CHAPTER 6 EVALUATION OF EXISTING AIRPORT FACILITIES

[illegible]

CHAPTER 6 EVALUATION OF EXISTING AIRPORT FACILITIES

6.1 SUMMARY

This chapter describes the existing condition of airport facilities as of September 1995 and any major deficiencies. The evaluations were made by comparing the existing conditions and future requirements established in Chapter 4. Table 6.1.1 summarises the results of the evaluation of the major airport facilities by showing the anticipated time of saturation in which the existing facility will reach its maximum capacity.

Table 6.1.1 Evaluation of Existing Airport Facilities

Year Facility		2000	2005	2010	2015	Remarks
Runway						Weight restriction due to insufficient length. Traffic volume justifies short second runway in 2005.
Taxiway						Full parallel taxiway is required before 2000. Holding bays are required before 2015.
Apron						Capacity must be increased as demand grows. A1 expansion will be sufficient by 2005.
Passenger Terminal Building	x					Current peak hour traffic exceeds capacity. T1 will saturate before 2005.
Cargo Terminal Building	x					Insufficient capacity. Existing Pax Building to be converted for cargo will saturate before 2005.
Access Road						Capacity is sufficient beyond 2015.
Car Park	x					Existing carpark is overflown in peak hours. Car park for T1 will not be enough.
Radio Navigation Aids	x					Old equipment needs replacement. There is no automatic monitor system.
ATC & Communication System	x					Existing tower is a temporally one. New tower will suffice requirements beyond 2015.
Airfield Lighting System	x					SALS and PAPI are not provided for RWY29.
Meteorological Observation System	x					There is no RVR and ceilometer at present. They are to be installed in 1995.
Power Supply System						Power supply capacity must be increased as airport developed.
Telephone System						99% of capacity is used.
Water Supply System						Supply capacity is sufficient. Distribution network must be extended as airport developed.
Waste Disposal System	x					No treatment of waste water is made. Incineration of waste from aircraft is required.
Rescue & Fire Fighting						Level of protection must be improved as aircraft movements increase.
Aviation Fuel Supply						Storage capacity must be increased as demand increases.

x : Demand already exceeds the existing capacity.

: Existing capacity is sufficient for accomodating the anticipated demand.

: Existing facility is sufficient for accomodating the anticipated demand with some restriction.

: On going project will meet the anticipated demand.

6.2 RUNWAY, TAXIWAY AND APRON

6.2.1 Runway

The orientation of the existing runway is 107°/287°, providing a wind coverage of more than 99% with a 20 kt cross wind. The dimensions of the runway are 3,200 m x 45 m. It generally meets ICAO Standards and Recommended Practices.

The existing runway length of 3,200 m is insufficient for operating a B747-200B at the maximum take-off weight. It allows take-off of a B747-200B with a weight of about 334.9 tons. The weight restriction is equivalent to about 29% of the maximum payload. If it is operated at the maximum payload, the length of haul would be restricted to within 5,600 km (such as Dubai, approximately 5,200 km from Hanoi). Longer flights such as Hanoi - Moscow, approximately 6,700 km, at the maximum payload would require a technical stop. Details of the calculations are shown in Appendix 6.2.1. A second runway would become desirable in the year 2005 for reasons of demand and capacity as described in Section 5.2.2.

The existing runway was originally constructed in 1962 as a 2,800 m long runway with 28 cm thick cement concrete slabs on a 20 cm sand-cement stabilised base course. This portion was overlaid with 22 cm thick cement concrete slabs in 1976, when the runway was extended to the East by 400 m. The extended portion of the runway has 40 cm thick cement concrete slabs. The Pavement Classification Number (PCN) in the AIP is PCN 54 R/B/W/U. The CAAV recently quoted PCN 60 to 70 R/C/W/U. The assessment of the Study Team is PCN 73 R/D/W/U, since the bearing capacity of subgrade is very low. These PCNs are sufficient, however, for operation of a B747-200B at the maximum allowable take-off weight from the existing 3,200 m long runway. The pavement is generally in good condition except for some minor damage.

A paved shoulder, 7.5 m wide, is provided at each side of the runway. There is no paved stopway (except for 15 m on the Runway 29 end).

6.2.2 Runway Strip and Runway End Safety Areas

The AIP states that the dimensions of the runway strip are 4,000 m x 300 m. It is, however, appropriate to consider only 3,320 m x 300 m as the runway strip, since there is no paved stopway. These dimensions meet ICAO's recommendation for an instrument runway.

6.2.3 Obstacle Limitation Surfaces

The classification of the NBIA is 4E in accordance with Annex 14, Aerodromes, ICAO, and it is equipped with a Category-I ILS. Figure 6.2.1 shows the obstacle limitation surfaces at the NBIA based on these conditions. A study of obstacles was made on geographical maps with a scale of 1/50,000. An interim finding of the study indicates no obstacles, except for the mountains, N. Dom and N. Con Ca (246 m and 200 m above mean sea level respectively), approximately 6 km (3.3 NM) north of the Airport projecting from the conical surface. The mountains would, however, not adversely affect the safety of aircraft operations.

6.2.4 Taxiway and Taxiway Strip

The existing taxiway system is sufficient for the current level of traffic and consists of the following:

a) Y-shape taxiways (S3, S4 and S5) with its stub at 1,460 m from the Runway 29 threshold connecting the runway and apron. It has been used since 1981.
b) An exit taxiway (S2) at 600 m from the Runway 29 threshold constructed in 1992.
c) The eastern half of the parallel taxiway (S1) connecting a root of the Y-shaped taxiways and the Runway 29 threshold. The separation distance between the centrelines of runway and the parallel taxiway is 432.5 m. It was constructed in 1992.
d) A short taxiway connecting the parallel taxiway and the apron for the A76 Aircraft Maintenance Base.

The western half of the parallel taxiway is being constructed to the same specification as the eastern half. It is expected to be completed in 1996. After the construction of the western half of the parallel taxiway, it will be sufficient until the year 2010. In the year 2015, holding bays will be required.

The taxiways are 23 m wide with a 10.5 m wide paved shoulder at each side, and meet ICAO Standards and Recommended Practices in general. The pavement structure comprises 34 cm thick cement concrete slabs on a 20 cm sand-cement stabilised base course over a 25 cm laterite soil gravel sub-base course, except for the Y-shape taxiways which are of 40 cm thick cement concrete slabs. The PCN is judged to be 73 R/D/W/U, the same as that of the runway. It is strong enough for operation of B747's.

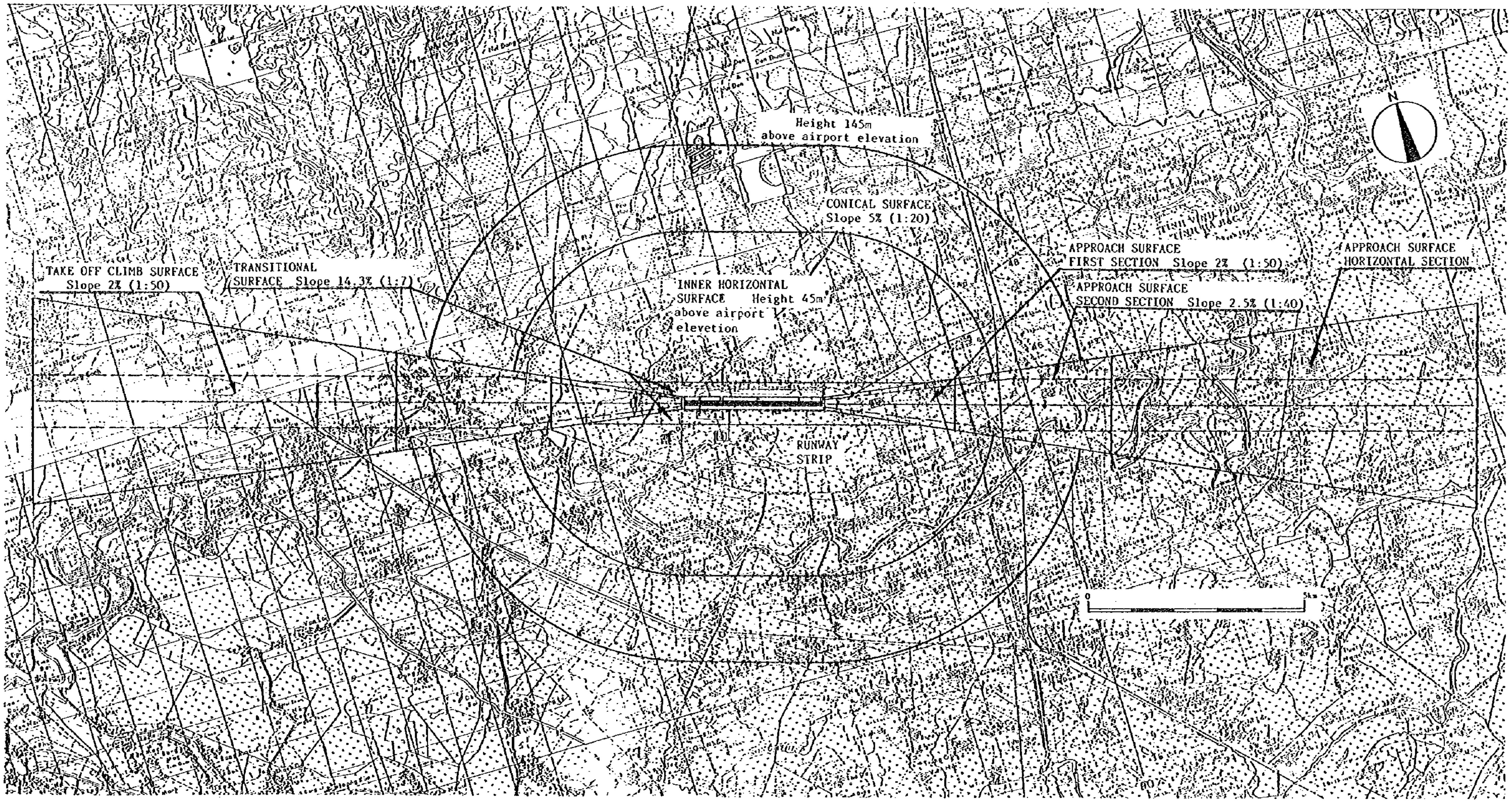


Figure 6.2.1 Obstacle Limitation Surfaces at Noi Bai International Airport

6.2.5 Aprons

The existing aprons consist of four (4) areas, namely A1, A2, A3 and A76. The dimensions, area and year of construction of each apron are shown in Table 6.2.1.

Table 6.2.1 Outlines of Each Apron

Name	Dimensions	Area	Year	Pavement
A1	114 m x 292 m 127 m x 99 m	33,300 m^2 12,600 m^2	1992 1994	34 cm slabs on 20 cm base course
A2	152 m x 292 m	44,400 m^2	1982	40 cm slabs on 20 cm base course
A3	280 m x 78 m	21,800 m^2	1987	28 cm slabs on 15 cm base course
A76	135 m x 166 m	22,400 m^2	1986	24 cm slabs on 20 cm base course

A total of eighteen (18) parking positions are marked on the Aprons A1, A2 and A3, eight (8) on Apron A1, four (4) on A2 and six (6) on A3. The existing aprons are capable of accommodating one (1) B747, six (6) medium to large jet aircraft and ten (10) small jet and/or turbo-prop aircraft. This is sufficient for the current demand. Since the dimensions of the existing aprons are insufficient for B747 class of aircraft, only one B747 stand can be provided without incapacitating too many stands. These will, therefore, become insufficient to meet the forecast demand before the year 2000. After expansion of A1 and the apron around the new terminal T1 have been completed, the apron capacity should be sufficient to the year 2005.

