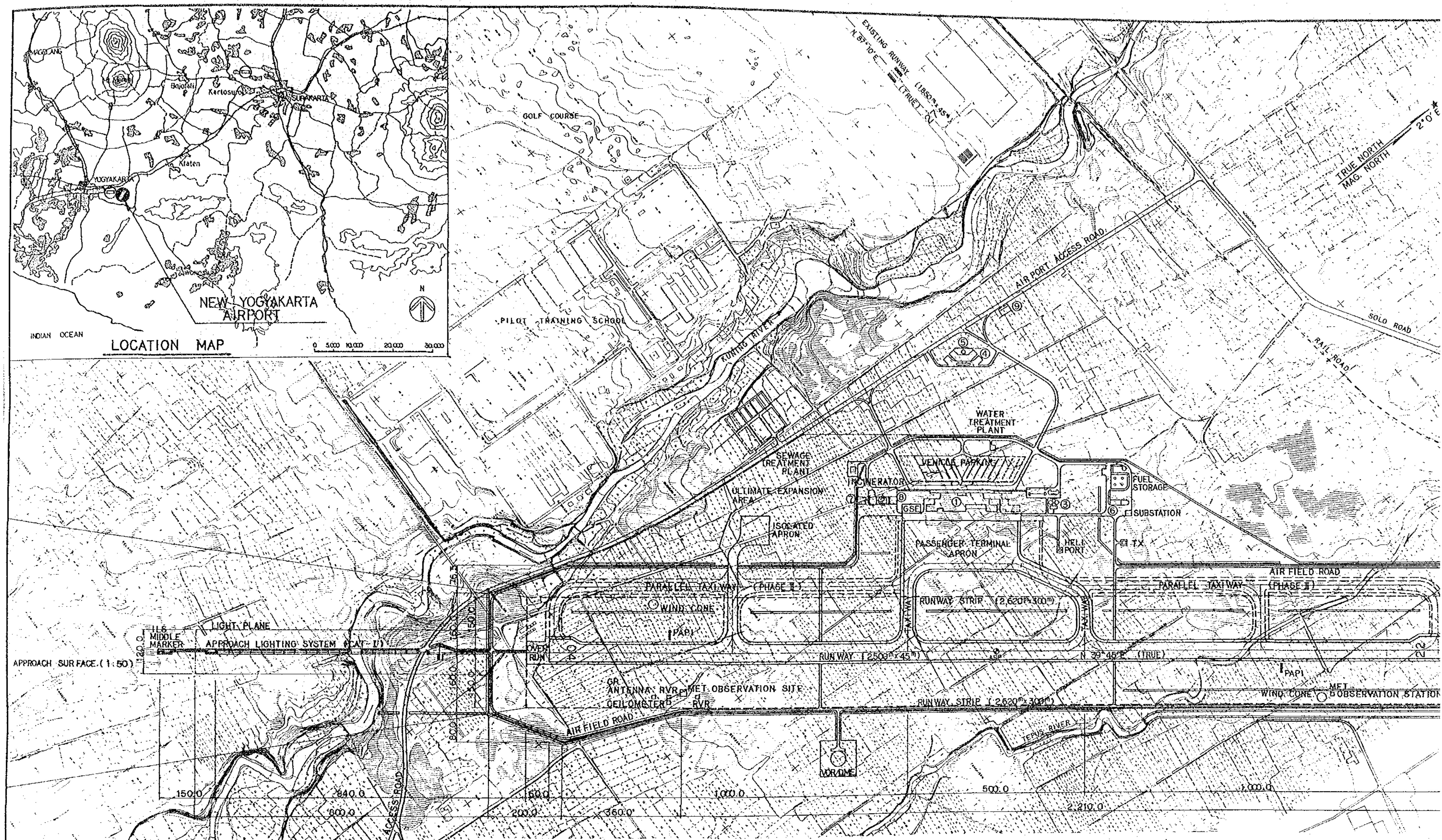
CHAPTER 3 AIRPORT MASTER PLAN

CHAPTER 3 AIRPORT MASTER PLAN

3.1 General

The facility planning and facility layout plan are described in this Chapter based on the airport facility requirements for Phases I and II which were established in Chapter 2. The airport layout plan is shown in Fig. 3.1.1 and the facilities proposed for Phase I are outlined in Table 3.1.1.

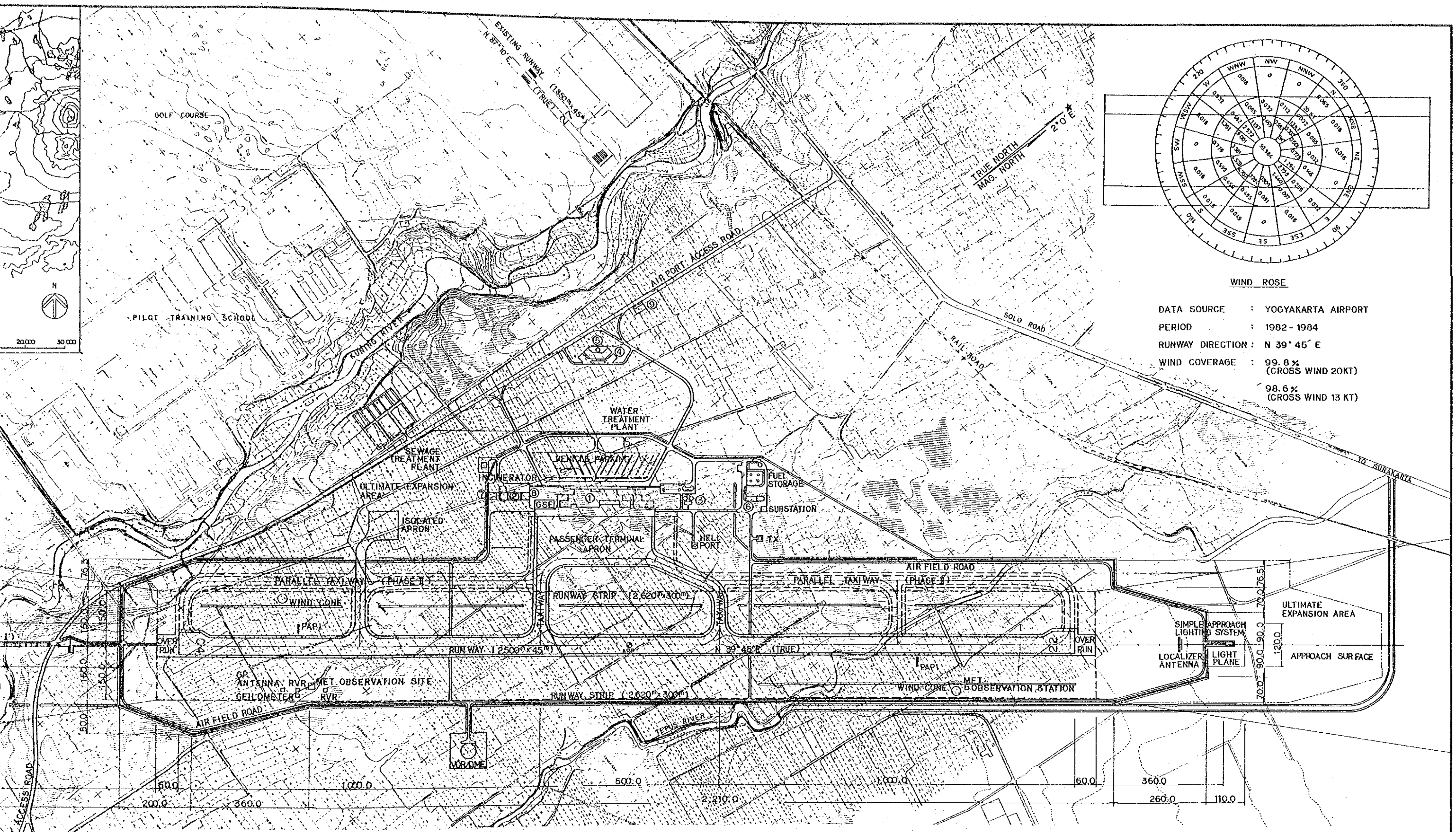


BASIC DATA TABLE	
RUNWAY DATA	
EFFECTIVE RUNWAY GRADIENT	0.594 %
WIND COVERAGE	20 KNOT 99.8 % 13 KNOT 98.6 %
INSTRUMENT RUNWAY	YES
PAVEMENT STRENGTH	PCN 58
APPROACH SURFACE	1/50
RUNWAY LIGHTING	HIRL
RUNWAY MARKING	ALL WEATHER
NAVIGATIONAL AIDS	ILS, ALS, PAPI

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

BUILDINGS	
①	PASSENGER TERMINAL BUI
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 BUI
⑨	MAIN SWITCHING AND GENE



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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

Fig. 3.1.1 Airport Layout Plan

Table 3.1.1 Outline of New Airport in Phase I

"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/G	AFS	TTY	MICROWAVE	ATIS
	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	

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

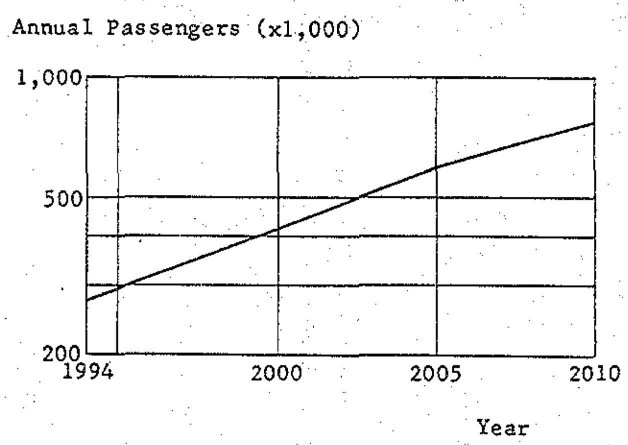
Basic Facilities

	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 m^2	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 m^2	Self-maneuvering

Other Facilities

	Size	Structure	Note
Passenger Bldg.	12,000 m^2	RC	
Cargo Building	700 m^2	RC	
Administration Bldg.	1,700 m^2	RC	
Control Tower	60 m^2	RC	Height 30 m
Fire Station	400 m^2	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	



Note. Completion of Phase I development: End of 1994

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	

Drawn by JICA
As of 1986

3.2 Airport Layout Planning

3.2.1 New Airport Site

The proposed new airport site area now consists mainly of rice fields and small villages. The Kuning and Tepus Rivers supply water to the irrigation channels around the site. It is necessary to divert the Tepus River which runs across the site. The portion of the existing irrigation channel intercepted by the new airport must be redeveloped.

The site has a flat terrain with a slope of 0.7-0.8 % from north to south and very little abrupt change in topography.

There are no obstacles such as mountains, man-made structures etc., which protrude upon the obstacle limitation surfaces except for a few trees which must be cut.

3.2.2 Layout Plan of the New Airport

(1) New Runway Location

The new runway location shown in Fig. 3.2.1 is determined based on a study of the following items.

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

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

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

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

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

- The runway direction is to have a wind coverage of more than 95 %.

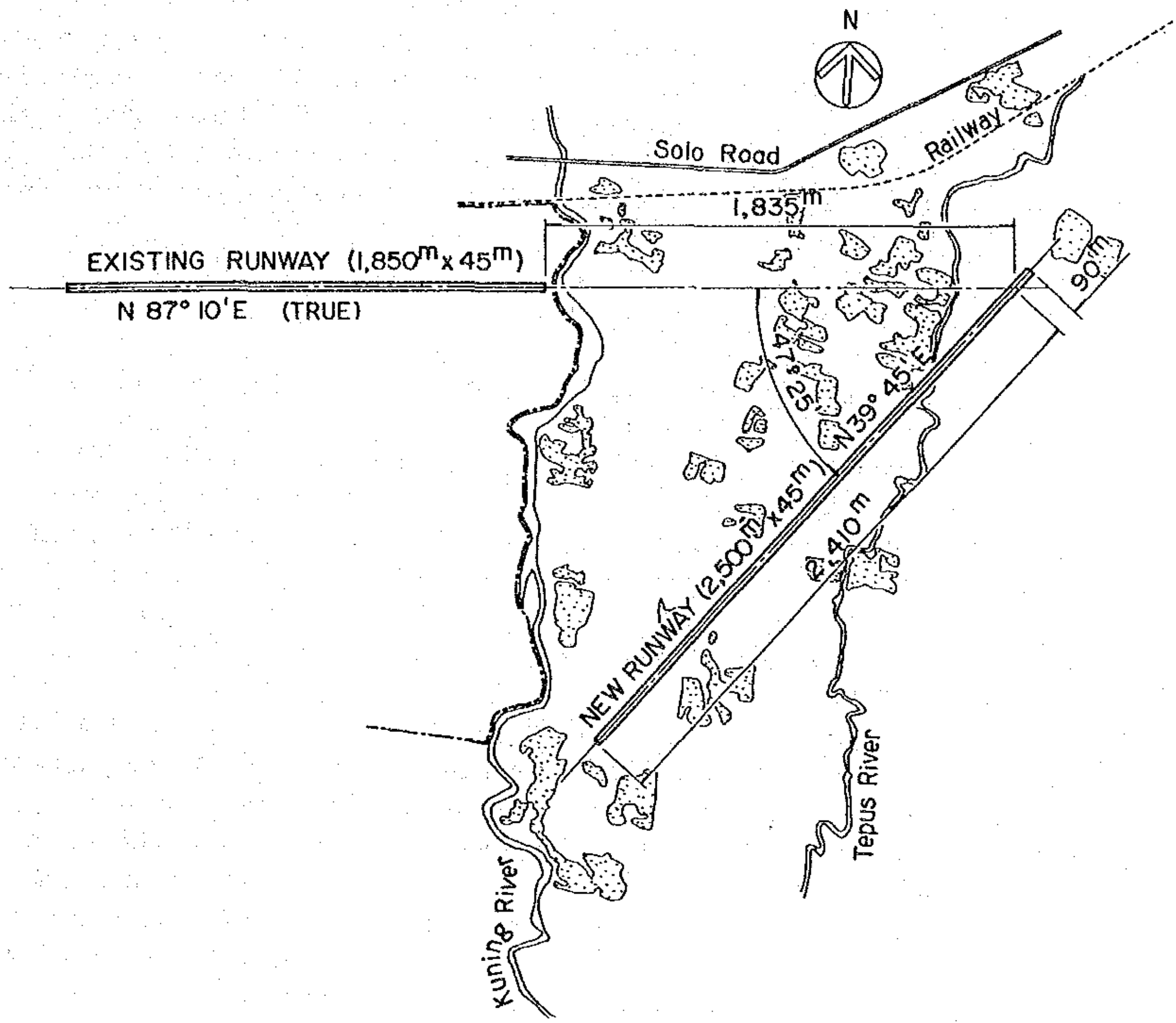


Fig. 3.2.1 Location of Runway for New Airport

(2) Main Approach Direction

The main approach direction was planned to be southwest (Runway 22) in Part I. However, since there is not so much difference between the wind coverage of Runway 04 and 22, the main approach direction is determined to be Runway 04 taking into consideration that the traffic from Jakarta will be most frequent. Instrument Landing System (ILS), Approach Lighting System (ALS), etc., for precision approach Category-I are therefore, planned for Runway 04 approach.

(3) Configuration of Taxiway and Apron

The runway will be 2,500 m long and 45 m wide, and is planned to allow precision approach Category-I. As stated in the facility requirements analysis, a complete parallel taxiway is justified in Phase I.

Although the number of justified instrument approaches is 4 for peak hour, the forecast is 4.5 instrument approaches/peak hour, exceeding only by 0.5 instrument approaches/peak hour. In order that the initial investment is kept small, the construction of the complete parallel taxiway will be delayed until Phase II.

Three rectangular exit taxiways connecting the runway and the passenger apron or the isolated apron are planned for Phase I, and a complete parallel taxiway in Phase II. The apron is planned for the vertical stabilizer of B-747 not to protrude upon the transitional surface when B-747 is introduced in the future. The apron edge facing the terminal building is therefore located 362.5 m from the center line of the runway taking into account the accommodation of B-747 aircraft.

(4) Location of the Terminal Area

The terminal area is planned to be located west of the runway. The location is established approximately central in the west area to avoid the area under the existing runway 27 approach surface to take into account the future possibility of utilization of both existing and new runways for civil aviation.

(5) Aerodrome Location

The location of the new airport was determined as follows:

Runway Orientation	:	N 39° 45' E (true)
Aerodrome Reference Point (ARP)	:	7° 47' 54" S 110° 26' 35" E
Airport Elevation	:	103.2 m (338.5 ft)

(6) Airport Property Area

The airport property area should be fixed so as to be compatible with the future development inside and outside the airport. If the airport property area is planned with not enough leeway provided for future expansion, it will be unable to expand to cope with the increases in air traffic demand due to an escalation of social and economic factors.

