CHAPTER 6 SITE SELECTION FOR A NEW AIRPORT

6.1 General

In general, the site selection process for a new airport begins when the authorities concerned acknowledge its need under the situations as follows :

i) Need of a new airport in future for the community currently without airport is realized.

ii) Need of a replacement airport is determined because of the infeasibility or undesirability of expanding existing airport to meet demand.

iii) Need of an additional airport is anticipated to cope with growing demand.

Whichever the case may be, the site selection process would follow the flow chart as shown in Figure 6.1.1. More detailed flow chart is shown in Figure 6.1.2.

In the case of Padang airport Feasibility Study, the methodology is a little bit different than normal case since the Study aims to compare the following two schemes in the end:

i) Expanded Tabing Airport

ii) New Airport

Therefore this chapter discusses on site selection of new airport for Padang assuming a replacement airport is required.

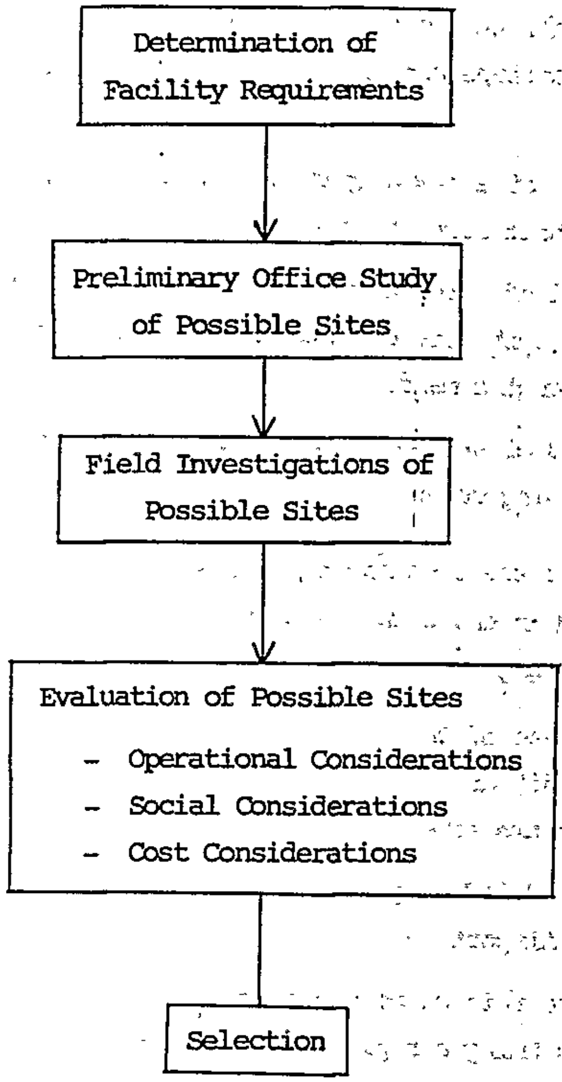

Figure 6.1.1 AIRPORT SITE SELECTION PROCESS

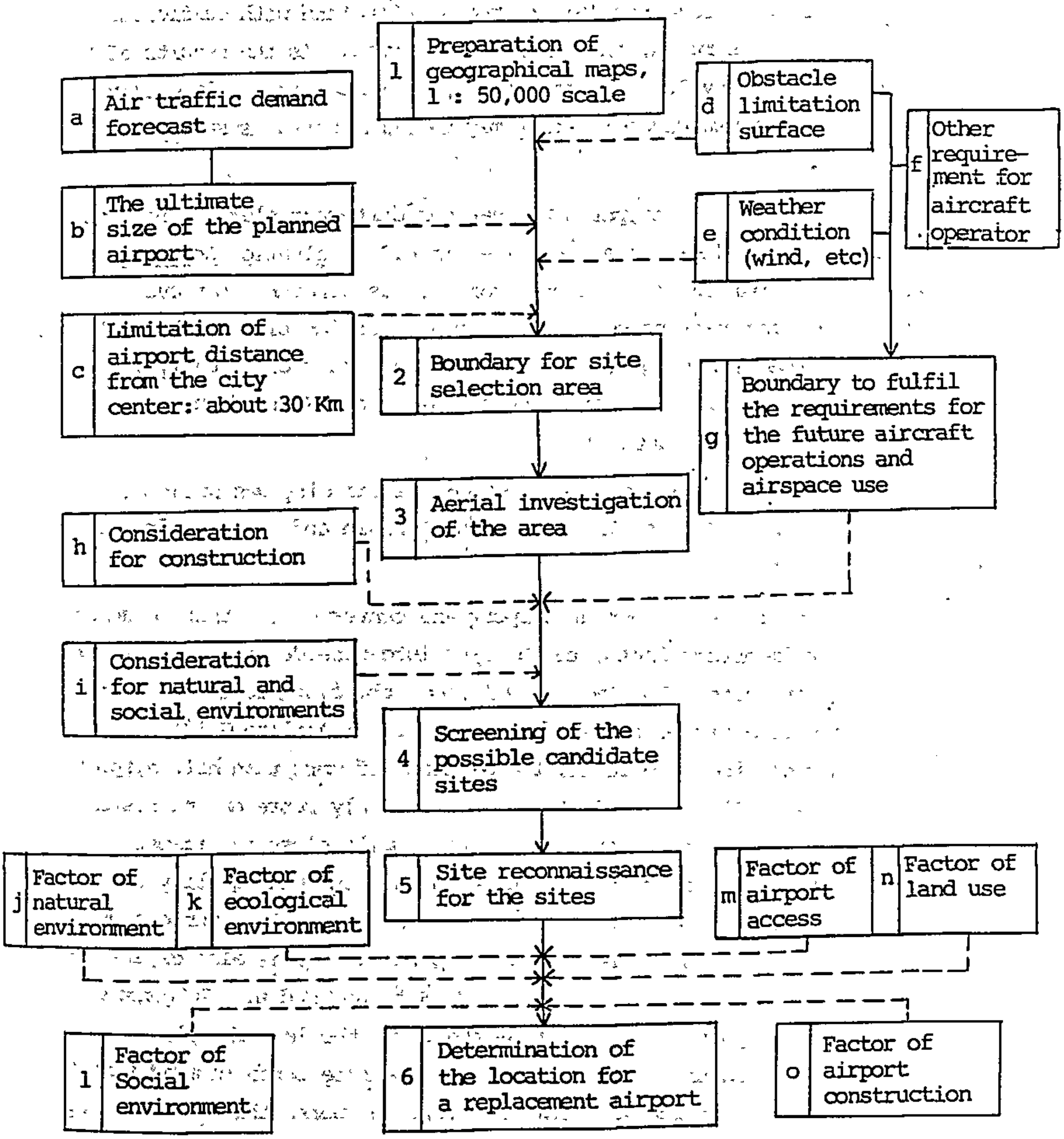

Figure 6.1.2

DETAILED FLOW CHART FOR SITE SELECTION OF A NEW AIRPORT

6.2 Office Study of Possible Sites

The airport requires larger area of flat land with sufficient airspace for its runway and aircraft operation. As the results of the chapter 4 Facility Requirements, the approximate size of land area required for a new Padang Airport may be illustrated as shown in Figure 6 .2.1.

In selecting an airport site, various different elements have to be taken into consideration as described in 6.3 Evaluation Criteria hereinafter. As a particular case of Padang, it is apparent that availability of land and airspace becomes a prime consideration since high mountainous terrain almost reaching to the coast around Padang city really limits availability of flat land and required airspace (Refer Figure 4 .2.1. Obstacle Limitation Surface)

First, the topographic map covering Padang city was studied. The Figure 6.2.2 depict the mountainous terrain and distance from C B D of Padang City.

Accessibility between an airport and center of air traffic demand is another important factor to be taken into consideration for selecting a new airport site. The Table 6.2.1 shows the distance between airports and destination city obtained from the Official Airline Guide. As it is clear from the Table, the distance of more than half airports in the Table falls in within 0 - 10 Km, probably representing historical facts that many airports in old days were built close-by cities. Because of growing concerns of public on environmental quality and increased jet traffic, the aircraft noise now presents a serious problem at many major cities in the world. This phenomenon is also experienced in major cities in Indonesia such as Jakarta and Medan. In general, the farther the airport is located from the city, the less the aircraft noise impacts become on the city. However, it shall be borne in mind that the farther the airport becomes from the city, the worse the accessibility. Considering those two contradicting factors as well as future population size of Padang City (Predicted to be some 1,000,000 in 2005) it is deemed that the new airport site should fall in the area within some

