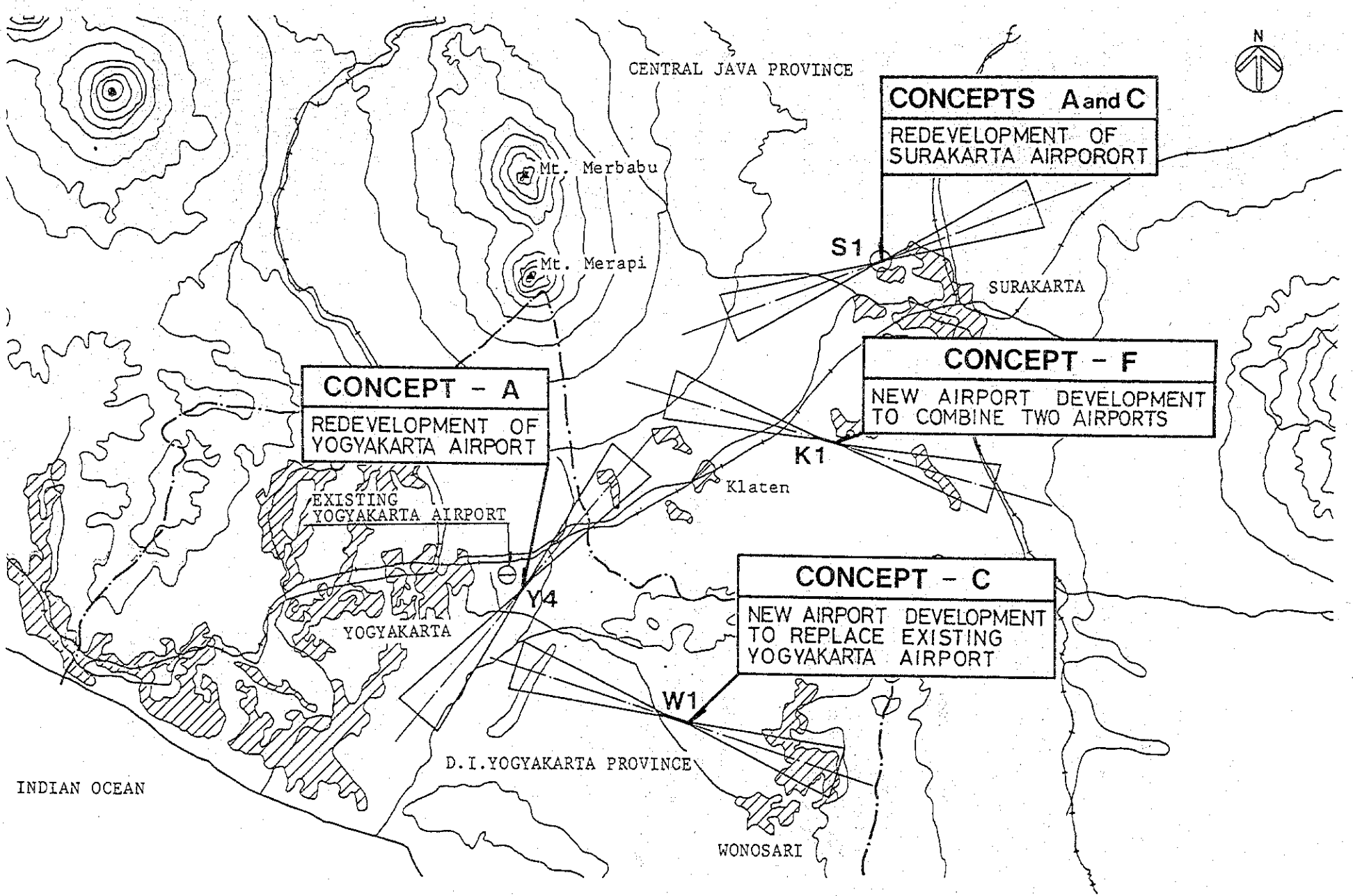


Fig. 3.8 Location of Airports in Alternative Concepts

3.5 Comparative Evaluation of the Alternative Development Concepts

Table 3.6 shows the summary of comparative evaluation of the alternative development concepts.

From the overall comparison of the aforementioned 3 concepts, Concept-A which comprises redevelopment of the existing 3 airports, i.e., Y4 for Yogyakarta, S1 for Surakarta and Semarang airport, is recommended to be the most adequate in this Study area. The major reasons are described hereafter.

