## 8.7 Airport Utilities

### 8.7.1 Power Supply System

A power supply system is planned to cope with requirements of Phase I development. The system diagram is shown in Figure 8.7.1. The electrical commercial power shall be supplied one line from the Bangladesh Power Development Board.

(1) Estimated Load Capacity

The capacity of load of each building is estimated as follows:

| | | |
|---|---|---|
| - Passenger Terminal Building | : | 450 KVA |
| - Cargo Terminal Building | : | 50 KVA |
| - Administration Building and Operation Center | : | 160 KVA |
| - Air Navigation System | : | 250 KVA |
| - Others | : | 90 KVA |
| - Total | : | 1,000 KVA |

(2) Major Conditions

The major conditions are summarized as follows:

a) Main equipment is planned to be installed in the power house.

b) Outline of the system
- Trunk line: 3 Phase 3 Wires 11 kv 50 Hz
- Capacity of the main transformer: 500 KVA 2 sets
- Capacity of the emergency generator: 300 kva
  $11^{kv}/380\text{-}220^{v}$ 2 sets
- Distribution line: Radial network system
  3 phase 4 wires $380/220^{v}$ 50 Hz
- Power source: Each building will be fed by a commercial and an emergency source. ILS/GP, VOR/DME and LLZ/DME will be fed by high tension voltage of 11 kv, which is stepped up by a transformer.

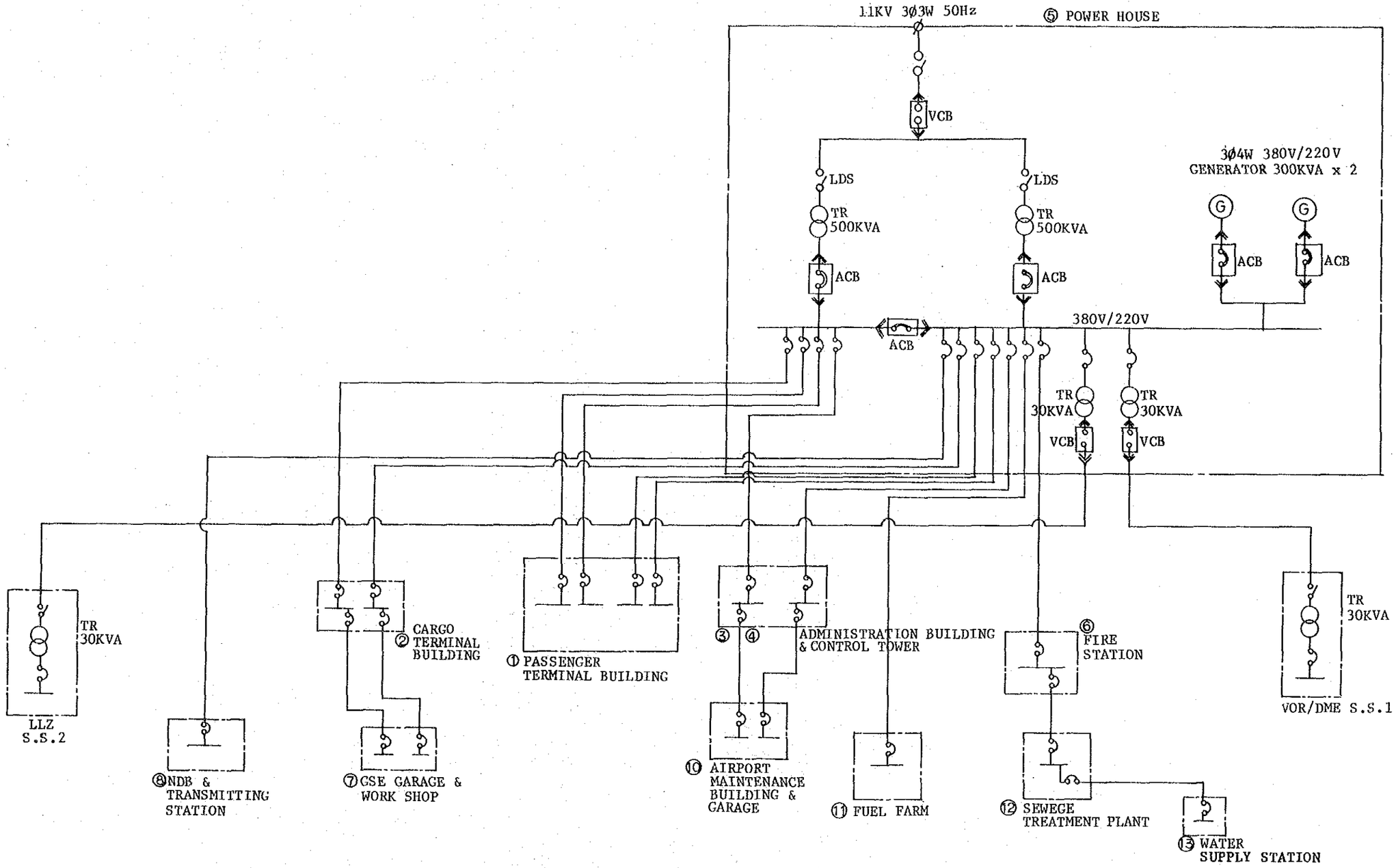



Figure 8.7.1 System Diagram of Power Supply System

### 8.7.2 Telephone Systems

The trunk line of the telephone system from the telephone service agency is planned to connect to the exchanger through the main distribution frame in the operation ceneter. The exchanger will be an electronics private automatic branch exchanger (EPABX) type. The following line capacity will be required for the exchanger:

- Trunk line : 40 lines
- Extension line : 120 lines

### 8.7.3 Water Supply System

Potable water will be supplied from a new well to be dug in the new terminal area.

An automatic delivery pump unit system will be adopted for the water distribution system, because this system is cheaper than an elevated tank system in terms of construction cost. The concept for the water supply system is shown in Figure 8.7.2.

The water supply volume is planned based on the demand in the Phase I development as indicated in Table 4.1.1 as follows:

Daily maximum water supply volume : 170 cu.m
Hourly maximum water supply volume : 50 cu.m

The capacity of the facilities are assumed for cost estimates as follows:

Pump for a well : 50 cu.m per hour
Service reservoir : 60 cu.m
(equivalent to about 8 hours supply of daily maximum water supply volume)
Automatic delivery pump unit and distribution lines
: 50 cu.m per hour

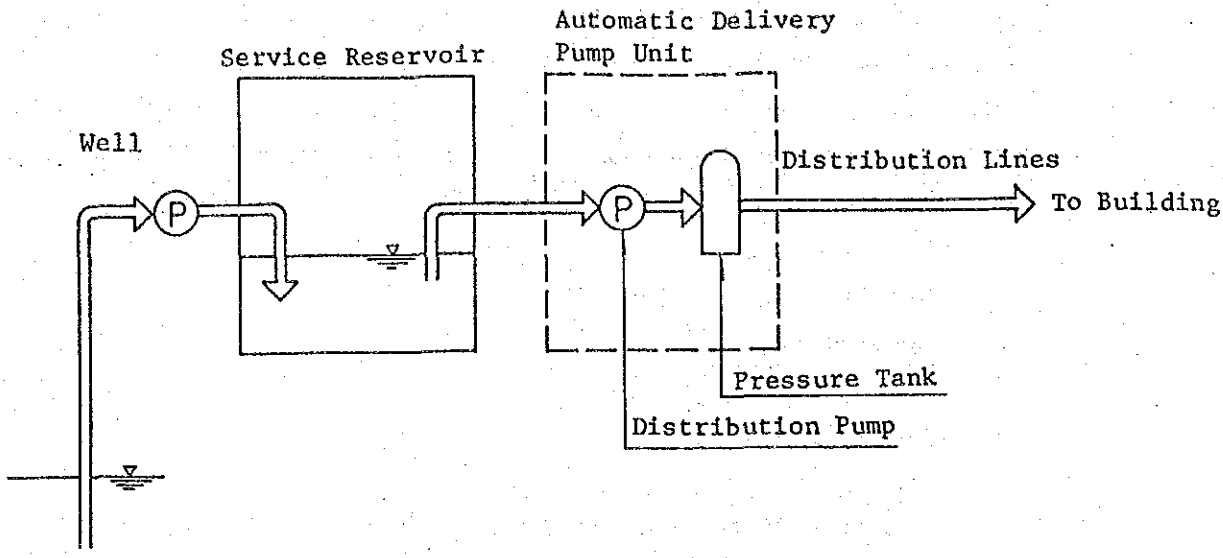



Figure 8.7.2 Concept of Water Supply System

### 8.7.4 Central Sewarage Treatment Plant

A wastewater collection and treatment system are planned based on the following conditions and assumptions:

a) Wastewater Volume

Daily maximum : 170 cu.m
Hourly maximum : 50 cu.m

b) Quality of Wastewater (influent)

$BOD_5$ : 200 mg/liter
SS : 250 mg/liter

c) Quality of Wastewater (effluent)

$BOD_5$ : Less than 20 mg/liter
SS : Less than 30 mg/liter

There are various systems to be considered for sewage treatment, such as extended aeration, soil filtration, oxidation pond with imhoff tank etc. Among these systems, an oxidation pond with imhoff tank method is recommended for the following reasons:

- No influence on the public area in terms of a bad odor
- Stabler quality of the effluent water than that of the soil filtration
- Lower operation and maintenance cost than that of the extended aeration
- More suitable for the central sewarage treatment than soil filtration

The concept of the above method is shown in Figure 8.7.3.

The wastewater disposed from each building and facility will be collected and concentrated to the central sewage treatment plant through sewer pipe network, and the effluent water will be discharged into the canal near the central sewarage treatment plant.

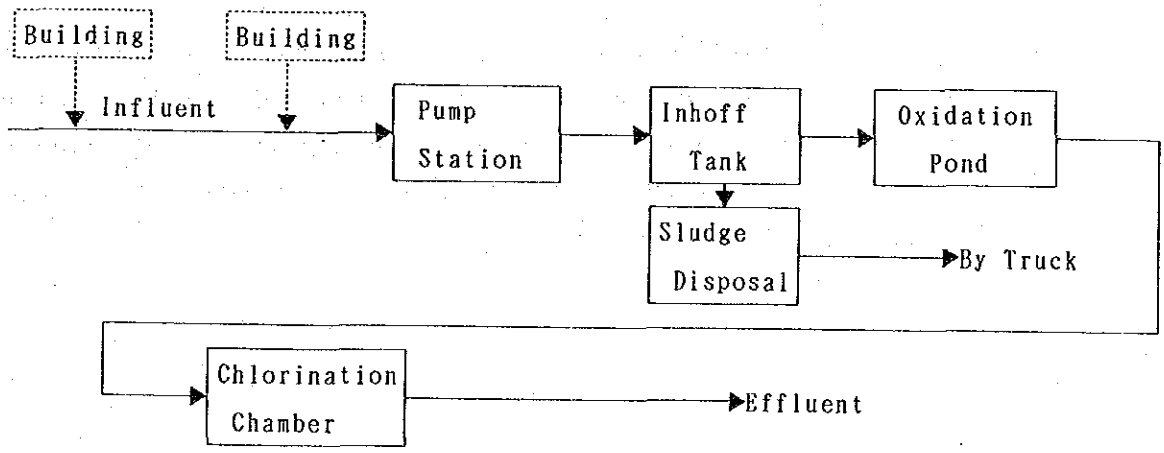



Figure 8.7.3 Concept of Central Sewerage Treatment Plant

### 8.7.5 Solid Waste Disposal System

The installation of an incinerator which can handle both rubbish and garbage waste is recommended. The solid waste collected by trucks will be burned in the incinerator which will be located near the sewage treatment plant.

The capacity of the incinerator is planned to be 700 kg per day, which is based on the demand in the Phase I development as indicated in Table 4.1.1.

## 8.8 Fencing

A new airport boundary fence to define the airport property area will be set up along the new boundary as shown in Figure 6.4.1.

A security fence in the new terminal area is planned as shown in Figure 6.5.3, in order to keep unauthorized persons from entering the restricted area.

The existing metallic fence which may reflect or refract the glide slope signal will be replaced with a wooden fence. A wooden fence will be adopted also for the new boundary fence for economical reasons. For the security fence, a metallic fence will be adopted for appearance and endurance.

# CHAPTER 9 AIRSPACE USE

# CHAPTER 9 AIRSPACE USE

## 9.1 General

This chapter discusses the airspace use for Chittagong airport after the completion of the Phase I development.

## 9.2 Aircraft Operations Procedures

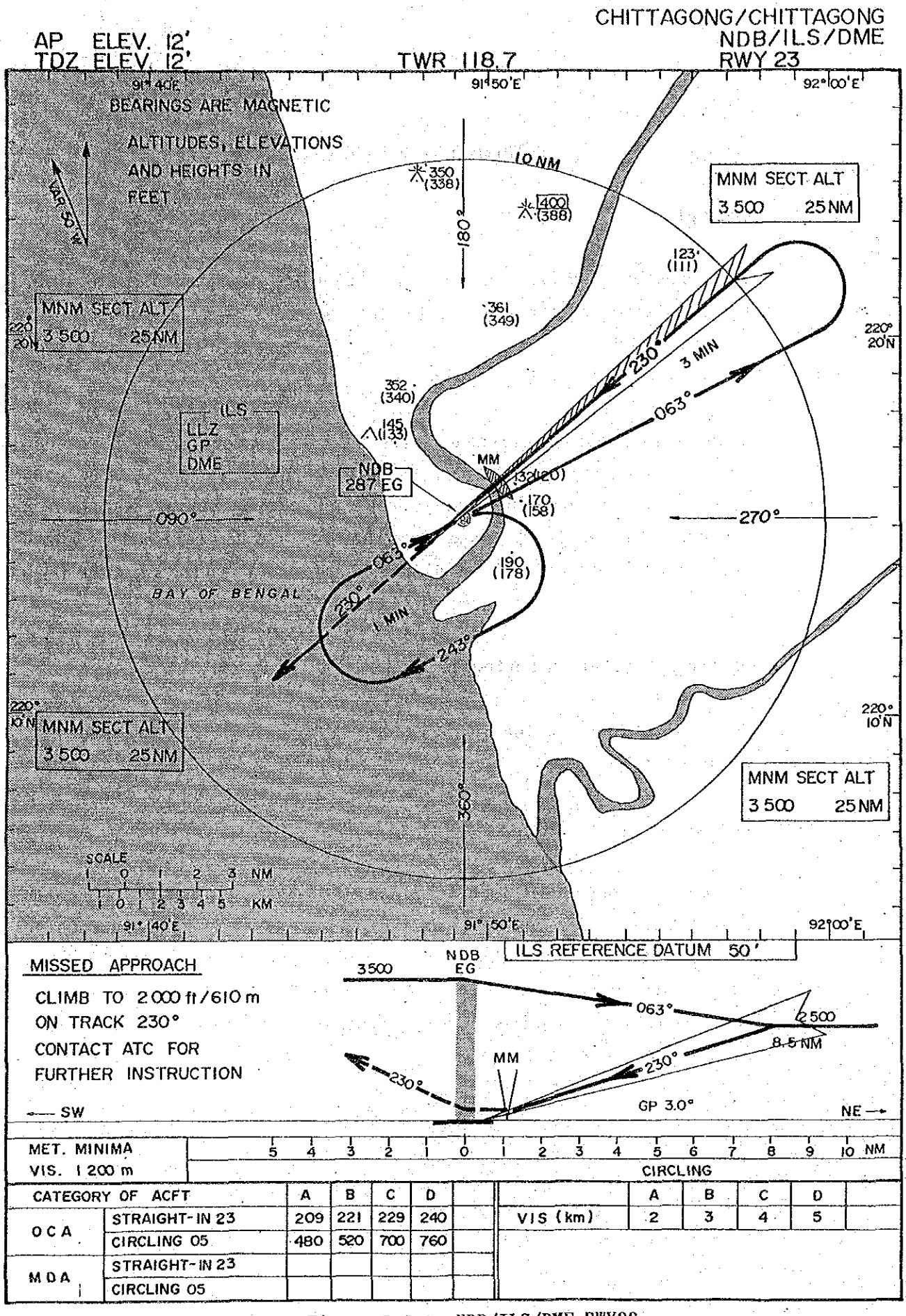
A precision approach procedure for runway 23 needs to be developed by the installation of ILS as the main approach procedure. Runway 05 however, will remain basically unchanged. The instrument approach procedure of NDB/ILS/DME and VOR/ILS/DME for runway 23 and standard instrument departure are studied as shown in Figures 9.2.1 through 9.2.3.

