1.9 Review of Master Plan of Tribhuvan International Airport (TIA)

1.9.1 Breakdown of Air Traffic Demand

Air traffic demand at TIA is summarized as shown in Tables 1.9.1 and 1.9.2.

Table 1.9.1 Summary of Air Traffic Demand (Domestic)

Year	Item / Period	Passenger Embarked/ Disembarked	Cargo (Ton)	Number of Aircraft Movements			
				B-727 Class	HS-748 Class	DHC-6 Class	Total
1995	Annual	280,000	2,200	500	3,930	4,070	8,500
	Peak Month	33,700	-	60	470	490	1,020
	Design Day	1,110	-	2	16	16	34
	Peak Hour	270	-	0.4	3.1	3.1	6.6
	Heavy Direction Peak Hour	160	-	-	-	-	4
2000	Annual	332,900	2,400	640	4,930	4,640	10,210
	Peak Month	46,900	-	100	590	560	1,250
	Design Day	1,330	-	2	20	18	40
	Peak Hour	320	-	0.4	3.7	3.4	7.5
	Heavy Direction Peak Hour	190	-	-	-	-	5
2005	Annual	388,900	2,600	790	5,790	5,290	11,870
	Peak Month	46,900	-	100	700	640	1,440
	Design Day	1,560	-	4	24	22	50
	Peak Hour	370	-	0.7	4.2	3.9	8.8
	Heavy Direction Peak Hour	220	-	-	-	-	5
2010	Annual	443,900	2,900	860	6,790	6,000	13,650
	Peak Month	53,500	-	100	820	720	1,640
	Design Day	1,780	-	4	28	24	56
	Peak Hour	420	-	0.7	4.8	4.1	9.6
	Heavy Direction Peak Hour	250	-	-	-	-	5

Table 1.9.2 Summary of Air Traffic Demand (International)

Year	Item / Period	Passenger Embarked/ Disembarked	Cargo (Ton)	Number of Aircraft Movements					
				B-747 Class	DC-10 Class	B-767 Class	B-757 Class	B-727 Class	Total
1995	Annual	924,000	45,000	-	1,000	600	1,800	4,600	8,000
	Peak Month	100,000	-	-	100	60	170	450	780
	Design Day	3,300	-	-	4	2	6	14	26
	Peak Hour	700	-	-	0.8	0.4	1.3	3	5.5
	Heavy Direction Peak Hour	400	-	-	-	-	-	-	3.3
2000	Annual	1,234,000	69,000	-	1,500	1,000	2,500	5,100	10,100
	Peak Month	134,000	-	-	150	100	240	500	990
	Design Day	4,410	-	-	4	4	8	16	32
	Peak Hour	900	-	-	0.8	0.8	1.6	3.3	6.5
	Heavy Direction Peak Hour	530	-	-	-	-	-	-	3.9
2005	Annual	1,567,000	100,000	500	1,600	1,300	2,800	4,100	10,300
	Peak Month	170,000	-	50	150	130	270	390	990
	Design Day	5,600	-	2	6	4	10	14	36
	Peak Hour	1,120	-	0.4	1.2	0.8	2	2.8	7.2
	Heavy Direction Peak Hour	670	-	-	-	-	-	-	4.3
2010	Annual	1,946,000	138,000	1,200	1,800	1,800	3,500	3,500	11,800
	Peak Month	212,000	-	120	170	170	340	340	1,140
	Design Day	6,950	-	4	6	6	12	12	40
	Peak Hour	1,370	-	0.8	1.2	1.2	2.4	2.4	8.0
	Heavy Direction Peak Hour	830	-	-	-	-	-	-	4.8

1.9.2 Analysis of Airport Facility Requirements

Table 1.9.3 shows the airport facility requirements which should be used as the bases for the subsequent planning and design.

Table 1.9.3 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) Water (Ton/Month) Sewage (Ton/Month) Solid Waste (Ton/Month)		N.A N.A N.A N.A	1,800 8,700 6,300 60	2,300 10,900 7,800 80	2,900 13,300 9,600 110	3,600 16,100 11,600 140
	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.

1.9.3 Demand/Capacity Analysis

Table 1.9.4 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.

Table 1.9.4 Anticipated Time of Saturation of the Existing Facilities

Facility	1990	1995	2000	2005	2010
1. Departure Lobby					
2. Check-in Counter					
3. Custom Baggage Inspection (Dep.)					
4. Outbound Baggage System					
5. Immigration Inspection (Dep.)					
6. Departure Lounge					
7. Immigration Inspection (Arr.)					
8. Baggage Claim Area					
9. Baggage Claim Dispencer					
10. Customs Inspection (Arr.)					
11. Arrival Lobby					

1.9.4 Alternative Airport Master Plans

(1) Alternative Plans

Alternative airport master plans are presented in order to compare them to the future development policy of Tribhuvan International Airport for the design target year of 2010.

The four alternative airport master plans are presented in Figs.1.9.1 through 1.9.4. The concepts of four alternative plans are as follows.

a) Alternative Airport Master Plan - A1

A new apron and new terminal buildings will be developed at the northern part of the operations/airline complex. Existing facilities such as the Royal enclosure and military base must be removed to the other site.

b) Alternative Airport Master Plan - A2

A new apron will be developed at the same location as Alternative A1. The international terminal will be converted and used as both a domestic terminal and an international terminal building without constructing a new domestic terminal buidling. The future second international terminal building will be constructed in the same area as Alternative A1.

c) Alternative Airport Master Plan - B

A new apron and a second international building will be constructed at the southern part of the international terminal building. The domestic terminal building will be constructed to the north of the operations/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.

d) Alternative Airport Master 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 in front of the international terminal building. The domestic terminal building will be to the north of the operations/airline complex. Project cost is the highest of the four plans due to the land acquisition and earth work of the eastern part of the runway.

(2) Evaluation of Alternative Airport Master Plans

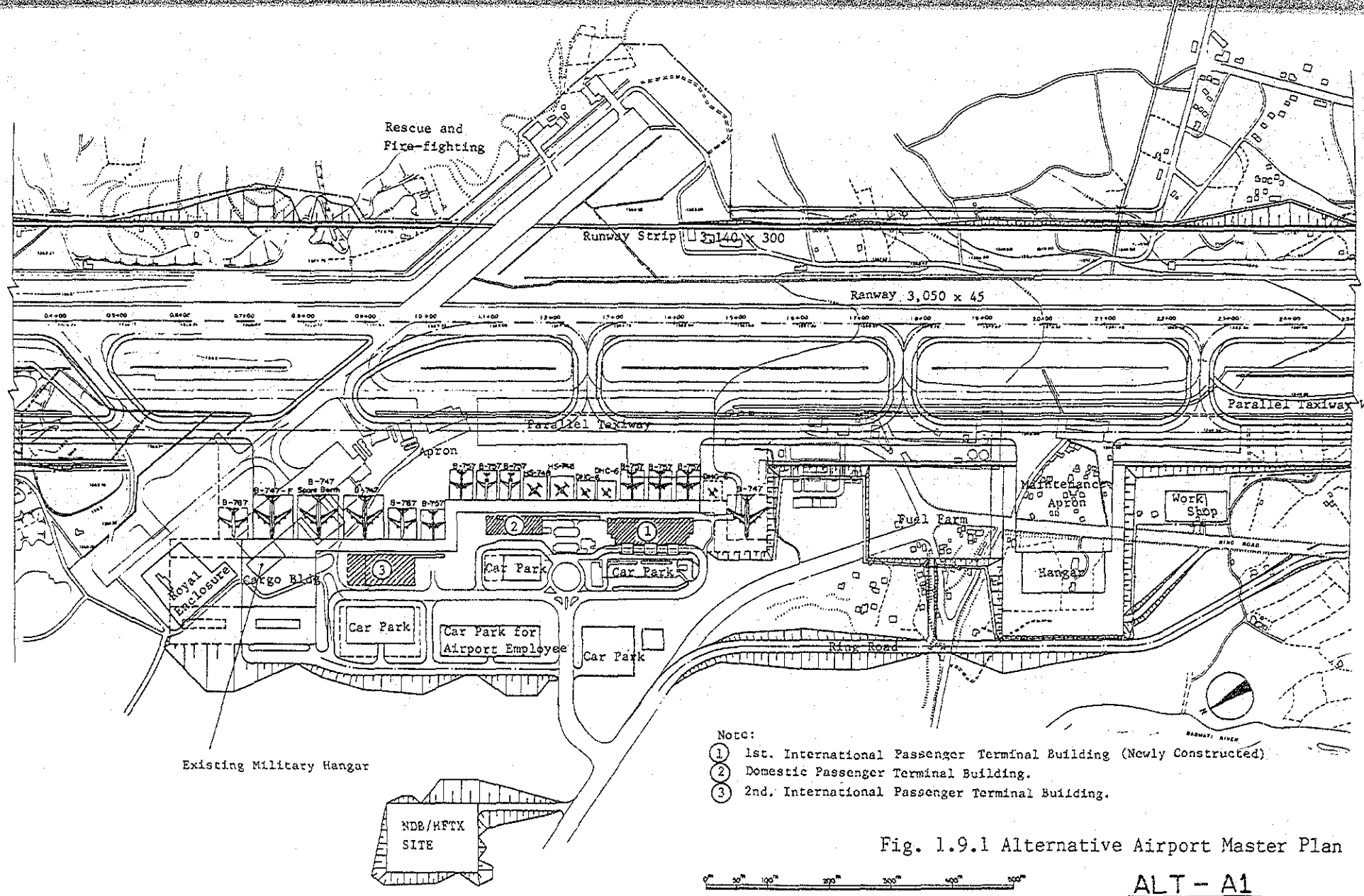
The four alternative airport master plans have been assessed and evaluated analytically based on various considerations in order to determine the most suitable plan for the future development of Tribhuvan International Airport.

Four alternative airport master plans were evaluated as shown in Table 1.9.5. In this table, "x" indicates disadvantage or poor performance. As can be seen in this table, ALT A-2 and 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. In ALT A-2, however, it is necessary to remove 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 above reasons, DCA has abandoned ALT A-2 and selected ALT B as the most suitable airport master plan.



Note:

1. 1st. International Passenger Terminal Building (Newly Constructed)
2. Domestic Passenger Terminal Building.
3. 2nd. International Passenger Terminal Building.

