4) Reserve fuel: for 1.25 hours of extra flight

5) Effective runway gradient: 0.6%

6) Aerodrome reference temperature: 26.5 degrees C.

7) Airport elevation: 35 m above sea level

The required runway length calculated on the basis of the above design conditions is as shown below:

Table 5-3-2 Required Runway Length

(Unit: m)

Required runway length (B-747-200B)*-1	Required runway length (DC-10-30)*-2	Existing runway length	Projected runway length
3,470	3,430	3,507	3,507

*-1: Based on "FAA AC 150/5325-4"

*-2: Based on "DC-10 Airplane Characteristics for Airport Planning"

(3) Width of Runway

The width of runway should be 45 m in accordance with the ICAO recommendations for the corresponding runway category for 1995 and 2005.

5.3.3 Taxiway

In view of the aircraft movement forecast, a high-speed exit taxiway for wide-body jet aircraft is planned to be constructed to reduce runway occupancy of landing aircraft for the year 1995.

5.3.4 Passenger Loading Apron

Based on the hourly requirements of aircraft parking positions assessed from the simulated flight schedules as per Appendix 5-1, it is considered necessary to provide the airport with the following number of aircraft parking positions:

Table 5-3-3 Number of Passenger Aircraft Parking Positions

		1995		2005	
		Fixed	Remote	Fixed	Remote
International Services	A type	3	3	4	3
	B type	4	0	4	0
	C type	1	2	1	2
Domestic Services	D type	2	2	4	2
	E type	6	3	6	2
	F type	2	2	2	2
	Total	18	12	21	11

Notes:
1) Taking into consideration the anticipated delay, the number of fixed spots for international services should include one A type spot in reserve.
2) To supplement the inadequate number of fixed spots for night-stay aircraft in domestic service, remote spots should be provided.
3) To ensure efficient use of the fixed spots, remote spots are provided for aircraft in international service that will have to stay at the airport longer than 90 minutes.

5.3.5 Cargo Loading Apron

The analysis of the projected total belly cargo capacity has shown that the entire cargo traffic volume projected for the year 2005 can be transported in belly. However, taking into account the fact that freighters are operated by Aeronaves at present and the expected future worldwide trend for greater increase in freighter traffic than in belly cargo traffic in international service, the following number of freighter parking positions are provided for the purpose of this study:

Table 5-3-4 Number of Freighter Parking Positions

Year	Number of Parking Positions
1995	1 spot for DC-8-62F
2005	1 spot for B 747-F
	1 spot for DC-8-62F

5.4 Terminal Area Facilities

5.4.1 Passenger Terminal Building

Based on the simulated flight schedules, the number of passengers to be processed during the peak-hour period is determined as follows:

Table 5-4-1 Passenger-Processing Capacity Required

		1995		2005	
		Number of Flights	Number of Passengers	Number of Flights	Number of Passengers
International	Departing	A type: 1 B type: 5 C type: 0	960	A type: 1 B type: 6 C type: 1	1,110
	Arriving	A type: 0 B type: 5 C type: 2	930	A type: 3 B type: 4 C type: 2	1,320
Domestic	Departing	D type: 2 E type: 6 F type: 2	820	D type: 5 E type: 5 F type: 2	1,070
	Arriving	D type: 1 E type: 6 F type: 1	640	D type: 4 E type: 5 F type: 1	900

The passenger-processing area capacity required to accommodate the number of passengers estimated above are determined as follows from the basic data derived from the passenger-flow survey (Appendix 5-3):

Table 5-4-2 Passenger-Processing Area Capacity Required

Facility		1995	2005
International			
Check-in counter	(unit)	24	28
Departure public lobby	(sq.m)	5,350	6,200
Immigration counter (Departing)	(booth)	10	12
Security check counter	(spot)	3	3
Departure lounge	(sq.m)	1,920	2,220
Immigration counter (Arriving)	(booth)	12	17
Baggage claim	(section)	4	4
Baggage check counter	(section)	18	25
Arrival lobby	(sq.m)	1,670	2,380
Domestic			
Check-in counter	(unit)	14	18
Departure lobby	(sq.m)	1,770	2,310
Security check counter	(spot)	3	4
Departure lounge	(sq.m)	1,640	2,140
Baggage claim	(section)	3	4
Arrival lobby	(sq.m)	1,380	1,940

Note: Required area per one unit of each facility is as shown in Appendix 5-4.

Through analyses of all relevant factors such as relationship between different office space and number of airport employees or number of passengers, the following floor area requirements are established for the CIQ offices, office of CORPAC, airline office and concessions.

Table 5-4-3 Floor Area Requirements for Offices and Concessions in the Passenger Terminal Building

(Unit : sq.m)

	1995	2005
Office of CIQ, CORPAC	2,000	2,800
Airline office	3,750	4,200
Concessions	2,100	2,600

5.4.2 Cargo Terminal Building

Based on the projected annual cargo traffic and basic data shown in Appendix 5-5, the floor area required of the cargo terminal building is established as follows:

Table 5-4-4 Floor Area of Cargo Terminal Building

(Unit : sq.m)

		1995	2005
International	Outbound cargo	2,390	3,090
	Inbound cargo	7,410	10,950
	Inspection	320	750
	Office	980	1,400
Domestic		1,380	1,790

Through analysis of relationship between office space and number of related employees, the following floor area requirement is established for cargo administration building:

Table 5-4-5 Floor Area Requirements of Cargo Administration Building

(Unit : sq.m)

	1995	2005
Cargo administration building	2,800	3,900

5.4.3 Catering Facility

Based on the simulated flight schedules, the catering facility requirements for the preparation of inflight meals required for forecast peak-day scheduled international departing passengers are calculated as shown in Table 5-4-6.

Table 5-4-6 Catering Facility Requirements

	1995	2005
Number of inflight meals per day	9,000	11,000
Floor area (sq.m)	7,700	9,200
Premises (sq.m)	18,500	22,000

5.4.4 Aircraft Maintenance Hangar

Based on the basic concept shown in Appendix 5-6, the number of aircraft maintenance hangars required for maintenance of aircrafts engaged in scheduled flights is calculated as shown in Table 5-4-7.

Table 5-4-7 Number of Aircraft Maintenance Hangars

(Unit : Hangar)

		1995	2005
350 Seater Jet	International	-	-
200 Seater Jet	International	1	1
& 250 Seater Jet	Domestic	1	1
120 Seater Jet	Domestic	1	1

5.4.5 Fire Station

In addition to the existing 4 vehicles, 3 new fire-fighting vehicles have been ordered by CORPAC. Upon their delivery, the airport will conform to the requirements of Aerodrome Category 9 of the ICAO recommendations (Table 5-4-8). A new fire station having an area of 1,300 sq.m must be constructed to accommodate these vehicles.

Table 5-4-8 ICAO Recommendation (Category 9)

	Main Agents		Complementary Agents		
	Water (l)	Discharge Rate (l/min.)	Dry Chem. Powd. (kg)	or Halon (kg)	or CO2 (kg)
AFFF	24,300	900	450	450	900
Protein Foam	36,400	13,500	450	450	900

5.4.6. Fuel Supply Facilities

The capacity of aviation fuel supply required per day is calculated from the simulated flight schedules shown in Appendix 5-7. Through analysis of the present operational capacity, the fuel storage requirements are estimated as shown in Table 5-4-9.

Table 5-4-9 Fuel Storage Requirements

		1995	2005
Amount of daily fuel consumption (kl)	Jet A-1	1,530	1,920
	Av-Gas	3.7	4.6
Storage capacity (kl)	Jet A-1	4,600	5,800
	Av-Gas	30	30
Distribution capacity (kl/h)		410	440
Distribution system		Hydrant	Hydrant
Receiving system		Refueller	Refueller
Fuel storage/supply area (sq.m)		25,500	25,500

5.4.7 Water Supply Facility

Capacity requirements for water supply facility are derived from the forecast number of air passengers and airport employees, as shown in Table 5-4-10.

Table 5-4-10 Water Supply Requirements

	1995	2005
Demand of water supply per day (m^3/day)	900	1,100
Demand at constant level (l/sec.)	13	15
Demand at peak level (l/sec.)	28	32

Note: Demand of water supply per day
= (number of air passengers x 20 l/day + number of employees x 120 l/day) x 1.2

5.4.8 Sewage Disposal Facility

Sewage disposal capacity should be sufficient to accommodate the forecast sewage volume corresponding to the forecast water consumption of the entire airport tabulated in Table 5-4-10.

5.4.9 Car Parking

The car parking capacity to be provided at the airport is calculated as shown in Table 5-4-11, from the result of car flow survey (Appendix 5-8).

Table 5-4-11 Number of Parking Spaces Required

(Unit: Cars)

	1995	2005
Passengers and well-wishers	720	900
Airport employees	650	750
Total	1,370	1,650

5.4.10 Electric Power Supply Facility

A dual system of separated routes is required to ensure reliable power supply of sufficient capacity to meet the needs of the entire airport facilities. In addition, provision of emergency backup power supply system is indispensable for the facilities so required by the ICAO recommendation. Demand of electric power supply for each facilities are calculated as shown in Table 5-4-12.

Table 5-4-12 Demand of Electric Power Supply

(Unit: kVA)

	1995	2005
Air Navigation Facilities		
ATC Facilities	120	130
Radio Navigational Aids	20	20
Meteo. Facilities	30	30
Visual Aids	300	300
Sub Total	470	480
Terminal Area Facilities		
Pax. Terminal Bldg.	1,000	1,300
Cargo & Addm. Bldg.	350	550
Fuel Supply Facility	500	600
Water Supply Facility	140	210
Sub Total	1,990	2,660
Grand Total	2,460	3,140

5.5 Air Navigation Facility

The air navigation facility requirements are determined in conformity with the ICAO standards and recommended practices, and also taking into consideration the following planning factors, and the results are summarized in Table 5-5-1.

(1) Lima International Airport is:

1) the gateway serving the capital of the Republic of Peru,
2) categorized by ICAO as the international regional scheduled (RS) airport,
3) served by wide-body aircraft,
4) utilized after dark, and
5) utilized by the international/domestic general aviation aircraft.

5.5.1 ATC Facilities

(1) Terminal Area Surveillance Radar

The existing Airport Surveillance Radar Facility of the Lima International Airport will adequately meet the requirements for the Target Year of 1995. For the year 2005 Data Entry Display Sub-system (DEDS) should be increased by 3 to a total of 6, with 3 each separately serving the ACC and Approach Control in order to meet the forecast traffic increase. To alleviate controllers' work load and thereby enhance air safety Bright Display (BD) should be introduced in the Control Tower for the year 1995.

(2) Communications Facilities

The communications equipment in the Control Tower should be increased for the year 1995 so as to provide for a separate channel frequency for exclusive use of ground control. For 2005 another channel frequency for the local control should be added. Radio link circuit system should be provided for the year 1995 between the airport and the off-airport transmitter and receiver stations, and this should be added for 2005.

5.5.2 Radio Navigational Aids

(1) VOR/DME

The 3 existing VORs plus 2 to be newly installed in 1986 by CORPAC should be sufficient quantitywise to meet the 1995 requirements, provided that a DME is colocated with each and every use of the 5 VORs. No further increase or modification should be necessary for 2005.

(2) ILS

ILS of the Airport should be upgraded to Category II for the following reasons:

1) Most of the national capital airports in Central and South America as well as in most other parts of the world are equipped with CAT-II ILS.
2) Pisco Airport, an alternate aerodrome within Peru for the Airport, is not equipped to accommodate international service, and therefore, it is highly desirable to improve the runway usability of the Lima International Airport with the upgraded ILS.
3) CAT-II ILS is recommended for the Airport in the Air Navigation Plan of ICAO.

For the year 2005 MLS should be introduced.

(3) NDB

Both the 1995 and the 2005 requirements for NDB will be sufficiently met by the planned addition of 2 new NDBs on the southern extension of the runway by CORPAC in 1986, provided that the 6 existing NDBs including those presently colocated with Middle Marker are renewed to make a total of 8 up-to-date NDBs available for the Target Year 1995.

5.5.3 Visual Aids

Runway edge lights, runway centreline lights, taxiway edge lights and apron flood lights need to be modified commensurate with the runway, taxiway and apron improvement and expansion required for the year 1995. The Approach Lighting System (ALS), touchdown zone lights, runway threshold lights, taxiway centreline lights as well as the related Uninterrupted Power Supply System (UPS) should also be improved and/or increased corresponding to the upgrading of ILS to CAT-II. Furthermore R/W 33 should be provided with adequate lighting system so as to be able to accommodate emergency landings and night time operation in strong northerly winds. These improvements made for the Target Year 1995 should adequately meet the long term requirements through the year 2005.

5.5.4 Aeronautical Meteorological Facilities

Runway Visual Range Measurement Equipment (RVR), ceilometer, Automatic Picture Transmittion Receiver (APT) and weather facsimile recorder need to be rehabilitated, renewed or modernised as appropriate, and RVR indicators should be installed in the Control Tower and the radar room for the Target Year 1995. For the year 2005 no further improvement is required.

Table 5-5-1 Facility Requirements (Air Navigation Facilities)

Facility	1995	2005
VHF Transmitter Receiver	5 frequencies	6 frequencies
Radio Link for TX Station	24 channels	36 channels
Radio Link for RX Station	24 channels	36 channels
ATC Console	1 set	1 set
Radar	TSR/SSR/DPS	TSR/SSR/DPS
Bright Display	1 set	1 set
VOR/DME	5 stations	5 stations
ILS/MLS	ILS (Cat-II)	MLS
NDB	8 stations	8 stations
Lighting System for R/W 15	Cat-II	Cat-II
Lighting System for R/W 33	Instrument	Instrument
Lighting System for Taxiway	Cat-II	Cat-II
VASIS/PAPI (R/W 15 & 33)	PAPI	PAPI
Apron Flood Light	1 set	1 set
Satellite Receiver	1 set	1 set
Weather Data Recorder	1 set	1 set
Weather Data Processing System	1 set	1 set

CHAPTER 6

MASTER PLAN

CHAPTER 6 MASTER PLAN

6.1 Basic Conditions

6.1.1 Target Year

The target year will be set at 2005 for the purpose of the master plan.

6.1.2 Scale of Facilities

As stated previously in Chapter 5. Airport Facility Requirements, the master plan will be prepared to meet the facility requirements that will satisfy the main case in the demand forecast.

6.1.3 Site Area Required for Future Development

Area of the site required for development is taken to be the portion of Lima International Airport now used for civil aviation, with the proviso that use may be made of the spare site of about 470 ha reserved by the Peruvian Government west of the present airport for future expansion, in case the master plan calls for extension of the site beyond of the present area.

6.2 Airfield Facilities

6.2.1 Runway

As mentioned previously in Chapter 5, the aircraft movement forecast for the year 2005 does not call for a second runway to be built. The existing single runway should meet the requirement up to 2005.

6.2.2 Taxiway

In view of the aircraft movement forecast, a high-speed exit taxiway leaving the runway 2,212 m from the end of Runway 15 for wide-body jet aircraft is planned to be constructed to reduce runway occupancy of landing aircraft.

6.2.3 Maintenance and Fire Rescue Roads

To enable fire-fighting and maintenance vehicles to move about smoothly in the runway strip, paved roads are planned to be constructed between the runway and the parallel taxiway, and along the boundary fence.

6.3 Terminal Area Facilities

6.3.1 Planning Concept

The present terminal area, as shown in Appendix 3-3, contains all the facilities required for the operation of an airport, such as passenger terminal building, cargo facilities, fuel supply facilities and aircraft maintenance facilities.

Based upon the conditions of the existing facilities (Chapter 3) and the airport facility requirement (Chapter 5), the layout plan of the terminal area facilities is prepared.

(1) Site Area of Terminal Area Facilities

The following two alternative plans were considered as a possible site for accommodating terminal area facilities, and compared:

Alternative 1.

Developments are planned to be implemented within the present terminal area.

Alternative 2.

Developments to cover not only the present terminal area but also the spare site reserved by the Peruvian Government.

As a result Alternative 1 was chosen as the better plan, for the following reasons:

1) Less costs for developments;

2) Maximum utilization of the existing facilities;

3) The existing single runway should meet the requirement up to 2005;

4) The present terminal area has sufficient space for meeting the facility requirement up to 2005.

The spare site of about 470 ha should however be kept reserved for future expansion, including new construction of the second runway.

(2) Facility Plan

The following developments are planned within the present terminal area:

1) Passenger Terminal Building

This is the most important facility in the terminal area and is the largest in scale. As aircraft stands may be added by expanding the present apron, the present terminal building will be extended in the plan to take care of the additional aircraft stands required.

The master plan is also designed to solve the problems of the present passenger terminal building in the following manners:

a) Construct a new international-flight finger and gate lounges and remove the existing international-flight finger.

b) Expand arrival-passenger facilities, both international and domestic.

c) Separate flow of departing passengers from that of arrival passengers, both international and domestic, and provide sufficient space for departure lounge, to meet the demand of 2005.

2) Export Cargo Warehouse

The present warehouse is about 20 years old and contains storage area for export cargo, customs office, general storage area, fire station and administration office. It is also not quite suitable for smooth flow of cargo from land side to air side. Therefore, the master plan aims at demolishing it, and rebuilding a new export cargo warehouse, and separately a customs building, a fire station and administration office building.

3) Import Cargo Warehouse

The present facility will be kept intact in the plan, since it is fairly new in construction, and has sufficient capacity for meeting the future demand.

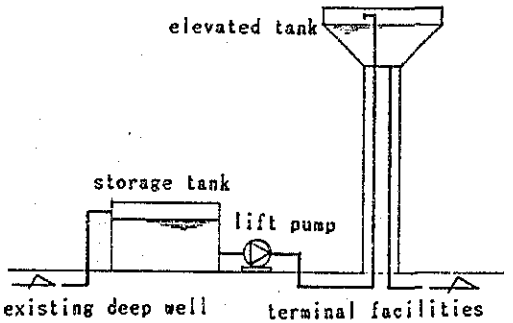
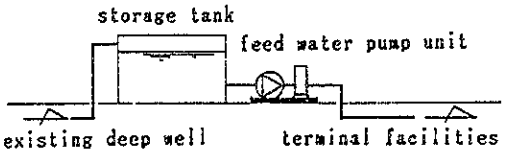
4) Fuel Supply Facilities

The present facilities may well have been positioned properly at the time they were constructed, but they will become situated right in the middle of the terminal area when the apron is expanded in the future. They must therefore be relocated in the master plan.

5) Water Supply Facility

To meet the future demand, it is planned to install a new storage tank to ensure constant water supply to the terminal area facilities. Since construction and maintenance costs of a feed water pump system are less than those of an elevated tank system, feed water pump system should be adopted as the water supply system of the airport.

Table 6-3-1 Comparison between Elevated Tank System and Feed Water Pump System

	Elevated Tank System	Feed Water Pump System
Outline of System		
Construction Cost	This system is more expensive than feed water pump system, because it requires installation of an elevated tank of 30 metres in height and a lift pump.	This system is cheaper than elevated tank system.
Constant Supply	Water pressure fluctuates little. Water may be continued to be supplied for a while, even during electric power failure.	It is possible to minimize fluctuation of water presure, by installing plural feed water pump units. If back-up power supply is made available, it is possible to feed water even when main power is suspended.

6) Car Parks

Expansion of the car park will be confined to the present terminal area, and will use the adjoining space south of the car park up to the import cargo warehouse.

Any shortage in parking area will be covered by an additional car park elsewhere within the area.

7) Fire Station

Taking into account the need for additional fire-fighting vehicles and for ready turn-out in case of emergency, the fire station will be rebuilt closer to the runway in the master planning.

8) Other Facilities

The following developments are planned to be implemented for the purpose of the master plan.

a) Construction of a main substation

b) Construction of an administration building

c) Demolition and rebuilding of training centre

d) Construction of aircraft maintenance hangar.

(3) Zoning of Terminal Area Facilities

Two alternative zoning plans were drawn up as shown in Fig. 6-3-1, for comparison. They differ mainly in the functional arrangement of the terminal building as outlined below:

1) Alternative zoning 1.

