Table 3.6.10 Peak Hour Passengers (1 way)

	1995	2000	2005	2010
Domestic International Overall	112 272 328	112 336 392	176 384 440	296 384 504

3.7 Annual Aircraft Movements

Annual movements of commercial aircraft are estimated by analyzing the typical week aircraft movements. Other aircraft movements including BAF and general aviation are assumed to be maintained at the present level of 5,700 annual movements in 1988 taking into account the recent stable trend. The result is shown in Table 3.7.1.

Table 3.7.1 Annual Aircraft Movements

	1995	2000	2005	2010
Domestic Dhaka Cox's Bazar	 SJ/TP:4,200 - SJ/TP:200	 SJ/TP:5,600 - SJ/TP:200	 SJ/TP:4,200 NB :1,400 SJ/TP:300	 SJ/TP:2,800 NB :2,800 SJ/TP:300
Subtotal	4,400	5,800	5,900	5,900
International Middle East Calcutta Bangkok	 WB:370 SJ/TP:840 - WB:190	 WB:560 SJ/TP:460 NB:370 WB:280	 WB:560 NB:840 - WB:370	 WB:740 NB:1,110 - WB:460
Sub-total	1,400	1,670	1,770	2,310
Commercial Aircraft	5,800	7,480	7,670	8,210
Others	5,700	5,700	5,700	5,700
Total	11,500	13,170	13,370	13,910

3.8 Summary of Air Traffic Demand Forecasts

Traffic demands at Chittagong Airport are summarized in Table 3.8.1.

Table 3.8.1 Summary of Air Traffic Demand Forecast (1)

ITEMS	YEAR 1995		YEAR 2000		YEAR 2005		Year 2010	
Annual Passengers								
Domestic		165,000		200,000		240,000		290,000
CGP-DAC		161,000		195,000		234,000		283,000
CGP-CXB		4,000		5,000		6,000		7,000
International		160,000		240,000		330,000		440,000
CGP-DAC		51,000		77,000		107,000		140,000
CGP-Middle East		50,000		74,000		100,000		134,000
CGP-CCU		40,000		61,000		84,000		113,000
CGP-BKK		19,000		28,000		39,000		53,000
Total		325,000		440,000		570,000		730,000
Annual Cargo								
Domestic		500		800		1,000		1,300
International		3,000		6,500		8,800		11,600
Total		3,500		7,300		9,800		12,900
Annual Aircraft Movements								
Domestic		4,400		5,800		5,900		5,900
CGP-DAC	SJ/TP (70)	4,200	SJ/TP (70)	5,600	SJ/TP (70)	4,200	SJ/TP (70)	2,800
	NB (150)	0	NB (150)	0	NB (150)	1,400	NB (150)	2,800
CGP-CXB	SJ/TP (70)	200	SJ/TP (70)	200	SJ/TP (70)	300	SJ/TP (70)	300
International		1,400		1,670		1,770		2,310
CGP-Middle East	WB (270)	370	WB (270)	560	WB (330)	560	WB (330)	740
CGP-CCU	SJ/TP (70)	840	SJ/TP (70)	460	SJ/TP (70)	0	SJ/TP (70)	0
	NB (150)	0	NB (150)	370	NB (150)	840	NB (150)	1,110
CGP-BKK	WB (270)	190	WB (270)	280	WB (330)	370	WB (330)	460
Others		5,700		5,700		5,700		5,700
Total		11,500		13,170		13,370		13,910

Table 3.8.1 Summary of Air Traffic Demand Forecast (2)

ITEMS	YEAR 1995	YEAR 2000	YEAR 2005	Year 2010
Typical Week Passengers				
Domestic	3,790	4,590	5,510	6,660
CGP-DAC	3,700	4,480	5,370	6,500
CGP-CXB	90	110	140	160
International	3,930	5,900	8,110	10,810
CGP-DAC	1,250	1,890	2,630	3,440
CGP-Middle East	1,230	1,820	2,460	3,290
CGP-CCU	980	1,500	2,060	2,780
CGP-BKK	470	690	960	1,300
Total	7,720	10,490	13,620	17,470
Typical Week Aircraft Movements				
Domestic	88	116	118	118
CGP-DAC	SJ/TP (70) 84	SJ/TP (70) 112	SJ/TP (70) 84	SJ/TP (70) 56
	NB (150) 0	NB (150) 0	NB (150) 28	NB (150) 56
CGP-CXB	SJ/TP (70) 4	SJ/TP (70) 4	SJ/TP (70) 6	SJ/TP (70) 6
International	30	36	38	50
CGP-Middle East	WB (270) 8	WB (270) 12	WB (330) 12	WB (330) 16
CGP-CCU	SJ/TP (70) 18	SJ/TP (70) 10	SJ/TP (70) 0	SJ/TP (70) 0
	NB (150) 0	NB (150) 8	NB (150) 18	NB (150) 24
CGP-BKK	WB (270) 4	WB (270) 6	WB (330) 8	WB (330) 10
Others	110	110	110	110
Total	228	262	266	278
Design Day Passengers				
Domestic	558	686	829	977
CGP-DAC	502	630	773	921
CGP-CXB	56	56	56	56
International	719	1,159	1,520	1,628
CGP-DAC	170	266	379	487
CGP-Middle East	325	325	397	397
CGP-CCU	224	352	480	480
CGP-BKK	0	216	264	264
Total	1,277	1,845	2,349	2,605
Design Day Aircraft Movements				
Domestic	14	18	18	18
CGP-DAC	SJ/TP (70) 12	SJ/TP (70) 16	SJ/TP (70) 12	SJ/TP (70) 8
	NB (150) 0	NB (150) 0	NB (150) 4	NB (150) 8
CGP-CXB	SJ/TP (70) 2	SJ/TP (70) 2	SJ/TP (70) 2	SJ/TP (70) 2
International	6	8	8	8
CGP-Middle East	WB (270) 2	WB (270) 2	WB (330) 2	WB (330) 2
CGP-CCU	SJ/TP (70) 4	SJ/TP (70) 2	SJ/TP (70) 0	SJ/TP (70) 0
	NB (150) 0	NB (150) 2	NB (150) 4	NB (150) 4
CGP-BKK	WB (270) 0	WB (270) 2	WB (330) 2	WB (330) 2
Others	16	16	16	16
Total	36	42	42	42

Table 3.8.1 Summary of Air Traffic Demand Forecast (3)

ITEMS	YEAR 1995	YEAR 2000	YEAR 2005	Year 2010
Peak Hour Passengers (2 ways)				
Domestic	168	224	288	352
International	328	456	504	504
Overall	440	568	616	680
Peak Hour Aircraft Movements (2 ways)				
Domestic	3	4	4	4
	SJ/TP (70) 3	SJ/TP (70) 4	SJ/TP (70) 3	SJ/TP (70) 2
			NB (150) 1	NB (150) 2
International	3	3	3	3
	WB (270) 1	WB (270) 1	WB (330) 1	WB (330) 1
	SJ/TP (70) 2	NB (150) 2	NB (150) 2	NB (150) 2
Others	2	2	2	2
Overall	7	7	7	7
(Domestic)	SJ/TP (70) 2	SJ/TP (70) 2	SJ/TP (70) 2	SJ/TP (70) 1
(Domestic)				NB (150) 1
(International)	WB (270) 1	WB (270) 1	WB (330) 1	WB (330) 1
(International)	SJ/TP (70) 2	NB (150) 2	NB (150) 2	NB (150) 2
	Others 2	Others 2	Others 2	Others 2
Peak Hour Passengers (1 way)				
Domestic	112	112	176	176
International	272	336	384	384
Overall	328	392	440	504
Peak Hour Aircraft Movements (1 way)				
Domestic	2	2	2	2
	SJ/TP (70) 2	SJ/TP (70) 2	SJ/TP (70) 1	SJ/TP (70) 1
			NB (150) 1	NB (150) 1
International	2	2	2	2
	WB (270) 1	WB (270) 1	WB (330) 1	WB (330) 1
	SJ/TP (70) 1	NB(150) 1	NB(150) 1	NB(150) 1
Others	1	1	1	1
Overall	4	4	4	4
(Domestic)	SJ/TP (70) 1	SJ/TP (70) 1	SJ/TP (70) 1	NB (150) 1
(International)	WB (270) 1	WB (270) 1	WB (330) 1	WB (330) 1
(International)	SJ/TP (70) 1	NB (150) 1	NB (150) 1	NB (150) 1
	Others 1	Others 1	Others 1	Others 1

3.9 Estimation of Diversions from Zia International Airport

3.9.1 Analysis of Historical Record

Records of flights diverted from ZIA were collected for a period between January 1981 and June 1988. The number of flights diverted from ZIA are shown in Table 3.9.1, of which 90% were due to bad weather at ZIA. The others were due to enroute bad weather (6%) and runway blockage by aircraft trouble (4%). A list of diverted aircraft at ZIA from January 1981 to June 1988 is indicated in Appendix 3.2.

Table 3.9.1 Number of Diverted Flights from ZIA

Year	International	Domestic	Total
1981	9	0	9
1982	6	5	11
1983	11	3	14
1984 *1	4	6	10
1985 *2	0	0	0
1986	15	1	16
1987	5	5	10
1988 *3	0	0	0
Total	50	20	70
Average *4	9	3	12

Note, *1 : Data from September to December are not available
*2 : Data from January to July are not available.
*3 : From January to June only.
*4 : Average of 1981, 1982, 1983, 1986, and 1987

The average rate of diversions to annual aircraft arrivals is about 0.2% for international flights and about 0.1 % for domestic flights. The size of diverted aircraft varies from B-747, the largest aircraft to DO-228, the smallest aircraft. Diversion rate were 24% in March, 20% in May and 13% in January. Other months account for 3 to 7% of the total respectively. Most of the international flights diverted to Calcutta (62%) and Bangkok (22%), 80% of the domestic flights diverted to Chittagong as shown in Table 3.9.2.

Table 3.9.2 Number of Diverted Flights from Zia

Aircraft Diverted to	International	Domestic	Total
Calcutta	31 (62%)	0	31
Bangkok	11 (31%)	0	11
Rangoon	2 (4%)	0	2
Kathmandu	1 (2%)	0	1
Paro	1 (2%)	0	1
Chittagong	4 (10%)	16 (80%)	20
Jessore	0	3 (15%)	3
Sylhet	0	1 (5%)	1
Total	50	20	70

A list of diverted international flights to Chittagong Airport is shown in Table 3.9.3.

Table 3.9.3 List of International Flights Diverted to Chittagong Airport

Date	Flight No.	Aircraft Type	Aerodrome of Departure	Reason of Diversion
19/04/1982	BG - 073	F - 28	Bangkok	Bad Weather at ZIA
24/12/1983	RA - 404	B - 727	Hongkong	Bad Weather at ZIA
15/01/1984	RA - 404	B - 727	Hongkong	Fog at ZIA
30/07/1984	BG - 071	B - 707	Bangkok	Bad Weather at ZIA

Although aircraft as large as B707's have been diverted to Chittagong Airport in the past, there has been no international diversion to Chittagong since 1985. In the opinion of Biman Bangladesh Airlines, poor terminal facilities, absence of aircraft maintenance facilities and insufficient ground staff prevent Chittagong Airport from being used as an alternate to ZIA at present.

3.9.2 Meteorological Relationship between ZIA and Chittagong

Most of the diversions were due to bad weather conditions at ZIA. Therefore, it is important for an alternate airport to have a supplemental relationship to meteorological conditions at ZIA.

As there are no record on estimated time of arrival of diverted flights in the past, it is difficult to recall the actual meteorological conditions of Chittagong Airport when the diversion occurred at ZIA.

Therefore, the meteorological relationship is checked by comparing the meteorological condition at Chittagong Airport when meteorological conditions are below certain criteria at ZIA. Bad meteorological observations at ZIA are picked up by the following criteria from the data of Meteorological Department.

- Cross-wind component of more than 20 kt
- Visibility less than 1 km
- Ceiling less than 100 m

Total 37 observations are picked up from the data, and meteorological conditions are compared at ZIA and Chittagong Airport as shown in Table 3.9.4. From this table it is known that the existing Chittagong Airport with VOR/DME can accommodate 82% of the bad meteorological conditions at ZIA. This can be confirmed by the fact that 80% of domestic diverted flights at ZIA utilized Chittagong Airport as an alternate airport. Introduction of ILS at Chittagong Airport is estimated to further improve the feasibility of diversion from 82% to 95%.

3.9.3 Estimation of Diversions from ZIA

Possible diversions from ZIA to Chittagong Airport are forecast on an assumption that 80% of the diversions will be accommodated at Chittagong Airport based on the actual rate of domestic diversions to Chittagong Airport. It is also assumed that diversions will occur at a rate of 0.2% to annual international aircraft arrivals at ZIA and 0.1% to annual domestic aircraft arrivals based on the actual data since 1981.

The future aircraft movements at ZIA are roughly estimated as shown in Table 3.9.5.

Table 3.9.4 The Meteorological Conditions at Chittagong Airport While ZIA Has Been Under Bad Meteorological Conditions

Year	Month	Day	UTC	ZIA			CHITTAGONG AIRPORT				
				CROSS WIND	VISIBI-LITY	CEILING	CROSS WIND	VISIBI-LITY	CEILING	FEASIBILITY OF DIVERSION	
										VOR/DME	ILS CAT-I
			(+6)	(kt)	(km)	(m)	(kt)	(km)	(m)		
1985	12	17	0		1		0	6	No cloud	OK	OK
		18	0		1		0	5	No cloud	OK	OK
		30	0		1		0	4	No cloud	OK	OK
1986	1	5	0		0		1	5	No cloud	OK	OK
	8	6	3			100-200	6	7	3000	OK	OK
		6	6			100-200	10	7	No cloud	OK	OK
		25	3			100-200	10	7	2400	OK	OK
		25	6			100-200	13	8	3000	OK	OK
		26	3			100-200	5	6	No cloud	OK	OK
		26	6			100-200	0	8	No cloud	OK	OK
	9	25	0			100-200	0	5	270	OK	OK
		27	3			100-200	2	5	No cloud	OK	OK
		27	6			100-200	9	6	450	OK	OK
		27	9			100-200	5	6	2400	OK	OK
		27	15			100-200	0	6	2400	OK	OK
		27	18			100-200	0	6	3000	OK	OK
		27	21			100-200	0	6	2400	OK	OK
	11	9	3			100-200	19	2	180	Not feasible	OK
		9	6			100-200	4	2	150	Not feasible	OK
		19	0		1		0	6	No cloud	OK	OK
		23	0		1		2	6	No cloud	OK	OK
		28	0		1		0	6	No cloud	OK	OK
1987	1	8	3		1		0	0	No cloud	Not feasible	Not feasible
		13	0		1		0	6	No cloud	OK	OK
		21	3		1		3	3	No cloud	OK	OK
		21	3		1	100-200	3	3	No cloud	OK	OK
		21	6		1	100-200	6	6	No cloud	OK	OK
		21	6			100-200	6	6	No cloud	OK	OK
		21	9			100-200	9	6	No cloud	OK	OK
		22	0		1		0	8	130	Not feasible	OK
		22	3		1		0	2	67	Not feasible	OK
		22	6		1		2	3	No cloud	OK	OK
		27	0		1		0	1	No cloud	Not feasible	OK
	12	31	0		1		0	6	No cloud	OK	OK
1988	1	30	3		1		2	3	No cloud	OK	OK
	4	25	6			50-100	0	8	No cloud	OK	OK
	10	19	9	28			24	2	200	Not feasible	Not feasible

Table 3.9.5 Future Aircraft Movements at ZIA

Item	1987 (Actual)	1995	2000	2005	2010
Passengers('000) *1					
International	846	1,780	2,550	3,460	4,580
Domestic	342	480	570	680	800
Total	1,188	2,260	2,820	4,140	5,380
Passenger/Aircraft Movements *2					
International	102	125	150	175	200
Domestic	42	45	50	55	60
Aircraft Movements					
International	8,303	14,000	17,000	20,000	23,000
Domestic	8,110	11,000	11,000	12,000	13,000
Total	16,413	25,000	28,000	32,000	36,000

Note 1 * : Passenger demand is estimated based on the forecasts of total international and domestic passengers in Bangladesh in Tables 3.4.7 and 3.4.2 and an assumption that ZIA will maintain its present share of 87.7% for international passengers and 54.6% for domestic passengers in 1987.

Note 2 * : Average number of passengers per aircraft movement is assumed to gradually increase due to the introduction of larger aircraft. Higher growth rate of the average number is assumed for international traffic.

The estimated number of diversions from ZIA to Chittagong Airport is shown in Table 3.9.6.

Table 3.9.6. Estimation of Diversions from ZIA

Item	1985	2000	2005	2010
Annual Aircraft Arrivals at ZIA				
International	7,000	8,500	10,000	11,500
Domestic	5,500	5,500	6,000	6,500
Total	12,500	14,000	16,000	18,000
Diversions at ZIA				
International	14	17	20	23
Domestic	6	6	6	7
Total	20	23	26	30
Diversions to Chittagong Airport				
International	11	14	16	18
Domestic	5	5	5	6
Total	16	19	21	24

3.9.4 Need to Develop Chittagong Airport as an Alternate to ZIA

Provision of an alternate airport for ZIA with international aircraft capability considerably improves the reliability of international air transport system in Bangladesh. Although the number of international flights diverted to Chittagong Airport will not be so many, Chittagong Airport can accommodate about 80% of diversions at ZIA due to its supplementary meteorological relationship with ZIA. Moreover, to develop Chittagong Airport as an alternate to ZIA is emphasized from the viewpoint of calamity preparedness in light of the closure of the runway at ZIA from September 2 to 6, 1988 when all international flights diverted to Calcutta due to flood water.

Benefits of developing Chittagong Airport from the viewpoint of flood preparedness are detailed in Section 12.2.6.

CHAPTER 4 AIRPORT FACILITY REQUIREMENTS

CHAPTER 4 AIRPORT FACILITY REQUIREMENTS

4.1 General

This chapter explains airport facility requirements which are established based on the air traffic demand forecasts in Chapter 3.

The facility requirements are in compliance with the relevant standards and recommended practices of ICAO (International Civil Aviation Organization). FAA (Federal Aviation administration of the United States) and JCAB (Civil Aviation Bureau of Japan) are also referred where ICAO does not describe.

The facility requirements are established for the period from 1995 to 2010 at five year intervals based on the air traffic demand forecast taking into account the flight diversion from Zia International Airport.

The airport facility requirements are summarized as in Table 4.1.1.

4.2 Runway, Taxiway and Apron

4.2.1 Aerodrome Reference Code and Operational Requirements

The aerodrome reference code will be 4E for B-747 aircraft which may be diverted from Zia International Airport. The operational category of the runway is desired to be precision approach Category-I as it is a mandatory requirement to reduce the work load of pilots when modern and large aircraft such as DC-10 are introduced.