Fig. 1.9.1 Alternative Airport Master Plan

ALT - A1

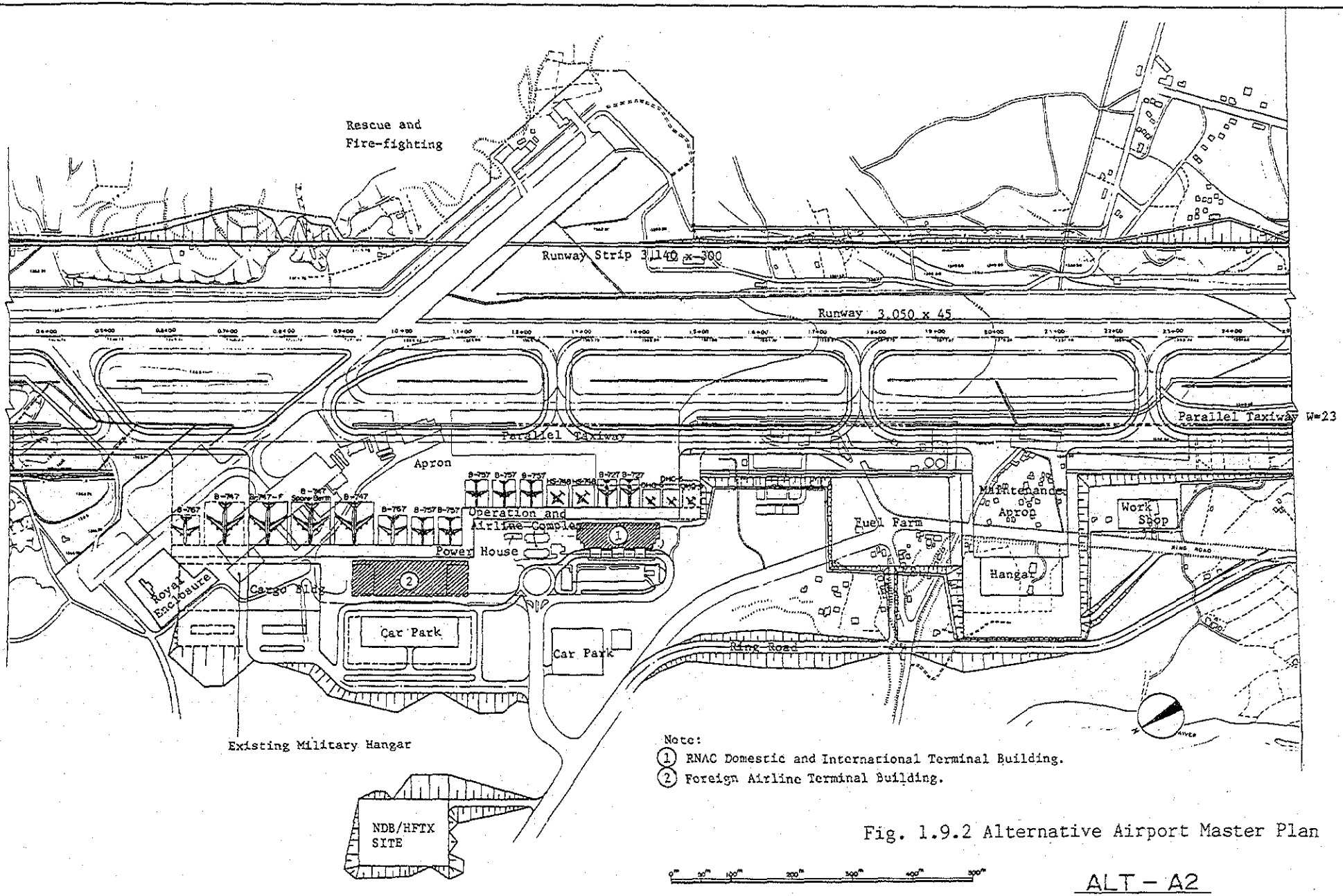


Fig. 1.9.2 Alternative Airport Master Plan

ALT - A2

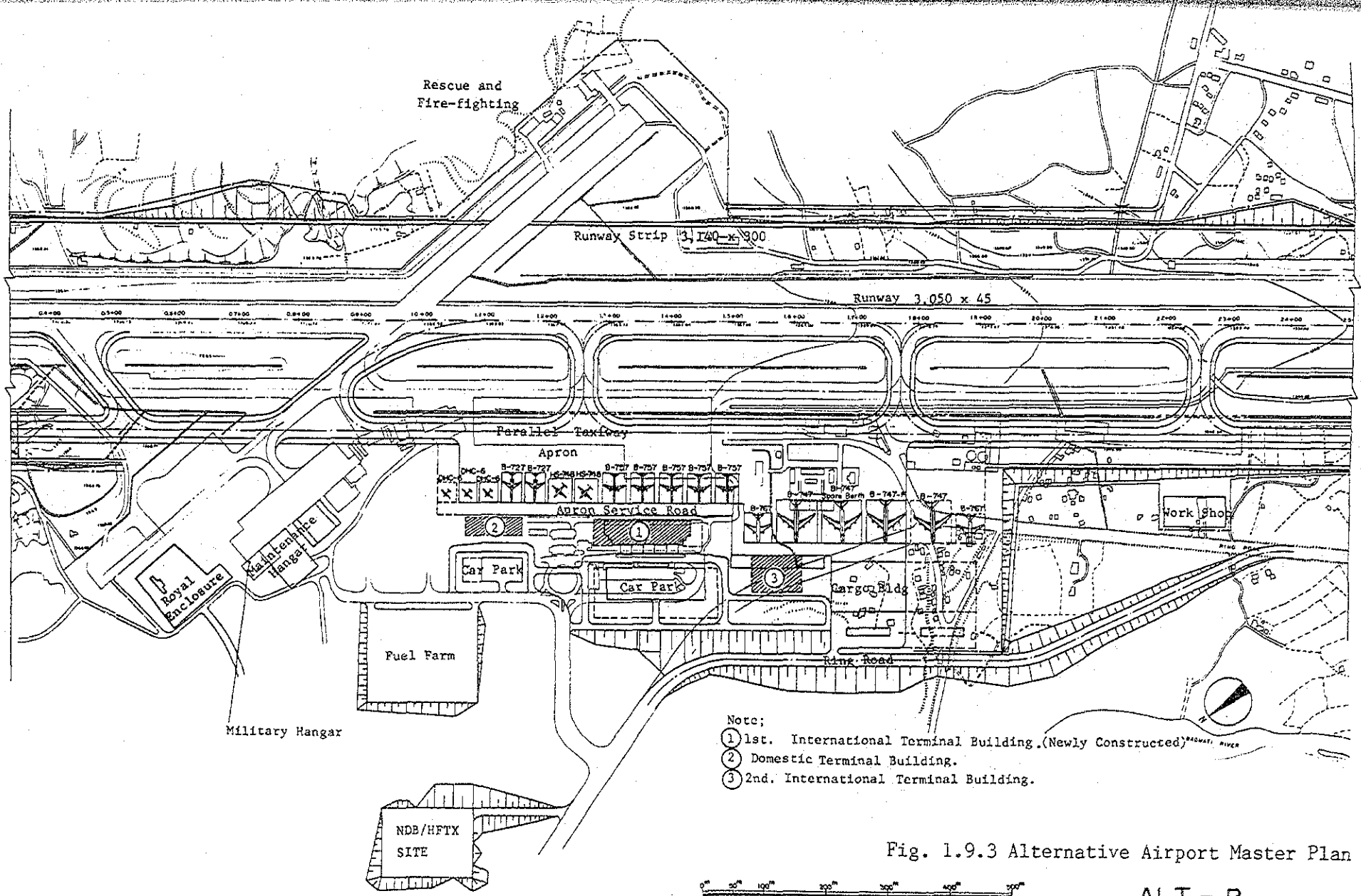


Fig. 1.9.3 Alternative Airport Master Plan

ALT - B

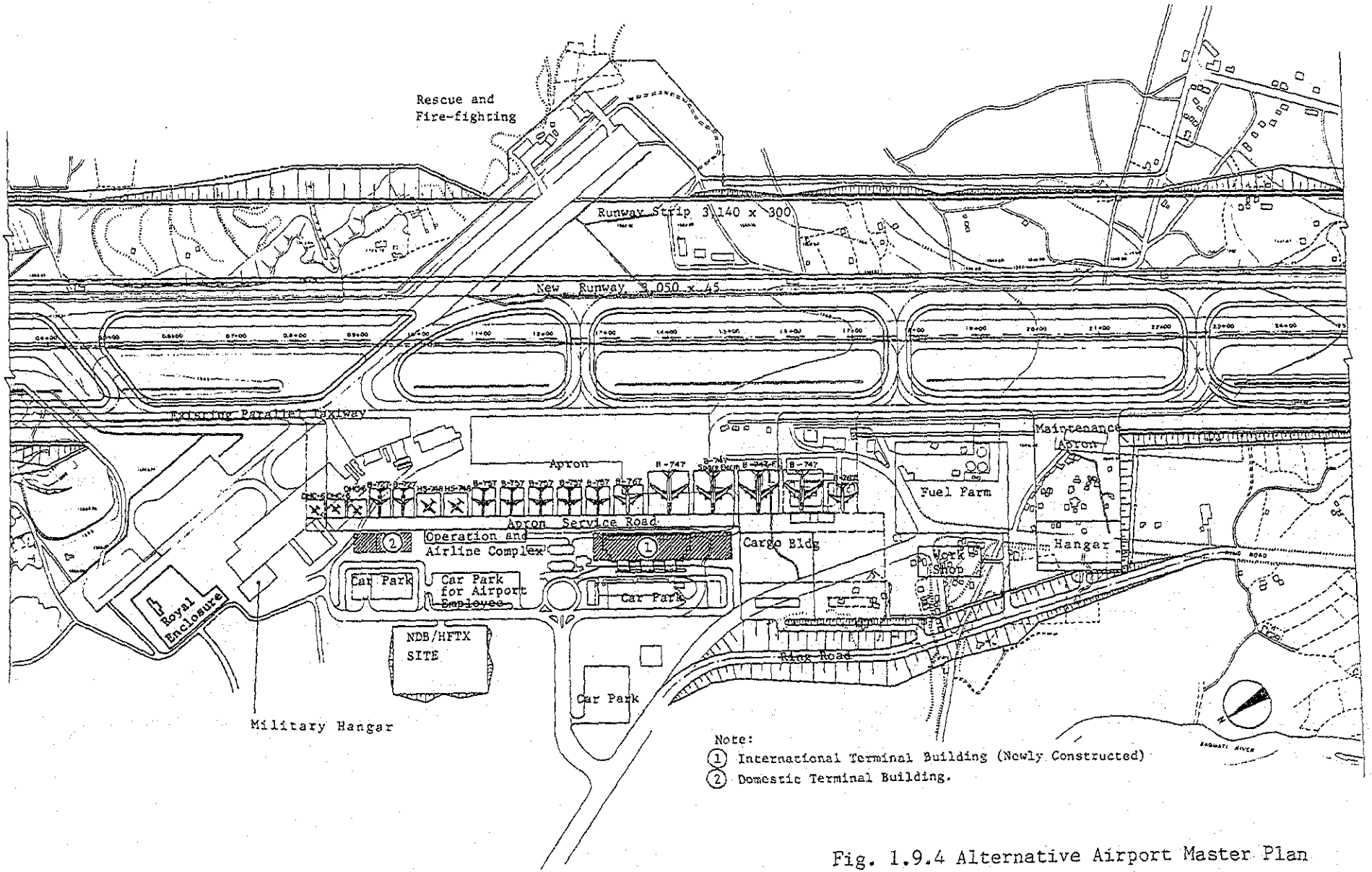


Fig. 1.9.4 Alternative Airport Master Plan

ALT - C

Table 1.9.5 Comparison Table of Alternative Airport Master Plans (1)

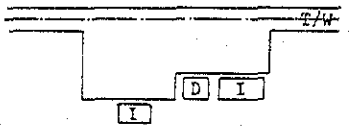
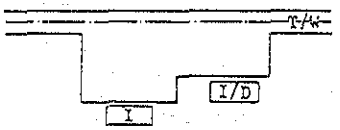
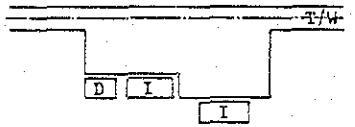
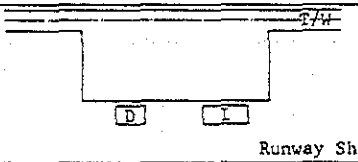
Item \ Plan	ALT-A1		ALT-A2		ALT-B		ALT-C	
Illustration of Terminal Area								
A. Convenience for Airport Users								
1 Passenger Convenience								
1) Transfer between Int'l and Dom	X	Poor	-	Most Transfer PAX will use RNAC	X	Poor	X	Poor
2) Possibility of Installing a Boarding Bridge	-	Good	-	Good	-	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

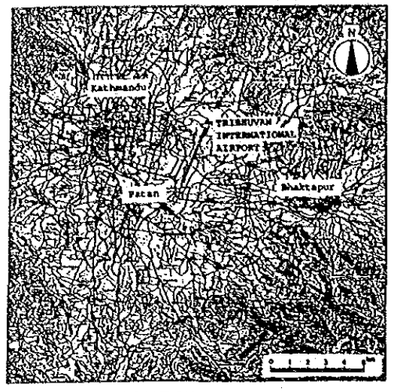
Table 1.9.5 Comparison Table of Alternative Airport Master Plans (2)

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		All things considered, a good plan with many advantages except for implementation problem. 7		Much expensive but fewer implementation problem. 10		11

Note : " X" indicates disadvantage or poorer performance.

(3) Airport Master Plan

Airport master plan "B-2" has been completed based on the above studies by amending "ALT-B" which was previously selected in above section. Airport master plan "B-2" is shown by phase in Figs. 1.9.5 and Fig. 1.9.6.



LOCATION MAP

APPROACH SURFACE
(1 : 50)

DME ANT
LOCALIZER/DME

RUNWAY STRIP
3,140m x 150m

RUNWAY 3,050m x 45m

NO.1 T/W
NO.2 T/W
NO.3 T/W
NO.4 T/W

PARALLEL TAXIWAY

PASSENGER TERMINAL APRON
B-757 Class
B-767 Class
DC-10 Class
DHC-6 Class
HS-748 Class

FUEL FARM

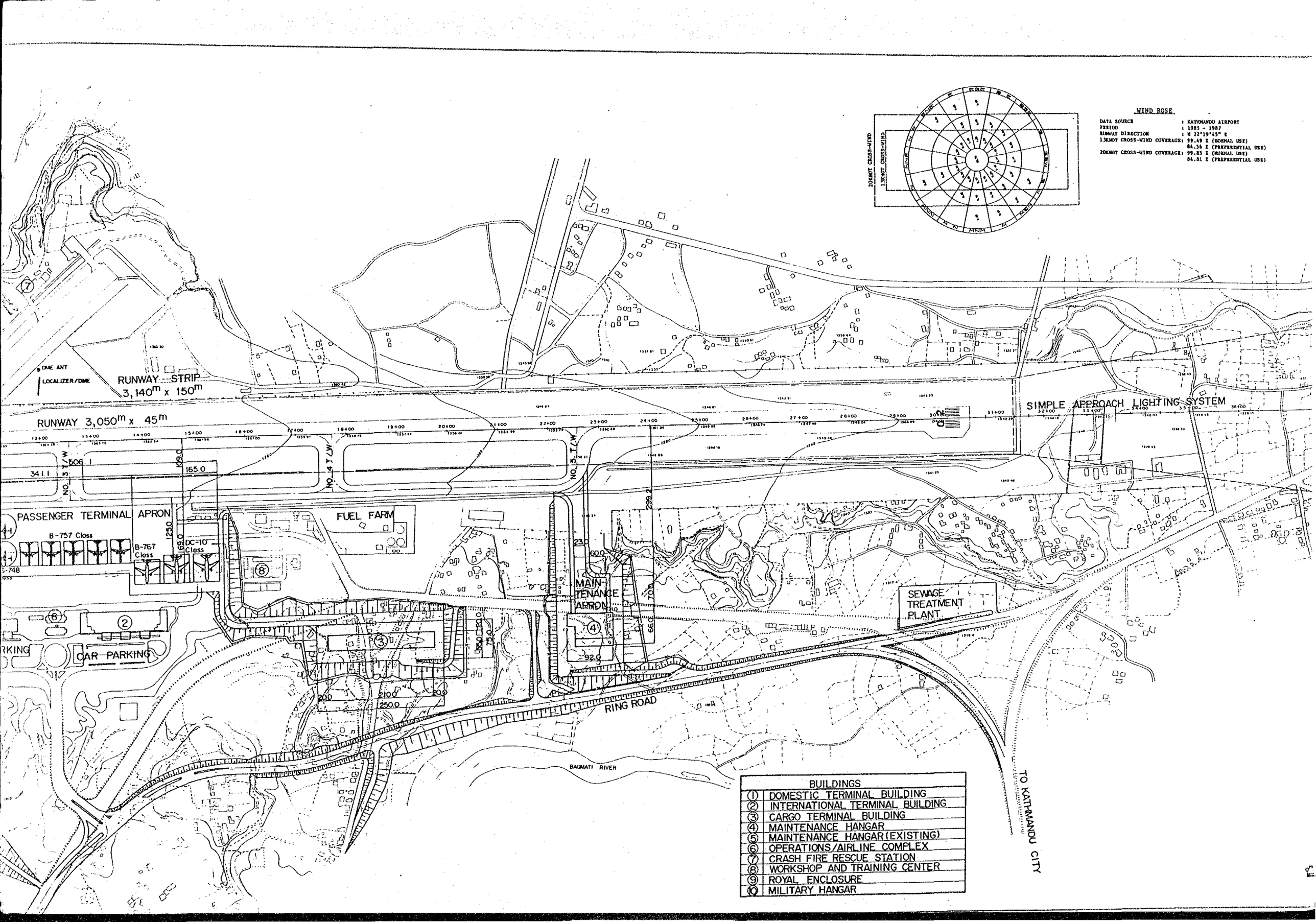
MAINTENANCE APRON

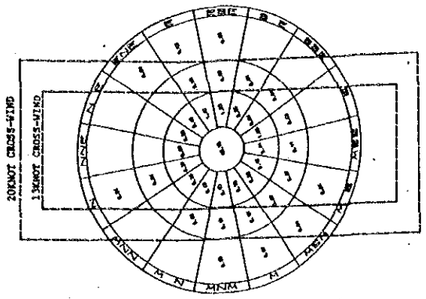
TEMPORARY CAR PARKING
CAR PARKING
CAR PARKING