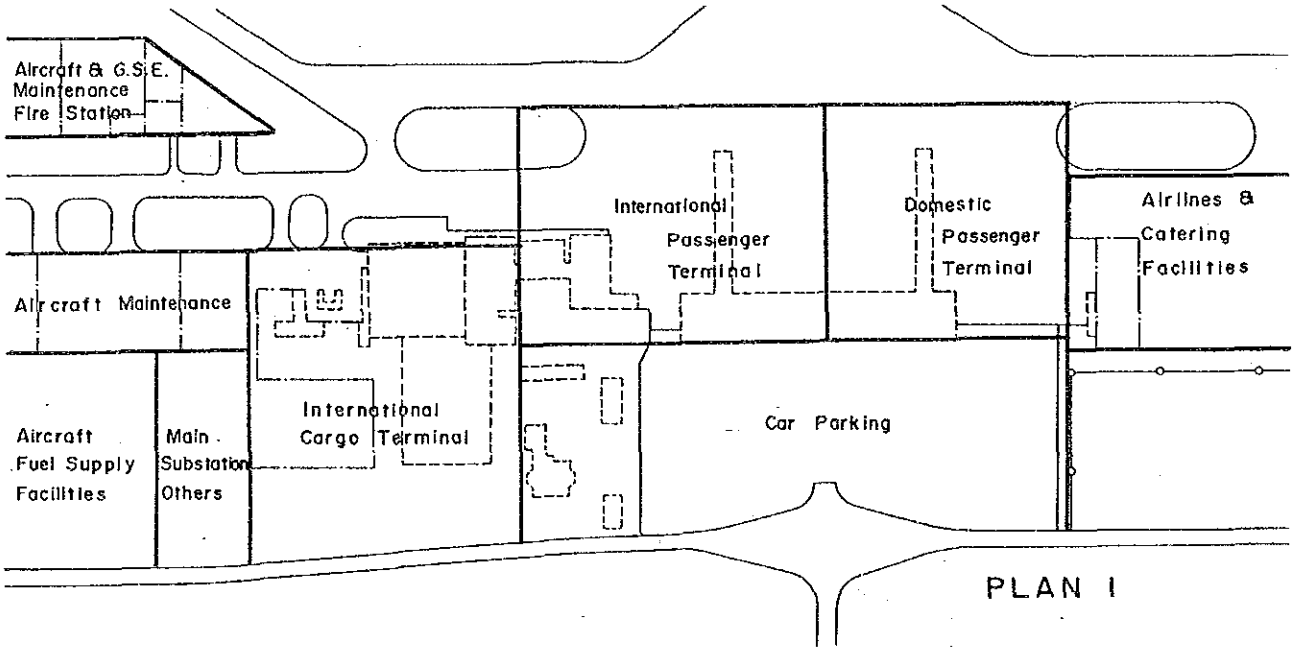
   The terminal building is expanded while keeping the present functional arrangements.

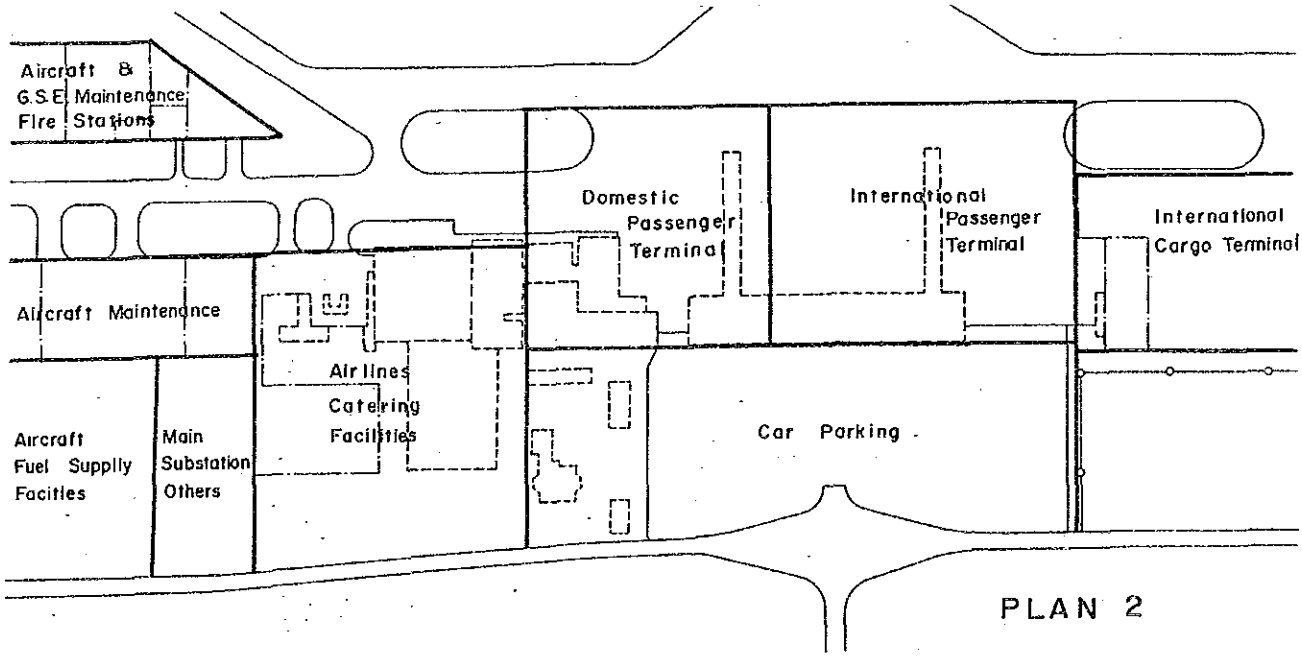
2) Alternative zoning 2.

   Positions of the present international and domestic blocks of the terminal building are reversed to reduce improvement cost of the existing terminal building.

Alternative zoning 1 is chosen as the best feasible zoning in this study, because Alternative zoning 2 necessitates deployment of international cargo facilities at the northern side of the terminal building, compelling the existing facilities there to be moved to the southern side where airline facilities are located at present.

Fig. 6-3-1 Alternative Zoning





6.3.2 Alternative Plans

In determining a layout plan for terminal area facilities, the most important aspects to be considered are terminal concept and layout of aircrafts stands.

On the basis of the planning conditions, terminal concept has been studied as follows:

There are four basic terminal concepts, namely frontal type, finger type, satellite type and open apron type. Sketches of these concepts are shown in Fig. 6-3-2.

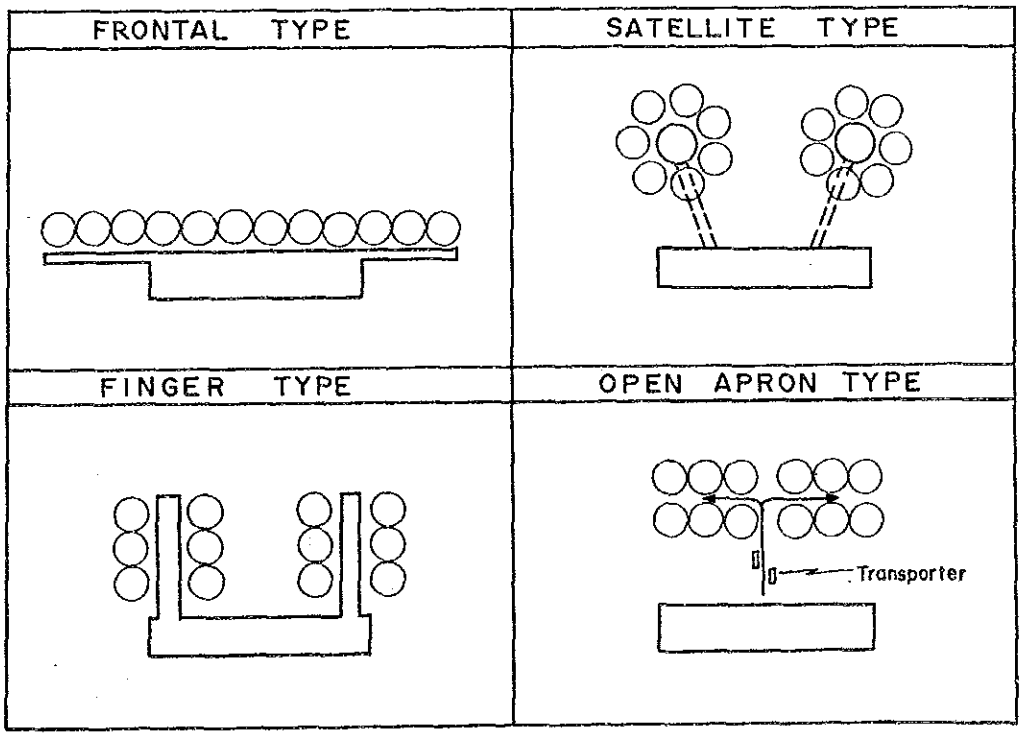


Fig. 6-3-2 Basic Terminal Concepts

The present terminal building is a finger type. In developing the present terminal building, finger type, satellite type and open apron type are fit, but frontal type is not fit because it necessitates replacement of many facilities located at both sides of the terminal building.

Three conceivable alternative plans have been prepared, by developing the basic concepts as shown in Fig. 6-3-3, to suit the situation of the airport. Fig. 6-3-4 shows the three alternative plans finally prepared.

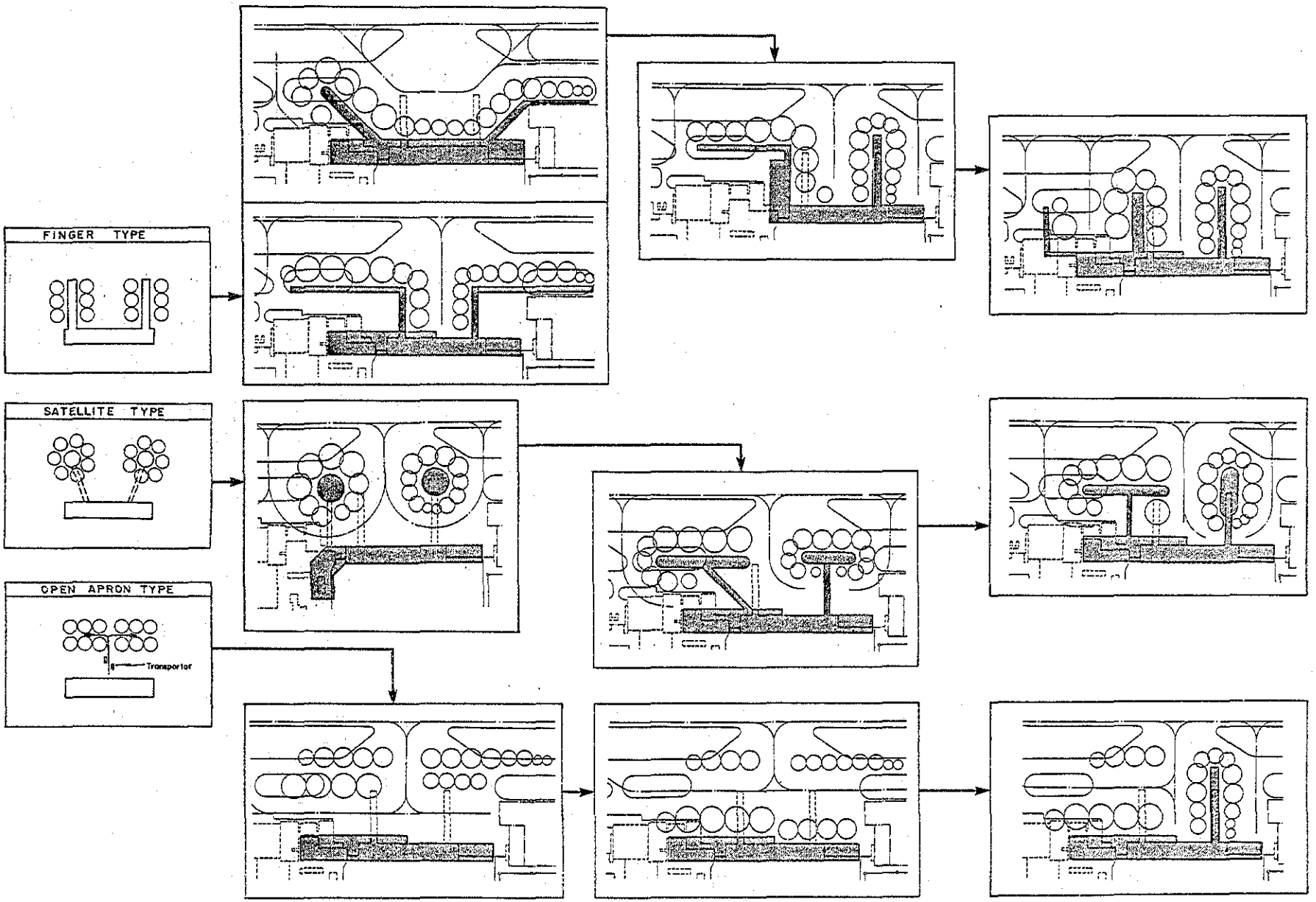
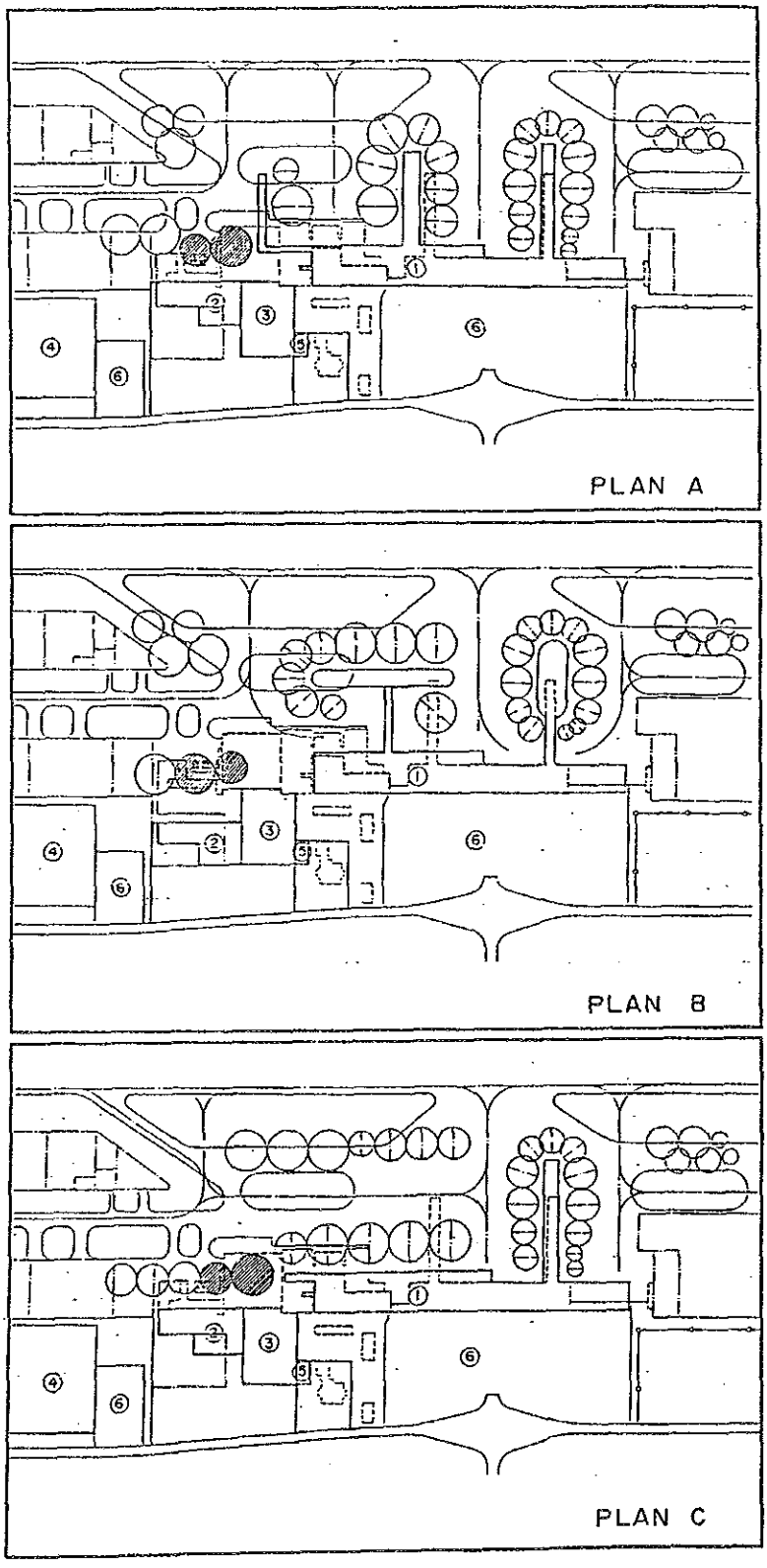


Fig. 6-3-3 Development of Basic Concepts

Fig. 6-3-4 Alternative Plans



6.3.3 Evaluation of Alternatives

(1) Evaluation Criteria

All the three alternatives will satisfy the 2005 demands and are feasible.

Lima International Airport is being operated as the main gateway airport of Peru serving its capital, and will have to be developed without interrupting its operation. Also in view of the need for development in stages, the plan must permit continued operation during each stage of development.

From the above points of view, the three alternatives are evaluated and compared in respect of the following five aspects:

1) Passenger Flow
   a) Minimum walking distance from ticket counter to aircraft
   b) Passenger flow separation in the terminal building (departing and arriving)

2) Manoeuvrability of Aircraft
   a) Efficient aircraft flow on aprons and between apron and taxiways
   b) Easy and efficient manoeuvring of aircraft parking at spots

3) Construction in Stages

a) Possibility of constructing apron and terminal building independently of each other

b) Construction period

c) Continued airport operation during construction works

4) Cost of Construction

a) Fewest facilities to be developed

b) Least temporary works for airport operation during construction works

5) Cost of Airport Operation

a) Easy and low-cost handling of aircraft and passengers.

(2) Evaluation of Alternatives

1) Passenger Flow

a) Alternative A:

- Walking distance of transit passengers is longer than Alternative B.
- Separation of departing and arriving passenger flow is difficult.

b) Alternative B:

- Gate lounge is separated completely from the terminal building, which is desirable for security control.

- Because transit passengers will stay in satellite, their walking distance is short and their flow may be separated from departing and arriving passengers.

c) Alternative C:

- Because a mobile conveyance system is used to take passengers to and from the aircraft, passenger flow will be complicated.
- Walking distance of transit passengers is long.

2) Manoeuvrability of Aircraft

a) Alternative A:

- Because each pier has a large number of gates, it is probable that two or more aircraft may frequently have to taxi between and in parallel with two piers, sometimes in opposite direction, causing hold-up off the apron.
- Problem of blast may occur at the spots located between two piers.

b) Alternative B:

- It is probable that two or more aircraft may have to taxi between two satellites, often in opposite direction, causing similar hold-up as above.

c) Alternative C:

- Problem of blast may occur at the remote spots.

- Aircraft manoeuvring may sometimes be hindered at the aircraft taxilane located between remote spots and fixed spots.

3) Construction in Stages

a) Alternative A:

- Expansion of apron and construction of fingers should be so arranged as to permit uninterrupted operation of airport during construction period.

b) Alternative B:

- Expansion of apron and construction of satellites should be so arranged as to permit continued operation during construction period.

c) Alternative C:

- Expansion of apron and terminal building may be carried out independently of each other.

4) Cost of Construction

Since Alternatives A and B incorporate a gate lounge separately the terminal building, construction costs under Alternative A and B are about U.S. dollar two million higher than Alternative C.

5) Cost of Airport Operation

Alternative C requires purchase of 10 airside buses to take passengers to and from the aircraft. Their annual operation cost will be about US$250,000.

Consequent upon the above evaluation, Alternative B, one of the easiest in passenger flow processing, and having high marks in the other aspects, is chosen as the best feasible plan.

6.3.4 Electric Power Supply

The existing main substation and other substations of the Airport will be reorganized, modernized and/or rehabilitated as appropriate, but within the framework of, and commensurate with the planned expansion and improvement of the apron, passenger terminal building, and radio and visual navigational aids.