(1) Semarang Airport

Semarang is the capital city of the Central Java province and functions as the center of economic activities for the northern part of Central Java. Under these circumstances, Semarang airport plays an important role as the trunk line airport at present, and is expected to maintain its role in the future.

It is, therefore, recommended that the development of Semarang airport be implemented independently irrespective of the airports development of Yogyakarta and Surakarta, after a review of the detailed design which has been already completed, based on the updated air traffic demand.

(2) Yogyakarta and Surakarta Airports

a) Comparing the construction cost and economic internal rate of return (EIRR) of the each of the 3 concepts, it is obvious that Concept-C is the worst as regards both construction cost and national economy. There are no other reasons which would make Concept-C advantagous.

   Although the construction cost for Concept-F is estimated to be Rp. 118 billion which is about Rp. 47.5 billion cheaper than that for Concept-A, there are no big differences in EIRR and NPV between the two concepts. The major reason is that the additional time and travelling cost in Concept-F due to the remote location of the new airport site K1 have been counted in the additional disbenefits.

   Concepts A and F are, accordingly, considered almost the same in terms of national economy.

b) The restricted airspaces for the training of military aircraft are established at present above the existing Yogyakarta and Surakarta airports.

In Concept-A, airspace utilization is basically the same as at present because ALTs. Y4 and S1 are redevelopment plans for the existing airports.

On the contrary, both Concepts C and F will require drastic adjustment of the said airspace. Moreover, such adjustment is considered very difficult because the adoption of Concept C or F requires an additional airport other than the existing two airports so that the training of military aircraft might be maintained in the future.

c) The total access distance to K1 in Concept-F from both Yogyakarta and Surakarta city is almost triple that of Concept-A.

It is, furthermore, desirable to improve Solo road, which is in a crowded condition at present and only 6 m in width, in order to cope with the increase in vehicular traffic generated through the expanded air traffic demand. This imposes an additional construction cost for Concept-F.

d) The area covered by the aircraft noise level above WECPNL 70 is considered not suitable for comfortable living and community services such as schools, hospitals, etc.

Aircraft noise contours above WECPNL 70 in Concept-F cover the residential area of approximately 430 ha, which is about 1.5 times larger than the other concepts.

This is mainly because of the introduction of larger-size aircraft such as the B-747 so as to handle the total air traffic demand of both Yogyakarta and Surakarta airports at one airport.

In this respect, Concept-F is considered inadequate for the airports development concept in this Study area.

Table 3.6. Comparison Table of Alternative Concepts

Comparison Items \ Concepts	Concept - A YOG - Redevelopment (Y4) SOC - Redevelopment (S1)	Concept - C YOG - New Airport (W1) SOC - Redevelopment (S1)	Concept - F YOG, SOC - Combined New Airport (K1)
1. Aircraft Operational Considerations	x		
(1) Air Traffic Control	- Yogyakarta Airport: Consolidated aerodrome control to be necessary for simultaneous operation on two runways		
(2) Air Space Utilization	x - Adjustment of training area for the air force and corridors to be necessary	x - Same as Concept - A but very difficult	x - Same as Concept - A but very difficult
2. Airport Development considerations		x	x
(1) Accessibility	- Good accessibility for passengers with both airports YOG - 8 km (15 min.) SOC - 14 km (20 min.) Borobudur - 50 km (65 min.)	- Far from Yogyakarta city and Borobudur to the New Airport YOG - 30 km (40 min.) SOC - 14 km (20 min.) Borobudur - 72 km (90 min.)	- Far from both city and Borobudur YOG - 47 km (60 min.) SOC - 29 km (35 min.) Borobudur - 89 km (110 min.)
(2) Land Aquisition	x - Residential area 38 ha Agricultural area 122 ha	- Residential area 10 ha Agricultural area 137 ha	- Agricultura Area 143 ha
(3) Utilization of Existing Facilities	- Terminal facilities, etc. will be able to be utilized	- Same as Concept - A	x - Non
3. Social Considerations			
(1) Noise Problems	x - Residential area (290 ha) influenced by aircraft noise	x - Residential Area (250 ha) influenced by aircraft noise	x - Large residential area (430 ha) Influenced by aircraft noise
(2) Compensations	x - Relocation of many houses (380 nos.)	x - Relocation of many houses (100 nos.)	
4. Construction Considerations			
(1) Construction cost (Billion Rp)	x - YOG 113.1 SOC 52.1 Total 165.2	x - YOG 113.9 SOC 52.1 Total 166.0	- 117.8
5. Economic Analysis			
(1) EIRR	15.5%	x 15.0%	16.2%
(2) NPV (Million Rp)	39,735	x 32,387	35,863

YOG: Yogyakarta Airport

SOC: Surakarta Airport

EIRR: Economic Internal Rate of Return

NPV: Net Present Value (at discount rate 12%)

3.6 Conclusions and Recommendations

Based on this extensive and comprehensive study, a long-term airports development plan in Central Java and D.I. Yogyakarta is recommended to be implemented in accordance with the following development policy.

