1.12 Identification of Priority Projects

Priority projects should be selected for the subsequent feasibility study by the following considerations:

(1) Projects with high priority for the purpose of the enhancement of air safety and punctuality of aircraft operations

(2) Projects with high efficiency of investment which will contribute to the development of the national economy and tourism

(3) Projects requiring urgent improvement

The following projects have been selected as priority projects:

- Tribhuvan International Airport Development Project

  * Domestic terminal building
  * Passenger loading apron
  * Air navigation systems
  * Cargo terminal building
  * Maintenance hangar

- New Pokhara Airport Development Project

- Jomsom and Simikot Airports Development Projects

- Lukla, Syangboche and Mugu Airports

- Nationwide Navaids Network and Aeronautical Telecommunications Network

The estimated project costs of priority projects are tabulated in Table 1.12.1.

Table 1.12.1 Estimated Project Costs of Priority Projects

Unit : US$1,000

Project Name	Costs
1) Tribhuvan International Airport Development Project	
- Phase I	174,200
- Phase II	313,300
2) New Pokhara Airport Development Project	
- Phase I	39,700
- Phase II	45,200
3) Jomsom Airport Development Project	3,200
4) Simikot Airport Development Project	2,600
5) Lukla Airport Development Project	1,900
6) Syangboche Airport Development Project	2,900
7) Mugu Airport Development Project	5,400
8) En-route Navaids Network Project and Nationwide Aeronautical Telecom. Network Project	16,600
Grand Total	605,000

CHAPTER 2 FEASIBILITY STUDY OF PRIORITY PROJECTS

CHAPTER 2 FEASIBILITY STUDY OF PRIORITY PROJECTS

2.1 Preliminary Study of TIA

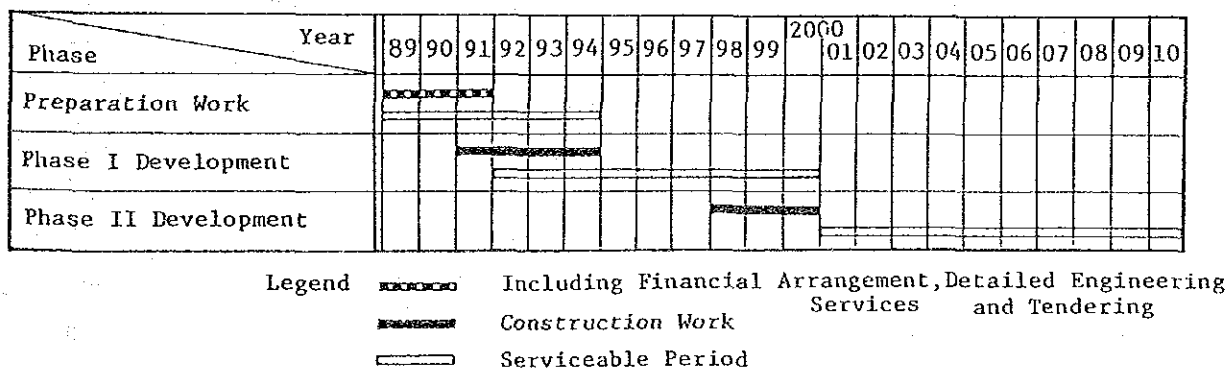
2.1.1 Preliminary Study of Airport Facilities

(1) Project Phases

The phases of airport development are summarized below and are shown in Fig. 2.1.1.

Phase	Design Year	Service Period
Phase I development	2000	1995-2000
Phase II development	2010	2001-2010

Fig. 2.1.1 Phases of Airport Development



(2) Facility Requirements for Phases I and II

The facility requirements for Phases I and II are summarized in Table 2.1.1.

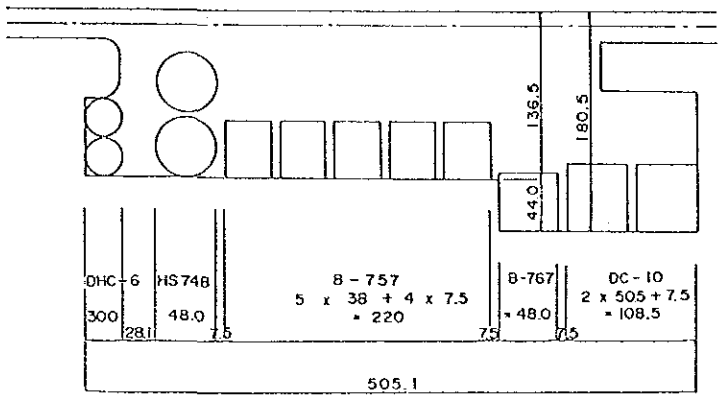
Table 2.1.1 Airport Facility Requirements for Phase I and II at TIA

No	Facility	Phase / Design Year / Unit	Present Conditions (as of 1988)	Phase I 2000	Phase II 2010
1	Runway	meter	3,050 x 46	3,050 x 45	3,050 x 45
2	Runway Strip	meter	3,140 x 150	3,140 x 150	3,110 X 300
3	Taxiway	meter	Partial Parallel Taxiway	Partial Parallel Taxiway	Parallel Taxiway
4	Passenger Terminal Apron	gate position	Dom : 3 Int'l : 6 Total : 9	Dom HS748 class: 2 DHC6 class : 2 Int'l J,L class : 2 M class : 1 N.S class : 5 Total :12	Dom HS748 class: 2 DHC6 class : 2 Int'l J,L class : 4 M class : 1 N.S class : 5 Total :14
5	Cargo Terminal Apron	gate position	Nil	Nil	J class : 1
6	Passenger Terminal Building Dom	sq.meter	700	3,200	4,200
	Int'l	sq.meter	10,750	10,800	19,700
	Total	sq.meter	11,450	14,000	23,900
7	Cargo Terminal Building	sq.meter	3,500	Dom 400 Int'l 13,500	500 27,000
8	Administration Building	sq.meter	2,100	4,000	4,000
9	Air Navigation Systems		Non Precision, Instrument	Non Precision, Instrument	Precision Approach Cat-I (MLS)
10	Car Park	cars sq.meter	17,000	550 19,300	970 34,000
11	Access Road		1 lane for each direction	1 lane for each direction	1 lane for each direction
12	Fuel Supply (Jet. A-1)	kl/week sq.meter	500 15,000	1,100 25,000	2,000 30,000
13	Rescue and Fire-Fighting	Category cars sq.meter	5 6 800	7 5 450	8 5or6 550
14	Utilities Power Supply System Water Supply System Sewerage System Solid Waste Disposal System	KVA ton/month ton/month ton/month	N.A N.A N.A N.A	2,300 10,900 7,800 80	3,600 16,100 11,600 140
15	Ground Support Equipment	cars	Nil	Towing tractor 2	Towing tractor 3

(3) Apron

The dimension of the passenger terminal apron in Phase I and Phase II are shown in Fig. 2.1.2.

Phase I



Phase II

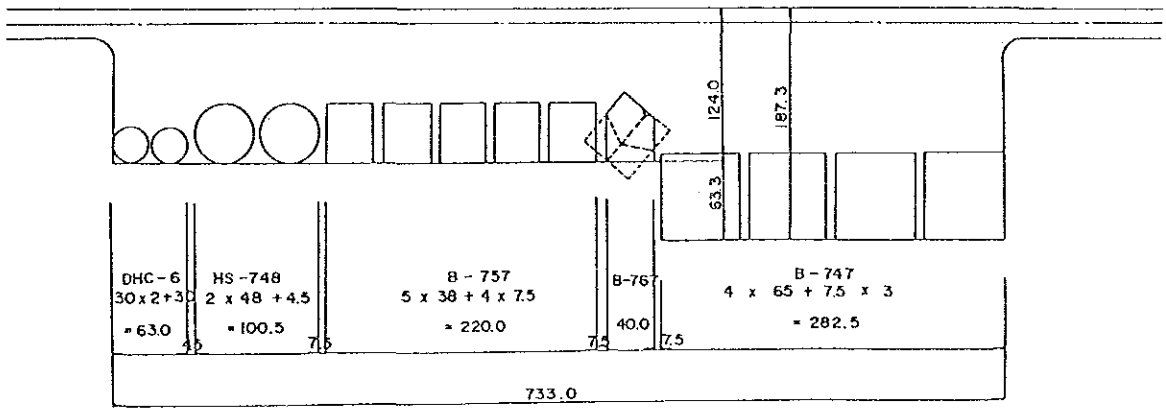


Fig. 2.1.2 Dimension of Passenger Terminal Apron

(4) Domestic Terminal Building

A domestic terminal building with a total floor area of 3200 sq.m is planned for the Phase I development as shown in Figs. 2.1.3 and 2.1.4.

A linear type concept with one and a half floor levels will be employed for the passenger terminal building. This configuration was chosen in consideration of the number of aircraft stands and the number of passengers to be served.

The building will be a reinforced concrete structure with the same exterior design as the international terminal building.

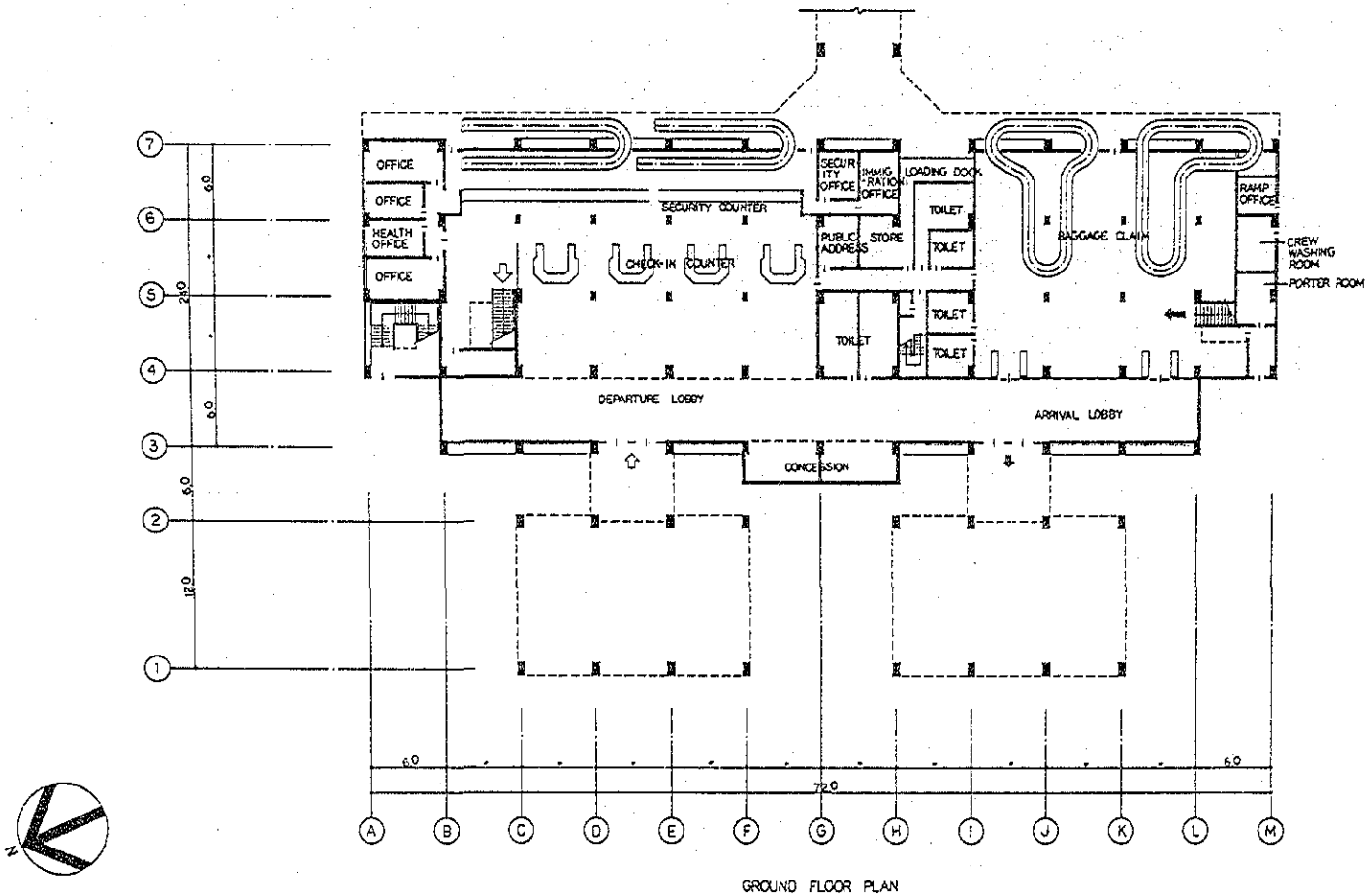
(5) Cargo Terminal Building

The cargo terminal building will have a floor area of 9000 sq.m for Phase I. Depth of the building will be set at 30 m so as to handle the cargo efficiently from curb side to air side or vice versa. Airline offices will be located on the first floor so that the ground floor may be exclusively used for cargo handling and airline counter in the limited space of the site.

