5.3 Passenger Terminal Building

5.3.1 Passenger Processing Capacity Requirements

The peak hour concentration of passengers to be processed was obtained by simulated aircraft movements on a South-bound route between Europe and Asia. The number of international passengers to be processed in the terminal building during the peak 60-minute period was calculated on the basis of the above peak hour concentration. The number of domestic passengers to be processed during the peak 60-minute period was calculated by applying a peak concentration ratio to the total daily flights. The results are shown in Table 5-5.

Table 5-5 Number of Passengers During Peak Hour

		1995	2005
International Passenger	Departing	85	175
	Arriving	85	175
	Transit	210	350
	Sub Total	380	700
Domestic Passenger	Departing	240	320
	Arriving	240	320
	Sub Total	480	640
Total		860	1,340

5.3.2 Terminal Concept

Considering the number of apron spots required, the number of passengers to be processed, and the need to effectively utilize the existing facilities and to cope with future expansion, a centralized, linear terminal concept is regarded to be the most suitable.

Both international and domestic terminals to be newly built by stages should be of one-and-a-half level passenger processing system considering the bigger aircraft anticipated in future and the corresponding increase in the number of passengers to be processed. In Phase I, however, the existing all purpose terminal building with only one level shall be converted for exclusive use of domestic passenger service.

5.3.2 Floor Area of Passenger Terminal Buildings

The required floor area to process the number of passengers shown in Table 5-5 was determined as shown in Table 5-6.

Table 5-6 Floor Area of Passenger Terminal Buildings

(Square feet)

Service Category	Phase I	Phase II
International	103,000	189,000
Domestic	77,000	102,500
Total	180,000	291,500

5.4 Cargo Terminal Building

5.4.1 Cargo Processing Capacity

On the basis of forecast future demand, annual cargo tonnage to be processed was estimated as shown in Table 5-7.

Table 5-7 Cargo Processing Capacity

(Ton/year)

Cargo Category		Phase I	Phase II
International Cargo	Outbound	1,500	6,750
	Inbound	1,500	6,750
	Sub Total	3,000	13,500
Domestic Cargo		5,800	8,100
Total		8,800	21,600

5.4.2 Cargo Processing

Manual processing of cargo was assumed, and the required capacity was calculated based on the following conditions.

i) Outbound international cargo to be processed within the same day as received, and inbound cargo to stay for 7 days in a bonded warehouse at the airport.

ii) Both inbound and outbound domestic cargo to be processed within the same day as received.

5.4.3 Required Floor Area of Cargo Terminal Building

The required floor area of cargo terminal building is as shown in Table 5-8.

Table 5-8 Floor Area of Cargo Terminal Building

(Square feet)

Service Category	Phase I	Phase II
International	5,200	23,500
Domestic	900	1,300
Total	6,100	24,800

5.5 Car Parking Requirements

Car parking space and area requirements were determined as shown in Table 5-9 based on the number of passengers during the peak hour.

Table 5-9 Number of Parking Spaces and Area Requirements

Parking Requirement	Phase I	Phase II
Parking Space	520 cars	790 cars
Area	196,000 ft^2	298,000 ft^2

5.6 Fire Fighting and Rescue Facilities

The necessary number of fire fighting and rescue vehicles to conform to the requirements of the ICAO recommendations for Aerodrome Category 9 and the area needed to accommodate the required facilities are shown in Table 5-10.

Table 5-10 Fire Fighting and Rescue Facility Requirements

		Phase I & Phase II	
Vehicles	Rapid International Vehicles	1	
	Crash Fire and Rescue Truck	1	
	Water Supply Truck	2	2,000 Imp.gal
Total Area Required	w/Garage	29,000 ft^2	

5.7 Aviation Fuel Storage Facilities

Fuel storage facility is to be large enough for 7-days' supply, and the required capacity was calculated on the basis of projected daily supply requirements per aircraft and number of flights by aircraft category as shown in Table 5-11.

Table 5-11 Fuel Storage Requirements

	Phase I	Phase II
	(1,000 Imp. gal)	(1,000 Imp. gal)
Amount of Daily Fuel Consumption	200	430
7-Day Storing Capacity	1,400	3,000
Area Required	161,500 ft^2	226,000 ft^2

5.8 Radio Nav-Aids, Telecommunications and Meteorological Service Facilities

To assure a high degree of safety and efficiency of aircraft operation the facilities to conform to the requirements of ICAO's Air Navigation Plan shall be provided, with dual system or standby unit for critical elements of the facilities.

5.9 Airfield Lighting and Electric Power Supply Facilities

The airfield lighting system shall be renewed entirely and shall be designed to meet the requirements of precision approach runway CAT-1 as specified in Annex 14, ICAO, along with the following additional facilities required by the Burmese authorities.

i) Taxiing Guidance Sign

ii) Runway Distance Marker Lights

The service voltage of electric supply to the airport will be raised from the present 6,600 V to 33,000 V.

5.10 Other Necessary Facilities

Of the various other facilities to be planned for the airport, Table 5-12 lists additional facilities that are considered necessary.

Table 5-12 Other Facilities Required

Facility	Area	Remarks
Hangar No. 1	72,700 ft^2	B-747
No. 2	29,000 ft^2	DC-10 or B-727
No. 3	22,600 ft^2	F-27 and F-28
G.S.E. Building	6,100 ft^2	W/outdoor parking
Catering Building	145,000 ft^2	
Utilities		
	Phase I	Phase II
Water Supply/Day	253,000 Imp.gal	355,300 Imp.gal
Sewege Treatment/Day	193,600 Imp.gal	273,000 Imp.gal
Telephone Circuits	250	370
Hotel	44,000 ft^2	100 Guest Rooms

CHAPTER 6. AIRPORT FACILITY AND AIRSPACE USE PLAN

CHAPTER 6 AIRPORT FACILITY AND AIRSPACE USE PLAN

6.1 Planning Criteria

The airport facility and airspace use plan for the target years of 1995 and 2005 was made to conform to the Standards and Recommendations of ICAO and/or FAA advisory circulars and to meet the projected air transport demand and the airport facility requirements established in the preceding chapters as summarized in Table 6-1.

Table 6-1 Air Transport Demand and Airport Facility Requirements

	Case 1		Case 2	
	Phase I (1995)	Phase II (2005)	Phase I (1995)	Phase II (2005)
Annual Air Traffic				
Passengers				
International Emb. and Disemb.	334,000	900,000	335,000	911,000
Transit	393,000	864,000	402,000	898,000
Total	727,000	1,764,000	737,000	1,809,000
Domestic Emb. and Disemb.	802,000	1,246,000	802,000	1,246,000
Cargo (metric tons)				
International	3,800	13,500	3,800	13,500
Domestic	5,800	8,100	5,800	8,100
Aircraft Movements				
International Passenger Flight	4,060	8,927	4,108	9,122
Domestic Passenger Flight	11,023	16,742	11,023	16,742
International Freighter	5	15	5	15
Domestic Freighter	1,063	1,268	1,063	1,268
Total	16,151	26,925	16,199	27,147
Peak Hour Demand				
Scheduled Aircraft Movements/day	55	91	55	91
Aircraft Parking Positions				
360-Seater Jet	2	3	2	3
250-Seater Jet	1	3	1	3
170-Seater Jet	1	1	1	1
120-Seater Jet	2	3	2	3
60/40-Seater Jet	2	3	2	3
Total	8	13	8	13
Freighter	1	2	1	2

Table 6-1 -- continued

		Case 1		Case 2	
		Phase I (1995)	Phase II (2005)	Phase I (1995)	Phase II (2005)
Passengers/hour					
International	Departure	85	175	85	175
	Arrival	85	175	85	175
	Transit	210	350	210	350
	Total	380	700	380	700
Domestic	Departure	240	320	240	320
	Arrival	240	320	240	320
	Total	480	640	480	640
Facility Requirements					
Runway Strip		11,500ft x 1,000ft	11,500ft x 1,000ft	11,500ft x 1,000ft	12,500ft x 1,000ft
Runway		11,100ft x 200ft	11,100ft x 200ft	11,100ft x 200ft	12,100ft x 200ft
Taxiway,	Strip	11,100ft x 200ft	11,100ft x 200ft	11,100ft x 200ft	12,100ft x 200ft
	Parallel	11,100ft x 100ft	11,100ft x 100ft	11,100ft x 100ft	12,100ft x 100ft
	Exit	550ft x 100ft x 6	550ft x 100ft x 6	550ft x 100ft x 5	550ft x 100ft x 6
Apron, Passenger and Cargo		1,228,100ft^2	1,528,100ft^2	1,228,100ft^2	1,528,100ft^2
Maintenance		210,600ft^2	467,500ft^2	210,600ft^2	467,500ft^2
Buildings					
Passenger Terminal,	International	103,000ft^2	189,000ft^2	103,000ft^2	189,000ft^2
	Domestic	77,000ft^2	102,500ft^2	77,000ft^2	102,500ft^2
Cargo Terminal,	International		23,500ft^2		23,500ft^2
	Domestic		1,300ft^2		1,300ft^2
Control Tower and Operation		32,000ft^2	32,000ft^2	32,000ft^2	32,000ft^2
Fire Station/Garage		29,000ft^2	29,000ft^2	29,000ft^2	29,000ft^2
Main Power Substation		11,000ft^2	11,000ft^2	11,000ft^2	11,000ft^2

Table 6-1 -- continued

	Case 1		Case 2	
	Phase I (1995)	Phase II (2005)	Phase I (1995)	Phase II (2005)
Aeronautical Telecommunications Facilities				
Aeronautical Mobile Service Facilities				
VHF Transmitter 50W	6 units	12 units	6 units	12 units
VHF Receiver	6 units	12 units	6 units	12 units
Air Traffic Control Consoles	1 set	1 set	1 set	1 set
Magnetic Taperecorder	1 set	1 set	1 set	1 set
VHF Auto Direction Finder	1 set	1 set	1 set	1 set
Aeronautical Mobile Service Facility (for ACC)				
Air Traffic Control Consoles	1 set	1 set	1 set	1 set
Aeronautical Fixed Service Facilities				
Aeronautical Operation Consoles	1 set	1 set	1 set	1 set
Teletypewriter	18 units	18 units	18 units	18 units
Airport Surveillance Radar Facility				
ASR		1 set		1 set
SSR		1 set		1 set
Radar Data Processing System		1 set		1 set
Bright Display or TV Scope		1 set		1 set
Radio Navigational Aids				
ILS Cat-I	1 set	1 set	1 set	1 set (LLZ relocated)
NDB 2 kW	1 set	1 set	1 set	1 set
NDB 100 W	2 sets	2 sets	2 sets	2 sets
Terminal VOR/DME	1 set	1 set	1 set	1 set
Meteorological Service Facility				
Weather Data Collecting Equipment	1 set	1 set	1 set	1 set
Runway Visual Range Measuring Equipment (RVR)	2 sets	2 sets	2 sets	2 sets
Ceilometer	1 set	1 set	1 set	1 set
Weather Facsimile Receiver	2 units	2 units	2 units	2 units
Teletypewriter	4 units	4 units	4 units	4 units

Table 6-1 -- continued

	Case 1		Case 2	
	Phase I (1995)	Phase II (2005)	Phase I (1995)	Phase II (2005)
Car Parking				
For Passengers and Employees				
Parking Spaces	520	790	520	790
Area	196,000ft^2	298,000ft^2	196,000ft^2	298,000ft^2
For Cargo Use				
Area	3,000ft^2	26,000ft^2	3,000ft^2	26,000ft^2
Fuel Storage				
Daily Capacity	200,000Imp.gal	430,000Imp.gal	200,000Imp.gal	430,000Imp.gal
7-day Reserve	1,400,000Imp.gal	3,000,000Imp.gal	1,400,000Imp.gal	3,000,000Imp.gal
Storage Area	226,000ft^2	226,000ft^2	226,000ft^2	226,000ft^2
Distribution System	Hydrant	Hydrant	Hydrant	Hydrant
Utilities				
Electric Power Capacity				
Passenger Terminal Buildings	700kVA	1,900kVA	700kVA	1,900kVA
Cargo Terminal Buildings	120kVA	120kVA	120kVA	120kVA
Admini./Operation Building	230kVA	230kVA	230kVA	230kVA
Airfield Lighting	220kVA	220kVA	220kVA	220kVA
Radio Nav-aids	60kVA	140kVA	60kVA	140kVA
Others	300kVA	830kVA	300kVA	830kVA
Sub-Total	1,630kVA	3,440kVA	1,630kVA	3,440kVA
Existing Facilities	400kVA	200kVA	400kVA	200kVA
Total	2,030kVA	3,640kVA	2,030kVA	3,640kVA
Water Supply/day	253,000Imp.gal	355,300Imp.gal	253,000Imp.gal	355,300Imp.gal
Sewage Treatment Capacity/day	193,600Imp.gal	273,000Imp.gal	193,600Imp.gal	273,000Imp.gal
Telephone Circuit Facility	1 set	1 set	1 set	1 set

Table 6-1 -- continued

	Case 1		Case 2	
	Phase I (1995)	Phase II (2005)	Phase I (1995)	Phase II (2005)
Airfield Lighting System				
Approach Lighting System				
Runway 21, Culvert System, 900 m	1 set	1 set	1 set	1 set
Runway 03, Simple System, 420 m	1 set	1 set	1 set	Relocated
Approach Light Beacon	2 sets	2 sets	2 sets	Relocated
Visual Approach Slope Indicator System (3-BAR Type)	2 sets	2 sets	2 sets	Relocated
Runway Edge Lights				
High Intensity Elevated Type	1 set	1 set	1 set	1 set
Runway End Lights				
High Intensity Elevated Type	1 set	1 set	1 set	Relocated
Runway Threshold Lights				
High Intensity Elevated Type	1 set	1 set	1 set	Relocated
Taxiway Edge Lights				
Medium Intensity Elevated Type	1 set	1 set	1 set	1 set
Taxing Guidance Sign	1 set	1 set	1 set	1 set
Runway Distance Marker Lights	1 set	1 set	1 set	1 set
Aerodrome Beacon	1 unit	1 unit	1 unit	1 unit
Wind Direction Indicator Lights	2 units	2 units	2 units	2 units
Apron Flood Lights	1 set	1 set	1 set	1 set
Car Parking and Street Lights	1 set	1 set	1 set	1 set

Table 6-1 -- continued

	Case 1		Case 2	
	Phase I (1995)	Phase II (2005)	Phase I (1995)	Phase II (2005)
Airport Special Equipment				
Boarding Bridge	2	4	2	4
Baggage Handling Unit				
International, Out-bound	2	3	2	3
In-bound	2	4	2	4
Domestic, Out-bound	1	1	1	1
In-bound	2	2	2	2
X-Ray Baggage Inspection System				
International	1	2	1	2
Domestic	2	2	2	2
Metal Detector System				
International	1	2	1	2
Domestic	2	2	2	2
Flight Information Display System				
International	1	1	1	1
Domestic	-	1	-	1
Elevator				
International Passenger Terminal (750 kg)	1	1	1	1
Domestic Passenger Terminal (750 kg)	-	1	-	1
Tower (600 kg)	2	2	2	2
Escalator, International Passenger Terminal	-	1	-	1
Domestic Passenger Terminal	-	1	-	1
Vehicles				
Fire Fighting and Rescue				
Crash Fire and Rescue Truck, 1,890 lit./minute	1	1	1	1
Water Supply Truck, 6,000 litres	2	2	2	2
Rapid Intervention Vehicle	1	1	1	1

6.2 Airport Facility Planning

6.2.1 Review of Existing Facilities

(1) Basic Facilities

As already mentioned in the foregoing some of the existing facilities at Rangoon International Airport, such as runway strip, taxiway, apron, etc. are capable of accommodating wide-bodied aircraft when the airport is upgraded to a higher service category. However the runway length and the ILS equipment are inadequate and must be revised.

Specifically, the width of 1,000 feet of the existing runway strip satisfies the ICAO precision approach runway requirements. The runway width of 200 feet and the taxiway width of 100 feet exceed the requirements of ICAO Standards and are comparable to the airports of major cities in other countries of the region which serve Boeing 747 and other wide-bodied aircraft. The 700 feet distance secured between the center lines of the runway and taxiway, is also adequate.

The apron depth of 675 feet from the center-line of the taxiway to the far edge of the area provides adequate clearance and also plenty of manoeuvering space for the wide-bodied aircraft to park at right angles in nose-in and push-out procedures.

The lengths of both runway strip and runway, however, are inadequate to accommodate wide-bodied aircraft to fly long-distance international routes.

Concrete paving of the runway, taxiway and apron, despite the fact that they have retained an adequate thickness and bearing strength, concrete pavement materials have deteriorated in a lapse of 25 years. Peeling of surface and disintegration of aggregates due to weathering are observed, necessitating urgent overlay at the earliest possible opportunity. Cracks in the concrete slabs of the central and side lanes of the runway and in parts of the taxiway are considered to be causing erosion by rainwater accelerating uneven sinking and caulking failure between slab joints.

The existing ILS localizer siting must be improved to meet the ICAO siting criteria. To accommodate wide-bodied aircraft operations, relocation of the glide path aerial to the west side of the runway is also necessary.

High weeds now found on the runway strip is detrimental to drainage and to aircraft operation, and must be cut at regular intervals.

Also, the trees on both the East and West sides of the runway strip could interfere with the transitional surface and may need to be felled after a more detailed investigation.

(2) Meteorological, Telecommunications and Air Traffic Control Building

Accompanying the runway extension, this building must be relocated close to the centre of the runway.

(3) Passenger Terminal Building

Table 6-2 shows the peak-hour passenger processing capacity of the existing terminal building for the assumed high and low of the tolerable peak-hour handling capacity to be provided; and the year in which the capacity limit will be reached in each case.

Table 6-2 Passenger Processing Capacity of Existing Terminal

	Floor Area	Tolerable Peak-Hour Passenger Handling Capacity	Year in which Capacity is Reached
International Service	50,680ft^2	156	1980
		186	1986
Domestic Service	24,700ft^2	115	1980
		154	1981

The above table shows that both international and domestic portions of the terminal building require an expanded accommodation in early stage of Phase I development.

If the existing terminal is converted to exclusive domestic use, the total domestic passenger processing capacity during the peak hour will be as shown in Table 6-3.

Table 6-3 Domestic Passenger Processing Capacity of Existing Terminal Renewal

Floor Area	Tolerable Peak-Hour Passenger Handling Capacity	Year in which Capacity is Reached
75,380ft^2	350	1989
	471	1995

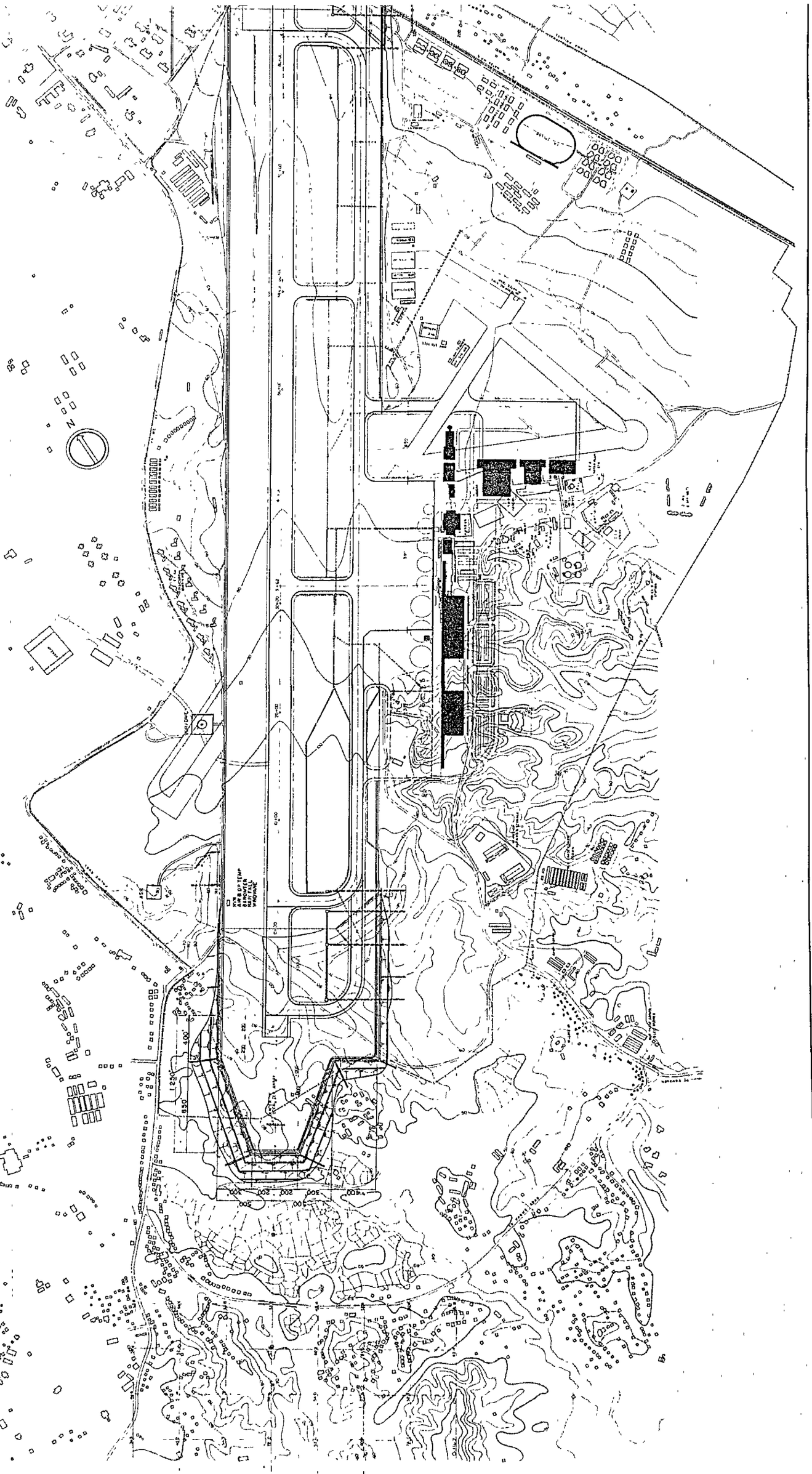
(4) Fire Fighting and Rescue Facilities

In view of the anticipated change in the airport service category and the need to optimise the airport layout, the existing facilities must be demolished and rebuilt.

6.2.2 Facility Layout Plan

(1) Runway, Taxiway and Apron

The runway strip, runway, taxiway and apron shall be arranged as per layout plan shown in Figures 6-1 and 6-2 for each of the alternative cases of development studied for this Project.



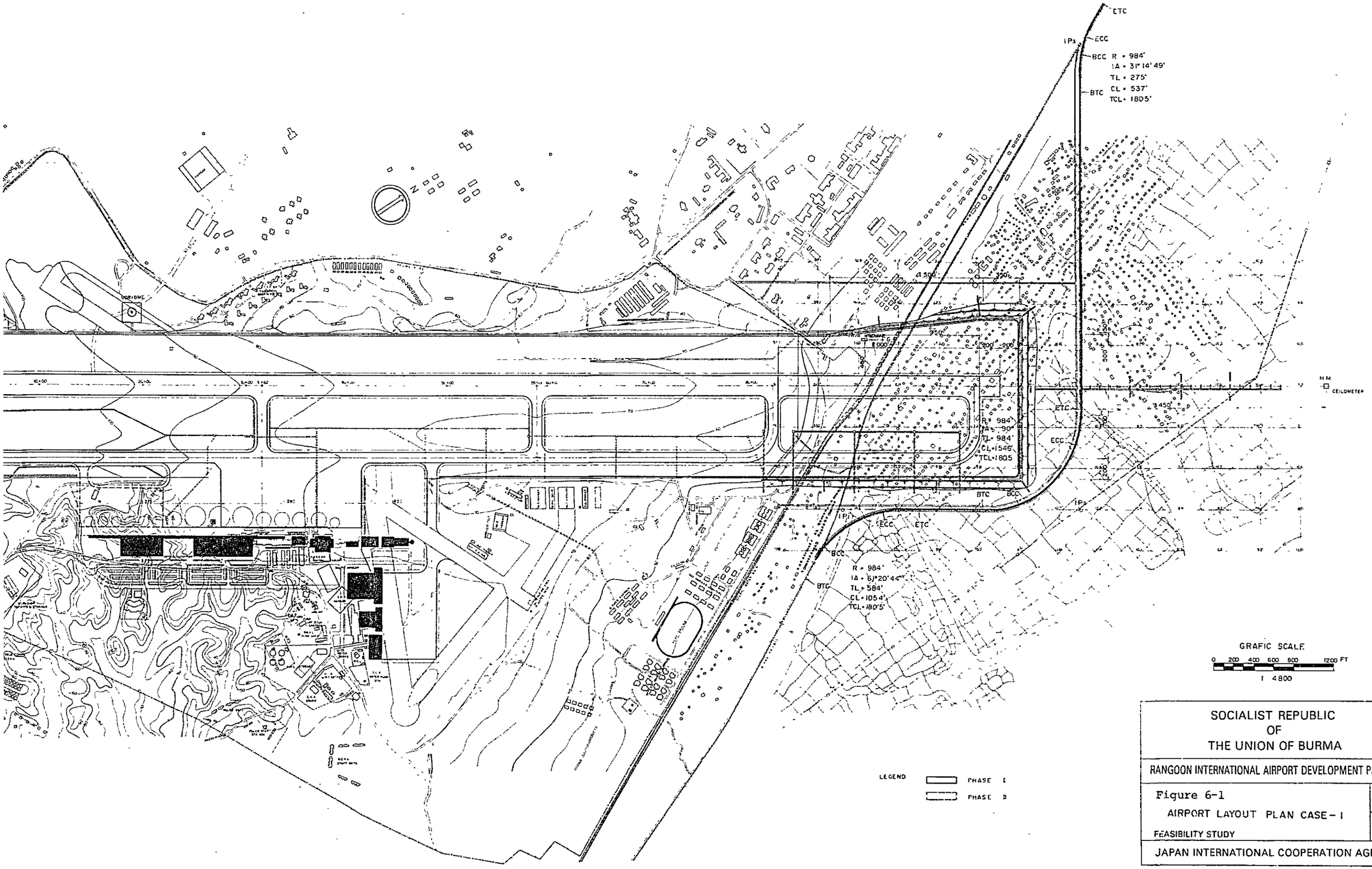


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Figure 6-1
AIRPORT LAYOUT PLAN CASE - I

