(2) **Ships to be Controlled**

According to the actual record in 1988, oceangoing ships vary in mast height as follows:

Height of Mast	Number
10 - 20	119 (13%)
21 - 30	330 (35%)
31 - 50	488 (52%)
Total	937 (100%)

The ships with masts higher than 21.6 m protrude into the approach surface of ALT-3. It is therefore practical to control only the ships with masts higher than 21 m for the efficient control of ship traffic without undue delay.

6.3 Location of Terminal Area

This section sets out the location of the new terminal area. The new terminal area is planned in the midway to the south of the runway through an alternative study described hereafter.

6.3.1 Basic Conditions for Terminal Location Planning

Basic conditions for the establishment of the alternative terminal locations are listed as follows:

a) The runway centerline divides the airport property area into two jurisdictions, i.e., the north by BAF and the south by CAAB. A new terminal area should be planned in the CAAB area.

b) The existing cross wind runway will remain unused.

c) The airport access road will be changed from the existing Port Road to Patenga Road.

d) The main approach runway is runway 23 which is planned to be displaced by 298 m.

6.3.2 Alternative Locations for Terminal Area

Five alternatives have been generated, taking into account existing land use and other natural conditions. They are shown in Figure 6.3.1.

ALT-TA: A location in the paddy field close to the runway 05 threshold. The distance from/to the center of Chittagong City via Patenga road is shortest among the alternatives.

ALT-TB: A location in the paddy field close to the midway of the runway. This alternative is nearest from the exit point of B-737 class aircraft, i.e. about 1,700 m from the runway 23 threshold for the main approach direction.

ALT-TC: A location nearest to the center of the runway where a channel, a main outlet of storm water from the airport, is located.

ALT-TD: A location in the existing airport staff housing area. Staff housing needs to be relocated to another place.

ALT-TE: A location in the existing airport property area close to the runway 23 threshold.

6.3.3 Comparative Evaluation

The alternatives are compared from the viewpoints of users' and operators' convenience, construction cost, future expansibility and other criteria in Table 6.3.1. ALT-TB is chosen as the most suitable location of the new terminal area for the following reasons:

- The shortest taxing distance for the aircraft anticipated to be most common in the future, i.e. B-737 and F-28 class aircraft,

- Convenience in airport operational and administrative aspects,

- Large expansibility,

- Comparatively short airport access, and

- No difficulty anticipated for land acquisition, compensation works and construction works, although the terminal area is planned in a village with paddy fields.

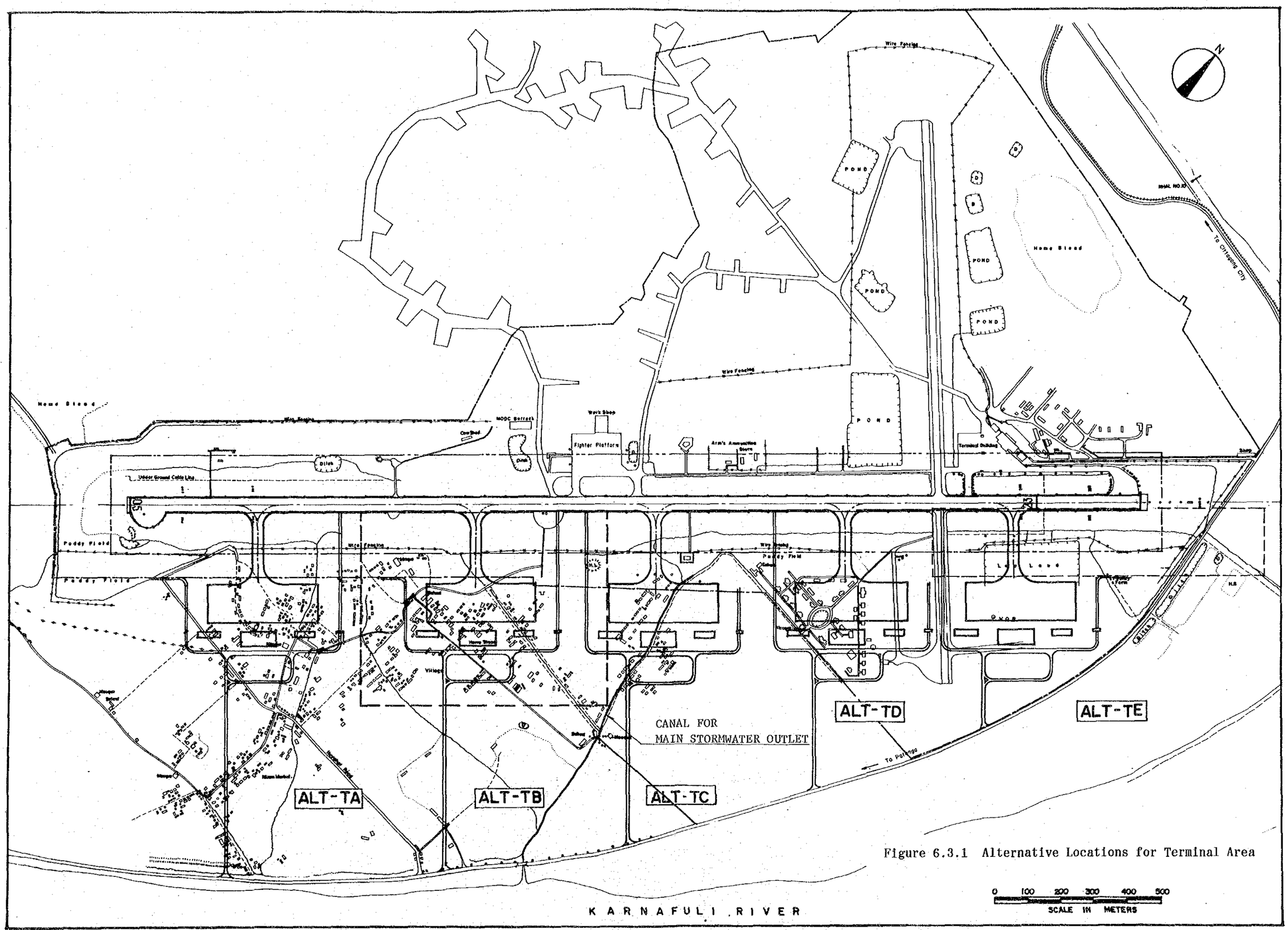


Figure 6.3.1 Alternative Locations for Terminal Area

Table 6.3.1 Comparative Evaluation of Alternative Locations for Terminal Area (1)

Note, "G" indicates Excellent "F" indicates Good "P" indicates Fair

Comparison Item \ Alternative Schemes	ALT - TA		ALT - TB		ALT - TC		ALT - TD		ALT - TE		Remarks
1. Convenience for Airport Users											
1.1 Passenger Convernience a) Airport accessibility (Distance between Terminal and Chittagong station via Patenga road)	G	17.8km (Nerest to the Center of City)	F	18.6km	F	19.0km	F	19.3km	F	19.7km	
1.2 Aircraft Operational Consideration a) Average taxiing distance	P	2,300m	G	1,800m (Most effective Location)	F	1,900m	F	2,000m	P	2,200m	1) 91% of landing will be from RWY 23. 2) B-737 class aircraft will be the major aircraft in operation.
b) Sight distance from Tower to the farther RWY end	F	2,500m	G	1,900m (Best location for sight)	G	1,900m (Best location for sight)	F	2,400m	P	2,900m	The control tower is planned to be located in the terminal area
c) Sight distance from Tower to Karnafuli river	P	3,400m	P	2,800m	F	2,200m	F	1,600m	G	1,100m (Best location for sight)	
1.3 Airport Development Aspect a) Airport security	P	Close to the RWY 05 end with a potential hazard.	P	Midway of the RWY but close to the sensitive area	P	Midway of the RWY but close to the strategic area	G	Good as compared with other alternatives	F	Close to the RWY 23 end	Distance and visibility to sensitive and critical area are considered
b) Response time for fire fighting	F	2.4 minutes	G	2.0 minutes (Shortest time)	G	2.1 minutes	G	2.2 minutes	F	2.5 minutes	A new firestation will be located facing apron in the new terminal area
2. Airport Development Aspect											
2.1 Compatibility with Existing Airport Facilities	G	NO conflict	G	NO conflict	G	NO conflict	P	Airport staff housing to be totally relocated. VOR/DME to be relocated	P	Relocation for VOR/DME is prerequisite for this scheme	
2.2 Compatibility with Airport Development	G	NO conflict with other development	G	NO conflict with other development	G	NO conflict with other development	P	Area for new airport staff houseing, maintenance office and water tank to be sought	P	ILS/GP to be on the north	ILS/GP to be on the south of the Runway unless the north area is cleared off
2.3 Expansibility	G	NO conflict with other development	G	NO conflict with other development	G	No conflict with other development	G	No conflict with other development	P	Limited by surrounding road	
3. Social Consideration											
3.1 Compensation a) Houses	P	Many houses to be compensated	P	Many houses to be compensated	F	Many houses to be compensated but fewer than ALTs-TA and -TB	F	No houses except airport staff houses to be compensated	G	No houses to be compensated	
b) Paddy field	F	Small area of paddy field	F	Small area of paddy field	P	Large area of paddy field	G	No paddy field	G	No paddy field	
3.2 Land Acquisition	P	30 ha for new terminal area	P	30 ha for new terminal area	P	30 ha for new terminal area	F	10 ha for new airport staff housing area	G	Land acquisition is not necessary	

Table 6.3.1 Comparative Evaluation of Alternative Locations for Terminal Area (2)

Comparison Item \ Alternative Schemes		ALT - TA		ALT - TB		ALT - TC		ALT - TD		ALT - TE	Remarks
4. Construction Consideration											
4.1 Construction Ease	G	Easy because of no special restriction to the works and the site segregated from the operational area	G	Easy because of no special restriction to the works and the site segregated from the operational area	F	Existing canal to be relocated prior to the works. This area is generally low land and poor subsoil condition is expected	P	Difficult due to all facilities including utilities, pipe, cable, etc. in airport staff houses to be relocated prior to the works and proximity to the operational area.	P	Difficult because of VOR/DME to be relocated prior to the works and the works in the limited area with low land close to the operational area.	
4.2 Constuction Cost	G	Midium cost	G	Midium cost	F	Midium to high cost due to diversion of canal and poor subsoil condition	P	High cost due to the construction of new airport staff houses	G	Medium cost, no land acquisition	
5. Overall Evaluation		2nd Option Closest to the city Longest taxiing distance Large expansibility Midium cost		Most Suitable Shortest taxiing distance Convenience for airport operator Closer to the City Large expansibility Midium cost		3rd Option Shortest taxiing distance Convenience for airport operator Large expansibility Midium to high cost		Not suitable Prerequisite to relocate all existing facilities in the airport staff housing area. High cost		Not suitable Larger taxiing distance VOR/DME in a new site Installation of ILS/GP on the north side Limited expensibility	

6.4 Airport Layout Planning

The airport layout plan for Phase I and Phase II developments is shown in Figure 6.4.1. Descriptions for each facility are given thereafter.

6.4.1 Runway

(1) Runway Layout

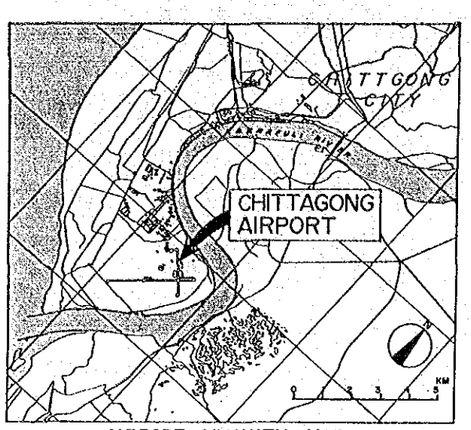
The runway layout has been discussed in Section 6.2 with respect to aircraft operations and ship movements on Karnafuli River and ALT-3 has been selected as the best alternative. In this alternative, a 2,750 m long runway is assumed in order to permit the take-off of DC-10 aircraft for Jeddah with maximum payload and to enable the landing of B-747 aircraft with maximum landing weight based on the air traffic demand forecast and the requirement of Chittagong Airport as an alternate airport of Zia International Airport.

However, the following conditions particular to Bangladesh may justify a 3,000 m long runway with the extension of runway 05 by 250 m.

- There will be a possibility that long range flights with large aircraft, (e.g. B-747) to Jeddah will be operated at Chittagong Airport taking into account its role as an alternate airport of ZIA and an unexpected change in demand.

- It is desirable that Chittagong Airport will fulfill an equivalent function to that of Zia International Airport in order to cope with the closure of ZIA in case of calamity such as floods.

- A longer runway is desirable to provide the flexibility of aircraft operation and airport maintenance.



AIRPORT VICINITY MAP

RUNWAY DATA	
RUNWAY ORIENTATION 049/239	(TRUE NORTH)
EFFECTIVE GRADIENT	0.0 %
WIND COVERAGE	91.6 % (13KT)
	98.4 % (20KT)
INSTRUMENT RUNWAY	
PAVEMENT STRENGTH	PCN 75 / FCXT
APPROACH SURFACE RWY 23	1 : 50
RWY 05	1 : 40
RUNWAY LIGHTING	HIRL
LANDING AIDS RWY 23	ILS CAT-1,
	ALS, PAPI
RWY 05	SALS, PAPI

AERODROME DATA	
ELEVATION	3.96m
REFERENCE POINT LAT.	N 22° 15' 22"
LONG.	E 90° 49' 30"
REFERENCE TEMPERATURE	32.0 °C
MAGNETIC VARIATION	00°55'(1985)
	02' W/YEAR
AERODROME NAVAIDS	D-VOR/DME,NDB
FIRE PROTECTION	CATEGORY-6

BUILDINGS	
①	PASSENGER TERMINAL BUILDING
②	CARGO TERMINAL BUILDING
③	ADMINISTRATION BUILDING
④	CONTROL TOWER
⑤	POWER HOUSE
⑥	FIRE STATION
⑦	OPERATION CENTER
⑧	OTHER GOVERNMENT OFFICE BUILDING
⑨	GSE MAINTENANCE GARAGE
⑩	NDB AND TRANSMITTING STATION
⑪	CAR PARK
⑫	AIRPORT MAINTENANCE BUILDING AND GARAGE
⑬	FUEL FARM
⑭	WATER SUPPLY STATION
⑮	INCINERATOR
⑯	CENTRAL SEWERAGE TREATMENT PLANT
⑰	MAINTENANCE APRON
⑱	PUBLIC AND COMMERCIAL FACILITIES' AREA
⑲	VVIP BUILDING

BAY OF BENGAL

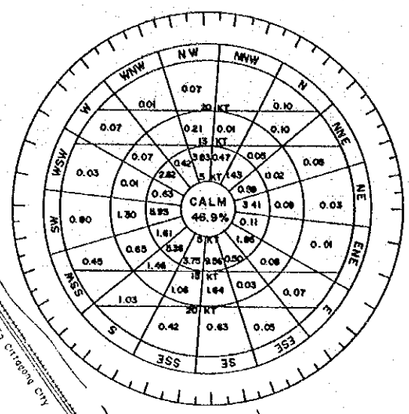
270.0 m
410.0 m
FUTURE RUNWAY EXTENSION
250.0m
980.0 m
RUNWAY LENGTH 2,750.0 m
1 770.0 m
RUNWAY END SAFETY AREA (90m x 90m)
PAVED STOPWAY (150m x 60m)
RUNWAY STRIP 2,870m x 300m
RUNWAY 2,750m x 45m
1 : 40 APPROCH SURFACE
RESERVED FOR RUNWAY EXTENSION UP TO 3,000m
LOCALIZER ANTENNA
SIMPLE APPROACH LIGHTING SYSTEM
PAPI
160.0 m
80.0 m
240.0 m
MET.OBSERVATION STATION(RWY 23)
MODC Barrack
Fighter Platform
Arm's Ammunition Store
Ditch
Under Ground Cable Line
Wire Fencing
Paddy Field
Mosque
School
Nayabat Road
Nirom Market
POND

LEGEND

	AIRPORT BOUNDARY LINE
	FENCE
	PHASE I : DESIGN TARGET YEAR 2000
	PHASE II : DESIGN TARGET YEAR 2010
	FUTURE PROVISION

KARNAFULI RIVER

	BUILDINGS
①	PASSENGER TERMINAL BUILDING
②	CARGO TERMINAL BUILDING
③	ADMINISTRATION BUILDING
④	CONTROL TOWER
⑤	POWER HOUSE
⑥	FIRE STATION
⑦	OPERATION CENTER
⑧	OTHER GOVERNMENT OFFICE BUILDING
⑨	GSE MAINTENANCE GARAGE
⑩	NDB AND TRANSMITTING STATION
⑪	CAR PARK
⑫	AIRPORT MAINTENANCE BUILDING AND GARAGE
⑬	FUEL FARM
⑭	WATER SUPPLY STATION
⑮	INCINERATOR
⑯	CENTRAL SEWERAGE TREATMENT PLANT
⑰	MAINTENANCE APRON
⑱	PUBLIC AND COMMERCIAL FACILITIES' AREA
⑲	VVIP BUILDING



SOURCE : METEOROLOGICAL DEPARTMENT
LOCATION : CHITTAGONG AIRPORT
PERIOD : 1986 - 1988 (8765 OBSERVATIONS)
RUNWAY ORIENTATION : N 49°E
WIND COVERAGE : 91.6% (CROSS-WIND 13 KT)
: 98.4% (CROSS-WIND 20KT)

ALL WEATHER WIND COVERAGE

Figure 6.4.1 Airport Layout Plan

This 250 m additional runway length will require 70 million TK which is about 4.1 % of the total project cost and reduces EIRR by 0.4 %. This impact to the project economic viability may be small.

However, the priority of development is given to the facilities which will achieve maximum benefit with minimum investment in the light of the current condition of the airport facilities at Chittagong Airport and air transportation in Bangladesh. The 3,000 m long runway is thus considered not to be a matter of immediate necessity in this respect, even though the impact to the project economic viability is small.

Therefore, the runway length for Phase I development is planned to be 2,750 m and safety for the landing will be improved by pavement overlay, the provision of stopways, and the installation of ILS, etc. The land necessary for the runway extension is planned to be acquired in Phase I development so that the additional runway length can easily be provided when necessary.

The breakdown of the additional cost for the 250 m long runway extension is shown in Table 6.4.1 for reference.

Table 6.4.1 Additional Cost for 3,000 m Long Runway

Items	Quantity	Cost (1,000 TK)
Pavement Runway	11,250 sq.m	39,500
Shoulder	3,750 sq.m	900
Site Preparation	10,000 sq.m	7,300
Drainage	L.S.	1,000
Land Acquisition	8 ha	6,000
Compensation	1,300 m	3,900
(Diversion of Power Lines)		
Air Field Lighting	L.S.	11,500
Total		70,100

(2) **Runway Shoulder**

The existing 2 m wide runway shoulders will be widened to 7.5 m in compliance with ICAO recommendations in Phase I Development.

(3) **Turnaround Pad**

Turnaround pads will be constructed at each end of the runway in Phase I Development in order to permit large aircraft to turn around.

(4) **Stopway**

Stopways with a size of 150 m by 60 m will be constructed at each end of the runway in Phase I Development in compliance with the Civil Aviation Rules of Bangladesh.

6.4.2 **Runway Strip**

A 300 m wide runway strip should be provided for precision approach Category-I operations as far as practicable.

6.4.3 **Taxiway**

One connecting taxiway will be constructed 1,770 m from the runway 23 threshold taking into consideration the turn-off distance of B-737 class aircraft and the layout of terminal area in the existing geography. Taxiway fillets will be constructed taking into account the ground operations of large aircraft.

A parallel taxiway will not be justified according to the forecast of peak hour aircraft movements up to 2010. However, the right of way required for the parallel taxiway will be reserved in Phase I development taking into account unexpected demand and an increasing number of large aircraft.

6.4.4 Terminal Facilities

This section describes the basic terminal concept to be applied to the new terminal area. Respective facility layouts in the terminal area will be discussed in the succeeding Section 6.5.

Typical terminal concepts include the linear concept, the pier concept, the satellite concept and the transporter concept as shown in Figure 6.4.2. Each concept has a lot of variations and a combination of concepts is sometimes selected depending on the traffic demand of an airport. Certain criteria should be observed in the selection of a terminal concept, including;

a) Shortest walking distance of passengers;
b) Easy orientation for passengers;
c) Convenient movement of passengers through the terminal complex (direction change, level change and crossing);
d) Decrease congestion at each element (car park, curbside, check-in lobby, government control areas, concourse, waiting lounge, baggage claim, etc.);
e) Aircraft maneuverability at gate positions;
f) Easy processing of passengers and baggage;
g) Minimum required number of airline and government officials;
h) Expansibility of the terminal building;
i) Low capital, operating and maintenance cost.

For an airport similar in size to Chittagong Airport, with annual passengers less than one million and apron size of four to five aircraft stands, the linear concept is the most adequate concept for the following reasons:

a) Although passenger walking distance tends to increase in the linear concept in accordance with the development of the terminal, such a problem will not occur at the traffic level of two to three million passengers annually.