(6) Maintenance Hangar

A maintenance hangar is planned to accommodate one B-767 aircraft in Phase I development. The largest aircraft operated by RNAC is the B-757 at present, however, larger aircraft will be introduced according to increased demand. Therefore, B-767 has been adopted for the design aircraft of the maintenance hangar. Tool shops, stores, office etc. will be located in the hangar.

Note: This drawing does not bind
the final concept of the building



GROUND FLOOR PLAN

Fig. 2.1.3 Domestic Passenger Terminal Building (Ground Floor Plan)

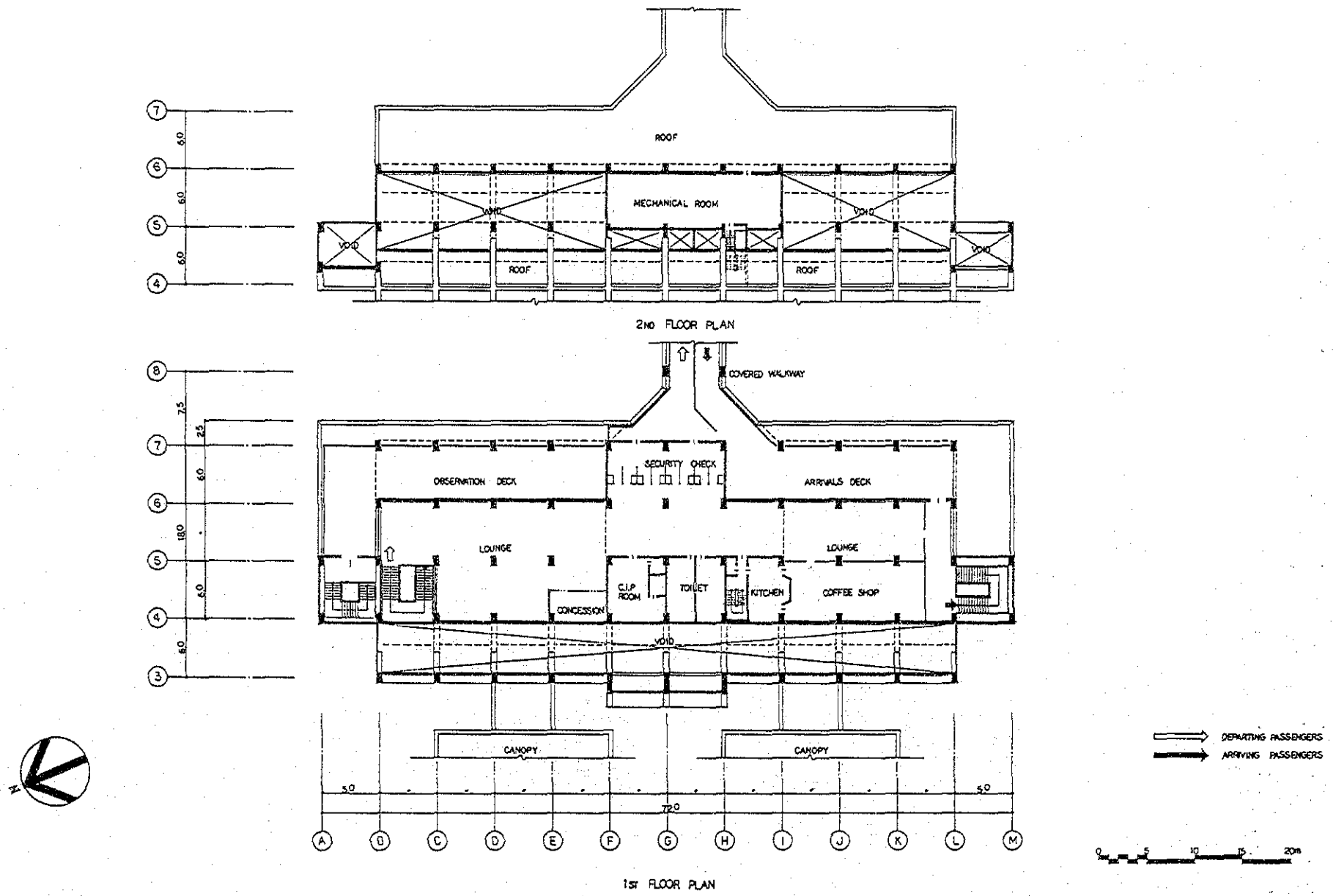


Fig. 2.1.4 Domestic Passenger Terminal Building (First Floor Plan)

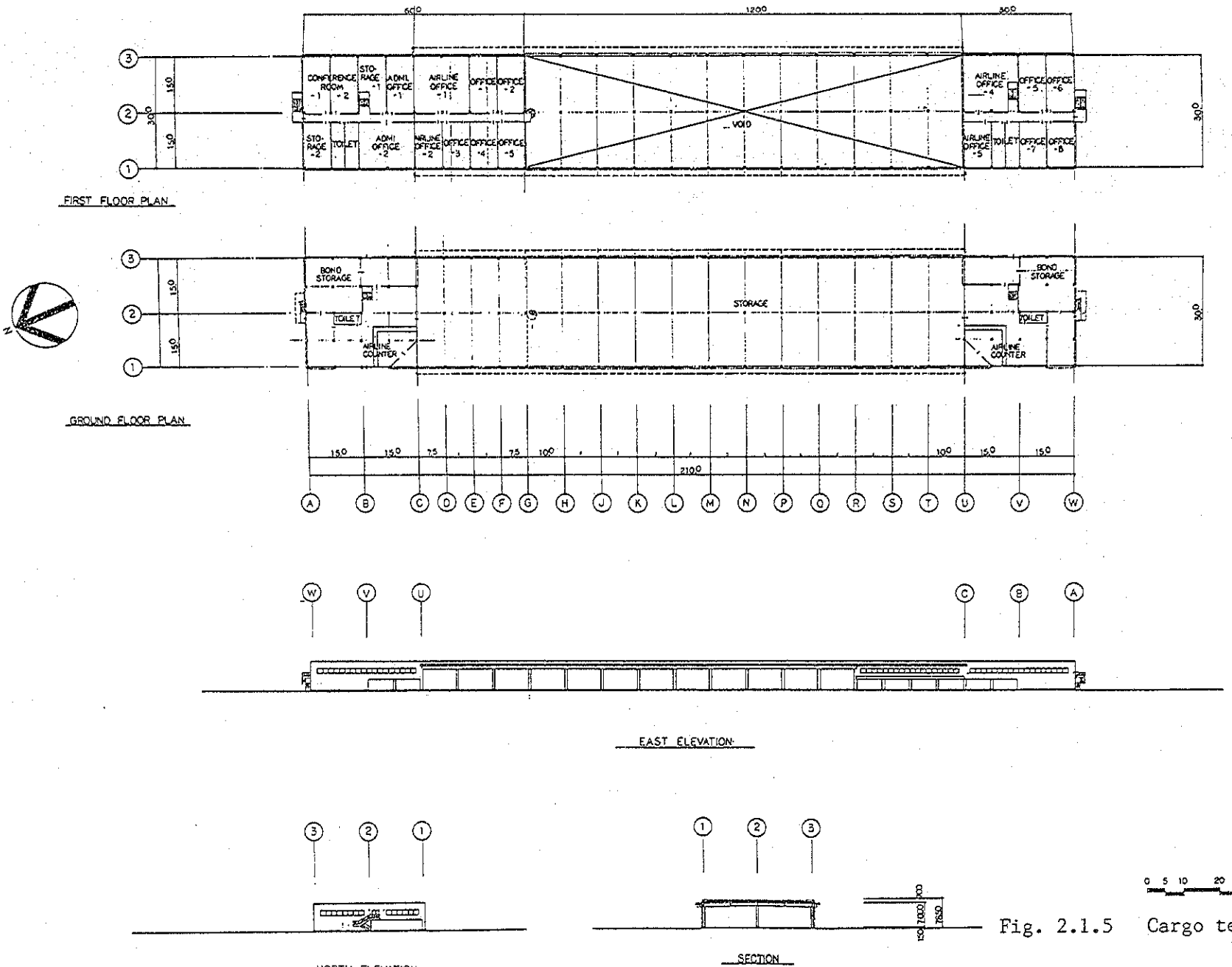
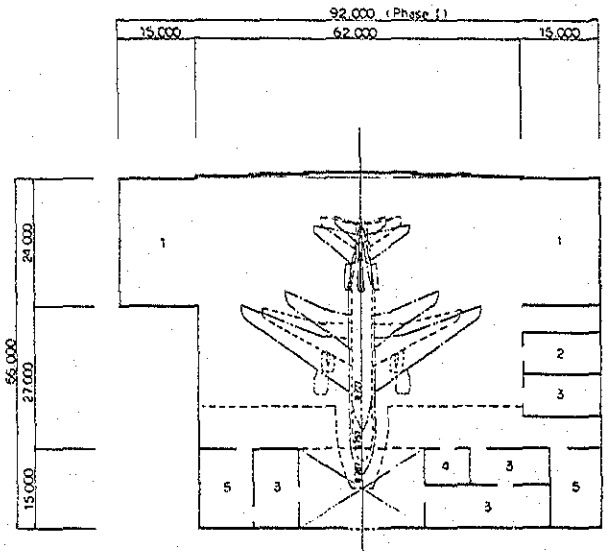
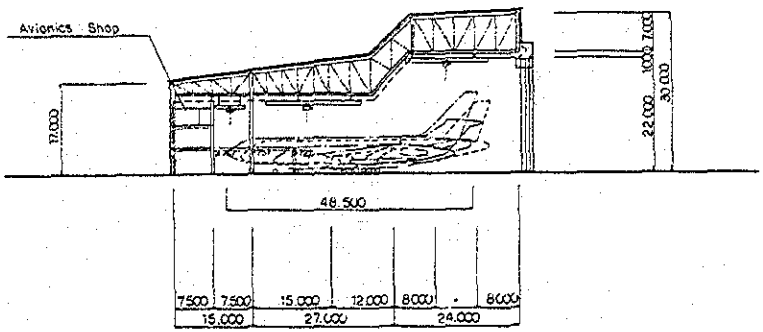


Fig. 2.1.5 Cargo terminal Building



PLAN

1. Workstand Storage
2. Tool Room
3. Support Shop
4. Job Control Room
5. Store



SECTION

0 5 10 20 30 40 50m

Fig. 2.1.6 Maintenance Hanger

(7) Air Navigation Systems

The following are the outline of air navigation system plan for Phase I.

(NAVAIDS)

1) Installation of Localizer/DME for RWY 02 Approach
2) Replacement of KTM DVOR/DME with power supply equipment and an emergency generator
3) Installation of a new DVOR/DME for Kathmandu terminal control area
4) Relocation and replacement of the NDB

(AIR TRAFFIC CONTROL AND TELECOMMUNICATIONS SYSTEM)

1) Relocation and replacement of the HF transmitters for air ground radio, CW (Continuous Wave) circuit and international AFTN circuits
2) Relocation of the HF transmitters for ATS direct speech circuits

(AERONAUTICAL GROUND LIGHTS)

1) Replacement or upgrading of the following lights:

- Simple approach lighting system (RWY 02)
- Runway edge lights (high intensity)
- Runway threshold and end lights
- PAPI
- Taxiway edge lights
- Aerodrome beacon
- Wind direction indicator lights

2) Extension of apron floodlights
3) Construction of a substation and power supply system for aeronautical grouond lights

(METEOROLOGICAL SYSTEM)

1) Installation of meteorological observation (airport surface data), data collection, recording and display systems.

2.1.2 Airspace Use

(1) Issues on Aircraft Operations

a) At present, almost all international flights to TIA come from the south via Delhi and Calcutta FIRs. These arriving aircraft are often encountered around Simara NDB with same flight level due to a convergence of international airways over Simara NDB.