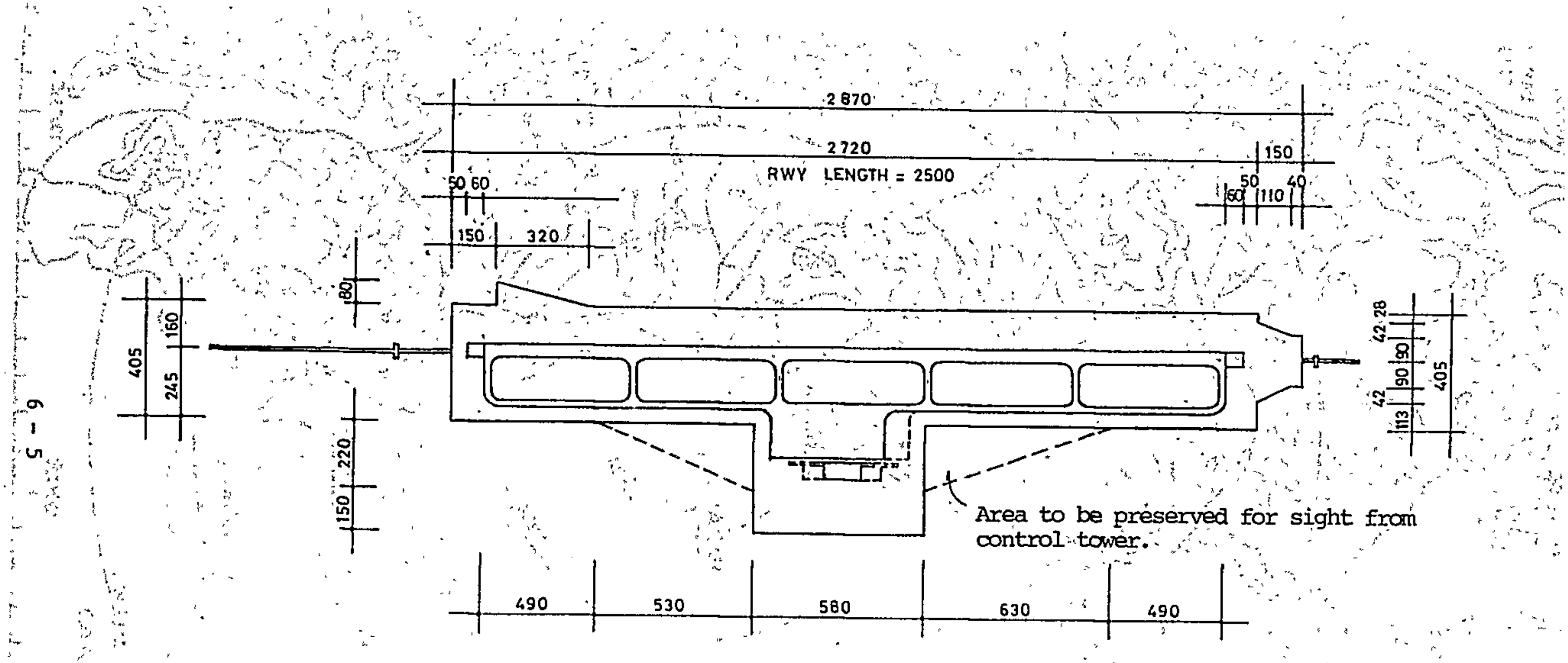

Figure 6.2.1. REQUIRED LAND AREA FOR A NEW AIRPORT
DIMENSION IN METER

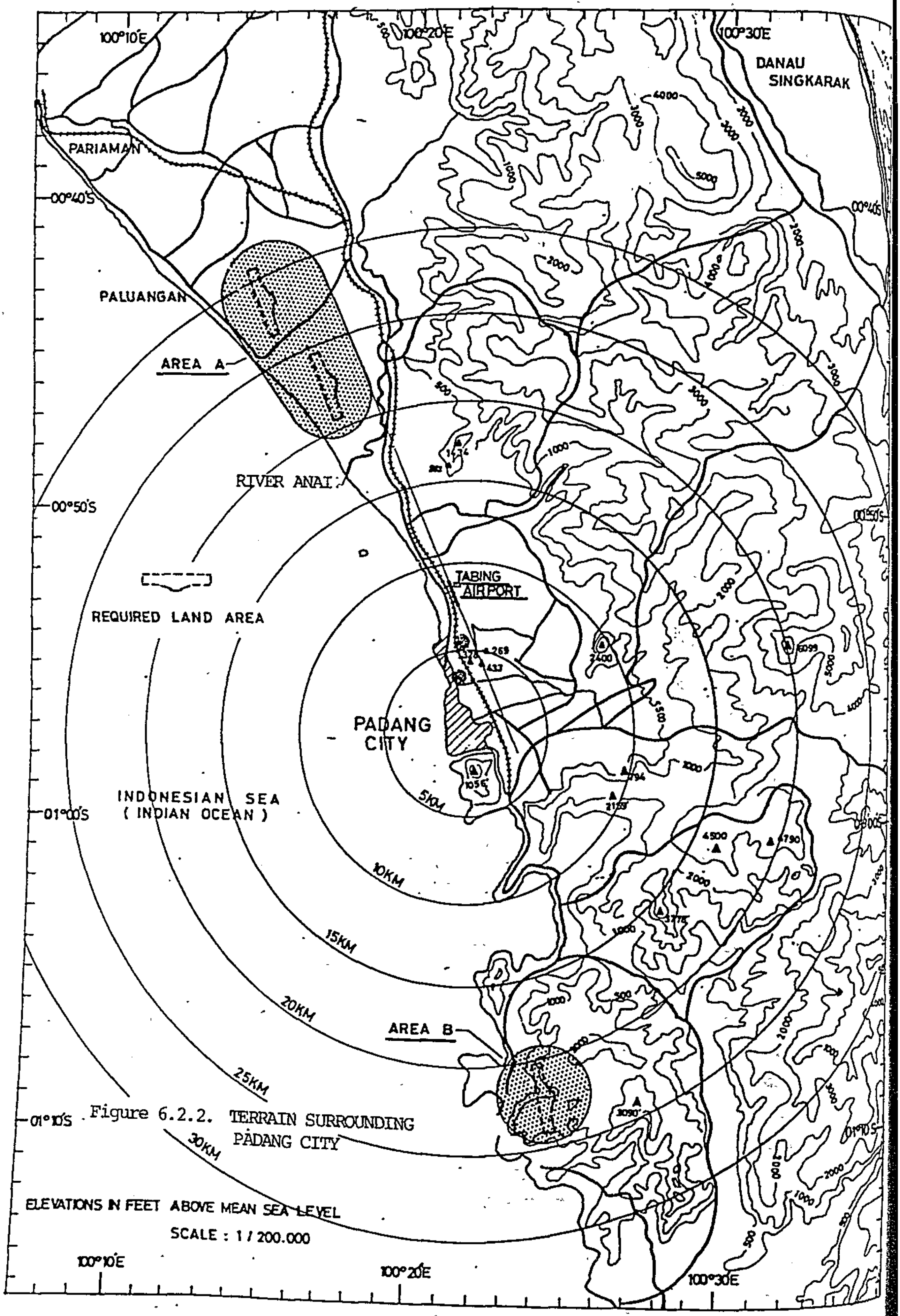

Figure 6.2.2. TERRAIN SURROUNDING PADANG CITY

Table 6.2.1 DISTANCE BETWEEN AIRPORT AND CITIES

City Name	Ground Access		Population (in '000) (1980)	Number of Annual pax (in '000) (1979)	Remarks
	Distance*1 (Km)	Travel*2 Time			
Jakarta (Kemayoran)	1.6		6,503*3	2,730	*3 DKI Jakarta
Jakarta (Halim)	18	30 min		1,900	
Surabaya	8		2,028	1,030	
Denpasar	9.6		2,470*4	790	*4 Total Bali
Ujung Pandang	17.6		790	770	
Medan	1.6		1,379	690	
Balikpapan	8		281	490	
Palembang	11.2		787	430	
Banjarmasin	26		381	370	
Semarang	4	15 min	1,027	340	
Yogyakarta	8		399	240	
Pontianak	19.3	30 min	304	210	
Padang	6.4		480	187	
Menado	17.6		217	170	
Pekanbaru	8		186	170	

Source: Official Airline Guide, August 1981
*1 Distance from Airport to destination city
*2 Approximate traveling time from Airport to destination city

30 km radius of Padang city.

Mainly because of the required airspace boundary and existing mountainous terrain, it is judged as a desk work that the possible sites for a new airport only can be sought at places either northwest (regarded as Area - A) or southeast (regarded as Area - B) of Padang city.

As the results of aerial investigation carried out on July 1, 1981, it was revealed that the prevailing terrain at Area - B is more mountainous than what it appeared in the map. Thus considering high construction cost for preparation of a large flat land area, this Site B was abandoned for further consideration.

Figure 6.2.3 illustrates possible sites with required airspace layout. In this Figure, the Layout - A represents closest possible location toward mountains in the east (nothern boundary limit is set forth in such way that the runway locates within the 30 km radius shown in the Fig. 6.2.2) and Layout - B represents most southeast possible location within the Area - A. Thus back-shaded area in the Figure indicates possible site for a new airport on the land from the airspace standpoint.

Figure 6.2.4 depicts the current land use plan in 1977 prepared by Agrarian Department in Padang. The compatibility of an airport with the land use plan of the airport surrounding area is one of the most important factors for the airport to be viable in future. It is obvious that the area depicted by dotted line in the Figure 6.2.4 is quite ideal site within the Area - A because of the reasons as follows:

i) Selected site is within the property owned by the Local Government which means least land acquisition cost.

ii) The land is very sparsely inhabited and underdeveloped which means least interference with present land use and less compensation cost for the airport development.

iii) The airport vicinities at north and east are mostly agriculture fields and west and south are bordered by the Indonesian sea which means less aircraft noise problem to and more compatibility with the sourrounding community.

Although there are some minor descrepancies such as the existence of

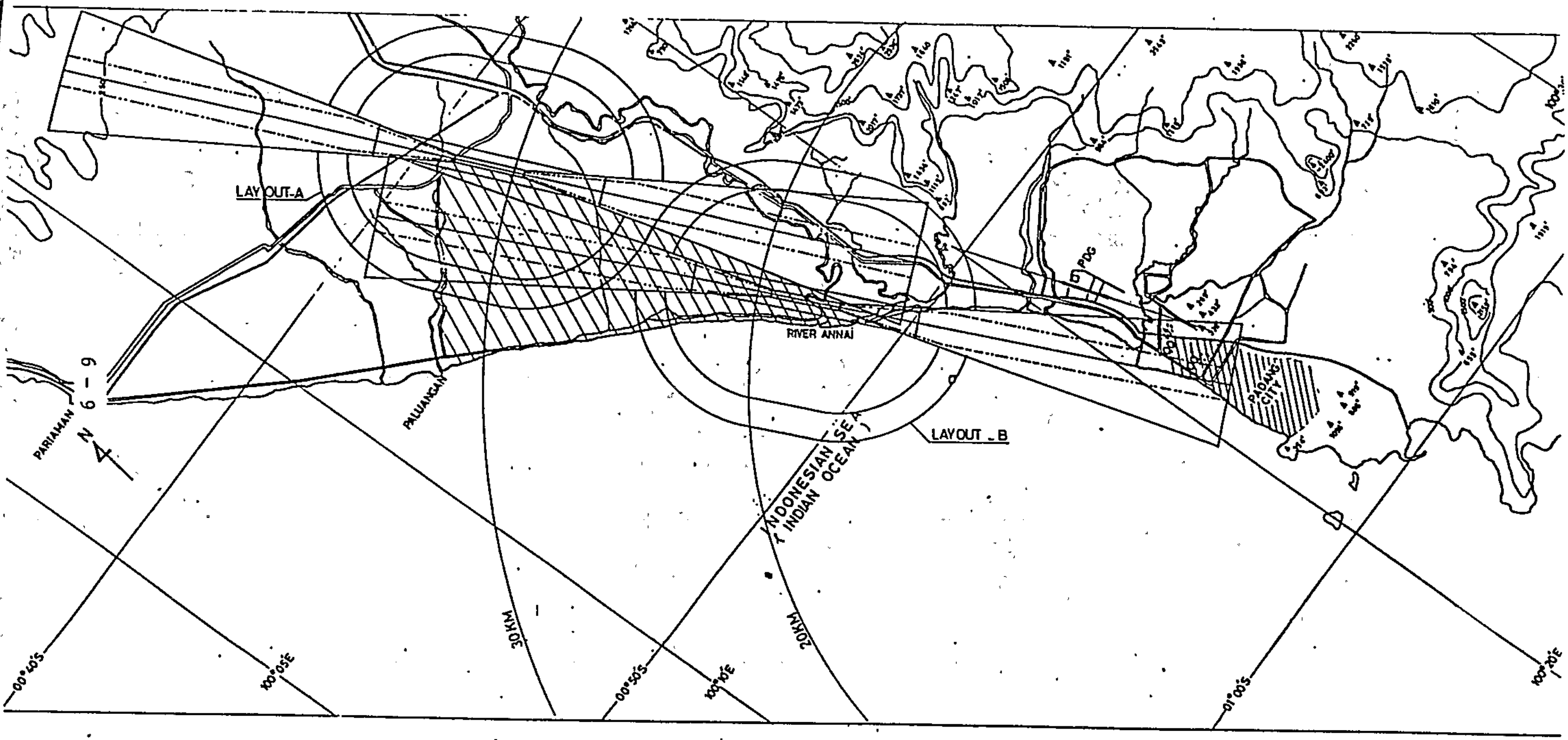

Figure 6.2.3 POSSIBLE SITE AND REQUIRED AIRSPACE LAYOUT

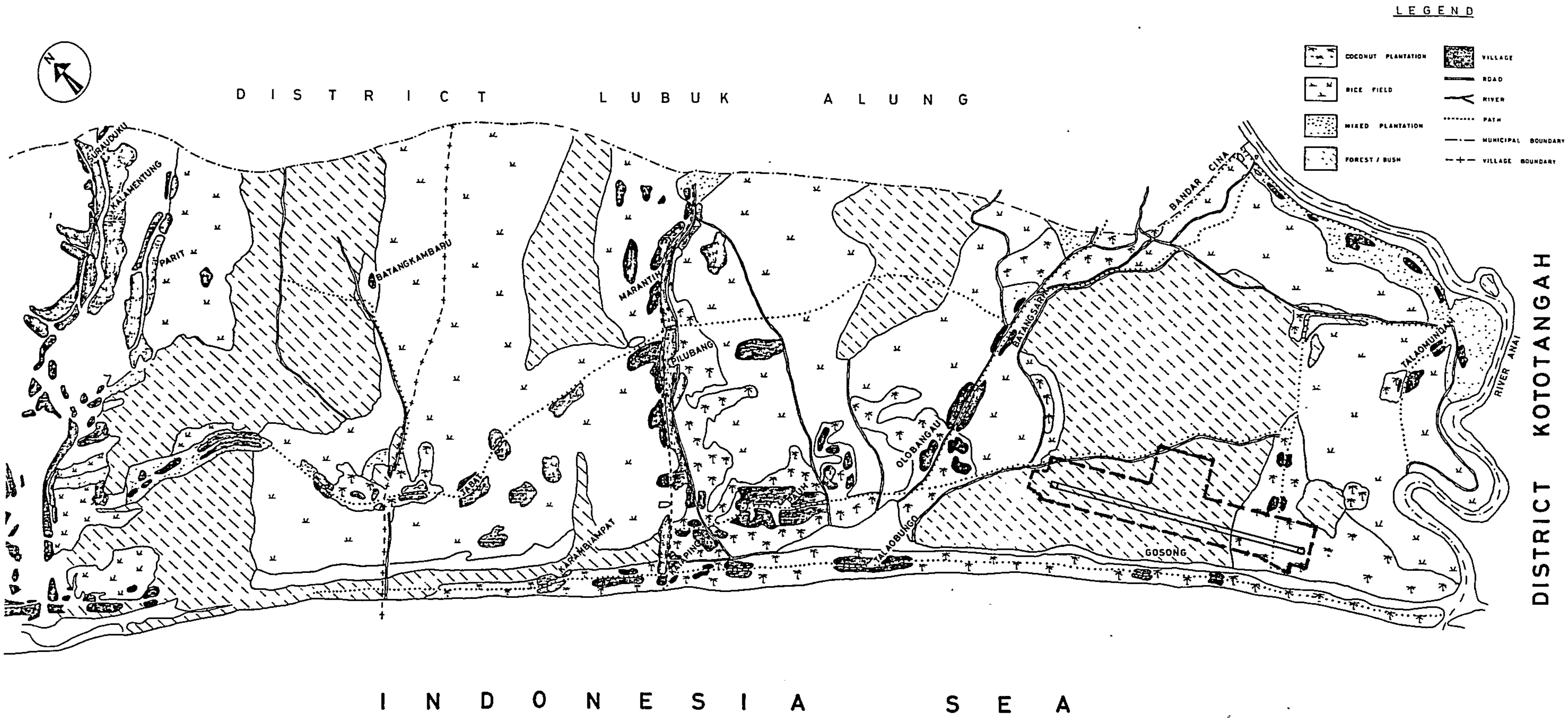

Figure 6.2.4 PLAN OF PRESENT LAND USE AT NEW AIRPORT SITE SCALE 1:40,000

forests between the land use plan and the actual site which were realized during the field reconnaissance made on July 21, 1981, the land use plan shown in Figure 6.2.4 mostly agrees with the present conditions of the site.