Hence the future airport property area should provide an ultimate expansion area for extension of the runway up to 3,000 m and for expansion of the terminal area, etc., in addition to an area for further expansion for Phase II. The area for extension of the runway is to be included in the master plan and the river diversion is planned taking into consideration this requirement. The area for ultimate expansion is 35 ha.

3.2.3 Terminal Area Layout

The terminal area consists of the apron, passenger terminal building, cargo terminal building, control tower, administration building, vehicle parking and other facilities necessary for civil air transport.

The layout of the terminal area at the new airport designed based on a linear concept in which passenger and cargo terminal buildings, etc., are in a line facing the apron, is shown in Fig. 3.2.3.

The prime considerations for the terminal area layout are as follows:

(1) Passenger Terminal Apron

The location of the passenger terminal apron is as described in "Configuration of Taxiways and Apron" of Section 3.2.2.(3).

The positions for each aircraft stand on the apron are planned as shown in Fig. 3.2.2. Expansion of the apron in Phase II is planned to extend mainly to the north.

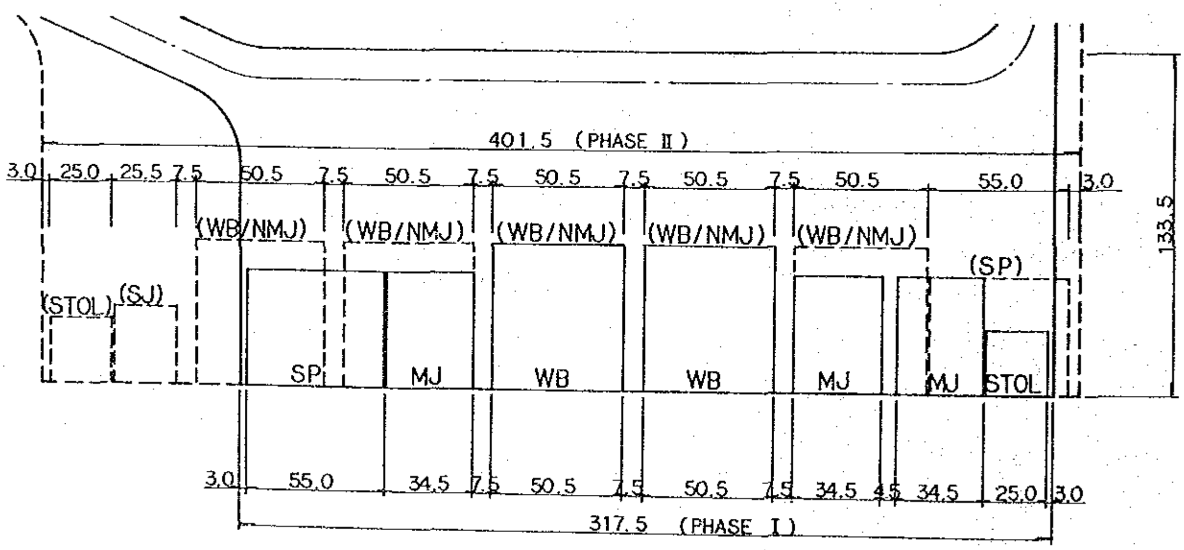


Fig. 3.2.2 Apron Arrangement for the New Airport

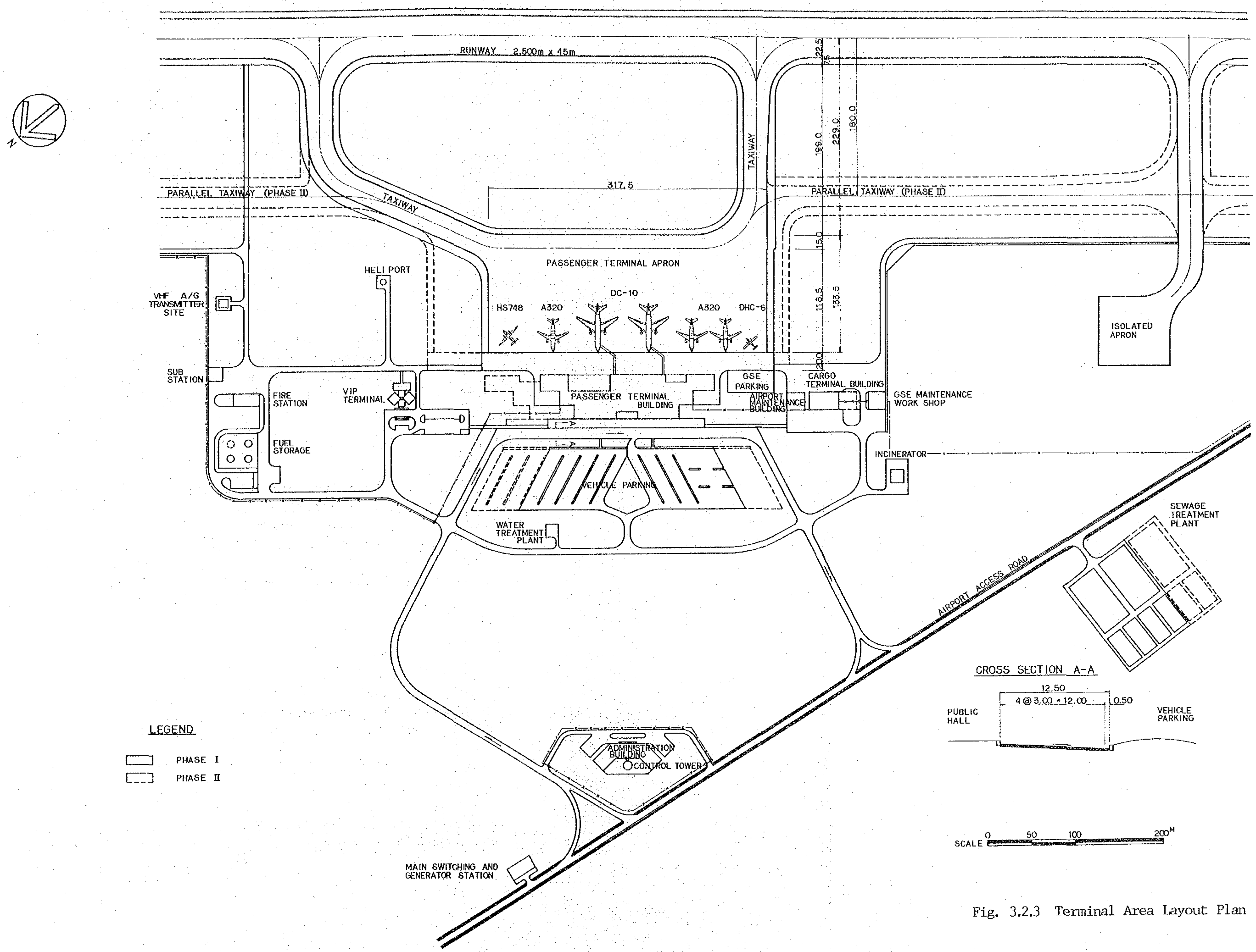


Fig. 3.2.3 Terminal Area Layout Plan

(2) Passenger Terminal Building

The passenger terminal building follows the aforementioned linear concept and is planned so as to face the apron taking into consideration the shortest and easiest access for passengers and baggage from/to the aircraft stands.

The expansion in Phase II is planned to be in the north direction. North of the passenger terminal building, a sufficiently wide area exists for future expansion.

(3) Cargo Terminal Building

The cargo terminal building is located at the south side of the passenger terminal building. A sufficiently wide space will remain between future expansion of both the cargo and the GSE maintenance buildings. The cargo terminal building is located close enough so that this layout will make cargo handling efficient.

(4) Administration Building and Control Tower

It is desirable that the administration building and control tower are to be located next to each other in order to facilitate security control and maintain adequate functions. The new control tower is planned to be located in-between the runways in order to control both the new and the existing runway and to minimize the required height of the control tower. The location as shown in Fig.3.2.3 meets this requirement and makes the control tower to be a landmark for the new airport.

(5) Fire Station

The fire station is to be located next to the proposed runway to permit response times of two minutes, not exceeding three minutes, to the end of the runway in accordance with the ICAO recommendations. The building is planned so as not to infringe upon the obstacle limitation surfaces at this location.

(6) VIP Building

Independent building, vehicle parking and the internal road for VIP are to be located separately from the public area, surrounded by a security fence and north of the passenger terminal building.

(7) Vehicle Parking and Internal Road

The public vehicle parking area is located in front of the passenger terminal building to minimize walking distance between the terminal building and vehicle parking for the convenience of passengers and visitors. Staff parking is also provided near each building.

The internal road is planned to be basically regulated in a one way (clockwise direction) so as to provide orderly vehicular movement and to facilitate pedestrian crossing.

(8) Parking for Ground Service Equipment

Although ground service equipment (hereinafter referred to as "GSE") such as towing tractors, passenger stair cars, etc., will be provided by the airlines, the areas for parking, maintenance workshop and fuel station for GSE are reserved in this master plan.

The GSE parking area is to be located west of the passenger terminal building, adjacent to both the apron and the passenger and cargo terminal buildings.

The maintenance workshop and fuel station for the GSE are to be located adjacent to the cargo terminal building.

(9) Isolated Apron

An isolated apron is planned to handle an emergency aircraft (hijacked, etc.) based on the ICAO Aerodrome Master Planning. In general, the location of an isolated apron should not be nearer than 100 m from other aircraft parking positions, buildings, public areas, and airport fences. Taking the above into consideration, the isolated apron is to be located south of the terminal area in the ultimate expansion area.

(10) Heliport

A heliport is located beside the passenger terminal apron and in front of the VIP building for the convenience of users.

The clearance between the heliport and the runway center line is planned to be 280 m in accordance with FAA standards in order to permit simultaneous operations of helicopter and aircraft under VFR conditions.

(11) Airport Utilities

The airport utilities such as power supply, water supply, sewerage systems are planned in the proximity of the load center and the airport administration area in order to minimize the length of cables and pipes required, and to permit easy operation and maintenance.

The major water supply facilities are located within the area isolated from the public access area, in order to enhance security.

A sewage treatment facility and incinerator are located leeward of the prevailing wind and west of the passenger terminal building in order to avoid disturbing passengers.

(12) Fuel Storage

The facilities for fuel storage will be constructed by PERTAMINA. The area for the fuel storage facilities has been prepared and reserved north of the terminal area in order to permit easy access to/from airside and landside.

3.3 Airport Facilities Plan

3.3.1 Site Preparation

(1) Grading Plan

Since the new airport site is located in the immediate vicinity of Mt. Merapi, the existing terrain slopes down gradually toward the south and southeast. The new airport site lies between 113 m and 97 m above mean sea level and the average slope of the existing terrain along the runway center line is approximately 0.8 % and 0.4 % for the northern and southern half of the proposed runway respectively.

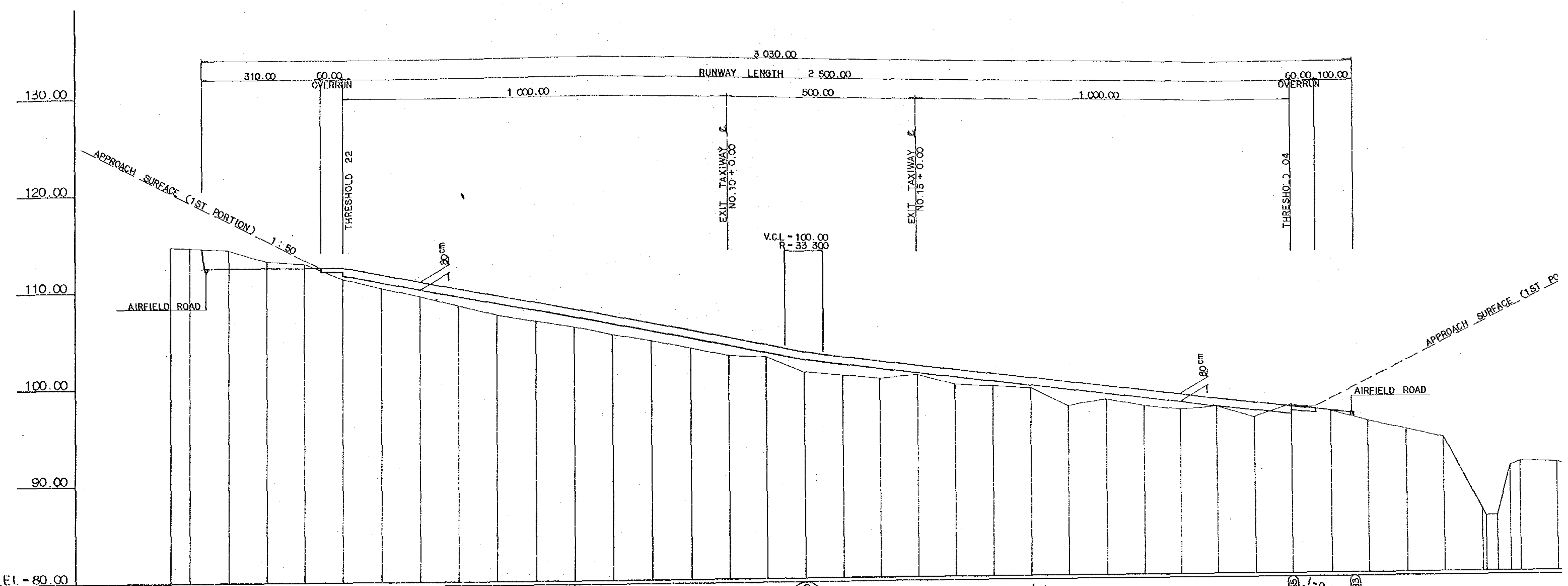
The subsurface soils at the new airport site consist mostly of silty sand or sandy silt with relatively high water contents caused by a high ground water table (about 1.0 m below ground level). The lowering of ground water is considered possible by digging drainage channels around the airport perimeter and cutting off the flow of rainfall from outside the boundary.

In addition to the existing topographic and geological conditions, the following factors were taken into consideration for the grading plan.

- The area to be graded for the runway strip of precision approach runway is based on ICAO ANNEX 14.
- A transverse slope of 1.0 % for this grading area is adopted as the minimum slope for adequate drainage.
- Longitudinal and transverse slopes of the runway and taxiway are planned to be less than the maximum slopes which are stipulated in ANNEX 14, taking into account the tolerance for pavements and/or future differential settlement.
- Topsoils which are composed of decayed vegetation and organic matter, will be removed and hauled into fill areas except the pavement area.
- The bulk factor of soil (dry density/90 % of max. dry density) is expected to be 0.8 based on the results of the soil investigation. (Refer to Appendix II-1-3)

Taking into consideration the abovementioned conditions, the grading for the new airport is planned to make earth work volume minimal, balanced and compatible with the storm water drainage planning.

After a few trial studies, the runway profile and typical cross sections were determined as indicated in Figs. 3.3.1 and 3.3.2. The resulting cut and fill volumes for Phase I are estimated to be about 690,000 cu.m and 540,000 cu.m, and 70,000 cu.m of cut and 40,000 cu.m of fill for Phase II.