This will include total replacement of the substation for the airfield lighting facilities which are to be upgraded to CAT-II. Improvement of the electric power supply system will involve modification not only of the equipment but of all related cables and cable ducts, as well as relocation of the receiving point of the electric supply from the power company.

6.4 Air Navigation Facilities

Improvement of air nagivation facilities aims at increasing runway usability, shortening approach and departure route distances, streamlining Air Traffic Service and maintenance services. It includes, among other things, addition of a DME to every VOR presently not colocated therewith, upgrading of radar performance, upgrading to CAT-II of both ILS and visual aids, and ultimate introduction of MLS, as well as all other improvements identified in the facility requirements in the preceding chapter. Along with these improvements all related communication cables and cable ducts will be renewed and/or added as necessary.

As for the meteorological facilities, all requirements identified in the preceding chapter are planned to be accommodated. Location and quantity of VOR and NDB in the improvement plan are based on an assumption, for the purpose of the present Study, that the operational conditions and procedures of the existing Airport will remain unchanged through the year 2005.

6.5 Summary of Improvement Measures for Master Plan

Table 6-5-1 presents the improvement measures envisaged for the Master Plan, complete with a brief description of the work to be done for each facility.

Fig. 6-5-1 shows the airport layout plan for the Master Plan of the Lima International Airport Development Project.

Table 6-5-1 Summary of Improvement Measures for Master Plan

(Page 1 of 3)

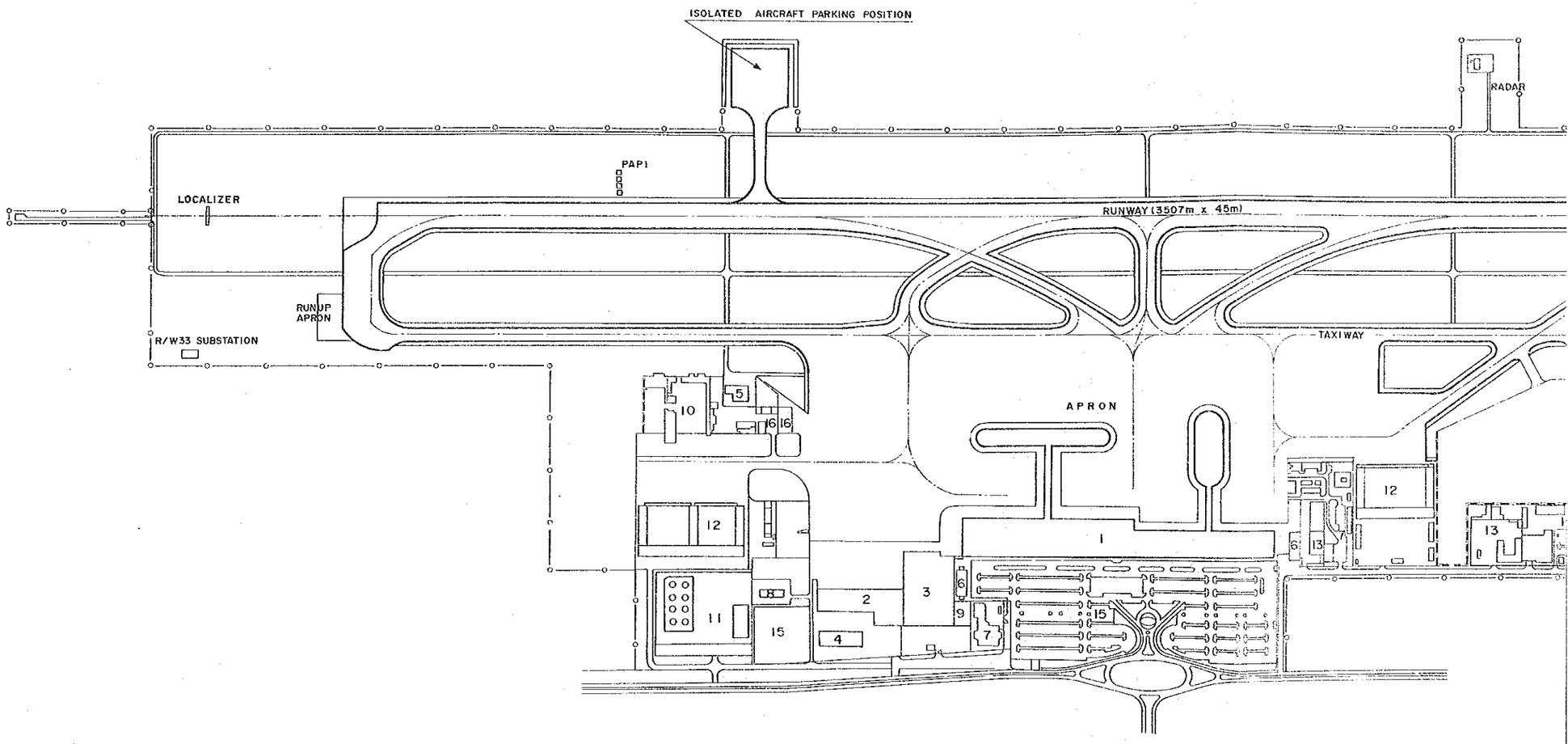
Facility	Description
Airfield Facilities	
- Runway Strip	- Grading (850,000 sq.m) - Surface treatment (425,000 sq.m)
- Runway	- Bituminous overlay (158,000 sq.m)
- Runway Shoulder	- Bituminous overlay (47,000 sq.m)
- Taxiway	- Bituminous overlay (133,000 sq.m) - Construction of a high-speed exit taxiway (10,200 sq.m)
- Taxiway Shoulder	- Bituminous overlay (48,000 sq.m) - New construction (4,900 sq.m)
- Apron	- Expansion with concrete pavement (130,000 sq.m) - Expansion with asphalt pavement (24,400 sq.m) - Construction of an isolated aircraft parking position (10,000 sq.m)
- Maintenance and Fire Rescue Roads	- Construction of a paved road (9,900 m)
- Others	- Security fence, marking, etc.
Terminal Area Facilities	
- Passenger Terminal Building	- Expansion (35,000 sq.m)

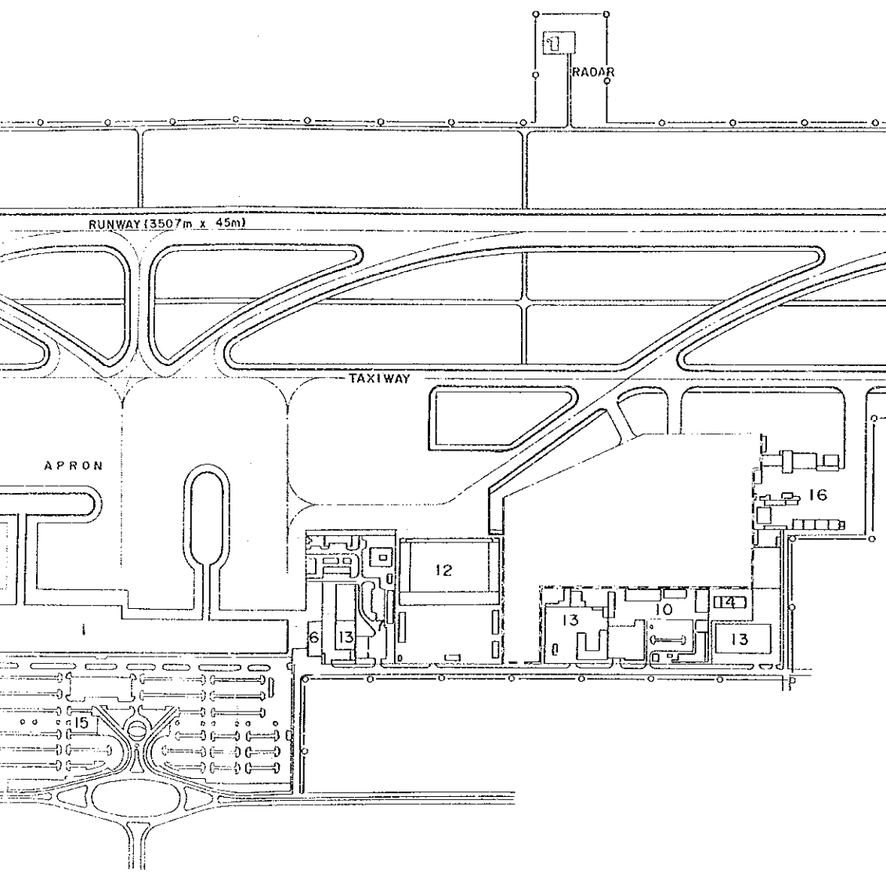
Table 6-5-1 (Cont'd) Summary of Improvement Measures for Master Plan

Facility	Description
Terminal Area Facilities	
- Export Cargo Terminal Building	- Removal of existing building and construction of a new building (8,400 sq.m)
- Customs Office	- Construction of a new buillding (4,200 sq.m)
- Airport Administration Building	- Construction of a new building (4,000 sq.m x 2)
- Fire Station	- Construction of a new station (1,000 sq.m)
- Aircraft Maintenance Hangar	- Construction of new hangars (17,000 sq.m and 23,500 sq.m)
- Catering Facility	- Construction of a new work (3,300 sq.m)
- Training Centre	- Removal of existing building and construction of a new building (1,500 sq.m)
- Fuel Supply Facilities	- Removal of existing facilities and construction of new facilities (site area : 25,500 sq.m)
- Water Supply Facility	- Construction of a new facility (site area : 500 sq.m)
- Car Parks	- Expansion (17,000 sq.m)
- Main Sub-station	- Construction of a new station (700 sq.m)
- Sub Station	- Construction of new stations (405 sq.m x 2)

Table 6-5-1 (Cont'd) Summary of Improvement Measures for Master Plan

Facility	Description
Air Navigation Facilities	
- VOR	- Replacement (1 set)
- DME	- New installation (3 sets)
- ILS/MLS	- Upgrading to Cat. II for 1995 and new installation of MLS for 2005
- NDB	- Replacement (4 sets)
- Lighting System of R/W 15	- Upgrading to Cat. II
- Lighting System of R/W 33	- New installation of SALS
- VASIS/PAPI	- R/W 15 PAPI (Replacement) - R/W 33 PAPI (New installaltion)
- Apron Flood Light	- Increase
- Weather Observation Facilities	- Replacement
- Satellite Receiver	- Replacement
- Weather Data Recorder	- New installation
- Weather Data Processing System	- New installation


ISOLATED AIRCRAFT PARKING POSITION
RADAR
PAPI
LOCALIZER
RUNWAY (3507m x 45m)
RUNUP APRON
R/W33 SUBSTATION
TAXIWAY
APRON
1
2
3
4
5
6
7
8
9
10
11
12
13
15
16

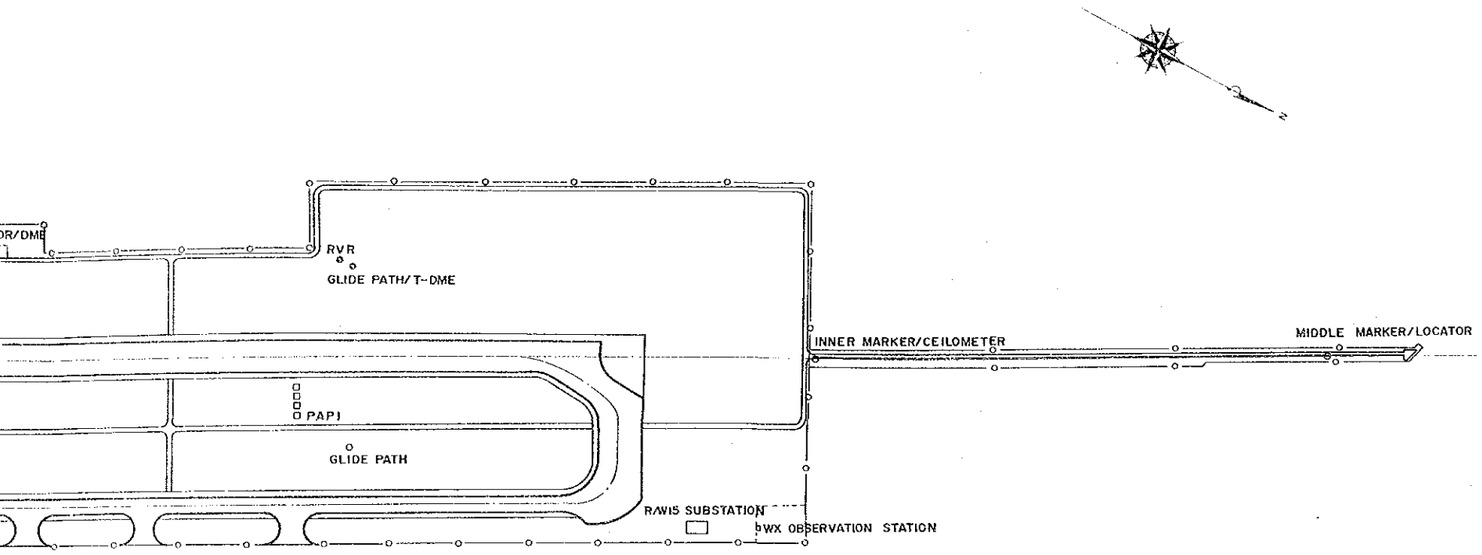


1 PASSENGER TERMINAL BUILDING
2 CARGO TERMINAL BUILDING
3 BONDED WAREHOUSE
4 CUSTOMS BUILDING
5 FIRE FIGHTING STATION
6 ADMINISTRATION BUILDING
7 ACC BUILDING
8 POWER STATION
9 WATER SUPPLY FACILITY
10 AIRPORT MAINTENANCE FACILITIES
11 AIRCRAFT FUEL SUPPLY FACILITY
12 AIRCRAFT MAINTENANCE HANGAR
13 CATERING BUILDING
14 AERONAUTICAL TRAINING CENTER
15 CAR PARKING
16 SMALL AIRCRAFT FACILITIES

0 200 400 800M

FIG. 6-5-1

THE DEVELOPMENT PR
OF
JORGE CHAVEZ LIMA-CALLAO INTER
MASTER PLAN
THE JAPAN INTERNATIONAL COOPE



1 PASSENGER TERMINAL BUILDING
2 CARGO TERMINAL BUILDING
3 BONDED WAREHOUSE
4 CUSTOMS BUILDING
5 FIRE FIGHTING STATION
6 ADMINISTRATION BUILDING
7 ACC BUILDING
8 POWER STATION
9 WATER SUPPLY FACILITY
10 AIRPORT MAINTENANCE FACILITIES
11 AIRCRAFT FUEL SUPPLY FACILITY
12 AIRCRAFT MAINTENANCE HANGAR
13 CATERING BUILDING
14 AERONAUTICAL TRAINING CENTER
15 CAR PARKING
16 SMALL AIRCRAFT FACILITIES

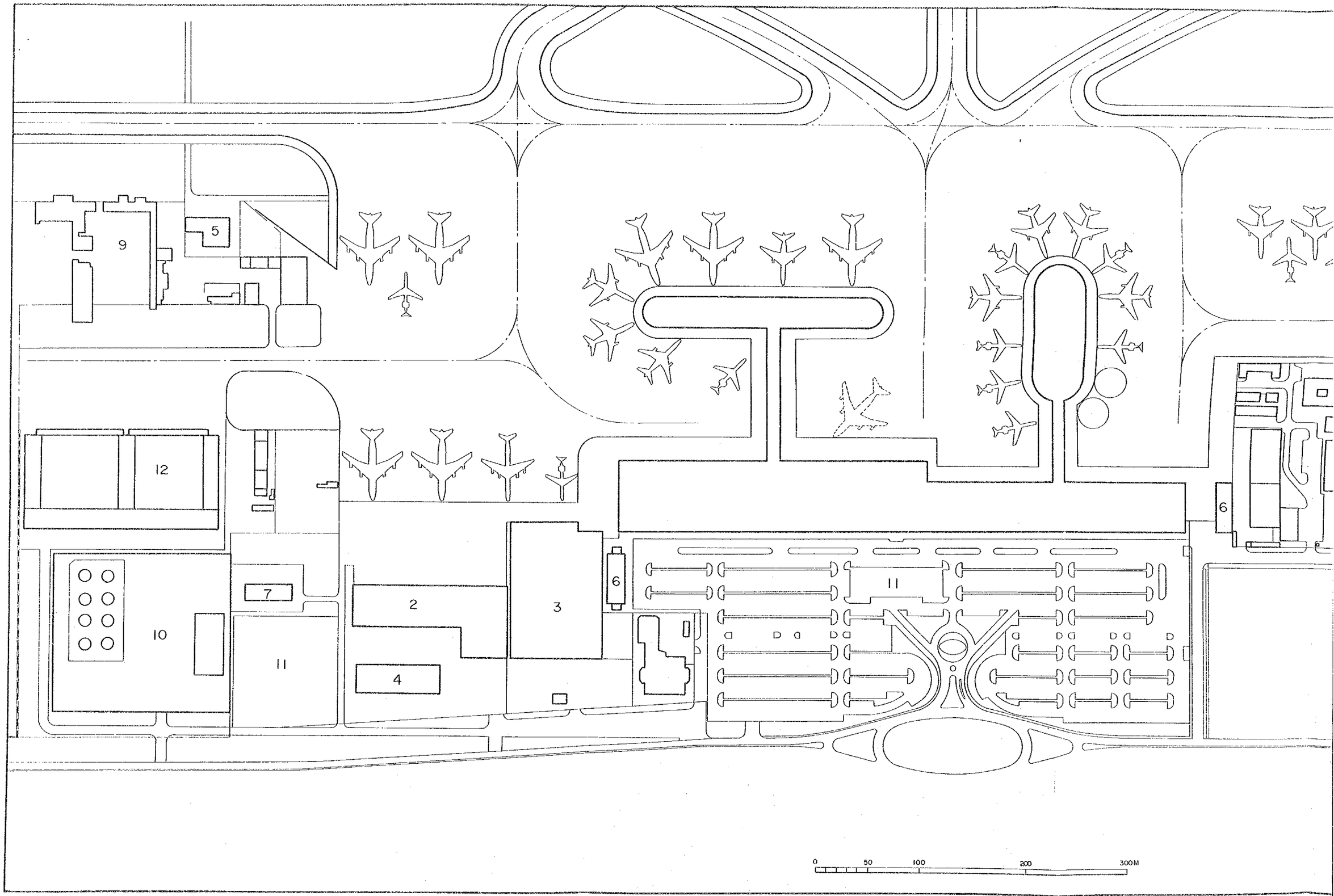
0 200 400 800M

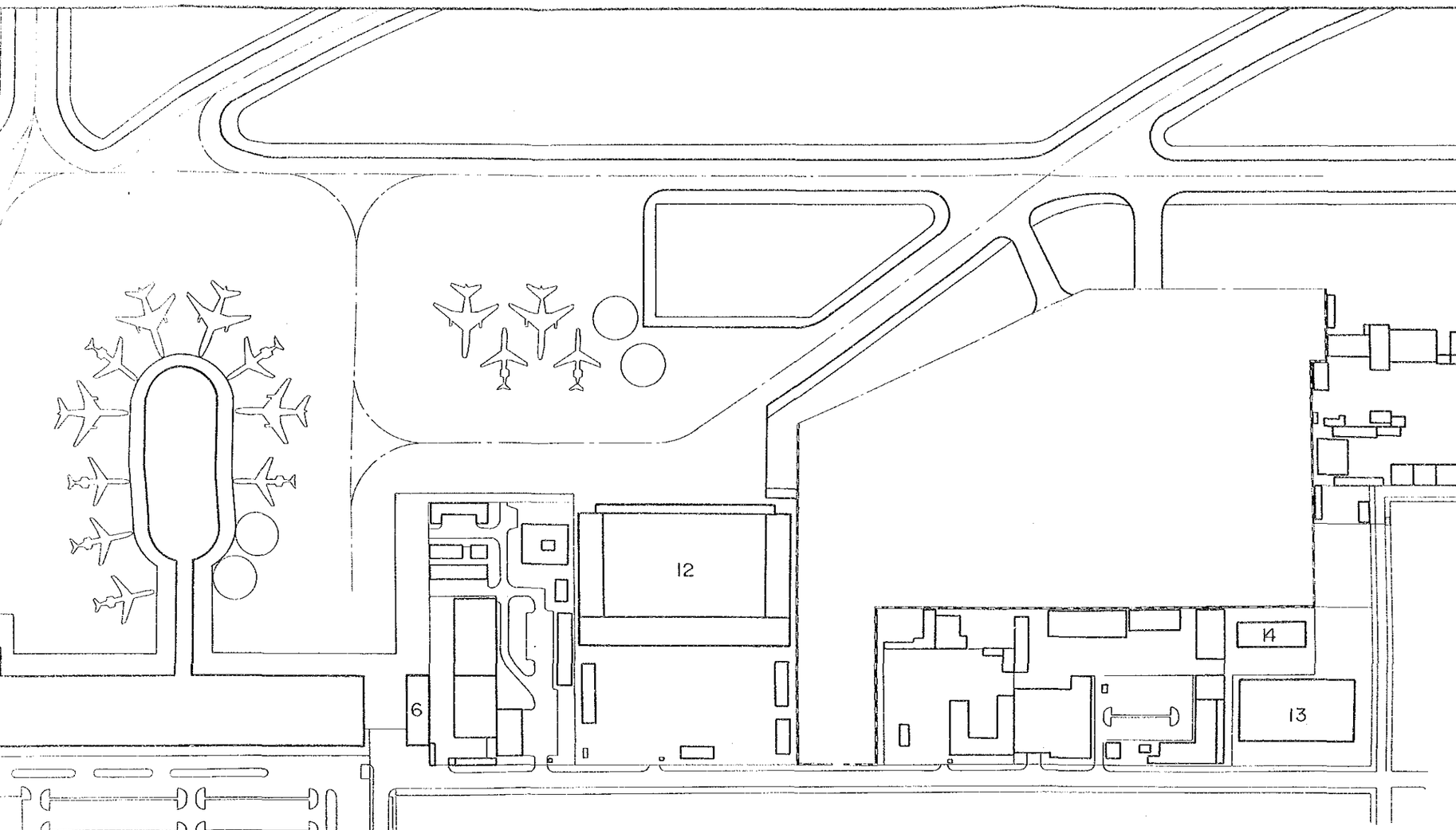
FIG. 6-5-1

THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

MASTER PLAN | S = 1 : 8,000

THE JAPAN INTERNATIONAL COOPERATION AGENCY


9
5
12
10
7
11
2
3
4
6
11
6
0
50
100
200
300M



1 PASSENGER TERMINAL BUILDING
2 CARGO TERMINAL BUILDING
3 BONDED WAREHOUSE
4 CUSTOMS BUILDING
5 FIRE FIGHTING STATION
6 ADMINISTRATION BUILDING
7 POWER STATION
8 WATER SUPPLY FACILITY
9 AIRPORT MAINTENANCE
10 AIRCRAFT FUEL SUPPLY FACILITY
11 CAR PARKING
12 AIRCRAFT MAINTENANCE HANGER
13 CATERING FACILTY
14 TRAINING CENTER