(1) Development Policy for the Major Airport

The existing Yogyakarta airport, considered to reach its capacity around the year 1994, has great defects in terms not only of size and the system of the facilities but safe aircraft operations. Due to the defects, it cannot be considered practical and recommendable to redevelop the existing airport as a large-size commercial airport from the long-term viewpoint. The existing Yogyakarta airport should, therefore, transfer its civil aviation functions to a new airport which is planned to be located 2 km east of the existing airport so that the new airport can inaugurate the operations in 1995.

It is judged that the existing Surakarta airport will be saturated due to the increasing passengers in 1993 at latest. Since the existing airport has no significant defects as regards redevelopment unlike Yogyakarta airport, redevelopment works composed mainly of runway extension and replacement of the terminal area should be implemented prior to reaching this saturation.

With respect to Semarang airport, in order to maintain its important role as the gateway to Semarang city which is the capital and the center of economic activities in the Central Java province, redevelopment of the existing airport at earliest possible time should be implemented in accordance with the previous master plan and detailed design after a necessary review based on the updated traffic demand.

(2) Development Policy for the Airstrips

Although the introduction of the F-27/HS748 class propeller aircraft into Cilacap airport is expected after the year 2000, the extension of existing runway is considered economically impractical due to geographical constraints.

It is, therefore, recommended to carry out a detailed study including the site selection for a new airport at an appropriate stage.

As for the new local airstrip development, there seems a possibility of establishing new airstrips in both Tegal and Pati in the northern part of the Central Java province. Thus, a further study should be prepared at an appropriate stage after thoroughly ascertaining its necessity.

(3) Rearrangement Policy for Airspace Utilization

In order to ensure the safe aircraft operations over Yogyakarta and Surakarta airports, it is recommended that the following measures be taken with close coordination and understanding of military authorities by constituting a committee as required.

- Establishment of Terminal Radar Approach Control System (PSR/SSR) to cover the Yogya Military Controlled Airspace (MCA)

- Enforcement of the provision of SSR transponder with aircraft operated in Yogya MCA

- Widening the corridors in compliance with the stipulation of ICAO

- Installation of navigational aids at or in the vicinity of the compulsory reporting point "Lumba"

CHAPTER 4 MASTER PLAN FOR NEW YOGYAKARTA AIRPORT DEVELOPMENT

CHAPTER 4 MASTER PLAN FOR NEW YOGYAKARTA AIRPORT DEVELOPMENT

4.1 General

This chapter summarizes the feasibility study for the new Yogyakarta airport development which constitutes airports development concept-A selected in Chapter 3.

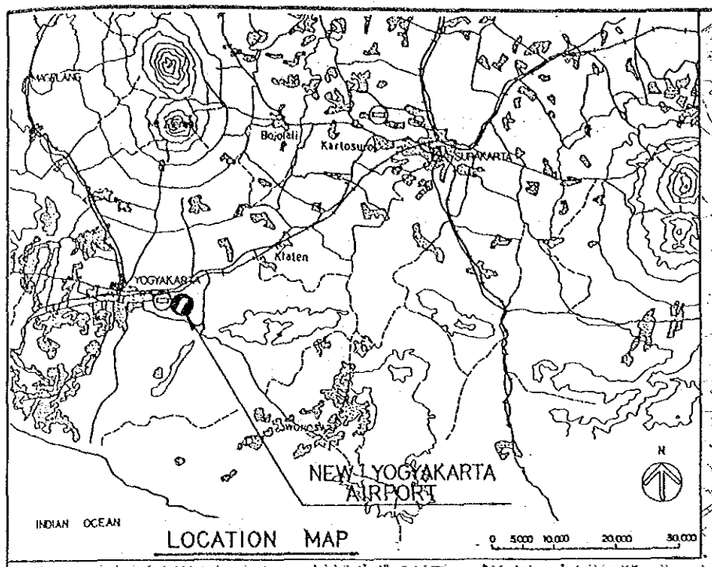
As discussed in Chapter 3, existing Yogyakarta airport will reach its capacities around 1994, and therefore, Phase I construction works should be completed by that time.