The PCN of the apron A1 and A2 is the same as that of the existing runway and taxiways. According to CAAV, the bearing capacity of apron A3 and A76 is strong enough for a B747-200B only at its operating empty weight plus 30% of fuel. In this case, PCN is estimated to be about 35 R/D/W/U.

6.3 PASSENGER TERMINAL BUILDING AND OTHER BUILDINGS

6.3.1 Layout of Major Buildings

Figure 6.3.1 shows the layout of major buildings in the vicinity of the passenger terminal buildings. The passenger terminal building complex is located at the end of the Thang Long - Noi Bai Expressway. Cargo warehouses are located in front of the passenger terminal building G2 (landside). The fire station along with the temporary control tower, meteorological office and catering building are located near the passenger terminal complex. The aircraft maintenance hangar and related buildings are located on the east of the passenger terminal complex, and the fuel farm is located still further east.

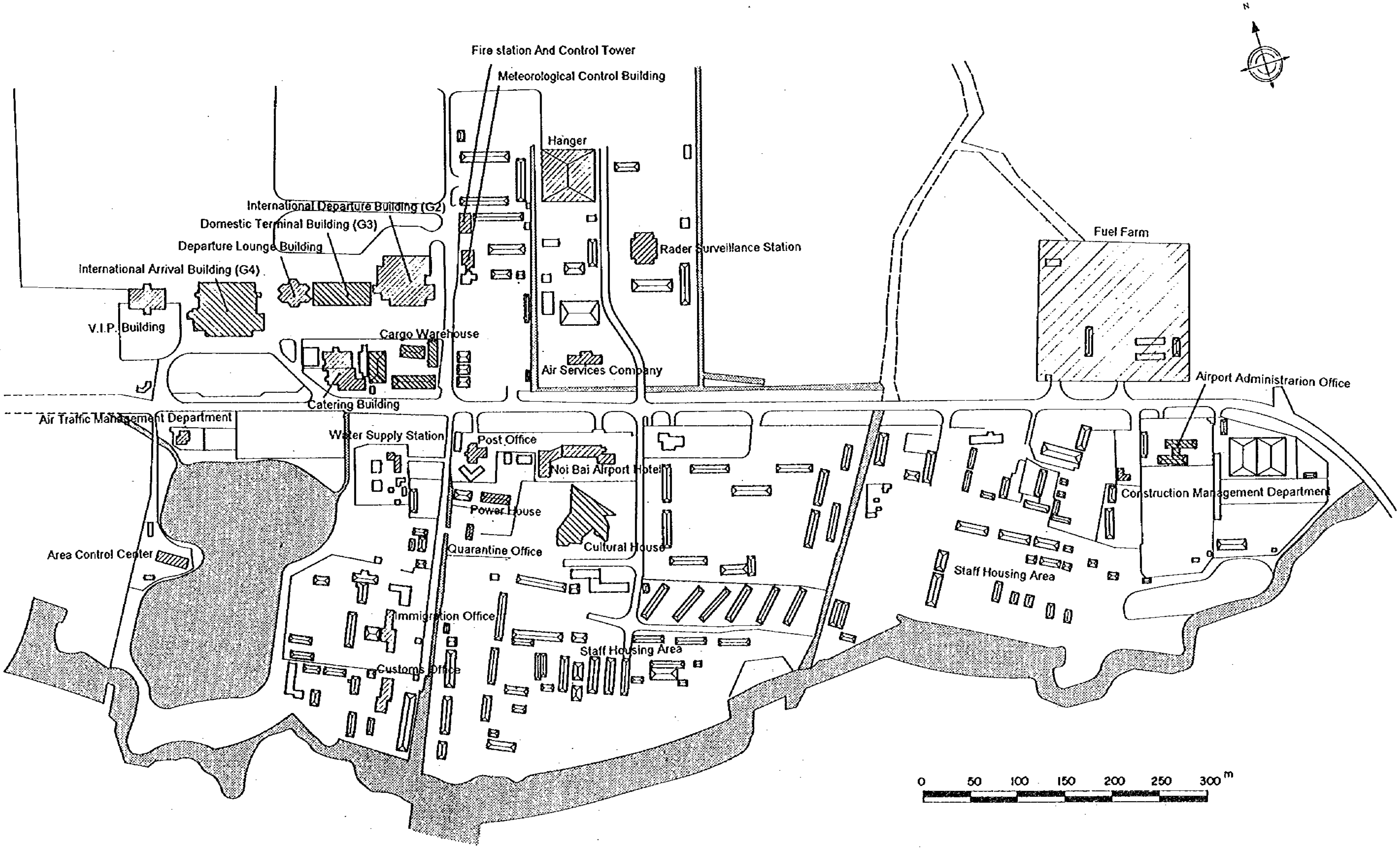


Figure 6.3.1 Layout of Major Buildings

On the south side of the express way, the following buildings are located: Hanoi AACC, air traffic management office, post office, immigration office, customs office, quarantine office, water supply station, power house, airport hotel, cultural centre, airport administration office and airport and airline staff housing.

6.3.2 Passenger Terminal Buildings

1) General

The passenger terminal building complex consists of the following five (5) buildings in order from the east to the west:

a) International Departure Terminal (G2 Building)

b) Domestic Terminal (G3 Building)

c) Departure Lounge Building

d) International Arrival Terminal (G4 Building)

e) VIP Terminal

Although some facilities for international departures are provided on the second floor of G2, the passenger terminal concept is basically that of one level processing both for domestic and international passengers. Since no passenger loading bridge is available, all passengers are transported by buses between the terminal buildings and aircraft.

The International Departure Terminal (G2) is a one story building with small mezzanine floor for airline offices. It is a reinforced concrete structure constructed in 1986, and the total floor area is about 3,200 sq. m. The Domestic Terminal (G3) was built in 1985 as a one story building with a reinforced concrete structure. The total floor area is about 1,920 sq. m. Figures 6.3.2 and 6.3.3 show the first and second floor plans for the G2, G3 and Departure Lounge Buildings respectively.

The Departure Lounge Building was originally built as a restaurant. This building has been renovated to accommodate increasing passenger traffic. The first floor is now used as a domestic departure lounge, and the second floor as an international departure lounge. A long corridor with some concession areas and seating space was built on the roof of the Domestic Terminal (G3) to connect the international departure lounge and International Departure Terminal (G2).

