SOCIALIST REPUBLIC

OF

THE UNION OF BURMA

RANGOON INTERNATIONAL AIRPORT DEVELOPMENT

FEASIBILITY STUDY REPORT

MARCH 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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FOREWARD

In response to the request of the Government of the Socialist Republic of the Union of Burma, the Government of Japan has decided to conduct a feasibility study on the Rangoon International Airport Development Project, and the Study has been carried out by the Japan International Cooperation Agency (JICA).

The JICA dispatched to Burma a preliminary survey team headed by Mr. Takashi Koreeda of Airport Facility Planning Office, New Tokyo International Airport Authority in June 1979, and the Feasibility Study was started in October 1979. The present Report is based on the Draft Final Report of January 1980, the subsequent supplementary studies made in Japan, and on the comments made by the officials concerned of Burma.

In view of the great contribution this project is expected to make to the economic development of Burma, I hope that the present study will serve to expedite the implementation of the project, and also contribute to furthering the friendly relations between our two countries.

I wish to express my heartfelt appreciation for the close cooperation extended to our team by the officials concerned of the Government of the Socialist Republic of the Union of Burma.

Tokyo, March 1980

Keisuke Arita
President
JAPAN INTERNATIONAL COOPERATION AGENCY
Tokyo, Japan

RANGOON INTERNATIONAL AIRPORT DEVELOPMENT

FEASIBILITY STUDY

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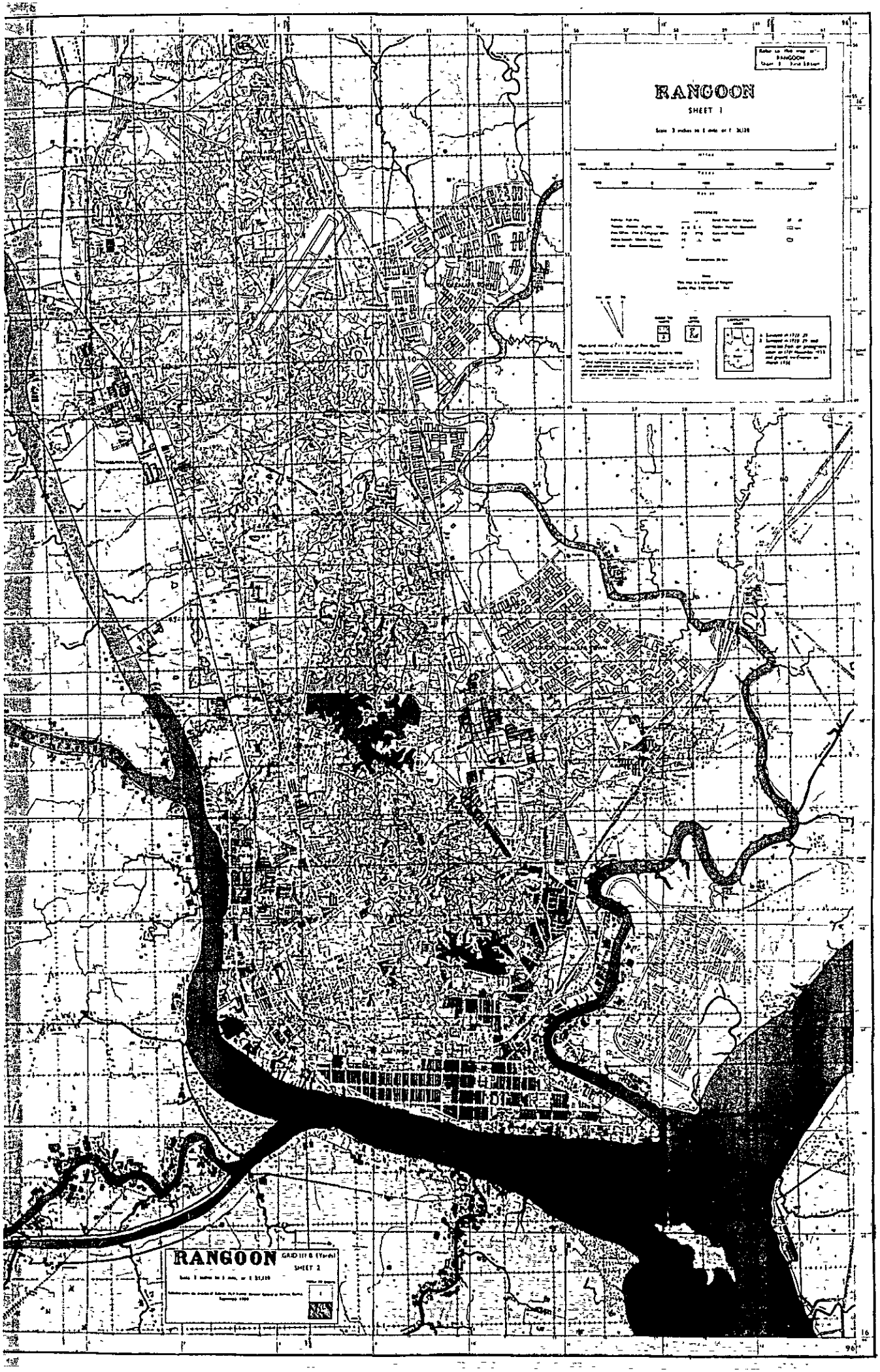
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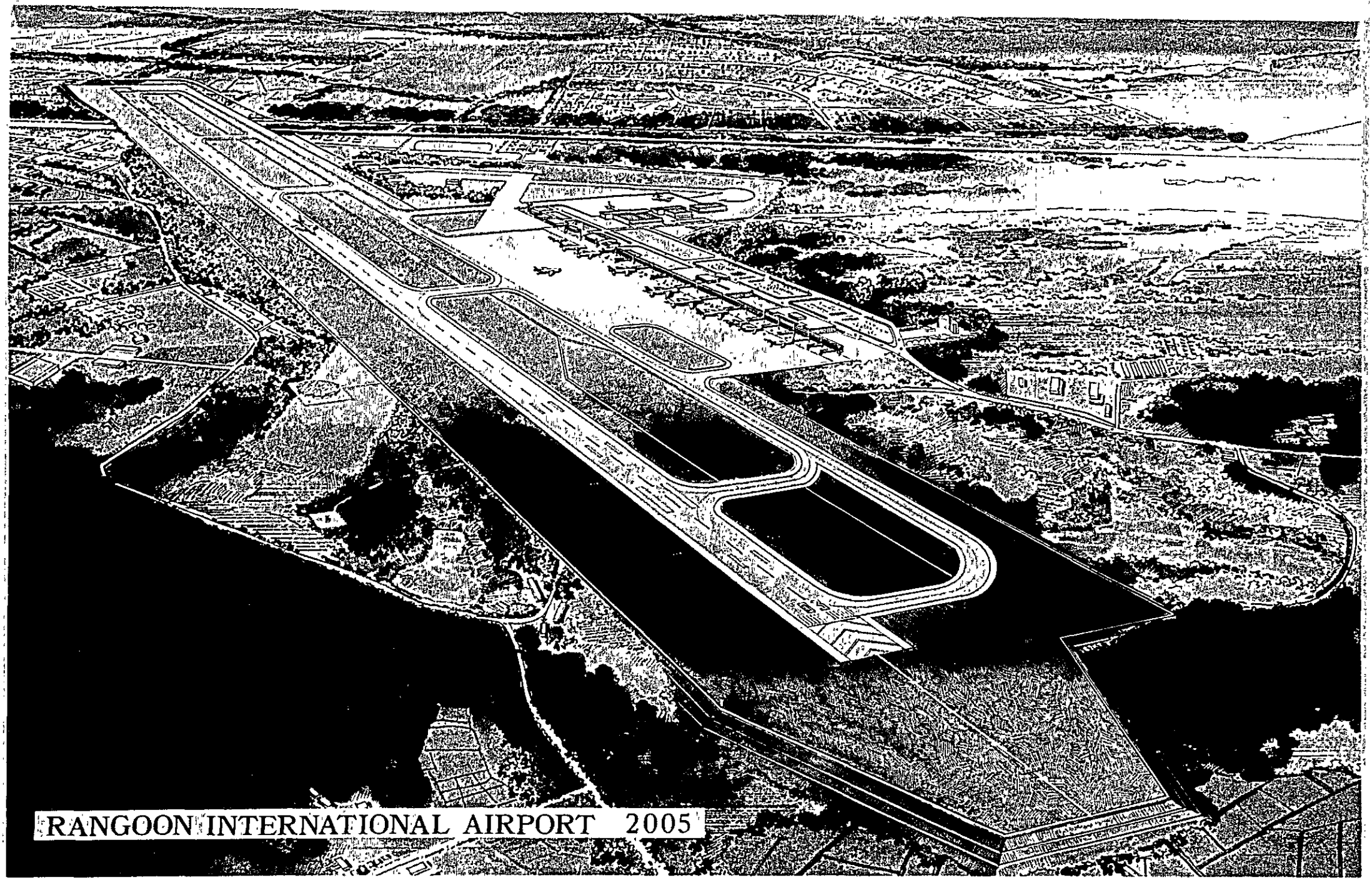
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CONCLUSION AND SUMMARY

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1. The present feasibility study has shown the Rangoon International Airport Development Project to be economically feasible when analysed from the viewpoint of national economy of the Socialist Republic of the Union of Burma, with the economic internal rate of return of over 11% which is greater than the assumed discount rate of the Burmese economy.

2. No significant technical difficulties are anticipated in the implementation of the Project.

3. On a solely financial basis, the Project is not self-supporting given the current structure of airport tariffs, and would, therefore, require some effective measures to increase revenues, either by raising the airport tariff level considerably or by creating system of governmental financial support, or both.

4. The Project's indirect economic and social impacts, such as increased employment opportunities, increased earnings of foreign exchange, and promotion of industry, trade and technology, etc. that are identified in qualitative terms only, are considered to equal if not exceed the benefits quantified in the economic analysis, adding all the more to the economic feasibility of the Project.

5. Considering the present state of the Rangoon International Airport, the Project is recommended for earliest possible implementation particularly in the interest of safety and efficiency of aviation. The year 1985 is considered to be the earliest opening date that can be reasonably expected for the airport, based on an optimum implementation time schedule as proposed, which calls for commencement of the necessary preparatory work without delay.

SUMMARY

1. INTRODUCTION

The primary purpose of the present feasibility study is to make a comprehensive evaluation of the Rangoon International Airport Development Project from the technical, financial and economic point of view.

The method and timing of the study proposed in the Inception Report were approved by the Burmese Government in October 1979, and it was immediately followed by field survey of the existing facilities and site, and the collection of other relevant data and information for the Project.

A comprehensive feasibility study was then carried out, and its findings submitted in the form of Draft Final Report in January 1980 were basically approved shortly thereafter, except for a few points on which a further study was made and the results have been duly incorporated in the present Final Report.

2. PROCEDURES OF STUDY AND ESTABLISHMENT OF DEVELOPMENT ALTERNATIVES

Following the field survey, and using earthworks as a major design parameter, 2 alternatives of the development were identified for detailed study. For each of these development alternatives with different combinations of runway length and direction of runway extension, demand forecasts, facility requirements and Project costs were established.

A financial analysis on the basis of the cash flow of the Project was then made together with an economic evaluation based on a "with and without" Project assessment. Social impacts and indirect economic benefits not dealt with in the economic analysis were identified on a qualitative basis.

The "without" Project situation was defined as the Base Case where no improvements to the existing facilities will be made during the assumed Project life of 1980-2005. The "with" Project situations were established in two above-mentioned development alternatives defined as Case 1 and Case 2.

Phase I (Target Year 1995)

Case 1	Case 2
Extend runway by 3,000 ft. to a total of 11,100 ft., 2,000 ft. to the North and 1,000 ft. to the South	Extend runway by 3,000 ft. to 11,100 ft. to the North
Expand the existing apron	Expand the existing apron
Construct new international passenger terminal;	Construct new international passenger terminal;
Convert existing terminal for domestic use until 1995;	Convert existing terminal for domestic use until 1995;
Construct control tower and operation building	Construct control tower and operation building

Phase II (Target Year 2005)

Case 1	Case 2
No further extension of runway	Further extend runway by 1,000 ft. to the South to a total of 12,100 ft., and relocate ancillary facilities
Expand apron	Expand apron
Expand international passenger terminal for 2005 traffic requirements;	Expand international passenger terminal for 2005 traffic requirements;
Construct new domestic passenger terminal;	Construct new domestic passenger terminal;
Construct new cargo building	Construct new cargo building

3. BACKGROUND OF PROJECT

Burma is presently undergoing the Third Four-Year Plan. The gross domestic product growth rate is 6%, whereas that of population is 2.2%. The economy of Burma, which has an area of 261 thousand square miles and a population of 32.6 million, is gradually being industrialized. The principal industries are mostly state-owned. Tourism although not on a large scale at present, is considered to have significant potential.

The transportation system of the country consists of roads, railways, water transport, and aviation. Roads have a 72% share of total passenger traffic, and railways 18% in passenger and 42% in freight in 1978/79.

There are 66 airports, 53 of which being commercially operated by the state-owned Burma Airways Corporation, the only airline in Burma. International routes operated by BAC consist of 4 routes bound for Bangkok, Dacca, Calcutta, Kathmandu and Singapore, and the Government's intentions for future international services are for direct flights to Tokyo and Frankfurt by Boeing 747.

4. AIR TRAFFIC FORECAST

Forecast was made of the passenger and cargo transportation demand at Rangoon International Airport for a period of 25 years from 1980 to the ultimate design year of 2005. Forecasts were made for Case 1 with an 11,100 feet Runway, and Case 2 with a 12,100 feet Runway. The existing international air route network serving Rangoon was assumed to remain and in addition, 13 new air routes were assumed to be established.

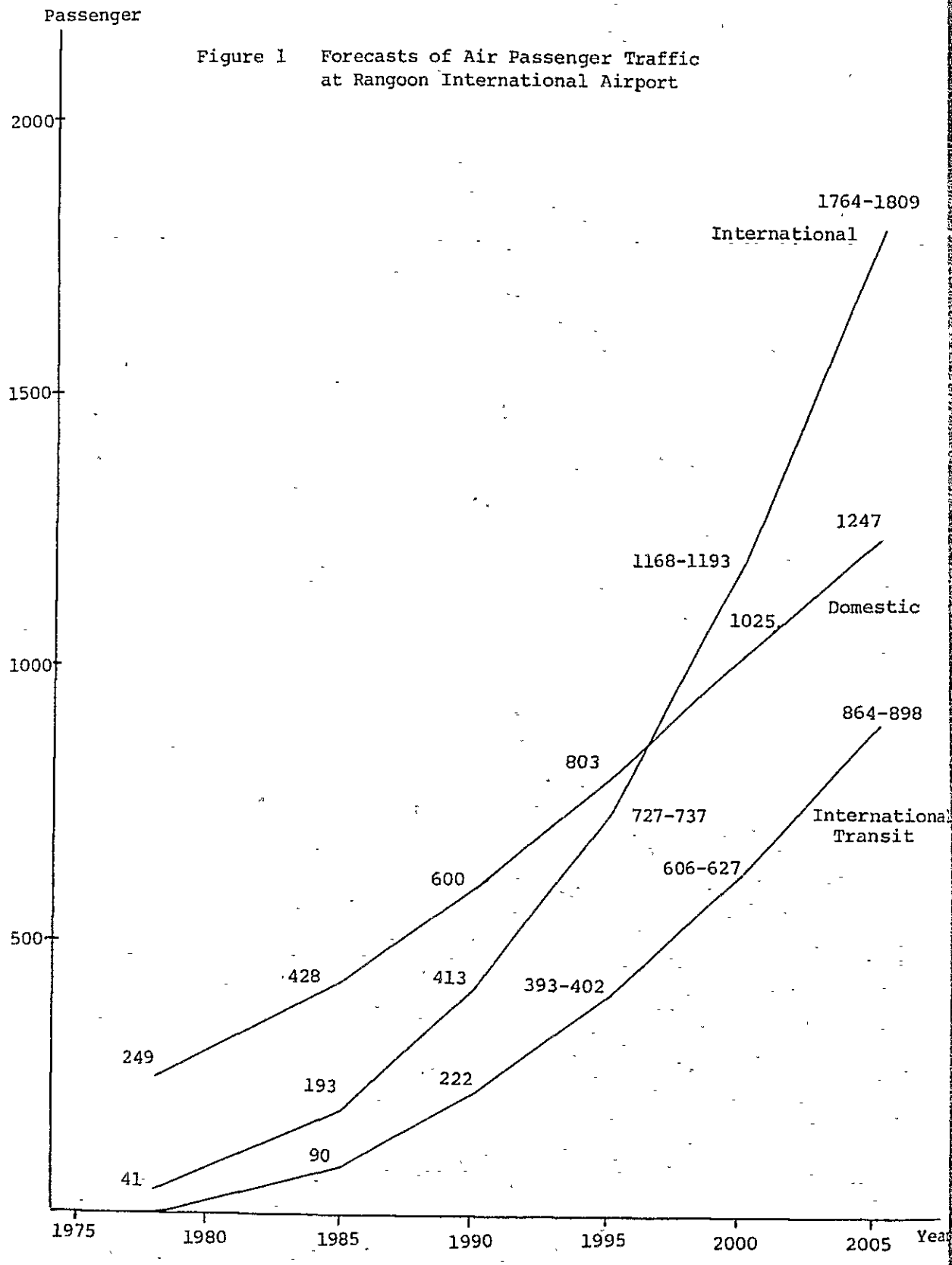
An air traffic forecast for passengers at Rangoon International Airport was made by assuming that the growth of air traffic demand which at present is very low in comparison with other countries in the world would correspond to the level of economic activity of Burma.

The result of the air traffic forecasts are summarized in Table 1 and Figure 1.

Table 1 Summary of Air Traffic Forecast at Rangoon International Airport

	Case 1			Case 2		
	1985	1995	2005	1985	1995	2005
International Passengers ('000 persons)						
Embarking & Disembarking	103	334	900	103	336	911
Transit	90	393	864	90	402	898
Total	193	727	1,764	193	738	1,809
Domestic Passengers ('000 persons)						
Embarking & Disembarking	427	802	1,246	427	802	1,246
International Cargo ('00 tons)						
Loaded & Unloaded	9	38	135	9	38	135
Domestic Cargo ('00 tons)						
Loaded & Unloaded	34	58	81	34	58	81

Figure 1 Forecasts of Air Passenger Traffic at Rangoon International Airport



5. FACILITY REQUIREMENTS

The design years for the planning of the airport facilities are 1995 for Phase I, and 2005 for Phase II.

Runway length requirements were studied with an assumed long-haul service by B-747 with a minimum economic payload of 60 to 70% and the following physical characteristics of the airport appropriate design factors for this study, and as a result 11,100 feet and 12,100 feet were established for Case 1 and Case 2 development alternatives respectively.

Altitude	: 109 feet above sea level
Reference Temperature	: 37°C
Effective Slope of Runway	: 0.55%
Surface Condition of Runway	: Wet
Wind Direction and Velocity	: Calm

Facility requirements for aprons, terminal buildings, control tower and operation building, car parking lots and other terminal facilities required were also studied for each phase of the Project, with the results as shown in Table 2 below.