STATION	DISTANCE	ACCUMULATED DISTANCE	GROUND HEIGHT	PROPOSED HEIGHT	CUT	BANK	GRADIENT
NO. -5	-50.00	-500.00					
-50.00	-50.00	-450.00	114.68				
NO. -4	-30.00	-400.00	114.58				
-70.00	-70.00	-370.00	114.53	112.40	2.13		112.40
NO. -3	100.00	-300.00	114.41	112.40	2.01		
NO. -2	100.00	-200.00	113.23	112.40	0.83		LEVEL L=370.00
NO. -1	100.00	-100.00	112.92	112.40	0.52		
NO. 0	0.00	0.00	111.35	112.40		0.25	112.40
NO. 1	100.00	100.00	110.37	111.65		0.48	
NO. 2	100.00	200.00	109.49	110.90		0.61	
NO. 3	100.00	300.00	108.45	110.15		0.90	
NO. 4	100.00	400.00	107.53	109.40		1.07	
NO. 5	100.00	500.00	106.74	108.65		1.11	I=0.75% L=1200.00
NO. 6	100.00	600.00	106.15	107.90		0.95	
NO. 7	100.00	700.00	105.27	107.15		1.08	
NO. 8	100.00	800.00	104.64	106.40		0.96	
NO. 9	100.00	900.00	103.94	105.65		0.91	
NO. 10	100.00	1000.00	103.13	104.90		0.97	
NO. 11	100.00	1100.00	102.95	104.15		0.40	
NO. 12	100.00	1200.00	101.37	103.44		1.27	103.40
NO. 13	100.00	1300.00	101.05	102.95		1.10	
NO. 14	100.00	1400.00	100.69	102.50		1.01	
NO. 15	100.00	1500.00	101.12	102.05		0.13	
NO. 16	100.00	1600.00	100.08	101.60		0.72	
NO. 17	100.00	1700.00	99.85	101.15		0.50	
NO. 18	100.00	1800.00	99.66	100.70		0.24	I=0.45% L=1300.00
NO. 19	100.00	1900.00	97.78	100.25		1.67	
NO. 20	100.00	2000.00	98.40	99.80		0.60	
NO. 21	100.00	2100.00	97.77	99.35		0.78	
NO. 22	100.00	2200.00	97.35	98.90		0.75	
NO. 23	100.00	2300.00	97.61	98.45		0.04	
NO. 24	100.00	2400.00	96.46	98.00		0.74	
NO. 25	100.00	2500.00	97.79	97.55	0.04		97.55
NO. 26	100.00	2600.00	97.12	97.10	0.02		I=0.45% L=160.00
+60.00	60.00	2660.00		96.83			96.83
NO. 27	40.00	2700.00	95.97				
NO. 28	100.00	2800.00	95.25				
NO. 29	100.00	2900.00	94.10				
NO. 30	100.00	3000.00	86.50				
NO. 31	100.00	3100.00	91.52				
NO. 32	[illegible]	[illegible]	[illegible]				

SCALE VERTICAL 0 5 10 20 M

HORIZONTAL 0 50 100 200 500 M

Fig. 3.3

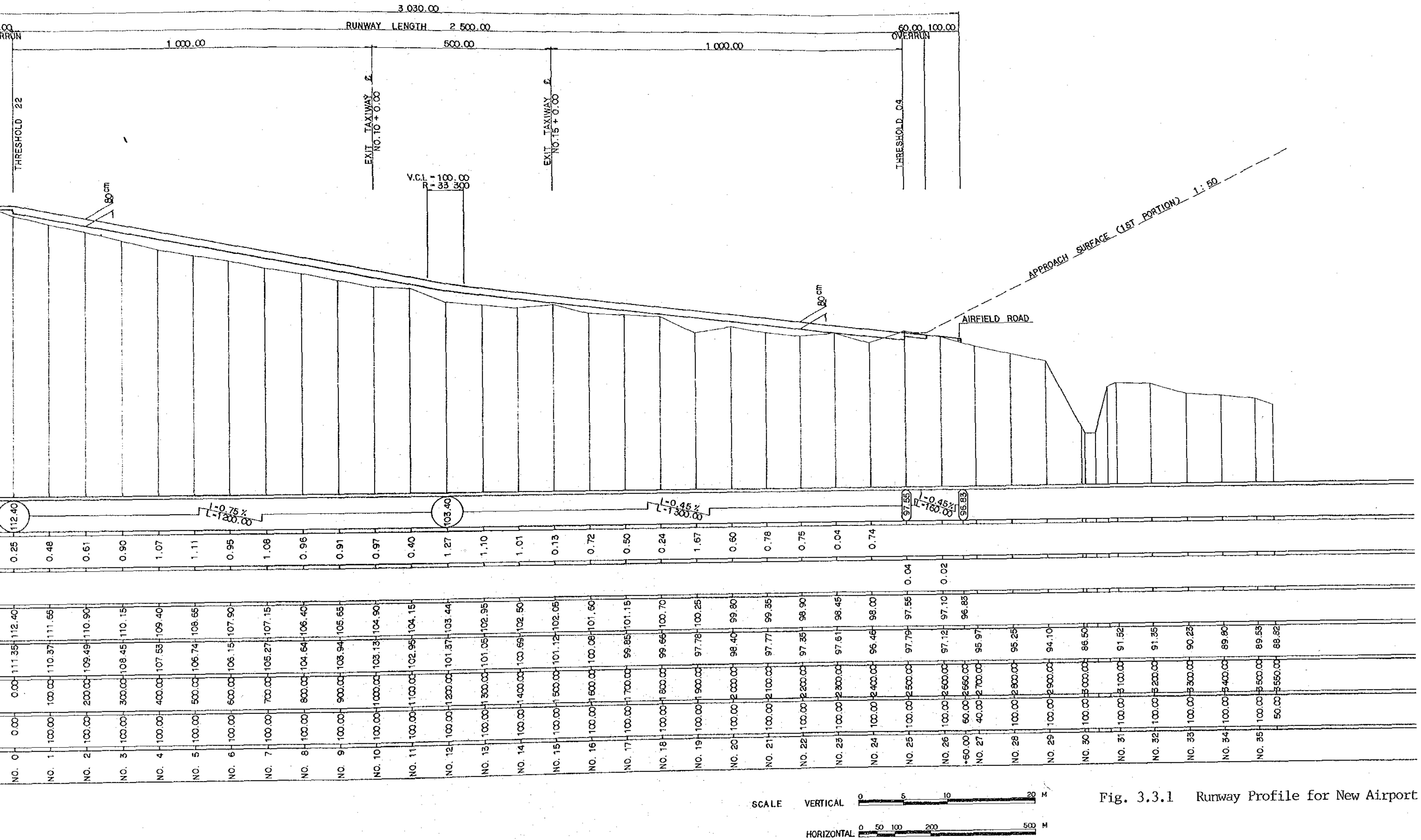
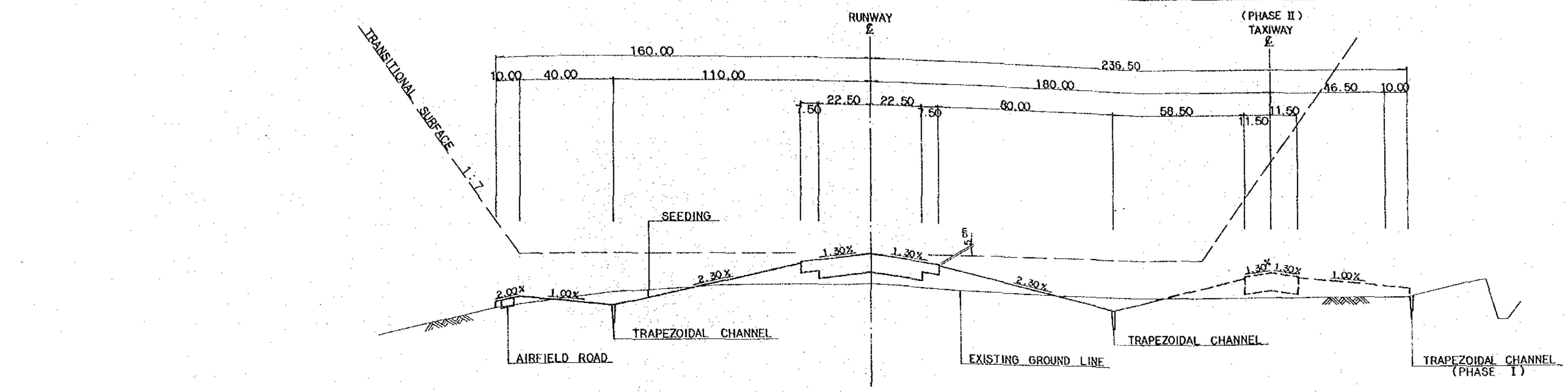
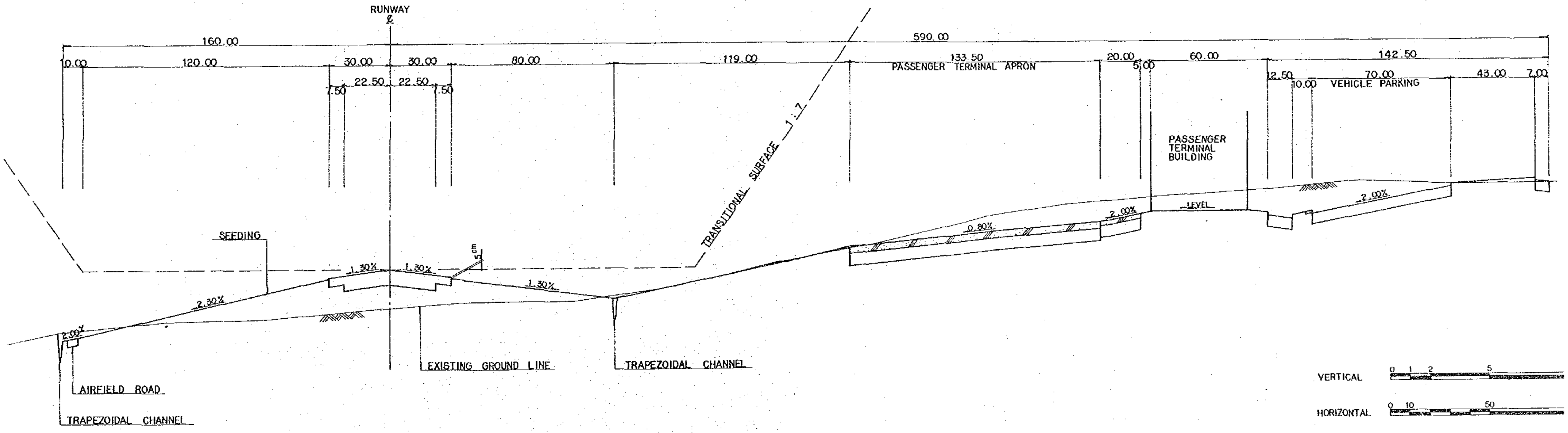


Fig. 3.3.1 Runway Profile for New Airport

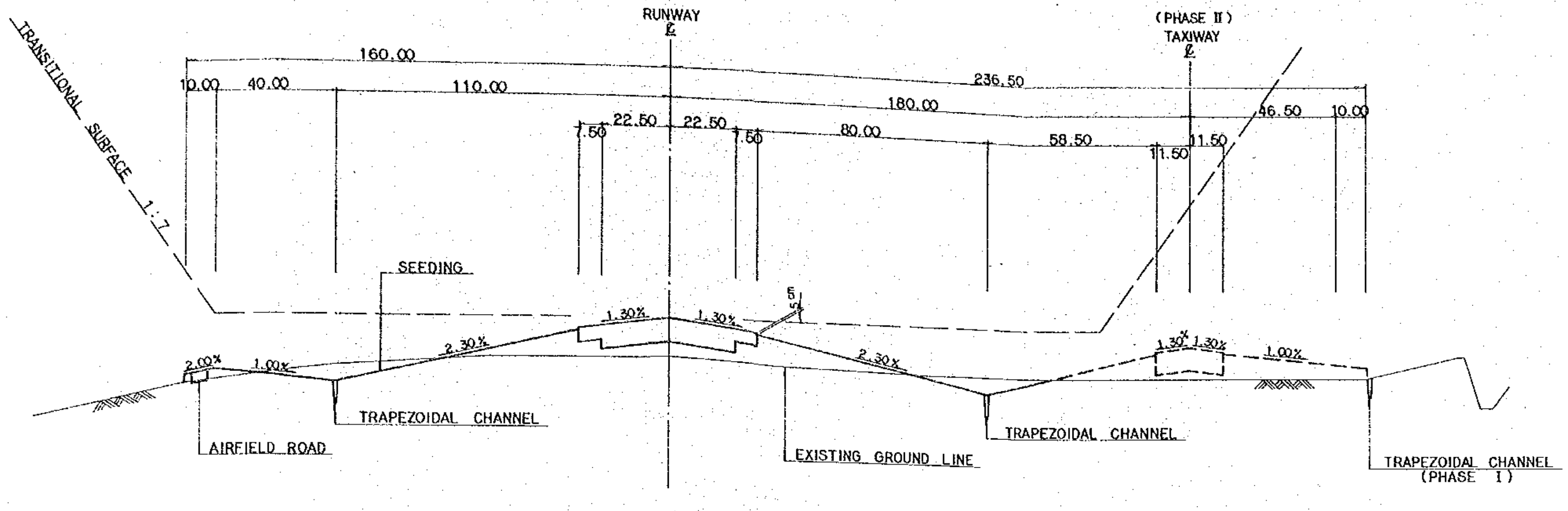


RUNWAY STRIP AND TAXIWAY

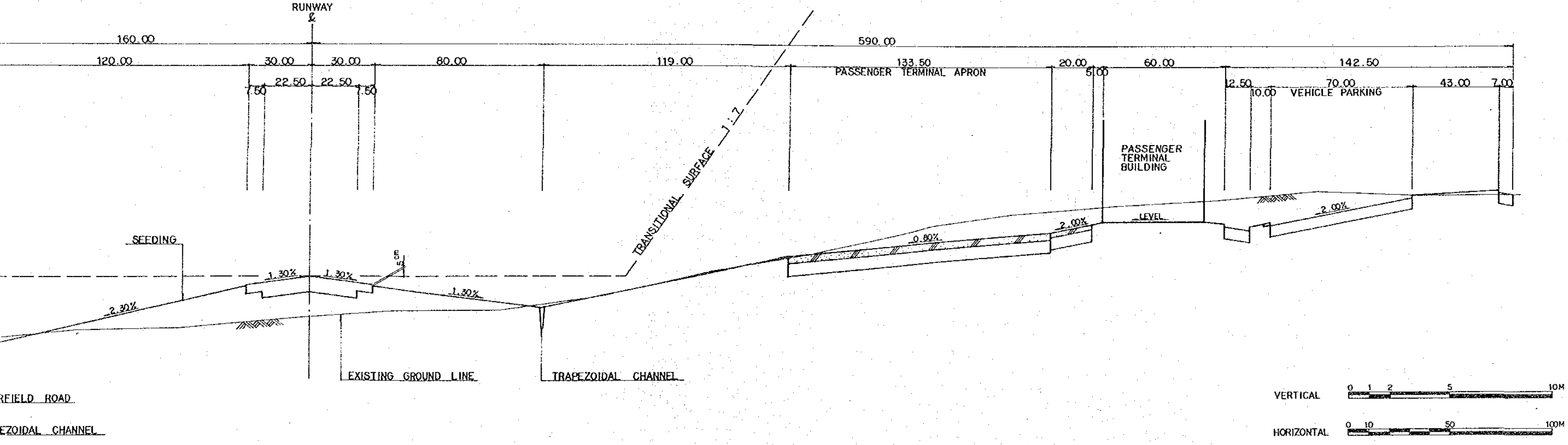


RUNWAY STRIP, APRON AND TERMINAL AREA

Fig. 3.3.2 Typical Cross Sections for New A



RUNWAY STRIP AND TAXIWAY



RUNWAY STRIP, APRON AND TERMINAL AREA

Fig. 3.3.2 Typical Cross Sections for New Airport

(2) Storm Water Drainage Plan

The airport drainage system is planned to be discharged mainlyinto the Kuning River which flows between the existing and new airports, and part of the Tepus River is to be diverted due to the airport construction.

A trapezoidal channel in the runway strip was adopted based on economical considerations and is to be located parallel to and 110 m from the runway center line so as to avoid possible damage to landing aircraft which miss the runway.

An open channel is to be located around the airport in order to lower the ground water table prior to construction site preparation and to function as both irrigation channel for the rice fields and cut-off channel for outside storm water drainage.

The overall storm water drainage system and the outline of drainage facilities are planned as shown in Fig. 3.3.3.

The planning criteria employed for drainage facilities planning are summarized as follows:

a) Runoff

The rational formula is used to estimate runoff.