6.3 Site Evaluation Criteria and Selected Site

In general site selection procedure, more two different sites remains as candidate sites to the end to be weighed against various selection criteria. The site selection criteria may be categolized broadly into three major considerations as follows:

i) Operational Considerations

ii) Social Considerations

iii) Cost Considerations

In addition to above three major considerations, Political Considerations may become decisive element; e.g. the Regional Government has definite regional development plan including land use plan where to locate an airport.

In this specific site selection study for New Padang Airport, other candidate sites has been abandoned during the study process by apparent disadvantages. Therefore instead of weighing various candidate sites, the selected site is assessed against sub-divided evaluation criteria as shown in Table 6.3.1.

Table 6.3.1 ASSESMENT OF SELECTED SITE

Evaluation Criteria	Assessment
A. Operational Considerations	
a) Airspace	- Satisfy all requirements
b) Obstacles	- No existence of obstacles
c) Hazards	- Occurence of fog and bird hazards to be investigated
d) Weather	- No weather data available (Data at Tabing A/P is used tentatively)
e) Approach and Landing Aids	- No problem for installation from airspace standpoint, however, setting equipment over the sea may require more construction cost
B. Social Considerations	
a) Proximity to Demand Centers	- Approximately 23 km to Padang City is considered reasonable - Better location for Pariaman & Bukittinggi
b) Ground Access	- Convenient connection be made to existing highway and planned By-pass Highway (Jalan Tol Padang refer Fig. 7.2.2)
c) Noise	- No problem on south and little problem on north, ideal situation
d) Land Use	- Compatible with current land use in the vicinity
C. Cost Considerations	
a) Land Value	- Property owned by Local Government --- DGAC may acquire the required area almost for free

b) Topography	- Ideal condition since the area is almost flat with minor elevation changes
c) Soil and Construction Materials	- Foundation is composed of sand to be utilized for subbase course by cement stabilization for construction economy.
d) Services	- No utility service available
D. Environmental Consideration	- No significant factor is found

CHAPTER 7 AIRPORT LAYOUT PLANNING FOR THE SELECTED ALTERNATIVE SCHEMES

7.1. General

The airport layout plan shall be prepared in accordance with the established airport facility requirements detailed in Chapter 4 of this report. The development of the airport layout plan should establish the configuration of the runway, taxiways, aprons, terminal areas and other required facilities. Due consideration shall be paid to the airspace and environmental features in preparing the layout plan of the airport. In addition, it is very important to plan for an orderly phased development as well as to provide sufficient leeway for each facility to expand.

7.2 The redevelopment of the existing airport

The layout plan of the redevelopment of Tabing Airport is as shown in Figure 5.4.6. As seen in the figure, a 2500 m long and 45m wide new runway is planned parallel to the existing runway with 184 m center to center separation. The existing runway of 45 m in width will then be converted into a portion of the parallel taxiway. In between the two exit taxiways at both runway ends, four other 90 degree exit taxiways are placed at 500 m intervals. In order to accomplish this extension work on the runway and taxiway, private property of some 25 ha in area shall be acquired at the north end of the runway as shown in Figure 7.2.1. A runway extension towards the south would be very costly due to the existing hill. The additional land acquisition will not only disrupt the existing community along the road but also require 1400 m of road relocation including 50 m length of new bridge construction.

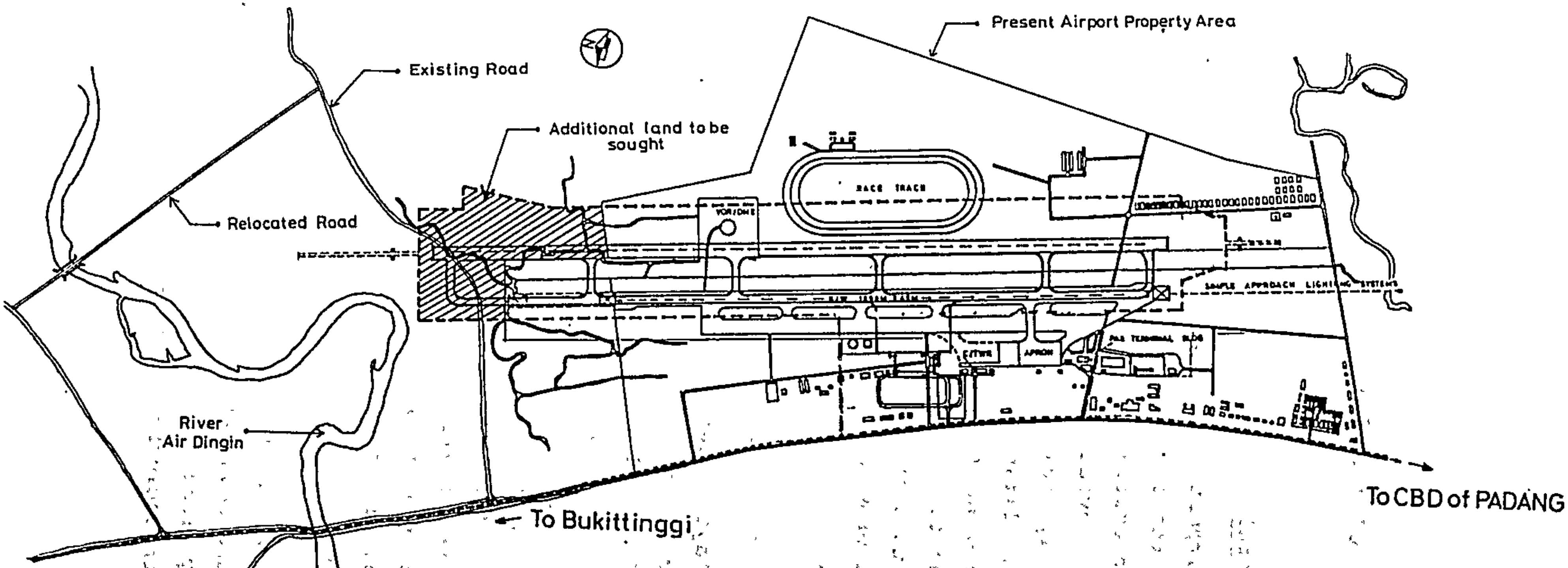

Figure 7.2.1. ADDITIONAL LAND ACQUISITION FOR RUNWAY EXTENSION

The new apron is located close to the mid-point of the new runway. Since the existing apron can still accommodate DC-9 class and other smaller aircraft, the new apron is only designed to accommodate four DC-10 class aircraft by nose in and push out configuration for the first stage development. This apron will then be expanded to accommodate two DC-10 class and three B-747 class aircraft at some time beyond 1995 as the second stage development. The linear concept passenger terminal building placed parallel to the edge of the apron follows the same expansion procedure as the apron. The car parking lot in front of the terminal building and surrounded by the circulation road also can be expanded in the same manner as the apron and the passenger terminal building. However, the existing rx-station shall be shifted towards the south in the second phase development.

Figure 7.2.2 depicts the By-pass Toll Highway expected to be completed around 1989 by Bina Marga. The branch route connecting the airport to this highway shall be determined after close consultation with Bina Marga at the design stage.

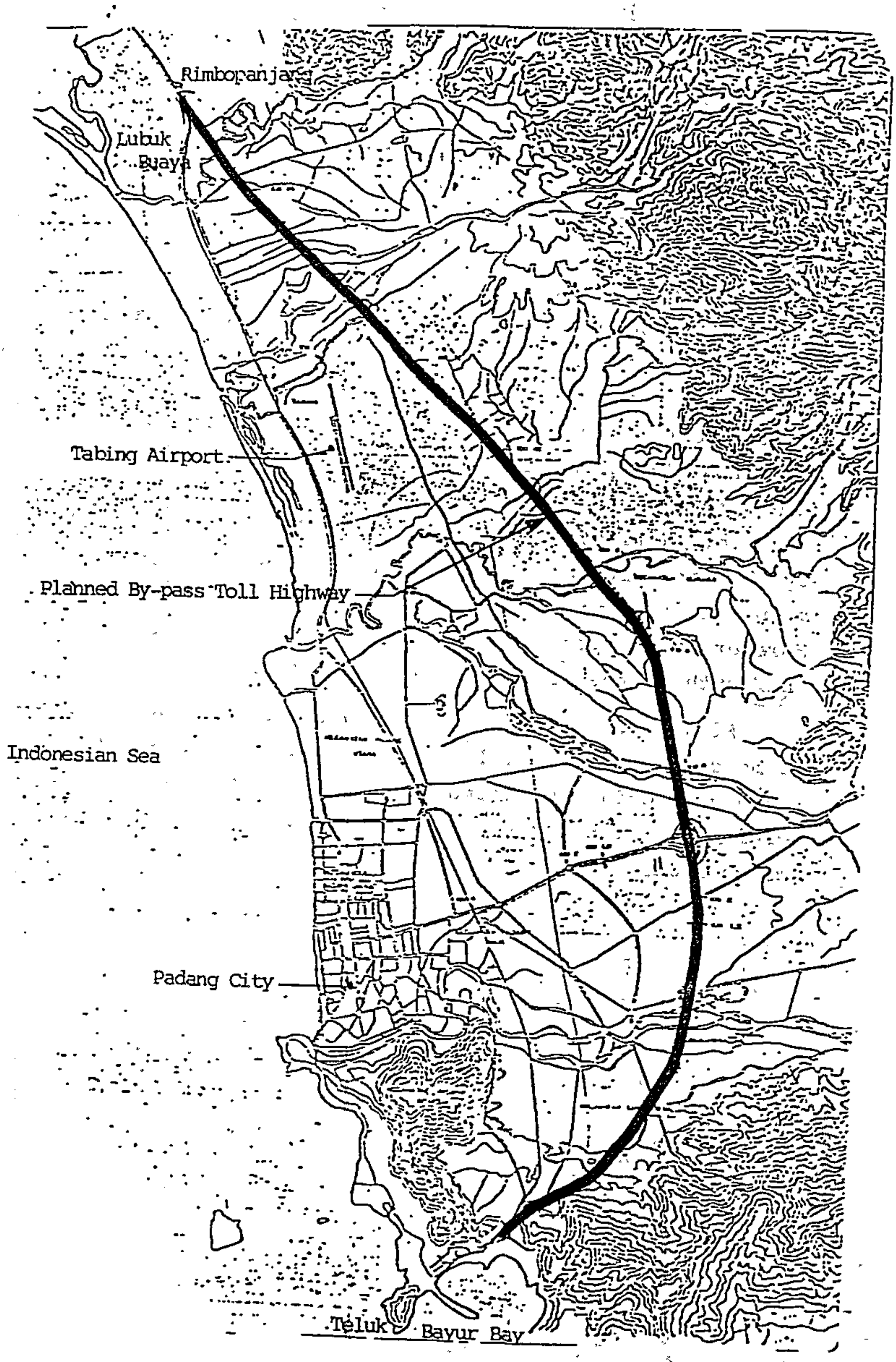

Figure 7.2.2 PLANNED BY-PASS TOLL HIGHWAY BY BINA MARGA

7.3. The New Airport Construction

As shown in Figure 7.3.1., the new airport site with a property area of some 150 ha at Ketaping, is located along the sea shore some 23 km north from Padang city. The terrain at the site is generally flat with elevations of 2.5 meters to 5 meters. As was discussed previously in Chapter 6, the land at the site is owned by the local government and remains undeveloped except for some coconut plantations. In addition, the site is capable of providing the required airspace for the establishment of preferable flight procedures. Thus the site is considered to be the ideal spot for an airport.