## 9.3 Obstacle Limitation Surfaces

The obstacle limitation surfaces of Chittagong airport are shown in Figure 9.3.1.

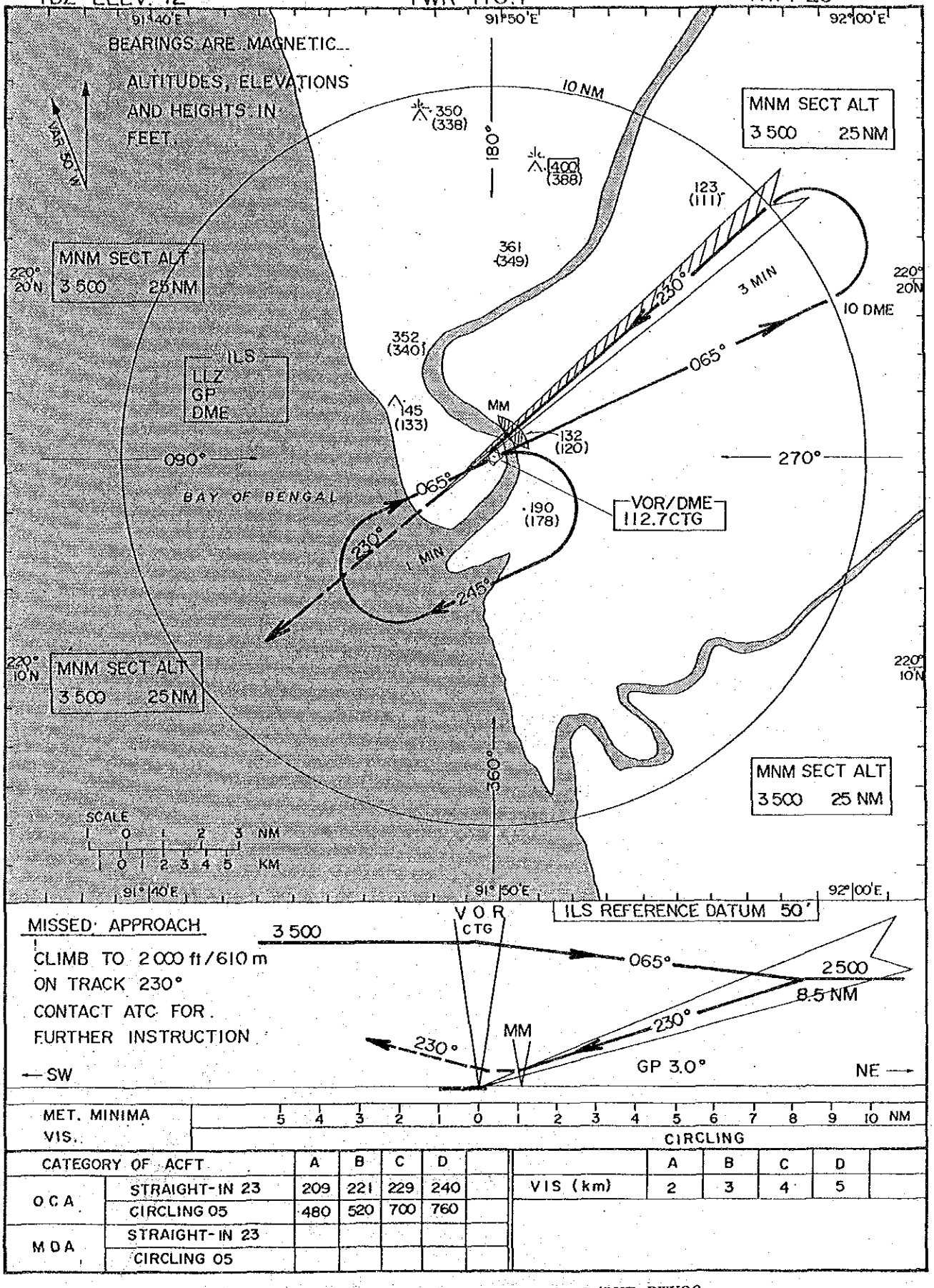
### (1) Runway Strip

Various obstacles are scattered on the runway strip as shown in Figure 9.3.2. The obstacles on the runway strip need to be removed in compliance with Annex 14, Aerodrome, ICAO excluding the facilities to be required for air navigation purposes. Removal of some obstacles requires close coordination between CAAB and other authorities concerned.




| CATEGORY OF ACFT | | A | B | C | D | | | A | B | C | D | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OCA | STRAIGHT-IN 23 | 209 | 221 | 229 | 240 | | VIS (km) | 2 | 3 | 4 | 5 | |
| | CIRCLING 05 | 480 | 520 | 700 | 760 | | | | | | | |
| MDA | STRAIGHT-IN 23 | | | | | | | | | | | |
| | CIRCLING 05 | | | | | | | | | | | |

Figure 9.2.1 NDB/ILS/DME RWY23




| CATEGORY OF ACFT | | A | B | C | D | |
|---|---|---|---|---|---|---|
| OCA | STRAIGHT-IN 23 | 209 | 221 | 229 | 240 | |
| | CIRCLING 05 | 480 | 520 | 700 | 760 | |
| MDA | STRAIGHT-IN 23 | | | | | |
| | CIRCLING 05 | | | | | |

| | A | B | C | D | |
|---|---|---|---|---|---|
| VIS (km) | 2 | 3 | 4 | 5 | |

Figure 9.2.2 VOR/ILS/DME RWY23

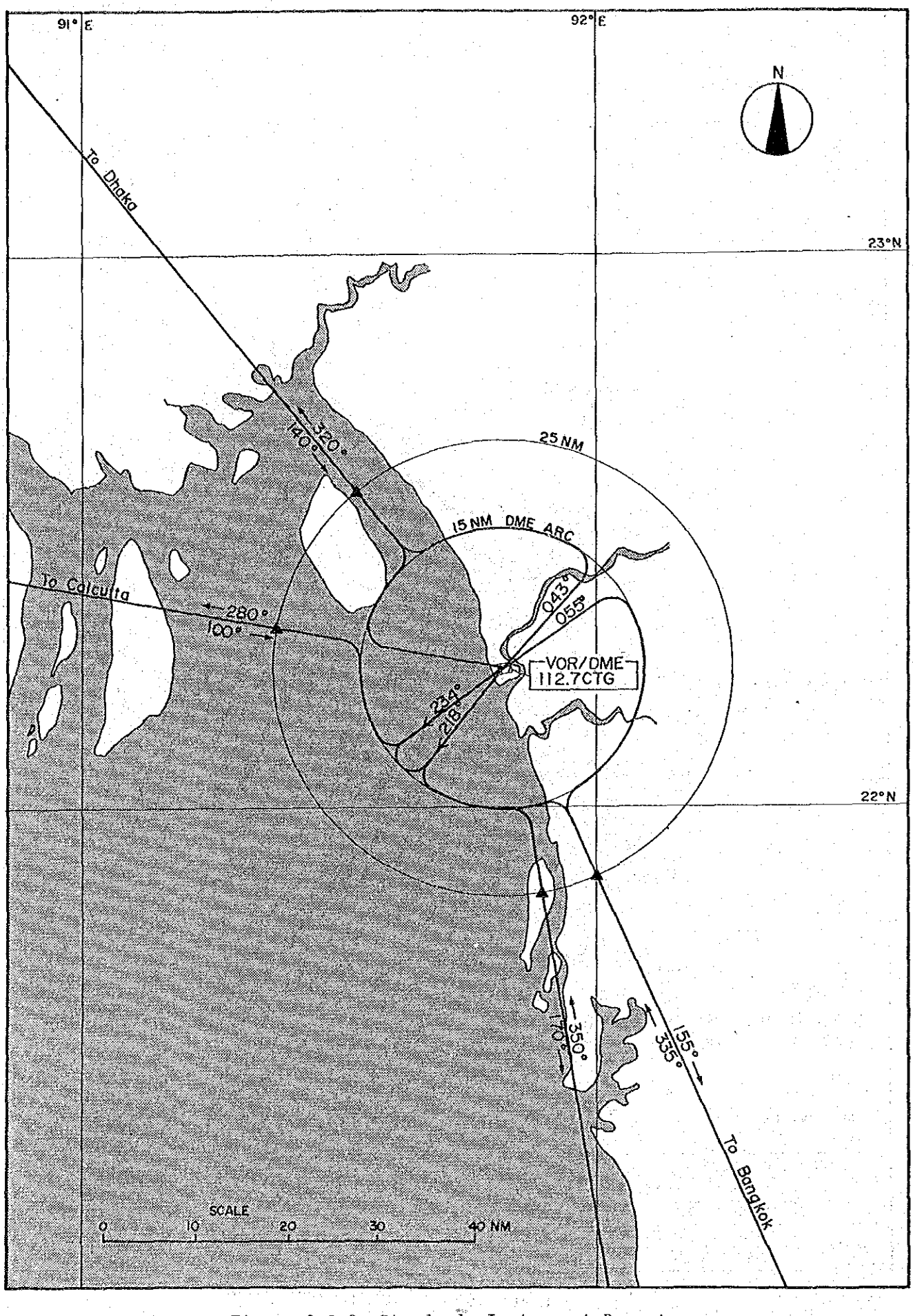



Figure 9.2.3 Standard Instrument Departure

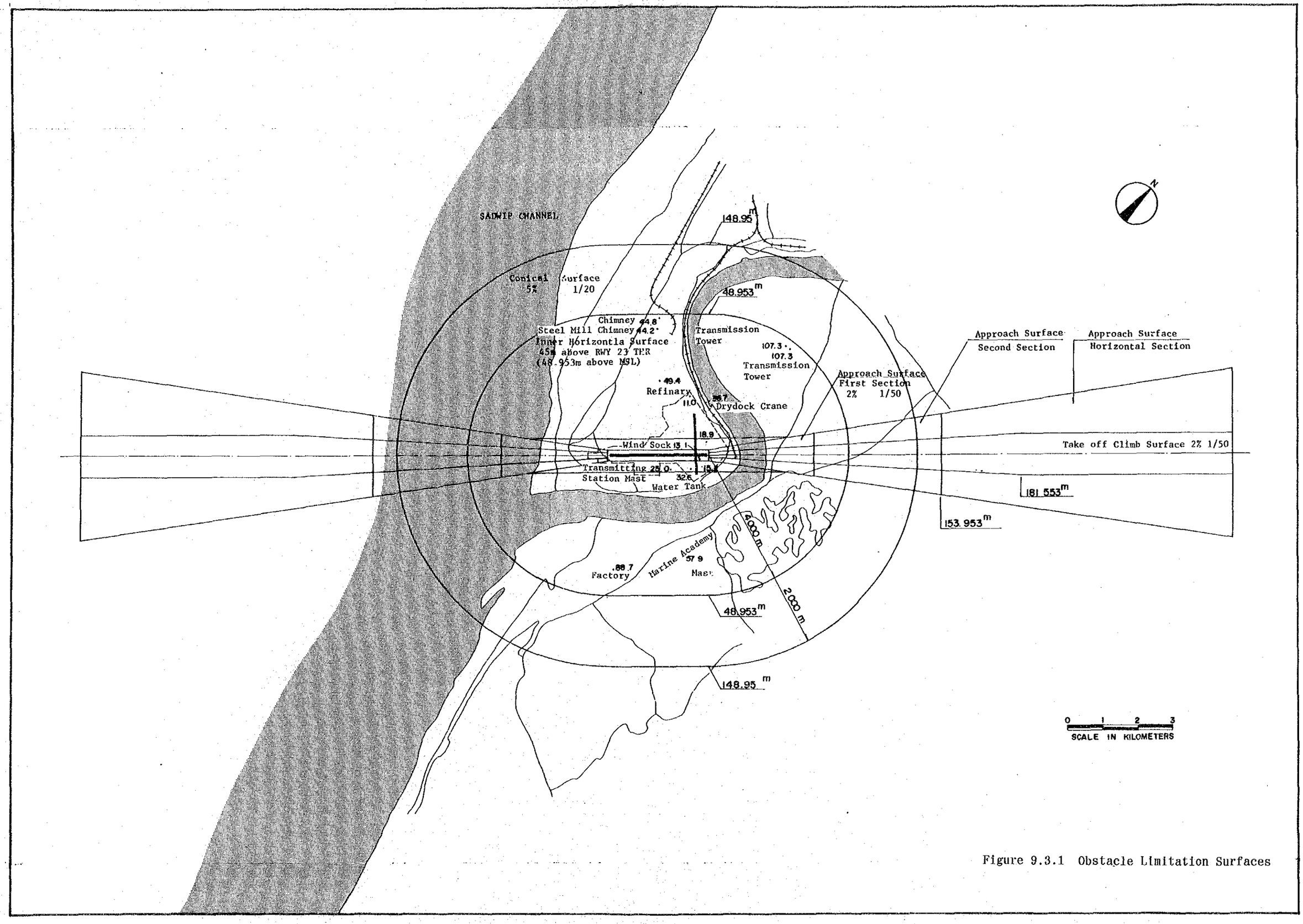
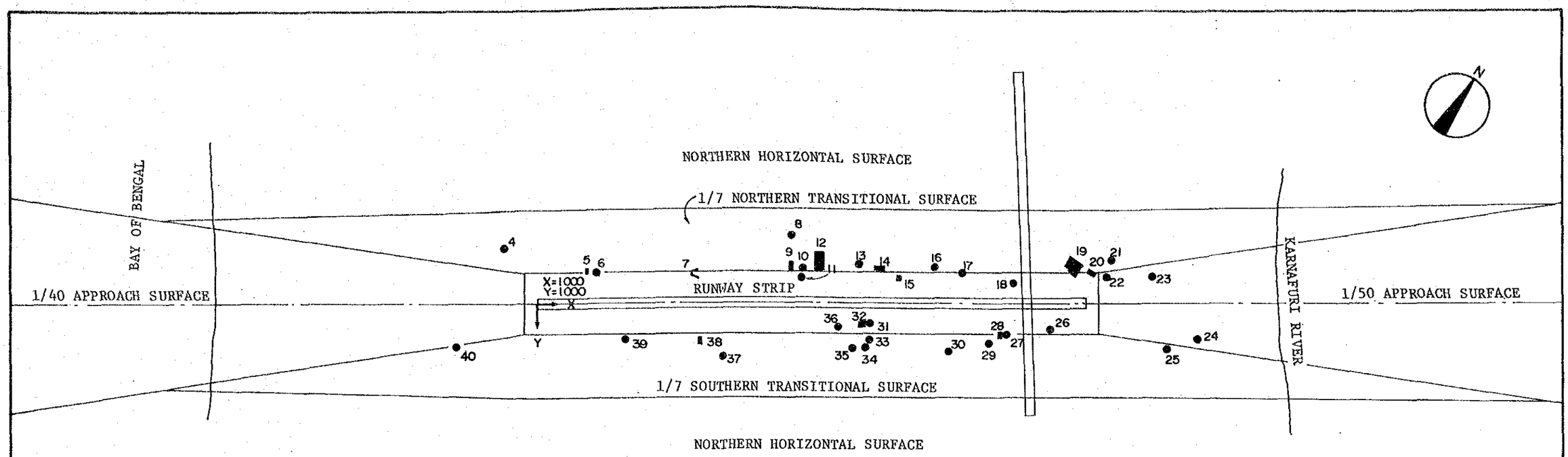