Table 4.1.1 Summary of Facility Requirements (1)

ITEMS	Present Conditions (as of 1989)	Year 1995	YEAR 2000 (Phase I Development)	YEAR 2005	Year 2010 (Phase II Development)
1. Annual Passengers					
Domestic	109,153 (1987)	165,000	200,000	240,000	290,000
International	66,599 (1987)	160,000	240,000	330,000	440,000
Total	175,752 (1987)	325,000	440,000	570,000	730,000
2. Annual Cargo					
Domestic	278 ton (1987)	500 ton	800 ton	1,000 ton	1,300 ton
International	270 ton (1987)	3,000 ton	6,500 ton	8,800 ton	11,600 ton
Total	548 ton (1987)	3,500 ton	7,300 ton	9,800 ton	12,900 ton
3. Annual Aircraft Movements					
Domestic	2,359 (1988)	4,400	5,800	5,900	5,900
International	496 (1988)	1,400	1,670	1,770	2,310
Others	5,726 (1988)	5,700	5,700	5,700	5,700
Total	8,581 (1988)	11,500	13,170	13,370	13,910
4. Peak Hour Passengers (2 ways)					
Domestic	130	168	224	288	352
International	150	328	456	504	504
Overall	160	440	568	616	680
5. Peak Hour Aircraft Movements (2 ways)					
Domestic	2	3	4	4	4
International	2	3	3	3	3
Others	0	2	2	2	2
Overall	2	7	7	7	7
6. Largest Aircraft					
Schedule	F-28	DC-10	DC-10	DC-10	DC-10
Diversion	B-707	B-747	B-747	B-747	B-747
7. Longest Route	Calcutta	Jeddah	Jeddah	Jeddah	Jeddah
8. Reference Code	4D	4E	4E	4E	4E
9. Runway					
Take-off Length	3,048 m	2,750 m	2,750 m	2,750 m	2,750 m
Landing Length	3,048 m	2,450 m	2,450 m	2,450 m	2,450 m
Width	46 m	45 m	45 m	45 m	45 m
10. Runway Strip					
Length	3,170 m	2,870 m	2,870 m	2,870 m	2,870 m
Width	150 m	300 m	300 m	300 m	300 m
11. Taxiway					
System	1 Exit Taxiway	1 Exit Taxiway	1 Exit Taxiway	1 Exit Taxiway	1 Exit Taxiway
Width	15 m	23 m	23 m	23 m	23 m
12. Apron					
Commercial Aircraft Stands	B-707 : 1 F-28 : 2 Total : 3	B-747 : 1 DC-10 : 1 F-28 : 2 Total : 4	B-747 : 1 DC-10 : 1 B-737 : 2 Total : 4	B-747 : 1 DC-10 : 1 B-737 : 2 Total : 4	B-747 : 1 DC-10 : 1 B-737 : 2 Total : 4

Table 4.1.1 Summary of Facility Requirements (2)

ITEMS	Present Conditions (as of 1989)	Year 1995	YEAR 2000 (Phase I Development)	YEAR 2005	Year 2010 (Phase II Development)
13. Passenger Terminal Building					
Domestic	320 sq.m	1,000 sq.m	1,300 sq.m	1,700 sq.m	2,100 sq.m
International	880 sq.m	3,000 sq.m	4,100 sq.m	4,500 sq.m	4,500 sq.m
Total	1,200 sq.m	4,000 sq.m	5,400 sq.m	6,200 sq.m	6,600 sq.m
14. Cargo Terminal Building	NIL	900 sq.m	2,000 sq.m	2,700 sq.m	3,500 sq.m
15. Administration Building	670 sq.m	1,800 sq.m	1,800 sq.m	1,800 sq.m	1,800 sq.m
16. Car Park					
Parking Lots	96	220	284	308	340
Area	1,600 sq.m	6,600 sq.m	8,500 sq.m	9,200 sq.m	10,200 sq.m
17. Access Road					
Traffic Lanes	1 lane per direction	1 lane per direction	1 lane per direction	1 lane per direction	1 lane per direction
Width	5.5 m	7.0 m	7.0 m	7.0 m	7.0 m
18. Air Navigation Systems	Non-Precision (VOR/DME, NDB)	Precision Category-I	Precision Category-I	Precision Category-I	Precision Category-I
19. Public Utilities					
Power Supply	400 KVA	900 KVA	1,100 KVA	1,200 KVA	1,300 KVA
Water Supply	-	3,600 t/month	4,700 t/month	5,300 t/month	5,600 t/month
Sewege Disposal	-	3,600 t/month	4,700 t/month	5,300 t/month	5,600 t/month
Solid Waste Disposal	-	15 t/month	20 t/month	25 t/month	30 t/month
20. Rescue and Fire Fighting					
Category	Category-6	Category-6	Category-6	Category-6	Category-6
Fire Vehicles	4	4	4	4	4
Fire Station	300 sq.m	450 sq.m	450 sq.m	450 sq.m	450 sq.m
21. Airport Maintenance Building	280 sq.m	300 sq.m	300 sq.m	300 sq.m	300 sq.m
22. Fuel Supply Facility					
Tank Capacity	54.5 kl	1,500 kl	2,000 kl	2,000 kl	2,500 kl
Fuel Farm	920 sq.m	6,300 sq.m	6,300 sq.m	6,300 sq.m	7,700 sq.m

4.2.2 **Runway Length and Width**

The required runway lengths are calculated to be 2,750 m for take-off and 2,450 m for landing. (See Appendices 4.1 and 4.2 for runway length calculation)

a) Take-off Runway Length : 2,750 m

The take-off runway length is determined for DC-10 class aircraft which are anticipated to be the largest aircraft in scheduled operations although B-747 will use this airport as an alternate. (B-747 requires 2,950m long runway for the same condition.)

1)	Design Aircraft	: DC-10-30
2)	The Farthest Destination	: Jeddah
3)	Distance	: 5,400 km
4)	Reserve Fuel	: 2 hours
5)	Pay Load	: Maximum Structural Payload
6)	Airport Altitude	: Sea Level
7)	Surface Wind	: No wind
8)	Runway Slope	: 0 %
9)	Surface Condition	: Wet
10)	Temperature	: $35^{o}C$

b) Landing Runway Length : 2,450 m

The landing runway length is the minimum for B-747's which may be diverted from Dhaka.

1)	Design Aircraft	: B-747-200B
2)	Weight	: Maximum Landing Weight
3)	Airport Altitude	: Sea Level
4)	Surface Wind	: No Wind
5)	Runway Slope	: 0 %
6)	Surface Condition	: Wet

The width of the runway is 45 m with 7.5 m shoulders on each side.

4.2.3 Runway Strip and Runway End Safety Area

The minimum runway strip for a 2,750 m long runway is 2,870m for a precision approach Category-I runway with the code number 4, though the length depends on the layouts of take-off and landing runways. The width of the runway strip should be 300m wide as far as it is practicable.

4.2.4 Obstacle Limitation Surfaces

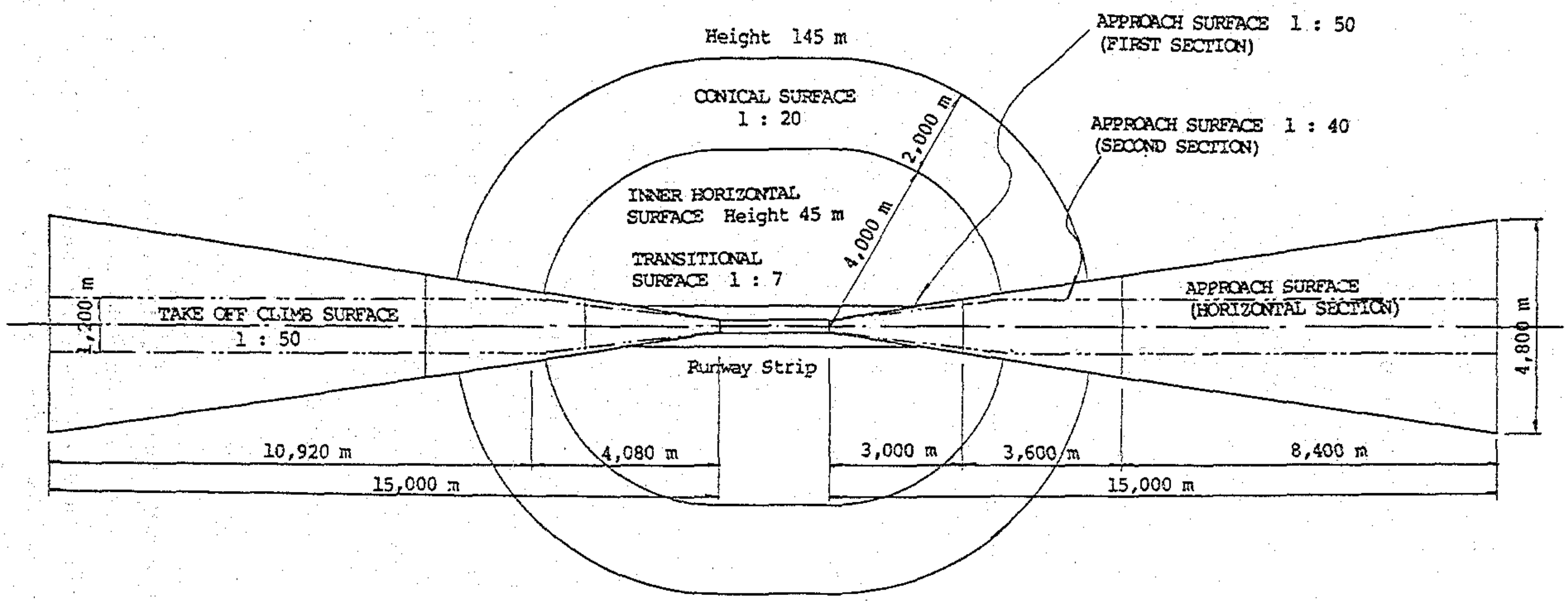
The requirements of the obstacle limitation surface for a precision approach Category-I runway with the code number 4 are summarized in Figure 4.2.1 and Table 4.2.1. ILS obstacle assessment surfaces for the precision approach Category-I runway with 3 degree glide path angle are also presented in Figure 4.2.2.

4.2.5 Taxiway

A complete parallel taxiway with right angle exits may be economically justifiable where the number of instrument approaches exceeds 4 during the peak hour and the operation of wide body jet aircraft becomes frequent. In these criteria a parallel taxiway will not be necessary up to the year 2010. However, the right of way required for the parallel taxiway should be provided so as to cope with an unexpected demand change because more frequent operations of wide body jet and about 4 approaches are anticipated in 2010. One connecting taxiway is considered sufficient for the expected aircraft movements during the peak hour up to 2010.

4.2.6 Apron

The necessary number of aircraft stands is calculated as indicated in Table 4.2.3 assuming the apron to be commonly utilized by both regional international and domestic flights. The actual apron occupancy times for F-28 and F-27 are 30 minutes and 25 minutes



Note : Height above aerodrome elevation

Figure 4.2.1 Obstacle Limitation Surfaces (1)

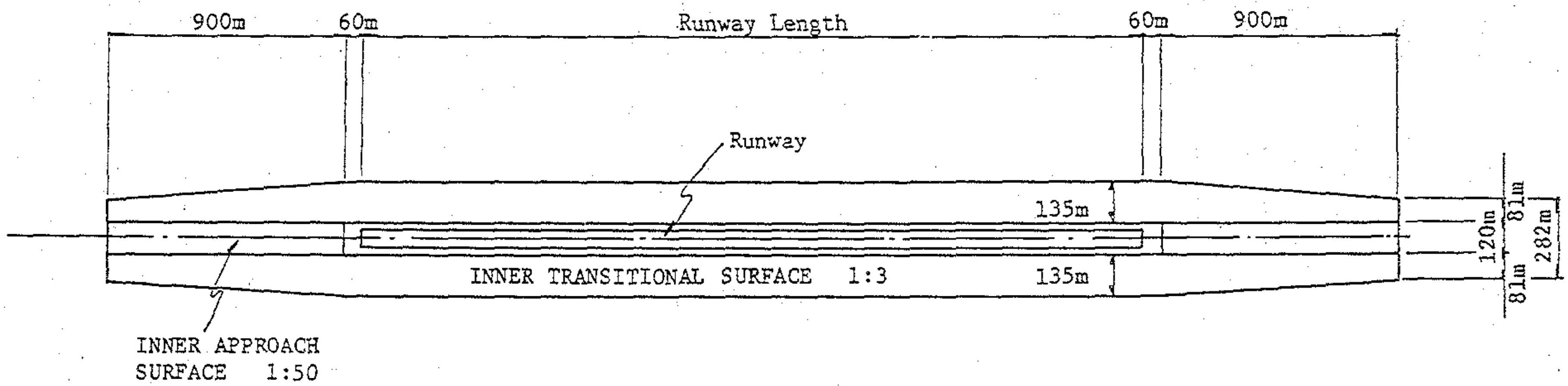


Figure 4.2.1 Obstacle Limitation Surfaces (2)

Table 4.2.1 Dimensions and Slopes of Obstacle Limitation Surfaces (1)

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: Annex 14 - Aerodrome, ICAO

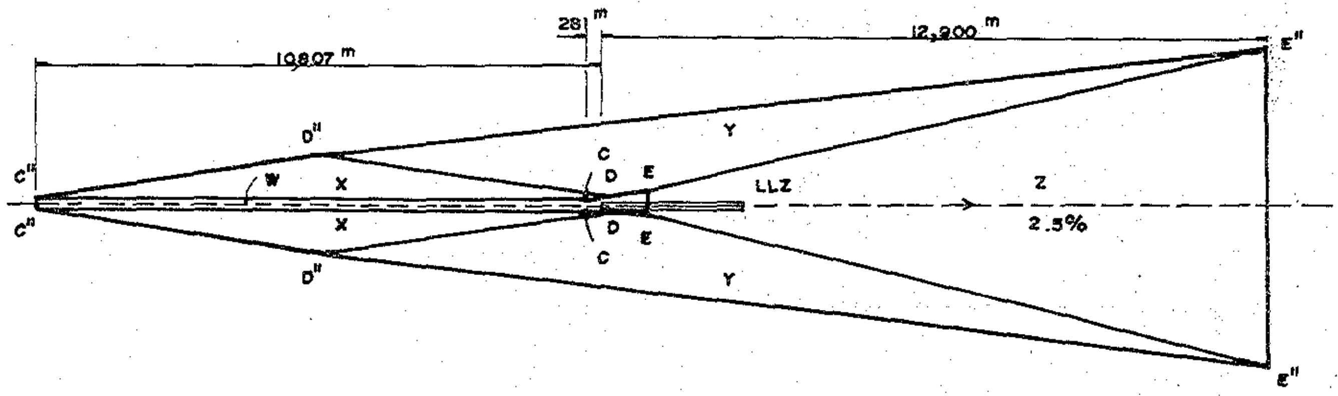
Table 4.2.1 Dimensions and Slopes of Obstacle Limitation Surfaces (2)

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: Annex 14 - Aerodrome, ICAO



Equations of the obstacle assessment surfaces

$$W_{lz} = 0.0285x - 8.01$$
$$X_{lz} = 0.027681x + 0.1825y - 16.72$$
$$Y_{lz} = 0.023948x + 0.210054y - 21.51$$
$$Z_{lz} = 0.025x - 22.50$$

Condition: Category I/GP angle 3°/LLZ-THR 3400m/ missed approach gradient 2.5 per cent

Co-ordinates of points C, D, E, C", D", E", (m):

	C	D	E	C"	D"	E"
X	281	-286	-900	10 807	5 438	-10 900
Y	49	135	198	63	877	2553
Z	0	0	0	300	300	300

Figure 4.2.2 ILS Obstacle Assessment Surface

respectively at present. Small jet and turbo prop (SJ/TP) of the domestic flights including regional international flights connecting with Calcutta are assumed to require 45 minutes for turning around taking into account a margin for delay. The international flight by wide body jet (WB) is assumed to require 90 minutes for transit from/to Dhaka taking into account a possible delay and the present operations at Zia International Airport.

Table 4.2.2 shows the classification of aircraft for the planning of the aircraft parking apron. The classification is planned taking account the wing span, overall length, etc. of aircraft dimension.

Table 4.2.2 Aircraft Classification for Parking Apron

Representative Aircraft	Aircraft Types to be Accommodated	Design Aircraft	Wing Span	Clearance on Apron
B-747 (J)	B-747	B-747-400	64.7m	7.5m
DC-10 (WB)	MD-11, DC-10 L-1011, B-767, A-300, A-310, B-707, B-757	MD-11	50.4m	7.5m
B-737 (NB)	A-320, B-727, MD-80, B-737 DC-9	A-320	34.5m	4.5m
F-28 (SJ/TP)	ATP, F-50 F-27, DHC-8 F-28	ATP	30.6m	4.5m

The size of the various types of the aircraft are included in Appendix 4. 3. The number of aircraft stands is calculated as shown in Table 4.2.3. In this table one extra stand is added, taking into account the concentration of unexpected delays of flights, a possible diversion flight from ZIA and general aviation aircraft.

Table 4.2.3 Required Number of Aircraft Stands

Aircraft Stands / Year		1995	2000	2005	2010
Domestic including Regional International	SJ NB	2 -	1 1	1 1	- 2
	Subtotal	2	2 *	2 *	2
International	WB	1	1	1	1
	Subtotal	1	1	1	1
Extra Stand	J	1	1	1	1
Total		4	4	4	4

Note * : 2 narrow body (NB) stands are planned for flexible apron utilization

4.3 Passenger Terminal Building and Other Buildings

4.3.1 Passenger Terminal Building

The floor area required for the passenger terminal building is calculated by multiplying the number of peak hour passengers by the unit floor area.

The domestic passenger terminal building with one level can accommodate necessary functions in 6 sq.m per peak hour passenger (2 ways). An unit floor area of 9 sq.m per peak hour passengers (2 ways) is adopted for the international passenger terminal building based on the IATA's practice. The result is shown in Table 4.3.1.

Table 4.3.1 Required Floor Area for Passenger Terminal Building
(Unit : sq.m)

Year	1995	2000	2005	2010
Domestic	1,000	1,300	1,700	2,100
International	3,000	4,100	4,500	4,500
Total	4,000	5,400	6,200	6,600

4.3.2 Cargo Terminal Building

The floor area required for the cargo terminal building is estimated based on the annual cargo volume and unit cargo handling capacity. As manual cargo handling capacity is generally considered as 5 ton/sq.m, this unit capacity is used for the calculation of cargo handling area. The total floor area of the cargo terminal building is estimated to be about 1.33 times that of the cargo handling area for the accommodation of airline office, customs office, cargo agents, etc.

Table 4.3.2 Required Floor Area for Cargo Terminal Building

(Unit : sq.m)

Year	1995	2000	2005	2010
Cargo Handling Area	700	1,500	2,000	2,600
Total Floor Area	900	2,000	2,700	3,500

4.3.3 Administration Building and Operation Center

The required total floor area for the building including administrative and operational functions of the CAAB airport office and the meteorological office is estimated as 1,800 sq.m in light of the current practice of Japanese airports provided that precision approach Category-I operations are introduced at Chittagong Airport.

A control tower cab with a floor area of 60 sq.m will be necessary for air traffic controllers and control consoles. The height of the tower will be determined by the visibility to the runway ends from the tower location.

4.4 Car Park and Access Road

4.4.1 Car Park

The following formula is used to calculate the required number of parking lots:

$$V = P \times C$$

Where, V : Required number of parking lots
P : Number of peak hour passengers (2 ways)
C : Number of parking lots per peak hour passenger
(C = 0.5 from the traffic survey)

In this airport, auto-rickshaws account for 76 percent of all the parked vehicles according to the traffic survey. Auto-rickshaw will gradually be replaced with taxi's and private cars in the future. The total car parking area is estimated by assuming the unit space for a parking lot to be 30 sq.m per lot including internal road and green zone for convenience sake because this estimation will not affect the size and the layout of passenger terminal area.

The unit price space for a parking lot is calculated in Appendix 4.4.

Table 4.4.1 Number of Car Parking Lots and Space

	1995	2000	2005	2010
Total Parking Lots	220	284	308	340
Required Space (sq.m)	6,600	8,500	9,200	10,200

4.4.2 Access Road

The required number of traffic lanes for the access road is calculated based on incoming and outgoing traffic from/to the airport terminal area. The number of cars generated per direction per peak hour passenger is estimated to be 1.0 based on the traffic survey. The vehicle traffic per direction will be 680 vehicles during the peak hour in 2010. On the other hand the maximum capacity of an access road is about 1,000 cars/hour for one lane. Therefore, one lane for each direction is sufficient up to 2010.

4.5 Air Navigation Systems

Air navigation systems including radio navigation aids, air traffic control and aeronautical telecommunications system, aeronautical ground light, meteorological system and power supply system will be planned to cope with the precision approach runway Category-I on condition that appropriate organization for operation and maintenance is provided by CAAB.

Instrument Landing System (ILS) is adequate up to the year 1999. Microwave Landing System (MLS) will be a single standard after 2000 according to ICAO implementation plan.

4.6 Airport Utilities

The airport utility requirements are calculated based on the unit demand established here as shown in Table 4.6.1.

Table 4.6.1 Unit Demand

Utilities	Unit Demand
Electricity	Passenger Terminal Building : 100 VA/sq.m Cargo Terminal Building : 60 VA/sq.m Administration Building : 80 VA/sq.m Equipment : Calculated by Equipment
Water	Passenger Terminal Building : 0.023 ton/sq.m/day Cargo Terminal Building : 0.003 ton/sq.m/day Administration Building and Others : 0.010 ton/sq.m/day
Sewage	Passenger Terminal Building : 0.023 ton/sq.m/day Cargo Terminal Building : 0.003 ton/sq.m/day Administration Building and Others : 0.010 ton/sq.m/day
Waste	Passenger Terminal Building : 0.072 Kg/sq.m/day Cargo Terminal Building : 0.144 Kg/sq.m/day Administration Building and Others : 0.144 Kg/sq.m/day

Source : Average unit demand of airports in Japan

Table 4.6.2 shows the demand of airport utilities.

Table 4.6.2 Airport Utilities Demand

Utilities	1995	2000	2005	2010
Electricity Demand (KVA)	900	1,000	1,200	1,300
Water Demand (ton/month)	3,600	4,700	5,300	5,600
Sewage (ton/month)	3,600	4,700	5,300	5,600
Waste Deposit (ton/month)	15	20	25	30

4.7 Rescue and Fire Fighting Services

The facility requirements for the rescue and fire fighting services are estimated in compliance with ICAO AIRPORT SERVICE MANUAL PART I. The level of protection required for DC-10 class aircraft which is the largest aircraft envisaged for scheduled services is Category-8. However, this can be reduced to Category-6 in accordance with ICAO because of infrequent operations of DC-10 class aircraft. The requirements up to the year 2010 will be as shown below:

Airport Category	:	6
Extinguishing Agent		
- Water for Protein Foam Production (l)	:	11,800
- Discharge Rate (l/min)	:	6,000
- Dry Chemical Powders (kg)	:	225
Vehicles		
- Rapid Intervention Vehicle	:	1
- Major Vehicle	:	2
- Ambulance	:	1
Fire Station		
- Required Floor Area (sq.m)	:	450

4.8 Other Service Facilities

4.8.1 Airport Maintenance Facility

For the efficient maintenance of the airside pavement and runway strip, one sweeper car and one tractor with attached mowing machine are desired if possible. An airport maintenance building with a floor area of 300 sq.m will be required based on the existing condition.

4.8.2 Aviation Fuel Supply System

The fuel consumption is calculated by multiplying the trip fuel by the number of departing flights for each aircraft type. The required fuel storage capacity is estimated based on the condition that the airport is provided with 7 day storage capacity in accordance with the normal planning practice. The tank capacity is planned to be 1.25 times that of the storage requirement.