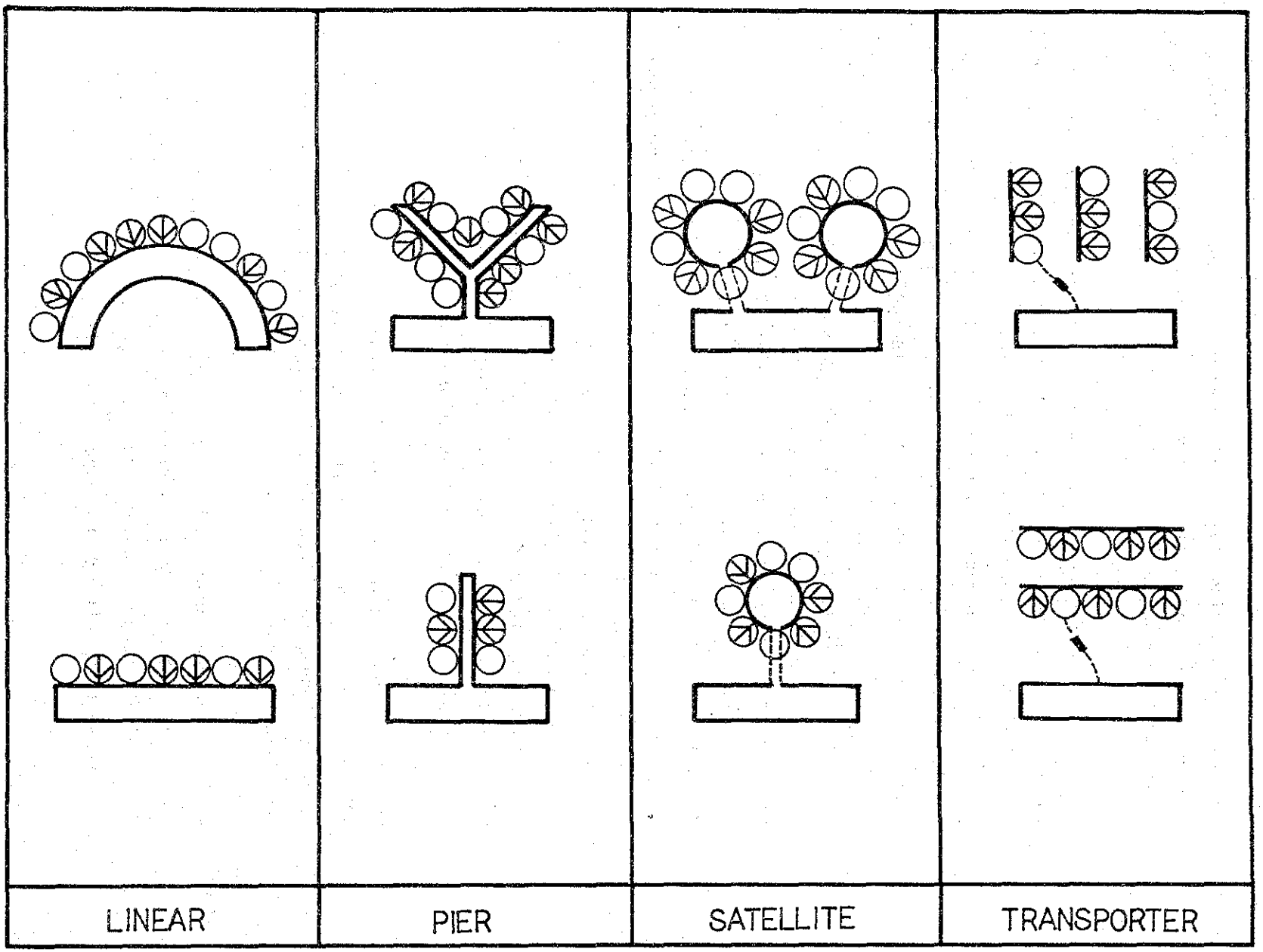


Figure 6.4.2 Typical Terminal Concepts

b) The linear concept can minimize the confusion of passengers because aircraft stands, terminal building and car park are linearly laid out in the same direction with the orientation of passengers.

c) Aircraft maneuvering is relatively simple with the linear concept.

d) The linear concept is superior in expansibility and the terminal building can be flexibly expanded in accordance with traffic demand.

e) Construction, operating and maintenance costs are the lowest among the four concepts.

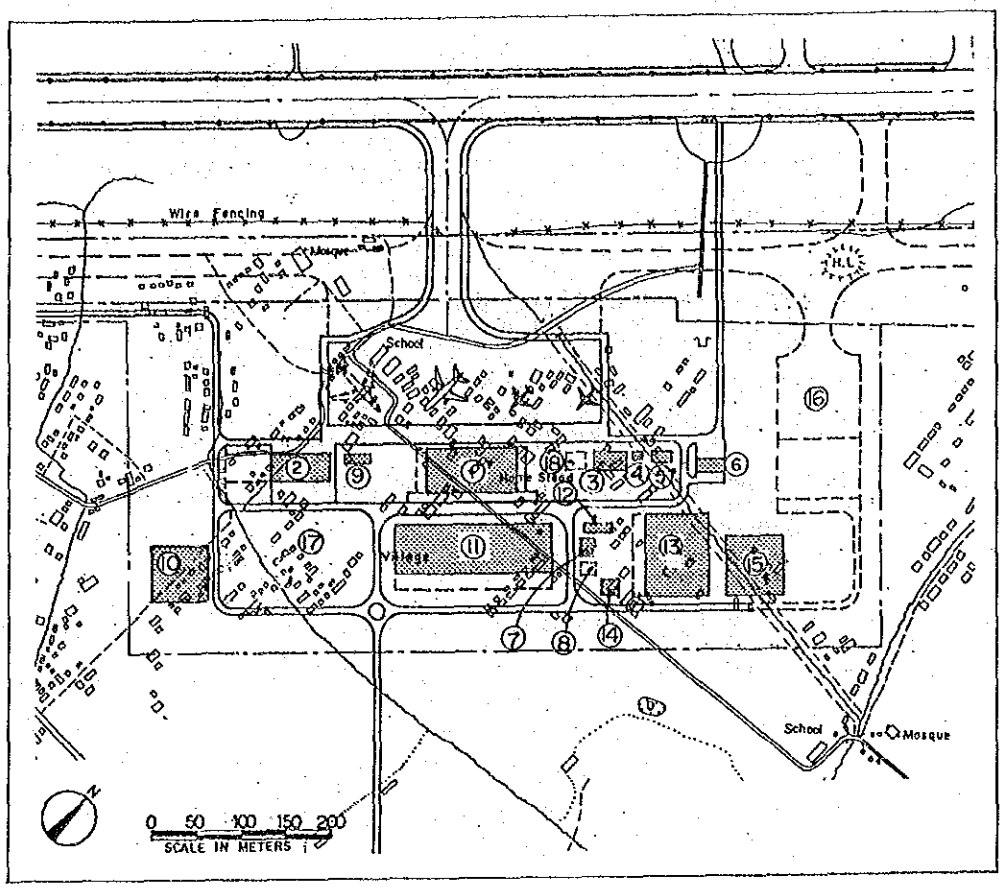
f) Pier and satellite concepts are generally adopted for large airports with more than five million annual passengers.

g) The transporter concept is usually utilized to supplement the other concepts in order to process the excessive peak load with smaller initial investment.

The shape of the apron to be utilized in the linear concept is selected through the comparison of the following two alternatives.

ALT-AQ: Quadrilateral Shape Apron
ALT-AC: Crescent Shape Apron

Terminal area layouts in each alternative are shown in Figures 6.4.3 and 6.4.4. Two alternatives are compared from the viewpoints of users' convenience, construction cost, construction ease and expansibility of facilities in Table 6.4.1. ALT-AQ is finally selected as an appropriate apron shape.

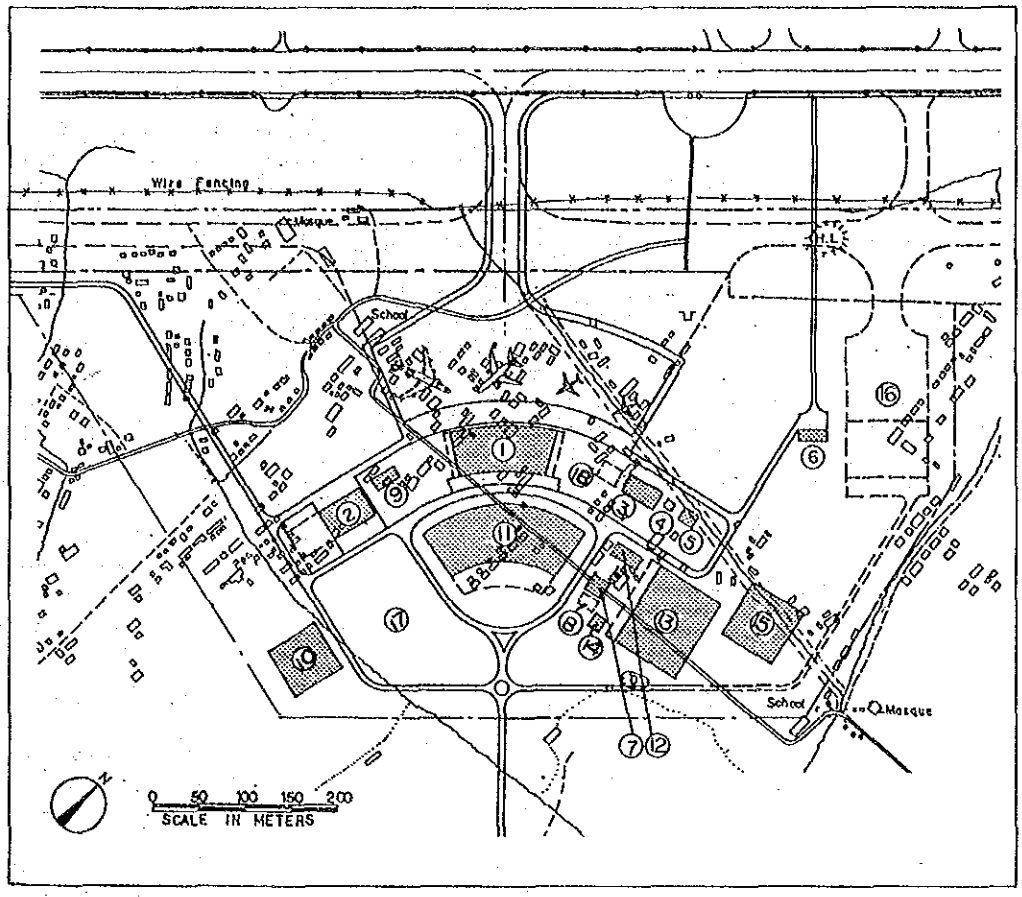


LEGEND

① Passenger Terminal Building
② Cargo Terminal Building
③ Operation Center
④ Control Tower
⑤ Power House
⑥ Fire Station
⑦ Administration Building
⑧ Other Government Office Building (Future Provision)
⑨ GSE Maintenance Garage
⑩ NDB and Transmitting Station
⑪ Car Park
⑫ Airport Maintenance Building and Garage
⑬ Fuel Farm
⑭ Water Supply Station
⑮ Incinarator and Central Sewerage Treatment Plant
⑯ Future Possible Maintenance Area
⑰ Public and Commercial Facilities' Area
⑱ VVIP Building (Future Provision)

: Phase I
: Phase II or Future Provision

Figure 6.4.3 Alternative Terminal Area Layout with Quadrilateral Shape Apron (ALT-AQ)



LEGEND

① Passenger Terminal Building
② Cargo Terminal Building
③ Operation Center
④ Control Tower
⑤ Power House
⑥ Fire Station
⑦ Administration Building
⑧ Other Government Office Building (Future Provision)
⑨ GSE Maintenance Garage
⑩ NDB and Transmitting Station
⑪ Car Park
⑫ Airport Maintenance Building and Garage
⑬ Fuel Farm
⑭ Water Supply Station
⑮ Incinarator and Central Sewerage Treatment Plant
⑯ Future Possible Maintenance Area
⑰ Public and Commercial Facilities' Area
⑱ VVIP Building (Future Provision)

: Phase I
: Phase II or Future Provision

Figure 6.4.4 Alternative Terminal Area Layout with Crescent Shape Apron (ALT-AC)

Table 6.4.1 Comparison of Alternative Apron Shapes

Note - G: Good F: Fair P: Poor

Alternatives / Comparison Items		ALT-AQ (Quadrilateral Shape Apron)		ALT-AC (Crescent Shape Apron)
1. Passenger Walking Distance	G	Maximum 100m (From Car Park to Check-in) (From Aircraft to Baggage claim)	G	Same as ALT-AQ
2. Maneuverability of Aircraft on the Apron	G	Simple maneuvering	F	Maneuvering will be slightly complicated as compared with ALT-AQ.
3. Land Acquisition Required for the New Terminal Area	G	28 ha	P	37 ha Large area will be required due to idling space caused by oblique facility layout.
4. Number of Houses to be Compensated	G	250 nos.	P	350 nos.
5. Apron Pavement Area	G	27,000m^2	F	27,800m^2
6. Construction Ease of the Apron Pavement	G	No difficulty will be expected because of simple shape of the apron.	F	Many deformed slabs will take longer to construct.
7. Long-Term Expansibility of Terminal Area	G	Terminal area can be easily expanded towards the runway longitudinal direction. Economy of aircraft ground operation will be maintained because the separation between the runway and aircraft stands will not change.	P	Terminal area will have a limit in expansibility unless additional terminal units are constructed. Distance from the runway to aircraft stands will increase in accordance with the development of the terminal.
8. Overall Evaluation	G	Superior to ALT-AC in aircraft maneuverability, cheaper construction cost, smaller compensation for houses, easier construction and larger expansibility.	F	Crescent shape apron is utilized at large airports, ex. Dallas Fortworth Regional Airport, in order to minimize the passenger walking distance with unit terminals. Chittagong Airport can handle expected passenger traffic in quadrilateral shape apron with short walking distance, and utilization of crescent shape apron will be uneconomical and less expansible.

6.4.5 Air Navigation Systems

Air navigation systems are planned to cope with the requirements for the precision Category-I approach runway in order to improve runway usability and aircraft operational safety.

(1) Radio Navigation Aid

- Category-I ILS will be installed for runway 23 on condition that appropriate organization for the operation and maintenance is provided by CAAB. It will be replaced by MLS in Phase II development in accordance with ICAO transition plan from ILS to MLS. The glide path antenna will be on the south side of the runway so that it is on CAAB property. DME will be collocated with the localizer antenna.

- The existing antiquated VOR/DME will be replaced by D-VOR/DME. It will be installed about 100 m closer to the runway relative to the existing VOR site in order to allow straight-in approaches for runway 05 and 23.

- The existing NDB which infringes the transitional surface will be relocated in the new terminal area.

- A middle marker will be installed for the runway 23 precision approach.

(2) Air Traffic Control and Aeronautical Telecommunications System

- Most of the existing equipment will be replaced because of their superannuated conditions and a necessity to transfer to the new control tower without an interruption of the routine operation. The functions of the existing system will be maintained basically, but the dual frequency as stand-by concept is planned for TWR, SMC and Emergency.

- Communications between the Tower and the Control Center of Chittagong Port Authority will be established to coordinate approaching aircraft and oceangoing ships on Karnafuli River.

- A new transmitting station will be planned together with NDB in the new terminal area. Receiving antennas will be installed on the roof of the administration building and control tower in the new terminal area.

- The layout of the transmitting station, NDB and control tower will be discussed in the terminal area layout planning in Section 6.5.

(3) **Aeronautical Ground Lights**

- Category-1 Approach Lighting System (ALS) will be installed for runway 23.

- Simple Approach Lighting System (SALS) will be installed for runway 05.

- PAPIs will be installed for runways 05 and 23.

- Runway lights, runway end/threshold lights, stopway lights, taxiway lights, aerodrome beacon, illuminated wind direction indicators, apron floodlights will be installed.

- High intensity lights will be used in order to meet the requirements of Category-I.

(4) **Meteorological Observation System**

- All the existing equipment will be replaced because they are superannuated and a transfer of the field observation site to the airside is necessary.

- New meteorological equipment including a wind direction/speed meter, transmissiometer, ceilometer and other observation equipment will be installed in the airside.

- An automated system for processing data from the observation site will be intorudced.

- A branch office of Bangladesh Meteorological Department will be accommodated in the new operation center.

6.4.6 Access Road

- An access road connecting the new terminal area will be planned so that the main access to the new terminal area will be from Patenga Road.

6.5 Terminal Area Layout Planning

This section describes the layout of respective terminal facilities in the new terminal area. The facility layout is determined through the comparison of four alternatives which are produced based on the following conditions.

6.5.1 Basic Conditions for Alternative Layouts for Terminal Facilities

(1) The new terminal area will be located in ALT-TB area as selected in Section 6.3. A 810 m wide area up to 600 m from the runway centerline in Figure 6.3.1 is to be laid out for the terminal facilities of Phase I and Phase II development with minimum relocation of houses.

(2) The terminal concept for the passengers terminal complex will be a linear concept with a quadrilateral shape apron as discussed in Section 6.4.4. Self-maneuvering parking will be employed as the aircraft parking method taking into consideration the required number of aircraft stands. Aircraft will be parked with 45^{o} nose angle to the terminal building in order to minimize passenger walking distance and the effect of the aircraft engine blast. Aircraft parking configuration is determined by the comparison of the two alternatives in Figure 6.5.1.

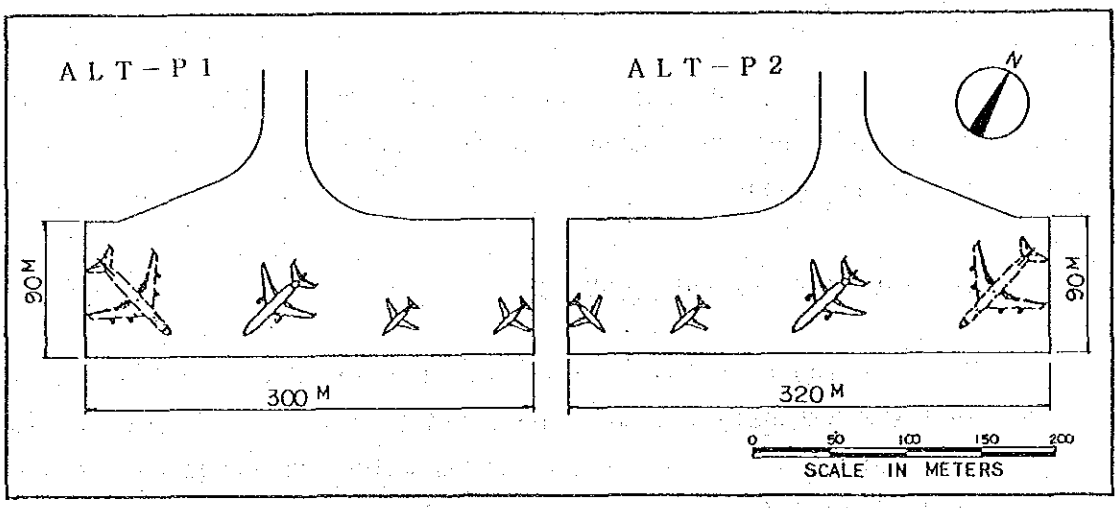


Figure 6.5.1 Alternatives for Aircraft Parking Configuration

ALT-P2 which locates the aircraft stands for large aircraft to the east will require a 20 m wider apron than ALT-P1. ALT-P1 is, therefore, selected as an adequate parking configuration for its cheaper construction cost.

(3) One exit taxiway will be located about 1,700 m from the runway 23 threshold taking into account the turn-off distance of B-737 class aircraft.

(4) One passenger terminal building for both international and domestic services will be planned in a one-level passenger processing concept as mentioned in Section 6.7.3. It will be located corresponding to the operating aircraft stands in order to minimize walking distance for the passengers.

(5) The cargo terminal building and operation center will be located on either side of the passenger terminal building.

(6) Although the present cargo volume at Chittagong Airport is very limited due to small loading capacity of the aircraft serving this airport, it is expected to increase considerably by an introduction of the large aircraft reflecting local industrial activities. A cargo terminal building will be, therefore, located facing the airside and at the end of the terminal area in order to secure large expansibility.

(7) Space for a future possible maintenance area will be reserved for one DC-10 aircraft based on the hearing from Biman. However, the future policy on aircraft maintenance is not clear at this time and thus it may be appropriate to secure large expansibility. The cargo terminal building and the aircraft maintenance area are therefore located at either end of the terminal area respectively.

(8) An access road will be connected with the terminal circulation road at the west side of the car park in order to minimize access distance from Chittagong City.

6.5.2 Alternative Layouts for Terminal Facilities

Alternative layouts for terminal facilities are produced based on the following two basic considerations:

Future Expansibility:

Since the terminal area will expand in proportion to the increase of air traffic demand, future expansibility is a very important requirement for the layout of terminal facilities.

Separation of Functions:

Terminal facilities are classified by their functions into passenger (P), cargo (C), administration (A) and maintenance (M) areas. The separation of these areas should be considered in the terminal facility layout for operational ease of facilities and regulated movements of passengers and vehicles. Four alternative plans in Figure 6.5.2 have been produced in compliance with the above considerations.

ALT-TB1: Facilities which will be relatively easy to relocate will be located to the west of the passenger area in order to secure large expansibility to the west of the terminal area.

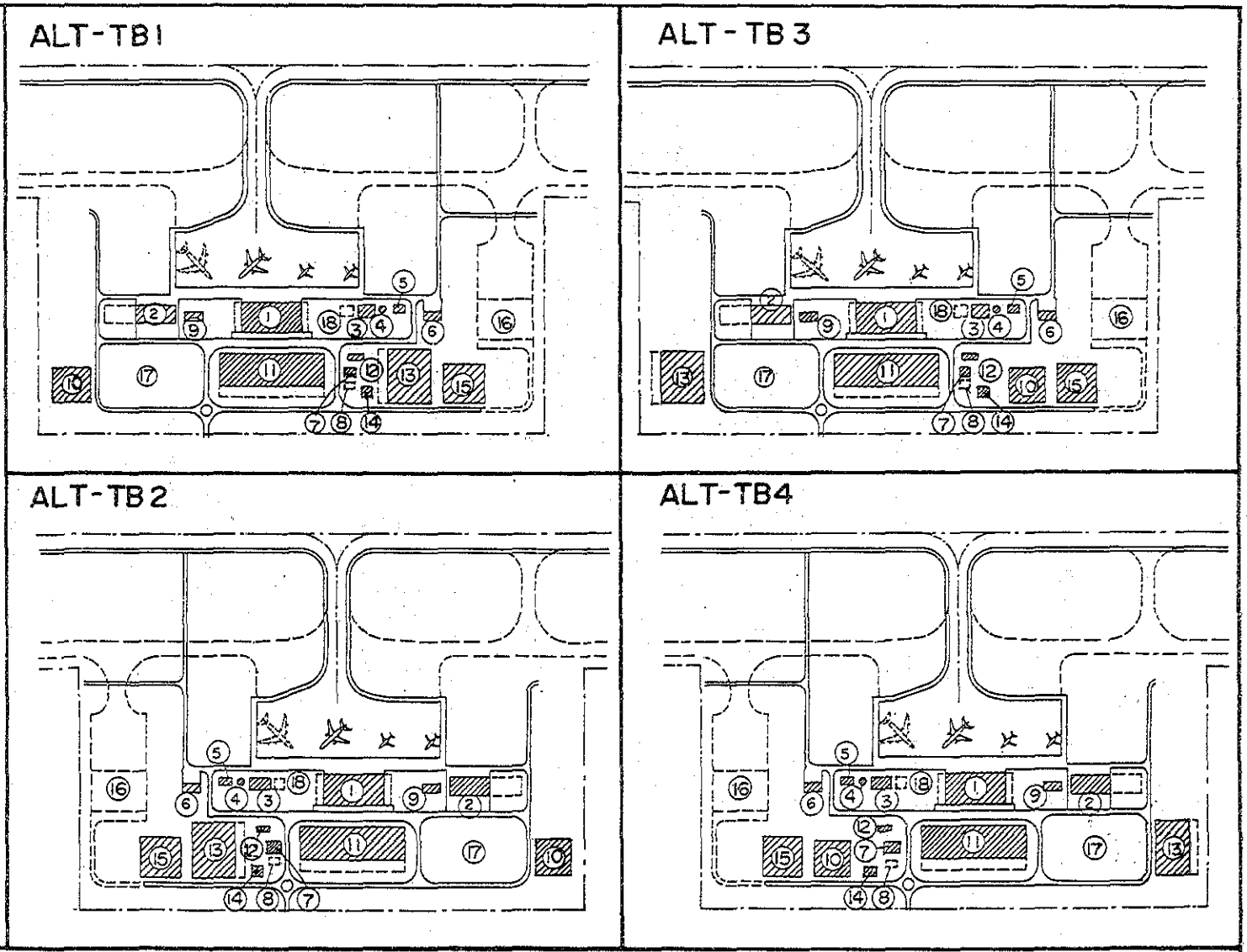
- Cargo Terminal Building
- GSE Maintenance Garage
- NDB and Transmitting Station

Facilities which will not require extensive expansion and be difficult to relocate after their construction will be located to the east of the passenger area.