FIG. 6-5-2

THE DEVELOPMENT PROJECT OF
JORGE CHAVEZ LIMA-CALLAO
INTERNATIONAL AIRPORT

MASTER PLAN (TERMINAL AREA)

THE JAPAN INTERNATIONAL COOPERATION AGENCY

6.6 Aircraft Noise Impact

The impact of aircraft noise, which would be caused by the 2005 traffic on the surrounding area of the airport, was calculated in terms of WECPNL (Weighted Equivalent Continuous Perceived Noise Level), on the basis of the forecast number of flights by type of aircraft.

Fig. 6-6-1 shows the WECPNL contours anticipated in 2005 as compared with 1985.

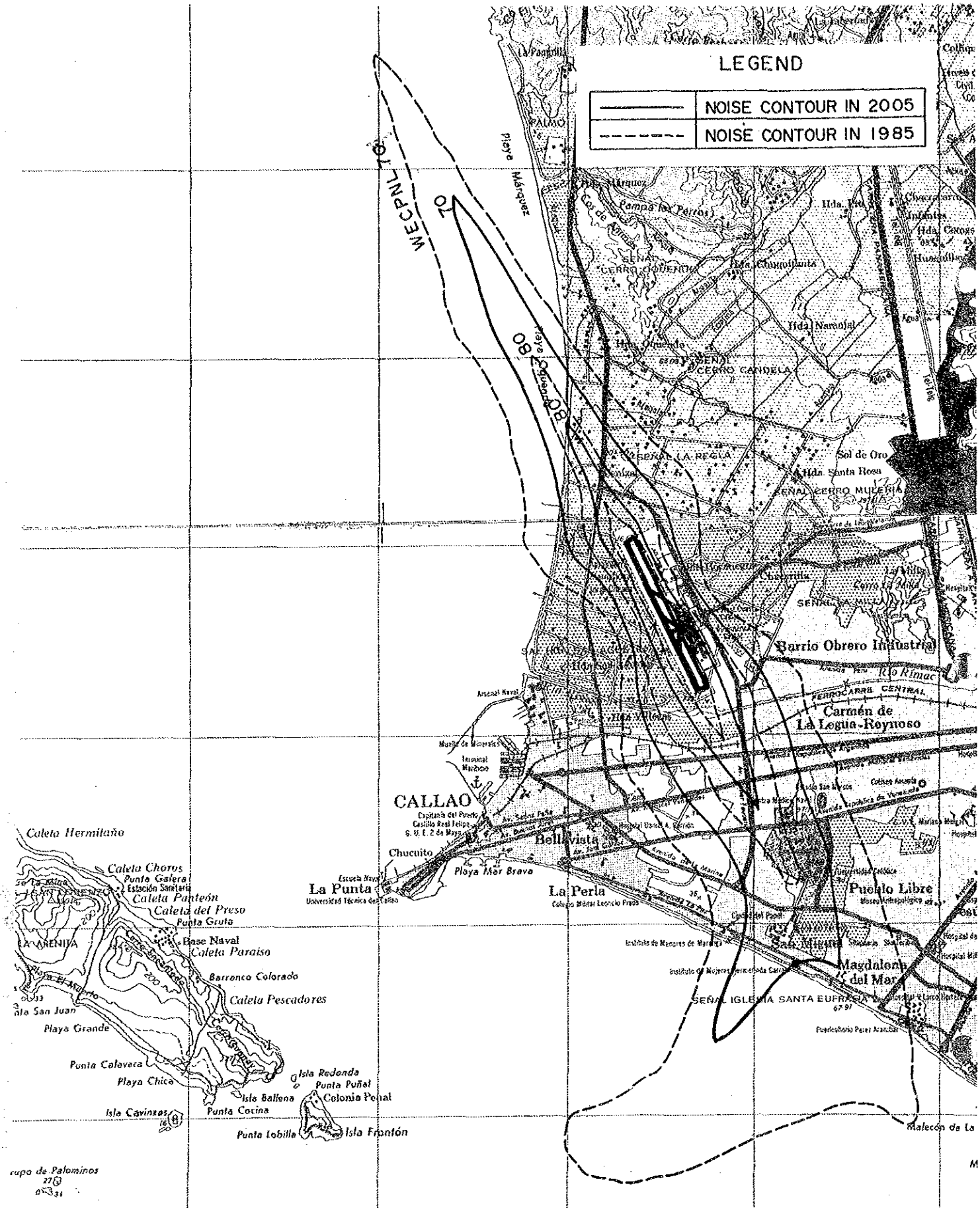


Fig. 6-6-1 WECPNL Noise Contour

CHAPTER 7

SHORT-TERM DEVELOPMENT PLAN

CHAPTER 7 SHORT-TERM DEVELOPMENT PLAN

7.1 Airfield Facilities

7.1.1 Runway

As explained in Chapter 5, the existing single runway, with its length and width, should meet the requirement for the years 1995 and 2005.

The pavement surface survey, carried out in August 1985, found many conspicuous cracks in the runway. Improvement of the whole runway is therefore needed to ensure safety of aircraft operations.

(1) Improvement Method

1) Basic Condition

As the runway continues to be in operation, improvement work must be performed, as a rule, in early hours (1:00 a.m. - 6:00 a.m.). Before and after the daily construction work, the runway should remain open for aircraft operations.

2) Determination of Improvement Measures

There are three basic measures for improvement, namely, overlay, reconstruction (replacement of the concrete slabs), and impregnation. Since

a) Asphaltic Concrete Overlay

Merits

- Because of relatively less work items and simple method, high working efficiency can be obtained.
- This is the ordinary method, proven by many successful precedents.
- In this method, longitudinal and transverse runway slopes can be readily maintained.
- Tapered ends of daily overlaid sections need not be removed.

Demerits

- Reflection cracks are apt to occur, thus requiring crack prevention measures to be taken.
- Pavement wears out faster than concrete.
- Relatively frequent maintenance is required.

Direct Construction Cost

- Average thickness 11 cm : US$2.00/sq.m (including crack prevention)

b) PC-Precast Concrete Overlay

Merits

- PC-precast concrete slab is durable under repeated loads.
- Maintenance is easier.
- Concrete slabs, being precast in factory, can be made to high quality.

Demerits

- Temporary end-tapering of the overlaid section is needed at the end of daily work, and this must be removed when the next work begins, thus lowering construction efficiency.
- This method requires levelling of existing concrete slabs, and makes it difficult and time-consuming to lay new slabs to design slopes.
- Curing of joint sealer is required.
- No experience in any airport in Peru.

Direct Construction Cost

- Slab thickness 20 cm : US$130.00/sq.m (including overlay work)

The above comparison clearly indicates the advantages of asphaltic concrete overlay over PC-precast concrete overlay, particularly in respect of work efficiency and construction cost. Asphaltic concrete overlay is therefore adopted as a means of improving the runway pavement.

3) Pavement Structure

Since temperature fluctuates little throughout the year, and reflection cracks will be prevented, asphaltic concrete overlay of 11 cm thickness is considered appropriate. Pavement

structure is shown in Fig. 7-1-3. Computation of required thickness of overlay is shown in Appendix 7-1.

7.1.2 Runway Shoulder and Overrun

Runway shoulder and overrun will also taper-overlayed with asphaltic concrete in line with the overlaid runway surface.

7.1.3 Taxiway

High-speed exit taxiway, of the following features, for wide-body jet aircraft such as B-747 and DC-10 will be constructed to reduce runway occupancy of landing aircraft.

- Exit point : 2,212 m from the end of RWY15
- Width : 30 m
- Width of shoulder : 7 m
- Layout : Although it is desirable to take the same figuration as the other existing high-speed exit taxiways, this exit taxiway is designed as shown in the figure below, so as to be as far away as possible from the existing right-angle eixt taxiway, and to lead into the taxilane to aircraft stands.

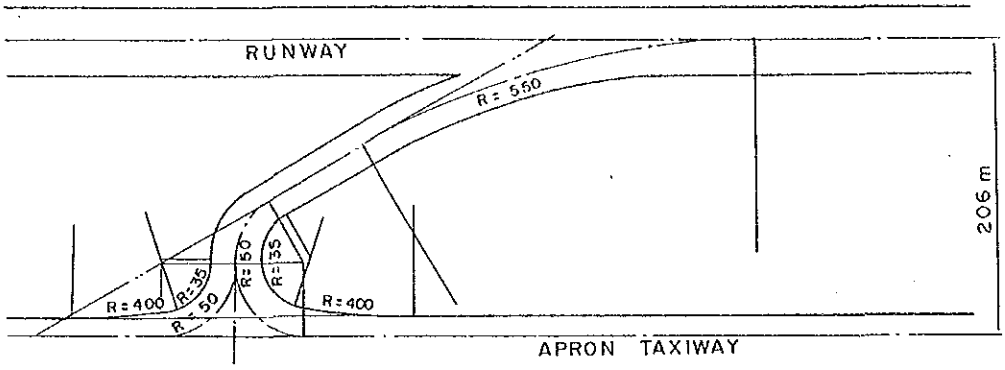


Fig. 7-1-1 Layout Plan of New High-speed Exit Taxiway

(1) Pavement Structure

High-speed exit taxiway will be paved with asphaltic concrete because of high efficiency of construction and economy.

Pavement structure is shown in Fig. 7-1-3 and computation of required thickness is shown in Appendix 7-1.

(2) Extension of Existing Taxiway Fillets

As a result of shifting the aircraft stands in the development plan, many aircraft will enter the apron taxiway from the existing exit taxiways. In that event, existing fillets at the junction of exit taxiways with apron taxiway will be inadequate to allow minimum clearance to be kept between outer main

wheel of the aircraft and the edge of taxiways. To avoid this problem, fillets marked with circles in the figure below will have to be widened.

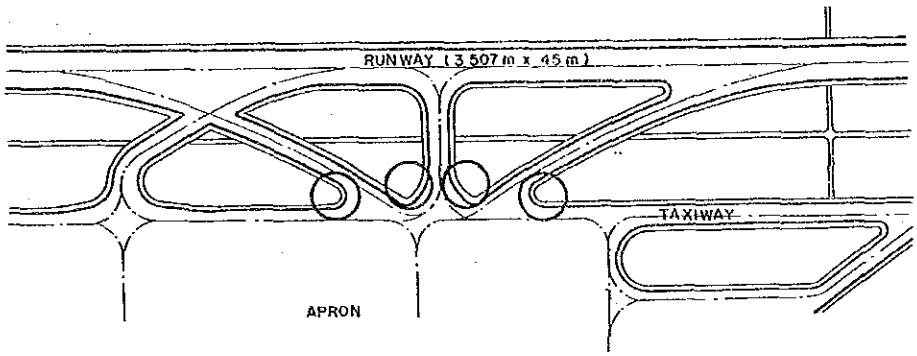


Fig. 7-1-2 Taxiway Fillets to be Widened

7.1.4 Apron

As a result of change and increase in aircraft stands, apron will have to be expanded and pavement reconstructed. Paving area is shown in Fig. 7-1-3. Additionally, apron for aircraft engine run up will be constructed at a site adjoining the existing holding bay at the end of RWY33.

(1) Pavement Structure

Portland-cement concrete pavement is so strong against large concentrated static loads and repeated loads that it is hardly susceptible to caving-in/or rutting, and is also resistant to oil. Portland-

cement concrete will therefore be adopted for apron pavement. However, a part of the apron where the removed cargo facility was located will be paved with asphaltic concrete, to economize future extension of the terminal building.

Pavement structure is shown in Fig. 7-1-3 and computation of pavement thickness is explained in Appendix 7-1.

7.1.5 Maintenance and Fire Rescue Roads

Asphaltic concrete paving roads will be constructed between the runway and the parallel taxiway, and along the boundary fence. Pavement structure is shown in Fig. 7-1-3.

7.1.6 Car Parks and Roads

The part of car park to be extended in front of the existing passenger terminal building and around the new buildings such as export cargo warehouse, customs building, main substation and fire station will be paved with asphaltic concrete.

Access roads connecting with each terminal facility will also have to be constructed.

7.1.7 Security Fence

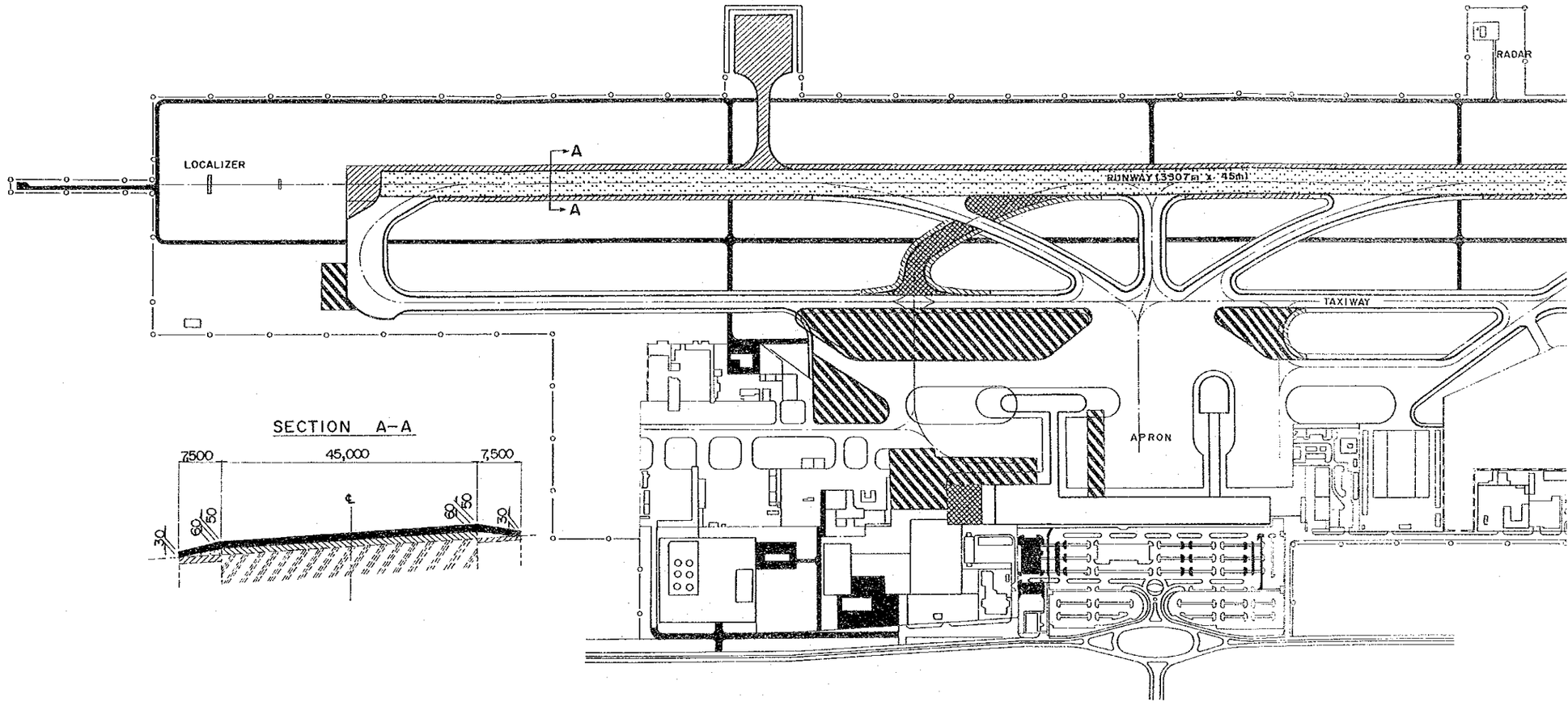
Fences will have to be erected around the area of relocated glide slope antenna and the site of approach lighting system at both ends of the runway.