To avoid confusion near Simara NDB, Kathmandu ACC tries to make contact with ACCs concerned and request them to change their flight level before reaching Simara NDB. But communication between ACCs is not easy.

b) International flights coming from the south maintain high flight levels until Simara NDB. Thus, it is very difficult to descend into the initial approach altitude for TIA.

(2) Evaluation of Existing Airspace Use

a) Expansion of Controlled Airspace and Installation of Radar Control System

To solve the confusion over Simara NDB, and to facilitate arrivals at TIA, the following actions have been taken by DCA:

1) Establishment of additional controlled airspace to the south of TIA as shown in Fig. 1.5.1

2) Alteration of the airway system from one way traffic to two way traffic on the main airway

3) Increase the number of arrival routes to TIA from Bhairahawa, Biratnagar and Simara

b) Installation of an Additional Navaids

Therefore, alternative Navaid should be installed to ensure a straight-in approach to runway 02 even if the main Navaid at TIA, KTM VOR/DME is out of order. Installation of an ILS

facility, a proposed navaid for TIA, has been studied but there are many problems with installation.

Accordingly, it is recommended that an LLZ/DME facility is suitable as an alternative Navaid at TIA.

2.1.3 Supplementary Considerations

(1) Aircraft Noise

Development of aircraft noise contours measured in Weighted Equivalent Continuous Perceived Noise Level (WECPNL) is shown in Figs. 2.1.7 and 2.1.8.

(2) Land Use Planning of the Area Surrounding the Airport

Land use controls are broadly classified into the land use zoning regulations (especially based on aircraft noise), height limitation to ensure the safe operation of aircraft, etc..

A criteria for land use controls for aircraft noise is proposed as shown below based on experience in Japan.

- Proposed Criteria -

WECPNL	$\geq$ 70:	Not suitable for public facilities such as schools, hospitals, churches, etc.
	$\geq$ 75:	No new residences are recommended
	$\geq$ 90:	Not suitable for residence

It is desirable to restrict the construction of new buildings in the areas for the Phase II development. All the structures and trees surrounding the airport property area must be strictly restricted so as not to infringe upon the approach surfaces.

The land use plan is proposed for the area surrounding the airport as shown in Fig. 2.1.9.

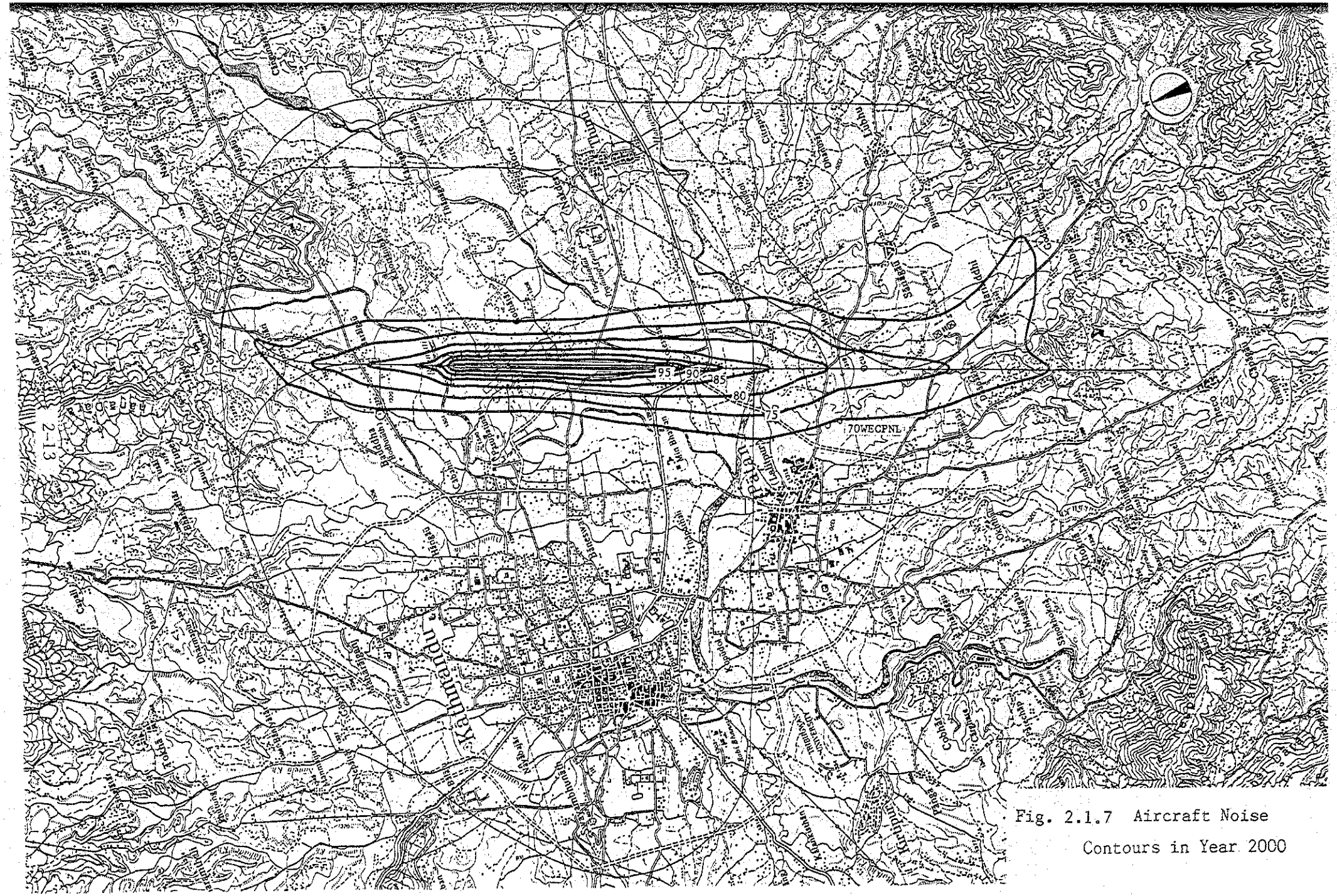


Fig. 2.1.7 Aircraft Noise Contours in Year 2000

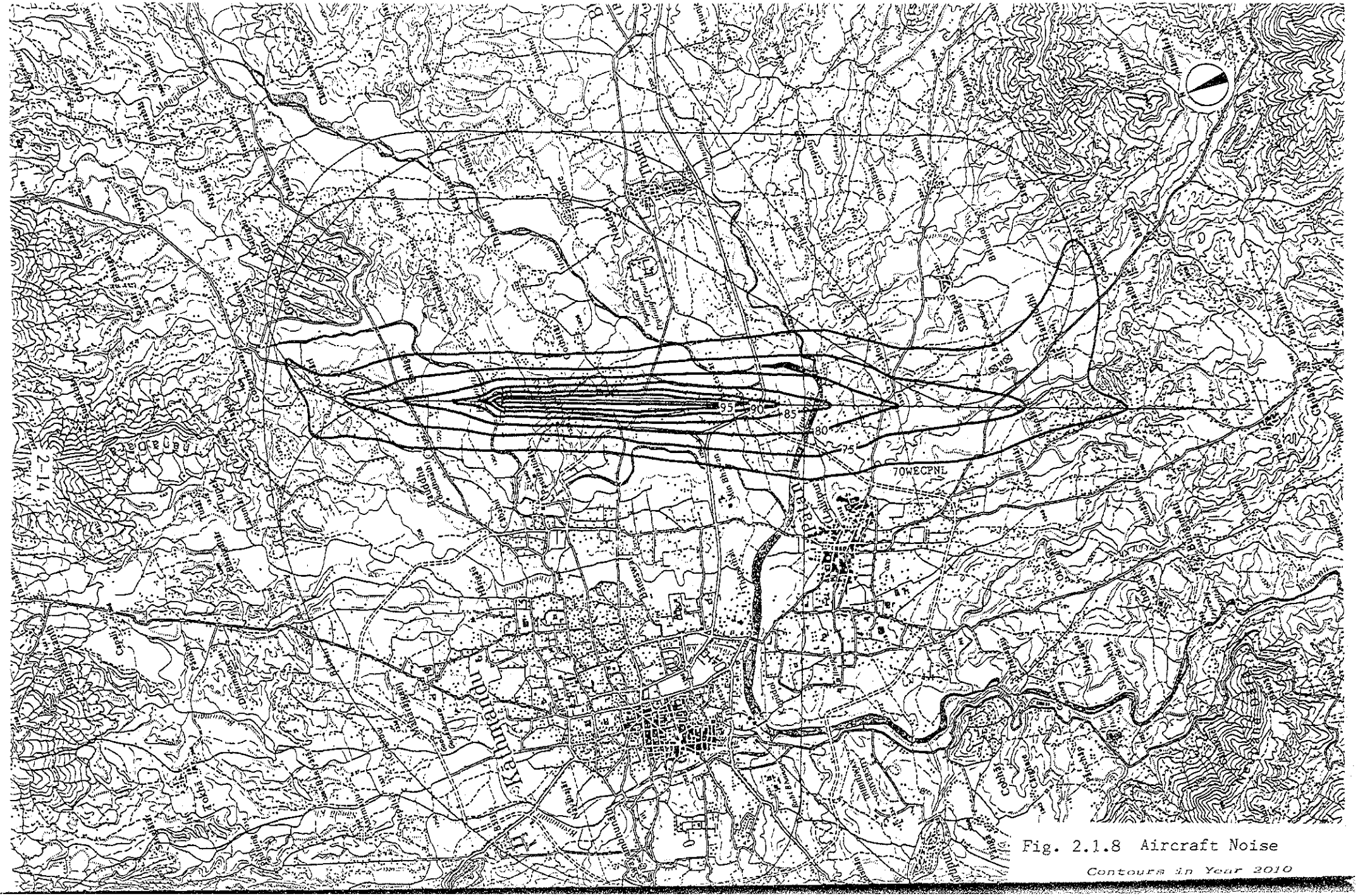
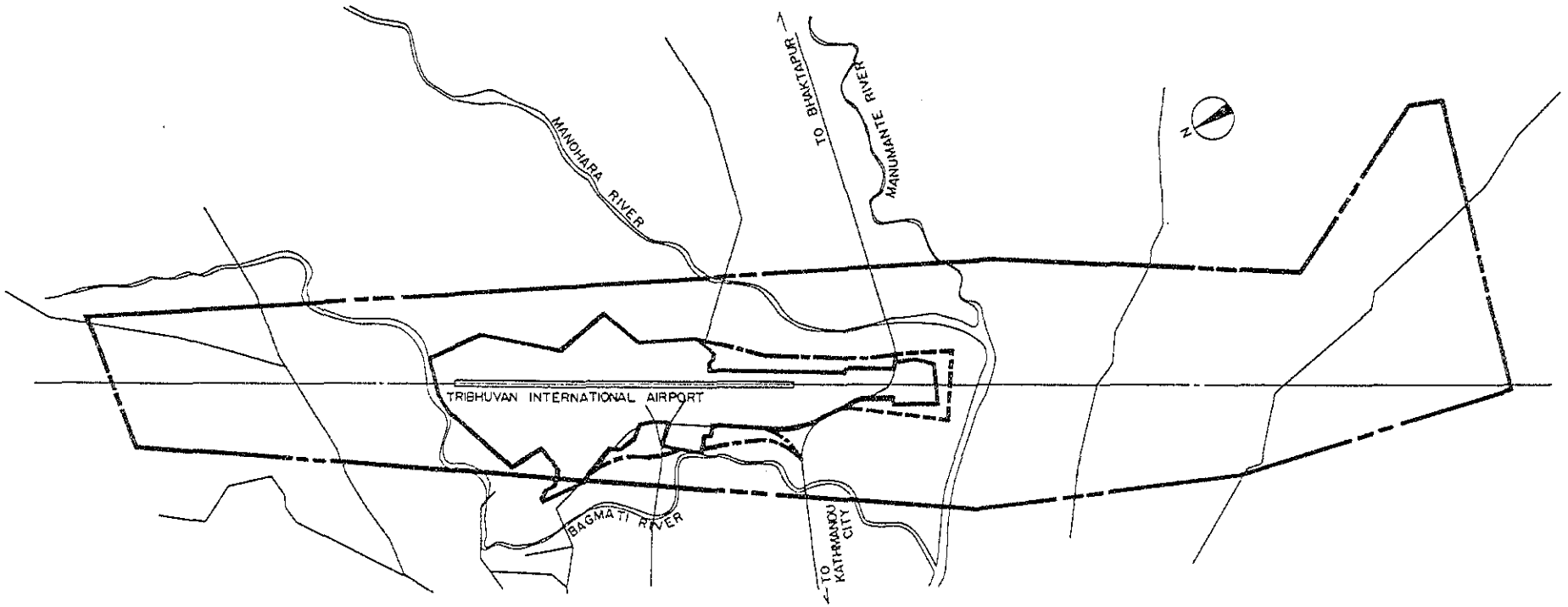