LEGEND

① Passenger Terminal Building
② Cargo Terminal Building
③ Operation Center
④ Control Tower
⑤ Power House
⑥ Fire Station
⑦ Administration Building
⑧ Other Government Office Building (Future Provision)
⑨ GSE Maintenance Garage
⑩ NDB and Transmitting Station
⑪ Car Park
⑫ Airport Maintenance Building and Garage
⑬ Fuel Farm
⑭ Water Supply Station
⑮ Incinarator and Central Sewerage Treatment Plant
⑯ Future Possible Maintenance Area
⑰ Public and Commercial Facilities' Area
⑱ VVIP Building (Future Provision)

▨ : Phase I
⬚ : Phase II or Future Provision



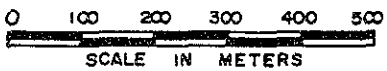


Figure 6.5.2 Alternative Layouts for Terminal Facilities

- Operation Center
- Administration Building
- Other Government Office Building
- Control Tower
- Power House
- Fuel Farm
- Water Supply Station

ALT-TB2: Two facilities groups in ALT-TB1 will be located in reverse to ALT-TB1 in order to secure future expansibility to the east of the passenger area.

ALT-TB3: Facility layout is produced by considering the separation of each function, i.e. P, C, A and M in this alternative. Facilities under the operation of CAAB, i.e. the administration area, will be located to the east of the passenger area.

- Operation Center
- Administration Building
- Other Government Office Building
- Control Tower
- Power House
- Fire Station
- Airport Maintenance Building and Garage
- NDB and Transmitting Station
- Water Supply Station

Cargo area will be to the west of passenger area. Facilities under the operation of other organizations than CAAB are located to the west together with the cargo terminal. Terminal area will develop to the west in the future.

- Cargo Terminal Building
- GSE Maintenance Garage
- Fuel Farm

ALT-TB4: Two facility groups in ALT-TB3 are located in reverse to ALT-TB3 securing expansibility to the east.

6.5.3 Comparative Evaluation

The alternatives are compared from the viewpoints of users' and operators' convenience, construction cost, future expansibility and other criteria in Table 6.5.1. As a result of the comparison, no significant difference is expected in construction cost, and ALT-TB1 is selected as an adequate plan for the following reasons:

- Large expansibility for future terminal area development can be secured.

- Separation of passenger, cargo, administration and maintenance areas will be sufficient although NDB and the transmitting station will not be located in the administration area in order to secure larger expansibility of the terminal area.

- The administration area will be located near the runway center.

- Regulated vehicle circulation will be achieved.

6.5.4 Terminal Area Layout

The terminal area layout plan studied in the previous section is shown in Figure 6.5.3. Descriptions are given below.

(1) Apron

A 300 m by 90 m apron will be constructed for aircraft parking in front of the passenger terminal building in the Phase I development. The landside edge of the apron should be determined so that the vertical tail wing of B-747 may not infringe the transitional surface in nose-in parking configuration for the future provision although aircraft will be parked with self-maneuvering in the Phase I development as mentioned in Section 6.5.1.

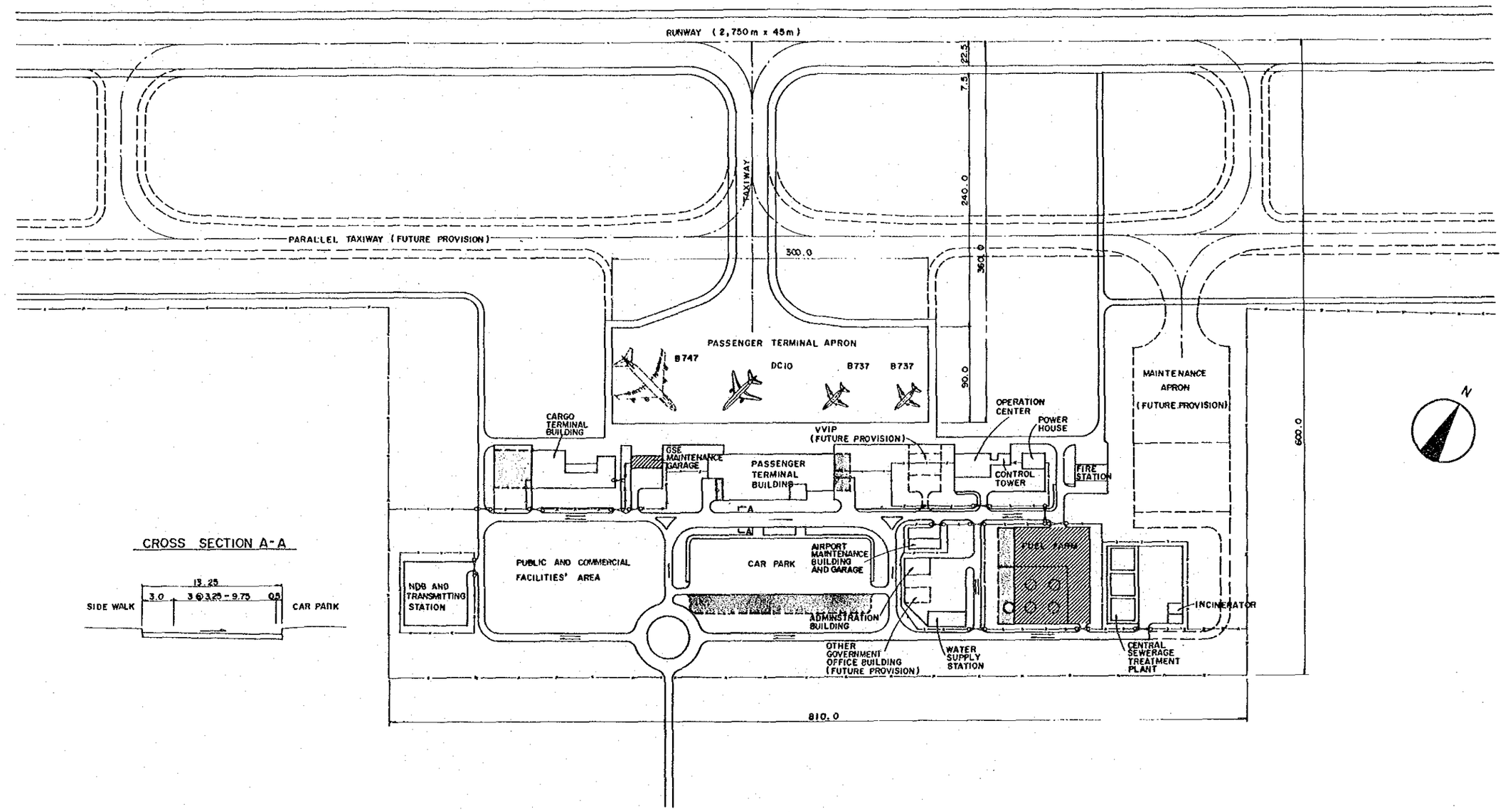
Table 6.5.1 Comparative Evaluation of Alternative Layouts for Terminal Area

Note - G: Good F: Fair P: Poor

Comparison Items \ Alternatives	ALT-TB1	ALT-TB2	ALT-TB3	ALT-TB4
1. Passenger Convenience (Distance from Passenger Terminal Building to Aircraft Stands)	- Average walking distance 70 m	- 70 m	- 70 m	- 70 m
2. Cargo Handling Convenience (Distance from Cargo Terminal Building to Aircraft Stands)	F Average cargo hauling on the apron 260 m	G 180 m	G 260 m	G 180 m
3. Airport Administrative Convenience of CAAB				
a. Layout of CAAB Facilities	F Only transmitting station is separate from other CAAB facilities.	F Same as ALT-TB1	G All CAAB facilities are located closely each other.	G Same as ALT-TB3
b. Visibility of Aircraft on the Apron from the Control Tower	G Control tower is located facing the apron.	G Same as ALT-TB1	G Same as ALT-TB1	G Same as ALT-TB1
c. Visibility of Runway threshold from the Control Tower (Distance from Control Tower to Runway 23 Threshold)	G Aerial distance 1,830 m	F 2,250 m	G 1,830 m	F 2,250 m
d. Response Time of Fire Vehicle (Response Time to Runway 23 Threshold)	G 120 sec.	F 140 sec.	G 120 sec.	F 140 sec.
4. Refueling Convenience (Distance from Fuel Farm to Aircraft Stands)	G Average hauling of fuel truck 310 m	F 410 m	P 450 m, however this distance will be longer when the cargo terminal building is expanded in the future.	P 380 m, however this distance will be longer when the cargo terminal building is expanded in the future.
5. Vehicle Circulation				
a. Public Vehicles and Taxis	G No problem	G Same as ALT-TB1	G Same as ALT-TB1	G Same as ALT-TB1
b. Cargo Trucks (Passage of Cargo Trucks in Front of the Passenger Terminal Building)	G No	G No	G No	G No
c. Fuel Truck from the Outside Airport (Passage of Fuel Truck in Front of the Passenger Terminal Building)	G No	G No	G No	G No
6. Land Acquisition for the Terminal Area	- 28 ha	- 28 ha	- 28 ha	- 28 ha
7. Number of Houses to be Relocated	- 250 nos.	- 250 nos.	- 250 nos.	- 250 nos.

Note - G: Good F: Fair P: Poor

Comparison Items \ Alternatives	ALT-TB1	ALT-TB2	ALT-TB3	ALT-TB4
8. Apron Pavement Area	- 2,700 m^2	- 2,700 m^2	- 2,700 m^2	- 2,700 m^2
9. Height of the Control Tower (Elevation of the Eye Level of Air Traffic Controller)	G 23 m	F 26 m	G 23 m	F 26 m
10. Long-term Expansibility of Terminal Area	G Large expansibility will be secured toward the west by locating facilities which will be relatively easy to relocate to the west.	P Terminal area will be expanded toward the east. Although the extension of terminal facilities towards the center of the runway is desirable, the extension area is generally a low land with a 10 to 15 m wide canal. Diversion of the canal is necessary and poor soil condition is expected. Since the larger demand increase is expected for international traffic, large aircraft should be parked in the east of the apron in this alternative. This requires larger apron as mentioned in Section 6.5.1.	F Terminal area will be expanded toward the west. In this alternative, fuel farm will be isolated in the landside when the cargo terminal building is expanded in the future. Access distance from the fuel farm to aircraft stands will increase in accordance with the development of terminal area. Flexible development of the terminal area may be prevented by the fuel farm located in the center of future terminal area.	P Problems in direction of terminal expansion in ALT-TB2 and location of fuel farm in ALT-TB3 will be both envisaged in this alternative.
12. Overall Evaluation	G Considered to be the best alternative appreciating its large expansibility and the location of administration area nearer to the runway center. Separation of functional areas (P, C, A & M) is also practically sufficient.	P Inferior in terms of long-term expansibility and farther location of administration area from the runway centerline.	F Although this alternative is recommendable from the viewpoint of separation of functional areas, distance from the fuel farm to the aircraft stand will be long and much longer in the future.	P Inferior in terms of long-term expansibility and farther location of administration area from the runway center.



CROSS SECTION A-A

LEGEND	
SECURITY AND BOUNDARY FENCES	—x—x—
PHASE I DEVELOPMENT (DESIGN TARGET YEAR 2000)	
FACILITIES TO BE CONSTRUCTED BY CAAB	
FACILITIES TO BE CONSTRUCTED BY OTHER ORGANIZATIONS	
PHASE II DEVELOPMENT (DESIGN TARGET YEAR 2010)	
FUTURE PROVISION	

Note : See Figure 6.6.1 for area of land acquisition

Figure 6.5.3 Terminal Area Layout Plan

0 50 100 150 200
SCALE IN METERS

(2) **Passenger Terminal Building**

A passenger terminal building for international and domestic services with a total floor area of 5,400 sq.m will be constructed in the Phase I development in front of the apron. A one-level passenger processing concept will be applied as discussed in Section 6.7.3. In case of unexpected increase of future demand, an independent international building can be constructed in the west adjacent area of the terminal building by relocating the GSE maintenance garage.

The reservation of a vacant space for future international building on the west of Phase I passenger terminal building is not made because of long (approx. 100 m) and operationally inconvenient separation between cargo terminal building and apron.

(3) **Cargo Terminal Building**

A cargo terminal building with a floor area of 2,000 sq.m will be constructed in the west of the GSE maintenance garage. Parking space for GSE and maneuvering space for cargo trucks are considered in the airside and the landside of the cargo terminal building respectively. The cargo terminal building will be expanded mainly to the west in the Phase II development in order to cater to demand increase.

(4) **GSE Maintenance Garage**

Although GSE such as passenger step, ground power unit, etc. will be provided by the airlines, an area for a GSE maintenance garage is reserved in the termional area facing the apron and in-between the passenger terminal building and the cargo terminal building.

(5) **VVIP**

Space for a future VVIP building is reserved in the master plan between the passenger terminal building and the operation center.

(6) **Operation Center and Control Tower**

An operaion center and a control tower will be located to the east of the passenger terminal building. They are planned to be located adjacent to each other from operation, administration and security viewpoints.

(7) **Power House**

A main power house will be located in the restricted area to the east of the control tower from the viewpoint of security. This location will facilitate the maintenance of the aeronautical ground lights since the lights will be visible from the power house. The noise of emergency generators will not disturb the passengers due to adequate distance from the passenger terminal building.

(8) **Fire Station**

A Fire station for Category-6 service will be constructed on the airside to the east of the power house in the Phase I development. A paved service road is planned in front of the fire station to connect the fire station with the runway.

(9) **NDB and Transmitting Facilities' Area**

NDB and transmitting station shall be separated from the public area from the security and maintenance view points. These facilities are therefore located in the west of public and commercial area.

(10) **Public and Commercial Facilities' Area**

Public and commercial facilities including airlines, restaurant, hotel, toilet etc. will be necessary for the improvement of airport service in future. Taking account of the function of these facilities, the location of the area will be desirable to be adjacent to passenger terminal area.

Public and commercial facilities' area is resereved in the west of car park and in front of cargo terminal building. This area can be also utilized for the future expansion area of cargo terminal facilities in future.

(11) **Road and Car Park**

A car park for 280 vehicles will be constructed in the Phase I development in the landside in front of the passenger terminal building so that passenger walking distance may be minimized. An entrance with a toll booth will be located in the west and an exit in the east. Parking space for taxis will be also reserved in this car park as it is at ZIA International Airport. The expansion area for the car park is reserved to the south.

A circulation road around the car park is planned to be basically one way traffic for regulated vehicular flow. However, the portion to the south of the car park is planned to be two lanes for two way traffic in order to permit the direct access for fuel trucks to the fuel farm without passing in front of the passenger terminal building. The terminal frontage road is planned to be four lanes i.e. a standing lane, a weaving lane and two through lanes. Terminal road accessing from/to cargo terminal area is separated from the circulation road and is planned to be two way. A roundabout is

planned for the connection of the terminal road and the access road because it is suitable to regulate relatively light traffic as anticipated at Chittagong Airport.

(12) **Administration Building**

An administration building housing the airport manager's office, an engineering office and other administration offices is required to be separated from the operation center because of the requirement of the airport organization of Bangladesh.

Independent administration office is not necessary to face to airside. Therfore, the building is located in the administration area and in the south of the airport maintenance building.

(13) **Other Government Office Building**

An other government office building consists of some offices for customs, immigration, quarantine, security and police, etc. is located next to the administration building.

(14) **Airport Maintenance Building and Vehicle Garage**

An airport maintenance building will be constructed in the landside to the south of the operation center for the convenience of the airport administrator. A vehicle garage accommodating CAAB vehicles will be located adjacent to the airport maintenance building.

(15) **Aviation Fuel Supply System**

An aviation fuel supply facility will be constructed by Burmah Eastern, therefore the area for the fuel farm including future expansion space is reserved in the terminal area. It will be located to the east of the car park, and the road connections are planned so that the fuel truck may access directly from the airside and the landside. Refueling of the aircraft is assumed to be done by fuel trucks since the introduction of a hydrant system is uneconomical for this size of airport.

(16) **Water Supply Station, Incinerator and Central Sewerage Treatment Plant**

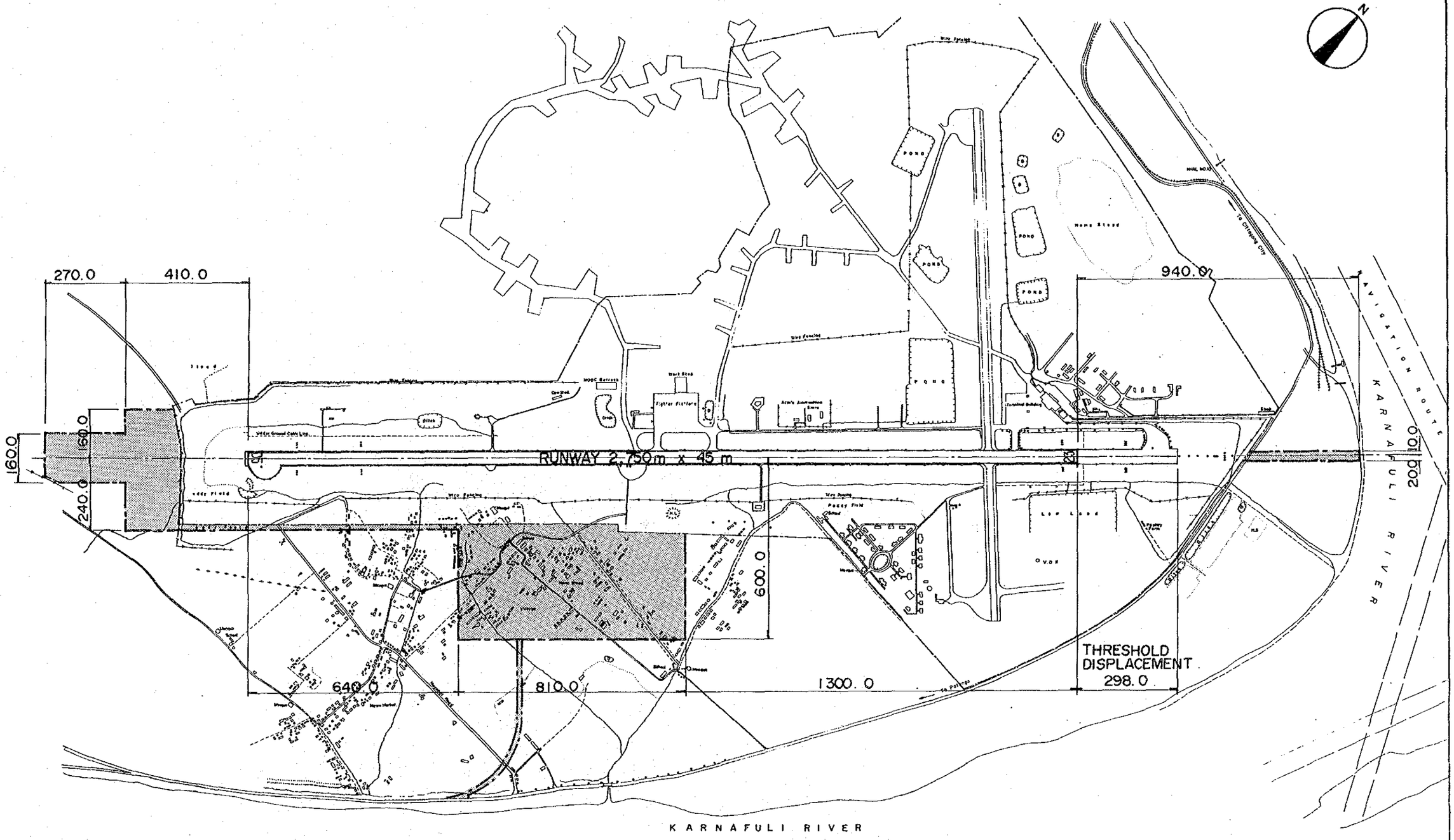
It is desirable that these facilities will be located altogether separate from the public in the eastern landside of the terminal area from the security viewpoint. However,the water supply station should be separated from the central sewerage treatment plant taking account of sanitary condition. Hence, only water supply station will be located to the west of the fuel farm, and the remaining two facilities will be located to the east of the fuel farm.The incinerator will be on the leeward side of the passenger terminal building relative to the prevailing wind direction, and thus will not disturb passengers.

(17) **Aircraft Maintenance Facilities**

Space for a future maintenance apron and an aircraft maintenance hanger is reserved plan in the east of the terminal area. The right-of-way for an access road from the landside is also reserved in the terminal area layout plan.

6.6 Land Acquisition Plan

The area to be acquired prior to Phase I development is estimated based on the airport layout planning and is shown in Figure 6.6.1. The area is about 43.8 ha and includes land acquisition for the new terminal area, the precision and the simple approach lighting system area, and future provision for the runway extension and the parallel taxiway. No additional land acquisition will be required in Phase II development.