Table 4.8.1 Aviation Fuel Storage Requirements (JET-A1)

Item \ Year	1995	2000	2005	2010
Weekly Consumption (kl)	900	1,400	1,600	1,900
Fuel Tanks	500klx3	500klx4	500klx4	500klx5
Area Required for Fuel Tanks (sq.m)	6,300	6,300	6,300	7,700

4.8.3 Aircraft Maintenance Facilities

According to Biman's Engineering Section, the introduction of DC-10 class aircraft at Chittagong Airport may require aircraft maintenance facilities for light maintenance though the heavy maintenance will be carried out at ZIA. The detailed requirements are to be studied when the new terminal project will be implemented. However, a space adequate for an aircraft maintenance hangar for DC-10 class aircraft and a maintenance garage for GSE (Ground Service Equipment) should be reserved in the layout plan.

The passenger stair cars, electricity supply cars, cargo loaders, container carts, cart tractors, etc. may be at least provided by the airline to meet the future traffic.

CHAPTER 5 EVALUATION OF EXISTING AIRPORT

CHAPTER 5 EVALUATION OF THE EXISTING AIRPORT

5.1 General

The existing Chittagong Airport is evaluated by comparing the present conditions with the future requirements estimated based on the air traffic demand forecasts.

Table 5.1.1 summarizes the results of the evaluation of the major airport facilities by showing the anticipated time of saturation in which the existing facilities will reach their respective capacities.

5.2 Runway, Taxiway and Apron

5.2.1 Runway

(1) General

The existing main runway was constructed as 1,829 m long and 30 m wide runway in the early 1940s. It was extended to the west up to 2,286 m and widened to 46 m in the early 1970s, and further to 3,048 m in 1980.

The cross wind runway 14/32 is located with a right angle to the runway 05/23 at a distance of about 600 m from runway 23 threshold. This 1,692 m long runway is closed for landing and take-off of aircraft and not maintained as a runway at present.

The maximum aircraft presently in service is F-28, one B-707 of Biman Bangladesh Airlines and two B-727s of Royal Nepal Airlines diverted from ZIA and landed in the past.

Figure 5.1.1 Capacity of Existing Facilities

Sl. No.	FACILITIES \ YEAR		DC-10 DIRECT FLIGHT TO MIDDLE EAST												REMARKS
			89	90	91	92	93	94 ▽	95	96	97	98	99	2000	
1.	Runway	• Length													- Existing runway length permits DC-10-30 to fly directly to Jeddah.
		• Pavement													- Existing pavement may need overlay to accommodate DC-10 class aircraft.
2.	Runway Strip		X												- Only 150 m wide strip is secured at present.
3.	Approach Surface		X												- Sailing vessels with more than 14.6m high mast are obstacles to runway 23 approach surface.
4.	Exist Taxiway	• System													- One existing taxiway is sufficient for non-peak hour aircraft movements.
		• Pavement	X												
5.	Apron	• Aircraft Stands													- Expansion of existing apron to accomodate DC-10 class aircraft is difficult due to the limited area.
		• Pavement	X												
6.	Passenger Terminal Buildings														- Passenger terminals buildings are too small to handle even the present traffic.
		• International	X												
		• Domestic	X												
7.	Cargo Terminal Building		X												- No cargo terminal building is available.
8.	Car Park		X												- Existing car park reached its capacity. Absence of vehicular circulation is also a problem.
9.	Assess Road		X												- Pavement width is below standard. There are many depressions.
10.	Air Navigation Systems														
		• VOR/DME													- The life span will be reached soon.
		• NDB													- No renewal required because of the new installation
		• ATC & COM													- Most equipment will reach their life span soon.
		• AGL													- Most equipment will reach their life span soon.
		• MET	X												- Total system performances is in an obsolescent condition.
11.	Airport Utilities														
		• Power													- The capacity will reach its maximum soon.
		• Water													- The capacity will reach its maximum soon.
		• Sewerege	X												- Nil.
		• Solid Waste	X												- Nil.
		• Telephone	X												- System is in an obsolescent condition.
12.	Rescue and Fire Fighting														- No additional equipment is required because of the existing Cat-6.
13.	Aviation Fuel Supply														- Introduction of DC-10 class aircraft will require bigger capacity for fuel supply system.

Note : "x" indicates that facility reached its capacity or is not available.

(2) **Runway Layout in Relation to Mobile Obstacles on Karnafuli River**

Chittagong Airport is bounded by Karnafuli River on the east and the south. Oceangoing ships under the approach path to the runway 23 constitute mobile obstacles to aircraft operations. The slope of the approach surface for an instrument runway is 1/50 in accordance with ICAO. In this condition, all the ships with about 14.6 m high masts infringe the runway 23 approach surface as shown in Figure 5.2.1. These ships are also obstacles to 1/50 take-off climb surface for runway 05.

The maximum height of ships in the past was 46.5 m from the water level, and the oceangoing ships sail on the river during high tide for sufficient water depth. The high tide period is 5 to 6 hours per day and occurs about 45 minutes later each day. Coasters which account for about 90% of the total ship movements have a mast of 10 to 20 m. Therefore, some of them are obstacles to the approach and take-off climb surfaces.

However, in the light of Japanese standard on the approach surface for non-precision instrument runway, the slope can be increased to 1/40. If this standard is applied, the ships with less than 19.1 m high masts are free from the approach surface.

The distribution of mast height of oceangoing ships in 1988 is shown in Table 5.2.1.

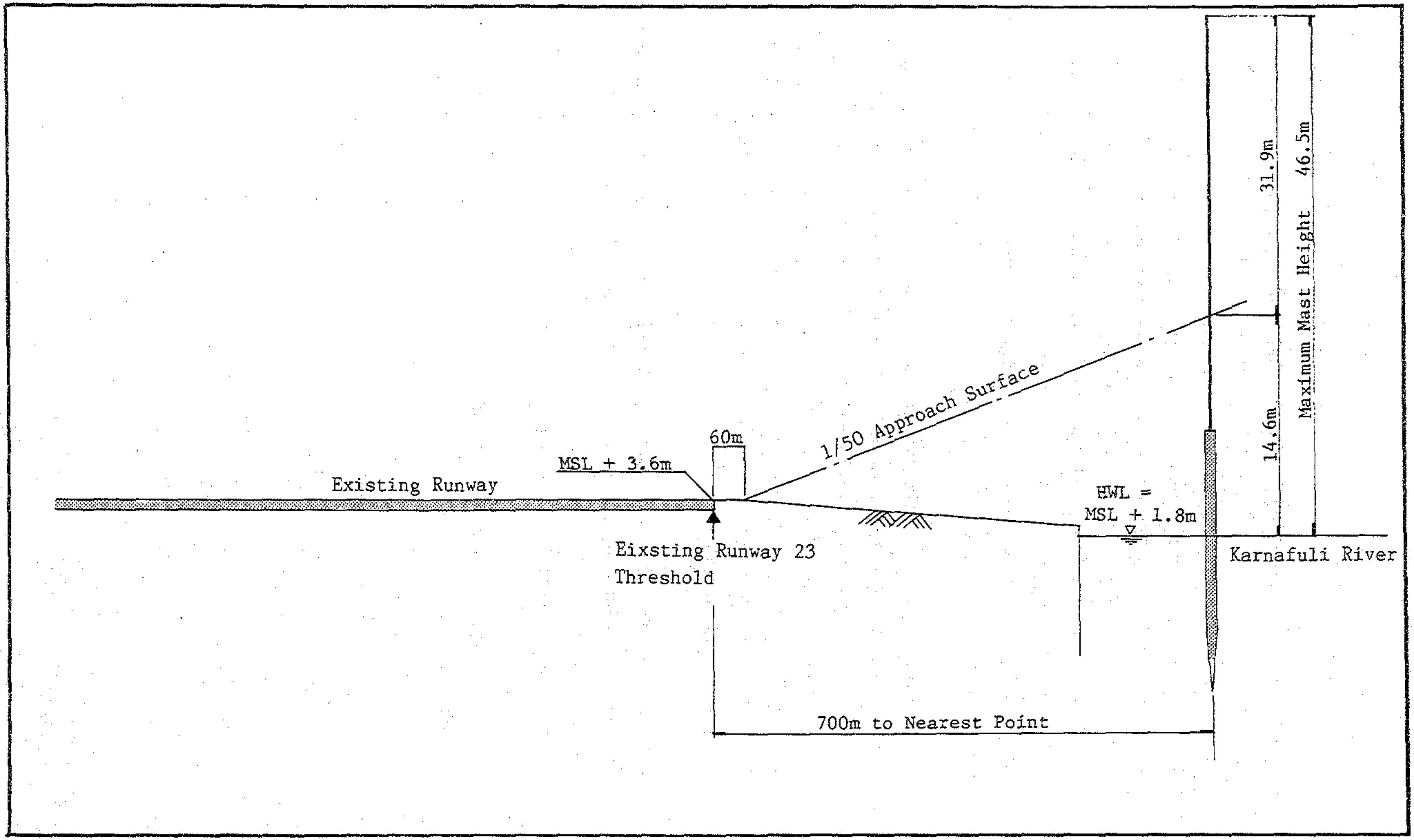


Figure 5.2.1 Infringement of Approach Surface by a Ship on Karnafuli River

Table 5.2.1 Distribution of Mast Height

Mast Height	Movements	Percentage
10m - 20m	238	12.7 %
21m - 25m	206	11.0 %
26m - 30m	454	24.2 %
31m - 38m	578	30.9 %
36m - 40m	294	15.7 %
41m - 45m	98	5.2 %
46m - 50m	6	0.3 %
Total	1,874	100.0 %
Average		29.8 m

Source: Chittagong Port Authority
Note: Movements are estimated by doubling the number of ships that entered the port.

Average daily movements of the ships were five in 1988 and there was no significant monthly variation. The number of landing aircraft during high tide is 2.5 on an average at present.

Presently the air traffic controller provides advice to the landing aircraft when a ship is seen from the control tower. The distance from the control tower to the channel is about 1,300 m, but visual surveillance of the river is not reliable.

VHF communication equipment is installed at the control tower in order to obtain information about ship movements from Chittagong Port Authority (CPA). There is no agreement between CAAB and CPA on the restriction of ship movements at present.

Although the traffic volume of aircraft and ship movements are small, the existing measure to avoid a collision between an aircraft and a ship is insufficient from the viewpoint of safety because it rests with the visual judgment of a pilot.

(3) **Runway Layout in Relation to Obstacles on Port Road**

Port Road which runs along the Karnafuli River is also an obstacle to the runway 23 approach and runway 05 take-off climb surfaces. As mentioned in ICAO Annex-14, all the roads except aerodrome service roads should be considered as obstacles extending 4.8 m above the crown of the road. The distance between Port Road and the inner edge of the approach surface is about 70 m at the nearest point, and elevation of Port Road is 1.4 m higher than that of the runway 23 threshold. The profile of the approach surface at the critical point on the road is shown in Figure 5.2.2.

(4) **Runway Usability**

The runway usability is estimated based on meteorological analysis.

a) Wind Analysis

A wind rose is produced as shown in Figure 5.2.3 based on the wind data during 3 years from 1986 to 1988. The wind coverage of the existing runway is calculated as shown in Table 5.2.2.

Table 5.2.2 All Weather Wind Coverage

Cross-wind Component	Runway 05/23	Runway 23 Landing with less than 5 kt Tail Wind	Runway 05 Landing with less than 5 kt Tail Wind
Less than 13 kt	91.6%	84.8%	72.6%
Less than 20 kt	98.4%	91.4%	76.8%

This table shows that the main approach runway should be runway 23 from the prevailing wind condition.

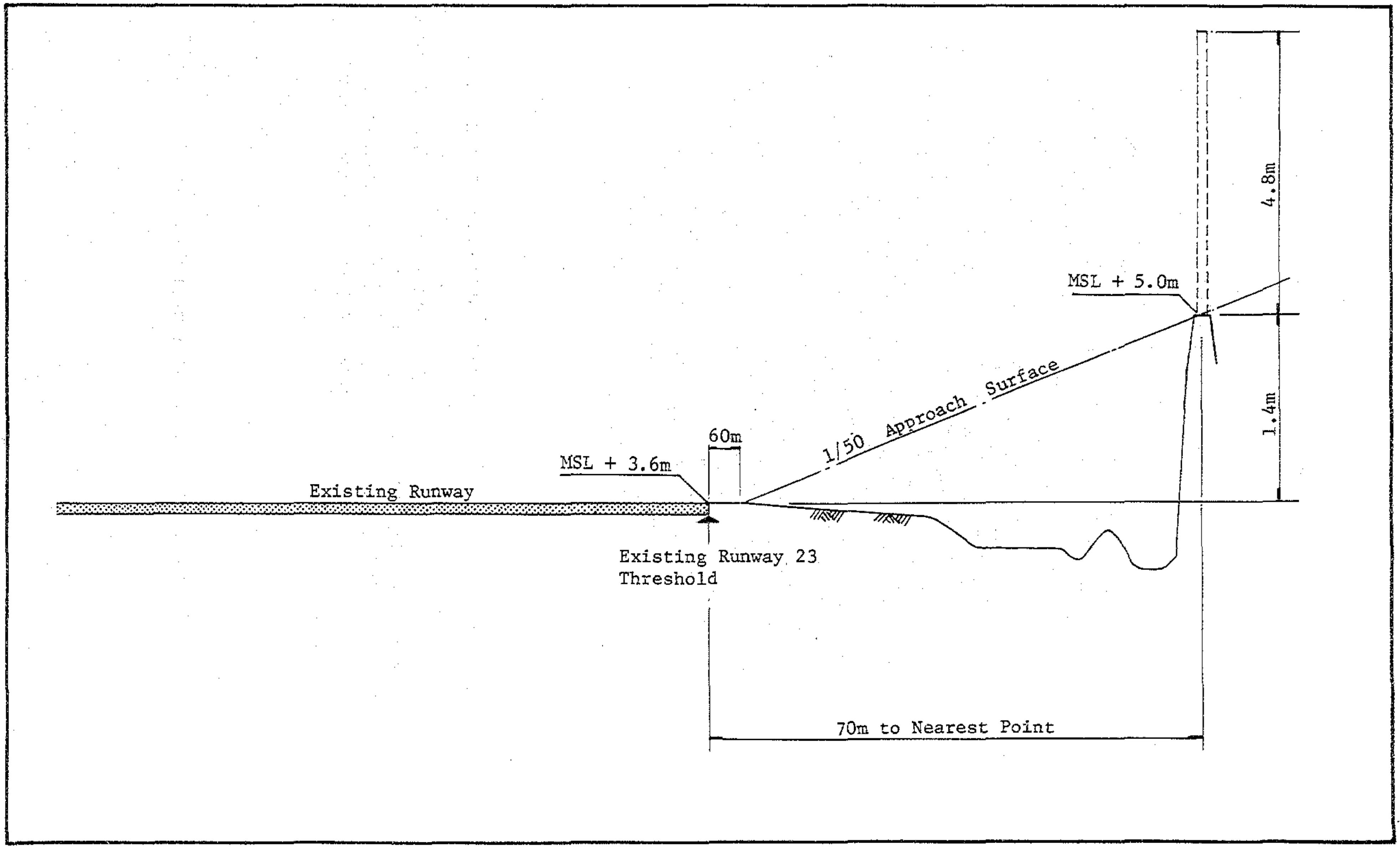
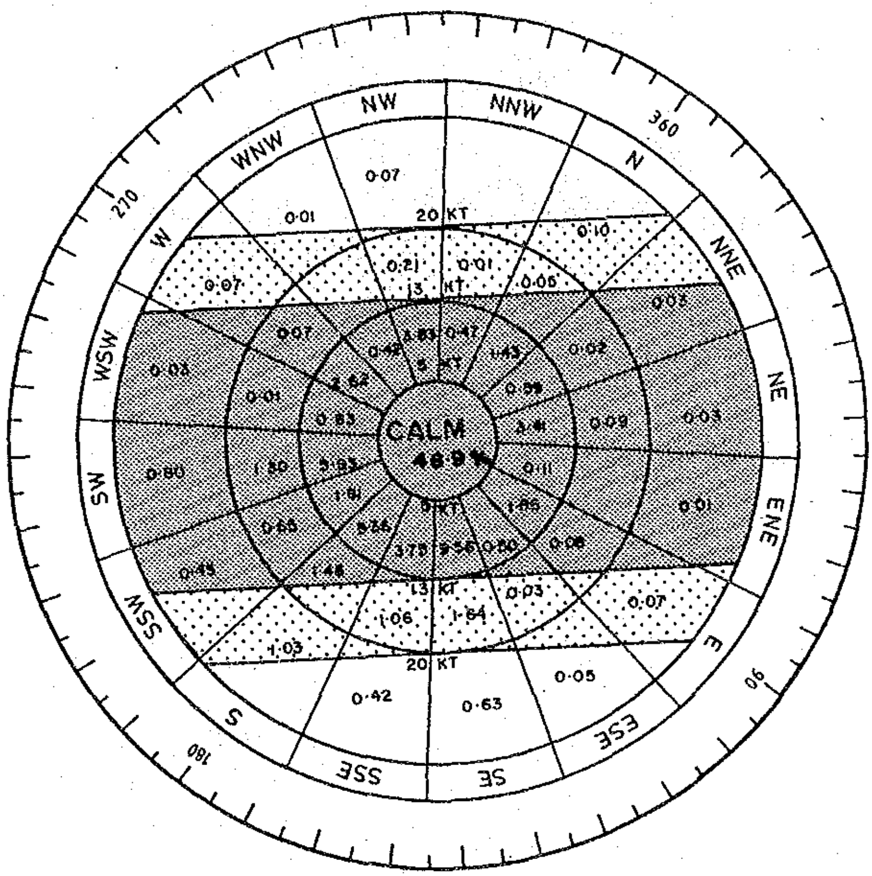


Figure 5.2.2 Infringement of Approach Surface by a Vehicle on Port Road



SOURCE	:	METEOROLOGICAL DEPARTMENT
LOCATION	:	CHITTAGONG AIRPORT
PERIOD	:	1986—1988 (8768 OBSERVATIONS)
RUNWAY ORIENTATION	:	N49°E
WIND COVERAGE	:	91.6% (CROSS— WIND 13KT)
		98.4% (CROSS— WIND 20KT)

Figure 5.2.3 All Weather Wind Coverage

Table 5.2.3 Correlation Table between Ceiling and Visibility

Clei- ling \ Visibi- lity	0 -400	401 -800	801 -1200	1201 -1400	1401 -1500	1601 -2400	2401 -3200	3201-	Total
0 - 100	0	0	0	0	0	1	0	23	24
101 - 200	0	0	0	0	0	0	0	4	4
201 - 300	0	0	0	0	0	1	1	21	23
301 - 400	0	0	1	0	0	0	1	13	15
401 - 500	0	0	5	0	0	3	2	5	15
501 - 600	0	0	4	0	0	6	5	17	32
601 - 700	2	0	17	0	0	45	58	203	325
701 - 800	0	1	1	0	0	2	7	39	50
801 - 900	1	0	1	0	0	0	2	35	39
901 - 1000	0	2	2	0	0	5	3	115	127
1001 - 1100	0	0	3	0	0	16	33	481	533
1101 - 1200	0	0	0	0	0	0	0	4	4
1201 - 1300	0	0	0	0	0	0	0	10	10
1301 - 1400	0	0	0	0	0	0	0	18	18
1401 - 1500	0	0	0	0	0	1	0	0	1
1501 -	5	8	8	0	0	7	30	2087	2145
1 <5/8	10	17	17	0	0	36	59	5264	5403
Total	18	28	59	0	0	123	201	8339	8768

SOURCE : METEOROLOGICAL DEPARTMENT
LOCATION : CHITTAGONG AIRPORT
PERIOD : 1986 - 1988 (8768 OBSERVATIONS)
WEATHER CONDITION : 94.2% (BETTER THAN VOR MINIMA, 600 FT-3200M)
99.2% (BETTER THAN ILS CAT I MINIMA, 200 FT-800M)

b) Ceiling and Visibility Analysis

Meteorological data for ceiling and visibility for a 3 year period from 1986 to 1988 are also analyzed and a correlation table between ceiling and visibility is shown in Table 5.2.3. The coverages by VOR weather minima and ILS minima are compared in Table 5.2.4

Table 5.2.4 Ceiling and Visibility Coverage (All Wind)

Weather Condition		Ceiling and Visibility Coverage
Better than Minima for VOR*1		94.2%
Better than Minima for ILS	CAT-I *2 CAT-II *3 CAT-III *4	99.2% 99.5% 100.0%

Note, *1: Ceiling height more than 600 ft and visibility more than 3,200 m
*2: Ceiling height more than 200 ft and visibility more than 800 m
*3: Ceiling height more than 100 ft and visibility more than 400 m
*4: Ceiling height 0 ft

c) Runway Usability Factor

The runway usability factors are calculated for two cases, i.e., the existing condition with VOR and the improved condition with ILS as shown in Table 5.2.5.