Table 2 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 2 -- 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 2 -- 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 2 -- 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 2 -- 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, Calvent 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 2 -- 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

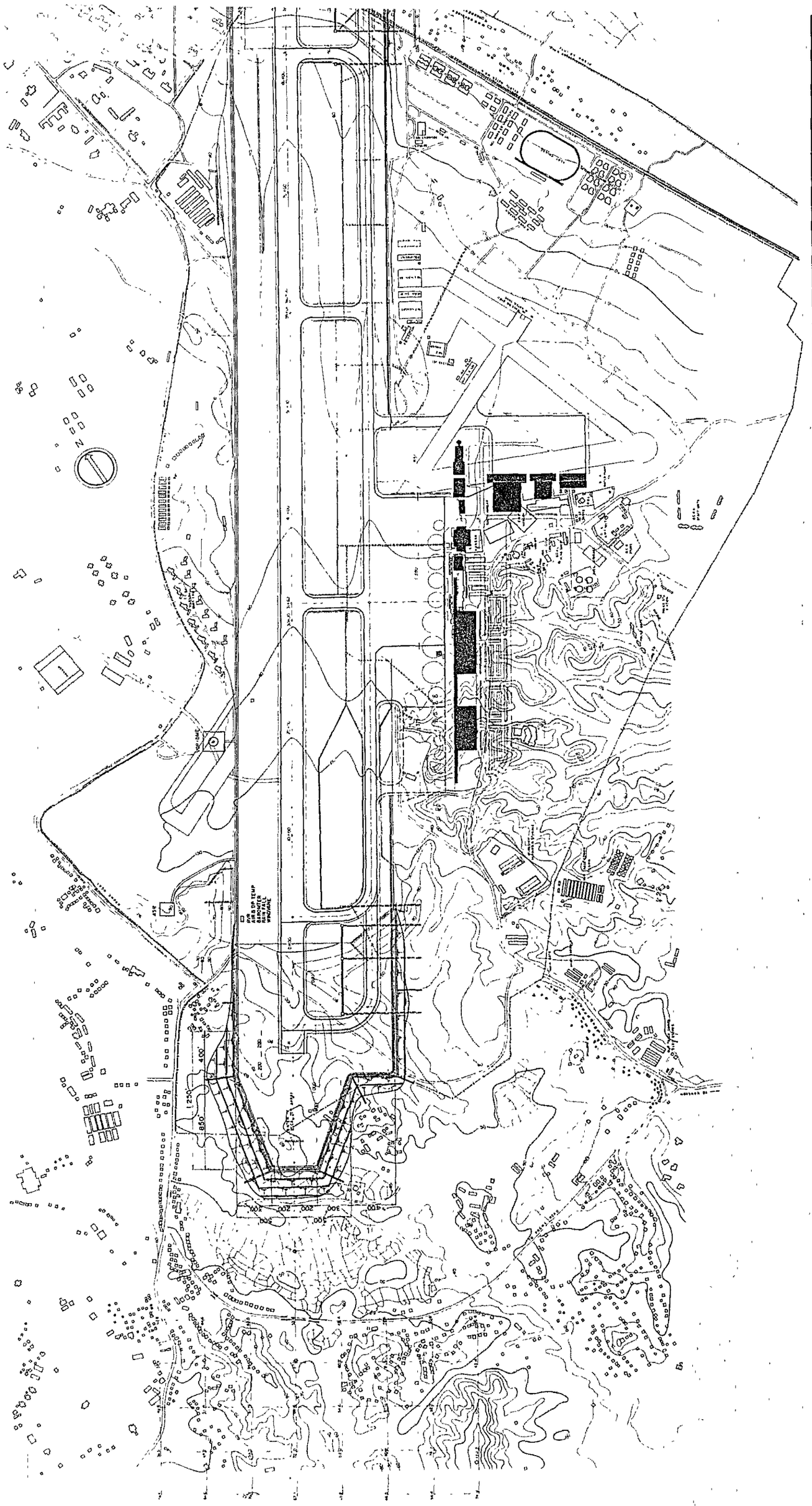
6. AIRPORT FACILITY AND AIRSPACE USE PLAN

The examination of the existing airport facilities, the demand/capacity forecasts, the preliminary engineering assessments and the layout requirements of the Project, has resulted in the following facility plan.

Runway and parallel taxiway extensions were planned for both Case 1 and Case 2 as follows with the alternatives of layout plan in both cases as shown in Figure 2 and Figure 3.

Case 1	Case 2
Phase I	
Runway length of 11,100 ft. consisting of 2,000 ft. extension to the North and 1,000 ft. to the South. Overlaying of the existing runway pavement is also required.	Runway length of 11,100 ft. with entire 3,000 ft. extension to the North. Overlaying of the existing pavement is required.
Phase II	
No further development is proposed.	An additional runway extension of 1,000 ft. to the South is to be constructed.

The aircraft parking apron is expanded to the South in Phase I and Phase II, and an aircraft maintenance apron is planned under Phase II of the Project in both cases of development alternatives.



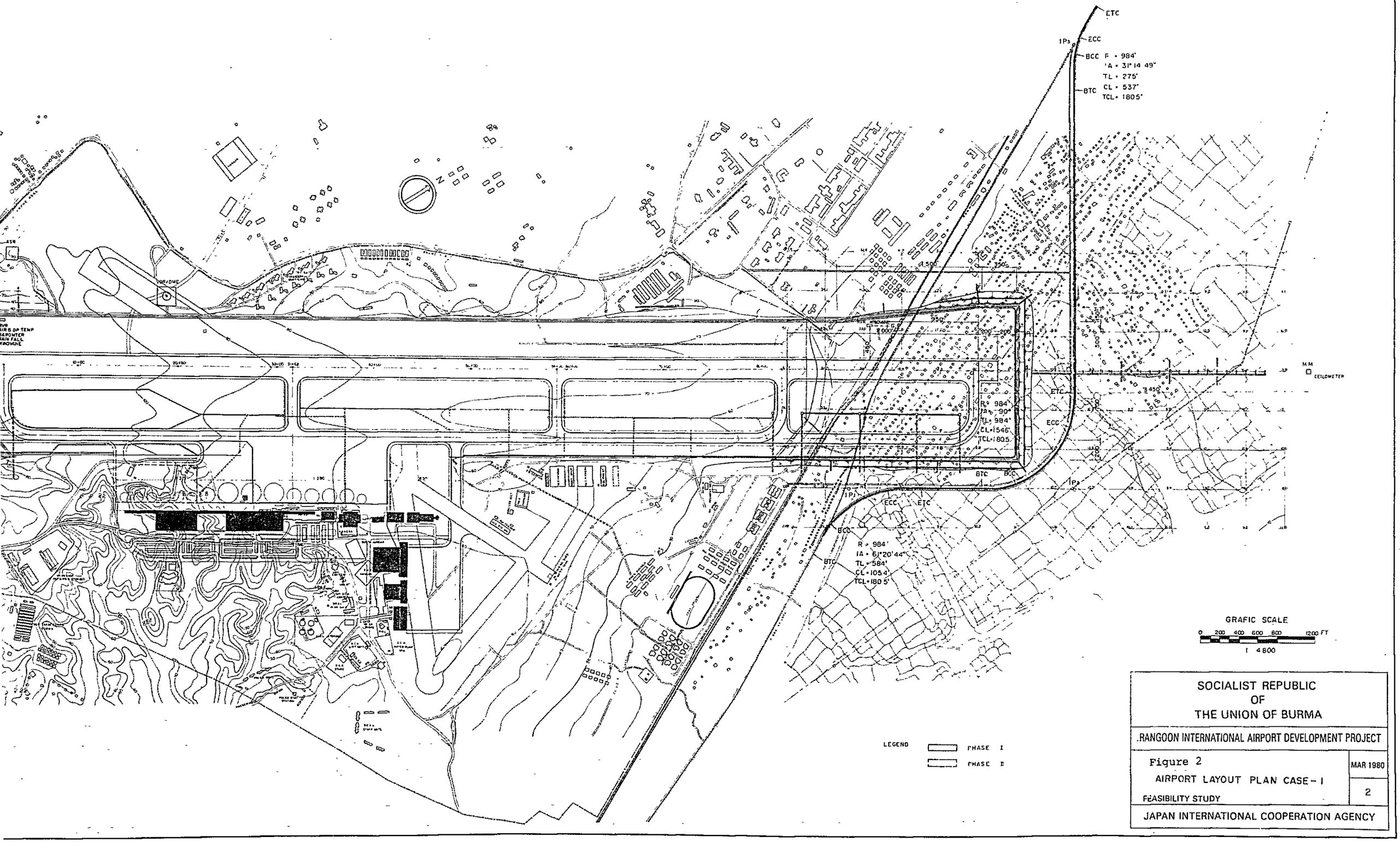


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Figure 2
AIRPORT LAYOUT PLAN CASE-1

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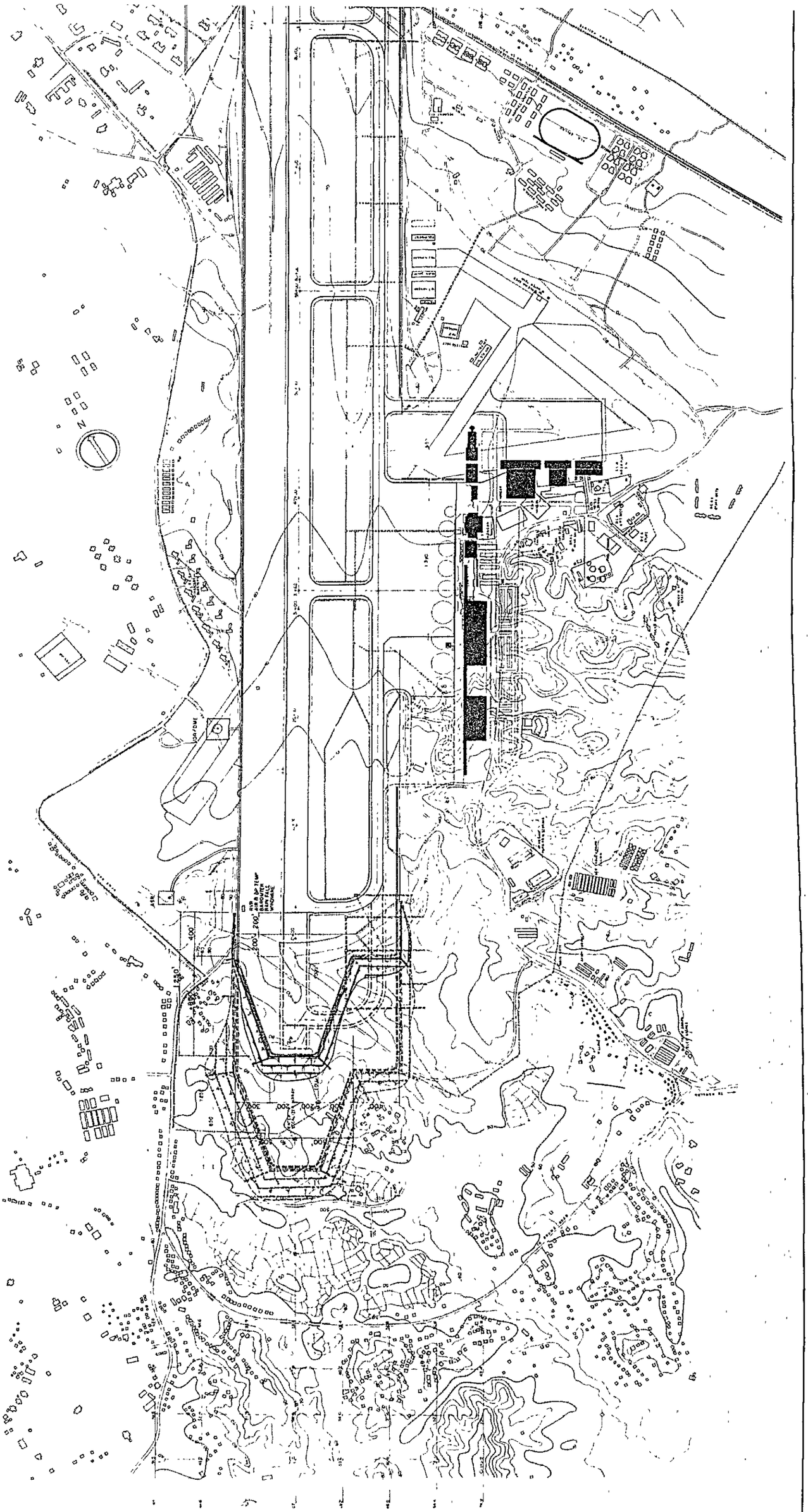

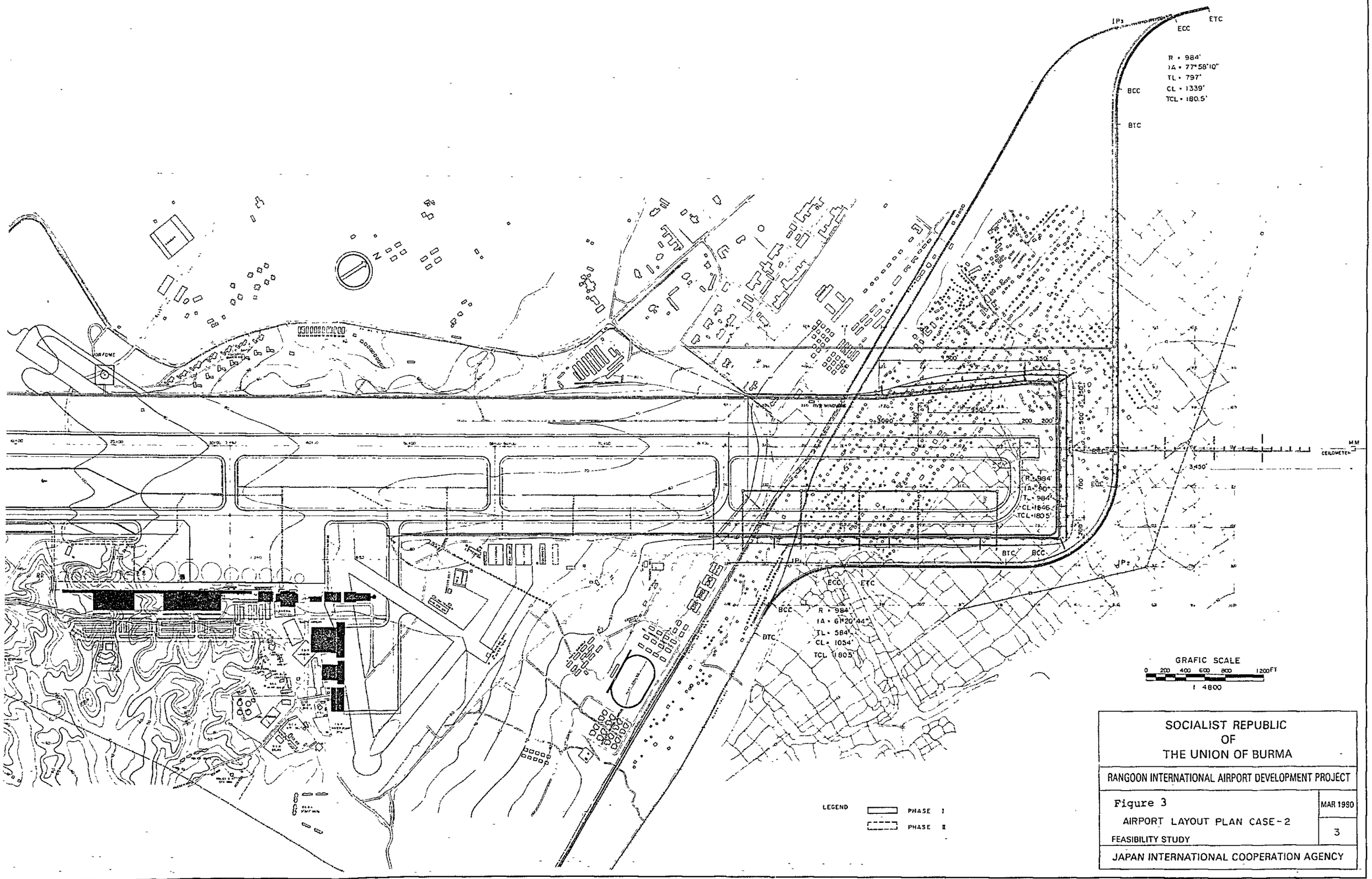

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Figure 3
AIRPORT LAYOUT PLAN CASE-2
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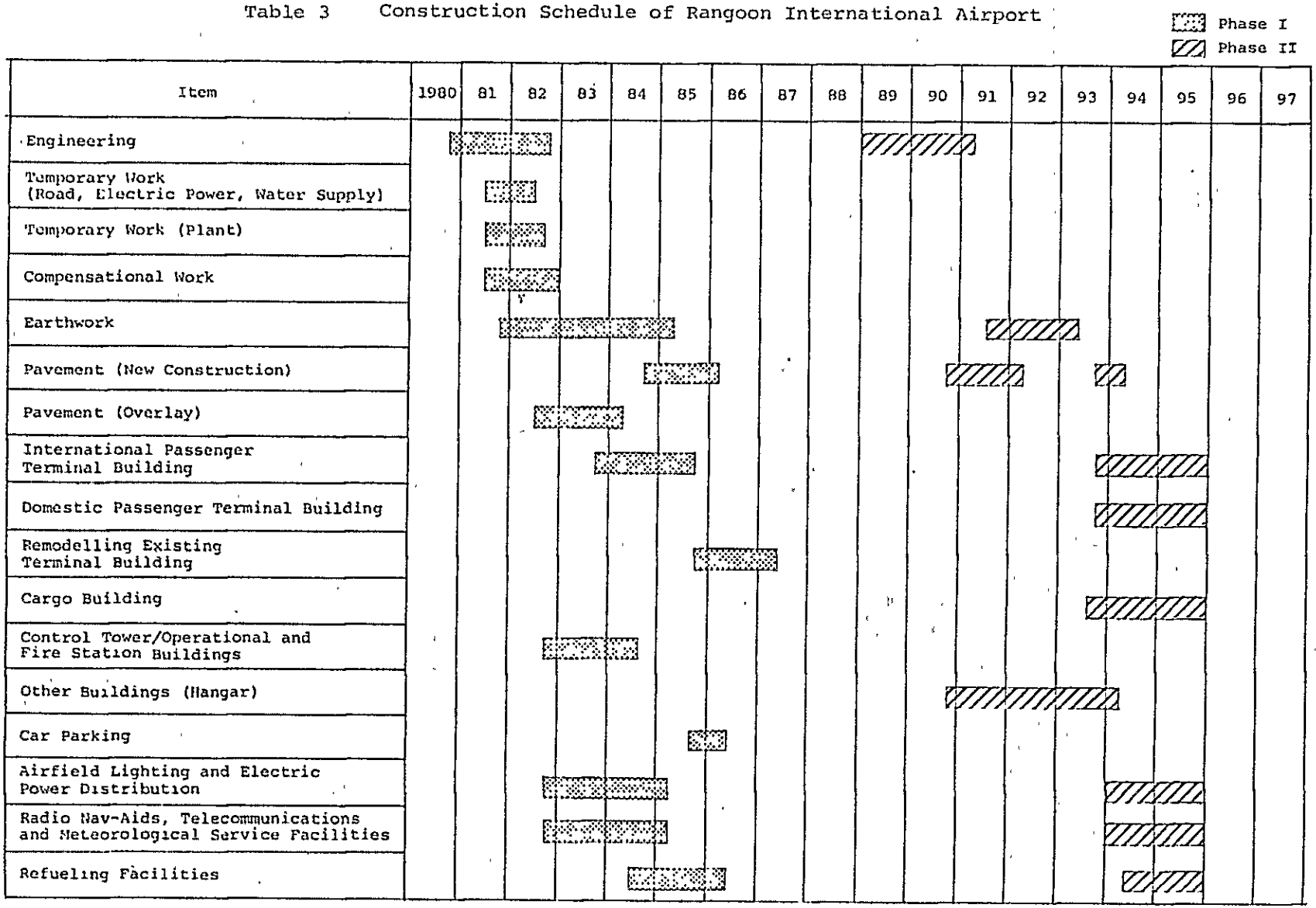
A new terminal building is planned for international passengers, adjacent to the new apron area, with expansion required in Phase II. The existing terminal building is to be remodelled to cater solely for domestic passengers in Phase I. By 1996 this building will have reached its capacity and a new domestic terminal building is planned in Phase II on the South side of the new international terminal building. A new cargo terminal building is planned in Phase II.