AREA OF LAND ACQUISITION

Figure 6.6.1 Area of the Land Acquisition for Phase I Development

6.7 Conceptual Facility Planning

This section sets out the conceptual facility planning for improving the runway pavement and the passenger handling concept of the passenger terminal building which are considered particularly important as basic conditions to success for the preliminary design. The more detailed facility plan, covering all the facilities of Phase I development, is presented in Chapter 8.

6.7.1 Runway Pavement

In Section 5.2.1, it is concluded based on the soil investigation and analysis that the existing pavement is usable for the operations of DC-10 class aircraft if it is strengthened. This section succeedingly explains the method of strengthening and repair of the existing runway.

The pavement overlay by asphalt concrete is selected for the following reasons. The method of overlay by precast concrete slab is explained for reference.

Subsoil drains will be installed in order to increase the bearing strength of the subgrade.

a) The partial defects of the existing pavement are not fatal ones and the settlement of the pavement probably will not continue because consolidation is estimated to have completed already.

   Therefore, pavement overlay is effective to deal with the existing defects and is the most economical and practical method. Even if the cracks emerge again, they can be easily repaired by partial overlay or patching in regular maintenance work.

b) Uneven surface of the existing pavement was caused by the previous overlay works without filling depressions. This can be avoided by using a detailed study including elevation and filling plan of the runway surface prior to the overlay works.

c) Longitudinal cracks are mainly located at the old edges of the existing runway which was widened in the early 1970s. These 1 to 2 mm wide cracks which probably emerged due to poor workmanship are not major defects. These cracks can be avoided by careful overlay works, in which the existing cracks will be cut in V-shape in order to prevent reflection cracks and the construction joints will be laid out at different places from the existing cracks.

d) The required thickness of the precast concrete slab will be 31 cm and the construction cost of this method is estimated to be more than twice that of the pavement overlay by the asphalt concrete.

With this method, the existing depressions of the runway pavement should be smoothed out by asphalt concrete prior to the installation of the concrete slabs, and the installation itself will include difficult workmanship. The pavement overlay by asphalt concrete is therefore apparently superior to the overlay by precast concrete slabs.

This study proposes an economical and practical method of runway strengthening in the light of practices in other airport and based on the soil investigation and analysis during the Study Team's stay in Bangladesh. However, detailed investigation and analysis will be necessary in order to finalize the pavement structure.

6.7.2 Construction Method for the Overlay Works of the Existing Runway Pavement

In this section, a construction method for the overlay work of the existing runway pavement is studied comparing of the following two alternative methods:

ALT-RN: The overlay work of the existing runway pavement will be done at night.

ALT-RD: A parallel taxiway will be first constructed as a temporary runway, and the overlay works of the existing runway pavement will be done afterward, during the day.

The cost of each alternative is shown in Table 6.7.1.

The construction cost for a 2,750 m long parallel taxiway is estimated to be about 560 million TK including pavement work, site preparation, drainage works and compensation for staff housing. The cost difference between the night and the day work of the runway overlay is about 40 million TK. Thus, ALT-RD will require an additional cost of 520 million TK compared to ALT-RN.

In case that new parallel taxiway will be constructed as temporary runway, the parallel taxiway will be useful not only for the easy overlay works of the main runway but also for another repair works beside runway. And even after the completion of overlay works, it enable uninterrupted operations of airport in an emergency case such as closure of the main runway by utilizing as a temporary runway.

However, the utilization of parallel taxiway for the temporary runway is very rare, so that the additional investment for the parallel taxiway which accounts for about 30% of the total cost for such a limited utilization will not be justified because it will reduce the EIRR by 3% and make the project economically unfeasible.

As the result of the above consideration, the runway overlay is planned to be constructed at night. The parallel taxiway will be constructed when demand will justify its provision in the future, and only the right of way will be acquired for the future provision in Phase I development.

Table 6.7.1 Cost Comparison of Alternative Construction Methods

Alternatives / Items	ALT-RN Night Works		ALT-RD Day Work with Parallel Taxiway	
	Quantity	Cost (1,000TK)	Quantity	Cost (1,000TK)
1. Runway Pavement				
a) Overlay (t=20cm)	123,750m^2	216,200	123,750m^2	180,200
b) Shoulder Widening	41,250m^2	17,300	41,250m^2	14,400
c) Turnaround Pads	1,400m^2	6,400	1,400m^2	5,300
d) Sub-total		239,900		199,900
2. Parallel Taxiway (Temporary Runway)				
a) Parallel Taxiway (w=45m)			123,750m^2	361,800
b) Exit Taxiway			16,200m^2	47,400
c) Exit Taxiway Shoulder			8,100m^2	1,900
d) Site preparation			100,000m^3	72,700
e) Drainage			L.S.	50,000
f) Compensation Works (Staff Housing)			15 nos.	30,000
g) Sub-total				563,800
Total		239,900		763,700

6.7.3 Passenger Terminal Building

One passenger terminal building is planned for international and domestic services because both international and domestic passengers can be handled sufficiently in a single terminal building judging from the expected level of the demand and also because it will economize the construction cost by avoiding the duplication of facilities such as check-in counters, toilet, etc. and facilitate the operation and maintenance of the facilities.

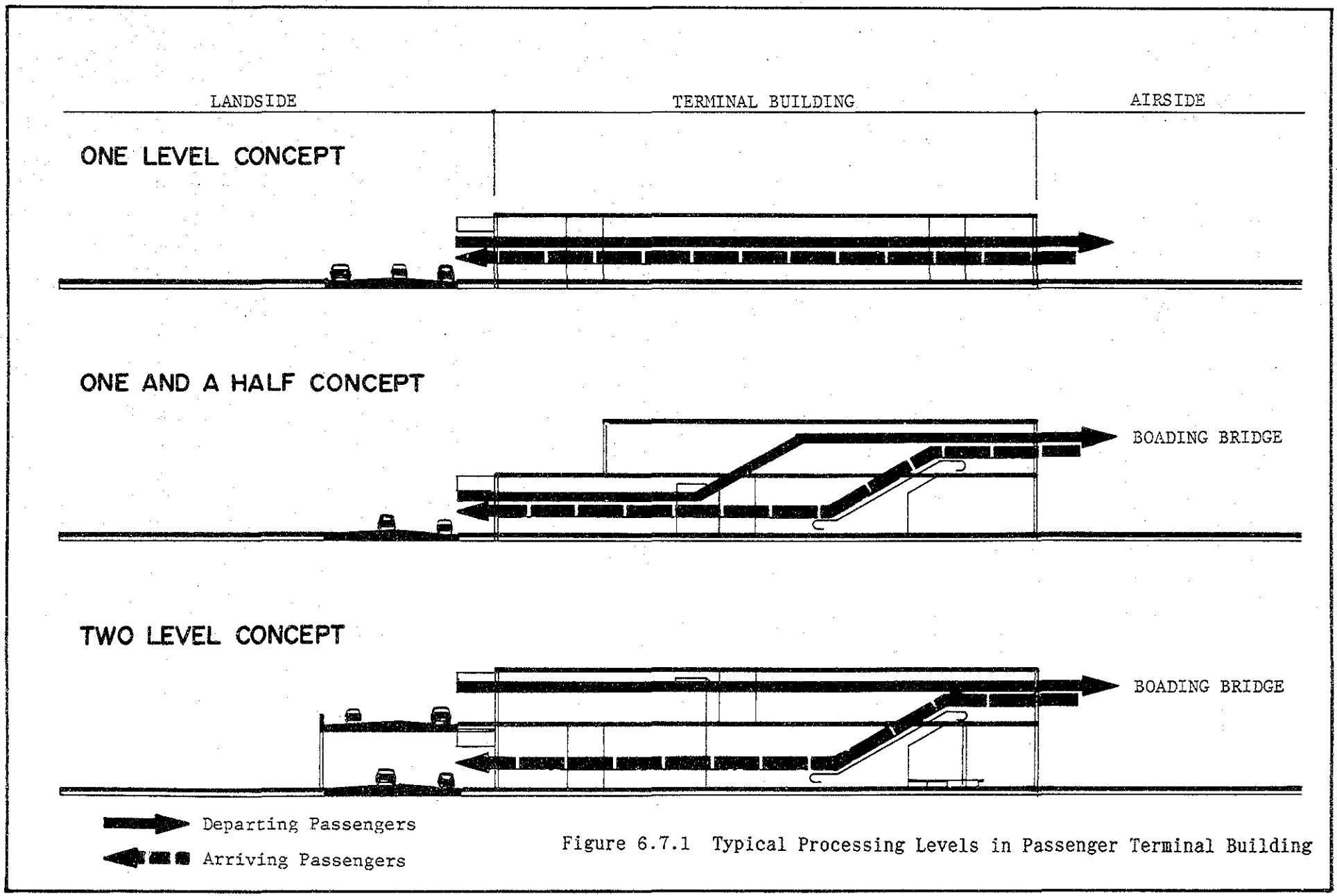


Figure 6.7.1 Typical Processing Levels in Passenger Terminal Building

Typical processing levels in the passenger terminal building are shown in Figure 6.7.1 In these plans, the one-level concept which segregates departing and arriving passengers horizontally on the ground floor, and the one-and-a-half-level concept which segregates them internally on the ground floor and the first floor are conceivable for Chittagong Airport.

The two-level concept which provides double level curbs for the terminal building will not be economically justified since the curb length required in front of the terminal building is about 100 m which is sufficiently provided with a single curb.

The one level concept has the following advantages over the one-and-a-half concept:

a) A one-level passenger terminal building can handle more than one million annual passengers without any difficulty.

b) A one-and-a-half-level concept requires 30% more floor area than a one-level building for the same traffic volume due to the duplication of facilities and space for staircases. The one level concept is therefore comparatively economical when demand is within its capacity.

c) The one-and-a-half-level concept is associated with an introduction of a boarding bridge, an escalator and an elevator in order to facilitate the level change of passengers, which will make the operation and maintenance cost per floor area expensive for a small terminal building. A towing tractor and its operator will be also required for the push-out of the aircraft if a boarding bridge is installed.

Based on the above considerations the one-level concept is adopted for the passenger terminal building at Chittagong Airport from the viewpoint of construction economy and operation and maintenance ease.

CHAPTER 7 SCOPE OF THE PHASE I DEVELOPMENT PROJECT

CHAPTER 7 SCOPE OF THE PHASE I DEVELOPMENT PROJECT

7.1 General

In this chapter, the construction items for phased development, i.e. scope of the Phase I development project are clarified. The airport master plan will be implemented utilizing the basic concept of phased development in order to achieve cost-effective development with a minimum initial investment.

(1) Phase I Development

To be planned to meet traffic demands anticipated for the year 2000 based on a consideration that major work will not be required for at least 5 years after completion of construction.

(2) Phase II Development

To be planned to meet traffic demands anticipated for the year 2010 in order to visualize the airport development in the foreseeable future.

(3) Beyond Phase II

To be planned to meet traffic demands beyond the year 2010.

7.2 Construction Items of the Phased Development

Based on the facility requirements discussed in Chapter 4, the construction items required for Phase I, Phase II and Future Provision (beyond Phase II) are planned as shown in Table 7.2.1. In Table 7.2.1 the mark "x" indicates the phase in which each construction item should be implemented.

Table 7.2.1 Construction Items of the Phases (I)

Construction Items	Phase I	Phase II	Future Provision (Beyond Phase II)
A. Civil Works			
1) Displacement of runway 23 threshold	x		
2) Overlay of the existing runway	x		
3) Widening of the existing runway shoulders	x		
4) Extension of runway			x
5) Provision of stopways	x		
6) Provision of runway end safety area	x		
7) Construction of turnaround pads, an exit taxiway and an apron	x		
8) Construction of parallel taxiway			x
9) Construction of an access road, terminal roads and a car park with lighting system	x	x	
10) Construction of maintenance apron and its connecting taxiway			x
11) Construction of airport service roads	x		
12) Improvement of the existing storm water drainage system	x		
13) Installation of boundary and security fences	x x		
B. Architectural Works			
Construction of the following new buildings:			
1) Passenger terminal building	x	x	
2) Cargo terminal building	x	x	
3) Administration building	x		
4) Operation Center	x		
5) Control tower	x		
6) Power House	x		
7) Fire station	x		
8) Airport maintenance building with vehicle garages	x		

Table 7.2.1 Construction Items of the Phases (2)

Construction Items	Phase I	Phase II	Future Provision (Beyond Phase II)
9) VVIP Building			x
10) Other Government Office Building			x
C. Air Navigation Systems			
C.1 Radio Navigation Aids (Navaids)			
1) Installation of a category I ILS (RWY23) including localizer/DME, glide path and middle marker	x	x (MLS)	
2) Replacement of the existing CVOR/DME by a DVOR/DME	x		
3) Relocation of the existing NDB	x		
4) Construction of external power supply cables and airside substations for navaids	x		
C.2 Air Traffic Control and Aeronautical Telecommunications			
Installation of the following new equipment:			
1) VHF air-ground radio facilities for aerodrome control, surface movement control and emergency use	x		
2) VHF multi-channel transceiver to back-up the above radios	x		
3) HF SSB transmitters and receivers for ATS direct speech circuits	x		
4) HF CW transmitters and receivers for AFTN circuits	x		
5) AFTN teletypewriters	x		
6) Aerodrome control console and communications control unit	x		

Table 7.2.1 Construction Items of the Phases (3)

Construction Items	Phase I	Phase II	Future Provision (Beyond Phase II)
7) Automatic terminal information services (ATIS) equipment	x		
8) VHF link between Chittagong airport and Chittagong port authority for direct speech telephone and facsimile	x		
9) Magnetic tape-recorder for ATC use	x		
10) Air traffic light guns	x		
11) DC power supply equipment	x		
C.3 Aeronautical Ground Lights			
Installation of the following new lights:			
1) Precision approach category I lighting system (RWY23)	x		
2) Simple approach lighting system (RWY05)	x		
3) High intensity runway edge lights and turnaround pad lights	x		
4) Wing bar, runway threshold and end lights	x		
5) Precision approach path indicator (RWY05/23)	x		
6) Stopway lights	x		
7) Taxiway edge lights	x		
8) Illuminated wind direction indicator lights	x		
9) Aerodrome beacon	x		
10) Apron floodlights	x		
11) Power distribution and control system for aeronautical ground lights	x		
12) HT switch gear and generator stations and emergency generators	x		

Table 7.2.1 Construction Items of the Phases (4)

Construction Items	Phase I	Phase II	Future Provision (Beyond Phase II)
C.4 Meteorological Observation System			
Installation of the following new equipment:			
1) Field weather observation, collecting, recording and display equipment	x		
2) HF transmitter and receiver for Met, services	x		
3) HF facsimile receiver and printer	x		
4) Radio teletypewriters	x		
D. Airport Utilities			
Provision of the following systems and facility			
1) Power supply system	x	x	
2) Water supply system	x	x	
3) Sewarage treatment plant	x	x	
4) Incinerator	x		
5) Public telecommunications system	x	x	
E. Land Acquistion and Compensation	x		

CHAPTER 8 PRELIMINARY DESIGN FOR AIRPORT FACILITIES

CHAPTER 8 PRELIMINARY DESIGN FOR AIRPORT FACILITIES

8.1 General

The preliminary design for Phase I development project has been prepared, based on the airport facility requirements and airport facility layout established in Chapters 4 and 6 respectively.

The design concepts, including basic conditions and assumptions, applied design criteria, study considerations, result of the design, etc., are described in this chapter.

8.2 Runway, Taxiway and Apron

8.2.1 Runway

A 2,750 m long and 45 m wide runway with 7.5 m wide shoulders is planned for Phase I development.

The 2,750 m long portion of the existing runway to be used in Phase I development requires pavement overlay work to accommodate large aircraft such as DC-10. This portion will be overlaid with asphalt concrete.

The runway profile of the pavement overlay is designed considering existing runway profile and required overlay thickness, so as to minimize the quantity of bituminous materials.

As described in Section 8.2.7, the required overlay thickness varies as the existing pavement structure differs at sections. The required overlay thickness of each portion is estimated based on the result of visual investigation of existing pavement and soil investigation, and is summarized as follows:

Station Number	Required Overlay Thickness
No. 0 - No. 7 + 62	28 cm
No. 7 + 62 - No.12 + 19	24 cm
No.12 + 19 - No.18 + 0	8 cm
No.18 - No.27 + 50	27 cm

The detailed process of calculation is shown in Appendix 8.1.

The required overlay thickness of the runway profile is planned in compliance with ICAO recommendations, as indicated in Figure 8.2.1.

8.2.2 Taxiway

In compliance with ICAO recommendation, the width of a taxiway is basically 23 m. However, the width of the new taxiway is planned to be 30 m because the junctions of the taxiway with the runway and the apron require fillets to maintain minimum wheel clearances for B-747 aircraft.

Taxiway shoulders 7.5 m wide will be provided on each side in accordance with ICAO recommendation.

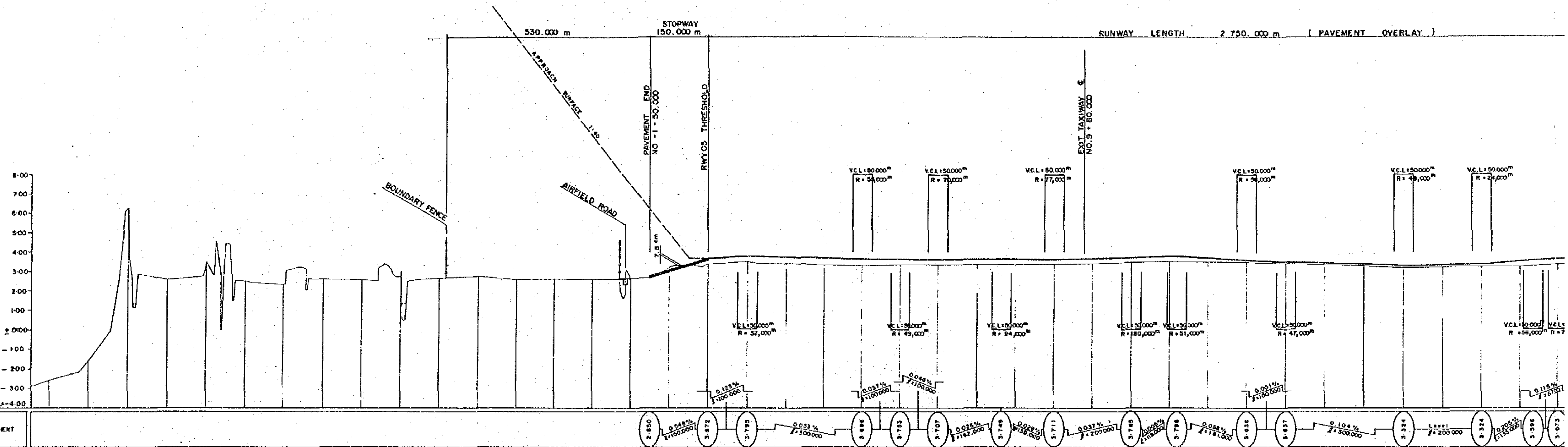
8.2.3 Apron

The new apron is designed to accommodate one B-747 class, one DC-10 class and two B-737 class aircraft adopting the self-maneuvering parking configuration in Phase I development. Its width and depth are designed to be 300 m and 90 m respectively as shown in Figure 6.5.4.

8.2.4 Airfield Road

Airfield roads including perimeter roads and maintenance roads are planned for rescue and fire fighting services, security patrol, and maintenance of facilities as shown in Figure 6.4.1.

The width of the roads is designed to be 4 m.



STATION	ACCUMULATED DISTANCE (M)	GROUND HEIGHT (M)	PROPOSED HEIGHT (M)	FILL / OVERLAY (M)	CUT (M)
NO-17	1700.000				
NO-16	1600.000				
NO-15	1500.000	3.678			
NO-14	1400.000	2.608			
NO-13	1300.000	3.567			
NO-12	1200.000	2.536			
NO-11	1100.000	2.432			
NO-10	1000.000	2.706			
NO-9	900.000	2.689			
NO-8	800.000	2.802			
NO-7	700.000	2.710			
NO-6	600.000	2.698			
NO-5	500.000	2.715			
NO-4	400.000	2.720			
NO-3	300.000	2.700			
NO-2	200.000	2.787			
-50.000	150.000	2.800	2.850		0.470
NO-1	100.000	3.350	3.124		0.746
NO-0	000.000	3.392	3.672	0.280	0.240
NO 1	100.000	3.505	3.785	0.280	
NO 2	200.000	3.478	3.762	0.234	
NO 3	300.000	3.439	3.728	0.280	
NO 4	400.000	3.366	3.702	0.336	
NO 5	500.000	3.467	3.747	0.280	
NO 6	600.000	3.427	3.711		
NO 7	700.000	3.444	3.733	0.289	
+62.000	762.000	3.464	3.746	0.282	
NO 8	800.000	3.494	3.738	0.284	
NO 9	900.000	3.471	3.715	0.244	
NO 10	1000.000	3.492	3.746	0.256	
NO 11	1100.000	3.543	3.783	0.240	
NO 12	1200.000	3.536	3.794	0.258	
+19.000	1219.000	3.550	3.790	0.240	
NO 13	1300.000	3.632	3.726	0.093	
NO 14	1400.000	3.556	3.642	0.086	
NO 15	1500.000	3.550	3.630	0.080	
NO 16	1600.000	3.437	3.533	0.100	
NO 17	1700.000	3.349	3.429	0.080	
NO 18	1800.000	3.240	3.331	0.091	
NO 19	1900.000	3.244	3.324	0.080	
NO 20	2000.000	3.224	3.337	0.115	
NO 21	2100.000	3.287	3.529	0.242	
+33.000	2133.000	3.320	3.590	0.270	
NO 22	2200.000	3.403	3.673	0.270	

VERTICAL

HORIZONTAL

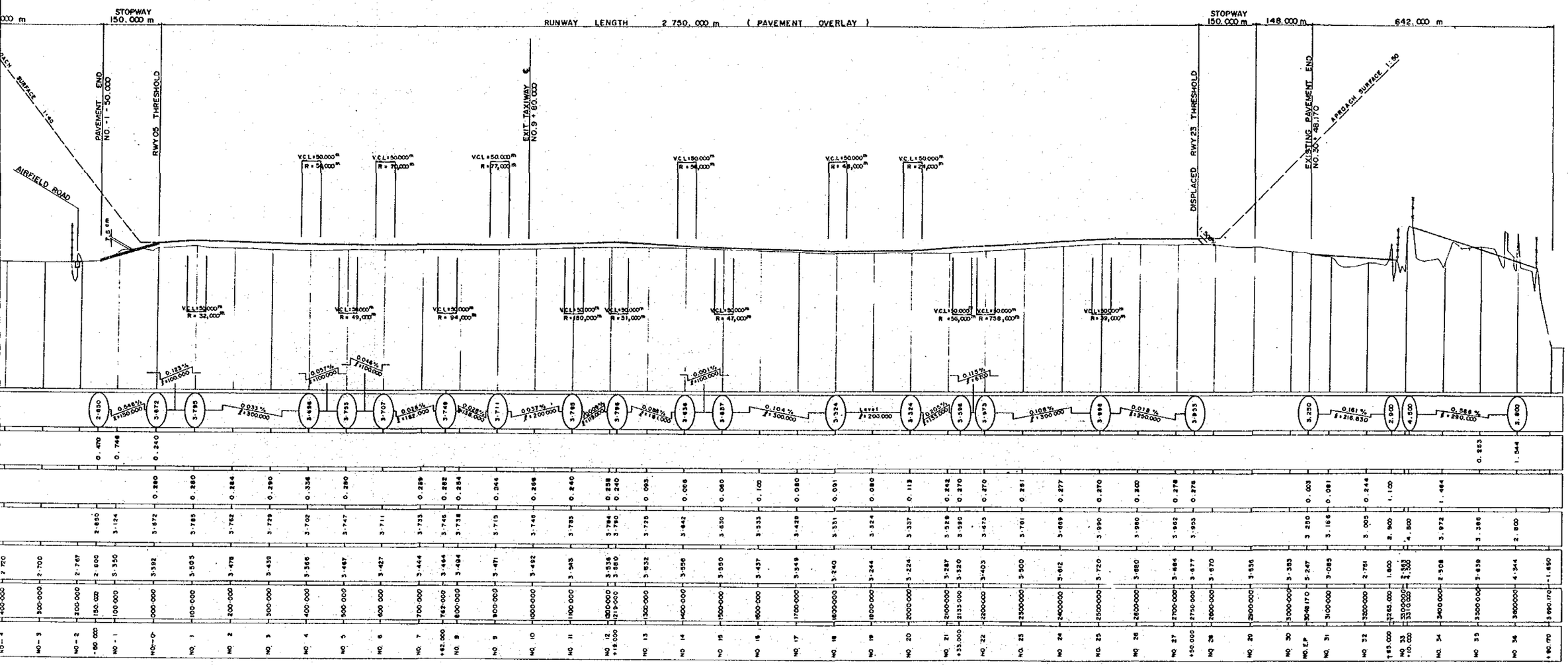


Figure 8.2.1 Runway Profile

8.2.5 Grading Plan

(1) Runway Strip

Phase I development requires a 300 m wide runway strip to be precision approach runway Category-I. The longitudinal and transverse slopes of the existing runway strip conform with ICAO recommendations; hence grading of this area is unnecessary. The portion of the strip more than 75 m from the center line of the runway will be graded up to at least 110 m in compliance with ICAO recommendations.

