9.2 Analysis of Airport Facility Requirements

Table 9.2.1 shows the airport facility requirements which should be used as the bases for the subsequent planning and design.

Table 9.2.1 Air Traffic Demand vs. Airport Facility Requirements

	Item	Year	Present Condition (as of 1987)	1995	2000	2005	2010
Air Traffic Forecast	1. Annual Passenger	Dom	203,200	280,000	332,900	388,900	443,900
		Int'l	574,000	924,000	1,234,000	1,567,000	1,946,000
		Total	777,200	1,204,000	1,566,900	1,955,900	2,389,900
	2. Annual Cargo (ton)	Dom	1,900	2,200	2,400	2,600	2,900
		Int'l	14,000	45,000	69,000	100,000	138,000
		Total	15,900	47,200	71,400	102,600	140,900
	3. Annual Aircraft Movement (operation)	Dom	12,500*1	8,500	10,200	11,900	13,700
		Int'l	6,567*1	8,000	10,100	10,300	11,800
		Total	19,067*1	16,500	20,300	22,200	25,500
	4. Peak Hour Passenger	Dom		270	320	370	420
		Int'l		700	900	1,120	1,370
		Total		970	1,220	1,490	1,790
	5. Peak Hour Aircraft Movement (operation)	Dom		6.6	7.5	8.8	9.6
		Int'l		5.5	6.5	7.2	8.0
		Total	10	12.1	14.0	16.0	17.6
	6. Largest Aircraft		DC-10 Class	DC-10Class	do	B-747Class	do
Facility Requirements	7. Runway	(m x m)	3,050x 45	do	do	do	do
	8. Runway Strip	(m x m)	3,140x150	do	do	3,110X300	do
	9. Taxiway	(m x m)	1,945x 23	do	do	P-T/W	do
	10. Passenger Terminal Apron (gate position)	Dom	HS748: 3	HS:2 DH:2 Total:4	HS:2 DH:2 Total:4	HS:2 DH:2 Total:4	HS:2 DH:2 Total:4
		Int'l	DC-10 class:6	L : 2 M : 1 N,S : 4 Total: 7	L : 2 M : 1 N,S : 5 Total: 8	J,L : 4 M : 1 N,S : 5 Total:10	J,L : 4 M : 1 N,S : 5 Total:10
	11. Cargo Terminal Apron		-	-	-	J : 1	J : 1
	12. Passenger Terminal Building(sq.meter) *2	Dom	700	2,700	3,200	3,700	4,200
		Int'l	10,750	8,400	10,800 (13,000)	13,400 (16,100)	16,400 (19,700)
	13. Cargo Terminal Building(sq.meter)	Dom		200	200	300	300
		Int'l	3,500	8,800	13,500	19,600	27,000
	14. Administration Building(sq.meter)		2,100	4,000	4,000	4,000	4,000
	15. Air Navigation Systems		Non Precision Instrument	Non Precision Instrument		Precision Approach CAT-I (MLS)	
	16. Car Parks	(cars)	*4 135	340	550	670	970
		(sq.meter)	17,000	11,900	19,300	23,500	34,000
	17. Access Road(lane)		2	2	2	2	2
	18. Fuel Supply	(Fuel Tank)	*3	*3	*3	2x1000kl	3x1000kl
		(kl/Week)	500	840	1,100	1,500	2,000
	19. Rescue and Fire-Fighting	(Category)	5	7	do	8	do
		(Cars)	6	5	do	5or6	do
		(Fire Station, sq.m)	800	450	do	550	do
	20. Utilities						
	Electricity (KVA)		N.A	1,800	2,300	2,900	3,600
	Water (Ton/Month)		N.A	8,700	10,900	13,300	16,100
	Sewage (Ton/Month)		N.A	6,300	7,800	9,600	11,600
	Solid Waste (Ton/Month)		N.A	60	80	110	140
	21. Maintenance Hangar		5,800 sq.m	B767 x 1 existing hangar	do	B767 X 1 B757 X 1	do

Note : *1 including charter and military flights

*2 ( ) shows total floor area in case of two international units

*3 Existing facilities : 2x756kl, 8x(70~ 80)kl
2x1600kl (under construction)

*4 International terminal only. Parking of 20 motorcycles and 6 buses is available other than parking of 135 cars.

9.2.1 Aerodrome Reference Code and Operational Requirements

An aerodrome reference code, viz., code number and code letter by ICAO recommendation and standard, will be established as shown in Table 9.2.2 in accordance with the largest aircraft anticipated.

Table 9.2.2 Aerodrome Reference Code

Year	1995	2000	2005	2010
Code number	4	4	4	4
Code letter	D	D	E	E

9.2.2 Runway

(1) Runway Operational Category

Operational category of runway 02/20 is established to be precision approach category I runway after year 2000.

(2) Runway Length

The existing runway is capable to operate domestic schedule and international long haul aircraft.

However, some type of aircraft are weight restricted when taking off at TIA due to runway length. Table 9.2.3 shows the result of a study on the take-off performances and flight distance with a full load of passengers for the typical aircraft operated at the present time on runways of 3,050m (existing), 3,300m and 3,500m in length respectively.

In this Table, it is shown that weight restrictions are imposed on the operations of B-747 and B-727 aircraft on the existing runway.

Although the B-747 is now operated occasionally by foreign airlines, operation of the B-747 will increase in accordance with the world trend.

Table 9.2.3 TKOF Performance at TIA by Different Type of Aircraft

	Runway Length	Flap	MTOW	AGTOW	Weight Restriction	Full PAX.	OEW plus Reserved Fuel (1.25h)	Loading Fuel	Flight Distance
	(m)	(deg)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(nm)
B-727-100	3,050	15°	160,000	148,000	12,000	25,000 (125x200)	101,330	21.670	990
	3,300			155,800	4,200			29,470	1,350
	3,500			160,000	--			33,670	1,540
B-747-200	3,050	20°	785,000	645,000	140,000	100,000 (500x200)	395,000	150,000	2,700
	3,300			667,000	118,000			172,000	3,180
	3,500			683,000	102,000			188,000	3,480
B-757	3,050 3,300 3,500	15°	220,000	220,000	--	37,200 (186x200)	162,000	58,000	2,400
B-767-300	3,050	15°	315,200	282,000	33,200	57,000 (285x200)	171,550	53,450	2,400
	3,300			291,000	24,200			62,450	2,800
	3,500			301,000	14,200			72,450	3,200

Note: The following conditions are premised for calculation of this Table;
TIA Elevation - 1,338m/4,390'
Temperature - 27.8°C/82°F
Runway Slope - 0.77%

Abbreviations

MTOW : Maximum Take Off Weight
AGTOW: Allowable Gross Take Off Weight
OEW : Operating Empty Weight
PAX : Passenger

Under the above-mentioned conditions, the existing runway is considered sufficient for the route to Bangkok or Dubai.

Table 9.2.4 shows the result of calculation of Allowable Gross Take Off Weight and Allowable Cabin Load to be carried by B-727-100 for Bangkok on different runway Length.

Table 9.2.4 Result of Calculation of ACL to be carried by B-727-100 on Bangkok Route by Different Runway Length

	Runway Length	Flap	MTOW	AGTOW	Weight Restriction	OEW plus Reserved Fuel (1.25h)	Fuel Consumption	Distance VNKT-VTBD	ACL
	(m)	(deg)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(nm)	(lbs)
B-727-100	3,050	15°	160,000	148,000	12,000	101,330	26,160	1,200	20,510 (82%)*
	3,300			155,800	4,200				28,310 (100%)*
	3,500			160,000	---				32,510 (100%)*

* indicates the percentage to the full passengers weight.

Note: The following conditions are premised for calculation of this Table;
TIA Elevation - 1,338m/4,390'
Temperature - 27.8°C/82°F
Runway Slope - 0.77%

Abbreviations
MTOW : Maximum Take Off Weight
AGTOW: Allowable Gross Take Off Weight
OEW : Operating Empty Weight
PAX : Passenger
ACL : Allowable Cabin Load
VNKT : Kathmandu
VTBD : Bangkok

Since weight restrictions have been put on the operations of B-727-100 aircraft on the existing ruwnay, the number of passengers to be carried by B-727-100 on Bangkok route reaches only approximately 82% of the maximum number of the passengers.

Figure 9.2.1 shows the distance between TIA and foreign international airports.

In case the runway is extended to 3,300m, the operations of B-727-100 aircraft will almost be releived from the weight restrictions when taking off at TIA.

However, the approach areas for ruwnays 20 and 02 which will be planned for ruwnay extension works, have many issues against the extension works.

The followings are summary of these issues:

i) Approach Area for Runway 02

There are smoke stacks, high broadcasting antennas and high hills on and around this area. Unless otherwise removed and or cut off, these objects will become obstacles to aircraft operations when the runway is extended to the south.

ii) Approach Area for Runway 20

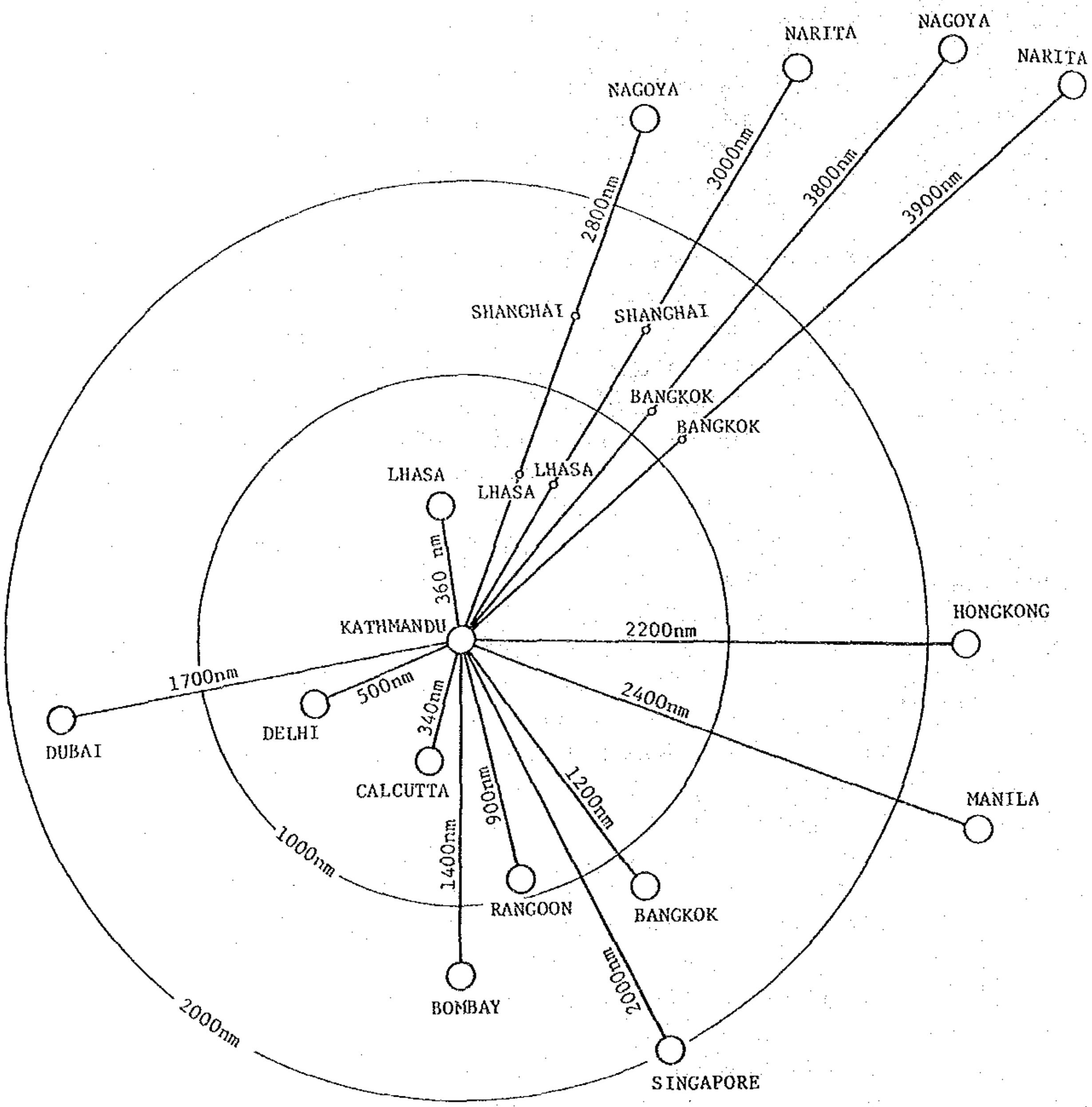
There is a steep cliff close to the runway end and a river which runs across the approach area. Furthermore, high hills surround this area. Thus, very critical topographical conditions will exist for aircraft operations when the runway is extended to the north.