Figure 9.3.1 Obstacle Limitation Surfaces




LIST OF OBSTACLES

UNIT : m

RWY23 APPROACH SURFACE

| NO | OBJECT | X | Y | ELEVATION | ELEVATION OF THE SURFACE | DEGREE OF INFRINGEMENT | |
|---|---|---|---|---|---|---|---|
| 22 | TREE | 3,853.84 | 865.58 | 16.10 | 4.68 | 11.42 | ◎ |
| 23 | TREE | 4,072.45 | 368.88 | 18.60 | 9.05 | 9.55 | |
| 24 | TREE | 4,298.16 | 1,173.51 | 15.51 | 13.56 | 1.95 | |

NORTHERN TRANSITIONAL SURFACE

| NO | OBJECT | X | Y | ELEVATION | ELEVATION OF THE SURFACE | DEGREE OF INFRINGEMENT |
|---|---|---|---|---|---|---|
| 4 | TREE | 837.43 | 772.40 | 17.09 | 15.12 | 1.97 |
| 5 | B.A.FRUDER BUILDING | 1,254.22 | 833.08 | 6.80 | 6.09 | 0.71 |
| 6 | RADAR ANTENNA | 1,306.24 | 841.26 | 11.72 | 4.92 | 6.80 |
| 8 | WIRELESS TOWER | 2,269.33 | 660.51 | 39.03 | 30.74 | 8.29 |
| 9 | BUILDING B.A.F. | 2,257.27 | 815.25 | 10.82 | 8.63 | 2.19 |
| 10 | LIGHT POST | 2,325.82 | 826.29 | 15.58 | 7.06 | 8.52 |
| 12 | FIGHTER HANGER | 2,405.22 | 790.57 | 15.96 | 12.16 | 3.80 |
| 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 | 4.26 | 5.11 |
| 19 | TERMINAL BUILDING | 3,634.25 | 803.78 | 16.42 | 10.40 | 6.02 |
| 20 | ENGINEERING OFF. | 3,757.82 | 840.57 | 9.97 | 5.15 | 4.82 |
| 21 | TREE | 3,874.08 | 785.32 | 15.33 | 12.95 | 2.38 |

SOUTHERN TRANSITIONAL SURFACE

| NO | OBJECT | X | Y | ELEVATION | ELEVATION OF THE SURFACE | DEGREE OF INFRINGEMENT | |
|---|---|---|---|---|---|---|---|
| 25 | TREE | 4,146.61 | 1,226.37 | 14.63 | 14.23 | 0.40 | |
| 27 | LIGHT POST | 3,348.67 | 1,160.68 | 10.28 | 5.13 | 5.15 | |
| 29 | POWER POST | 3,258.46 | 1,191.31 | 10.40 | 9.50 | 0.90 | |
| 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 | 19.92 | 2.91 | |
| 38 | MOSQUE | 1,812.03 | 1,189.06 | 12.35 | 9.25 | 3.10 | |
| 39 | TREE | 1,451.50 | 1,178.28 | 10.17 | 7.71 | 2.46 | |
| 40 | POWER POST | 601.74 | 1,209.52 | 13.72 | 13.38 | 0.34 | |

RUNWAY STRIP

| NO | OBJECT | X | Y | ELEVATION | ELEVATION OF THE SURFACE | DEGREE OF INFRINGEMENT | |
|---|---|---|---|---|---|---|---|
| 7 | FIREING RANGE | 1,752.94 | 868.55 | 10.60 | 3.67 | 6.93 | |
| 11 | LIGHT POST | 2,318.30 | 874.62 | 14.87 | 3.67 | 11.20 | ◎ |
| 15 | ARMS AMMU BUILDING | 2,805.58 | 872.32 | 8.15 | 3.33 | 4.82 | |
| 18 | TREE | 3,383.94 | 896.35 | 9.10 | 3.60 | 5.50 | ◎ |
| 26 | WIND SOCK | 3,567.61 | 1,124.73 | 12.38 | 3.80 | 8.58 | ◎ |
| 28 | SUB STATION BUILDING | 3,315.60 | 1,131.03 | 7.96 | 3.60 | 4.36 | |
| 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 | |

NOTE1, "◎"indicates obstacles which are not collapsable and protruding upon the limitation surface for the 150m wide runway strip, and are recommended to be shifted or removed with higher priority.

NOTE2, Slope of the approach surface will be increased from 1/50 to 1/40 in the light of Japanese standard for non-precision approach runway in order to avoid the diversion of power transmitting lines under the runway 05 approach surface.

NOTE3, X and Y in the above table are based on the airport coordinate.

Figure 9.3.2 Obstacles to Runway Strip, Transitional Surface, and Approach Surface

(2) **Transitional Surface**

Obstacles infringing upon the transitional surface are concentrated at the northern part of the runway as shown in Figure 9.3.2. These obstacles shall be removed as far as practicable.

(3) **Approach Surface**

There are some trees infringing the approach surface of runway 23. These obstacles shall be removed in accordance with the requirements of precision approach runway.

As shown in Figure 5.2.5, power posts and a tree also protrude the 1/50 approach surface of runway 05. However, if this slope is changed to 1/40 in accordance with Japanese standard, these obstacles will be free from the approach surface. Because of the following reasons, a 1/40 slope of approach surface is adopted for the runway 05:

- Non-precision instrument runway is established for the runway 05.
- The existing obstacles i.e. power posts and a tree do not produce any operational trouble.
- The cost of the diversion for the power transmission line will be saved by establishing an 1/40 approach surface.

(4) **Inner Horizontal Surface**

There are some obstacles such as the high tension transmission mast (107.3m), at the northwest side and, the Marine Academy's Mast (57.9m) and the factory (88.7m) at the eastern side of the airport as shown in Figure 9.3.1. Obstacle lights have been installed on these structures. Therefore, additional measures are not required in the implementation of the Project.

# CHAPTER 10 SUPPLEMENTARY CONSIDERATIONS

# CHAPTER 10 SUPPLEMENTARY CONSIDERATIONS

## 10.1 General

This chapter explains a study on aircraft noise influence and land use of the area surrounding the airport.

Assessment on aircraft noise contours indicate that aircraft noise control is necessary in the land use plan in order to harmonize the airport with the surrounding area.

## 10.2 Aircraft Noise

Aircraft noise contours are calculated for the years 1989 (present), 2000 (Phase I) and 2010 (Phase II) based on the conditions as tabulated in Table 10.2.1.

Figures 10.2.1 through 10.2.3 show the calculated aircraft noise contours in Weighted Equivalent Continuous Perceived Noise Level (WECPNL). (For details, refer to Attachment F to Annex 16 Environmental Protection, Vol. I, Aircraft Noise, ICAO.)