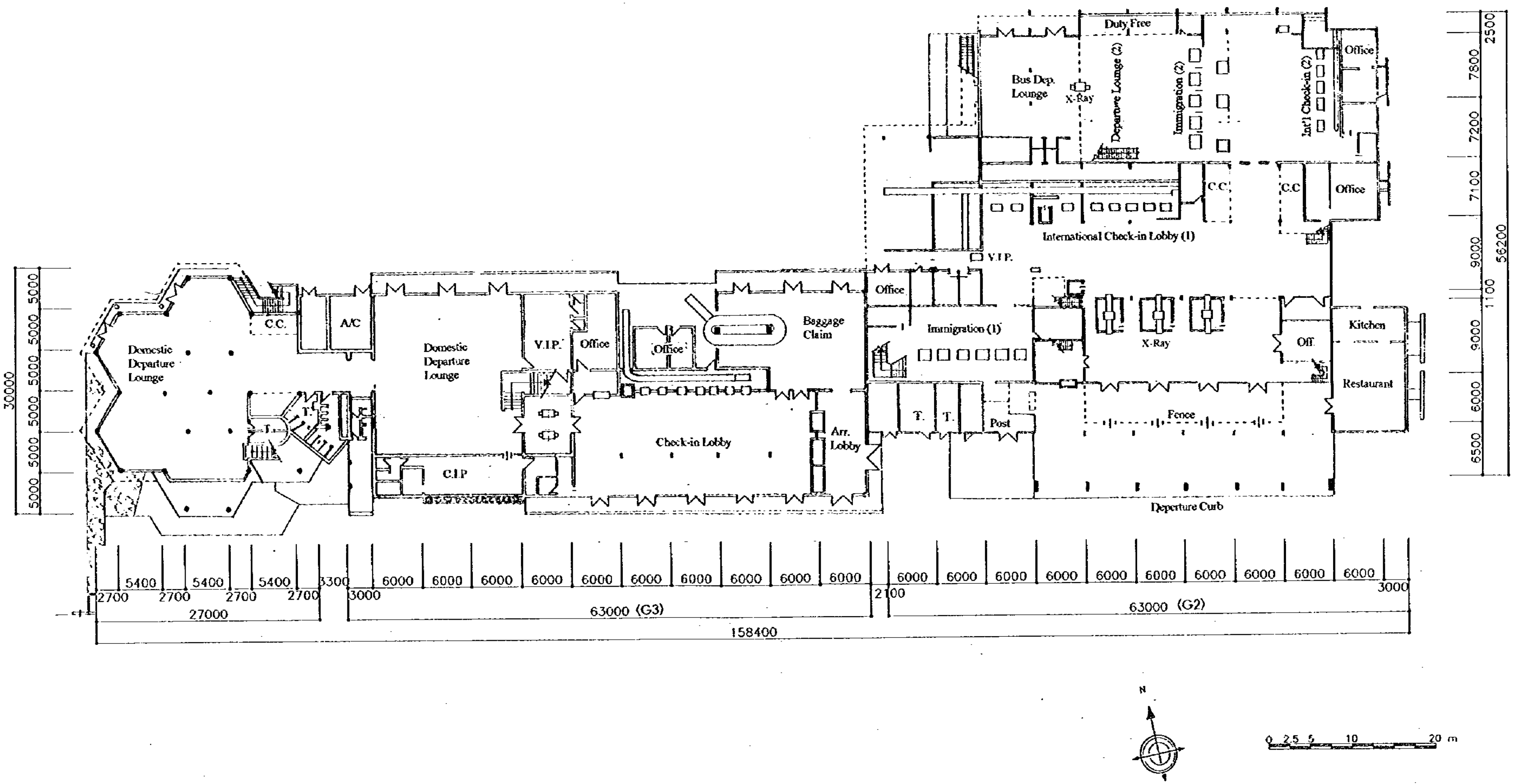


Figure 6.3.2 G2, G3 and Lounge Buildings - First Floor

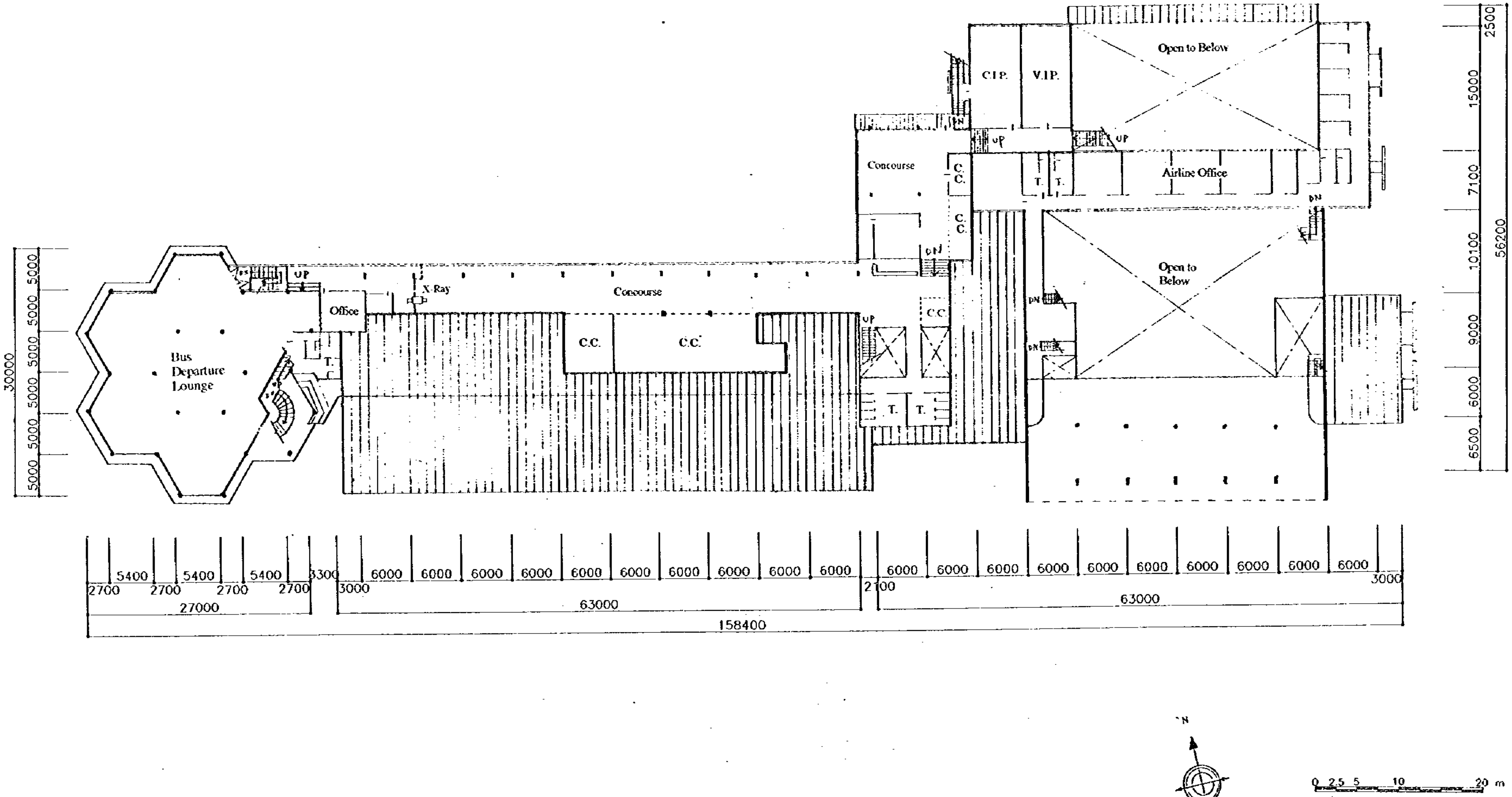


Figure 6.3.3 G2, G3 and Lounge Buildings - Second Floor

The International Arrival Terminal (G4) is a one story building with a small mezzanine floor for airline offices. It is a reinforced concrete structure built in 1986, and the total floor area is about 3,450 sq. m. Figure 6.3.4 shows the floor plan of the G4 Building. The VIP Terminal is a one story, reinforced concrete building. Further expansion and renovation of the existing terminal buildings is being planned, but their expansion space is limited due to neighbouring buildings on both sides.

As the VIP Terminal and International Arrival Terminal (G4) are located in front of the aircraft parking apron A2, bussing distance is less than the International Departure Terminal and Domestic Terminal which are located remotely from the aprons A1 and A2.

Due to the old design of the passenger terminal buildings and subsequent expansions, the existing terminal buildings have the following deficiencies, in addition to the limited space and capacity. Comments from passengers are shown in Appendix 6.3.1.

a) Information systems, including signs, public address systems and flight information display systems, are inefficient.
b) No provision has been made for the disabled.
c) Few amenities and services have been provided for passengers.

2) **International Departure Facilities**

As mentioned in 1) above, these facilities are located in the G2 Building, the second floor of G3 and the Lounge Buildings. Check-in and departure passport control facilities are located on the first floor of the G2 Building. Well-wishers are not allowed to enter the International Departure Terminal.

There are three X-Ray machines for screening check-in baggage. Check-in counters are provided at two locations; Check-in Lobby (1) with 8 check-in counters; and Check-in Lobby (2) with 5 check-in counters. All the counters are in common use. Check-in Lobby (1) is the primary facility, and Check-in Lobby (2) is utilized for busy periods. The queuing space of Check-in Lobby (1) is smaller than that of Check-in Lobby (2).

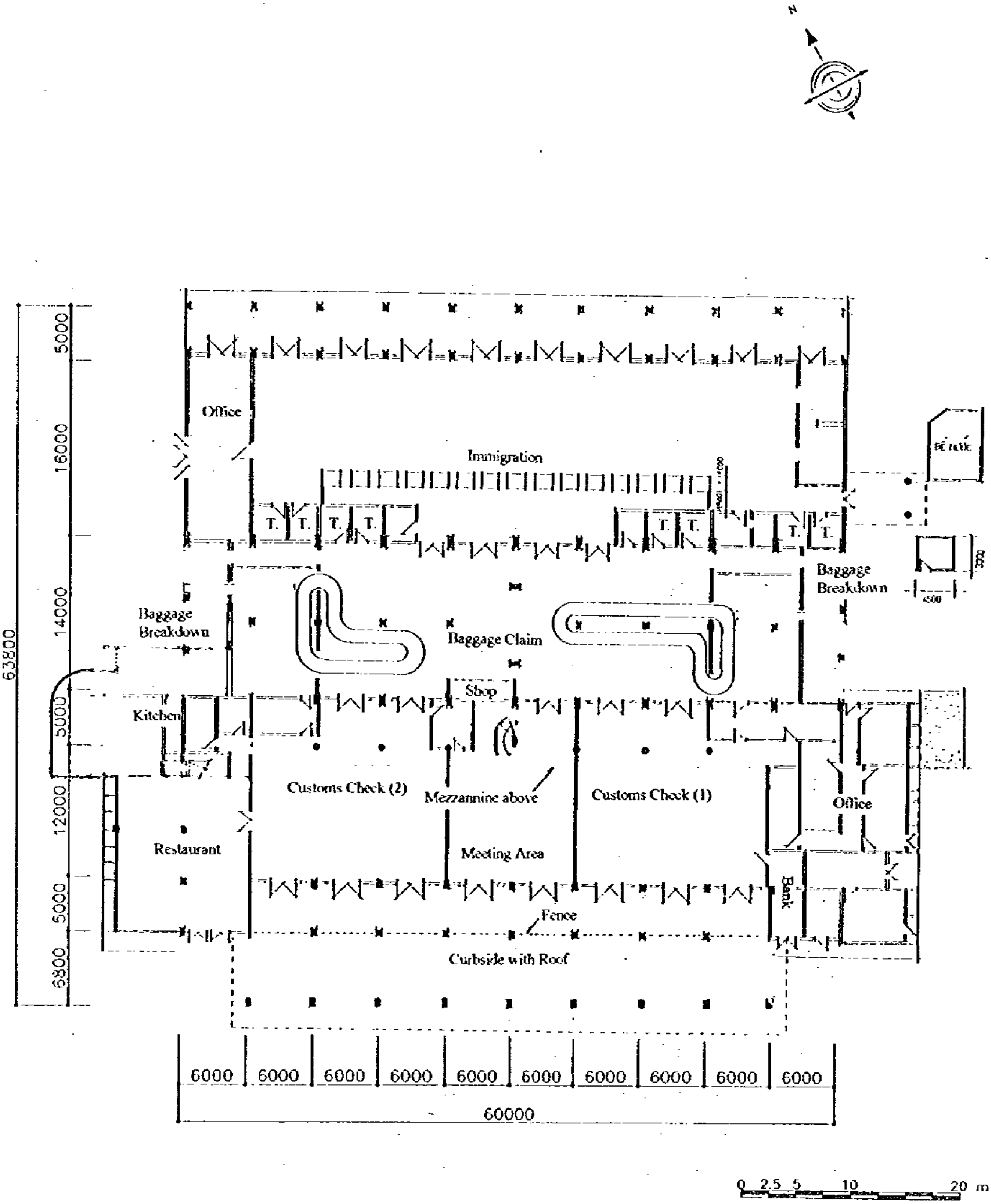


Figure 6.3.4 G4 Building - First Floor

A baggage conveyor system is installed for each check-in area. One system goes from behind the check-in counters at Lobby (1) to the northwest side of the buildings. This conveyor system is merged with a short conveyor system which runs from the VIP check-in counter. Another system goes out airside from the northeast corner of the building behind the check-in counters at Lobby (2).

Immigration control is also conducted at two locations near the two check-in areas; Immigration (1) with 6 counters and Immigration (2) with 5 counters. Queuing spaces for both immigration control areas are narrow and tight.

There are two separate departure lounges to match the two different check-in/immigration flows. One is on the second floor of Lounge Building with a floor area of 520 sq. m. Security screening of passengers and cabin bags is conducted before entering this lounge. Another departure lounge is on the first floor next to Immigration (2) with a floor area of 140 sq. m. Security screening of passengers and cabin bags is conducted at the exit of this lounge.

3) International Arrival Facilities

International arrival facilities are located as one unit at the International Arrival Terminal facing the main aircraft parking apron A1 and A2. This building has a 60 m long straight curb on the apron side for arrival buses. After leaving the ramp buses, the arrival passenger flow is simple and straight on the ground floor.

There are 15 arrival passport control counters. The queuing space in front of the passport control counter is only 10 m, which is small for the peak (busy) hours. It was noted, during the traffic survey, that the average processing time of arrival passport control was quite long (more than 3 minutes per passenger, see Appendix 6.3.2) although computers were being used.

Two baggage claim devices are provided. One has an effective length of 23 m, and another has an effective length of 19 m. Both are insufficient to handle passengers from a wide-body jet aircraft, such as a B767 or larger; therefore, airport staff are required to unload the baggage from the conveyor before passengers can claim their baggage.

There are two customs check areas, but only one area at the east side is used. Customs checks are made mainly by screening all baggage using three X-Ray machines in the area of

Customs Check (1). Processing times at tables were relatively short, and appeared to cause no significant problem during the peak hours.

The arrival concourse, which usually accommodates passengers and welcomers, is not situated in the interior of this building. Thus welcomers are forced to wait in forecourt outside of the building. Except for a bank and a restaurant, facilities normally available for arriving passengers at international airports, such as information counters for hotels, rental cars or limousines, are not available.

4) Domestic Facilities

Facilities for domestic passengers are provided in the G3 Building and on the first floor of the Lounge Building. Departure facilities are located in the west side, and arrival facilities are in the east side.

There are seven (7) check-in counters with a 12 m long of queuing space in front of the counters. The counters are common-use for all flights and classes. Well-wishers are allowed to enter the check-in area with passengers.

After passing security screening (there is one metal detector and two X-Ray machines), passengers can enter the departure lounge. The departure lounge has five departure gates. Some concession areas and a VIP room are available. The departure facilities seem adequate for the current level of traffic.

In the arrival area, only one baggage claim device (effective length 15 m) is provided.

5) VIP Facilities

The VIP Terminal has 13 rooms for VIP accommodation. There is no security screening equipment and no permanent facility for frontier control (immigration and customs). Immigration, customs, security and airline staff come to VIP Terminal for check-in and frontier controls of VIP's.

6) **Capacity of Existing Passenger Terminal Buildings**

Unit floor areas available per peak hour passenger are about 4.4 and 15 sq. m for domestic and international passengers respectively. These unit floor areas are far small compared with international standards for airport facilities. Table 6.3.1 shows the results of demand/capacity analyses for the existing passenger terminal buildings. (See Appendix 6.3.3 for capacity calculation.)