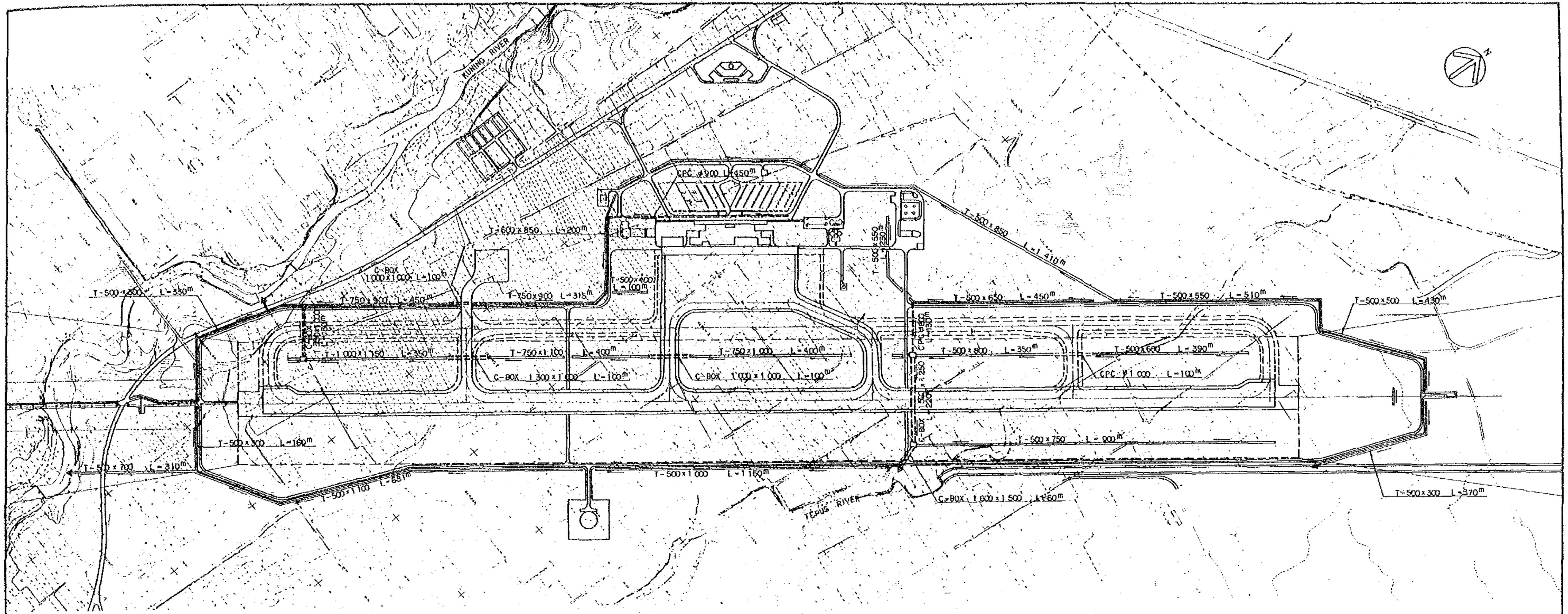
$$Q = \frac{1}{360} CIA$$

Where; Q: Runoff (cu.m/sec)

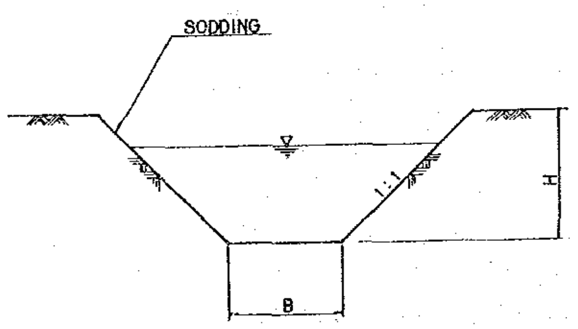
C: Runoff coefficient

I: Rainfall intensity (mm/hr)

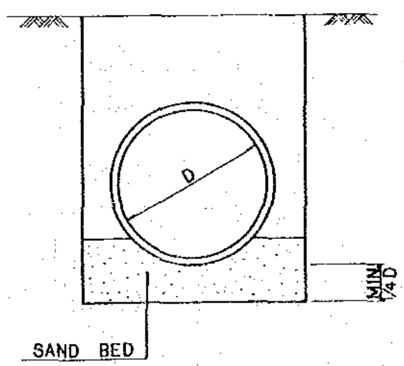
A: Catchment area (ha)



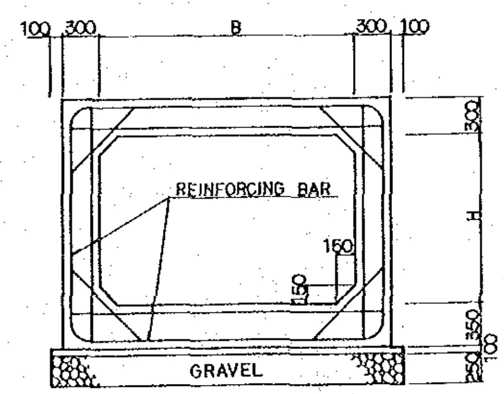
PLAN



TRAPEZOIDAL CHANNEL
T - (B) × (H)



REINFORCED CONCRETE PIPE
CPC ø(D)



BOX CULVERT
C-BOX (B) × (H)

SCALE 0 50 100 200 500 M

Fig. 3.3.3 Storm Water Drainage System and Typical Cross Sections

b) Runoff Coefficient

Pavement area	:	0.95
Building area	:	0.90
Turf area	:	0.30 (slightly pervious soil)

c) Rainfall Intensity

Due to the lack of hourly rainfall records, the rainfall intensity is estimated based on the following formula utilized for the master planning.

$$It = \frac{R24}{24}\left(\frac{24}{t}\right)^{2/3}$$

Where, It : Rainfall intensity for "t" time period (mm/hr)

R24 : Daily rainfall for specific return period (135 mm/day for 5 year return period is estimated from the daily maximum rainfall for 26 years)

t : Inlet time (hr)

(3) Diversion of River

This section sets forth the requirements for the diversion of the Tepus River, which will be necessary by the construction of the new Yogyakarta airport.

The Tepus River, with a small catchment area of approximately 28 km^2 and a length of about 25 km, is one of the tributaries of the Opak River system and flows between the Opak River and its major tributary, the Kuning River, from Mt. Merapi.

The river must be diverted by either an open channel or a box culvert under the runway strip.

Construction costs for the open channel and box culvert are as follows:

i) Diversion of the river

Open channel	L = 2,350 m	Rp. 600 million

ii) Culvert under the runway strip

Box culvert	L = 690 m	Rp. 3,200 million
Open channel	L = 410 m	Rp. 200 million
Total		Rp. 3,400 million

The Construction cost for the box culvert is more than five times the cost for diversion of the river. Therefore, in this master plan, the diversion of the river is recommended considering construction economy and uncertainty of the actual discharge which may be caused by various conditions.

The diversion of the river is planned where the open channel will not conflict with the runway extension to 3,000 m. The planning criteria used for the river diversion facility is summarized as the following.

a) Flood Discharge

The rational formula is utilized for estimation of the volume of flood discharge.

$$Q = \frac{1}{360} CIA$$

Where, Q : Flood discharge (cu.m/sec)

C : Run off coefficient (0.7 for rice field)

I : Rainfall intensity (mm/hr)

$$= \frac{R24}{24}\left(\frac{24}{t}\right)^{2/3}$$

(R24 = 150 mm/day for 10 year return period)

A : Catchment area (= 2,350 ha)

The flood discharge for 10 year return period is estimated to be 142 cu.m/sec.

b) Rate of Discharge

The rate of discharge in an open channel is estimated by using the Manning formula.

$$Q = AV, \qquad V = \frac{1}{n} R^{2/3} I^{1/2}$$

Where, Q : Rate of discharge (cu.m/sec)

A : Cross sectional area (sq.m)

V : Velocity of flood (m/sec)

n : Coefficient of roughness (= 0.030)

R : Hydraulic radius (m)

I : Hydraulic gradient (0.7 %, same as existing riverbed gradient)

c) Cross Section of Open Channel

Taking into account the width and depth of the existing Tepus River and allowance for safety, a cross section for the open channel is planned as described below in order to cope with the expected discharge based on a probability factor of 1/10.

Type of channel	:	Trapezoidal channel
Width of riverbed	:	10.0 m
Depth of channel	:	3.0 m (Including additional safety allowance of 0.6 m)
Slope gradient	:	1 : 2
Length of diversion	:	2,350 m

3.3.2 Runway, Taxiway and Apron

(1) Runway

The 2,500 m long and 45 m wide runway with 7.5 m wide paved shoulders is planned for Phase I. No extension will be required in Phase II.

Since a complete parallel taxiway is planned in Phase II, turningpads for the largest aircraft, DC-10/A300, are required in Phase I at both ends of the runway.

The proposed runway can be extended to the north up to 3,000 m. Even if the new airport will be upgraded to international standards in the future, the runway length of 3,000 m will be sufficient to accommodate direct B-747 class flights between Yogyakarta and Tokyo.

(2) Taxiway

Two rectangular exit taxiways are planned to connect the runway to the terminal apron, and another taxiway is planned between the runway and the isolated apron. A complete parallel taxiway will be constructed in Phase II.

These two rectangular exit taxiways are planned as shown in Fig. 3.2.3 in order to ensure smooth aircraft traffic flow and to reduce the paved area of the apron.

The dimensions of taxiways such as width, radius of taxiway centerline, radius of fillet, etc., are determined based on ICAO standards. The widths of the taxiways are planned to be 23 m with 10.5 m wide shoulders in order to accommodate DC-10/A300 class aircraft.

(3) Apron

The apron of the new airport is designed to accommodate two DC-10/A300 class, and three MD-82/A320 class aircraft using nose-in parking configuration and one F-27 class and one DHC-6 class aircraft using 45-degree nose-out parking configuration in Phase I.

Extension of the apron is required in Phase II in order to accommodate five DC-10/A300 class, one F-28 class, one F-27 class and one DHC-6 class aircraft.

(4) Pavement

a) Types of Pavement

Two types of pavement are designed; flexible pavement (asphalt concrete pavement) and rigid pavement (cement concrete pavement).

Cement concrete pavement with high resistance to fuel spillage is used for the apron in order to prevent subsequent damage or quality deterioration. Other areas outside the apron are to be paved with asphalt concrete.

b) Design Load and Coverage

Design load	B-747, DC-10 class
Design coverage	3,000

c) Subgrade Condition

The subgrade condition is based on the soil investigation executed in the site area. The results of the soil investigation are shown in Appendix II-1-3.

Based on the results of the soil investigation, field CBR values were estimated to be 3 to 5 %, and modified CBRs were more than 10 %. Since the field work for the soil investigation was executed in the rainy season, the ground-water level was high, and it seems that the field CBR values measured were relatively low. High values of the standard penetration tests, however, indicate that the soils at the site are not so loose, and high bearing capacity is expected by compaction.

The design CBR value is set at 10 % in the fill portion based on the modified CBR of banking material produced at the site. In the cut portion, a field CBR value of 3.1 % is adopted as the design CBR, which is equivalent to K-value of 2.7 kg/cu.cm.

d) Structure of Pavement

The pavement structure is designed as summarized in Fig. 3.3.4. on the basis of the Japanese design standard, which is explained as follows:

The standard thickness of asphalt concrete pavement is determined based on the design load, design coverage and design CBR of subgrade. The thickness for each categorized area such as the end and intermediate portions of the runways, taxiway shoulders, etc., is reduced in certain proportions to the determined standard thickness.

The layer configuration of pavement is designed to be mechanically well balanced by using the tabulated standard thickness of surface course, binder course and base course which are determined based the experiences and results of elasticity calculations. The remainder is given to subbase course.

Design of the thickness of cement concrete pavement is to be determined based on thickness of subbase course and cement concrete slab.

The thickness of subbase course are determined by using the authorized diagram showing the relationship between thickness of subbase course and ratio of coefficient of bearing capacity subbase course with subgrade.

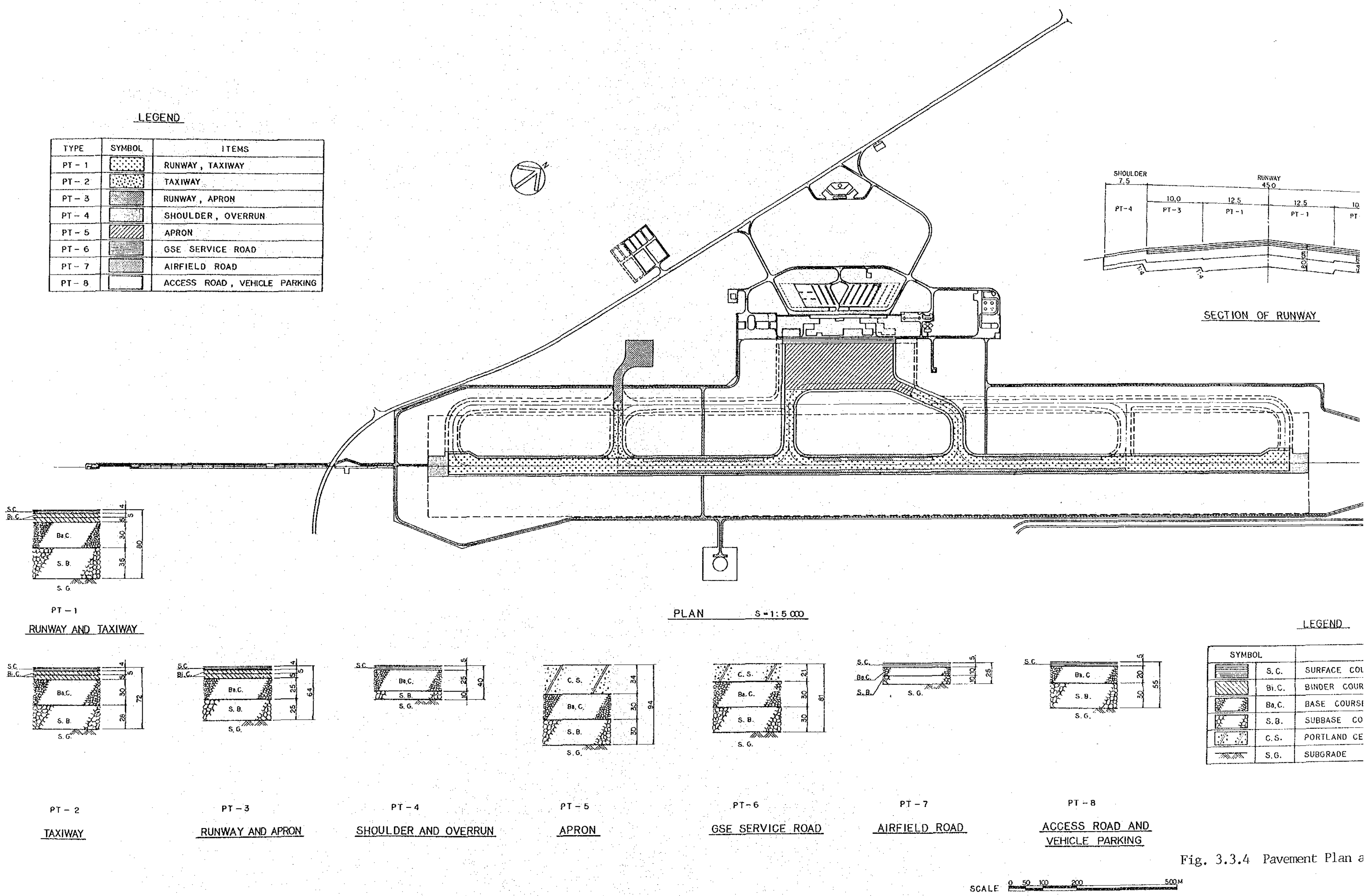
The coefficient of bearing capacity of subbase course is primarily standardized to be 7 kg/cm^3 tested by a loading plate 75 cm in diameter.

The thickness of cement concrete slab is determined by using the standardized table calculated based on design load, design coverage and coefficient of bearing capacity of subbase course - 7 kg/cu.m.

For each categoried area, the thickness of pavement is reduced in the same manner as the layer configuration criteria of asphalt concrete pavement planning.