Fig. 2.1.8 Aircraft Noise

Contours in Year 2010



LEGEND

———	AIRPORT PROPERTY AREA
——— — ———	FUTURE AIRPORT PROPERTY AREA
— — — —	AREA WHERE NEW CONSTRUCTION OF BUILDINGS ETC. ARE RESTRICTED BASED ON THE AIRCRAFT NOISE LEVELS
— — — —	AREA WHERE OBSTRUCTIONS PENETRATING THE OBSTACLE LIMITATION SURFACES ARE RESTRICTED

0 500 1000 1500 2000m

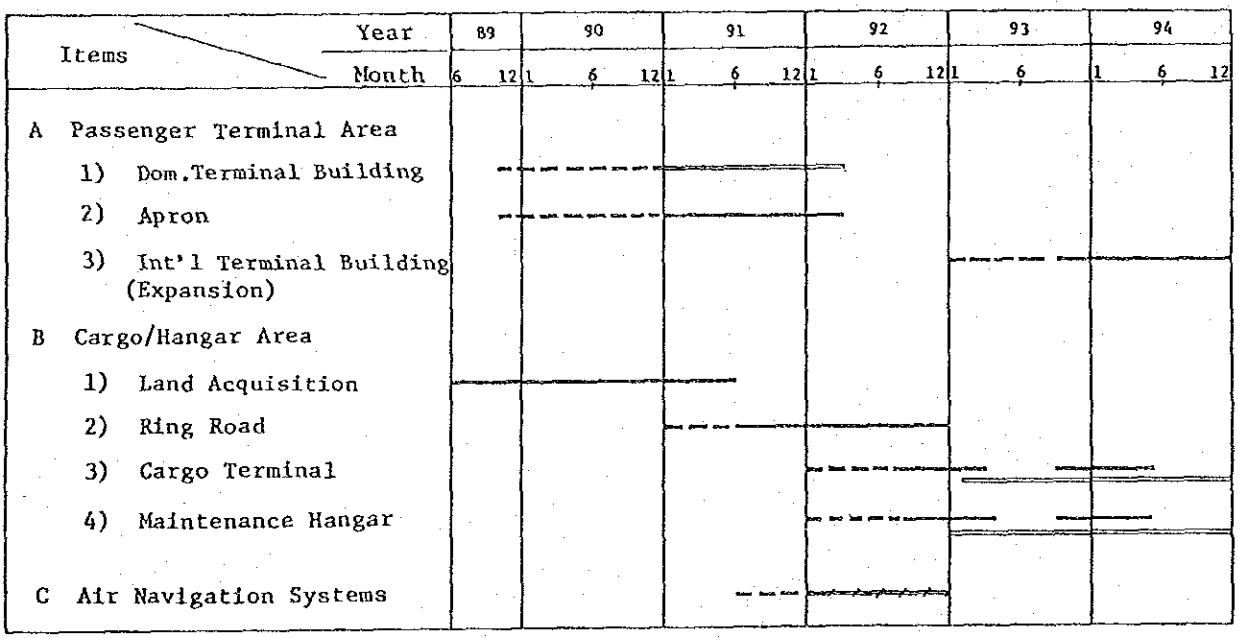
Fig. 2.1.9 Proposed Land Use Plan

2.1.4 Project Implementation Schedule and Cost Estimates

(1) Project Implementation Schedule

The construction schedule for the project is indicated in Table 2.1.2.

Table 2.1.2 Construction Schedule



Legend, Basic Design,Detailed Engineering Services and Tendering

Civil Work

Navigation Work

Architectural Work

(2) Project Cost Estimates

The project cost of Phase I development is summarized as shown in Table 2.1.3. The exchange rate used has been established at US$1.00 = Rs.25.0 = Yen125. The contingency is estimated at about 10% of the sum of the total cost of construction works, soil investigation and topographical survey, engineering services cost and construction supervision.

Table 2.1.3 Project Cost for Phase I Development of TIA

(Unit : US$1,000)

Item		Construction Cost		
		Local	Foreign	Total
1. Domestic Terminal Building	Civil Works	392	2,053	2,445
	Arch. Works	1,304	8,531	9,835
	Engineering	121	1,659	1,780
	Total	1,817	12,243	14,060
2. Cargo Terminal	Civil Works	3,336	10,544	13,880
	Arch. Works	1,526	11,681	13,207
	Engineering	268	3,660	3,928
	Total	5,130	25,885	31,015
3. Maintenance Hangar	Civil Works	4,825	16,576	21,401
	Arch. Works	4,705	39,361	44,066
	Engineering	648	8,845	9,493
	Total	10,178	64,782	74,960
4. Expansion of Apron (1) (Dom. & Int'l Apron)	Civil Works	1,717	4,134	5,851
	Supporting Equipment	-	745	745
	Engineering	65	891	956
	Total	1,782	5,770	7,552
5. Expansion of Apron (2) (Dom. Apron)	Civil Works	149	282	431
	Engineering	4	58	62
	Total	153	340	493
6. Diversion of Ring Road	Civil Works	3,636	10,398	14,034
	Engineering	139	1,896	2,035
	Total	3,775	12,294	16,069
7. Expansion of Int'l Terminal Building	Arch. Works	615	3,002	3,617
	Engineering	36	489	525
	Total	651	3,491	4,142

Table 2.1.3 Continued

Item		Construction Cost		
		Local	Foreign	Total
8. Air Navigation System	NAV	508	5,838	6,346
	ATC/COM	45	1,176	1,221
	Lights	670	3,707	4,377
	MET	88	617	705
	Others	-	344	344
	Civil Works	211	1,478	1,689
	Engineering	146	1,983	2,129
	Total	1,668	15,143	16,811
9. Rescue/Fire Fighting Vehicles	Equipment	-	1,562	1,562
	Engineering	15	211	226
	Total	15	1,773	1,788
10. Utilities	Civil Works	319	943	1,262
	Engineering	12	171	183
	Total	331	1,114	1,445
11. Land Acquisition		5,859	-	5,859
Total		31,359	142,835	174,194

Note : Engineering = Engineering Service Cost
Exchange rate : US$1.00 = NRs25.00
Cost estimates based on 1988 price

2.2 Preliminary Study of New Pokhara Airport

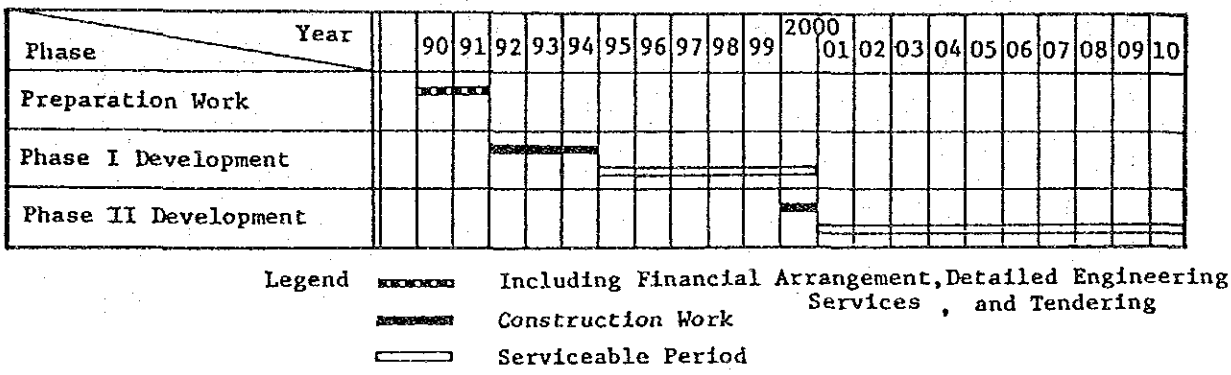
2.2.1 Preliminary Study of Airport Facilities

(1) Project Phases

The phases of airport development are summarized below and are shown in Fig. 2.2.1.

Phase	Design Year	Service Period
Phase I development	2000	1995-2000
Phase II development	2010	2001-2010

Fig. 2.2.1 Phases of Airport Development



(2) Facility Requirements for Phases I and II

The facility requirements for Phases I and II are summarized in Table 2.2.1.

Table 2.2.1 Airport Facility Requirements of New Pokhara Airport

	Item		Present Condition (as of 1987)	Phase I 2000	Phase II 2010
Air Traffic Forecast	1. Annual Passenger		46,500	79,900	107,600
	2. Annual Cargo	(ton)	195	330	440
	3. Annual Aircraft Movement	(operation)	N.A	2,900	3,900
	4. Peak Hour Passenger		N.A	100	120
	5. Peak Hour Aircraft Movement	(operation)	4.0	3.8	4.0
	6. Largest Aircraft		HS-748	do	B-757 class
Facility Requirements	7. Runway	(m x m)	1433 X 30	1900 X 30	2500 x 45
	8. Runway Strip	(m x m)	1570 X 150	2020 X 150	2620 x 300
	9. Taxiway	(m x m)	-	179 X 15	165 x 18
	10. Passenger Terminal Apron	(gate position)	HS-748 X 1 DHC-6 X 1	HS 2 DH 1	B757 1 HS 1 DH 1
	11. Passenger Terminal Building	(sq.meter)		800	1,000
	12. Cargo Terminal Building	(sq.meter)	-	30	40
	13. Administration Building	(sq.meter)	-	200	200
	14. Air Navigation Systems		Non Precision, Instrument	Non Precision, Instrument	
	15. Car Parks	(cars) (sq.meter)	-	30 1,400	50 1,800
	16. Access Road	(lane)	1	2	2
	17. Fuel Supply	(Fuel Tank) (Kl/Week)	-	30 Kl 21 Kl	50 Kl 29 Kl
	18. Rescue and Fire-Fighting	(Category) (Cars) (Fire Station,sq.m)	-	3 2 300	4 3 400
	19. Utilities	Electricity (KVA)	N.A	80	90
		Water (Ton/Month)	N.A	420	500
		Waste Deposit (Ton/Month)	N.A	2.1	2.7
		Sewage (Ton/Month)	N.A	310	370

(3) Runway and Runway Strip

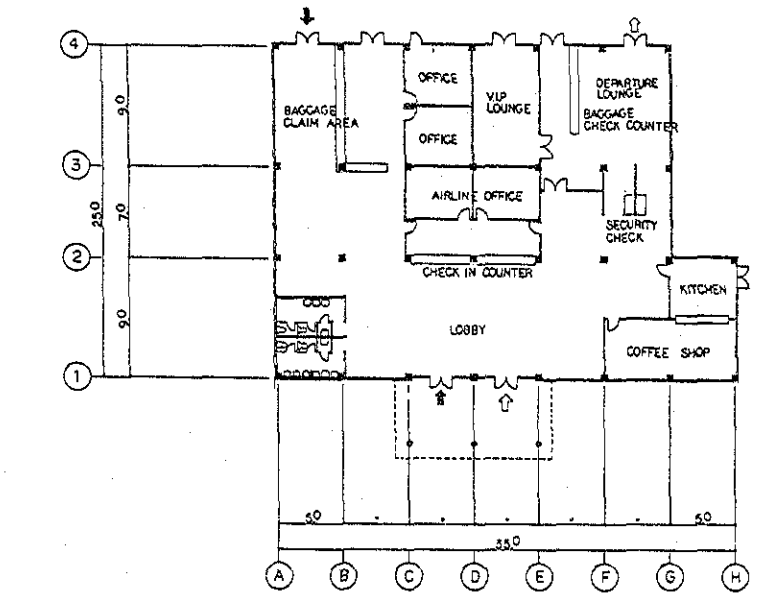
The profile of the runway is planned to best accommodate the following factors: volume of earth work, clearance to the obstacle limitation surfaces and easiness of drainage. The cross sections of the runway strip are also designed with these factors in mind.