Phase I development is planned to accommodate the traffic demand anticipated in the year 2000 so that no major investiment may be required for at least 5 years after the completion of works. Phase II development will satisfy the traffic demand up to the year 2010.

4.2 Airport Master Planning

A new airport, located 2 km east of the existing airport, was selected as the long-term development plan for Yogyakarta airport. This airport will be constructed outside the existing airport property area. Therefore, airport facilities except for the air traffic control facilities will be completely separated from the military sector.

The layout plan for the new airport development and the outline of the Phase I development are shown in Fig. 4.1 and Table 4.1, respectively.



LOCATION MAP

BASIC DATA TABLE	
RUNWAY DATA	
EFFECTIVE RUNWAY GRADIENT	0.594 %
WIND COVERAGE	20 KNOT 99.6% 13 KNOT 98.6%
INSTRUMENT RUNWAY	YES
PAVEMENT STRENGTH	PCN 58
APPROACH SURFACE	1/50
RUNWAY LIGHTING	HIRL
RUNWAY MARKING	ALL WEATHER
NAVIGATIONAL AIDS	ILS, ALS, PAPI

BASIC DATA TABLE	
AIRPORT DATA	
AIRPORT ELEVATION	103.2 m
AIRPORT REFERENCE POINT (ARP) COORDINATES	LAT 7°47'S LNG 110°26'E
AIRPORT AND TERMINAL NAVAIDS	VOR/DME NDB ASR/SSR
AIRPORT REFERENCE TEMPERATURE	33°C

LEGEND	
	BUILDING / HOUSE
	VILLAGE
	RICE FIELD
	FIELD / GARDEN
	COCONUT TREES
	TREES
	CEMETERY
	RIVER
	GROUND CONTOURS (0.5m PITCH)
	SECURITY FENCE

BUILDINGS	
①	PASSENGER TERMINAL BUILDING
②	CARGO TERMINAL BUILDING
③	V.I.P. TERMINAL BUILDING
④	ADMINISTRATION BUILDING
⑤	CONTROL TOWER
⑥	FIRE STATION
⑦	GSE MAINTENANCE SHOP
⑧	AIRPORT MAINTENANCE BUILDING
⑨	MAIN SWITCHING AND GENERATOR STATION