MAR 1980

2

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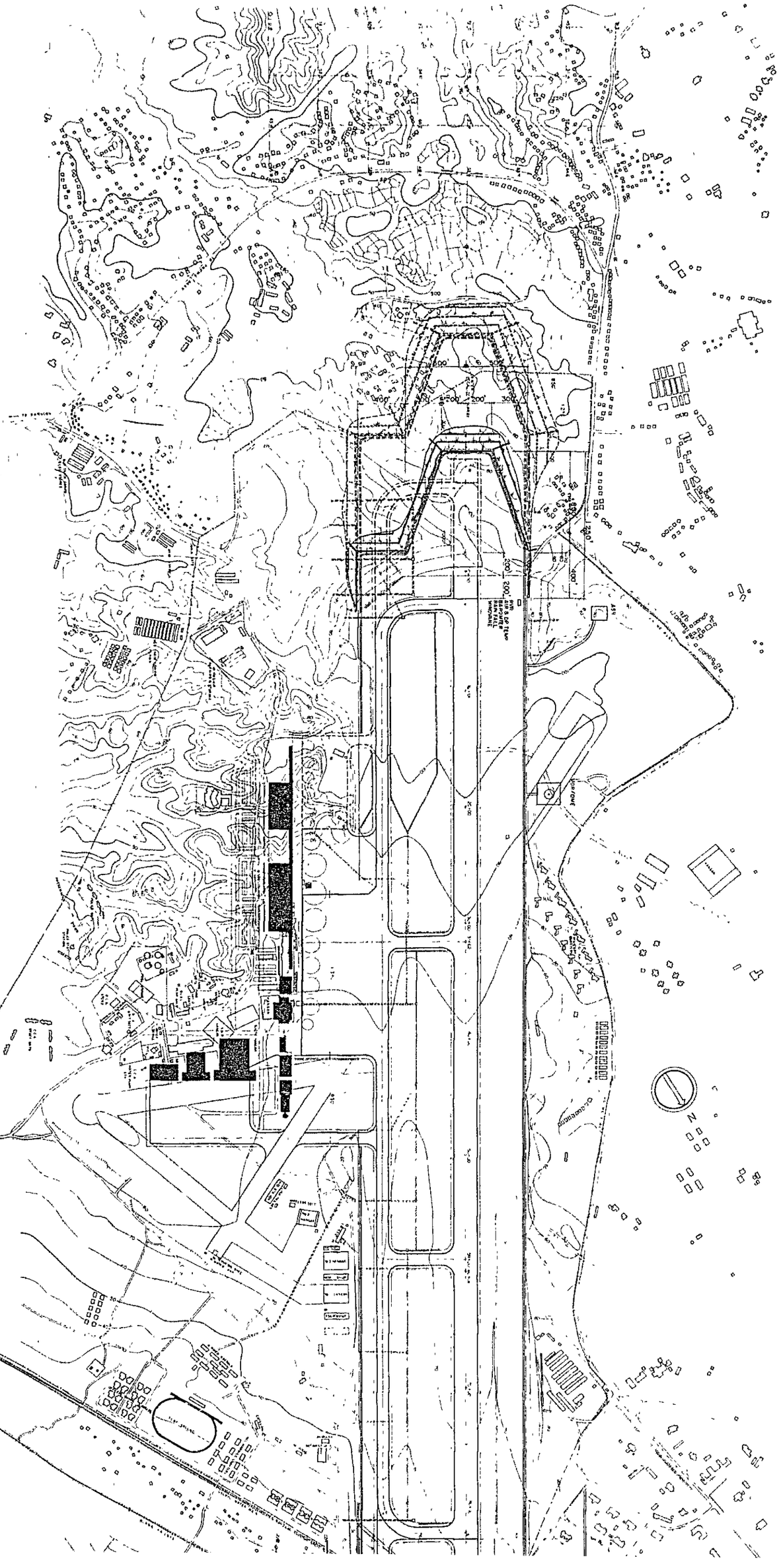

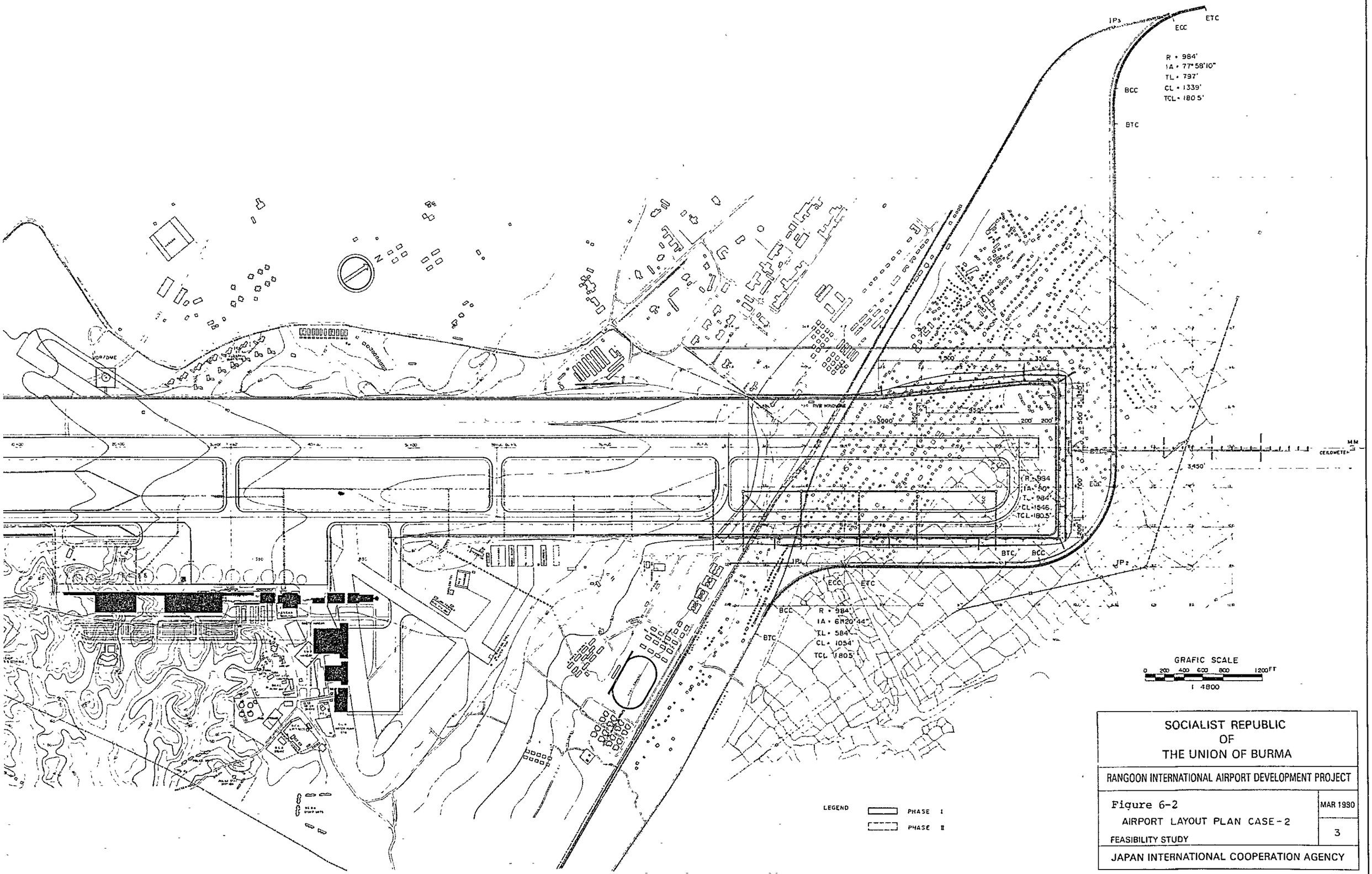

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Figure 6-2 AIRPORT LAYOUT PLAN CASE-2	MAR 1980
FEASIBILITY STUDY	3
JAPAN INTERNATIONAL COOPERATION AGENCY	

(2) Terminal Facilities

1) Passenger Terminal Building

Separate passenger terminal buildings are planned for international and domestic passengers for their efficient and convenient embarkation and disembarkation and because of the need to consider aircraft parking and phased construction of the Project.

a. International Passenger Terminal Building

The new international passenger terminal for Phase I is planned to be divided into departure and arrival blocks and for one-and-a-half-level passenger processing. The departure block is designed to cater for check-in and processing functions on the first floor and waiting lounge for embarking passengers on the second floor, while the arrival block is divided into baggage claim and customs inspection area on the first floor, and quarantine and immigration facilities on the second floor (see Figure 6-3).

In Phase II, an extension with 6 spans of 25 feet each in North and South directions of the terminal building are planned for the arrival and departure functions respectively (see Figure 6-4).

b. Domestic Passenger Terminal Building

The existing all purpose terminal building is planned to be remodelled into an exclusive domestic passenger terminal with one-level passenger handling system for Phase I. After the remodelling the existing international passenger area will cater for domestic arrivals, while for departures (with a central lobby) the existing domestic facilities will be expanded and refurnished. Almost no alteration to the structural framework of the building itself is planned (see Figure 6-3).

In Phase II, a new one-and-a-half-level domestic terminal building with departure and arrival blocks is planned to be built on the South side of the international terminal building. The departure block is planned to accommodate check-in and other processing functions on the first floor and departure lounge on the second floor. The arrival block is planned to accommodate arrival lounge connected to fingers on the second floor, with baggage claim are on the first floor. To accentuate the continuity of the first and second levels, a void space with the entire ceiling height of the two-story building is provided on the curb side of the terminal building (see Figure 6-4).

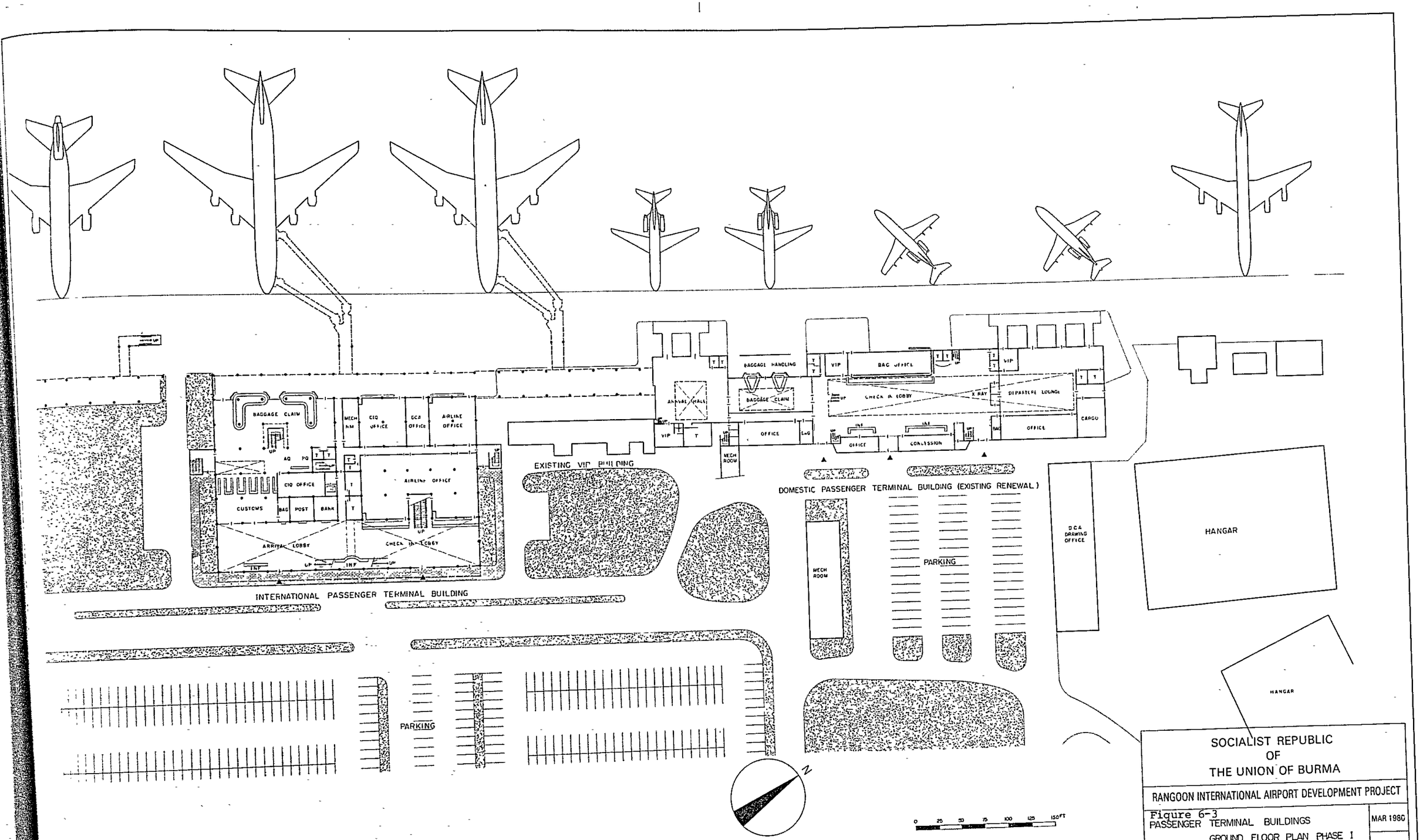

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Figure 6-3
PASSENGER TERMINAL BUILDINGS
GROUND FLOOR PLAN PHASE I

MAR 1980

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FEASIBILITY STUDY

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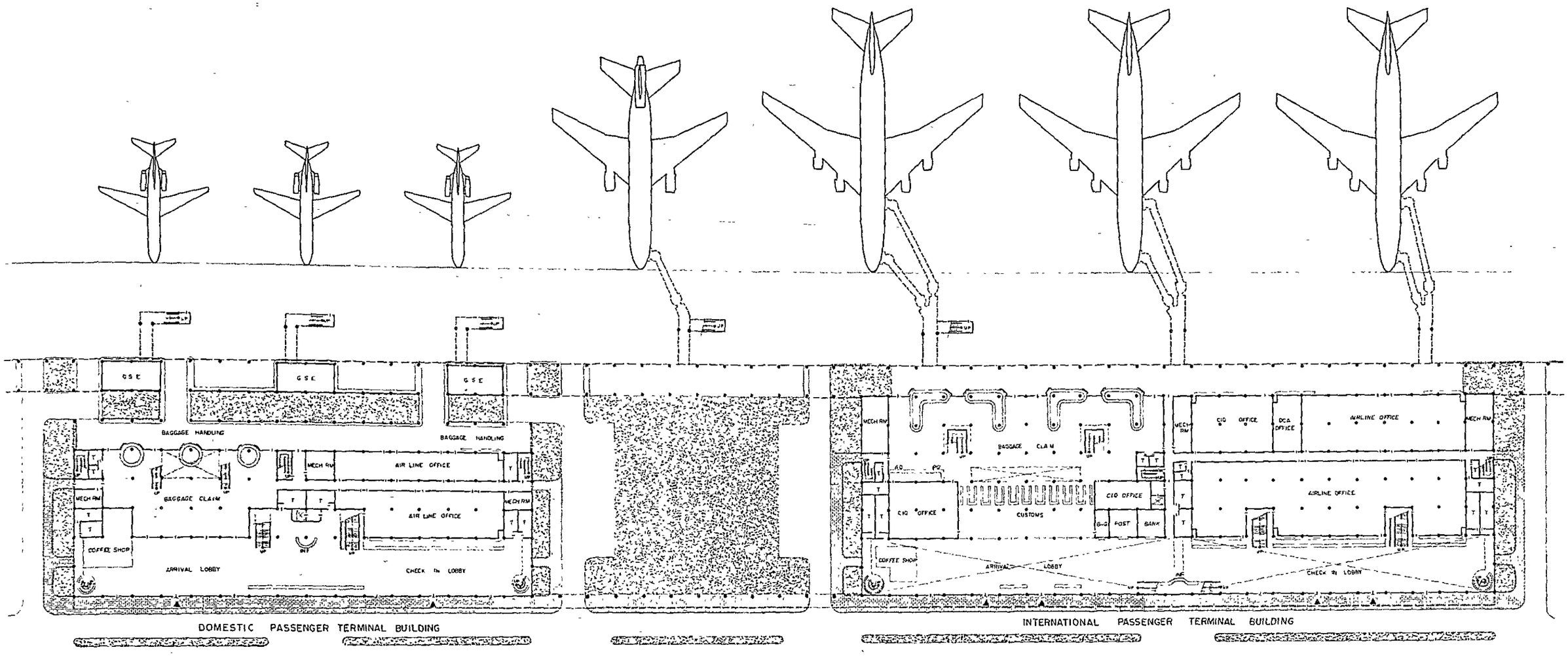

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Figure 6-4
PASSENGER TERMINAL BUILDINGS
GROUND FLOOR PLAN PHASE II

MAR 1980

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FEASIBILITY STUDY

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2) Cargo Terminal Building

The cargo terminal building is planned to be located on the North of the international passenger terminal building in order to segregate the cargo handling vehicles from the general airport vehicle traffic and also considerating the location of the cargo loading apron. The cargo building is planned for common use by both international and domestic cargoes. Within the cargo building there will be separate high security areas for international and domestic cargoes besides the space for loading and sorting (see Figure 6-5).

3) Control Tower and Operational Building

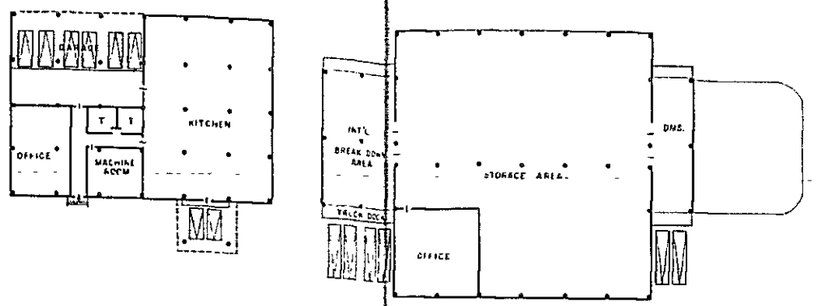
For the sake of security, the control tower and operational building is planned as an independent building to be located at the North end of the terminal area close to the centre of the runway.

4) Main Substation

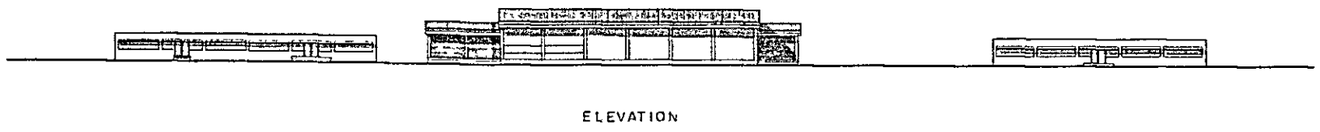
The main substation is planned to be integrated into the control tower and operational building for security reasons.

5) Fire Fighting and Rescue Facilities

To facilitate emergency action, fire fighting and rescue facilities are placed on the South of the control tower, operational and main substation building.



PLAN GROUND FLOOR



ELEVATION

SECTION

CATERING BUILDING

INTERNATIONAL & DOMESTIC CARGO BUILDING

GSE BUILDING

0 25 50 75 100 125 150FT

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Figure 6-5 INTERNATIONAL & DOMESTIC CARGO BUILDING, G.S.E.& CATERING BUILDINGS	MAR 1980
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JAPAN INTERNATIONAL COOPERATION AGENCY	

(3) Radio Navigational Aid Facilities

Installation of ILS, NDB, Terminal VOR/DME is planned in Phase I in both Case 1 and Case 2 as shown in Figure 6-6. ILS comprises a localizer, glide path, middle marker and outer marker. The existing ILS is not operative due to equipment failure. It may be repaired if the necessary spare parts could be obtained, but the facility is already 10 years old and will require renewal sooner or later during the period of the Rangoon International Airport Development Project. For this reason renewal is planned in Phase I.

All three NDBs are more than 20 years old and obsolete, and are planned to be renewed.

Existing VOR/DME at 12 NM to the North of the proposed runway extension is only a few years old and is planned to be used as is. However, in order to facilitate approach and departure courses on the existing VOR/DME installation of T-VOR/DME is planned within the airport perimeter in Phase I.

(4) Telecommunications Facilities

Installation of new telecommunications facilities, including air traffic control consoles for the Area Control Centre, are planned as detailed in Table 6-1 in order to modernize the facilities and, at the same time, to avoid interruption of telecommunication services of both the airport and the Area Control Centre during the period of relocation of the airport administration building.

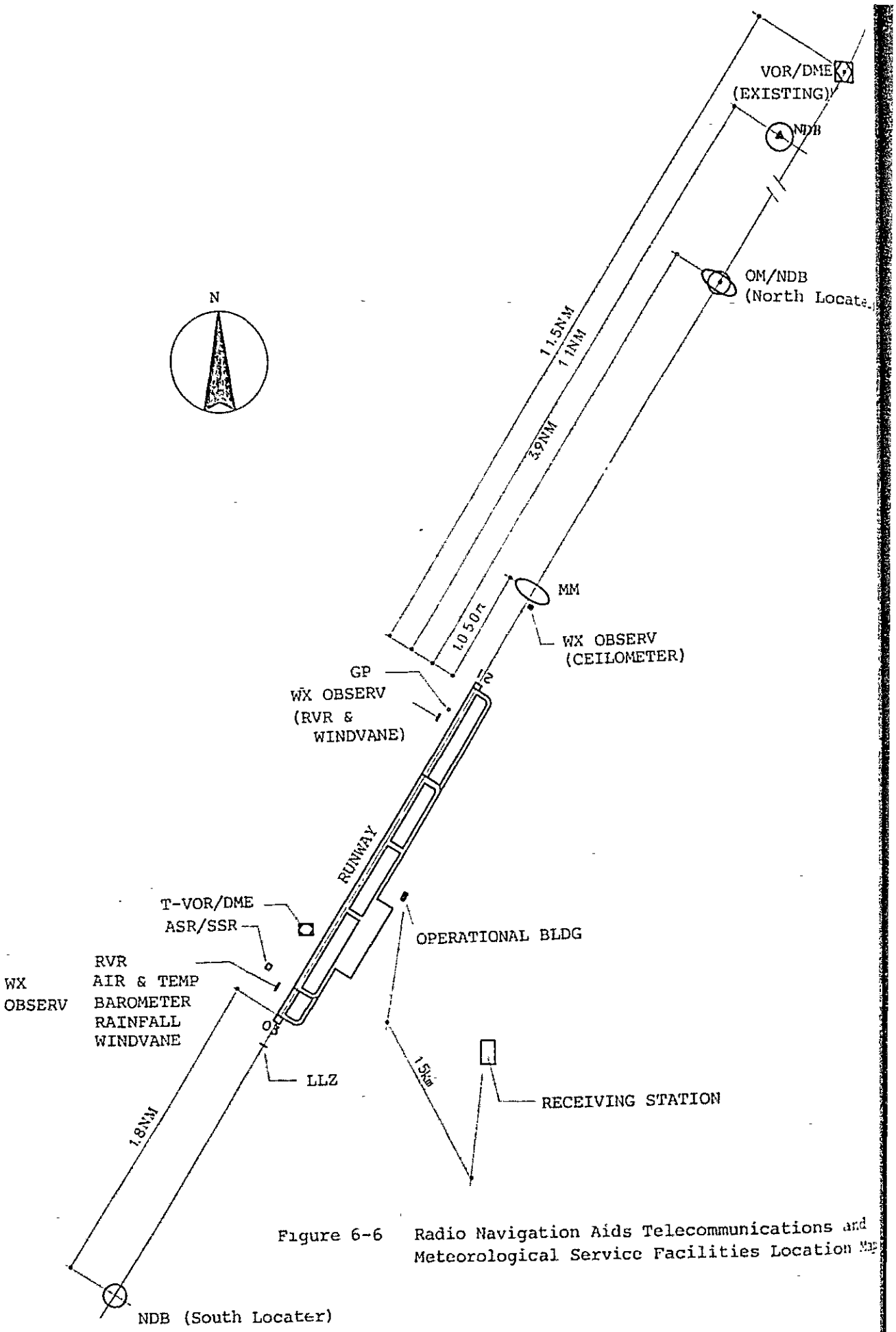


Figure 6-6 Radio Navigation Aids Telecommunications and Meteorological Service Facilities Location Map

As indicated also on Table 6-1, installation of an airport surveillance radar system consisting of ASR, SSR, RDP and Bright Display or TV scope is planned in Phase II in both Case 1 and Case 2.

(5) Meteorological Service Facilities

In order to modernize the facilities and to again avoid service interruption while relocating the airport administration building, installation of the meteorological service facilities is planned as shown in Table 6-1 in accordance with the ICAO Annex 3 recommendations.

(6) Airfield Lighting System

The airfield lighting system is planned in conformity with the standards and recommendations of Annex 14 and Part 4 of the Aerodrome Design Manual of ICAO. Table 6-1 lists the facilities illustrated in Appendix 7A. A culvert type approach lighting system is planned for precision approach runway 21, and a simplified approach lighting system is planned for the non-precision runway 03.

(7) Electric Power Supply System

Power is to be supplied by the Electric Power Corporation from the 33 kV Insein Substation about 10 miles away at 33 kV, 3-phase 3-wire system in 50 Hz cycle through a new 33 kV EPC Substation to be built just outside the airport premises.

Construction of a main substation is planned on the airport premises to receive the 33 kV power supplied by EPC and reduce the voltage to 6.6 kV for distribution to the airport facilities including the passenger terminal building, cargo terminal building, administration building, lighting and telecommunications facilities. Schematic diagram of the electric power distribution system is shown in Figure 6-7. Power for the existing facilities is to be supplied from the new main substation through the existing main substation in Phase I.

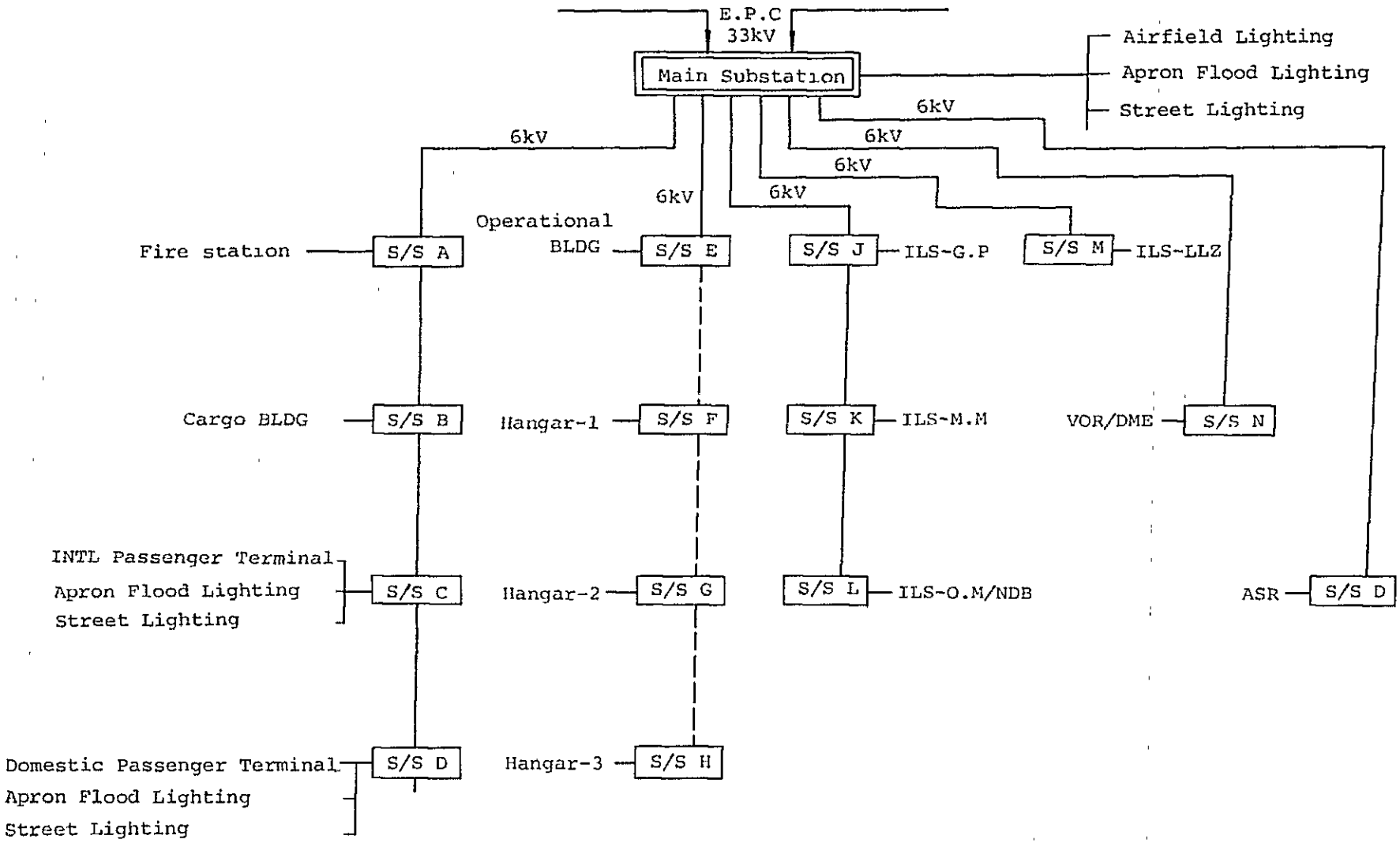


Figure 6-7 Electric Power Distribution System

6.3 Airspace Use Plan

Instrument approach and departure procedures for the extended runway are planned primarily in accordance with the criteria contained in ICAO PANS OPS Doc. 8161/611/3 and partly with the Criteria for Establishment of Instrument Approach/Departure Procedures and Weather Minima established by the Civil Aviation Bureau of Japan.