Table 6.3.1 Demand and Capacity of Existing Passenger Terminal Building

	Domestic	International
Estimated Capacity of Major Facilities for Departures		
Check-In Desks	**380 pax/hr**	470 pax/hr
Departure Passport Control	-	**240 pax/hr**
Departure Lounge	750 pax/hr	330 pax/hr
Overall Capacity of Departure Facility	380 pax/hr	240 pax/hr
Current Peak Hour Passengers	330 pax/hr	360 pax/hr
Estimated Capacity of Major Facilities for Arrivals		
Arrival Passport Control	-	**270 pax/hr**
Arrival Customs	-	1,200 pax/hr
Overall Capacity of Arrival Facility	-	270 pax/hr
Current Peak Hour Passengers	350 pax/hr	430 pax/hr

As seen in the above table, capacities of domestic departures are greater than the current demands and will thus be sufficient for a few years to come. On the other hand, current demands at international passenger terminal exceed greatly the estimated capacity of almost all major facilities indicating urgent need of improvement. The capacity of T1 will be sufficient up to the year 2003 as described in Section 7.2.

6.3.3 Cargo Terminal Building

There is no proper cargo terminal in the NBIA. There are cargo warehouses in the southern area of the International Departure Terminal G2 (on the landside). This location is quite unusual since a cargo terminal is usually located on boundary of the airside and landside. Due to the unusual location of the cargo warehouses, the vehicles transporting cargo between aircraft and the storage area mingle with landside traffic, and cause some congestion. This is a problem for customs the control of international air cargo.

The total floor area of warehouses is about 1,900 sq. m and insufficient for handling the current demand; therefore, a properly sized cargo terminal building should be provided at a proper location.

If the existing passenger terminal buildings are converted to the cargo terminal building after completion of T1, they will be capable of accommodating the demand up to the year 20002 or 2003; however, the existing ceiling height may hinder the installation of mechanised modern cargo handling system. This problem needs to be investigated at the design stage.

6.3.4 Control Tower, Administration and Operation Buildings

A temporary control tower is located on top of the fire station. The building is a four story reinforced concrete structure with a 520 sq. m floor area. The ground floor of this building is completely used as a garage for fire fighting vehicles. The first floor is for offices, and the control cab stands on top of these, connected by exterior stairs from roof level. The size of cab is 3.1 m x 6.25 m and the floor level is 12.8 m from ground level. The height of the tower is insufficient to observe the entire airport. The Meteorological Office is located next to the Control Tower and Fire Station.

The New Control Tower and Operations Building is being built to the west of the VIP terminal building.

The Airport Administration Office is located about 900 m west of the passenger terminal complex (opposite the Fuel Farm). The Airport Administration Office is a 2 story reinforced concrete structure building with about 1,500 to 1,600 sq. m floor area.

6.4 ROAD AND CAR PARK

6.4.1 Access Road

1) Airport Access System

Airport access system of NBIA solely depends on road transportation. The main access road is Thang Long - Noi Bai Expressway. It directly connects NBIA and Hanoi Ring Road. The secondary access route is to use National Road No. 3 from Hanoi then change to National Road No. 2. Taxies and mini-buses for public are available at the Airport, and various sizes of buses are operated for transporting staff of the CAAV, VNA, and others. Modal split by access mode for passengers obtained from the passenger interview survey is summarised as follows:

	Car	Taxi	Bus	Others
Domestic Passengers	47%	21%	30%	2%
International Passengers	60%	19%	20%	1%

Airport limousine bus services (schedule services to/from major hotels in Hanoi by air-conditioned buses) are desirable to improve the airport access system. Provision of rail access system should also be planned for the future. Refer to Appendix 6.4.1 for more information regarding the rail access system. Mix of airport access vehicle traffic observed in the traffic survey is as shown below:

Car	Taxi	Mini-Bus	Bus	Truck	Motorcycle	Others
43%	5%	14%	3%	3%	30%	1%

2) Thang Long - Noi Bai Expressway

The expressway is a 23 m wide, 4-lane motor way with a lane at each side for pedestrians and non-auto vehicles (carts pulled by cows, bicycles, etc.). There is a cement concrete divider as the median, and steel guard rails between auto and non-auto lanes. Capacity of this expressway is considered sufficient beyond the year 2015 provided that non-airport related traffics remain as little as now. It is, however, appropriate to reserve the right-of-way to allow 6 to 8 lanes in the future.

Design standards of the expressway is generally good with mostly straight horizontal alignment and almost flat profile except some approaches at a few locations of bridges. Thus vehicles commonly drive at the high speed often exceeding 100 km/hr. However, once traffic volume increases serious problems are foreseen to occur. It is because the expressway does not have complete exclusive right-of-way but has number of level crossing with other roads and pedestrians. Since they increase the risk of traffic accidents, countermeasures (reducing the number of pedestrian cross and intersections, providing grade separation, etc.) should be considered. Education of traffic rules and manners is also very important to reduce the number of traffic accidents.

In addition, because of poor subgrade compaction probably caused by the short construction period, the existing paved surface has already wearing profile and further deterioration is expected as traffic volume increases in the near future.

3) National Roads No. 2 and No. 3

National Roads No. 2 and No. 3, which used to be the main airport access road, are 2-lane 2-way road with 8 to 9 m wide right-of-way (5 to 6 m wide carriage way). Since National Road No. 3 is heavily used by non-airport related traffic and already congested, it is judged that there is little capacity as an airport access road from Hanoi unless great deal of improvement is done. Because National Roads No. 2, No. 3 and No. 286 are important as access routes from the other places than Hanoi, they should be improved strategically.

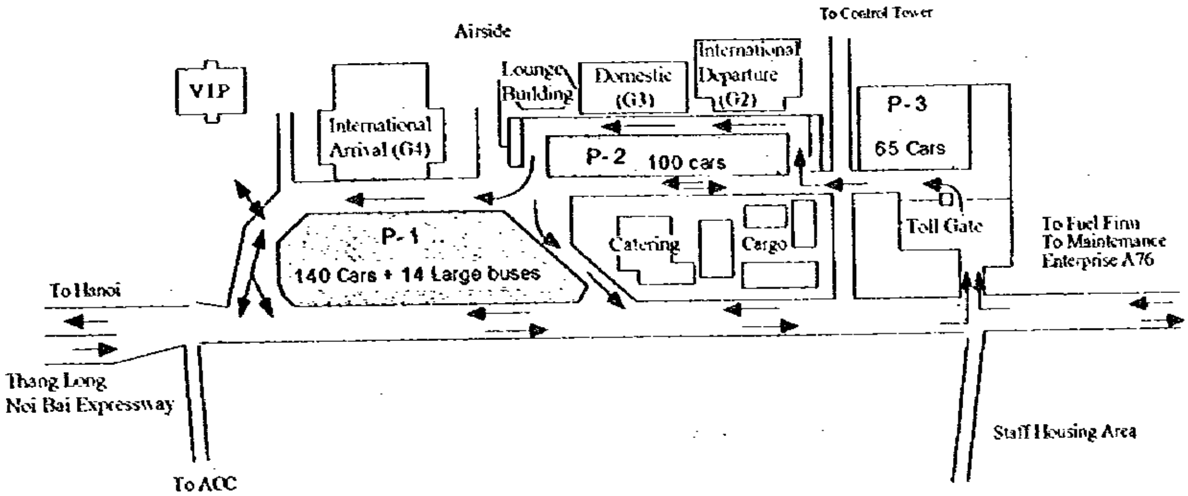
6.4.2 Terminal Roads

Figure 6.4.1 schematically shows the existing road systems within the terminal area and traffic directions. There is no separate internal circular road around the car park, and the access road is used for a part of circulation.

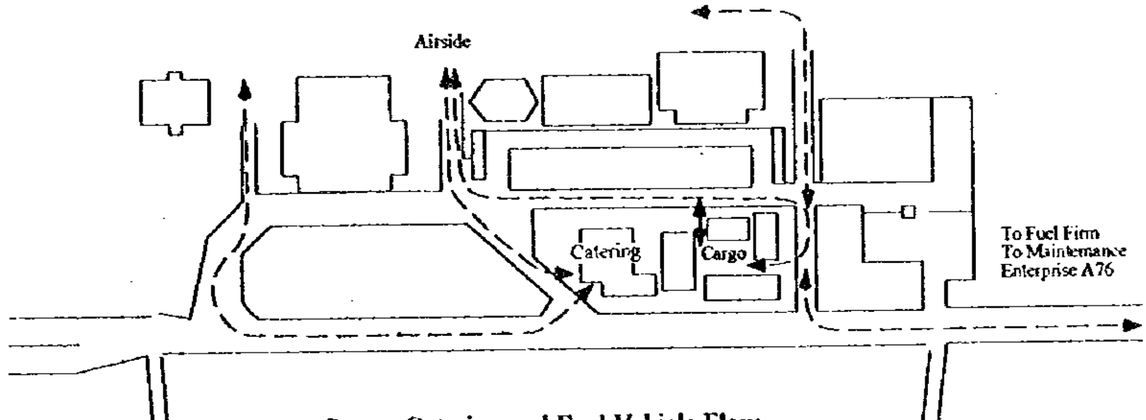
Curb length and width of the road in front of each passenger terminal building are as follows:

Building	Curb Length	Frontal Road
International Departure (G2)	36 m	6.7 m wide, 1 standing & 2 through lanes
Domestic (G3)	42 m	6.7 m wide, 1 standing & 2 through lanes
International Arrival (G4)	48 m	12 m wide, 1 90° parking & 2 through lanes

The existing curb length is insufficient in busy hours at present. Vehicles often stay between G2 and G3 building and in front of the Lounge Building. The width of the road in front of G2 and G3 is too narrow and congested during the busy hours.



Normal Vehicle Flow



Cargo, Catering and Fuel Vehicle Flow

Figure 6.4.1 Layout of Terminal Road and Car Park

6.4.3 Car Park

There are three car parks in the passenger terminal area as shown in Figure 6.4.1. Parking fee of VND 6,000 per entry per sedan is collected at the entrance to the passenger terminal area. Total area of car parks is about 14,000 sq. m, and 320 parking lots are marked as of May 1995. Number of parking lots are insufficient even for current demand. The car park P-2 in front of G2 and G3 building is most congested, and the car park P-3 in front of the toll gate is least utilised. Overflown vehicles are parked along the road and in the un-marked area near the terminal buildings. Although a car park of 20,000 to 25,000 sq. m is included in T1 project, it will not be enough because the existing car parks will no longer be used by passengers after all operations move to T1. Overflown vehicles are parked along the road and in the un-marked area near the terminal buildings. Although a car park of 20,000 to 25,000 sq. m is included in T1 project, it will not be enough because the existing car parks will no longer be used by passengers after all operations move to T1.

6.5 AIR NAVIGATION SYSTEMS

6.5.1 Radio Navigation Aids

1) Instrument landing System (ILS)

An ILS is provided for Runway 11 and configured as shown in Figure 6.5.1. It consists of a: Localizer (LLZ); Glide Path (GP); Middle Marker (MM); and an Outer Marker (OM). Key data for ILS appears in Table 6.5.1.

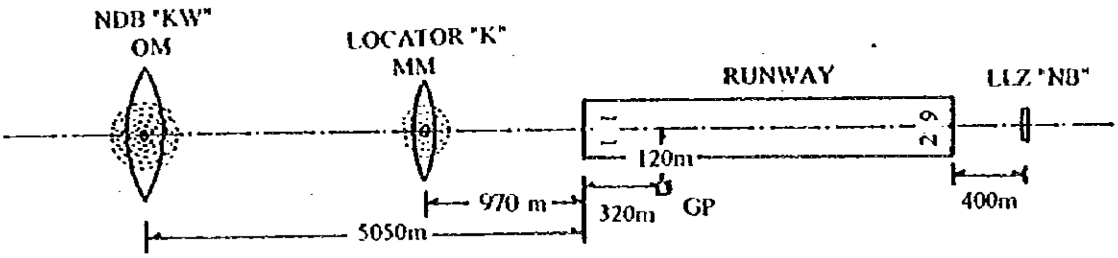


Figure 6.5.1 Configuration of the ILS

Table 6.5.1 Key Data for ILS

Facility	Frequency	Identification	Hours of Operation	Coordinates	Years of Installation	Remarks
LLZ	110.5 MHz	NB	24 hrs	21°12'57"N 105°49'29"E	1980	Thomson, France
GP	329.6 MHz	-	24 hrs	21°13'25"N 105°47'40"E	1980	Thomson, France
MM	75 MHz	-	24 hrs	21°13'41"N 105°46'58"E	1980	Nardeaux, France
OM	75 MHz	-	24 hrs	21°14'22"N 105°44'43"E	1980	Nardeaux, France

The equipment rooms for each of the ILS facilities are suitably air-conditioned and the equipment appears to be maintained in good conditions; however, these facilities are close to the end of their economic service lives and should be replaced.