(2) New Terminal Area

Grading of a new terminal area is determined by following conditions:

- To secure necessary gradient for storm water drainage
- To minimize the volume of earth work
- To facilitate future construction of a parallel taxiway in the future
- To lift the grading elevation of the line of buildings including the passenger terminal, cargo, and administration buildings so as to drain storm water separately to airside and to landside
- To optimize the grading elevation of the apron so as to keep the transitional surface free from the tails of aircraft parked on the apron

The distance between the runway center line and the landside edge of the apron is determined as 360 m based on the above conditions.

And the slope of the pavement are determined as follows:

Apron	: 0.5% downward to the runway
GSE Service Road	: 2% downward to the runway
Terminal Roads	: 2% upward to the passenger terminal building
Car Park	: 0.5% upward to the passenger terminal building

Typical grading section for terminal area is shown in Figure 8.2.2.

(3) **Localizer and Glide Slope Areas**

Areas for localizer and glide slope are planned to be graded in accordance with ICAO and FAA recommendations.

8.2.6 Storm Water Drainage Plan

(1) **Zoning of Catchment Area**

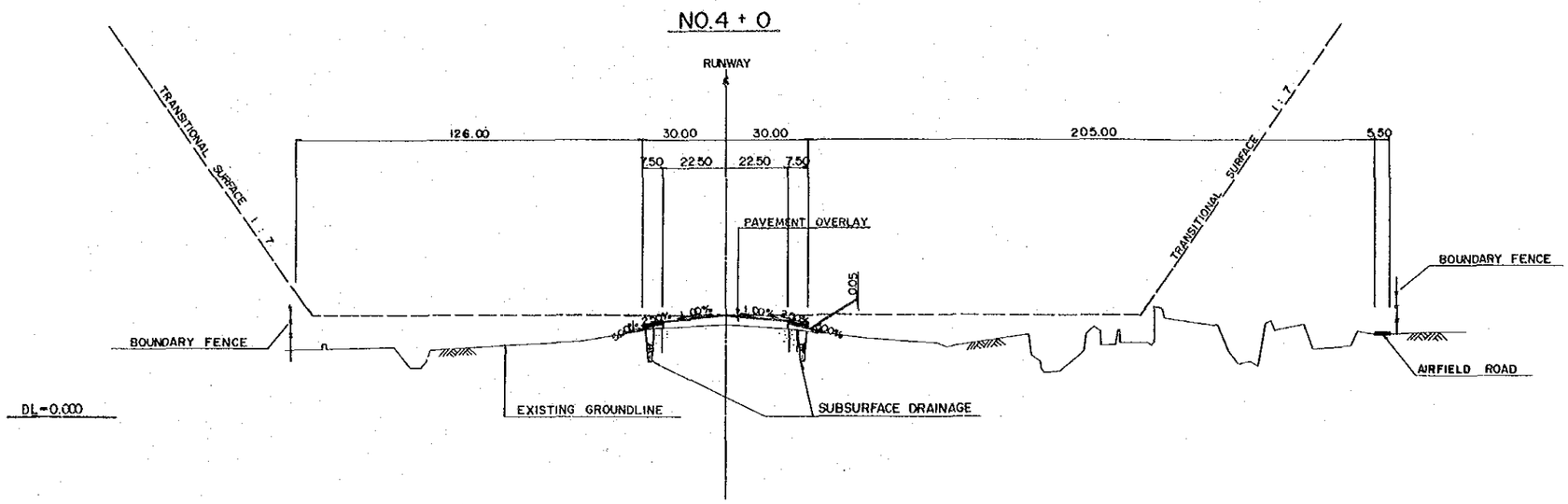
The airport drainage system is planned so as to basically discharge storm water into the Karnafuli River which flows south of the airport.

The catchment area is divided into the following four areas:

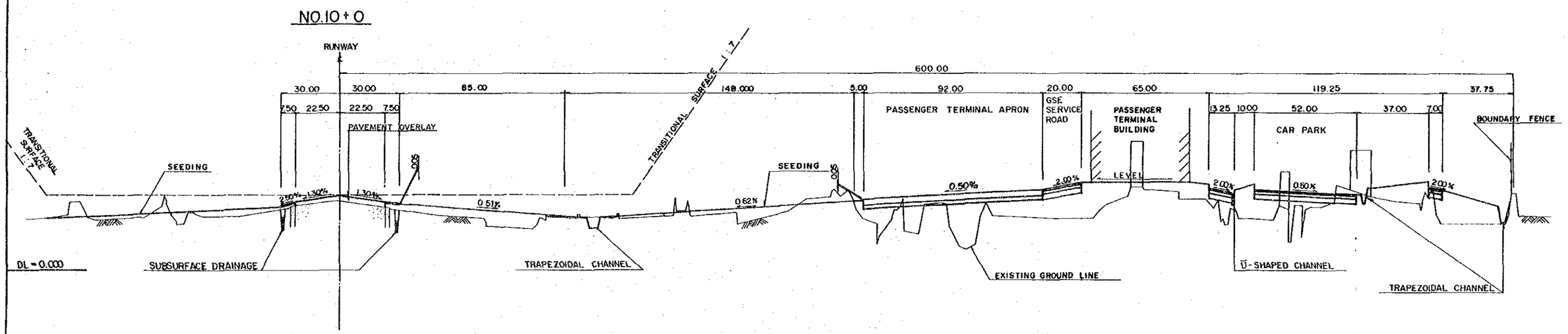
a) Area to the north of the runway ····· (①)
b) Area to the south of the runway and east of the new terminal area ····· (②)
c) Area to the south of the runway and west of the new terminal area ····· (③)
d) New terminal area ····· (④)

Figure 8.2.3 shows the location of the above four areas.

Among the above four areas, all except d) will be drained utilizing the existing drainage system and a new drainage system is planned for the new terminal area in Phase I development.



RUNWAY OVERLAY AND RUNWAY STRIP



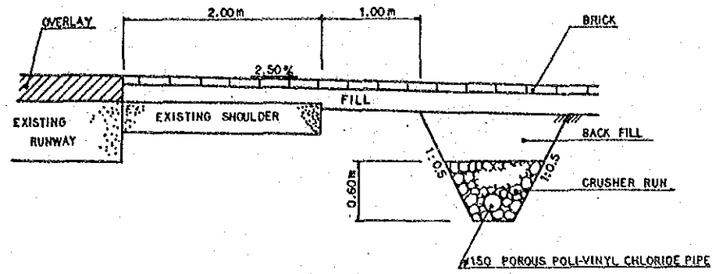
RUNWAY, APRON AND TERMINAL AREA

Figure 8.2.2 Typical Cross Sections

VERTICAL 0 1 2 3 4 5

HORIZONTAL 0 10 20 30 40 50

SCALE IN METERS



SUBSURFACE DRAIN

LEGEND

▬▬▬	BOUNDARY OF CATCHMENT AREA
~~	SUBSURFACE DRAIN (POROUS P.V.C. PIPE φ150)
①~④	NUMBER OF CATCHMENT AREA

Figure 8.2.3 Zoning of Catchment Area

0 100 200 300 400 500
SCALE IN METERS

The volume of storm water discharged into the existing channel which lies on the east of the new terminal area increases due to the construction of the terminal facilities such as buildings and pavement of passenger terminal apron, carpark, etc. However, the existing channel is 20m wide and considered to have enough capacity for discharging the storm water.

(2) **Layout of Drainage Facilities**

New trapezoidal channels which catch the storm water on the airside will be located 130 m away from the center line of the runway in accordance with ICAO recommendations taking account of the location of the parallel taxiway to be constructed in the future. The channels will be protected with brick.

Basically, the trapezoidal channels are adopted at unpaved area and U-shaped channels in paved areas. And the pipe or box culverts are laid across the roads. The storm water drainage plan for the new terminal area is indicated in Figure 8.2.4.

The criteria employed for the storm water drainage plan are summarized as follows:

a) Runoff

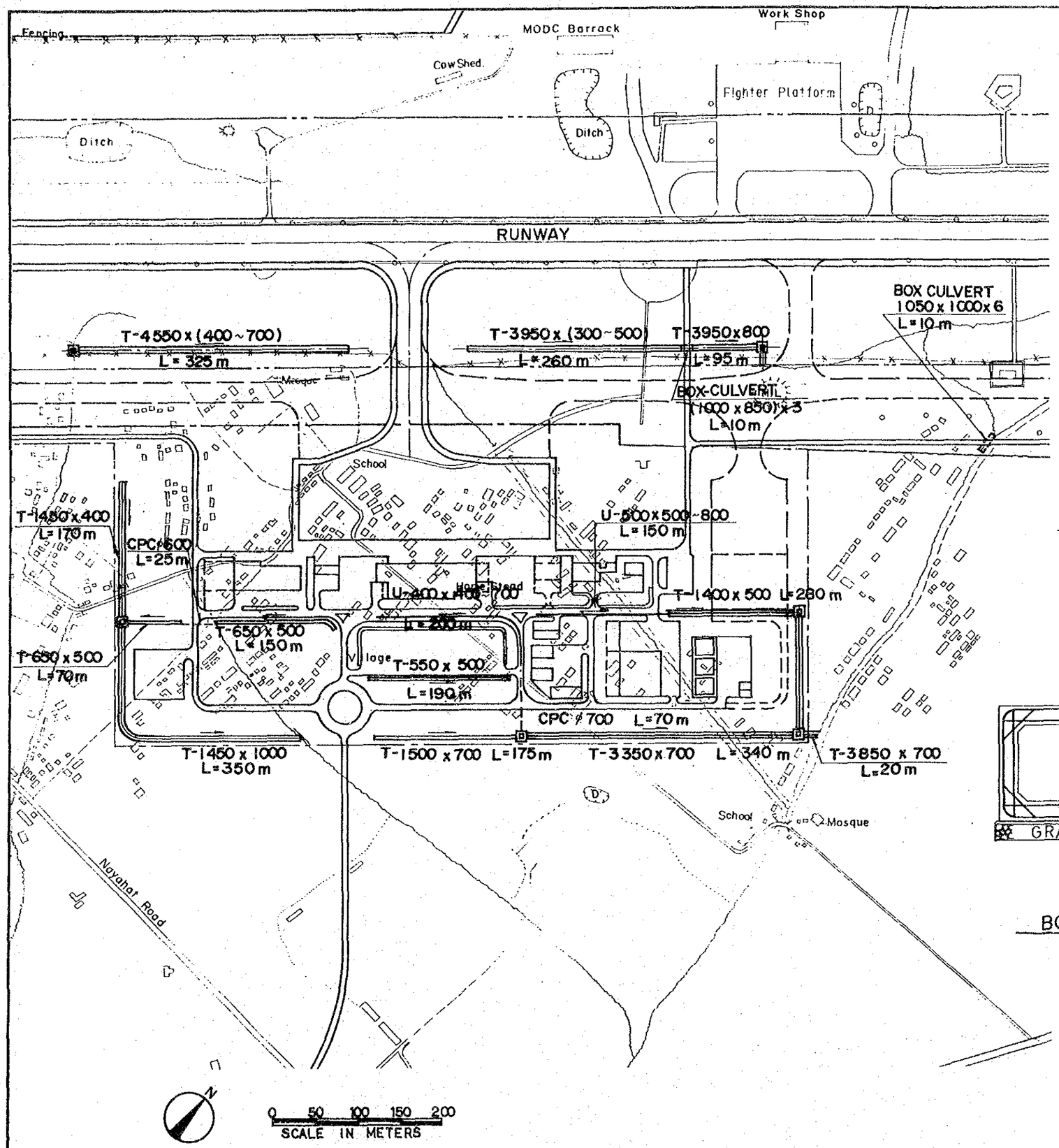
The rational formula is used to estimate runoff.

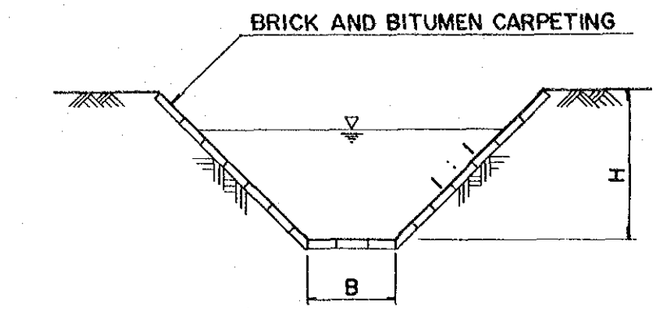
$$Q = \frac{1}{360} CIA$$

where, Q: Runoff (cu.m/sec)
C: Runoff coefficient
I: Rainfall intensity (mm/hr)
A: Catchment area (ha)

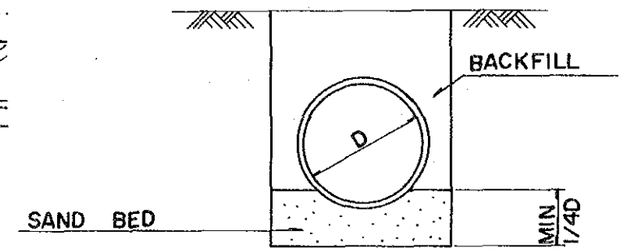
b) Runoff Coefficient

Pavement area : 0.95
Building area : 0.90
Turf area : 0.50 (clayer soil)

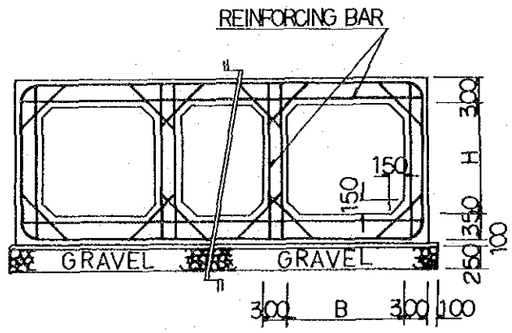




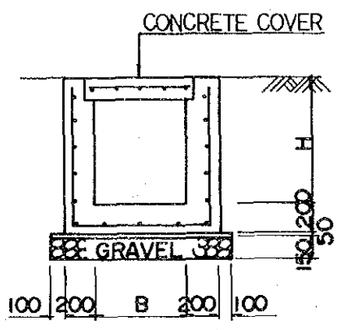
TRAPEZOIDAL CHANNEL
T - (B) x (H)



REINFORCED CONCRETE PIPE
CPC ø(D)



BOX - CULVERT
(B)x(H) x (n)



U-SHAPED CHANNEL
U-(B)x(H)

Figure 8.2.4 Storm Water Drainage Plan

c) Rainfall intensity

Based on the rainfall precipitation data from 1960 to 1968, the following formula was produced to estimate rainfall intensity. The process of estimation is shown in Appendix 8.2.

$$It = \frac{25,900}{t + 180}$$

where, It: Rainfall intensity for "t" times period (mm/hr)
t : Duration of rainfall (minute)

(3) **Subsurface Drainage Plan**

Subsurface drainage will be provided along the existing runway shoulders in order to drop the ground water level and increase the bearing strength of the subgrade. The Subdrain will be laid at least 60 cm below the bottom of the existing pavement as shown in Figure 8.2.3.

Porous poli-vinyl chloride (PVC) pipe 150 mm in diameter will be utilized for the subdrain.

The water will be collected and discharged into the existing canal or trapezoidal channel by the pipe which is laid at right angles to the runway.

8.2.7 **Pavement Plan**

(1) **Types of Pavement**

As mentioned in Section 6.7.1, asphalt concrete pavement is adopted for the runway overlay. Cement concrete pavements is adopted for the passenger terminal apron in order to avoid rutting by maneuvering and standing load of jet aircraft and also to take advantage of its oil-proof character. For the taxiway, cement concrete pavement is adopted based on a comparison of the cost for asphalt and cement concrete pavements as shown below:

Unit Price of Pavement Work

Asphalt concrete pavement : 3,900 Taka per sq.m
Cement concrete pavement : 3,100 Taka per sq.m

Taxiway shoulders, apron shoulders, and stopway will be paved with bricks and carpeted with asphalt concrete. This type of pavement is used on the stopway of Dhaka International Airport.

(2) **Subgrade Condition**

The subgrade conditions were studied based on the result of the soil investigation and the results are shown in Appendix 5.3.

Based on the results of the soil investigation, the design CBR value under the base of the existing runway is set at about 5.5% and the design K-value at the site of the new passenger terminal apron is estimated to be 0.38 kg/cu.cm.

The design CBR for access road and car park is estimated to be 4.0% based on the improvement of its subgrade with 30 cm thickness of qualified sand layer.

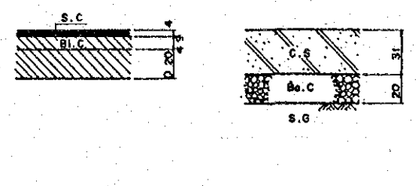
(3) **Pavement Thickness**

The pavement thickness is designed on the basis of the "ICAO AERODROME DESIGN MANUAL PART 3" and is shown in Figure 8.2.5. The applied design criteria for the aircraft pavement are as follows:

Design aircraft : DC-10
Repetition of design load : 1,200 times

The detailed process of calculation of pavement thickness is shown in Appendix 8.1 and 8.2.

The pavement thickness of access road and car park is determined as 28 cm in total under the conditions of low frequent traffic heavy weighted vehicles and CBR 4 % for the subgrade.

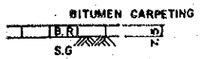


PT - 1

RUNWAY OVERLAY

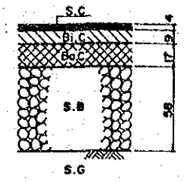
PT-2

TAXIWAY AND APRON



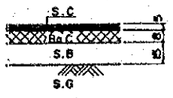
PT-3

SHOULDER AND STOPWAY
AIRFIELD ROAD (BRICK)



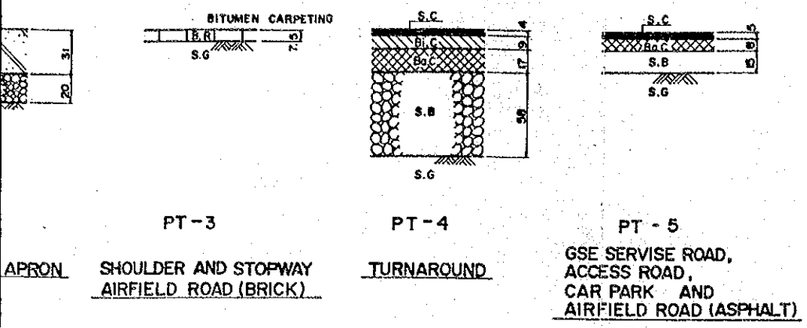
PT-4

TURNAROUND



PT - 5

GSE SERVISE ROAD,
ACCESS ROAD,
CAR PARK AND
AIRFIELD ROAD (ASPHALT)



PT-3

APRON

SHOULDER AND STOPWAY
AIRFIELD ROAD (BRICK)

PT-4

TURNAROUND

PT - 5

GSE SERVISE ROAD,
ACCESS ROAD,
CAR PARK AND
AIRFIELD ROAD (ASPHALT)

LEGEND			
TYPE	SYMBOL	ITEMS	REMARKS
PT - 1		RUNWAY OVERLAY	
PT - 2		TAXIWAY AND APRON	DC - 10
PT - 3		SHOULDER AND STOPWAY AIRFIELD ROAD	ASPHALT PAVEMENT
PT - 4		TURNAROUND	
PT - 5		GSE SERVICE ROAD, ACCESS ROAD, CAR PARK AND AIRFIELD ROAD	

LEGEND		
SYMBOL		ITEMS
	S.C	SURFACE COURSE (ASPHALT CONCRETE)
	Bi.C	BINDER COURSE (ASPHALT CONCRETE)
	Ba.C	BASE COURSE (ASPHALT STABILIZATION)
	Ba.C	BASE COURSE (GRADED AGGREGATE)
	S.B	SUBBASE COURSE (CRUSHER RUN)
	C.S	PORTLAND CEMENT CONCRETE SLAB
	BR.	BRICK
	S.G	SUBGRADE

Figure 8.2.5 Pavement Plan

0 100 200 300 400 500
SCALE IN METERS

8.3 Passenger Terminal Building

8.3.1 Concept

A new passenger terminal building will be used for both international and domestic passengers.