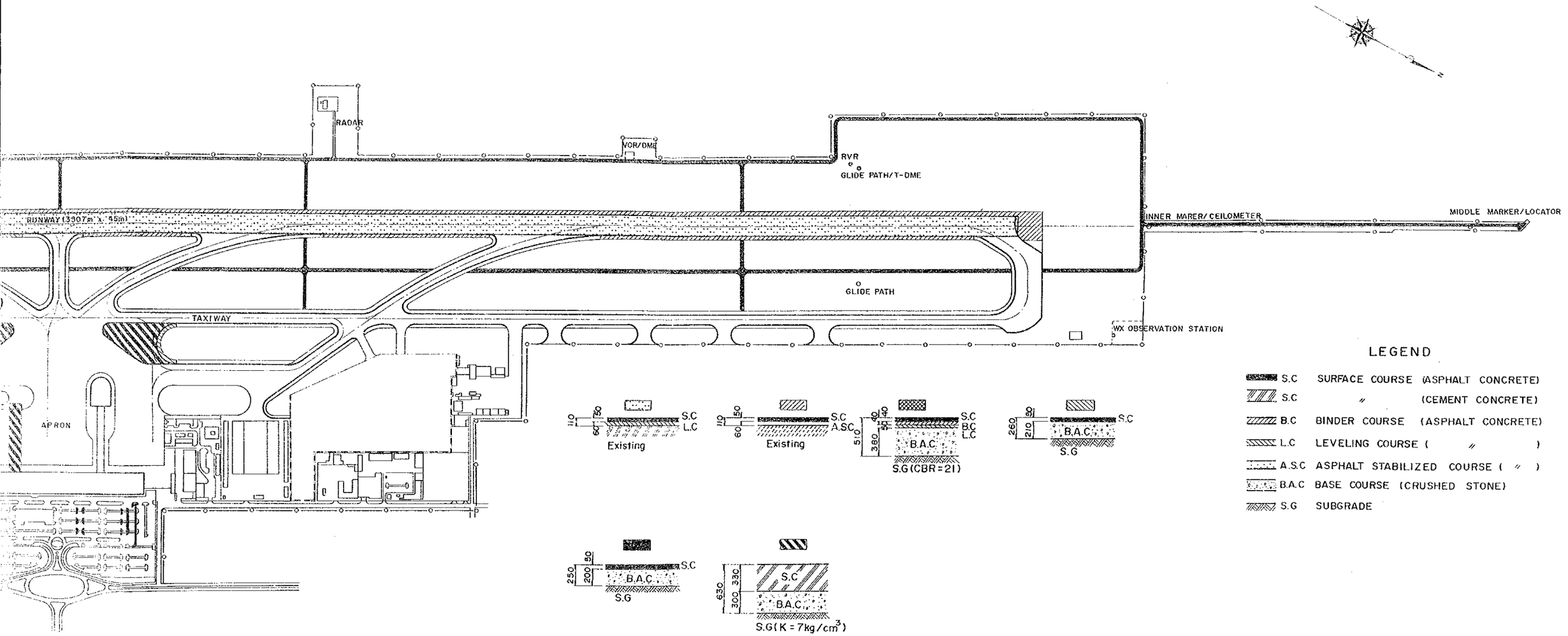
7.1.8 Anti-blast Treatment of the Runway Strip

The runway and taxiway strips, 10 m wide, outside the shoulders will be treated with asphalt emulsion, to prevent dust from rising when wide-body aircraft take off and land and/or accelerate on the taxiway.

7.1.9 Isolated Aircraft Parking Position

An isolated aircraft parking position will be constructed westward of the runway and in front of the planned fire station, for parking of an aircraft which is known or believed to be the subject of unlawful interference, or which for other reasons needs isolation from normal airport activities.


LOCALIZER
A
A
RUNWAY (3307m) x (45m)
RADAR
TAXIWAY
APRON
SECTION A-A
7,500
45,000
7,500
30
60
50
60
50
30



LEGEND

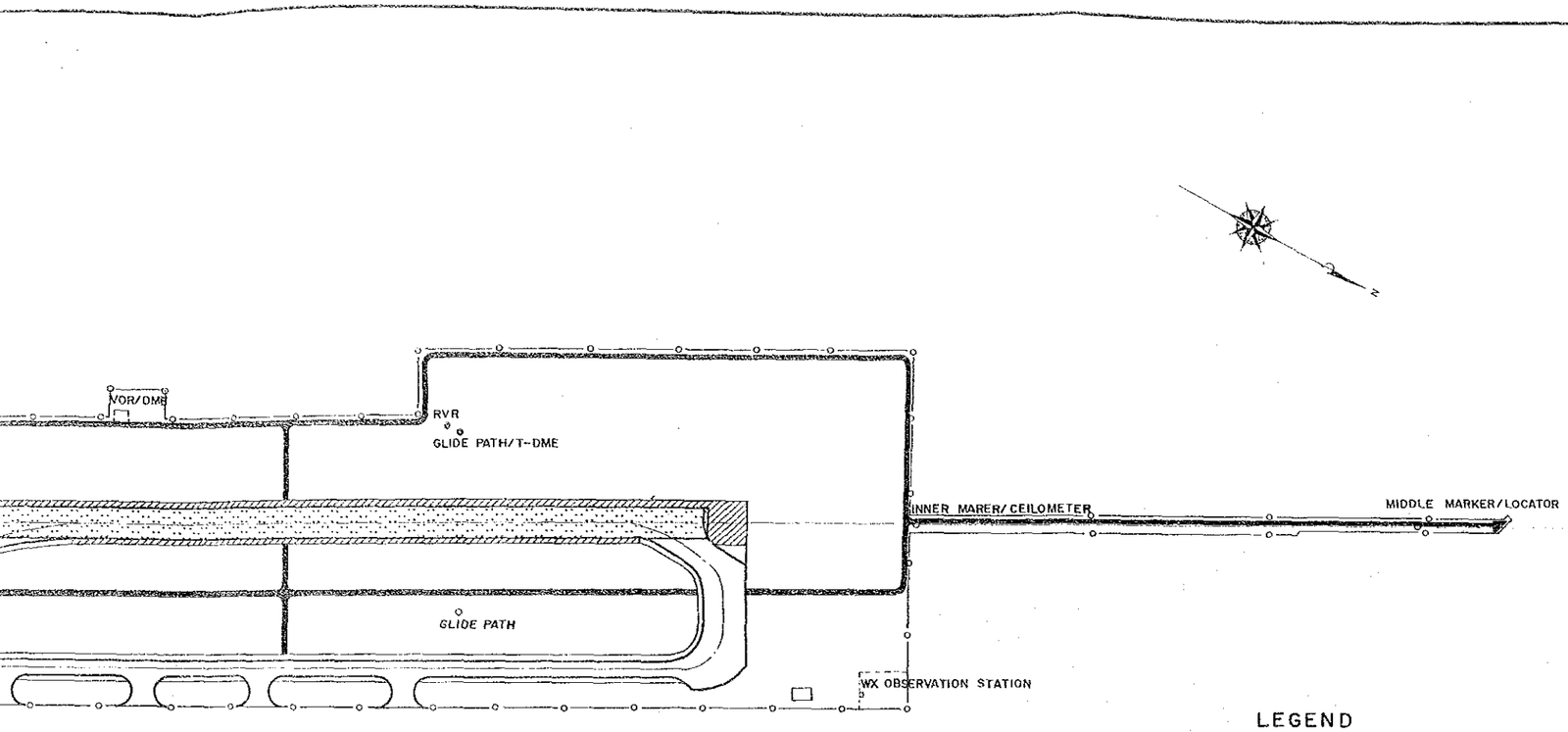
S.C	SURFACE COURSE	(ASPHALT CONCRETE)
S.C	〃	(CEMENT CONCRETE)
B.C	BINDER COURSE	(ASPHALT CONCRETE)
L.C	LEVELING COURSE	(〃)
A.S.C	ASPHALT STABILIZED COURSE	(〃)
B.A.C	BASE COURSE	(CRUSHED STONE)
S.G	SUBGRADE	

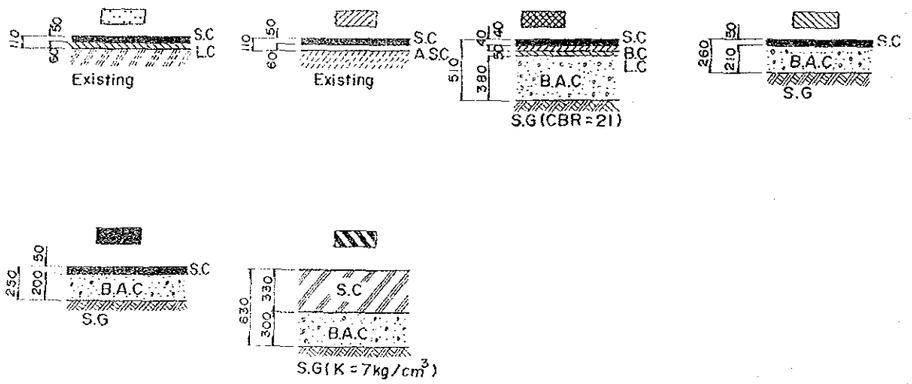
FIG. 7-1-3

THE DEVELOPMENT PROJE
OF
JORGE CHAVEZ LIMA-CALLAO INTERNA

PAVEMENT

THE JAPAN INTERNATIONAL COOPERA





LEGEND

- S.C SURFACE COURSE (ASPHALT CONCRETE)
- S.C 〃 (CEMENT CONCRETE)
- B.C BINDER COURSE (ASPHALT CONCRETE)
- L.C LEVELING COURSE (〃)
- A.S.C ASPHALT STABILIZED COURSE (〃)
- B.A.C BASE COURSE (CRUSHED STONE)
- S.G SUBGRADE

0 200 400 800M

FIG. 7-1-3

THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

PAVEMENT | S = 1 : 8,000

THE JAPAN INTERNATIONAL COOPERATION AGENCY

7.2 Terminal Area Facilities

7.2.1 Passenger Terminal Building

Construction work under the short-term development plan consists primarily of remodelling and expansion of the existing terminal building, to meet the design year demand.

Domestic and international departure lounges will be relocated to the second floor of the new satellite buildings, to improve security control and to separate arriving and departing passenger flows as shown in Fig. 7-2-1.

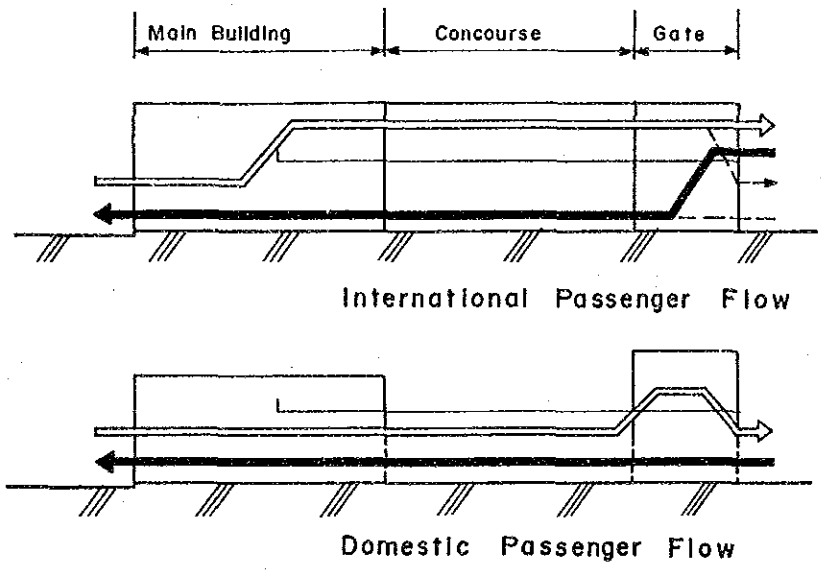


Fig. 7-2-1 Passenger Flow

Capacity of the existing arrival facilities is insufficient for the present demand. Therefore, both the international and domestic arrival area will be expanded to shorten processing time. The existing arrival facilities will be relocated to the expanded area of the terminal building where a baggage claim conveyor system is newly installed, and the vacated space is utilized for the international check-in area. The domestic check-in facility will be relocated to the present international check-in area, and the vacated space is converted to the domestic arrival area.

Departure lounge and transit room will be relocated to the satellite for concentrated passenger control, and service facilities such as duty-free shop and coffee shop will also be relocated to the satellite for convenience of passengers.

The terminal building will be equipped with three elevators at appropriate locations for the phisically handicapped.

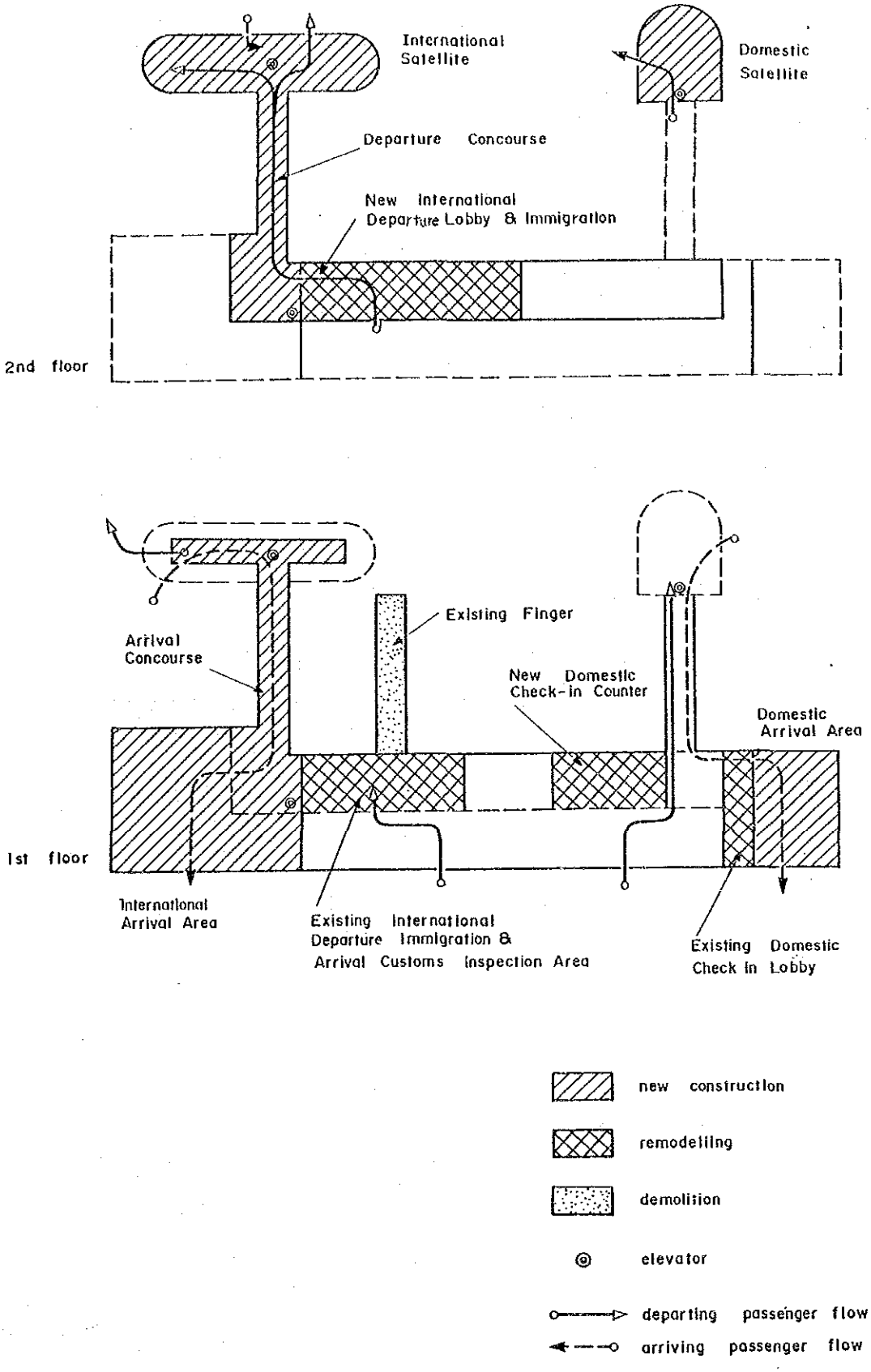


Fig. 7-2-2 Outline of Development/Improvemtns for Terminal Building

7.2.2 Cargo Terminal Building

(1) Export Cargo Warehouse

The existing export cargo building will be relocated to the south side of the existing import warehouse building. Two-storey cargo office will be provided at the land side area of the building. An exclusive space for transit cargo will be incorporated in the building.

(2) Customs Building

New two-storey customs building will be constructed separately in front of the new export cargo building.

(3) Import Cargo Warehouse

Flow of import cargo will be revised to meet the concept of the existing import cargo warehouse as shown in Fig. 7-2-3.

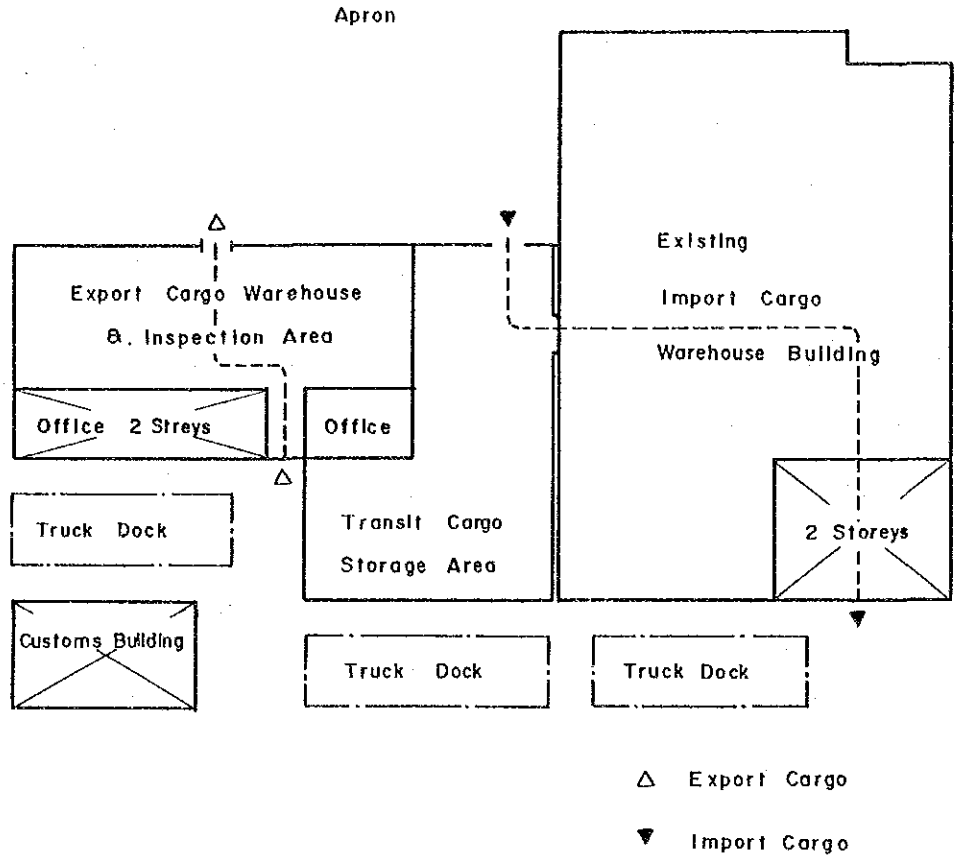


Fig. 7-2-3 Conceptual Plan of Cargo Terminal Buildings

7.2.3 Car Parks

The existing cargo office building including the ICAO office will be demolished and rebuilt elsewhere, and the vacated area will be utilized for expansion of the car parks.

The present car parks will be rearrenged to have an efficient layout.

7.2.4 Administration Building

An four-storey administration building will be newly constructed to accommodate the CORPAC administration office, ICAO office, restaurants, banks, etc.

Service facilities such as restaurants and banks will be accommodated on the first floor. The CORPAC administration office and ICAO office will be located on the second floor and above, as shown in Fig. 7-2-4.

The administration building will be equipped with two elevators and stairs at both sides of the building, for enhancement of security control.

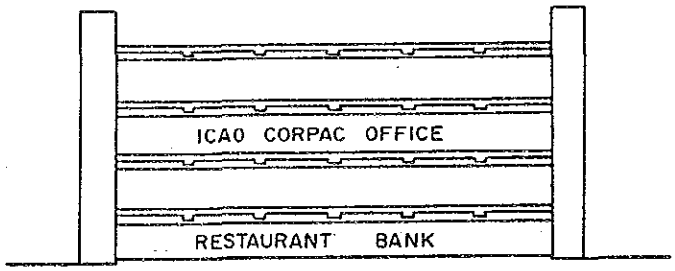


Fig. 7-2-4 Administration Building

7.2.5 Fire Station

The fire station will be rebuilt closer to the runway with a garage (for seven fire-fighting vehicles and a commander vehicle), office room, watching room, and other rooms shown in the figure below.