Relocation of the control tower and operation building, electric power substation and the rescue and fire fighting station are planned in Phase I and shall be located approximately mid-way along the runway for air traffic control requirements and for security. Nav-Aids and telecommunications shall be modernized to conform to international standards.

7. CONSTRUCTION SCHEDULE AND COST ESTIMATES

The construction schedule of the Project is planned as shown in Table 3, based on the assumption that detailed design work, topographical survey, soil investigation, land acquisition and compensation are commenced during 1980. If this schedule is kept to, the Project airport will be open for planned operation by 1985.

Table 3 Construction Schedule of Rangoon International Airport



The construction cost of the Project including civil works, buildings and land acquisition costs, and contingencies is estimated for each development phase for Case 1 and Case 2 and subdivided into the foreign and local currency elements as follows. All exchange rates between Kyat, Yen and U.S. Dollars were based on rates prevailing in November 1979. All prices used are those of November 1979.

	Case 1	Case 2
Phase I (1980-1987)		
Foreign currency element	US$ 55,147,000	US$ 54,711,000
Local currency element	US$ 25,948,000	US$ 26,191,000
Total	US$81,095,000	US$80,902,000
Phase II (1989-1995)		
Foreign currency element	US$ 29,418,000	US$34,267,000
Local currency element	US$ 8,964,000	US$ 11,965,000
Total	US$38,382,000	US$46,232,000

8. FINANCIAL ANALYSIS

Financial feasibility of the Rangoon International Airport Development Project was analysed assuming that the new airport would be managed on a self-supporting accounting basis.

Financial costs comprise the construction cost and the maintenance and operation cost of runway, taxiway, aprons, approach road and car parking, buildings, airport utilities, air navigation facilities and the special equipment, plus the manpower costs of the airport, and other costs incurred in the new airport operation.

The present tariff was assumed to be revised from 1985 on to meet the costs of the development of the airport. The revised airport tariff structure shall contain the following items.

(1) Landing Charge
(2) Housing Charge
(3) Air Navigation Facilities Charge
(4) Passenger Charge
(5) Terminal Rental
(6) Car Parking Charge
(7) Fuel Service Charge

The financial internal rate of return of the Project that resulted from the financial analysis indicates a negative value. Consequently, it is concluded that with the assumed level of tariff revision the Rangoon International Airport Development Project will not be financially feasible as long as it is administered on a self-supporting basis. To be a financially independent entity, a system of government support will be required for this Project, and/or

airport charges must be increased beyond the level on the basis of which the FIRR was calculated.

To help visualize the annual funds situation of the Project a projected funds flow was prepared with the repayment conditions of a foreign loan assumed as follows:

Grace period	:	10 years
Term of Redemption	:	20 years
Interest Rate	:	2% and 4%

9. ECONOMIC ANALYSIS

A comprehensive evaluation was made of the economic worth brought about by the Rangoon International Airport Development Project for the Socialist Republic of the Union of Burma.

The Base Case is defined as the case of continued utilization of the existing Rangoon International Airport at the present facility level with no new investments.

The economic costs comprise the construction costs and maintenance and operating costs obtained by deducting the customs duties and indirect taxes from the financial costs, and by applying shadow prices.

The economic benefits considered attributable to the Project from the viewpoint of the national economy are quantified by comparison of the relevant elements in the Base Case and in the Project Case. This analysis is limited to the following direct tangible benefits.

(1) Benefits of overflowing passengers forced to give up the trip.
(2) Benefits of overflowing passengers who make the trip by other means.
(3) Time saving increment by overseas direct flights.
(4) Net increase in tourism income.
(5) Net increase in airport revenue.
(6) Net increase in fuel supply revenue.
(7) Saved maintenance costs of existing facilities.

The cost-benefit analysis, based on the cash flow of 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 Project. It is concluded, therefore, that both alternatives of the Rangoon International Airport Development Project are economically feasible from the viewpoint of national economy, since the social discount rate of the country is assumed to be 10%.

Sensitivity analysis was made on the value of the economic internal rate of return (EIRR) for fluctuations in certain key direct tangible benefits, with the results as shown in Table 4.

Table 4 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

10. PROJECT IMPLEMENTATION AND ADMINISTRATION ORGANIZATION OF RANGOON INTERNATIONAL AIRPORT

The Department of Civil Aviation employs over 1,000 people of whom 409 are engaged in the operation and administration of the existing RIA. It does not, however, have the structure or resources to plan, design or supervise actual implementation of projects of the magnitude of the present Project, and, therefore, it would be unreasonalbe to expect the present DCA to cope with the implementation of the Project even if its staff were increased in size.

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

11. SOCIAL IMPACTS

To help make an overall assessment of the economic benefits of the Rangoon International Airport Development Project, social impacts or likely repercussions of the Project was analysed with emphasis on intangible benefits, with the view to supplementing the economic analysis which was based on the tangible, direct benefits alone. Following are the major items of the intangible benefits assessed qualitatively in terms of effect, possibility of occurrence and magnitude. Where adverse affects are possible, countermeasures are also suggested.

- Decreasing aircraft accidents by relieving pilot stress by virtue of modernized air navigation system with new improved facilities.
- Saving in fuel for airlines when used as alternative airport to Bangkok International Airport.
- Establishment of foreign carriers' offices in Rangoon.
- Stimulating petroleum industry through increased fuel sales.
- Enlarging export market of perishable goods.
- Promoting development of labour-intensive high value added industries.
- Activating inter-regional interaction within Burma.
- Increasing employment opportunities.
- Activating economic and cultural exchange with foreign countries.
- Enhanced national prestige.

The intangible effects thus identified appear to comprise, substantial benefits for the Burmese economy and that these benefits may well be over and above those quantified in the economic analysis.

Table 5 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	-	

12. COMPARATIVE EVALUATION OF DEVELOPMENT ALTERNATIVES

Development alternatives of Case 1 and Case 2 were evaluated comparatively in every conceivable aspects involved. Major difference between the two alternatives is in runway extension, i.e., Case 1 calling for an ultimate total length of 11,100 feet to be provided in Phase I, against the 12,100 feet of Case 1 to be attained in two stages. Other major differences in the facility plan are listed in Table 6 and the cost comparison in Table 7.

As a result of the overall comparative evaluation, as summarized in Table 8, Case 2 was found to be slightly in advantage over the other.

Table 6 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

Table 7 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

Table 8 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

CHAPTER 1. INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background and Chronology of Study

The Socialist Republic of the Union of Burma in its Third Four-Year National Development Plan (1978/79 - 1981/82) gives high priority to the development of the Rangoon International Airport to make it capable of accommodating long haul flights of the current B-747 class wide-bodied jet aircraft. This will end the present situation, wherein the majority of international flights pass, without stopping, over the national capital of Burma, Rangoon, which is on major international air routes. Implementation of the Project is expected to have favourable repercussions for the social and economic development of the country. In particular tourism is expected to be greatly stimulated and among several other factors this will contribute to improving the international balance of payments of the Republic.

In October 1978 the Government of the Socialist Republic of the Union of Burma requested the Government of Japan to render technical assistance related to producing a feasibility study of the Rangoon International Airport Development Project. The Government of Japan responded by having a preliminary survey mission organized and despatched by the Japan International Cooperation Agency (JICA) between the 19th and the 28th of June 1979. Having ascertained the necessity to carry out a feasibility study, and the Scope of Work preliminary agreed upon, the Japanese Government officially decided to render the technical assistance required for the implementation of the study.

An official agreement between the Government of the Socialist Republic of the Union of Burma and the JICA on the Scope of Work of the study was signed on October 4, 1979 (Appendix 1A).

A feasibility study mission of JICA arrived in Burma on the 3rd of October and remained there until November 4, 1979. On its arrival the mission submitted the Inception Report and with its approval by the Burmese Government conducted the necessary field surveys with close co-operation from the appropriate authorities. The mission ascertained the requirements of the Burmese Government related to the Project, and collected the necessary data and information. The survey findings of the mission were compiled in Burma and submitted in the form of the Progress Report to the government for their approval, which was obtained before the mission's departure from the country.

Upon return to Japan in early November 1979 the mission engaged itself in the office study starting with sorting and analysis of the data and information collected in the field, followed by the forecasting of air transport demand. Technical aspects of the Feasibility Study comprising the airport facility planning and estimation of the construction costs, were carried out first, followed by the financial and economic analyses to complete the study. The resultant comprehensive analysis and evaluation of the Project form the contents of the present Final Report.

1.2 Objectives of Study

The objectives of the Feasibility Study are: i) to make long range forecasts of air traffic at Rangoon International Airport; ii) to make a development plan to upgrade the existing airport facilities to be capable of accommodating long haul scheduled international flights and to establish optimum phasing of the Project with due regard to the degree of technical sophistication necessary and the capacity requirements at different future stages and to make a construction schedule and a construction cost estimate; iii) to make an economic evaluation of the Project from the viewpoint of the national economy of Burma, and to examine the financial feasibility of the Project; iv) to make recommendations on matters related to the organizational and managerial aspects of the airport administration as well as on matters related to the implementation of the Project; and v) finally to evaluate the possible wider repercussions of the Project on the national and regional economy and social environment of Burma.

1.3 Supervisory Committee

The Supervisory Committee established as an advisory body to the president of JICA consisting of the following members performed the supervision of the present Feasibility Study.

Chairman:

Takashi KOREEDA	Project Manager of Airport Facility Planning Office, New Tokyo International Airport Authority

Members:

Eiichi NAKANO	Deputy Director of International Affairs Division, Civil Aviation Bureau, Ministry of Transport
Mitsugu IKEGAI	Deputy Director of Construction Division, Civil Aviation Bureau, Ministry of Transport
Osamu INOKUCHI	Deputy Director of Flight Standards Division, Civil Aviation Bureau, Ministry of Transport

1.4 Study Team

The study team consisted of the following engineers and specialists.

Kiyoshi TSUGAWA	Project Manager
Tsugumichi TOMISHIGE	Deputy Project Manager, Airport Facility Planning
Isao KOBAYASHI	Air Traffic Forecast, Economic and Financial Analysis
Susumu KOHNO	Airport Administration and Organization Planning
Eiichiro TAMABAYASHI	Aircraft Operation and Air Space Use Planning
Masaaki UEHARA	Airport Facility Planning
Akio NAKASHIMA	Planning of Nav-Aids and Telecommunications Facilities
Akio YAMAMOTO	Planning of Nav-Aids and Electric Power Supply System
Hajime HONJO	Airport Facility Planning and Cost Estimate
Kazuto SAITO	Construction Planning and Cost Estimate

CHAPTER 2. PROCEDURES OF STUDY AND ESTABLISHMENT OF DEVELOPMENT ALTERNATIVES

CHAPTER 2 PROCEDURES OF STUDY AND ESTABLISHMENT OF DEVELOPMENT ALTERNATIVES

2.1 Study Procedures

The feasibility study was conducted by closely adhering to the methodology and procedures proposed in the Inception Report and covering in full the Scope of Work agreed between the Government of the Socialist Republic of the Union of Burma and the JICA.

Based on the field survey results contained in the Progress Report which has already been approved by the Burmese Government, air traffic demand forecasts and basic runway length requirements were established in the initial stage of the home office study.

Using the required earthworks as a major design parameter, two development alternatives with different combinations of runway length, direction of extension and of construction phasing plans, were identified as appropriate for detailed study. The assumed design factors of these alternatives were then fed back into the traffic forecast, and the specific traffic demand was established for each development alternative. Then the facility requirements and layout plans and estimates of construction quantities and project costs in respect of each alternative were determined.

Having completed the analysis of the technical possibilities of the proposed development, a financial analysis was made on each of the two alternatives by calculating the financial benefits and financial costs of the Project. An economic evaluation was then made on the basis of "with and without" Project situations, with economic benefits analysed from the viewpoint of the Republic's national economy. Unquantifiable benefits of the Project including indirect impacts on the economy and social environment of the nation were also qualitatively identified.

2.2 Establishment of Development Alternatives

2.2.1 Base Case

The "without project" case was defined in the present study as the Base Case where the existing Rangoon Airport is to be maintained simply in its existing state, with no new investment made during the proposed project life of 25 years (from 1980 to 2005). The Base Case was made the basis for comparative analysis of the Project's worth in the economic evaluation as outlined below.

2.2.2 "With Project" Cases (Development Alternatives)

(1) Choice of Alternatives

During the period of the field survey and the first part of the home office study, a preliminary engineering assessment was made to obtain feasible alternatives for the study. Thus several runway lengths of 9,000, 10,000, 11,000 and 12,000 feet long were considered and assessed by parametric techniques to study the non-stop flight implications for different types of aircraft.

At the same time, earthwork volumes involved in several possibilities of the necessary runway extension works were calculated. The advantages and disadvantages of each runway extension both lengthwise and whether to the south or north and/or both of the existing runway, were analysed by examining the following factors:

- land values
- topographical and soil conditions

- obstacles to aircraft operation
- noise impact
- cost of compensation
- relocation possibilities of existing facilities including national railway, roads, water main and power supply lines

As a result of this preliminary engineering assessment, the following basic development concepts were identified as being the most appropriate for further study.

1) To provide an ultimate runway lengths of 11,000 to 12,000 feet which would enable B-747 class aircraft to make longest non-stop flights to points such as Tokyo East-bound, and West-bound to the European gateway cities of Rome and Athens, for example.

2) To extend the runway to the north which not only costs least in the earthwork but is also recommendable considering the impact of noise on the urban area of Rangoon.

From above considerations, two development alternatives were established as outlined below.

(2) Case-1

1) Phase I Development

- Extend runway by 2,000 feet to the North and 1,000 feet to the South to a total length of 11,100 feet, and to develop it as precision approach runway CAT-I.

- Expand existing apron.
- Construct new international passenger terminal building to accommodate the 1995 traffic requirements.
- Remodel the existing passenger terminal building for exclusive domestic use until 1995.
- Construct control tower and operational building.
- Develop other facilities as necessary.

2) Phase II Development

- Expand apron.
- Expand international passenger terminal building to meet the 2005 traffic requirements.
- Construct new domestic passenger terminal building.
- Construct new international and domestic cargo building.
- Develop other facilities as necessary.

(3) Case-2

1) Phase I Development

- Extend runway by 3,000 feet to the North to a total of 11,100 feet, and develop it as precision approach runway CAT-I.
- Expand existing apron.
- Construct new international passenger terminal building to accommodate the 1995 traffic requirements.

- Remodel the existing passenger terminal building for exclusive domestic use until 1995.
- Construct control tower and operational building.
- Develop other facilities as necessary.

2) Phase II Development

- Extend runway by 1,000 feet to the South to a total of 12,100 feet, and relocate the ancillary facilities as necessary.
- Expand apron.
- Expand international passenger terminal building to meet the 2005 traffic requirements.
- Construct new domestic passenger terminal building to meet the 2005 traffic requirements.
- Construct new domestic passenger terminal building.
- Construct new international and domestic cargo building.
- Develop other facilities as necessary.

CHAPTER 3. BACKGROUND OF PROJECT

CHAPTER 3 BACKGROUND OF PROJECT

3.1 Economic Development of Burma

As a socialist republic, Burma has formulated and begun implementing a 20-year plan starting from 1974/75 which happened to be the first year of the Second Four-Year Plan.

Following are the major objectives of the current Third Four-Year Plan:

i) The main objective shall be to steer the economy back to the original growth path envisaged in the 20-year plan.

ii) GDP in real term shall grow at an average annual rate of 6.6%.

iii) Sustained improvement of labour productivity shall be attained during the plan period.

iv) Expansion of exports shall be accelerated.

v) The level of public investment shall be an average of 4,140 million Kyats per annum. Also, in line with Government policy, a programme that will contribute to the expansion of cooperatives and private enterprises shall be established and realized.

vi) In accordance with the Party's guiding principles, a programme that will achieve full utilization of the nation's manpower resources shall be established and implemented.

Based on the above-mentioned 20-year long ranged plan, the Burmese Government has formulated a five-year development programme for the period between 1977/78 and 1981/82 with a view to stimulating its economic activity by the expansion of investment. Accordingly, the basic policy of actively utilizing overseas assistance is being adopted insofar as it does not interfere with the socialist economic system of Burma. It is under such circumstances that the Government of the Socialist Republic of the Union of Burma decided to make detailed study on the Rangoon International Airport Development Project.

3.1.1 Geographical Situation

Burma lies in South-East Asia between latitudes 9°58'N and 28°31'N, longitudes 92°10'E and 101°11'E, with a total land area of 261,228 sq. miles. The country is bordered by Bangladesh and India on the North-West, China on the North-East, Laos and Thailand on the South-East, Andaman Sea and the Bay of Bengal on the South and South-West.

Three main rivers flow almost parallel from North to South, and most of the plains lie in these river basins.

The climate is tropical on the whole. The cool dry season is from November to mid-March, followed by the hot season which lasts until May, and the rainy season begins in mid-May and ends in mid-October. In the Northern highland area, however, the climate is more comfortable with relatively less rainfall and humidity, and the mean temperature is less than 25°C.

3.1.2 Population

The population of Burma in 1978/79 by Government estimate is 32.57 million (Appenendix Table 2A-1). Annual growth rate of population during the last twenty years was 2.20%.

The projections for population growth during the Third Four-Year Plan period is estimated as shown in Table 3-1, which indicates a gradual increase in annual rate of growth.

Table 3-1 Population Growth

Year	Population (In thousands)	Annual Rate of Growth (%)
1977/78	31,859	
1978/79	32,573	2.24
1979/80	33,313	2.27
1980/81	34,083	2.31
1981/82	34,882	2.34

Source: An Outline of The Third Four-Year Plan Adopted at The Second Pyithu Hluttaw

Urbanization is also in progress as shown in Table 3-2. According to the authorities concerned, the number of towns with a population of more than 50,000 people increased from 5 to 21 during the period of 1953-1971.