(4) Passenger Terminal Building

The passenger terminal building is planned as shown in Fig. 2.2.2 with one floor level which will best accommodate the number of passengers to be served. The building will be a reinforced concrete structure.

(5) Air Navigation System

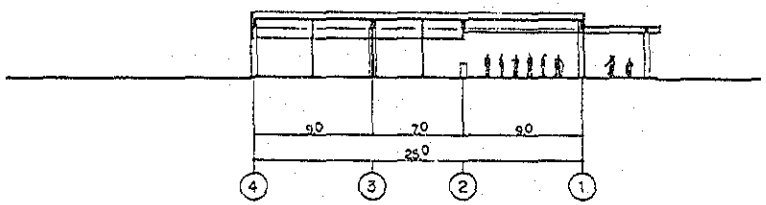
The operation category of New Pokhara Airport is classified to be "instrument, non-precision". Based on this operational category, the minimum air navigation systems including Doppler VOR/DME, NDB, and simple approach lighting system have been planned.



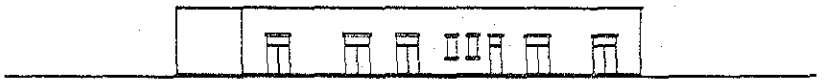
GROUND FLOOR PLAN

DEPARTING PASSENGERS

ARRIVING PASSENGERS



SECTION



ELEVATION 1

ELEVATION 2

ELEVATION 3

ELEVATION 4

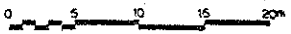


Fig. 2.2.2 Passenger Terminal Building

2.2.2 Airspace Use

(1) Obstacle Limitation Surfaces

Obstacle Limitation Surfaces for Phase II development plan of New Pokhara Airport is shown in Fig. 2.2.3.

(2) Controlled Airspaces

The following controlled airspaces are proposed for New Pokhara Airport as shown in Fig. 2.2.4 and Tables 2.2.2 - 2.2.3.

Table 2.2.2 Proposed Aerodrome Traffic Zone

Aerodrome	Dimension of Aerodrome	Traffic Zone
	Lateral Limit	Vertical Limit
New Pokhara Airport	An area of a circle of 5 NM radius centered at aerodrome reference point	From ground level up to 2000 feet

Table 2.2.3 Proposed Controlled Airspace

Tower	Controlled Airspace and Lateral Limits	Upper Limit / Lower Limit	Language
Pokhara Tower	CTR, a circle with a radius of 20 NM centered at Pokhara VOR/DME, excluding the portion of area which is overlapped with airway W-17	10500' / GND	English

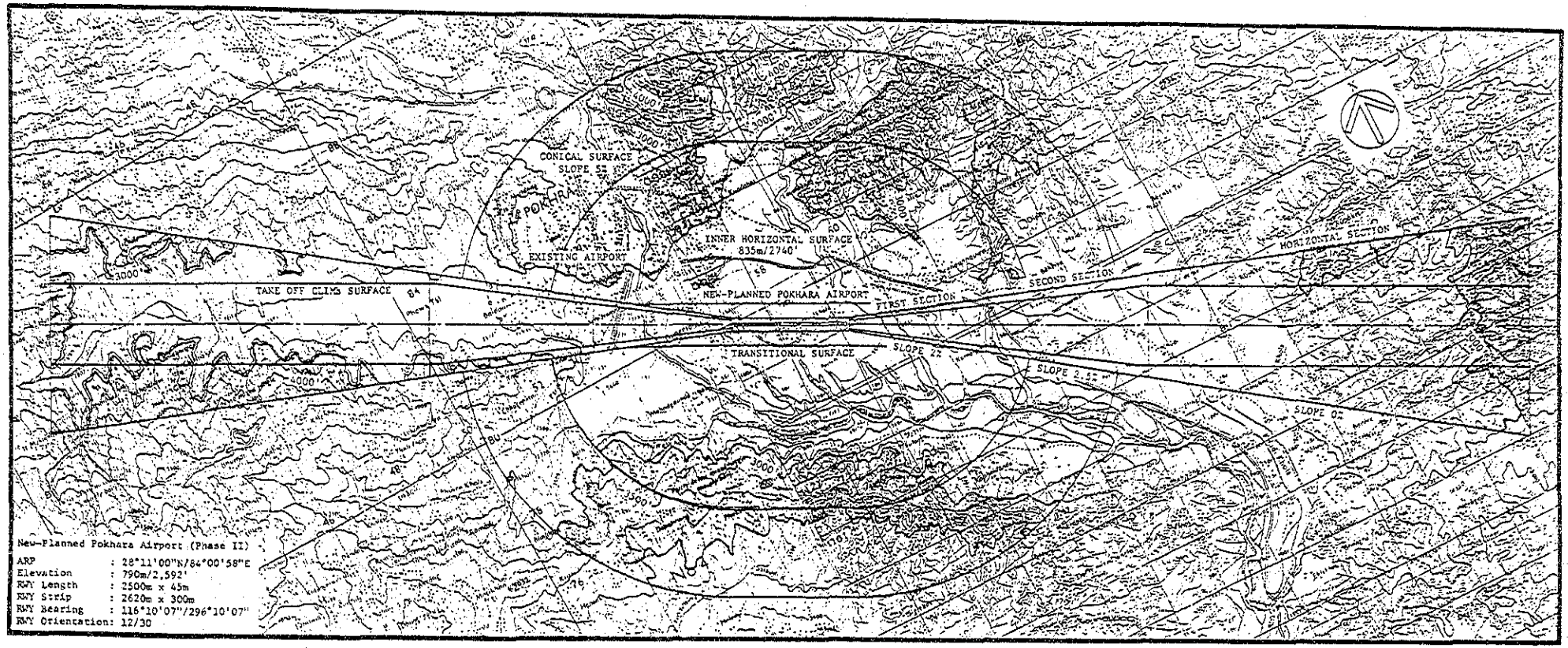


Fig. 2.2.3 Obstacle Limitation Surfaces of New Pokhara Airport (Phase II)

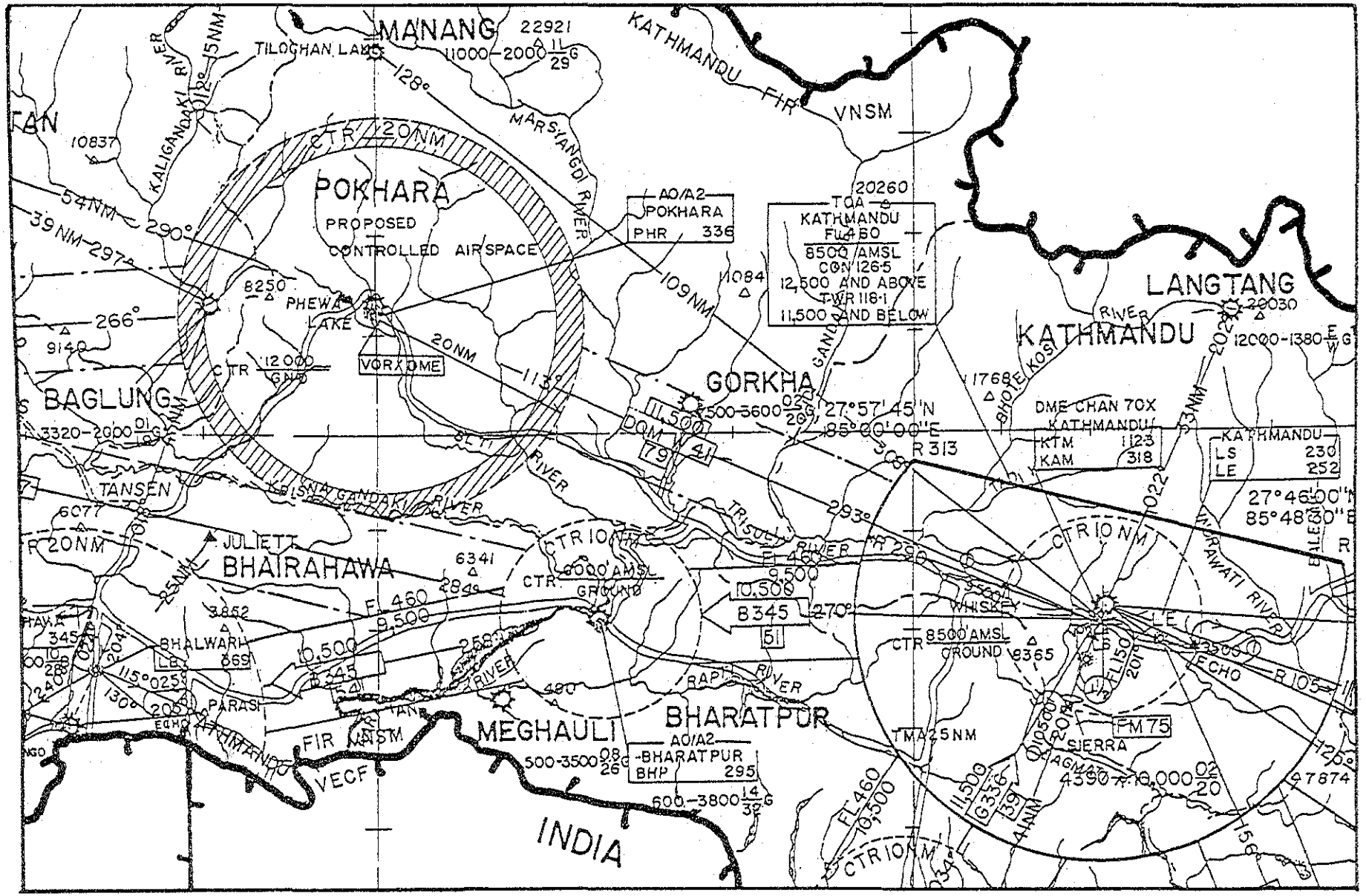


Fig. 2.2.4 Proposed Controlled Airspace for New

(3) Instrument Approach and Departure Procedures

a) Instrument Approach Procedure

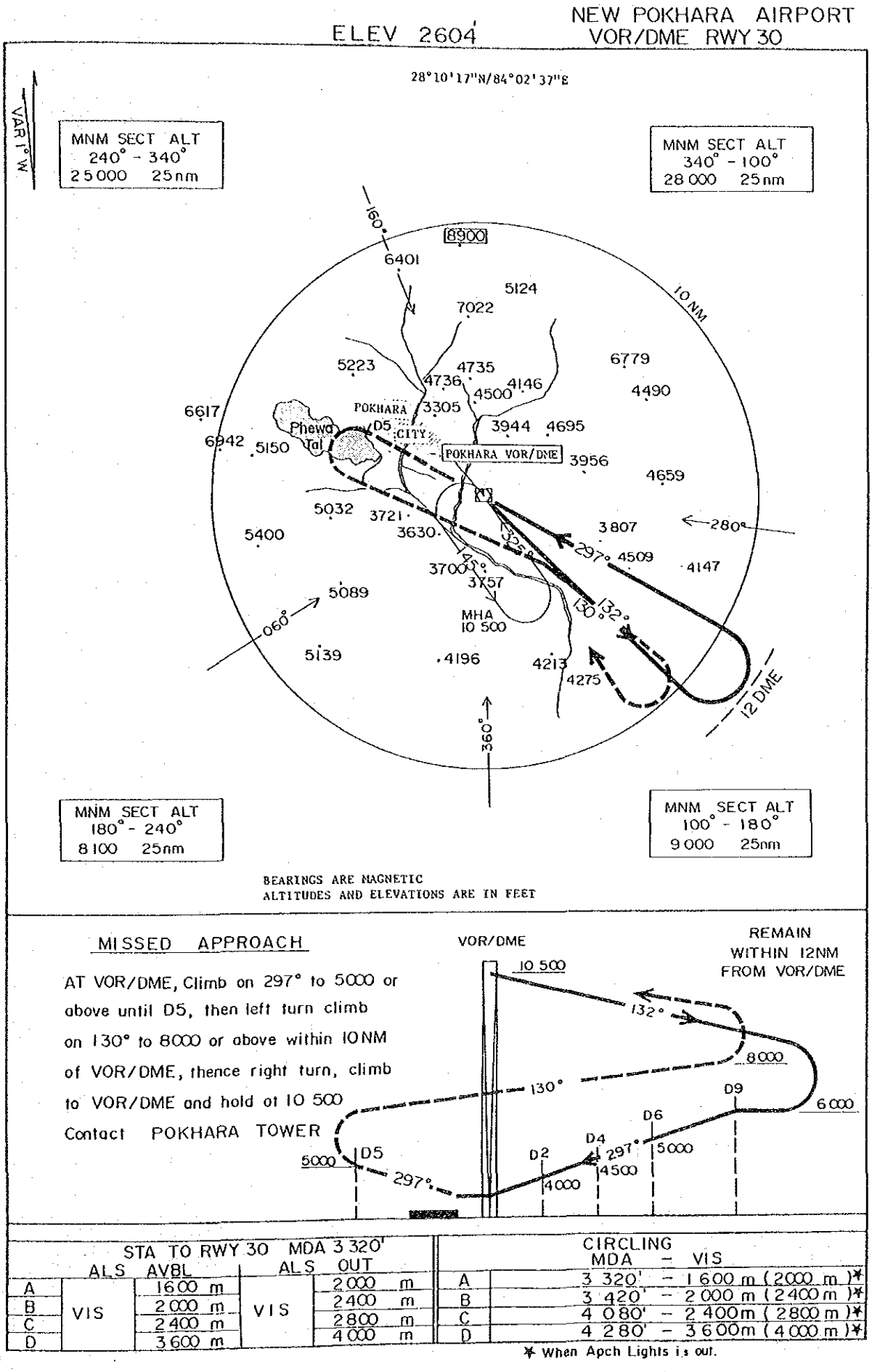
Fig. 2.2.5 is a draft of straight-in approach procedures based on the Phase I development plan.

b) Standard Instrument Departures

Fig. 2.2.6 shows drafts of Standard Instrument Departures for New Pokhara Airport.