Table 5.2.5 Runway Usability Factor

Cross-wind Component	VOR	ILS CAT-I	Usability Factor Improvement by ILS		
			CAT-I	CAT-II	CAT-III
Less than 13 kt	86.8% *1	90.1%	3.5% *3	3.7% *5	4.1% *7
Less than 20 kt	92.9% *2	96.8%	3.9% *4	4.1% *6	4.5% *8

Note, *1: 92.1% (Wind coverage with less than 20 kt cross-wind for a weather condition better than VOR minima) x 94.2%

*2: 98.6% (Wind coverage with less than 13 kt cross-wind for a weather condition better than VOR minima) x 94.2%

*3 70.5% (Wind coverage for runway 23 landing with 5 kt tail wind and less than 13 kt cross-wind for a weather condition less than VOR minima and better than ILS CAT-I minima) x (99.2% - 94.2%)

*4: 78.1% (Wind coverage for runway 23 landing with 5 kt tail wind and less than 20 kt cross wind for a weather condition less than VOR minima and better than ILS CAT-I minima) x (99.2% - 94.2%)

*5: 70.5% (Wind coverage for runway 23 landing with 5 kt tail wind and less than 13 kt cross-wind for a weather condition less than VOR minima and better than ILS CAT-II minima) x (99.5% - 94.2%)

*6: 78.1% (Wind coverage for runway 23 landing with 5 kt tail wind and less than 20 kt cross wind for a weather condition less than VOR minima and better than ILS CAT-II minima) x (99.5% - 94.2%)

*7: 70.5% (Wind coverage for runway 23 landing with 5 kt tail wind and less than 13 kt cross-wind for a weather condition less than VOR minima and better than ILS CAT-III minima) x (100% - 94.2%)

*8: 78.1% (Wind coverage for runway 23 landing with 5 kt tail wind and less than 20 kt cross wind for a weather condition less than VOR minima and better than ILS CAT-III minima) x (100% - 94.2%)

The result shows that the existing runway usability factor with less than 20 kt cross-wind condition is 92.9% and less than the recommended value of 95% by ICAO. However, the introduction of ILS Category-I will considerably improve the usability factor up to 96.8%. The improvement of usability factor by grading up of ILS up to Category-II or III is considered to be very small.

(5) **Runway Capacity**

The existing runway is estimated to handle 66,000 operations annually (refer to Appendix 5.1.) and considered sufficient even for the traffic anticipated beyond 2010.

(6) **Runway Length and Width**

The existing runway length of 3,048 m permits DC-10-30 and B-747-200 to fly directly to Jeddah. As the longest section is anticipated to be from Chittagong to Jeddah, no extension is required for takeing off. The runway width of 46 m complies with ICAO recommendation for aerodrome reference code letter of 4, which corresponds to the large aircraft such as DC-10 and B-747.

(7) **Pavement**

Since the inauguration of this airport in the early 1940s, the runway has been extended and improved by overlay or patching works out of necessity. The latest overlay work was executed for the portion of 2,250 m from the runway 23 threshold in 1985. Depressions and cracks are however still observed on the surface of the runway.

One of the most crucial subjects concerning the runway pavement is to clarify the cause of these defects, to evaluate the pavement and to find an appropriate solution. In this study, the above subject has been studied based on the visual inspection, soil investigation and topographic survey of the runway pavement by the Study Team.

a) Cause of Depression and Cracks

Based on the results of the visual inspection of the runway surface, soil investigation and its analysis, the depressions and cracks are analyzed to have been caused by the following reasons:

- Unequal bearing strength of the subgrade of runway due to partially insufficient compaction works.

- Overlay works without sufficient filling of depressions by asphalt material.

- Construction joints in the previous overlay works.

- Cracks due to unequal settlement at the old edge of the runway which was widened from 30 m to 46 m in the early 1970's.

The result and the detailed explanation of the visual inspection, soil investigation, topographic survey and their analyses are described in Appendix 5.2 through 5.6.

b) Evaluation of Runway Pavement

The existing pavement was overlaid in 1985. However, depressions was not considered to be filled but overlay works are considered to have been carried out without design and levelling to smooth the surface .

The situation of the surface of the existing runway pavement is shown in Appendix 5.2.

According to the consolidation analysis in Appendix 5.4, settlement of the foundation, i.e. subgrade and its sublayer has already completed. And the calculation of stress distribution in Appendix 5.6 shows that the foundation of the pavement has sufficient strength to bear the load of aircraft presently in operation and even the load of DC-10 or B-747-400 aircraft anticipated in the future. Therefore, further settlement will not occur even if the large aircraft are introduced.

The existing pavement thickness is sufficient for F-28 aircraft, however it is necessary to be strengthened for the operation of DC-10 aircraft.

Although the depressions and cracks are still observed on the surface of runway, these are not judged to be fatal defects from the results of the investigation and analysis.

Based on the above studies, it is concluded that the existing pavement is usable for the operations of large aircraft if it is strengthened. The method of repair for the depressions and cracks is described in Section 6.7.1 together with the strengthening method of the existing runway pavement.

(8) **Shoulder**

The existing 2 m wide shoulders are made of cement concrete pavement. They should be widened so that the overall width of the runway and its shoulders will be 60 m for the introduction of DC-10 and B-747.

5.2.2 Runway Strip and Runway End Safety Area

Although a 305 m wide runway strip is stated in the AIP, there are many obstacles on the runway strip such as the apron, Biman GSE maintenance garage, access road, and tombs. An apron, guard houses storage, etc. of BAF are also on the runway strip. Therefore, the existing runway strip is deemed to be 150 m wide which is adequate for a non-instrument runway. The above obstructions should be removed in accordance with the Civil Aviation Rules of Bangladesh, and ICAO which recommends the clearance of obstacles as far as practicable. It is also necessary to strictly restrict the creation of new objects which may endanger airplanes.

Although a runway end safety area is not provided at present, this should be provided in accordance with ICAO.

5.2.3 Obstacle Limitation Surfaces

The obstacles limitation surfaces of the existing airport and the obstacles which are recognized by the airport authority are shown in Figure 5.2.4.

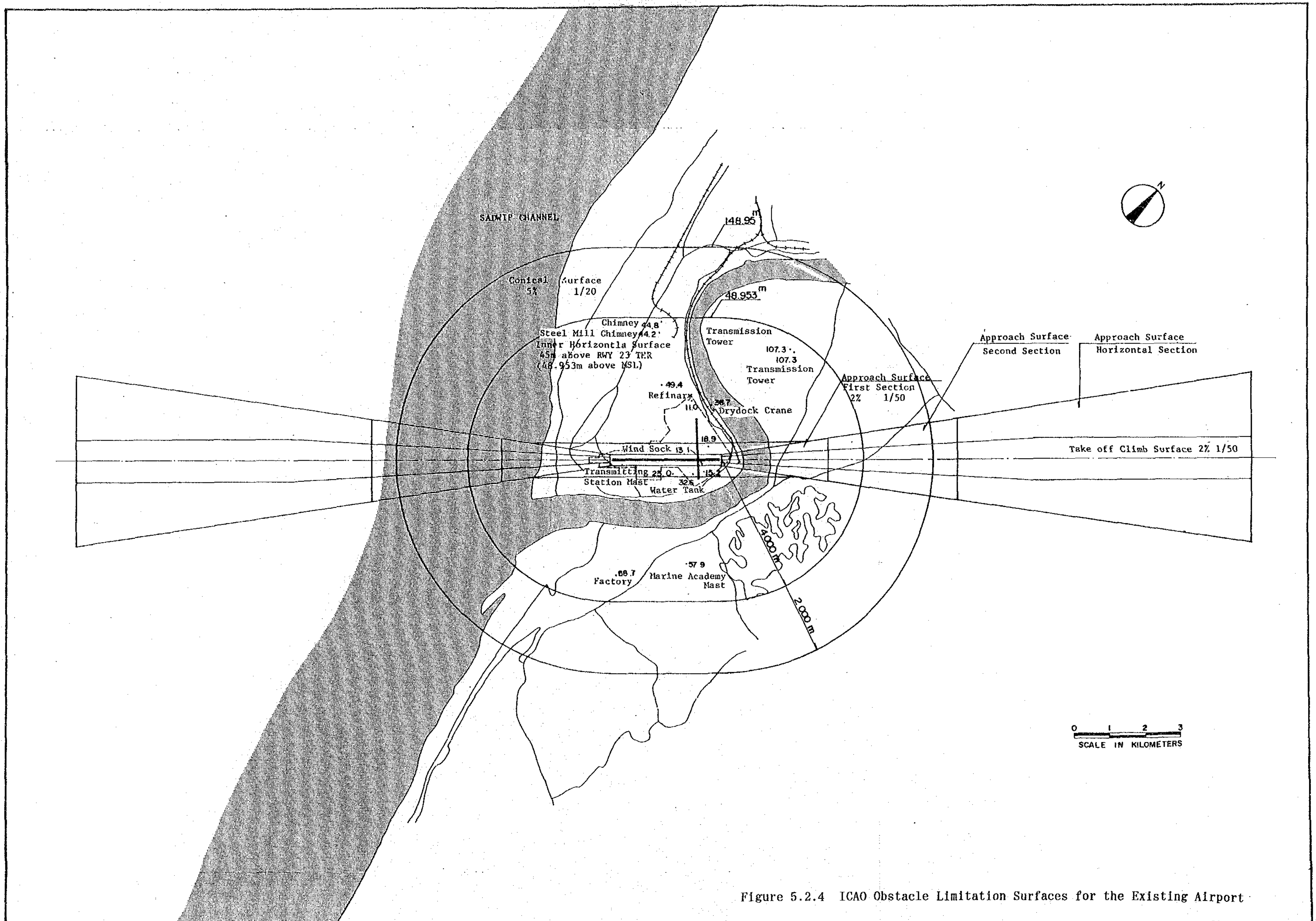
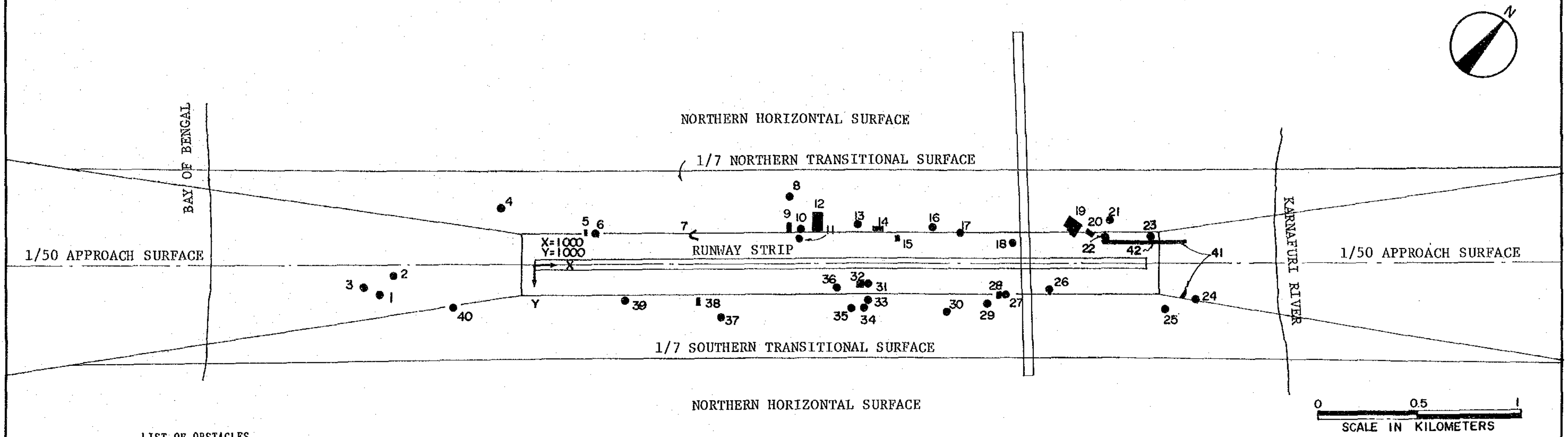


Figure 5.2.4 ICAO Obstacle Limitation Surfaces for the Existing Airport



LIST OF OBSTACLES

Unit : m

RWY05 APPROACH SURFACE

NO	OBJECT	X	Y	ELEVATION	ELEVATION OF THE SURFACE	DEGREE OF INFRINGEMENT
1	POWER POST	233.57	1,142.12	19.86	17.52	2.34
2	POWER POST	306.62	1,044.76	16.65	16.06	0.59
3	TREE	156.91	1,105.24	19.86	19.05	0.81

RWY23 APPROACH SURFACE

NO	OBJECT	X	Y	ELEVATION	ELEVATION OF THE SURFACE	DEGREE OF INFRINGEMENT
41	ACCESS ROAD	4,208.00	1,150.00	9.3 (4.5+4.8)	5.25	4.05

NORTHERN TRANSITIONAL SURFACE

NO	OBJECT	X	Y	ELEVATION	ELEVATION OF THE SURFACE	DEGREE OF INFRINGEMENT
4	TREE	837.43	772.40	17.09	14.33	2.76
5	B.A.FRUDER BUILDING	1,254.22	833.08	6.80	5.82	0.98
6	RADAR ANTENNA	1,306.24	841.26	11.72	4.65	7.07
8	WIRELESS TOWER	2,269.33	660.51	39.03	30.47	8.56
9	BUILDING B.A.F.	2,257.27	815.25	10.82	8.36	2.46
10	LIGHT POST	2,325.62	826.29	15.58	6.79	8.79
12	FIGHTER HANGER	2,405.22	790.57	15.96	11.89	4.07
13	TREE	2,604.89	800.53	13.92	10.40	3.52
14	SQUADRAN BUILDING	2,682.02	827.83	11.39	6.50	4.89
16	POWER POST	2,983.81	814.25	9.10	8.44	0.66
17	LIGHT POST	3,124.16	845.39	9.37	3.99	5.38
19	TERMINAL BUILDING	3,634.25	803.78	16.42	10.20	6.22
20	ENGINEERING OFF.	3,757.82	840.57	9.97	4.95	5.02
21	TREE	3,874.08	785.32	15.33	12.84	2.49

RUNWAY STRIP

NO	OBJECT	X	Y	ELEVATION	ELEVATION OF THE SURFACE	DEGREE OF INFRINGEMENT
7	FIREING RANGE	1,752.94	868.55	10.60	3.40	7.20
11	LIGHT POST	2,318.30	874.82	14.87	3.40	11.47
15	ARMS AMMU BUILDING	2,805.58	872.32	8.15	3.33	4.82
18	TREE	3,383.94	896.35	9.10	3.50	5.60
22	TREE	3,853.84	865.58	16.10	3.60	12.50
23	TREE	4,072.45	868.88	18.60	3.40	15.20
26	WIND SOCK	3,567.61	1,124.73	12.38	3.60	8.78
28	SUB STATION BUILDING	3,315.60	1,131.03	7.96	3.50	4.46
31	LIGHT POST	2,651.85	1,097.32	7.68	3.33	4.35
32	NDB BUILDING	2,637.29	1,102.85	6.38	3.33	3.05
36	HIGH LAND	2,500.51	1,113.18	6.85	3.33	3.52
42	ACCESS ROAD		850.00	8.70 (3.9+4.8)	3.40	5.30

SOUTHERN TRANSITIONAL SURFACE

NO	OBJECT	X	Y	ELEVATION	ELEVATION OF THE SURFACE	DEGREE OF INFRINGEMENT
24	TREE	4,298.16	1,173.51	15.51	7.05	8.46
25	TREE	4,146.61	1,226.37	14.63	14.31	0.32
27	LIGHT POST	3,348.67	1,160.68	10.28	5.03	5.25
29	POWER POST	3,258.46	1,191.31	10.40	9.40	1.00
30	TREE	3,054.41	1,231.18	16.07	14.93	1.14
33	TREE	2,657.40	1,175.95	9.63	7.04	2.59
34	WERELESS TOWER	2,636.99	1,214.16	24.97	12.50	12.47
35	WERELESS TOWER	2,573.74	1,217.69	20.82	13.00	7.82
37	TREE	1,926.31	1,263.73	22.83	19.65	3.18
38	MOSQUE	1,812.03	1,189.06	12.35	8.98	3.37
39	TREE	1,451.50	1,178.28	10.17	7.44	2.73
40	POWER POST	601.74	1,209.52	13.72	11.41	2.31

NOTE, X and Y in the above table are based on the airport coordinate.

Figure 5.2.5 Obstacles to Approach Surface, Transitional Surface and Runway Strip

A detailed survey on the existing obstacle in the airport property and its vicinity was carried out by the Study Team. The analysis of the survey result was based on the 300 m wide runway strip. The obstacles infringing transitional surfaces and approach surfaces and those on the runway strip are listed with their locations in Figure 5.2.5.

As aforementioned, all ships with a mast of heigher than 14.6 m are mobile obstacles infringing upon runway 23 approach surface and runway 05 take-off climb surface. An appropriate measure is required to ensure aircraft operational safety while the runway is utilized for landing and take-off.

There are no obstacles on the northern and southern parts of the inner horizontal surface in the airport property. However, the marine academy mast, high tension transmission tower etc. infringe upon the inner horizontal surface outside the airport as shown in Figure 5.2.4. Obstacles lights have been installed on these obstacles.

5.2.4 Taxiway

One right angle taxiway which connects the runway with the apron is located about 500 m from runway 23 threshold. The existing exit system is quite sufficient for the present traffic of two movements during peak hours. The width of the taxiway is 18 m and adequate for F-28, F-27 and smaller aircraft.

A parallel taxiway connecting runway 23 threshold with the apron is not used due to insufficient pavement strength and insufficient separation from the runway centerline.

5.2.5 Apron

(1) Location of Apron in Relation to Obstacle Limitation Surfaces

The airside edge of the existing apron is located 90 m from the runway centerline, which is within the 300 m runway strip in width. All commercial aircraft parked on the apron are obstacles to aircraft operations.

(2) Aircraft Stands

The existing apron has a total area of 16,200 sq.m. There are 5 parking positions on the apron, of which three are used for commercial airliners. Three F-28's can be parked simultaneously. The other two parking positions are for light aircraft such as Cessna or Pilatus.

According to the present flight schedule, one F-28 and one F-27 park on the apron simultaneously once in a week. However, 3 parking positions are occasionally occupied due to delayed flights mainly in the monsoon season. The civil aircraft utilizes fuel hydrant pits on the apron. Expansion of the apron to accommodate large aircraft expected around 1995 based on the traffic forecast is difficult due to the limited land area.

(3) Pavement

The apron is made of asphalt concrete and cement concrete pavements. The declared strength of 7 ton/sq.ft in the AIP may be sufficient for F-28 judging from the tire pressure of a single wheel, but cannot accommodate large aircraft. Standing water appears at many places on the apron due to unevenness of the surface.

5.3 Passenger Terminal Building and Other Buildings

5.3.1 Passenger Terminal Buildings

(1) General

The existing international terminal building was constructed in 1942. Piecemeal development has been made and now it accommodates the international passenger terminal and the administrative/ operational functions of CAAB. Another passenger terminal building was constructed in 1983 and is presently used as a domestic passenger terminal. The floor plans of the existing international and the domestic passenger terminal buildings are shown in Figures 5.3.1 through 5.3.4.

(2) Location of Passenger Terminal Building in Relation to Obstacle Limitation Surfaces

The control tower on the top of the international passenger terminal building is located about 180 m from the centerline of the runway and has a height of 15.2 m above aerodrome elevation. Therefore, most of the international terminal building infringes the transitional surface required by ICAO.

(3) Expansibility of Passenger Terminal Buildings

It is difficult to expand the existing passenger terminal area due to the limited land area. The existing terminal area is located in the BAF area and there is no room for CAAB to accommodate future facility development.