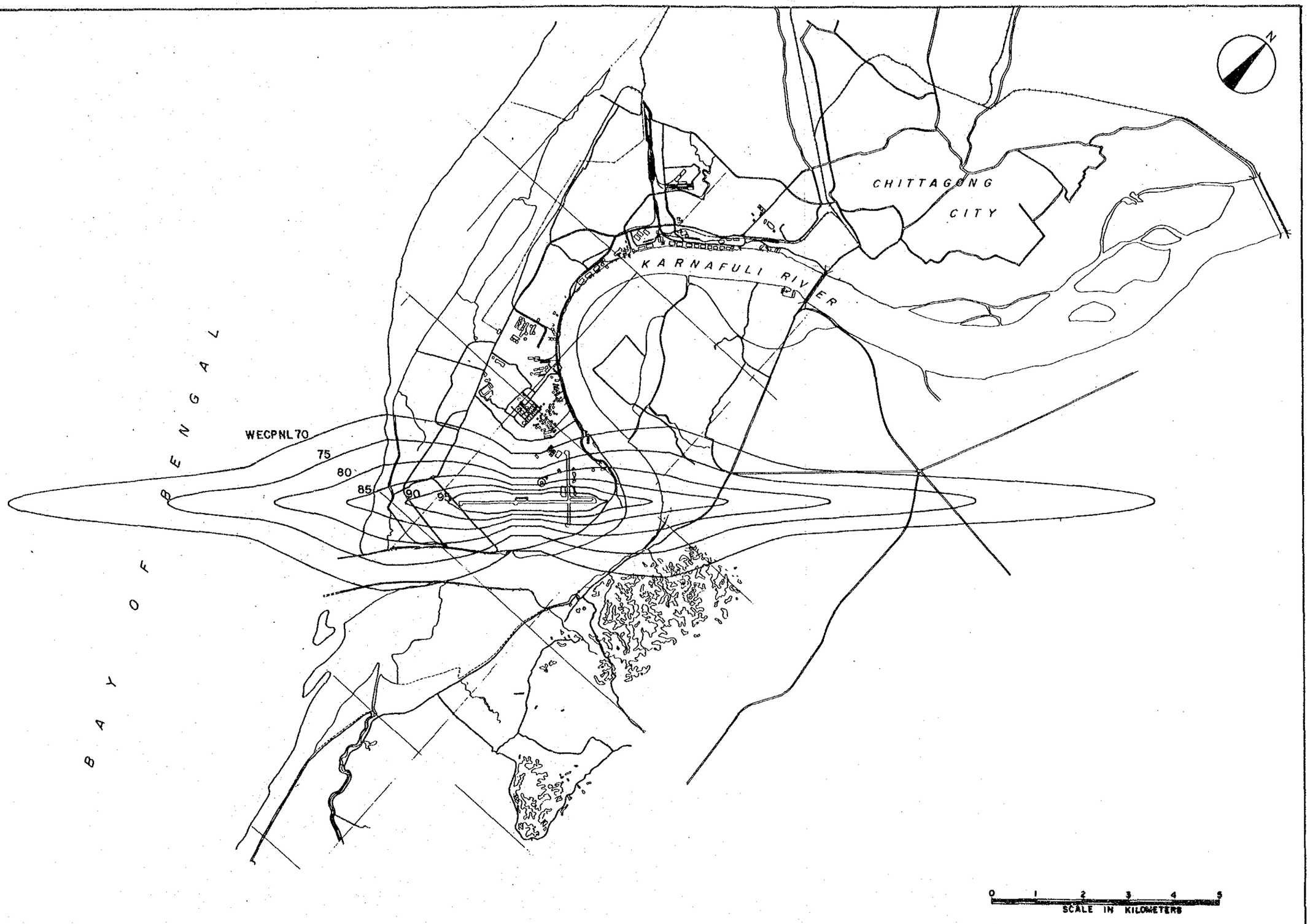



Figure 10.2.1 Aircraft Noise Contours in 1989

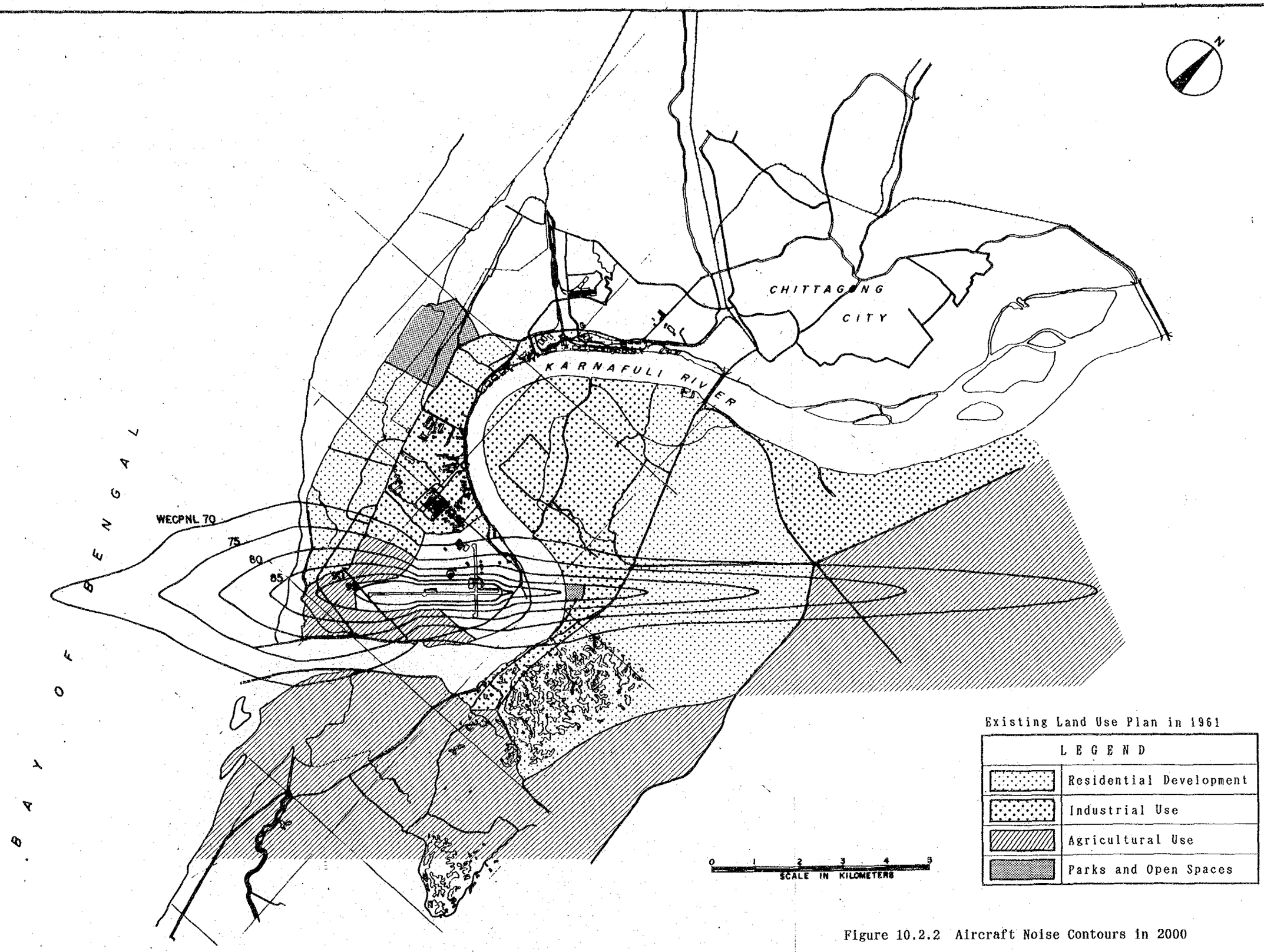



Figure 10.2.2 Aircraft Noise Contours in 2000

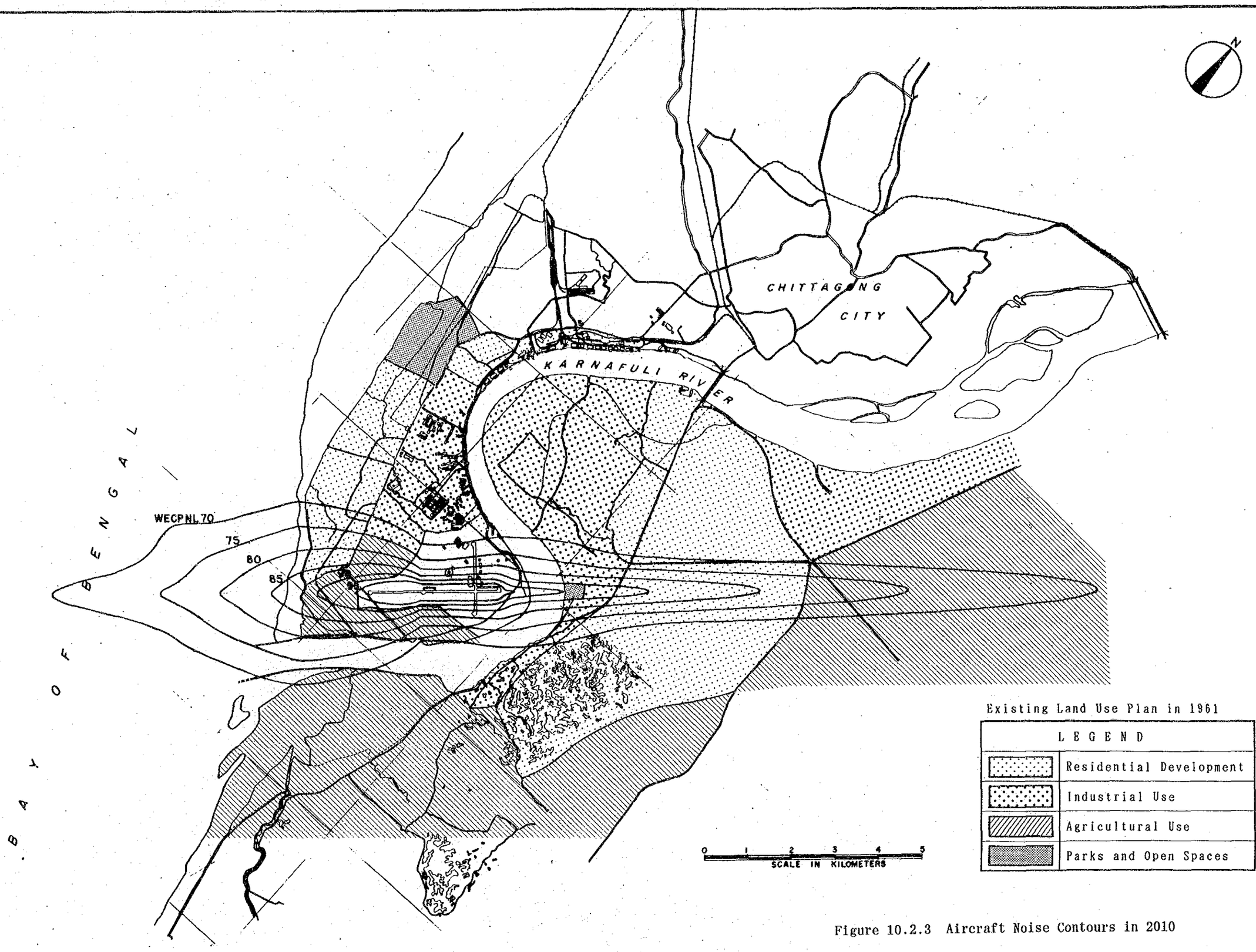



Figure 10.2.3 Aircraft Noise Contours in 2010

Table 10.2.1 Assumption on the Calculation of Aircraft Noise Contour

| Item | | Assumptions | | |
|---|---|---|---|---|
| Target Year | | 1989 (Present) | 2000 (Phase I) | 2010 (Phase II) |
| Traffic Pattern | | See Appendix 10.1. | | |
| Ratio of Runway Use | RWY 05 | 35% | 10% | 10% |
| | RWY 23 | 65% | 90% | 90% |
| Runway Length | | 3,048 m | 2,750 m | 2,750 m |
| Glide Slope Angle | | - | 3.0 degrees | 3.0 degrees |
| Number of Daily Flights | | SJ(F28) : 4<br>TP(F27) : 6<br>Others : 16 | WB(DC-10) : 4<br>NB(B-737) : 2<br>SJ(F28) : 10<br>TP(F27) : 10<br>Others : 16 | WB(DC-10) : 4<br>NB(B-737) : 12<br>SJ(F28) : 5<br>TP(F27) : 5<br>Others : 16 |
| | | Total : 26 | Total : 42 | Total : 42 |
| Distribution of Flights | | 7:00 - 19:00 : 100% | | |

Areas in which WECPNL is greater than 70 and in which appropriate measures are required for land use will be total 2,400 ha in 1989 and 2,200 ha in 2000 and 2010. The area in 2000 and 2010 is smaller than that in 1989 because a larger area is projected on the sea in 2000 and 2010 due to increased utilization of runway 23 for take-offs which generate more noise than landings. WECPNL 70 contour will extend about 14 km to the east from runway 23 threshold and about 7.5 km to the west from runway 05 threshold in 2000. Villages and staff housing area to the south of the airport will be within the contours of WECPNL 75 and 85 respectively.

In case that the ratio of runway use of other flights in 2,000 (Phase I) is the same as that in 1989 (Present), the aircraft noise contours are estimated as shown in Appendix 10.2.

There will be no influence of aircraft noise to commercial and residential areas of Chittagong City because they are further than 5 km from the noise contour of WECPNL 70.

## 10.3 Land Use Planning of the Area Surrounding the Airport

The existing land use plan of Chittagong area was produced by Chittagong Development Authority in 1961, and it is under revision at present. Figures 10.2.2 and 10.2.3 in which 1961 land use plan is included together with the future noise contours show that the existing land use plan is not harmonized with the airport development because areas under the approach surface of runway 23 and to the northwest of the airport were planned to be developed as residential areas.

Aircraft noise tends to be a serious problem in improving the living standard and eventually will prevent the social development of the region. Therefore, it is desirable to establish a land use plan to provide guidance on the location of facilities without possible noise problems in the future.

General guidelines for improvement works for existing facilities and land use planning in relation to aircraft noise in Japan are shown for reference in Tables 10.3.1. and 10.3.2.

Table 10.3.1 Improvement Works for Existing Facilities in Japan

| Level of WECPNL | Works |
|---|---|
| More than 75 | Noise proof works for existing residences and countermeasures to the jamming to television will be promoted. |
| More than 90 | Relocation of existing residences will be compensated. |
| More than 95 | Relocation of existing residences will be compensated.<br>Relocated residences will be converted into green areas as buffer zones to aircraft noise. |

Table 10.3.2 Land Use Planning in Japan

| Level of WECPNL | Land Use |
|---|---|
| More than 75 | Construction of new residences, etc. will be restricted by imposing compulsory noise proof works to new facilities. |
| More than 80 | Construction of new residences, etc. will not be permitted. |

# CHAPTER 11 PROJECT IMPLEMENTATION SCHEDULE AND COST ESTIMATES

# CHAPTER 11 PROJECT IMPLEMENTATION SCHEDULE AND COST ESTIMATES

## 11.1 General

This chapter explains the project implementation schedule and cost estimates based on the preliminary design for the Phase I development as described in Chapter 8.

The project cost is estimated to be 1,693.7 million Taka and 105.5 million Taka in Phase I and II respectively.

## 11.2 Project Implementation Schedule

The project implementation schedule for the project is indicated in Table 11.2.1.

## 11.3 Project Cost Estimates

### (1) Assumptions of Project Cost Estimates

The estimated costs are based on the following assumptions:

a) Construction cost is estimated based on the unit construction prices existing in 1989.

b) Exchange rates are fixed at US$1.00 = TK.32.2 = ¥140.

c) The following facilities which will be constructed and/or supplied by other related authorities are not included in the cost estimates.

- Fuel farm
- Airlines' GSE maintenance garage
- Airlines' ground service equipment

d) Foreign currency portion of the project cost includes the following items:

Table 11.2.1 Project Implementation Schedule

| Items \ Year | 1989 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Service Period | | | | | | | PHASE-I | | | | | |
| 2. Feasibility Study | | | | | | | | | | | | |
| 3. Financial Arrangement | | | | | | | | | | | | |
| 4. Topographic Survey and Soil Investigation | | | | | | | | | | | | |
| 5. Basic Design and Detailed Design | | | | | | | | | | | | |
| 6. Land Acquisition | | | | | | | | | | | | |
| 7. Construction Works | | | | | | | | | | | | |
| 7-1 Airside Facilities (Runway Overlay, Taxiway and Apron) | | | | | | | | | | | | |
| 7-2 Landside Facilities (Terminal Road, Car Park, Access Road and Other Civil Work) | | | | | | | | | | | | |
| 7-3 Buildings | | | | | | | | | | | | |
| 7-4 Airport Utilities | | | | | | | | | | | | |
| 7-5 Air Navigation Sysytems | | | | | | | | | | | | |
| 8. Test Operation and Flight Check etc. | | | | | | | | | | | | |

- Procurement cost for the imported materials and equipment
- Procurement cost for the imported construction equipment
- The general expenses and profit for the foreign contractors and engineering firms
- Wages for foreign staff

e) Bangladesh currency portion of the project cost includes the following items:

- Operation cost of the construction equipment including fuel and lubricants
- Procurement costs of the construction materials which are available in Bangladesh such as aggregate and others
- Transportation costs for procured materials and labors employed in Bangladesh
- The contractors' expenses and profits, for both foreign and local, for the amounts paid in Bangladesh currency
- Wages for Bangladesh laborers

f) Contingencies are estimated to be about 10% of the sum of the total cost of construction works, soil invetigation and topographic survey and engineering services cost.

g) Price escalation is not considered in this estimation.

(2) **Project Cost for Phase I and II Development**

The project cost required for the Phase I and II development is estimated to be 1,693.7 million Taka and 105.5 million Taka respectivily. The break down of the project cost are shown in Table 11.3.1 and Table 11.3.2.

This cost includes soil investigation, topographic survey, engineering services and physical contingencies.

### (3) Study for the Reduction of Project Cost for Phase I Development

The possibility of the reduction of the project cost for Phase I development is studied for reference in order to reduce an initial investment. The following work items can be eliminated from the Phase I project by the reasons described below.

a) Widening of paved runway shoulder

The cost of widening work of paved runway shoulder from 2.0 m to 7.5 m can be eliminated from Phase I project. This work is judged not to be urgent because of infrequent operations of large aircraft.

b) Airport Maintenance Building

The cost of new airport maintenance building can be eliminated from the Phase I project under the condition that the existing maintenance building on the south of the runway will be utilized in Phase I development.

c) Incinerator

Incinerator cost is eliminated under the condition that the solid waste will be disposed or burned in the vacant area of the airport.

d) Land Acquisition

The cost of the additional land acquisition for future extension of runway 250m to the west and for construction of parallel taxiway is eliminated from the project cost.

The reduced project cost is shown in Table 11.3.3. According to the above consideration, the project cost was reducted by 25 million Taka.

Table 11.3.1 Estimated Project Cost for Phase I Development

Exchange Rate : US$ 1.0 = TK.32.2 = YEN 140 ( As of May 1989 )
Cost estimated based on 1989 price ( Unit : 1,000 TK)

| Item | Bangladesh Portion | Foreign Portion | Total |
|---|---|---|---|
| Civil | | | |
| Runway Overlay and Turnaround | 39,900 | 199,200 | 239,100 |
| Taxiway | 6,200 | 25,700 | 31,900 |
| Apron | 18,200 | 73,700 | 91,900 |
| Terminal Road and Car Park | 15,000 | 61,600 | 76,600 |
| Access Road | 5,200 | 9,200 | 14,400 |
| Earth Work | 54,500 | 8,100 | 62,600 |
| Drainage | 4,000 | 4,400 | 8,400 |
| Miscellaneous | 3,900 | 4,400 | 8,300 |
| Sub-Total | 146,900 | 386,300 | 533,200 |
| Architectual Works | | | |
| Passenger Terminal Building | 58,600 | 136,000 | 194,600 |
| Cargo Terminal Building | 18,500 | 35,900 | 54,400 |
| Administration Building and | 21,500 | 41,100 | 62,600 |
| Control Tower | | | |
| Power House | 2,600 | 4,800 | 7,400 |
| Fire Station | 2,300 | 4,300 | 6,600 |
| Airport Maintenance Building | 1,300 | 3,200 | 4,500 |
| Sub-Total | 104,800 | 225,300 | 330,100 |
| Air Navigation Systems | | | |
| Radio Navigation Aids | 2,800 | 137,500 | 140,300 |
| ATC and Communication | 1,600 | 80,000 | 81,600 |
| Aeronautical Ground Lights | 13,300 | 156,100 | 169,400 |
| Meteorological System | 1,000 | 42,600 | 43,600 |
| Sub-Total | 18,700 | 416,200 | 434,900 |
| Airport Utilities | | | |
| Power Supply System | 1,700 | 57,500 | 59,200 |
| Water Supply System | 700 | 4,800 | 5,500 |
| Sewage Treatement System and | 4,600 | 13,800 | 18,400 |
| Incinarator | | | |
| Public Telecommunication | 200 | 4,300 | 4,500 |
| Sub-Total | 7,200 | 80,400 | 87,600 |
| | | | |
| Total of Construction Cost | 277,600 | 1,108,200 | 1,385,800 |
| | | | |
| Engineering Services | 35,100 | 87,600 | 122,700 |
| Land Acquisition and Compensation | 31,200 | 0 | 31,200 |
| Contingency | 34,390 | 119,580 | 153,970 |
| | | | |
| Total of Project Cost | 378,290 | 1,315,380 | 1,693,670 |

Table 11.3.2 Estimated Project Cost for Phase II Development

Exchange Rate : US$ 1.0 = TK. 32.2 = YEN 140 ( As of May 1989 )
Cost estimated based on 1989 price ( Unit : 1,000 TK)

| Item | Bangladesh Portion | Foreign Portion | Total |
|---|---|---|---|
| Civil | | | |
| Runway Overlay and Turnaround | 0 | 0 | 0 |
| Taxiway | 0 | 0 | 0 |
| Apron | 0 | 0 | 0 |
| Terminal Road and Car Park | 700 | 2,800 | 3,500 |
| Access Road | 0 | 0 | 0 |
| Earth Work | 100 | 300 | 400 |
| Drainage | 300 | 900 | 1,200 |
| Miscellaneous | 100 | 300 | 400 |
| Sub-Total | 1,200 | 4,300 | 5,500 |
| Architectual Works | | | |
| Passenger Terminal Building | 12,400 | 26,000 | 38,400 |
| Cargo Terminal Building | 13,000 | 25,800 | 38,800 |
| Administration Building and | 0 | 0 | 0 |
| Control Tower | 0 | 0 | 0 |
| Power House | 0 | 0 | 0 |
| Fire Station | 0 | 0 | 0 |
| Airport Maintenance Building | 0 | 0 | 0 |
| Sub-Total | 25,400 | 51,800 | 77,200 |
| Air Navigation Systems | | | |
| Radio Navigation Aids | 0 | 0 | 0 |
| ATC and Communication | 0 | 0 | 0 |
| Aeronautical Ground Lights | 0 | 0 | 0 |
| Meteorological System | 0 | 0 | 0 |
| Sub-Total | 0 | 0 | 0 |
| Airport Utilities | | | |
| Power Supply System | 200 | 5,800 | 6,000 |
| Water Supply System | 100 | 500 | 600 |
| Sewage Treatement System and | 700 | 2,300 | 3,000 |
| Incinarator | | | |
| Public Telecommunication | 0 | 400 | 400 |
| Sub-Total | 1,000 | 9,000 | 10,000 |
| | | | |
| Total of Construction Cost | 27,600 | 65,100 | 92,700 |
| | | | |
| Engineering Services | 1,800 | 1,400 | 3,200 |
| Land Acquisition and Compensation | 0 | 0 | 0 |
| Contingency | 2,940 | 6,650 | 9,590 |
| | | | |
| Total of Project Cost | 32,340 | 73,150 | 105,490 |

Table 11.3.3 Reduced Project Cost for Phase I Development

Exchange Rate : US$ 1.0 = TK. 32.2 = YEN 140 ( As of May 1989 )
Cost estimated based on 1989 price ( Unit : 1,000 TK)

| Item | Bangladesh Portion | Foreign Portion | Total |
|---|---|---|---|
| Civil | | | |
| * Runway Overlay and Turnaround | 33,900 | 193,400 | 227,300 |
| Taxiway | 6,200 | 25,700 | 31,900 |
| Apron | 18,200 | 73,700 | 91,900 |
| Terminal Road and Car Park | 15,000 | 61,600 | 76,600 |
| Access Road | 5,200 | 9,200 | 14,400 |
| Earth Work | 54,500 | 8,100 | 62,600 |
| Drainage | 4,000 | 4,400 | 8,400 |
| Miscellaneous | 3,900 | 4,400 | 8,300 |
| Sub-Total | 140,900 | 380,500 | 521,400 |
| Architectual Works | | | |
| Passenger Terminal Building | 58,600 | 136,000 | 194,600 |
| Cargo Terminal Building | 18,500 | 35,900 | 54,400 |
| Administration Building and | 21,500 | 41,100 | 62,600 |
| Control Tower | | | |
| Power House | 2,600 | 4,800 | 7,400 |
| Fire Station | 2,300 | 4,300 | 6,600 |
| * Airport Maintenance Building | 0 | 0 | 0 |
| Sub-Total | 103,500 | 222,100 | 325,600 |
| Air Navigation Systems | | | |
| Radio Navigation Aids | 2,800 | 137,500 | 140,300 |
| ATC and Communication | 1,600 | 80,000 | 81,600 |
| Aeronautical Ground Lights | 13,300 | 156,100 | 169,400 |
| Meteorological System | 1,000 | 42,600 | 43,600 |
| Sub-Total | 18,700 | 416,200 | 434,900 |
| Airport Utilities | | | |
| Power Supply System | 1,700 | 57,500 | 59,200 |
| Water Supply System | 700 | 4,800 | 5,500 |
| * Sewage Treatement System and | 4,300 | 13,000 | 17,300 |
| Incinarator | | | |
| Public Telecommunication | 200 | 4,300 | 4,500 |
| Sub-Total | 6,900 | 79,600 | 86,500 |
| Total of Construction Cost | 270,000 | 1,098,400 | 1,368,400 |
| | | | |
| Engineering Services | 35,100 | 87,600 | 122,700 |
| *Land Acquisition & Compensation | 26,000 | 0 | 26,000 |
| Contingency | 33,110 | 118,600 | 151,710 |
| | | | |
| Total of Project Cost | 364,210 | 1,304,600 | 1,668,810 |

NOTE : (*) indicates the item of which cost is reducted from the original case shown in Table 11.3.1

# CHAPTER 12 ECONOMIC AND FINANCIAL ANALYSES

# CHAPTER 12 ECONOMIC AND FINANCIAL ANALYSES

## 12.1 General

Economic and financial analyses are carried out on the development of Chittagong Airport. In the economic analysis, the Project is evaluated from the viewpoint of its contribution to the national economy. Financial analysis is carried out to study the financial viability of the Project.