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PERIOD
RUNWAY DIR
WIND COVE

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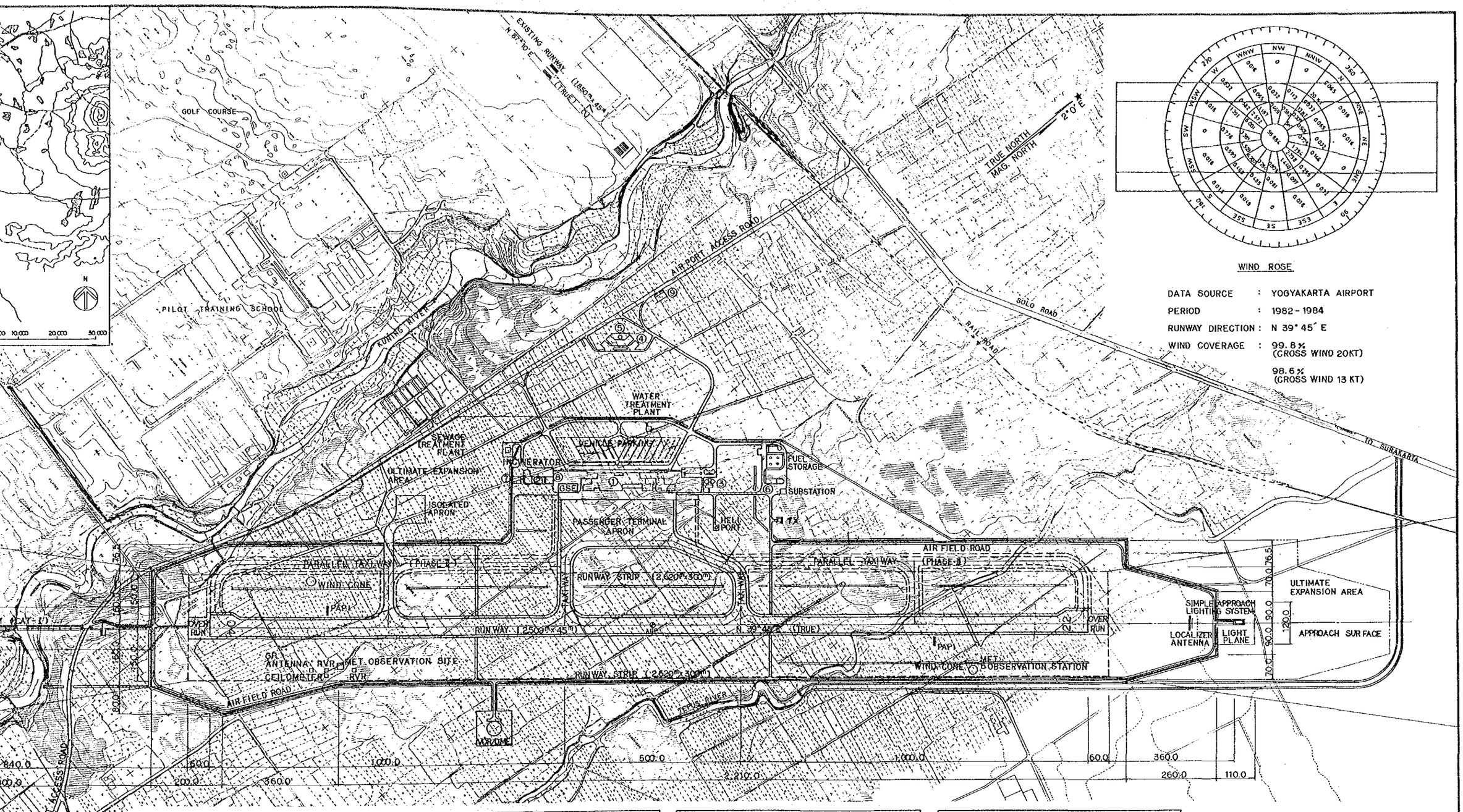
Air



WIND ROSE

DATA SOURCE : YOGYAKARTA AIRPORT
PERIOD : 1982 - 1984
RUNWAY DIRECTION : N 39° 45' E
WIND COVERAGE : 99.8% (CROSS WIND 20KT)
98.6% (CROSS WIND 13 KT)

BASIC DATA TABLE	
RUNWAY DATA	
EFFECTIVE RUNWAY GRADIENT	0.594 %
WIND COVERAGE	20 KNOT 99.8% 13 KNOT 99.6%
INSTRUMENT RUNWAY	YES
PAVEMENT STRENGTH	PCN 58
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RUNWAY LIGHTING	HIRL
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NAVIGATIONAL AIDS	ILS, ALS, PAPI

BASIC DATA TABLE	
AIRPORT DATA	
AIRPORT ELEVATION	103.2 m
AIRPORT REFERENCE POINT (ARP) COORDINATES	LAT 7°47'S LNG 110°26'E
AIRPORT AND TERMINAL NAVAIDS	VOR/DME NDB ASR/SSR
AIRPORT REFERENCE TEMPERATURE	33°C

LEGEND	
	BUILDING / HOUSE
	VILLAGE
	RICE FIELD
	FIELD / GARDEN
	COCONUT TREES
	TREES
	CEMETERY
	RIVER
	GROUND CONTOURS (0.5m PITCH)
	SECURITY FENCE

BUILDINGS	
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⑤	CONTROL TOWER
⑥	FIRE STATION
⑦	GSE MAINTENANCE SHOP
⑧	AIRPORT MAINTENANCE BUILDING
⑨	MAIN SWITCHING AND GENERATOR STATION