Table 3-2 Urbanization Trend

Year	Urban Population (%)	Rural Population (%)
1941	12.00	88.00
1950	15.01	84.99
1960	17.00	83.00
1970	20.00	80.00
1973	24.27	75.73

Source: Census and Estimates from SAC Figures

3.1.3 Labour Force

The total active labour force of Burma as of the end of March 1979 was estimated at 12.94 million, of which 8.36 million, or 64.61%, were engaged in agriculture which is the largest sector, 1.24 million, or 9.58%, in the trade sector, and 0.97 million, or 7.48%, in the processing and manufacturing sector.

Of the total active labour force, 1.36 million, or 10.51%, were employed by state-owned enterprises, while the rest belonged to cooperatives and the private sector (Appendix Table 2A-2).

3.1.4 Gross Domestic Product

The real value of Burma's Gross Domestic Product (GDP) grew at an average annual rate of 3.446% between 1961/62 and 1978/79 (Appendix Table 2A-3). Burma's economy experienced some setback in 1974/75, but recovered and is expected to make further progress as a result of the

implementation of reforms and new approaches introduced in 1975/76. Among these, the introduction of the programme for operating the state owned enterprises on a commercial basis played the most crucial role in relation to the economic growth, and consequently the GDP growth rate improved significantly since then.

Table 3-3 GDP Trend

(At 1969/70 constant producer's prices)

Year	GDP (Kyats in million)	Annual Growth Rate (%)
1973/74	10,812	
1974/75	11,101	2.67
1975/76	11,562	4.15
1976/77	12,265	6.08
1977/78	12,999	5.98
1978/79	13,870	6.70

Source: Report to the Pyithu Hluttaw, 1979/80

As regards the structure of the economy, the production sector's share has been consistently over 50% since 1969, while the service sector's share increased from 23.0% to 25.0% during the period 1969/70 - 1978/79, and the trade sector declined from 25.3% to 23.4% during the same period.

For the Third Four-Year Plan, the structural changes are planned as shown in Table 3-4.

Table 3-4 Planned Structural Changes for the Third Four-Year Plan

Sector	1977/78 (%)	1981/82 (%)
Production	50.6	52.7
Agriculture	26.6	25.8
Livestock and Fishery	6.9	6.5
Forestry	2.4	2.3
Mining	1.4	1.7
Processing and Manufacturing	10.7	13.1
Power	0.9	1.2
Construction	1.7	2.1
Services	24.8	23.7
Transportation	4.8	5.1
Communications	0.3	0.4
Financial Institutions	1.4	1.5
Social and Administrative	11.4	10.7
Rentals and Other Services	6.9	6.0
Trade	24.6	23.6
GDP	100.0	100.0

Source: An Outline of The Third Four-Year Plan

3.1.5 Exports and Imports

Agricultural products were the main exports, of which rice was the principal item. According to the authorities concerned, agricultural products will still continue to be the main exports, while other crops, such as maize, jute, beans and pulses and sugar-cane are expected to become promising export items in the future.

Forest products were also the main exports of Burma and the exports of timber, especially of teak, are likely to expand further.

Exports of minerals are expected to grow, because many mining projects have almost been completed or are nearing completion. Oil, tin, tungsten, lead and silver are likely to become the leading items.

Imports of capital goods are increasing rapidly, while imports for inter-industry use (intermediate goods) have also been growing steadily. Imports of consumer goods recorded the lowest increase during the period of 1974/75 - 1977/78.

3.1.6 Tourism

Foreign exchange earnings from tourism speak for the importance of tourism development in the economy of Burma. As shown in Table 3-5, the foreign exchange earnings from tourism has contributed to improving the foreign exchange reserve position.

Table 3-5 Foreign Exchange and Tourism

(Kyat in lakhs)

Year	Foreign Exchange from Tourism	Balance of Trade	Foreign Exchange Reserve
1973	148	3,921	4,038
1974	124	-900	5,612
1975	146	-1,207	10,241
1976	167	878	8,392
1977	231	-4,635	7,014
1978	304	-18,737	8,450

Source: Report to the Pyithu Hluttaw, 1979/80

Note: Foreign Exchange Reserves (exclusive of Gold)
1973, 1978 -- as of End of September
1974-1977 -- as of End of March

Foreign exchange earnings in 1978 were 30 million Kyats, while the balance of the foreign exchange reserves at the end of September 1978 was 845 million Kyats.

Table 3-6 Foreign Tourists

Year	Tourist Arrivals	Average Length of Stay (days)
1970	7,538	n.a.
1971	11,529	n.a.
1972	13,568	n.a.
1973	16,448	n.a.
1974	15,637	5.4
1975	16,537	5.3
1976	18,580	4.7
1977	22,076	4.8
1978	21,908	4.8

Source: Hotel and Tourist Corporation

Foreign tourist arrivals in Burma increased at an average annual rate of 14.25% during the period 1970-1978.

As regards the distribution by nationality of tourists, France, U.S.A., West Germany and Japan have always been the top four.

Places of interest for tourists are abundant, especially historical and scenic sites. For example, the places shown below are some of the most often visited attractions.

Historical and Religious Sites:

Pagodas, temples and Buddha statues are scattered all over the country.
The famous ones are:

Rangoon	Shwedagon Pagoda
	Arzani Mausoleum
Mandalay	The Royal Palace
	The Mandalay Hill
Sagaing	The Great Bell of Mingun
Pagan	Ananda Pagoda
Syriam	Historical Sites
Pegu	Shwemawdaw Pagoda
	Kalayani Ordination Hall

Scenic Sites:

- Inle Lake [Taunggyi (4,675 feet above sea level)]
- Waterfalls and Botanical Gardens, etc. [Maymyo (3,519 feet above sea level)]
- Pindaya Caves and Orchards [Kalaw (4,340 feet above sea level)]
- Ngapali Beach [Sandoway]
- Maungmagan Beach [Tavoy]
- Waterfalls, Lakes, Caves [Loikaw]

Handicrafts, music, dancing, the many varieties of orchids, plus the hospitality of the good-natured Burmese people should also be equally attractive tourism resources.

Hotel accommodation, transportation and information services are inadequate to meet the demands of increasing tourists. In order to accommodate the influx of tourists, the Burma Tourism Development Study Project and the Hotel and Tourism Training Centre Projects are included in the UNDP Burma Country Programme (1979-1982) for feasibility studies.

There are only 615 hotel rooms in the whole country at present. Plans are underway to build new hotels in Rangoon, Mandalay and Pagan, and a floating restaurant in the Inle Lake is also under study.

3.2 Transportation System of Burma

3.2.1 Roads

According to the "World Road Statistics 1977" of International Road Federation, total length of road existing in Burma as of 1976 reached 25,444 km, and 8,321 km, or 32.7% of the total length is paved. The length of road per square kilometer is 37.6 km, which is considerably lower than that of India (362.0 km) and of Thailand (60.3 km). Main trunk roads connect major cities as shown in Figure 3-1.

In 1976, the number of passenger cars and commercial vehicles were 37,707 and 40,526, respectively. The number of persons per one passenger car in the same year was 817.8, which is almost the same as that of India (793.1), but much larger than that of Thailand (157.3).

In 1978/79, State-owned road vehicles transported 71.7% of the total passenger traffic, and 21.5% of the total freight tonnage (Appendix Table 2A-4).

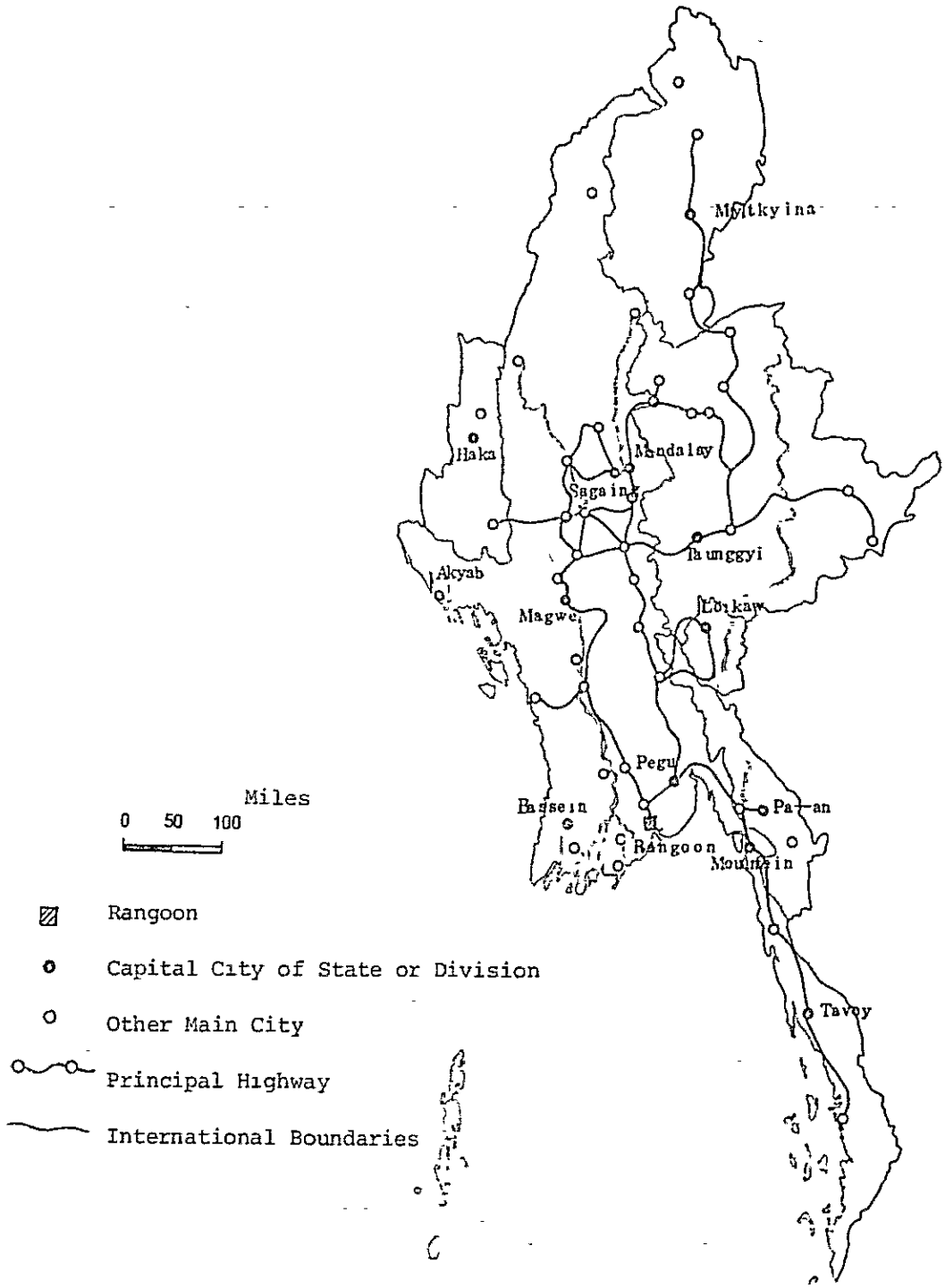


Figure 3-1 Highway System

3.2.2 Railways

The total length of the existing railway system, as of 1976, amounted to 1,949 miles. The routes are presented in Figure 3-2.

The number of passengers carried was similar in 1978/79 to 1961/62 but there has been considerable variation in intervening years. For example, the number of passengers in 1961/62 amounted to 43.1 million, while in 1971/72 and in 1978/79 they were 53.4 million and 44.5 million, respectively. As regards freight, total freight tonnage carried in 1961/62 amounted to 2.94 million, while in 1971/72 and in 1978/79 they were 2.93 million and 1.97 million, respectively.

In 1978/79, railway transport accounted for 18.4% of total passenger traffic, and 42.2% of total freight tonnage (Appendix Table 2A-4).

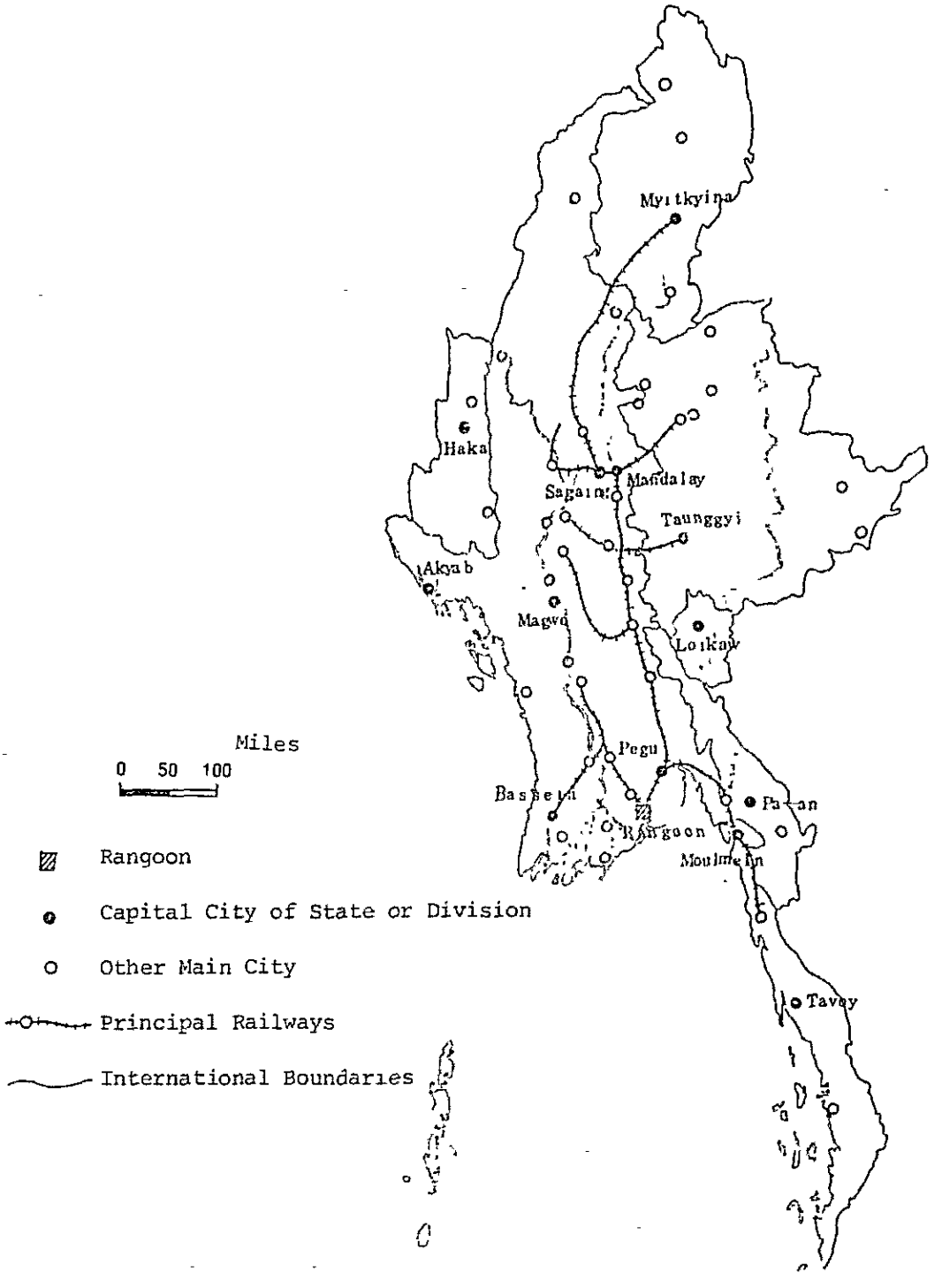


Figure 3-2 Railway System

3.2.3 Water Transport

In Burma water transportation is important even for inland freight transport. The Irrawaddy, 1,250 miles long, is navigable for 900 miles inland from Rangoon, and the Chindwin, the main tributary of the Irrawaddy, is navigable for 500 miles. Furthermore, in coastal areas, such as Irrawaddy Division in Arakan State, Tenasserim Division in Mon State, coastal water transport is extremely important. In 1976, the number of private owned powered crafts on register amounted to 1,408, of which 1,141, or 81% were riverine boats. The Inland Water Transport Corporation (IWTC) possessed 640 powered crafts in the same year.

The relative share of state-owned crafting inland water transport was 5.1% for passengers, and 22.7% for freight tonnage in 1978/79.

3.2.4 Aviation

The number of airports in Burma as of October 1979 was 66 including Rangoon International Airport (RIA). At present 42 airports are under the control of the Department of Civil Aviation (DCA) and the remaining 24 airports are under the control of regional authorities.

53 airports are served by commercial flights of Burma Airways Corporation (BAC), while the remaining 13 airports are not operated for commercial use.

Out of the 53 commercial airports, 35 airports are in scheduled operation, while 18 airports are in non-scheduled operation, mostly outside the monsoon season.

The existing RIA is the sole international airport in Burma at present, and BAC has been offering 12 international services per week since 1977/78. The routes are presented below.

Existing International Routes by BAC

RANGOON - BANGKOK	7	services/week
RANGOON - DACCA - CALCUTTA	1	"
RANGOON - CALCUTTA - KATHMANDU	2	"
RANGOON - SINGAPORE	2	"

Domestic routes are illustrated in Figure 3-3. As the Figure indicates, the domestic route network complements the surface transport network, and offers considerable time savings for domestic travellers. Consequently, the role of the aviation system is considered extremely significant and in fact, the number of domestic flight passengers has increased steadily during the last eighteen years, as presented in Table 3-7.