As stated above, there are various problems with extending TIA's runway, such as obstacles (south side) and difficult civil works (north side).

However, a runway extension of approximately 300 m - 500 m will bring operational benefits in the form of increased takeoff payloads for medium and large jet aircraft at TIA.

A runway extension to the south is more profitable than an extension to the north from the viewpoint of air safety and civil works. Accordingly, if it is possible to remove obstables (smoke stacks and antennas) and reroute the road crossing the takeoff climb area, a runway extension to the south is worth investigation.

Even if the runway is extended to the south, it is still possible to land from the south on the existing touchdown zone.



The routes between Nepal and Japan via Shanghai are planned as follows:

Kathmandu - Lhasa - Chengdu - Shanghai - Fukue - Awy V-17 - Awy G-97 - Awy A-1.

Fig. 9.2.1 Distance from Tribhuvan International Airport to foreign airports

(3) Meteorological Condition

a) Wind Coverage

The wind coverage has been analyzed based on the recent three years observation data (1985 through 1987) at TIA.

Following Table summarizes the cross wind coverage.

Runway	Cross-wind Coverage	
	Cross-wind Component of less than 13 Kt	Cross-wind Component of less than 20 Kt
RWY 02/20	99.49%	99.85%

The runway 02/20 has an excellent cross-wind coverage.

Following Table shows the result of analysis on the possibility of the preferential operations of the runway.

(Unit=%)

	Preferential RWY	Others	Total
Landing RWY Wind Coverage	RWY02 95.93	RWY20 3.56	99.49
Take-off RWY Wind Coverage	RWY20 96.26	RWY02 3.23	99.49
Probability of RWY Use	96.59	3.41	100

It is noted that this analysis is made based on the conditions of cross-wind component of less than 13 Kt and tail wind of less than 10 Kt.

From this table, the preferential operations can be performed at a probability of more than 95%.

b) Visibility and Ceiling

The visibility and cloud height at TIA has been also analyzed based on the three years observation data from 1985 to 1987 as shown in Table 9.2.5.

The airport operating minima for existing instrument approach procedure using VOR/DME is established as follows:

Ceiling 800 ft (MDA 5186 ft)
Visibility 1500 m

(Straight-in, Daytime)

The usability factor of the airport under the above operating minima and wind coverage is summarized as shown in Table 9.2.6. Average usability through the year is 89.5%, which is below the minimum usability factor 95% which is

Table 9.2.5 Co-relation between Visibility and Ceiling at TIA

CEILING	VISIBILITY (M)									
(FT)	0-400	-800	-1200	-1400	-1500	-1600	-2400	-3200	3200-	TOTAL
0-100	1631	145	159	4	85	85	71	308	0	2488
-200	0	0	0	0	0	0	0	0	0	0
-300	0	0	0	0	0	0	0	0	0	0
-400	0	0	0	0	0	0	0	0	0	0
-500	0	0	0	0	0	0	0	0	0	0
-600	0	0	0	0	0	0	0	0	0	0
-700	0	0	1	1	1	1	0	1	0	5
-800	0	0	0	0	0	0	0	0	0	0
-900	1	1	5	3	9	8	7	15	12	61
-1000	0	0	0	0	0	0	0	0	0	0
-1100	0	1	0	0	1	1	0	4	24	31
-1200	0	0	0	0	0	0	0	0	0	0
-1300	0	0	0	0	0	0	2	1	0	3
-1400	0	0	0	0	0	0	0	0	0	0
-1500	0	0	0	0	0	0	0	0	0	0
1500-	31	20	41	3	51	50	72	374	8379	9021
<5/8 *	255	51	183	5	104	102	83	458	17436	18677
TOTAL	1918	218	389	16	251	247	235	1161	25851	30286

* : Cloud amount < 5/8

recommended by ICAO for the runway orientation. It is because the usability goes down to about 80% in autumn and winter due to the fog generated in the morning.

By the installation of ILS, operating minima will be improved as follows:

Ceiling	200 ft
Visibility	800 m

The usability factor of the airport will be, therefore, improved up to 90.8%. Although the increment of the usability is not considerable, the installation of ILS will contribute to the improvement of the safety of aircraft operation.

Table 9.2.6 Usability Factor of the Airport

(Unit=%)

	VOR Approach	ILS Approach
Average through the year	89.51	90.82
Spring	97.60	98.28
Summer	98.44	98.83
Autumn	80.17	82.46
Winter	81.84	83.70

9.2.3 Runway Strip

The runway strip should be 3110 m x 300 m for precision approach category I runway in compliance with the ICAO standards. But widening of the runway strip from 150 m to 300 m is very expensive and cannot be justified economically in early stage. Therefore, the runway strip is planned to be 3140 m x 150 m and 3110 m x 300 m for Phase I and II respectively.

9.2.4 Taxiway

A complete parallel taxiway is planned to be 180 m from the runway center line which is in accordance with the aerodrome reference code 4E of the ICAO recommendation.

A rapid exit taxiway for Runway 02 landing will be provided by widening of the existing No.2 taxiway for the safe and expeditious movement of aircraft operations.

9.2.5 Apron

The required number of aircraft stands is summarized in Table 9.2.7. One aircraft stand for a B-747 freighter is included after year 2000. B-727 of RNAC are operated for both international and domestic flights (mountain flight). Therefore, the aircraft stands of B-727 class may be used in common for international and domestic aircraft to reduce the total number of aircraft stands.

Table 9.2.7 Required Number of Aircraft Stands

Year	International				Domestic			
	B747 DC10 Class	B767 Class	B757 B727 Class	Total	B727 Class *	HS748 Class	DHC6 Class	Total
1995	2*	1	4(4)	7	0(2)	2	2	4(6)
2000	2*	1	5(5)	8	0(2)	2	2	4(6)
2005	4**	1	5(5)	10	0(2)	2	2	4(6)
2010	4**	1	5(5)	10	0(2)	2	2	4(6)

Note: *=including one extra stand
**=including one extra stand and one freighter stand
( ) shows the case of exclusive use of B-727 class stands for international and domestic aircraft respectively.

9.2.6 Buildings

(1) Passenger Terminal Building

The unit floor area per peak hour passenger of 10 sq.m/passenger and 12 sq.m/passenger are generally used respectively for the domestic and international terminal buildings. Therefore, required floor area for the future is estimated by multiplying the number of peak hour passengers in the target year by the above unit floor area.

Table 9.2.8 shows the required floor area for the passenger terminal buildings.

Table 9.2.8 Floor Area Requirements for Passenger Terminal Buildings

Year	1995	2000	2005	2010
Peak Hour Passenger				
Domestic	270	320	370	420
International	700	900	1,120	1,370
Required Floor Area (sq.m)				
Domestic	2,700	3,200	3,700	4,200
International	8,400	10,800	13,400	16,400

(2) Cargo Terminal Building

The floor area for a cargo terminal building has been calculated by multiplying the forecast annual cargo volume by the unit cargo handling capacity. The handling capacity per unit floor area is set at 12 ton/sq.m and 6 ton/sq.m for domestic and international use respectively considering the standard value for airport planning and future improvement of cargo handling system in Nepal. The office space is set at 15% of total floor area.

Table 9.2.9 Cargo Terminal Building Requirements

Year	1995	2000	2005	2010
Annual Cargo Volume (ton)				
Domestic	2,200	2,400	2,600	2,900
International	45,000	69,000	100,000	138,000
Required Floor Area (sq.m)				
Domestic	200	200	300	300
International	8,800	13,500	19,600	27,000

Note: The required floor area indicates total of floor area of city cargo building in the city and that of cargo building in the airport.

9.2.7 Car Parking

The required number of parking spaces is calculated by multiplying the number of peak hour passengers by the number of parking cars per peak hour passenger, which is assumed as shown in the following table, taking into consideration the popularization of private cars in future. The amount of space per parking lot is required to be 35 sq.m including a green zone.

Table 9.2.10 Parking Lot Requirements

Year	1995	2000	2005	2010
Parking Cars per Peak Hour Passenger				
Domestic	0.4	0.5	0.5	0.6
International	0.4	0.5	0.5	0.6
Required Number of Parking Spaces (lots)				
Domestic	60	100	110	150
International	280	450	560	820
Total	340	550	670	970
Required space (sq.m)				
Total	11,900	19,300	23,500	34,000

9.2.8 Rescue and Fire-Fighting Facilities

The facility requirements for the rescue and fire-fighting services are estimated in compliance with the Airport Service Manual, Part I, ICAO.

Airport category is determined by the largest aircraft movements for the busiest consecutive three months of the year.
The facilities are determined and tabulated in Table 9.2.11.

Table 9.2.11 Requirements for Rescue and Fire-Fighting Services

Year	1995	2000	2005	2010
Airport Category	7	7	8	8
Extinguishing Agents				
- Water for Aqueous Film Forming Foam Production (1)	12,100	do	18,200	do
- Dry Chemical Powder (kg)	225	do	450	do
- CO_2 (kg)	450	do	900	do
Vehicles				
- Rapid Intervention Vehicle	1	do	1	do
- Major Vehicle	2	do	2 or 3	do
- Ambulance	1	do	1	do
- Command Car	1	do	1	do
Fire Station (sq.m)	450	do	550	do

9.2.9 Aviation Fuel

The daily fuel consumption is established by multiplying the trip fuel by the number of departing aircraft.

The required fuel storage capacity is estimated as tabulated in Table 9.2.12 based on the condition that the airport is provided with one week storage capacity.

Table 9.2.12 Aviation Fuel Storage Requirement

Year	1995	2000	2005	2010
Daily Consumption (kl)	120	150	210	280
7 days Storage (kl)	840	1,050	1,470	1,960
Tank Capacity (kl)*	1,200	1,400	2,000	2,600

* including the margin of about 25%

9.2.10 Air Navigation Systems

Air navigation systems include radio navigation aids, air traffic control system, aeronautical telecommunications system, visual aids, meteorological system, and the related power supply system.

Tribhuvan International Airport is classified as a "Cat. A" airport.

The air navigation systems should be designed to meet the following operational requirements and to sufficiently handle the forecast aircraft movements in each target year in a safe and effective manner.