TRANSMITTING STATION

RUNWAY DATA	
EFFECTIVE GRADIENT	0.786 %
PERCENTAGE WIND COVERAGE	99.5% (13KNOT) 99.9% (20KNOT)
INSTRUMENT RUNWAY	✓
PAVEMENT STRENGTH	PCN54/F/A/W/T
APPROACH SURFACES	1:50
RUNWAY LIGHTING	RWYL, RWTL
RUNWAY MARKING	ALL WEATHER
NAVIGATIONAL AIDS	SALS T-VASIS

AIRPORT DATA	
AIRPORT ELEVATION	1,338m
AIRPORT REFERENCE POINT (ARP) COORDINATES	LAT 27°41'47"N LNG 85°21'42"E
AIRPORT REFERENCE TEMPERATURE	27.8 °C
AIRPORT AND TERMINAL NAVAIDS	DVOR/DME, NDB
MAGNETIC VARIATIONS	1° W
CRASH PROTECTION PROVIDED	CAT-7


WIND ROSE
DATA SOURCE : KATHMANDU AIRPORT
PERIOD : 1985 - 1987
RUNWAY DIRECTION : N 22°19'45" E
13KNOT CROSS-WIND COVERAGE: 99.49 % (NORMAL USE)
84.56 % (PREFERENTIAL USE)
20KNOT CROSS-WIND COVERAGE: 99.85 % (NORMAL USE)
84.81 % (PREFERENTIAL USE)
20KNOT CROSS-WIND
13KNOT CROSS-WIND
DME ANT
LOCALIZER/DME
RUNWAY STRIP
3,140m x 150m
RUNWAY 3,050m x 45m
SIMPLE APPROACH LIGHTING SYSTEM
PASSENGER TERMINAL APRON
B-757 Class
B-767 Class
DC-10 Class
B-748
CAR PARKING
FUEL FARM
MAIN-TENANCE APRON
SEWAGE TREATMENT PLANT
RING ROAD
BAGMATI RIVER
TO KATHMANDU CITY
NO.3 T/W
NO.4 T/W
NO.5 T/W
BUILDINGS
① DOMESTIC TERMINAL BUILDING
② INTERNATIONAL TERMINAL BUILDING
③ CARGO TERMINAL BUILDING
④ MAINTENANCE HANGAR
⑤ MAINTENANCE HANGAR(EXISTING)
⑥ OPERATIONS/AIRLINE COMPLEX
⑦ CRASH FIRE RESCUE STATION
⑧ WORKSHOP AND TRAINING CENTER
⑨ ROYAL ENCLOSURE
⑩ MILITARY HANGAR

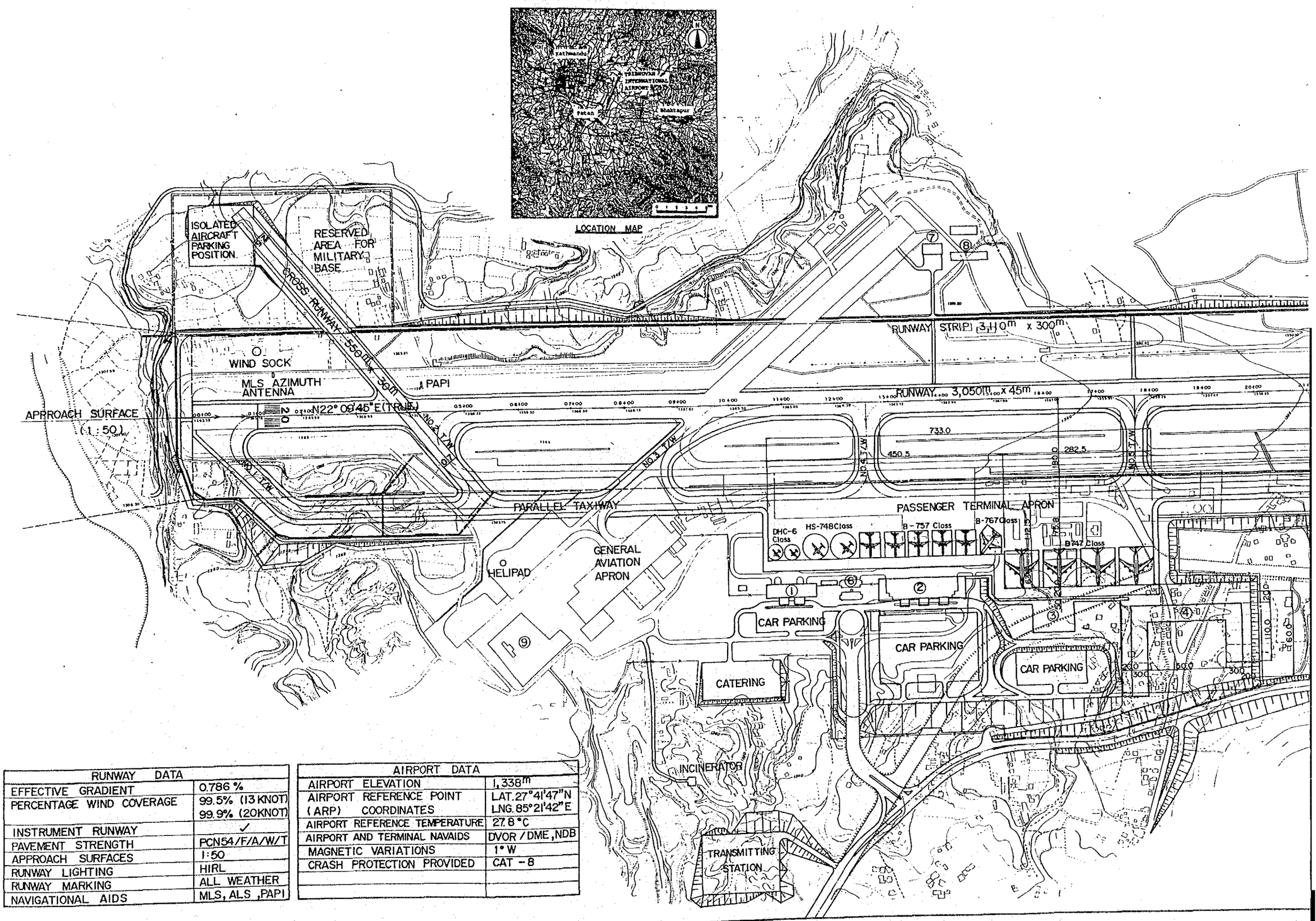


WIND ROSE

DATA SOURCE	: KATHMANDU AIRPORT
PERIOD	: 1985 - 1987
RUNWAY DIRECTION	: N 22°19'45" E
13KNOT CROSS-WIND COVERAGE	: 99.49 % (NORMAL USE)
	84.56 % (PREFERENTIAL USE)
20KNOT CROSS-WIND COVERAGE	: 99.85 % (NORMAL USE)
	84.81 % (PREFERENTIAL USE)

Fig. 1.9.5

AIRPORT MASTER PLAN OF
TRIBHUVAN INTERNATIONAL AIRPORT
PHASE I DEVELOPMENT (YEAR 2000)



RUNWAY DATA	
EFFECTIVE GRADIENT	0.786 %
PERCENTAGE WIND COVERAGE	99.5% (13 KNOT) 99.9% (20KNOT)
INSTRUMENT RUNWAY	✓
PAVEMENT STRENGTH	PCN54/F/A/W/T
APPROACH SURFACES	1:50
RUNWAY LIGHTING	HIRL
RUNWAY MARKING	ALL WEATHER
NAVIGATIONAL AIDS	MLS, ALS, PAPI

AIRPORT DATA	
AIRPORT ELEVATION	1,338m
AIRPORT REFERENCE POINT (ARP) COORDINATES	LAT. 27°41'47"N LNG. 85°21'42"E
AIRPORT REFERENCE TEMPERATURE	27.8 °C
AIRPORT AND TERMINAL NAVAIDS	DVOR / DME, NDB
MAGNETIC VARIATIONS	1° W
CRASH PROTECTION PROVIDED	CAT - 8

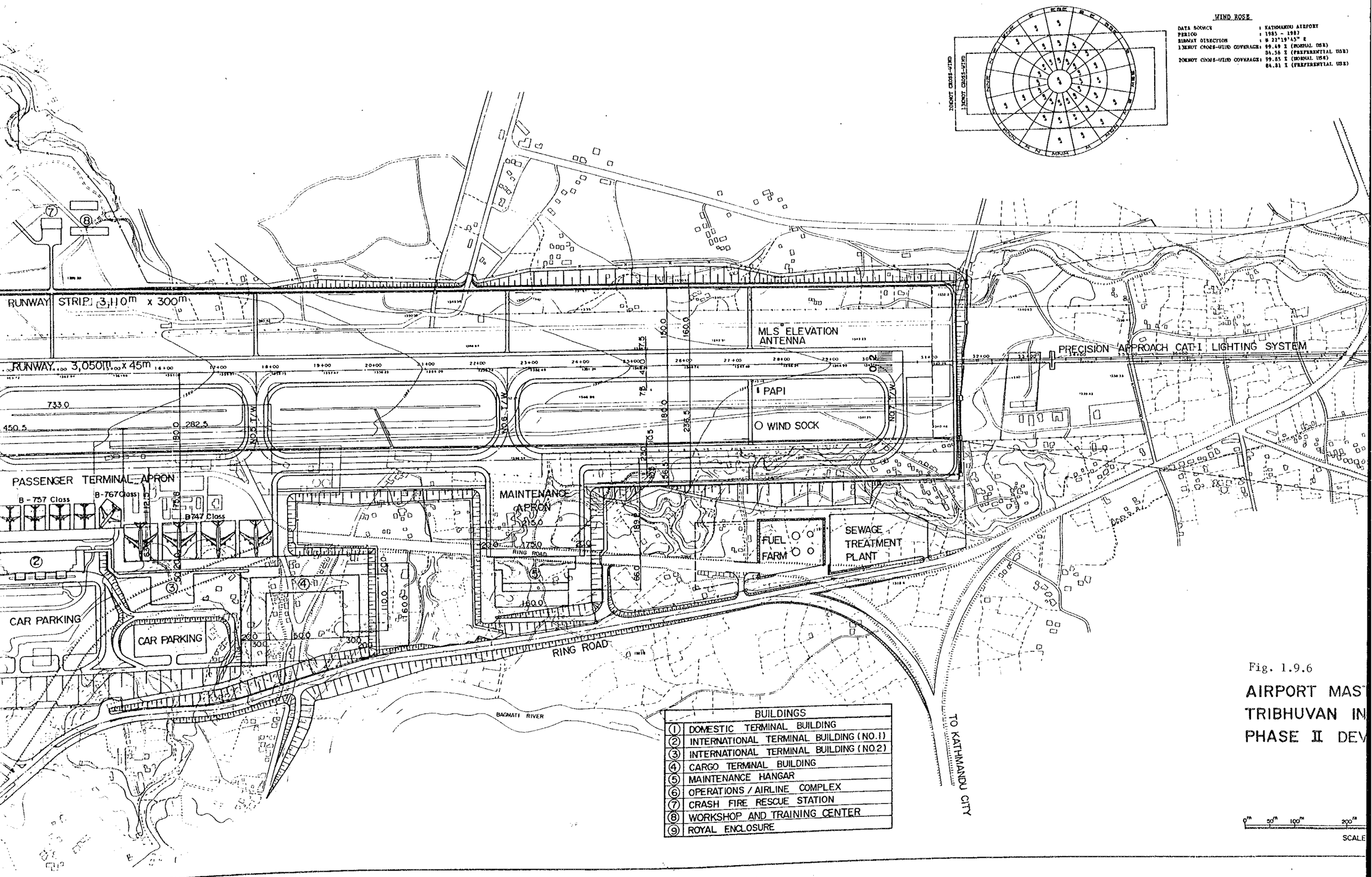
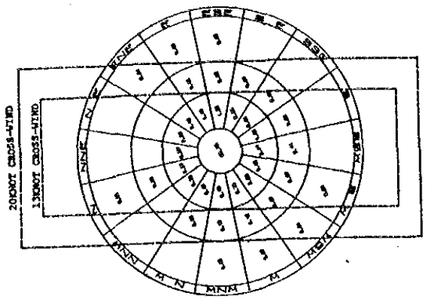


Fig. 1.9.6

AIRPORT MAS
TRIBHUVAN IN
PHASE II DEV



WIND ROSE

DATA SOURCE	: KATHMANDU AIRPORT
PERIOD	: 1985 - 1987
RUNWAY DIRECTION	: N 22°19'45" E
13KNOT CROSS-WIND COVERAGE	: 99.49 % (NORMAL USE)
	84.56 % (PREFERENTIAL USE)
20KNOT CROSS-WIND COVERAGE	: 99.85 % (NORMAL USE)
	84.81 % (PREFERENTIAL USE)

MLS ELEVATION ANTENNA
PAPI
WIND SOCK
MAINTENANCE APRON
FUEL FARM
SEWAGE TREATMENT PLANT
RING ROAD
PRECISION APPROACH CAT-I LIGHTING SYSTEM
DVOR / DME
APPROACH SURFACE (1:50)
TO KATHMANDU CITY
BAGMATI RIVER

BUILDINGS	
(1)	DOMESTIC TERMINAL BUILDING
(2)	INTERNATIONAL TERMINAL BUILDING (NO.1)
(3)	INTERNATIONAL TERMINAL BUILDING (NO.2)
(4)	CARGO TERMINAL BUILDING
(5)	MAINTENANCE HANGAR
(6)	OPERATIONS / AIRLINE COMPLEX
(7)	CRASH FIRE RESCUE STATION
(8)	WORKSHOP AND TRAINING CENTER
(9)	ROYAL ENCLOSURE

Fig. 1.9.6

AIRPORT MASTER PLAN OF
TRIBHUVAN INTERNATIONAL AIRPORT
PHASE II DEVELOPMENT (YEAR 2010)

0m 50m 100m 200m 300m 400m 500m
SCALE 1:6000

1.10 Master Plan of New Pokhara Airport

1.10.1 Breakdown of Air Traffic Demand

Air traffic demand at New Pokhara Airport is summarized as shown in Table 1.10.1.