6.3.1 Radio Navigational Aids

Instrument approach and departure procedures are planned as shown in Figure 6-8 based upon the following assumed location of the new and existing radio navigational aids in relation to the new extended runway configuration (extended 2,000 feet to the North and 1,000 feet to the South).

(1) VOR/DME (HGU), existing

To remain at 033° magnetic, 22.2 km from the North end of the existing runway.

(2) VOR/DME (xxx), new

To be located at 220 m West of the runway centre line at a point 850 m North from a line drawn perpendicular to the centre-line at the South end of the extended runway.

(3) Localizer (IMD), renewed and relocated

Approximately 300 m South-West of runway threshold, on the extended runway centre-line.

(4) Glide Path (xxx), renewed and relocated

Approximately 350 m inward from the North end of the extended runway.

(5) Outer Marker (xxx), renewed and relocated

7.2 km away from the North end of the extended runway on the extended runway centre-line.

(6) Middle Marker (xxx), renewed and relocated

1,060 m away from the North end of the extended runway on the extended runway centre-line.

(7) NDB (RGN), renewed

(8) NDB (MDN), renewed and relocated

Co-located with the outer marker.

(9) NDB (MDS), renewed

Approximately 3.4 km from the South end of the extended runway.

6.3.2 Instrument Approach Procedures

Four different types of instrument approach procedures are planned to accommodate various types of aircraft operating into Rangoon International Airport.

- ILS Approach Procedure to Runway 21 (Cat. I) (Figure 6-9)
- VOR-ADF Approach Procedure (Figure 6-10)
- VOR Approach Procedure (Figure 6-11)
- ADF Approach Procedure (Figure 6-12)

6.3.3 Landing Minimum

(1) ILS straight-in approach to runway 21 (Cat. I)

DH	RVR	VIS
258 ft	800 m	800 m

(2) VOR-ADF straight-in approach to runway 21

MDA	RVR	VIS
400 ft	1,600 m	1,600 m

(3) VOR straight-in approach to runway 21

MDA	RVR	VIS
400 ft	1,600 m	1,600 m

(4) ADF straight-in approach to runway 03

MDA	RVR	VIS
480 ft	1,600 m	1,600 m

(5) Circling Minimum*

Assumed Approach Category	MDA	VIS
A	480 ft	1,600 m
B	560 ft	1,600 m
C	560 ft	2,400 m
D	660 ft	3,200 m

* Circling not authorized East of runway

(6) Alternate Minimum

CIG	VIS
600 ft	3,200 m

Notes: 1. According to the information made available to the survey team during the field survey, there exists no major obstacle in the vicinity of the airport except for a Pagoda, 55 m above MSL, located 1.3 km South-West of the airport, Power Line Towers approximately 1.7 km North-East of the North end of runway, and radio antenna 61 m above MSL located 1.8 km South-East of airport. It is understood that appropriate measures will be taken for the removal of the Power Line Towers in question. Decision Height (DH) and Minimum Descent Altitude (MDA) are calculated accordingly.

2. Runway usability of the extended runway, calculated on the basis of landing/take-off minima for each procedure is undetermined due to lack of sufficient weather data. However, a precision approach system will certainly contribute to improving the runway usability.

3. Information obtained from the authority indicates that South and Southwesterly winds prevail at Rangoon International Airport. Therefore, the ILS approach is planned to be made from the North.

6.3.4 Instrument Departure Procedures

Standard Instrument Departure Procedures are planned as illustrated in Figure 6-13. SID No.1 and No.3 bring aircraft directly from the airport to the enroute navigational aids, HGU VOR/RGN NDB, while SID No.2 and No.4 are planned to gain altitude before entering enroute airspace.

Take Off Minimum

CIG	RVR	VIS
200 ft	800 m	800 m

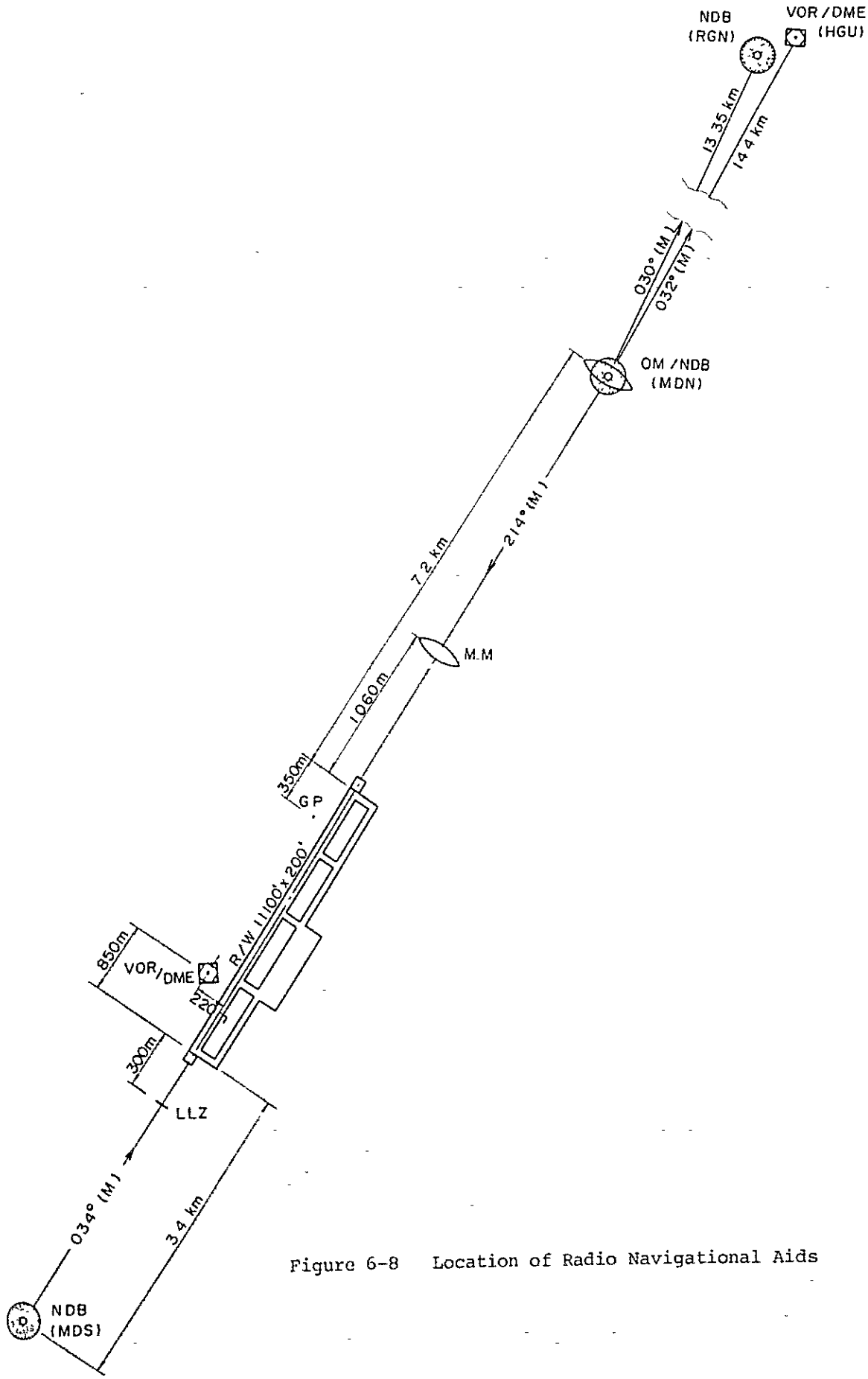
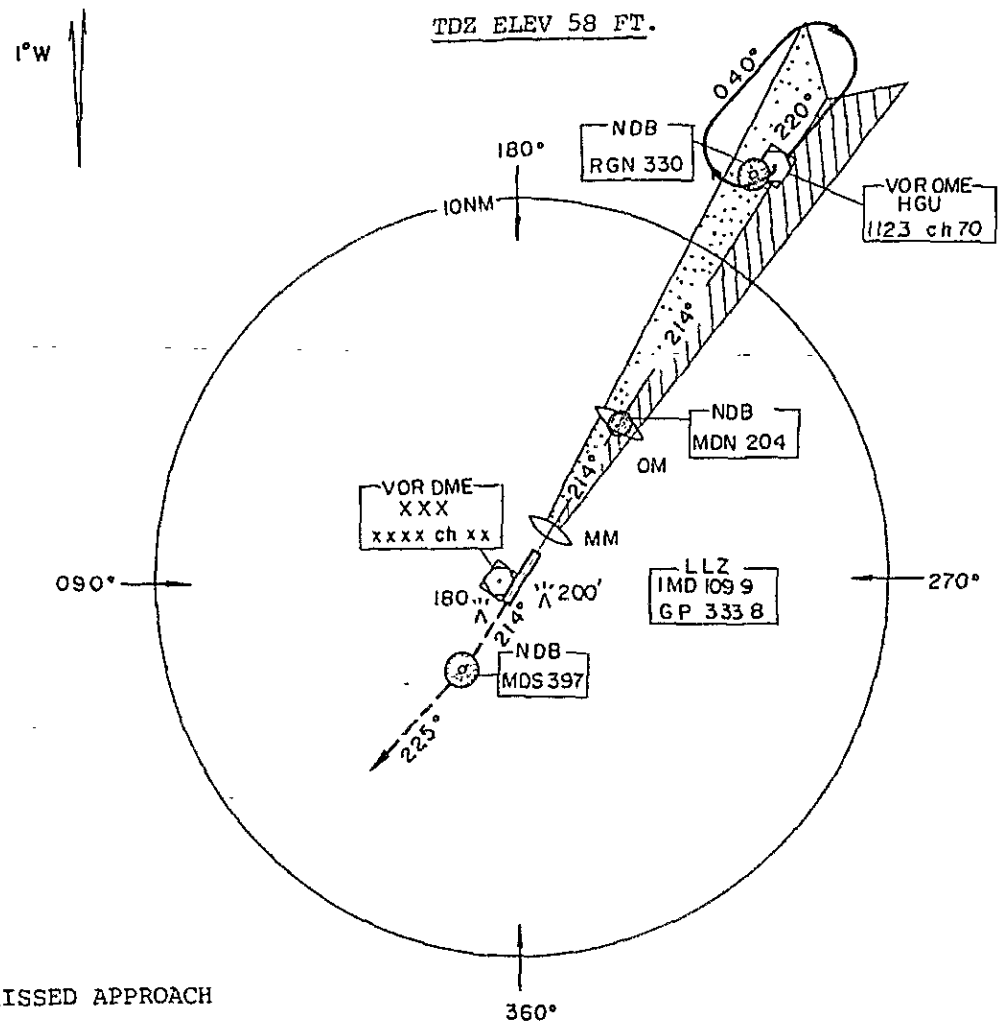


Figure 6-8 Location of Radio Navigational Aids



MISSED APPROACH

At D.H., Climb on 210° to MDS NDB, right turn continue climb on 225° bearing from MDS DNB to 2,000 feet, Contact RANGOON APP.

ILS REFERENCE DATUM 60 FT.

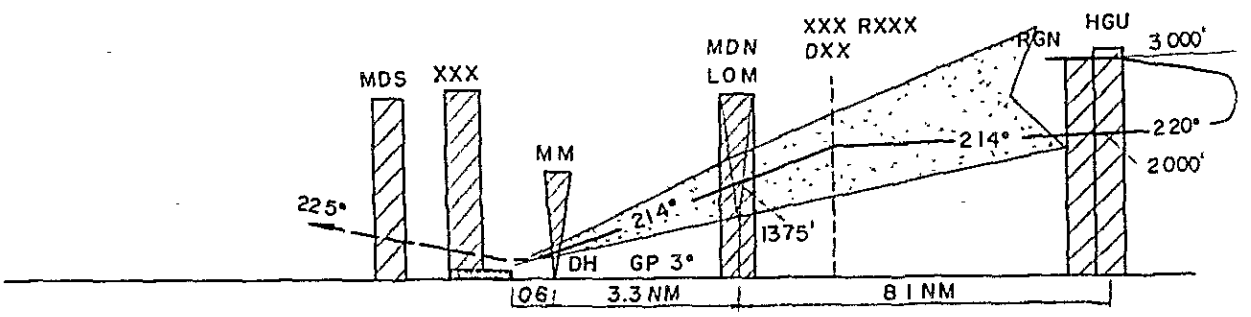
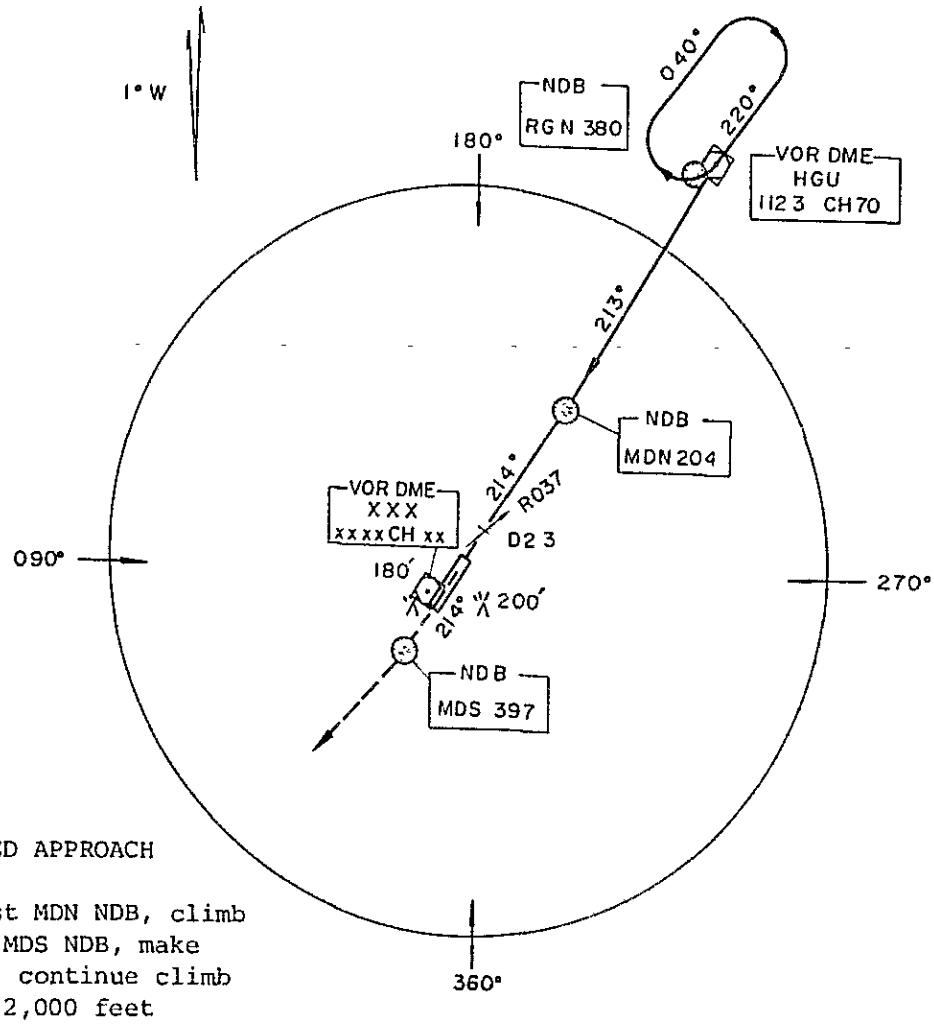


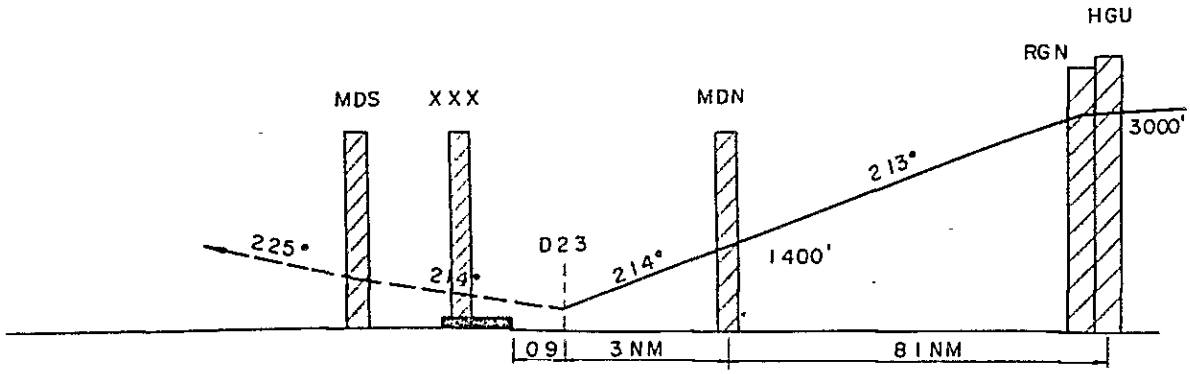
Figure 6-9 Rangoon ILS RWY 21

AP ELEV 109 FT.



MISSED APPROACH

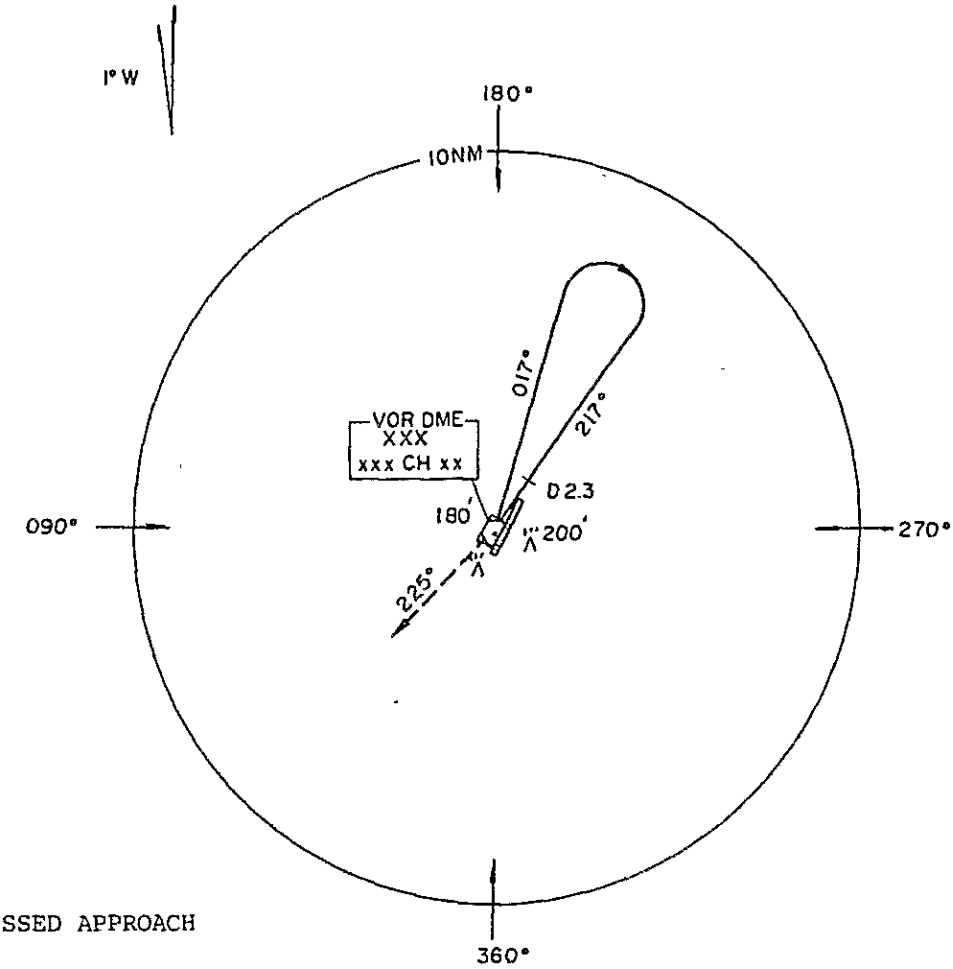
At 3 NM past MDN NDB, climb on 214° to MDS NDB, make right turn, continue climb on 225° to 2,000 feet contact APP.



MDN to MISSED APPROACH POINT						
Kts	60	90	120	150	180	210
Sec	180"	120"	90"	72"	60"	51"

Figure 6-10 Rangoon VOR-ADF APCH

AP ELEV 109 FT.



MISSED APPROACH

At 2.3 DME, climb on 217°
to XXX VOR, turn right continue
climb on 225 Radial of XXX VOR
to 2,000 feet, contact APP.

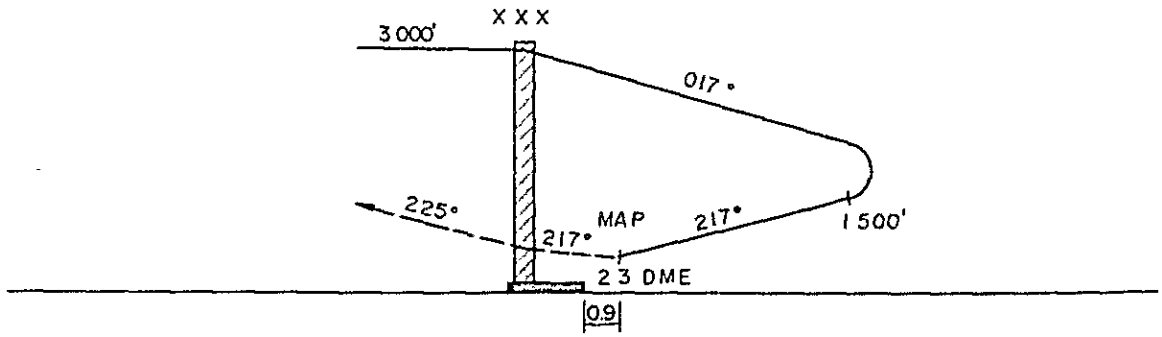
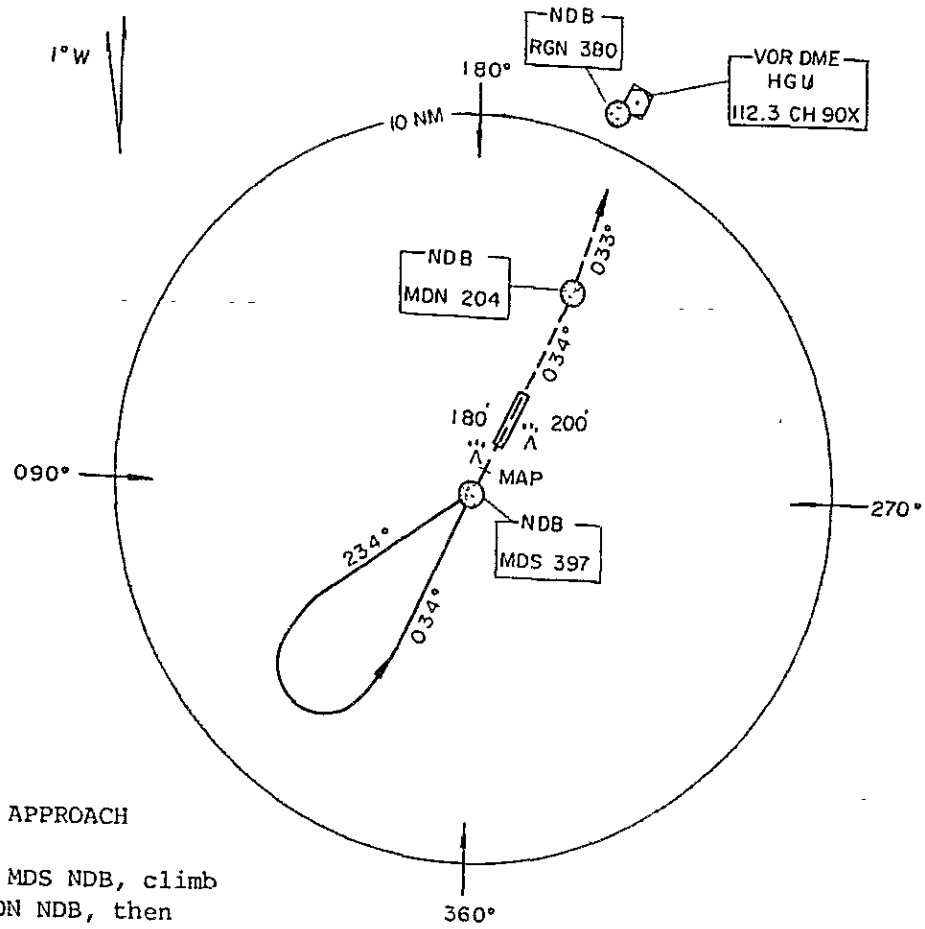


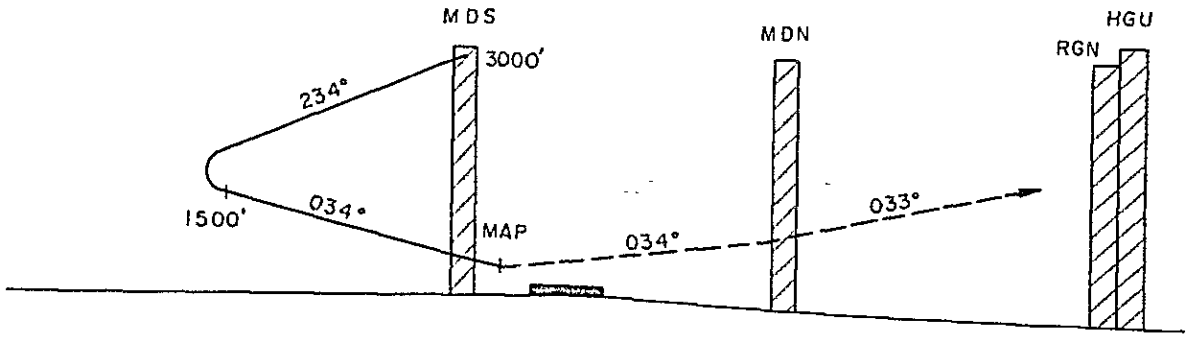
Figure 6-11 Rangoon VOR APCH

AP ELEV 109 FT.