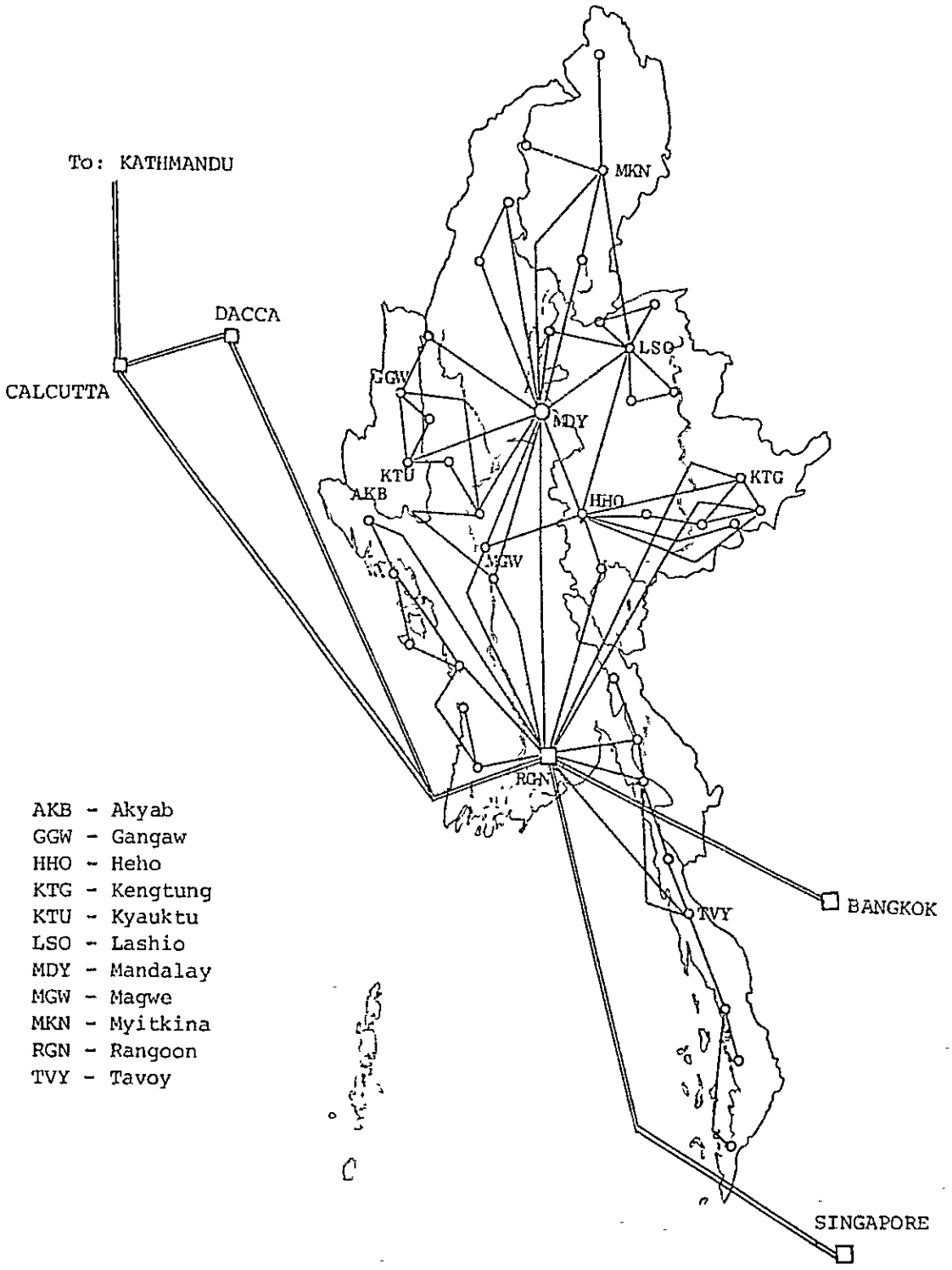


Figure 3-3 Current Routes by Burma Airways Corporation

Table 3-7 Air Traffic in Burma

Year	Domestic		International	
	Passenger	Freight	Passenger	Freight
	(thousand)	(ton)	(thousand)	(ton)
1961/62	133	2.9	34	0.3
1967/68	277	6.2	20	0.3
1968/69	313	6.5	23	0.3
1969/70	334	6.7	45	0.5
1970/71	368	7.2	40	0.8
1971/72	399	6.5	50	0.9
1972/73	409	5.9	55	1.0
1973/74	404	3.7	54	1.1
1974/75	371	3.5	51	1.0
1975/76	399	3.9	43	0.6
1976/77	409	4.4	43	0.5
1977/78	536	5.0	46	0.4
1978/79	685	7.1	43	1.2

Source: DCA

At one time, RIA accommodated many foreign airlines including BA, AIR FRANCE, KLM, PANAM, etc. The plans of the Burmese Government for the future international operations are shown below.

Aircraft ..... Boeing 747 or equivalent class

Points to be reached:

West-bound ... India, Pakistan, European Countries (longest direct flight: Rangoon/Frankfurt)

East-bound ... South-East Asia, and Far East Countries (longest direct flight: Rangoon/Tokyo)

3.3 Existing Rangoon International Airport

3.3.1 Outline of Airport

Rangoon International Airport, which is the only gateway open to international air traffic in Burma, is located 11 miles North of Rangoon on a plateau 60 to 100 feet above sea level. The runway runs approximately in the North-South direction, and the terminal area lies to its East.

The existing airport was originally built in 1945 at the present location. The currently used runway was completed in 1952 and the terminal building in 1957, all of which have been in service ever since.

The airport is placed under the control and administration of the Department of Civil Aviation which is under the Ministry of Transport and Communications of the Government of the Socialist Republic of the Union of Burma.

Today, regular international flights are being operated by the Burma Airways Corporation (BAC), a subordinate agency of the Ministry of Transport and Communications, and by three foreign airline companies, namely Thai International, CAAC and Aeroflot. Domestic flights are operated solely by BAC.

The current weekly scheduled flight services for international and domestic routes are shown in Table 3-8 and Table 3-9 respectively.

Table 3-8 *Scheduled International Services at Rangoon International Airport*

Carrier	Type of Aircraft	No. of Flight	Destination
BAC	F-28	7/week	RGN/BKK/RGN
		2/week	RGN/SIN/RGN
		2/week	RGN/CCU/KTM/CCU/RGN
		1/week	RGN/DAC/CCU/DAC/RGN
Thai International	DC-8	1/week	BKK/RGN/BKK
CAAC	BAC-111 B-707	1/week	KUNMING/RGN/KUNMING
Aeroflot	TU-154	1/week	BOMBAY/RGN/VIENTIANE/ RGN/BOMBAY

Source: BAC

Table 3-9 *Scheduled Domestic Services at Rangoon International Airport*

Carrier	Type of Aircraft	No. of Flight	Destination (Direct Flight)
BAC	F-28	21/week	Akyab, Mandalay, Tavoy
	F-27	52/week	Bassein, Heho, Kengtung, Loikaw, Magwe, Mandalay, Moulmein, Sandoway, Tavoy, Pagan
	DHC-6	3/week	*Gwa, Moulmein, Paan

Source: BAC Note: * Dry season only

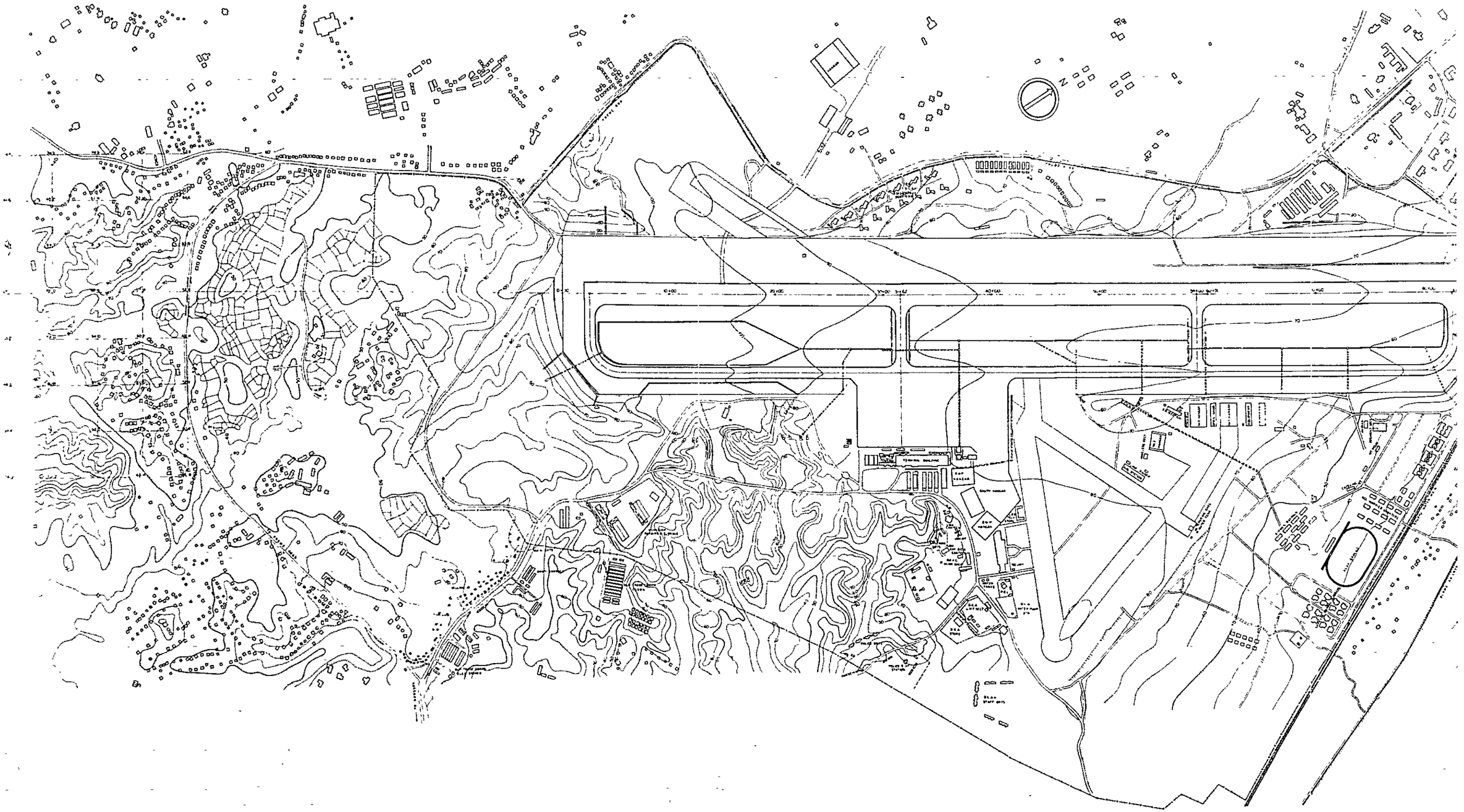
The number of air passengers processed, cargoes handled and the number of flights at Rangoon International Airport are presented in Table 3-10.

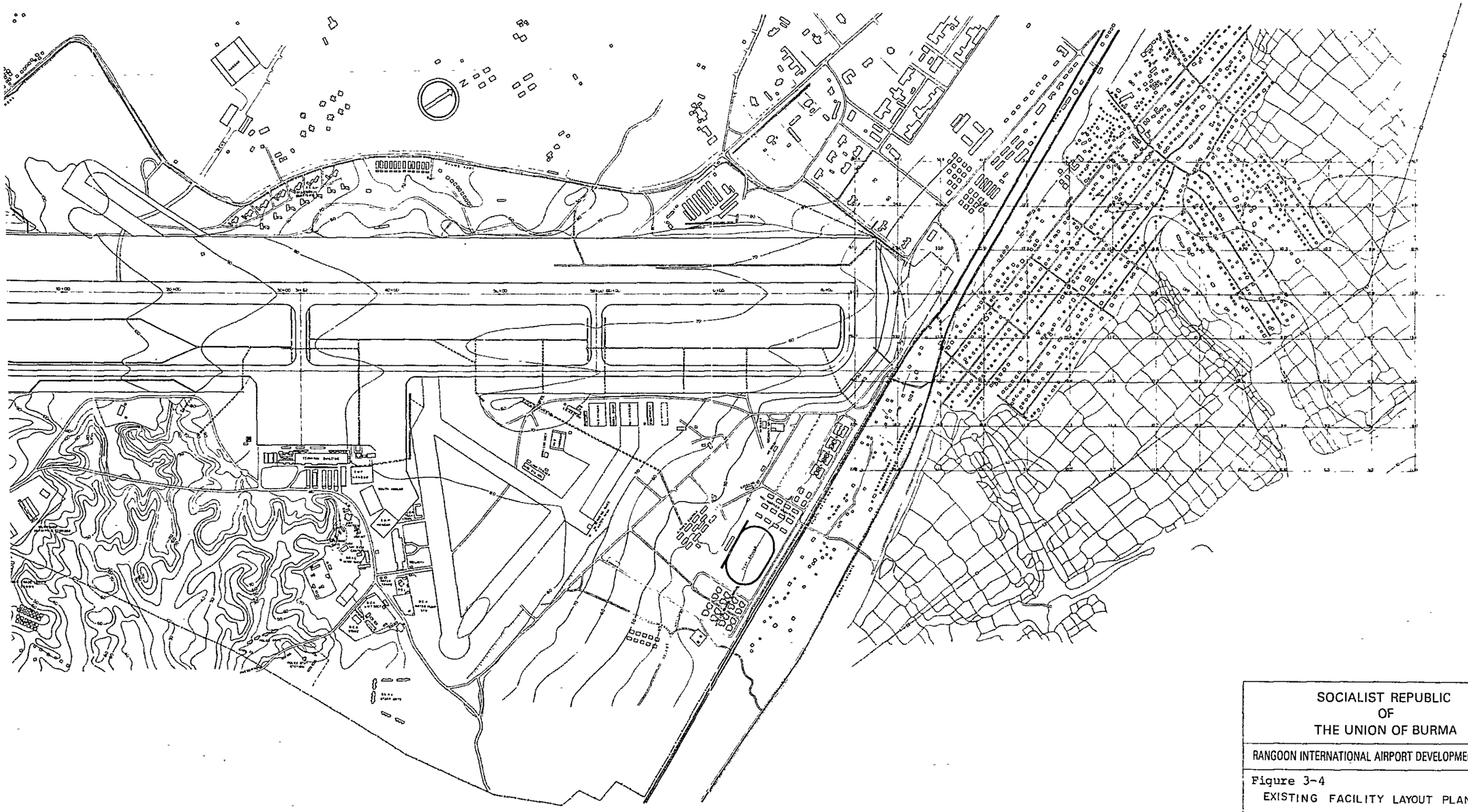
Table 3-10 Air Passengers and Cargoes Handled at Rangoon International Airport

Year		1974	1975	1976	1977	1978
Aircraft Movements (Flts.)	INT	1,483	1,224	1,269	1,194	1,233
	DOM	7,645	8,059	7,310	8,448	7,202
Passengers	INT	67,835	46,545	43,779	45,152	41,369
	DOM	271,281	317,519	253,867	304,571	249,607
Cargo Volume (lbs.)	INT	895	641	729	679	706
	DOM	4,252	4,571	3,737	4,570	2,084

Source: DCA

The existing layout of facilities at Rangoon International Airport is illustrated on Figure 3-4, and their physical characteristics in Table 3-11.





SOCIALIST REPUBLIC
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THE UNION OF BURMA

RANGOON INTERNATIONAL AIRPORT DEVELOPMENT PROJECT

Figure 3-4
EXISTING FACILITY LAYOUT PLAN

MAR 1980

FEASIBILITY STUDY

I

JAPAN INTERNATIONAL COOPERATION AGENCY

Table 3-11 Description of Rangoon International Airport and Its Facilities

Location	19.8 km to North from Rangoon city centre
Reference Point Elevation	N16°54'15" E96°08'30" 109 ft A.M.S.L.
Operated by	Department of Civil Aviation
Operational Hour	24 hours
Reference Temperature	37°C

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mean Max.	31.8	34.0	35.5	36.3	33.1	30.2	29.7	29.6	30.2	31.5	31.9	31.2
Mean Min.	19.1	19.8	22.0	24.4	24.3	24.6	20.3	24.3	24.4	24.4	23.0	20.0

Airfield Facilities	Runway Length : 8,100 ft Width : 200 ft Pavement : Concrete Strength : 340,000 lbs. A.U.W. Shoulder : Nil Taxiway Width : 100 ft Pavement : Concrete Number of exit taxiway : 4 Shoulder : Nil Apron Area : 1,390 ft x 625 ft (excluding Taxiway) Pavement : Concrete
Airfield Lighting	Runway lights, Taxiway lights, Threshold lights, Runway end lights, Apron flood lights, Aerodrome Beacon, Approach lights, VASIS, L.D.I.
Airfield Marking	Runway centre line, Runway side stripe, Threshold, Taxiway centre line, Taxiway holding position, Touch down zone, etc.
Radio Navaids	ILS (inoperative). NDB, VOR/DME
Telecommunications	Aeronautical Fixed Service Facilities AFTN, ATS Aeronautical Mobile Service Facilities VHF Air-Ground, HF Air-Ground, VDF
Terminal Building, etc.	Passenger terminal building, Administration and Operation building, Airline offices, Hangars, Fuel storage and Distribution facilities, Parking lot, Electric power station, etc.

3.3.2 Basic Facilities (Runway, Taxiway and Apron)

(1) Runway Strip

For the runway strip, a width of 1,000 feet is secured for the entire length of the runway to enable a precision approach.

(2) Runway

The 8,100 feet long and 200 feet wide runway is concrete-paved. Although no shoulder is provided vegetation along the runway is trimmed to a width of about 10 feet on each side. The grade of the runway formation is downward from the Southern to the Northern end with an average gradient of 0.6%, but the section from around 1,200 feet from the Southern end to around 2,800 feet is graded at 1%, which exceeds the ICAO Standards.

(3) Taxiway

Parallel taxiway is built for the entire length of the runway at 700 feet interval from the centre line of the runway, and exit taxiways are built at 2,400 feet and 5,138 feet from the Northern end of the runway. All taxiways are 100 feet wide and concrete-paved. No shoulders are provided.

(4) Apron

The size of the apron is 625 feet deep from the parallel taxiway edge and 1,390 feet wide, and is large enough to meet the future requirements

of a higher service category. The rear of the passenger terminal area is used as BAC's maintenance area and the front yard of the three hangars as their maintenance apron. All apron pavements are of concrete.

3.3.3 Terminal Area Facilities

The existing layout of the terminal area is shown in Figure 3-5. The terminal area was expanded along with the reorientation of the runway in 1952, by relocating the passenger terminal building though the associated facilities have remained unchanged. Existing major facilities are outlined in Table 3-12 and the floor plans of the passenger terminal building are presented in Figure 3-6.