The building, with a total floor area of approximate 5,300 sq.m, is planned for the Phase I development as shown in Figures 8.3.1 and 8.3.2. A linear type concept with a single floor level is employed for the passenger terminal building based on the conceptual facility planning in Section 6.7.3.

8.3.2 Zoning

The new passenger terminal building is devided into four zones, that is, departure and arrival of domestic zones, and departure and arrival of international zones.

In order to create reasonable and functional arrangements for these zones, the following studies are carried out:

(1) Alternative Zonings

Four zones mathematically make 24 permutations, out of which five alternatives were selected as practical cases.

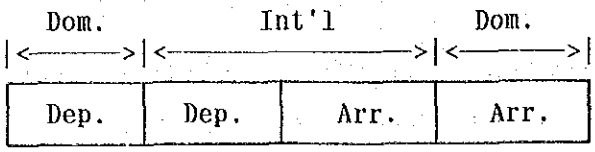
The selected alternatives and the reasons for their selection are explained as follows:

a) Alternatives of Adjacent Departure Zone of Domestic and International

Two alternatives are chosen and shown below. Both domestic and international departure zones are adjacent to each other, so that international and domestic check-in space can be shared. And these departure zones are located on the west side of the building so that departure passengers can be quickly led into

the building from the entrance of access road.

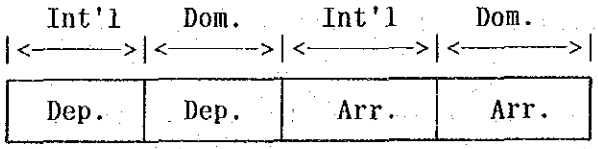
ALT-P1 :



Domestic and international departure zones are arranged on the west side.

CIQ facilities inherent in an internantional passenger terminal building can be put together by adjoining international departure and arrival zones. By this arrangement, the effective use of the CIQ facilities can be expected.

ALT-P2 :

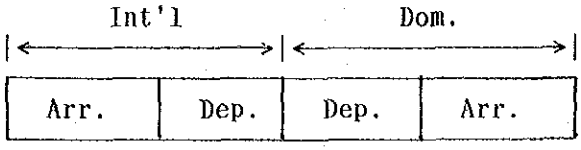


Departure zones are both on the west side, but in this case, the domestic and international departure zones are opposite their ALT-P1 position. This is to allow the domestic departure zone to be near the domestic aircraft stand.

b) Alternatives of International Zone in West Side

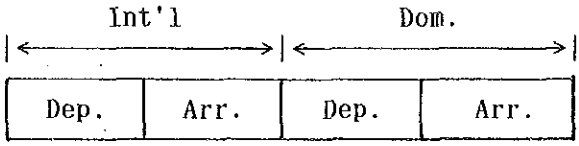
Three alternatives are chosen and shown below, in which the west half of the building is alloted to international zone in consideration of aircraft parking positions on the apron.

ALT-P3 :



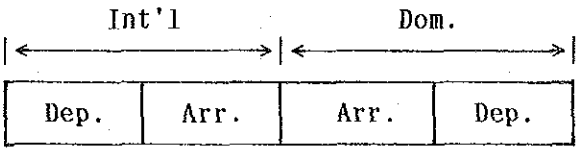
Domestic and international departure zones are next to each other at the building center. This layout promotes effective utilization of the check-in lobby.

ALT-P4 :



The international departure zone to the west of the international arrival zone so as to swiftly guide departure passengers to the building. As for the domestic zone of the east half of the building, the departure zone is also on the west side, next to the international arrival zone.

ALT-P5 :



International and domestic departure zones, in which major future expansion is expected, are arranged at the east and west ends of the building in order to facilitate future expansion.

(2) Comparison of Alternatives and Conclusion

ALT-P2 is selected among the above five alternatives based on the comparison shown in Table 8.3.1.

Table 8.3.1 Comparison for Zoning of Passenger Terminal Building (1)

Note : "G" indicates Good
"F" indicates Fair
"P" indicates Poor

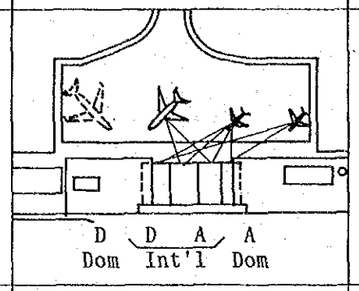
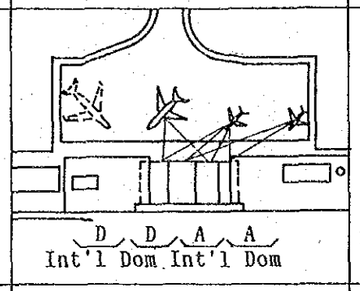
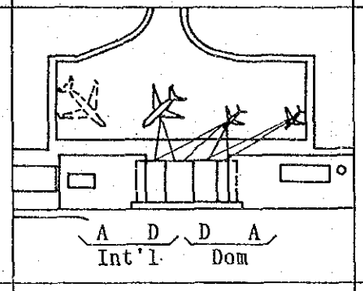
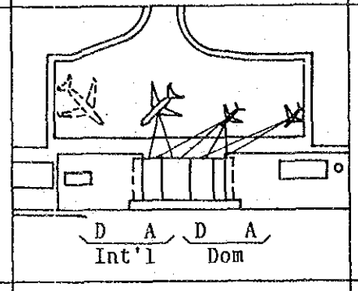
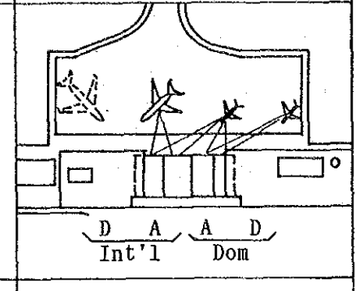
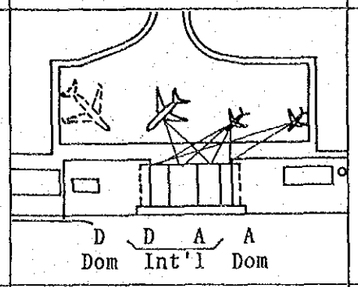
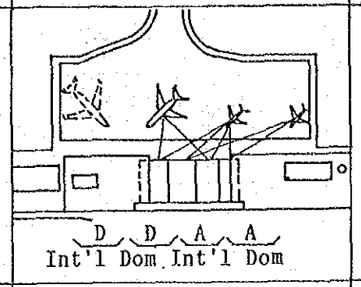
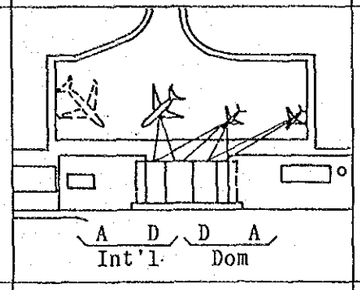
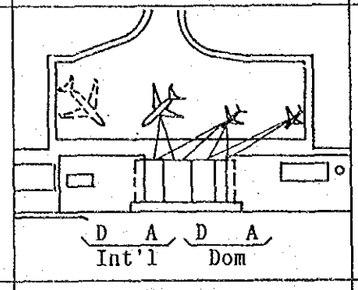
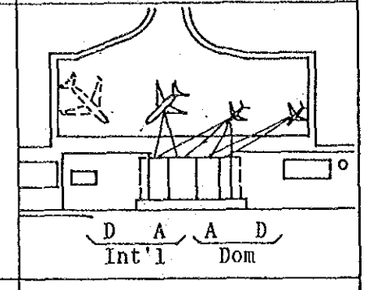
Alternatives		ALT-P1		ALT-P2		ALT-P3		ALT-P4		ALT-P5
										
1. Convenience for Passengers										
1.1 Walking Distance (Maximum distance in airside)	P	About 160m Distance between domestic departure and the farthest aircraft (The longest distance)	F	About 120m Distance between domestic departure and the farthest aircraft (Medium distance)	G	About 95m Distance between domestic departure and the farthest aircraft (Short distance)	G	About 95m Same as ALT-P1 (Short distance)	P	About 95m Distance between domestic arrival and the farthest aircraft (Short distance)
1.2 Crossing of International and Domestic Passengers' Flow on apron	P	There are 6 crossing points. Control of passengers on apron is the most difficult.	F	There are 3 crossing points. Control of passengers on apron is a lititle difficult.	G	No crossing point Control of passengers on apron is easy.	F	Same as ALT-P3 Same as ALT-P3	P	Same as ALT-P3 Same as ALT-P3
1.3 Utilization of Curb Side	G	Departure passengers can be quickly conducted to terminal building. Traffic congestion is few infrequent because of the complete separation of departure and arrival.	G	Same as ALT-P1	P	As arrival zones are separated into east and west, traffic congestion may be caused frequently.	P	The zoning of this alternative is complicated and traffic congestion may be caused frequently.	P	As departure zones are separated into east and west, traffic congestion may be caused frequently.
2. Convenience for Airlines										
2.1 Effective Use of Check-in Lobby	G	As international and domestic departure zones are adjacent, the common use of check-in lobby is possible.	G	Same as ALT-P1	G	Same as ALT-P1	P	Common use of check-in lobby is impossible.	P	Same as ALT-P4

Table 8.3.1 Comparison for Zoning of Passenger Terminal Building (2)

Alternatives		ALT-P1		ALT-P2		ALT-P3		ALT-P4		ALT-P5
										
2.2 Baggage Handling	G	Since baggage handling areas for depature and arrival zones are separated at the middle of building, baggage handling is easy.	G	Same as ALT-P1	F	Since baggage handling areas for arrival zone are divided into east and west ends of the building, baggage handling of arrival is not efficient.	P	Baggage handling procedure is not efficient becuase of a intricate order of departure and arrival zones.	G	Since baggage handling areas for depature zone are divided into east and west ends of the building, baggage handling of departure is not efficient.
3. Convenience for Airport Authority										
3.1 Secutiry	G	Since international and domestic departure zones are adjacent on the west of the building, security operations is effective.	G	Same as ALT-P1	G	Since international and domestic departure zones are also adjacent on the middle of the building, security operation is effective.	F	Security operation is not effective due to the separation of inter-national and domestic departure in the building.	P	Same as ALT-P4
3.2 Operation for C.I.Q. Facilities	G	As C.I.Q. for depature and arrival zones are adjacent, management and operation of C.I.Q. are easy.	F	Although C.I.Q. facilities for departure and arrival are divided, the facilities can be managed and operated in terms of the building size.	G	Same as ALT-P1	G	Same as ALT-P1	G	Same as ALT-P1
4. Expansibility	G	As departure and arrival zones are separated in the building, expansion is easy.	G	Same as ALT-P1	P	As arrival zones are divided into east and west ends of the building, expansion is not so easy.	P	Expansion is not easy because of the complicated order of zoning in the building.	P	As arrival zones are located at the middle part of the building, expansion for the arrival zones is not easy.
5. Overall Evaluation		2nd option - Easy expansion - Effective utilization of curb side - Effective common use of check-in lobby - The longest walking distance and 6 crossing of international and domestic passengers' flow on apron are serious disadvantages.		Most suitable - Easy expansion - Effective utilization of curb side - Effective common use of check-in lobby - Shorter walking distance on the apron as compared with ALT-P1		Not suitable - Not easy expansion - Frequent curb side congestion		Not suitable Same as ALT-P3		Not suitable Same as ALT-P3

8.3.3 Architectural Design

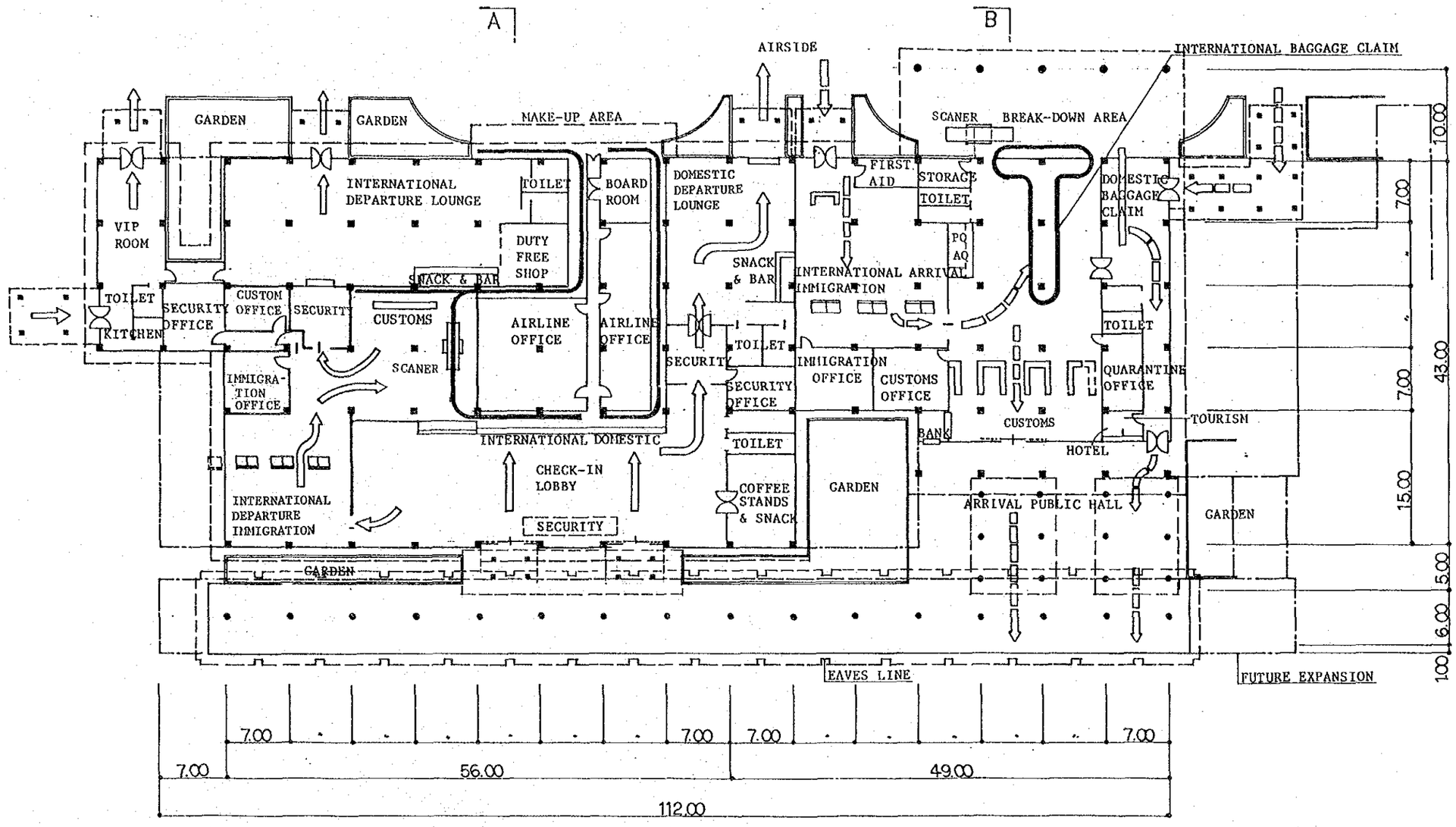
The building will have a modern design and will be equipped with facilities suitable for the second gateway of Bangladesh. Climatic and natural conditions such as high temperature, heavy rainfall, flood, and monsoon will also be considered in the design of the building.

An international baggage belt conveyor is laid out to connect from check-in area to baggage make-up area through departure custom area. By this layout only suspicious baggage judged by custom officer are picked up and checked on the custom counter. The remaining baggages can be conveyed to baggage makek-up area directly.

By the operational requirement of this country, the space of a scanner is reserved in the international baggage break-down area.

A public-address system and airport security system including closed circuit television (CCTV) and electrical auto door are considered necessary and will be installed.

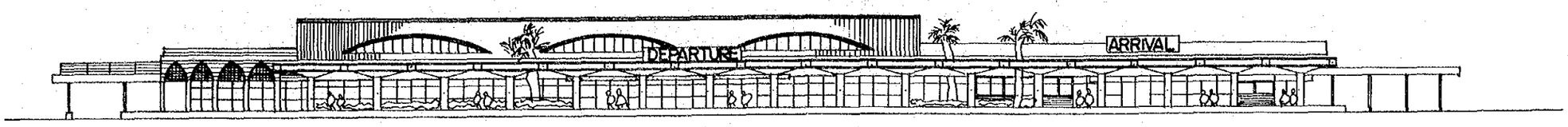
The building will be a reinforced concrete structure with 7.0m x 7.0m standard spans for economical construction.



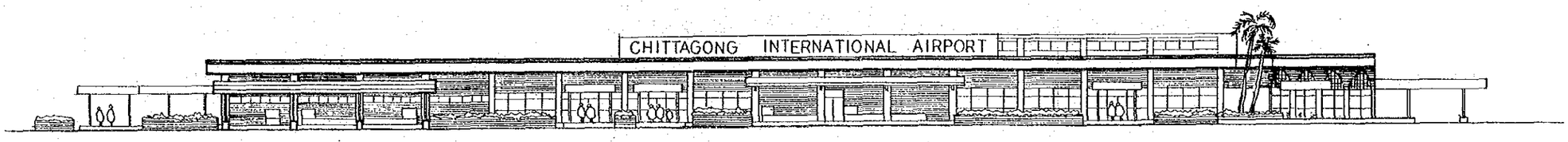
NOTE : This drawing does not bind the final concept of the building.

GROUND FLOOR PLAN

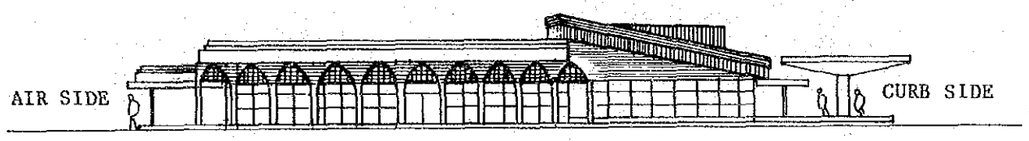
Figure 8.3.1 Passenger Terminal Building Plan



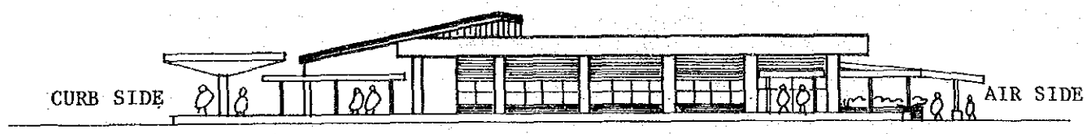
SOUTH ELEVATION (CURB SIDE)



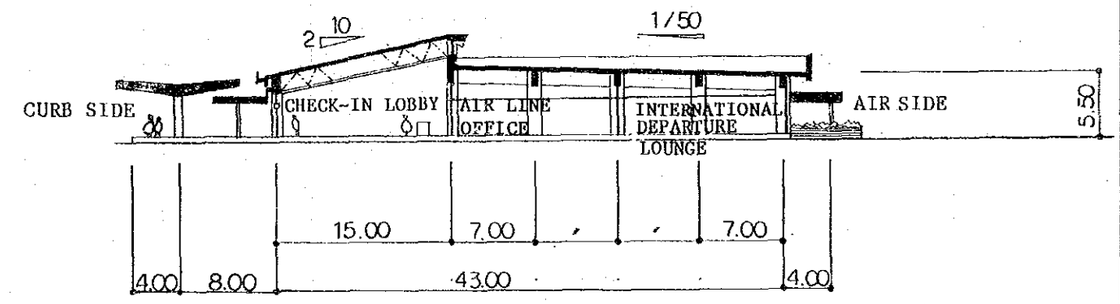
NORTH ELEVATION (AIR SIDE)



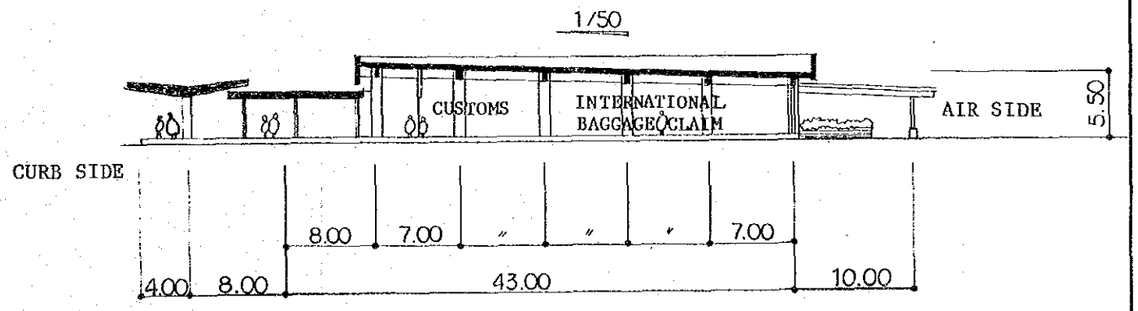
WEST ELEVATION



EAST ELEVATION



A - A SECTION



B - B SECTION

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

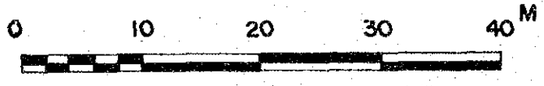


Figure 8.3.2 Passenger Terminal Building Elevation and Sections

8.4 Other Buildings

8.4.1 Cargo Terminal Buildings

A cargo terminal building with a total floor area of approximately 2,000 sq.m is planned for the Phase I development as shown in Figure 8.4.1.

The east side of the building will be a domestic cargo terminal, and international facilities are planned on the west side facing the apron. Offices are located between the domestic and international facilities.