SCALE 0 100 200 500 M

Fig. 4.1
Layout Plan of New Yogyakarta Airport Development

Table 4.1 Outline of New Yogyakarta Airport in the Phase I Development

"X" indicates services available

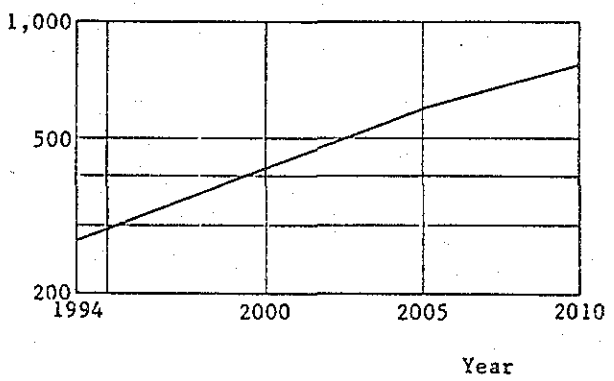
Country	Name of Airport	INTL/DOM. ICAO CODE	Commencement of Services	Airport Total Area	Aerodrome Ref. Point	Airport Elevation	Runway Orientation	Aerodrome Ref. Temp.	Operation Hours	Seasonal Availability	Note: Control Agency; DGAC
Republic of Indonesia	Yogyakarta (Adisucipto)	Dom. 4D	1995	185 ha	7°47'54"S 110°26'35"E	103.175 m (338.5 ft)	N 39°45'33"E (True)	33°C		All Seasons	

City/Town			Transportation			Wind Coverage	Operating Minimum					Note: Approach Category; Instrument, Precision Approach
Name	Population	Distance to Airport	Railway	Taxi	Bus		Runway	Procedure	DH/MDA	VIS		
Yogyakarta	0.4 Million (1983)	8.0 KM by Road	N.A.	X	X	98.6% (13kt) 99.8% (20kt)	Apch to 04	ILS	533'	800 m		
								VOR	800'	1200 m		
							Apch to 22	ILS	-	-		
								VOR	1000'	2100 m		

Air Navigation Systems																						
Navaids	NDB		VOR		DME		TACAN		ILS		LOCATOR		VHF D.F.									
	X		X		X		-		X		X		-									
ATC/COM	ASR		SSR		PAR		ASDE		ARTS		VHF A/C		AFS		TTY		MICROWAVE		ATIS			
	X		X		-		-		X		X		X		X		X		X			
Lights	ALS	SFL	SALS	ALB	CGL	RWL	RWCL	RWTL	ORL	TDZL	REIL	DML	PAPI	TWL	TWCL	TGS	ABN	IWDI	AFL	O.L.		
	X	-	X	-	-	X	X	X	X	-	-	-	X	X	-	X	X	X	X	X		
MET	RWY Surface Sensors				RVR		Ceilometer		WX-FAX		APT-RX		Radiosonde		WX Radar		WX-TTY					
	X				X		X		X		-		-		-		X					

Basic Facilities								
			Size		Pavement		Note	
Runway Strip			2,620 m x 300 m		-			
Runway			2,500 m x 45 m		Asphalt			
Taxiway			535 m x 23 m		Asphalt			
		Design Aircraft	Nr. of Stands	Pavement	Area		Parking Configuration	
Loading Apron		DC-10 class	2	Concrete	41,275 m²		Nose-in	
		MD-82 class	3				Nose-in	
		F-27 class	1				Self-maneuvering	
		DHC-6 class	1				Self-maneuvering	
Isolated Apron		DC-10 class	1	Asphalt	6,400 m²		Self-maneuvering	

Other Facilities				
	Size	Structure	Note	
Passenger Bldg.	12,000 m²	RC		
Cargo Building	700 m²	RC		
Administration Bldg.	1,700 m²	RC		
Control Tower	60 m²	RC	Height 30 m	
Fire Station	400 m²	2 Air Crash Tenders 2 Fire Engines	CAT-7	
Fuel Supply System	(Jet A1 1,070 kℓ)		PERTAMINA	
Hangar	-			
Vehicle Parking Spaces	300 cars	Asphalt		
Access Road	2 lanes	Asphalt		



Traffic Demand					
LDG AND TOF	6,054	7,100	9,600	11,000	
Annual Freight (ton)	815	1,660	2,210	3,820	
Annual Passengers	292,415	697,000	908,000	1,610,000	
Year	1983	1995	2000	2010	

Note.
Completion of Phase I development:
End of 1994

Drawn by JICA
As of 1986

(1) Airport Layout Planning

a) Runway and Taxiways

A 2,500 m long new runway was planned to be located at the east side of the existing airport with about 2 km separation between aerodrome reference points, and with a 47° 25' intersecting angle of the runway center lines. Factors which determined the runway layout are as follows.

- No obstacle in the airspace over the extended runway center line which hinders safe aircraft operations, especially for arrivals and departures.

- Good visibility from the control tower which controls the traffic on the 2 runways.

- To enable simultaneous operations on the 2 runways as much as practically possible.