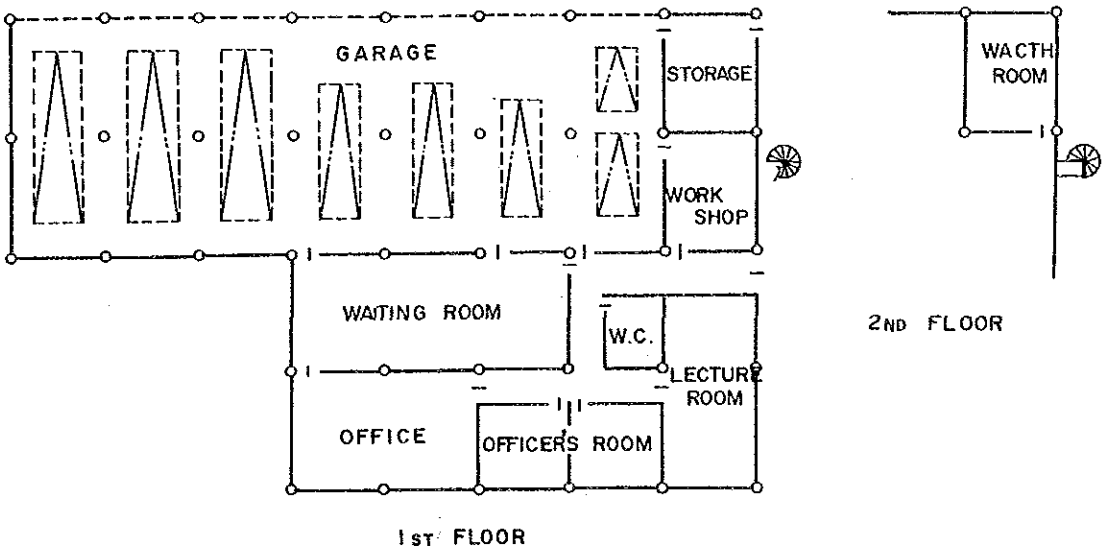


Fig. 7-2-5 Fire Station Plan

7.2.6 Aircraft Fuel Supply Facilities

Aircraft fuel supply facilities will be relocated in conjunction with expansion of the apron in accordance with the following plan:

(1) Site area will be prepared to meet the requirement for the year 2005, and six 800-kilolitre storage tanks will be constructed for the demand of 1995.

(2) Fuel supply pipeline will be changed to meet the new storage facilities and aircraft stands. Pipes will be laid under the ground to conformed with the new dispositions air-craft stands under the master plan.

7.2.7 Water Supply Facilities

To ensure constant water supply, the following new facilities will have to be constructed, even though the existing water supply system may possibly be able to meet the demand of 1995.

(1) Storage facilities capable of holding 1,100 cu.m of water will be installed, so as to lighten the load on the well at peak hours, and to reserve extra water for an emergency.

(2) Feed water pump system is adopted. The existing main water pipeline, 6 inches in diameter, will be utilized. This water pipeline is barely capable of meeting the demand, but not much more. Therefore, to mitigate the burden on the pipeline at peak hours, large water-consumers should be recommended to install their own storage tanks.

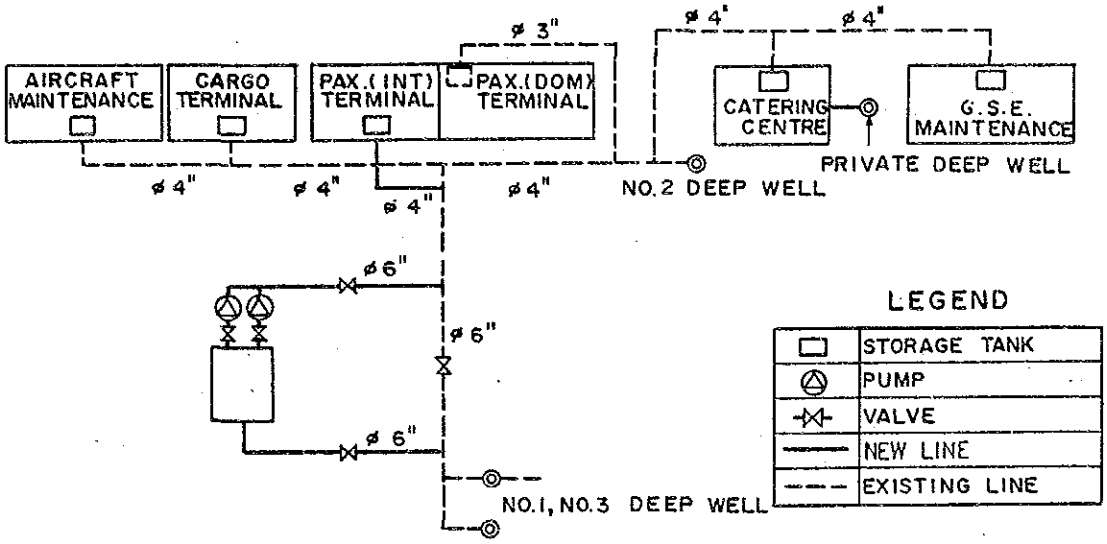


Fig. 7-2-6 Schematic Diagram of the Water Supply System

7.2.8 Electric Power Supply Facility

The main sub-station will be relocated to south of the existing CORPAC training centre. Two sub-stations will be newly installed near both ends of the runway, in addition to the existing sub-station in the basement of the passenger terminal building. Fig. 7-2-7 shows the schematic diagram of the electric power distribution system.

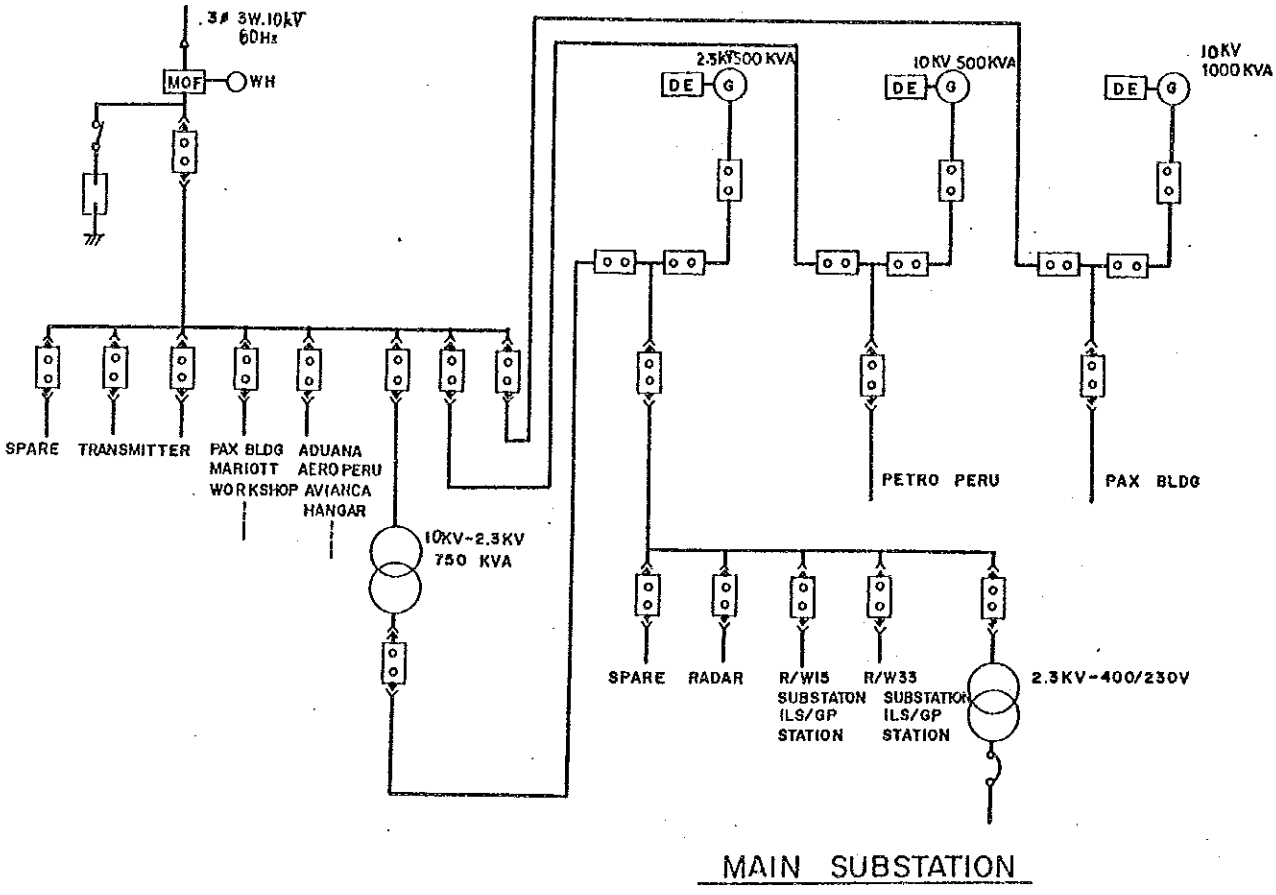


Fig. 7-2-7 Schematic Diagram of the Electric Power Distribution System

7.3 Air Navigation Facilities

7.3.1 ATC Facilities

(1) Bright Display Equipment

A Bright Display (BD) Scope will be installed in the control tower for the purpose of reducing inter-facility ATC co-ordination work load. (Appendix 7-8.) The display and control units will be placed in the tower cabin, while the main unit will be fitted in the radar equipment room of the ACC. They will be linked by cable.

(2) Mobile Communication System for Vehicular Traffic

A mobile communication centre will be installed in the control tower. At present, air and ground traffics use the same frequency, but they should have separate channels. Mobile stations will be installed in vehicles engaged in ground services such as fire-fighting, maintenance, runway inspection and others.

7.3.2 Radio Navigational Aids

(1) VOR/DME

Asia VOR, serving as ingress/egress fix to the TMA Lima, will be renewed since the whole set is some 20 years old and considered to be superannuated. A set of DME will be supplemented for better utilization of the facility.

(2) DME

The CORPAC plans to install two additional VOR stations in the TMA Lima. DME will be provided to each station for further improvement of the function of aids to navigation. (Appendix 7-9.)

(3) NDB

Four NDBs, out of six now in service, will be renewed to replace timeworn units which were manufactured more than 20 years ago.

7.3.3 Visual Aids

(1) Visual Aids to Navigation

Lighting facilities serving the runway and taxiway, including the power supply system thereof, will be upgraded as required for the introduction of ILS Category II operation. (Appendix 7-10.)

SALS and PAPI will be newly installed to serve Runway 33. Installation of lighting devices and wiring will have to be performed at night, keeping pace with the progress of runway pavement work.

(2) Apron Illumination

With the progress of reconstruction of the terminal building and the apron, the apron lighting facility will be removed and installed, with increase in quantity as necessary.

7.3.4 Aeronautical Meteorological Facilities

(1) Observation Equipment

RVR ceilometer and other observation devices which have become functionally out of order, or timeworn, after in use for more than 20 years, will be renewed.

(2) Modernization of System

For the purpose of modernizing recording, processing and delivery of the meteorological system, automatic recording and processing equipment will be furnished in the weather observatory, and the terminal display and/or receiving unit will be placed in the ATS units within the airport. A dissemination circuit connecting the observatory and respective units in the terminal and ACC buildings will be newly installed.

7.4 Summary of Improvement Measures for Short-Term Development

Table 7-4-1 presents the improvement measures envisaged for the Short-Term Development Plan, complete with a brief description of the work to be done for each facility.

Fig. 7-4-1 shows the airport layout plan for the Short-Term Development Plan of the Lima International Airport Development Project.

Table 7-4-1 Summary of Improvement Measures for Short-Term Development Plan

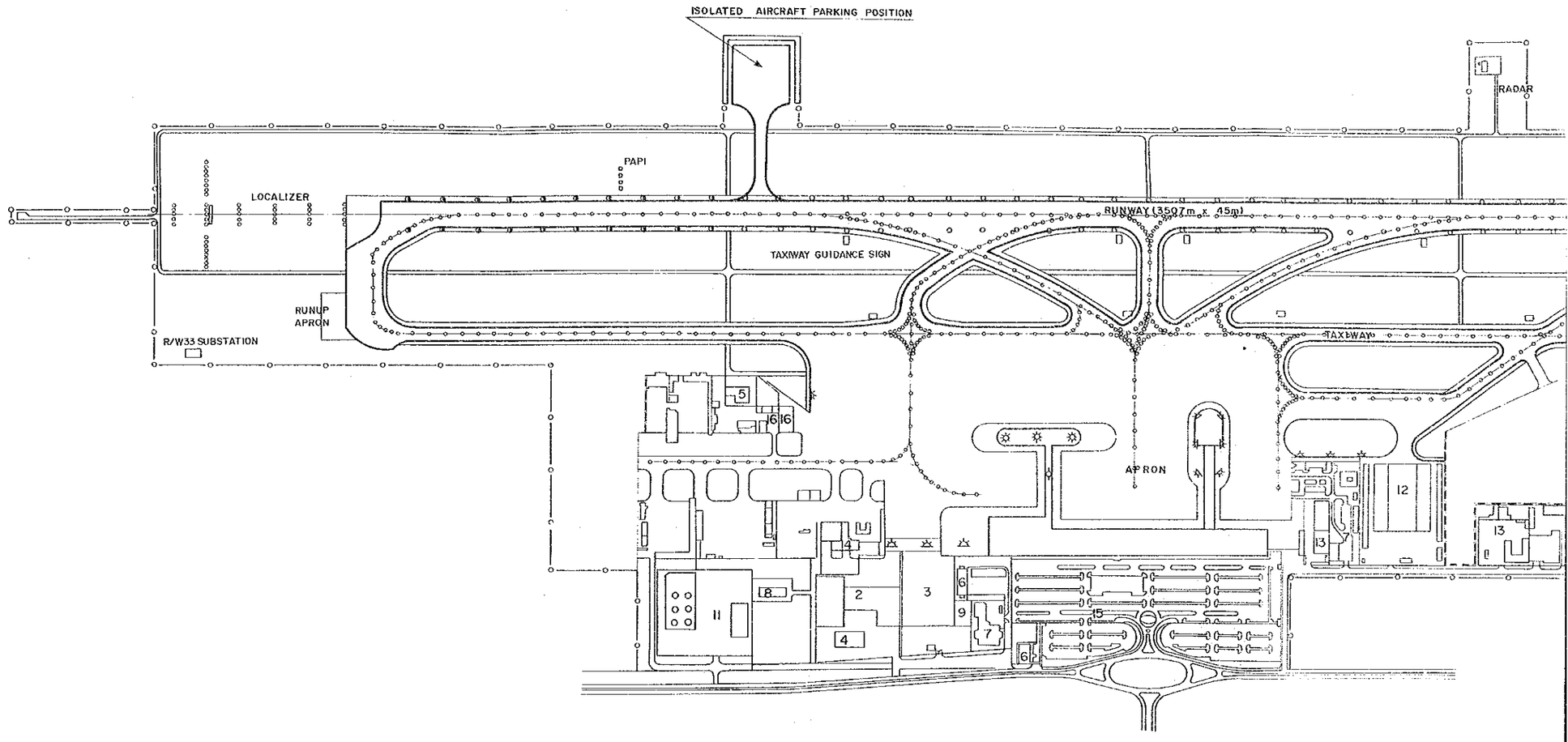
Facility	Description
Airfield Facilities	
- Runway Strip	- Grading (70,000 sq.m) - Surface treatment (70,000 sq.m)
- Runway	- Bituminous overlay (158,000 sq.m)
- Runway Shoulder	- Bituminous overlay (47,000 sq.m)
- Taxiway	- Construction of a high-speed exit taxiway (10,200 sq.m)
- Taxiway Shoulder	- New construction (4,900 sq.m)
- Apron	- Expansion with concrete pavement (100,900 sq.m) - Expansion with asphalt pavement (4,000 sq.m) - Construction of an isolated aircraft parking position (10,000 sq.m)
- Maintenance and Fire Rescue Roads	- Construction of a paved road (9,900 m)
- Others	- Security fence, marking, etc.
Terminal Area Facilities	
- Passenger Terminal Building	- Expansion (21,000 sq.m)
- Export Cargo Terminal Building	- Removal of existing building and construction of a new building (6,150 sq.m)

Table 7-4-1 (Cont'd) Summary of Improvement Measures for Short-Term Development Plan

Facility	Description
Terminal Area Facilities	
- Customs Office	- Construction of a new buillding (3,000 sq.m)
- Airport Administration Building	- Construction of a new building (4,000 sq.m)
- Fire Station	- Construction of a new station (1,000 sq.m)
- Fuel Supply Facilities	- Removal of existing facilities and construction of new facilities (site area : 25,500 sq.m)
- Water Supply Facility	- Construction of a new facility (site area : 500 sq.m)
- Car Parks	- Expansion (2,500 sq.m)
- Main Sub-station	- Construction of a new station (720 sq.m)
- Sub Station	- Construction of new stations (405 sq.m x 2)
Air Navigation Facilities	
- VOR	- Replacement (1 set)
- DME	- New installation (3 sets)
- NDB	- Replacement (4 sets)
- Lighting System of R/W 15	- Upgrading to Cat. II
- Lighting System of R/W 33	- New installation of SALS

Table 7-4-1 (Cont'd) Summary of Improvement Measures for Short-Term Development Plan

Facility	Description
Air Navigation Facilities	
- VASIS/PAPI	- R/W 15 PAPI (Replacement) - R/W 33 PAPI (New installation)
- Apron Flood Light	- Increase
- Weather Observation Facilities	- Replacement
- Satellite Receiver	- Replacement
- Weather Data Recorder	- New installation
- Weather Data Processing System	- New installation


ISOLATED AIRCRAFT PARKING POSITION
RADAR
PAPI
LOCALIZER
RUNWAY (3507m x 45m)
TAXIWAY GUIDANCE SIGN
RUNUP APRON
R/W33 SUBSTATION
TAXIWAY
APRON
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6
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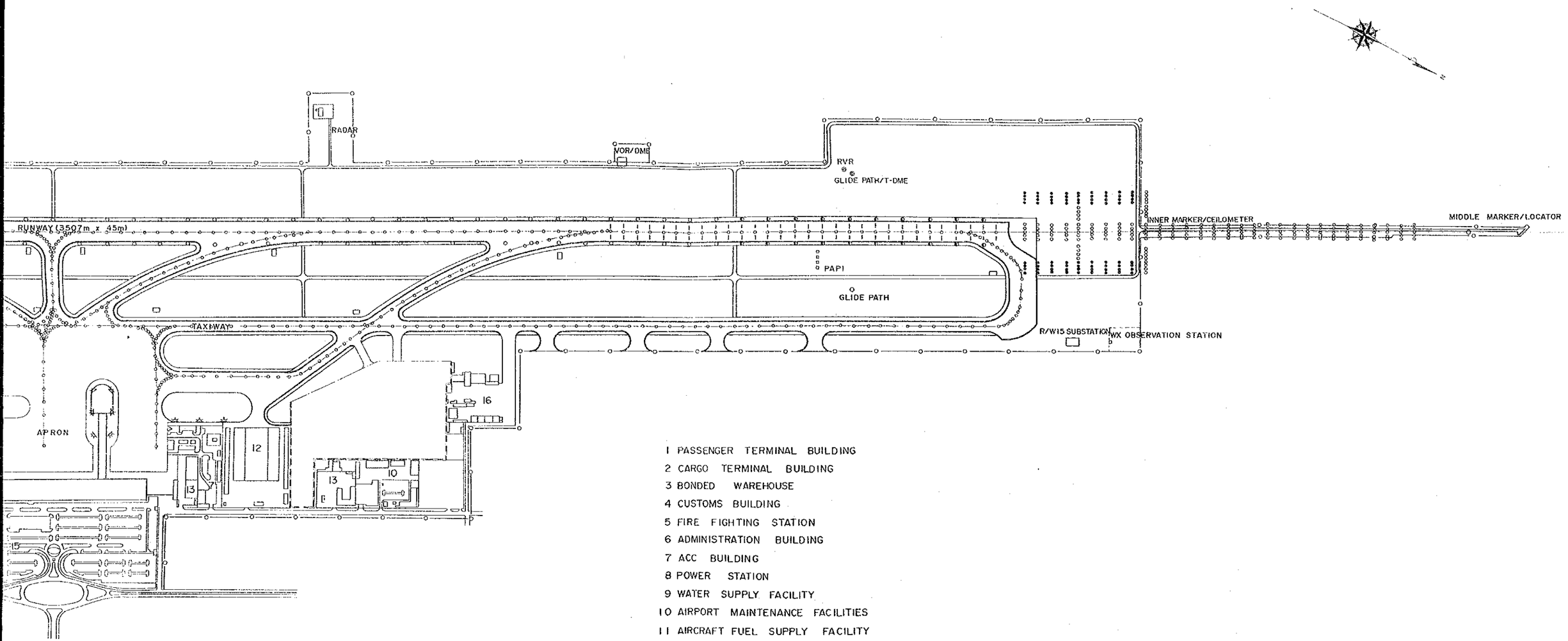
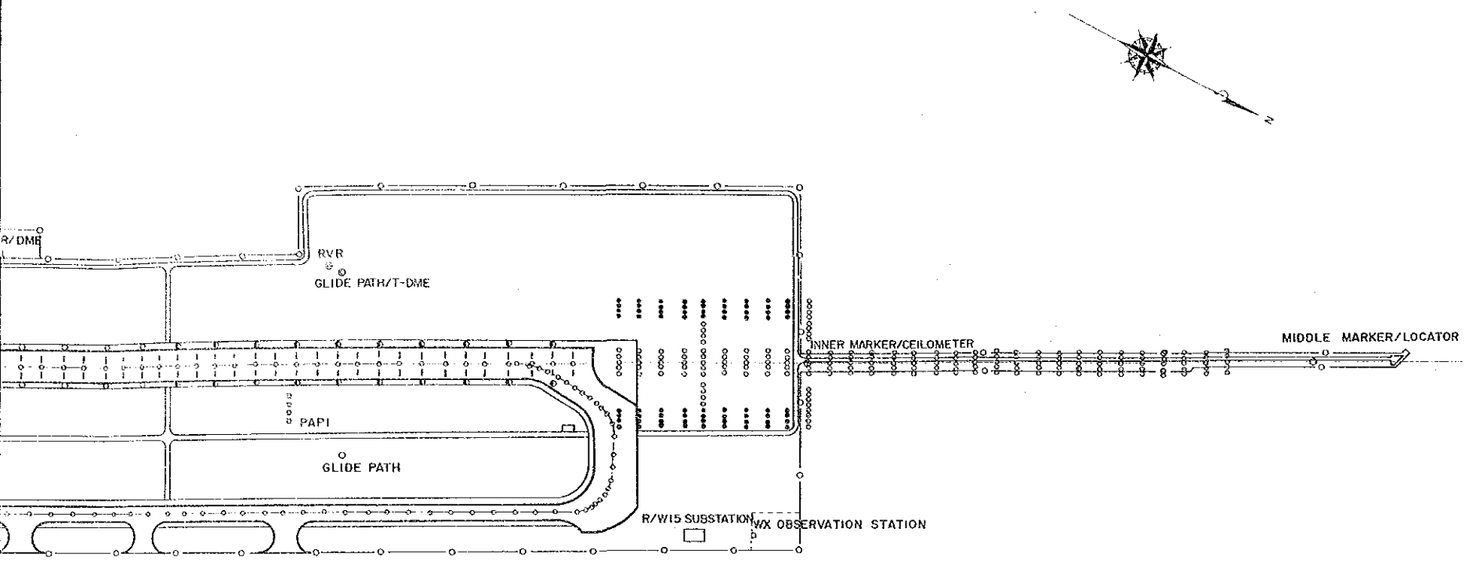