In this Study, Phase I and Phase II developments are regarded as an aggregated investment to produce economic benefits and financial revenues. Most of the investment involved in the airport development is concentrated in the initial stages due to the poor condition of existing facilities. Only partial expansion of the facilities, i.e. passenger terminal building, cargo terminal building and car park is required for Phase II development while the benefits and revenues will gradually increase in accordance with an increase in air traffic demand. If the airport development is evaluated for the two phases respectively, the viability of Phase I development will be underestimated and that for Phase II development overestimated.

Since the airport development is planned on the premise that minimum facilities will be constructed in Phase I development with succeeding expansion work, Phase II development should be regarded as a deffered part of Phase I development. It is therefore necessary to evaluate the feasibility inclusive of Phase I and Phase II developments.

A case with only Phase I development is evaluated in a sensitivity analysis.

## 12.2 Economic Analysis

### 12.2.1 Standard Conversion Factor

The economic analysis evaluates all inputs and outputs for a project at economic prices because existing market prices are influenced by various kinds of market distortions such as import and export taxes and subsidies. In Bangladesh, the Little-Mirrlees method is used in the economic analyses. In this method, all values of project inputs and outputs are expressed in terms of international/border price equivalents.

The Planning Commission has recommended the use of the following Standard Conversion Factor (SCF) to attain economic prices and it is also used in this study.

Standard Conversion Factor (SCF) = 0.82*

Source *: "Manual of Instructions For Submission of Development Projects on Project Proforma (PP) Whose Benefits can be Quantified", Planning Commission, July, 1988

### 12.2.2 Economic Costs of the Project

#### (1) Construction Cost

The annual disbursement schedule of the construction costs for Phase I and Phase II developments are indicated in Table 12.2.1 in accordance with the implementation schedule in Table 11.2.1. The local portion of the construction cost is converted from financial price to economic price by multiplying the Standard Conversion Factor of 0.82.

The total construction cost at economic prices is valued at 1,725 million TK. which is 96% of the total cost at the financial price.

Table 12.2.1 Disbursement Schedule of Investment Costs

(Unit: 1,000TK)

| Item \ Year | | 1991 | 1992 | 1993 | 1994 | Sub Total (Phase I) | 2000 (Phase II) | Total |
|---|---|---|---|---|---|---|---|---|
| Foreign Currency | | 143,900 | 437,080 | 377,500 | 356,900 | 1,315,380 | 73,200 | 1,388,580 |
| Local Currency | Financial | 85,200 | 161,100 | 97,390 | 34,600 | 378,290 | 32,300 | 410,590 |
| | Economic | 69,864 | 132,102 | 79,860 | 28,372 | 310,198 | 26,486 | 336,684 |
| Total Economic Cost | | 213,764 | 569,182 | 457,360 | 385,272 | 1,625,578 | 99,686 | 1,725,264 |

After the construction of Phase I facilities, the following costs will be incurred every 12 years in replacing air navigation equipment which accounts for 70% of the construction cost of the air navigation systems work in Phase I development.

Foreign currency : 291,394 (thousand TK)
Bangladesh currency : 10,734 (thousand TK)

## (2) Operation and Maintenance Costs

Operation and maintenance costs include personnel cost and material and equipment costs.

a) Personnel Cost

Expansion of the terminal area and the introduction of modern equipment such as the instrument landing system planned in the Project will require additional staff for their operations and maintenance. The total number of CAAB staff at Chittagong Airport is estimated to increase from the present 196 persons to 250 persons in Phase I development and to 265 persons in Phase II development. Therefore, the number of additional staff for Phase I and Phase II developments are 54 and 69 persons respectively, (Refer to Appendix 12.1).

Additional personnel cost required for the development of Chittagong Airport is calculated by multiplying the number of additional staff by an average salary at Chittagong Airport (4,000 TK/month including general administration cost) as shown in Table 12.2.2. The average salary is assumed to increase at the same rate as annual Per Capita GDP.

Table 12.2.2 Additional Personnel Cost

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| No. of Additional Staff | 54 | 54 | 69 | 69 |
| Cost per Person per Month (TK) | 4,530 | 5,050 | 5,650 | 6,320 |
| Personnel Cost (1,000TK) | 2,935 | 3,272 | 4,678 | 5,233 |
| Economic Cost (1,000TK) | 2,407 | 2,683 | 3,836 | 4,291 |

b) Material and Equipment Costs

The additional material and equipment costs required for the operations and maintenance of the facilities in Phase I and Phase II developments are estimated by the following method and shown in Table 12.2.3.

Civil and Building Facilities : 1% of construction cost for civil and architectural works

Equipment : 5% of equipment cost for air navigation systems, airport utilities and fire fighting vehicles

Table 12.2.3 Annual Costs for Material and Equipment

(Unit: 1,000TK)

| Item \ Year | | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|
| Civil and Building Facilities | Foreign Currency | 6,116 | 6,116 | 6,677 | 6,677 |
| | Local Currency | 2,064 | 2,064 | 2,282 | 2,282 |
| | Sub Total | 8,180 | 8,180 | 8,959 | 8,959 |
| Equipment | Foreign Currency | 24,830 | 24,830 | 25,280 | 25,280 |
| | Local Currency | 1,062 | 1,062 | 1,103 | 1,103 |
| | Sub Total | 25,892 | 25,892 | 26,383 | 26,383 |
| Grand Total | | 34,072 | 34,072 | 35,342 | 35,342 |

## 12.2.3 Project Benefits

### (1) Benefits to be Quantified

The development of Chittagong Airport will offer various benefits to the national and regional economy. In this Study, the following benefits and disbenefit are quantified and evaluated:

- Benefit due to accommodation of overflowing domestic passengers,
- Benefit due to accommodation of overflowing international passengers,
- Benefit due to accommodation of overflowing foreign visitors,
- Reduction of flight connecting time in Dhaka,
- Reduction of passenger processing time at the airport,
- Benefit due to accommodation of overflowing air cargo,
- Benefit due to accommodation of possible diversions from ZIA to Chittagong Airport,
- Reduction of aircraft operating costs by introduction of larger aircraft,
- Benefit due to introduction of Instrument Landing System (ILS) and
- Disbenefit due to longer access to the new terminal.

(2) Definition of "Without Project Case"

This Project is designed to expand the air transport services at Chittagong Airport by redeveloping the existing airport. Hence the "without project case" is specified as the maintenance of the existing airport in the present condition with minimum maintenance and replacement.

In the "without project case", it is next necessary to determine the capacity of the existing Chittagong Airport with the present condition. The existing international and domestic terminal buildings have already reached their capacities as evaluated in Section 5.3. Therefore it is assumed that in the "without project case", the traffic will remain constant at the present level.

The overflowing traffic which cannot be realized in the "without project case" is estimated as the difference between future air traffic demand and the existing airport capacity, i.e. the present traffic volume.

Future air traffic demands, the existing airport capacity and the volume of overflowing traffic are presented in Table 12.2.4.

Table 12.2.4 Volume of Overflowing Traffic

| Route \ Year | 1987 Present Capacity | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|
| Domestic Passengers | | | | | |
| Chittagong - Dhaka | 106,000 | 161,000 ( 55,000) | 195,000 ( 89,000) | 234,000 (128,000) | 283,000 (177,000) |
| Chittagong - Cox's Bazar | 3,000 | 4,000 ( 1,000) | 5,000 ( 2,000) | 6,000 ( 3,000) | 7,000 ( 4,000) |
| Total | 109,000 | 165,000 ( 56,000) | 200,000 ( 91,000) | 240,000 (131,000) | 290,000 (181,000) |
| International Passengers | | | | | |
| Chittagong - Via ZIA | 5,000 | 51,000 ( 30,000) | 77,000 (56,000) | 107,000 ( 85,000) | 140,000 (119,000) |
| Chittagong - Middle East (Direct flights) | - | 50,000 ( 29,000) | 74,000 ( 53,000) | 100,000 ( 80,000) | 134,000 (113,000) |
| Chittagong - Calcutta (Direct flights) | 17,000 | 40,000 ( 23,000) | 61,000 ( 44,000) | 84,000 ( 67,000) | 113,000 ( 96,000) |
| Chittagong - Bangkok (Direct flights) | - | 19,000 ( 11,000) | 28,000 ( 20,000) | 39,000 ( 31,000) | 53,000 ( 45,000) |
| Total | 67,000 | 160,000 ( 93,000) | 240,000 (173,000) | 330,000 (263,000) | 440,000 (373,000) |
| Domestic Air Cargo | | | | | |
| Chittagong - Dhaka | 272 | 490 ( 218) | 784 ( 512) | 980 ( 708) | 1,274 (1,002) |
| Chittagong - Cox's Bazar | 6 | 10 ( 4) | 16 ( 10) | 20 ( 14) | 26 ( 20) |
| Total | 278 | 500 ( 222) | 800 ( 522) | 1,000 ( 722) | 1,300 (1,022) |
| International Air Cargo | | | | | (Unit: ton) |
| Chittagong - via ZIA - Middle East - Calcutta - Bangkok | 270 | 3,000 ( 2,730) | 6,500 ( 6,230) | 8,800 ( 8,530) | 11,600 ( 11,330) |
| Total | 270 | 3,000 ( 2,730) | 6,500 ( 6,230) | 8,800 ( 8,530) | 11,600 ( 11,330) |

Note, Upper: Air traffic demand
( ): Overflowing traffic

### (3) Unit Benefit in Monetary Terms in "With Project Case"

a) Time Value of Bangladeshi Passengers

The time value necessary for the estimation of benefits is calculated based on the results of the traffic survey conducted by the Study Team at Chittagong Airport in December 1988.

According to this survey, the average annual income of Bangladeshi domestic and international passengers were estimated at 188,200 TK and 110,700 TK respectively.

The time values per hour are calculated assuming the average annual working hours of 1,920 hours (8 hours/day x 20 days/month x 12 months) and shown below:

Domestic: Average annual income (188,200 TK)/
Average annual working hours (1,920 hours)
= 98.0 TK/hour

International: Average annual income (110,700 TK)/
Average annual working hours (1,920 hours)
= 57.7 TK/hour

Furthermore, these time values are assumed to increase at the same rate as Per Capita GDP along with the economic development of the country as presented in Table 12.2.5.

Table 12.2.5 Time Value of Bangladeshi Passengers

| Category \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| Domestic Passenger (TK/hour) | 110.9 | 123.7 | 138.4 | 154.9 |
| International Passenger (TK/hour) | 65.3 | 72.8 | 81.5 | 91.2 |

b) Foreign Exchange Earning

The time saving benefits are quantified only for Bangladeshi passengers, and those for foreigners are not included in the project benefits. Instead, the increase in foreign exchange earnings from foreign visitors in Bangladesh in "with project case" are quantified as the project benefit from foreign passengers.

According to the information from the Bangladesh Parjaton (Tourism) Corporation, foreign exchange spent by foreign tourists in Bangladesh is US$128 (= 4,122 TK) per person on an average.

(4) Estimation of Project Benefits

a) Accommodation of Overflowing Domestic Passengers

In the "without project case", overflowing domestic passengers cannot satisfy their desire for air travel. Overflowing Bangladshi passengers will have to utilize other transport modes. The implementation of the project, therefore, will provide benefits to the overflowing passengers by enabling the utilization of air transport. This benefit will be evaluated by their willingness to pay. The willingness to pay for air trip of overflowing passengers is estimated by the following formula:

$$WTP = (Co + V \times To) - V \times T_A$$

Where, WTP : Willingness to pay for air trip
Co : Fare of alternative mode
To : Travel time by alternative mode
$T_A$ : Travel time by air
V : Time value of air passenger

The accommodation of overflowing foreign passengers on domestic routes will lead to foreign exchange earnings for Bangladeshi economy. The earned foreign exchange is equivalent to the airfare and airport tax minus the fare of alternative transport modes.

The benefit due to accommodation of overflowing domestic passengers is shown in Table 12.2.6. The detailed calculation is presented in Appendix 12.2.

Table 12.2.6 Benefit Due to the Accommodation of Overflowing Domestic Passengers

(Unit: 1,000 TK)

| Route \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| Chittagong - Dhaka | 47,617 | 83,205 | 129,825 | 195,295 |
| - Cox's Bazar | 333 | 735 | 1,223 | 1,809 |
| Total | 47,950 | 83,940 | 131,048 | 197,104 |
| At Economic Price | 39,684 | 69,424 | 108,312 | 162,804 |

Note: See detail in Appendix 12.2

b) Accommodation of Overflowing International Passengers

In the "without project case", the overflowing Bangladeshi passengers will go from Chittagong to foreign countries using Zia International Airport in Dhaka. The willingness to pay for the air trip from Chittagong to Dhaka is the benefit to the overflowing passengers and estimated in the same way as Bangladeshi domestic passengers.

With regard to the overflowing foreign passengers, it is assumed that about 20% of foreign passengers will give up their travel unless the air transport services at Chittagong Airport are available, and that the remaining 80% will visit Bangladesh regardless of availability of air transport services.

The rate of 20% is determined by applying the share of tourism purpose visitors in the total foreign visitors to Bangladesh since the availability of air transport is essential in particular for tourists.

The amount of airfair paid to Biman Bangladesh Airlines by the above 20% of foreign passengers in "with project case" will be additional income to Bangladesh and part of the Project benefits. Foreign exchange earnings from foreign passengers which will increase in "with project case" are estimated in the next section c).

Benefits due to accommodation of overflowing international passengers are summarized in Table 12.2.7. The detailed calculation is shown in Appendix 12.3.

Table 12.2.7 Benefit Due to Accommodation of Overflowing International Passengers

(Unit: 1,000 TK)

| Route \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| Chittagong - via ZIA | 19,646 | 38,562 | 61,859 | 91,797 |
| Chittagong - Middle East Calcutta Bangkok | 48,498 | 95,227 | 154,369 | 235,319 |
| Total | 68,144 | 133,789 | 216,228 | 327,116 |
| At Economic Price | 58,761 | 115,021 | 185,370 | 279,634 |

Note: See detail in Appendix 12.3

c) Benefit due to Accommodation of Foreign Visitors

The implementation of the Project will increase foreign exchange earnings from the foreign international passengers who will be induced by the unrestricted international air transport services at Chittagong Airport. This portion of foreign passengers is estimated to be 20% of the total number of foreign international passengers at Chittagong Airport as aforementioned, and the benefit is calculated by multiplying

the number of induced visitors by the average foreign exchange expenditure of US$128 (= 4,122 TK) per person.