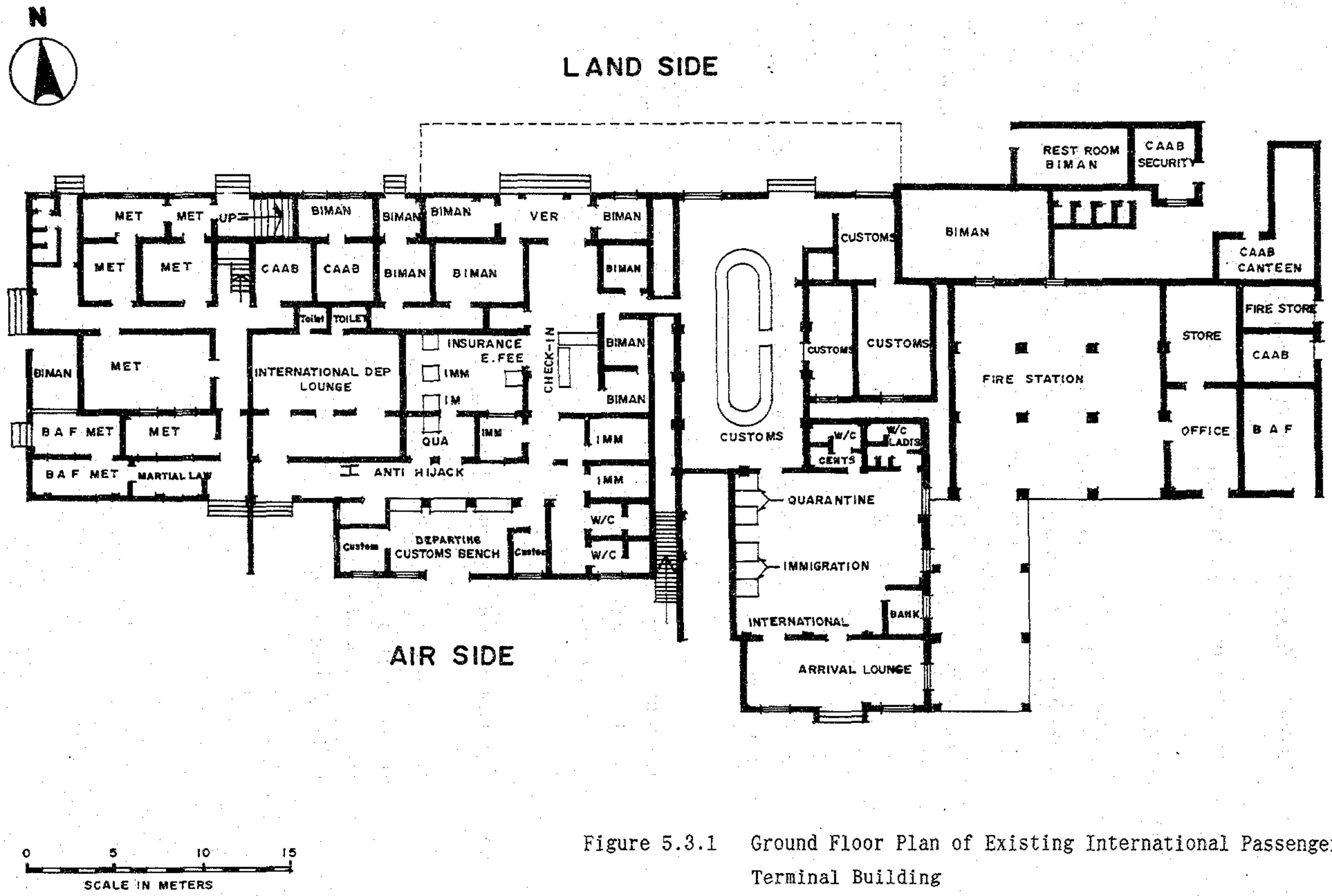


Figure 5.3.1 Ground Floor Plan of Existing International Passenger Terminal Building

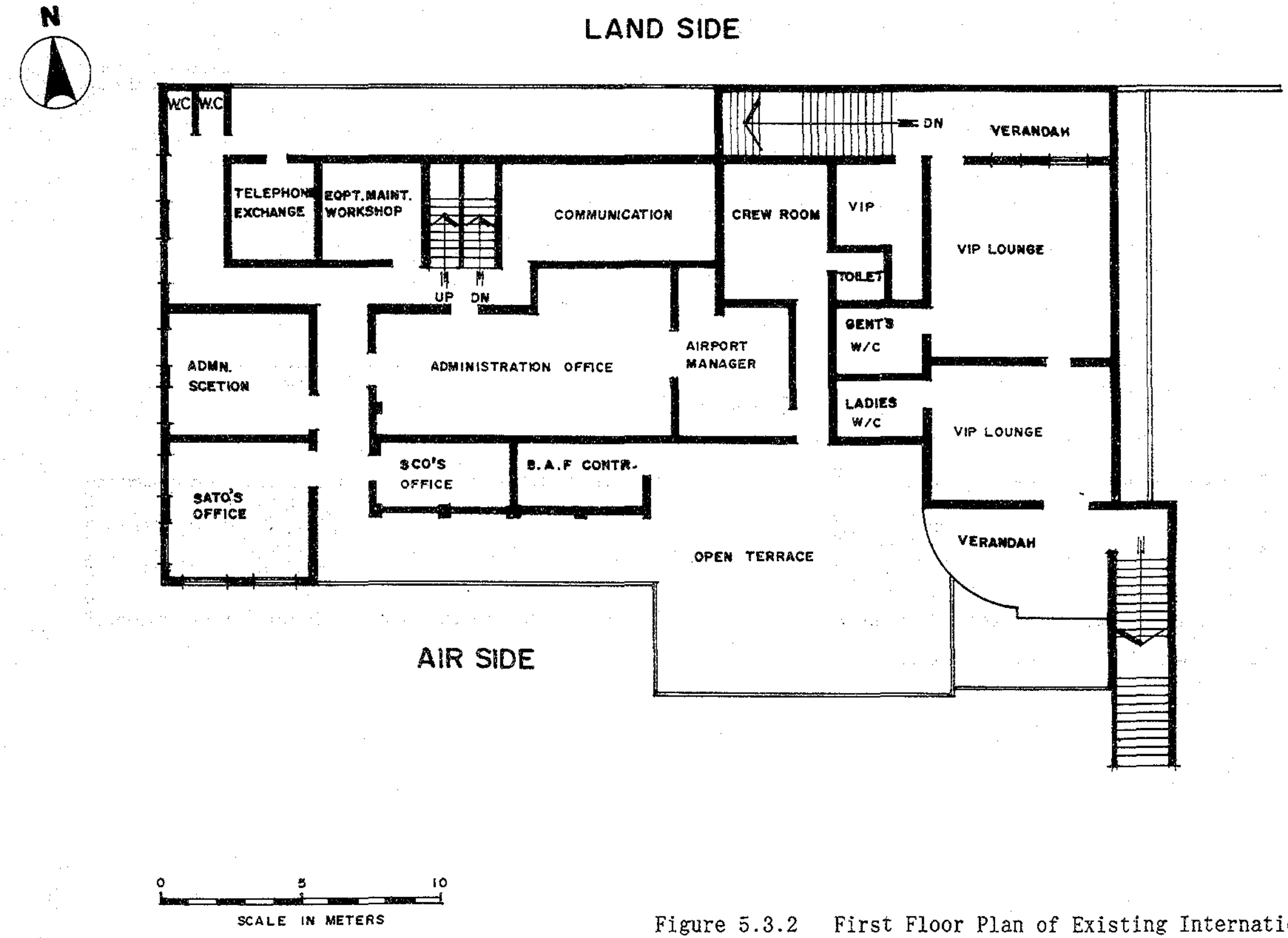


Figure 5.3.2 First Floor Plan of Existing International Passenger Terminal Building

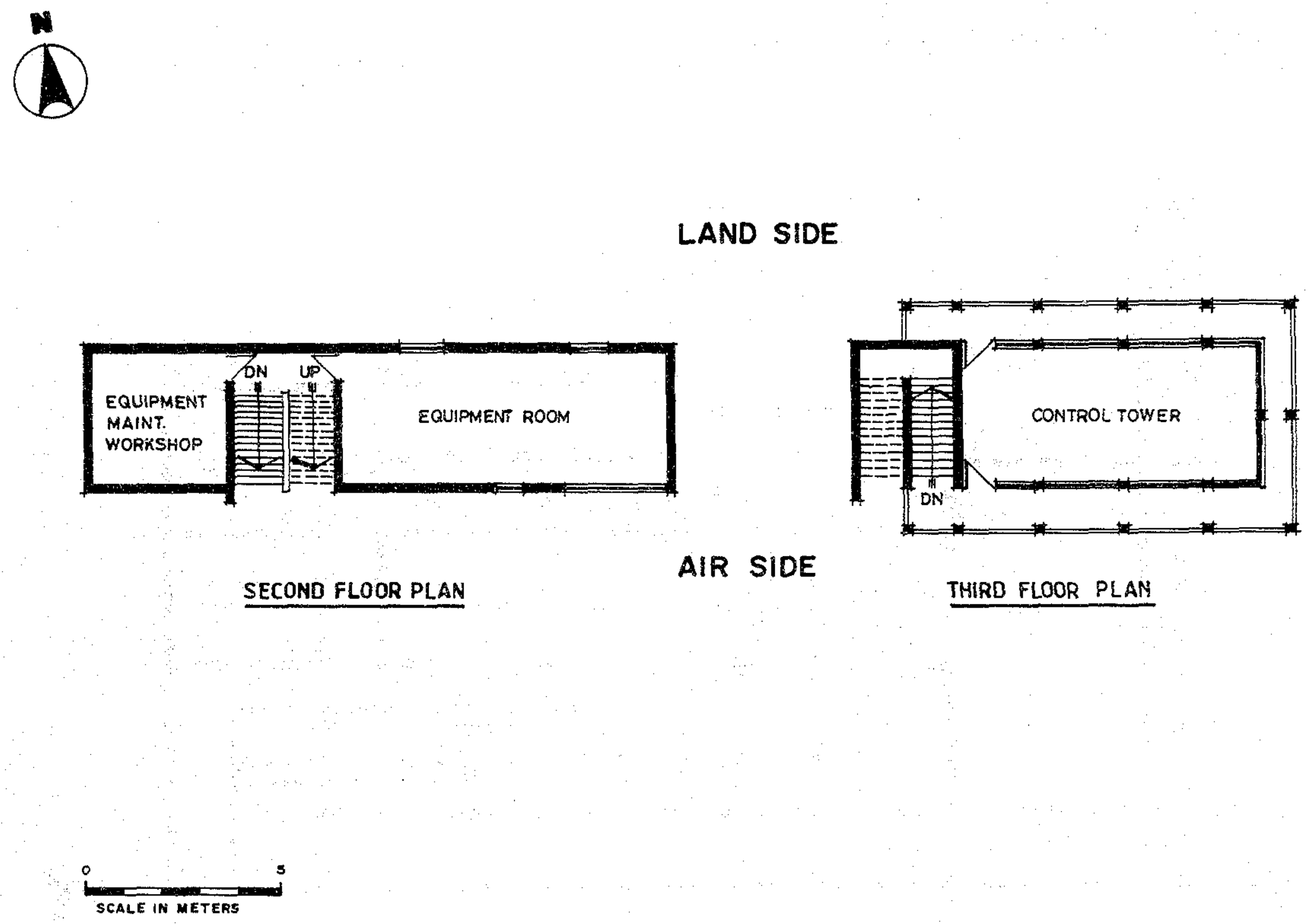


Figure 5.3.3 Second Floor Plan of Existing International Passenger Terminal Building

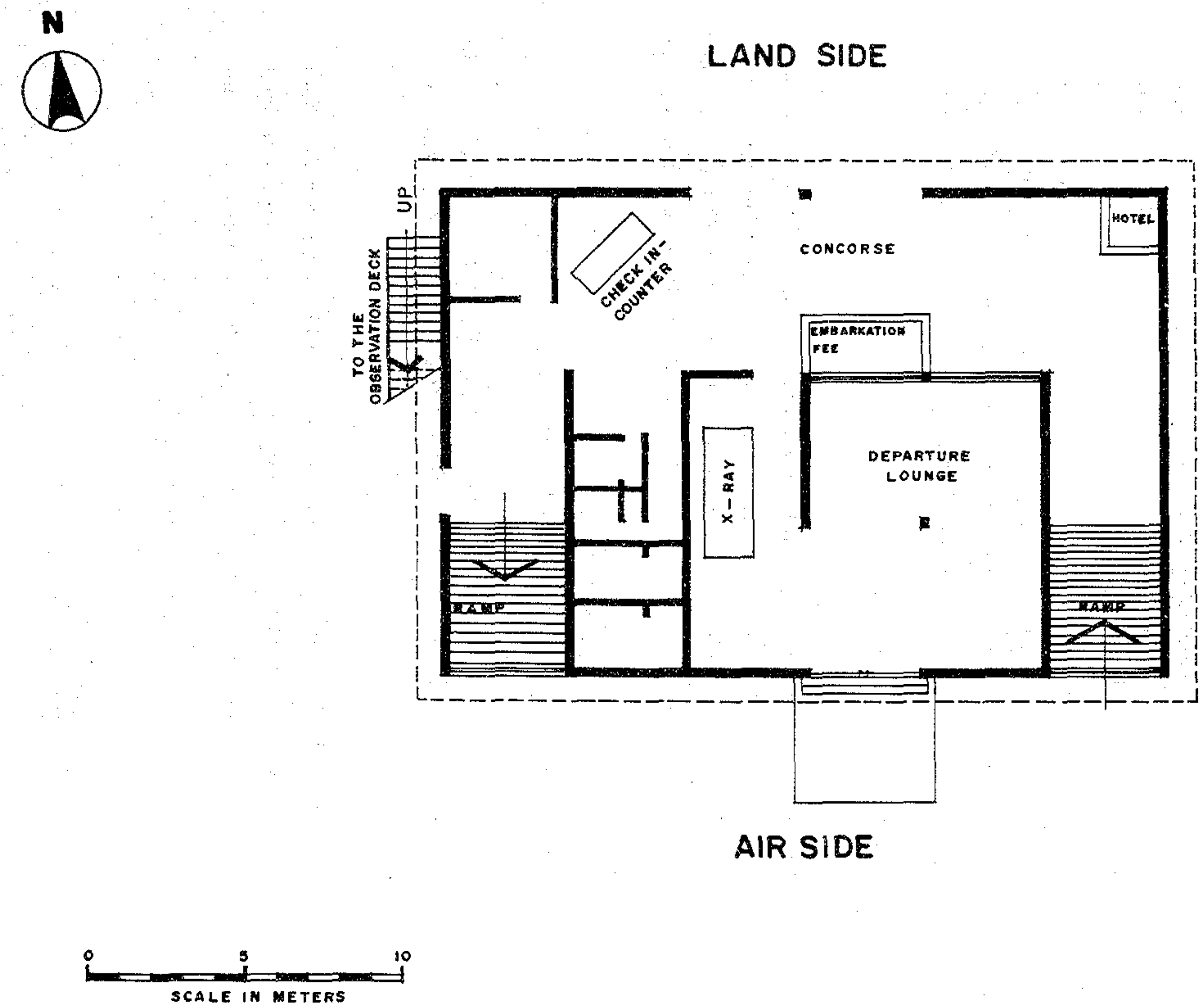


Figure 5.3.4 Ground Floor Plan of Existing Domestic International Passenger Terminal Building

(4) International Passenger Terminal Building

The floor utilization of the existing international terminal building is as follows and shown in Figures 5.3.1 through 5.3.4.

Total Floor Area			1,660 sq.m
Ground Floor	Passenger Terminal Use Departure	:	440 sq.m
	Arrival	:	440 sq.m
	Meteorological Department	:	210 sq.m
	CAAB (Security Quarter)	:	20 sq.m
	Total	:	1,110 sq.m
First Floor	CAAB (Adm.and Ops.)	:	350 sq.m
	VIP Use	:	110 sq.m
	Total	:	460 sq.m
Second Floor	CAAB (Equip. Room and Workshop)	:	50 sq.m
Third Floor	CAAB (Control Tower)	:	40 sq.m

a) Floor Area

The floor area used for passenger processing is 880 sq.m while the peak hour passenger (2 ways) is 150 at present. This building has reached its capacity because the floor area per peak hour passenger is only 5.9 sq.m which is about 65% of the requirements.

b) Departing Passenger and Baggage Processing

The passenger processing capacity of each component of the departure terminal is estimated from the traffic survey as follows:

Check-in Counter (1 counter)	:	100 passenger per hour
Immigration Counters (2 counters)	:	70 passenger per hour
Customs Counter (3 positions)	:	70 passenger per hour

An adequate number of counters is provided for the present traffic of 75 peak hour departing passengers. However, lack of queuing space causes heavy congestion before each counter. The excessive concentration of passengers at the check-in counter creates a long queue sometimes out of the building. One embarkation fee counter and a walk through metal detector are also sufficient for the present traffic, but no queuing space is available.

The floor area of the departure lounge is 60 sq.m, which is not sufficient for the design aircraft of F-28 at present.

The passenger flow in the departure terminal is complicated due to insufficient building depth, which is about 21 m. Passengers are confused by many direction changes in the terminal.

Departing customs clearance is a special requirement of Bangladesh. All the check-in baggage as well as hand baggage is subject to inspection. An area sufficient for conducting the requirement is necessary in the terminal.

c) Arriving Passenger Processing

The passenger processing capacity of each component of the arrival terminal is estimated from the traffic survey as follows:

Immigration Counters (2 counters) : 140 passengers per hour
Customs Counter (6 positions) : 25 passengers per hour

Baggage flow in the terminal is relatively simple. However no baggage claim facility is provided for passengers.

The capacity of inbound customs is too small to handle the present traffic due to a long processing time of about 15 minutes per passenger. Many passengers are obliged to wait for one to two hours at the arrival hall. Customs inspection area should be enlarged to increase the number of inspection positions.

d) Structure

This reinforced concrete building was constructed 46 years ago and in an obsolescent condition. Water leaks from several places of the building. The column spacing varies between 2.0 and 4.5 m, which obstructs any internal remodeling.

e) Others

- Due to repeated extension of the building, the electrical and mechanical systems are not sufficient in terms of function, operation and maintenance.

- The existing curb length is insufficient for the present vehicular traffic. Greeters and vehicles always crowd at the entrance of the building.

- No X-ray detective equipment is available.

- There is neither a flight information system nor signs for passengers.

- There is no fire alarm, fire hydrant or fire extinguisher.

- No restaurant, snack bar or duty free shop is available in the terminal.

(5) Domestic Passenger Terminal Building

The domestic terminal building is one story building with a total floor area of 320 sq.m. The ground floor is exclusively used for passenger processing. The roof of this building is used as the observation deck for greeters.

a) Floor Area

The number of peak hour passengers (2 ways) is 130 at present. Therefore, the floor area per peak hour passenger is estimated to be 2.5 sq.m which is about 40 % of the requirements. Thus the building has already reached its capacity.

b) Departing Passenger Processing

The passenger processing capacity of the check-in counter (1 position) is 100 passengers per hour and adequate for the present peak hour traffic of 65 departing passengers. One is embarkation fee counter and an X-ray detective equipment is also sufficient for the present traffic.

The floor area of departure hall is 100 sq.m, which is adequate for one F-28 aircraft. However, aircraft delays often make it necessary to accommodate passengers for two flights and causes heavy congestion in the departure lounge.

c) Arriving Passenger and Baggage Processing

The arriving passenger and baggage processing is relatively simple. The passengers pick up their baggage at the airside entrance of the building and go through the terminal. There is no baggage claim facility for passengers.

d) Structure

The domestic terminal building is made of reinforced concrete with three column spacings of 3.7m, 4.6m and 5.5m.

e) Others

- There is no fire alarm, fire hydrant and fire extinguisher.

- The area in front of the building is too small to handle vehicle circulation.

- No passenger amenities such as snacks are available.

5.3.2 Cargo Terminal Building

No cargo terminal building is available at Chittagong Airport. Domestic cargo is transported between Biman's city office and the airport by a truck synchronized with the flight schedule. International outbound cargo is transported from the customs office in the city to the airport before the departure time of the first flight and inbound cargo vice versa after the arrival of the last flight. There is a 20 sq.m customs storage facilities in the international arrival terminal. An independent cargo terminal building is required to meet the increasing traffic need.

5.3.3 Administration Building

The administrative and operational functions of CAAB are accommodated in the international passenger terminal building. The total floor area used by the above functions is 460 sq.m. The Meteorological Department occupies 210 sq.m of the ground floor. The existing floor area is considered sufficient for the requirements of the present non-precision approach operations. However, if the precision approach operations are introduced, additional space will be necessary. The airport maintenance function of CAAB is accommodated in a remote building located near the staff housing area south of the runway.

5.4 Car Park and Access Road

5.4.1 Car Park

The car parks are located in front of the international and domestic passenger terminal buildings respectively. Although there is no physical boundary between the car park and terminal frontage road, parking space in front of the international terminal building seems to have a capacity of 30 cars and 60 auto-rickshaws. Six cars can be parked in front of the domestic terminal building. The car park has already reached its capacity and needs expansion.

Many spots of standing water appear after rainfall in the car park due to depressions of the pavement.

The terminal frontage road is in a cul-de-sac shape and has a width of three lanes consisting of two lanes for both directions and one standing lane.

5.4.2 Access Road

The existing access road connects the terminal area with Port Road which runs along the shore of Karnafuli River. The road runs in parallel with the runway 135 m from the runway centerline. This asphalt concrete road is 5.5 m wide and has two traffic lanes. There are many depressions on the surface pavement.

5.5 Airspace Use

5.5.1 Airspace Configuration

(1) **Flight Information Regions (FIR)**

The air space over the territory of Bangladesh is surrounded by the borders of India and Burma. The control space is established from the ground or water level up to unlimited space.

(2) **Terminal Control Area**

A terminal control area in Bangladesh is only established for Zia International Airport.

(3) **Aerodrome Control Zone**

An aerodrome control zone in Bangladesh is established for Zia International Airport and Chittagong Airport as shown in Figure 5.5.1.

(4) **Restricted Area**

In Bangladesh, 13 restricted areas are established for training military aircraft. In the vicinity of Chittagong Control Zone, three restricted areas have been established as shown in Figure 5.5.1.

VG-D14 and VG-D10 are located below the air route of G-63 which connects Dhaka with Chittagong. During the air work in the restricted areas, G-63 is changed from N140^{o} E to N148^{o}E and the aircraft flies via RUXIL in order to avoid of these areas.