The airport layout plan for this new airport at Ketaping is as shown in Figure 7.3.2. The orientation of 2500m long new runway is set at 15-33*1 considering the factors as follows:

i) The wind coverage of the runway satisfies ICAO requirement (Due to the absence of wind data at Ketaping, the data at Tabing is applied);

ii) The approach and take-off path from/to the south will avoid passing over the land area;

iii) Minimize triangular shaped dead zone to be produced between Talao Bunga and the airport boundary line on the west.

Thus the threshold of RWY 33 is placed transversely some 250m away from Talao Bunga to provide sufficient space for the required runway strip and glide path antenna area. Longitudinally the threshold of RWY 33 is some 1200m away from the relocated Anai River, to provide sufficient space for installation of approach lighting system and middle marker. Straightening of the river is scheduled to be completed before 1986 by PWD, West Sumatra Province.

Note *1 15-33 runway orientation is tentative only and subject to modification during Master Planning Stage.

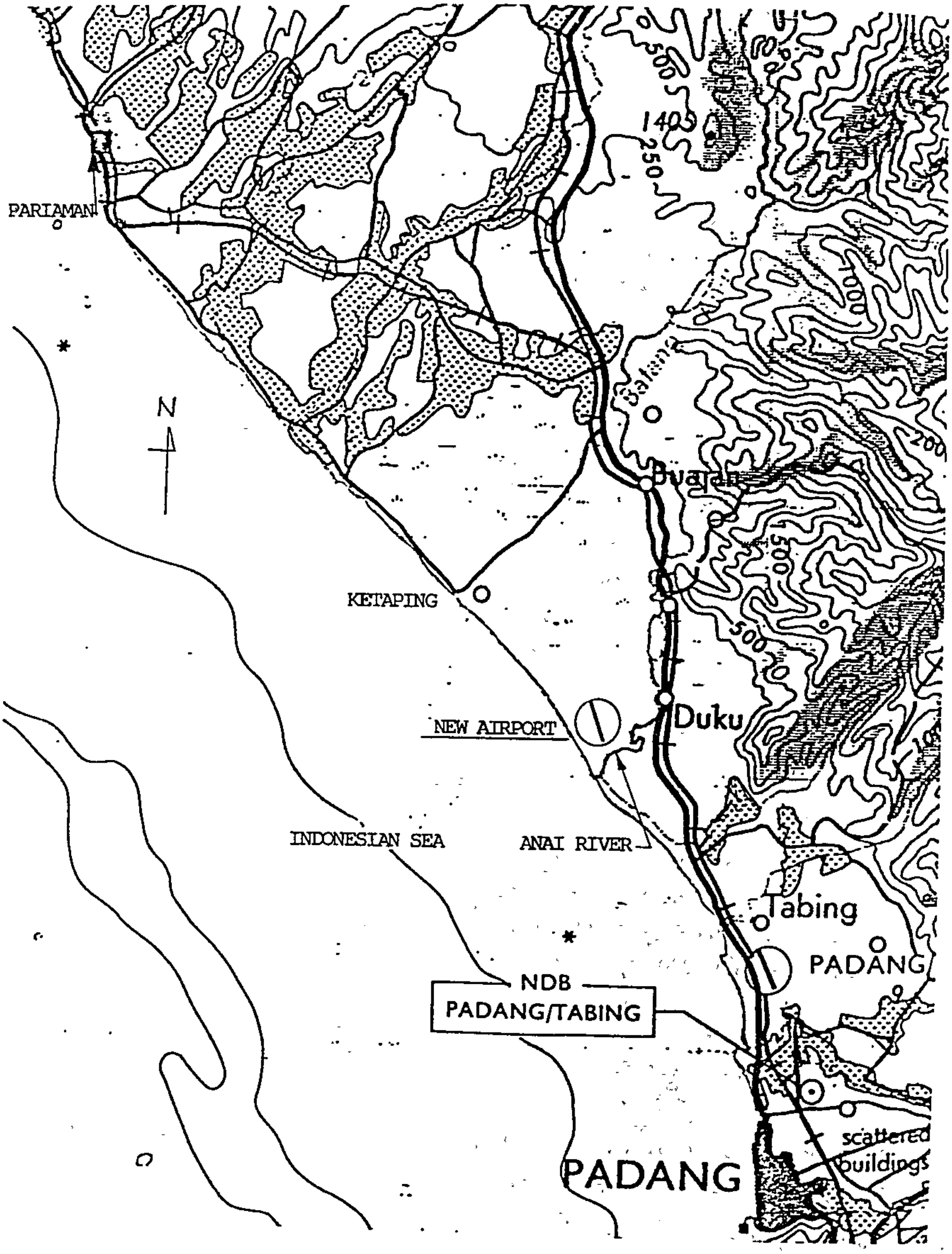

Figure 7.3.1 VICINITY MAP OF NEW AIRPORT AT KETAPING

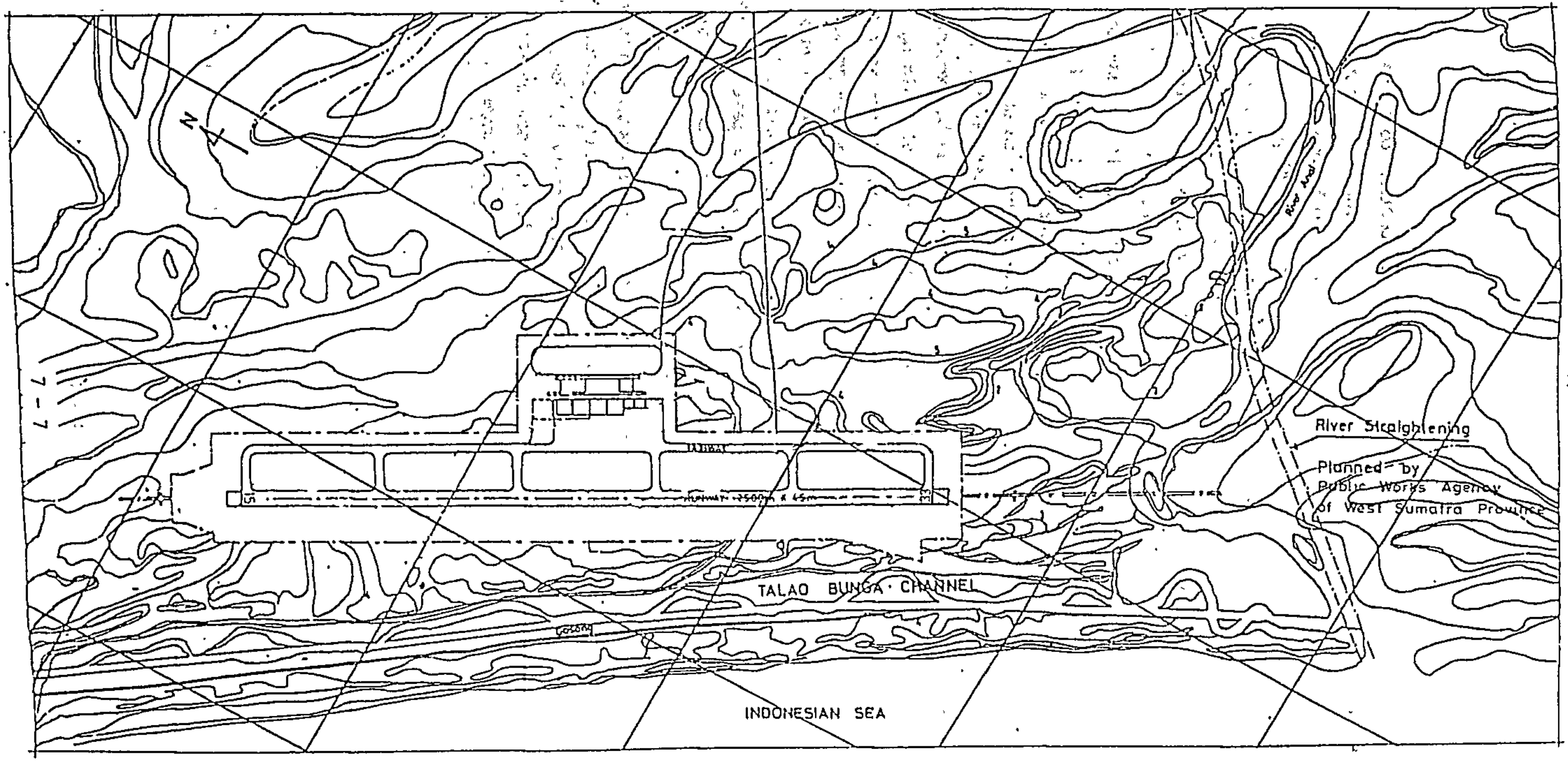

Figure 7.3.2 AIRPORT LAYOUT PLAN AT KETAPING

The complete parallel taxiway with 184m centerline to centerline seperation from the runway is placed on the east side of the runway. This parallel taxiway is tied into the runway at both ends. Considering the relatively low traffic demand for runway, 90 degree angle exit taxiways are planned at every 500m intervals. The passenger terminal area is located at the centre of gravity of the airport to provide efficient operation and sufficient ability to expand in both directions along the parallel taxiway. As shown in Figure 7.3.3., the apron is designed to accommodate four DC-10 class, two DC-9 class and one small class aircraft for the first phase development. Except for small class aircraft which can easily self-maneuver to a 45 degree nose out angle, all aircraft stands are planned by nose-in and push-out configuration with usage of boarding bridges for efficient passenger handling. For the demand after 1995 the apron can be expanded as seen in the figure. The linear type passenger terminal building placed along the apron edge can also be expanded in accordance with the future demand. The circulation road in front of the passenger terminal building is planned to provide sufficient land area so as to accommodate the car parking and other facilities to cope with the demand at least up to year 2010. Approximately half of the area shall be paved for the first stage development and construction of the rest will be arranged to suit the increase in parking demand.

An entirely new access road which diverts from the exsisting highway near Lubuk Buaya shall be constructed to reach the new airport. The total length of this new access road is approximately 4,5 km including 80m and 20m bridges. As seen in Figure 7.2.1., the new access road may be connected to the planned Tollway near Lubuk Buaya.