Table 1.10.1 Summary of Air Traffic Demand

Year	Item / Period	Passenger Embarked/ Disembarked	Cargo (Ton)	Number of Aircraft Movements		
				HS-748 Class	DHC-6 Class	Total
1995	Annual	66,900	270	1,270	1,470	2,740
	Peak Month	8,100		153	177	330
	Design Day	270		4	6	10
	Peak Hour	90		1.4	2.1	3.5
	Heavy Direction Peak Hour	54				2
2000	Annual	79,900	330	1,550	1,640	3,190
	Peak Month	9,600		187	198	385
	Design Day	320		6	6	12
	Peak Hour	90		1.9	1.9	3.8
	Heavy Direction Peak Hour	54				2
2005	Annual	94,000	390	1,860	1,830	3,690
	Peak Month	11,300		224	220	444
	Design Day	380		8	6	14
	Peak Hour	100		2.3	1.7	4.0
	Heavy Direction Peak Hour	60				2
2010	Annual	107,600	440	2,150	2,030	4,180
	Peak Month	13,000		260	206	466
	Design Day	430		8	6	14
	Peak Hour	110		2.3	1.7	4.0
	Heavy Direction Peak Hour	66				2

1.10.2 Analysis of Airport Facility Requirements

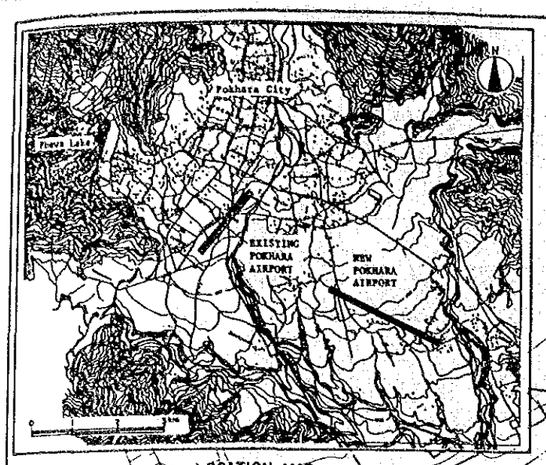
Table 1.10.2 shows the airport facility requirements which should be used as the bases for subsequent planning and design.

Table 1.10.2 Air Traffic Demand vs. Airport Facility Requirements

	Item \ Year		Present Condition (as of 1987)	1995	2000	2005	2010
Air Traffic Forecast	1.Annual Passenger		46,500	66,900	79,900	94,000	107,600
	2.Annual Cargo (ton)		195	270	330	390	440
	3.Annual Aircraft Movement (operation)		N.A	2,500	2,900	3,400	3,900
	4.Peak Hour Passenger		N.A	90	100	110	120
	5.Peak Hour Aircraft Movement (operation)		4.0	3.5	3.8	4.0	4.0
	6.Largest Aircraft		HS-748	do	do	B-757 class	do
Facility Requirements	7.Runway (m x m)		1433 X 30	1900 X 30	do	2500 x 45	do
	8.Runway Strip (m x m)		1570 X 150	2020 X 150	do	2620 x 300	do
	9.Taxiway (m x m)		-	179 X 15	do	165 x 18	do
	10.Passenger Terminal Apron (gate position)		HS-748 X 1 DHC-6 X 1	HS 2 DH 1	HS 2 DH 1	B757 1 HS 1 DH 1	do do do
	11.Passenger Terminal Building (sq.meter)			700	800	900	1,000
	12.Cargo Terminal Building (sq.meter)		-	20	30	30	40
	13.Administration Building (sq.meter)		-	200	200	200	200
	14.Air Navigation Systems		Non Precision, Instrument	Non Precision, Instrument			
	15.Car Parks (cars) (sq.meter)		-	30 1,100	30 1,400	40 1,400	50 1,800
	16.Access Road (lane)		1	2	2	2	2
	17.Fuel Supply (Fuel Tank) (Kl/Week)		-	30 Kl 18 Kl	do 21 Kl	40 Kl 25 Kl	50 Kl 29 Kl
	18.Rescue and Fire-Fighting	(Category) (Cars) (Fire Station,sq.m)	-	3 2 300	3 2 300	3 2 300	4 3 400
	19.Utilities	Electricity (KVA)	N.A	70	80	90	90
		Water (Ton/Month)	N.A	390	420	470	500
		Waste Deposit (Ton/Month)	N.A	2.0	2.1	2.6	2.7
		Sewage (Ton/Month)	N.A	280	310	340	370

1.10.3 Airport Master Plan

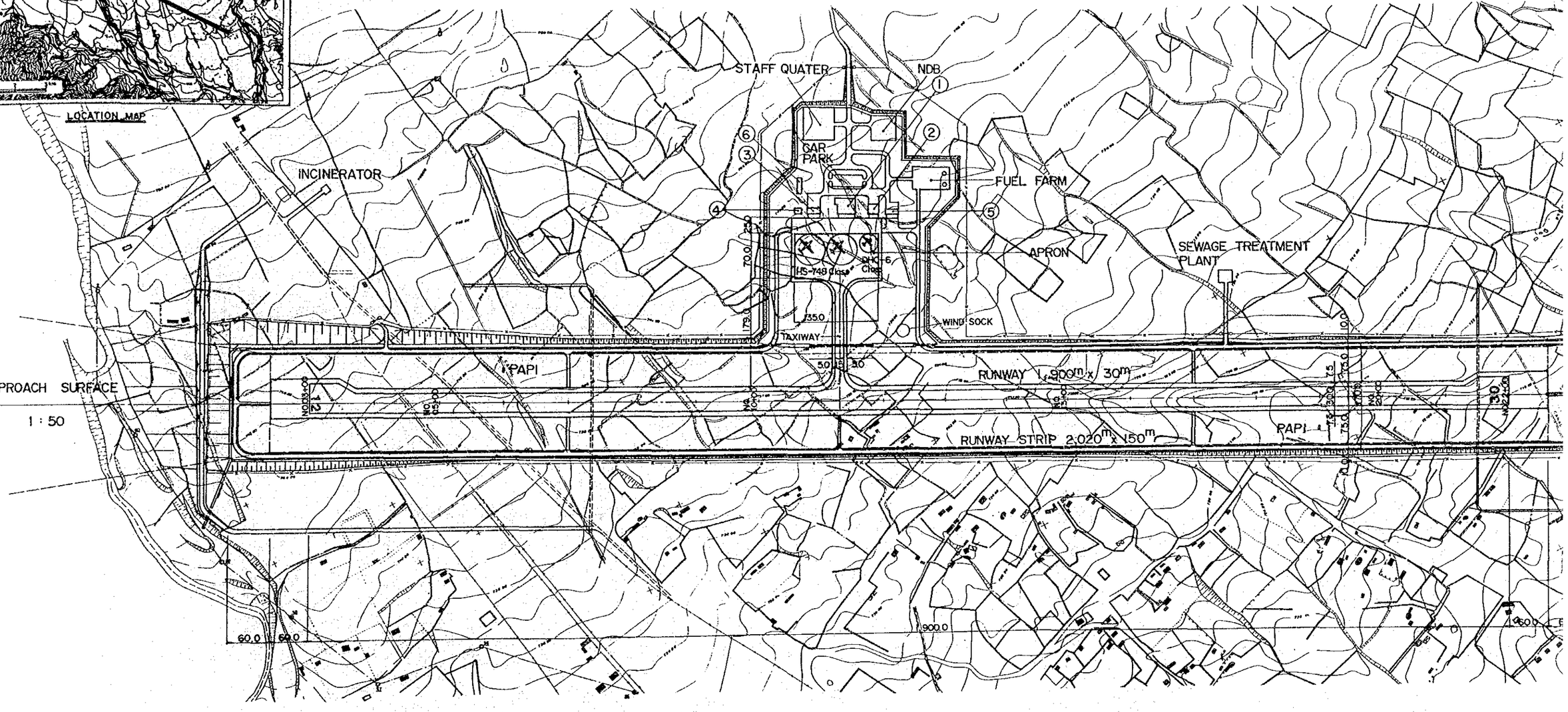
Based on the airport facility requirements, the airport layout plan for Phase I and II were prepared as shown in Figs. 1.10.1 and 2.



LOCATION MAP

APPROACH SURFACE

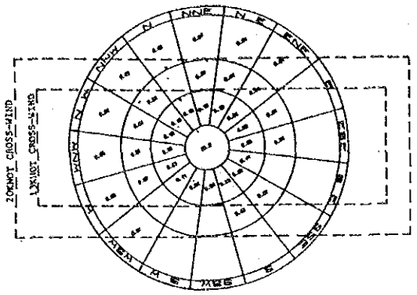
1 : 50



RUNWAY DATA	
EFFECTIVE GRADIENT	0.99 %
PERCENTAGE WIND COVERAGE	99.8 %(13KNOT) 99.9 %(20KNOT)
INSTRUMENT RUNWAY	✓
PAVEMENT STRENGTH	PCN 8/F/A/W/T
APPROACH SURFACES	1 : 50
RUNWAY LIGHTING	HIRL
RUNWAY MARKING	ALL WEATHER
NAVIGATIONAL AIDS	SALS, PAPI

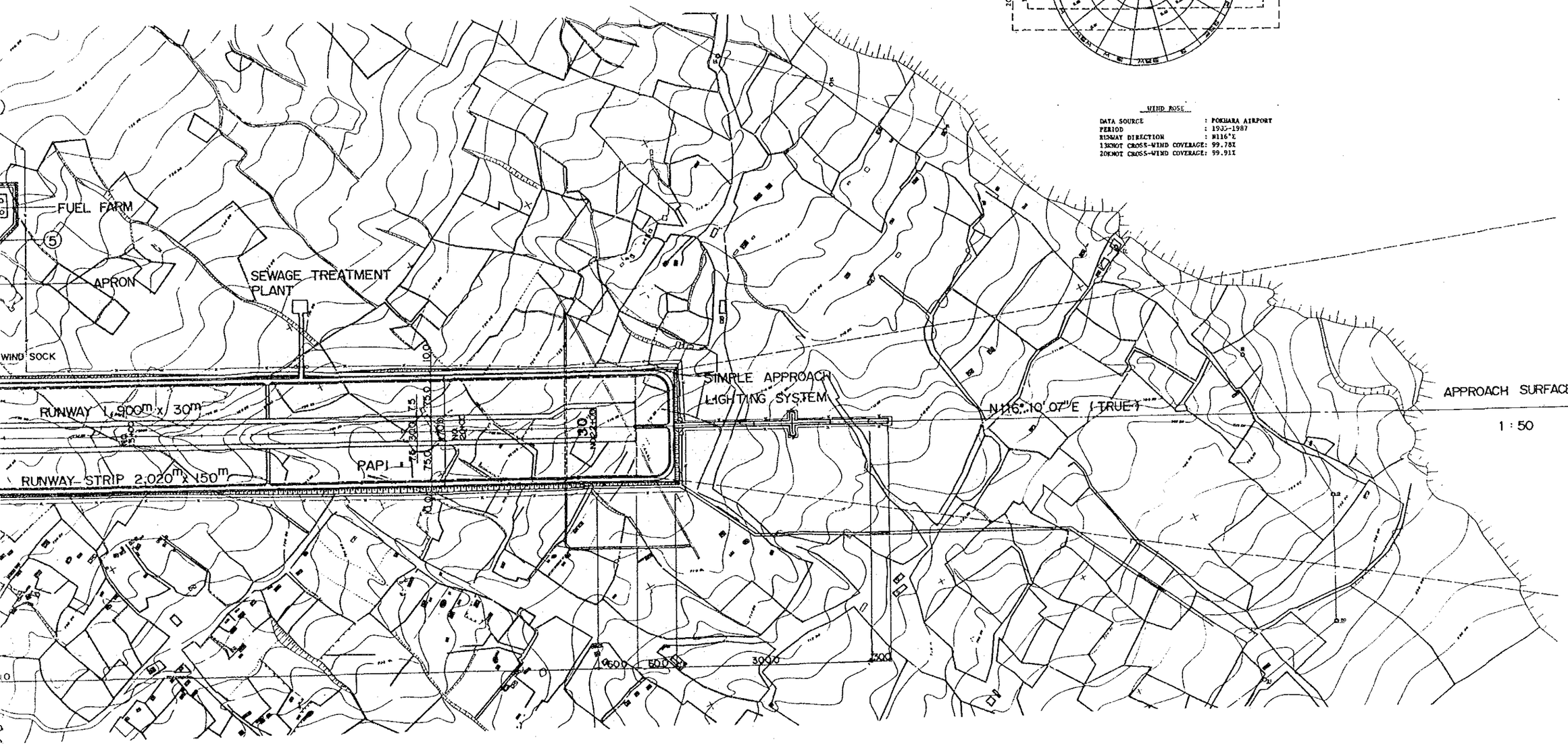
AIRPORT DATA	
AIRPORT ELEVATION	737m
AIRPORT REFERENCE POINT (ARP)	LAT 28°11'04"N LNG 84°00'48"E
AIRPORT REFERENCE TEMPERATURE	27.8°C
AIRPORT AND TERMINAL NAVAIDS	DVOR/DME,NDB
MAGNETIC VARIATIONS	1°W
CRASH PROTECTION PROVIDED	CAT-3