The estimated increase in foreign exchange from foreign visitors is presented in Table 12.2.8.

Table 12.2.8 Benefit Due to Accommodation of Overflowing Foreign Tourists

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| (1) No. of Overflowing International Pax. | 93,000 | 173,000 | 263,000 | 373,000 |
| (2) No. of Overflowing Foreign Visitors Emb. + Disemb. (1) x 25% | 23,250 | 43,250 | 65,750 | 93,250 |
| (3) No. of Induced Foreign Visitors (2) x 20%/2 | 2,325 | 4,325 | 6,575 | 9,325 |
| (4) Foreign Exchange (1,000 TK) (3) x 4,122 | 9,584 | 17,828 | 27,102 | 38,438 |

d) Reduction of Flight Connecting Time in Dhaka

By using direct flights, international passengers from/to Chittagong will be able to save connecting time necessary for transferring from domestic flights to international flights and vice versa at Zia International Airport.

The present 5-hours average connecting time will be saved in the "with project case". This benefit, however, will only be enjoyed by Bangladeshi passengers within the capacity of the existing airport and will not exist for the overflowing Bangladeshi passengers because they will travel between Chittagong and Dhaka by other modes in the "without project case".

The number of Bangladeshi passengers who will shift to new direct flights is estimated as follows:

Total No. of existing international passengers : 67,000*

Future share of new direct route (to Middle East and Bangkok) : 43%*

Share of Bangladeshi international passengers : 75%**

No. of Bangladeshi who will shift to direct flight
= 67,000 x 0.43 x 0.75 = 21,600

Note, *: Refer to Table 12.2.4
**: From the result of traffic survey

Table 12.2.9 Benefit Due to Reduction of Flight Connecting Time

| Year | No. of Bangladeshi passengers (In WOP Case) Chittagong - Middle East Chittagong - Bangkok (1) | Time Value (TK/hr) (2) | Saving time (3) | Amount at Economic Price (1,000 TK) (1)x(2)x(3) x 0.82 |
|---|---|---|---|---|
| 1995 | 21,600 | 65.3 | 5 hrs | 5,783 |
| 2000 | 21,600 | 72.8 | 5 hrs | 6,447 |
| 2005 | 21,600 | 81.5 | 5 hrs | 7,218 |
| 2010 | 21,600 | 91.2 | 5 hrs | 8,077 |

e) Reduction of Passenger Processing Time at Airport

Passenger processing time at the airport is assumed to be reduced by 0.5 hour per passenger by the introduction of modern and efficient passenger and baggage handling equipment, compared with the congested existing terminal in the "without project case".

This benefit will also be enjoyed by Bangladeshi passengers within the capacity of the existing airport because the overflowing portion of Bangladeshi passengers will use other transport modes in the "without project case".

The expected time saving benefit to the Bangladeshi passengers in the "without project case" is calculated as summarized below:

Table 12.2.10 Number of Bangladeshi Passengers in "Without Project Case"

| Category | Total passengers (In WOP Case)* | Share of Bangladeshi** | Bangladeshi passengers | |
|---|---|---|---|---|
| Domestic | 109,000 | 0.90 | 98,100 | (66.1%) |
| Int'l | 67,000 | 0.75 | 50,300 | (33.9%) |
| Total | | | 148,400 | |

Note, *: Refer to Table 12.2.4
**: From the result of traffic survey

Weighted Average Time Value:

Year 1995; (0.661 x 110.9) + (0.339 x 65.3) = 95.4 TK/hr
2000; (0.661 x 123.7) + (0.339 x 72.8) = 106.5
2005; (0.661 x 138.4) + (0.339 x 81.5) = 119.1
2010; (0.661 x 154.9) + (0.339 x 91.2) = 133.3

Table 12.2.11 Benefit Due to Reduction of Passenger Processing Time at Airport

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| (1) Time Value (TK/0.5hr) | 47.7 | 53.3 | 59.6 | 66.7 |
| (2) No. of Passengers (Bangladeshi) | 148,400 | 148,400 | 148,400 | 148,400 |
| (3) Time Benefit (1,000TK) (1) x (2) | 7,079 | 7,910 | 8,845 | 9,898 |
| (4) At Economic Prices (3) x 0.82 | 5,805 | 6,486 | 7,253 | 8,116 |

f) Accommodation of Overflowing Air Cargo

The commodities transported by air are high value perishables or high technology consumer goods. Many air cargoes may not be moved at all unless air transport services are available because alternative land transport may damage sensitive machinery or foods. Therefore, in the "without project case", overflowing air cargo demand is not considered at all.

In this situation, it is considered reasonable to use willingness to pay of cargo shippers for the estimation of the benefit.

According to the information from Biman Bangladesh Airlines, the total freight in 1985/86 was estimated at 17,590 ton and corresponding revenue from freight transportation was about 497 million TK. Therefore, average fare per ton is estimated at 28,300 TK. Since the willingness to pay is higher than the fare, the willingness to pay for air cargo is estimated by applying the same ratio of willingness to pay to air fare as in the case of Bangladeshi air passengers (willingness to pay/air fare = 1.35(*)) and valued at 38,000 TK/ton (= 28,300 x 1.35). This value is probably a conservative estimate because the value of air cargo is usually high and many air cargoes may not be moved by other transport modes. Applying this value of willingness pay, the benefit due to accommodation of overflowing air cargo is calculated as shown below:

Note *: For Chittagong - Dhaka route, in 1995, Railway Fare 256 TK + Time Value 95.4TK/hr x (Time by Railway 8.25 hrs -Time by Air 2.25 hrs) = Willingness to pay 828.4 TK. Willingness to Pay 828.4 ÷ Air fare 615 = 1.35

Table 12.2.12 Benefit Due to Accommodation of Overflowing Air Cargo

(1,000TK)

| Item \ Year | | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|
| Overflowing Air Cargo (ton) | | | | | |
| | Domestic Air Cargo | 222 | 522 | 722 | 1,022 |
| | International * | 2,730/2 | 6,230/2 | 8,530/2 | 11,330/2 |
| (1) | Total | 1,587 | 3,637 | 4,987 | 6,687 |
| (2) | Average Willingness to Pay (TK/ton) | 38,000 | 38,000 | 38,000 | 38,000 |
| (3) | Total Benefit (1,000 TK) (1) x (2) | 60,306 | 138,206 | 189,506 | 254,106 |
| (4) | At Economic Prices (3) x 0.82 | 49,451 | 113,329 | 155,395 | 208,367 |

Note *: Half of the benefit is assumed to belong to Bangladesh and rest of half flows out to foreign countries in case of international air cargo.

g) Accommodation of the Possible Diversions From ZIA to Chittagong Airport

The development of Chittagong Airport as an alternate to Zia International Airport in Dhaka will enable it to accommodate aircraft diverted from ZIA in case ZIA is not serviceable.

The disbenefits of diversions to neighbouring countries which will be avoided in the "with project case" are:

- Extra foreign exchange loss for the landing charge that should be paid by Bangladesh Biman to the airport authorities of neighbouring countries.
- Time loss to Bangladeshi passengers for waiting at a diverted airport until ZIA recovers its operations.

However, the latter disbenefit is considered to be more or less the same whether the aircraft will divert to Chittagong Airport or to other foreign airports because the passengers whose final destinations is Dhaka have to wait also at Chittagong Airport. Therefore only the benefit of saving foreign exchange loss is estimated based on the forecast of diversions from ZIA in the Section 3.9 and the landing charge of 74,000 TK for DC-10 aircraft at Calcutta Airport to which most plane were diverted in the past.

Results of benefit calculation are presented in Table 12.2.13.

Table 12.2.13 Benefit Due to Accommodation of Possible Diversions from ZIA

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| (1) Divisions to Chittagong Airport | 11 | 14 | 16 | 18 |
| (2) Biman's Diversions (1) x 50% | 6 | 7 | 8 | 9 |
| (3) Landing Charge at Calcutta (TK/Landing) | 74,000 | 74,000 | 74,00 | 74,000 |
| (4) Foreign Exchange Saving (1,000 TK) (2) x (3) | 444 | 518 | 592 | 666 |

Note, (1): Refer to Table 3.9.6

(3): Assumed as the same landing charge at New Delhi Airport

h) Reduction of Aircraft Operating Cost by the Introduction of Larger Aircraft

With the development of Chittagong Airport, larger aircraft such as DC-10 aircraft will be able to operate at Chittagong Airport. Introduction of larger aircraft will reduce the operating costs per passenger kilometer and benefit Bangladesh Biman Airlines.

The present average unit costs for aircraft operation are estimated as follows:

| Aircraft Type | Unit Cost for Operation |
|---|---|
| SJ/TP | 2.45 TK/passenger·km |
| NB | 2.00 |
| WB | 1.80 |

Source: "Annual Report 1985 - 86" of Biman Bangladesh Airlines and operating cost data from other airlines.

Note, SJ/TP: Small Jet/Turbo Prop., F-28
NB : Narrow Body, B-737
WB : Wide Body, DC-10

The benefit due to the introduction of larger aircraft is estimated based on the forecast of annual aircraft movement in Table 3.7.1 and applying the above unit costs. This benefit is quantified for aircraft operations corresponding to passenger demand within the existing airport capacity and not to the overflowing passenger demand as overflowing passengers will use other transport modes in the "without project case"

The results of the benefit calculation are summarized in Table 12.2.14. Detailed calculation is presented in Appendix 12.4

Table 12.2.14 Benefit Due to the Introduction of Larger Aircraft

(Unit: 1,000 TK)

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| Domestic * | - | - | 3,572 | 5,845 |
| International | 12,316 | 13,013 | 14,136 | 14,592 |
| Total | 12,316 | 13,013 | 17,708 | 20,437 |

Note: See detail in Appendix 12.4
* Introduction of large aircraft is planned only for Chittagong - Dhaka in domestic routes.

i) Benefit due to the Introduction of an Instrument Landing System (ILS)

With the implementation of the Project, an Instrument Landing System (ILS) is to be introduced to Chittagong Airport. The introduction of ILS will improve the runway usability factor and enable aircraft to land safely without delay even with bad visibility and low ceiling.

Therefore, the introduction of ILS will save the passengers extra delay time and the extra operating costs of airlines due to waiting, returning, or diverting to other airports in the "without project case". In this study, only the passengers' time saving benefit is estimated because there is insufficient data on the disbenefit to airlines in the "without project case".

By introducing ILS, the runway usability factor will increase by 3.9% compared to the existing condition at Chittagong Airport. (Refer to Table 5.2.5) Namely, 3.9% of passengers in the existing capacity will enjoy avoiding of extra time loss.

This benefit, however, does not belong to overflowing passengers as they will use other transport modes in the "without project case".

The benefit due to the introduction of ILS is estimated assuming 1 hour* extra time loss for passengers in "without project case" and presented as follows:

Beneficiaries = No. of Bangladeshi Passengers in WOP case (148,400**) x Improvement of Usability Factor (0.039) = 5,800

Note, *: Difference of average flight delay time in winter and monsoon season.
**: Refer to Table 12.2.10.

Table 12.2.15 Benefit Due to the Introduction of An Instrument Landing System (ILS)

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| (1) Time Value (TK/hour) | 95.4 | 106.5 | 119.1 | 133.3 |
| (2) No. of Passengers (Bangladeshi) | 5,800 | 5,800 | 5,800 | 5,800 |
| (3) Time Benefit (1,000TK) (1) x (2) | 553 | 618 | 691 | 773 |
| (4) At Economic Prices (3) x 0.82 | 453 | 507 | 567 | 634 |

j) Longer Access to the New Terminal (Disbenefit)

In the "with project case", the location of the new terminal area will be moved to the south of the runway, farther than the present location.

The additional 5km is equivalent to a 0.125 hour (7.5 minutes) vehicle trip assuming an average speed of 40km/hr. This disbenefit will be related to the passengers within the capacity of the existing airport and calculated as shown in Table 12.2.16.

Table 12.2.16 Disbenefit Due to the Longer Access to the New Terminal

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| (1) Time Value (TK/0.125hr) | 11.9 | 13.3 | 14.9 | 16.7 |
| (2) No. of Passengers (Bangladeshi) | 148,400 | 148,400 | 148,400 | 148,400 |
| (3) Disbenefit (1,000TK) (1) x (2) | 1,766 | 1,974 | 2,211 | 2,478 |
| (4) At Economic Prices (3) x 0.82 | 1,448 | 1,619 | 1,813 | 2,032 |

### 12.2.4 Evaluation of the Project

#### (1) Premises

- The evaluation period of the Project is from the beginning of the investment and up to 25 years after the completion of Phase I development taking into account the economic project life and based on the practices of airport project evaluation.

- Opportunity cost of capital is set at 15% based on the evaluation criterion for the selection of viable project by the Planning Commission.

The costs and benefits over the entire project period are shown in Table 12.2.17.

#### (2) Results of Economic Evaluation

The Economic Internal Rate of Return (EIRR), Benefit/Cost Ratio (B/C Ratio) and Net Present Value (NPV) of the Project are calculated and summarized in Table 12.2.18.

Table 12.2.18 Evaluation Indicators

| EIRR (%) | B/C Ratio* | NPV* (thousand TK) |
|---|---|---|
| 15.0 | 1.00 | 1,186 |

Note *: At discount rate of 15%

The results of the economic analysis shows that the development of Chittagong Airport is feasible because the EIRR of 15.0% is just equal to the opportunity cost of capital which the Planning Commission adopts as a criterion for the selection of economically viable projects.

Explanation of economic indicators are included in Appendix 12.5.