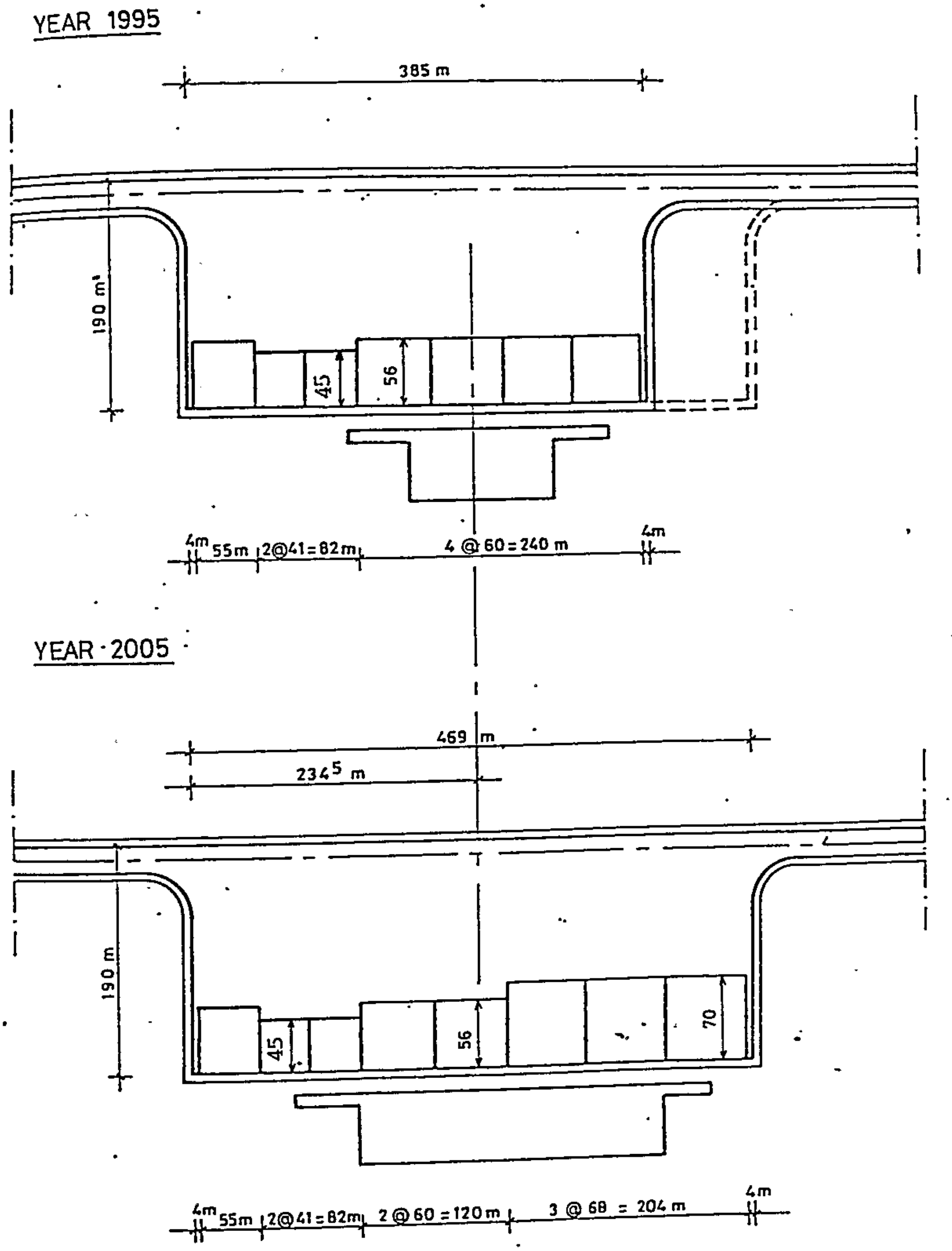

Figure 7.3.3 APRON ARRANGEMENT FOR KETAPING AIRPORT

CHAPTER 8 AIRPORT FACILITY PLANNING FOR THE SELECTED ALTERNATIVE SCHEMES

8.1. General

Based on the facility requirements estimated in Chapter 4 of this report, major airport facilities are planned for the selected schemes at Tabing Airport and the new airport at Ketaping. This Chapter describes the main aspects of the facility planning separately for each airport.

The Table 8.1.1 summarizing the major facilities to be completed at the first phase development at each airport is prepared to give a quick glance over the size and degree of work required. As is clear from the table, the redevelopment of the existing airport will call for almost same degree and size of the construction works as that of a new airport at Ketaping. The reason for this is that the most of the existing facilities at Tabing airport are only capable to handle current level of traffic (about 200,000 annual passengers) and thus almost all of the facilities will be newly developed to meet the forecast demand of 1,300,000 annual passengers in 1995. In addition, it shall be noticed that the redevelopment of Tabing Airport will require a large volume of hill cut, (some 170,000 cu.m), road relocation, compensation of some 120 houses, and some 70 ha. land acquisition.

Table 8.1.1 COMPARISON OF REQUIRED FACILITIES TO BE COMPLETED AT FIRST PHASE

Item	Existing Airport	New Airport
Runway	New one 2500^{m} x 45^{m}	New one 2500^{m} x 45^{m}
Parallel taxiway	Overlay of existing runway 2150^{m} new taxiway 350^{m}	New taxiway 2500^{m}
Exit taxiway	New 6 x 150^{m} x 23^{m}	New 6 x 150^{m} x 23^{m}
Apron	New 248^{m} x 177^{m} plus existing apron	New 385^{m} x 177^{m}
Passenger terminal building	New 14,900^{m2}	New 14,900^{m2}
Cargo terminal building	Existing pax terminal shall be converted to cargo handling area	Total area of 2900^{m2} with 1900^{m2} of cargo handling area.
Car parking	New 15,100^{m2}	New 15,100^{m2}
Control tower	New one	New one
Administration Building	the existing building to be utilized as a part of office build-ing	New one
Drainage	Ditch 6400^{m} Box Culvert 350^{m} Pipe Culvert 770^{m}	Ditch 9200^{m} Pipe 720^{m}
Road	Road relocation 1400^{m}	Access Road 4500^{m}

8.2. The Redevelopment of the Existing Airport

8.2.1. Grading and Drainage System

The profile of the centerline of the new runway and the typical cross section of the airfield are as shown in Figure 8.2.1 and Figure 8.2.2 respectively. As is clear from the Figures, the runway centerline slope, transverse slope of runway, runway strip and taxiway slopes are within the ICAO recommendations.

By utilizing excavated materials at Pangilun Hills the runway and most parts of the runway strip will be constructed basically on an embankment. The planned drainage system is shown in Figure 8.2.3.