LEGEND

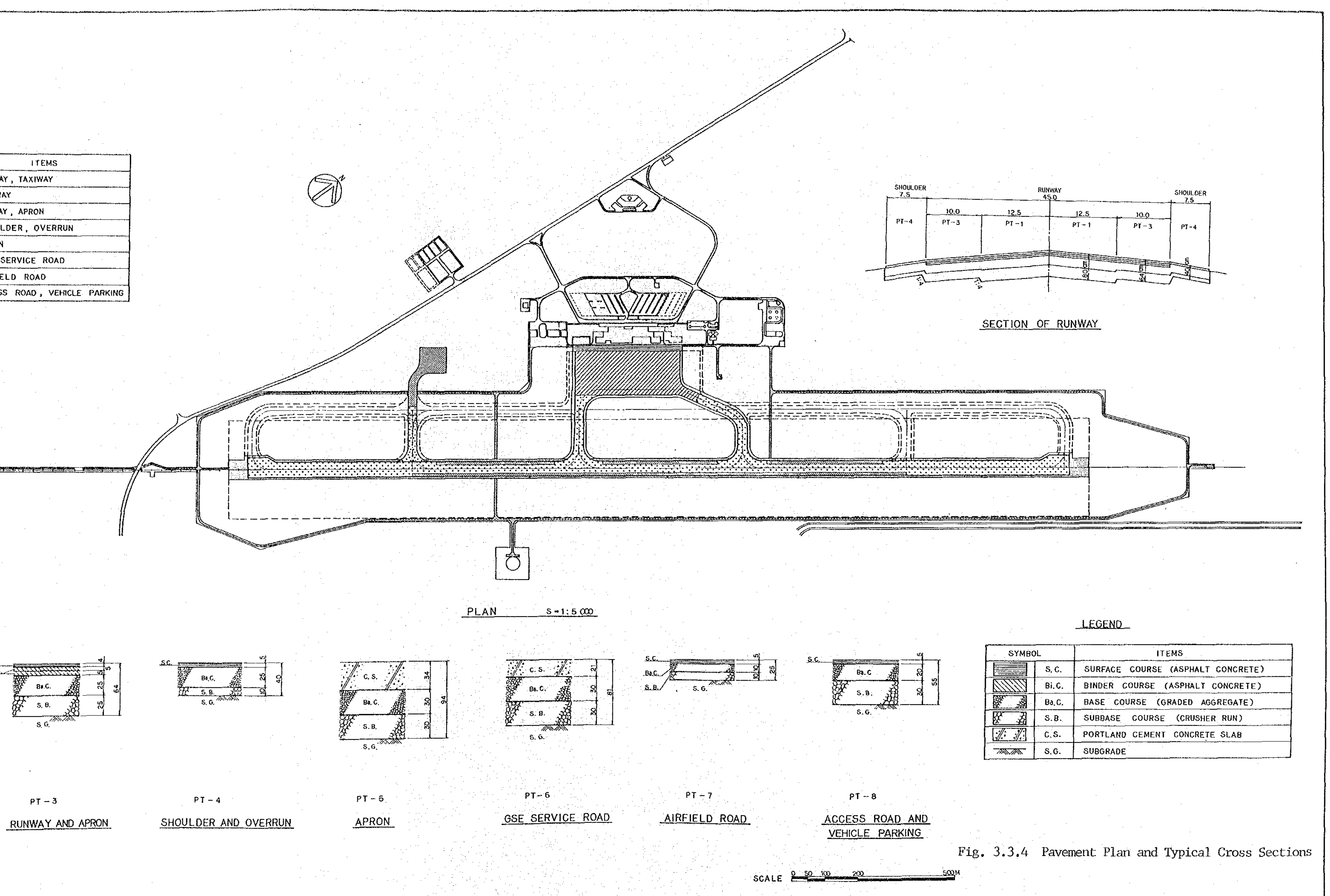
TYPE	SYMBOL	ITEMS
PT - 1		RUNWAY , TAXIWAY
PT - 2		TAXIWAY
PT - 3		RUNWAY , APRON
PT - 4		SHOULDER , OVERRUN
PT - 5		APRON
PT - 6		GSE SERVICE ROAD
PT - 7		AIRFIELD ROAD
PT - 8		ACCESS ROAD , VEHICLE PARKING



LEGEND

SYMBOL		
	S. C.	SURFACE CO
	Bi. C.	BINDER COUR
	Ba. C.	BASE COURSE
	S. B.	SUBBASE CO
	C. S.	PORTLAND CE
	S. G.	SUBGRADE

Fig. 3.3.4 Pavement Plan a



LEGEND

SYMBOL		ITEMS
	S.C.	SURFACE COURSE (ASPHALT CONCRETE)
	Bi.C.	BINDER COURSE (ASPHALT CONCRETE)
	Ba.C.	BASE COURSE (GRADED AGGREGATE)
	S.B.	SUBBASE COURSE (CRUSHER RUN)
	C.S.	PORTLAND CEMENT CONCRETE SLAB
	S.G.	SUBGRADE

Fig. 3.3.4 Pavement Plan and Typical Cross Sections

3.3.3 Passenger Terminal Building

The passenger terminal building is planned as shown in Figs. 3.3.5 through 3.3.7.

(1) General Concept

A linear type concept with one and half floor levels will be employed for the passenger terminal building considering the number of aircraft stands and the number of passengers to be served.

Since the installation of boarding bridges is considered necessary in Phase I taking into account the international trend for improved service for passengers, 2 boarding bridges will be initially installed for 2 wide-bodied aircraft (WB) stands.

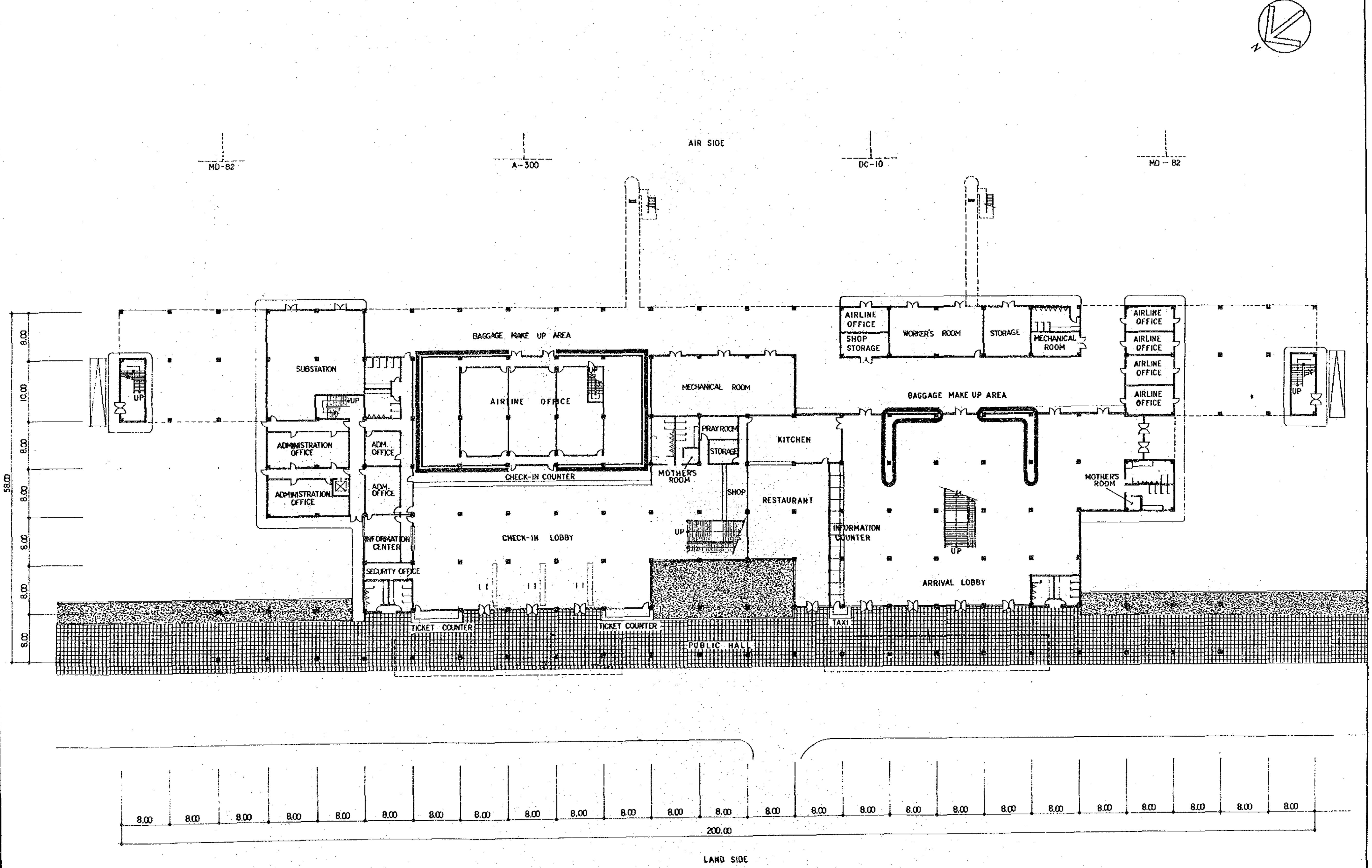
The aesthetic design should be a combination of the Yogyakarta traditional features and modern architecture with functional considerations based on the characteristics of this airport as the gateway to Yogyakarta and international resorts.

(2) Planning

The plan for the terminal building with a total design floor area of 12,000 sq.m in Phase I shown in Figs. 3.3.5 through 7, does not dictate the final concept, and it is only used for cost estimation. In this building area, about 800 peak hour passengers will be accommodated in Phase I.

The concept of simple passenger flow which is one of the major elements to the functional design of the passenger terminal building is considered. A mother's room and a prayer room are also planned in the terminal building for the convenience of passengers.

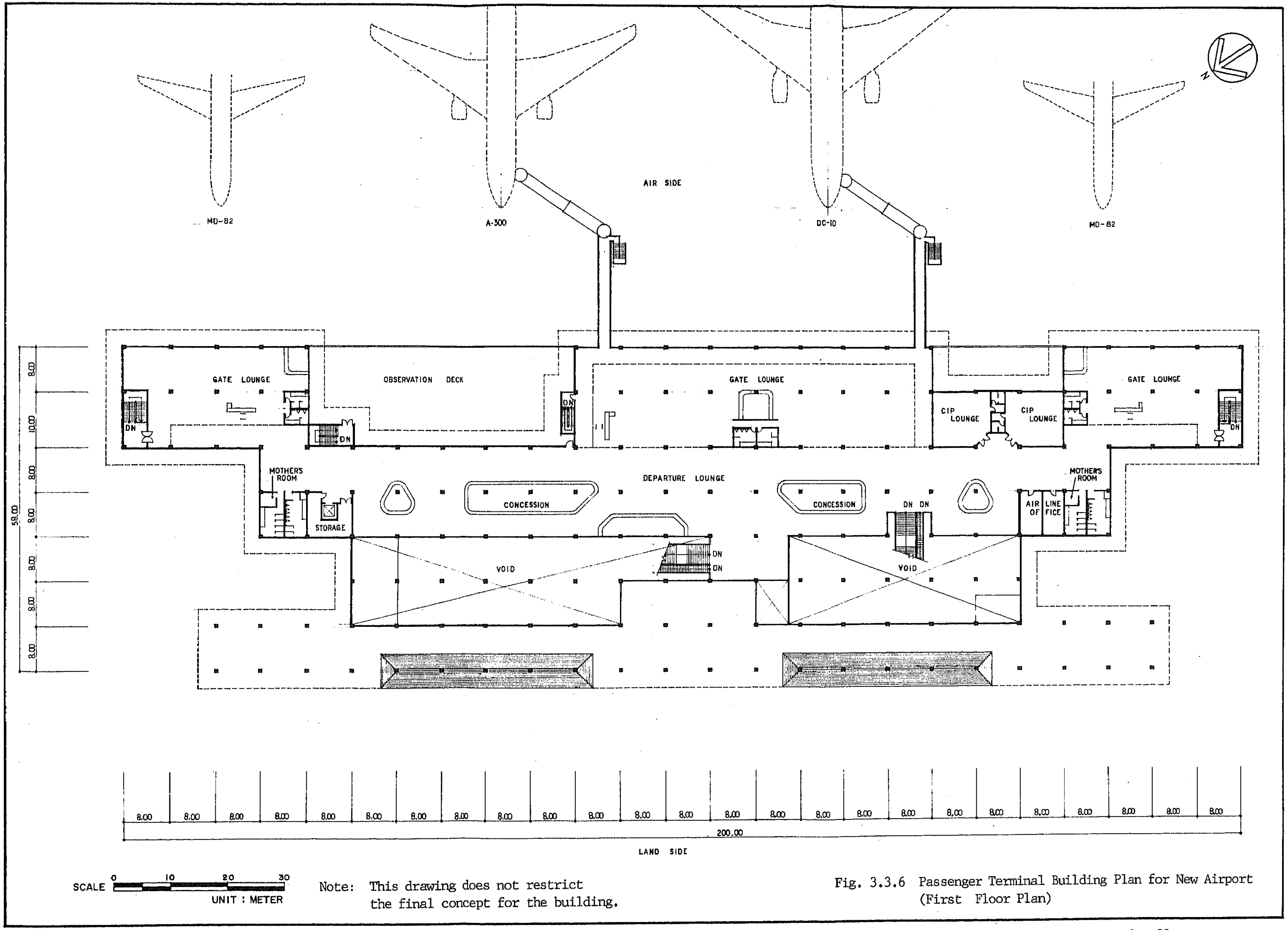
The building will be made of a reinforced concrete structure with 8 m x 8 m spans for greatest economy of construction.
The passenger terminal building will be expanded by 7,700 sq.m in Phase II.



SCALE 0 10 20 30
UNIT : METER

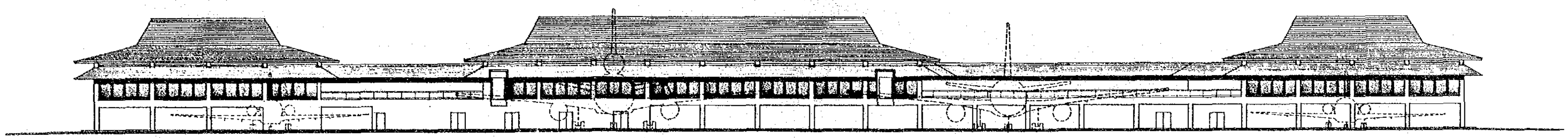
Note: This drawing does not restrict the final concept for the building.

Fig. 3.3.5 Passenger Terminal Building Plan for New Airport (Ground Floor Plan)

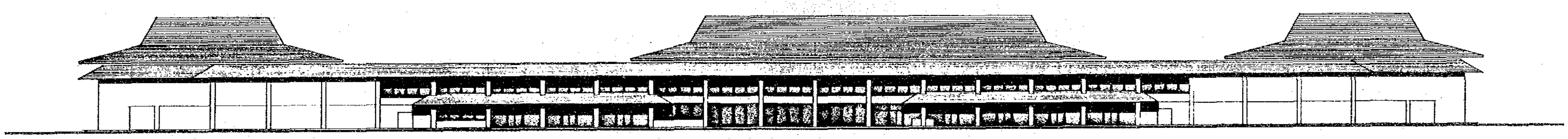


Note: This drawing does not restrict the final concept for the building.

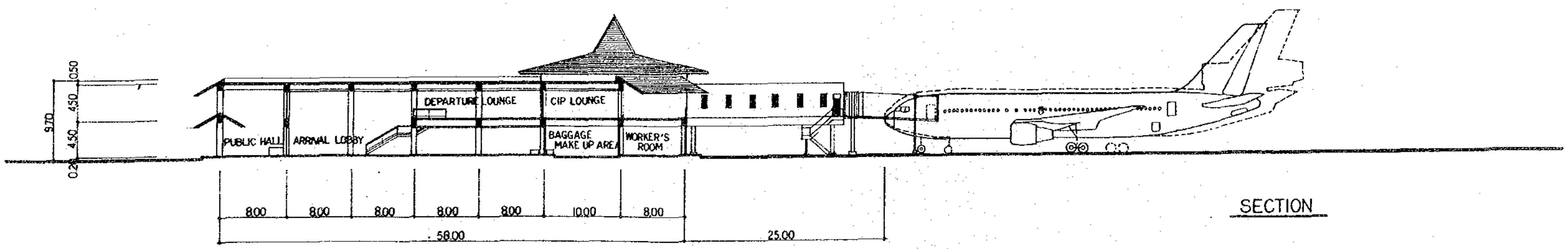
Fig. 3.3.6 Passenger Terminal Building Plan for New Airport (First Floor Plan)



ELEVATION - AIR SIDE



ELEVATION - LAND SIDE



SECTION

SCALE 0 10 20 30
UNIT : METER

Note: This drawing does not restrict the final concept for the building.

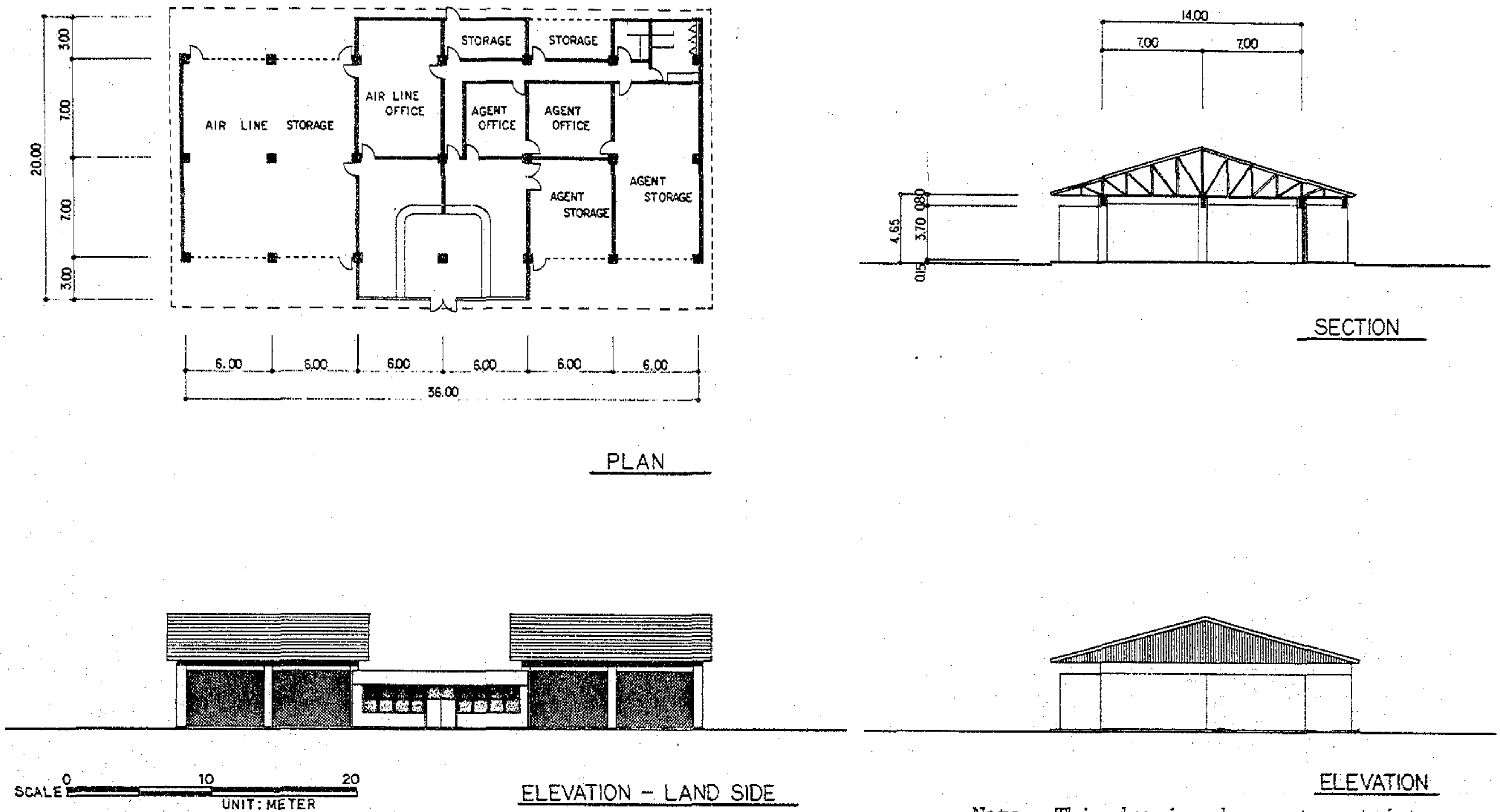
Fig. 3.3.7 Passenger Terminal Building for New Airport Elevation and Section

3.3.4 Other Buildings

(1) Cargo Terminal Building

The cargo terminal building with a total floor area of approx. 700 sq.m consisting mainly of a cargo storage area and an office area is planned as shown in Fig. 3.3.8.