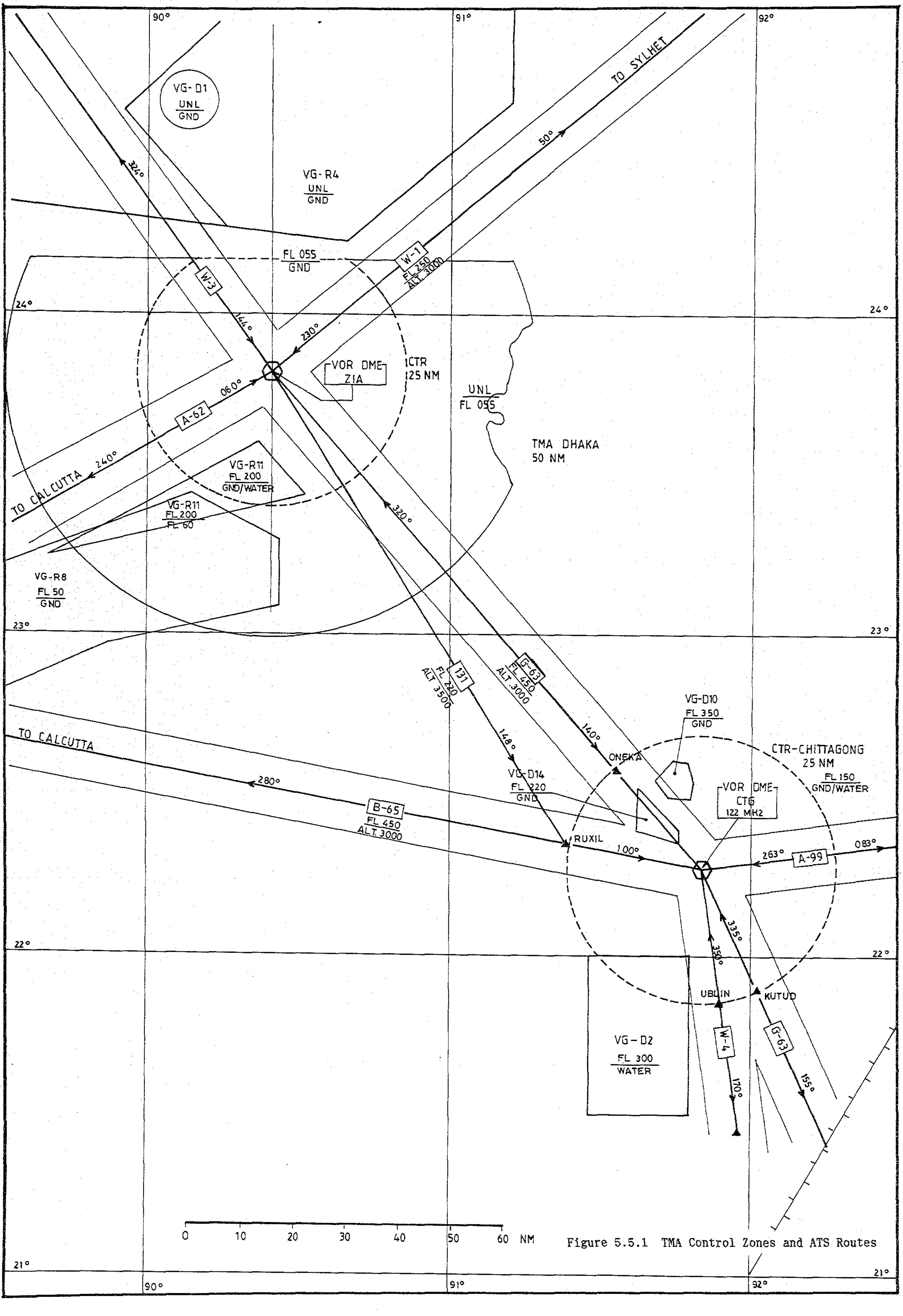


Figure 5.5.1 TMA Control Zones and ATS Routes

(5) **Aircraft Operation Procedures**

Four instrument approach and holding procedures are established for Chittagong Airport as follows:

VOR RWY 23
NDB RWY 23
VOR RWY 05
NDB RWY 05

Standard Instrument Departure Procedure (SID) for Chittagong Airport is not established.

5.6 Air Navigation Systems

Air navigation systems consist of the followings:

- Radio Navigation System
- Aeronautical Telecommunications System
- Aeronautical Ground Light
- Meteorological Observation System

The existing systems are outlined in Table 5.6.1 and their system diagram is shown in Figure 5.6.1

These systems are described as follows:

5.6.1 Radio Navigation System

(1) **VOR/DME**

The conventional type of VOR was manufactured in July 1975 and commissioned in February 1979. The system performance reliability is occasionally reduced by flood water in the surrounding area of VOR/DME. The existing equipment will reach its life span shortly and needs to be replaced by a Doppler type VOR for better reliability under this condition.

Table 5.6.1 Outline of the Existing Air Navigation Systems (1)

Item	Description	Year of Manufacture
1. Radio Navaids		
- Non Directional Radio Beacon (NDB)	- 287KHz.100W	- 1987
- VHF Omnidirectionaol Radio Range (VOR) and co-located Distance Measuring Equipment (DME).	- 113MHz.100W - 1668MHz.1KW	- 1975 - 1975
- Instrument Landing System	- Nil	
2. Aeronautical Telecommunications		
- Air to Ground VHF Communications	- TWR 118.7MHz - SMC 121.8MHz	- 1961 - 1961
- VHF Multiplex	- Provided	- 1983
- Automated Terminal Information system (ATIS)	- Nil	
- HF/SSB Point to Point Telecom	- 4 channels 6828,6826,6814 & 3660 KHZ	
- AFTN Message Teletypewriter	- Dhaka	- 1960
- Magnetic Tape Recorder	- 4 channels	- 1977
- Time Distribution System	- Nil	
- Control Console	- Aerodrome/ Approach Control	
- ATC Intercommunication	- Provided	

Table 5.6.1 Outline of the Existing Air Navigation Systems (2)

Item	Description	Year of Manufacture
3. Aeronautical Ground Light		
- Aerodrome Beacon	- 2KW	- 1948
- Approach Lighting System	- RWY 23 (240 m length)	- 1978
- Visual Approach Slope Indicator System	- 2 Bar VASIS for RWY 23 & 05	- 1974
- Runway Threshold and End Light	- RWY 05 & 23	- 1978
- Runway Edge Lights	- Provided	- 1978
- Taxiway Edge Lights	- Provided	- 1978
- Apron Edge Lights	- Provided	- 1978
- Wind Direction Indicator Lights	- Provided (illuminated) 2 sets	- 1978
- Landing T Bar Lights	- Provided	- 1978
- Emergency Generator	- 125 & 75 KVA	- 1943
4. Meteorological Observation System		
- Runway Surface Observation Sensors	- Anemometer - Thermometer - Precipitation gauge - Barometer	- 1960
- Runway Visual Range Equipment	- Not Usable	-
- Ceilometer	- Nil	-
- WX Teletypewriter	- Cox's Bazar, Dhaka, Calcutta, Delhi	- 1960
- WX Facsimile	- Delhi, Tokyo, Bangkok, Dhaka	- 1981
- HF Transceiver	- Dhaka 150 Ch.	
- WX Data Processing Equipment	- Nil	

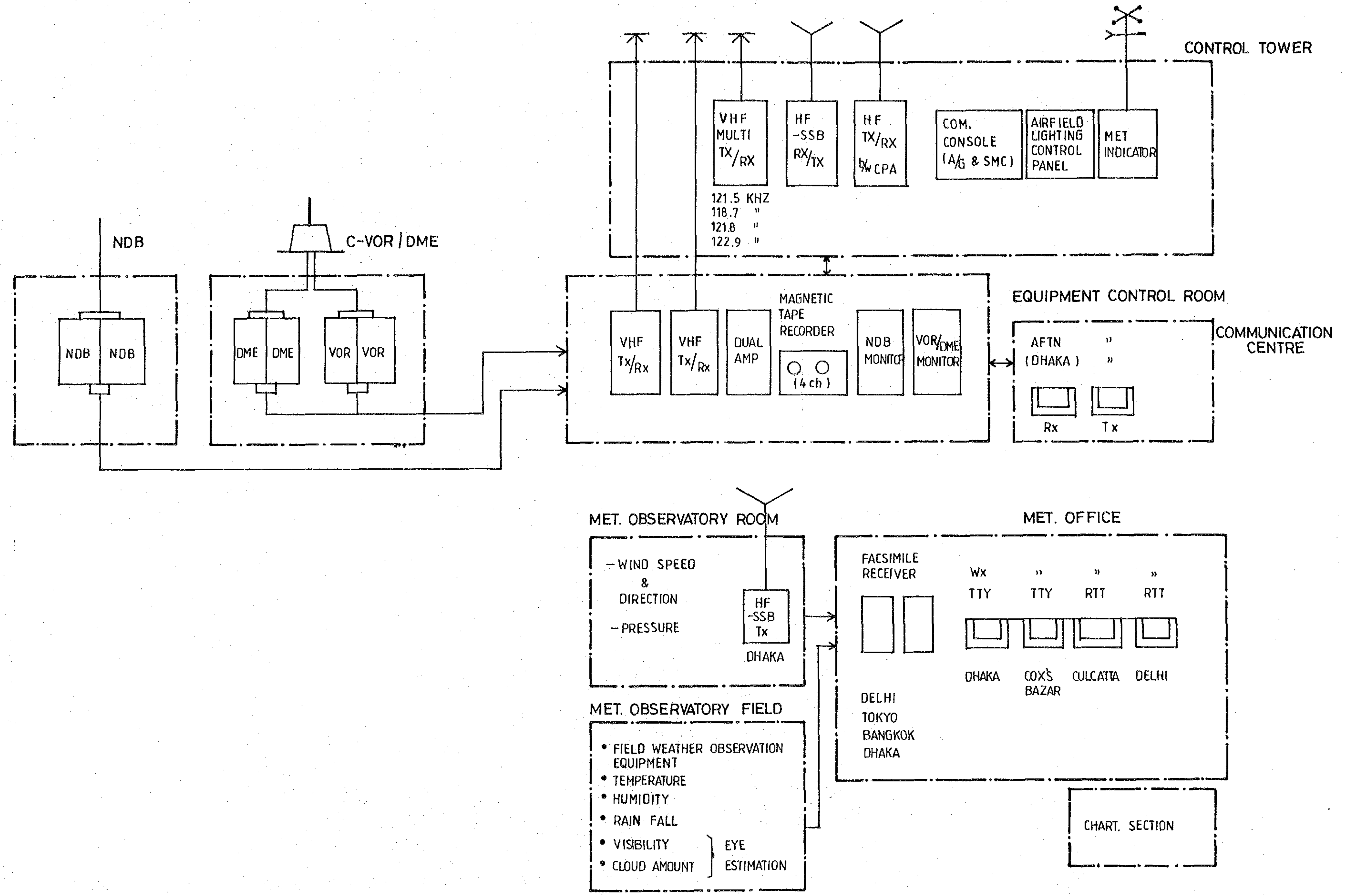


Figure 5.6.1 Diagram of Existing Air Navigation Systems

The DME was manufactured in December 1975 and was transferred from Zia International Airport in 1988 and commissioned at Chittagong Airport in January, 1989. There are no major problems with DME. However, this equipment also needs to be replaced because it is at the end of its designated period of use.

(2) **NDB**

The NDB equipment was produced in 1987 and commissioned in the beginning of 1988. There is no major problem with the existing equipment, but it infringes the transitional surface.

(3) **Others**

The monitor equipment for VOR/DME and NDB system was produced in 1979 and was installed at the equipment control room in the international passenger terminal building. There is no major problem with the existing system.

5.6.2 Aeronautical Telecommunication System

(1) **Air to Ground Communications**

- The transmitter and receiver equipment for the Tower (TWR) (118.7MHz) and Surface Movement Control (SMC) (121.8MHz) were manufactured in October 1961. The sound quality is poor.

- VHF multiple transmitter and receiver utilized as a stand-by for the above communications were manufactured in October 1983 and are in good condition. This equipment includes the emergency frequency 121.5 MHz.

- The control console for aeronautical telecommunications was installed in VFR room in the 1960s and is obsolete. The console accommodates analogue type indicators of wind direction and speed wind speed.

- The magnetic tape recorder with 4 channels was manufactured in October 1977. There are no major problems.

(2) **Aeronautical Fixed Telecommunications Network**

The Aeronautical Fixed Telecommunications Network (AFTN) at the airport is composed of land line teletypewriter (LTT) connected with the Dhaka Communication Center by the duplex circuit.

The teletypewriter equipment was manufactured in the 1960s and is obsolete. The HF SSB transmitter and receiver used for point to point communications of the aeronautical fixed services was manufactured in 1983 and commissioned in March 1984.

(3) **Others**

- The main spare parts for the radio navigation system are stocked at ZIA, and they are dispatched to the site on request.

- Automated Terminal Information System (ATIS) for flight information services is not provided

5.6.3 Aeronautical Ground Light

The following aeronautical ground lights are provided at the existing airport.

- Simple approach lighting system (SALS) on Runway 23
- Visual approach slope indicator (VASI) on Runways 05 and 23
- Runway edge lights
- Runway threshold and end light on Runways 05 and 23
- Taxiway edge lights
- Apron edge lights
- Apron floodlights
- Aerodrome beacon
- Illuminated wind direction indicator on Runways 05 and 23
- Landing T bar lights

The above lights are outlined as follows:

(1) **SALS**

The existing approach lighting system is 240 m in length and composed of seven units of barrettes by a single 200 watt lamp at 30 m intervals and 1 unit of cross bar with 11 units of 200 watt lamps at 210 m from the runway 23 threshold. This system does not comply with ICAO standard for a simple approach lighting system. The light is connected with one circuit in parallel.

(2) **VASI**

The existing VASI complies with ICAO standard and consists of two pairs of wing bars made up with three light units each. Each unit has four 200 watt lamps and there is no major problem.

(3) **Runway and Taxiway Edge Lights and Other Lights**

The existing runway and taxiway edge lights are 200 and 45 watt lamps respectively. The lamps are alternately connected with two circuits. The existing runway threshold and end lights consist of six units of semi-flush mounted type 200 watt lamps.

These lights comply with the ICAO Standards for a non-instrument approach runway.

(4) **Apron Flood Lights**

The apron floodlights include seven units each with 1 KW incandescent lamp.

The illumination level at the apron area does not meet the requirements in ICAO AERODROME DESIGN MANUAL PART 4.

(5) **Control System**

The brightness of the runway and taxiway edge lights is controlled by the control panel in the VFR room which adjusts to five steps, i.e. 100, 30, 10, 3 and 1 % of intensity. Sub-control function for the aeronautical ground lights is provided in the substation for the aeronautical ground lights. The control system diagram is outlined in Figure 5.6.2. PVC/PVC cable is used for direct buried cabling.

There is short circuit trouble occasionally because of the reduced insulation resistance of cable during the rainy season.

5.6.4 Meteorological Observation System

(1) **Observation Services**

The meteorological observation services at the existing airport are carried out by Chittagong Branch Office of Bangladesh Meteorological Department (BMD).

The diagram of the existing meteorological observation system is outlined in Figure 5.6.3.

The observation items and locations are as follows:

Items	Locations
- Wind speed & direction:	Met observation room
- Pressure:	Ditto
- Temperature:	Met observation field
- Humidity:	Ditto
- Rainfall:	Ditto
- Visibility:	Ditto (eye estimation)
- Cloud amount:	Ditto (eye estimation)

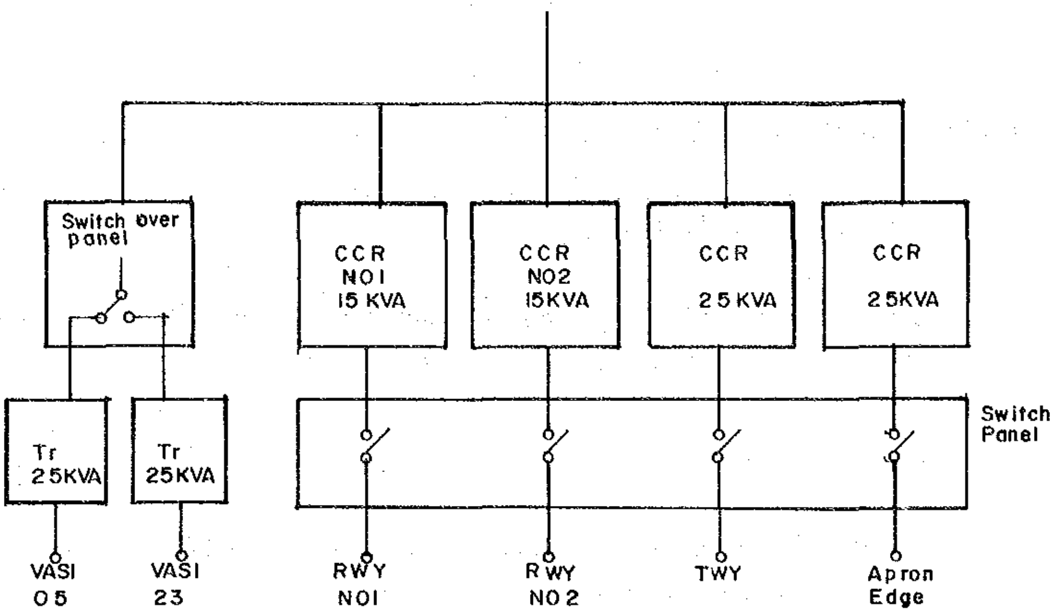


Figure 5.6.2 Outline Diagram of Aerounautical Ground Light

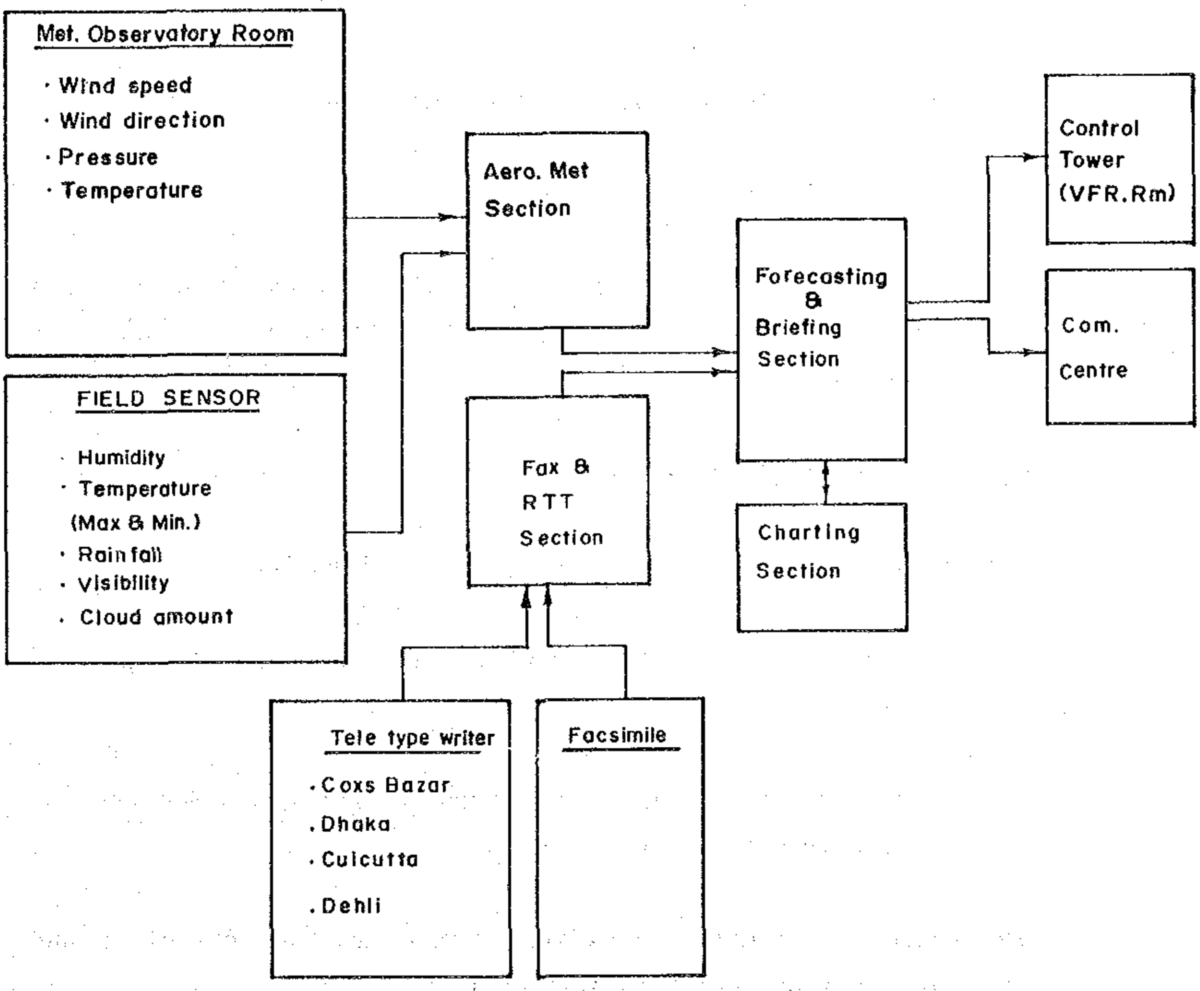


Figure 5.6.3 Outline Diaragam of Meteorological Observation System

(2) **Distribution and Receiving of Weather Information**

a) Radio Teletypewriter

The meteorological office has communication channels to connect with Delhi, Calcutta, Dhaka and Cox's Bazar.

b) Weather Facsimile

The meteorological office has the following number of channels connected with each station.

Delhi:	5 channels
Tokyo:	3 channels
Bangkok:	3 channels
Dhaka:	2 channels

A marine facsimile recorder is also furnished.

c) HF-SSB Transmitter

The meteorological office has one communications line to send data by HF-SSB transmitter connected with the head quarter of BMD in Dhaka.