1 PASSENGER TERMINAL BUILDING
2 CARGO TERMINAL BUILDING
3 BONDED WAREHOUSE
4 CUSTOMS BUILDING
5 FIRE FIGHTING STATION
6 ADMINISTRATION BUILDING
7 ACC BUILDING
8 POWER STATION
9 WATER SUPPLY FACILITY
10 AIRPORT MAINTENANCE FACILITIES
11 AIRCRAFT FUEL SUPPLY FACILITY
12 AIRCRAFT MAINTENANCE HANGAR
13 CATERING BUILDING
14 AERONAUTICAL TRAINING CENTER
15 CAR PARKING
16 SMALL AIRCRAFT FACILITIES

0 200 400 800M

FIG. 7-4-1

THE DEVELOPMENT PROJEC
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATI
SHORT TERM DEVELOPMENT PLAN
THE JAPAN INTERNATIONAL COOPERAT



1 PASSENGER TERMINAL BUILDING
2 CARGO TERMINAL BUILDING
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13 CATERING BUILDING
14 AERONAUTICAL TRAINING CENTER
15 CAR PARKING
16 SMALL AIRCRAFT FACILITIES

0 200 400 800M

FIG. 7-4-1

THE DEVELOPMENT PROJECT
OF
JORGE CHAVEZ LIMA-CALLAO INTERNATIONAL AIRPORT

SHORT TERM DEVELOPMENT PLAN S = 1 : 8,000

THE JAPAN INTERNATIONAL COOPERATION AGENCY

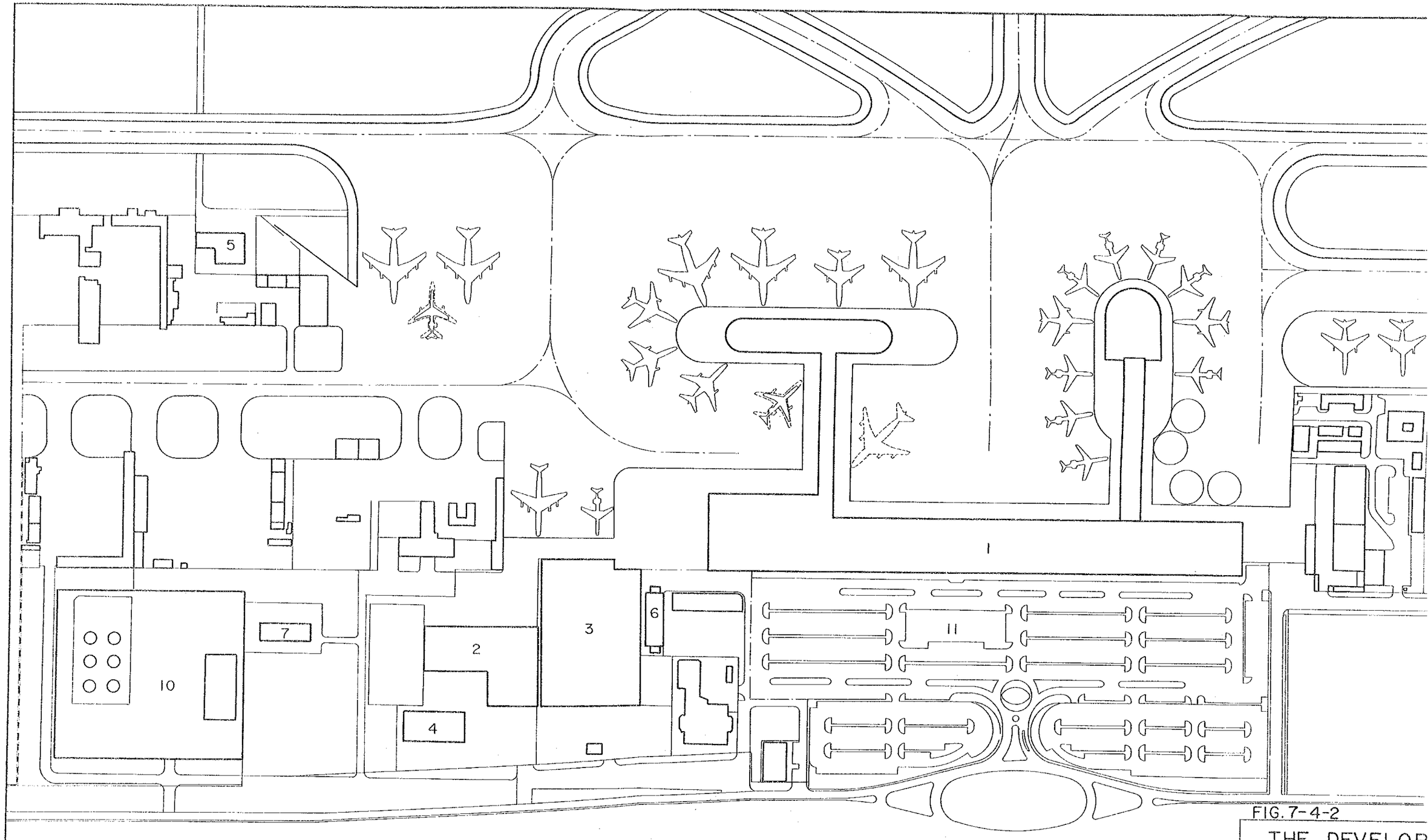

FIG. 7-4-2

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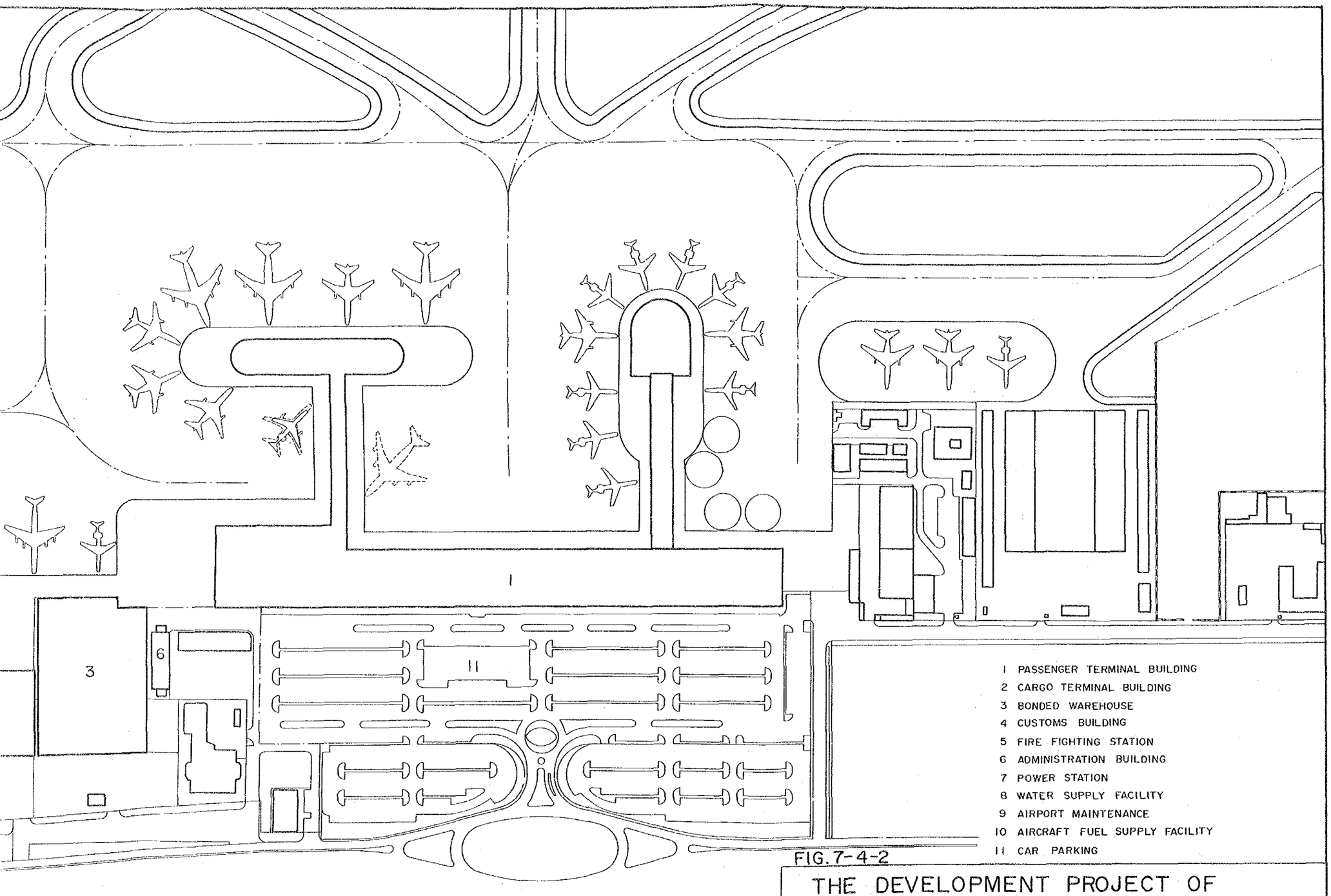


1 PASSENGER TERMINAL BUILDING
2 CARGO TERMINAL BUILDING
3 BONDED WAREHOUSE
4 CUSTOMS BUILDING
5 FIRE FIGHTING STATION
6 ADMINISTRATION BUILDING
7 POWER STATION
8 WATER SUPPLY FACILITY
9 AIRPORT MAINTENANCE
10 AIRCRAFT FUEL SUPPLY FACILITY
11 CAR PARKING

FIG. 7-4-2

THE DEVELOPMENT PROJECT OF
JORGE CHAVEZ LIMA-CALLAO
INTERNATIONAL AIRPORT

SHORT TERM DEVELOPMENT PLAN(TERMINAL AREA)

THE JAPAN INTERNATIONAL COOPERATION AGENCY

CHAPTER 8

CONSTRUCTION SCHEDULE AND COST ESTIMATE

CHAPTER 8 CONSTRUCTION SCHEDULE AND COST ESTIMATE

8.1 General

Construction schedule and cost estimate for the short-term development plan are drawn up on the basis of the study results of the preceding chapters as well as of the data and information collected during the field survey.

8.2 Construction Conditions

8.2.1 Site Conditions

The Lima International Airport is located about 10 km west of Lima, capital of the country. Imported materials and equipment have to be transported from Callao port located about 10 km southwest of the airport, and the access roads for transportation are adequately developed and will give no problem.

The airport is operated 24 hours every day, but flights are relatively scarce in early hours. In view of this situation, airfield construction works that might interfere with the operation of the Airport will have to be executed during the hours between 01:00 and 06:00.

8.2.2 Construction Materials

Aggregate (crushed stone and sand) can be obtained in adequate supply both in quantity and quality from the Arenera la Molina located about 35 km east of the Airport.

Cement and asphalt may be 100% locally procured as they are produced in Peru.

Steel materials are not produced in Peru with the exception of reinforcing bar, flat steel. Therefore, shape steel must be imported.

All architectural building materials need to be imported with the exception of a few locally produced items such as bricks, concrete blocks, and the like.

All equipment, and materials for air navigation facilities, as well as such special passenger terminal equipment as metal detectors, baggage conveyors, etc. are to be imported.

8.2.3 Construction Equipment and Construction Plant

Almost all of construction equipment must be imported.

The present asphalt plant is located about 35 km east of the Airport, and the concrete plant about 25 km east of the Airport. Since it takes more than one hour for transportation of

products from the present plants to the project site, new plants must be erected at the project site.

8.2.4 Labour

In view of the recent rise in unemployment and urban population in Lima, there should be no problem for the local procurement of unskilled labour.

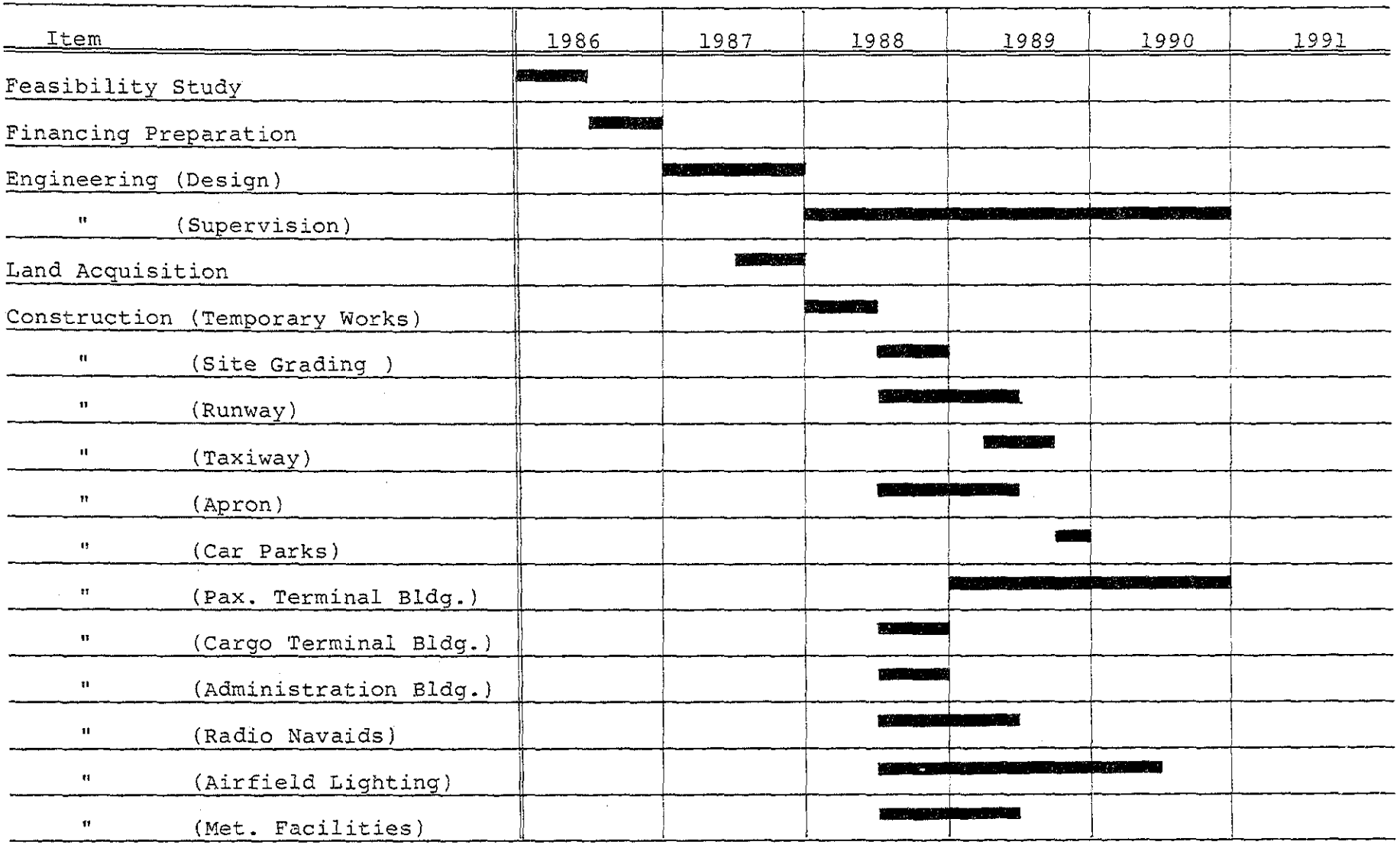
8.3 Construction Schedule

The construction schedule is developed with due regard to the timing and availability of funds for the Project, time length required for the pre-construction engineering services, and land acquisition.

Engineering design and construction of the short-term development for the design year 1995 is scheduled to commence around 1987 for completion in time for opening of the new facilities in 1991.

Construction schedule for the short-term development plan is shown in Table 8-3-1.

Table 8-3-1 Construction Scheudule for Short-Term Development Plan



8.4 Cost Estimate

Construction cost of short-term development is estimated as shown in Table 8-4-1. Breakdown by year of the construction cost based on the construction schedules as per Table 8-3-1 is shown in Table 8-4-2.

It should be noted that the construction costs of catering facility and aircraft maintenance hangar are not included in the present cost estimation, as these are considered to be outside the scope of this study. For the same reason, purchase cost of the aircraft ground service equipment is not estimated either.

The present cost estimate is based on the following conditions.

(1) Unit prices used in the cost estimate are based on the data collected by the JICA survey team in July 1985.

(2) Foreign currency portion of the construction cost includes the following items:
   1) Purchase cost of construction equipment,
   2) Cost of imported materials such as glass, shape steel and special passenger terminal equipment,
   3) Foreign remittance portion of the overhead and profit of foreign contractor,
   4) Wages of foreign labour.

(3) Local currency portion of the cost includes the following items:

1) Operation cost of the construction equipment,
2) Construction materials procured in Peru such as cement, asphalt and aggregate,
3) Local portion of foreign and local contractor's overhead cost and profits,
4) Wages of local labour,
5) Land acquisition cost of the glide path area and SALS area.

(4) Engineering fee is estimated at 10% of the total cost of works as shown in Table 8-4-1.

(5) Physical contingency to cover any extra unforeseeable cost is estimated at 5% of the sum of the total cost of works, engineering fee and the cost of land acquisition as shown in Table 8-4-1.

(6) Conversion between US dollar, Soles and Yen is based on the exchange rates as of July 1985 of US$1.00 = S/14,000 = ¥240.00.