The cargo storage area is to be a single storey reinforced concrete structure with high ceiling for free cargo handling, and to be flexible for internal rearrangement and possible future mechanization. The office portion will be a single storey reinforced concrete structure.



Note: This drawing does not restrict *the final concept for the building.*

Fig. 3.3.8 Cargo Terminal Building Plan, Elevation and Section

(2) Administration Building and Control Tower

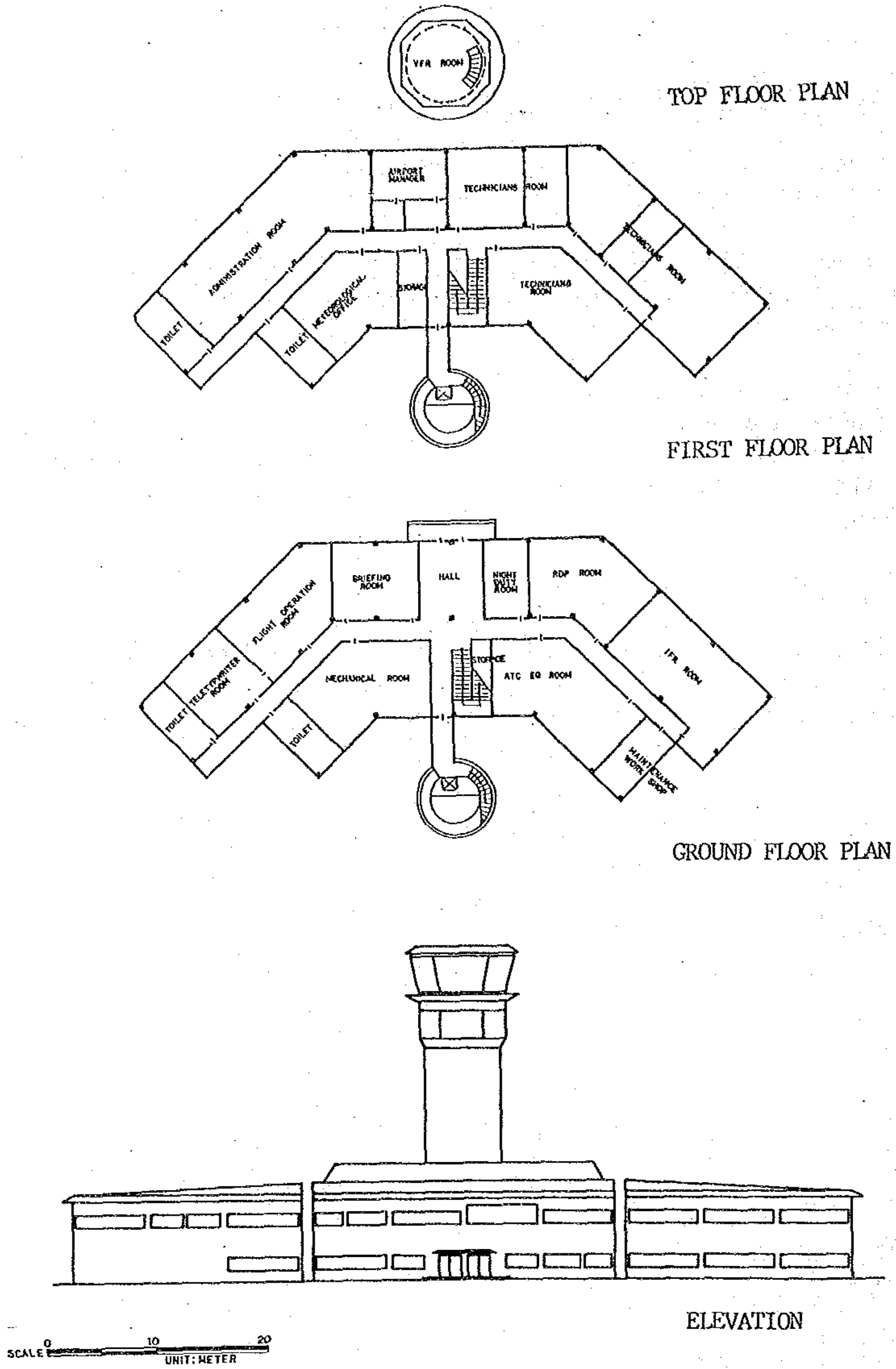
The administration building and control tower are planned in Phase I as shown in Fig. 3.3.9.

The administration building is planned to have about 1,700 sq.m in total floor area to meet the requirements for Phase I. The building consists of two storeys and will be constructed of reinforced concrete.

The height of the control tower is planned to be 30 m above ground level in compliance with the FAA standards. This height is determined for both the runway thresholds of the new airport and existing airport to be visible from VFR room. The control tower is designed to be a reinforced concrete structure.

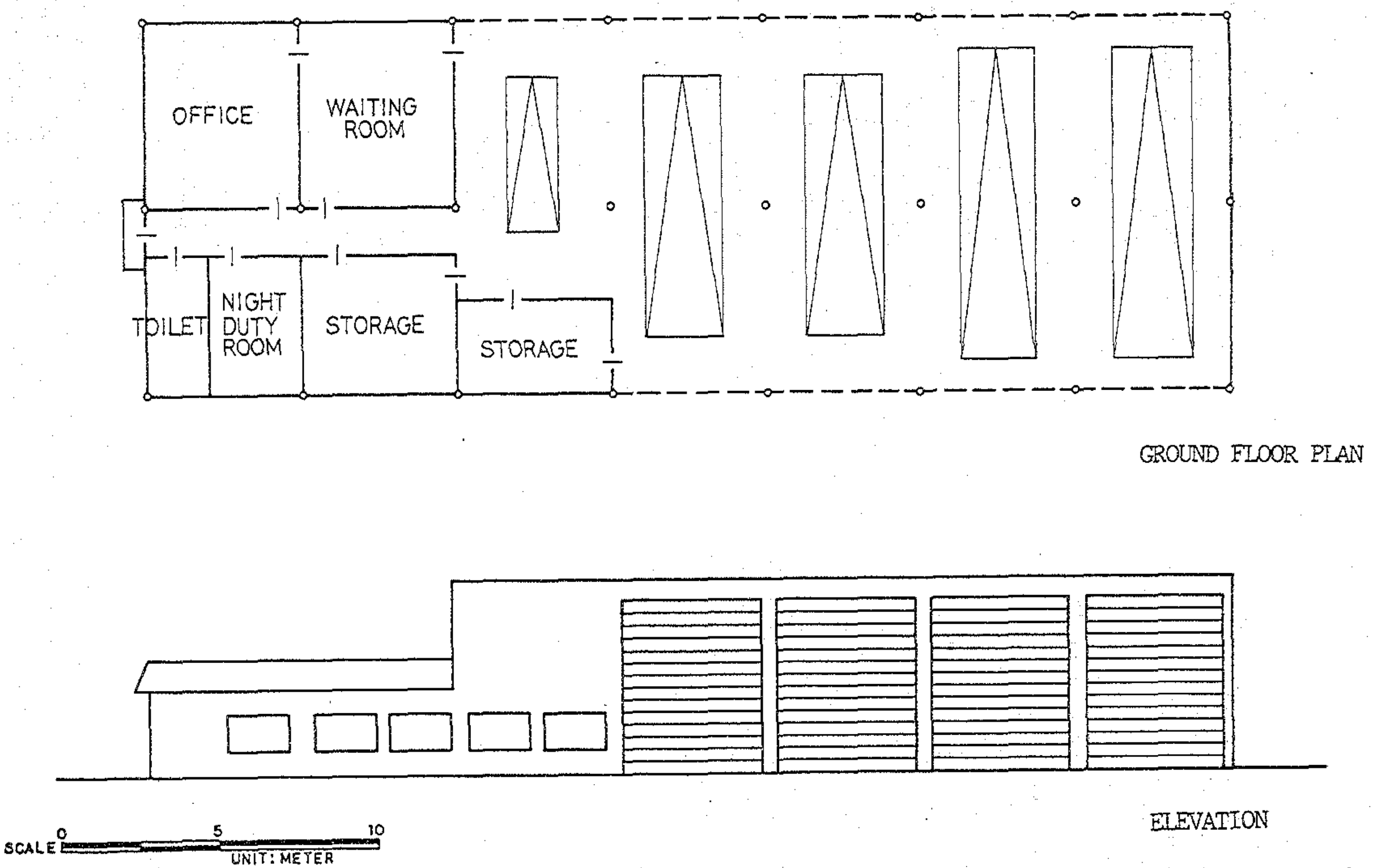
(3) Fire Station

The fire station of the new airport is planned to have a floor area of approx. 400 sq.m to meet the facility requirements. The fire station will be a one-storey reinforced-concrete structure. The layout plan is shown in Fig. 3.3.10.



Note: This drawing does not restrict the final concept for the building.

Fig. 3.3.9 Administration Building and Control Tower Plan and Elevation



Note: This drawing does not restrict the final concept for the building.

Fig. 3.3.10 Fire Station Plan and Elevation

3.3.5 Access Road and Vehicle Parking Area

(1) Airport Access Road

The airport access road is planned to be connected with Yogyakarta-Solo road and Yogyakarta-Wonosari road, as shown in Fig. 3.3.11. One lane for each direction is planned. The total distance of the selected route is about 3.4 km.

The transverse shape of the road is established based on the Indonesian design standard of the regional road as follows.

The width of the access road with two lanes in both directions is planned to be 7.0 m. Green belts 1.5 m wide and paved areas of 1.5 m wide for pedestrians, bicycles etc., are planned on both sides of the road.

The pavement for the access road is designed to be asphalt concrete with a total thickness of 55 cm. This thickness consists of 5 cm surface course, 20 cm base course and 30 cm subbase course. The thickness is designed based on the CBR design method, assuming 100 to 250 trucks daily with a 5 ton wheel load and a CBR value of 10 % for the subgrade.

(2) Access to Airport by Railroad

The access to the new airport is not only road but also railroad.

The access to the new airport by railroad can be planned by an extention line from the existing railroad which runs approximately one (1) Km north of new airport.

In consideration of the passenger's convenience, it shall be considered to operate 30 minute service. However, it is considered that no shuttle service for passengers will be required based on the passenger demand forecast. Also the existing facilities have no capabilities to accommodate shuttle service.

Thus, the extension line from existing railroad to terminal area should be planned when air passengers demand requires these services.

Under the existing conditions, it is considered that shuttle service by bus between Yogyakarta city and the new airport same system with Soekarno Hatta International Airport is economical and sufficient from viewpoint of accessibility.

(3) Vehicle Parking and Internal Road

A public vehicle parking area with about 300 parking spaces is planned to meet the Phase I requirements. The dimensions of the unit parking space are 5 m x 2.5 m and the width of the aisle in the parking area is determined to be 6 m.

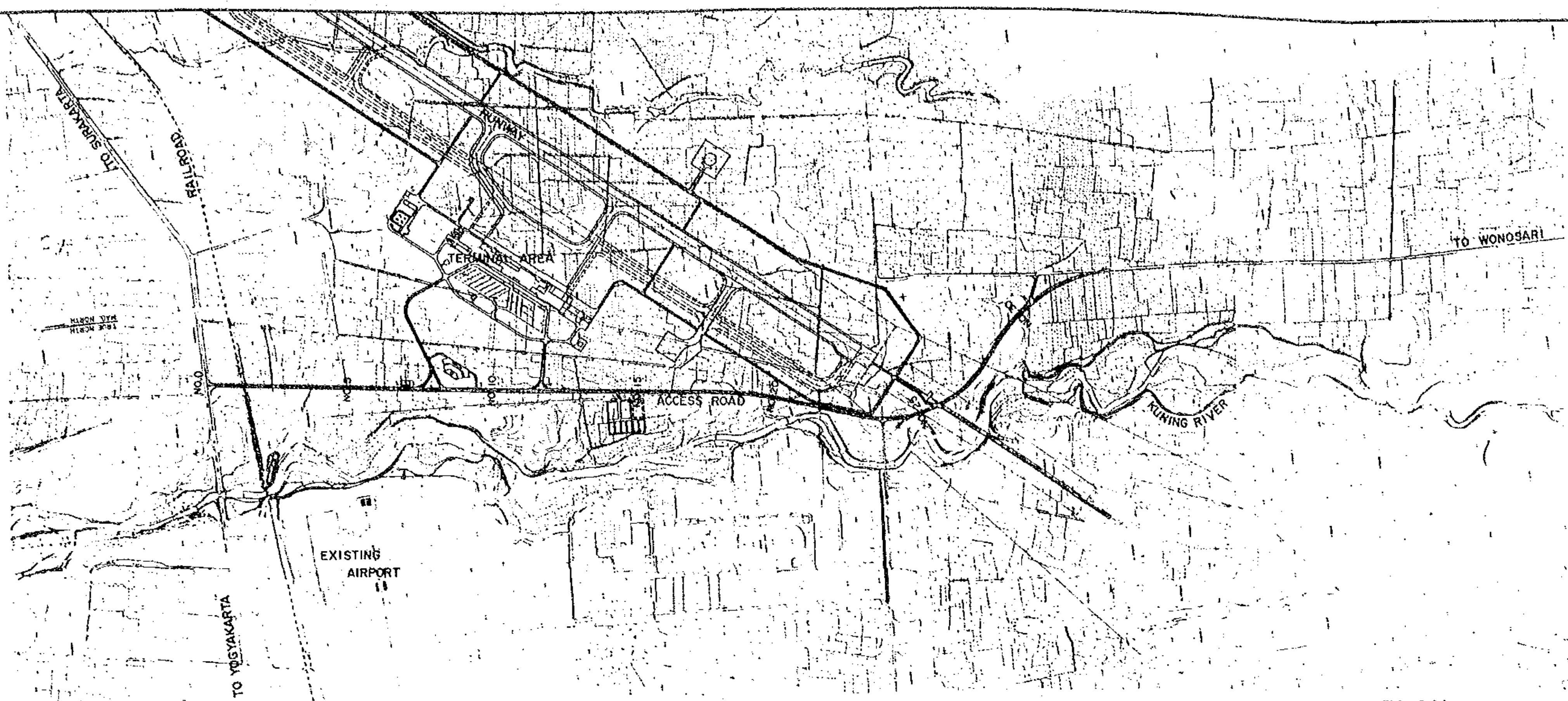
The width of the internal road with two lanes is designed to be 7.0 m except for the terminal frontage road. The terminal frontage road consists of two through traffic lanes, one weaving lane and one parking lane; hence the width is to total 12.5 m as shown in Fig. 3.2.3.

The pavement for the vehicle parking and internal road is to be asphalt-concrete with the same 55-cm thickness as that of access road.