BUILDING	
①	PASSENGER TERMINAL BUILDING
②	CARGO TERMINAL BUILDING
③	ADMINISTRATION OFFICE AND CONTROL TOWER
④	METEOROLOGICAL OFFICE
⑤	FIRE STATION
⑥	GENERATOR HOUSE



WIND ROSE

DATA SOURCE	: POKHARA AIRPORT
PERIOD	: 1935-1987
RUNWAY DIRECTION	: N116°E
13KNOT CROSS-WIND COVERAGE	: 99.78%
20KNOT CROSS-WIND COVERAGE	: 99.91%

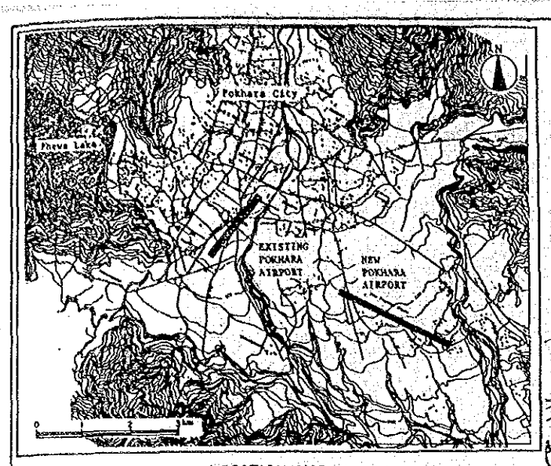


BUILDING	
①	PASSENGER TERMINAL BUILDING
②	CARGO TERMINAL BUILDING
③	ADMINISTRATION OFFICE AND CONTROL TOWER
④	METEOROLOGICAL OFFICE
⑤	FIRE STATION
⑥	GENERATOR HOUSE

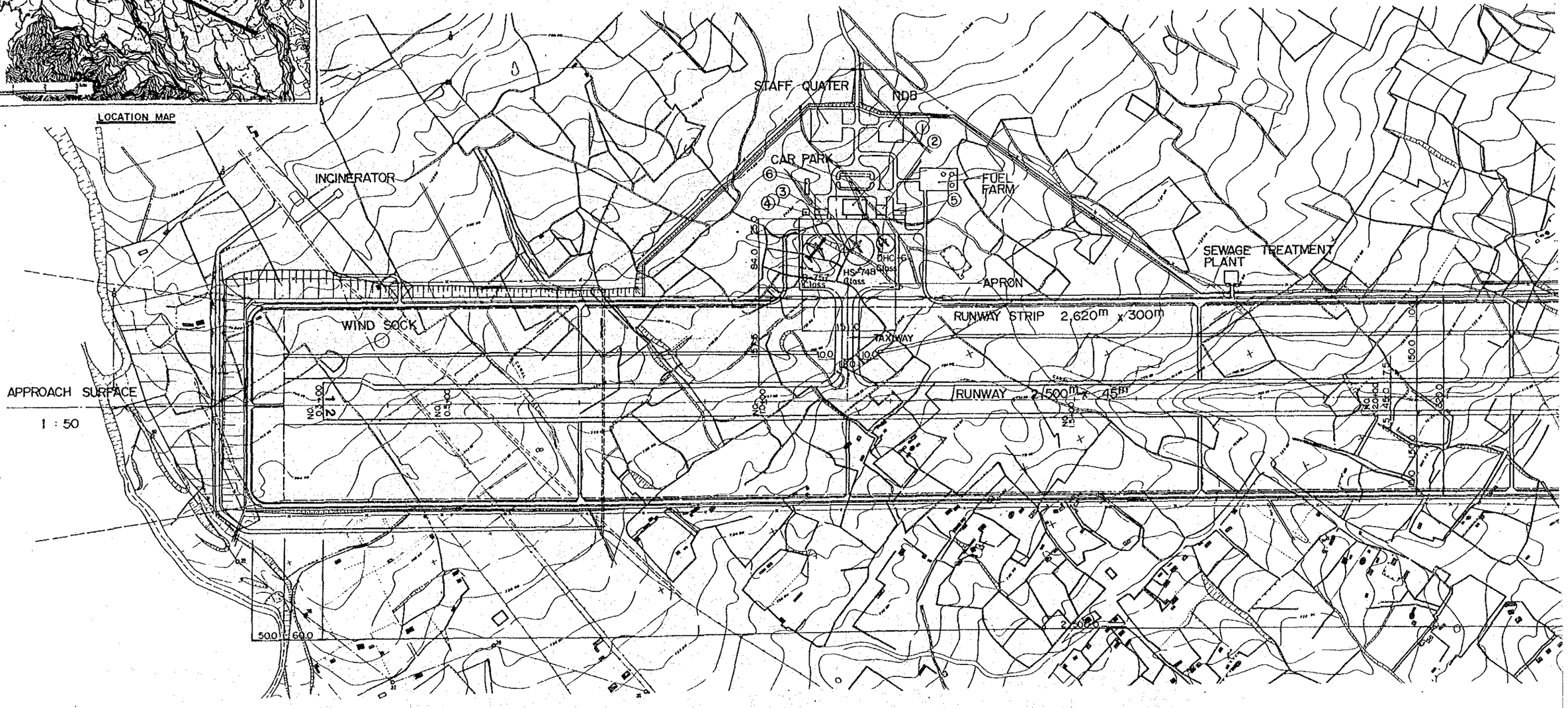
Fig. 1.10.1

AIRPORT MASTER PLAN OF
NEW POKHARA AIRPORT
PHASE I DEVELOPMENT (YEAR 2000)

0 50 100 200 300
SCALE IN METERS



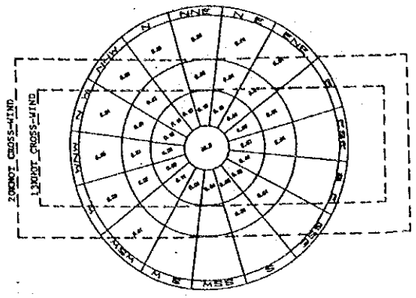
LOCATION MAP



RUNWAY DATA	
EFFECTIVE GRADIENT	0.975 %
PERCENTAGE WIND COVERAGE	99.8 % (13KNOT) 99.9 % (20KNOT)
INSTRUMENT RUNWAY	
PAVEMENT STRENGTH	PCN48/F/B/W/T
APPROACH SURFACES	1 : 50
RUNWAY LIGHTING	HIRL
RUNWAY MARKING	ALL WEATHER
NAVIGATIONAL AIDS	SALS , PAPI

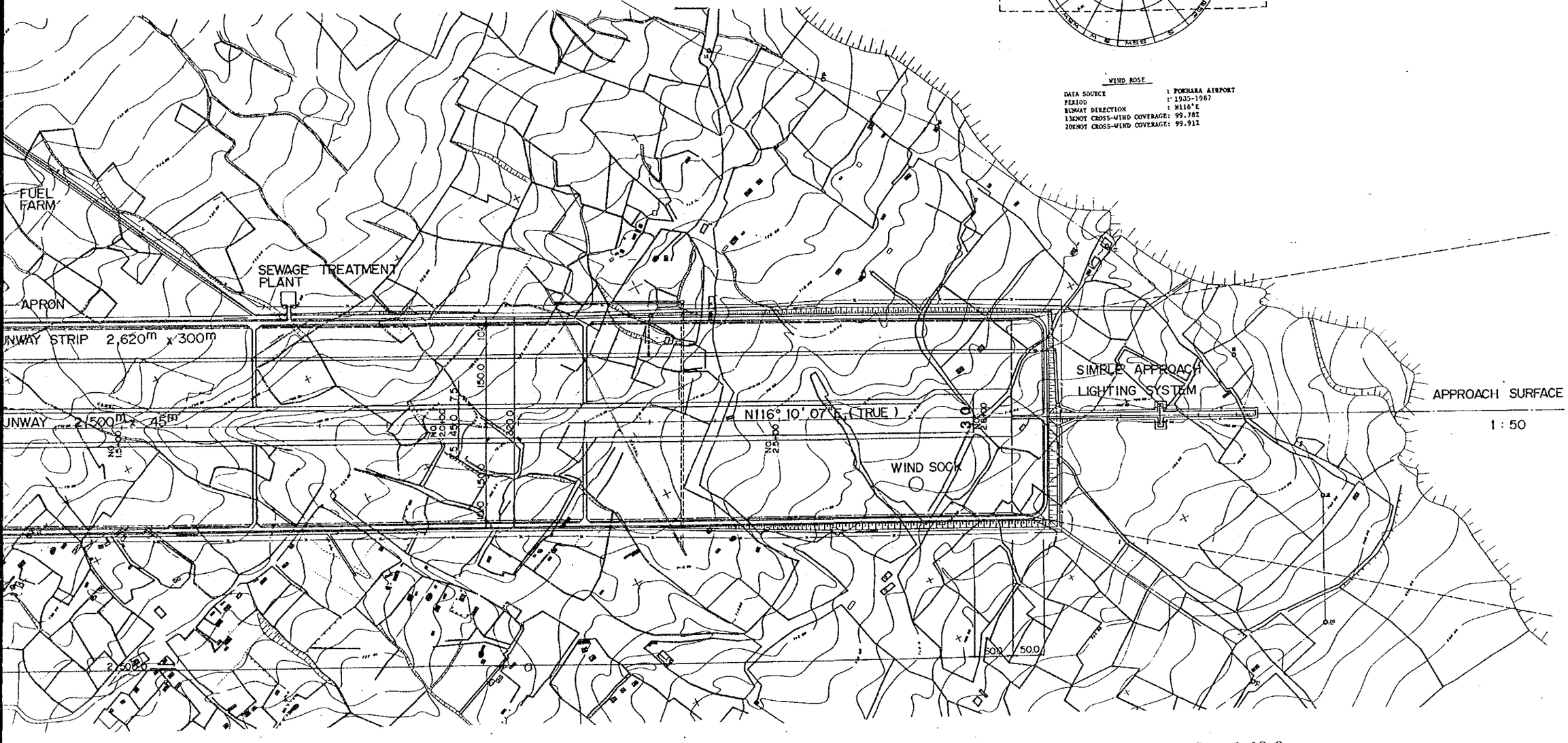
AIRPORT DATA	
AIRPORT ELEVATION	737 m
AIRPORT REFERENCE POINT (ARP)	LAT 28°11'04" N LNG 84°00'48"E
AIRPORT REFERENCE TEMPERATURE	27.8°C
AIRPORT AND TERMNAL NAVAIDS	DVOR/DME , NDB
MAGNETIC VARIATIONS	1° W
CRASH PROTECTION PROVIDED	CAT-4

BUILDING	
①	PASSENGER TERMINAL BUILDING
②	CARGO TERMINAL BUILDING
③	ADMINISTRATION OFFICE AND CONTROL TOWER
④	METEOROLOGICAL OFFICE
⑤	FIRE STATION
⑥	GENERATOR HOUSE



WIND ROSE

DATA SOURCE	: POKHARA AIRPORT
PERIOD	: 1935-1987
RUNWAY DIRECTION	: N116°E
13KNOT CROSS-WIND COVERAGE:	99.78%
20KNOT CROSS-WIND COVERAGE:	99.91%



BUILDING	
①	PASSENGER TERMINAL BUILDING
②	CARGO TERMINAL BUILDING
③	ADMINISTRATION OFFICE AND CONTROL TOWER
④	METEOROLOGICAL OFFICE
⑤	FIRE STATION
⑥	GENERATOR HOUSE

Fig. 1.10.2

AIRPORT MASTER PLAN OF
NEW POKHARA AIRPORT
PHASE II DEVELOPMENT (YEAR 2010)

0 50 100 200 300
SCALE IN METERS

1.11 Master Plan of STOL Airports

1.11.1 General

Table 1.11.1 shows the development works for key airports.

Table 1.11.1 Development Works at Key Airports

Name of Airport	Runway		Buil-dings	Navaids	Other Works
	Exten-tion	paving			
Dolpa	-	o			High speed turn off
Jomsom	o	o			Protection works for river erosion
Jumla	-	o	*		* Under construction
Lukla	-	o			Additional apron
Sanfebagar	o	o			Protection works for river erosion
Simikot	o	o			New apron Paving is difficult due to freezing
Phaplu	-	o	o	o	
Syangboche	*	o	o		* DCA plans to expand to introduce DHC-6
Mugu	*	o	o	o	* DCA plans newly to construct

Note: Symbol of o indicates necessary works.

1.11.2 Master Plan of Jomsom Airport

Development works to be carried out are as follows:

(1) Runway extension

Runway will be extended to 720 m from the existing 610 m length. Physical characteristics are set by the regulations of the Stolport Manual.