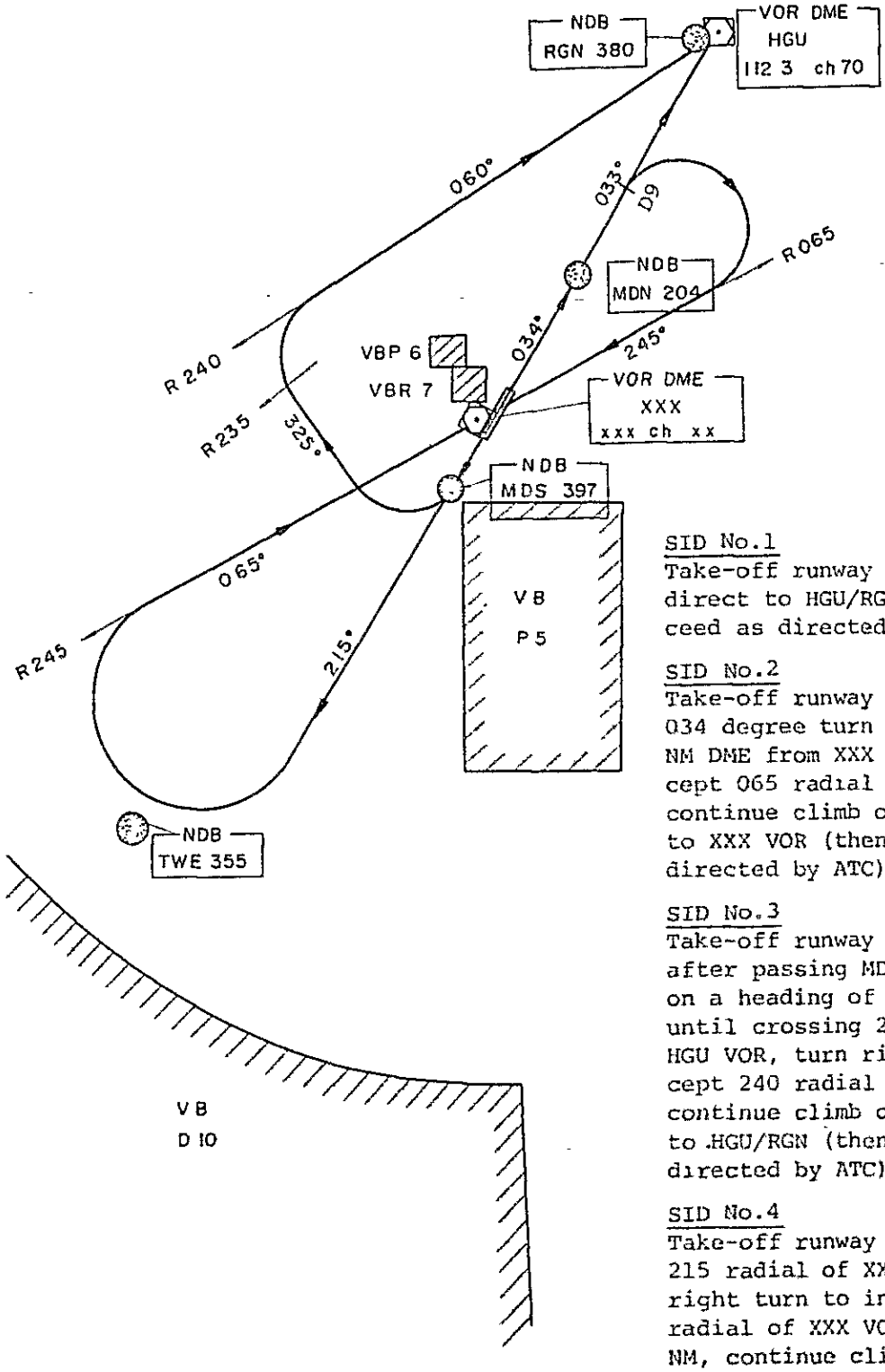
MISSED APPROACH

At 1 NM past MDS NDB, climb on 034° to MDN NDB, then proceed to HGU/RGN climbing to 2,000 feet, contact APP.



MDS NDB to MISSED APPROACH POINT					
Kts	60	90	120	150	180
Sec	60"	40"	30"	24"	20"

Figure 6-12 Rangoon ADF APCH



SID No.1
Take-off runway 03, proceed direct to HGU/RGN (then proceed as directed by ATC).

SID No.2
Take-off runway 03, climb on 034 degree turn right at 9 NM DME from XXX VOR to intercept 065 radial of XXX VOR, continue climb on 245 degree to XXX VOR (then proceed as directed by ATC).

SID No.3
Take-off runway 21, right turn after passing MDS NDB, climb on a heading of 325 degree until crossing 235 radial of HGU VOR, turn right to intercept 240 radial of HGU VOR continue climb on 060 degree to HGU/RGN (then proceed as directed by ATC).

SID No.4
Take-off runway 21, climb on 215 radial of XXX VOR, make right turn to intercept 245 radial of XXX VOR within 15 NM, continue climb on 065 degree to XXX VOR (then proceed as directed by ATC).

Figure 6-13 Standard Instrument Departure

CHAPTER 7. CONSTRUCTION SCHEDULE AND COST ESTIMATES

CHAPTER 7 CONSTRUCTION SCHEDULE AND COST ESTIMATES

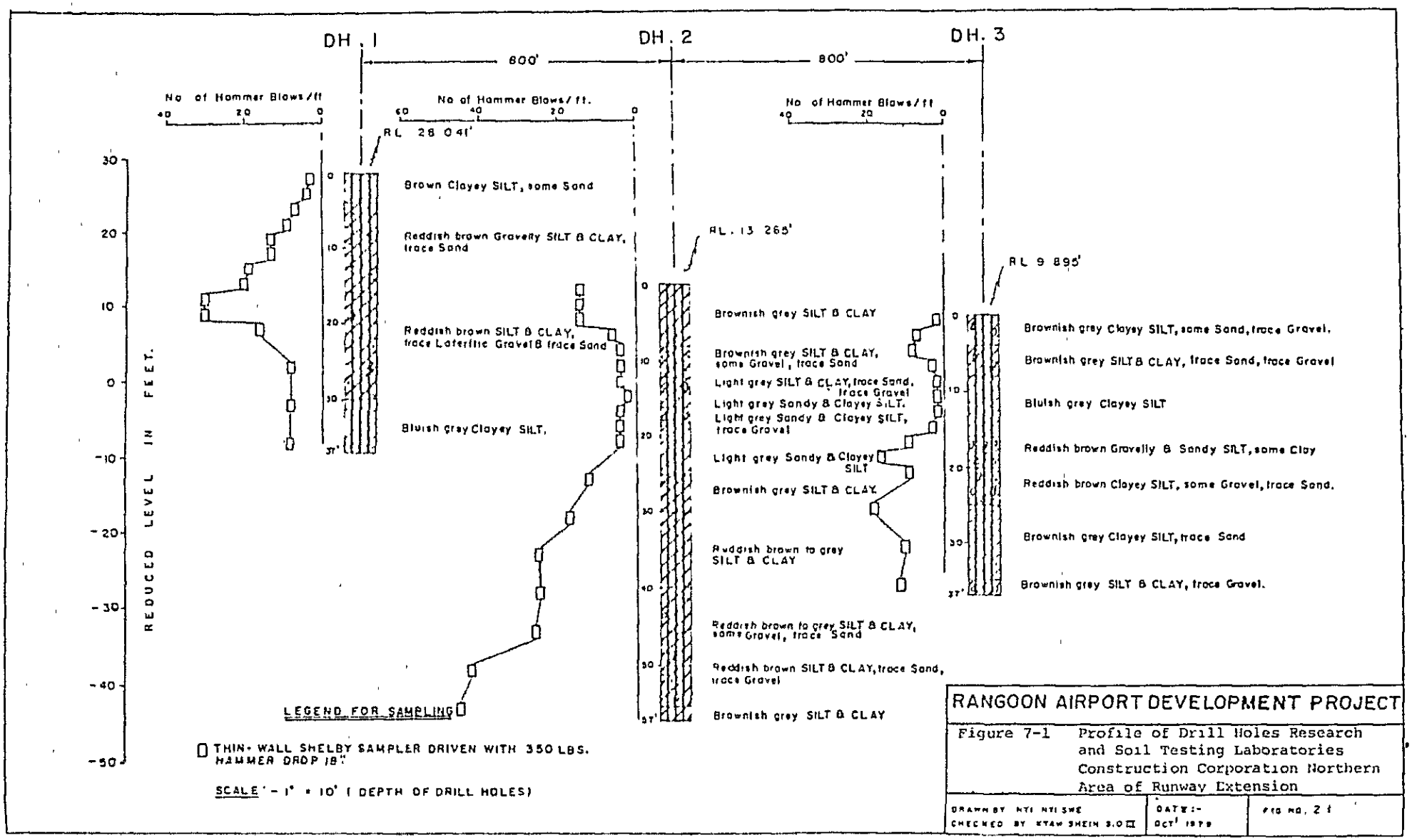
7.1 Construction Conditions

7.1.1 Soil

According to the results of the soil survey as shown in Figure 7-1, the soil in the proposed site area consists mainly of approximately 5 feet thick wearing course (top soil) of lateritic clay fairly well consolidated with an N value of around five. Because of this the amount of settlement due to consolidation by the ultimate banking load is estimated to be about 1.8 feet at the most, or around 6% of the average height of banking. The Northward extension site of the runway is seen to abound more in gravel mixture than the Southward extension area, due presumably to the influence of the creek located about 3,500 feet North of the Northern edge of the existing runway.

7.1.2 Construction Materials

The sources of the major materials necessary for this Project, namely gravel, crushed stone, cement, asphalt and steel materials are indicated below with their source of supply and local availability.



RANGOON AIRPORT DEVELOPMENT PROJECT

Figure 7-1 Profile of Drill Holes Research and Soil Testing Laboratories Construction Corporation Northern Area of Runway Extension

DRAWN BY NYI NYI SWE | CHECKED BY KYAW SHEIN S.O.E | DATE :- OCT' 1979 | FIG NO. 2 f

(1) Borrow Pits

With regard to the use of borrow pits as source of earth fill, there are five prospective sites around the existing airport as indicated in Figure 7-2. Table 7-1 shows the available earth volumes expected which, however, may include a fine sand layer besides lateritic clay.

Table 7-1 Available Earth Volume

P-I	25.13	Lakh%cft	equal to	7.11 x 10^6	m^3
P-II	7.80	"	"	2.21	"
P-III	3.47	"	"	0.98	"
P-IV	19.70	"	"	5.58	"
P-V	2.01	"	"	0.57	"
Total	58.11	Lakh%cft	equal to	16.45 x 10^6	m^3

(2) Sand, Gravel and Crushed Stone

Sand is available from various places along the Irrawaddy River and between Rangoon and Mandalay among which that from Pyinbongyi near Pegu is of the finest quality.

Gravel is available from Henzada and Pegu, with that from Henzada being of the finest quality.

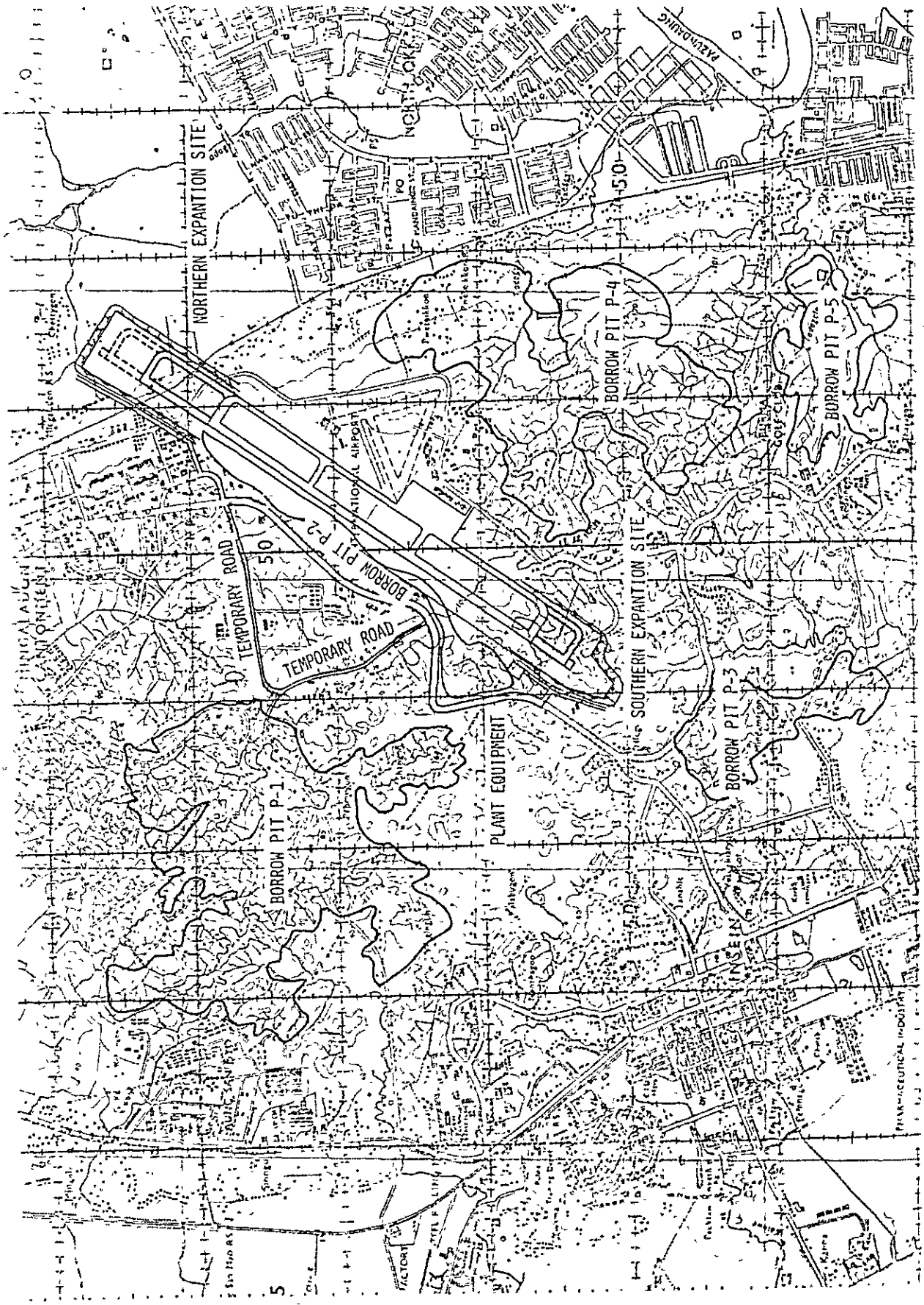


Figure 7-2 Location of Borrow Pits, Temporary Road, and Plant Equipment Yard

Granite and gneiss available in sufficient quantities from quarries between Kyaikto and Zingyaik in Lower Burma and limestone from quarries in Kyangin, Toungoo and Mandalay are considered to be suitable source of material for crushed stone needed for the Project.

(3) Cement and Asphalt

At present, Burma has two local cement mills, one in Kyangin and another in Thayetmyo, but their combined production volume is only 1,200 tons per day. Although expansion of the Kyangin cement mill is planned, the supply of cement is not considered adequate for this Project.

Asphalt is not produced in Burma and has to be imported from Japan or some other country.

(4) Steel Materials

Hardly any steel is produced in Burma except for a small volume of reclaimed round bar. Accordingly, steel materials must be imported from Japan or some other country.

7.1.3 Construction Equipment and Machinery

The principal equipment and machinery needed for the Project are as follows.

(1) Plants

Asphalt Plant
Batcher Plant
Crushing Plant

(2) Major Construction Machinery for Earthwork

21-32 ton class Bulldozer
3.5 m^3 Wheeled-loader
11 ton Dump Truck
3.7 m class Motorized Grader
26 ton class Tamping-roller
12-28 ton Tire Roller
15-25 ton class Hydrocrane

(3) Major Construction Machinery for Pavement

Asphalt Distributor
Asphalt Finisher
12-15 ton Macadam Roller
15-30 ton Tire Roller
11 ton Dump Truck

(4) Soil Exploration Equipment and Material Testing Apparatus (Appendix 7B).

7.2 Civil Works

7.2.1 Earthwork

(1) Volume of Earthwork

The required volume of earth fill calculated from the design formation level is shown in Table 7-2. The longitudinal section and the tipical cross sections are shown in Appendix 7A.

Table 7-2 Volume of Earth Fill

		(mill. cft)
Case 1	Phase I	186.7
	Phase II	3.3
Case 2	Phase I	180.6
	Phase II	60.9

(2) Earthwork Plan

Prior to banking work, soft soil in the construction site must be removed and trees felled and uprooted. In banking, earthmoving is done by 21 ton class bulldozer and rolling and compacting by 26 ton class soil compactor.

Filling earth from the borrow pit is excavated by 32 ton class bulldozer with ripper, loaded by wheel loader and hauled to the construction site by 11 ton class dump truck. A temporary road at least 13 m wide with two lanes on either side should be provided for the hauling of earth and

sand to RIA. This road should be kept sprinkled with water and repaired by motor grader from time to time as required.

Earthwork is planned on a 24-hour day basis and requires lighting facilities. Lighting for the banking site shall have an average of 25 luxes of illumination to be provided by mobile generators and lighting equipment.

Lighting for the borrow pit shall also be of 25 luxes coming from a mobile source. An average 5 luxes of lighting is planned for the temporary haul road.

Since the estuary of Pazundaung Creek exists to the North of the planned runway extension area, coffering shall be made to prevent the water from interfering with the earthwork.

7.2.2 Pavement Work

(1) Bearing Strength of Subgrade

No CBR test of planned embankment subgrade was conducted, and the design CBR and K-value were assumed at 8 and 100 pci respectively by reference to the FAA's soil classification chart.

(2) Pavement Surface Material

Table 7-3 compares the characteristics of asphalt and cement concrete pavements normally applied to airport surfacing. As shown in this table asphalt is more advantageous because of its

economy, workability and ease of maintenance and repair, and is adopted for all new pavement surfaces of the airport.

Table 7-3 Comparison of Asphalt and Cement Concrete Pavements

	Asphalt	Cement
Thickness	Thick	Thin
Load Bearing Characteristics	Surface may be rutted depending on load	Can accommodate variety of loads without rutting
Joint	Not needed	Needed between slabs to absorb effects of temperature variation
Weathering	Surface tends to harden and lose cohesion rather soon	Weathering does not much affect the bearing strength
Cost	About 190 kyats/m^2 (CBR = 8%)	About 290 kyats/m^2 (K = 100 pci)
Construction Period	Rather short and suitable for surfacing of extensive area	Longer
Maintenance and Repair	Easier because spot repair is possible	Difficult, because it involves breaking up of concrete slabs, and long curing period

(3) Pavement Thickness

Design conditions for determining the pavement thickness are as follows:

Aircraft type	:	B-747 200B
Annual frequency of departure and landing	:	2,700 times
CBR of subgrade	:	8%
CBR of subbase	:	20%
K-value of subgrade	:	100 pci
K-value of subbase	:	200 pci

The typical cross section of a new pavement is shown in Appendix 7A.

(4) Pavement Construction Method

Pavement work is planned for execution mostly during the dry season, and the design value of subgrade CBR is based on the assumption that the subgrade will be constructed in dry conditions.

The actual level of subgrade, therefore, shall be made slightly higher than the design height so that if the subbase work cannot be carried out immediately after the subgrading work on wet days, the wet soil on the surface of subgrade may be graded off before proceeding to the subbase work.

The construction schedule, however, necessarily involves the months of May and October which are the beginning and the end of the rainy season. All subgrading surfaces shall be provided with temporary sumps and 2-4% gradients in order to assure rapid surface drainage and to allow pumping off of collected water.

(5) Overlay Work

The planned thickness of overlay is based on the FAA standards. As for the material asphalt is adopted, as it seems more appropriate in view of the various constraints imposed by airport operation.

The typical cross section of overlay is shown in Appendix 7A. The finished overlay thickness of a layer of overlay shall be 2.5" at the most, and its edges shall rub on the existing pavement at the slope of 1% or less.

Overlay work shall be executed without causing interruption to normal operation of the airport. The runway overlay in particular shall be constructed during the night and restored to serviceable condition by the following morning. Overlay work of the runway shall be commenced in the centre lane. First, the middle one-third of the centre lane shall be worked on, followed by work on the southern one-third and finally on the remaining northern portion. Then, work on the side lanes shall be executed.

7.3 Building Works

7.3.1 Types of Building Structure

As shown in Table 7-4, the proposed types of building structure are: steel framed structure for the international and domestic passenger terminal buildings and the cargo terminal building, and reinforced concrete for the control tower and operational building and the fire station.

Table 7-4 Type of Building Structure

Buildings	Structure
International Passenger Terminal	Steel-framed
Domestic Passenger Terminal	Steel-framed
Cargo Terminal	Steel-framed
Control Tower and Operational	Reinforced Concrete
Fire Station	Reinforced Concrete

7.3.2 Foundation of Buildings

Judging from the profile of drill holes obtained in the soil survey, the foundation of each building is planned to be of steel piles.

7.3.3 Construction Programme

Bearing in mind the constraints of the rainy season, the construction schedule of each building is made as shown in Table 7-5. This schedule is based on the assumption that finishing work, including work on the interior, may be executed during the rainy season after completion of the structural frame in dry season.

Since the existing administration and operation building, and fire fighting and rescue facilities are located on the proposed site of the international terminal building, they must be demolished before the construction of that building is started. Thus, the new control tower and operational building and the new fire fighting and rescue facilities must be constructed in the initial stages of the Project.

7.4 Equipment Installation

7.4.1 Radio Navigational Aids, Telecommunications and Meteorological Service Facilities

(1) Radio Navigational Aid Facilities

There is no plan for relocation of the NDB located at 11.5 NM on the Northward extension of the existing runway and another NDB at 2.0 NM on the Southward extension of the runway, but the equipment is planned to be renewed.

As for the NDB installed at 3.5 NM to the North of the runway, the equipment shall be renewed and the total facility relocated to the ILS-OM site.

The entire ILS equipment and ancillary facilities shall be renewed. Each component facility site shall be connected by underground cables with the new control tower and operational building.

In Phase II of Case 2, the localizer must be relocated in conjunction with the planned Southward extension of the runway by 1,000 feet.

(2) Telecommunications Facilities

As for the telecommunications facilities, the main air-ground radiotelephony equipment shall be installed in the receiving station, and other facilities including facilities for Area Control Centre shall be installed in the control tower and operational building, which shall be connected by underground cable with the receiving station.

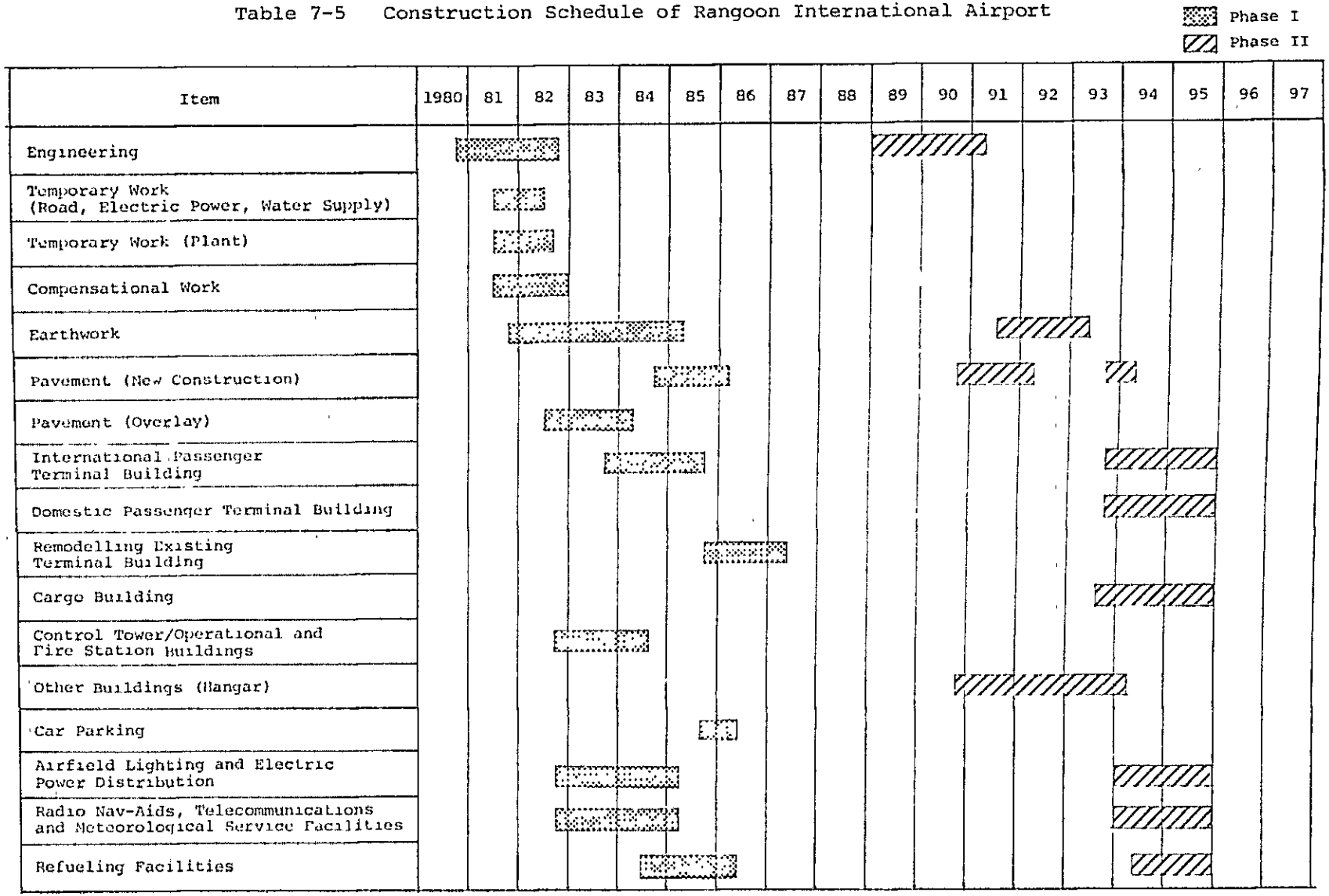
(3) Meteorological Service Facilities

The new weather observation sensors for the meteorological observation facilities shall be installed within the airport premises, together with meteorological data recording devices and meteorological telecommunications facilities in the control tower and operational building, which shall be connected by underground cable to each of the above-mentioned site.

7.5 Construction Schedule

The construction schedule shown in Table 7-5 is based on the premise that survey, engineering and design work will commence during 1980.

Table 7-5 Construction Schedule of Rangoon International Airport



7.6 Construction Cost Estimates

Construction costs estimated by type of work on the basis of the following conditions are presented in Tables 7-6 and 7-7.

1) Unit costs used in the estimation of construction costs are based on the data obtained by the JICA survey mission during October and November 1979.