The existing ILS facilities have no automatic monitor system which is required by the Annex 10, ICAO.

2) **Very High Frequency Omni-directional Range and Distance Measuring Equipment (VOR/DME)**

The VOR/DME is located 1.4 km east of the threshold of Runway 29 on the extended runway centreline. It was installed in 1978 and has been operational since 1980. The VOR is in a conventional configuration. Key data for the VOR/DME appears in Table 6.5.2. The equipment room is suitably air-conditioned and the equipment appears to be maintained in a good condition; however, it is approaching the end of its economic service life. The CAAV plans to replace with new equipment with the VOR in a Doppler configuration, in the near future.

Flight Calibrations are conducted once a year for both the VOR and the ILS by the CAAV.

Table 6.5.2 Key Data for VOR/DME

Facility	Frequency	Identifi-cation	Hours of Operation	Coordinates	Years of Installation	Remarks
VOR	116.1 MHz	NOB	24 hrs	21°12'46"N 105°50'02"E	1978	Thomson, France
DME	CH 108	-	24 hrs	ditto	1978	Thomson, France

3) **Non-directional Radio Beacons (NDB)**

Two NDB's are installed at the NBIA. One is used as an ILS locator, call sign "K", and is collocated with the Middle Marker. The other, call sign "KW", is collocated with the Outer Marker. Key data for the NDB's appears in Table 6.5.3.

Table 6.5.2 Key Data for NDB's

Facility	Frequency	Identifi-cation	Hours of Operation	Coordinates	Years of Installation	Remarks
NDB	320 kHz	KW	24 hrs	21°14'22"N 105°44'43"E	1992	Russia
Locator	230 kHz	K	24 hrs	21°13'41"N 105°46'58"E	1980	Nautel, Canada

The power outputs of the NDB's is 500 W for "KW" and 62 W for "K". Both appear to be well maintained but "K" should soon be replaced as it has now been in use for 15 years.

6.5.2 ATC and Communication Systems

1) Noi Bai Aerodrome Control Tower

The present tower is a temporary structure located on top of the Rescue and Fire Fighting Station for use until a new permanent tower has been constructed; therefore, only the following minimal equipment has been provided.

a) ATC Consoles with 2 positions: Controller and Assistant;
b) Telephone; direct-line (hot-line) to Approach Control in Hanoi AACC;
c) Air Ground radio: one VHF Frequency of 118.1 MHz, and receiving only function of Emergency Frequency of 121.5 MHz;
d) Tape recorder: ordinary cassette recorder made by Sony which is not adequate for recording ATC data;
e) Clock;
f) Microphones;
g) Aerodrome Lighting Panel;
h) Visual Display Unit (VDU);
i) Altimeter Setting Indicator;
j) Transceiver, single channel of 145.15 MHz for controlling surface vehicle movements;
k) Automatic Meteorological Display showing current QNH, QFE and wind speed and direction.

Navaids Remote Control and Monitoring Units, Light Guns, Head Sets and Sound-Absorbing Coverings are not provided.

The main control unit for the ATC Console is located in a separate equipment room and provides circuit distribution power and a UPS.

2) ATC Radars

Noi Bai Approach in Hanoi AACC provides radar advisory services using ACC's long range radar within its TMA area. As the surveillance data rate of the ACC's radar is not adequate for providing approach control service, and non-radar separation (vertical 1,000 ft, longitudinal 10 minutes) is applied for the approach control at present.

There is an old truck-mounted Russian made (RSP-10) GCA on the north side of the runway. It is now housed in a small building and only usable for runway 11 for an "on-request" advisory service. It was installed in 1984, as second-hand equipment, but still maintains about 70% of its initial capability. There is another GCA facility alongside which is operated by military personnel, solely for military purposes.

3) ATS Direct Speech

Intercom is provided for ATS Direct Speech between Noi Bai Tower and Hanoi AACC. Hanoi AACC is also connected with HCM ACC, Danang Approach and Gia Lam Tower by ATS Direct Speech circuit.

6.5.3 Aeronautical Ground Lighting System

1) Aeronautical Ground Lights

The following aeronautical ground lights, which generally conform to the requirements of Annex 14, Aerodromes, ICAO, are operational at the NBIA:

a) Category-I Precision Approach Lighting System (distance coded centreline) for Runway 11;
b) Precision Approach Path Indicator (PAPI) for Runway 11; and
c) Runway Edge Lights;
d) Runway Threshold and End Lights for Runways 11 and 29;
e) Taxiway Edge Lights;
f) Apron Flood Lighting.

The aerodrome beacon located on top of the old tower was withdrawn from the services since last year. It does not meet the ICAO standard.

Simple Approach Lighting System and PAPI should be installed for Runway 29 based on the ICAO standards.

2) **Power Supply**

Sub-station No. 2, located on the north side of the runway is primarily used for airfield lighting. The transformers, manufactured in France and Sweden, have been operational since 1990. There are two emergency power generators, one 250 and one 200 kVA, collocated with this sub-station, one installed in 1990 and the other in 1994. The sub-station and associated facilities appear to be well maintained.

6.5.4 Meteorological Observation Systems

The Noi Bai Meteorological Watch Office, located in the AACC, is responsible for meteorological observations and forecasts within the Hanoi FIR; however, the necessary data is provided from the Noi Bai Meteorological Centre (NBMC), located on the Airport, which also provides flight meteorological data for flight crew members.

The NBMC forecasting and briefing office is adjacent to the Aeronautical Information Services (AIS) briefing office. The observation site, which provides cloud height and amount, and ground visibility is located on the opposite side of the terminal area. Equipment for measuring air temperature, air pressure, and surface wind strength and direction is installed at both ends of the runway, and the data are sent automatically to Area Control, Approach Control, the Tower and the briefing office.

There is currently no Runway Visual Range (RVR) and ceilometer equipment at the NBIA but such equipment is scheduled to be installed by the end of October 1995. Ceilometers will be installed at the Middle Marker site and RVR's at both ends of the runway.

Meteorological information for Southeast Asia from the Global Meteorological Satellite (GMS) system is continuously displayed in the briefing room for the use of flight crew.

6.6 AIRPORT UTILITIES

6.6.1 Power Supply System

1) Capacity and Source

Power is supplied from the State electricity distribution network. A sub-station is located outside of the Airport, in the Dong Anh District, a few kilometres from the Airport. There are two power supply circuits. The main power house receives power from the 35 kV line from the sub-station for distribution to the terminal and military area. For essential operational equipment e.g. air navigation and communication systems, distribution boards receive 35 kV at each facility's location.

Supplying for	Receiving Voltage	No. of Transformers	Location
Operational Equipment	35 kV	Direct feed at each facility	
Terminal Area (Civilian)	35 kV	1 (630 kVA)	Main Power House
Military Side	35 kV	1 (630 kVA)	Main Power House

The capacity of power supply system must be increased before the new terminal T1 is constructed. Two 1,000 kVA transformers are planned in basement of T1.

2) Emergency Backup

The emergency back-up system for power failures consists of one 1,000 kVA and two 500 kVA generators. The key data for each generator is as follows:

Purpose	Capacity	Manufacturer	Location
Operational Equipment	Each has individual power back-up. Capacity depends on equip.		
Terminal Area (Civilian)	500 kVA	Japanese	Main Power House
Military Side	500 kVA	Japanese	Main Power House
	1,000 kVA	Russian (1991)	

A diagram of the power supply system is shown in Figure 6.6.1.

Two 750 kVA generators have been planned for the T1 project.

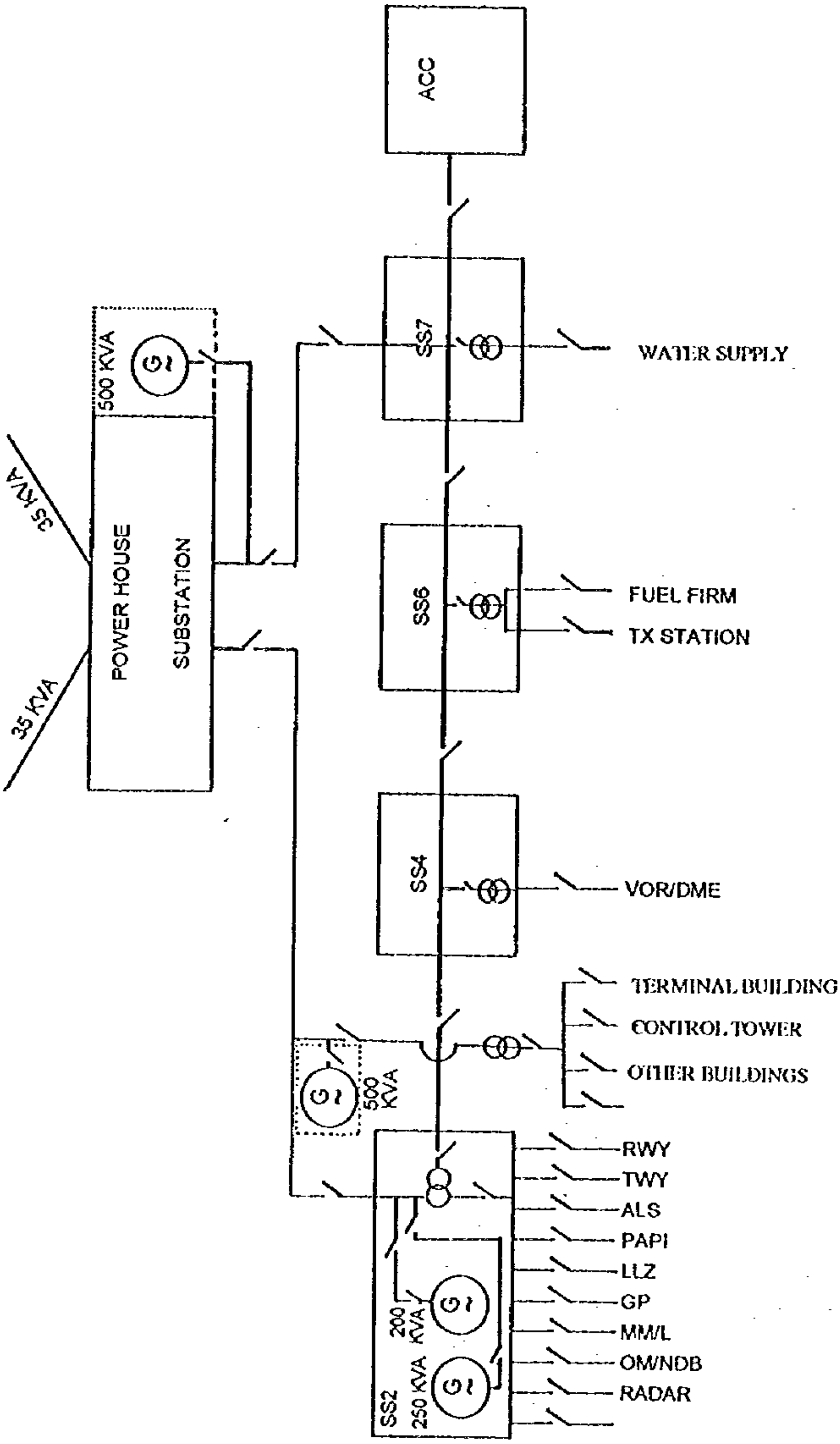


Figure 6.6.1 Existing Power Supply System at NBIA

6.6.2 Telephone System

Two telephone cables are connected to the CAAV's Private Automatic Branch Exchanger (PABX), SIEMENS, HICOM 130. One cable more than 100 pairs connects the PABX and Noi Bai Post Office. The other cable with about 40 pairs connects the PABX and Soc Son Post Office.