## Table 12.2.17 Cash Flow of Costs and Benefits

(UNIT : 1,000TK)

| No. | Year | Costs | | | | | Benefits | | | | | | | | | | | Net Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | O & M | | Total | Domestic Pax | Int. Pax via ZIA | Foreign Visitors | Connect. Time | Process. Time | Air Cargo | Divert from ZIA | Larger Aircraft | ILS | Longer Access | Total | |
| | | Foreign | Local | Foreign | Local | | | | | | | | | | | | | |
| 1 | 1991 | 143,900 | 69,864 | | | 213,764 | | | | | | | | | | | | -213,764 |
| 2 | 1992 | 437,080 | 132,102 | | | 569,182 | | | | | | | | | | | | -569,182 |
| 3 | 1993 | 377,500 | 79,860 | | | 457,360 | | | | | | | | | | | | -457,360 |
| 4 | 1994 | 356,900 | 28,372 | | | 385,272 | | | | | | | | | | | | -385,272 |
| 5 | 1995 | | | 30,940 | 5,533 | 36,473 | 39,684 | 58,761 | 9,584 | 5,783 | 5,805 | 49,451 | 444 | 12,316 | 453 | -1,448 | 180,333 | 144,360 |
| 6 | 1996 | | | 30,940 | 5,588 | 36,528 | 44,381 | 67,209 | 10,851 | 5,910 | 5,935 | 58,372 | 458 | 12,452 | 463 | -1,481 | 204,551 | 168,023 |
| 7 | 1997 | | | 30,940 | 5,643 | 36,583 | 49,633 | 76,871 | 12,285 | 6,040 | 6,068 | 68,904 | 472 | 12,590 | 474 | -1,514 | 231,824 | 195,240 |
| 8 | 1998 | | | 30,940 | 5,699 | 36,639 | 55,508 | 87,923 | 13,909 | 6,173 | 6,205 | 81,334 | 487 | 12,730 | 485 | -1,548 | 263,204 | 226,565 |
| 9 | 1999 | | | 30,940 | 5,754 | 36,694 | 62,077 | 100,563 | 15,747 | 6,308 | 6,344 | 96,008 | 502 | 12,871 | 496 | -1,583 | 299,332 | 262,639 |
| 10 | 2000 | 73,200 | 26,486 | 30,940 | 5,809 | 136,435 | 69,424 | 115,021 | 17,828 | 6,447 | 6,486 | 113,329 | 518 | 13,013 | 507 | -1,619 | 340,954 | 204,519 |
| 11 | 2001 | | | 31,957 | 6,091 | 38,048 | 75,883 | 126,541 | 19,386 | 6,594 | 6,633 | 120,715 | 532 | 13,840 | 518 | -1,656 | 368,985 | 330,937 |
| 12 | 2002 | | | 31,957 | 6,374 | 38,331 | 82,942 | 139,214 | 21,080 | 6,745 | 6,783 | 128,582 | 546 | 14,720 | 530 | -1,694 | 399,447 | 361,116 |
| 13 | 2003 | | | 31,957 | 6,656 | 38,613 | 90,659 | 153,156 | 22,921 | 6,899 | 6,936 | 136,962 | 561 | 15,655 | 542 | -1,733 | 432,559 | 393,945 |
| 14 | 2004 | | | 31,957 | 6,939 | 38,896 | 99,093 | 168,495 | 24,924 | 7,057 | 7,093 | 145,887 | 576 | 16,650 | 554 | -1,772 | 468,557 | 429,662 |
| 15 | 2005 | | | 31,957 | 7,221 | 39,178 | 108,312 | 185,370 | 27,102 | 7,218 | 7,253 | 155,395 | 592 | 17,708 | 567 | -1,813 | 507,704 | 468,526 |
| 16 | 2006 | 291,394 | 10,734 | 31,957 | 7,312 | 341,397 | 117,510 | 201,256 | 29,064 | 7,382 | 7,418 | 164,784 | 606 | 18,223 | 580 | -1,855 | 544,968 | 203,571 |
| 17 | 2007 | | | 31,957 | 7,403 | 39,360 | 127,489 | 218,504 | 31,168 | 7,550 | 7,587 | 174,741 | 621 | 18,753 | 593 | -1,898 | 585,107 | 545,747 |
| 18 | 2008 | | | 31,957 | 7,494 | 39,451 | 138,315 | 237,230 | 33,424 | 7,722 | 7,759 | 185,299 | 635 | 19,298 | 606 | -1,941 | 628,347 | 588,896 |
| 19 | 2009 | | | 31,957 | 7,585 | 39,542 | 150,061 | 257,561 | 35,843 | 7,897 | 7,936 | 196,495 | 650 | 19,859 | 620 | -1,986 | 674,936 | 635,394 |
| 20 | 2010 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |
| 21 | 2011 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |
| 22 | 2012 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |
| 23 | 2013 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |
| 24 | 2014 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |
| 25 | 2015 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |
| 26 | 2016 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |
| 27 | 2017 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |
| 28 | 2018 | 291,394 | 10,734 | 31,957 | 7,676 | 341,761 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 383,380 |
| 29 | 2019 | | | 31,957 | 7,676 | 39,633 | 162,804 | 279,634 | 38,438 | 8,077 | 8,116 | 208,367 | 666 | 20,437 | 634 | -2,032 | 725,141 | 685,508 |

| | |
|---|---|
| EIRR | 15.0% |
| NPV at 10% Discount Rate | 909,430 |
| NPV at 15% Discount Rate | 1,186 |
| B/C at 10% Discount Rate | 1.56 |
| B/C at 15% Discount Rate | 1.00 |

### 12.2.5 Sensitivity Analyses

Sensitivity analyses are also carried out to provide probablistic judgement on the investment. The EIRRs are calculated on various projections and summarized in Table 12.2.19.

Table 12.2.19 Results of Sensitivity Analyses

| Projections | | EIRR (%) |
|---|---|---|
| Original Case | | 15.0 |
| Case 1 | Costs Down by 10% and Traffic Demands up by 10% | 17.5 |
| Case 2 | Costs up by 10% | 13.9 |
| Case 3 | Traffic Demands down by 10% | 13.8 |
| Case 4 | Costs up by 10% and Traffic Demands down by 10% | 12.7 |
| Case 5 | Costs up by 20% and Traffic Demands down by 20% | 10.4 |
| Case 6 | Phase I development without further investment | 12.3 |
| Case 7 | Phase I and Phase II facilities in the first phase | 14.7 |

The above sensitivity analyses show that even if the project costs go up by 20% and traffic demands go down by 20% simultaneously, the project maintains an EIRR of more than 10%.

### 12.2.6 Indirect/Intangible Benefits

Although the cost-benefit analysis has been executed based on direct and tangible benefits, projects in the transport sector are generally characterized by extensive indirect and intangible benefits which are not quantified by the cost-benefit analysis as follows. In this particular case, the implementation of the Project will bring the following indirect and intangible benefits and is considered necessary for the following reasons.

a) Social Welfare from the Viewpoint of Calamity Preparedness

Zia International Airport in Dhaka was closed from September 2 to 6, 1988 due to a flood. All the international flights diverted to Calcutta during that period because there were no alternate airports in Bangladesh which could accommodate large aircraft.

Bangladesh is situated on low land and frequently suffers from flooding in the upper stream of Gandes River and by cyclones. Calamity preparedness is therefore very important for the social welfare and the continuous socio-economic development of this country.

The Chittagong area is free from floods and the second largest commercial industrial center favored by large harbor. The development of Chittagong Airport to cope with the present increasing air traffic demands will enable it to function as an altinate airport for Zia International Airport and assure Bangladesh of a reliable international air communications without any interruption. With the Project, Chittagong Airport will act not only as the nation's main gateway in case Zia is closed but also as the center for relief activities including distribution of rescue aid, food & commodities which may be transported to Chittagong by large aircraft such as DC-10 and B-747 from foreign countries and be transported promptly to calamity areas from Chittagong Airport by helicopters.

Chittagong Airport is also expected to function as a relay station of relief goods by sea transport taking advantage of its proximity to Chittagong Port.

Both prevention and preparedness need to be implemented at the same time as countermeasures to flood calamities. Preparedness for the flood is considered very important because immediately effective prevention is difficult because

of geographical characteristics and the required cost. The development of Chittagong airport will greatly benefit Bangladesh for the above reasons.

b) Promotion of Foreign Investment

Promotion of foreign investment is one of Bangladesh's national policies for economic development.

The Chittagong Export Processing Zone (EPZ) located about 5km north west of Chittagong Airport was established in 1983, and 21 foreign companies including joint ventures with Bangladesh firms are operating there. The EPZ is expected to increase foreign exchange earnings and local employment opportunities. The number of factories and employees at the end of fiscal year 1992/93 are planned to be 66 and 9,180 respectively, three times the present level.

In order to promote foreign investment and to achieve the aim of EPZ as planned, Chittagong Airport has to ensure unrestricted air transport services with convenient direct international flights to major international hub airports such as Bangkok, etc. The Phase I development of Chittagong Airport will support EPZ development and as a result, contribute to the nation's economy by increasing foreign exchange earnings, employment opportunities, and opportunities to advance Bangladeshi industries through technology transfer from the operation of foreign factories.

Although the present share of air transport is only 10% of the total cargo transport demand from the EPZ, the operation of high-value-added industries such as manufacturing electrical parts will require adequate air cargo transport services. The development of Chittagong Airport will satisfy such air cargo demands, enable EPZ to establish an exclusive cargo handling facility at Chittagong Airport as required, and promote a structural change of local industries as observed in other countries.

Therefore, this Project is considered as a prerequisite not only for the development of the EPZ but also for seizing an opportunity to activate the regional and national economy.

c) Enhancement of Foreign Trade

There are two landlocked countries to the north of Bangladesh, i.e. Nepal and Bhutan. Due to the landlocked geography, air transport is essential for economic and social development of such countries.

Chittagong Airport will be able to play a role as a trans-shipment station of sea cargo to air cargo, vice versa for such countries. The development of Chittagong Airport is therefore expected to create new trade demands and enhance foreign trade in Bangladesh as a whole.

It will also provide these countries with an alternative lifeline and thereby contribute to international regional stability.

d) Improvement of Air Safety

The approach surface of the existing Chittagong Airport is infringed by the ships on Karunafuli River and air safety is one of the major problems at Chittagong Airport. The measure proposed in this Study will prevent a collision of aircraft and a ship and assure the safety of the air transport which is the most essential requirement for socio-economic activities.

e) Contribution to Tourist Attraction

Chittagong City is the second largest city and the most historical city in Bangladesh, which has a sea port and is favored by its natural beauty and green hills. The development of Chittagong Airport will increase the

accessibility to such tourist resources and increase the number of foreign tourists. It will also attract foreign tourists to Cox's Bazar which is a famous beach resort in Bangladesh. The introduction of direct flight to Chittagong Airport will not only attract such foreign tourists, but also make the average length of stay longer than the present situation in which most foreign tourists arrive via Dhaka.

An increase in foreign tourists and a longer average stay will contribute to the national economy and social stability in the form of foreign exchange earnings and employment opportunities.

As mentioned above, the development of Chittagong Airport will generate various kinds of indirect and intangible benefits in addition to the benefits evaluated in the cost-benefit analysis. In view of sufficient economic rate of return, the calamity preparedness and other extensive indirect effects of the project, its implementation is considered as the most urgent requirement for both social stability and the economic development of the nation.

## 12.3 Financial Analysis

### 12.3.1 Introduction

Financial analysis is usually carried out on projects which are accompanied with revenue. The main objective of a financial analysis is to make clear whether or not the revenue from a project itself is enough to carry out implementation, maintenance and operation of a project.

### 12.3.2 Expenditures

#### (1) Investment Costs

The financial investment cost of the Project have been described in Section 12.2.2 together with the economic cost.

#### (2) Operation and Maintenance Costs

a) Personnel Cost

With the implementation of this Project, the number of personnel for Chittagong Airport is assumed to increase from the present 196 to 250 in Phase I and 265 in Phase II. (Refer to Appendix 12.1)

The future personnel cost for Chittagong Airport is estimated as shown in Table 12.3.1 taking into account the annual increase in Per Capita GDP.

Table 12.3.1 Estimated Personnel Cost

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| No. of Personnel | 250 | 250 | 265 | 265 |
| Cost per Person per Month (TK) | 4,530 | 5,050 | 5,650 | 6,320 |
| Personnel Cost (Per Annum, 1,000 TK) | 13,590 | 15,150 | 17,967 | 20,098 |

b) Material and Equipment Costs

The costs for material and equipment are the financial costs described in Section 12.2.2.

## 12.3.3 Revenues

### (1) Air Passenger Service Charge (Airport Tax)

The revenue from air passenger service charge is calculated by multiplying the number of air passengers by 50 TK for domestic passengers and 200 TK for international ones. The results are summarized in Table 12.3.2.

Table 12.3.2 Revenue from Air Passenger Service Charge

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| Domestic | | | | |
| No. of Passengers | 82,500 | 100,000 | 120,000 | 145,000 |
| Revenue (1,000 TK) | 4,125 | 5,000 | 6,000 | 7,250 |
| International | | | | |
| No. of Passengers | 80,000 | 120,000 | 165,000 | 220,000 |
| Revenue (1,000 TK) | 16,000 | 24,000 | 33,000 | 44,000 |
| Total | 20,125 | 29,000 | 39,000 | 51,250 |

## (2) Aircraft Landing Charge, etc.

The revenue from aircraft the landing charge, security charges and route navigation charges is calculated based on the existing charging system as shown in Table 12.3.3.

The estimated revenue from these charges is summarized in Table 12.3.4.

Table 12.3.3 Unit Charge by Type of Aircraft

| Charge | Category | | SJ/TP | NB | WB |
|---|---|---|---|---|---|
| Landing Charge | International<br>Domestic | (US$)<br>(TK) | 99<br>1,450 | 300<br>4,500 | 1,690<br>25,350 |
| Security Charge | International<br>Domestic | (US$)<br>(TK) | 100<br>250 | 100<br>250 | 169<br>254 |
| Route Navigation Charge | International<br>Domestic | (US$)<br>(TK) | 40<br>400 | 80<br>800 | 160<br>1,600 |

Note: WB : Wide Body, Present Biman DC-10-30
SJ/TP: Small Jet/Turbo Prop, F-28
NB : Narrow Body, B-737

Source: "Notification No. S.R.O. 128/L/86", April 19/1986

Table 12.3.4 Revenue from Aircraft Landing Charge, etc.

(1,000 TK)

| Charge \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| Landing Charge | 19,766 | 29,581 | 35,774 | 46,560 |
| Security Charge | 3,426 | 4,348 | 4,621 | 5,790 |
| Route Navigation Charge | 2,864 | 4,097 | 4,938 | 6,261 |
| Total | 26,056 | 38,026 | 45,333 | 58,611 |

### (3) Rent on Concession in Terminal Building

The space for concession in the new terminal building will be increased to 10,760 sq. feet (1,000 sq. meter) in Phase I development. The present monthly rental charge at Chittagong Airport is 6 TK/sq.feet.

Therefore, the total annual rent revenue is calculated as follows:

6 TK/month x 10,760 sq.feet x 12 months
= 775 (thousand TK/year)

### (4) Revenue from Vehicle Parking Charges

The vehicle parking charges are estimated by forecasting the number of vehicles and applying a unit parking charge of 5 TK per vehicle.

Table 12.3.5 Revenue from Vehicle Parking Charge

| Item \ Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| No. of vehicles (vehicles/year) | 163,000 | 220,000 | 285,000 | 365,000 |
| Parking charge (TK/vehicle) | 5 | 5 | 5 | 5 |
| Revenue (1,000 TK) | 815 | 1,100 | 1,425 | 1,825 |

### 12.3.4 Financial Evaluation of the Project

The streams of annual revenues and expenditures are shown in Table 12.3.6.

The financial cash flow shows that the expected revenues will not cover the total expenditure including investment cost and operation and maintenance costs. Generally speaking, it is difficult for airport projects to be balanced financially.

However, this project is appreciated since the operation and maintenance costs will be sufficiently covered by the airport operations. This indicates that if the construction cost is provided, the airport can sustain its operation with the revenue from the airport services.

### 12.3.5 Pricing Policy for the Airport Management

As analyzed above, the airport revenue will not cover the investment cost under the existing charging levels. Results of the financial analysis indicate that if airport revenue should cover the total expenditure including investment cost and operation and maintenance costs at a 10% interest rate, each charge has to be increased more than three times the present level.

Two main resources of revenue, aircraft landing charges and airport tax are compared with that of several countries as shown in Tables 12.3.7 and 12.3.8.