(3) **Problems of the Existing System**

The following problems are found by site investigation.

- The equipment at the observation room and the observation field is very old.
- The observation of runway visual range is not conducted because the transmissiometer is out of order.
- The weather information is given to air traffic controller and the communication center in written form.

- The observation field is not located in the airfield and the routine obsevation activities are sometimes hindered because the field is located in the BAF area.

5.7 Airport Utilities

Airport utilities consist of the following:

- Power Supply System
- Telephone System
- Water Supply System
- Sewage Treatment System
- Solid Waste Disposal

Their existing conditions are summarized as follows:

5.7.1 Power Supply System

The diagram of the power supply system is shown in Figure 5.7.1.

The electrical power is supplied through two substations in the airport connected by two commercial lines from Power Development Board (PDB).

One substation supply to the international and domestic passenger terminal buildings, aeronautical ground light, fuel depot, water pump and street lighting. Another one is to VOR/DME and NDB.

A stand-by generator system is provided to cope with a failure of commercial power. The switch-over operation of the stand-by generator is done manually.

The frequency of the power failures lasting 10 minutes to 2 hours is about 10 times per month.

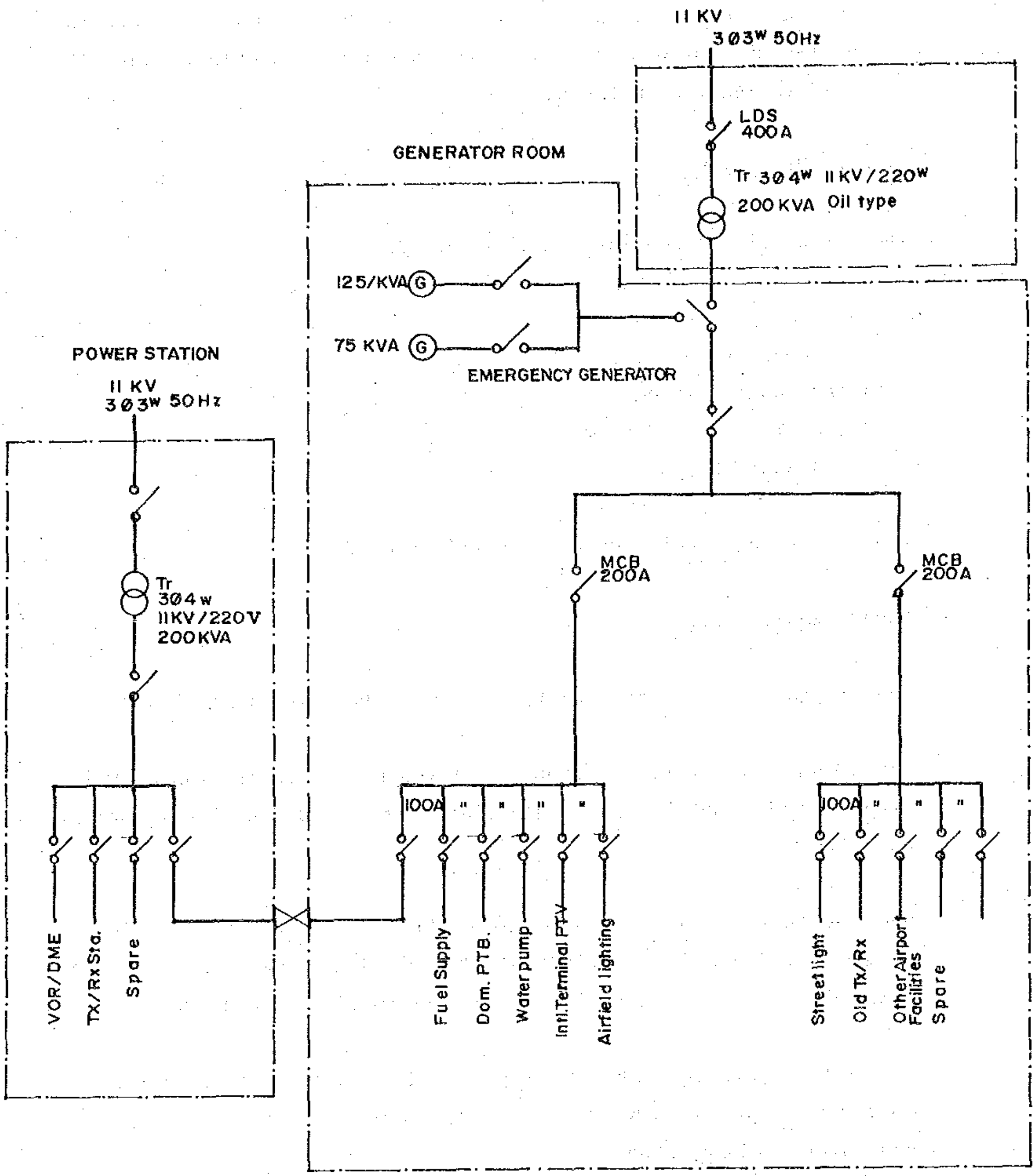


Figure 5.7.1 System Diagram of Existing Power Supply System

Most of the equipment are obsolete because they were manufactured in the 1960s.

The existing system is now operational and is considered to be serviceable in terms of capacity at least several years from now if the present load does not increase due to the expansion of the facility.

5.7.2 Telephone System

(1) Telephone System

The existing telephone system at the airport was manufactured in 1978. The exchanger (PBX) is a manual type. The capacity of PBX and Main Distribution Frame (MDF) are as follows:

- 4 lines from outside
- 40 lines for the internal branch circuits.
- 60 terminals at MDF

There are six direct lines at the existing airport, i.e. one for the VFR room, four for the PBX and one for the VIP room. PBX and MDF are obsolete and need to be replaced in order to increase the service level and capacity.

(2) Intercommunication System

The existing intercommunication system for the air traffic service is connected with the following stations:

- Equipment control room
- Control tower (VFR room)
- Communications center
- Fire station
- Meteorological office
- Security office
- Anti-hijacking office
- Airport manager

- Station communications manager
- Station air traffic officer
- Transmitter site
- Teleprinter work shops

(3) **Intercommunication Between Control Tower and Fire Station**

The intercommunication system between the VFR room and the fire station consists of the following:

- Intercommunication
- Walky talky/radio telephone
- VHF

5.7.3 Water Supply System

The existing water supply system for the airport facilities consists of pumping facility, well and elevated tank. The capacity of each facility is as follows:

Well of 11 m deep:	5,000 IG/hour
Pump capacity:	4 Hp
Tank capacity:	20,000 IG (91 Kb)
Distribution system:	Gravity distribution

The facility is located 400 m north of the terminal building.

Another water supply system is provided for the staff housing area on the south of runway as follows:

Well of 34 m deep:	18,000 IG/hour
Pump capacity:	30 Hp
Tank capacity:	50,000 IG (227 Kb)
Distribution system:	Gravity distribution

This system is now out of order and the water to the staff housing area is supplied from the north water tank. It is serviceable in terms of capacity if the present load does not increase due to on expansion of the facility for several years.

5.7.4 Sewarage System and Solid Waste Disposal

The sewage water is treated by septic tank.

A solid waste disposal system is not provided at the existing airport. Combustible waste disposal is burned in the airport area and incombustible waste disposal is dumped outside the airport.

5.8 Rescue and Fire Fighting Services

5.8.1 Fire Vehicle

The analysis of the aircraft movements in the busiest consecutive three months indicates that the required level of protection at Chittagong is presently Category-6.

The outline of the existing rescue and fire fighting services are as follows:

a)	Level of Protection	:	Category	: 6
b)	Major Vehicle 1	:	Water Tank Capacity	: 9,100 l
			Protein Foam Capacity	: 1,000 l
			Manufactured in	: 1985
c)	Major Vehicle 2	:	Water Tank Capacity	: 1,800 l
			Protein Foam Capacity	: 200 l
			Manufactured in	: 1973
d)	Rapid Intervention Vehicle	:	Water Tank Capacity	: 1,200 l
			Dry Chemical Powder	: 225 kg
e)	Fire Jeep	:	Dry Chemical Powder	: 90 kg
			Nitrogen Gas	: 6 cu.m
f)	Ambulance	:		: 2 nos.
g)	Number of trained Personnel	:		: 25

There is another 1,800 l major vehicle at the airport, however, it is not presently serviceable due to a lack of spare parts. In addition to the above CAAB vehicles, one BAF major vehicle with a water tank capacity of 7,300 l is available in case of emergency.

5.8.2 Fire Station

The fire station is located beside the international passenger terminal building. The fire vehicles can reach the runway 05 threshold from the existing fire station within 3 minutes as required by ICAO. This building is made of reinforced concrete and has an area of 300 sq.m. The floor plan is indicated in Figure 5.3.1. Three major vehicles, one fire jeep and one ambulance can be accommodated in the fire garage. The 9,100 l major vehicle is parked in front of the other vehicle and it may prevent the rapid exit of the vehicle parked behind.

5.9 Other Service Facilities

5.9.1 Airport Maintenance Facilities

The airport maintenance function of CAAB is accommodated in a remote building near the staff housing area. This one story building is made of reinforced concrete and has a floor area of 280 sq.m. About 60 airport staff are stationed in this building. No sweeper car or mowing machine is available for the maintenance of the pavement surface and the runway strip. The construction equipment used for the pavement overlay work in 1984/85 are left in the vacant area in front of the airport maintenance building.

5.9.2 Vehicle Garage

A vehicle garage is located in-between the two substations to the north of the terminal area. This is used for the parking and maintenance of CAAB vehicles. Two mini-bus, one jeep, one pick-up van and one truck are owned by the CAAB airport office.

5.9.3 Aviation Fuel Supply System

The aviation fuel is supplied by a private company, Burmah Eastern Ltd. Jet fuel A-1 is carried by a fuel truck from the company's main installation which is on Port Road and 3 km from the airport by road. Three half-buried fuel tanks are located to the north of the apron in the BAF area. Total capacity of the tanks is 55 kl, which is three day consumption volume for Biman and BAF. Jet fuel A-1 is supplied to the aircraft of Biman by hydrant system through three hydrant pits on the apron. Daily average consumption of Jet fuel A-1 by Biman was 7,300 l in 1988.

The consumption of Avigas by general aviation aircraft is very limited and it is supplied by a drum. Burmah Eastern's airport office is located facing the apron and beside the fire station.

Although there is no major problems in the existing facilities, a new aviation fuel supply system will be required in the new terminal area because the increased fuel demand will not justify the transportation of fuel from the existing fuel farm to the new terminal area.

5.9.4 Aircraft Maintenance Facilities

A walk-around check is only executed before every departure by the pilot. A GSE (Ground Service Equipment) maintenance garage is located facing the apron and besides the airport office of Burmah Eastern.

5.10 Staff Housing Area

The housing area for CAAB and Meteorological Department is located to the south of the runway. The number of houses is 24 for CAAB and 6 for Meteorological Department respectively. Although the existing houses don't infringe the transitional surface, a part of the staff housing will have to be removed when a parallel taxiway becomes necessary.

CHAPTER 6 AIRPORT MASTER PLAN

CHAPTER 6 AIRPORT MASTER PLAN

6.1 Phases of the Airport Development

Taking into account the general conditions of the project implementation, Phase I development will be based on the demand anticipated in the year 2000 so that no major improvement work will be required for about five years from the likely date of the completion of construction.

The design target year of Phase II development is set at the year 2010 in order to visualize the airport development in the foreseeable future.

6.2 Aircraft Operation and Runway Layout

This section sets out the runway layout in connection with aircraft operation so as to avoid a collision between an aircraft approaching Chittagong Airport and a ship on Karnafuli River.

6.2.1 Basic Conditions for Runway Layout Planning

(1) Aircraft and Ship Movements

The oceangoing ships can sail during the daytime for 5 hours during high tide. Daily movements of aircraft and ships in 2000 and 2010 are estimated as follows:

Year / Traffic	Present (1988)	2000	2010
Ship	5	7	10
Arriving Aircraft	3	6	7

Based on the above traffic volume, the meeting frequencies of the aircraft and the ships in 2010 is calculated to be 280 times a year. Here, the meeting of aircraft and a ship is defined as an occasion when aircraft is within a 12 km long final approach area and an oceangoing ship is under the approach surface area simultaneously.

(2) **Required Runway Length**

The required runway length is planned as follows:

- Take-off runway length: 2,750 m for DC-10 with maximum payload to fly directly to Jeddah
- Landing runway length : 2,450 m for B-747 with maximum landing weight

(3) **Other Conditions**

- The main approach runway is runway 23, equipped with Category-I Instrument Landing System (ILS)

- ILS with a glide slope angle of 3^o is planned for runway 23 approach provided that the required performance is maintained at all times.

- Precision Approach Category-I Lighting System is planned for runway 23.

6.2.2 **Alternative Runway Layouts**

Three alternatives are studied for the runway layout planning in accordance with ICAO and taking into account various conditions obtained through discussions with the organizations concerned.

The three alternatives are outlined as follows:

ALT-1: An approach surface of Obstacle Limitation Surfaces (OLS) free from ships with a maximum mast height of 46.5 m will be established for the runway 23 approach in accordance with ANNEX 14 of ICAO by displacing the runway 23 threshold by 1,650 m. In this case it is necessary to extend runway 05 by 1,052 m.

ALT-2: Obstacle Assessment Surface (OAS) free from the largest ships with a mast 46.5 m high will be established so as to ensure the safety of ILS approach procedure with a glide slope angle of 3^{o} in accordance with PANS-OPS (Procedure for Air Navigation Services, Aircraft Operations) of ICAO.

The runway 23 threshold is required to be displaced by 1,000 m and runway 05 to be extended by 402 m.

ALT-3: The 1/50 approach surface free from the vehicle traffic on Port Road close to the runway 23 will be established by displacing runway 23 threshold by 298 m.

In this case, ship traffic constituting a mobile obstacle is to be controlled by Chittagong Port Authority (CPA) so that the ships may not infringe the approach surface when it is in use. There is no need to extend runway 05.

The displacement of runway 23 and the extension of runway 05 for each alternative are comparatively illustrated in relation to the existing runway layout in Figure 6.2.1.

Approach surfaces, transitional surfaces and runway strips for respective alternatives are indicated in Figure 6.2.2

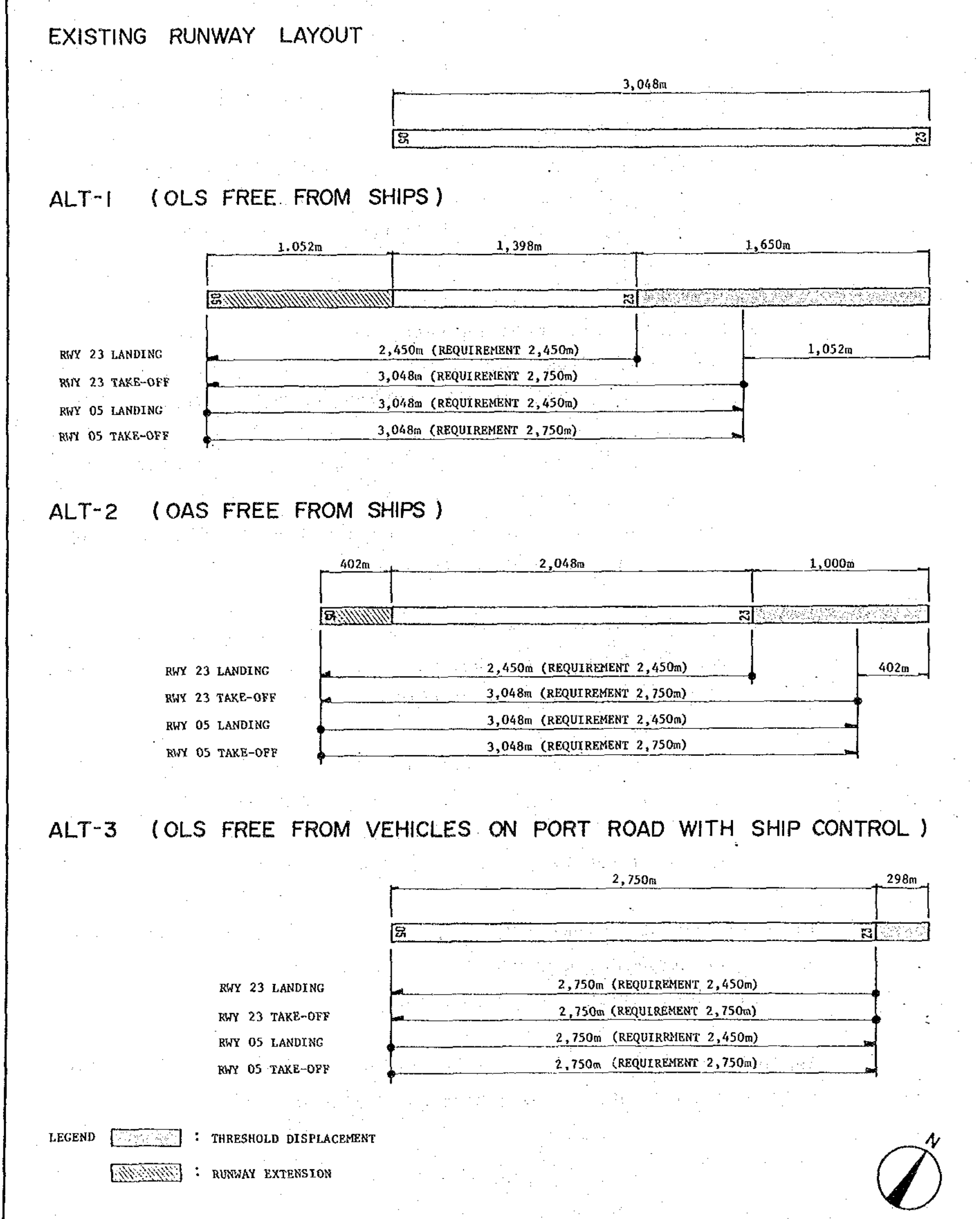
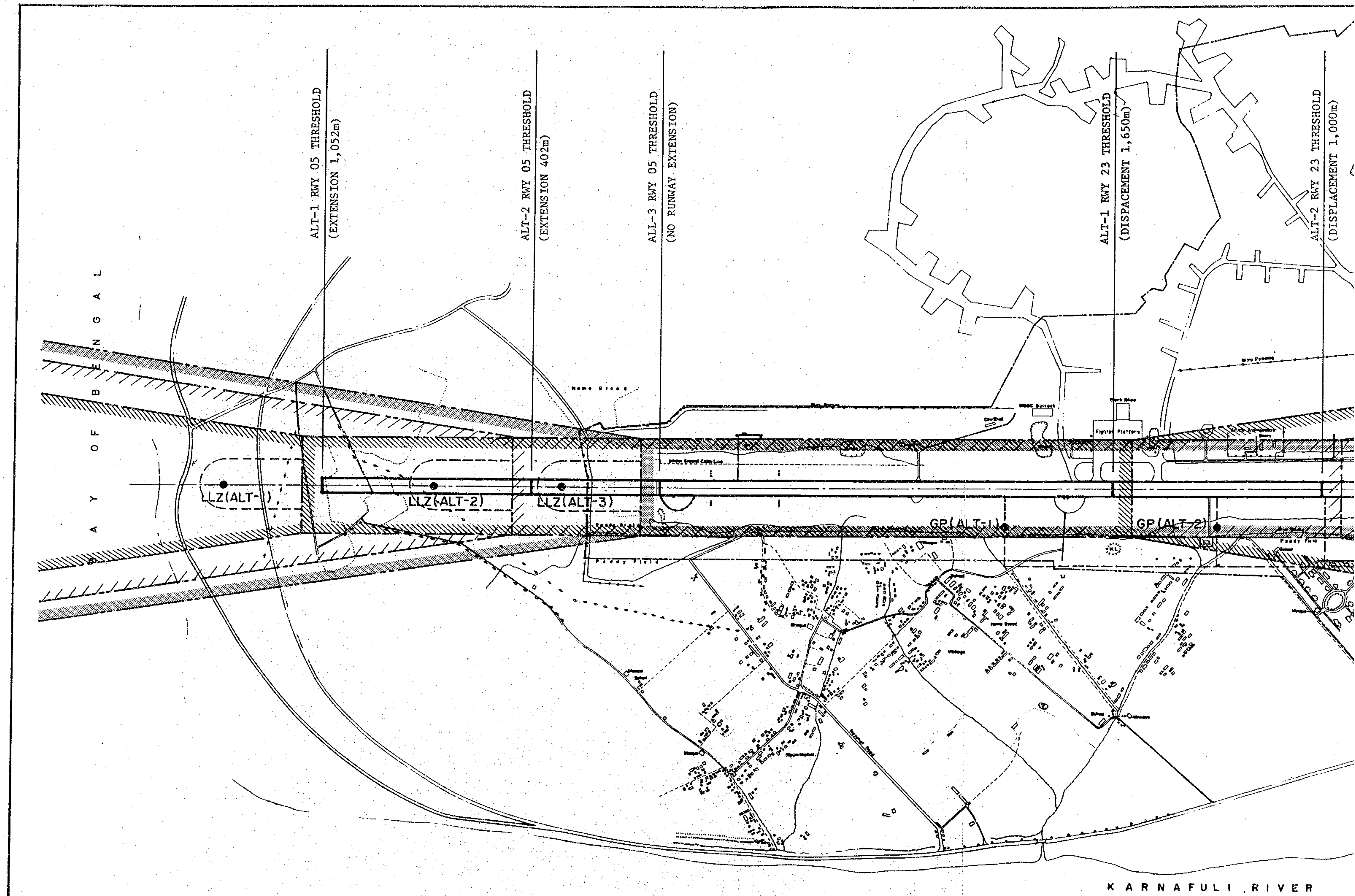