The PABX for the internal telephone network at NBIA is now used for 128 lines and is very close to its capacity. It is necessary to increase the capacity of PABX so as to meet the increasing demand. A PABX with 500 lines capacity has been planned in the T1 project.

6.6.3 Water Supply System

The current source of the water supply at the NBIA is underground water from a depth of 70 to 80 m. There are six (6) deep-wells with a diameter of about 300 mm each. Water is pumped up from four (4) wells, i.e. Nos. 2, 4, 5 and 6, by a 60 to 90 cu. m per hour capacity pump for each. Water is treated by natural settlement and chloride gas at the Water Treatment Station near to the Post Office. The existing water treatment facility was built in 1986. There are two 500 cu. m reservoirs in the water treatment station. Processed water is pressured by a pump for distribution, and no elevated reservoir is provided. Figure 6.6.2 shows a diagram of water supply system.

The capacity of the existing water supply system is 3,000 to 3,500 cu. m per day (24 hours). Current daily water consumption is about 1,800 cu. m. It is sufficient for forecast demand to the year 2015. In order to meet the demand in peak hours, construction of a 300 cu. m water tower has been planned.

6.6.4 Waste Disposal System

1) Waste Water Disposal

Waste water from the Airport is discharged without processing directly into Noi Bai Canal, then flow into the Ca Lo River. Waste water from lavatories is decomposed in septic tanks. The water is self-purified in the Noi Bai Canal, and the quality of water becomes acceptable for fishery and irrigation purposes at present.

A waste water treatment plant will be required to maintain the water quality because the quantity of waste water will increase as traffic grows.

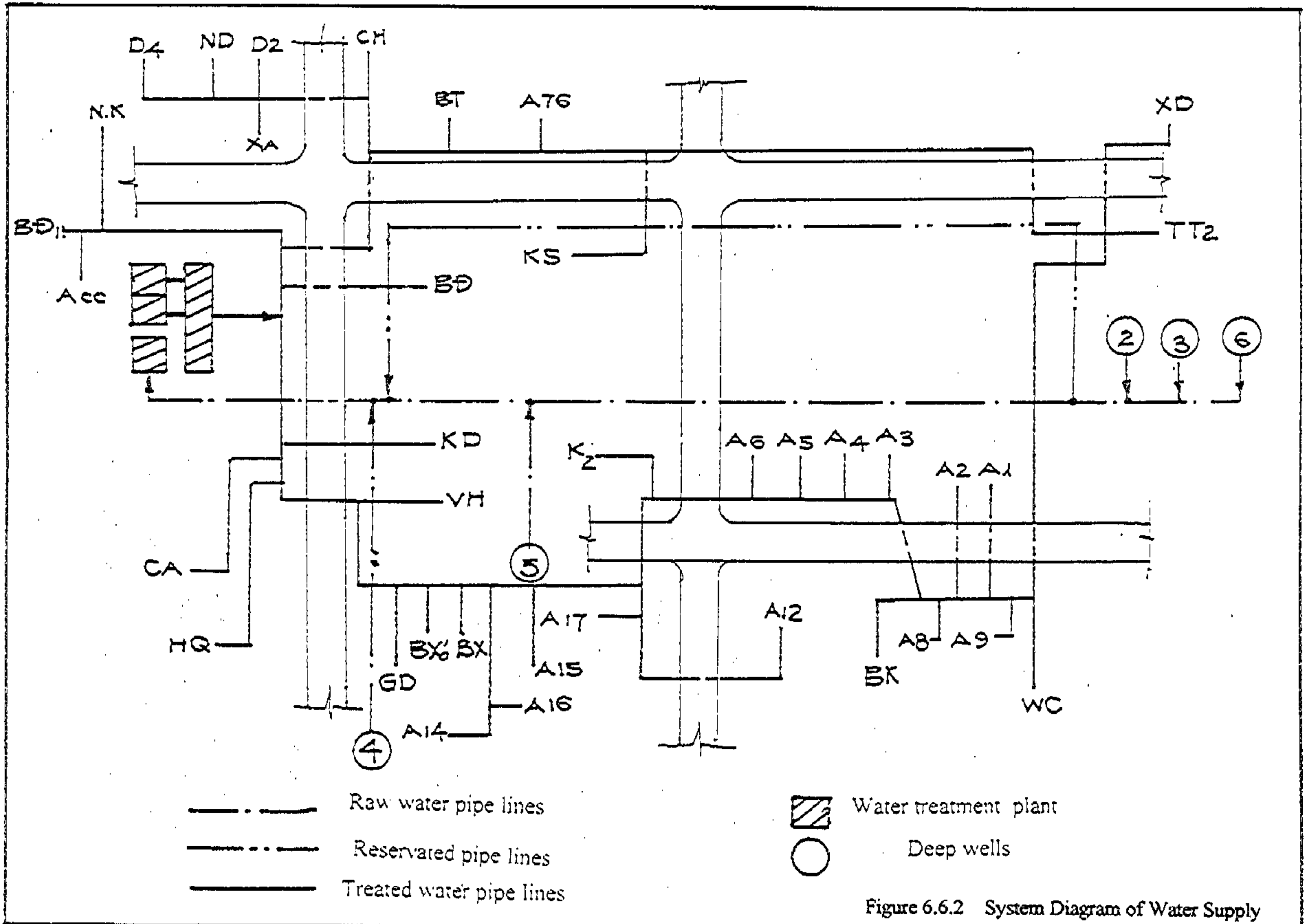


Figure 6.6.2 System Diagram of Water Supply

2) **Solid Waste Disposal**

Solid waste collection is done by a local agent and processed by reclaiming. No separate treatment is made for solid waste from aircraft used for international services. This may cause a problem in health and quarantine control at the Airport.

An incinerator is required to process combustible waste from aircraft and other facilities.

6.7 RESCUE AND FIRE FIGHTING FACILITIES

The rescue and fire fighting services is shown as ICAO Category 8 in the AIP. The existing number of vehicles, water storage capacity and availability of Aqueous Film Forming Foam (AFFF) satisfy the Category 8 requirements. This level of protection is sufficient for the demand in the year 2000. Services should be upgraded to Category 9 toward the year 2005.

	Water	AFFF	Year of Manufacture
Major Vehicle (1):	8,000 l	1,000 l	1989
Major Vehicle (2):	8,000 l	1,000 l	1989
Rapid Intervention Vehicle:	2,400 l	300 l	1989

The fire station is located in the same building complex as the control tower. Its location is in the middle of the airport, and the response time to the ends of the runway is less than 3 minutes, which is within the limit specified in Annex 14. There are 100 cu. m water reservoirs near to the each end of runway.

There are fifty-four CAAV staff for rescue and fire fighting organised in three shifts on 24 hour operation. The military rescue and fire fighting units cooperate in emergencies.

When the second runway is constructed, a satellite fire station will be required to maintain the response time to within the ICAO recommendation.

6.8 OTHER FACILITIES

6.8.1 Aviation Fuel Supply Facilities

Aviation fuel is supplied by Vietnam Air Petrol Company (VINAPCO). There are two aviation fuel storage areas; the main station "N-1" about 5 km east of the Airport and "N-2" in the Airport (at about 1 km east of the passenger terminal). The storage capacities of Jet A-1 at N-1 and N-2 are 6,500 and 1,500 kl respectively. It is sufficient for the demand to the year 2000, but expansion of the capacity will be required thereafter.

The two storage facilities are connected by pipelines, but no fuel hydrant system is provided at the apron. Eight refuelling trucks, with 22 kl capacity each, are currently used for the transportation of fuel to the aircraft. Since a direct access road to the airside does not exist, the refuelling trucks use the normal airport access road. Installation of a fuel hydrant system is being considered for the new passenger terminal "T1".

CHAPTER 7 VERIFICATION OF T1 CONSTRUCTION PROJECT

CHAPTER 7 VERIFICATION OF T1 CONSTRUCTION PROJECT

7.1 GENERAL

As described in Section 3.4.6, the CAAV intended to develop the New Passenger Terminal T1 to the west of the existing terminal complex. The feasibility Study for Construction of T1 (T1 F/S) was approved by the Prime Minister on 5 May, 1995. Since construction of T1 was closely related to the formulation of New Development Plan, the sizing of facilities, general layout, construction cost, implementation plan and viability of the T1 Construction Project as of September 1995 were verified in this chapter based on the air traffic demand forecast described in Chapter 4.

7.2 SIZING OF FACILITIES

1) Total Floor Area

Total floor area of T1 is about 55,700 sq. m, and its breakdown is shown below:

First Floor	18,300 sq. m	Arrival Floor
Second Floor	22,100 sq. m	Departure Floor
Third Floor	7,800 sq. m	Transit Lounge, Restaurant, Office, etc.
Fourth Floor	2,500 sq. m	Hotel
Fifth Floor	2,500 sq. m	Hotel
Basement	2,500 sq. m	Equipment Room
Total	55,700 sq. m	

This does not include a spare area of 21,300 sq. m in the basement; therefore, the total floor area of construction is about 77,000 sq. m. T1 is planned to be constructed in two stages: the complete building structures will be constructed in Phase 1, but an area of 18,200 sq. m out of 55,700 sq. m will remain unfinished until Phase 2.

About 50,000 sq. m of area will be used as a passenger terminal, since the fourth and fifth floors are to be used as a hotel. From a comparison with the facility requirements established in Chapter 5, this floor area is considered to be sufficient for accommodating anticipated international and domestic passengers throughputs to the year 2003.

2) Major Functional Areas and Facilities

The required size and number of major functional facilities within the passenger terminal building in the years 2000 and 2005 have been determined based on the practices established by IATA. The results are summarised in table 7.2.1.

Table 7.2.1 Required Size and Number of Major Functional Facilities in T1

	Year 2000	Year 2005
Domestic		
Departure Curb	65 m	95 m
Check-In Desks	14 nos.	21 nos.
Baggage Claim Device	3 nos.	4 nos.
Arrival Curb	65 m	95 m
International		
Departure Curb	55 m	75 m
Check-In Desks	18 nos.	24 nos.
Departure Passport Control Desks	28 nos.	40 nos.
Arrival Passport Control Desks	34 nos.	48 nos.
Baggage Claim Device	2 nos.	3 nos.
Arrival Customs Control Desks	5 nos.	7 nos.
Arrival Curb	55 m	75 m

The number of major facilities planned in the T1 F/S are summarised in Table 7.2.2.

Table 7.2.2 Number of Major Facilities Planned in T1 F/S

	4 mppa	6 mppa
X-ray Machine	24	42
Check-in Desks	82	137
Immigration & Customs Desks (Arr. + Dep.)	36	59
Baggage Conveyor	9	14

It can be said from the above tables that more of check-in but less immigration and customs desks are planned in T1 F/S than was estimated by the Study Team. The probable reasons for these differences are:

a) If the check-in desks are not for common use, the more will be required.

b) Passenger processing time at the immigration desks are relatively long at present. If these times are shortened to world-wide standards, the number of immigration desks can be reduced.

These differences are minor in the feasibility study stage, although they should be resolved during the basic design.