2) The foreign currency portion of the construction costs include the following items:

   a. Costs of construction equipment not including customs duty.

   b. Imported items such as asphalt, building interior materials, radio and lighting equipment, not including any taxes or duty.

   c. Wages and salaries of non-resident engineers and technical staff.

   d. Maintenance expenses of construction equipment, including spare tyres, etc.

3) The local currency portion includes the following items:

   a. Operating expenses of construction equipment.

   b. Construction materials available in Burma such as aggregates, timber, etc.

c. Wages and salaries of local workers.

d. Inland transportation expenses of imported materials and equipment.

e. Compensation for relocation and land acquisition costs.

4) Engineering fees shall be 10% of the total construction costs.

5) Contingency reserve shall be 10% of the total construction costs.

6) The exchange rate of U.S.Dollar, Burmese Kyat and Japanese Yen used in the calculation is 1 US$ = 6.35 Kyat = ¥240, prevailing as of November 1979.

Table 7-6 Case 1 - Estimate Construction Cost of Rangoon International Airport

(thousand US$)

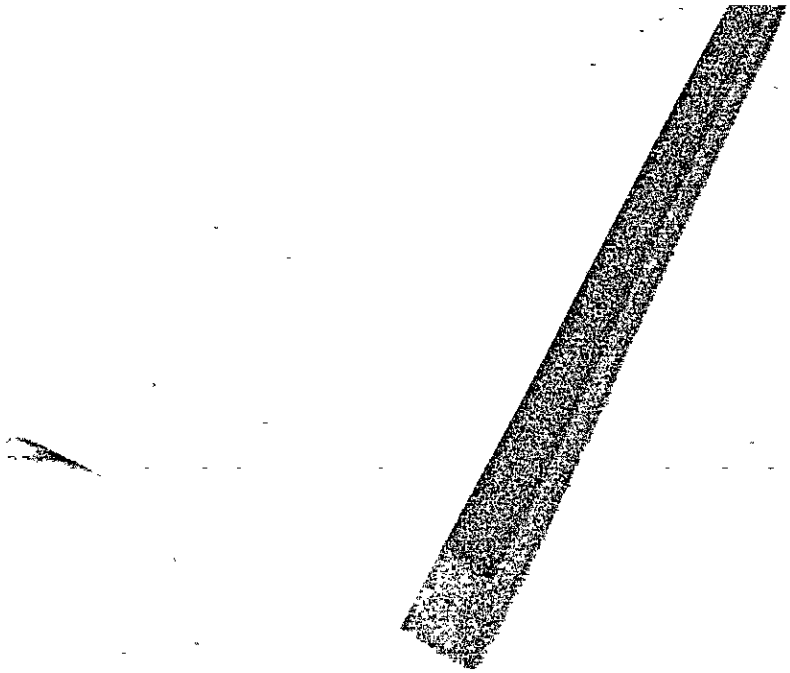
Cost Item	Phase I			Phase II			Total		
	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total
nd Acquisition and Relocation of Building	0	54	54	0	0	0	0	54	54
mporary Work	2,370	835	3,205	0	0	0	2,370	835	3,205
mpensational Work	207	3,415	3,622	0	0	0	207	3,415	3,622
rthwork	10,841	5,098	15,939	191	82	273	11,032	5,180	16,212
vement	5,624	7,534	13,158	391	1,954	2,345	6,015	9,488	15,503
ildings	9,564	5,475	15,039	13,614	3,963	17,577	23,178	9,438	32,616
ıcraft Maintenance Facilities	0	0	0	2,568	1,804	4,372	2,568	1,804	4,372
rfield Lighting and Electric Power Supply	5,439	683	6,122	968	169	1,137	6,407	852	7,259
dio Nav-Aids Telecommunications and Meteorological Service Facilities	3,510	243	3,753	3,347	69	3,416	6,857	312	7,169
fueling Facilities	6,435	252	6,687	2,757	108	2,865	9,192	360	9,552
tal Construction Cost	43,990	23,589	67,579	23,836	8,149	31,985	67,826	31,738	99,564
gineering Fee	6,758		6,758	3,199		3,199	9,957		9,957
ntingency	4,399	2,359	6,758	2,383	815	3,198	6,782	3,174	9,956
and Total	55,147	25,948	81,095	29,418	8,964	38,382	84,565	34,912	119,477

Table 7-7 Case 2 - Estimate Construction Cost of Rangoon International Airport

(thousand US$)

Cost Item	Phase I			Phase II			Total		
	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total
Land Acquisition and Relocation of Building	0	61	61	0	0	0	0	61	61
Temporary Work	2,370	835	3,205	0	0	0	2,370	835	3,205
Compensational Work	240	3,941	4,181	0	0	0	240	3,941	4,181
Earthwork	10,370	4,888	15,258	3,496	1,661	5,157	13,866	6,549	20,415
Pavement	5,593	7,438	13,031	600	2,997	3,597	6,193	10,435	16,628
Buildings	9,564	5,475	15,039	13,614	3,963	17,577	23,178	9,438	32,616
Aircraft Maintenance Facilities	0	0	0	2,568	1,804	4,372	2,568	1,804	4,372
Airfield Lighting and Electric Power Supply	5,524	677	6,201	1,219	258	1,477	6,743	935	7,678
Radio Nav-Aids Telecommunications and Meteorological Service Facilities	3,512	243	3,755	3,395	87	3,482	6,907	330	7,237
Refueling Facilities	6,435	252	6,687	2,757	108	2,865	9,192	360	9,552
Total Construction Cost	43,608	23,810	67,418	27,649	10,878	38,527	71,257	34,688	105,945
Engineering Fee	6,742		6,742	3,853		3,853	10,595		10,595
Contingency	4,361	2,381	6,742	2,765	1,087	3,852	7,126	3,468	10,594
Grand Total	54,711	26,191	80,902	34,267	11,965	46,232	88,978	38,156	127,134

CHAPTER 8. FINANCIAL ANALYSIS



CHAPTER 8 FINANCIAL ANALYSIS

8.1 General

The financial viability of the Rangoon International Airport Development Project was analysed based on the assumption that the new improved airport will be operated on a self-supporting accounting system. The evaluation was made in terms of the financial internal rate of return (FIRR) based on the cash flow of the financial costs and benefits of the Project calculated for the period of 1980-2005.

8.2 Estimate of Financial Costs

8.2.1 Construction Costs

Since the annual disbursement programme to cover the construction cost of the Project as presented in Tables 7-6 and 7-7 of Chapter 7 is based on the market prices, these figures are used as financial cost of the Project in the present analysis.

8.2.2 Maintenance and Operating Cost

Annual maintenance and operating costs of the newly developed airport facilities are assumed to be 2% of the construction costs.

8.3 Estimate of Financial Benefits

The financial benefits of the Rangoon International Airport Development Project comprise the operating revenues expected from the newly developed airport facilities and the cost of maintenance and operation of the existing airport facilities which will be fully saved once the new improved airport starts operating.

8.3.1 Airport Tariff Structure

The existing airport tariff structure is assumed to be revised effective 1986 when the new improved facilities are expected to open to traffic, so as to contribute to a maximum extent to recovering the investment required for the development. The revised new airport tariff structure will consist of the following items.

i) Landing Charge
ii) Aircraft Parking Charge
iii) Air Navigation Facility Use Charge
iv) Fuel Service Charge
v) Passenger Charge (Head Tax on Departing International Passengers)
vi) Terminal Building Rental
vii) Car Parking Charge

Of the above items, the new tariff levels of the fuel service charge, terminal building rental and car parking charge are set so the total investment and maintenance cost of the facilities related to each item may be completely recovered before the year 2005. On the other hand, the new tariff rates of the rest of the revenue items are set at highest tolerable or competitive levels at discretion of the present study team.

8.3.2 Estimate of Airport Revenue

Annual operating revenue attributable to the newly developed airport facilities of RIA comprise the difference between the total annual operating revenue of RIA from 1986 on and that of the existing RIA. Description of each new tariff item and the methods of calculation of the revenues expected are outlined below.

(1) Landing Charges

Landing charges are levied on aircraft according to the landing weight, and include aircraft parking rights of up to 12 hours. The assumed landing charges rate, at the RIA is shown in Table 8-1.

Table 8-1 Schedule of Landing Charges Rate at Rangoon International Airport

(Kyat)

Landing Weight		International Service	Domestic Service
Class A	Up to 2,500 lb.	4	2
B	7,499	20	10
C	14,999	40	20
D	24,999	100	50
E	49,999	200	100
F	99,999	600	300
G	199,999	1,200	600
H	200,000 and above	3,000	1,500

The landing charges on aircraft in domestic service shown in Table 8-1 above are rated twice as much as the current level, while charges on international flights are four times the current level.

Landing charges on the types of aircraft expected to serve the improved RIA amount to:

	Class of Landing Weight	Landing Charge (Kyat)
International Service		
360 seater	H	3,000
250	H	3,000
170	H	3,000
120	G	1,200
60	E	200
Domestic Service		
120 seater	G	600
60	E	100
40	E	100
20	C	20

(2) Aircraft Parking Charges

Aircraft parked beyond the initial 12 hour period are levied parking charges according the landing weights by the following rates.

Table 8-2 Schedule of Aircraft Parking Charges Rates at Rangoon International Airport

(Kyat)

	Landing Weight	Daily	Monthly	Quarterly
A	Up to 2,500 lb.	2	40	80
B	7,499	10	200	400
C	14,999	25	500	1,000
D	24,999	40	800	1,600
E	49,999	60	1,200	2,400
F	99,999	100	2,000	4,000
G	199,999	200	4,000	8,000
H	200,000 and above	300	6,000	12,000

(3) Air Navigational Aids User Charges

Air navigational aids user charges are levied on each aircraft, based on the following rates.

		Operational Charge Kyat	Movement Charge Kyat
A class:	Privately Owned Light Aircraft with VHF/RT only	10	5
B class:	Privately Owned Aircraft with All Radio Facilities	50	25
C class:	Chartered Aircraft and/or Common Carrier	200	100

(4) Fuel Service Charges

Fuel service charges are levied on the use of refueling facilities at an assumed constant rate of 0.1 Kyats per imperial gallon (2% of 1979 fuel price) through the year 2005.

(5) Passenger Charges (Head Tax on Departing International Passengers)

Passenger charges are collected from each passenger on outgoing international flights at a rate of US$2 per capita.

(6) Terminal Building Rental

Rentals are collected from tenants of the terminal building space such as offices, bars and restaurants, shops, etc. It is assumed that 21.5% of the terminal building space will be rentable at a rate of US$0.8 per sft.month.

(7) Car Parking Charges

Car parking charges are levied at a rate of 2 Kyats per car for one parking regardless of parking time. The annual number of parked cars of air passengers and well-wishers was assumed to equal the sum of 80% of the forecast number of international air passengers and 50% of domestic air passengers.

8.3.2 Saved Maintenance Costs of Existing Facilities

Maintenance cost presently being incurred at the existing RIA will be saved when the Project is implemented. This is considered to constitute benefits attributable to the Project. The saved costs are estimated from the relevant annual expenditure of the existing RIA, assuming that the annual amount calculated for each stage of development remains constant throughout the respective stage. The result is shown in Table 8-3.

Table 8-3 Estimated Saved Maintenance Costs of Existing Facilities

(In thousand 1979 US$)

Item	1985-1994	1995-2005
Equipment and Tools	3	3
Buildings	-	95
Road	8	16
Others	140	140
Total	151	254

8.4 Cash Flow of Financial Costs and Revenues

Cash flow of annual financial costs and revenues estimated in the foregoing for the period of 1980-2005 are shown in Table 8-4 and Table 8-5 for Case 1 and Case 2 respectively.

Table 8-4 Cash Flow of Financial Costs and Revenues of the Rangoon International Airport Development Project - Case 1

(In 1979 thousand US$)

	Costs			Revenues										
	Construction Cost	Maintenance & Operation Cost of New Facilities	Total Cost	Landing Charge	Housing Charge	Air Navigation Facilities Charge	Passenger Charge	Fuel Service Charge	Terminal Rental	Car Parking Charge	Saved Maintenance Cost	Total Revenue	Operating Surplus	Cumulative Balance
1980	13,667	0	13,667	0	0	0	0	0	0	0	0	0	0	-13,667
1	13,667	0	13,667	0	0	0	0	0	0	0	0	0	0	-27,334
2	13,667	0	13,667	0	0	0	0	0	0	0	0	0	0	-41,001
3	13,667	0	13,667	0	0	0	0	0	0	0	0	0	0	-54,668
4	13,667	0	13,667	0	0	0	0	0	0	0	0	0	0	-68,335
1985	13,667	0	13,667	0	0	0	0	0	210	0	151	361	361	-81,641
6	13,667	1,640	15,307	191	0	31	14	57	210	9	151	663	-977	-96,285
7	0	1,913	1,913	256	0	58	29	114	210	18	151	836	-1,077	-97,362
8	0	1,913	1,913	367	15	58	46	171	210	29	151	1,047	-866	-98,228
9	6,450	1,913	8,363	473	25	51	65	228	210	38	151	1,241	-672	-105,350
1990	6,450	1,913	8,363	540	32	76	87	285	210	50	151	1,431	-482	-112,282
1	6,450	1,913	8,363	690	62	73	110	369	210	61	151	1,726	-187	-118,919
2	6,450	1,913	8,363	779	62	100	136	449	210	73	151	1,960	47	-125,322
3	6,450	1,913	8,363	877	62	127	165	530	210	87	151	2,209	296	-131,476
4	6,450	1,913	8,363	1,032	52	92	197	612	210	102	151	2,448	535	-137,391
1995	6,450	1,913	8,363	1,128	65	55	231	694	450	117	254	2,994	1,081	-142,760
6	0	2,816	2,816	1,237	65	78	269	806	450	134	254	3,293	477	-142,283
7	0	2,816	2,816	1,366	71	106	309	919	450	150	254	3,625	809	-141,474
8	0	2,816	2,816	1,496	75	130	354	1,031	450	168	254	3,958	1,142	-140,332
9	0	2,816	2,816	1,607	75	153	404	1,144	450	188	254	4,275	1,459	-139,873
2000	0	2,816	2,816	1,749	83	182	459	1,256	450	210	254	4,643	1,827	-137,046
1	0	2,816	2,816	1,918	83	211	517	1,393	450	230	254	5,056	2,240	-134,806
2	0	2,816	2,816	2,058	94	232	577	1,531	450	253	254	5,449	2,633	-132,173
3	0	2,816	2,816	2,224	97	258	644	1,668	450	276	254	5,871	3,055	-129,118
4	0	2,816	2,816	2,389	97	285	716	1,806	450	303	254	6,300	3,484	-125,634
2005	0	2,816	2,816	2,522	103	309	797	1,943	450	330	254	6,708	3,892	-121,742
Total	140,819	47,017	187,836	24,699	1,218	2,665	6,126	17,006	7,050	2,826	4,304	66,094	19,077	-121,742

Residual Value = 22,525

Table 8-5 Cash Flow of Financial Costs and Revenues of the Rangoon International Airport Development Project - Case 2

(In 1979 thousand US$)

	Costs			Revenues										
	Construction Cost	Maintenance & Operation Cost of New Facilities	Total Cost	Landing Charge	Housing Charge	Air Navigation Facilities Charge	Passenger Charge	Fuel Service Charge	Terminal Rental	Car Parking Charge	Saved Maintenance Cost	Total Revenue	Operating Surplus	Cumulative Balance
1980	13,641	0	13,641	0	0	0	0	0	0	0	0	0	0	-13,641
1	13,641	0	13,641	0	0	0	0	0	0	0	0	0	0	-27,282
2	13,641	0	13,641	0	0	0	0	0	0	0	0	0	0	-40,923
3	13,641	0	13,641	0	0	0	0	0	0	0	0	0	0	-54,564
4	13,641	0	13,611	0	0	0	0	0	0	0	0	0	0	-68,205
1985	13,641	0	13,641	0	0	0	0	0	210	0	151	361	361	-81,485
6	13,641	1,637	15,278	191	0	31	14	57	210	9	151	663	-974	-96,100
7	0	1,910	1,910	256	0	58	29	114	210	18	151	836	-1,074	-97,174
8	0	1,910	1,910	367	15	58	46	171	210	29	151	1,047	-863	-98,037
9	7,781	1,910	9,691	473	25	51	65	228	210	38	151	1,241	-669	-106,487
1990	7,781	1,910	9,691	540	32	76	87	285	210	50	151	1,431	-479	-114,747
1	7,781	1,910	9,691	690	62	73	110	369	210	61	151	1,726	-186	-122,712
2	7,781	1,910	9,691	779	62	100	136	449	210	73	151	1,960	50	-130,443
3	7,781	1,910	9,691	877	62	127	165	530	210	87	151	2,209	299	-137,925
4	7,781	1,910	9,691	1,032	52	92	197	612	210	102	151	2,448	538	-145,168
1995	7,781	1,910	9,691	1,139	65	56	233	746	450	118	254	3,061	1,151	-151,798
6	0	2,999	2,999	1,253	65	80	270	871	450	134	254	3,377	378	-151,420
7	0	2,999	2,999	1,388	71	108	311	996	450	151	254	3,729	730	-150,690
8	0	2,999	2,999	1,520	75	133	356	1,120	450	169	254	4,077	1,078	-149,612
9	0	2,999	2,999	1,620	75	154	407	1,245	450	189	254	4,394	1,395	-148,117
2000	0	2,999	2,999	1,773	83	184	462	1,370	450	211	254	4,787	1,788	-146,429
1	0	2,999	2,999	1,947	83	214	519	1,527	450	231	254	5,225	2,226	-144,203
2	0	2,999	2,999	2,091	94	235	581	1,684	450	254	254	5,643	2,644	-141,559
3	0	2,999	2,999	2,261	97	262	650	1,840	450	278	254	6,092	3,093	-138,466
4	0	2,999	2,999	2,431	97	289	725	1,997	450	305	254	6,548	3,549	-134,917
2005	0	2,999	2,999	2,568	103	314	808	2,154	450	333	254	6,984	3,985	-130,932
Total	149,954	48,817	198,771	25,196	1,218	2,695	6,171	18,365	7,050	2,840	4,304	67,839	19,022	-130,932

Residual Value = 27,234

8.5 Results of Financial Cost-Benefit Analysis

The financial internal rate of return (FIRR) of the Rangoon International Airport Development Project which has resulted from the financial cost-benefit analysis based on the cash flow of the financial costs and the financial benefits as summarized in Tables 8-4 and 8-5 show a negative value. To arrive at a positive FIRR value, or in other words to make the Project financially feasible, the airport tariffs should be raised to a level much higher than the assumed level on which the foregoing calculations were based. Calculation was made on the FIRR of the five assumed cases of higher tariff revisions named A through E, with the results shown in Table 8-6.

Table 8-6 Financial Internal Rate of Return

	Percentage Raise to*		FIRR	
	Phase I	Phase II	Case 1	Case 2
A	200	400	2.4%	2.3%
B	250	400	2.5%	2.5%
C	300	400	2.9%	2.8%
D	200	500	3.9%	3.8%
E	250	500	4.1%	4.0%

* Over the tariff level assumed in the foregoing study.

8.6 Projection of Funds Flow

To help visualize the Project's funds flow in case the Rangoon International Airport Development Project were to be financed by a foreign loan, possible repayment schedules were projected as shown in Table 8-8, assuming that only the foreign element of the total construction costs including the equipment purchases will be financed by a foreign loan with assumed annual interest rates of 2% or 4% a year, 10-year grace and 20-year repayment period (Table 8-7).

Table 8-7 Principal and Interest of Foreign Loans

(In 1979 thousand US$)

	Case 1			Case 2		
	Phase I	Phase II	Total	Phase I	Phase II	Total
Principal	65,723	34,902	100,625	65,121	40,740	105,861
Interest 2%	14,637	7,798	22,435	14,539	9,100	23,639
Total	80,360	42,700	123,060	79,660	49,840	129,500
Principal	65,723	34,902	100,625	65,121	40,740	105,861
Interest 4%	31,017	16,478	47,495	30,779	19,180	49,959
Total	96,740	51,380	148,120	95,900	59,920	155,820

Table 8-8 Repayment Schedule of Foreign Loans

(In 1979 thousand US$)

	Interest Rate of 2%						Interest Rate of 4%					
	Case 1			Case 2			Case 1			Case 2		
	Phase I	Phase II	Total	Phase I	Phase II	Total	Phase I	Phase II	Total	Phase I	Phase II	Total
1990	574		574	569		569	691		691	685		685
1	1,148		1,148	1,138		1,138	1,382		1,382	1,370		1,370
2	1,722		1,722	1,707		1,707	2,073		2,073	2,055		2,055
3	2,296		2,296	2,276		2,276	2,764		2,764	2,740		2,740
4	2,870		2,870	2,845		2,845	3,455		3,455	3,425		3,425
5	3,444		3,444	3,414		3,414	4,146		4,146	4,110		4,110
6	4,018		4,018	3,983		3,983	4,837		4,837	4,795		4,795
7	4,018		4,018	3,983		3,983	4,837		4,837	4,795		4,795
8	4,018		4,018	3,983		3,983	4,837		4,837	4,795		4,795
9	4,018	305	4,323	3,983	356	4,339	4,837	367	5,204	4,795	428	5,223
2000	4,018	610	4,628	3,983	712	4,695	4,837	734	5,571	4,795	856	5,651
1	4,018	915	4,933	3,983	1,068	5,051	4,837	1,101	5,938	4,795	1,284	6,079
2	4,018	1,220	5,238	3,983	1,424	5,407	4,837	1,468	6,305	4,795	1,712	6,507
3	4,018	1,525	5,543	3,983	1,780	5,763	4,837	1,835	6,672	4,795	2,140	6,935
4	4,018	1,830	5,848	3,983	2,136	6,119	4,837	2,202	7,039	4,795	2,568	7,363
5	4,018	2,135	6,153	3,983	2,492	6,475	4,837	2,569	7,406	4,795	2,996	7,791
6	4,018	2,135	6,153	3,983	2,492	6,475	4,837	2,569	7,406	4,795	2,996	7,791
7	4,018	2,135	6,153	3,983	2,492	6,475	4,837	2,569	7,406	4,795	2,996	7,791
8	4,018	2,135	6,153	3,983	2,492	6,475	4,837	2,569	7,406	4,795	2,996	7,791
9	4,018	2,135	6,153	3,983	2,492	6,475	4,837	2,569	7,406	4,795	2,996	7,791
2010	3,444	2,135	5,579	3,414	2,492	5,906	4,146	2,569	6,715	4,110	2,996	7,106
1	2,870	2,135	5,005	2,845	2,492	5,337	3,455	2,569	6,024	3,425	2,996	6,421
2	2,296	2,135	4,431	2,276	2,492	4,768	2,764	2,569	5,333	2,740	2,996	5,736
3	1,722	2,135	3,857	1,707	2,492	4,199	2,073	2,569	4,642	2,055	2,996	5,051
4	1,148	2,135	3,283	1,138	2,492	3,630	1,382	2,569	3,951	1,370	2,996	4,366
5	574	2,135	2,709	569	2,492	3,061	691	2,569	3,260	685	2,996	3,681
6		2,135	2,135		2,492	2,492		2,569	2,569		2,996	2,996
7		2,135	2,135		2,492	2,492		2,569	2,569		2,996	2,996
8		2,135	2,135		2,492	2,492		2,569	2,569		2,996	2,996
9		1,830	1,830		2,136	2,136		2,202	2,202		2,568	2,568
2020		1,525	1,525		1,780	1,780		1,835	1,835		2,140	2,140
1		1,220	1,220		1,424	1,424		1,468	1,468		1,712	1,712
2		915	915		1,068	1,068		1,101	1,101		1,284	1,284
3		610	610		712	712		734	734		856	856
4		305	305		356	356		367	367		428	428
Total	80,360	42,700	123,060	79,660	49,840	129,500	96,740	51,380	148,120	95,900	59,920	155,820

CHAPTER 9. ECONOMIC ANALYSIS

CHAPTER 9 ECONOMIC ANALYSIS

9.1 General

The purpose of the economic analysis is to evaluate the economic worth of the Rangoon International Airport Development Project for the Socialist Republic of the Union of Burma. The economic evaluation was made in terms of the economic internal rate of return (EIRR) based on the economic costs and economic benefits of the Project identified from the viewpoint of the national economy on the principle of "with and without project" test. The case "without project" is defined as the Base Case in which utilization of the existing Rangoon International Airport is continued at the present facility level without any new investment.

The economic costs and the economic benefits of the Project were calculated in U.S. dollars in 1979 price for an assumed project life of the 25-year period 1980-2005.

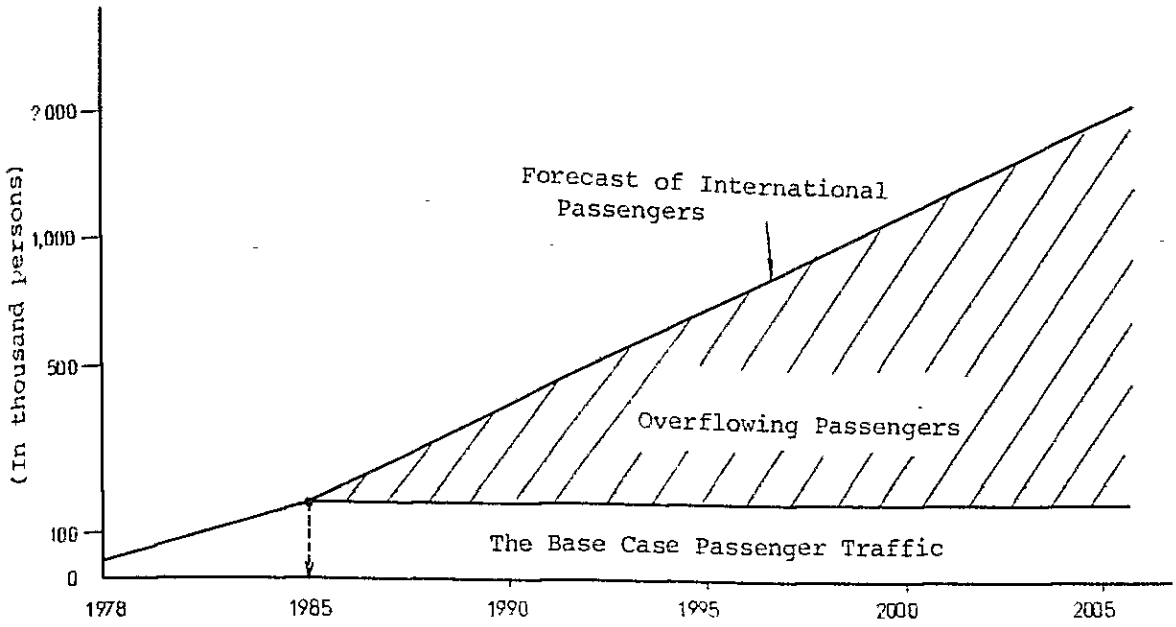
9.2 Base Case

9.2.1 Timing of Traffic Saturation

From the factors of the forecast peak hour passengers and the hourly processing capacity assessed at 154 and 186 for domestic and international passengers respectively of the existing passenger terminal building, it is projected that the physical capacity limits of the existing Rangoon International Airport terminal will be reached in 1981 and 1986 for domestic and international services respectively.