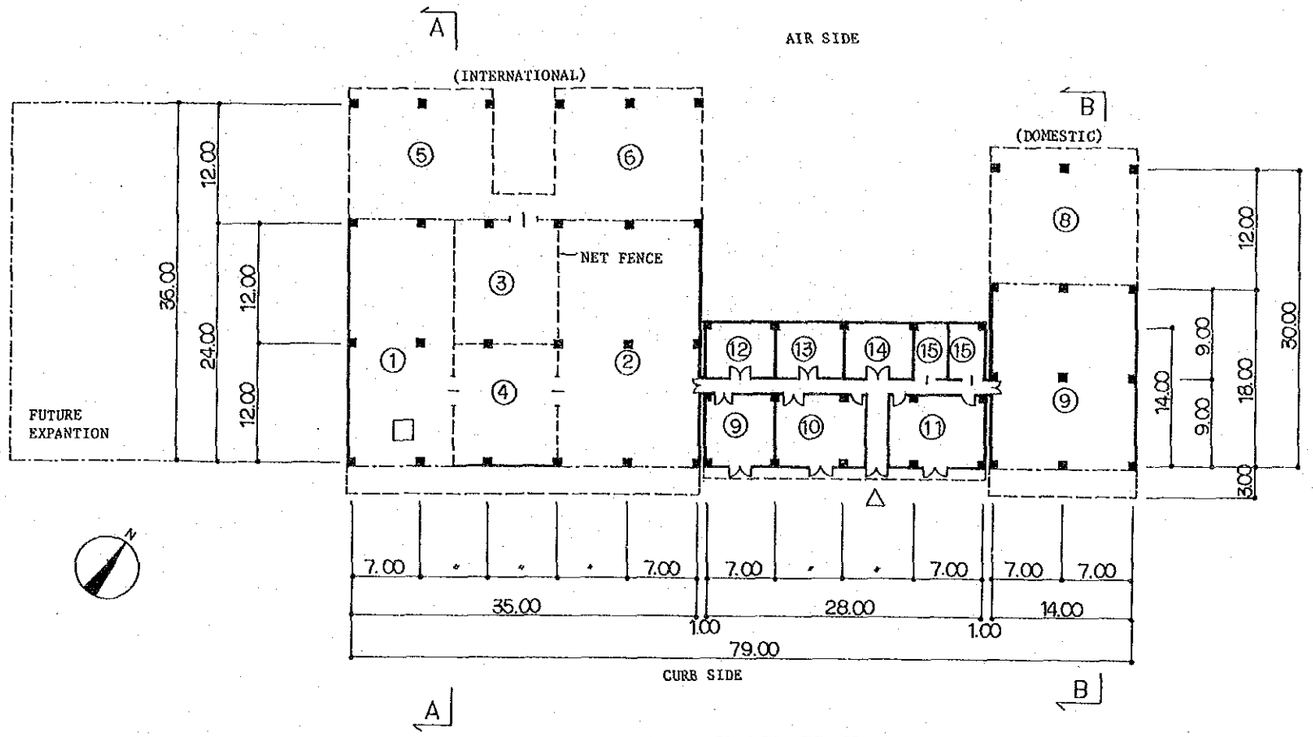
The cargo storage area will be a single story steel frame structure with a high ceiling to permit easy cargo handling, and to be flexible for internal rearrangement and possible future mechanization. The office portion will be a single story reinforced concrete structure.

8.4.2. Operation Center and Control Tower

The operation center and control tower are planned as shown in Figure 8.4.2.

The operation center is planned to be about 1,100 sq.m in total floor area to meet the requirements for the Phase I development. The building will be a two story reinforced concrete structure.

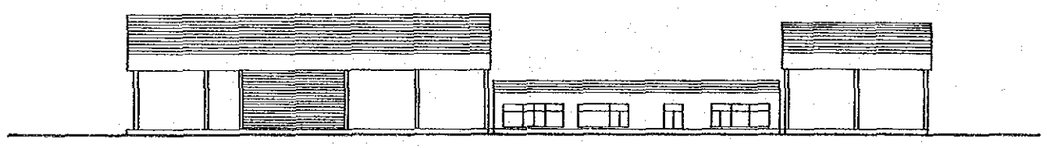
The height of the control tower is planned to be 22m above the proposed ground level (eye level 23.0m above sea level) in compliance with FAA standards. This height was determined so that the runway thresholds may be visible from the VFR room. The control tower is designed to be a reinforced concrete structure and to be structurally capable to accomodate a radome on the roof.



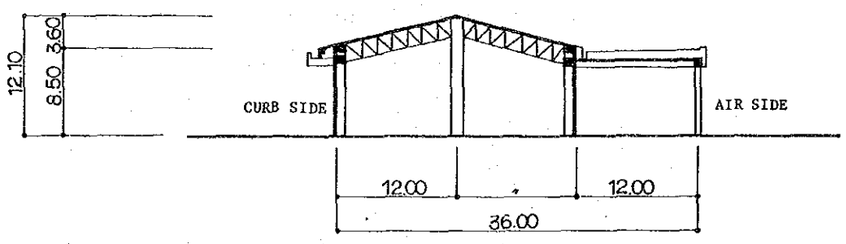
GROUND FLOOR PLAN

LEGEND

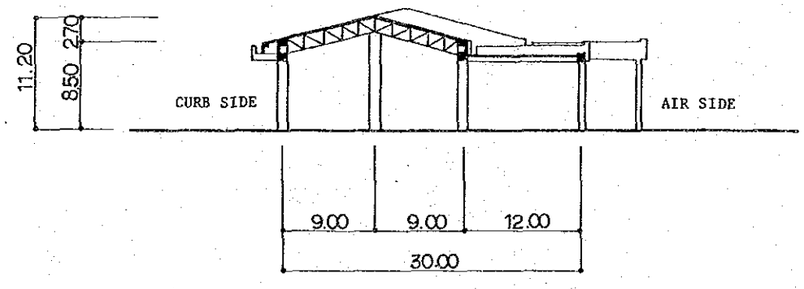
1. OUT-BOUND (INTERNATIONAL)
2. IN-BOUND (INTERNATIONAL)
3. TRANSIT STORAGE (INTERNATIONAL)
4. BOND STRAGE (INTERNATIONAL)
5. MAKE-UP AREA (INTERNATIONAL)
6. BREAK-DOWN AREA (INTERNATIONAL)
7. STORAGE (DOMESTIC)
8. MAKE-UP & BREAK-DOWN AREA (DOMESTIC)
9. CUSTOMS OFFICE
10. AIRLINE OFFICE
11. AGENT OFFICE
12. FREEZER & COLD STORAGE
13. STORAGE
14. SUB-STATION
15. TOILET



SOUTH ELEVATION



A - A SECTION



B - B SECTION

NOTE : This drawing does not bind the final concept of the building.

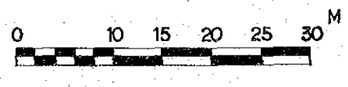
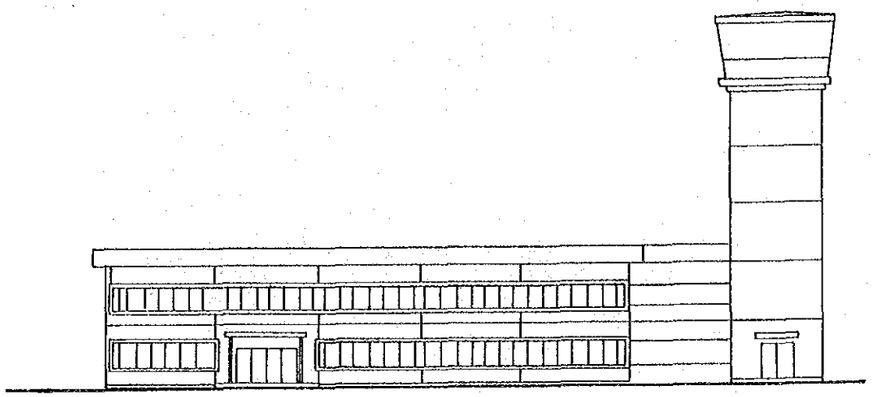
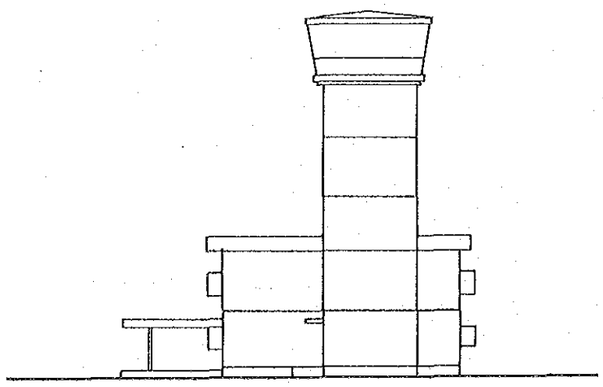


Figure 8.4.1 Cargo Terminal Building Plan



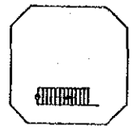
SOUTH ELEVATION



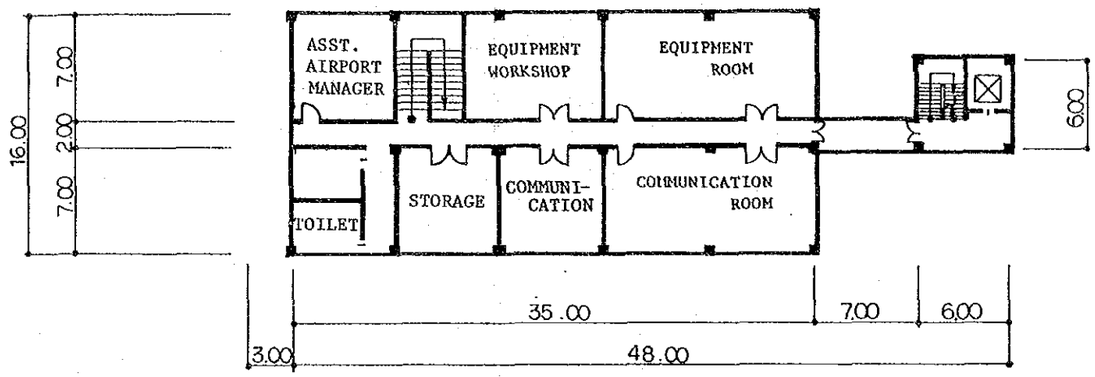
EAST ELEVATION

2ND FLOOR

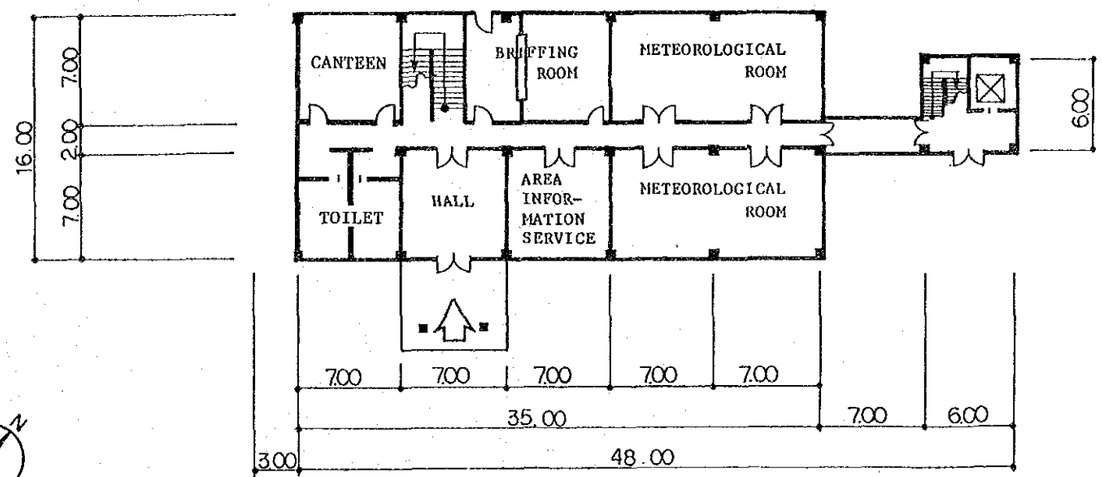
3RD FLOOR



VFR ROOM



FIRST FLOOR PLAN



GROUND FLOOR PLAN

NOTE :This drawing does not bind the final concept of the building.

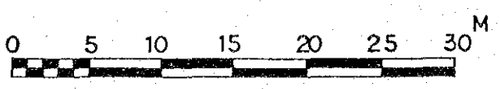


Figure 8.4.2 Operation Center and Control Tower Plan

8.4.3 Administration Building

The administration building is planned as shown in Figure 8.4.3.

The total floor area is estimated to be about 700 sq.m to meet the requirements for the Phase I development. The building will be two story reinforced concrete structure.

8.4.4 Fire Station

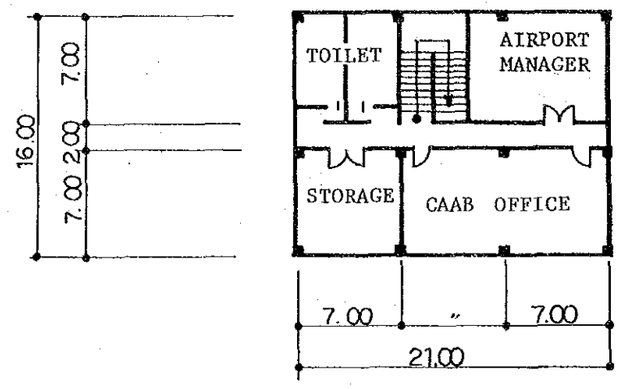
The fire station is planned to have a floor area of approximately 450 sq.m so as to accommodate two major vehicles, one rapid intervention vehicle, one fire jeep, and two ambulance cars.

The fire station will be a one story reinforced concrete structure. The floor and elevation plan is shown in Figure 8.4.4.

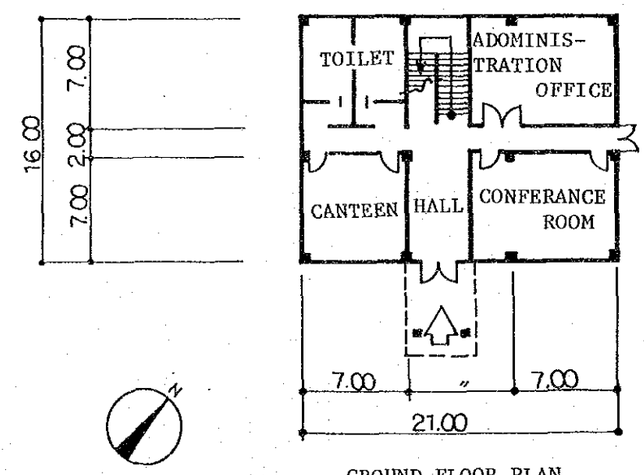
8.4.5 Airport Maintenance Building

The airport maintenance building is planned to have a floor area of 300 sq.m, the same as the existing airport maintenance building. The building will be a one story reinforced concrete structure.

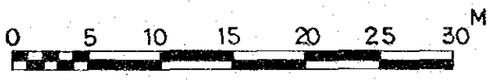
A garage will be provided for the airport administration and maintenance vehicles adjacent to the building. The garage will have a floor area of approximately 170 sq.m to accommodate the vehicles presently owned by the airport. The structure is planned to be reinforced concrete.



FIRST FLOOR PLAN

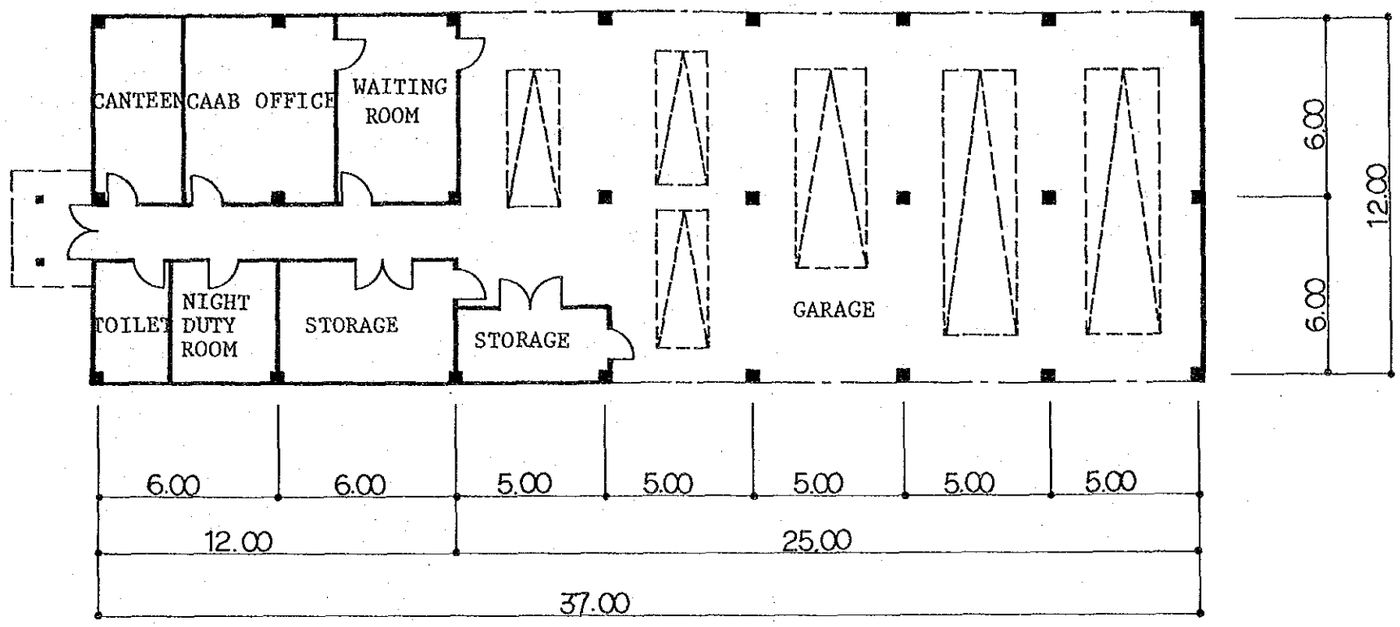


GROUND FLOOR PLAN

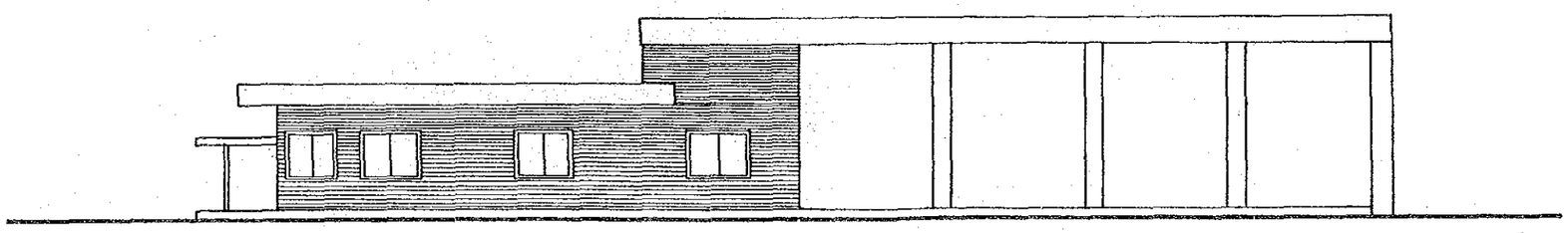


Note : This drawing does not bind the final concept of the building.

Figure 8.4.3 Adiministration Building Plan



GROUND FLOOR PLAN



SOUTH ELEVATION

NOTE . This drawing does not bind the final concept of the building.

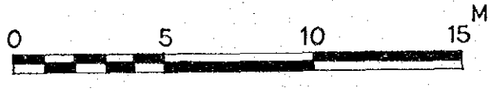


Figure 8.4.4 Fire Station Plan

8.5 Access Road and Car Park

8.5.1 Airport Access Road

The airport access road is planned to be connected with Patenga road at the point to the south of the new terminal area, as shown in Figure 8.5.1. The total length of the road to be constructed is about 600 m.

The width of the access road with one lane for each direction is designed to be 6 m with a 0.5 m wide shoulder on each side.

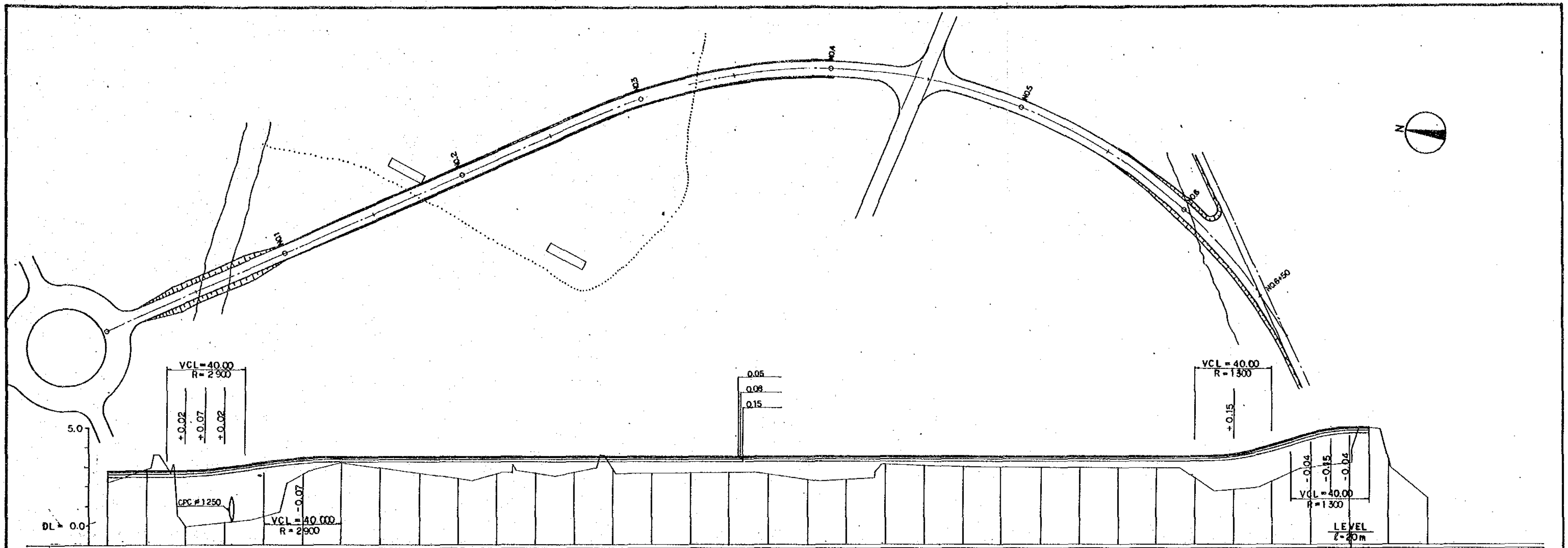
Asphalt concrete is adopted for the pavement of the access road by economical reason.