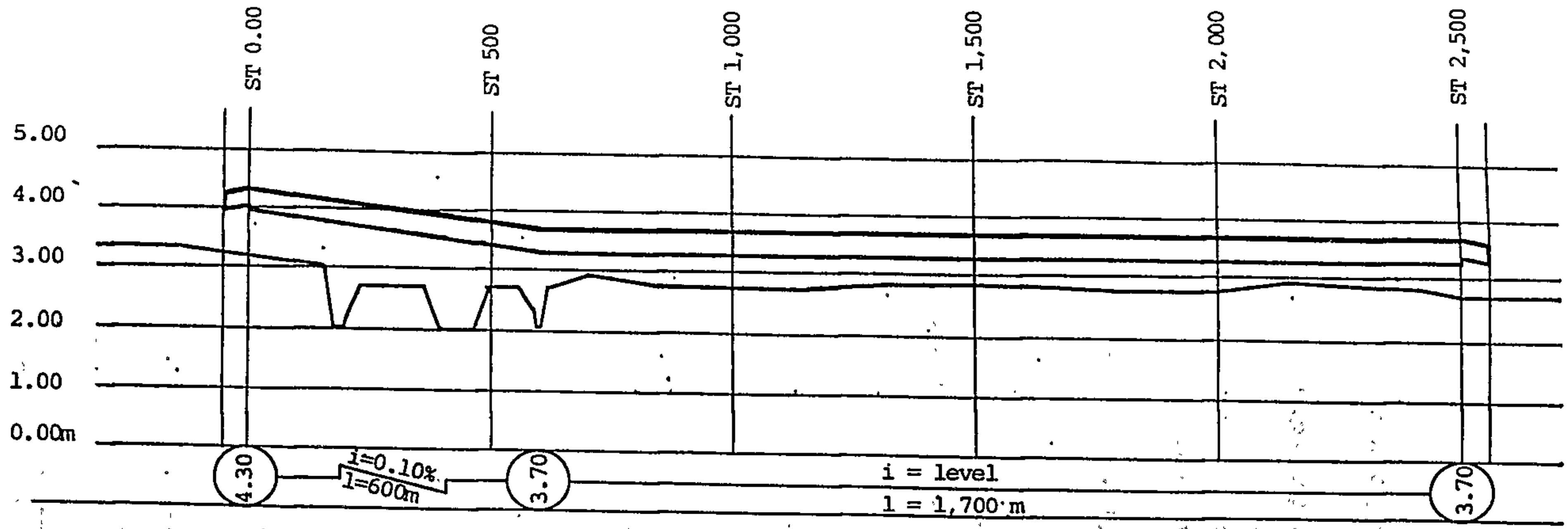

Figure 8.2.1 NEW RUNWAY PROFILE AT TABING

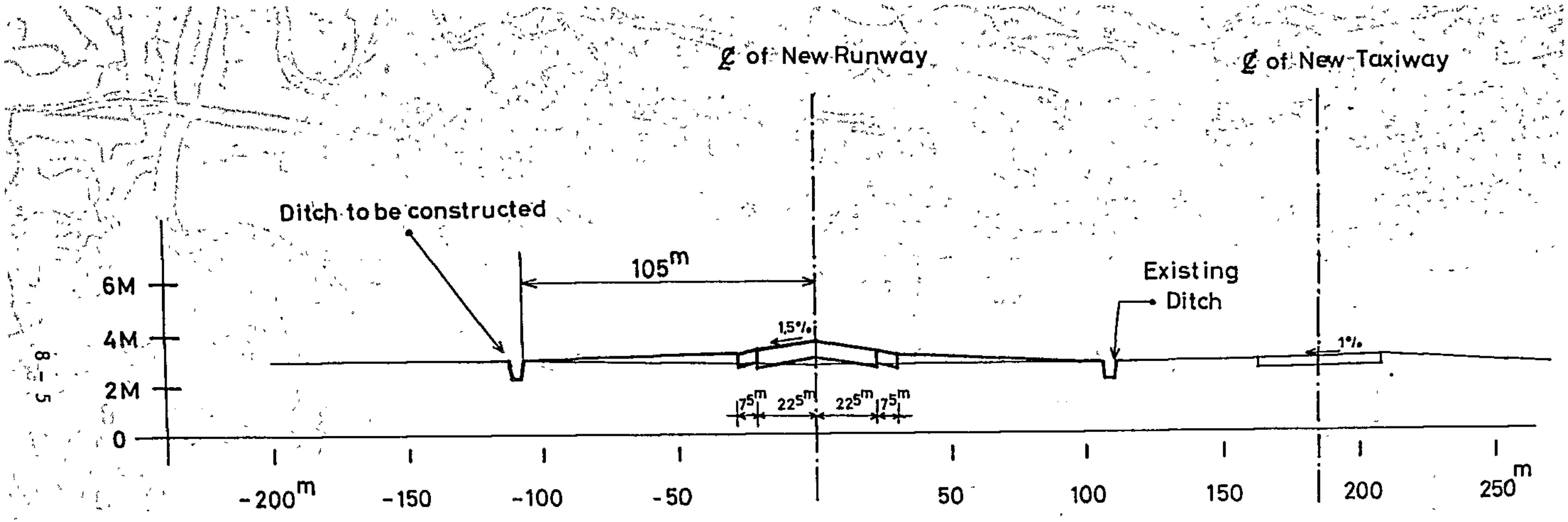

Figure 8.2.2 TYPICAL CROSS SECTION AT TABING AIRPORT

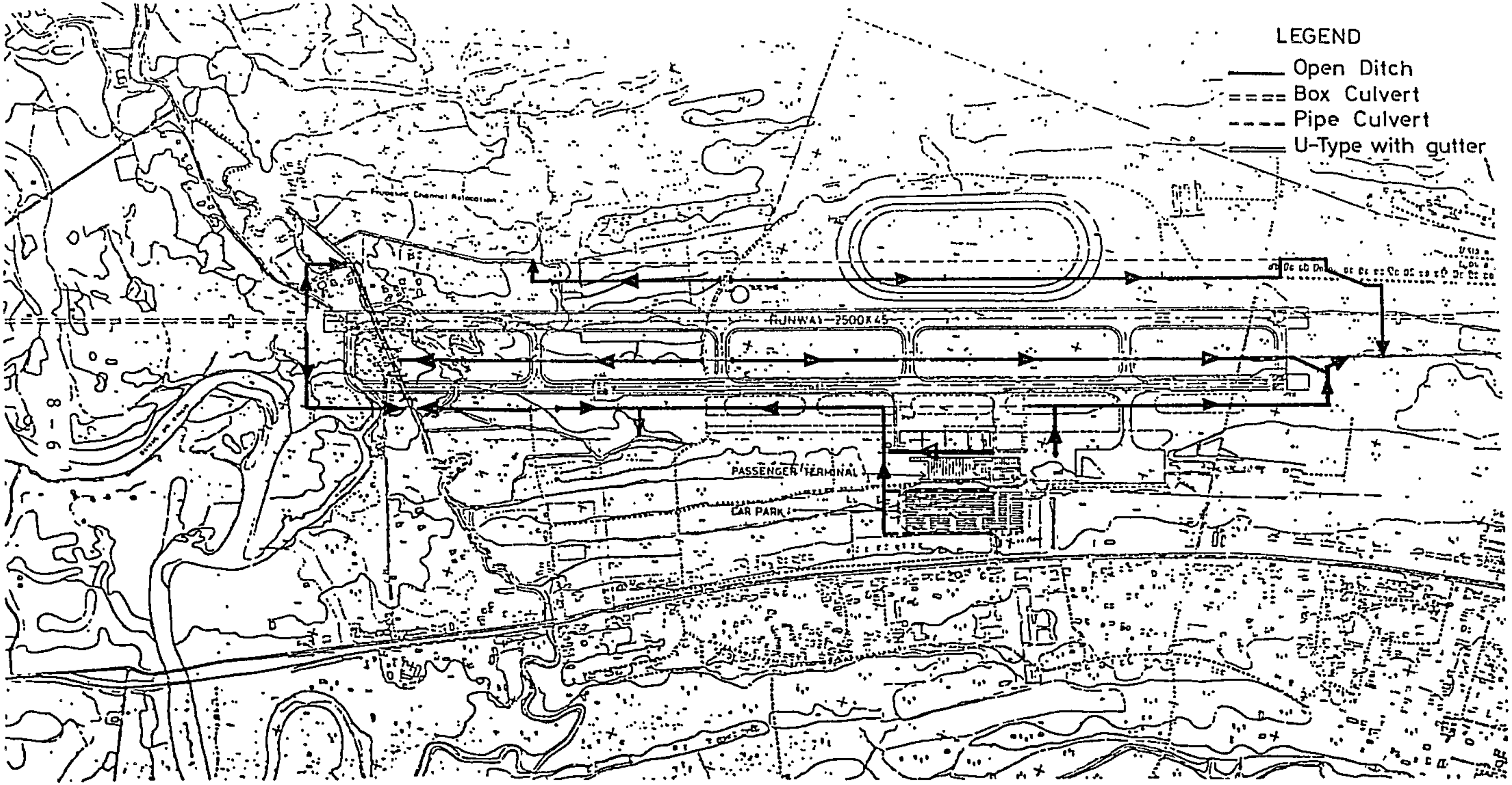

Figure 8.2.3 DRAINAGE SYSTEM AT TABING AIRPORT

8.2.2 Pavement

1) Subgrade bearing strength

Based on the site soil investigation and laboratory soil tests conducted in August 1981, the existing soil at subgrade layer for the new runway to be located to the east side of the existing runway can generally be regarded as poorly graded sand (SP) or silty sand (SM), in accordance with the ASTM classification system, and has a soaked CBR value of 13%.

Whereas, the subgrade in the rice field corresponding to the northern part of the new runway and taxiway consists of inorganic silt (MH) or organic clay (OH) and has a soaked CBR value of 3.6%.

2) Types of Pavement

There are two major types of pavement commonly used as airfield pavements, namely the rigid pavement (cement concrete) and the flexible pavement (asphalt concrete).

In consequence of the comparative analysis on both characteristics of these pavements as shown in Table 8.2.1, the flexible pavement is considered suitable for this project except for the passenger loading apron where the rigid pavement is preferred due to oil leakage and possible subsequent rutting or defacement of the flexible pavement surface.

3) Pavement thickness

The thickness of the flexible pavement can be determined by the Corps of Engineers method.

The applied design criteria are as follows:

Design aircraft	:	DC-10
Repetition of design load	:	5,000 times
Subgrade CBR for rice field area	:	3.6%
Subgrade CBR for other area	:	13%

The standard flexible pavement structures are as follows:

*CBR = 13%

component	thickness
Asphalt concrete surface course	4 cm
Ditto binder course	5 cm
Ditto	5 cm
Graded aggregate base course	25 cm
Sand subbase course	34 cm
Total	73 cm

*CBR = 3.6%

component	thickness
Asphalt concrete surface course	4 cm
Ditto binder course	5 cm
Ditto	5 cm
Graded aggregate base course	40 cm
Sand Subbase course	45 cm
Ditto	50 cm
Local waste	45 cm
Total	194 cm

Thickness of the rigid pavement for the apron can be determined by PCA (Portland Cement Association) method.

Applied design criteria are as follows:

Design aircraft	: DC-10
Repetition of design load	: 5,000 times
Flexural strength of concrete	: 50 kg/cm^2
Modulus of subgrade reaction on subgrade (from the data of Tabing Airport)	: $K_{75} = 2.2\ kg/cm^3$
Modulus of subgrade reaction on base course:	$K_{75} = 7\ kg/cm^3$

Desirable rigid pavement structure is obtained as follows:

component	thickness
Cement concrete slab	38 cm
Graded aggregate base course	35 cm
Gravel/Sand subbase course	35 cm
Total	108 cm

4) Pavement overlay

The existing runway, which is to be overlayed by 10 cm of asphalt concrete to accommodate A-300-B4 and to become a part of the parallel taxiway, will be reoverlayed by 8 cm of asphalt conrete in the 1st Phase development because DC-10 operation is anticipated after 1990. However, the 2nd Phase development will not require any overlay for strengthening the pavement because the main gear load of B-747 is smaller than that of DC-10.

Table 8.2.1 COMPARISON BETWEEN RIGID PAVEMENT AND FLEXIBLE PAVEMENT

	Flexible Pavement	Rigid Pavement
Total thickness	73 cm (CBR = 13%)	66 cm (K_{75} = 7 kg/cm^3)
Joint	Not needed	Needed between panels
Load Bearing characteristics	Rutting may occur in case of channelized traffic	Very little rutting
Cost	Rp16,600/m^2	Rp33,000/m^2
Construction Period	Relatively short	Relatively long
Maintenance and repair	Easier because spot repair is possible	Comparatively difficult

8.2.3. Building

1) Passenger Terminal Building

Even though the existing passenger terminal building is expanded to handle the increased peak hour passengers to be brought forth by the introduction of A-300, the further remodeling of the existing one to meet the demand beyond 1987 is not practical when the consideration is given to the factors as follows:

i) Demand size of peak hour passenger will be almost six times of that of current one; and

ii) Accordingly new apron will be required at different site to accommodate larger aircraft.

Thus considering the efficiency and comfortability of passenger handling as well as future expansibility, the linear type of passenger terminal building is planned along the edge of the new apron.

2) Cargo Terminal Building

The existing passenger terminal building may be converted for the future cargo terminal building with interior modification and slight expansion of it. Although the distance between the new passenger and future cargo terminals is bit great, the site is ideal location in respect of land-side traffic since it separates land-side cargo traffic from other airport traffic within the airport at the entrance.

3) Administration Building

New administration building shall be constructed in Phase-1, since the existing one, which has now 600sq.m in the total floor area, will not meet the projected requirements as explained below:

a. The administration building will be required to have the total floor area of 1,800m^2 in Phase-1 as shown in Table 8.2.2.

b. Fully new equipment of air navigation systems are to be installed in Phase-1. This means that, in case of the existing building utilization, new equipment shall be installed together with the existing one and be made ready for the redeveloped airport inauguration without any disruption of the existing airport operation. However, there will not be enough spaces for both the existing equipment and the newly planned equipment.

The administration building will be co-located with the air traffic control tower for a convenience sake of controllers' access and cabling.

4) Power House

New power house is required to have an effective floor area of 500m^2 for the installation of emergency generatiors and power supply equipment. This power house is not necessarily co-located with the administration building. A minimum distance to the aeronautical ground lights and air navigational equipment are rather necessary conditions.

Table 8.2.2. ADMINISTRATION BUILDING FLOOR AREA PLAN

Rooms	Approx. Floor Area
ATC/COM Equipment Room	50 m^2
AFTN Room	35 m^2
Meteorological Equipment Room	75 m^2
FIS Room	50 m^2
Briefing Room	25 m^2
Other Operational Office	150 m^2
Others (Workshop, Equipment Storage, etc)	135 m^2
Engineer Office Maintenace Office Administration Office	*1,230 m^2
TOTAL	1,750 m^2

410 persons x 0.5 x 6m^2/person = *1,230m^2

(0.5 — Coefficient of simultaneous working staff established by the study of the existing Tabing Airport Operation.)

8.2.4. Air Navigation Systems

Air navigation systems as tabulated in Table 8.2.3 are planned in Phase-1 and only major items which are thought to affect this redevelopment plan are outlined hereinunder.

1) ILS Category-I will be installed for the runway 16 approach together with the approach lighting system (category I, Calvert type, 900 m) and RVR measuring equipment.

2) It is necessary to relocate the existing VOR/DME away from the site of the new runway in order to keep the runway strip and the transitional surface free of obstructions.

It is, however, not practical to remove the existing VOR/DME for the following reasons :

- The existing VOR/DME is the only one reliable navigational aid at Tabing airport for both approach/take-off and en-route (Tabing Terminal) procedures.
- The removal means that VOR/DME operational services would be stopped during the relocation construction, and this would generally be considered to take more than 6 months in the case of the doppler type.

Hence, the existing VOR/DME shall remain in operation until such time as the new VOR/DME is ready to commence operational services. Later, the utilization of the existing VOR/DME will be considered taking into account the equipment reliability and suitability for re-use, and these factors will depend on the maintenance quality.

3) The number of radio frequences available for the air/ground VHF radio will be increased. All the communications and peripheral equipment such as radio TTY will be newly installed in view of the age of the existing equipment.

4) All the aeronautical ground lights will be newly installed so as not to disrupt the airport operation during the redevelopment construction. By the time of the completion of Phase-I

construction, the life-time of these lights and fittings will be be at an end. (The existing lights, mainly consisting of ABN, VASI, SALS, RWL etc, were installed around 1976 - 1979)

5) New meteorological equipment will be istalled for the category I operation since there is at this moment insufficient and no-automated meteorological equipment in Tabing.

6) A new air traffc control tower will be constructed for the following reasons :

- The existing control tower has the following dimensions ;

Height of the cab floor	: 15 m
(Effective contollers eye level)	: (16 m)
Floor Area	: 25 m^2
(Effective Floor Area)	: (15 m^2)

Control console position : 1 control position and
1 lighting control desk

- While, it is considered that at least three control positions as below will be necessary for the forecast aircraft movements.

i)	FIS position	: 1*
ii)	APP control position	: 1*
iii)	Aerodrome control position	: 1*
iv)	Surface movement control or stand-by position	: (1)
v)	Aeronautical light control	: 1
vi)	ATIS control desk	: 1

- For the installtion of these control positions, at least 7.5 X 7.5 m (56m^2) floor area will be required.

- The height of the contollers eye level will require to be approxiamtely 25 meters for a 2,500 m class runway in accordance with FAA standard.

- The existing tower therefore does not meet the necessary floor area and height requirements.

Table 8.2.3 AIR NAVIGATION SYSTEMS PLAN

SYSTEMS	EQUIPMENT	NUMBERS
NAVAID	- ILS Category-I	1 set
	- VOR/DME (Doppler)	1 set
	- NDB	1 set
	- Monitor and Control Equipment	1 set
ATC / COMMUNICATION	- Air traffic control consoles	1 set
	- VHF transmitter/receiver	4 radios
	- UHF transmitter/receiver	1 set
	- Automatic terminal information service equipment (ATIS)	1 set
	- ATIS console	1 set
	- Magnetic Tape Recorder	
	- Radio Teletypewriter (AFTN)	10 set
	- ATC telephone exchange	
MET.	- Weather data recollecting equipment	1 set
	- Runway visual range measuring equipment (RVR)	1 set
	- Ceilometer	1 set
	- Weather fax receiver	1 set
	- HF transmitter and receiver	1 set
	- Teletypewriter	4 set
LIGHTS	- Approach Lighting System :	
	RWY 16 Category I (900m) Calvert System	1 set
	RWY 34 SALS (420m)	1 set

Table 8.2.3 (Continued)

SYSTEMS	EQUIPMENT	NUMBERS
LIGHTS	- Approach Light Beacon	2 units
	- Visual Approach Slope Indicator	2 sets
	- Runway Edge Light (High intensity elevated type)	1 set
	- Runway Threshold Light (High intensity inset type)	1 set
	- Runway End Light (High intensity inset type)	1 set
	- Taxiway Edge Light (Medium intensity elevated type)	1 set
	- Aerodrome Beacon	1 set
	- Illuminated Wind Cone	2 sets
	- Apron Flood Lighting	1 sum
	- Control Console	1 set
OTHERS	- Air Traffic Control Tower	1

8.3 The New Airport Construction

8.3.1 Grading and drainage system

The profile of the centerline of the new runway and the typical cross section of the airfield are as shown in Figure 8.3.1 and Figure 8.3.2 respectively. As is clear from the Figures, the runway center-line slope, transverse slope of runway, runway strip and taxiway are within the ICAO recommendation.

Since the existing terrain is gradually sloping up from west to east in general, the grading work is planned to cut the taxiway and apron area in the east and embank the runway area in the west, and thus balance the cut and fill volume. The total earth work volume is estimated to be about 400 to 450 thousands cu.m.