Table 3-12 Existing Terminal Facilities

Apron	625 ft x 1,390 ft		868,750 ft^2
Terminal Building	2-story	Approx.	76,600 ft^2
		(International	50,700)
		(Domestic	24,700)
		(Cargo	1,200)
Control Tower	3-story	Approx.	5,300 ft^2
		Floor Height	29 ft
V.I.P. Facility	1-story	Approx.	4,000 ft^2
Fire Fighting and Rescue Facility	1-story	Approx.	10,500 ft^2
Car Parking		Approx.	100 cars

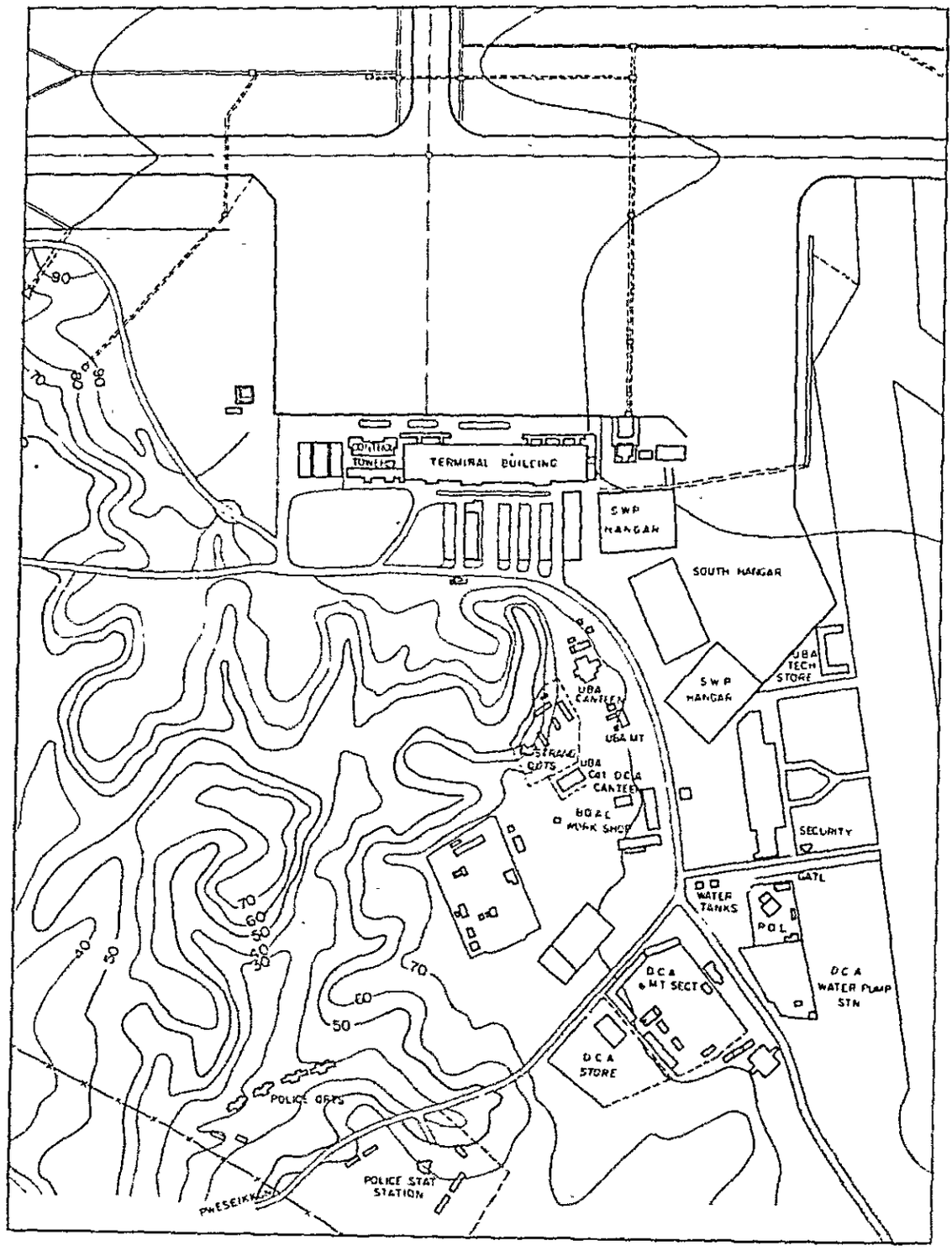

Figure 3-5 Existing Terminal Area Plan

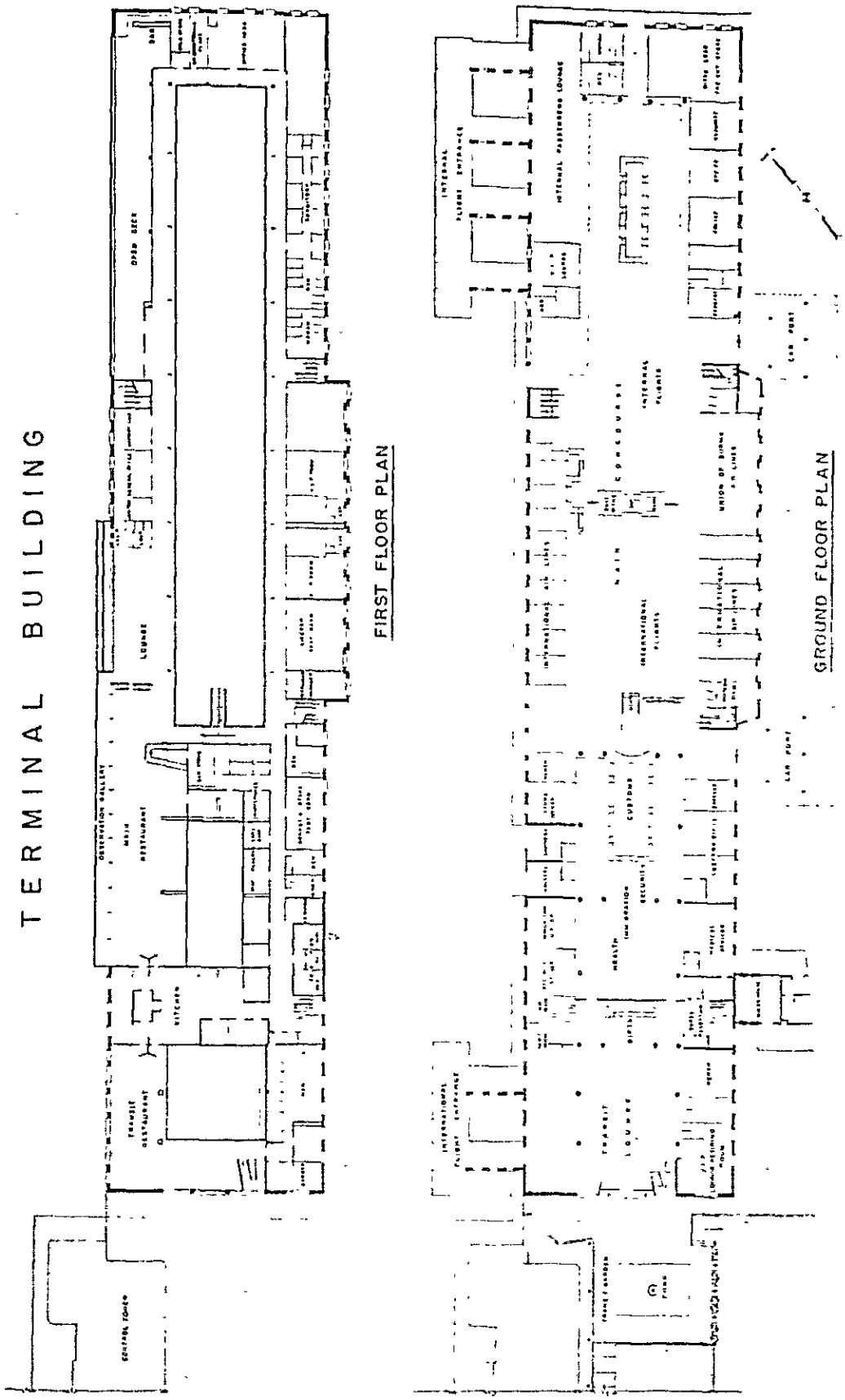

Figure 3-6 Existing Passenger Terminal Building Floor Plan

3.3.4 Radio Navigational Aids, Telecommunications and Meteorological Service Facilities

Radio nav-aids installed are ILS, NDB and VOR/DME, which are located as shown in Figure 3-7. ILS is installed for the precision approach runway 21, but the glide path is presently out of service due to equipment failure. The localizer is also inoperative due to the destruction of the aerial during the last rainy season. NDB and VOR/DME are both operating normally.

Telecommunications facilities installed are Air-Ground (A/G) radiotelephony facilities, control consoles for aerodrome control, VDF and control consoles belonging to the Rangoon Area Control Centre. A/G radiotelephony equipment consists of the main and standby units. The main units are installed at the receiving station located 1.5 km to South-East of the airport. The airport and the receiving station are connected by communications cable.

Meteorological service facilities installed are windvane and anemometer, air and dewpoint thermometer and hygrometer, barometer and rainfall gauge.

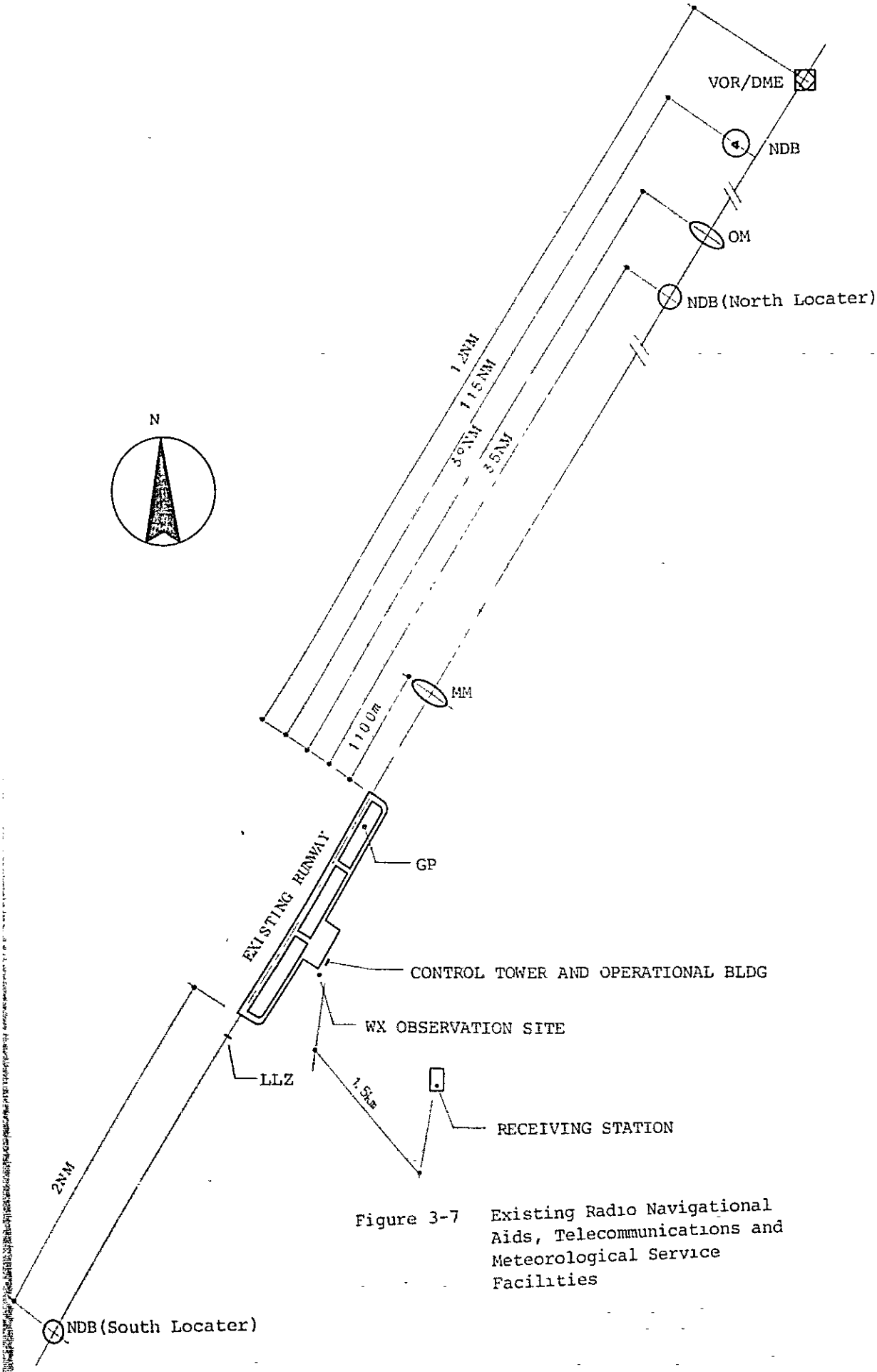

Figure 3-7 Existing Radio Navigational Aids, Telecommunications and Meteorological Service Facilities

3.3.5 Lighting Facilities

Existing lighting facilities are as follows:

		Q'ty	Year Installed
1.	Approach Lights, Medium Intensity, Culvert Type	1 set	1961
2.	Visual Approach Slope Indicator System, Cover Type (24 boxes)	1 set	1968
3.	Runway Edge Lights	1 set	1967
4.	Threshold Lights/End Lights (including Wing Bar Lights)	1 set	1967
5.	Taxiway Edge Lights	1 set	1954
6.	Aerodrome Beacon	1 set	1968
7.	Wind Direction Indicator Lights	1 set	1961
8.	Landing Direction Indicator	1 set	1956
9.	Apron Floodlights, 1,500 W	9 nos.	1967
10.	Obstruction Light, 75 W x 2	12 sets	1954

36 W low intensity lights were installed as runway lights in 1954, and renewed in 1967. With regard to the taxiway lights, cables and isolating transformers were renewed in 1968.

3.3.6 Electric Power Supply System

DCA is the sole primary consumer of electricity supplied to RIA by Electric Power Corporation. The maximum total power demand of the airport amounts to 550 kW. Power for both primary and secondary power distribution system of

the airport is received at the airport's 1,200 kVA main substation from the two separate 6.6 kV EPC substations located close to the airport, each of which is supplied through a 6.6 kV line from the 33/6.6 kV EPC substation, i.e., one in Mayangon for the primary system and the other in Insein for the secondary system, approximately 10 and 12 miles away respectively.

Standby generators comprise one 32 kVA unit installed in 1954 and one 150 kVA unit installed in 1976. The 150 kVA unit, however, has not been maintained and is unrepairable. The nav-aids, telecommunications and meteorological service and airfield lighting load comes to about 110 kW in total, so the effective capacity of the existing standby generator is inadequate.

Four units of 75 kW motor are being used for air-conditioning.

CHAPTER 4. AIR TRAFFIC FORECAST

CHAPTER 4 AIR TRAFFIC FORECAST

4.1 Methodology and Assumptions

4.1.1 General

Air transport demand of a country is considered to have a close relationship in general with the level of economic activity of that country. As the country develops economically, social, economic and cultural interchange with foreign countries increases, causing an increasing number of foreigners to visit the country and many Burmese to travel abroad, thus resulting in increased international air passenger traffic. Similarly, as the level of economic activity of the country rises and with it personal income, so the value of time of the Burmese increases. This will result in increases in both domestic inter-city passenger traffic and the share of passenger air transport within the domestic transport system by virtue of the large time saving involved. Economic growth of the country, with associated increases in imports and exports, will result in greater utilization of air transportation for commodities that can bear higher freight charges. By the same token, the share of air transport within the domestic cargo transport system is also expected to increase.

In the present study forecasts were made of passenger and cargo traffic at Rangoon International Airport based on the premises that the aviation activities of the country will develop during the forecast period to reach ultimately by the year 2005 a level to match that of the future economic development of the country in a manner comparable to the situation observed in other countries of the region and of the world.

4.1.2 Outline of Methodology

The Gross Domestic Product (GDP) of Burma was used as an independent variable in all regression models formulated for the present air transport demand forecast, since it is regarded as one of the best indices of the level of economic activities of the country.

As a first step, air transport demand at Rangoon International Airport in the year 2005 was projected on the basis of the above-mentioned assumption, namely that by that year the demand will have reached a level to match that of Burma's economy, or specifically the GDP of Burma projected for 2005. Projection by this concept was named Case A in this study, and the growth trend of traffic during the forecast period was formulated in reverse operation to satisfy the said premise in relation to GDP. For the sake of comparation two modified versions of projection were worked out as Case B and Case C. In Case B the growth trend was formulated by taking into account ICAO's air traffic forecast 1978-1986 for the Asian region as well as the present Burmese infrastructural situation. Case C was formulated to represent a case in which relatively greater growth was assumed in earlier stage of the forecast period. The three different patterns of traffic growth thus established were compared, and as a result Case B was adopted for application in forecasting of all traffic items covered in the study.

Forecast of international transit passengers at Rangoon International Airport was made by distributing an appropriate share of air passengers travelling through South East Asia on major international routes with due regard to the transit traffic at the neighboring Bangkok International Airport.

The sequence of the forecasting procedures is shown in Figure 4-1.

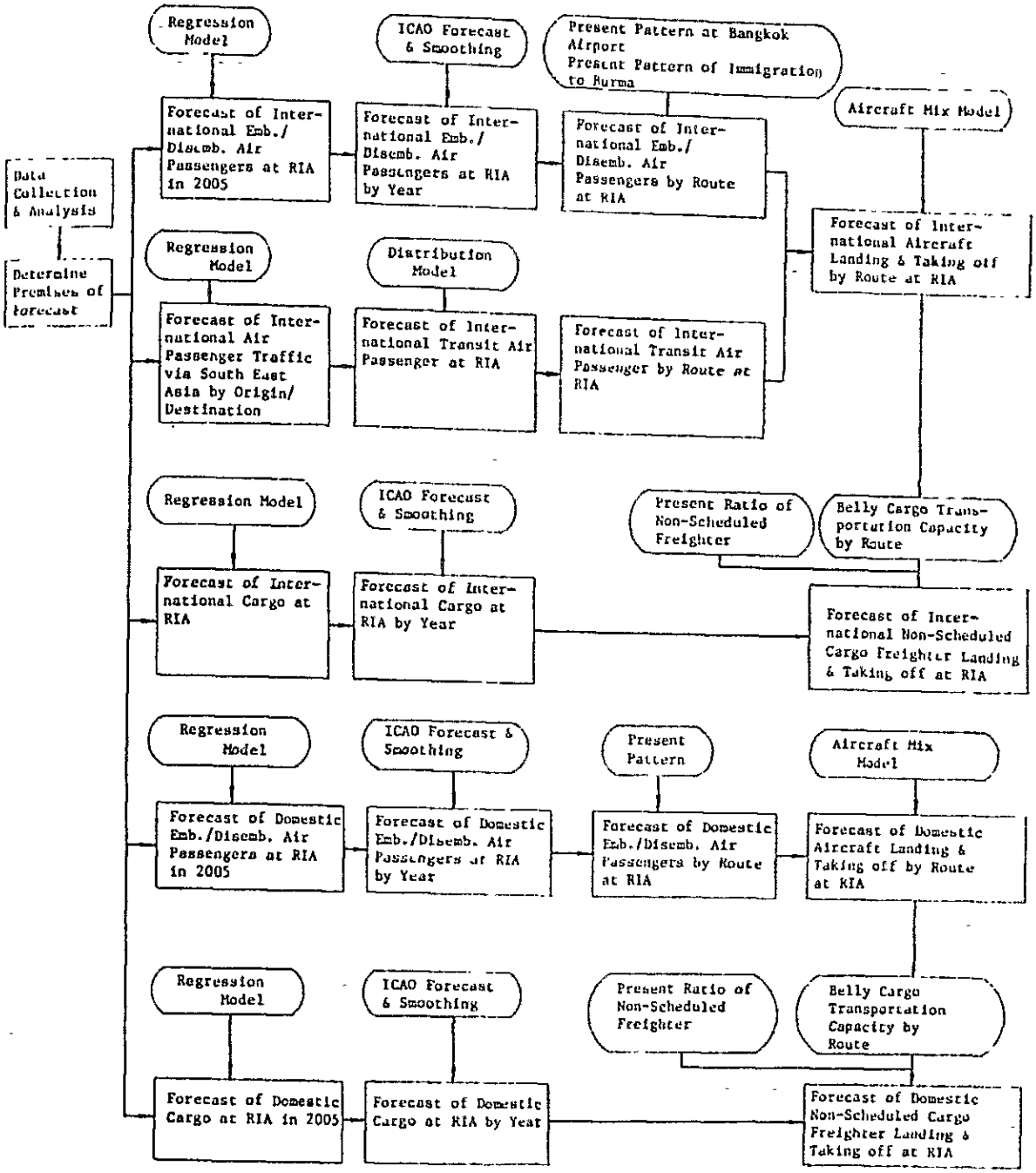

Figure 4-1 Sequence of Traffic Forecast Procedures

4.1.3 Basic Assumptions of Forecast

Based on the preliminary study and through discussions with appropriate Government officials the following assumptions of forecast were established.

(1) Period of Forecast

The period of forecast shall be for 25 years beginning in 1980 through to the ultimate design year of 2005 established for the purpose of this study.

(2) Air Route Network

1) International Air Routes

The existing 5 international air routes serving Rangoon International Airport is assumed to remain unchanged. In addition, 13 new air routes were assumed to be established. The projected international air route network to serve the Rangoon International Airport is shown in Figure 4-2.

2) Domestic Air Routes

The existing 38 domestic air routes serving Rangoon International Airport were assumed to remain unchanged. No new routes were assumed to be established.