Table 12.3.6 Revenues and Expenditures

(Unit: 1,000 TK)

| No. | Year | Expenditure | | | Revenues | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Investment | O & M | Total | Airport Tax | Landing Charge, etc. | Conces-sion | Car Parking | Total |
| 1 | 1991 | 229,100 | | 229,100 | | | | | |
| 2 | 1992 | 598,180 | | 598,180 | | | | | |
| 3 | 1993 | 474,890 | | 474,890 | | | | | |
| 4 | 1994 | 391,500 | | 391,500 | | | | | |
| 5 | 1995 | | 48,348 | 48,348 | 20,125 | 26,056 | 775 | 815 | 47,771 |
| 6 | 1996 | | 48,660 | 48,660 | 21,900 | 28,450 | 775 | 872 | 51,997 |
| 7 | 1997 | | 48,972 | 48,972 | 23,675 | 30,844 | 775 | 929 | 56,223 |
| 8 | 1998 | | 49,284 | 49,284 | 25,450 | 33,238 | 775 | 986 | 60,449 |
| 9 | 1999 | | 49,596 | 49,596 | 27,225 | 35,632 | 775 | 1,043 | 64,675 |
| 10 | 2000 | 105,500 | 49,908 | 155,408 | 29,000 | 38,026 | 775 | 1,100 | 68,901 |
| 11 | 2001 | | 50,737 | 50,737 | 31,000 | 39,487 | 775 | 1,165 | 72,427 |
| 12 | 2002 | | 51,566 | 51,566 | 33,000 | 40,948 | 775 | 1,230 | 75,953 |
| 13 | 2003 | | 52,394 | 52,394 | 35,000 | 42,409 | 775 | 1,295 | 79,479 |
| 14 | 2004 | | 53,223 | 53,223 | 37,000 | 43,870 | 775 | 1,360 | 83,005 |
| 15 | 2005 | | 54,052 | 54,052 | 39,000 | 45,333 | 775 | 1,425 | 86,533 |
| 16 | 2006 | 304,484 | 54,478 | 358,962 | 41,450 | 47,989 | 775 | 1,505 | 91,719 |
| 17 | 2007 | | 54,904 | 54,904 | 43,900 | 50,645 | 775 | 1,585 | 96,905 |
| 18 | 2008 | | 55,331 | 55,331 | 46,350 | 53,301 | 775 | 1,665 | 102,091 |
| 19 | 2009 | | 55,757 | 55,757 | 48,800 | 55,957 | 775 | 1,745 | 107,277 |
| 20 | 2010 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 21 | 2011 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 22 | 2012 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 23 | 2013 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 24 | 2014 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 25 | 2015 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 26 | 2016 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 27 | 2017 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 28 | 2018 | 304,484 | 56,183 | 360,667 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| 29 | 2019 | | 56,183 | 56,183 | 51,250 | 58,611 | 775 | 1,825 | 112,461 |
| PV at 0% Discount Rate | | | | 3,747,178 | PV at 0% Discount Rate | | | | 2,270,015 |
| PV at 5% Discount Rate | | | | 2,384,658 | PV at 5% Discount Rate | | | | 964,251 |
| PV at 10% Discount Rate | | | | 1,775,344 | PV at 10% Discount Rate | | | | 473,262 |

Table 12.3.7 Comparison of Aircraft Landing Charge of B-747

(Unit: US$)

| Country | Airport | Landing Charge |
|---|---|---|
| Bangladesh | Chittagong | 2,460 |
| United States | Los Angeles | 300 |
| France | CH. De Gaulle | 2,280 |
| West Germany | Frankfurt | 3,520 |
| United Kingdom | Heathrow | 290 |
| Australia | Kingsford | 1,000 |
| India | New Delhi | 3,300 |
| Indonesia | Jakarta | 1,680 |
| Philippines | Manila | 1,180 |
| Thailand | Bangkok | 1,250 |
| Japan | Narita | 6,030 |

Note: As of May 1989 for B-747 with MTOW 378 ton

Table 12.3.8 Comparison of Airport Tax

(Unit: US$)

| Country | Domestic | International |
|---|---|---|
| Bangladesh | 1.5 | 6.2 |
| Australia | - | 8.3 |
| Burma | 2.3 | 2.3 |
| India | 3.2 | 6.4 |
| Indonesia | 1.4 - 2.3 | 5.1 |
| Malaysia | 1.1 | 5.6 |
| Nepal | 1.0 | 4.2 |
| Pakistan | 0.5 | 5.0 |
| Thailand | - | 5.7 |
| Japan (Narita) | - | 14.3 |

Note: As of May 1989

The present landing charge and airport tax are within the average range of airports in the world, and thus it is not practicable to raise such charges in order to cover the investment cost of the Project.

Although the existing charging system is sufficient to sustain the operation and maintenance of the airport, new ways to increase revenue should be studied in order to attain self-reliance for future investment in airport development.

# CHAPTER 13 CONCLUSIONS AND RECOMMENDATIONS

# CHAPTER 13 CONCLUSIONS AND RECOMMENDATIONS

## 13.1 Conclusions

As a result of the comprehensive study presented in this report including airport master planning and a feasibility study on Phase I development project (the Project), it is concluded that the existing airport be rehabilitated and developed in order to solve the present capacity problems, to cope with traffic requirements anticipated up to 2000, and to secure a reliable gateway, which can cooperatively be linked with the nation's major seaport, the relief center and lifeline in case of flood calamity.

The Project will consist of the construction of a new terminal area, improvement of existing runway pavement and improvement of air navigation systems. The construction works of the Project will begin in 1991 and completed at the end of 1994.

These conclusions have been reached for the following major reasons:

a) The project cost is estimated to be 1,693.7 million Taka and 105.5 million Taka in Phase I and II developments respectively and the economic internal rate of return (EIRR) is 15.0 percent. Hence, the Project is feasible from the viewpoint of the optimum allocation of resources in the national economy.

b) The implementation of the Project will have impacts in the form of:

- Contribution to calamity preparedness as a major relief base which is serviceable at all times without interruption and can be effectively linked by air, water and land transport,

- Increased opportunities for trade and business as a basic infrastructure through the promotion and implementation of various regional development projects such as Export Processing Zone (EPZ) development, Chittagong Port development and other industrial projects,

- Stimulation of foreign investment,

- Increased employment opportunities,

- Stimulation of international tourism development,

- Assurance of air transport safety,

- Flexibility in adverse weather, an emergency, maintenance work, etc., which require the closure of Zia International Airport,

- Alleviation of congestion at Zia International Airport by the introduction of direct international flight to Chittagong Airport, and

- Provision of an alternate to Zia International Airport.

## 13.2 Recommendations

(1) It is recommended to implement the Project as soon as possible and the preparatory work should be initiated at the earliest possible date.

(2) The agreement should be concluded and signed between CAAB and CPA (Chittagong Port Authority) in order to control the ship traffic from/to Chittagong Port and to ensure the safety of aircraft approaching runway 23 as planned in Chapter 6.

(3) In order to maintain and operate the facilities at the original levels of performance and services after the completion of the Project, regular maintenance work should be carried out especially on air navigation system, electrical and mechanical facilities, pavement, etc.

(4) The existing objects in the 300 meter wide runway strip and the existing obstacles to ICAO obstacle limitation surfaces should as far as practicable be removed.

(5) In order to harmonize the airport with the area surrounding the airport, height restriction should be enforced in order not to permit any new obstacles and to ensure the required obstacle limitation surfaces. A land use plan in the airport vicinity where aircraft noise influences will exceed an allowable level should be implemented.

# APPENDICES

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# APPENDIX - A MINUTES OF MEETINGS

# MINUTES OF MEETING
# ON
# THE INCEPTION REPORT OF THE STUDY ON THE DEVELOPMENT OF CHITTAGONG AIRPORT IN THE PEOPLE'S REPUBLIC OF BANGLADESH

The Japanese Study Team, organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") headed by Mr. Shota Morita held meetings for the captioned study with the Ministry of Civil Aviation and Tourism (hereinafter referred to as "MCAT") headed by Mr. M.G. Kibria, Joint Secretary and with the Civil Aviation Authority of Bangladesh (hereinafter referred to as "CAAB") headed by Air Commodore Moinul Islam (Retd.), Chirman respectively at the conference rooms of MCAT and CAAB on 12th and 13th December, 1988.

List of attendants from both sides is attached in the ATTACHMENT to this minutes. Japanese Study Team submitted twenty (20) copies of the Inception Report on the above-mentioned study to CAAB and made explanation on the report. The Inception Report was accepted in principle by CAAB.

Upon the acceptance of the Inception Report, CAAB assured the Japanese Study Team of furnishing necessary data by the end of January 1989. It was also assured that CAAB will make necessary arrangements for the team's site survey to Chittagong Airport and office space in Dhaka.

Dhaka, December 17, 1988

Air Commodore Moinul Islam (Retd.)
Chairman
CIVIL AVIATION AUTHORITY
OF BANGLADESH

Shota Morita
Leader of the Study Team
JAPAN INTERNATIONAL
COOPERATION AGENCY

ATTACHMENT

## LIST OF ATTENDANTS

I. 12th December, 1988

a) BANGLADESH SIDE

| | |
|---|---|
| Mr. M.G. Kibria | : Joint Secretary, MCAT |
| Mr. M.A. Samad | : Deputy Secretary, MCAT |
| Mr. Hussain Ahmed Chowdhury | : Senior Assistant Secretary, MCAT |
| Wing Commodore W.D. Ahmed (Retd.) | : Member (Operation & Planning), CAAB |
| Mr. Asaduzzaman Choudhury | : Superintending Engineer (P&DQS), CAAB |
| Mr. M. Fazle Ali | : Director Planning, CAAB |

b) JAPANESE SIDE

| | |
|---|---|
| Mr. Masato Tamura | : Chairman, JICA Advisory Committee |
| Mr. Kiyoshi Hoji | : Member, JICA Advisory Committee |
| Mr. Akitoshi Mori | : Member, JICA Advisory Committee |
| Mr. Hiroshi Yamamoto | : JICA Project Officer |
| Mr. Shota Morita | : Leader, JICA Study Team |
| Mr. Hiroyuki Ueda | : Member, JICA Study Team |
| Mr. Masahito Honma | : Member, JICA Study Team |
| Mr. Osamu Nogoshi | : Member, JICA Study Team |

II. 13th December, 1988

a) BANGLADESH SIDE

| | |
|---|---|
| Air Commodore Moinul Islam (Retd.) | : Chairman, CAAB |
| Wing Commodore W.D. Ahmed (Retd.) | : Member (Operation & Planning), CAAB |
| Group Captain Shamin Hossain (Retd.) | : Member (Administration/Finance), CAAB |
| Mr. Mahtab uddin Ahmed | : Chief Engineer, CAAB |
| Mr. Asaduzzaman Choudhury | : Superintending Engineer (P&DQS), CAAB |
| Mr. Kamal Ahmed | : Superintending Engineer (Civil Circle), CAAB |
| Mr. M. Fazle Ali | : Director Planning, CAAB |
| Mr. Abdul Haque Bhuiyan | : Economist, CAAB |

b) JAPANESE SIDE

| | |
|---|---|
| Mr. Masato Tamura | : Chairman, JICA Advisory Committee |
| Mr. Kiyoshi Hoji | : Member, JICA Advisory Committee |
| Mr. Akitoshi Mori | : Member, JICA Advisory Committee |
| Mr. Hiroshi Yamamoto | : JICA Project Officer |
| Mr. Shota Morita | : Leader, JICA Study Team |
| Mr. Hiroyuki Ueda | : Member, JICA Study Team |
| Mr. Masahito Honma | : Member, JICA Study Team |
| Mr. Osamu Nogoshi | : Member, JICA Study Team |

MINUTES OF MEETING
ON
PROGRESS REPORT
OF
THE STUDY ON THE DEVELOPMENT OF CHITTAGONG AIRPORT
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

1. The meeting on the Progress Report was held on February 20,1989 at the conference room of CAAB,Dhaka. The list of attendants is attached herewith.

2. The JICA Study Team submitted twenty (20) copies of the Progress Report to CAAB and explained the Report to CAAB.

3. The Progress Report was accepted in principle by CAAB,except the following points:

   a) possibility of considering an alternate site e.g.Juldia;
   b) possibility of lengthening of Runway 23 as consequence of displaced threshold;
   c) possibility of designing the apron area in a crescent rather than in quadrilateral shape;
   d) possibility of constructing a parallel taxiway prior to undertaking any work on the existing runway;
   e) possibility of smoothening out of undulations now present on the runway.

   As a result of the meeting,CAAB agreed to the following items:-

   1) CAAB will inform the JICA Study Team of the unifying and technical comments of Bangladesh Government on the Report, if any,by the end of March,1989.
   2) In the mean time,JICA study team will proceed with the finalization of the airport master plan in accordance with the requirements as described in Chapter 1,Section 1.1 except for the points outlined in para 3 above.

Dhaka,February 22,1989.

Air Commodore Mojnul Islam(Retd)
Chairman
Civil Aviation Authority
of Bangladesh

Shota Morita
Leader of Study Team
Japan International
Cooperation Agency

## LIST OF ATTENDANTS

a. Wg.Cdr.(Retd.) W.D.Ahmed,Member(Ops. & Planning),CAAB.

b. Mr.Mahtab Uddin Ahmed,Chief Engineer,CAAB.

c. Mr.N.I.Chowdhury,Director A.T.S. Aero & Comm.,CAAB.

d. Capt.Ashraf,Director Flight Operation,Bangladesh Biman.

e. Mr.Asaduzzaman Chowdhury,Superintending Engineer, Civil Circle,CAAB,Kurmitola,Dhaka.

f. Mr.M.Fazle Ali,Director Planning(current charge),CAAB.

g. Capt.Rahmat Ali,Flight Safety Inspector,ICAO.

h. Mr.S.Morita (Leader), JICA Study Team

i. Mr.Niso Wada, Member " " "

j. Mr.H.Ueda, " " "

k. Mr.Y.Niinomi, " " "

l. Mr.M.Homma, " " "

m. Mr.M.Kaburagi, " " "

n. Mr.Sharfuddin Ahmed,Bangladesh Biman.

o. Mr.Abdul Haque, Economist,CAAB.

MINUTES OF MEETING
ON
THE DRAFT FINAL REPORT OF THE STUDY ON THE DEVELOPMENT
OF
CHITTAGONG AIRPORT IN THE PEOPLE'S REPUBLIC OF BANGLADESH

A series of meeting on the Draft Final Report of the Study on the development of Chittagong Airport were held on 16th through 19th July, 1989 at CAAB, Dhaka. All the attendants are listed in Attachment - 1.

JICA Study Team submitted twenty (20) copies of the Draft Final Report to CAAB and explained to CAAB in detail the Report including the studies about the CAAB comments on the Progress Report and a result of the Feasibility Study.

CAAB understood the study result and accepted the Draft Final Report with the comments as listed in Attachment - 2. CAAB also expressed their appreciation on the activities of the Study Team for the Project.

The Final Report, which will incorporate the above comments, will be submitted to CAAB in the beginning of October, 1989.

At the end of the meetings, JICA Advisory Committee and the Study Team expressed their thanks to CAAB for their kind cooperation extended to the Study Team during the study period.

Dhaka, 19th July, 1989

For CAAB

Air Commodore Moinul Islam (Retd.)
Chairman
CIVIL AVIATION AUTHORITY
OF BANGLADESH

For JICA Study Team

Mr. Shota MORITA
Leader of the JICA Study
Team

Attachment - 1

## LIST OF ATTENDANTS

1. CAAB

Wg. Cdr. W. D. Ahmed (Retd.)
Member (Operation and Planning)

Mr. Mahtabuddin Ahmed
Chief Engineer

Mr. Asaduzzaman Chowdhury
Superintending Engineer
P&D/ QS Circle

Mr. Kamal Ahmed
Superintending Engineer
Civil Circle

Wg. Cdr.(Retd.) G.H. Mirza
Director of Communication

Mr. N. I. Chowdhury
Director of ATS and Aerodrome

Mr. M. Fazle Ali
Director (Planning)

Capt. Rahmat Ali (ICAO)

Sqn. Ldr. (Retd.) Nazrul Islam
Dy. Director of Communication

Mr. A. F. M. Fazle Karim
Assistant Director (Planning)

2. JICA Advisory Committee

Mr. Masato Tamura
Chairman

Mr. Akitoshi Mori
Member

Mr. Hiroshi Yamamoto
JICA Project Officer

3. JICA Study Team

Mr. Shota Morita
Leader

Mr. Niso Wada
Member

Mr. Masashi Kaburagi
Member

Mr. Masahito Honma
Member

Attachment - 2

CAAB Comments on the Draft Final Report

1. Administration Building and Control Tower Plan (Figure 8.4.2)

   1) An independent building housing the airport manager's office, an engineering office and other administration offices is to be planned and sited in a vacant space between car park and fuel farm. The building is named Administration building.

   2) The proposed administration building excluding the above offices is to remain as it is sited and to be named Operation center.

2. Terminal Area Layout Plan (Figure 6.5.3)

   Reserved area are to be planned for the following facilities:

   - VVIP terminal (Future provision)
   - Other government office building including Customs, Immigration, Quarantine, Security and Police.
   - Public and Commercial facilities including airlines, restaurant, hotel, toilet, etc.

3. Rescue and Fire Fighting

   After the Progress Report, one additional fire engine was put in service. Therefore, necessary modification is to be made in the Final Report based on the current capacity of the fire fighting equipment available at Chittagong Airport.

4. NDB and Transmitting Station

   The proposed terminal area is to be expanded by acquiring a little more land to the southwest so as to shift NDB and transmitting station accordingly and keep the southern area of the cargo terminal for public and commercial uses.

5. Sewerage System

   A central sewage treatment plant is to be provided instead of an individual plant for each building.