Table 9.2.13 Operational Requirements

Item \ Year	1995	2000	2005	2010
Operational Requirements	Instrument Non-precision		Precision Approach Category-I	
Radar Control	See Note 1).		Radar Control Justified	
Landing aid	LLZ/DME VOR/DME		MLS VOR/DME	

Note: 1) Due to constraints of the Kathmandu Valley and the short distance between Kathmandu and the FIR boundary, a Radar Control System will help to expedite flow of arriving and departing aircraft there by increasing the capacity of the runway.

2) MLS will replace the conventional ILS after year 1998 in accordance with ICAO plan.

The required facilities for a "Cat. A" airport are described in Table 6.2.3 in detail.

9.2.11 Obstacle Limitation Requirements

The requirements of the obstacle limitation surfaces for the runway with non-precision approach runway are summarized in Fig. 9.2.2 and Tables 9.2.14 and 9.2.15 for the aerodrome reference code number 4 in accordance with ICAO Annex 14.

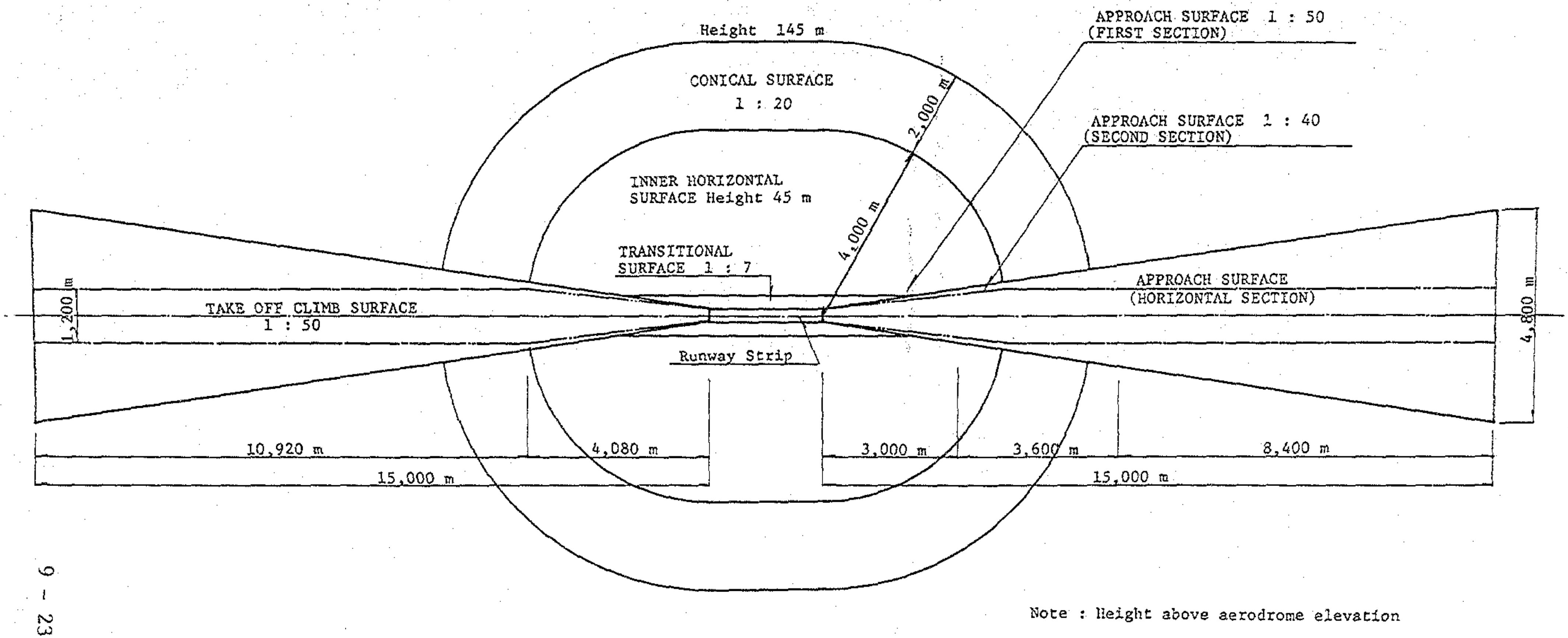


Fig. 9.2.2 Obstacle Limitation Surfaces

Table 9.2.14 Dimensions and Slopes of Obstacle Limitation Surfaces

APPROACH RUNWAYS

Surface and dimensions[a]	Runway classification									
	Non-instrument				Non-precision approach			Precision approach category I		Precision approach category II or III
	Code number 1	2	3	4	Code number 1,2	3	4	Code number 1,2	3,4	Code number 3,4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2 000 m	2 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m
INNER APPROACH										
Width	–	–	–	–	–	–	–	90 m	120 m	120 m
Distance from threshold	–	–	–	–	–	–	–	60 m	60 m	60 m
Length	–	–	–	–	–	–	–	900 m	900 m	900 m
Slope								2.5%	2%	2%
APPROACH										
Length of inner edge	60 m	80 m	150 m	150 m	150 m	300 m	300 m	150 m	300 m	300 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	–	–	–	–	–	3 600 m[b]	3 600 m[b]	12 000 m	3 600 m[b]	3 600 m[b]
Slope	–	–	–	–	–	2.5%	2.5%	3%	2.5%	2.5%
Horizontal section										
Length	–	–	–	–	–	8 400 m[b]	8 400 m[b]	–	8 400 m[b]	8 400 m[b]
Total length	–	–	–	–	–	15 000 m	15 000 m	15 000 m	15 000 m	15 000 m
TRANSITIONAL										
Slope	20%	20%	14.3%	14.3%	20%	14.3%	14.3%	14.3%	14.3%	14.3%
INNER TRANSITIONAL										
Slope	–	–	–	–	–	–	–	40%	33.3%	33.3%
BALKED LANDING SURFACE										
Length of inner edge	–	–	–	–	–	–	–	90 m	120 m	120 m
Distance from threshold	–	–	–	–	–	–	–	d	1 800 m[c]	1 800 m[c]
Divergence (each side)	–	–	–	–	–	–	–	10%	10%	10%
Slope	–	–	–	–	–	–	–	4%	3.33%	3.33%

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (see 4.2.9 or 4.2.17).
c. Or end of runway whichever is less.
d. Distance to the end of strip.

(Source: ICAO Annex 14)

Table 9.2.15 Dimensions and Slopes of Obstacle Limitation Surfaces

TAKE-OFF RUNWAYS

Surface and dimensions[a]	Code number		
	1	2	3 or 4
(1)	(2)	(3)	(4)
TAKE-OFF CLIMB			
Length of inner edge	60 m	80 m	180 m
Distance from runway end[b]	30 m	60 m	60 m
Divergence (each side)	10%	10%	12.5%
Final width	380 m	580 m	1 200 m 1 800 m[c]
Length	1 600 m	2 500 m	15 000 m
Slope	5%	4%	2%[d]

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
d. See 4.2.24 and 4.2.26.

(Source: ICAO Annex 14)

9.3 Demand/Capacity Analysis

9.3.1 General

Table 9.3.1 summarizes the results of the evaluation of the major existing facilities and the anticipated time of saturation when the existing facilities reach their respective capacities, based on the description presented in later sections.

Although the saturation time varies for the facilities, the following points are noted in Table 9.3.1.

(1) Aircraft Movement Area

The area of the apron is already saturated for the present number of aircraft movements.

Existing parallel taxiway is a partial parallel taxiway with insufficient clearance from both runway and existing terminal building.

(2) Terminal Area

The domestic passenger terminal building, cargo terminal buildings and hangars are insufficient for present needs in terms of floor areas and functions. The new international building and the new operations and airline complex are sufficient for the year 1995.

The total capacity of the existing terminal area is, therefore, also considered to be insufficient to accommodate the future air traffic demand.

(3) Other Airport Facilities

Most of the aeronautical equipment is antiquated and requires replacement.

(4) The Airport in General

The capacity of the existing airport facilities is already insufficient to accommodate the present air traffic demand.

The airport master plans will be prepared for the year 2000 and 2010 in order to overcome the above deficiencies in capacity and performance requirements for a modern airport.

Table 9.3.1 Anticipated Time of Saturation of the Existing Facilities

	1990–1995	1995–2000	2000–2005	2005–2010	Description
Runway -Number	▒	▒	▒	▒	
-Length	▒	▒	▒	▒	
-Pavement	▒	▒ *	- - -	- - -	Existing pavement (54/F/A/W/T) is sufficient for all type of commercial aircraft except Concorde and L-1011-100/200/500. * : Overlay will be required.
Runway Strip	▒	▒			
Parallel Taxiway	x				Existing parallel taxiway is a partial parallel taxiway with insufficient clearance between large aircraft and the existing terminal building.
-Pavement	▒	▒	- - -	- - -	Same as runway pavement.
Exit Taxiway -Pavement	▒	▒	- - -	- - -	
Apron -Gate Positions	x				Clearance between parking positions and taxiway is not sufficient.
-Pavement	▒	▒ *	- - -	- - -	Existing pavement (53/R/B/W/T) is not sufficient for B-747-200, L-1011-100/200/500, etc. * : Restrengthening wil be required.
Passenger Terminal Building -International	▒	- - -			Ground floor facilities will be satulated in 1995. But if expand these, the capacity will be extended untill 2000.
-Domestic	x				
Cargo Terminal Building -International	x				Existing facilities are old and not efficient.
-Domestic	x				Same as international.
Car Parking	x				Temporary parking area is available.
Air Navigation Systems -Navaids	x				The major navaids are old and need replacement.
-ATC/COM	▒	▒			The major ATC/COM equipment are under renovation by Australian grant aid. The nation wide telecom, equipment such as AFTN,ATS direct speech circuits, etc. which are not included in the above renovation work will require replacement.
-Lights	▒				The major lighting equipment are old and the existing concept of lighting system can not meet the operation requirements, when precision approach is applied.
-Met	▒				An automated observation system incl. RVR and ceilometer will be raquired when precision approach is applied.

x : Already out of capacity ▒ : Existing capacity

9.3.2 Airport Facilities

(1) Runway

a) The existing runway length is enough for the operation of B-747's under the condition of reference temperature 27.8 deg C. But weight restrictions are occasionally imposed on B-727's operated on the Bangkok routes.

b) The existing runway shoulder width is only 2m which causes engine trouble for aircraft since small stones and/or dust are sucked into the engines. The runway shoulders definitely need to be widened.

c) The exisiting runway capacity is 11 operations (take-off or landing) per hour under the preferential runway operations that is Runway 20 take-off and Runway 02 landing. The forecast of peak hour aircraft movements shown in Table 9.2.1 will exceed the above capacity by the year 1995.

The estimation of the capacity is taken into account the present problems in terms of flight separation and taxiway utilization as mentioned below.

- The flight separation between departure and arrival aircraft requires about ten minutes so as to avoid the collision which may occur on missed approach course upon the abandonment of landing, since the approach and departure route patterns conflict due to the small airspace surrounded by the mountains.

- The aircraft larger than B-737 is not allowed to pass on the existing parallel taxiway in front of the existing international passenger terminal building and domestic apron for lack of necessary separation between the taxiway and these facilities.

- The flows of landing and take-off aircraft conflict on the existing Taxiway 1 because of no entrance taxiway for Runway 20 threshold.

If the above problems are resolved, the runway capacity will increase as tabulated in Table 9.3.2.

Table 9.3.2 Runway Capacity

(Unit=Operations per hour)

Flight Separation / Taxiway Utilization	Same as present	No particular separation is required
Same as present	11	18
Whole of the existing parallel taxiway is available to all aircraft	13	22
Entrance taxiway for Runway 20 threshold is available	15	27

Detailes of calculation of the runway capacity is described in Appendix 9.3.2.

d) Rubber from aircraft tires has accumulated on the runway 02 touch down zone. This reduces runway friction and cleaning is required in order to ensure safe aircraft operations.

e) A runway end safety area is not provided at the north end of the runway.

f) The existing operational category of runway 02/20 is non-precision instrument. Upgrading to category I cannot be justified economically in Phase I.