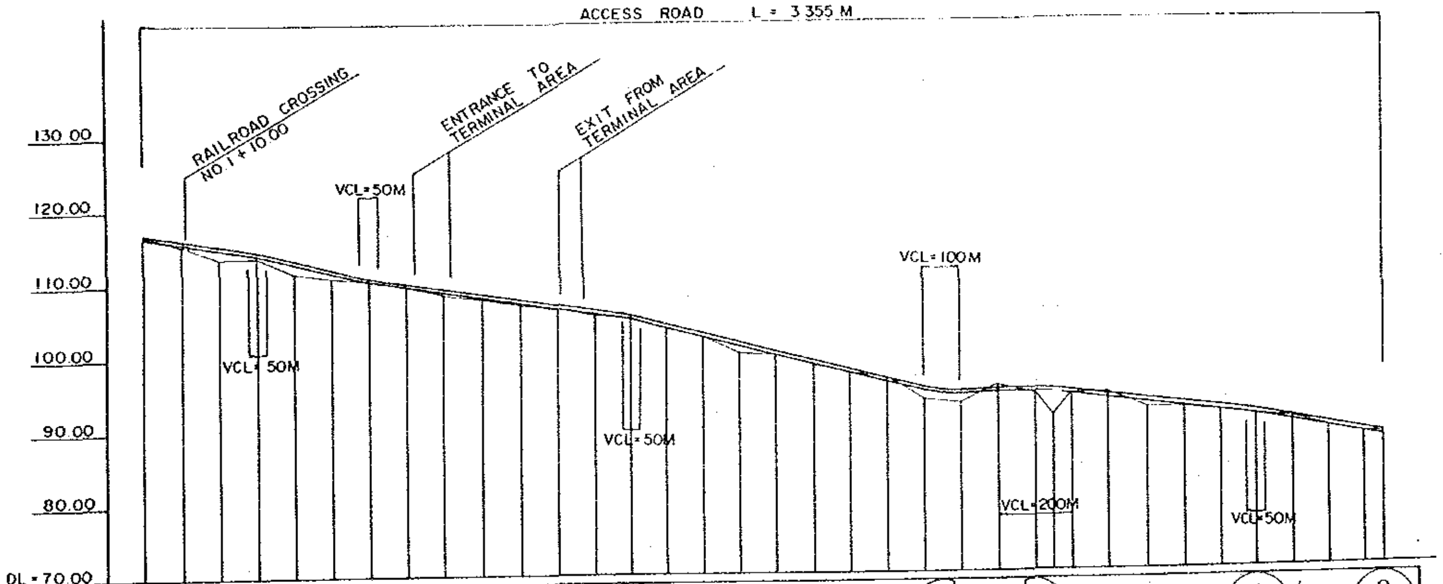
(4) Airfield Road

The airfield roads in the new airport, consisting of a perimeter road and security roads are planned for maintenance and security patrol, as shown in Fig. 3.1.1.

The pavement thickness for the airfield roads is estimated to be 25 cm. This thickness consists of a 5-cm surface, 10-cm base course and 10-cm subbase course to meet the design conditions of low frequency for heavy loaded vehicles and a CBR of 10 % for the subgrade.



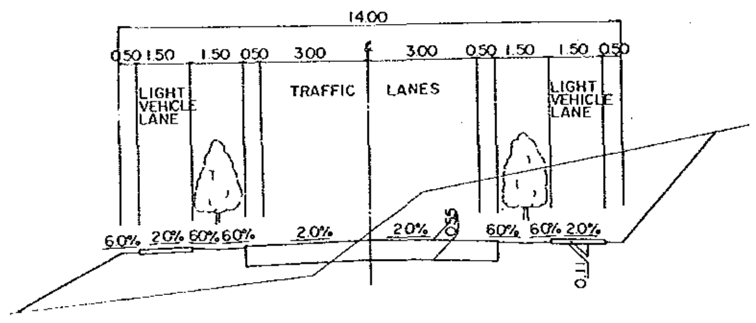
PLAN



GRADIENT: 116.70 — I=0.70% L=300M — 114.60 — I=1.29% L=300M — 110.70 — I=0.75% L=700M — 105.45 — I=1.30% L=850M — 94.40 — I=0.24% L=250M — 95.00 — I=0.60% L=600M — 91.39 — I=0.95% L=355M — 88.00

STATION	CUT & FILL (M)	PROPOSED HEIGHT (M)	GROUND HEIGHT (M)	ACCUMULATED DISTANCE (M)	DISTANCE (M)
NO. 0	-0.55	116.70	116.70	0.000	0.000
1	0.15	116.00	115.30	100.000	100.000
2	1.25	115.30	113.50	200.000	100.000
3	0.41	114.56	113.60	300.000	100.000
4	1.15	113.30	111.60	400.000	100.000
5	0.65	112.00	110.80	500.000	100.000
6	0.08	110.73	111.10	600.000	100.000
7	-0.10	109.95	109.50	700.000	100.000
8	0.15	109.20	108.50	800.000	100.000
9	0.20	108.45	107.70	900.000	100.000
NO.10	0.25	107.70	106.90	1000.000	100.000
11	0.10	106.95	106.30	1100.000	100.000
12	0.35	106.20	105.30	1200.000	100.000
13	0.07	105.42	104.80	1300.000	100.000
14	0.10	104.15	103.50	1400.000	100.000
15	0.20	102.85	102.10	1500.000	100.000
16	1.00	101.55	100.00	1600.000	100.000
17	-0.10	100.25	99.80	1700.000	100.000
18	0.10	98.95	98.30	1800.000	100.000
19	0.00	97.65	97.10	1900.000	100.000
NO.20	-0.70	96.35	96.50	2000.000	100.000
21	1.00	95.05	93.50	2100.000	100.000
+50.00	0.79	94.59	93.25	2150.000	50.000
22	0.97	94.52	93.00	2200.000	50.000
23	-0.99	94.76	95.20	2300.000	100.000
24	0.14	94.79	94.10	2400.000	100.000
+50.00	3.12	94.67	91.00	2450.000	50.000
25	-0.05	94.40	93.90	2500.000	50.000
26	-0.75	93.80	94.00	2600.000	100.000
27	0.75	93.20	91.90	2700.000	100.000
28	0.24	92.59	91.80	2800.000	100.000
29	0.14	91.99	91.30	2900.000	100.000
NO.30	0.12	91.37	90.70	3000.000	100.000
31	-0.31	90.44	90.20	3100.000	100.000
32	-0.07	89.48	89.00	3200.000	100.000
33	0.08	88.53	87.90	3300.000	100.000
+55.00	-0.55	88.00	88.00	3355.000	55.000

PROFILE



TYPICAL CROSS SECTION

SCALE 0 0.5 1 KM

Fig. 3.3.11 Airport Access Road Plan, Profile and Typical Cross Section

3.3.6 Air Navigation Systems

(1) General

Air navigation systems for new Yogyakarta airport will consist of radio navigation aids, aeronautical telecommunications system, air traffic control system, meteorological system, and aeronautical ground lights.

The air navigation systems are planned for the design (maximum) aircraft of A300/DC-10 class to meet the ICAO aircraft operational category of precision approach Category-I. In addition to the existing air navigation systems, almost all the air navigation systems except the ILS are new for the new airport in order to perform the precision approach Category-I. The ILS facilities required for the new airport will be relocated from the existing airport which is under construction.

The plan for the air navigation systems is shown in Fig. 3.3.12 and the planned equipment is listed in Table 3.3.1.

The equipment which is to be installed in Phase I will have to be replaced by new equipment in Phase II due to the limited service life of the equipment.

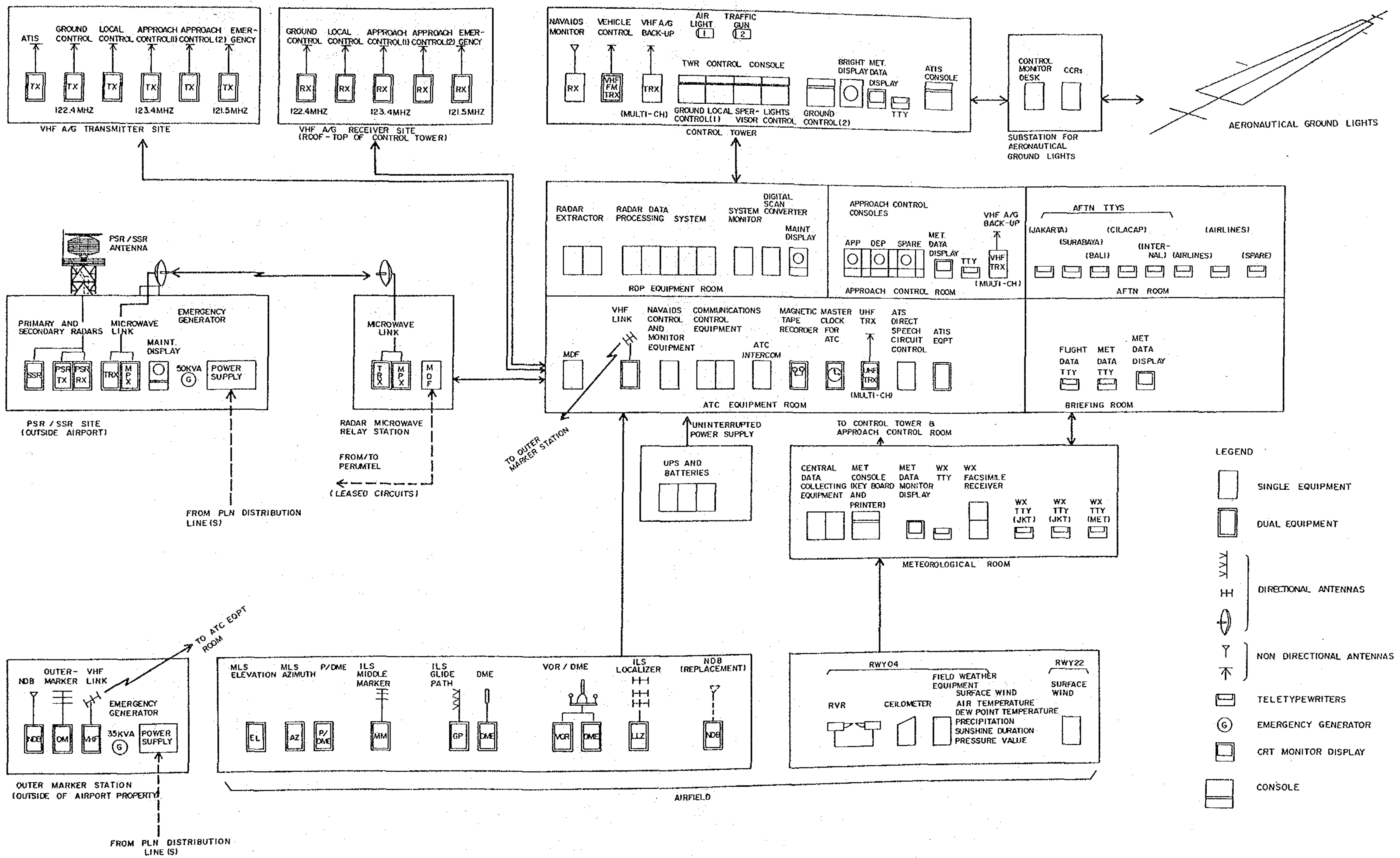


Fig. 3.3.12 Air Navigation Systems Plan (Phase I)

Table 3.3.1 Equipment List for Air Navigation Systems (Yogyakarta Airport)

Equipment	Outline of Equipment	Number	Remarks
<u>Navaids</u>			
. ILS LLZ, GP, MM, OM, DME	Precision Approach Category I, RWY 04	1 set	Relocation
. VOR/DME	Doppler type/terminal use	1 set	
. NDB	Located jointly with the outer marker	1 set	
. MLS	Collocation with ILS in Phase I	1 set	
. Navaids control and monitor equipment		1 set	
<u>ATC/COM</u>			
. PSR/SSR	S-Band radar, coverage PSR 90 NM, SSR 200 NM, Outside of airport property	1 set	
. Radar Microwave Link	7 GHz Band for radar data transmission	2 sets	Repeater stations
. Radar Data Processing System		1 set	
. Radar Control consoles	3 approach control positions	1 set	

Equipment	Outline of Equipment	Number	Remarks
. VHF Air-ground radio	5 frequencies (TWR x 2, APP x 2, Emergency)	5 sets	
. VHF A/G Transceiver	Back up	2 sets	
. UHF Air-ground radio	Multi-channel UHF transceiver	1 set	For Coordination of training aircraft
. VHF FM radio	For vehicle control	1 set	
. VHF Link	Between airport and outer marker station	2 sets	
. Control Console and Communications Control Units	For aerodrome control tower including bright display	1 set	
. AFTN Teletypewriters		9 sets	
. Magnetic Tape-recorder	ATC use	1 set	
. Master Clock and Interphone	ATC use	1 set	
. Air traffic light gun	In control tower	2 sets	
. ATIS Console, Tape-recorder, Transmitter		1 set	

Equipment	Outline of Equipment	Number	Remarks
<u>MET</u>			
. Surface sensors, data collection equipment, branch display and consoles	Surface wind, dew point, temperature, air pressure, humidity, precipitation, sunshine duration	1 set	
. Runway Visual Range Equipment		1 set	
. Ceilometer	For cloud height measurement	1 set	
. Weather facsimile		2 sets	
. Weather teletype-writers		7 sets	
<u>Lights</u>			
. Precision approach category I lighting system	RWY04 approach	1 sum	
. Simple approach lighting system	RWY 22 approach	1 sum	
. Runway edge lights	High Intensity, elevated type	1 sum	
. Runway centerline lights	Surface type	1 sum	
. Runway threshold and end lights	RWY 04/22, Surface type	1 sum	
. Runway wing bar lights	RWY 04 only	1 sum	

Equipment	Outline of Equipment	Number	Remarks
. Stopway lights	Elevated type	1 sum	
. PAPI		2 ea	RWY 04/22
. Taxiway edge lights		1 sum	
. Taxiing guidance sign		2 ea	
. Apron floodlights		8 ea	
. Illuminated wind direction indicator	RWY 04/22	2 ea	
. Aerodrome beacon	On roof of control tower	1 set	
. Distribution and control system		1 sum	
. Control console	In control tower	1 set	
<u>Power Supply</u>			
. UPS		1 set	
. DC Power Supply equipment		1 set	
<u>Others</u>			
. Spare parts and maintenance tools		1 sum	
. Measuring and test equipment		1 sum	
. Flight check assistance and training		1 sum	

(2) Radio Navigation Aids

The following radio navigation aids are planned for the new airport; the layout plan is shown in Fig. 3.3.13.

- ILS precision approach category I including localizer, glide path and DME, middle marker, and outer marker.

- Microwave Landing System

- Doppler VOR/DME

- NDB located jointly with the outer marker

a) Microwave Landing System (MLS)

The ILS which is the ICAO standard primary landing system at present will be replaced by the MLS by the end of 1997 as shown in Table 3.3.2. Afterwards, the MLS will be the sole ICAO standards. Accordingly, a MLS will be required to be installed by the end of 1997. The cost necessary for the MLS is to be included in Phase I.

b) ILS and NDB

The conventional ILS Category-I will still be necessary before the transition to MLS as a navaid for precision approach.

The ILS facilities required for the new airport will be relocated from the present airport, which is under construction.

The outer marker station will be located about 4.6 nautical miles from the runway 04 threshold on the extended centerline of the runway in order to facilitate a final approach fix. The outer marker station will be connected to the airport by means of VHF radio link for economic reasons.

ILS/DME was planned at the glide path site and NDB at the outer marker station in order to ensure more acurate flight course and also to avoid flight over the sacred Imogiri (area) where the ancestors of the Sultan are buried.

Table 3.3.2 ILS/MLS Transition Plan

Year	86 – 89	1990 – 97	98 – 99	2000 – 2010
ILS	Primary System	Primary System	Optional	
MLS	Optional	Recommended	TRANSITION	Primary System
Status	Dual Standards exist. ILS ICAO primary system, use of MLS optional.	Dual standards exist. ILS ICAO primary system, increased use of MLS is recommended.	MLS is the ICAO primary system. Continued use of ILS is optional.	MLS is a sole ICAO Standard approach and landing guidance system.

(Source: Communications/Operations Division Meeting, 1985, ICAO)

c) DVOR/DME

A doppler type VOR/DME was planned beside the new runway in order to facilitate straight-in approaches from both Runways 04 and 22.

d) Existing DVOR/DME and NDB

The existing DVOR/DME ("YOG", 112.8 MHz, CH75X) which is located about 7 nm west of the existing runway and on the extended center line of the runway will be maintained until the completion of the new DVOR/DME. The existing NDB ("OF", 270 KHz) will be maintained until the new NDB is installed at the outer marker station.