Figure 6.2.1 Illustration of Alternative Runway Layouts


ALT-1 RWY 05 THRESHOLD
(EXTENSION 1,052m)
ALT-2 RWY 05 THRESHOLD
(EXTENSION 402m)
ALT-3 RWY 05 THRESHOLD
(NO RUNWAY EXTENSION)
ALT-1 RWY 23 THRESHOLD
(DISPACEMENT 1,650m)
ALT-2 RWY 23 THRESHOLD
(DISPLACEMENT 1,000m)
A Y O F B E N G A L
LLZ(ALT-1)
LLZ(ALT-2)
LLZ(ALT-3)
GP(ALT-1)
GP(ALT-2)
K A R N A F U L I R I V E R

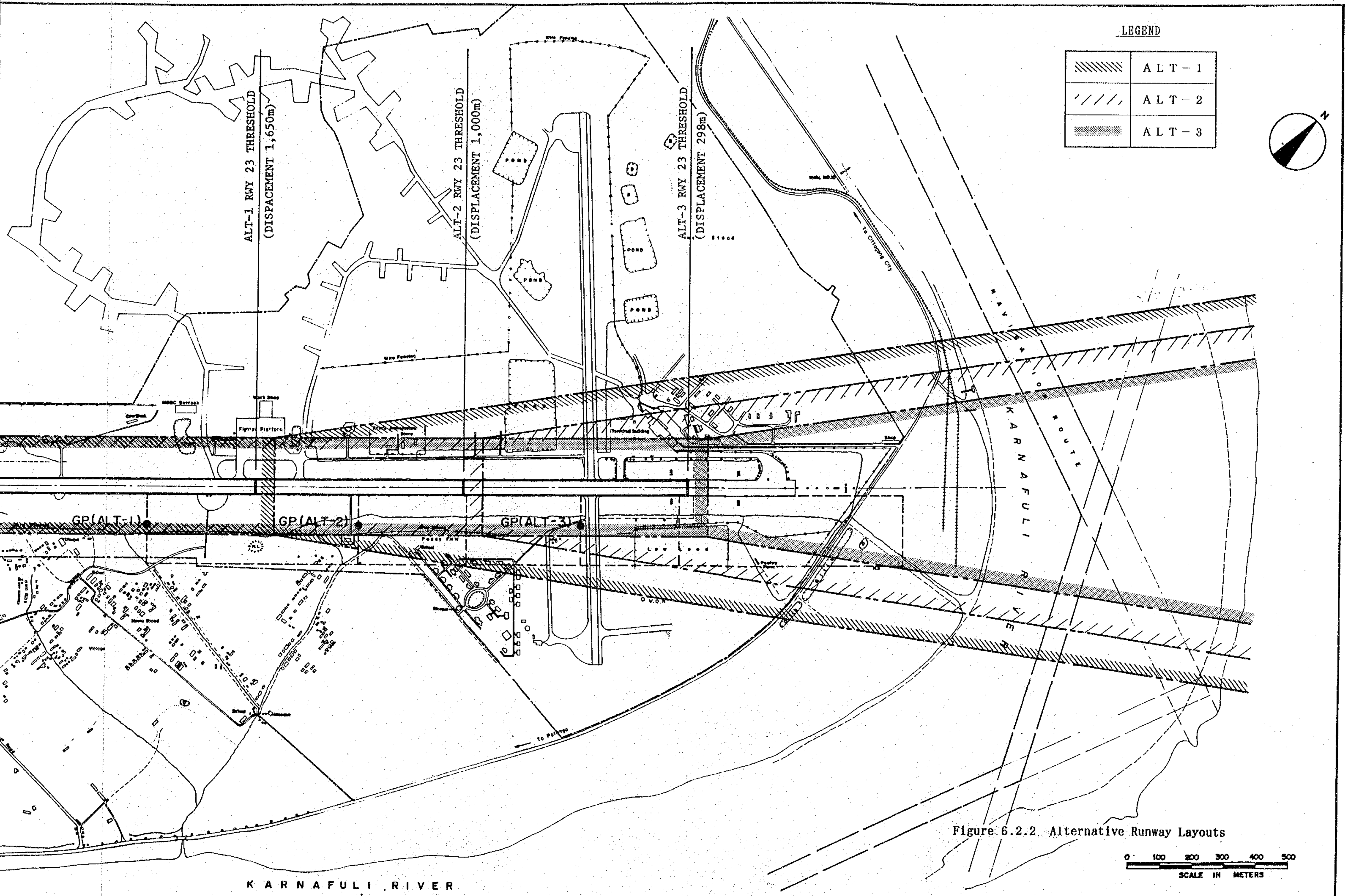


Figure 6.2.2 Alternative Runway Layouts

6.2.3 Comparative Evaluation

The three alternatives are evaluated and compared with each other as shown in Table 6.2.1.

As a result of the alternative study, ALT-3 is chosen as the most suitable solution for the following reasons:

- Controllability of ship traffic taking into consideration the future anticipated movements of aircraft and ships,

- Least displacement of the runway 23,

- Cheapest construction cost,

- Effective utilization of the existing facilities with least restriction, and

- Least land acquisition and compensation works.

Table 6.2.1 Comparative Evaluation of Alternative Runway Layouts (1)

Present Conditions.
- Traffic Control . Advisory of ship traffic to aircraft from ATC Tower . Aircraft landing with caution . No problem reported from airlines - Subject Ship Traffic . Oceangoing ship with a mast higher than 14.6m - Subject duration 5 hours of high water - Ship traffic : 5/5 hours of a day - Aircraft traffic : 3/5 hours of a day - Runway length : 3,048 m - Max Mast height : 46.5 m above HWL (Remains same in future)

Basic Requirements for Future Airport Development
- Traffic of 5 hours of a day Year / Ship / Aircraft 2000 / 7 / 6 2010 / 10 / 7 - Main approach from Rwy 23 - Installation of ALS and SALS - Installation of ILS/MLS - Runway length required B-747 / DC-10 Take-off (To JED) - / 2,750 m Landing (MLW) 2,450 m / 2,200 m

Characteristic \ Alternative		Alternative Schemes for Improving the Present Conditions		
		ALT - 1 (OLS * free from Vessel) (No vessel control)	ALT - 2 (OAS ** free from Vessel) (No vessel Control)	ALT - 3 (OLS free from Vehicle on Port Road.) (Vessel to be controlled)
Reference		ICAO ANNEX 14	ICAO ANNEX 14, PANS OPS ***	ICAO ANNEX 14
Displacement of RWY 23		1,650 m for landing only	1,000 m for landing only	300 m for landing only
Runway length Available	05 L/D	3,048m	3,048m	2,750m
	05 T/O	3,048m	3,048m	2,750m
	23 L/D	2,450m	2,450m	2,750m
	23 T/O	3,048m	3,048m	2,750m
Extension of RWY 05	B-747	1,052m	402 m	No need
	DC-10	802m	152 m	
Compensation for RWY 05 extension		Land acquisition, Patenga Road, Power lines, Houses, Paddy field	Land acquisition, Power lines, Paddy field	Extension not required
Influence of ships	Landing	None	Practically None	None if controlled
	Take off from 05	Wait for clearance	Wait for clearance	Wait for clearance

Note : * Obstacle Limitation Surfaces
Note : ** Obstacle Assessment Surface
*** Procedures for Air Navigation Services, Aircraft Operations

Table 6.2.1 Comparative Evaluation of Alternative Runway Layouts (2)

- 1,2,3 indicate priority of selection in terms of each comparison item.

Comprison Items			Eva.	ALT-1			Eva.	ALT-2			Eva.	ALT-3		
				RWY 23	RWY 05	RWY sides		RWY 23	RWY 05	RWY sides		RWY 23	RWY 05	RWY sides
1. Aircraft Operation	1) Obstacle (fixed)	Approach Surface	1	Nil	Nil		3	Int'l pax T.B. Substation Ligh post	Power Post 2 Nos. Trees 4 Nos.	-	2	Trees 3 Nos. Access road BAF Barrack	Tree 1 No. Power Post 2 Nos.	-
		Transitional Surface	1	Nil	Power Post Tree: 1 No.	Squadron Bldg. Fighters Hangar Light Post 2 Nos. BAF Bldg. Com. Tower TACAN Com. Antenna Mosque, Tree	1	Nil	Power Post 1 No.	Squadron Bldg. Fighters Hangar Light Post 2 Nos. BAF Bldg. Com. Tower TACAN Com. Antenna Mosque Tree 5 Nos.	2	Nil	Power post 1 No.	Pax T.B. Squadron Bldg. Fighters Hangar BAF Bldg. Com. Tower TACAN Com. Antenna Mosque Substation Light Post 2 Nos.
		Take-off Climb Surface	1	Nil	Nil	-	2	Nil	Trees 3 Nos. Power Post 1 No.	-	2	Nil	Tree 1 No Power Post 2 Nos.	-
		Runway Strip	1	-	-	Shooting range Light Post Power Post Trees	2	-	-	Shooting range Ammunition Bldg. NDB Bldg. Light post	2	-	-	Shooting range Ammunition Bldg NDB Bldg Wind sock Light post
		Evaluation on Obstacle Objects	1	The least obstacle in approach and take-off area			3	Many existing structures & trees will become obstacles to Approach and Take-off climb surfaces by displacement & extension of Runway. Power lines on Rwy 05 Approach Surface shall be relocated.			2	Trees and two barracks should be removed and the existing access road should be relocated so as to clear off the obstacles to Approach surface for Rwy 23. Power lines on Rwy 05 Approach Surface may be permitted to remain as there will be other solutions including a raise in MDA and obstacle lighting because approach and take-off climb surfaces with 1/40 slope will clear these obstacles if JCAB standard is applied.		
	2) Influence of Ship Traffic (Mobile obstacle)		1	No influence from ship movement			2	It is not neccessary to control the vessel traffic. There is practically no influence to aircraft operations.			3	In order to ensure aircraft operational safety, the control procedure of the ship movement and compulsory reporting point shall be established. The meeting frequency each other will be 280 times a year in 2010.		

Table 6.2.1 Comparative Evaluation of Alternative Runway Layouts (3)

Comparison Items			Eva.	ALT-1	Eva.	ALT-2	Eva.	ALT-3
2. Airport Operation	1) Utilization of existing runway and available runway length.		2	The exisiting runway 23 will be displaced by 1,650m. Of 1,650m, 1,052m will be abandoned. The abandoned portion is available for use but not considered to be utilized frequently because it will be used when the 2,750m long runway will not be enough for take off. The main approach runway length will be 2,450m by extending RWY 05 by 1,052m. If there is any requirement for an additional landing length, the extention will be increased accordingly.	2	The exisiting runway 23 will be displaced by 1,000m. Of 1,000m, 402m will be abandoned. The abandoned portion is available for use but not considered to be utilized frequently because it will be used when 2,750m long runway will not be enough for take off. The main approach runway length will be 2,450m by extending RWY 05 by 402m. If there is any requirement for an additional landing length, the extention will be increased accordingly.	1	This alternative achieves the maximum utilization of the existing runway. The available landing runway length is 2,750m which is 300m longer than ALTs 1 and 2. The approach and take off climb surface will not be affected with the utilization of the existing facility.
	2) Surface condition of the displaced section		2	The type of lighting fixture of ALS for the displaced section of RWY 23 shall be semi flush mounted type. The runway length without ALS is 2,500 m. Although their projections from the runway surface are very limited, they may influence small aircraft like fighters to vibrate when this section (900m) will be used.	2	Same as ALT-1	1	The section without a flushed mounted fixture is 2750m which is longer than ALT 1 and 2.
	3) Utilization of other existing facilities		3	The displacement longer ALT-2 will restrict the use of larger area by the approach surface but will ease the height restriction.	2	The existing terminal apron and cross runway area will be covered by the approach surface which restrict the use of the area including BAF activities.	1	The existing apron area is located outside the runway strip to be graded in accordance with ICAO. There is less limitation to the usage of the area than ALT-1 and 2. There is not a big change as compared with the present.
	4) Preferable location of new terminal area		1	South west of the existing runway 05 for the short taxing distance taking into account the main approach from Rwy 23.	1	A location close to the existing runway 05 end.	1	New terminal area will be located at the same as ALT-2 but not so close to the runway 05.
3. Construction Aspect	1) Siting of Aeronautical Equipment	-ILS/GP	2	A part of staff housing and villages have to be removed from Area "C" based on FAA standard. However, they are permitted to remain in accordance with JCAB standard.	2	A part of Staff housing substation, the existing cross runway and wind sock have to be removed in accordance wtih FAA standard. However they are permitted to remain in accordance with JCAB standard.	2	Port Road and low land area will be obstacles to FAA standard. Port Road will remain and the low land will be filled in accordance with JCAB standard.
		-ILS/LLZ	3	Patanga Road and village road have to be relocated. According to JCAB standard, only Patanga Road has to be relocated.	2	Power transmission towers and existing road will have to be relocated based on FAA standard. The towers will have to be relocated in accordance with JCAB standard.	1	No relocation of exisitng structure will be required.
		-M/M	1	If provided, the site will be 670 m inside the existing runway threshold 23.	1	If provided, the site will be near the end of the existing runway threshold 23.	2	The site will be near Karunafuli river bank.
		-VOR/DME	2	The existing equipment will be renewed near the original location. The equipment will not cater for strainght-in approach for RWY 23.	2	Same as ALT-1	1	The relocation of the new equipment will be installed 100m to the north of the original site in order to cope with straight-in approach for RWY 23.
		-ALS	2	ALS of 900m long will be installed at RWY 23, and all lighting fixtures shall be installed with semi-flush type in the existing runway.	2	Same as ALT-1	1	ALS of 300 m long will be installed with semi-flush type on the existing runway. Lightings of 600m long will be elevated type.
		-SALS	1	SALS will be installed at RWY 05. The site will be acquired together with the ILS/LLZ site.	1	Same as ALT-1	1	Same as ALT-1

Table 6.2.1 Comparative Evaluation of Alternative Runway Layouts (4)

Comparison Items		Eva.	ALT-1	Eva.	ALT-2	Eva.	ALT-3
	2) Replacement of existing road, etc.	3	Almost all of the southwestern area including arterial, Patenga Road, Transimission line and village have to be removed.	2	Less influence to the community than ALT-1. Transmission line and village road will be required to be removed.	1	There is no major influence on social activities in the airport vicinity.
	3) Scale of work Land acquisition (for runway extention) Construction cost	3	The largest scale of the construction wroks will be required for the runway extension and ancillary work. About 50 ha Highest	2	The large scale but smaller than ALT-1 About 27 ha High (but, less than ALT-1)	1	Most of works will be in the existing airport property area. About 3 ha Low
	4) Construction ease and safety considera-tion	3	Temporary and preparatory works of the larger scale will be required because of more work outside the existing airport. The ALS installation shall be carried out during the night together with pavement overlay so airport operation shall not be disrupted. The work should be carried out so as to maintain airport security and airport operational safety.	2	Same as ALT-1, but less difficult	1	Easier to manage because of the smaller size of the construction.
4. Overall Evaluation		3	This is not recommendable. • This plan is considered to be too costly to eonomically justify the necessity of 1650 m long displacement. • This plan will cause a great change in the social environment of the south western area of the airport. • This plan will impose more restrictions on the use of the existing terminal apron and cross runway area due to the coverage of approach and take-off area. • The shortest landing runway length available is 2,500m in this plan. If this has to be extended to the same as ALT-3 or the longer, the ILS site will be projected from the shore line of Bangal Bay.	2	This is practical and reasonable solution if this does not impose the same problem as ALT-1. However, this ALT will be very costly and will restrict the use of the existing terminal apron and cross runway area as ALT-1. This plan will aslo require relocation of power transmission line on Runway 05.	1	This is considered the most suitable solution. The meeting frequency between aircraft and ships will be 280 times a year even in 2010. Therefore, it is considered possible and practical to control large ships so as not to constitute an obstacle to the approach surface. This plan will require the least displacement of the runway and the cheapest construction cost. This plan enables the effective use of the existing facilities without the rectrictions of ALTs-1 and 2. The longest runway length available is 2750 m in this plan which is 300m longer than other alternatives.

6.2.4 Method of Ship Traffic Control

(1) Control Procedure of the Vessels

The basic concept of the ship traffic control system is shown in Figure 6.2.3. The following requirements are established to control ship traffic and to ensure the safety of aircraft approaching runway 23 through the investigation of the present conditions and discussions with CPA.

- CAAB will report the arrival time of the aircraft to CPA at least one hour before the estimated time of arrival (ETA).

- CPA will give clearance to enter the channel to the ships in such a way that the ships will not reach the approach surface area between 15 minutes before ETA and 15 minutes after ETA.

- CAAB will station an officer at CPA Communication Center so as to assist and monitor the ship control in relation to aircraft traffic.

- Compulsory reporting points for the ships will be established so the control tower of CAAB is made aware of ships under the approach surface area via CPA Communication Center.

The compulsory reporting point should be established at points 1 Km from and to the approach surface area so that the air traffic controller can decide the final clearance for landing or the direction of holding before the aircraft reaches the final approach point.

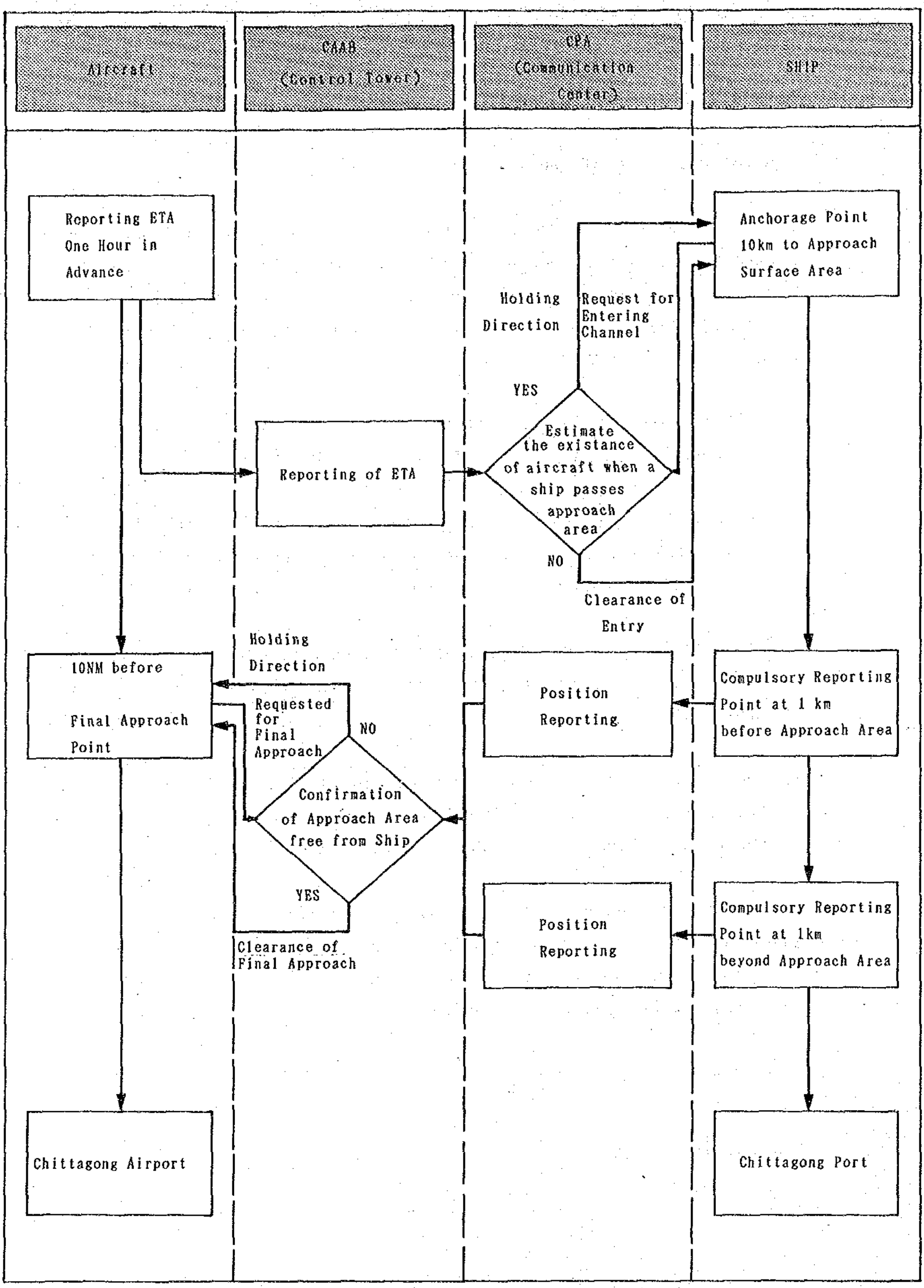


Figure 6.2.3 Basic Concept of Ship Traffic Control