- To avoid Kuning River which is the larger of the two rivers running across the new airport site.

- To be able to reserve an area for future runway extension by 500 m northward.

Parallel taxiway was planned to be constructed in Phase II because of absense of difficulty in aircraft operation without it, and in order to make the initial investment as low as possible.

b) Terminal Area and Access Road

Terminal area was planned to be situated at the west of the new runway taking into account the future possibility of utilization of both existing and new runways for civil aviation.

Airport access road was planned to connect Solo and Wonosari roads so that access from both directions will be easier.

(2) Airport Facility Planning

a) Site Preparation

The new airport site has a flat gradient of 0.7 - 0.8 % from north to south and there are very few abrupt changes in topography. A longitudinal slope of the runway was planned to be between 0.45 % and 0.75 % in order to minimize the earthwork volume. Earthwork volume for the Phase I construction works will be about 690,000 cu.m.

The Tepus River crossing the new airport site will be diverted to a location which will not conflict with the 500 m runway northward extension in the future. Diversion of the river should be planned so that it may not change the existing water distribution to the surrounding rice fields.

b) Building Facilities

The passenger terminal building will handle 908,000 and 1,610,000 passengers annually in Phases I and II, and required floor areas will be 12,000 sq.m and 19,700 sq.m, respectively.

The aesthetic design should be a combination of the Yogyakarta traditional features and modern architecture with functional considerations based on the characteristics of this airport as the gateway to Yogyakarta, an international resort city.

Simple passenger and cargo flows which are one of the major elements to the functional design of the passenger terminal building were considered.

The cargo terminal building, administration building, control tower, fire station, VIP building, etc., will be planned taking into consideration their functions, expansibility and security requirements.

c) Air Navigation Systems

Air navigation systems were planned for the design aircraft of A300/DC-10 class to meet the aircraft operational category of precision approach Category-I, ICAO.

Instrument Landing System (ILS) will be replaced by Microwave Landing System (MLS) in late 1990s in accordance with ILS/MLS transition plan

by ICAO.

d) Others

Airport utilities including power supply system, water supply system, sewerage system, solid waste disposal system and telecommunications system were planned based on facility requirements. General services facilities including rescue and fire fighting facilities, airport maintenance equipment, fuel supply system and a heliport are also necessary as airport supporting elements.

4.3 Airspace Use

(1) Rearrangement of ATS Routes and Terminal Area

Aircraft departing from and arriving at Yogyakarta airport at present utilize the air routes protected by Yogyakarta-Solo corridor which has been established in the military training area. The following rearrangements were proposed in this Study.

a) Establishment of New ATS Route from Jakarta

A new ATS route from Jakarta was proposed for the new airport. A new VOR/DME was planned at the compulsory reporting point "Lumba" or its vicinity in order to cancel present dead-reckoning flights.

b) Establishment and Rearrangement of Corridors

The corridors in the training area were proposed to be established and/or rearranged along new Yogyakarta and Surakarta VOR/DMEs. Widening of the corridors will be also necessary.

c) Shift of Training Area

The existing training area centered at "OF" NDB should be shifted as to be centered at new Yogyakarta VOR/DME for better self-recognition of aircraft position by air force trainees.

d) Establishment of Additional Controlled Airspaces

Additional controlled airspaces were proposed to be established in order to ensure the safety of IFR operations in the training area.

(2) Aircraft Operation Procedures for the New Airport

As basic instrument approach procedures, ILS approach for Runway 04, VOR/DME approach for Runway 04 and 22 were evaluated. Standard instrument departure routes for both Runways 04 and 22 were also studied. No problems are seen for the establishment of the procedures.

(3) Terminal Radar Approach Control System

Airspace over Yogyakarta airport is a very busy in terms of air traffic flow. This is due to the existance of military training aircraft in addition to civil airliners. It is expected that when the new airport inaugurates its operations, wide-body jets and many small training aircraft will have to share the same airspace.

In order to alleviate this problem fundamentally, introduction of a Terminal Radar Approach Control System is considered essential. With this, approach/departure control can completely ensure aircraft separation through a visual indication on the radar display.

Site selection for a terminal radar was made so that the radar can cover as wide an area as possible, i.e., including Surakarta and Semarang, in addition to functioning as an approach/departure control. However, it was difficult to select a site in this sense without spoiling radar's original function as an approach/departure control. Therefore, ATC radar was proposed to be located on a MSL 220 m mountain top, about 6 km northeast of the new Yogyakarta airport so that it can sufficiently function as the approach/departure control for the new Yogyakarta and Surakarta airports. PSR radar coverage is shown in Fig. 4.2.