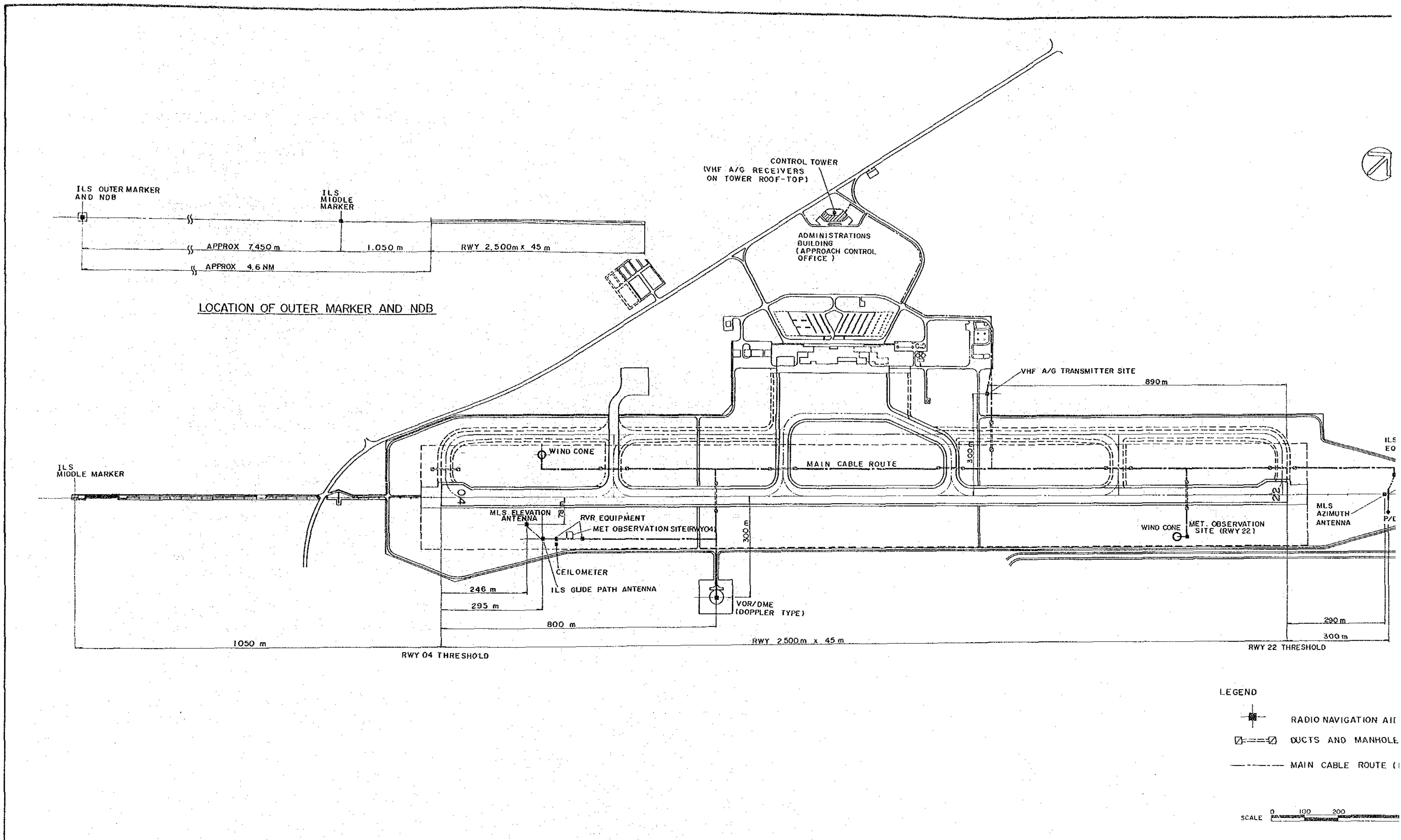


Fig. 3.3.13 Navaids Layout Plan

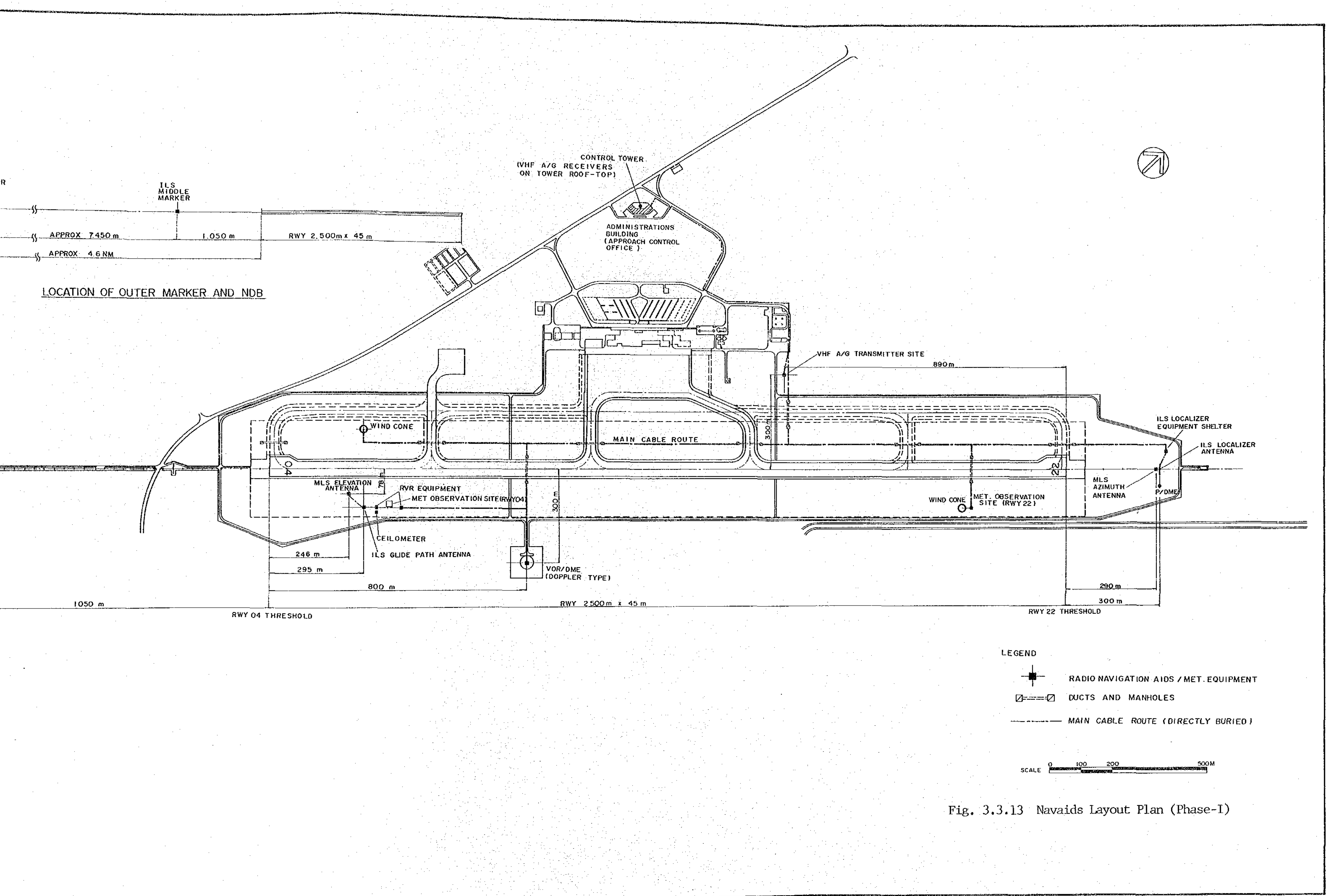


Fig. 3.3.13 Navaids Layout Plan (Phase-I)

(3) Aeronautical Telecommunications and Air Traffic Control System

A radar approach control office is established in order to ensure flight safety within the limited airspace.

Primary surveillance radar (PSR) and secondary surveillance radar (SSR) are planned outside airport property in order to obtain as much unrestricted radar coverage as possible.

A site selection study for the PSR/SSR will be discussed in Chapter 4.

The radar data will be transmitted to the new airport by means of a radar microwave link. The radar data will be processed by a radar data processing system to display the aircraft target information in alpha-numeric indications and symbols on the approach control consoles.

This radar data can be transmitted to adjacent airport and/or area control center as necessary by leased circuit of PERUMTEL.

With respect to the VHF air to ground radios, two frequencies (including existing frequency of 123.4 MHz and 120.2 MHz) will be required for radar approach control office, two frequencies (including existing 122.4 MHz) for aerodrome control, and one emergency frequency 121.5 MHz for both radar approach and aerodrome control. One additional VHF frequency for automated terminal information service (ATIS) equipment, and six VHF air/ground frequencies are required to be installed.

Taking into consideration the number of radio frequencies, the VHF transmitter site was planned north-east of the terminal area. The receiver site on the roof-top of the control tower maintains the necessary separation between both sites.

With regard to ATS direct speech circuits and AFTN, nation-wide and high reliable PERUMTEL circuits will be leased for those purposes instead of planning HF/SSB links of lower quality.

(4) Meteorological System

Field weather equipment to observe the following meteorological conditions is required for precision approach Category-I.

- Surface wind
- Air temperature
- Dew point temperature
- Precipitation
- Sunshine duration
- Pressure value
- Runway visual range
- Cloud height

All the data observed will be collected automatically using central data collection equipment which will process, distribute and display the meteorological information to the control tower, radar approach control room, briefing room, etc.

(5) Aeronautical Ground Lights

Aeronautical ground lights as listed in Table 3.3.1 are planned to meet the operational requirements for precision approach Category-I. Fig. 3.3.14 shows the layout of these aeronautical ground lights. All the lights will be controlled by a lighting control desk in the control tower. Power supply and control equipment for the lights, such as a constant current regulator, logical control equipment, etc., will be located in the substation north east of the passenger terminal building.

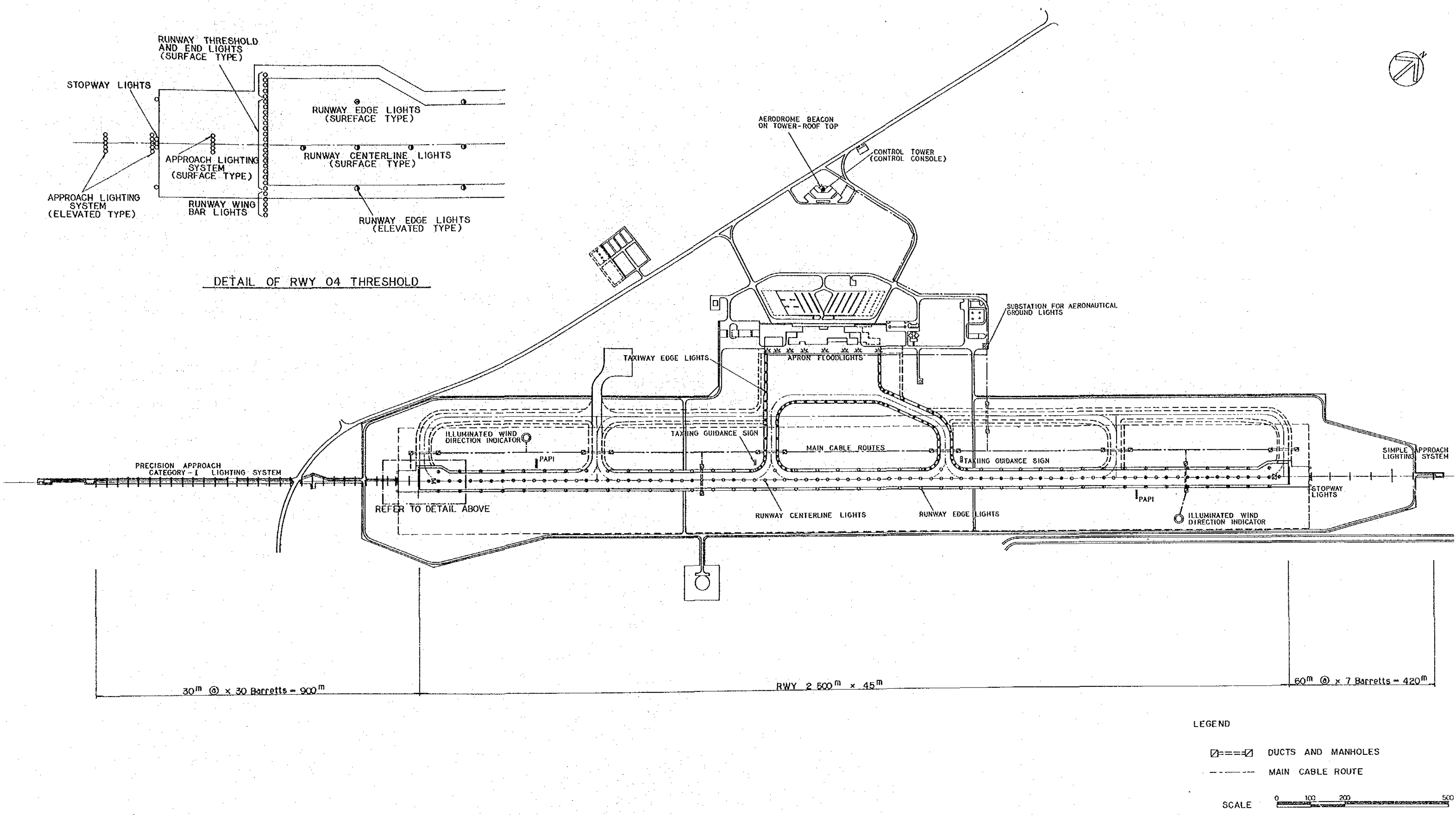


Fig. 3.3.14 Layout Plan of Aeronautical Ground Ligh

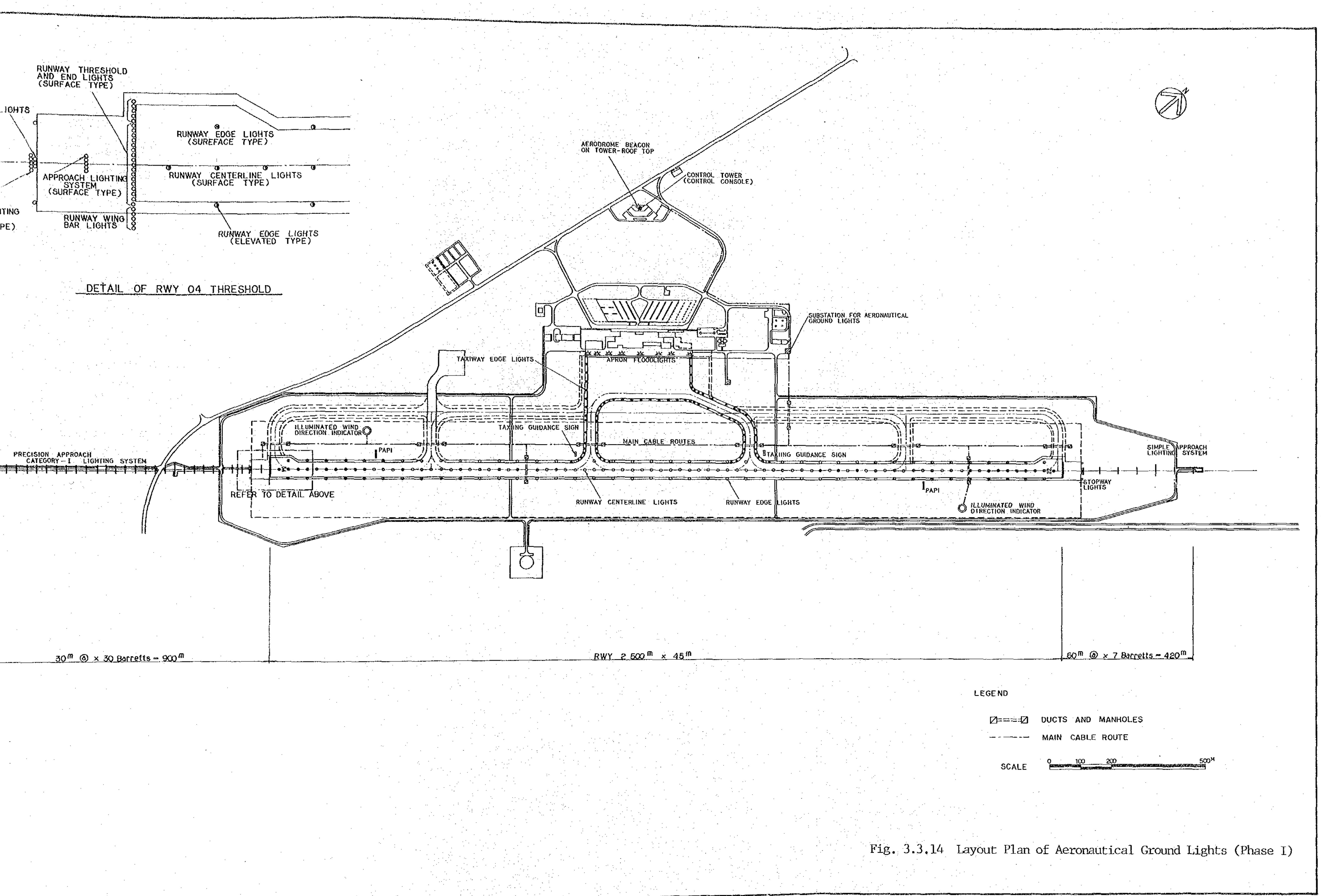


Fig. 3.3.14 Layout Plan of Aeronautical Ground Lights (Phase I)