(2) Runway Strip

a) The runway strip is established only at the south end of the runway. ICAO recommends that a strip should extend before the threshold and beyond the end of the runway for a distance of at least 60 m.

b) While the existing runway strip width is 150 m, it is only half of the 300 m of ICAO recommendation for non-precision instrument runway.

(3) Taxiways

a) A partial parallel taxiway will be insufficient for the anticipated movements under preferential runway operations.

(4) Aprons

a) The capacity of existing international apron is insufficient for the present demand.

b) The domestic apron in front of the domestic passenger terminal building is too small. In meeting the ICAO recommendation of 30 m from the taxiway edge, the number of aircraft in this space is limited to only one.

c) There is no road for the exclusive use of GSE.

(5) International Passenger Terminal building

Newly constructed international passenger terminal building has 10750 sq.m of total floor area. Although this figure is approximately equal to demand in the year 2000, expansion of the building will be required in 1995, because the check-in counter and custom baggage system will be saturated till then as shown in the Fig. 9.3.1 and Appendix 9.3.3.

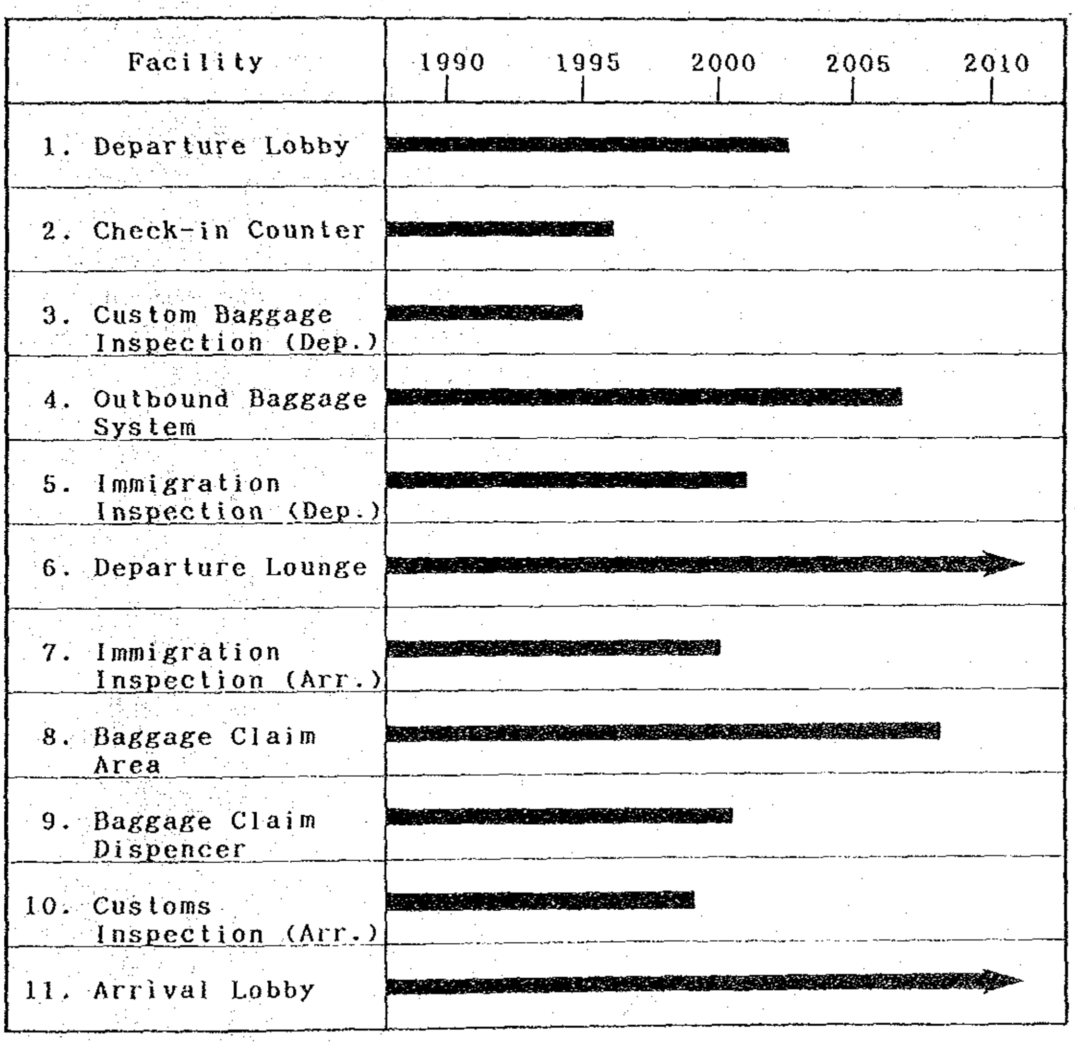
(6) Domestic Passenger Terminal Building

The existing floor areas are inadequate for the present passenger volume. Layout of the interior of the existing terminal building is not functional due to the disjointed expansion in the past.

(7) Cargo Terminal Building

The cargo terminal buildings are scattered into three blocks, and do not have enough capacity. Road connections with aircraft stands are not convenient for efficient cargo handling.

Fig. 9.3.1 Anticipated Time of Saturation of the Each Facilities in Newly Constructed ITB



(8) Car Parking

Capacity of the car parking areas in front of the domestic and international building are very small with no space for expansion. To compensate for the small capacity of the parking areas, a temporary parking area is available, but it is not adjacent to the terminal buildings and is not paved.

9.3.3 Obstacle Limitation Surfaces

Figs. 9.3.2 and 9.3.3 show the obstacle limitation surfaces which are established at Tribhuvan International Airport. The runway 02/20 is provided as a non-precision approach runway. A 245 m length of clearway for takeoff runway 02 and a 150 m length of clearway for takeoff runway 20 are established.

High mountains project through the horizontal section of the extended approach surface for runway 02 and some hills project through the inner horizontal surface and conical surface on the northern and eastern part of these surfaces.

Fig. 9.3.3 shows the takeoff flight path which curves to avoid obstacles in the vicinity of the airport.

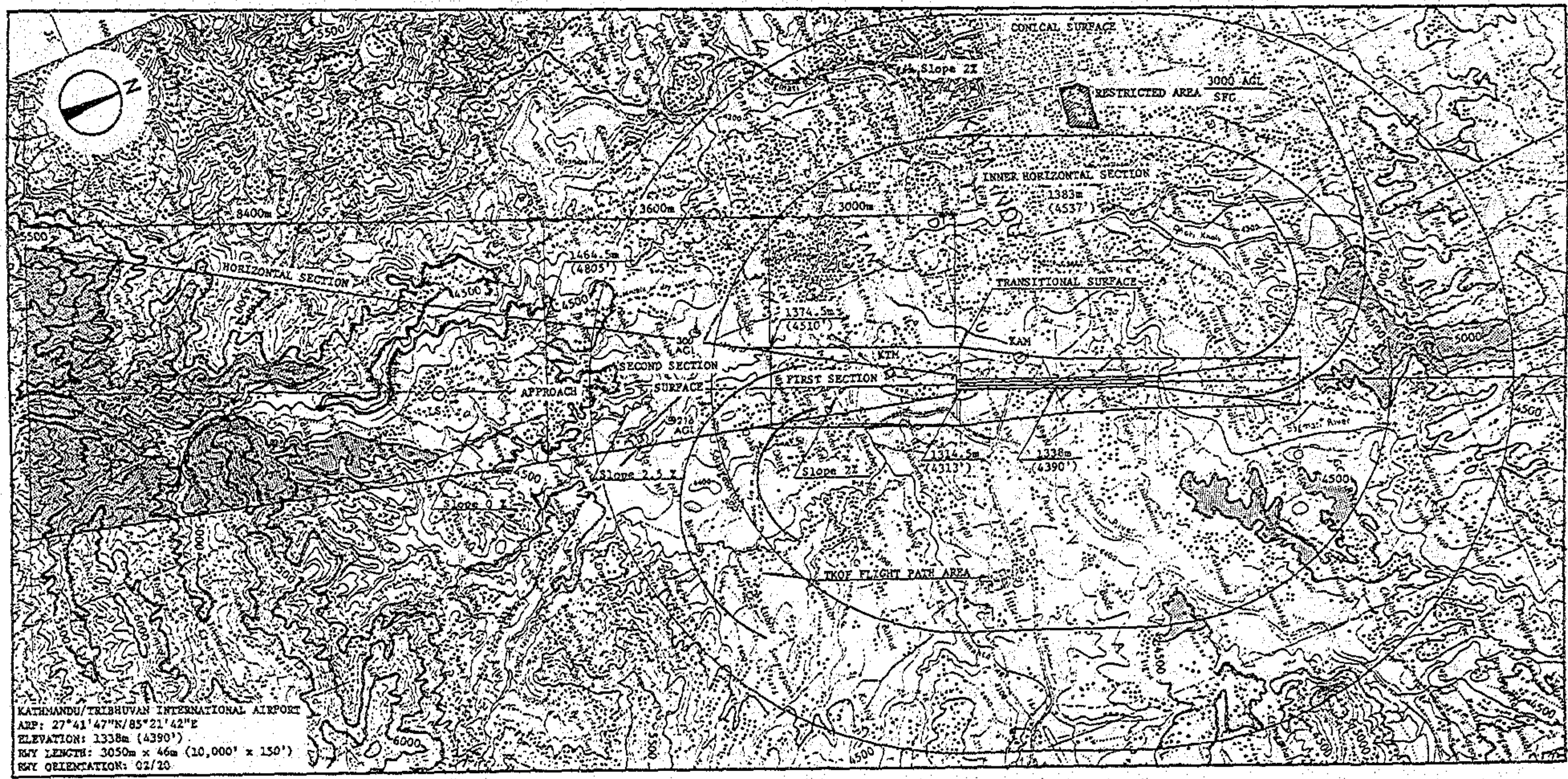


Fig. 9.3.2 Obstacle Limitation Surfaces at Tribhuvan International Airport

Fig. 9.3.3 Curved Take Off Flight Path Area at Tribhuvan International Airport

9.3.4 Air Navigation Systems

(1) Radio Navigation Aids

a) The DVOR/DME (AWA VRB500; 50 watt/WILCOX; 1 kwatt) are located about 1 km south of the Runway 02 threshold and on the extended center line of the runway. These are functioning well with good maintenance, however, the equipments were manufactured in 1975 and are obsolete. Replacement of the DVOR/DME will be urgently required.

b) The NDB (Aercom - 1000L; 1 kwatt) is located at the transmitting station. The equipment has been operated for more than 20 years and is obsolete. The electron tube needed for maintenance is very expensive and should be replaced by a solid-state type as soon as possible.

(2) Air Traffic Control and Telecommunications System

a) The VHF air-ground radios for the area control center (ACC) and flight information center (FIC) are located at the Phulchauki repeater station on the top of Phulchauki mountain (2762 m in elevation).

The VHF air-ground radios for aerodrome control, surface movement control and emergency use are located in Tribhuvan International Airport. These equipments are obsolete and DCA has recently procured and replaced these equipments.

b) The aeronautical fixed telecommunications network (AFTN) is linked to Kathmandu, Calcutta and Delhi by HF duplex circuits. However, severe interference occurs due to HF radiowave characteristics and the HF circuits are scheduled to be replaced by common carriers, i.e., microwave links.

c) AFTN is not provided for domestic use in Nepal. HF SSB ground-ground radio are only provided in 30 domestic airports in Nepal for flight data communications and air traffic services (ATS) direct speech circuit.