The shoulders will be covered with weeds.

8.5.2 Terminal Roads and Car Park

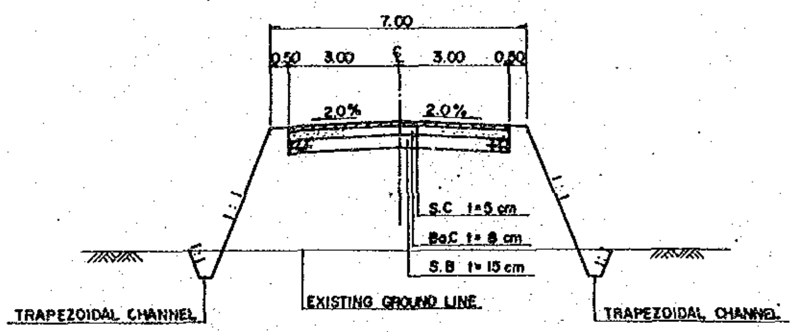
In order to minimize parking space, a 90^{o} parking configuration is adopted for this plan. The dimensions of the unit parking space are 5 m x 2.5 m and the width of the aisle in the parking area is determined to be 6 m.

The width of the terminal roads with two lanes are designed to be 7 m except for the terminal frontage road. The terminal frontage road consists of two through traffic lanes, one weaving lane and one standing lane, and is 13.25 m in width.



GRADIENT	2.80	LEVEL ℓ=50m	2.80	i=1.4% ℓ=50m	3.50	LEVEL ℓ=480m	3.50	i=3.00% ℓ=50m	5.00	5.00

STATION	ACCUMULATED DISTANCE (M)	GROUND HEIGHT (M)	PROPOSED HEIGHT (M)	FILL (M)	CUT (M)
NO. 0	0.0	2.2	2.80	0.32	
+20	20.0	2.9	2.80		0.38
+40	40.0	-0.1	2.82	2.64	
+50	50.0	0.0	2.87	2.59	
+60	60.0	0.1	2.96	2.58	
+80	80.0	0.4	3.22	2.54	
NO. 1	100.0	2.7	3.43	0.45	
+20	120.0	3.2	3.50	0.02	
+40	140.0	2.9	3.50	0.32	
+60	160.0	2.7	3.50	0.52	
+80	180.0	2.4	3.50	0.82	
NO. 2	200.0	2.6	3.50	0.62	
+20	220.0	2.7	3.50	0.52	
+40	240.0	2.7	3.50	0.52	
+60	260.0	2.8	3.50	0.42	
+80	280.0	2.7	3.50	0.52	
NO. 3	300.0	2.7	3.50	0.52	
+20	320.0	2.7	3.50	0.52	
+40	340.0	2.6	3.50	0.62	
+60	360.0	2.3	3.50	0.92	
+80	380.0	2.3	3.50	0.92	
NO. 4	400.0	3.1	3.50	0.12	
+20	420.0	3.0	3.50	0.22	
+40	440.0	3.0	3.50	0.22	
+60	460.0	3.0	3.50	0.22	
+80	480.0	3.0	3.50	0.22	
NO. 5	500.0	2.9	3.50	0.32	
+20	520.0	2.9	3.50	0.32	
+40	540.0	2.9	3.50	0.32	
+60	560.0	2.4	3.50	0.82	
+80	580.0	1.8	3.65	1.57	
NO. 6	600.0	2.2	4.10	1.62	
+20	620.0	3.0	4.66	1.38	
+30	630.0	3.0	4.85	1.57	
+40	640.0	3.2	4.96	1.48	
+50	650.0	5.0	5.00		0.28



TYPICAL CROSS SECTION

Figure 8.5.1 Access Road Plan

VERTICAL 0 1 2 3 4 5
HORIZONTAL 0 10 20 30 40 50
SCALE IN METERS

8.6 Air Navigation Systems

Preliminary design for the air navigation systems was carried out based on studies of the existing facilities and master plan. The system diagram and layout plan are shown in Figure 8.6.1 and 8.6.2.

8.6.1 Radio Navigation System

(1) VOR/DME

A new VOR/DME is planned to replace the existing one. Doppler type VOR is selected for the following reasons:

- to improve the accuracy of the radar system by reducing the influence of a hill located 4 km to the east,
- to improve the accuracy of the radar system by reducing the influence of flood water that occasionally surrounds the existing C-VOR/DME site.

This equipment will be located 135 m from the threshold of runway 23 and 250 m south of the runway centerline so as to allow for a straight-in approach for both runway 05 and 23.

(2) NDB

The existing NDB equipment will be relocated to the west of the terminal area to back-up navaid for DVOR/DME and homing beacon.

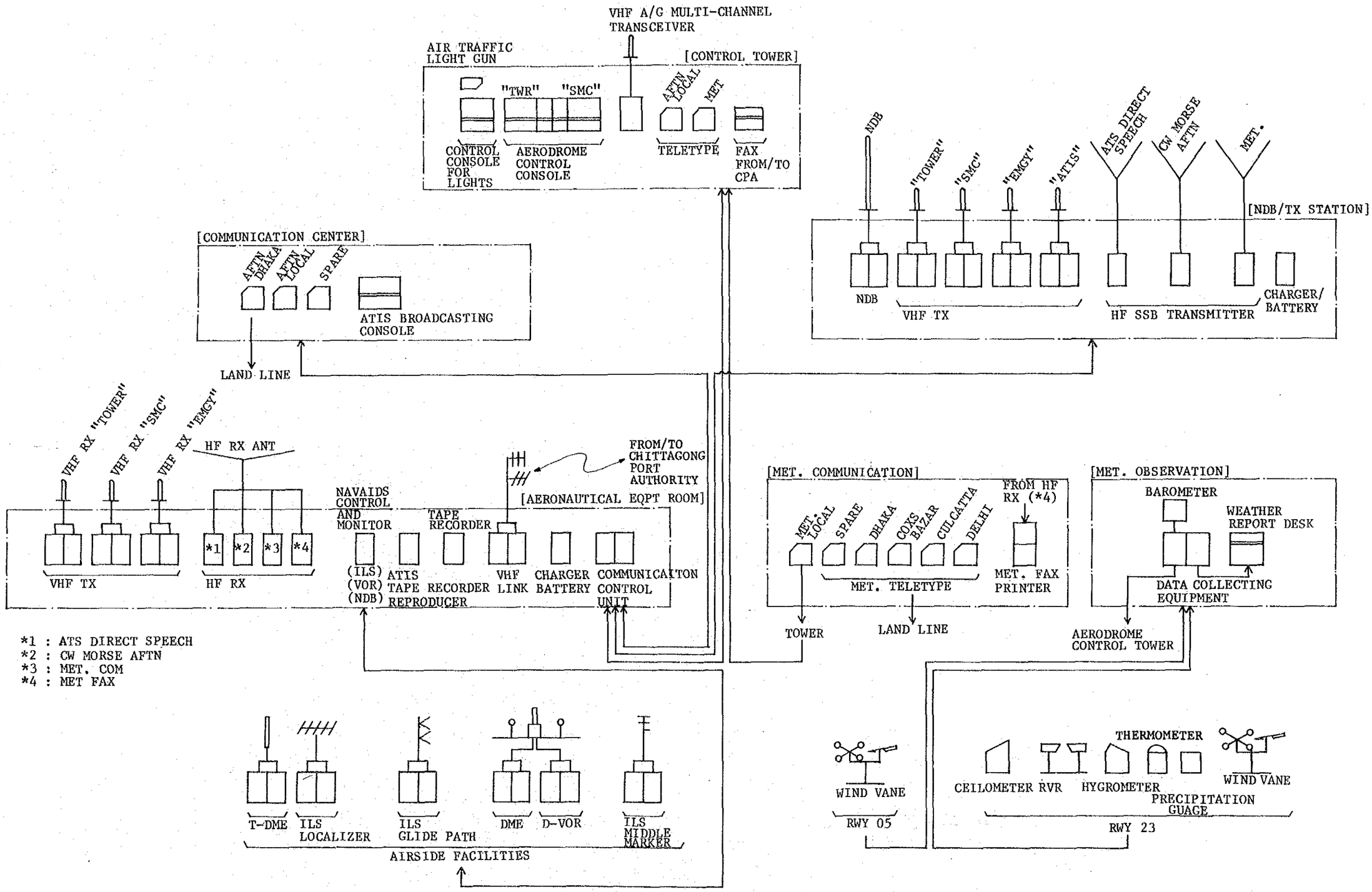


Figure 8.6.1 System Diagram of Air Navigation Systems

LEGEND	
□ S.S	SUB STATION
———	POWER CABLE (LT)
———	POWER CABLE (11kv)
———	TELECOM. CABLE

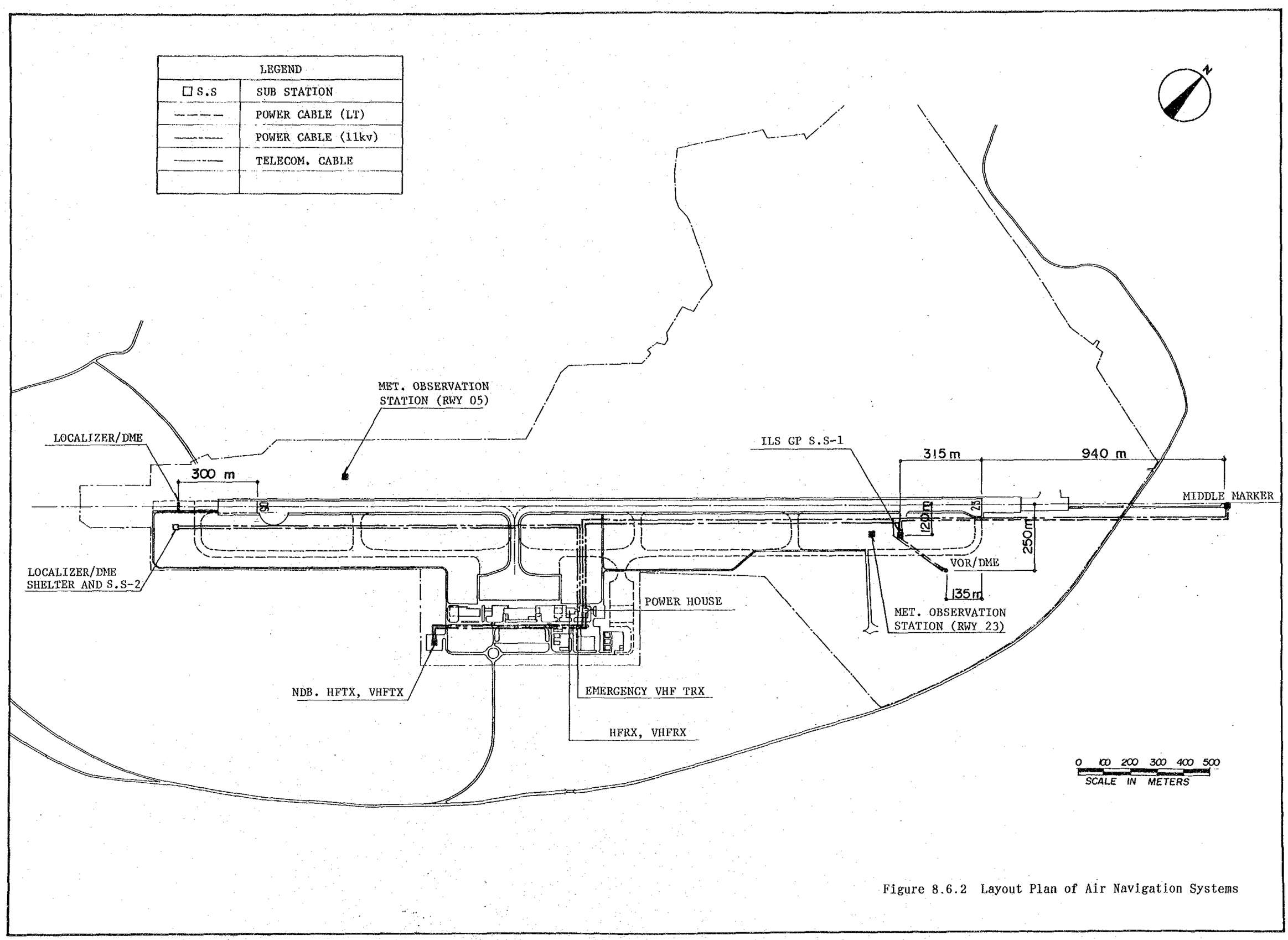


Figure 8.6.2 Layout Plan of Air Navigation Systems

(2) ILS

ILS will be provided to meet the operational condition of the precision approach category I if CAAB can and will provide the appropriate organization for the operation and maintenance of the equipment.

ILS/LLZ and GP is planned at the standard location based on the JCAB and FAA standard.

The middle marker is planned to be 930 m from the runway threshold on the extended centerline of the runway 23.

The DME co-located with LLZ is planned to allow approaching aircraft to establish the meeting point with the glide slope for the descent, and to avoid radiation interference by DME co-located with VOR because of the close range.

8.6.2 **Aeronautical Telecommunication and Air Traffic Control System**

The system concept of the aeronautical telecommunication and air traffic control system is the same as the existing one. The transmitter antennas for VHF air to ground communication is planned at the NDB station site. The receiver antennas site is planned on the roof of operation center. The emergency transmitter and receiver is planned independently because of its important function. The existing one will be used with other frequencies by using a multi-channel VHF transceiver.

A multi-channel VHF transceiver is planned at the Aerodrome Control Tower to back up the VHF air to ground communications and to maintain the existing function of aerodrome flight information service. A HF-SSB communication system is also planned for the aeronautical fixed service by CW morse and ATS direct speech aeronautical fixed services. The transmitter and receiver sites are planned at the NDB station site and on the roof of the operation center respectively.

This HF SSB communication system includes a channel for meteorological service because this function is provided at the existing meteorological observation room to communicate with the Dhaka Office. This room is planned to be located in the new operation center.

An Automatic Terminal Information Service (ATIS) is planned in order to upgrade service to a level commensurate with its classification as the alternative airport to ZIA.

The development of an aerodrome control console and the provision of a communication control unit are planned so as to cope with the development of Aeronautical Telecommunication and Air Traffic Control System.

A magnetic tape recorder with 12 channels is also planned to be newly installed to provide recording capacity for new communication systems.

A VHF link, facsimile and direct telephone line are planned to maintain the reliability of the communication between the aerodrome control tower and the Communication Center of Chittagong Port Authority for the control of the oceangoing ships on Karnafuli River.

8.6.3 Aeronautical Ground Lights

Replacement of all the existing aeronautical ground lights is planned to meet the requirements for a precision approach runway, Category I. The layout plan is shown in Figure 8.6.3.

(1) Approach Lighting System (ALS)

An approach lighting system for runway 23 is planned by the precision approach runway Cat-I lighting system with the barrette center line system. A simple approach lighting system is planned for runway 05.

(2) **Precision Approach Path Indicator (PAPI)**

A precision approach path indicator is planned for both runways 05 and 23.

(3) **Runway Edge Light**

A high intensity runway edge light is planned to meet the performance of Category I.

(4) **Runway Wing Bar Threshold and End Lights**

Precision threshold, wing bar and end lights are planned for runway 23. None-precision threshold and end lights are planned for runway 05.

(5) **Other Lights**

Taxiway edge and turnaround pad lights are planned. Illuminated wind directional indicator lights are planned on both runway 05 and 23. An aerodrome beacon is planned at the NDB site by the exclusive post. Five sets of high pressure sodium and metal halydo lights are to be installed on the apron to light the 4 parting spots.

(6) **Control Panel and Others**

The logical control panel, constant current regulator and power distribution board for the aeronautical ground lights are to be located in the power house. The control console for aeronautical ground lights is to be located in the control tower.

LEGEND	
———	MAIN CABLE ROUTE (DIRECTLY BURIED)
▭	DUCT
○	RUNWAY EDGE LIGHTS WHITE/WHITE
◑	RUNWAY EDGE LIGHTS WHITE/RED
●	TAXIWAY EDGE LIGHTS
▭	APPROACH LIGHTS
⌒	APRON FLOODLIGHTS
-○-	AERODROME BEACON

ILLUMINATED WIND DIRECTION INDICATOR

RUNWAY END LIGHTS & THRESHOLD LIGHTS (NON-PRECISION)

SIMPLE APPROACH LIGHTING SYSTEM

PAPI 05

05

RWY DUCT

RUNWAY EDGE LIGHTS

RUNWAY END LIGHTS & THRESHOLD LIGHTS (PRECISION)

STOPWAY LIGHTS

23

PAPI 23

STOPWAY LIGHTS

TURNAROUND PAD EDGE LIGHTS

TWY DUCT

TAXIWAY EDGE LIGHTS

RUNWAY WING BAR LIGHTS

ILLUMINATED WIND DIRECTION INDICATOR

TURNAROUND PAD EDGE LIGHTS

APRON FLOODLIGHTS

POWER HOUSE

AERODROME BEACON

Figure 8.6.3 Layou

LEGEND	
———	MAIN CABLE ROUTE (DIRECTLY BURIED)
▭	DUCT
○	RUNWAY EDGE LIGHTS WHITE/WHITE
◐	RUNWAY EDGE LIGHTS WHITE/RED
●	TAXIWAY EDGE LIGHTS
▭	APPROACH LIGHTS
⩍	APRON FLOODLIGHTS
-☼-	AERODROME BEACON

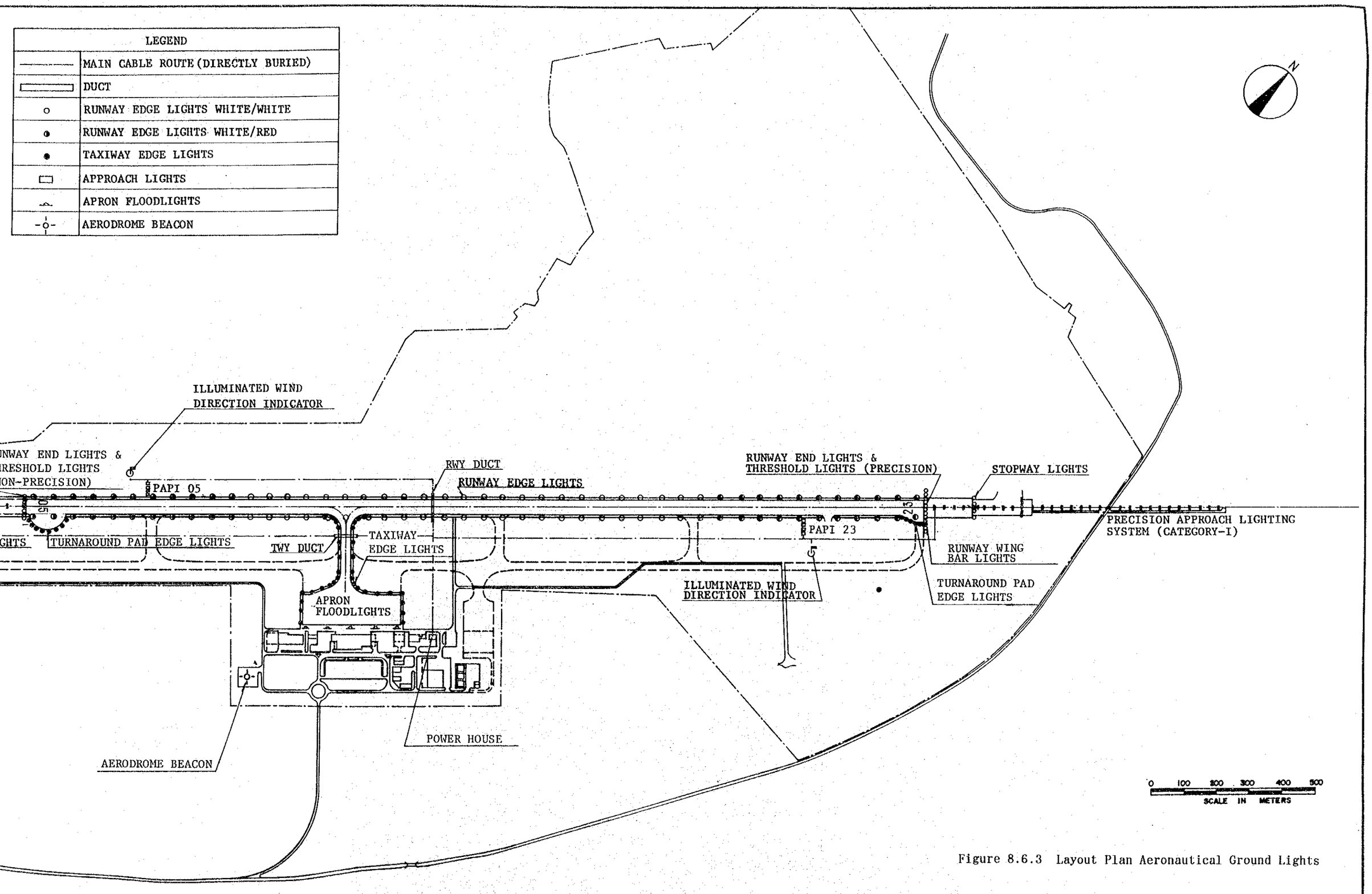


Figure 8.6.3 Layout Plan Aeronautical Ground Lights

8.6.4 Meteorological Observation System

All meteorological observation systems and equipment are to be replaced by new ones. The design is based on Annex-3 of ICAO.

(1) Field Weather Equipment

The following equipment is planned in the observation station of runway 23.

- Wind sensor (Speed/direction)
- Thermometer/hygrometer
- Precipitation gauge
- Transmissometer (RVR)
- Ceilometer

In the observation station of runway 05 only wind sensor (speed/direction) is planned.

(2) Data Processing System

An automatic data collecting and recording system is planned to process the weather data transmitted from the field weather sensors. A branch LED display is planned at the aerodrome control console to display the data of QNH, wind direction, wind speed and RVR. A weather report desk is also planned to include a video weather data display unit, a computer and keyboard and weather report printer.

(3) Others

Five automatic send and receive radio teletypwriters are to be installed. A HF-SSB transmitter and receiver, a HF facsimile receiver and printer are also planned to provide services provided by existing equipment without disruption.