9.2.2 Estimate of Overflowing Traffic

Although the timing of the terminal over-saturation point differs between the domestic and international services as discussed in Section 9.2.1, for the purpose of the present economic analysis, the overflowing passenger traffic at Rangoon International Airport for both domestic and international services is calculated from 1986 onwards as shown in Figure 9-1, reasoning for this being that between the years 1981 and 1985 the "overflowing" domestic passengers are somehow accommodated by efforts in flight schedule shifting and so on to level off the daily peaking pattern.



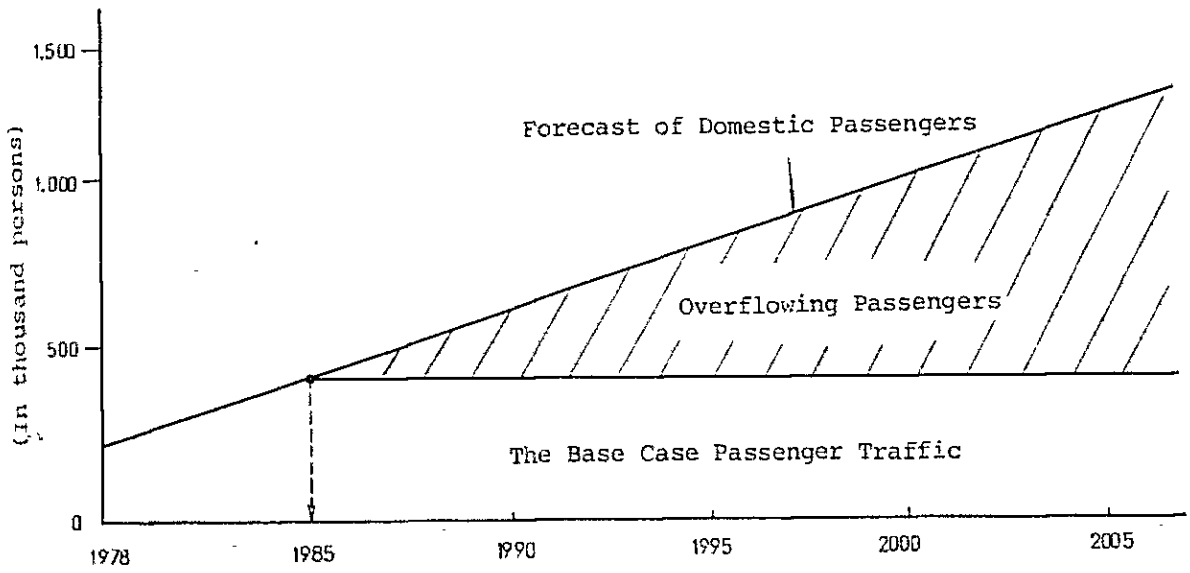


Figure 9-1 The Base Case Demand and Overflowing Traffic at Rangoon International Airport

9.3 Estimate of Economic Costs

9.3.1 Construction Cost

The method used in obtaining the economic construction cost of the Project is outlined below.

- Deduct the customs duty, equivalent to 30% of the cost, from the value of the foreign currency element of imported goods.
- Deduct indirect taxes, at an average 10% of the costs, from the value of the local currency element of domestic goods.
- Apply the shadow wage rate of 1,625 Kyats (US$255.9) a year, (equivalent to the per capita value added of the workers in the agricultural sector of Burma) to the cost of unskilled labour.

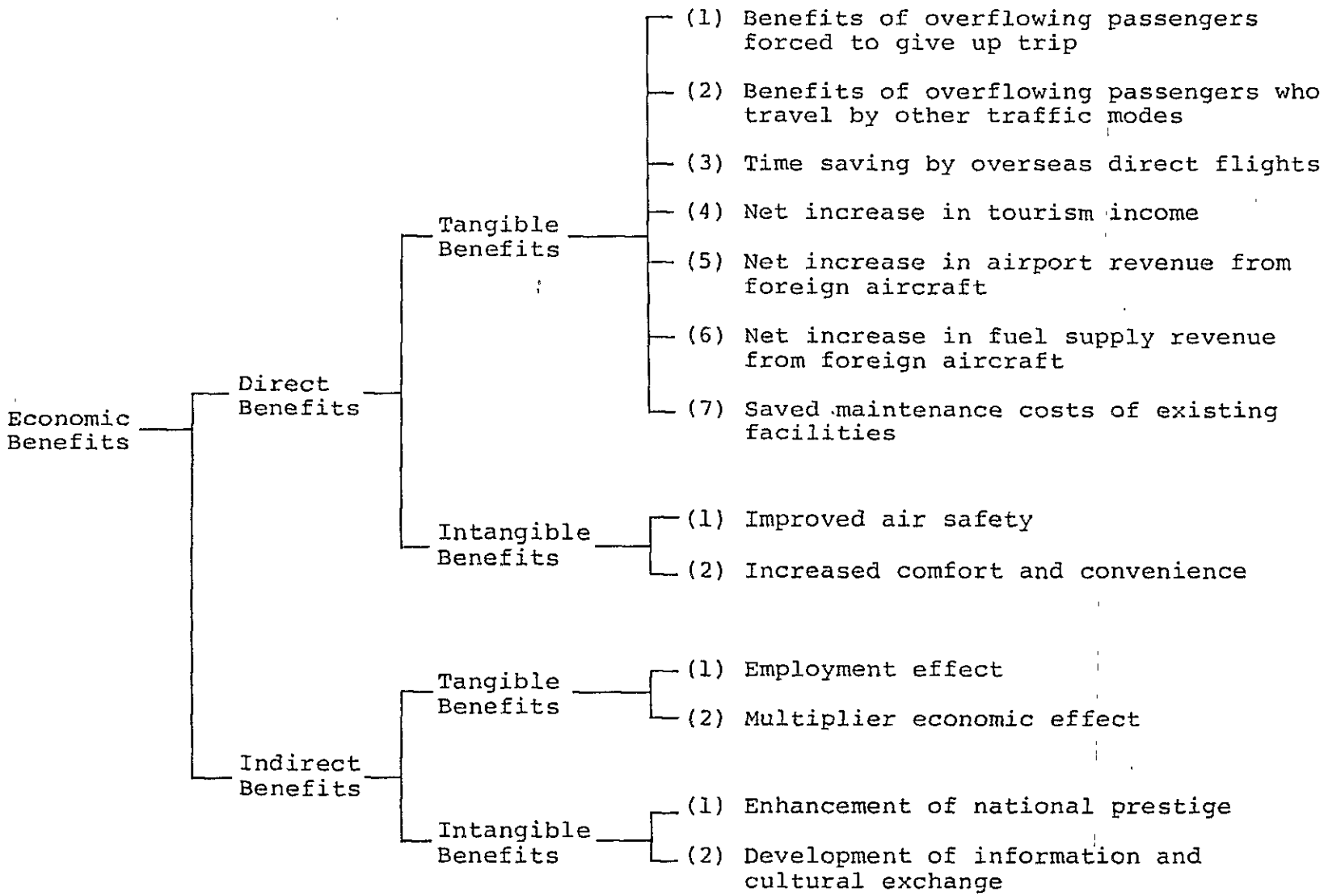
9.3.2 Maintenance and Operating Costs

The economic cost of maintenance and operation of the new improved airport is related to the economic cost of construction in the same manner as the financial costs mentioned in Section 8.2, Chapter 8.

9.4 Estimate of Economic Benefits

9.4.1 Classification of Economic Benefits

The economic benefits attributable to the Rangoon International Airport Development Project are identified by comparing the relevant elements in the Base Case and the Project Case from the viewpoint of the national economy. These benefits comprise direct and indirect benefits, each of which consist of tangible and intangible benefits. Intangible and indirect benefits are not easily quantified and, therefore, estimates of the economic benefits are limited to direct tangible benefits in the present analysis.


Economic Benefits
Direct Benefits
Tangible Benefits
(1) Benefits of overflowing passengers forced to give up trip
(2) Benefits of overflowing passengers who travel by other traffic modes
(3) Time saving by overseas direct flights
(4) Net increase in tourism income
(5) Net increase in airport revenue from foreign aircraft
(6) Net increase in fuel supply revenue from foreign aircraft
(7) Saved maintenance costs of existing facilities
Intangible Benefits
(1) Improved air safety
(2) Increased comfort and convenience
Indirect Benefits
Tangible Benefits
(1) Employment effect
(2) Multiplier economic effect
Intangible Benefits
(1) Enhancement of national prestige
(2) Development of information and cultural exchange

9.4.2 Estimate of Direct Tangible Benefits

(1) Benefits of Overflowing Domestic Passengers

The overflowing domestic passengers as discussed in Section 9.2 would either be forced to give up the trip, or would make the trip by other modes of transport.

In this analysis, the above two cases were assumed to be equally likely, i.e. 50% do not travel and 50% change mode.

The benefits of this item that accrue to resident passengers only are counted. The total overflowing resident domestic passengers were calculated on an assumption that, of the total overflowing international passengers, 85% are non-resident, of which 80% use domestic service. This number was regarded to constitute the non-resident element of the passengers on domestic service and was, therefore, deducted from the total overflowing domestic passengers to obtain the overflowing resident domestic passengers. As shown in the following equation.

$$TRP = T_D - 0.8 \times 0.85T_I$$

where TRP = total overflowing resident domestic passengers

T_D = total overflowing domestic passengers

T_I = total overflowing international passengers

1) Benefits of Overflowing Domestic Passengers Forced to Give up the Trip

The overflowing passengers forced to give up the trip in the Base Case situation would be able to make the intended trip if the Rangoon International Airport is expanded.

The value of the benefits to such passengers, whose trip demand is satisfied by the expanded Rangoon International Airport, are considered to equal the value that represents their "willingness to pay", which was assumed to be half of the value calculated in case of the overflowing passengers who make the intended trip by other modes of transport as discussed in 2) hereunder.

2) Benefits of Overflowing Domestic Passengers who Make the Trip by Other Transport Mode

Since as stated above, 50% of the domestic passengers overflowing at Rangoon International Airport are assumed to make the trip by other transport, an equal number of resident domestic passengers to that counted in the preceding paragraph (1) are considered to enjoy the benefits of savings in time and cost of trip compared to other transport modes when the Project is completed. Such benefits were calculated by the following formula.

$$TSD_t = \sum_i (V_t T_i + C_i) BD_{ti}$$

where, TSD_t = benefits of overflowing resident domestic passengers who make the trip by other transport modes in the year t

V_t = time value of resident domestic passengers in the year t

T_i = difference in the travel time between other transport modes and air on route i

C_i = difference in the transport cost between other transport modes and air on route i

BD_{ti} = 50% of the total number of overflowing resident passengers who use domestic air service in the year t on route i

The actual calculation was made in 1979 price with an assumed average travel time and average travel cost by route. The per capita value-added of the workers in the industrial and the service sectors of Burma in 1978 was 495 U.S. dollars. Assuming annual working hours as 2,000, the time value per worker in the industrial and the service sector in 1978 was estimated to be 0.25 U.S. dollars. As air passengers are generally considered to belong to the medium and high income classes, the time value of air passengers was increased to

0.5 U.S. dollars, or twice that of the average worker. Since the time values increase commensurate to the increase in real income, the expected time value of resident air passengers up to the year 2005 were calculated at an annual growth rate of 5.9%, which is equal to the real increase in GDP.

(2) Benefits of Overflowing International Passengers

The benefits under this item were quantified in terms of the time savings enjoyed by those passengers when they are able to make direct flights through newly developed RIA, which comprise value of the time spent for stop-overs at in-transit airports estimated at 2.5 hours per flight based on present average stop-over, landing and take-off times of aircraft at major international airports. The following is the formula used in calculating this benefit.

$$TSI_t = 2.5 \times BI_t \times DFR_t \times V_t$$

where, TSI_t = benefits of time saving by overseas direct flight in the year t

BI_t = number of resident passengers who use international air services in the year t

DFR_t = share of new routes by direct flight in the year t

V_t = time value of resident passengers in the year t

(3) Net Increase in Tourism Income

Based on the present tourist spending in Burma, it was assumed that the average length of stay and average spending per tourist in Burma will remain at 5 days and 45 U.S. dollars per day respectively through the year 2005. Assuming on the basis of the actual achievement in 1977/78 that the value added to the Burmese tourism industry will be 60% through to the year 2005, the net increase in the Burmese tourism income, brought about by the increase in non-resident air passengers, was calculated.

(4) Airport Revenue Increment by Foreign Aircraft

The expected increase in airport revenue attributable to foreign aircraft was calculated based on the assumed landing charges in Chapter 8 and on forcasts of annual foreign aircraft movements at Rangoon International Airport.

(5) Fuel Supply Revenue Increment by Foreign Aircraft

The present fuel price of US$0.132 per pound at Rangoon International Airport was assumed to remain unchanged through the year 2005. The benefit of the increment of fuel supply revenue was calculated on an assumption that the value added ratio of fuel supply is equal to the present value added ratio of the Burmese petroleum refining industry which is 40%, and that this will remain unchanged through the year 2005.

(6) Saved Maintenance Cost of Existing Facilities

The economic cost of maintenance of the existing facilities is calculated on the basis of current expenditure of Rangoon International Airport. Saved maintenance cost was estimated US$151,000 and US$254,000 for Phase I and Phase II, respectively.

9.5 Results of Cost-Benefit Analysis

9.5.1 Economic Evaluation

The cost benefit analysis, based on the cash flow of the economic costs and the direct tangible economic benefits, indicates an economic internal rate of return of 12.0% for Case 1 and 11.8% for Case 2 of the development alternatives of the Project, as shown in Table 9-2 and Table 9-3 respectively. At the request of the Burmese Government officials, further caluculation was made with a higher level of tourism income than that calculated hereinabove. Per capita spending and average stay time was assumed to increase starting from 1980 at such an average annual increase rate as to reach US$50.00 and 7 days in 1990, which was calculated to be 4% per annum, and this trend was extrapolated through the year 2005. The EIRR of this new assumed case amounted to 16.1% for Case 1 and 16.0% for Case 2. It is concluded, therefore, that both development alternatives of the Rangoon International Airport, are economically worthwhile from the viewpoint of the national economy of Burma, since the social discount rate of the country is assumed to be 10%.

9.5.2 Sensitivity Analysis

Sensitivity analysis was carried out to test the effects on the economic internal rate of return (EIRR) by changing certain key factors of the direct tangible benefits, with the results as shown in Table 9-1.

Table 9-1 Results of Sensitivity Analysis

Fluctuation	EIRR (%)	
	Case 1	Case 2
-10% of Net Increase in Tourism Income	11.4	11.2
+10% of Net Increase in Tourism Income	12.4	12.2
4% Annual Increase in Per Capita Tourism Spending and Stay Time	16.1	16.0
+20% of Fuel Supply Revenue	12.2	12.1
+40% of Fuel Supply Revenue	12.6	12.4

Table 9-2 Cash Flow of Economic Costs and Benefits of Rangoon International Airport Development Project - Case 1

(In 1979 thousand US$)

Year	Costs			Benefits								Discounted Cash Flow at 10%	
	Construction Cost	Cost of Maintenance & Operation of New Improved Facilities	Total Costs	Benefits of Overflowing Passengers forced to give up Trip	Benefits of Overflowing Passengers who continue Trip by Other Traffics	Time Saving Increment by Overseas Direct Flights	Net Increase in Tourism Income	Increased Airport Revenue from Foreign Aircraft	Increased Fuel Supply Revenue from Foreign Aircraft	Saved Maintenance Cost of Existing Facilities	Total Benefits	Total Costs	Total Benefits
1980	11,513	0	11,513	0	0	0	0	0	0	0	0	10,466	0
1981	11,513	0	11,513	0	0	0	0	0	0	0	0	9,515	0
1982	11,513	0	11,513	0	0	0	0	0	0	0	0	8,650	0
1983	11,513	0	11,513	0	0	0	0	0	0	0	0	7,864	0
1984	11,513	0	11,513	0	0	0	0	0	0	0	0	7,149	0
1985	11,513	0	11,513	0	0	0	0	0	0	151	151	6,499	85
1986	11,513	1,382	12,895	55	109	3	770	29	335	151	1,452	6,617	745
1987	0	1,612	1,612	130	260	8	1,647	56	670	151	2,922	752	1,363
1988	0	1,612	1,612	230	459	12	2,633	85	1,004	151	1,574	684	1,940
1989	5,463	1,612	7,075	358	717	18	3,740	113	1,339	151	6,436	2,728	2,481
1990	5,463	1,612	7,075	518	1,036	25	4,995	127	1,673	151	8,525	2,480	2,988
1991	5,463	1,612	7,075	689	1,378	34	6,305	188	2,209	151	10,954	2,254	3,490
1992	5,463	1,612	7,075	891	1,783	43	7,776	249	2,741	151	13,637	2,049	3,950
1993	5,463	1,612	7,075	1,126	2,253	55	9,423	311	3,280	151	16,599	1,863	4,371
1994	5,463	1,612	7,075	1,397	2,794	69	11,273	344	3,813	151	19,841	1,694	4,750
1995	5,463	1,612	7,075	1,705	3,410	86	13,203	404	4,597	254	23,659	1,540	5,149
1996	0	2,377	2,377	2,003	4,006	104	15,309	455	5,468	254	27,599	470	5,460
1997	0	2,377	2,377	2,329	4,657	126	17,672	504	6,337	254	31,879	428	5,734
1998	0	2,377	2,377	2,681	5,363	149	20,142	555	7,207	254	36,351	389	5,944
1999	0	2,377	2,377	3,056	6,111	178	23,045	600	8,335	254	41,579	353	6,181
2000	0	2,377	2,377	3,453	6,905	213	26,244	646	8,640	254	46,355	321	6,264
2001	0	2,377	2,377	3,779	7,559	251	29,484	786	10,143	254	52,256	292	6,419
2002	0	2,377	2,377	4,096	8,192	295	32,926	909	11,678	254	58,350	266	6,516
2003	0	2,377	2,377	4,393	8,787	348	36,707	1,034	13,191	254	64,714	241	6,570
2004	0	2,377	2,377	4,658	9,316	405	40,892	1,171	14,712	254	71,408	219	6,591
2005	0	2,377	2,377	4,869	9,738	475	45,644	1,287	15,428	254	77,695	199	6,519
Total	118,832	39,660	158,492	42,416	84,833	2,897	349,830	9,853	122,803	4,304	616,936	75,982	93,510

Economic Internal Rate of Return (EIRR) = 12.0%

Residual Value = 19,121, Net Present Value = 19,134
Profitability Index = 1.257, Pay Back Period = 24 (years)

Table 9-3 Cash Flow of Economic Costs and Benefits of Rangoon International Airport Development Project - Case 2

(In 1979 thousand US$)

Year	Costs			Benefits								Discounted Cash Flow at 10%	
	Construction Cost	Cost of Maintenance & Operation of New Improved Facilities	Total Costs	Benefits of Overflowing Passengers forced to give up Trip	Benefits of Overflowing Passengers who continue Trip by Other Traffics	Time Saving Increment by Overseas Direct Flights	Net Increase in Tourism Income	Increased Airport Revenue from Foreign Aircraft	Increased Fuel Supply Revenue from Foreign Aircraft	Saved Maintenance Cost of Existing Facilities	Total Benefits	Total Costs	Total Benefits
1980	11,487	0	11,487	0	0	0	0	0	0	0	0	10,443	0
1981	11,487	0	11,487	0	0	0	0	0	0	0	0	9,493	0
1982	11,487	0	11,487	0	0	0	0	0	0	0	0	8,630	0
1983	11,487	0	11,487	0	0	0	0	0	0	0	0	7,846	0
1984	11,487	0	11,487	0	0	0	0	0	0	0	0	7,133	0
1985	11,487	0	11,487	0	0	0	0	0	0	151	151	6,484	85
1986	11,487	1,378	12,865	55	109	3	770	29	335	151	1,452	6,602	745
1987	0	1,608	1,608	130	260	8	1,647	56	670	151	2,922	750	1,363
1988	0	1,608	1,608	230	459	12	2,633	85	1,004	151	4,574	682	1,940
1989	6,601	1,608	8,209	358	717	18	3,740	113	1,339	151	6,436	3,165	2,481
1990	6,601	1,608	8,209	518	1,036	25	4,995	127	1,673	151	8,525	2,877	2,988
1991	6,601	1,608	8,209	689	1,378	34	6,305	188	2,209	151	10,954	2,616	3,490
1992	6,601	1,608	8,209	891	1,783	43	7,776	249	2,744	151	13,637	2,378	3,950
1993	6,601	1,608	8,209	1,126	2,253	55	9,423	311	3,280	151	16,599	2,162	4,371
1994	6,601	1,608	8,209	1,397	2,794	69	11,273	344	3,813	151	19,841	1,965	4,750
1995	6,601	1,608	8,209	1,705	3,410	86	13,338	392	4,349	254	23,534	1,787	5,122
1996	0	2,532	2,532	2,003	4,006	104	15,444	446	5,271	254	27,528	501	5,446
1997	0	2,532	2,532	2,329	4,657	126	17,807	497	6,192	254	31,862	455	5,731
1998	0	2,532	2,532	2,681	5,363	151	20,412	550	7,114	254	36,525	414	5,972
1999	0	2,532	2,532	3,056	6,111	180	23,315	587	8,036	251	41,539	376	6,175
2000	0	2,532	2,532	3,453	6,905	215	26,514	644	8,956	254	46,941	342	6,343
2001	0	2,532	2,532	3,779	7,559	254	29,754	785	10,560	254	52,945	311	6,504
2002	0	2,532	2,532	4,096	8,192	298	33,331	911	12,165	254	59,247	283	6,617
2003	0	2,532	2,532	4,393	8,787	351	37,247	1,035	13,768	254	65,835	257	6,684
2004	0	2,532	2,532	4,658	9,316	412	41,567	1,174	15,372	254	72,753	234	6,715
2005	0	2,532	2,532	4,869	9,738	482	46,319	1,312	16,976	254	79,950	212	6,708
Total	126,616	41,170	167,786	42,416	84,833	2,926	353,610	9,835	125,826	4,304	623,750	78,398	94,180

Economic Internal Rate of Return (EIRR) = 11.8%

Residual Value = 23,104, Net Present Value = 17,721
Profitability Index = 1.232, Pay Back Period = 24 (years)

CHAPTER 10. PROJECT IMPLEMENTATION AND ADMINISTRATION ORGANIZATION OF RANGOON INTERNATIONAL AIRPORT

CHAPTER 10 PROJECT IMPLEMENTATION AND ADMINISTRATION ORGANIZATION OF RANGOON INTERNATIONAL AIRPORT

10.1 Existing Organization

10.1.1 DCA

The Department of Civil Aviation is one of several departments of the Ministry of Transport and Communications, and as shown on the organization chart (Figure 10-1), is composed of the following five divisions headed by the respective directors each reporting to the director general of DCA.

Flight Operations
Aviation Safety
Communications and Navigational Aids
Air Traffic Services
Administration and Works

DCA is primarily responsible for operation and administration of airport and airnavigation-related facilities, i.e. air traffic control, communications and Nav-Aids, etc. DCA at present is neither organized nor staffed for project implementation, including the present Project, which involves planning, design and construction management and supervision.

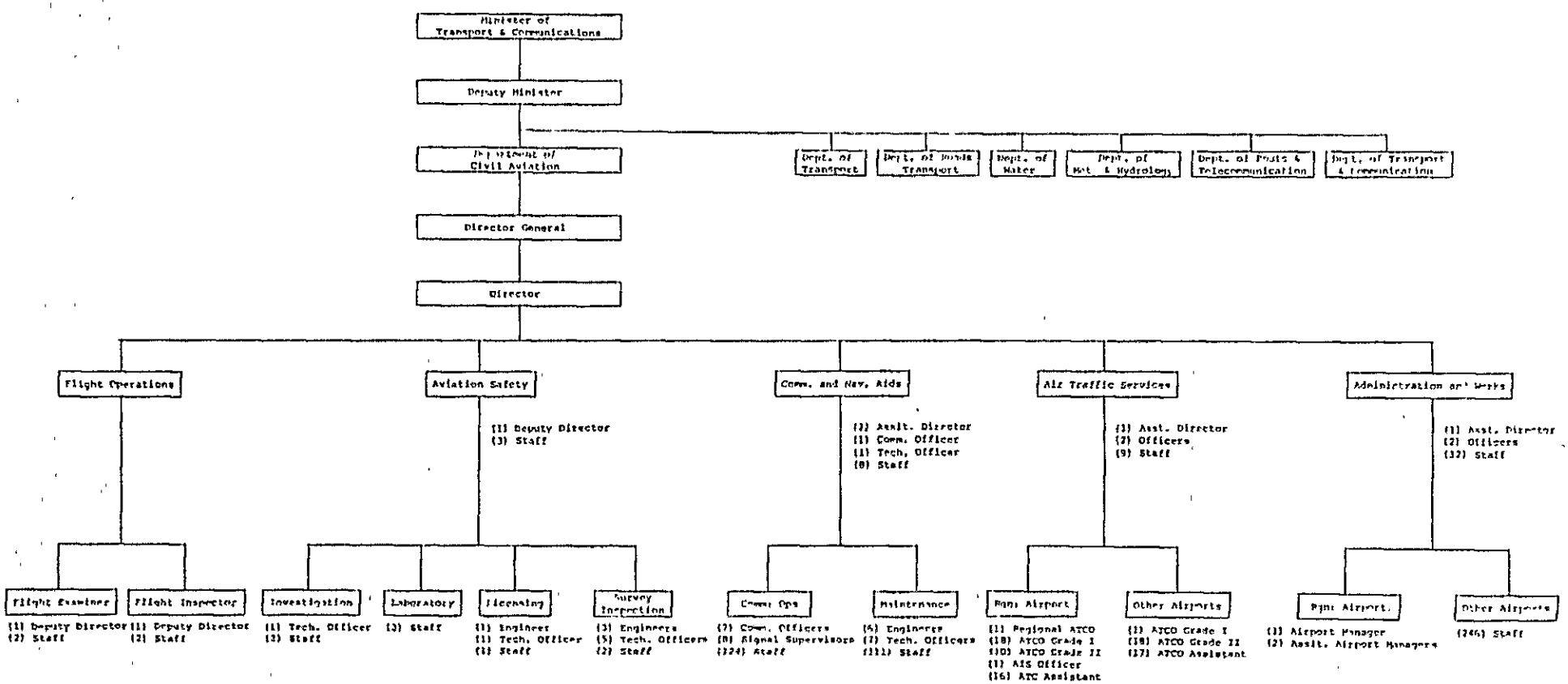


Figure 10-1 Organization Chart of Department of Civil Aviation

10.1.2 Administration of Rangoon International Airport

DCA controls and operates 43 civil aviation airports in Burma besides the RIA. Administrative organization of the RIA is shown in Figure 10-2. The present RIA staff headed by the airport manager comprises 407 as shown below.

RIA Staff of DCA

Airport Manager	1
Assistant Airport Manager	1
Head Clerk	1
Adm: Branch	7
Accountant	10
Motor Transport	42
Store Supervisor	8
Work Supervisor	99
Security Guards	19
Care-Taker (Airport Cleaning)	50
Airport Garden	8
Telephone Operator	5
Water Pump Drivers	12
Air Traffic Control	32
Rescue and Fire Officer	59
Signal Officer	32
Electrical Supervisor (Building)	12
Electrical Supervisor (Field)	9
Total:	(407)

Within the airport premises are the offices of Area Control Centre, Department of Meteorology and Hydrology which provides aeronautical meteorological information, and C.I.Q., as well as PPSC which runs the aviation fuel supply service.