Since all flights and air traffic control data are communicated between Tribhuvan International Airport and other domestic airports by HF 100 watt transceivers, severe interference occurs. A domestic AFTN for flight data transmission will be required in major domestic airports.

d) For ATS direct speech circuit, Kathmandu is connected with Delhi and Calcutta by HF radio telephone. The communications quality by HF radio is not good and HF radio is planned to be replaced by microwave link.

e) Air traffic control consoles (ACC, FIC, TWR) are obsolete and the replacement of those in the new operations and airline complex are underway by Australian grant aid.

(3) Aeronautical Ground Lights

The following aeronautical ground lights are provided at Tribhuvan International Airport:

a) Simple approach lighting system (SALS):

This is provided for runway 02 approach. Not barrette but one unit of omni-directional and medium intensity light is used to compose SALS.

b) Medium intensity runway edge, threshold and end lights:

The light circuit design is single, which does not meet the requirements of runway lights for the precision approach Category - I.

c) T-VASIS:

The T-VASIS are provided for Runways 02 and 20, however, the Runway 20 T-VASIS is limited when aircraft is positioned on the holding position.

d) Aerodrome beacon:

e) Apron floodlights:

The apron floodlights are provided only for the international apron.

f) Wind sock

Two wind socks are present.

g) CCR and control equipment:

Not CCR regulators, but transformers are used for the series circuits of aeronautical ground lights. Those are obsolete and need to be replaced.

All the aeronautical ground lights and associated facilities are as a whole old and should be replaced in order to continue the function.

(4) Meteorological System

The manual weather observation facilities for airport surface observation are provided in the control tower, however, neither runway visual range meter (transmissiometer) nor ceilometer is provided.

Automated airport surface sensors which should represent the runway data will be required to meet the operational requirements.

Weather Forecast Division which serves not only aviation but also national meteorological services is located west of the maintenance apron and hangars. The major meteorological observation, telecommunications and forecast facilities are accommodated in this building except that the radiosonde station is located east of the runway, i.e., the opposite side of the international apron crossing the runway.

Since Weather Forecast Division building is located relatively far from the new operations and airline complex in the terminal area, communication equipment such as video display units will be required for both buildings.

9.4 Alternative Airport Master Plans

9.4.1 General

In this section, alternative airport master plans are presented in order to compare them to the future development policy of Tribhuvan International Airport. Airport master plans are prepared for the design target year of 2010 based on the airport facility requirements analysis in Section 9.2 and demand/capacity analysis in Section 9.3.

Existing condition of the airport and surrounding area has some particularity as follows.

(1) Almost all passengers are international passengers (80%).

(2) Growth rate of cargo traffic is extremely high.

(3) Many facilities except newly constructed international passenger terminal building are in unsatisfactory condition.

(4) Topographical condition surrounding the airport is very severe.

Therefore, in planning, careful attention is given to project cost and coordination of project implementation.

The four alternative airport master plans are presented here.

9.4.2 Basic Concepts for Alternative Airport Master Plans

(1) Runway

The existing runway is in general satisfactory in terms of orientation and pavement strength, and runway extension is not considered as really necessary. Furthermore, if it is planned to be extended, the following problems might be caused.

- Approach slope angle will exceed 3 ^{o} because final approach course will be closer to the high mountains.
- Relocation of the Ring road is very difficult in this area.
- Land acquisition is almost impossible.
- Security for the airport boundary cannot be ensured.

From these reasons the existing runway is not planned to be extended and will continue to be utilized as it is if no other major problems occur. The runway will, however, be developed to a precision approach runway CAT-I.

(2) Taxiways

A parallel taxiway will be provided for aircraft operational efficiency and safety.

One rapid exit taxiway will add to efficiency by minimizing the runway occupancy time and enable rapid access to the terminal for landing aircraft.

(3) Location of Terminal Area

The existing runway will normally be operated as a preferential operation. It is preferred therefore that the terminal area be located on the northern part of the airport in order to minimize the taxiing distance required by aircraft. Continous utilization of the existing terminal area is considered satisfactory.

Competition arise due to the military base and the Royal Enclosure on the narrow terrace adjacent to the airport facilities used by civil aviation. Whether to retain or relocate these existing facilities is major item in the alternative study.

(4) Terminal Building

The newly constructed international terminal building and operations and airline complex have the following important points to be investigated in the alternative layout plan study.

- The distance from the center line of the runway to the new terminal building is 322.4 m, although a large jet aircraft needs 360 m of separation.

- These are located at the south end of the existing terminal area and the topographical features of this southern part drop off dramatically.

(5) VOR/DME

The existing VOR/DME is in good condition though it is old, and is located at best position for approaching aircraft. A new VOR/DME will be installed at same site or nearby in future.

9.4.3 Alternative Airport Master Plans

Four alternative terminal area layout plans have been prepared as shown in Figs. 9.4.1 through 9.4.5.