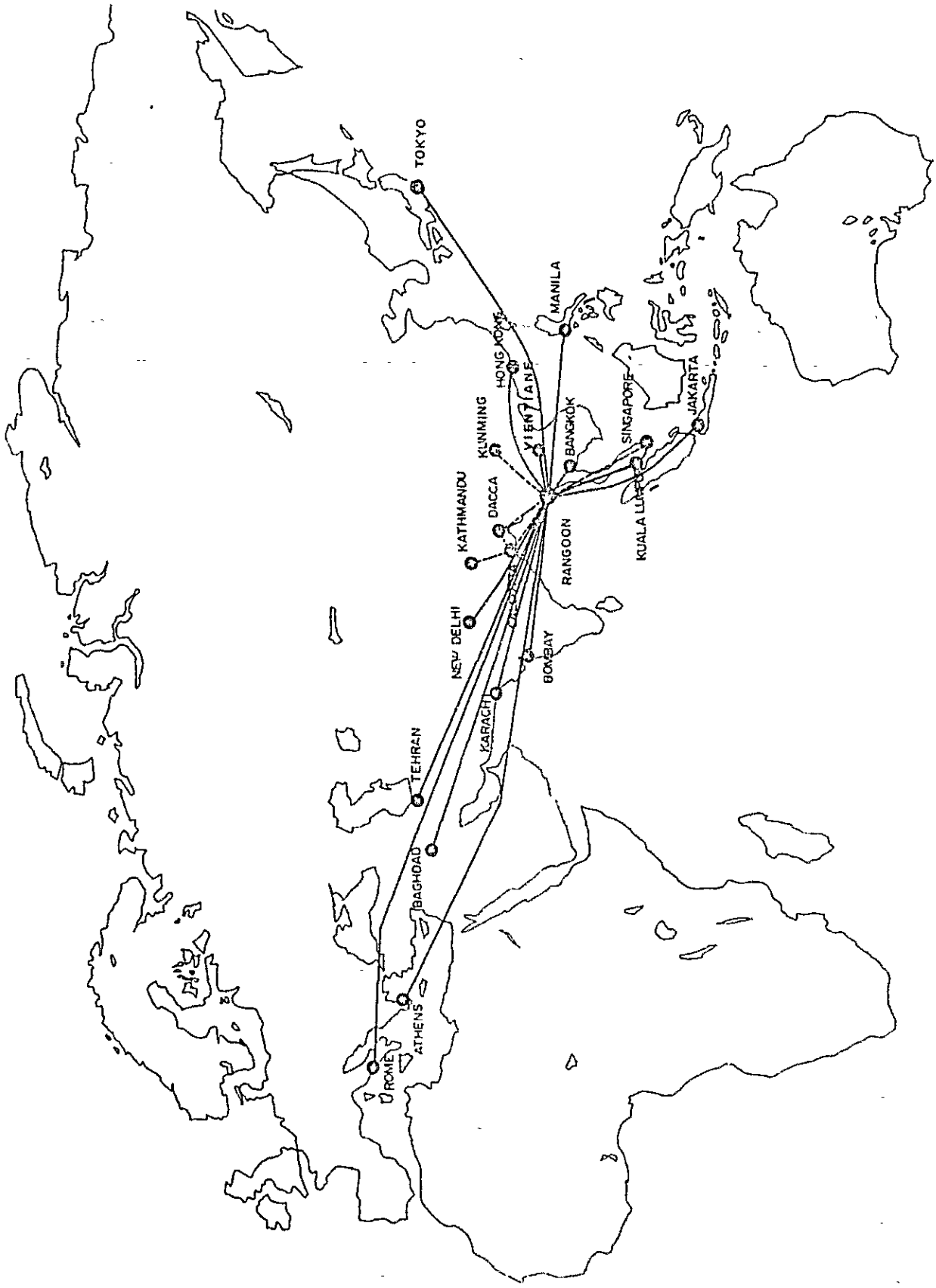

Figure 4-2 Projected Air Route Network Serving Rangoon International Airport in Year 2005

(3) Gross Domestic Product

The annual growth rate in real terms of Burmese GDP was assumed to be 5.9% throughout the forecast period based on the projection of the 20-Year National Economic Development Plan of Burma 1974/75 - 1993/94.

4.2 International Air Passenger Traffic Forecast

4.2.1 International Embarking and Disembarking Passengers at Rangoon International Airport

International embarking and disembarking passengers at Rangoon International Airport under Case A mentioned above were forecast by means of the regression model formulated from the relations between the GDP and the international air passenger traffic of the Pacific Basin countries, with a correlation coefficient of 0.927. The Case B and Case C forecasts were then made in a manner also as described above. Figure 4-3 shows the results of the three cases, and Case B, the lowest of all, was adopted for the present forecast.

4.2.2 International Transit Passenger Traffic at Rangoon International Airport

International transit passenger traffic forecast was made in a manner outlined above based on the assumption that the assumed share of RIA in total transit traffic in the South-East Asian region will remain unchanged throughout the forecast period. The result is shown in Figure 4-4.

4.2.3 International Embarking, Disembarking and Transit Passengers by Route

Forecast of passenger traffic by route was made by distributing the total international embarking and disembarking passengers and transit passengers at RIA forecast above in accordance with the assumed distribution ratio established by reference to the distribution by nationality

of visitors to Burma and to the distribution by route of international flights at Bangkok Airport.

As a first step the control total of forecast passengers were distributed to all potential routes including the 5 existing routes and all of the Asian and European routes that serve the neighboring Bangkok International Airport.

The traffic thus distributed was considered the potential demand of the respective potential route, and as far as the existing routes were concerned such potential demand was assumed to represent the forecast traffic in this study. As for the forecast traffic on the new potential routes, it was assumed that flights would commence only when the above-mentioned potential demand reached a high enough value to justify flights by an appropriate aircraft on a weekly scheduled basis. Potential demand of the routes thus found not worthy of scheduled service was rerouted to other potential new routes.

In Case 1 of the development alternative where the runway is to be extended to only 11,100 feet, direct flights to Athens and Rome or beyond would be technically impossible, and it was assumed that half of the potential passenger traffic on European routes would give up the trip with only the other half diverted to Baghdad and Tehran routes, thus resulting in a reduction in the total traffic forecast.

The results with 11,100 feet runway (Case 1) and with 12,100 feet runway (Case 2) are both shown in Table 4-1.

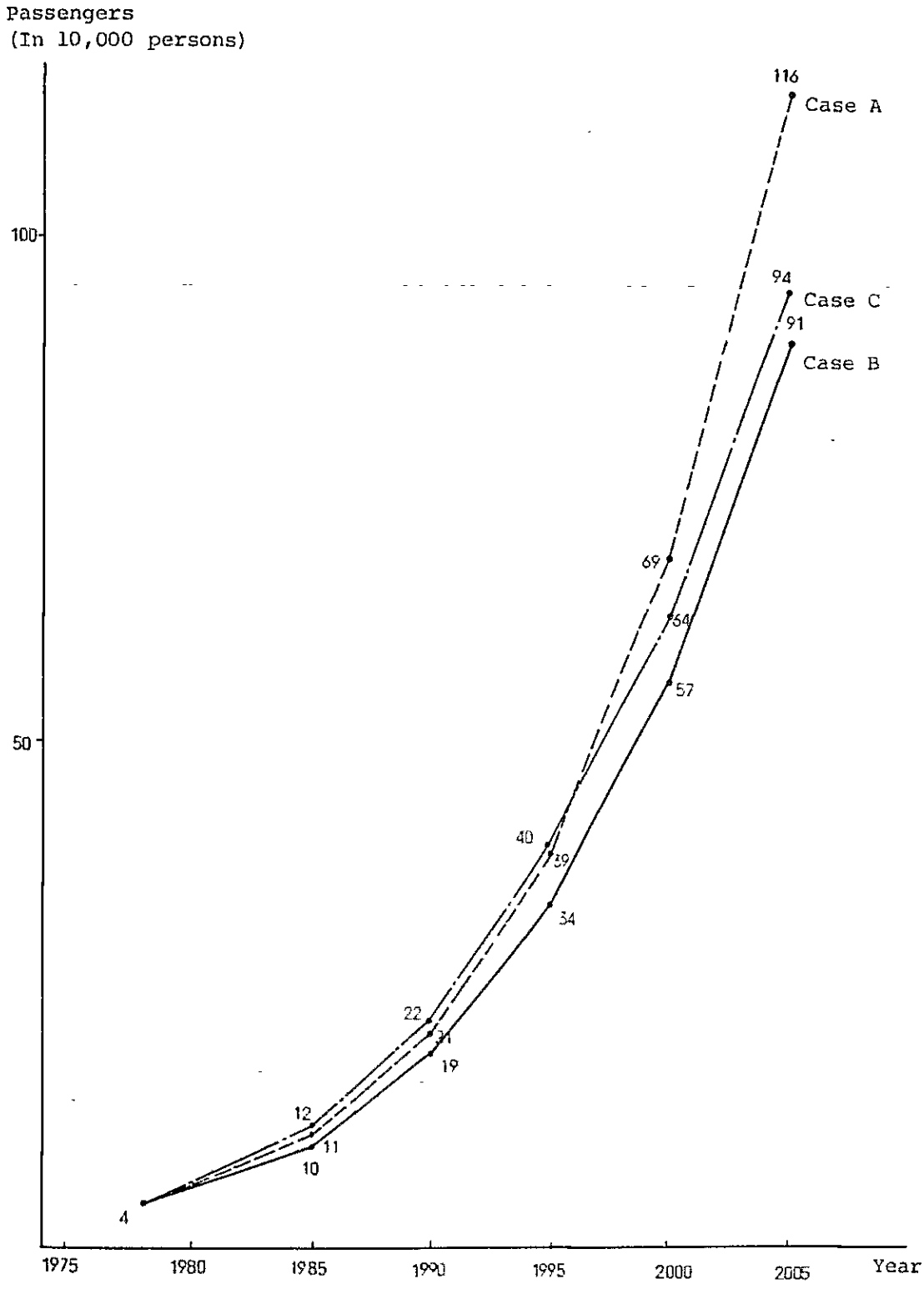

Figure 4-3 Forecast of International Embarking and Disembarking Passengers at Rangoon International Airport

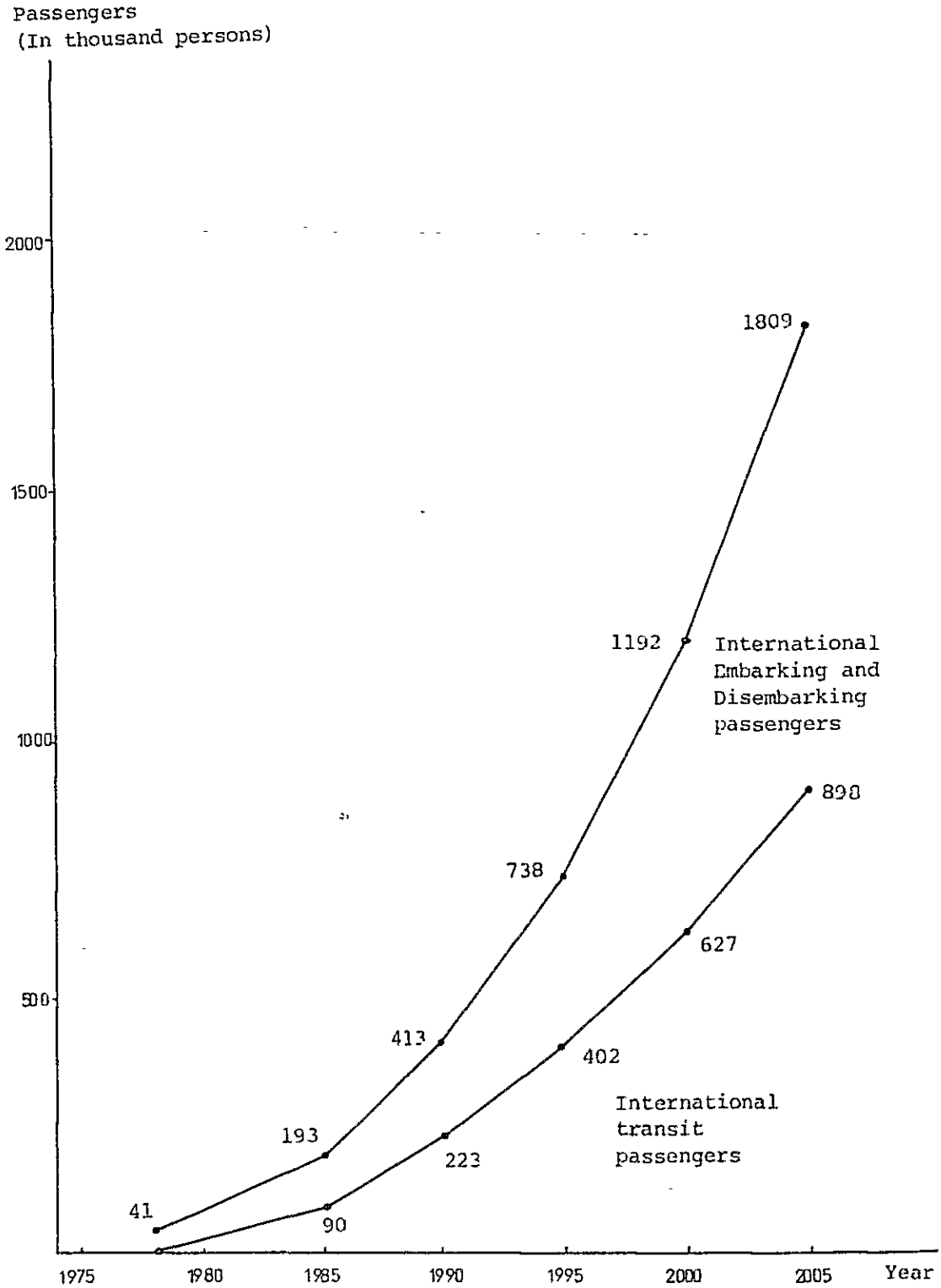

Figure 4-4 Forecast of International Terminal vs. Transit Passengers at Rangoon International Airport

Table 4-1 Forecast of International Air Passenger Traffic by Route at Rangoon International Airport

(In thousand persons)

Route	Case-1 (RWY: 11,100 ft)		Case-2 (RWY: 12,100 ft)	
	1995	2005	1995	2005
RGN - Rome	-	-	-	43
- Athens	-	-	22	42
- Baghdad	-	51	-	31
- Tehran	39	61	28	41
- Karachi	58	129	58	129
- Dacca	16	37	16	37
- Bombay	53	117	53	117
- Calcutta	36	89	36	89
- Delhi	63	145	63	145
- Bangkok	54	132	54	132
- Singapore	110	261	110	261
- Kuala Lumpur	15	30	15	30
- Jakarta	-	19	-	19
- Kunming	21	52	21	52
- Vientiane	17	39	17	39
- Hong Kong	105	251	105	251
- Manila	35	87	35	87
- Tokyo	69	175	69	175
Sub Total	691	1,675	702	1,720
Non-Scheduled	36	89	36	89
Total	727	1,764	738	1,809

4.3 Domestic Air Passenger Traffic Forecast

4.3.1 Domestic Embarking and Disembarking Passengers at Rangoon International Airport

Forecast was made by similar procedures to those used for international air passenger forecast. The regression model was formulated from the relations between the domestic air passenger traffic versus GDP and national area of several other ICAO member countries both in and out of the South-East Asian region.

The result is shown in Figure 4-5. Here again Case B was adopted for use in subsequent stages of the present study.

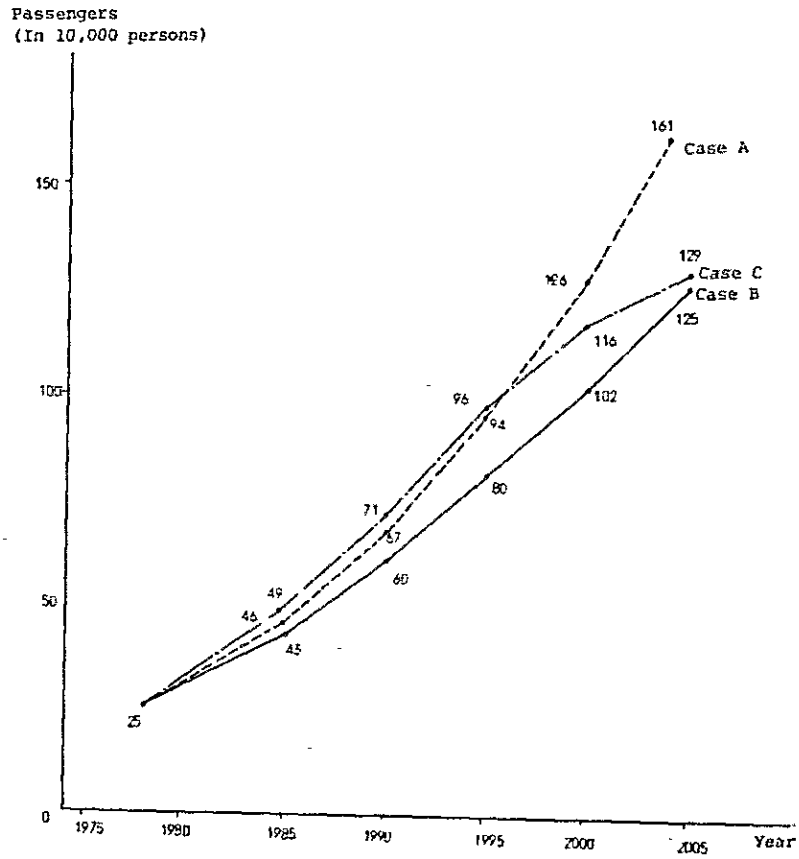

Figure 4-5 Forecast of Domestic Air Passengers at Rangoon International Airport

4.3.2 Domestic Embarking and Disembarking Passengers by Route at Rangoon International Airport

Due to lack of adequate data, however, traffic on the domestic air routes were made not for each individual route but for each of the 6 groups of several routes identified in BAC's service code as Series 300, 400, 500, 600, 700 and 800.

The result is shown in Table 4-2.

Table 4-2 Forecast of Domestic Embarking and Disembarking Passenger Traffic by Route at Rangoon International Airport

(In thousand persons)

Route Group	1985	1990	1995	2000	2005
BAC Series 300	64	91	121	155	188
400	78	109	146	186	227
500	12	16	22	28	34
600	87	122	163	208	253
700	94	131	176	224	273
800	62	87	116	148	181
Total Scheduled	396	556	743	949	1,155
Non-Scheduled	31	44	59	75	91
Grand Total	427	600	802	1,024	1,246

4.4 International Air Cargo Traffic Forecast

4.4.1 International Loaded and Unloaded Cargo Traffic at Rangoon International Airport

Forecast was made following the procedures similar to those of the international embarking/disembarking passenger forecast, likewise in Cases A, B and C. The results are shown in Figure 4-6. Here again Case B was adopted for planning purposes.

4.4.2 International Scheduled Loaded and Unloaded Cargo Traffic at Rangoon International Airport

Assuming that the scheduled cargo traffic accounts for 98% of total international loaded and unloaded cargo, the scheduled cargo traffic was forecast with the result as shown in Table 4-3.

4.4.3 International Non-Scheduled Loaded and Unloaded Cargo Traffic at Rangoon International Airport

The non-scheduled cargo traffic equal to 2% of the total forecast traffic is shown in Table 4-3.