The planned drainage system is shown in Figure 8.3.3.

8.3.2 Pavement

1) Subgrade Bearing Strength
   Based on the site soil investigation and laboratory soil tests, the existing soil at subgrade layer for the new runway site can be regarded as poorly graded sand (SP) in accordance with the ASTM classification system and has a soaked CBR value of 20% except for the expected apron area. As for the apron area, CBR of the subgrade is revealed to be 9%, through the laboratory tests.

2) Types of Pavement
   As mentioned in Section 8.2.2, flexible pavement shall be recommended as the most suitable type except for the passenger loading apron where a rigid pavement will be prepared.

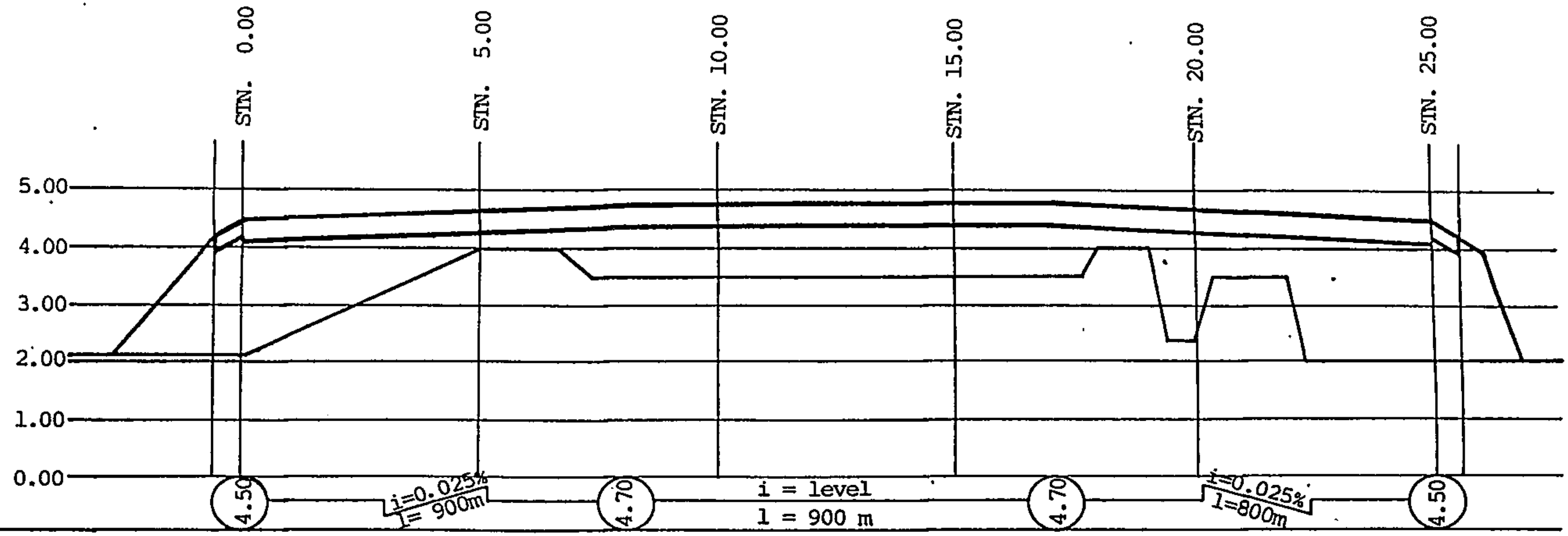

Figure 8.3.1 NEW RUNWAY PROFILE AT KETAPING

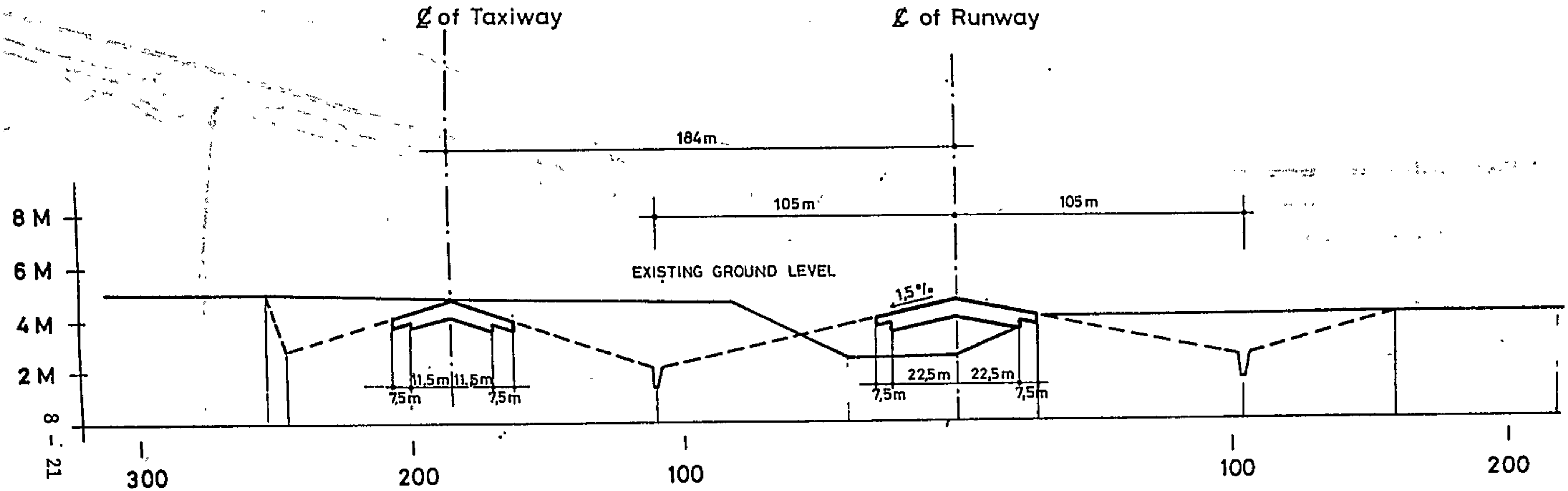

Figure 8.3.2 TYPICAL CROSS SECTION AT KETAPING

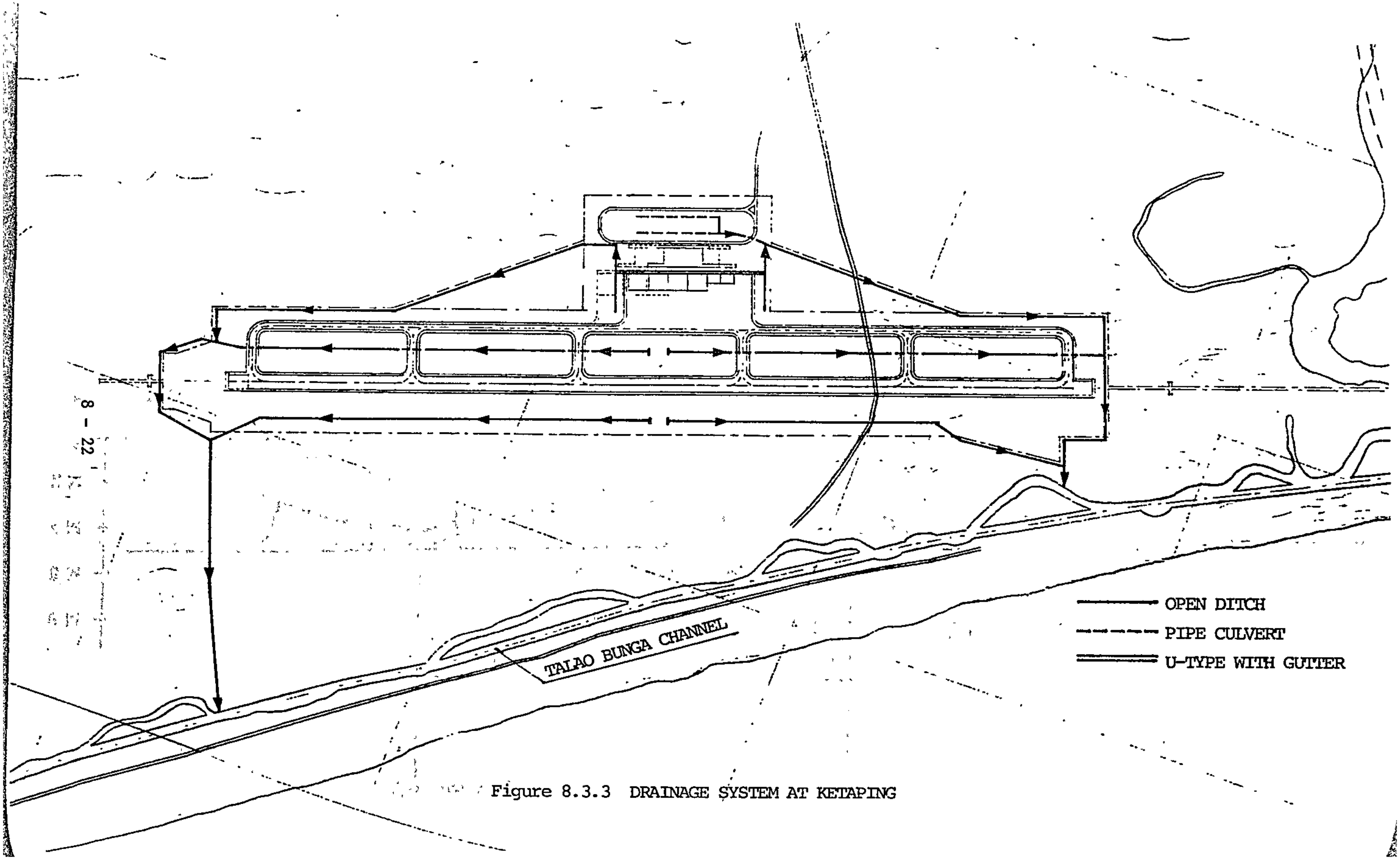

Figure 8.3.3 DRAINAGE SYSTEM AT KETAPING

3) Pavement thickness

The thickness of the flexible pavement can be determined by the Corps of Engineer design method.

The applied design criteria are as follows:

Design Aircraft	:	DC-10
Repetition of design load	:	5,000 times
Subgrade CBR	:	20%

The standard flexible pavement structure is as follows:

component	thickness
Asphalt concrete surface course	4 cm
Ditto binder course	5 cm
Ditto	5 cm
Graded aggregate base course	25 cm
Sand cement subbase course	14 cm
Total	53 cm

For the rigid pavement of the apron, the thickness can be determined by the PCA design method.

The applied design criteria are as follows:

Design Aircraft	:	DC-10
Repetition of design load	:	5,000 times
Flexural strength of concrete	:	50 kg/cm^2
Modulus of subgrade reaction on subgrade	:	K_{75} = 5 kg/cm^3 (assumption from CBR = 9%)
Modulus of subgrade reaction on base course	:	K_{75} = 7 kg/cm^3

Desirable rigid pavement structure is as follows:

component	thickness
Cement concrete slab	38 cm
Graded aggregate base course	35 cm
Total	73 cm

4) Pavement overlay for the 2nd phase

There is no necessity to overlay the existing pavement for an increase of pavement strength if B-747 will be the largest aircraft.

8.3.3. Building

1) Passenger Terminal Building and Cargo Terminal Building

New linear type of passenger terminal building and cargo terminal building will be planned, in accordance with the facilities requirements made in Chapter 4. of this report.

2) Administration Building and Power House

The same administration building and power house as reported in the previous section 8.2.3. are planned for the new airport.

8.3.4. Air Navigation Systems

New air navigation systems as tabulated in Table 8.3.1 will be constructed in Phase 1. There will be no equipment which are to be replaced by those from Tabing airport so as not to disrupt Tabing airport operation during the new airport construction.

The major items of the air navigation systems plan are outlined hereinunder.

1) ILS will be installed on the runway 33 taking into consideration the existing route structure.
The outermarker (OM) however, could not be installed because it will be located in the Indonesian Sea. Hence, one DME other than VOR/DME will be installed co-located with ILS equipment so that a pricise fix equivalent to OM could be established by DME and localizer.

Other plans on ATC, COM, MET, and Tower, etc., will be the same as those of the re-development plan, which are explained in the previous section 8.2.4.