(4) ATS Routes

Figs. 2.2.7 and 2.2.8 show the ATS routes from new Pokhara VOR/DME and NDB to other airports.



STA TO RWY 30 MDA 3 320'					
	ALS AVBL		ALS OUT		
A	VIS	1600 m	VIS	2000 m	
B		2000 m		2400 m	
C		2400 m		2800 m	
D		3600 m		4000 m	

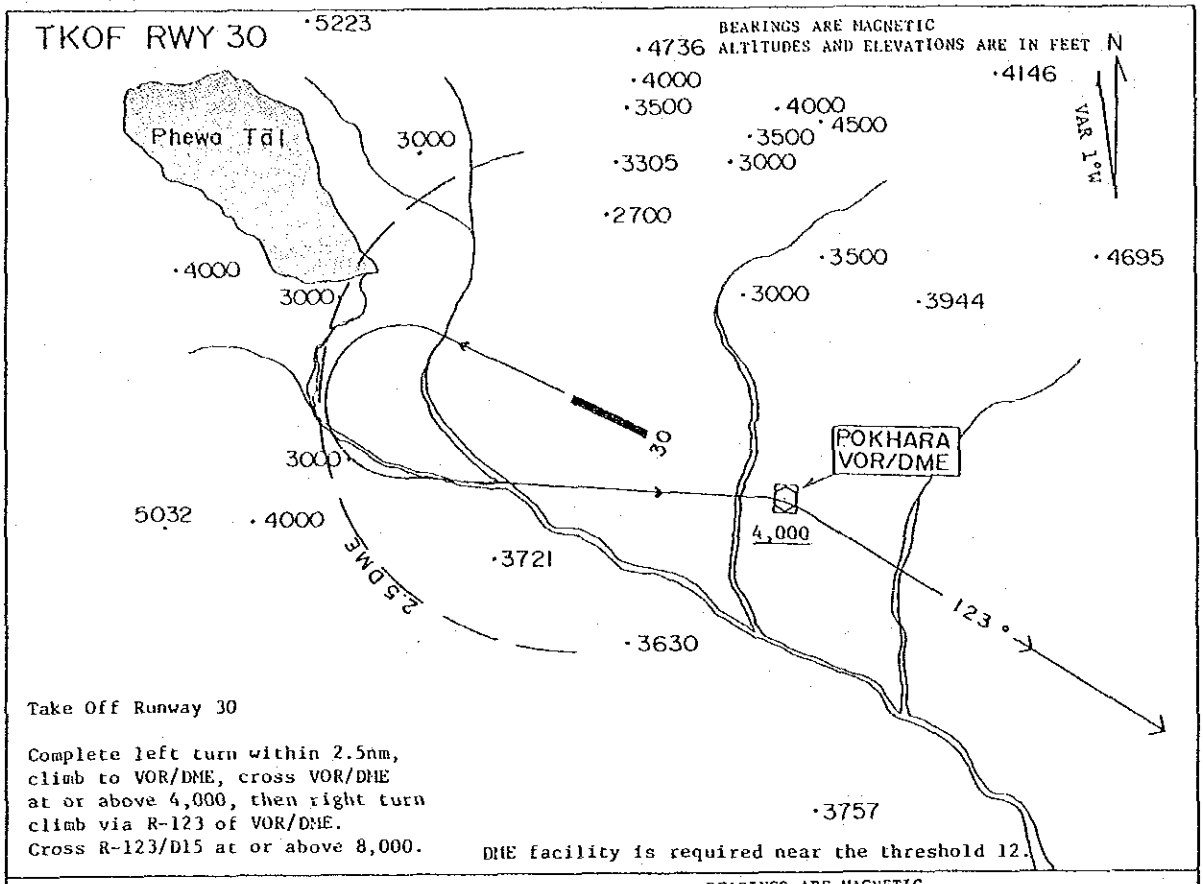
CIRCLING MDA - VIS	
A	3 320' - 1600 m (2000 m)*
B	3 420' - 2000 m (2400 m)*
C	4 080' - 2400m (2800 m)*
D	4 280' - 3600m (4000 m)*

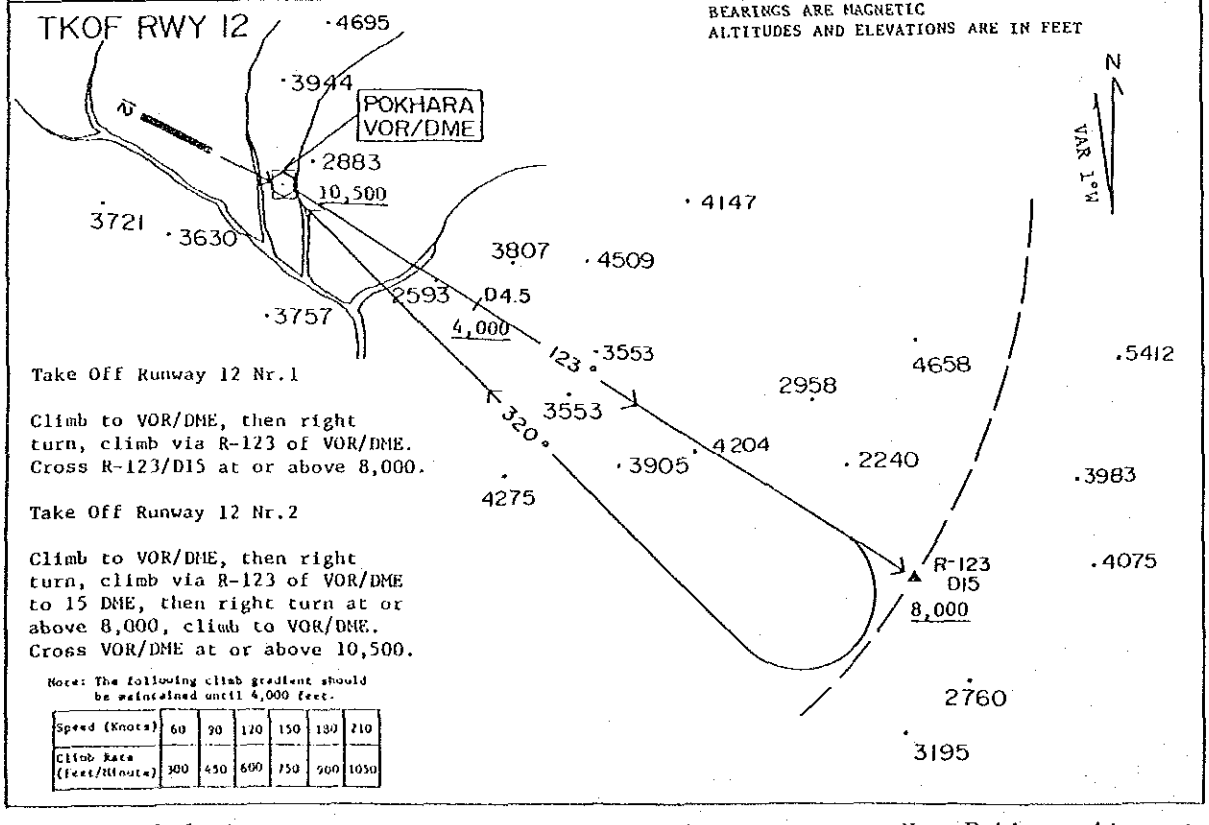
* When Apch Lights is out.

Fig.2.2.5 Proposed Instrument Approach Procedure, Pokhara VOR/DME RWY 30

STANDARD INSTRUMENT DEPARTURES | ATIS TWR GND | AP. ELEV: 2,604' TRANS LEVEL: FL 150 TRANS ALT:

NEW POKHARA AIRPORT





Speed (Knots)	60	90	120	150	180	210
Climb Rate (Feet/Minute)	300	450	600	750	900	1050