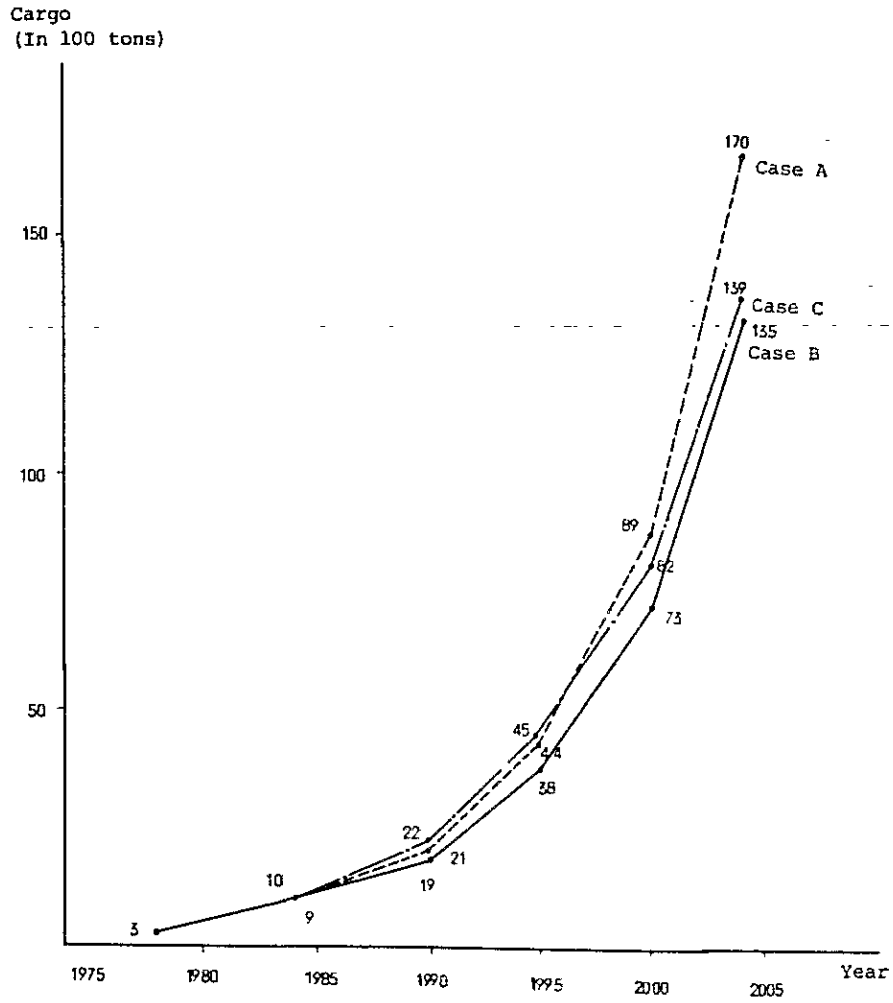

Figure 4-6 Forecast of International Loaded and Unloaded Cargo Traffic at Rangoon International Airport

Table 4-3 Forecast of International Cargo Traffic at Rangoon International Airport

	1985	1990	1995	2000	2005
Scheduled (Belly Cargo)	882	1,862	3,724	7,154	13,230
Non-Scheduled	18	38	76	146	270
Total	900	1,900	3,800	7,300	13,500

4.5 Domestic Air Cargo Traffic Forecast

4.5.1 Total Domestic Loaded and Unloaded Cargo at Rangoon International Airport

Forecast was made in a similar manner to those of the domestic air passenger forecast with the result as shown in Figure 4-7. Case B was adopted for planning purposes.

4.5.2 Scheduled Domestic Loaded and Unloaded Cargo at Rangoon International Airport

Based on the assumption that the share of scheduled traffic during the forecast period will remain unchanged at the present value of 56%, the scheduled domestic loaded and unloaded cargo traffic is shown in Table 4-4.

4.5.3 Non-Scheduled Domestic Loaded and Unloaded Cargo at Rangoon International Airport

The non-scheduled domestic cargo traffic equal to 44% of traffic is shown in Table 4-4.

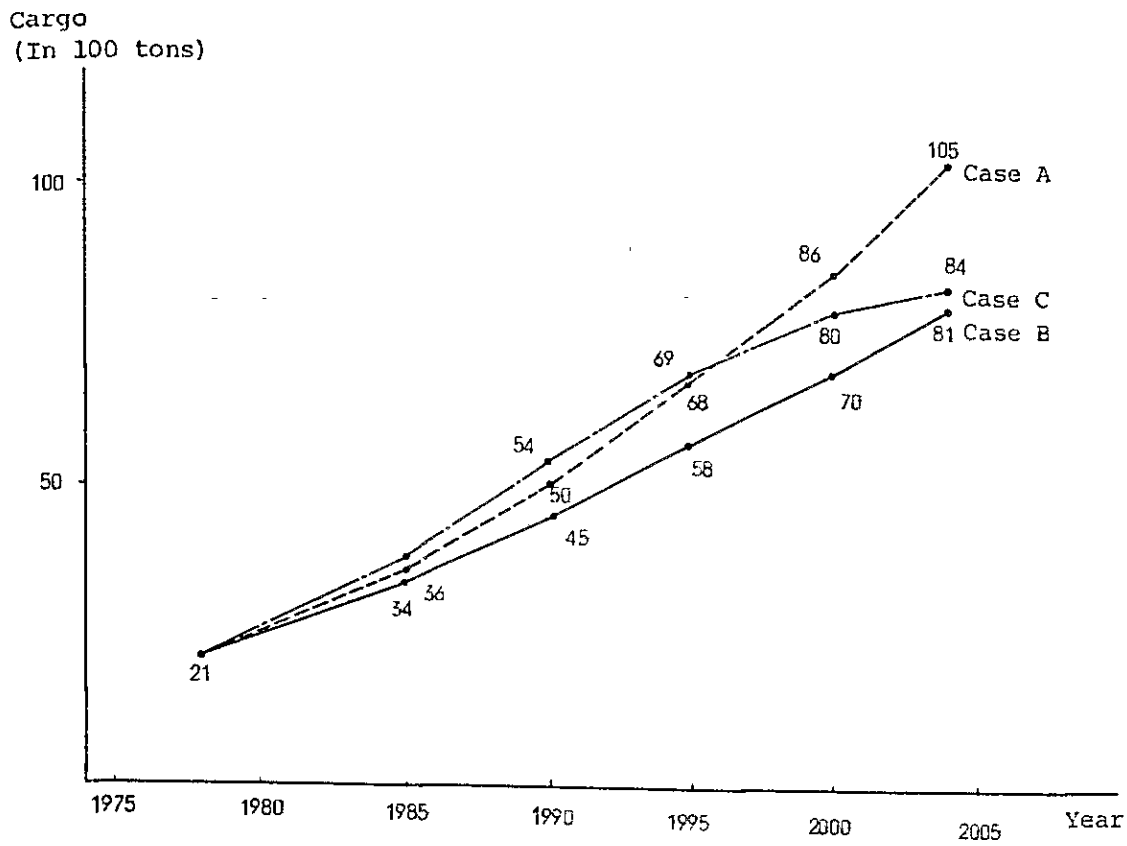

Figure 4-7 Forecast of Domestic Loaded and Unloaded Cargo at Rangoon International Airport

Table 4-4 Forecast of Domestic Cargo Traffic at Rangoon International Airport

(In thousand tons)

	1985	1990	1995	2000	2005
Scheduled	1.89	2.52	3.25	3.92	4.55
Non-Scheduled	1.51	1.98	2.55	3.08	3.55
Total	3.40	4.50	5.80	7.00	8.10

4.6 Forecast of Aircraft Movements

The international and domestic flight movements by type of aircraft were forecasted from the above passenger and cargo forecasts. The type of aircraft by route was projected based on the criteria of economic viability and aircraft flight range calculated according to the characteristics of current models. The load factor for scheduled passenger flights was assumed to be constant at 65% for international and 70% for domestic flights throughout the period of forecast to 2005. The result is shown in Table 4-5.

Table 4-5 Forecast of Annual Aircraft Movements by Type of Aircraft

Case	Year	Item	360 Seater	250 Seater	170 Seater	120 Seater	60 Seater	40 Seater	20 Seater - Non Jet
		International	363	298	274	309	110	-	-
	1985	Domestic	-	-	-	-	9,170	2,157	1,161
		Total	363	298	274	309	9,280	2,157	1,161
		International	1,774	1,300	638	353	-	-	-
1	1995	Domestic	-	-	-	8,598	1,639	1,849	-
		Total	1,774	1,300	638	8,951	1,639	1,849	-
		International	4,939	3,201	555	248	-	-	-
	2005	Domestic	-	-	-	13,360	2,167	2,483	-
		Total	4,939	3,201	555	13,608	2,167	2,483	-
		International	363	298	274	309	110	-	-
	1985	Domestic	-	-	-	-	9,170	2,157	1,161
		Total	363	298	274	309	9,280	2,157	1,161
		International	1,822	1,300	638	353	-	-	-
2	1995	Domestic	-	-	-	8,598	1,639	1,849	-
		Total	1,822	1,300	638	8,951	1,639	1,849	-
		International	5,133	3,201	555	248	-	-	-
	2005	Domestic	-	-	-	13,360	2,167	2,483	-
		Total	5,133	3,201	555	13,608	2,167	2,483	-

CHAPTER 5. AIRPORT FACILITY REQUIREMENTS

CHAPTER 5 AIRPORT FACILITY REQUIREMENTS

5.1 Assumptions of Planning

As assumptions for determining the future facility requirements at Rangoon International Airport, the target years for facility planning were selected to be 1995 for the interim phase of the Project, and 2005 for the ultimate phase of the Project. The planning criteria for these two target years have been determined as summarized in Table 5-1 for each development alternative of the Project.

Table 5-1 Annual Passenger and Cargo Volume, Aircraft Movements

	1995		2005	
	Case 1	Case 2	Case 1	Case 2
International Passenger (thousand)				
Scheduled				
Emb. and Disemb.	298	299	811	822
Transit	393	403	864	898
Total	691	702	1,675	1,720
Non-Scheduled	36	36	89	89
Total	727	738	1,764	1,809
Domestic Passenger (thousand)				
Scheduled	743		1,155	
Non-Scheduled	59		91	
Total	802		1,246	
International Cargo (thousand tons)				
Scheduled	3.72		13.23	
Non-Scheduled	0.76		0.27	
Total	3.80		13.50	
Domestic Cargo (thousand tons)				
Scheduled	3.25		4.55	
Non-Scheduled	2.55		3.55	
Total	5.80		8.10	
Aircraft Movements (nos.)				
International				
360 seater	1,774	1,822	4,939	5,133
250	1,300	1,300	3,201	3,201
170	638	638	555	555
120	353	353	248	248
Total	4,065	4,113	8,943	9,137
Domestic				
120	8,598		13,360	
60	1,639		2,167	
40	1,849		2,483	
Total	12,086		18,010	
Total	16,151	16,199	26,953	27,147

5.2 Basic Airport Facilities

5.2.1 Runway Strip

The existing runway strip already has the necessary width of 1,000 feet for precision approach. Along with the planned extension of the runway, however, the runway strip should also be extended at the same width of 1,000 feet for the entire length of the extended runway.

5.2.2 Runway Length

The runway length required for each aircraft movement depends on the physical and climatic characteristics of the runway i.e. runway elevation, slope, surface condition, temperature and wind and on the type of aircraft and its operational procedures, flight route/ distance and payload.

B-747 with a JT9D-7A engine was assumed to be the design aircraft, and the stage length-payload relationships were studied for different runway lengths with the following assumed conditions of the runway. The results are shown in Figure 5-1.

Elevation	:	109 feet A.M.S.L.
Reference Temperature	:	37°C
Effective Slope	:	0.55%
Surface Condition	:	Wet
Wind Direction and Velocity	:	Calm

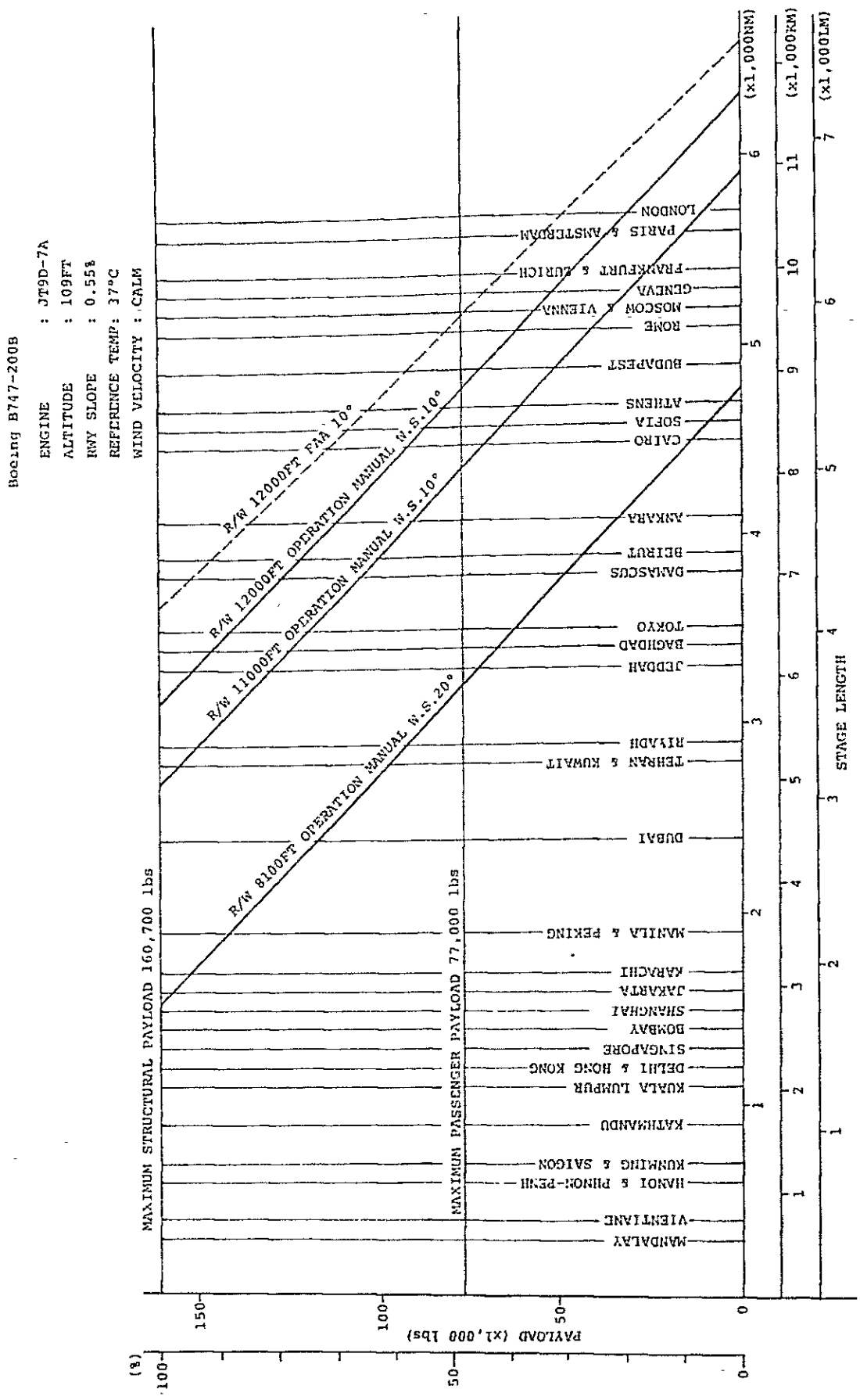

Figure 5-1 Stage Length-Payload Relationship

Assuming that the minimum economic payload of a scheduled flight is 60 to 70%, the farthest cities to which direct flights are possible with the runway length of 8,100 feet, 11,000 feet and 12,000 feet are as follows:

Runway Length	East-bound	West-bound
8,100 feet	Manila, Peking	Tehran, Kuwait
11,000 feet	Tokyo	Beirut
12,000 feet	Tokyo	Ankara (Athens)*

* Flights to Athens would be possible with a 45-minute reserve fuel load as used in similar FAA study.

On the basis of the above findings and the following considerations, the runway lengths of 11,100 feet and 12,100 feet respectively were established for Case 1 and Case 2 of the development alternatives to be considered in the present study.

i) The Government of the Socialist Republic of the Union of Burma strongly wishes for direct flights between Rangoon and Europe by wide-bodied aircraft.

ii) The farthest direct flights which the Burma Airways Corporation hopes to serve in the future are the East-bound route to Tokyo and the West-bound route to Frankfurt.

iii) The farthest cities to which direct flights are currently served from Bangkok International Airport are Tokyo East-bound and Athens West-bound.

iv) The longest runways of international airports in the major cities of South East Asia are generally in the range of 11,000 feet to 12,000 feet (Appendix Table 4A-1).

5.2.3 Runway Width

The present runway width is 200 feet. This is an adequate width for the wide-bodied aircraft expected to be in service and, therefore, no expansion of the runway width is required.

5.2.4 Layout of Taxiways

At present, there exists a 100 feet wide parallel taxiways for the entire length of the 8,100 feet runway. To accommodate the arrival of aircraft movements forecast for 1995 of 16,151 and 26,953 for 2005, as well as considerable number of touch-and-go training movements of F-27 type aircraft to be accommodated, the parallel taxiway should be extended with the same width along the entire extension of the runway.

5.2.5 Passenger Loading Apron

(1) Aircraft Parking Time

Aircraft parking time for each aircraft category, classified on the basis of aircraft design performance and actual record of past performances, are as indicated in Table 5-2.

Table 5-2 Aircraft Parking Time

Aircraft Category	Number of Seats	Through Flights	Turn-around Flight
		(Minutes)	(Minutes)
A	360	90	120
B	250	45	60
C	170	45	60
D	120	30	45
E	60	30	45
F	40	30	45

(2) Number of Aircraft Parking Positions

The required number of aircraft parking positions was calculated on the basis of hourly flight concentrations and parking times. Hourly flight concentration was calculated with a peak hour concentration ratio established on a model South-bound air route between Europe and Asia.

For domestic flights, calculations were made by use of a concentration ratio based on the concentration of the past aircraft movements at Rangoon by route.

Results of above calculations are indicated in Table 5-3.

Table 5-3 Number of Passenger Aircraft Parking Positions

	Aircraft Category	International Flight	Domestic Flight	Reserve	Total
Phase I 1995	A	2	0	0	2
	B	1	0	0	1
	C	1	0	0	1
	D	0	2	0	2
	E	0	1	0	1
	F	0	1	0	1
	Total	4	4	0	8
Phase II 2005	A	3	0	0	3
	B	1	0	2	3
	C	1	0	0	1
	D	0	3	0	3
	E	0	1	1	2
	F	0	1	0	1
	Total	5	5	3	13

5.2.6 Cargo Loading Apron

(1) Aircraft Parking Time

Parking time of cargo freighter is shown by aircraft category in Table 5-4.

Table 5-4 Aircraft Parking Time

Aircraft Category	Parking Time
C	120 minutes
F	90

(2) Number of Freighter Parking Positions

With due regard to the number of freighter flights expected the number of parking positions required for cargo freighter was determined to be one position for DC-8 type aircraft for use of both domestic and international service up to 1995 and two positions, one for DC-8 and one for F-27 type aircraft after that date.