(4) Equipment of SSR Transponder

In order to promote the air traffic control services, SSR transponder on aircraft operating within the Yogya Military Controlled Airspace was proposed to be equipped.

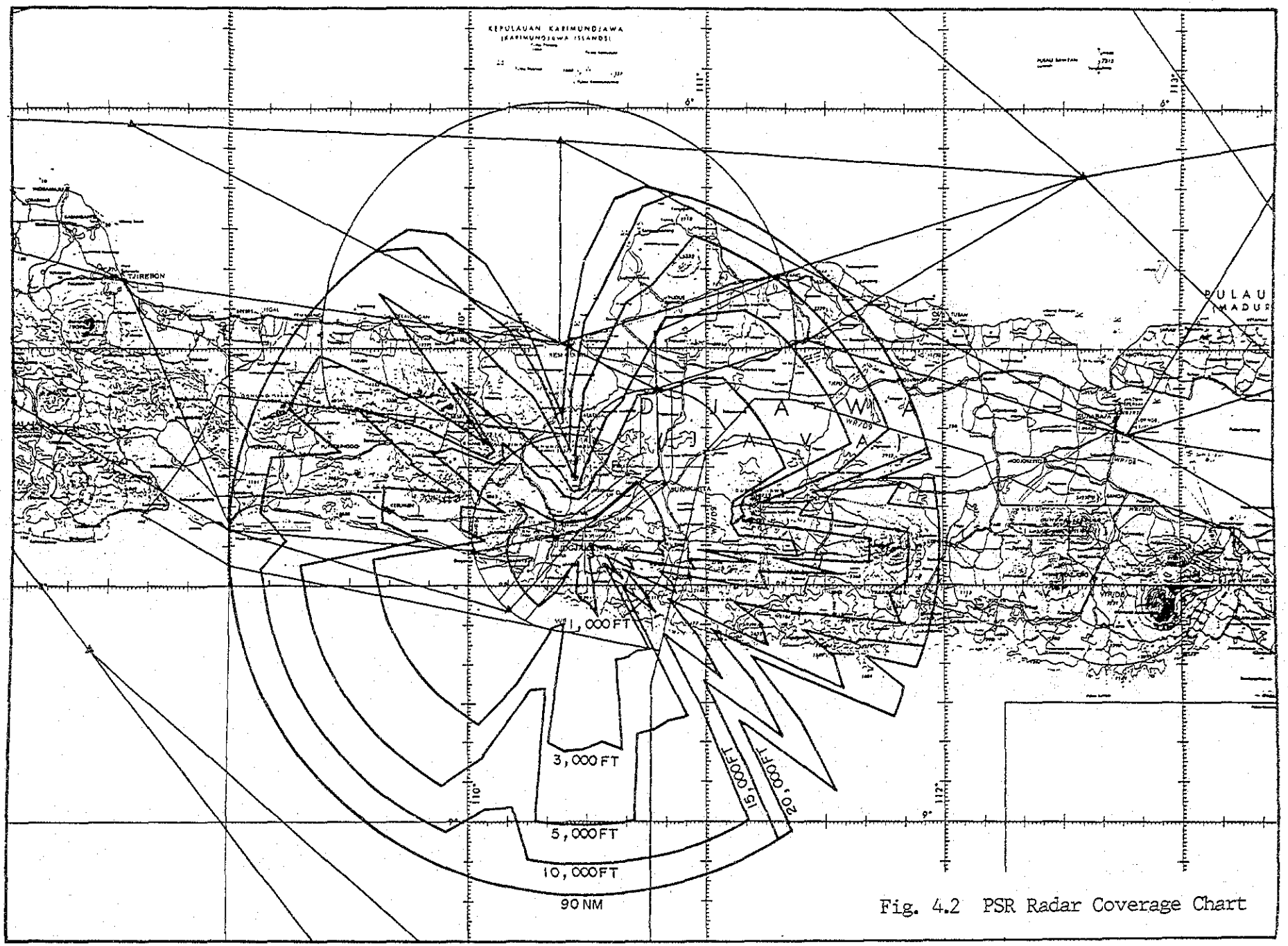


Fig. 4.2 PSR Radar Coverage Chart