Table 8.3.1 AIR NAVIGATION SYSTEMS PLAN

SYSTEM	EQUIPMENT	NUMBERS
NAVAIDS	- ILS Category - I DME instead of outermarker	1 Set
	- VOR/DME (Doppler)	1 Set
	- NDB	1 Set
	- Monitor and Control Equipment	1 Set
ATC/COM	- Air Traffic Control Console	1 Set
	- VHF Transmitter/Receiver	4 Radios
	- UHF Transmitter/Receiver	1 Set
	- Automatic Terminal Information Service (ATIS) equipment	1 Set
	- ATIS Console	1 Set
	- Magnetic Tape Recorder	1 Set
	- Radio Teletypewriter (AFTN)	10 Units
	- ATC Telephone exchange	1 set
	- HF Transmitter/Receiver (AFTN)	1 Set
MET	- Weather Data Collecting Equipment	1 Set
	- Runway Visual Range measuring equipment	1 Set
	- Ceilometer	1 Set
	- Weather Fax Receiver	1 Set
	- HF Transmitter/Receiver	1 Set
	- Teletypewriter	4 Units
LIGHTS	- Approach Lighting System RWY 33 Category I Calvert 900 m RWY 15 SALS	1 Set

Table 8.3.1 (Continue)

SYSTEM		EQUIPMENT	NUMBERS
LIGHTS	–	Approach Lighting Beacon	1 Set
	–	Visual Approach Slope Indicater (3 bar VASI)	2 Sets
	–	Runway Edge Light (High intensity elevated type)	1 Set
	–	Runway Threshold Light (High intensity inset type)	1 Set
	–	Runway End Light (High intensity inset type)	1 Set
	–	Taxiway Edge Light	1 Set
	–	Aerodrome Beacon	1 Set
	–	Illuminated Wind Cone	2 Sets
	–	Apron Flood Lighting	1 Sum
	–	Control Console	1 Set
OTHERS	–	Air Traffic Control Tower	1

CHAPTER 9

CONSTRUCTION SCHEDULES AND COST ESTIMATES OF THE SELECTED ALTERNATIVE SCHEMES

9.1. General

The necessary works and arrangements such as the detailed design, land acquisition, tendering, etc. prior to the commencement of the construction are deemed to take two and half years after this Feasibility Study. The required period to complete the first phase construction including various checks, test operations, NOTAM, maturity flights, etc. will be three and half years for both the existing and new airports. Thus, the inauguration of the first phase facilities of both cases will be early 1988, some six years later from February 1982.

The cost estimates are based on the following assumptions:

1) The unit construction prices used in the cost estimates are estimated based on the price data collected in August, 1981.

2) The exchange rates are set at US$ 1 = Rp625 = Jap. Yen 220.

3) Foreign currency portion of the construction cost includes the following items:

   - Purchase cost of construction equipment without customs duty.
   - Cost of imported materials such as asphalt, equipment and some building construction materials, etc., without customs duty.
   - Foreign remittance portion of the overhead and profit of foreign contractors and engineering firms.
   - Wages of foreign labor.

4) Local currency portion of the cost includes the following items:

- Operation cost of the construction equipment including fuel and lubricant.
- Construction materials procured in Indonesia such as steel bar, cement, aggregate and wooden material.
- Land transport cost of materials and labor.
- Local portion of foreign and local contractors' overhead costs and profits.
- Wages of local labor.
- Land acquisition cost.

5) Engineering fee is estimated at 15% of the total cost of works.

6) Contigency is estimated at 10% of the sum of the total cost of works, engineering fee and the cost of land acquisition.

9.2. The Redevelopment of The Existing Airport

The construction schedule is planned as indicated in Table 9.2.1. The total construction period is estimated to be as long as the new airport construction. However, it shall be noticed that the planned schedule may be achieved only when social affairs such as private land acquition, compensation of great number of houses, road relocation in the north of runway, etc. be settled within the scheduled time of one and half year.

The construction cost is estimated by work and phase, as tabulated in Tables 9.2.2. and 3. The estimate is based on the assumption that the excavation volume of 170,000 cu.m. of the Hill will consist of common soil and rock in the same proportion and will be carried to the existing airport. This hauling of large volume of materials will require improvement of the existing road and may be regarded as nuisance for its noise, vibration and dust caused by heavy traffic.

Although additional payments may be necessary for unusual working hours for the construction within the restricted area of the airfield to maintain normal airport operation, such extra is disregarded in the estimate.

Table 9.2.1 CONSTRUCTION SCHEDULE OF THE EXISTING AIRPORT

(hatched bar) 1st Phase Construction
(open bar) 2nd Phase Construction

Design Year for the 1st Phase: 1995

	WORK ITEMS \ Calender Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	Feasibility Study and Engineering Services.	F/S	Topo. Soil	D/D	T/E		C/S														
2	Land Acquisition and Compensation works.																				
3	Site Preparation.																				
4	Pavement																				
5	Car parking area and service road.																				
6	Passenger Terminal Building.																				
7	Cargo Terminal Building.																				
8	Administration and Other Building.																				
9	Lighting.																				
10	Radio-Nav-Aids Telecommunications and Meteorological Services Facilities.																				
11	Utilities																				

NOTE:
- F/S Feasibility Study
- Topo. Topographical Survey
- Soil Soil Investigation
- D/D Detail Design and Tender Document
- T/E Tender Evaluation for Construction
- C/S Construction Supervision

Table 9.2.2 ESTIMATED RECONSTRUCTION COST OF THE EXISTING AIRPORT

Unit : Million Rupiah

ITEM (PHASE OF CONSTRUCTION)		PHASE 1			PHASE 2			TOTAL		
		Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total
1	Civil Works	5,081	3,623	8,704	322	472	794	5,403	4,095	9,498
2	Building and Equipment Work	4,385	3,825	8,210	4,785	4,105	8,890	9,170	7,930	17,100
3	Air Navigation System Work	3,476	631	4,107	1,710	278	1,988	5,186	909	6,095
4	Utilities Work	2,151	729	2,880	806	152	958	2,957	881	3,838
5	Total of Works	15,093	8,808	23,901	7,623	5,007	12,630	22,716	13,815	36,531
6	Engineering	2,264	1,321	3,585	1,143	751	1,894	3,407	2,072	5,479
7	Land Acquisition and Compensations	-	15,373	15,373	-	-	-	-	15,373	15,373
8	Contingency	1,736	2,550	4,286	876	576	1,452	2,612	3,126	5,738
9	Grand Total	19,093	28,052	47,145	9,642	6,334	15,976	28,735	34,386	63,121

Table 9.2.3 ESTIMATED ANNUAL RECONSTRUCTION COST OF EXISTING AIRPORT

(Unit : Million Rupiah)

	Year	Foreign Portion	Local Portion	Total
Phase 1	1983	453	5,388	5,841
	1984	793	10,786	11,579
	1985	3,804	2,609	6,413
	1986	9,456	5,262	14,718
	1987	2,851	1,457	4,308
	Sub Total	17,357	25,502	42,859
Phase 2	1994	380	250	630
	1995	2,550	1,647	4,197
	1996	5,836	3,861	9,697
	Sub Total	8,766	5,758	14,524
Total		26,123	31,260	57,383

9.3. The New Airport Construction

The planned construction schedule is shown in Table 9.3.1. With minor improvement of the existing dust road, the site can be reached by vehicle via Buajan 1, although it is a little long detour when coming from Padang City. Except for the portion of some 1 km of the access road to be constructed near Lubuk Buaya, whole land to be acquired for the airport as well as the access road after crossing Anai River belongs to the Local Government. In addition, the area is scarcely inhabited. Therefore in case of the new airport, the land acquisiton including compensation for the house relocation and a part of the coconut plantation is considered to be much easier than that of the existing airport case. Due to the fact that the site is under-developed, the new site requires more work for the utility services, however, this problem could be solved by relatively small amount of investment such as constructing some 14 km new branch transmission line from the substation at Lubukalung planned to be completed in December 1983, digging well at site for water supply as same manner as currently practiced at Tabing Airport.

The construction cost of the new airport is estimated in Table 9.3.2. and 3. This construction cost includes all the necessary facilities and equipment except fuel supply facility and the additional vehicles to be purchased for fire fighting and rescue services.

In these tables, the figures shown in parenthesis represent the possible cost down for the first phase construction in case that the available budget is limited.

These figures are arrived on the assumptions as follows:

i) Postponing the construction of the parallel taxiway to the second phase could be possible from the viewpoints of the air traffic ;

ii) Postponing the installation of boarding bridges does not infringe the airport operation;

iii) To lower the terminal building standard to the acceptable service level (e.g. area requiement for passenger terminal building can be reduced from 17.5 m^2 to 15 m^2 for a peak hour passenger).

The required amount of the investment of the first phase construction for DGAC can be further reduced to 26.1 billion rupiahs if the cost of the access road is borne by Bina Marga.

Table 9.3.1 CONSTRUCTION SCHEDULE OF NEW AIRPORT

1st Phase Construction
2nd Phase Construction

Calender Year / WORK ITEMS	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
															Design Year for the 1st Phase					
1 Feasibility Study and Engineering Services	F/S	Topo. Soil	D/D	T/E		C/S														
2 Land Acquisition																				
3 Access Road *																				
4 Site Preparation																				
5 Pavement																				
6 Car Parking Area and Service Road																				
7 Passenger Terminal Building																				
8 Cargo Terminal Building																				
9 Administration and Other Buildings																				
10 Lighting																				
11 Radio Nav-aids, Telecommunications and Meteorological Services Facilities																				
12 Utilities																				

NOTE:
F/S Feasibility Study
Topo. Topographical Survey
Soil Soil Investigation
D/D Detail Design and Tender Document
T/E Tender Evaluation for Construction
C/S Construction Supervision

* 4.5 Km Access road connecting the airport to Lubuk Buaya.

Table 9.3.2 ESTIMATED CONSTRUCTION COST OF NEW AIRPORT

Unit : Million Rupiah

	ITEM / PHASE OF CONSTRUCTION	PHASE 1			PHASE 2			TOTAL		
		Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total
1	Civil Works	4,804 (3,743)	3,705 (3,425)	8,509 (7,168)	403 (1,464)	448 (728)	851 (2,192)	5,207	4,153	9,360
2	Building and Equipment Work	4,605 (3,395)	4,075 (3,585)	8,680 (6,980)	4,785 (5,995)	4,105 (4,595)	8,890 (10,590)	9,390	8,180	17,570
3	Air Navigation System Work	3,476	631	4,107	1,710	278	1,988	5,186	909	6,095
4	Utilities Work	2,256	820	3,076	806	152	958	3,062	972	4,034
5	Total of Works	15,141 (12,870)	9,231 (8,461)	24,372 (21,331)	7,704 (9,975)	4,983 (5,753)	12,687 (15,728)	22,845	14,214	37,059
6	Engineering	2,271 (1,931)	1,385 (1,269)	3,656 (3,200)	1,156 (1,496)	747 (863)	1,903 (2,359)	3,427	2,132	5,559
7	Land Acquisition and Compensations	-	565	565	-	-	-	-	565	565
8	Contingency	1,741 (1,480)	1,118 (1,030)	2,859 (2,510)	886 (1,147)	573 (661)	1,459 (1,808)	2,627	1,691	4,318
9	Grand Total	19,153 (16,281)	12,299 (11,325)	31,452 (27,606)	9,746 (12,618)	6,303 (7,277)	16,049 (19,895)	82,899	18,602	47,501

Note : Figures in ( ) represent possible cost down for Phase 1.

Table 9.3.3 ESTIMATED ANNUAL CONSTRUCTION COST OF THE NEW AIRPORT

(Unit : Million Rupiah)

	Year	Foreign Portion	Local Portion	Total
Phase 1	1983	454 (386)	599 (576)	1,053 (962)
	1984	949 (881)	830 (807)	1,779 (1,688)
	1985	4,531 (3,807)	2,993 (2,753)	7,524 (6,560)
	1986	8.004 (6,624)	5,023 (4,569)	13,027 (11,193)
	1987	3,474 (3,103)	1,736 (1,590)	5,210 (4,693)
	Sub Total	17,412 (14,801)	11,181 (10,295)	28,593 (25,096)
Phase 2	1994	385 (499)	249 (288)	634 (787)
	1995	2,638 (3,945)	1,666 (2,316)	4,304 (6,261)
	1996	5,837 (7,027)	3,815 (4,012)	9,652 (11,039)
	Sub Total	8,860 (11,471)	5,730 (6,616)	14,590 (18,087)
Total		26,272	16,911	43,183

Note : Figures in ( ) represent possible cost down for Phase 1.