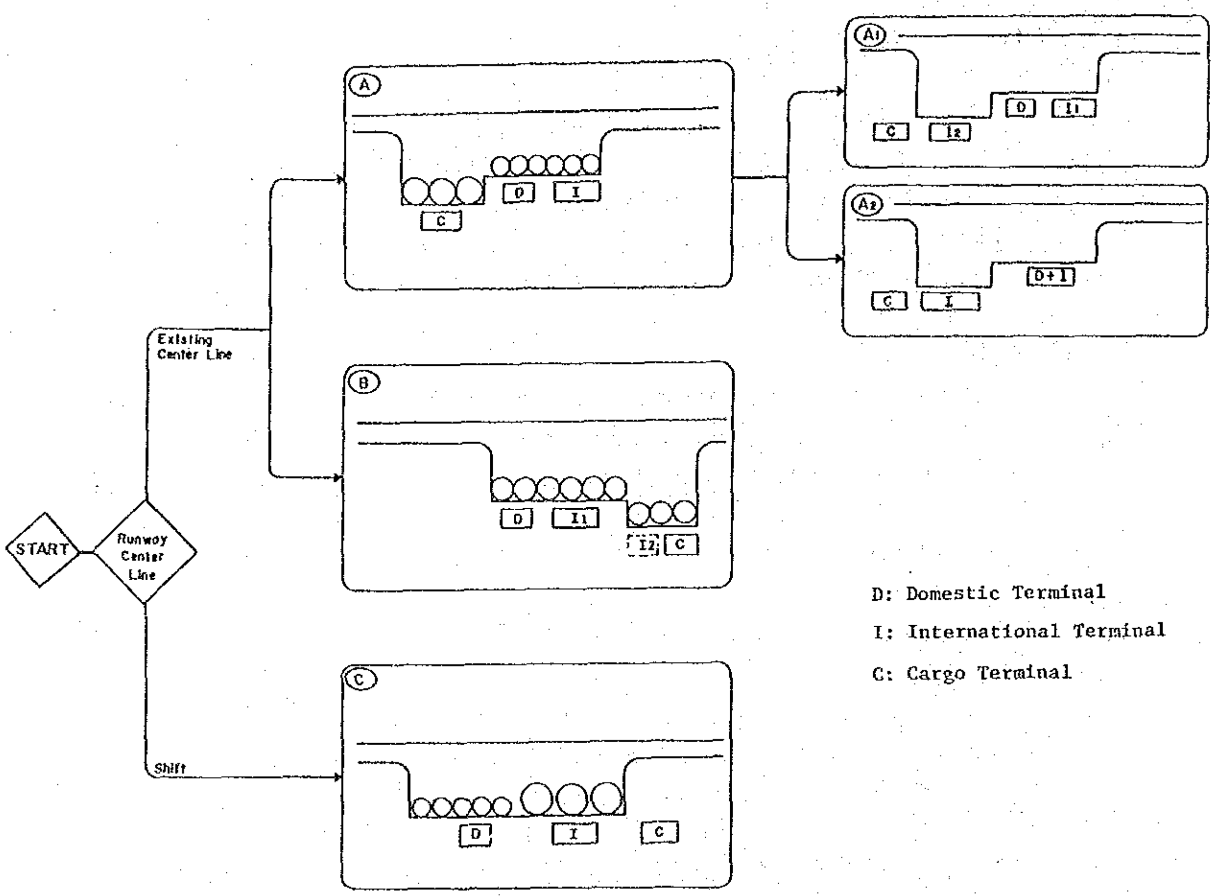


Fig. 9.4.1 Possible Alternatives for Layout Plan

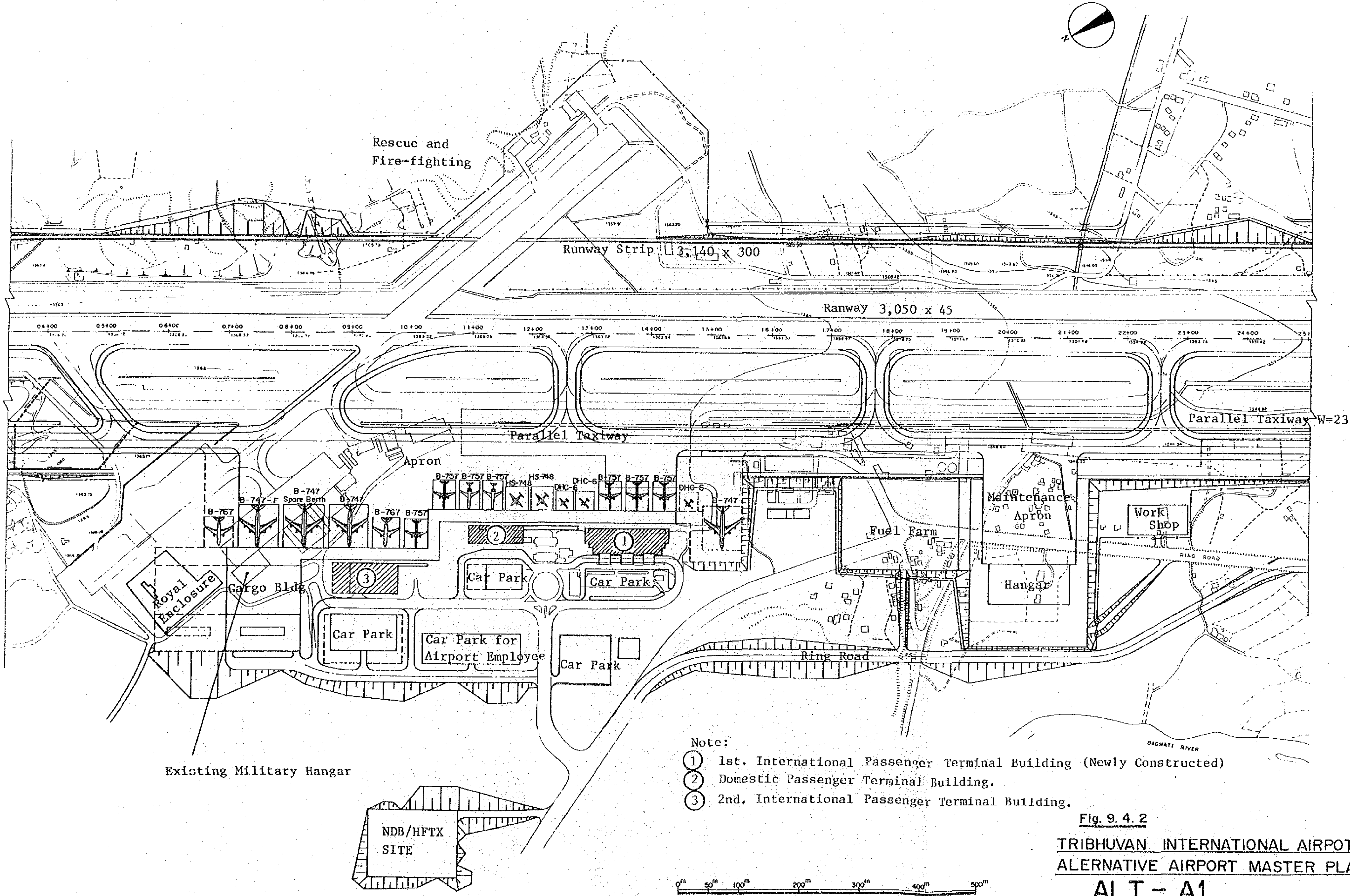


Fig. 9. 4. 2

TRIBHUVAN INTERNATIONAL AIRPOT
ALERNATIVE AIRPORT MASTER PLAN
ALT - A1

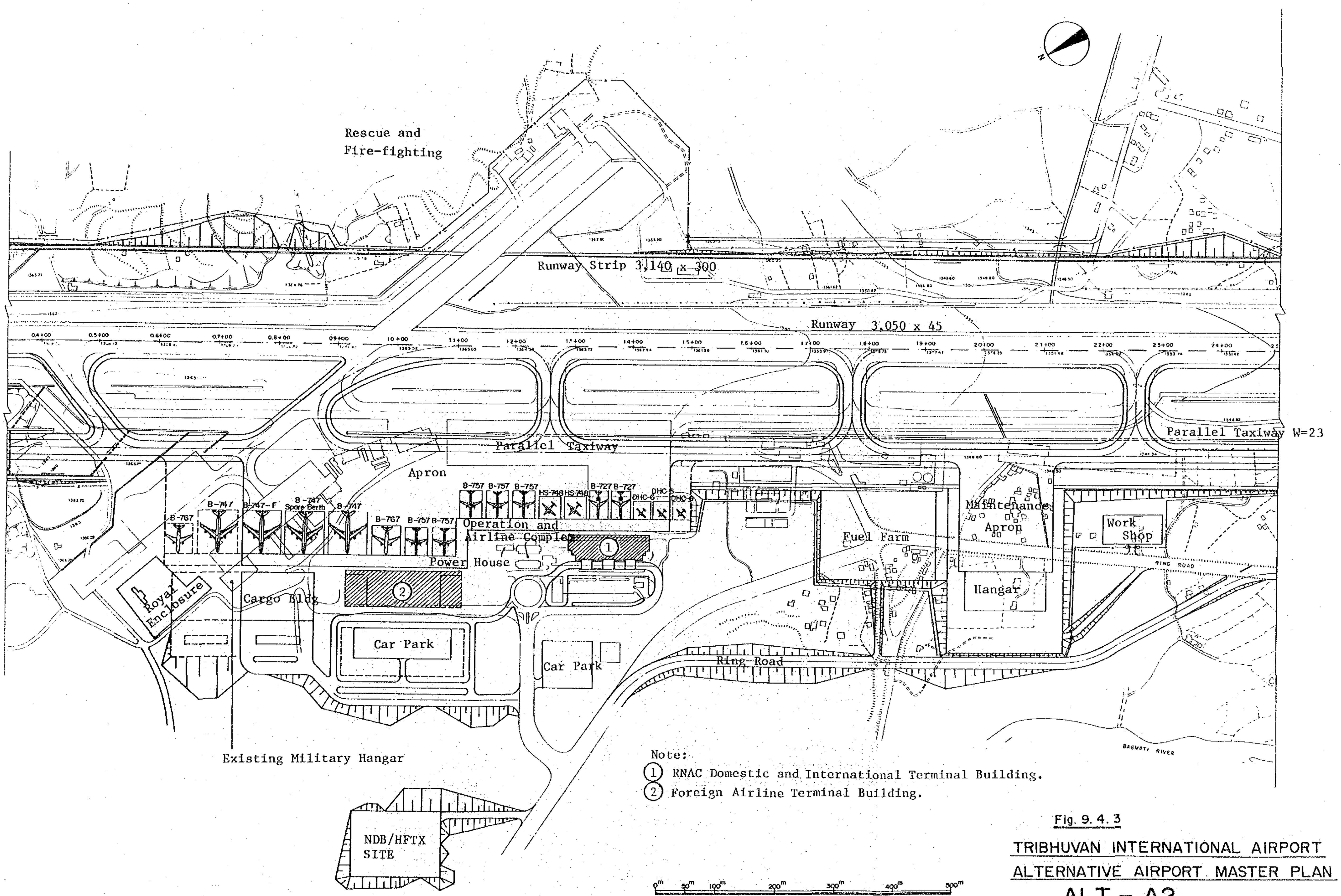


Fig. 9. 4. 3

TRIBHUVAN INTERNATIONAL AIRPORT
ALTERNATIVE AIRPORT MASTER PLAN
ALT - A2

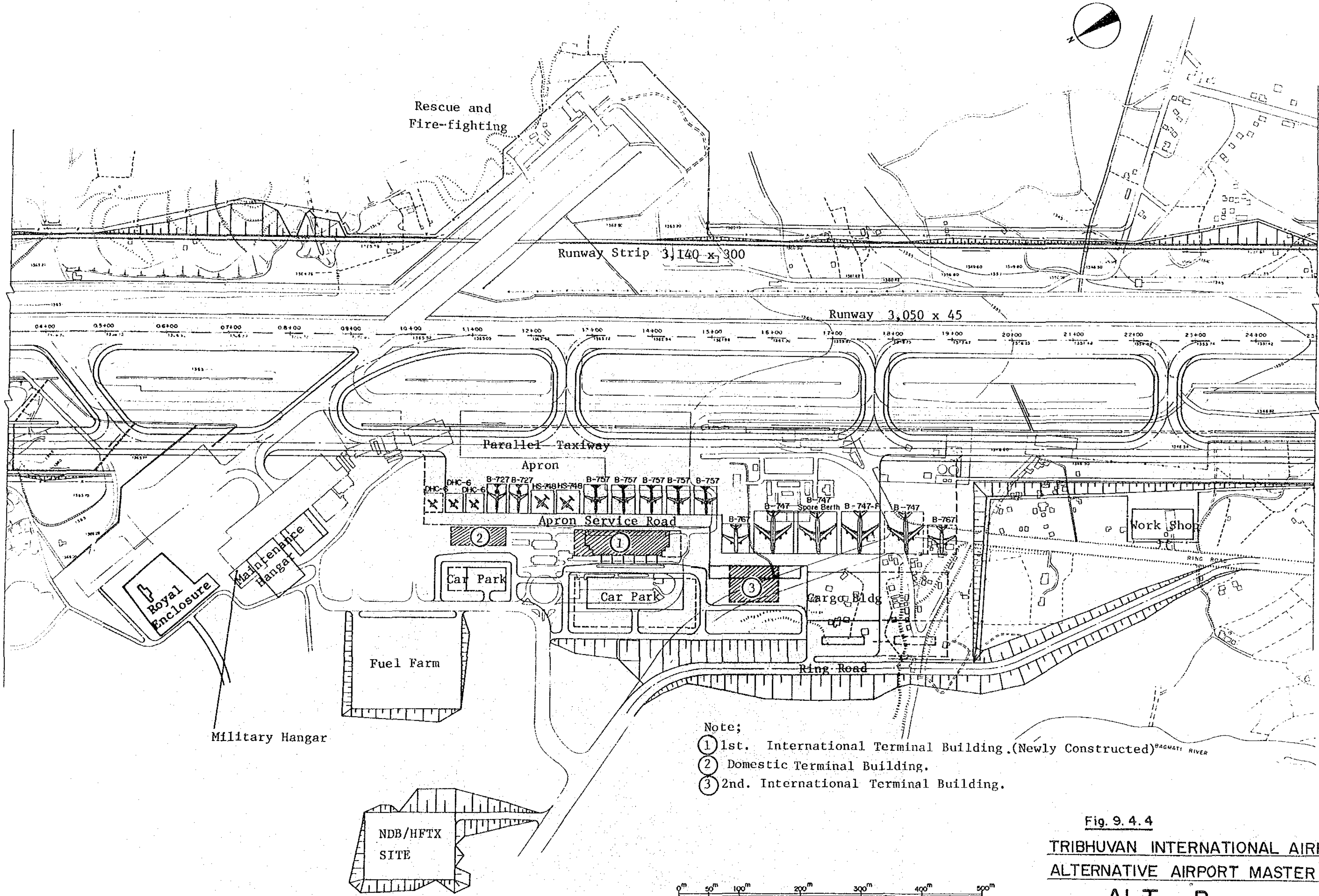


Fig. 9.4.4

TRIBHUVAN INTERNATIONAL AIRPORT

ALTERNATIVE AIRPORT MASTER PLAN

ALT - B

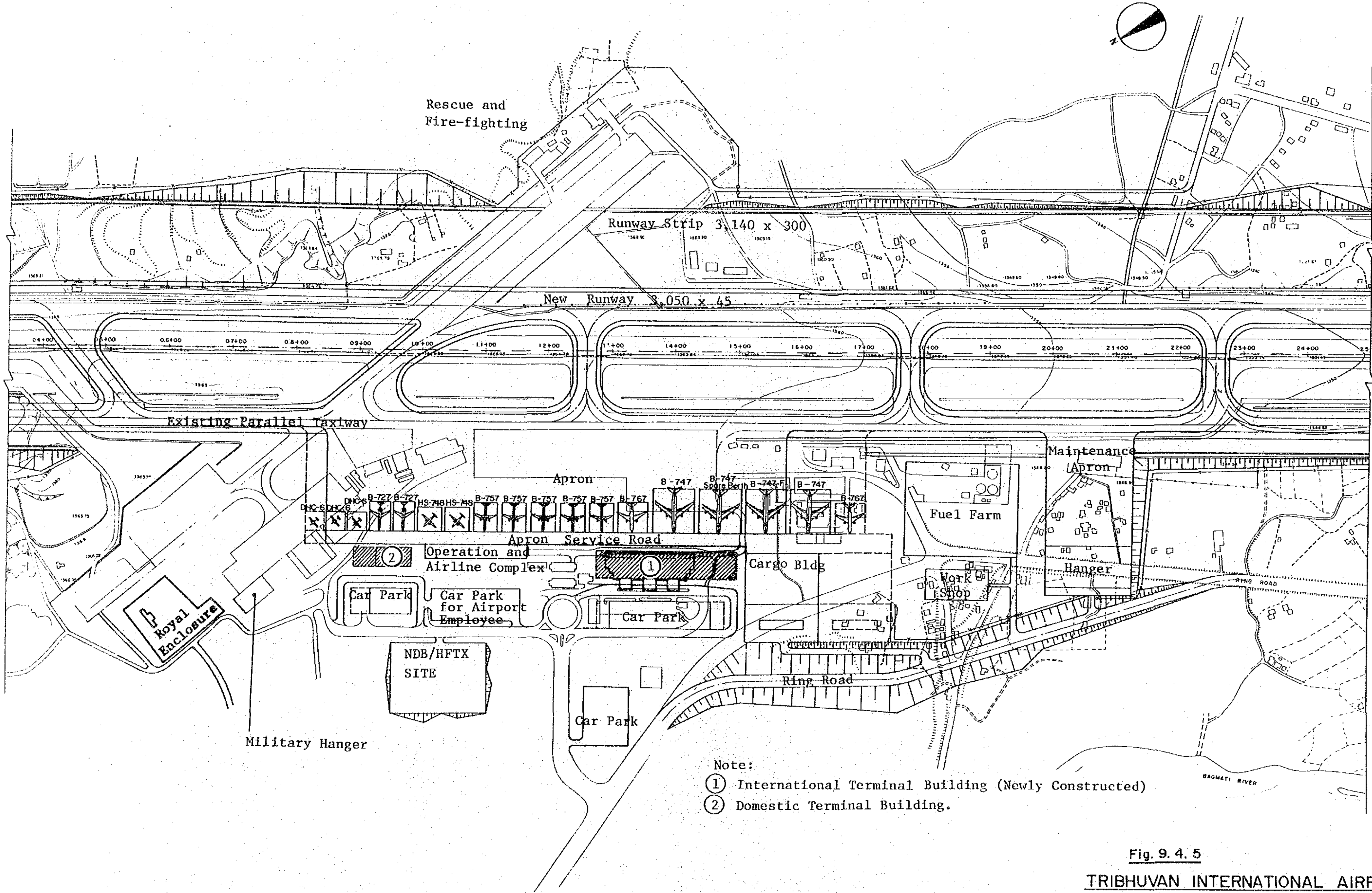


Fig. 9. 4. 5

TRIBHUVAN INTERNATIONAL AIRPORT

ALTERNATIVE AIRPORT MASTER PLAN

ALT - C

The concepts for four alternative plans are as follows. Details of comparison are described in following section.