(2) Grading of the runway strip

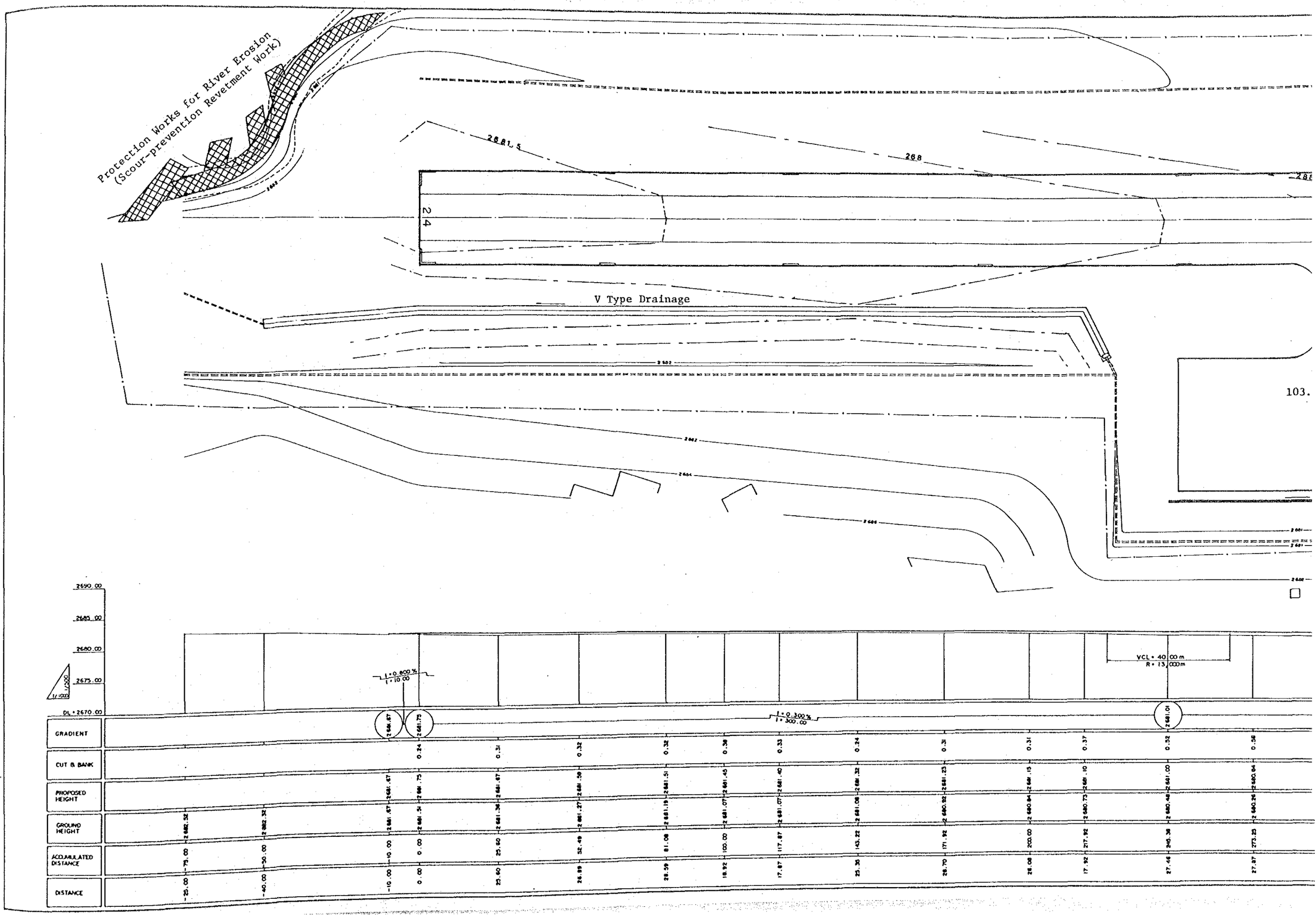
(3) Protection works for river erosion

Protection works by wire cylinders will be executed for river erosion at the north end of the runway strip.

(4) Paving of the runway

Asphalt concrete pavement has been adopted because of easy maintenance in comparison with other pavement types such as cement concrete pavement, asphalt penetration pavement, and cement stabilized pavement. Width of pavement is set at 18 m.

The development plan of Jomsom airport is shown in Fig. 1.11.1.


Protection Works for River Erosion
(Scour-prevention Revetment Work)
2681.5
288
24
V Type Drainage
2690.00
2685.00
2680.00
2675.00
V=200
1/1000
DL = 2670.00
1=0.800%
1=10.00
1=0.300%
1=300.00
VCL = 40.00 m
R = 13,000m
GRADIENT
CUT & BANK
PROPOSED HEIGHT
GROUND HEIGHT
ACCUMULATED DISTANCE
DISTANCE

Grading Work of Runway Strip

Runway 30.0 X 720.0 m

Pavement 18.0 X 720.0 m

2880.5 2880 2880 2880.5 2881 2881.5

V Type Drainage

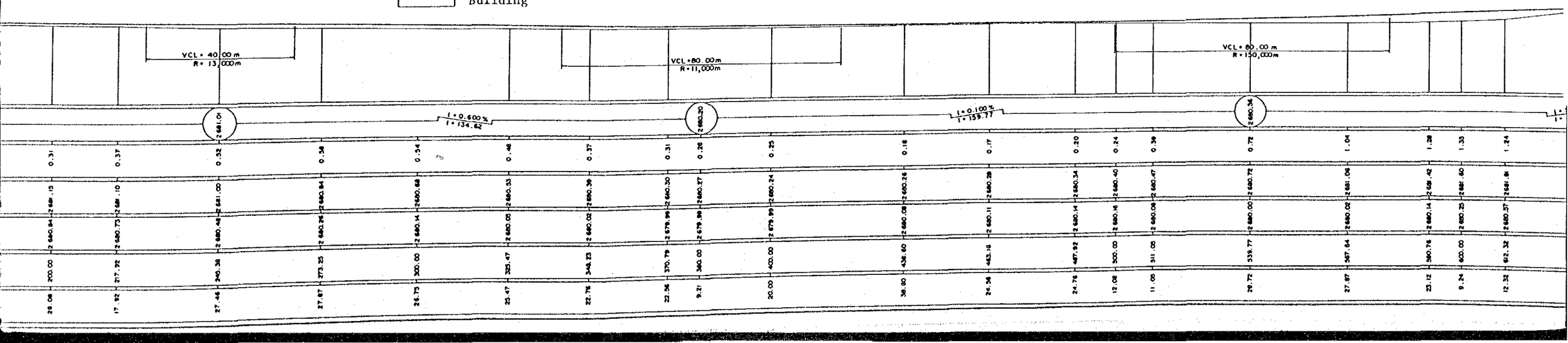
Apron

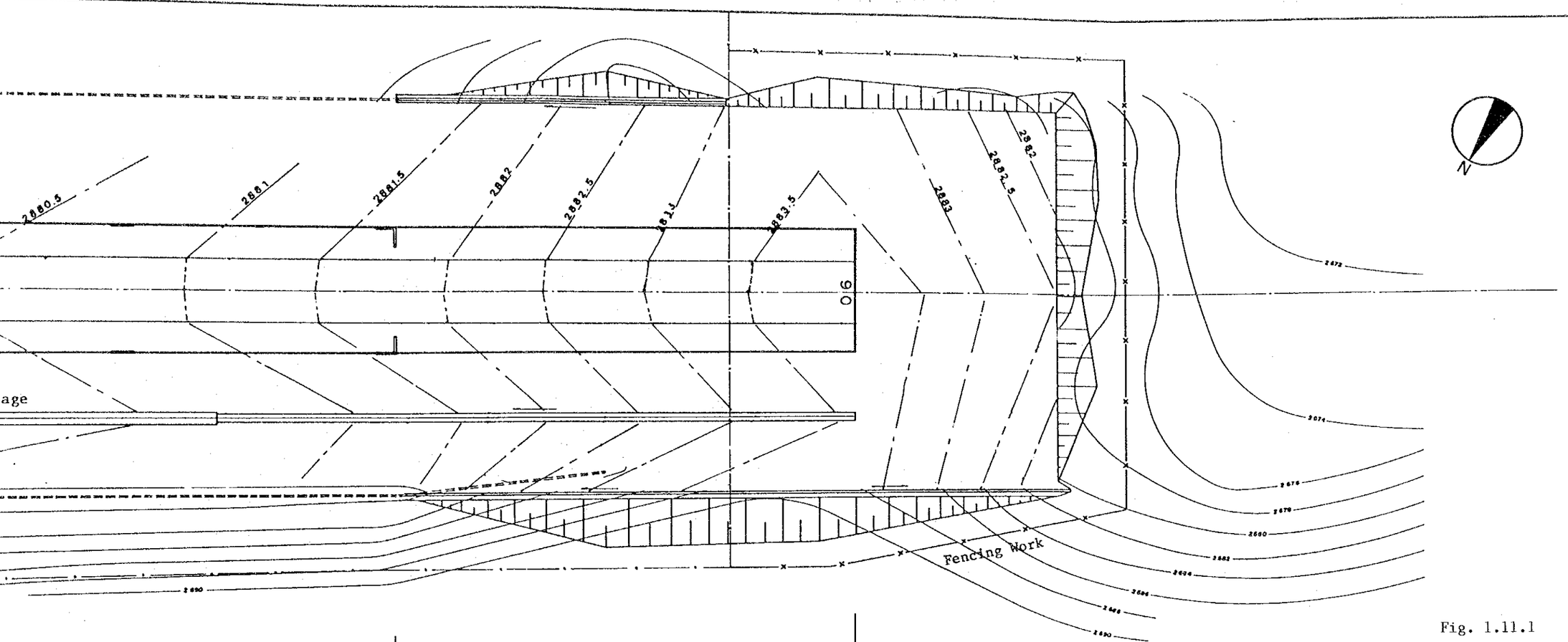
103.5 X 43.5 m

Terminal Building

PLAN S = 1 : 1000

RUNWAY PROFILE Y = 1 : 500 H = 1 : 1000





S = 1 : 1000

FILE Y = 1 : 500
H = 1 : 1000

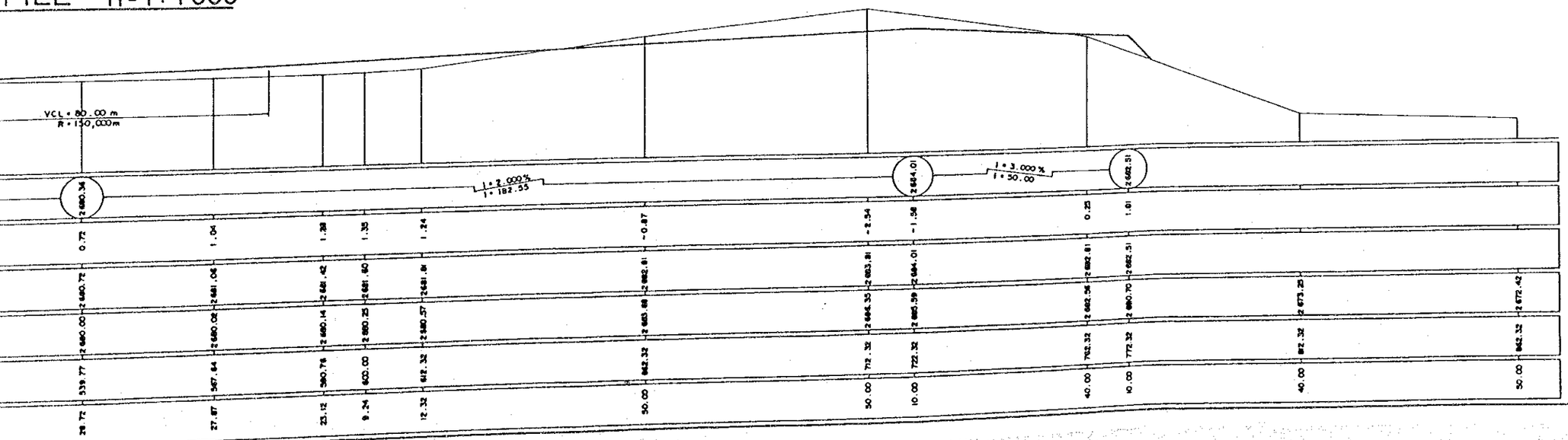


Fig. 1.11.1

JOMSOM AIRPORT
DEVELOPMENT PLAN

1.11.3 Master Plan of Simikot Airport

Development works to be carried out are as follows:

(1) Runway extension

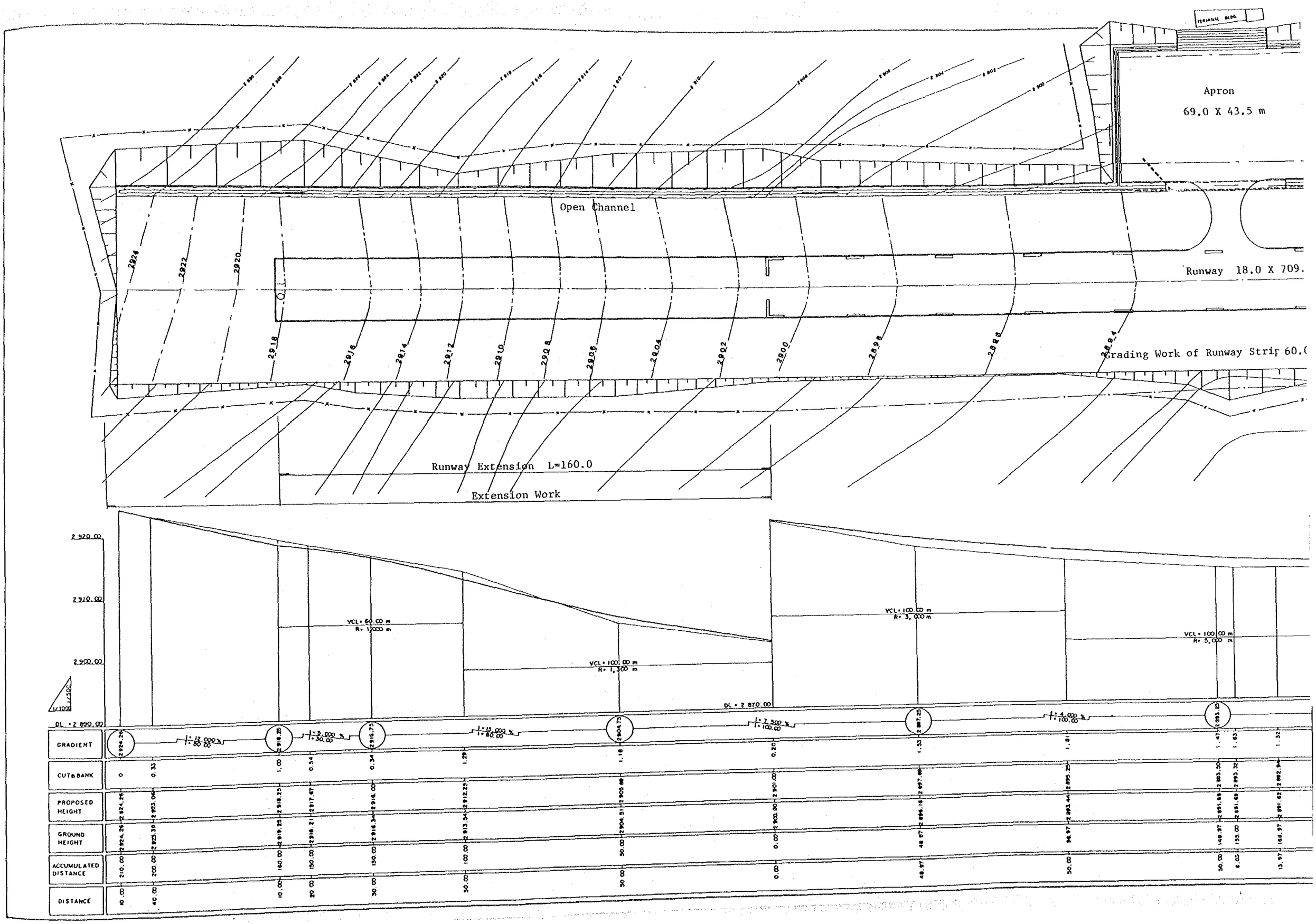
Runway will be extended to 709 m from the existing 549 m. Physical characteristics are based on the Altiport Recommendation in principle.

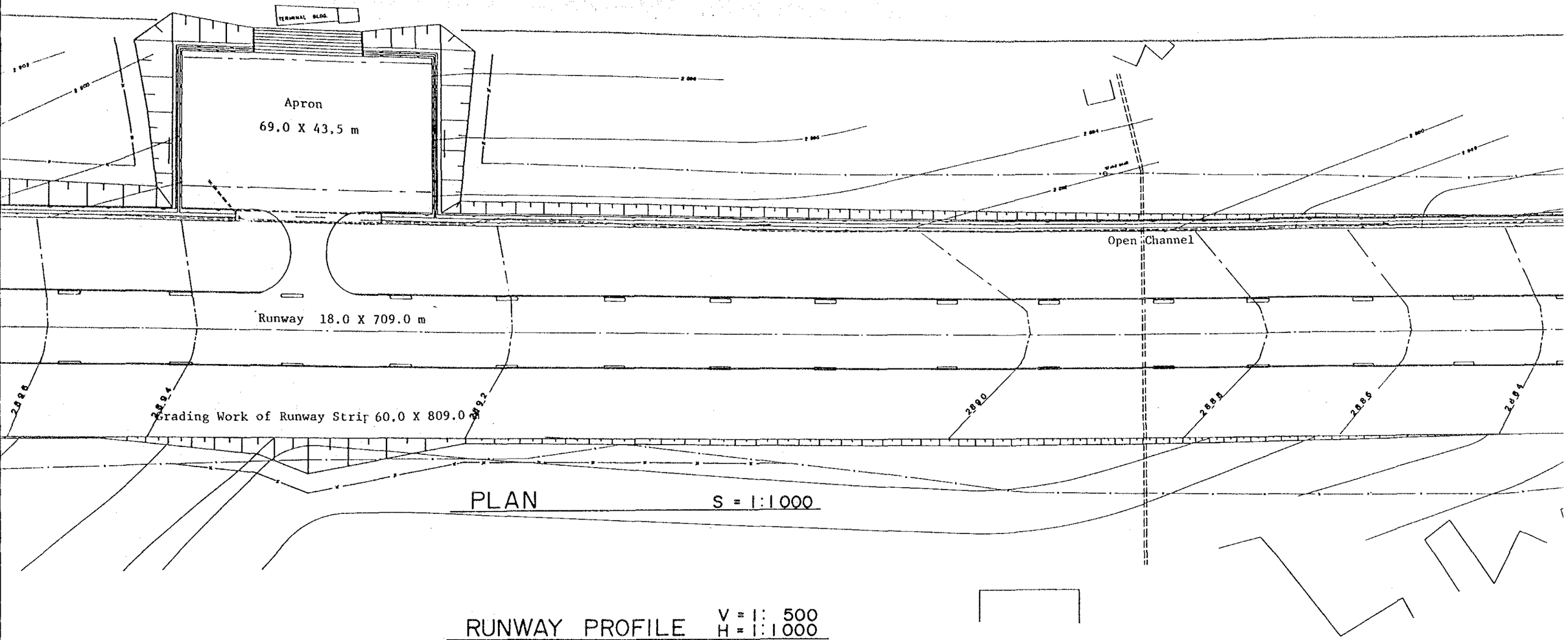
(2) Grading of the runway strip

(3) Paving of the runway

Aggregate-turf pavement recommended by FAA is adopted at this airport considering the low temperatures and snowfall during the winter.

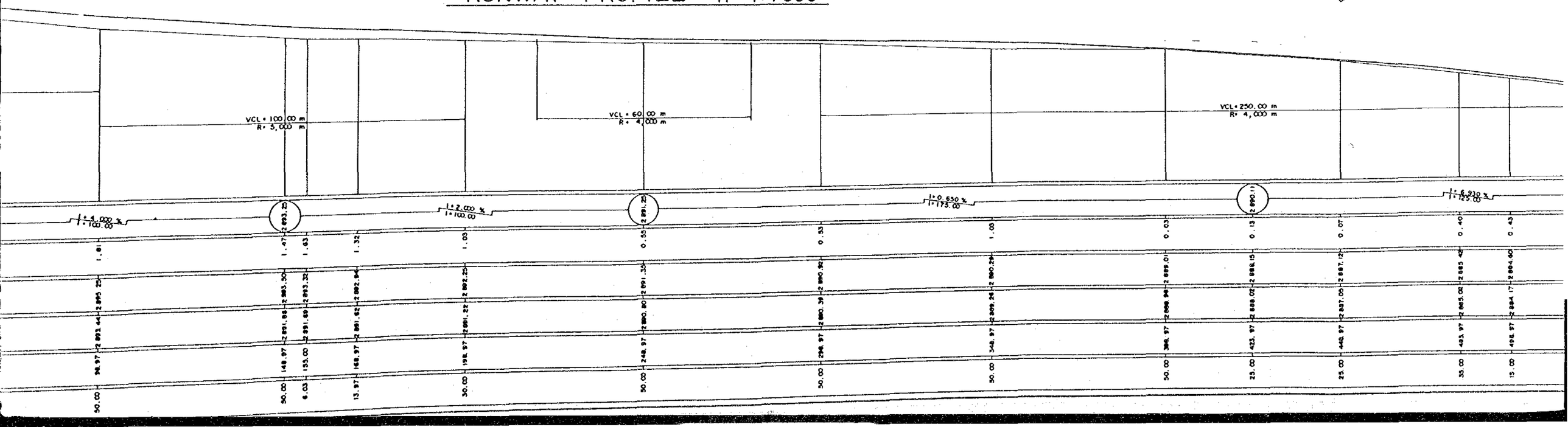
The development plan of Simikot airport is shown in Fig. 1.11.2.


Apron
69.0 X 43.5 m
Open Channel
Runway 18.0 X 709.
Grading Work of Runway Strip 60.0
Runway Extension L=160.0
Extension Work
2 920.00
2 910.00
2 900.00
DL = 2 890.00
DL = 2 870.00
VCL = 60.00 m
R= 1,000 m
VCL = 100.00 m
R= 1,300 m
VCL = 100.00 m
R= 3,000 m
VCL = 100.00 m
R= 5,000 m
GRADIENT
CUT & BANK
PROPOSED HEIGHT
GROUND HEIGHT
ACCUMULATED DISTANCE
DISTANCE



PLAN S = 1:1000

RUNWAY PROFILE V = 1: 500 H = 1:1000



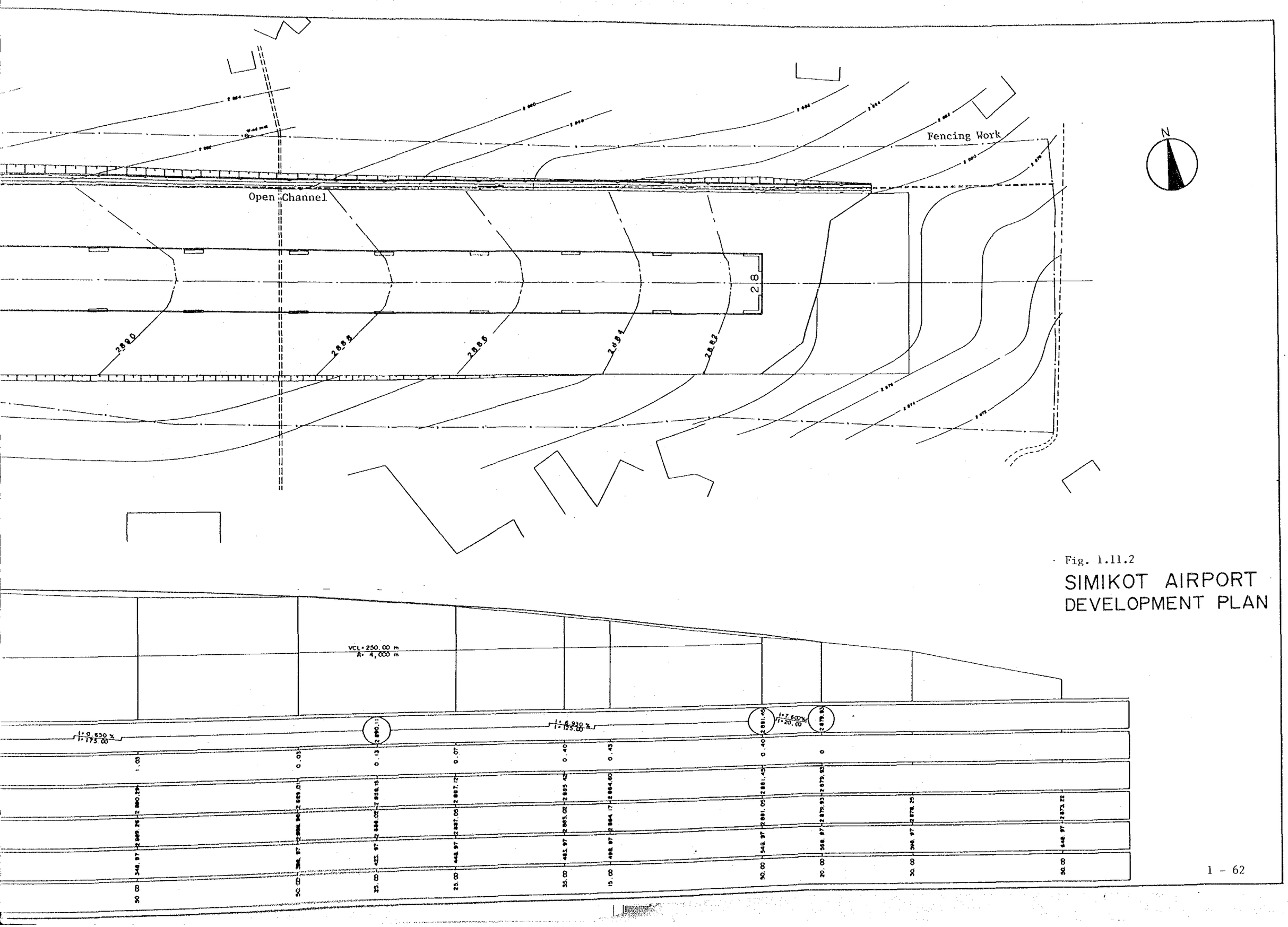


Fig. 1.11.2

SIMIKOT AIRPORT
DEVELOPMENT PLAN

1.11.4 Master Plan of Lukla Airport

Development works to be carried out at Lukla Airport are as follows:

(1) Grading of the runway strip

Maximum longitudinal slope is planned to be improved to 15.0 % as existng maximum slope is over the maximum slope of 15 % in the Altiport Recommendations.

(2) Paving of the runway

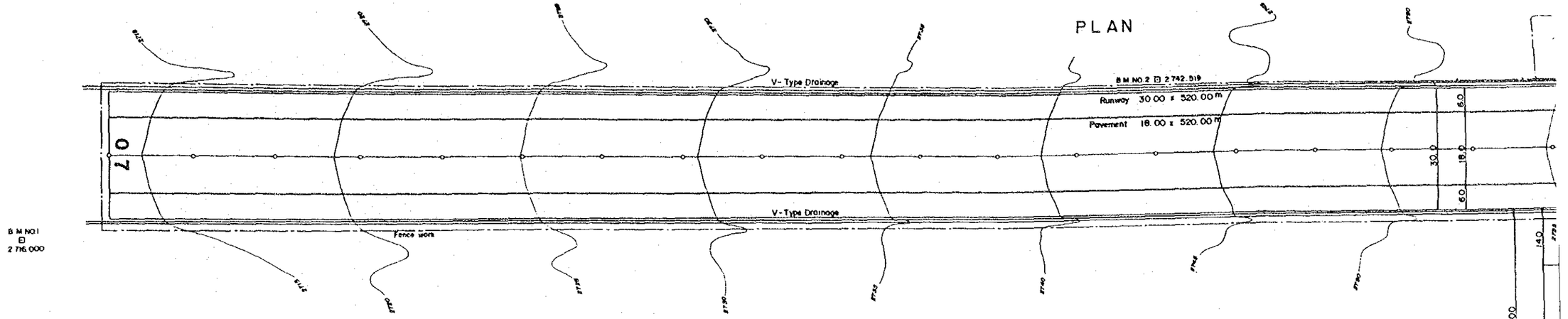
Asphalt concrete pavement is recommended, thickness of subgrade is set at 50 cm to prevednt freezing the pavement.