Fig. 2.2.6 Proposed Standard Instrument Departures at New Pokhara Airport

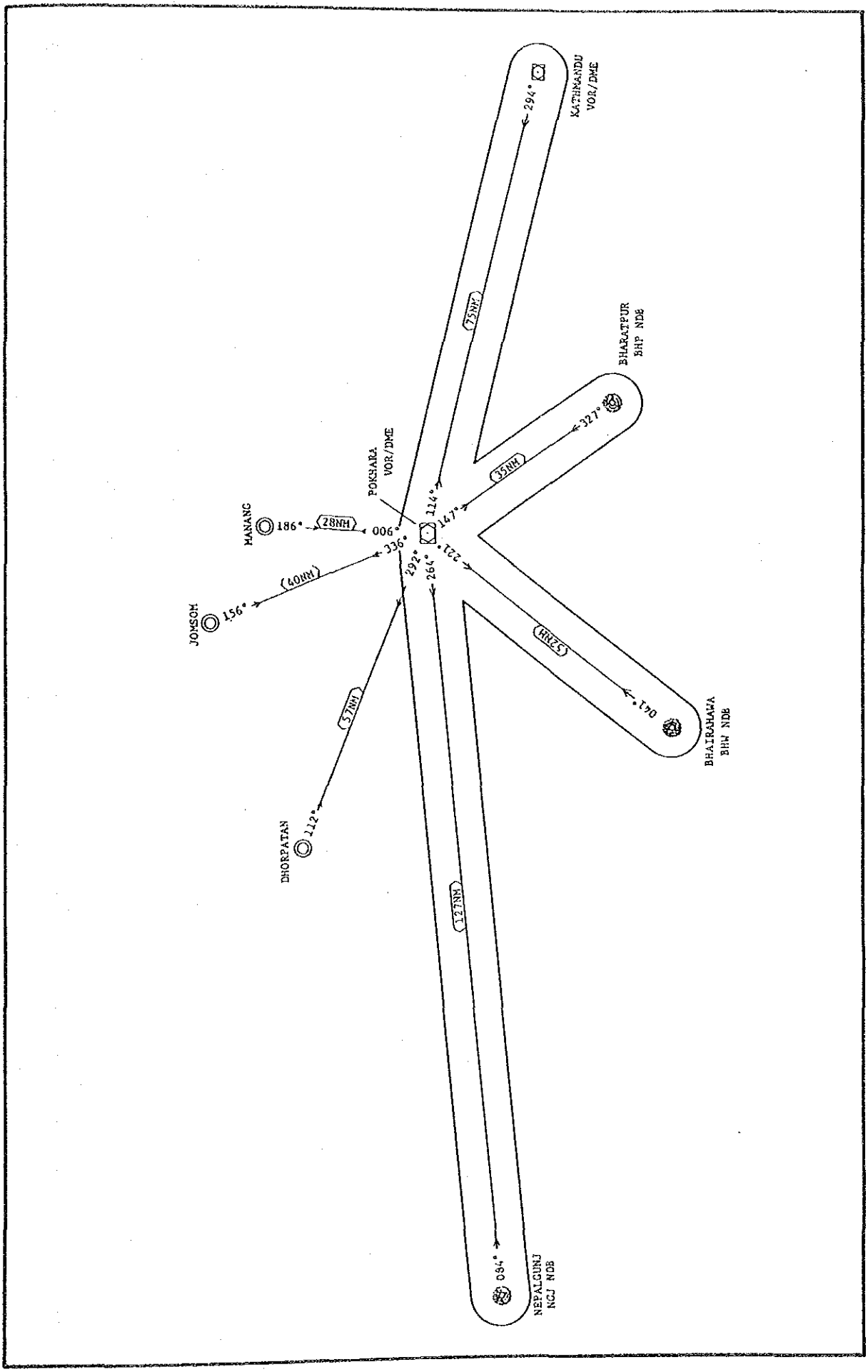


Fig. 2.2.7 Proposed ATS Routes from New Pokhara VOR/DME to Other Airports

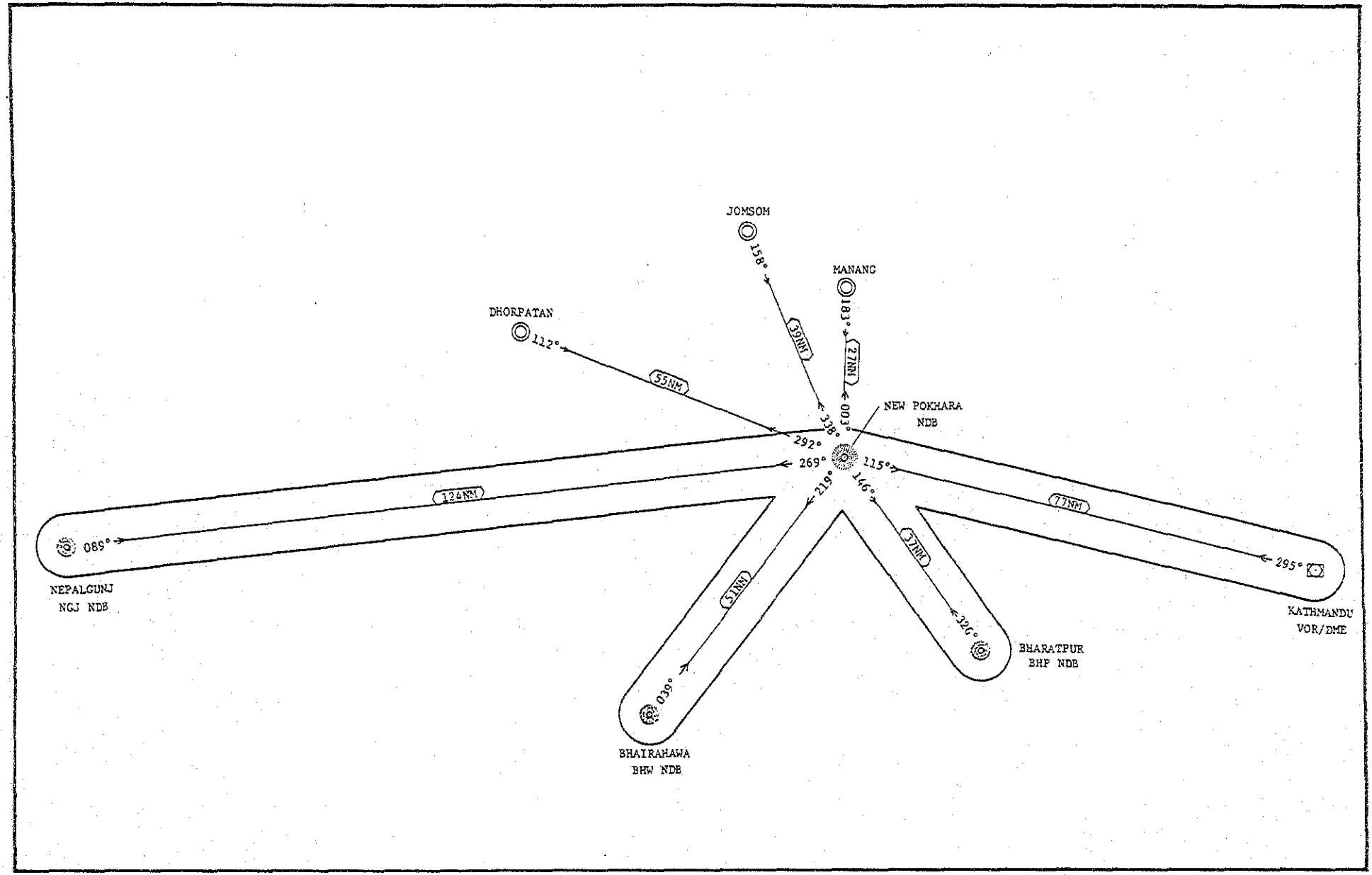


Fig. 2.2.8 Proposed ATS Routes from New Pokhara NDB to Other Airport

2.2.3 Project Implementation Schedule and Cost Estimates

(1) Project Implementation Schedule

The construction schedule for the project is indicated in Table 2.2.4.

Table 2.2.4 Construction Schedule

ITEM	1990	1991	1992	1993	1994
Soil Investigation and Topo Survey					
Basic Design					
Detailed Design and Tender documentation					
Construction					
(Construction Supervision)					
Land Acquisition					

(2) Project Cost Estimates

The project cost of Phase I development is summarized as shown in Table 2.2.5. The exchange rate used has been established at US$1.00 = Rs.25.0 = Yen125. The contingency is estimated at about 10% of the sum of the total cost of construction works, soil investigation and topographical survey, engineering services cost and construction supervision.

Table 2.2.5 Project Cost for Phase I Development of New Pokhara Airport

(Unit=US$1,000)

Item	Nepal Portion	Foreign Portion	Total
A. Land Acquisition Cost	279	0	279
B. Constructiion Cost			
1. Civil Works	7,482	12,332	19,814
2. Architectural Works	435	2,600	3,035
3. Air Navigation Systems	710	6,621	7,331
4. Utilities	62	512	574
5. Rescue & Fire Fighting Vehicles	0	328	328
6. Lighting for Car Parks & Road	8	152	160
Total of B	8,697	22,545	31,242
C. Engineering Services Cost	310	4,219	4,529
A+B+C	9,286	26,764	36,050
Contingency (approx. 10%)	929	2,676	3,605
Total of Project Cost	10,215	29,440	39,655

2.3 Preliminary Study of STOL Airports

2.3.1 Construction Schedule

Construction schedule of Jomsom, Simikot, Lukla, Mugu, and Syangboche Airport Development Projects are indicated in Tables 2.3.1 and 2.3.2.

Table 2.3.1 Construction Schedule for Jomsom, Simikot, Lukla, and Syangboche Airports

ITEM	1990	1991	1992	1993
Soil Investigation and Topo Survey	———			
Basic Design	———			
Detailed Design and Tender documentation		———		
Construction				
(Construction Supervision)				
Land Acquisition		———		

Table 2.3.2 Construction Schedule for Mugu Airport

ITEM	1990	1991	1992	1993
Soil Investigation and Topo Survey	———			
Basic Design	———			
Detailed Design and Tender documentation		———		
Construction				
(Construction Supervision)				
Land Acquisition				

2.3.2 Cost Estimates

Project cost estimates of Jomsom, Simikot, Lukla, Mugu, and Syangboche Airport Development Projects are indicated in Tables 2.3.3 through 2.3.7.

Table 2.3.3 Cost Estimates for Jomsom Airport

(Unit=US$1,000)

Item	Nepal Portion	Foreign Portion	Total
A. Land Acquisition Cost	51		51
B. Construction Cost	2,495	11	2,506
C. Engineering Services Cost	17	338	355
A+B+C	2,563	349	2,912
Contingency (approx. 10%)	256	35	291
Total Project Cost	2,819	384	3,203

Exchange rate US$1.00=NRs25.00
Cost estimates based on 1988 prices

Table 2.3.4 Cost Estimates for Simikot Airport

(Unit=US$1,000)

Item	Nepal Portion	Foreign Portion	Total
A. Land Acquisition Cost	77		77
B. Construction Cost	1,970	9	1,979
C. Engineering Services Cost	17	267	284
A+B+C	2,064	276	2,340
Contingency (approx. 10%)	206	28	234
Total Project Cost	2,270	304	2,574

Exchange rate US$1.00=NRs25.00
Cost estimates based on 1988 prices

Table 2.3.5 Cost Estimates for Lukla Airport

(Unit=US$1,000)

Item	Nepal Portion	Foreign Portion	Total
A. Land Acquisition Cost	50		50
B. Construction Cost	1,467	9	1,476
C. Engineering Services Cost	16	199	215
A+B+C	1,533	208	1,741
Contingency (approx. 10%)	153	21	174
Total Project Cost	1,686	229	1,915

Exchange rate US$1.00=NRs25.00
Cost estimates based on 1988 prices

Table 2.3.6 Cost Estimates for Mugu Airport

(Unit=US$1,000)

Item	Nepal Portion	Foreign Portion	Total
1. Civil Works	3,610	9	3,619
2. Architectural Works	176		176
3. Air Navigation Systems	18	337	355
Total of Constuction Cost	3,804	346	4,150
Soil Investigation & Topographical Survey	16		16
Engineering Services Cost		561	561
Sub Total	3,820	907	4,727
Contingency (approx. 10%)	382	91	473
Total Project Cost	4,202	998	5,200

Exchange rate US$1.00=NRs25.00
Cost estimates based on 1988 prices

Table 2.3.7 Cost Estimates for Syangboche Airport

(Unit=US$1,000)

Item	Nepal Portion	Foreign Portion	Total
1. Civil Works	1,883	9	1,892
2. Architectural Works	30		30
3. Air Navigation System	18	337	355
Total of Constuction Cost	1,931	346	2,277
Soil Investigation & Topographical Survey	23		23
Engineering Services Cost		307	307
Sub Total	1,954	653	2,607
Contingency (approx. 10%)	195	65	260
Total Project Cost	2,149	718	2,867

Exchange rate US$1.00=NRs25.00

Cost estimates based on 1988 prices

2.4 Preliminary Study of Nationwide Navaids and Telecommunication Network

2.4.1 Preliminary Study

(1) DVOR/DME Network

In order to provide en-route air navigation up to Phase I, or year 2000, the existing two sets of DVOR/DME at Kathmandu and Nepalgunj Airports will be replaced and six (6) sets of new DVOR/DMEs which will be installed at Bhairahawa, Biratnagar, Pokhara*, Tumlingtar, Janakpur and Simara* Airports.

Note: * The DVOR/DMEs which have been planned for airport use in Pokhara and Simara can be utilized for network use.

(2) NDB for Hub Network

The existing eight (8) sets of NDB which are obsolete or incomplete and used for both airport and en-route navigation will be replaced at Kathmandu, Bhairahawa, Biratnagar, Nepalgunj, Pokhara, Bharatpur, Janakpur and Simara Airports in order to continue the existing airport operation and to start en-route air navigation services for a hub network.

(3) NDB for Spoke Network

In order to provide en-route air navigation for the spoke network, ten new sets of low power NDB will be required at the following airports: Baitadi, Bajhang, Bhojpur, Darchula, Doti, Mahendranagar, Ramechhap, Rolpa, Rumjatar and Taplejung.

The existing NDBs which have been implemented by French aid can continuously be used at Tumlingtar, Chandragadi, Lamidada, and Rukumkot Airports.

(4) Telecommunications Network

A domestic AFTN and ATS direct speech circuits are planned in the hub airports in order to improve domestic fixed telecommunications.

Kathmandu Airport will be linked with Nepalgunj, Biratnagar and Pokhara Airports by a leased telephone line and domestic flight data will be transmitted among those airports. The domestic data will be distributed from those airports to the local airports in their vicinity by HF SSB radio.

2.4.2 Implementation Schedule and Cost Estimates

(1) Implementation Schedule

The earliest implementation schedule is expected as shown in Table 2.4.1.

Table 2.4.1 Project Implementation Schedule

Item \ Fiscal Year	1989	1990	1991	1992	1993	1994	1995
Project Preparation	▬	▬					
Basic Design		▬	▬				
Detail Design and Tender			▬				
Installation and Adjustment			▬	▬	▬		
Commissioning					O		

(2) Cost Estimate

The project costs necessary to implement the navaids and telecommunications network in Phase I have been preliminarily estimated in Table 2.4.2.