(1) Alternative Airport Master Plan - A1

This plan aims to utilize effctively the narrow terrace in order to minimize project cost. A J and L jet class apron, a new domestic terminal building, and a 2nd international terminal building will be developed at the northern part of the operations and airline complex.

Existing facilities such as the Royal enclosure and military base must be moved to the other site at the initial stage of the project.

(2) Alternative Airport Master Plan - A2

This plan is a variation of Alternative A1. The new international building will be converted and used as both a domestic terminal and an international terminal building without construrcting the new domestic terminal buidling. This plan may allow exclusive use of RNAC in future.

Also the future 2nd international terminal building will be constructed in the same area with Alternative A1.

(3) Alternative Airport Master Plan - B

A J and L jet class apron and a new 2nd international building will be developed at the southern part of a newly constructed international terminal building. The domestic terminal building will be located at the northern part of the operations and airline complex.

This plan can be implemented without demolishing the existing Military base, Royal enclosure, or aircraft hangar. However, construction cost is higher than Alternative A1 and A2 due to large scale earth work.

(4) Alternative Airport Master Plan - C

The above plans A-1, A-2, and B do not change the center line of the existing runway. On the contrary, in plan C the center line of the existing runway will be shifted so as to ensure enough depth of apron for a J and L jet class aircraft. A future second international terminal building will be developed at present site. The domestic terminal building will be in the northern part of the operations and airline complex.

Project cost is the highest of four plans due to the land acquisition and earth work of the eastern part of the runway.

9.4.4 Evaluation of Alternative Airport Master Plans

The four alternative airport master plans defined in Section 9.4.3 have been assessed and evaluated analytically based on various considerations in order to determine the most suitable plan for the future development of Tribhuvan International Airport.

Four alternative airport master plans were evaluated as shown in Table 9.4.1. In this table, "x" indicates disadvantage or poor performance.

As can be seen in this table, ALT A-2 and then B are considered to be superior to the other two.

For the development of Nepal, Tribhuvan International Airport should be aggressively planned for the long term by giving higher priority to convenience for airport users, expandability of airport facilities, and construction cost.

With this idea in mind, the JICA Study Team has recommended ALT A-2 as the best. ALT A-2, however, can not help removing the military base at the initial stage of the project, moreover, in the future it will be necessary to remove the Royal enclosure as well.

For the reason above, DCA has abandoned ALT A-2 and selected ALT B as the most suitable airport master plan.

Table 9.4.1 Comparison Table of Alternative Airport Master Plans (1)

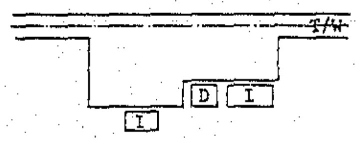
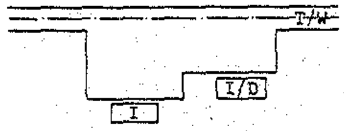
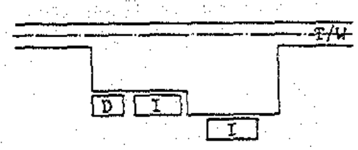
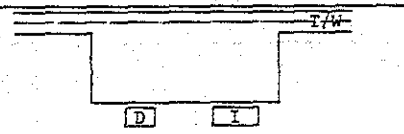
Item \ Plan		ALT-A1		ALT-A2		ALT-B		ALT-C
Illustration of Terminal Area								 Runway Shift
A. Convenience for Airport Users								
1 Passenger Convenience								
1) Transfer between Int'l and Dom	X	Poor	-	Most Transfer PAX will use RNAC	X	Poor	X	Poor
2) Possibility of Installing a Boarding Bridge	-	Good	-	Good	-	Good	-	Excellent
3) Easy Identification of Each Building	X	PAX from outside will be confused in finding the appropriate building	-	Good	X	Similar to A1	-	Good
4) Vehicle Traffic Flow in Landside area	X	Complicated	-	Simple	X	Complicated	-	Simple
2 Airline's Operation								
1) Access of Landing Aircraft to the Spot	-	Good	-	Good	X	Poor for larger aircraft	X	Poor for larger aircraft
2) Taxing Distance of Aircraft (preferential Operation)	-	Location of apron is at the desired northern part of the Runway	-	Same as ALT-A1	X	Longer distance	X	Longer distance
3) Management of RNAC	X	Scattered	-	Easy because of exclusive use	X	Scattered	X	Divided
4) Ground support Equipment and Staff	X	International spot is divided into two	-	Good	-	Good	-	Good
3 Airport Operation								
1) CIQ staff and Facilities	X	Disorganized	X	Disorganized	X	Disorganized	-	Good
2) Flexibility of Spot Operation	X	Poor	-	Good	-	Good	-	Good
3) Co-relation between PAX Bldg and Spot	X	Poor	-	Good	-	Good	-	Good
4) Distance between Int'l Spot and Cargo Bldg	-	Good	-	Good	-	Good	-	Good

Table 9.4.1 (Cont'd) Comparison Table of Alternative Airport Master Plans (2)

B. Expandability								
1 PAX Terminal Bldg	X	Domestic PAX Terminal Bldg is limited by apron and operation/airline complex	-	Good	-	Good	-	Good
2 Apron	-	Good	-	Good	-	Good	-	Good
3 Cargo	-	Good	-	Good	-	Good	-	Good
C. Effective Use of Existing Facilities								
1 Hanger	X		X		-		-	Available in initial stage
2 Military Base	X		X		-	Usable depend on the location of new hangar	-	
3 Ring Road	X	to be removed	X	Same as ALT-A1	X	Same as ALT-A1	X	Same as ALT-A1
4 Transmitting Station	X	Because the site is on good high land, a transmitting station is presently located there. The station will have to be moved if this is used.	X	Same as ALT-A1	X	Interference will be appeared because present location is planned to be lower than sourrounding.	X	Same as ALT-A1
D. Construction Considerations								
1 Night Works	-	Less	-	Less	-	Less	X	Much
2 Difficulties of Construction	-	Not so difficult	-	Same as ALT-A1	-	Same as ALT-A1	X	Construction of a new runway may disturb normal aircraft operation
3 Construction Cost (Civil Works)	-	1.1 Times of ALT A-2	-	1.0	X	1.2 Times of ALT A-2 Much earth work	X	1.3 Times of ALT A-2 Much pavement work Much earth work
4 Area of Land Acquisition	-	17ha	-	17ha	-	18ha	X	29 ha including 13 ha of southeast side of the runway.
E. Other Considerations								
1. Implementation problem	X	Military base should be removed at initial stage and similarly Royal enclosure in future	X	Same as ALT-A1	-		X	
2. Usage of Newly constructed International Terminal Building	-	Good	X	Due to mix use (Dom/Int) of New Int. Terminal Bldg. Modification is necessary occasionaly.	-	Good	-	Good
Total Evaluation (Number of X)	14		7	All things considered, a good plan with many advantages except for implementation problem.	10	Much expensive but fewer implementation problem.	11	

Note : "X" indicates disadvantage or poorer performance.

9.4.5 Layout of Maintenance Area, Cargo Terminal Area, and Other Facilities

ALT-B was selected of four alternatives, evaluating mainly basic facilities such as runway, taxiway, and terminal facilities. In this chapter, layout of some other facilities were investigated through mutual discussion, and ALT-B was developed to ALT B-2 which was accepted as the airport master plan.

(1) New Aircraft Maintenance Area

The area required to meet aircraft maintenance needs until year 2010 is estimated as illustration Fig. 9.4.6.

Five possible sites for the new aircraft maintenance area are presented (as shown in Fig. 9.4.7), taking into account the proposed taxiway system, terrain, and implementation problem. The five alternative sites were evaluated as tabulated in Table 9.4.2. In this table, "x" indicates a disadvantage or poor performance. As the result of this evaluation, it is recommended that site B be adopted mainly for the following reasons:

a) Since site B is planned to be located on the terrace as much as possible, site B requires fewer high embankments than other sites. Moreover, site B requires no additional land acquisition because it is located within the Ring road to be relocated. Therefore,the construction cost is estimated to be the least of all the alternative sites except site A.

b) Site B will not limit future expansion of the passenger terminal area beyond year 2010 because site B is located far from the proposed passenger terminal area.

c) Because site B is far from Royal enclosure, any densely populated area and the proposed passenger terminal area, engine test noise will not be a serious problem.