The airport is open 24 hours a day, but since there hardly is any landing or take-off during the night, night shifts are limited to certain special posts of ATC, ACC and airport security services.

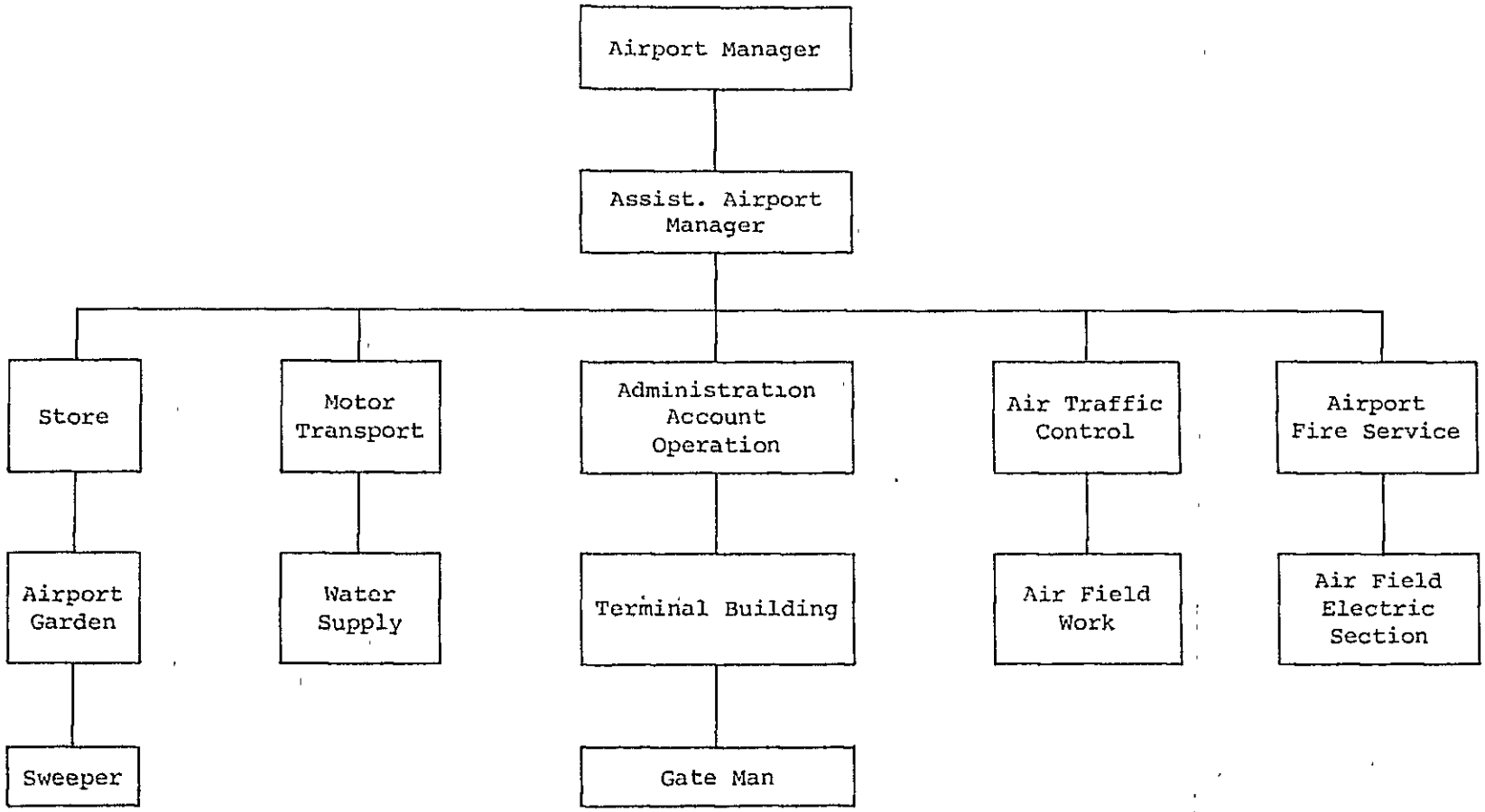


Figure 10-2 Present Rangoon International Airport Organization

10.2 Project Implementation Organization

10.2.1 Background

According to the present plan of the Government of the Socialist Republic of the Union of Burma, the Department of Civil Aviation is to be the body responsible for the implementation of the Rangoon International Airport Development Project.

Because of the complexity of the Project, and considering the current set-up of the Governmental structure, it is expected that the Project will involve quite a number of ministries and Governmental agencies. In particular, the Foreign Economic Relations Department of the Ministry of Planning and Finance will be directly involved in the Project's financing and disbursement programmes within the framework of the overall budgetary appropriation in coordination with other development projects of Burma. The Construction Corporation related to the Ministry of Construction (see Figure 10-3) will be involved in the construction phase of the Project, especially in civil and building works.

Since the Project is large and encompasses many specialized fields of engineering, it would be unreasonable to expect the Department of Civil Aviation to cope with its implementation with the existing staff structure and size. Accordingly, it is considered necessary either to strengthen the existing organization of the DCA or create an entirely new organization for the implementation of the Project.

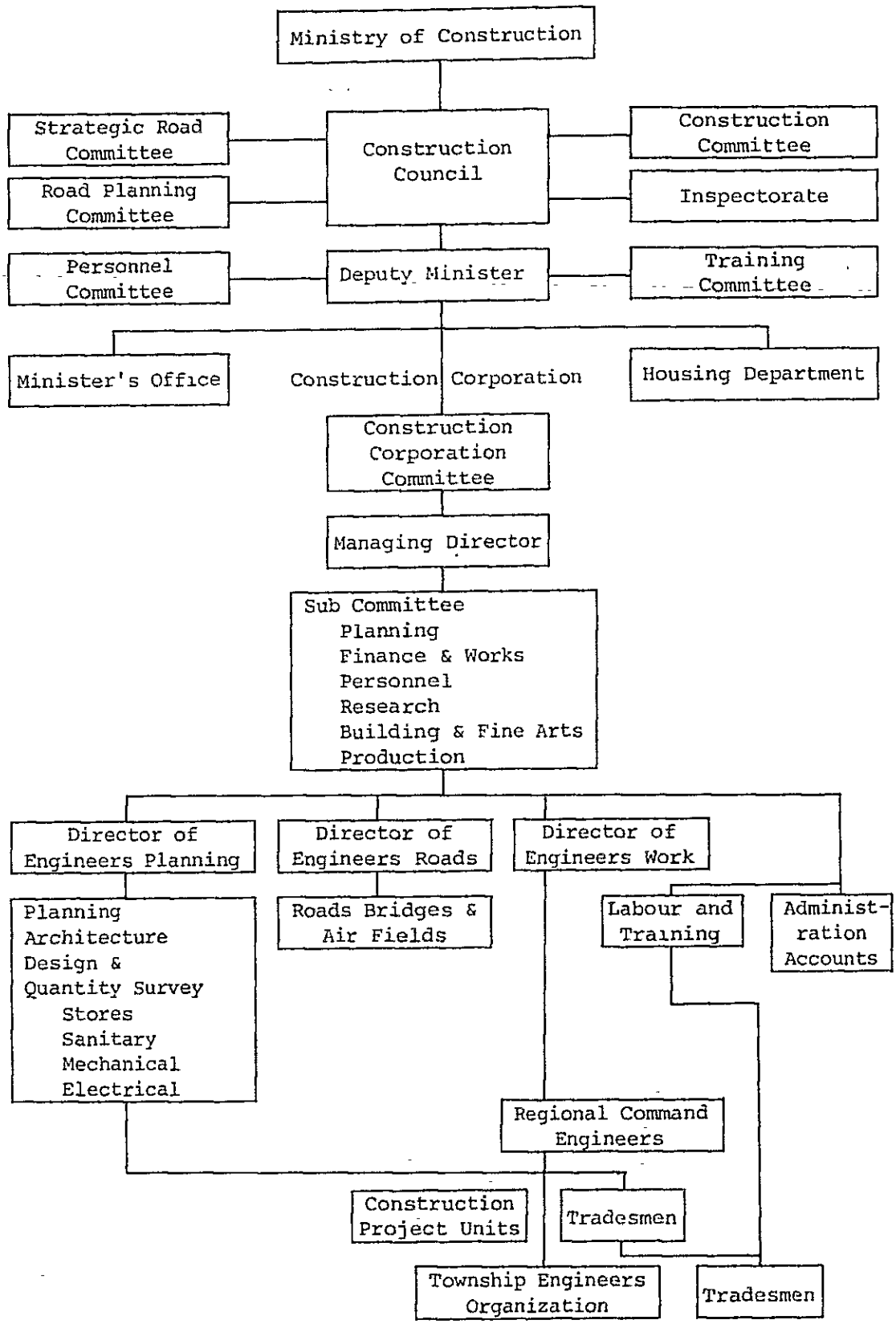


Figure 10-3 Organization Chart of Construction Corporation

10.2.2 Executing Agency and Support Organizations

Presented hereunder is a recommended organization that would adequately meet the various requirements of Project implementation through the construction and operation phases. This was developed by the study team as a result and as part of the present study with due consideration for the existing organizational situations of the Burmese Governmental authorities concerned.

The overall organizational structure comprises two new committees to be established and an executing agency that may be developed by reinforcing the present DCA both organizationally and in terms of manpower both quality- and quantity-wise.

(1) Steering Committee

In view of the magnitude of the national Project and the complexity of the matters involved in its implementation, envisaged is a ministerial level steering committee composed of the members each of whom should be authorized to represent the views and policies of the respective ministry or agency of the Burmese Government that has to do with the implementation of the Project. The Steering Committee is to be established as an auxiliary function to the office of the Ministry of Transport and Communications and shall make decisions in matters related to the national policy and intra-governmental coordination involved in the Project implementation throughout its construction and operation stages.

(2) Supervisory Committee

Director general of the DCA shall chair the Supervisory Committee designed to supervise the actual implementation work carried out by the executing agency of the Project. This committee shall be composed of senior experts in all disciplines involved in the actual implementation of the Project, including those of administration and management, air navigation and construction, etc. and shall give all necessary advice, examine and approve as appropriate the major technical, contractural, administrative and financial matters.

(3) Reinforcement of DCA Organization

Organizational reinforcement of the DCA as the executing agency so as to be able to cope with the requirements of the Project implementation is to be achieved by establishing two new divisions in both construction and operation phases of the Project as described below and illustrated in Figures 10-4 and 10-5.

1) Planning and Coordination Division

Functions of their division shall include management policy, financial planning, execution planning of the Project implementation at working level, as well as overall airport planning of long and short ranges. The division is also expected to perform working level coordination among the various ministries and agents concerned, attend to the Steering Committee matters in a secretarial capacity to the director general, and also to function as

parmanent secretariat of the Supervisory Committee chaired by the director of DCA.

In addition to the above functions, the Planning and Coordination Division, during the construction stage, shall be instrumental in the necessary coordination between the RIA Project Office and all the existing DCA organizations and functions that have to do with the administration and operation of the existing RIA to ensure smooth execution of the construction which has to be carried out without interrupting the normal operation of the airport.

2) Rangoon International Airport Project Division

This division may be called Project Office in construction phase and RIA Administration in operation phase.

a. Project Office

As Project Office during the construction stage (Figure 10-4), this division of DCA to be newly created shall be responsible for the actual management of the construction including project accounting, design and construction bidding leading to contracts, and procurement of all necessary goods and services, etc., all these through the administrative section, as well as for the supervision of design, construction schedule control, and inspections at different stages of construction, etc. through the technical services section. To be able to perform the above functions

satisfactorily the Project Office shall be staffed with personnel with practical experience and capability to execute the actual work.

b. RIA Administration

By the time the newly developed airport goes into operation, a new Rangoon International Airport Administration must be developed by integrating the functions of the existing RIA administration and those of the Project Office. An example of the new RIAA organization is given in Figure 10-5. It shall include at least the following functions.

Technical Services shall be responsible for the planning, design, supervision and management of overall maintenance and upkeep of the airport facilities. Minor repair and daily inspection and maintenance work shall be administered directly by the Administration, while major repair and remodelling work may be implemented under contract. In addition, collection and compilation of airport-related technical data shall be the responsibility of the Technical Services.

Airport Accounting shall be responsible for the control of the airport's operating revenues and expenditures to ensure that the planned repayment programme is duly carried out.

Property Management shall be responsible for matters related to the lease of airport properties including the terminal other rentable spaces, equipment and facilities. The actual services shall include negotiating and concluding lease agreements with the tenants and processing of tenants' sales and other reports, as well as attending to tenants' claimes and complaints related to the leased property.

In addition to the above mentioned compulsory service functions of the new RIA Administration, provision of ground service to aircraft may contribute to increase the airport revenue and help expedite repayment of the initial capital investment, provided that it requires additional investment in the purchase of necessary ground service equipment at training of personnel.

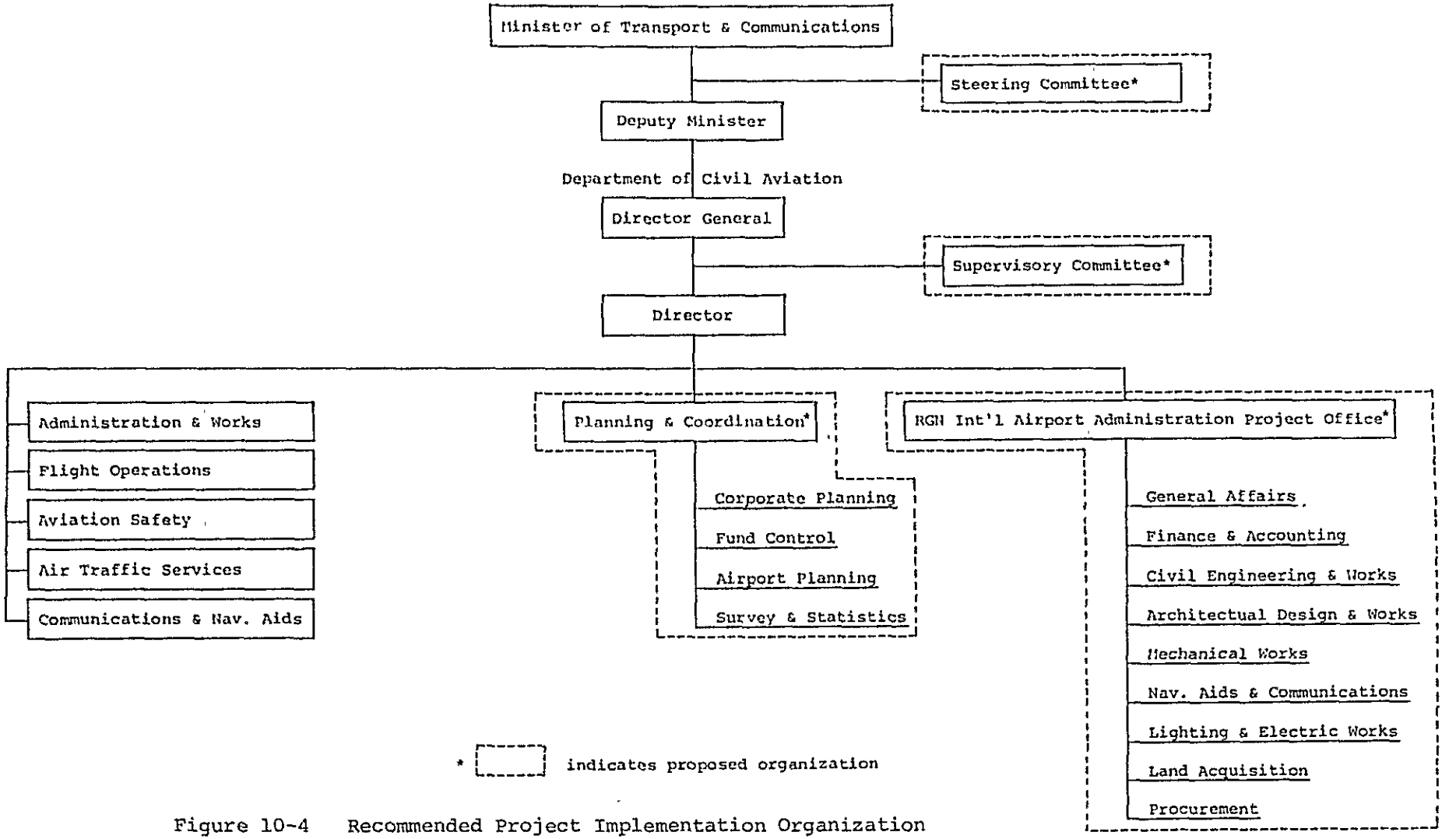


Figure 10-4 Recommended Project Implementation Organization (Construction Phase)

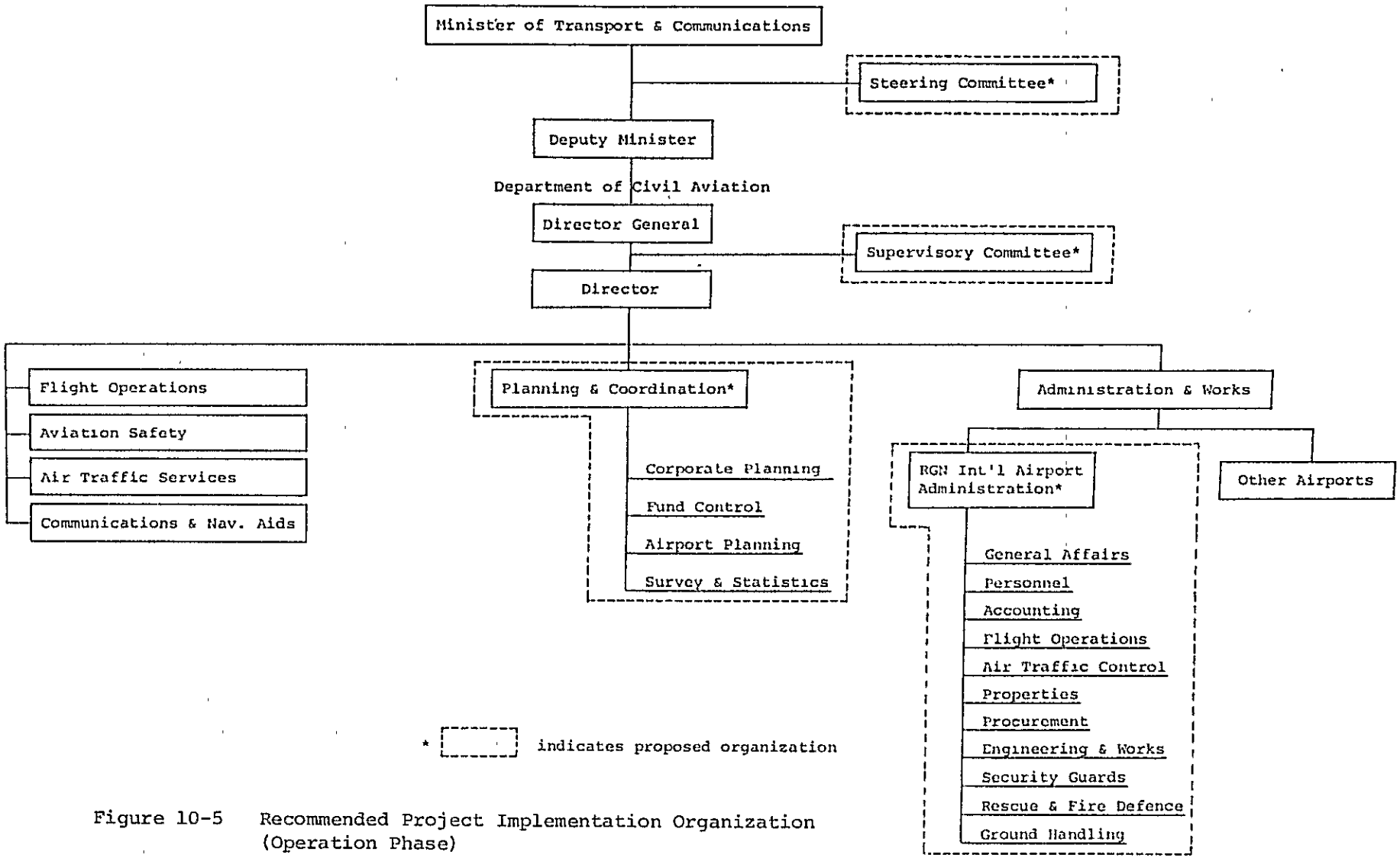


Figure 10-5 Recommended Project Implementation Organization (Operation Phase)

CHAPTER 11. SOCIAL IMPACTS

CHAPTER 11 SOCIAL IMPACTS

11.1 General

For the sake of a comprehensive evaluation of the Rangoon International Airport Development Project with emphasis on intangible impacts not dealt with in the economic analysis, study was made of possible social impacts of the Project, and their evaluation in terms of magnitude, possibility of occurrence, and controllability in case of undesirable impacts. Wherever necessary, remedial measures against any adverse effects were also studied.

The impacts of the Project were classified into two major categories, namely the investment effects or impacts of construction, and the production effects or impacts of the use of the airport. Impacts of construction are mostly short-lived and are generally small in magnitude. The emphasis here is, therefore, placed on the impacts of the use of the new improved airport.

11.2 Analysis of Impacts

11.2.1 Investment Effect (Impacts of Construction of Airport)

Impacts of construction are generally discussed in the following two categories, but for reasons stated above, they are negligible more often than not and were, therefore, not analysed in detail.

(1) Economic Impact

In general, public investments of the nature of the Project generate significant demand in the national economy. It generates additional employment which stimulates the national economy and overall business activities. Public investment thus is an effective means of controlling the national economy.

(2) Social Impact

Construction can bring many adverse effects such as noise, vibration, dust or destruction of natural environment. These impacts, however, are strictly local and often present little problem except in densely populated areas.

11.2.2 Production Effect (Impacts of Utilization of Airport)

Utilization of the airport produces direct impacts, which in turn generate indirect impacts of secondary, tertially or even further repercussive effects.

(1) Direct Impacts

Direct impacts of the Rangoon International Airport Develompent Project are caused primarily by the extension of the runway and improvement of the air traffic control system. Extension of the runway will enable landing and take-off of bigger aircraft, such as B-747 and DC-10. This will lead to the possibility of establishing direct flight operations to Europe, Japan, etc. and also its utilization as a transit airport for other international routes and as an alternate to Bangkok Airport. Having an airport of international standard will also contribute to enhancing Burma's national prestige.

Improvement of the air traffic control system will greatly increase the safety as well as frequency of landings and take-offs by the present fleet of DC-8, F-28 and F-27. Demand for trained engineers for the maintenance of the ATC system will stimulate electronics technology in Burma. Having one of the world's most modern ATC systems will certainly enhance Burma's national prestige.

(2) Indirect Impacts

1) Improved Accessibility to and from Rangoon Airport

Improved accessibility, i.e. time saved in travelling to and from Rangoon, and increased ease with which the travel is made, encompasses the following impact concepts.

The direct countable impacts of increased passenger and cargo traffic and resultant increase in airport operating revenues will stimulate national economy by increased employment opportunity and raised level of consumption, etc. For example, exports of perishable goods such as orchids and fruits made possible by the Project will promote the development of higher value added farming and the development of labour-intensive higher value added industries. These secondary impacts may be expected to generate still further repercussion effects in the economy such as are described below.

2) Further Repercussion Effects

a. Activated Inter-Regional Interaction

Inter-regional interaction within Burma is not very active today because of the natural barriers such as rivers and mountains, and the inadequate transportation network of the country. These are the major reasons for the nation's regional economic disparities. One of the major repercussion effects expected of this Project is increased inter-regional interaction in order to reduce such existing disparity and to dissipate economic inequality. Should this objective be achieved, conflicts among regions will be reduced substantially and the political stability of Burma greatly improved.

b. Undesirable Impacts of Increased Passenger and Well-Wisher Traffic

The increase in passengers will generate greater demand for taxi service between the airport and the central part of Rangoon. This may cause traffic congestion on the roads to and from and near the airport. Increasing interaction with foreign countries may also invite unsought increase in international crime like smuggling of narcotics. At the same time, it will increase the risks of such epidemics as cholera, etc.

c. Impacts of Increased Foreign Tourists

Tourists visiting Burma can be expected to introduce Burmese culture abroad. This will help promote better understanding of Burma in the world and at the same time will trigger active interaction between Burma and other countries of the world. Burmese contact with heterogeneous cultures of the West, Japan and elsewhere may affect and change the life-style of the Burmese people for better or for worse.

Foreign tourists will spur the development of tourist industries of hotels, taxi business and souvenir shops, etc. which are all important earners of foreign exchange for Burma.

d. Indirect Impacts of Increase in Aircraft Take-offs and Landings

Increase in take-offs and landings will increase the risk of accidents and polution, for example, by NOx, CO and noise. Accidents, however, may be substantially reduced, if not entirely prevented, by improving the air traffic control system.

e. Increased Demand for Aviation Fuel

Long-distance international charter flights and cargo freighters can be expected to stop over at Rangoon International Airport for refueling and this will bring increased income from fuel sales and will contribute to the improvement of the international balance of payments of Burma. Increased demand for fuel will also stimulate the growth of petroleum refining industry in Burma which is an oil producing country.

f. Increase of Airport Employment

Increased demand for airport and related services that the new improved airport is expected to create will generate additional employment opportunities not only on but also off the airport through multiplier effect.

g. New International Route Service by Foreign Carriers

Opening of services on new international routes by foreign carriers will compel BAC to improve its passenger services because

of increased competition. Possible establishment of Rangoon offices by foreign carriers that will serve the new Rangoon routes will bring additional employment and contribute to promoting cultural and technical interchange on global basis. It may also create increasing demand for international telecommunications services beyond the level the existing system is capable of accommodating.

h. Establishment of an International Cargo Distribution Centre

Establishment of an international cargo distribution centre is one means of capitalizing on the time savings produced by the Project. There are few obstacles to its realization because it requires neither sophisticated technology nor an elaborate industrial base. This will undoubtedly stimulate Burmese economy through development of such logistic industries like insurance, transportation, communication, etc. On the other hand, it could also have undesirable impacts such as the possible decline of local companies due to keen foreign competition.

i. Enlarged Export Market of Perishable Goods

Savings in cargo transportation time brought by the Project are likely to cause expansion of export market for such perishable produce of high value added as orchid and fruit. One of Burma's major industries is agriculture, and its higher productivity

attained with higher value added products will have significant effect upon the overall Burmese national economy.

j. Promotion of High Value Added, Labour-Intensive Export Industries

Shortening of cargo transportation time will help promote development of high value added labour-intensive export industries, which will also have a large effect upon employment.

3) Serving as Alternate to Bangkok International Airport

Since Rangoon is only 316 miles from Bangkok, it is possible that newly developed Rangoon International Airport may be designated as an alternate airport for Bangkok International Airport. Use of a nearer alternate airport will mean savings in time and fuel for air carriers, but the beneficiaries will mostly be foreign air carriers.

4) Improved Air Safety by Modernization of Air Navigation System

With modernization of air navigation system, number of accidents may well be expected to decrease as it will ease pilots' and navigators' stress and hence help prevent navigational error.