(3) Construction of apron

A new apron is planned to accomodate two DHC-6's adjacent to the existing apron.

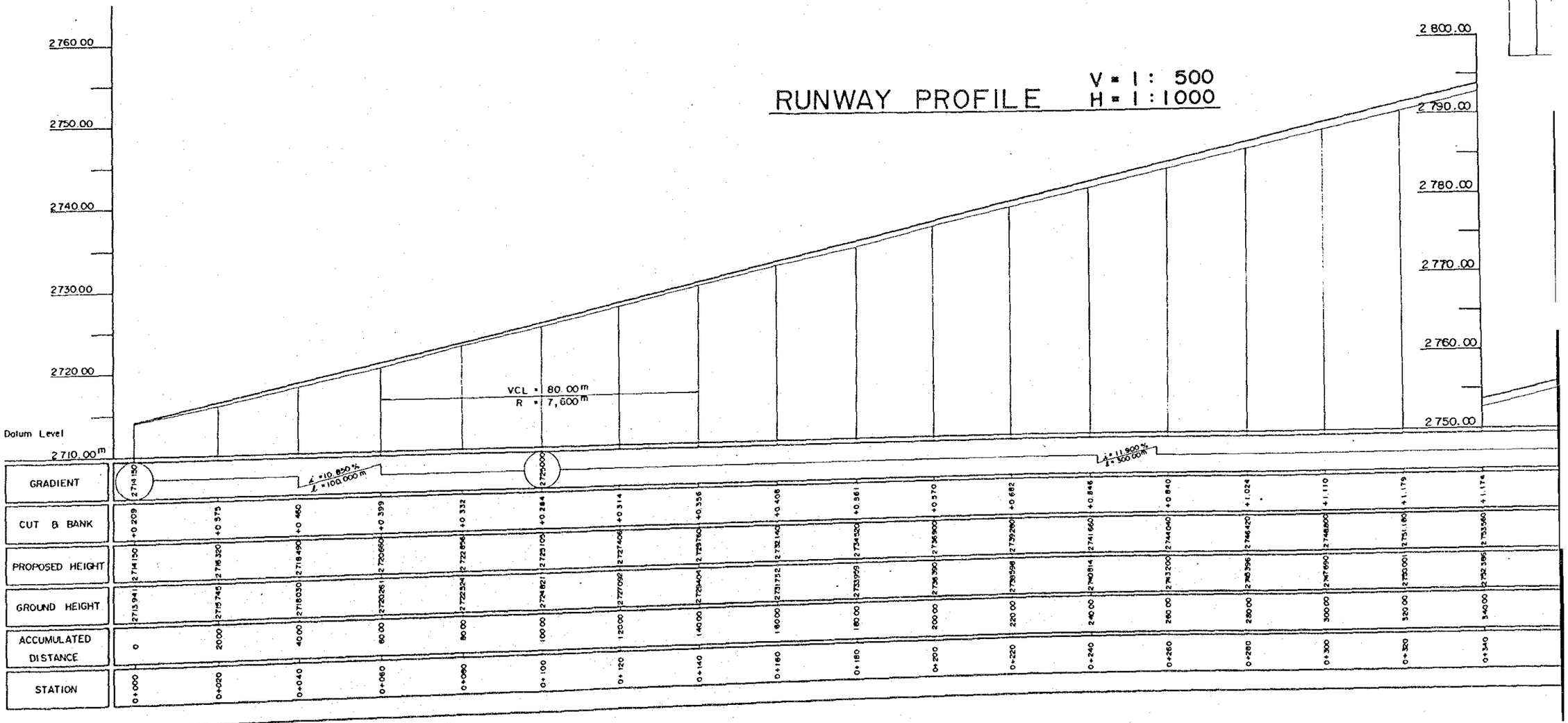
(4) Installation of storm water drainage facilities

The development plan of Lukla Airport is shown in Fig. 1.11.3.

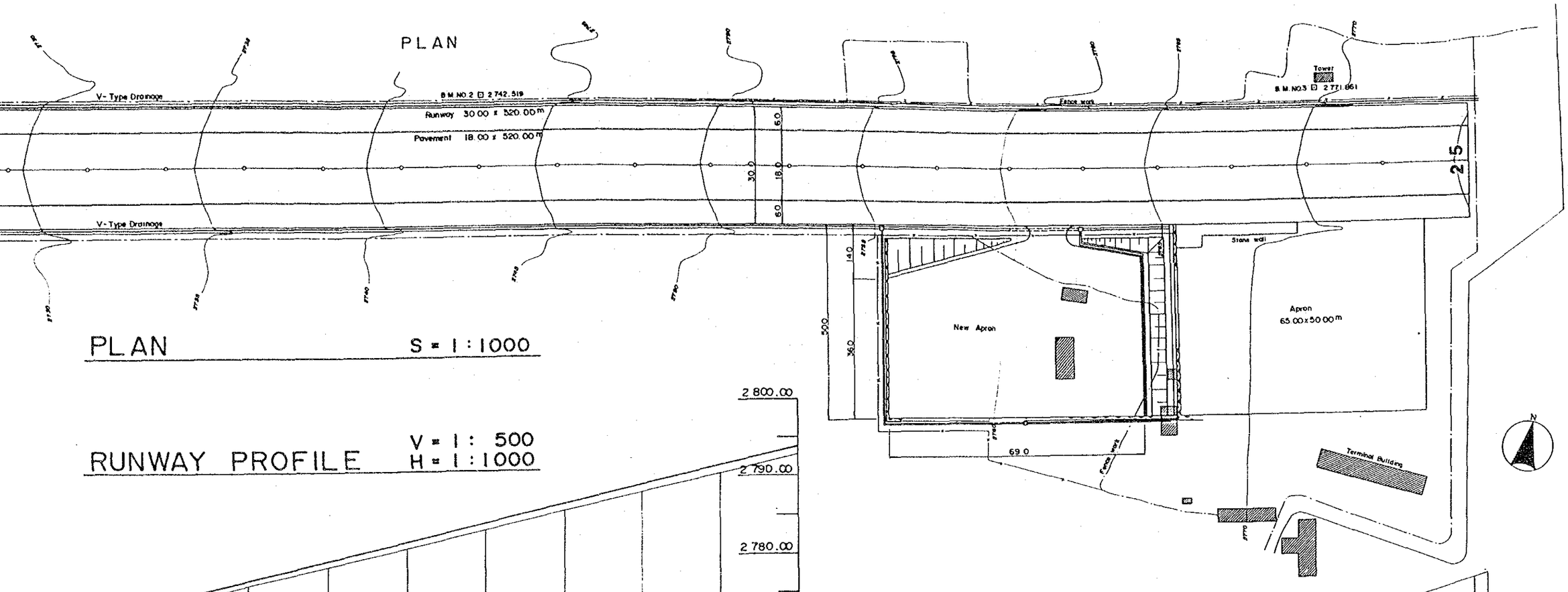


PLAN S = 1 : 1000

RUNWAY PROFILE V = 1 : 500 H = 1 : 1000



PLAN



PLAN S = 1 : 1000

RUNWAY PROFILE V = 1 : 500 H = 1 : 1000

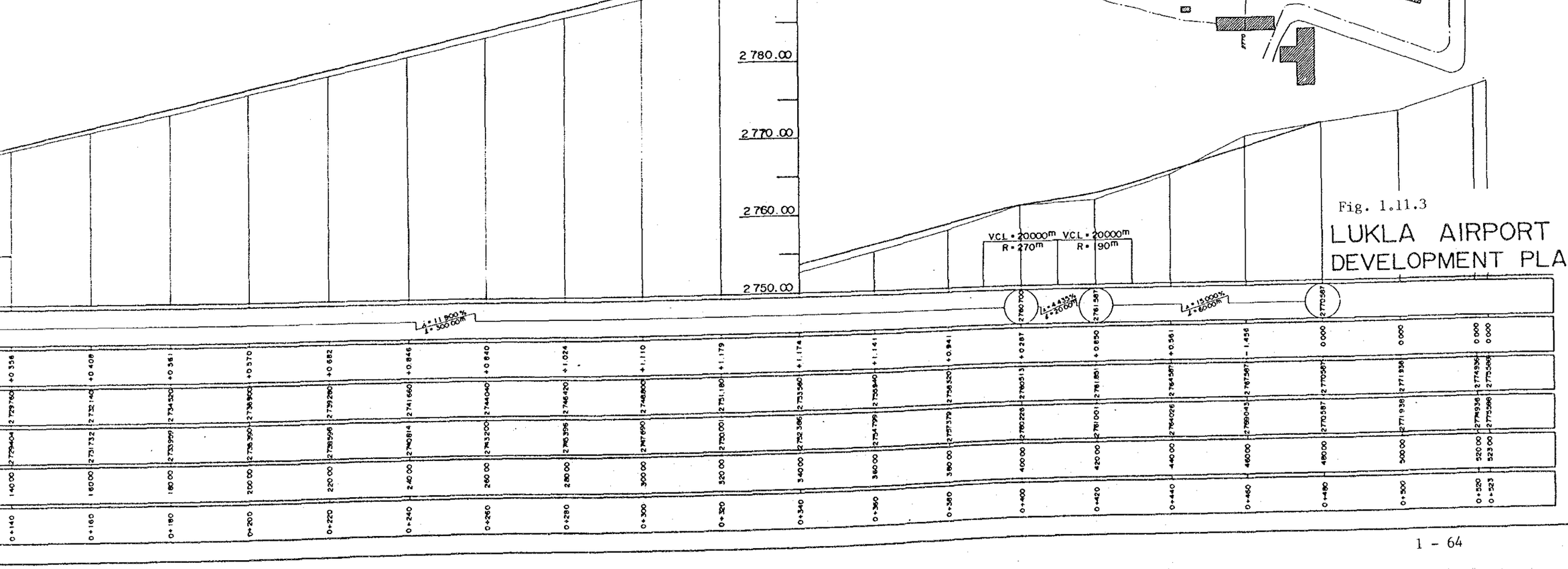


Fig. 1.11.3

LUKLA AIRPORT DEVELOPMENT PLAN

1.11.5 Review of Feasibility Study of Syangboche Airport

"Technical and Economical Feasibility Study of Syangboche Airport(final report, December 1986)" was reviewed as follows:

Table 1.11.2 Review of Feasibility Study of Syangboche Airport

1.Design Criteria :	The criteria from Altiport Recommendations were adopted.	
2.Length of Runway :	550 m	
Length of Runway Strip :	650 m	
3.Orientation of Runway :	5 degrees from the existing runway orientation,	
4.Width of Runway Strip :	50 m	Altiport Recommendation
5.Runway Longitudinal Slope :	Max. 10.5 %	
6.Drainage :	Construction of water energy dissipator, water drop, and increase in depth of drains	

1.11.6 Review of Feasibility Study of Mugu Airport

Review on "Feasibility Study of Talcha (Mugu) Airport (July, 1988)" is summarized as shown below:

Table 1.11.3 Review of Feasibility Study of Mugu Airport

1.Design Criteria :	Annex 14,ICAO is mainly used, and Stolport Mannual,ICAO, and Altiport Recommendations are partly used	
2.Length of Runway :	550 m	Altiport Recommendation
Length of Runway Strip :	610 m	Altiport Recommendation
3.Width of Runway :	30 m	Stolport Manual
Width of Runway Strip :	60 m	Annex 14
4.Runway Orientation :	Alternative B	Earth work already carried out, and hillside obstruction is also avoidable.
5.Runway Longitudinal Slope:	Max. 12 %	Altiport Recommendation
6.Transverse Slope :	2.0 %	Original Design
7.Drainage :	Construction of water energy dissipator, water drop, and increase in depth of drains	
8.Airspace :	Many obstructions in the inner horizontal, conical, and south approach surfaces. Therfore takeoff/landing is limitted to/from north.	

1.11.7 Master Plan of Other STOL Airports

The master plans for other four STOL airports are summarized as shown below:

Table 1.11.4 Preliminary Cost of the Development Work for Each Airport

Unit : US$ 1,000

Name of Airport	Surfacing Work for Runway		Building Work	Other Work	Total	Remarks (*)
	Length	Cost				
Dolpa	457 m	1,900		* 100	2,000	High speed turn-off, L=150m
Jumla	670	2,800			2,800	
Sanfebagar	427	1,800		* 100	1,900	Protection works for river erosion
Phaplu	670	2,800	* 300	450	3,550	Refer to Mugu Airport
Total	-	9,300	300	650	10,250	

1.11.8 Master Plan of Navigation Aids

The installation of navigation aids and air traffic control facilities, etc. has been carried out by a French grant aid program at Dolpa, Jomsom, Jumla, Lukla, Sanfebagar and Simikot airports.

The French grant aid program for airports included the following facilities:

(1) Single position console including the following components:

a) VHF transceiver
b) HF transceiver

c) Wind direction and speed observation and indicator
d) Barometer
e) Tape recorder
f) Public address system
g) Intercom and clock
h) Siren

(2) Solar power supply facilities

(3) Precision approach path indicator

(4) Non-directional beacon

The same navigational facilities as those included in the French grant aid package have been planned for Mugu, Phaplu and Syangboche airports.