3) Conclusion

In conclusion, it can be said that the sizing of T1 is reasonable and it will be capable of accommodating the anticipated demand to the year 2003.

7.3 GENERAL LAYOUT

1) Terminal Concept

Concept of T1 is not linear as recommended in the CAAV's Master Plan. It may be regarded as a variation of the pier or unit terminal concept. The linear concept is most suitable for airports with the annual throughputs of up to nearly 10 million passengers, mainly because it provides simple flows for passengers and their bags, and is easier to expand as demand grows.

The foot print of T1 is the same as the G5 building, of which construction was suspended in 1986, so that more than 1,200 existing piles can be effectively used; however, the following disadvantages exist due to the shape of the footprint:

a) Requires a larger apron area due to ineffective space usage.
b) Manoeuvring of aircraft is more complicated.
c) Available curb side length is relatively short.
d) Limited orderly expansion capability due to the complex building geometry.

2) Processing Level

The Two Level Concept was used for the planning of T1. One reason may have been to increase the total floor area so that T1 can handle 4 to 5 mppa, while the G5 was originally planed to accommodate 2 mppa.

The Two Level Concept, however, has the following problems due to the elevated road to the departure level.

a) Flexibility for expansion of the building in the future.
b) Ease and period of construction.
c) Routing of roads within the available space.

The One and a Half Level Concept is one alternative for these problems.

3) Conclusion

In conclusion, it is recommended that the concept of T1 be reviewed before commencing the basic design.

4) Comments on Other Aspects

The following comments on other aspects of the T1 design have been prepared by the Study Team (Refer to Figures 3.4.2 through 6 for floor plans):

a) The airside corridor will obstruct the airside views from the gate lounges. It can be avoided by the provision of mezzanine floor between departure and arrival floors.

b) Relocate arrival passport control to provide more flexibility for future expansion. One possible location is on the arrival floor at the same location as the departure passport control. The other possible location is on the mezzanine floor, between the departure and arrival floor, near to the baggage claim area.

c) More office space will be required near the check-in, passport control and customs inspection desks.

d) More space will be required for baggage make-up areas. One possibility for providing more space is to locate the baggage make-up area in the basement.

e) A reduction of the size of the basement floor must be considered unless some specific requirements exist.

f) A hotel within the landside of the passenger terminal building is not a good idea. It would adversely affect terminal operation, security and maintenance because it requires access for the general public, staff and services (food, linens, kitchen waste, etc.). It is better to provide small day-rooms/shower rooms in the airside and a landside hotel separate from the terminal building.

7.4 COST ESTIMATE

Cost estimates in the feasibility study of T1 are based on the State Project Rate in 1995. A world class passenger terminal building should be constructed to high standards through international competitive bidding, using high quality materials/equipment, the large construction technologies, and highly skilled labour. In such a case, the project budget based on the State Project Rate is considered insufficient. The International Contractor's Rate is about 2 to 3 times higher than the State Project Rate. Table 7.4.1 summarises the revised cost estimates based on the International Contractor's Rate in 1995.

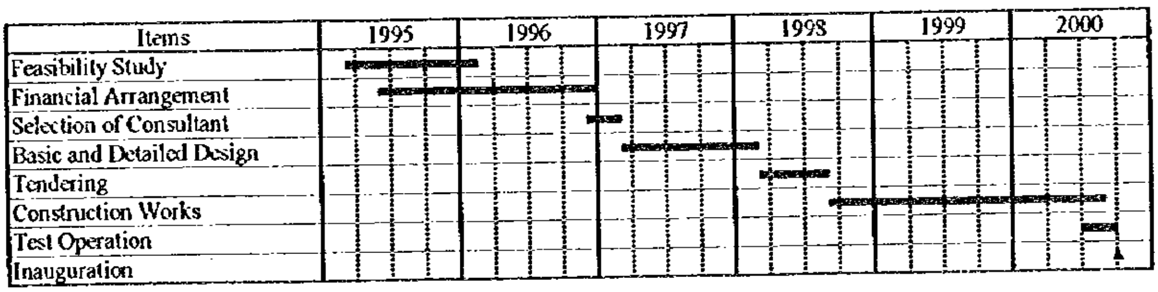
Table 7.4.1 Revised Cost Estimates of T1 (in million US$)

Item	Phase 1	Phase 2	Total
1. Civil Works	7.2	3.8	11.0
2. Building Works	80.6	17.3	97.9
3. Special Equipment	2.0	3.0	5.0
Total Construction Cost	89.8	24.1	120.3
Engineering Services	9.0	2.4	12.0
Contingency	9.9	2.7	12.6
Total	108.7	29.2	144.9

7.5 IMPLEMENTATION PLAN

The GOV intends to complete the project in 1997. As of July 1995, only 29 months are available at the maximum. This period is too short for a large scale project like T1 which normally involves many phases such as financing arrangements, design, tendering, construction and testing before inauguration. Table 7.5.1 shows a more realistic project implementation schedule.

Table 7.5.1 Probable Project Implementation Schedule



7.6 PROJECT VIABILITY

The feasibility study on the T1 Project conducted by the Aviation Survey and Design Company (ASDC) includes a financial analysis. It concludes that the Project has an financial rate of returns (FIRR) of 14.5%. The analysis in this section reviews this estimate based on the revised air traffic forecast, the construction cost estimate and the implementation schedule. The T1 Project, which is currently planned in two phases, is assumed to be implemented in one stage because of tight schedule to cope with high air traffic growth.

The costs and revenues considered in the analysis include the following items:

1) Costs
   - a) Construction cost
   - b) Maintenance cost
   - c) Personnel cost, overhead and other labor cost
   - d) Utilities cost

2) Revenues
   - a) Passenger service charge
   - b) Terminal equipment charge
   - c) Concession fees
   - d) Car parking charge
   - e) Space rent
   - f) Advertisement revenue

Aircraft parking charge and fuel concession fee, which are considered in the ASDC study, are excluded from the present analysis since the project cost does not include the corresponding construction of the apron and fuel hydrant system. The basic assumptions of the analysis are almost the same as those detailed in Section 9.7.3. The project entity is a hypothetical organization which will invest, manage and operate the T1 Terminal and its car parking.

The projected rates of terminal charges are as follows:

Table 7.6.1 Projected Rates of Charges for the T1 Project

Terminal Charges	Rates
1) International Passenger Servic Charge	Case A: US$9.0, Case B: US$12.0, Case C: US$15 (currently US$7.0)
2) Domestic Passenger Service Charge	Case A: VND20,000, Case B: VND30,000 Case C: VND40,000, (currently VND15,000)
3) Terminal Equipment Charge	US$0.8 per int'l passenger, US$0.2 per dor passenger
4) Concession Revenue	US$2.0 per int'l passenger, US$0.1 per dor passenger
5) Car Parking Charge	VND10,000 per time (currently VND5,000 per time
6) Space Rent	US$25.0 per sq.m per month in international area US$12.5 per sq.m per month in domestic area (currently US$15-20 per sq.m per month)
7) Advertisement Revenue	US$5.0 per sq.m per annum in international area US$2.5 per sq.m per annul in domestic area

The detailed estimation procedures of the costs and revenues of the T1 Project are shown in Appendices 7.6.1 through 7.6.8.

The FIRRs of the T1 Project are calculated for the three levels of passenger service charge as follows:

Table 7.6.2 FIRR of the T1 Project

Case	Passenger Service Charge (PSC)	FIRR
Case A	Int'l PSC: US$9.0 Dom. PSC: VND20,000	7.3%
Case B	Int'l PSC: US$12.0 Dom. PSC: VND30,000	10.1%
Case C	Int'l PSC: US$15.0 Dom. PSC: VND40,000	12.7%

The result indicates that the T1 Project is financially feasible at the passenger service charge level of the Case B, assuming that capital for the Project is procured at an interest rate of 8%. As analyzed in Table 9.7.4 later in this report, this level of passenger service charge is acceptable in the comparison with other major airports in Southeast Asia.

CHAPTER 8 VERIFICATION OF NEW DEVELOPMENT SITE

CHAPTER 8 VERIFICATION OF NEW DEVELOPMENT SITE

8.1 Summary

This chapter outlines the verification of the New Development Site which is identified in the CAAV's Master Plan. It consists of the following sections:

a) Geographical Conditions of the Site
b) Geological Conditions of the Site
c) Environmental Conditions of the Site

As a result of the study, the New Development Site is judged to be a suitable site for the new development of the NBIA toward the year 2015 and beyond.

8.2 Geographical Conditions of the Site

The New Development Site is approximately the area surrounded by Noi Bai -Thang Long Expressway, National Road No. 2 and a road connecting these two roads as shown in Figure 8.2.1. The area is approximately 1.1 km x 4.2 km. Their dimensions are considered reasonable for development of new airport facilities toward the year 2015 and beyond to the south of the existing airport. Some facilities, such as approach lighting systems, the middle marker of ILS, etc. will, however, require some additional area.

The site is relatively flat with a ground elevation of about 10 to 12 m above mean sea level, which is nearly equal to the existing runway elevation. There is no hilly terrain which will constitute obstacles around the site. The only exceptions are mountains approximately 6 km north of the existing runway, but these do not adversely affect the safety of aircraft operation; therefore, no significant difficulties would inhibit the construction of airport facilities.

From the geographical point of view, the area is reasonable for the site of the new development of the NBIA.

0 100 200 300 400 500 m

Figure 8.2.1 Map of New Development Site

8.3 Geological Conditions of the Site

Alluvial clayey deposits, which originate from the sediments of the Hong River and its tributaries, are widely distributed in and around the New Development Site. Alluvial clayey deposits underlain by basement rocks are about 20 to 25 m thick in the western area and more than 30 m in the eastern area.

Figures 8.3.1 and 8.3.2 show the location map of soil investigations and geological profiles of the site. As it can be seen in the geological profiles, alluvial deposits are categorised into the following three layers:

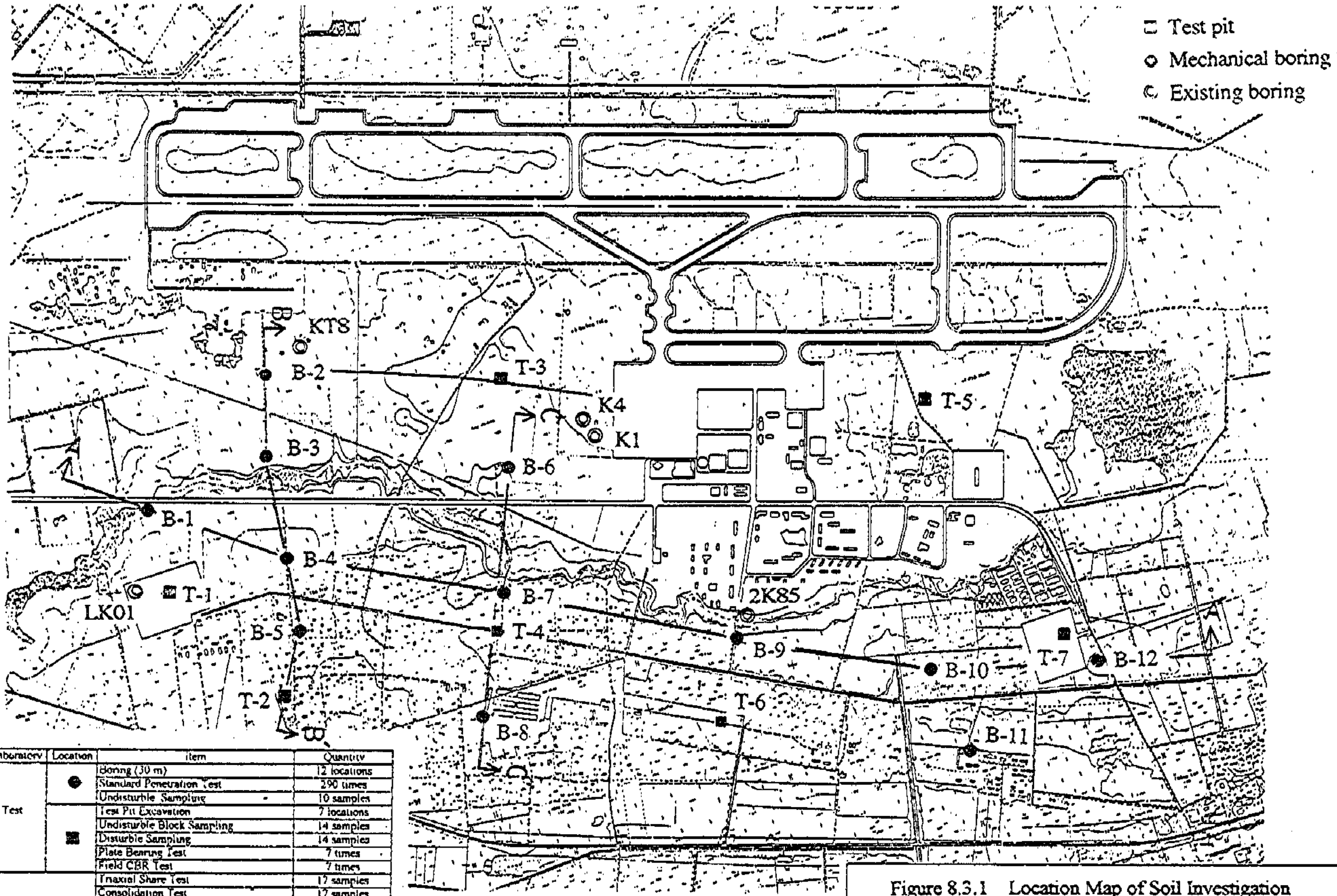
Upper Layer:	This layer includes top soil, clay layer (Ac1) and sandy clay layer (Ac1s, Ac1r), about 2 to 4 m deep from the surface.
Second Layer:	This layer includes clay layer (Ac2) and sand layer (As2) with a clayey sand layer (As2c) and thin gravel layer (Ag2), and is about 5 to 20 m thick.
Third Layer:	This layer is composed of gravel (Ag3).

General description of each layer is as follows:

1) Top Soil:
Top soil consists mainly of clay and sand with plant roots. The thickness of top soil is about 0.1 to 0.5 m.

2) Clay layer - Ac1:
This soil consists of light grey clay with reddish patches. The thickness of this layer is approximately 2 to 8 m. N-values of this layer range from 5 to 20 with an average of 11.8. Field CBR's of this layer are from 3.6 to 9.1%, and K_{30} = 6.5 - 10.0 kgf/cm^3. Laboratory CBR's are 2.0 to 3.2%. Compression Index (Cc) and Coefficient of Volume Compressibility (mv) of Ac1, Ac1s and Ac1r are 0.06 to 0.12 and 0.02 to 0.04 cm^2/kg respectively.

3) Sandy Clay Layer - Ac1s and Ac1r:
This soil is distributed around B-6, B-7, B-8, B-10, B-11, T-2, T-4 and T-6. The thickness of this layer is approximately 2 to 4 m. N-values are 6 to 14 with an average of 10.9. Ac1r is the recent river deposit. Field CBR's of this layer are from 8.4 to 12.9 %,, and K_{30} = 9.7 - 11.3 kgf/cm^3. Laboratory CBR's are 2.7 to 4.0%. Compression Index (Cc) and Coefficient of Volume Compressibility (mv) of Ac1, Ac1s and Ac1r are 0.05 to 0.14 and 0.02 to 0.05 cm^2/kg respectively.



Field / Laboratory	Location	Item	Quantity
Field Test	● (Mechanical boring)	Boring (30 m)	12 locations
		Standard Penetration Test	290 times
		Undisturble Sampling	10 samples
	■ (Test pit)	Test Pit Excavation	7 locations
		Undisturble Block Sampling	14 samples
		Disturble Sampling	14 samples
		Plate Bearing Test	7 times
		Field CBR Test	7 times
Laboratory Test		Triaxial Share Test	17 samples
		Consolidation Test	17 samples
		Compaction Test	14 samples
		Laboratory CBR Test	21 samples
		Physical Property Tests	80 samples

Figure 8.3.1 Location Map of Soil Investigation

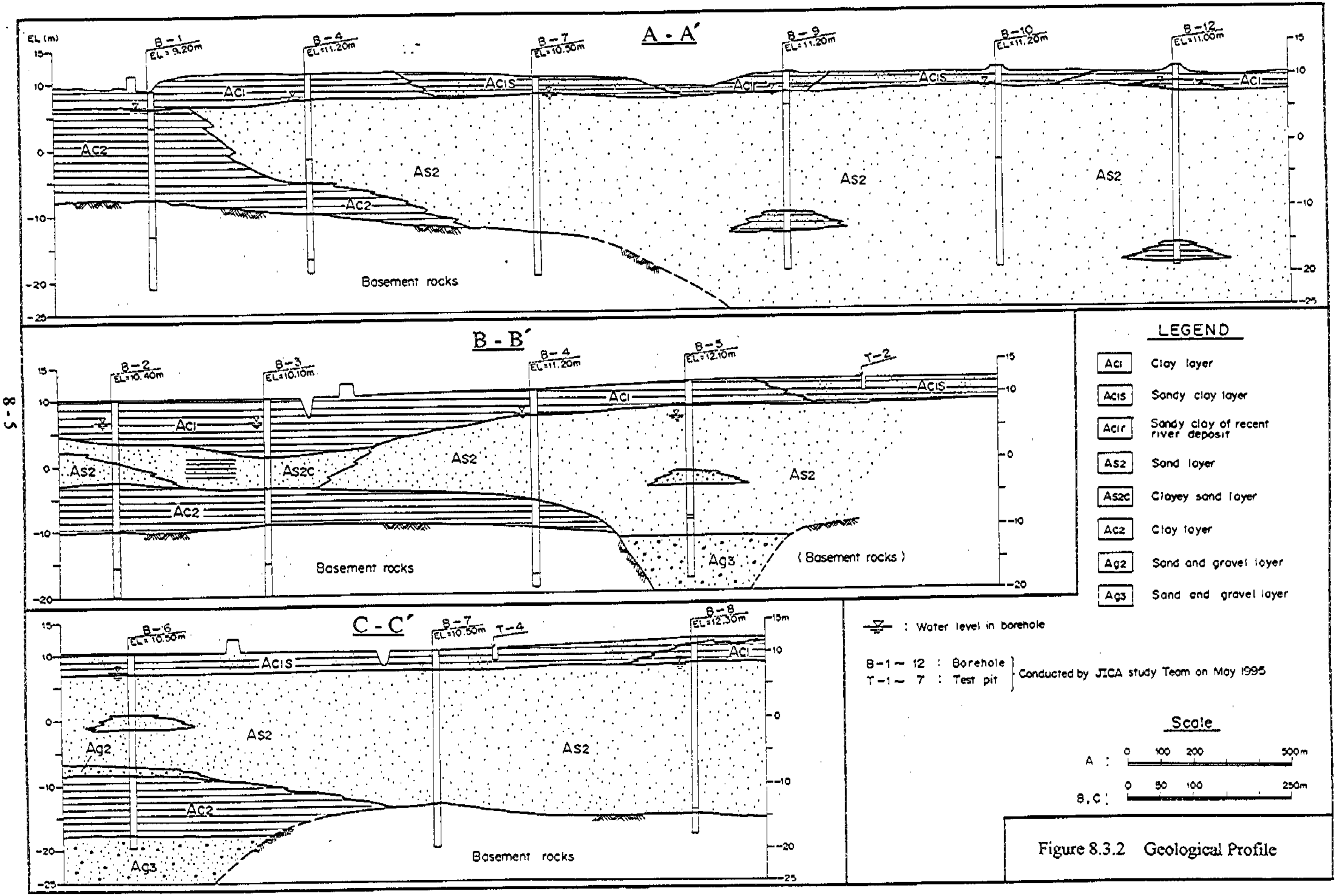


Figure 8.3.2 Geological Profile

4) Sand Layer - As2:

This soil is composed of fine to medium sand locally mixed with trace gravel. N-values of the upper part (up to 20 m deep) of this layer range from 4 to 24 with an average of 12.3, and lower part (deeper than 20 m) indicates N = 14 to 32 (average 21.8).

5) Clayey Sand Layer - As2c:

This layer is composed of clayey sand with loos sandy clay. This layer exists around B-2 and B-3, and its thickness is about 3 to 5 m. N-values are from 7 to 13, with an average of 9.3.

6) Clay Layer - Ac2:

This soil is very stiff clay with N-values of 7 to 40, with an average of 17.6. The thickness ranges from 5 to 13 m.

7) Gravel Layer - Ag3:

This is layer is composed of sand and gravel to boulder and miscellaneous grey colour. The N-values of this layer are 22 to over 50.

The bearing strength of upper layer of soils (Ac1, Ac1s and Ac1r) of the New Development Site is relatively low, but is acceptable for constructing the subgrade of pavements. These soils are capable of supporting single and 2 to 3 story normal buildings, but multi-story (more than 3 stories) buildings and important structures will require piling down to the Basement Rocks or Gravel Layer (Ag3) which are 17 to 28 m below the existing ground level in the western area, and more than 30 m in the eastern area. Settlement of the ground will not be a big problem (a 2 m thick fill will cause 6 to 7 cm settlement) since the Compression Indices of the Ac1, Ac1s and Ac1r are relatively low and the thickness of the layer is only 2 to 4 m in the most places.

From the geological point of view, the area is, therefore, considered reasonable for the new development of the NBIA.

8.4 Environmental Conditions of the Site

The existing social environment around the site is characterized by agriculture. More than one half of the land at the New Development Site is used for farming, and small resident areas are scattered on the farmland. Some land areas are used for roads, and water system such as rivers, lakes, ponds and canals. There are many irrigation channels which distribute irrigation water pumped up from lakes, ponds and canals around the site. The volumes of water flow are quite different between the dry (from October to May) and rainy (from June to September) seasons. The water from rivers, lakes, ponds and canals is used for irrigation and fishery, and the underground water from wells is used for domestic consumption around the site. The existing condition of water supply, sewerage and solid waste treatment systems are generally unsatisfactory. The transportation system around the site comprises the Noi Bai - Thang Long Expressway, National Road No. 2 and other roads, and a railway. Economic activities around the site are mainly agricultural. Some small retail shops and individual industries, such as brick factories, are located along the roads. There are some commercial fishermen around the site, but they are part time workers only and their income from fishery is not significant.

The existing condition of flora and fauna around the site is of no great significance, because the land is used mainly for farming. The landscape around the site is also determined by farming and related activities.

The existing air quality is relatively good, because there are no large factories, facilities or other activities which cause air pollution. The emission of air pollutants from the existing airport is not significant. There are, therefore, no complaints from nearby residents at present. Water pollution has progressively increased due to waste water from airport facilities, illegal waste disposal and agriculture chemical and fertilizer. The noise from aircraft and airport access vehicles has increased, however, there seems to have been no complaints from the residents at present.

The environmental conditions in the Noi Bai area can be found at almost any place in the areas surrounding of Hanoi City. The only significant difference between Noi Bai area and other areas is that the former is already equipped with airport facilities, including an access system from Hanoi. In terms of both environmental conditions and minimizing investment requirements, therefore, the site adjacent to the existing Noi Bai International Airport is considered quite acceptable for the new development of the NBIA.