5) Development of Electronic Technology

It will become necessary to train electronics engineers to maintain the airport-related electronic system, and possibility of transfer of such electronics technology to other industries of Burma can be a further potential benefit.

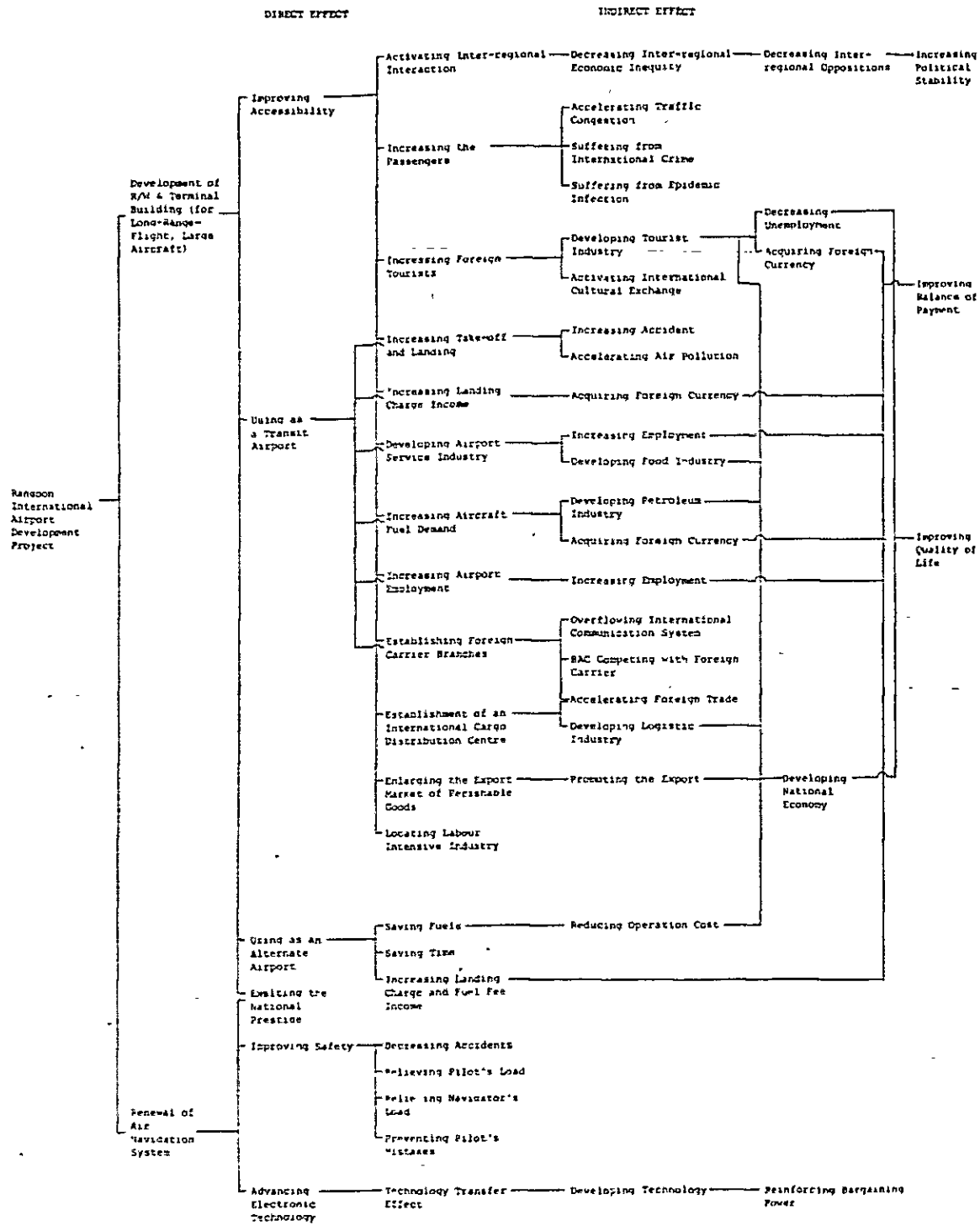


Figure 11-1 Impact Flow

11.3 Summary of Indirect Intangible Impacts

Summarized assessment of indirect intangible impacts is shown in Table 11-1.

These intangible impacts have been assessed only qualitatively in terms of their effect, possibility of occurrence, magnitude and controllability of the adverse effects by an unsophisticated ranking system because their numerical expression is impossible. They are classified into 3 categories, A, B and C which are large, medium and small, respectively.

Table 11-1 Summary of Indirect Intangible Impacts

Category		Effect	Possibility of Occurrence	Magnitude	Controllability	Countermeasures
Airport	Decreasing aircraft accidents by renewal of air navigation system	+	A	B	-	
	Relieving pilot's load	+	A	B	-	
	Relieving navigator's stress	+	A	A	-	
	Increasing aircraft accidents with increasing aircraft landing and take-off	-	B	B	B	Enforcement of aircraft inspection and air navigation
Air Carrier	Saving fuel with using as an alternate airport	+	A	A	-	
	Saving time with using as an alternate airport	+	A	A	-	
	Decreasing BAC's profit by competition with foreign carrier	-	B	B	B	Improving passenger service
Transportation	Accelerating the congestion on route to the airport	-	A	B	A	New road construction
	Overflowing international communication system	-	A	B	A	Reinforcement of communication system
	Establishing foreign carrier branches	+	A	B	-	
	Developing logistic industry	+	A	B	-	
Economy	Developing petroleum industry	+	A	B	-	
	Enlarging the perishable goods export	+	A	B	-	
	Locating labour intensive industry	+	A	B	-	
	Developing national economy	+	A	C	-	
	Activating inter-regional interaction	+	A	A	-	
	Improving employment	+	A	B	-	
	Improving quality of life	+	A	B	-	
Society	Activating international economic, cultural exchange	+	A	B	-	
	Developing technology	+	A	B	-	
	Suffering from international crime	-	B	B	A	Enforcement of regulation
	Suffering from epidemic infection	-	B	B	A	Enforcement of quarantine
	Accelerating air pollution	-	B	C	C	Development of Jet engines
	Exalting the national prestige	+	A	B	-	

CHAPTER 12. EVALUATION OF DEVELOPMENT ALTERNATIVES AND RECOMMENDATIONS

CHAPTER 12 EVALUATION OF DEVELOPMENT ALTERNATIVES AND RECOMMENDATION

12.1 Comparative Evaluation of Development Alternatives

The basic difference between the two development alternatives of Case 1 and Case 2 of the Rangoon International Airport Development Project as discussed throughout the present report lies in the ultimate runway length. In Case 1, the total length of 11,100 feet capable of accommodation direct flights to Tehran or Baghdad is to be provided in Phase I remaining unchanged through 2005. In Case 2, on the other hand, the Phase I length of 11,100 feet is further extended by 1,000 feet to a total of 12,100 feet in Phase II so as to enable the Project airport to accommodate long-haul direct international flights to European gateway cities by B-747 class aircraft, as well as to accommodate improved load factor on medium-haul flights. Technical, economic and financial evaluation of the two alternative cases of development are presented hereunder.

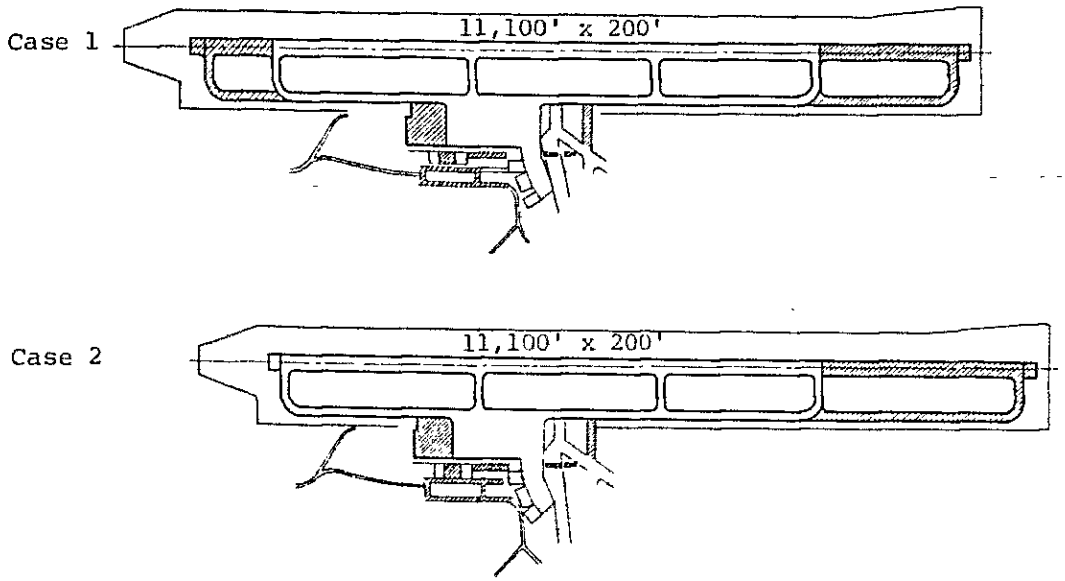
12.1.1 Technical Comparison

(1) Projected Traffic and Airport Facilities

As stated in Chapter 4, air traffic forecast was made separately for Case 1 and Case 2 taking into account the likely influence of the difference in the physical handling capability of the two cases in Phase II as reiterated in the preceding paragraph. The resultant difference in the forecast traffic between the two cases,

however, has not turned out to be big enough to produce any significant difference in the peak-hour traffic, and consequently to affect the overall facility requirements and subsequent facility planning of the airport, except, of course, for the runway and related airfield facilities of visual and radio navigational aids, etc. Figure 12-1 shows the layout plans by phase of Case 1 and Case 2 alternatives, while Table 12-1 summarizes the differences in the planned airport facilities for the two cases.

Phase I



Phase II

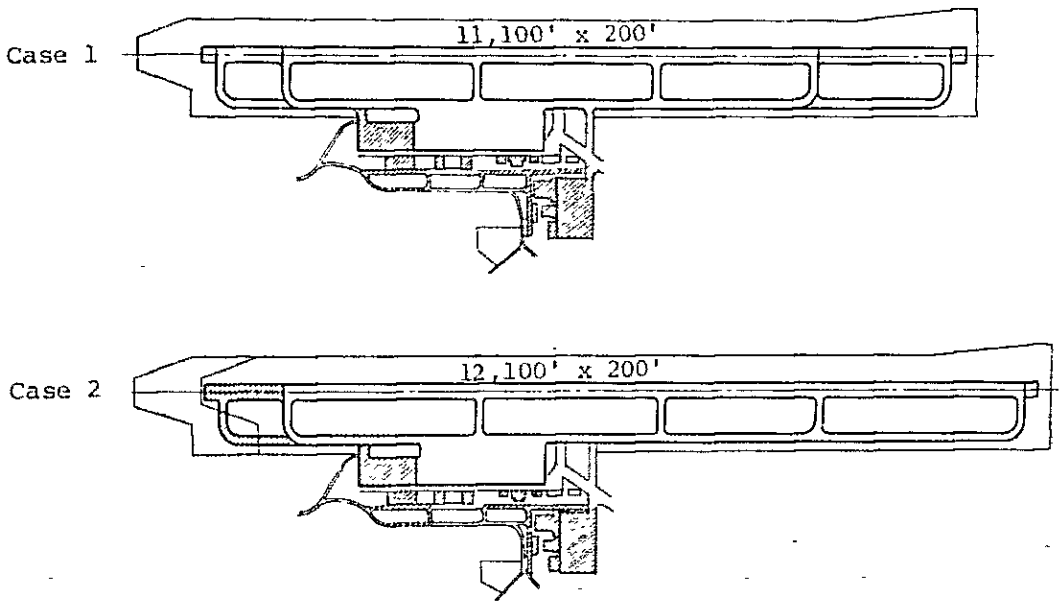


Figure 12-1 Layout and Work Plan of Alternatives

Table 12-1 Summary of Differences in Facility Plans for Case 1 and Case 2

Items of Comparison	Alternatives			
	Case 1		Case 2	
	Phase I	Phase II	Phase I	Phase II
Expansion Area Requirements				
Within Existing Airport Premises	5,042,000 ft^2	---	4,792,000 ft^2	1,116,000 ft^2
To be Newly Acquired	4,731,000 ft^2	---	5,195,000 ft^2	701,000 ft^2
Total Area	9,773,000 ft^2	---	9,987,000 ft^2	1,817,000 ft^2
Runway Extension				
Total Length Required	11,100 ft	11,100 ft	11,100 ft	12,100 ft
Extension	1,000' Southwards 2,000' Northwards	---	3,000' Northwards	1,000' Southwards
Taxiway Extension				
Length Required				
Parallel Taxiway	11,100 ft	11,100 ft	11,100 ft	12,100 ft
Exit Taxiways	550 ft x 6 Exits	550 ft x 6 Exits	550 ft x 5 Exits	550 ft x 6 Exits
Extension	Southwards and Northwards	---	Northwards	Southwards
Approach Lights Installation	Newly Install ALS for RWY 21 SALS for RWY 03 (CAT-I)	---	Newly Install ALS for RWY 21 SALS for RWY 03 (CAT-I)	Relocate SALS for RWY 21
Airfield Lighting Installation	Newly Install (CAT-I)	---	Newly Install (CAT-I)	Additionally Install on Runway and Taxiways Extended
Navigational Aids Installation	Newly Install CAT-I ILS	---	Newly Install CAT-I ILS	Relocate Localizer and Its' Critical Area

(2) Operational Considerations

1) Flight Stage and Payload

As stated above, the Case 2 runway in Phase II would accommodate longer non-stop flights of wide-bodied jets or greater payload for medium haul flights than in Case 1. Calculated with B-747-200B as the design aircraft, the increases amounts to 430 NM more of flight stage and 22,500 lbs more of payload. These results translate into the following operable payload on each route expressed in percentage of the maximum structural payload, with assumed flight time of 2 hours to alternate airport.

	Case 1 11,100 feet Runway	Case 2 12,100 feet Runway
Rome	25%	39%
Athens	37	51
Cairo	43	57
Beirut	62	76
Baghdad	78	92
Tokyo	74	88

2) Airspace Use Plan

There practically is no difference of any significant operational consequences in airspace use plan of the two alternative cases, which also require almost identical navigational aid facilities, provided that the necessary relocation of the high tension powerline and tower existing on the Northern

extension of the runway, that constitutes a common obstacle to the Obstacle Limitation Surfaces in the two cases, involves 3,700 feet of relocation distance in Case 1 and 4,900 feet in Case 2. Table 12-2 shows a detailed comparison of the airspace use plans for the two cases.

(3) Schedule and Cost of Construction

1) Construction Quantities

Major differences in construction quantities involved in Case 1 and Case 2 are shown in Table 12-3 below.

Table 12-2 Airspace Use Plan

Items	Case 1 Case 2	Remarks
Instrument Approach and Departure Procedures		
ILS-Rwy 21	Approach Course remains the same. Landing Minimum remains the same. DH should be calculated by adding 200ft to TDEL.	Location of MM and LOM in relation to the approach end of runway should remain the same.
VOR-ADF Approach	Approach Course remains the same. Straight-in Landing Minimum (runway 21) remains the same. Distance from Airport VOR to the Missed Approach Point indicated on the Approach Plate should read 2.4NM.	Assumed location of MDN NDB, 3.9NM from the approach end of runway 21. Distance from the approach end of runway to the Missed Approach Point should remain the same.
VOR Approach	Approach Course remains the same. Straight-in Landing Minimum (runway 21) remains the same. Distance from Airport VOR to the Missed Approach Point indicated on the Approach Plate should read 2.4NM.	
ADF Approach	Approach Course remains the same. Straight-in Landing Minimum (runway 03) remains the same.	
Circling Approach	Circling Minimum remains the same.	
Standard Instrument Departure	Departure Procedures need not be modified.	

Table 12-3 Comparison of Construction Quantities*

Items of Comparison	Case 1		Case 2	
	Phase I	Phase II	Phase I	Phase II
Earth Work	(cft) 1.87×10^8	(cft) 0.03×10^8	(cft) 1.81×10^8	(cft) 0.61×10^8
	Total 1.90×10^8 (cft)		Total 2.42×10^8 (cft)	
New Pavement	(sft) 1,786,000	(sft) 989,000	(sft) 1,673,000	(sft) 1,503,000
	Total 2,775,000 (sft)		Total 3,176,000 (sft)	
Pavement Overlay	(sft) 3,674,000	---	(sft) 3,674,000	---
Road Relocation	(ft) 6,600	---	(ft) 8,800	---
Railway Relocation	(ft) 6,800	---	(ft) 9,200	---
Water Main Realignment	(ft) 1,900	---	(ft) 1,900	---
Power Line Realignment	(ft) 3,700	---	(ft) 4,900	---
House Removal	(houses) 400	---	(houses) 450	(houses) 14
	Total 400 (houses)		Total 464 (houses)	

Note: * Not including construction of terminal and other buildings, pavement of roads and car parking, installation of lighting and telecommunications facilities.

2) Civil Work Construction Plan

Summary of the construction plan of the civil works characteristic of the two alternatives compare as tabulated below.

Case 1	Case 2
Site Conditions (Topography and Soil)	
Construction work site extends almost entirely within the New Chittygon area which is basically free of paddy fields or water-veins, except for a minor part that falls on the paddy field.	Construction work site extends well beyond the New Chittygon area into the Old Chittygon area which is predominantly covered with paddy fields and where a major water vein leading to the Pazundaung Creek exists.
This site condition facilitates provision of the temporary haul road and requires only a small amount of temporary drainage work and foundation work.	This site condition not only makes provision of the temporary construction site roads rather difficult but also requires large scale temporary drainage system, as well as sophisticated, large scale foundation work.
Paddy field subsoil is expected to be very poor and requires effective measures to prevent settlement due to consolidation which, however, is limited to a small area.	Paddy field subsoil which is expected to be very poor requires a large scale preventive measures against settlement by consolidation.

Case 1	Case 2
Work Plan	
40% and 54% of the total earthwork is made on the Southern and Northern runway extension respectively under Phase I, leaving only 6% for Phase II.	8% and 64% of the total earthwork is made on the Southern and Northern runway extension respectively under Phase I, and the balance of 28% in Phase II.
The nearly even work distribution between the two sites, or nearly halving of the work amount by site, facilitates scheduling of construction machinery work. On the other hand, due to the limited time allowed for the construction, this fact at the same time demands duplicated or overlapping investment on certain multi-purpose construction equipment that are required simultaneously at both sites.	Relatively large concentration of earthwork amount at one site requires more complex scheduling of construction work by equipment and of site road construction, etc. No duplication or overlapping of equipment investment is required, because use of larger capacity equipment justified by the site of work site and amount ensures completion of work to meet the 1985 opening.
Simultaneous execution of the civil work also necessitates siting of the various construction plants midway between the two sites, resulting in longer distances from either site than in a case where the plant can be placed at an optimum distance from the work site.	Siting of the various construction plants and provision of temporary utility, such as water and power, is relatively easy.
Construction Equipment Depreciation	
Since almost 100% of the investment on the construction equipment has to be made in Phase I, it constitutes an over-investment from the viewpoint of depreciation.	Since nearly 30% of the earthwork is left for execution in Phase II, the equipment investment situation can be in a better position from the viewpoint of depreciation.

3) Construction Cost

Case 1 and Case 2 construction costs compare as shown in Table 12-5.

Table 12-5 Comparison of Construction Cost

(thousand US$)

Cost Items	Case 1			Case 2		
	Phase I	Phase II	Total	Phase I	Phase II	Total
Land Acquisition and Relocation of Building	54	0	54	61	0	61
Temporary Work	3,205	0	3,205	3,205	0	3,205
Compensational Work	3,622	0	3,622	4,181	0	4,181
Earthwork	15,939	273	16,212	15,258	5,157	20,415
Pavement	13,158	2,345	15,503	13,031	3,597	16,628
Buildings	15,039	17,577	32,616	15,039	17,577	32,616
Aircraft Maintenance Facilities	0	4,372	4,372	0	4,372	4,372
Airfield Lighting & Electric Power Supply	6,122	1,137	7,259	6,201	1,477	7,678
Radio Nav-Aids Telecomm. & Meteo. Service Facilities	3,753	3,416	7,169	3,755	3,482	7,237
Refueling Facilities	6,687	2,865	9,552	6,687	2,865	9,552
Total	67,579	31,985	99,564	67,418	38,527	105,945
Engineering	6,758	3,199	9,957	6,742	3,853	10,595
Contingency	6,758	3,198	9,956	6,742	3,852	10,594
Grand Total	81,095	38,382	119,477	80,902	46,232	127,134

12.1.2 Financial and Economic Comparison

(1) Financial Feasibility

There hardly is any noticeable difference between the financial feasibility situations of the two alternatives, both showing a negative FIRR value when calculated with the raised tariff level assumed in Chapter 8 as summarized hereunder in Table 12-6. Results of sensitivity analysis are shown in Table 12-7.

Table 12-6 Assumed New Tariff Structure

Items	Assumed New Tariff Level	Remarks
Landing Charge	International services 4 times the present Domestic services 2 times the present	2/5 of Bangkok Airport's rates in 1979
Aircraft Parking Charge	Same as present	
Navigational Facility User Charge	Same as present	
Fuel Service Charge	Kyats 0.10/Imp.gal	
Passenger Charge	US$2.00/Emb. passenger - same as present	Equal to Bangkok Airport's rates in 1979
Terminal Building Rental	US$0.8/sft.month - same as present	
Car Parking Charge	Kyats 2.00/Vehicle - 2 times the present	

Table 12-7 Comparison of Financial Internal Rate of Return

		Percentage Raise to over the Assumed New Tariff		FIRR	
		Phase I	Phase II	Case 1	Case 2
With Assumed New Tariff System		--	--	Negative Value	Negative Value
Sensitivity Analyses	A	200%	400%	2.4%	2.3%
	B	250	400	2.5	2.5
	C	300	400	2.9	2.8
	D	200	500	3.9	3.8
	E	250	500	4.1	4.0

(2) Economic Feasibility

Both alternatives are found economically feasible as the results of economic analysis shown in Table 12-8 below clearly indicates.

Table 12-8 Comparison of Economic Analysis

(In 1979 thousand US$)

		Case 1		Case 2		Remarks
		Assumption a*	Assumption b**	Assumption a*	Assumption b**	
Economic Costs of Project		139,371		144,682		Residual value in 2005 deducted
Economic Benefits	Time Saving Value	130,146		130,175		
	Increased Foreign Exchange	482,486	936,311	489,271	948,575	
	Saved Maintenance Cost of Existing Facilities	4,304		4,304		
Total Benefits		616,936	1,070,761	623,750	1,083,054	
EIRR		12.0%	16.1%	11.8%	16.0%	Discount rate 10%

Notes: * Assumption a: Tourist spending and stay time in Burma assumed at US$45.00 and 5 days per person for the period 1985-2005.

** Assumption b: Per capita tourist spending and average stay time assumed to increase at 4% per annum.

12.1.3 Overall Evaluation

Based on the results of the foregoing comparison by item of the two development alternatives, an overall evaluation of the Rangoon International Airport Development Project Case 1 and Case 2 were made as summarized in Table 12-9, and as a result Case 2 is recommended for adoption as basis of actual implementation planning of the Project. The criteria of the overall evaluation reflect directly and indirectly what the Government of the Socialist Republic of the Union of Burma expects of the Project, namely that the Project should:

i) provide the airport with a runway capable of accommodating non-stop long-haul international service by wide-bodied jets with an economic payload;

ii) provide airport facilities of international standard good enough to re-attract major international carriers that once served Rangoon and to satisfy the operational demand of other airlines who are proposing to serve Rangoon once it is adequately developed;

iii) give Burma an international airport worthy of being a national gateway by air that would compare favourably with its counterparts in the neighbouring countries;

iv) help improve the international balance of payments of Burma through increased foreign exchange earnings from tourism and trade; and

v) bring to the nation enlarged social and economic repercussion effects.

Table 12-9 Overall Comparative Evaluation of Development Alternatives Case 1 and Case 2

Item	Case 1	Case 2
1. Is runway length sufficient for long haul direct flights by wide bodied jets?	11,100ft Fairly sufficient	12,100ft Sufficient
2. Do facilities meet requirements by international standard of efficient air navigational and passenger/cargo handling?	Well met	Well met
3. Is planned capacity sufficient to accommodate satisfactorily both total and peak-hour traffic projected?	Sufficient	Sufficient
4. Is construction technically difficult?	Rather difficult but practicable	Considerably difficult but practicable
5. Construction Cost Phase I Phase II Total	US$81,095,000 38,382,000 119,477,000	US$80,902,000 46,232,000 127,134,000
6. Financial Feasibility	Both feasible with considerable revision of tariff structure	
7. Economic Feasibility	Both feasible	
8. Adjustability to future demand?	Rather poor, as it may require further runway extension	Fairly good
9. Magnitude of social impacts	Moderate	Fairly great

12.2 Recommendation

1. The present feasibility study has shown the Rangoon International Airport Development Project to be economically feasible from the viewpoint of national economy of the Socialist Republic of the Union of Burma. Considering the present state of the air navigation-related facilities of the Rangoon International Airport, it is strongly recommended that the Project be implemented at an earliest possible time in the interest of aviation safety and efficiency by international standard.

2. It is recommended that the airport facilities be planned in the actual implementation stage along the lines of the design concept presented in Case 2 of the development alternatives, which features an extension of the existing runway to 11,100 feet for Phase I operation until 1995, and ultimately to 12,100 feet for Phase II operation through the year 2005.

3. The earliest date that can be reasonably expected for the opening to traffic of the new, improved airport facilities at RIA in toward the end of 1985, and to attain this target date, earliest possible commencement of the following necessary preparatory work for the implementation of the Project is recommended.

i) Detailed site survey including aerial photographic survey

ii) Detailed soil survey

iii) Construction material survey

iv) Preparation of airport master plan, and preliminary and detailed engineering design

v) Acquisition of necessary land area for the expansion, and compensation for house relocation

vi) Preparatory work including compensation for relocation or removal of existing facilities

4. Establishment within the Ministry of Transport and Communications of an adequately staffed executing agency by reinforcing the present DCA is a prerequisite to satisfactory implementation of the Proejct. It is, therefore, recommended that an effective institutional and organizational set up be provided through the construction and operation stages of the Project along the lines proposed in Chapter 11 hereinabove.

5. A substantial upward adjustment of the airport tariff level to match that of the international standard is recommended for execution from 1985 on in order not only to improve the Project's financial feasibility but also to establish the airport as a financially viable entity in a long run.

6. To help improve the Project's financial situation, an appropriate form of financial support from the national treasury of Burma is invited, especially in the early stage of the Project where such support can mean a great deal more than if it were given in the later stage.

7. It is highly desirable that stepped-up national efforts and practical measures aimed at bringing to reality the forecast air transport demand of the Project and at improving its financial situation be made as suggested hereunder.

i) Exploration and development of tourism resources, and development of tourism-related infrastructure such as hotels and domestic transportation service.

ii) Expediting CIQ processing, facilitating visa issuance procedure and extending the maximum stay period for visitors.

iii) Maintaining the current relatively low level of fuel prices in Burma which should be attractive enough to cause foreign airlines to schedule their international services with RIA as a major transit airport.