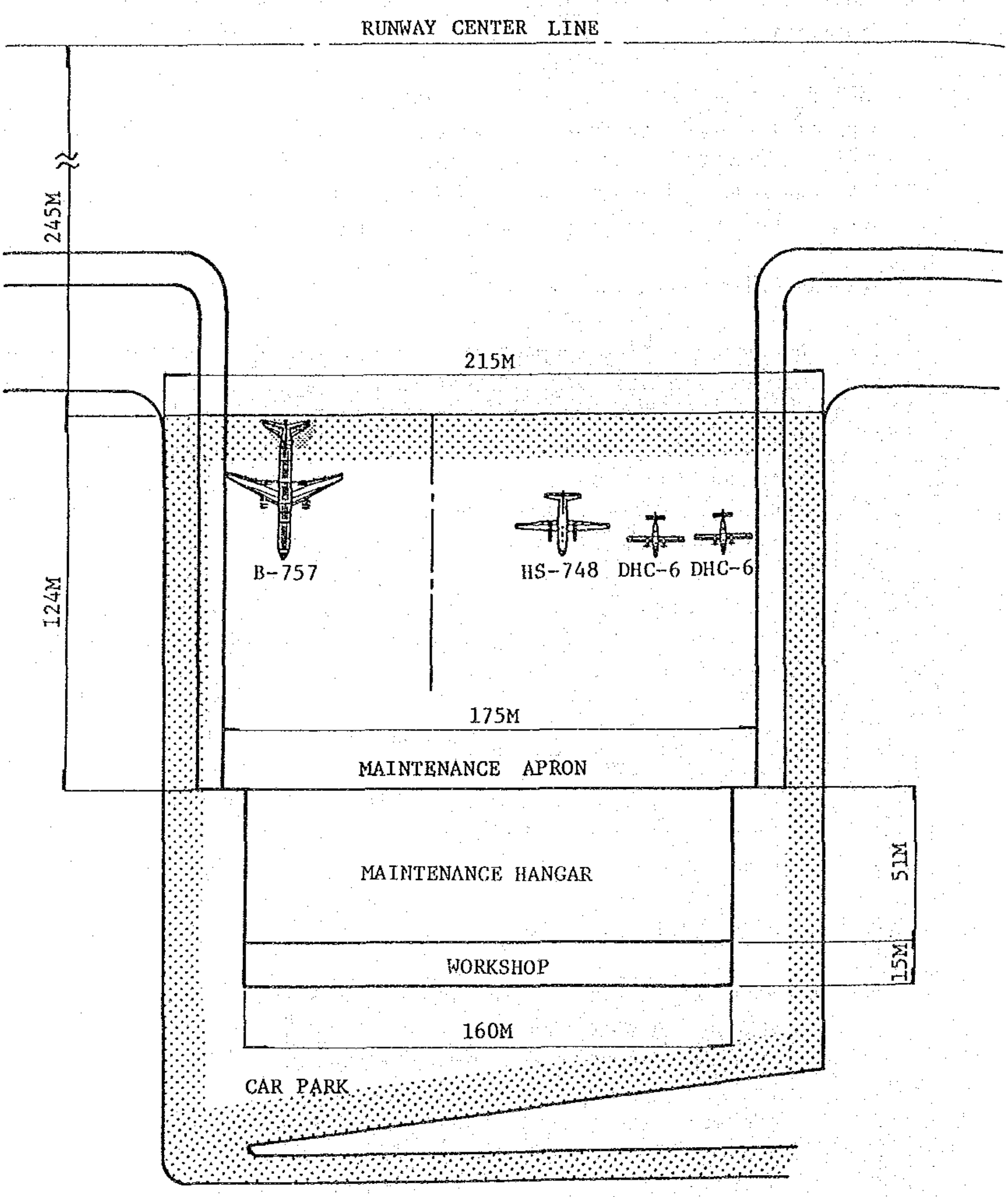


Fig. 9.4.6 Area Requirement for Aircraft Maintenance Area

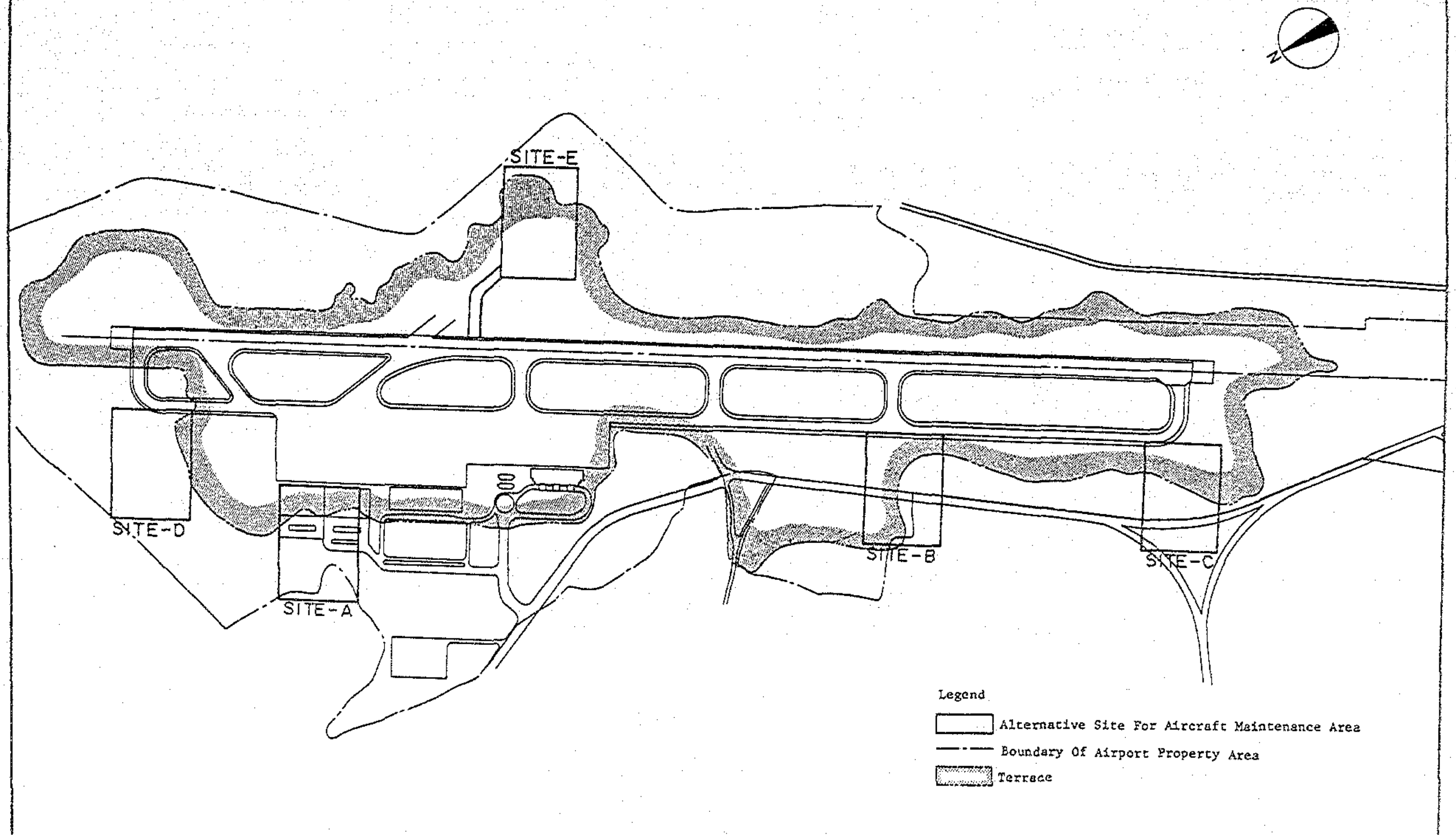


Fig. 9.4.7 Alternative Sites for Aircraft Maintenance Area

Comparison Items \ Site	SITE-A	SITE-B	SITE-C	SITE-D	SITE-E
A. Constructional Considerations					
1. Site preparation	Earth work volume is the least of all the alternative sites.	X The construction involves high embankments, but less than other sites.	X X The construction involves high embankments.	X X The construction involves high embankments.	X The construction involves high embankments.
2. Land acquisition	Not necessary	This site of 4,5ha is included within ring road diversion.	X X An area of approximately 1.6 ha needs to be acquired in addition to the area which is already scheduled to be acquired.	Not necessary	Not necessary
3. Diversion of the existing ring road	A section of 1.1 km is to be diverted for cargo Terminal.	X A section of 3.8 km is to be diverted.	X A section of 4.2 km is to be diverted.	A section of 1.1km is to be diverted.	A section of 1.1 km is to be diverted.
4. Others	X X Military base shall be removed.			X New access road is required.	
B. Airport Development Considerations.					
1. Influence on the expansibility of terminals	X Future expansion of the passenger terminal area beyond year 2010 is limited	No influence	No influence	No influence	No influence
2. Expansibility of aircraft maintenance area	X poor	Good	Good	Good	Good
C. Operational Considerations for Aircarft Maintenance					
1. Convenience for aircraft movements between passenger loading apron and maintenance apron	Taxiing distance is approximately 0.5 km.	Taxiing distance is approximately 0.7 km.	X Taxiing distance is approximately 1.4 km.	Taxiing distance is approximately 1.0 km.	X X Taxiing distance is approximately 1.1 km. Crossing runway is required.
D. Environmental Considerations					
1. Influence of engine test noise	X Royal enclosure and Passenger terminal will be influenced by noise.	No influence	No influence	X Royal enclosure will be influenced by noise.	No influence
Aethetic view	X There are Royal enclosure and passenger terminal area near this area.	Good	Good	X There are Royal enclosure and forest to be reserved nean this area.	
Total Evaluation (Number Of X)	6	2	6	5	3

Note : " X " indicates greater disadvantage or poorer performance.

Table 9.4.2 Comparison Table of Alternative Sites for Aircraft Maintenance Area

d) Site B is presently next to the area used as a NDB and HF transmitting station. It will be necessary to relocate these facilities, because these are remained in lower level than the level of cargo terminal area and aircraft maintenance area. This relocation will not be a serious disadvantage for site B because a new alternate site can be prepared as indicated in Fig. 9.4.4 taking into account the function of the facilities and the required construction cost.

e) There are few implementation problem, because site B does not require removal at the military base.

(2) Fuel Farm

The existing fuel farm will be embanked by new taxiway and apron. As a new possible site for fuel farm, north site of the apron and near the Ring road junction have been compared. If the north site was selected for fuel farm, following disadvantages are considered.

a) Because the north site of the apron is too close to the passenger terminal area and the Royal enclosure, its damage at emergency will be spread over.

b) Large iron tanks and other facilities are not aesetical for a main national gate.

c) Traffic of passenger vehicles and refuller car use same access road.

Therefore, near site to the Ring road junction has been chosen. New site of the fuel farm has a enough space for expansion, so that fuel stock for a couple of months is possible. Security is secured by the fence, while access roads from air/curb side are also provided.

It is possible to install fuel hydrant system in the apron to be constructed hereafter. However, necessity of the system at TIA and construction cost should be carefully studied.

(3) Catering

From the view point of followings, north side of passenger terminal area has been selected.

- Accessibility to/from apron and outside
- Easy countermeasure for security
- Availability of utilities

(4) Isolated Aircraft Parking Position

The isolated aircraft parking position is used for an aircraft subject to unlawful interference or for other reasons must be isolated from normal aerodrome activities. For this purpose, the east side of runway 20 end, which is the reserved area for the military base was selected.

(5) Cross Runway

The isolated aircraft parking position is seldom used, but it needs a connecting taxiway. Therefore, a new cross runway for small aircraft was planned instead of connecting taxiway between the isolated parking position and existing No. 1 taxiway. The cross runway will contribute to the aircraft operations during the strong cross winds ahead of monsoons and to augment runway capacity in the future.

Further investigation on the necessity of a cross runway is required because there has been no analytical information on it so far.

(6) General Aviation Apron

After the completion of the new maintenance hangar, existing maintenance apron will be planned to be mainly utilized as a general aviation apron. Helipad is to be located in this general aviation apron so as to minimize conflict with the scheduled aircraft operation.

(7) Workshop and Civil Aviation Training Center

Existing workshop buildings are relocated to the opposite side of the runway so as not to obstruct the apron expansion. Civil Aviation Training Center, which is currently in the same complex as the workshop, is also planned to be collocated with the new workshop.

(8) Fire Station

Fire station is planned to be relocated to the place with a short and direct access to the main runway in comparison with the existing CFR facilities. Fire station building will have the enough capacity to accommodate the required equipment in compliance with the ICAO recommendations. An underground water supply pipe crossing the runway to the fire station should be completed.

(9) Security Fence

Chain-linked security fence is planned to be located around the operational areas and around the airport boundaries in order to prevent the access of unauthorized persons onto the non-public areas. Security guard houses with power supply and telephone will be located around the airport.

For the airport security personnel, an office with dormitory building is planned in the airport.

(10) Utilities

The location of sewage treatment facility is planned near the Ring road junction with a direct outlet to the Bagmati River, to allow it to be at a level lower than any of the airport buildings.

Solid waste disposal is located at the site behind the catering building for accessibility to the passenger terminal buildings and catering building where raw garbage is discharged.

The necessity of excavation of a new well should be studied in order to supplement the insufficient water supply from WSSC.