Table 2.4.2 Estimated Project Cost for Phase I Development
(Nationwide Nav. and Telecom. Network)

Unit=US$1,000

Item	Nepal Portion	Foreign Portion	Total
1. En-route Nav. Network	720	13,690	14,410
-DVOR/DME Network	470	8,950	9,420
-NDB for Hub Network	180	3,370	3,550
-NDB for Spoke Network	70	1,370	1,440
2. Domestic Telecom. Network	30	650	680
Sub Total	750	14,340	15,090
Engineering	-	1,510	1,510
Total of Project Cost	750	15,850	16,600

Exchange rate: US$1.00=NRs25
Cost estimates based on 1988 prices

2.5 Project Evaluation

The economic and financial feasibility of the Priority projects in Phase I development have been evaluated.

2.5.1 Premises for Analysis

(1) Evaluation Period

TIA : 25 years from 1989
Other Airports : 25 years from 1990

(2) Life Time of Investment

40 years

(3) Standard Conversion Factor

0.88

(4) Exchange Rate

US$1.00 = NRs.25.00 (Average in August to October, 1988)

2.5.2 Cost and Benefit

The costs and benefits considerd in the analysis are shown in Table 2.5.1. These costs and benefits are the differences between "with" and "without" project cases.

Besides the quantitative benefits mentioned above, there are some qualitative benefits as follows:

(1) Increase in the safety of passengers
(2) Improvement of punctuality of aircraft operation
(3) Increase in the comfortability of passengers
(4) Improvement of environmental conditions

Although these benefits cannot be considered in cost-benefit analysis, they are, in some cases, the main target of project.

Therefore, the IRR in Table 2.5.2 is the result of analysis without leading actors and it is not a decisive factor but a reference point for project evaluation.

Table 2.5.1 Costs and Benefits Considerd in the Analysis

ITEM	TIA		POKHARA		JOMSON		SIMIKOT		LUKLA		MUGU		SYANGBOCHE	
	ECO.	FIN.	ECO.	FIN.	ECO.	FIN.	ECO.	FIN.	ECO.	FIN.	ECO.	FIN.	ECO.	FIN.
PROJECT COST														
1.INVESTMENT	O	O	O	O	O	O	O	O	O	O	O	O	O	O
2.MAINT.& ADMI.COST	O	O	O	O	O	O	O	O	O	O	O	O	O	O
PROJECT BENEFIT														
1.AIRCRAFT CHARGE REVENUE														
LANDING CHARGE	O	O	O	O	O	O	O	O	O	O	O	O	O	O
PARKING CHARGE	O	O	O	O	O	O	O	O	O	O	O	O	O	O
FACILITY CHARGE	O	O	O	O	O	O	O	O	O	O	O	O	O	O
NAV. AID CHARGE	O	O	O	O	—	—	—	—	—	—	—	—	—	—
2.SAVING IN MAINTENANCE COST														
AIRPORT MAINTENANCE	O	O	O	O	O	O	O	O	O	O	—	—	—	—
AIRCRAFT MAINTENANCE	—	—	—	—	O	—	O	—	O	—	—	—	—	—
3.AIRPORT SERVICE CHARGE	O	O	O	O	O	O	O	O	O	O	O	O	O	O
4.CARGO CHARGE	O	O	—	—	—	—	—	—	—	—	—	—	—	—
5.FUEL ROYALITY	O	O	O	O	O	O	O	O	O	O	O	O	O	O
6.OPERATING PROFIT OF RNAC	O	—	O	—	O	—	O	—	O	—	O	—	O	—
7.VALUE ADDED BY TOURIST	O	—	O	—	—	—	—	—	O	—	O	—	O	—
8.VALUE ADDED BY EXPORT CARGO	O	—	—	—	—	—	—	—	—	—	—	—	—	—
9.INCOME OF UNSKILLED LABOR	O	—	O	—	O	—	O	—	O	—	O	—	O	—
10.CONSUMER SURPLUS OF AIR TRAFFIC	O	—	O	—	O	—	O	—	O	—	O	—	O	—

O = Considered
— = Not Considered

ECO.= ECONOMIC
FIN.= FINANCIAL

2.5.3 Results of Analysis

The results of analysis are shown in Tables 2.5.2 and 2.5.3. As shown in Table 2.5.2, all the airports, except TIA, do not show positive FIRR.

In Nepal, the opportunity cost of capital is supposed to be about 12%. Therefore the EIRR above 12% may justify the project economically. As shown in Table 2.5.2, TIA, Lukla, and Jomsom show acceptable EIRR.

B/C ratio and NPV are shown in Table 2.5.3. Assuming the opportunity cost of capital to be 12%, TIA, Lukla and Jomsom show acceptable values.

Table 2.5.2 Internal Rate of Return
(Base Case)

Airport	FIRR	EIRR
TIA	3.0%	19.7%
Pokhara	0%	2.1%
Jomsom	0%	13.1%
Simikot	0%	9.6%
Lukla	0%	19.0%
Mugu	0%	1.3%
Syangboche	0%	5.0%

Table 2.5.3 B/C Ratio and NPV Assuming the Opportunity Cost of Capital at 12% (Base Case)

Airport	B/C Ratio in Economic Value	NPV in Economic Value (100 Rs)
TIA	1.68	2,375,200
Pokhara	0.38	-477,105
Jomsom	1.10	5,663
Simikot	0.82	-8,581
Lukla	1.66	23,087
Mugu	0.59	-39,789
Syangboche	0.51	-21,470

Note: Project bears totally the cost of construction and maintenance.

2.5.4 Estimated Profit and Loss Statement

Based on the estimated profit and loss statement which considers maintenance cost only the percentage of maintenance (or operating) cost which the project can bear is as follows:

TIA	100%
Pokhara	20%
Jomsom	85%
Simikot	30%
Lukla	100%
Mugu	5%
Syangboche	65%

As shown by the figures above, only the TIA and Lukla airport projects can bear the whole maintenance cost. The remaining five projects are not self-sustainable financially.

But when all seven airports are consolidated into one financial entity as shown in the main report, the entity can make a considerable net profit.

2.5.5 Sensitivity Analysis

A sensitivity analysis is also made to provide a basis for probabilistic judgement on the feasibility of the projects. The analysis has been carried out in the following cases:

Case I: Construction cost increases, or traffic demand increases or decrease.

Case II: Some portion of construction cost and maintenance cost is exempted so as to make EIRR and FIRR more than the opportunity cost of capital.

Table 2.5.4 shows the result of Case I. Increase and decrease of traffic demand and construction cost show no considerable change in EIRR and FIRR.

Table 2.5.5 shows the EIRR and FIRR for Case II. In the base case, Mugu Airport project shows a small value for EIRR. But, if 80% of the construction cost is exempted from the project, then the EIRR shows 13.4%. For the Mugu area, the airport is only one access mode. Therefore, regardless of EIRR, an airport is necessary for the area from the viewpoint of local welfare, and 80% exemption of the construction cost may be justified.

For the three other airports, Pokhara, Simikot and Syangboche, EIRR is less than 10%. Exempting 30 to 70% of construction cost improves EIRR to more than 13%.

Table 2.5.4 Sensitivity Analysis (Case I)
(Internal rate of return assuming 10% increase in construction cost and 10% increase/decrease in traffic demand)

Airport	Base Case	Case I			
		Traffic 10% up	Traffic 10% down	Cost 10% up	Traffic 10% down and Cost 10% up
FIRR					
TIA	3.0%	3.8%	2.0%	2.2%	1.6%
EIRR					
TIA	20 %	21 %	18 %	18 %	17 %
Jomsom	13 %	14 %	12 %	12 %	11 %
Simikot	10 %	11 %	9 %	9 %	8 %
Lukla	19 %	20 %	18 %	18 %	16 %

Note: Project bears totally the cost of construction and maintenance.

Table 2.5.5 Sensitivity Analysis (Case II)
(Internal rate of return when project bears X% of construction cost and Y% of maintenance cost)

Airport	Base Case	Case II	X	Y
FIRR				
TIA	3.0 %	13.7 %	25.0 %	100 %
Pokhara	0.0 %	13.1 %	1.5 %	10 %
Jomsom	0.0 %	12.4 %	5.0 %	10 %
Simikot	0.0 %	13.5 %	1.7 %	10 %
Lukla	0.0 %	13.2 %	11.0 %	100 %
Mugu	0.0 %	12.8 %	0.7 %	1 %
Syangboche	0.0 %	13.1 %	3.8 %	10 %
EIRR				
Pokhara	2.1 %	13.5 %	30 %	100 %
Simikot	9.6 %	13.8 %	70 %	100 %
Mugu	1.3 %	13.4 %	20 %	100 %
Syangboche	5.0 %	13.1 %	40 %	100 %

2.5.6 Project Evaluation

Among all the projects, TIA, Lukla and Jomsom Airport development projects may be justified by an acceptable EIRR value of more than 12%.

Pokhara, Simikot, and Syangboche Airport development projects may be only justified when 30 to 70% of construction cost is exempted. For Mugu Airport project, exemption of more than 80% of construction cost is required to justify the project.

The FIRR of each project is very low in the Base Case because financial benefits are relatively small in comparison with economic benefits.

The above-mentioned evaluation is not made in consideration of all aspects of the projects, because there are some qualitative benefits, besides the quantitative benefit which is considered in the above evaluation. These qualitative benefits are similar to that of hospitals and schools, and is important for the evaluation of the projects which aim to improve the public welfare in remote areas as well as the improvement of aircraft safety.

Accordingly, these projects are considered to be implemented from the viewpoint not only of the national economy but also of the local society.

CONCLUSION AND RECOMMENDATIONS

CONCLUSION AND RECOMMENDATIONS

The following nine projects were identified as priority projects from 44 airports and related facilities. Project costs and the economic internal rate of return (EIRR) of the priority projects have been estimated as shown in Table 1.

Table 1 Project Cost and Evaluation

Project	Project Cost (US$1,000)	EIRR (%)
Kathmandu (Phase I)	174,200	19.7
New Pokhara (Phase I)	39,700	2.1
Jomsom	3,200	13.1
Simikot	2,600	9.6
Lukla	1,900	19.0
Mugu	5,200	1.3
Syangboche	2,900	5.0
En-route Navaids Network and Nationwide Telecom. Network	16,600	-

Needless to say, attention should also be paid to the other airport projects such as Dolpa, Jumla, Phaplu, and Sanfebagar airports. The development of Nepalgunj airport, which is not selected as a key airport in this study because the master plan was already completed in 1988, is also important as a hub airport for the air transport network in Mid and Far Western Development Region.

Among these airport projects, the following projects are recommended to be implemented immediately in consideration of importance and urgency.

(1) Tribhuvan International Airport Project

a) Construction of the new domestic terminal building : US$14,100,000
b) Expansion of passenger apron : US$ 7,600,000
c) Installation of air navigation system : US$16,800,000

(2) New Pokhara Airport Project : US$39,700,000

(3) STOL Airports Project

a) Jomsom Airport development	: US$ 3,200,000
b) Lukla Airport development	: US$ 1,900,000
c) Simikot Airport development	: US$ 2,600,000
d) Syangboche Airport development	: US$ 2,900,000

With these projects, the function and capacity of the facilities can be remarkably improved, and safety and punctuality of aircraft operations will be promoted. In addition to these direct effects, indirect effects such as a contribution to the public welfare in remote districts and the promotion of the tourism sector are expected.

It is advisable to organize a suitable committee and begin the following preparatory and required coordination work:

- To execute presentation and discussion of the projects with the related organizations of HMG/N so as to form a concensus for project implementation

- To construct the domestic terminal building and passenger loading apron at TIA

- To initiate preparations including a request for financial assistance at the earliest possible date so as to execute and complete engineering services

- To start the construction work at the beginning of 1991

- To start the land acquisition and compensation for the Ring Road diversion as soon as possible preceding construction of cargo terminal and maintenance hangar

- To make preparation for other projects based on the priority

- To implement the land use plan and to enforce height restrictions in the airport vicinity

Master plans of some of the airports and related facilities should be reviewed in the future, because air traffic demand, (especially cargo volume), land acquisition, and the future plans of the Royal Enclosure and Military base cannot be predicted.

JICA