Table 8-4-1 Construction Cost Estimate for Short-Term Development Plan (Page 1 of 4)

(Unit: thousand US dollar)

Cost Item	Foreign Portion	Local Portion	Total
1. Airfield facilities	4,809.5	9,984.2	14,793.7
1) Site grading	10.9	8.0	18.9
2) Runway	1,276.7	2,233.2	3,509.9
3) Runway shoulder	315.7	561.6	877.3
4) Overrun	53.7	95.6	149.3
5) High-speed exit taxiway	193.9	337.6	531.5
6) High-speed exit taxiway shoulder	28.7	57.5	86.2
7) Apron (Concrete pavement)	1,999.4	4,331.1	6,330.5
8) Apron (Asphalt pavement)	51.3	87.3	138.6
9) Apron shoulder	7.0	14.1	21.1
10) Apron for aircraft engine run up	72.9	126.5	199.4
11) Isolated aircraft parking position	130.8	185.7	316.5
12) Maintenance and fire rescue roads	334.3	605.5	939.8
13) Roads and car parks	133.6	259.7	393.3
14) Anti-blast treatment of the runway strip	35.8	173.2	209.0
15) Miscellaneous	139.7	683.8	823.5
16) Mobilization and Demobilization	25.1	223.8	248.9

Table 8-4-1 (Cont'd) Construction Cost Estimate for Short-Term Development Plan (Page 2 of 4)

(Unit: thousand US dollar)

Cost Item	Foreign Portion	Local Portion	Total
2. Terminal area facilities	29,699.7	19,670.4	49,370.1
1) Mobilization	-	2,012.4	2,012.4
2) Pax. terminal bldg. (Expansion)	17,292.8	11,928.8	29,221.6
3) Pax. terminal bldg. (Remodelling)	725.4	2,187.0	2,912.4
4) Customs building	334.9	660.8	995.7
5) Administration bldg.	824.4	1,166.2	1,990.6
6) Fire station	71.8	222.8	294.6
7) Cargo terminal bldg.	1,144.5	1,011.4	2,155.9
8) Main sub-station	128.3	175.1	303.4
9) Sub-station	58.0	127.0	185.0
10) Water supply facilities	53.6	122.2	175.8
11) Airport special equipment	9,066.0	56.7	9,122.7

Table 8-4-1 (Cont'd) Construction Cost Estimate for Short-Term Development Plan (Page 3 of 4)

(Unit: thousand US dollar)

Cost Item	Foreign Portion	Local Portion	Total
3. Radio navigational aids	2,931.0	22.3	2,953.3
1) Bright display	1,061.7	0.7	1,062.4
2) Transmition	54.7	0.1	54.8
3) VOR/DME (ASIA)	538.6	10.0	548.6
4) DME	717.8	3.8	721.6
5) NDB	558.2	7.7	565.9
4. Airfield lighting system	10,362.3	2,333.9	12,696.2
1) Approach lighting system	372.1	83.3	455.4
2) Runway edge light	299.2	71.1	370.3
3) Runway centre line light	434.4	109.8	544.2
4) Runway touchdown zone light	829.5	209.7	1,039.2
5) PAPI	66.5	14.9	81.4
6) Threshold lights	178.5	38.1	216.6
7) Taxiway centre line light	824.8	208.5	1,033.3
8) Taxing guidance light	59.7	15.1	74.8
9) Apron floodlighting	1,831.3	410.0	2,241.3
10) Sub-stations	2,242.9	456.5	2,699.4
11) Electrical cable	148.2	33.2	181.4
12) Control equipment	312.5	70.0	382.5
13) Main sub-station	2,511.2	552.9	3,064.1
14) Distribution line	251.5	60.8	312.3

Table 8-4-1 (Cont'd) Construction Cost Estimate for Short-Term Development Plan (Page 4 of 4)

(Unit: thousand US dollar)

Cost Item	Foreign Portion	Local Portion	Total
5. Met. service facilities	1,118.9	42.6	1,161.5
1) RVR	189.4	3.1	192.5
2) Ceilometer	112.7	2.5	115.2
3) Rawinsonde	250.5	4.5	255.0
4) Weather facsimile receiver	26.4	2.9	29.3
5) Satellite receiver	233.1	1.7	234.8
6) Weather observation facilities	26.5	2.1	28.6
7) Weather data recorder	73.0	1.7	74.7
8) Weather data processing system	207.3	24.1	231.4
6. Fuel supply facility	3,695.0	1,040.0	4,735.0
1-6. Sub-total of works	52,617	33,093	85,710
7. Engineering services	5,262	3,309	8,571
8. Land acquisition	-	7	7
9. Contingency	2,894	1,820	4,714
1-9. Total	60,773	38,229	99,002

Table 8-4-2 Annual Breakdown of Estimated Construction Cost

(Unit: thousand US dollar)

Year	Foreign Portion	Local Portion	Total
1987	3,321	2,102	5,423
1988	17,551	8,386	25,937
1989	21,619	17,794	39,413
1990	18,282	9,947	28,229
Total	60,773	38,229	99,002

CHAPTER 9

ECONOMIC ANALYSIS

CHAPTER 9 ECONOMIC ANALYSIS

9.1 Basic Concept

The purpose of the economic analysis in this Study is to make a comprehensive evaluation of the economic feasibility of the Lima International Airport Development Project, by means of cost-benefit analysis, from the viewpoint of the national economy of Peru. In line with the Scope of Work of the Study, the analysis is made only of the Short-term Development Plan.

9.1.1 Method of Evaluation

The economic evaluation is based on the Economic Internal Rate of Return (EIRR) of the Project, derived from the cost-benefit analysis. Cost-benefit analysis is usually made on the "With-and-without Principle", that is to say, by comparing the two cases where the project is and is not implemented. The EIRR is calculated on the basis of the cash flow of the economic costs and the tangible direct benefits of both the "With Case" and the "Without Case", by using the discounted cash flow method. In such an analysis, whatever positive values, identified on a comparative basis as being saved or gained on account of the implementation of the Project, are defined as the benefits of the Project. On the other hand, any negative values, accruing from the implementation of the Project, are defined as the costs of the Project.

This evaluation deals only with the Short-term Development Plan of the Project, based on the social discount rate of the country.

(1) Definition of Internal Rate of Return

The internal rate of return is defined as the discount rate satisfying the following equation:

$$\sum_{t=1}^{T} \frac{Bt - Ct}{(1 + r)^t} = 0$$

where, Bt = Benefit in the year t

Ct = Cost in the year t

T = Period of economic calculation

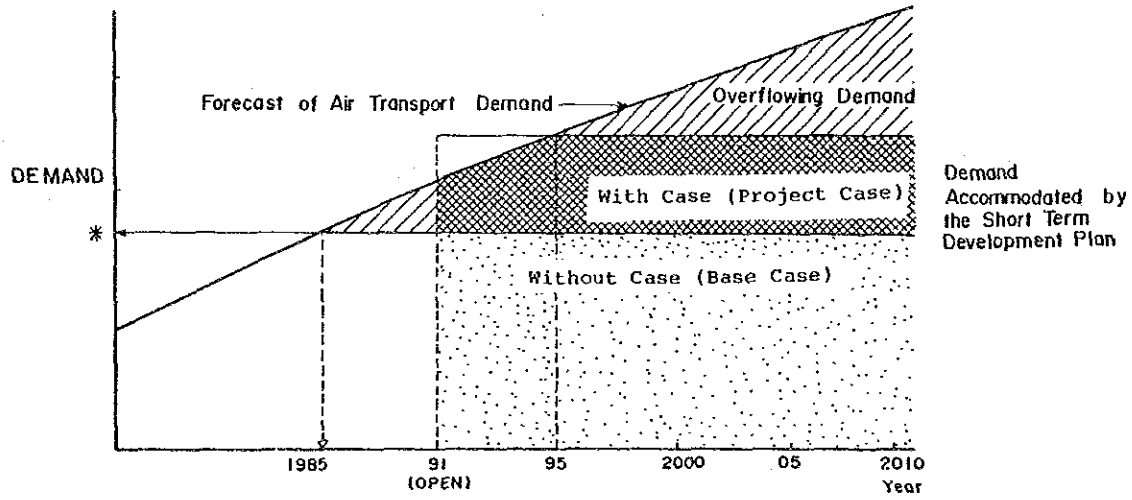
r = Discount rate

9.1.2 The With and Without Cases

In the present Study, the "Without Case" is defined as the Base Case in which the existing Lima International Airport is to continue operating at the present facility level without any new investment made therein, except in the renewal of equipment indispensable for the upkeep and normal operation of the Airport. The "With Case" is defined as the Project Case in which the Airport is developed according to the Short-term Development Plan.

In the Base Case, air traffic at the Lima International Airport is assumed to have reached the saturation point in 1985, and to remain unchanged thereafter throughout the project life.

If the Short-term Development Plan is implemented, it can accommodate the forecast air transport demand up to the year 1995 over and above the 1985 saturation point in the Base Case.



* Physical Capacity Limit of Existing Lima International Airport

9.1.3 Period of Analysis

The project life is assumed to be 20 years, based on the average useful life of the facilities to be introduced under the Shrot-term Development Plan. Accordingly, the analysis covers the construction period and the ensuing 20 years.

9.1.4 Shadow Pricing

In this economic analysis, economic feasibility of the Project is studied by using the shadow prices calculated on the basis of the world prices (border prices).

All costs calculated as above are based on the market prices, either world or domestic, but all benefits and costs are calculated by the world prices. Therefore, the domestic market prices are converted to the shadow prices.

The method of estimating shadow prices is as follows:

(1) Generally, all benefits and costs are divided into labour, traded goods and non-traded goods. Further, labour is divided into skilled and unskilled labour. The labour cost is calculated by multiplying its market price by a ratio of the Shadow Wage Rate (SWR) and the Standard Conversion Factor (SCF), both defined later.

Traded goods are expressed by CIF value for import. Prices for non-traded goods are derived by multiplying appropriate conversion factors.

(2) In this analysis, the local portion of the construction costs is divided into labour and goods. The shadow price for labour is calculated by the same method as for the above item (1) and that for goods is obtained by multiplying their market price by SCF.

(3) Standard Conversion Factor (SCF)

Standard conversion factor (SCF) is calculated by the following formula based on the Import and Export and Customs Statistics.

$$SCF = \frac{I + E}{I + Di + E - De}$$

Where I = Total amount of import
E = Total amount of export
Di = Total amount of import duties
De = Total amount of export duties

The standard conversion factor for 1980 and 1981 is about 0.91.

(4) Shadow Wage Rate

Skilled and unskilled labour to be engaged in the construction of the Project are supposed to be workers from the provinces in the vicinity of Lima. Shadow Wage Rate is estimated by the Instituto Nacional de Planificacion. The Shadow Wage Rates for labour in Lima are as follows:

Shadow Wage Rate for unskilled labour = 0.46

Shadow Wage Rate for skilled labour = 0.79

9.2 Estimate of Economic Costs

9.2.1 Investment Costs

In cost-benefit analysis, indirect taxes and customs duties are usually regarded as transfers to the Government, from the national economic point of view.

The construction costs estimated in Chapter 8 are based on the market prices, but customs duties are deducted.

Indirect taxes are deducted from the cost of domestic goods in the local portion at the uniform rate of 10%, which is the weighted average of the following rates:

Indirect Taxes in Peru

Portland cement	Nil
Asphalt	Nil
Bricks	Nil
Aggregate (Sand, gravel)	11%
Floor covering, Materials for floor(Carpet, paving stones)	11%
Paint	11%
Structural lumber	11%
Sanitary ware	11%

Annual economic costs of the investment for the Project are shown in Table 9-2-1.

Table 9-2-1 Annual Economic Costs of Investment

(In US$ thousand at 1985 value)

Year	Foreign Portion	Local Portion	Total
1987	3,321	1,662	4,983
1988	17,551	6,650	24,201
1989	21,619	14,055	35,674
1990	18,282	7,858	26,140
Total	60,773	30,225	90,998

9.2.2 Maintenance and Operation Costs

Annual economic costs of maintenance and operation for the Project are estimated for the assumed project life of 20 years in the following manner:

(1) Maintenance cost of Newly Introduced Facilities

1) Airfield Facilities

Estimated at 1% of the investment costs.

2) Terminal Area Facilities

Estimated at 1% of the investment costs.

3) Air Navigation, Lighting and Meteorological Facilities

Estimated at 5% of the investment costs.

(2) Operation Cost

The 1984 record of the maintenance and operation costs of the existing CORPAC facilities at the Lima International Airport is summarized in Table 9-2-2.

Table 9-2-2 Maintenance and Operation Cost of Existing CORPAC Facilities at Lima International Airport

	(In millions of Soles)
Salaries	34,186.0
Goods	6,792.8
Services	11,266.1
Current Transfers	2,836.9
Interests and Commissions	4,145.2
Allowances	32,280.1
Taxes	8,494.5
Total	100,001.6

In the Base Case, the cost of both maintenance and operation of the airport facilities are assumed to remain unchanged throughout the project life. In the Project Case, the wages are assumed to increase in proportion to the number of employees estimated in Chapter 5, with the wage rate remaining unchanged at an average per employee of US$3,920 in 1985.

The other expenses are estimated at 12% of the sum of (a) the maintenance cost for newly introduced facilities mentioned in (1) above, and (b) the wages.

Table 9-2-3 shows the annual economic costs of maintenance and operation in the Project Case.

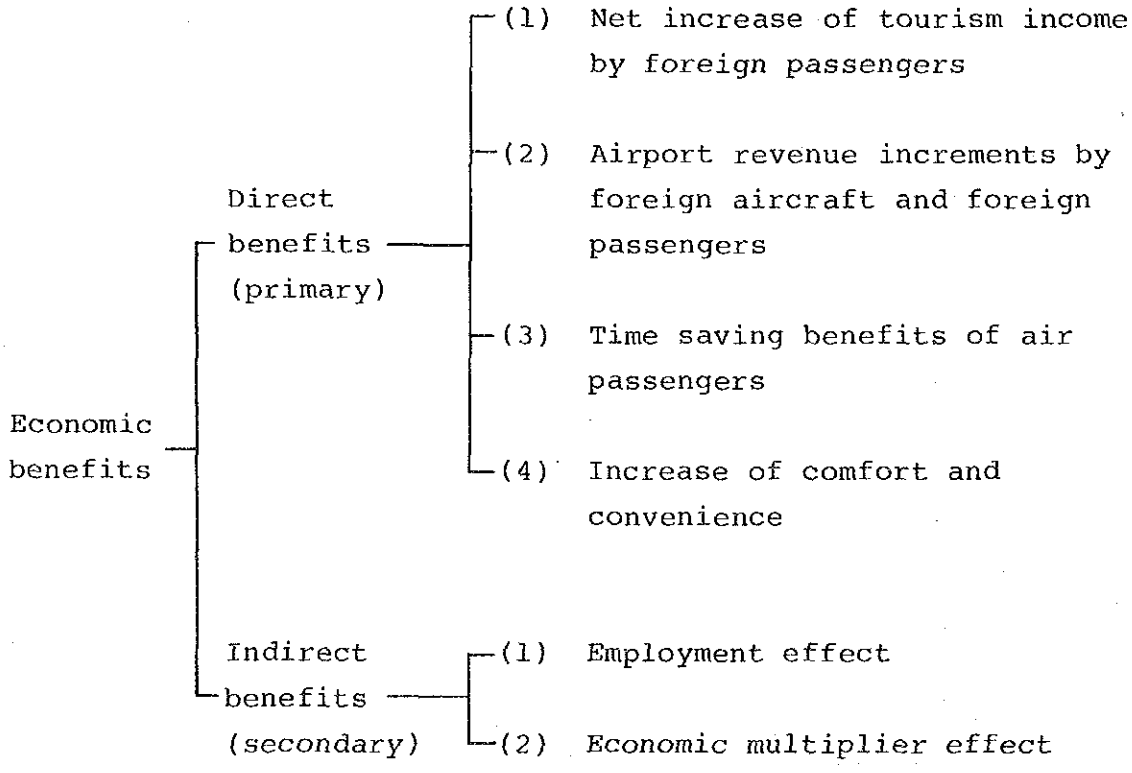
Table 9-2-3 Annual Economic Costs of Maintenance and Operation

(In US$ thousand at 1985 value)

Item	1991	1992	1993	1994	1995-2010
(1) Maintenance	999	999	999	999	999
(2) Operation					
1) Wages	1,413	1,518	1,631	1,752	1,883
2) Other	289	302	316	331	346
(3) Total	2,701	2,819	2,946	3,082	3,228

9.3 Estimate of Economic Benefits

The economic benefits considered derivable from the Short-term Development Plan from the point of view of the national economy of Peru are the direct (primary) benefits and the indirect (secondary) benefits, each consisting of both tangible and intangible benefits, as shown in the following:



9.3.1 Direct Benefits

(1) Net Increase of Tourism Income

As stated in Section 9.1.1, those overflowing international air passengers in the Base Case can be accommodated by the Airport if the project is implemented. The average expenditures of foreign tourist by region of their origin, according to the market research conducted by FONDA DE PROMOCION TURISTICA-PERU in 1983, are as shown in Table 9-3-1.

Table 9-3-1 Per Capita Tourism Expenditure by Region

(In US$ at 1985 value)

Region	Expenditure
South America	806
Central America	900
U.S.A. & Canada	1,136
Europe	1,005
Other	1,101

Assuming the value-added income ratio of Peruvian tourism industry to be at 50% (50% - 60% in Japan), calculation was made of the net increase in the Peruvian tourism income to be generated by the increase in arriving non-resident air passengers. The results are shown in Table 9-3-2.

Table 9-3-2 Incremental Net Tourism Income

YEAR	S.AMERICA Number ('000)	S.AMERICA Tourism Income ('000$)	C.AMERICA Number ('000)	C.AMERICA Tourism Income ('000$)	USA & CANADA Number ('000)	USA & CANADA Tourism Income ('000$)	EUROPE Number ('000)	EUROPE Tourism Income ('000$)	OTHER Number ('000)	OTHER Tourism Income ('000$)	GROSS Tourism Income (A) ('000$)	Net Addition to GNP Tourism Income (A) X 50% ('000$)
1991	25.00	20,150	7.00	6,300	11.00	12,496	14.00	14,070	2.00	2,202	55,218	27,609
1992	30.00	24,180	9.00	8,100	13.00	14,768	17.00	17,085	2.00	2,202	66,335	33,168
1993	36.00	29,016	11.00	9,900	16.00	18,176	20.00	20,100	2.00	2,202	79,394	39,697
1994	43.00	34,658	13.00	11,700	19.00	21,584	24.00	24,120	3.00	3,303	95,365	47,683
1995	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
1996	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
1997	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
1998	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
1999	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2000	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2001	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2002	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2003	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2004	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2005	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2006	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2007	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2008	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2009	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
2010	53.00	42,718	16.00	14,400	23.00	26,128	30.00	30,150	3.00	3,303	116,699	58,350
TOTAL		791,492		266,400		485,072		557,775		62,757	2,163,496	1,081,748

(2) Airport Revenue Increments

As discussed in Section 9.1.2, the future aircraft movements are expected to overflow after 1985, when the Airport's capacity would reach the saturation point.

Assuming that 75% of all aircraft movements will continue to be foreign airlines as they are today, the incremental airport revenues that would be paid by foreign airlines if the Project is implemented are considered to be the economic benefits of the Project in terms of foreign exchange earnings, along with the expected increase in international passenger service charges.

The incremental airport revenues are estimated on the basis of Peruvian Regulations for the Application of Tariffs for the Landing and Takeoff and Air Navigation En Route Services, as follows:

1) Landing Charges

Day landing charges are levied on international flights according to the aircraft type (the maximum permissible takeoff weight), as follows:

Aircraft type	Charges per landing (US$)
A	1,180
B	1,290
C	390

2) Lighting Charges

For all uses of the airport at night, 15% of the day landing charges are levied.

3) Parking Charges

Parking charges are levied on the basis of the aircraft type and parking hours, and are calculated as follows:

Aircraft type	Charges per parking (US$)
A	450
B	480
C	70

4) Navigation Charges

Navigation charges are levied on the basis of the aircraft type and flight distance, and are calculated as follows:

Aircraft type	Charges (US$/km)
A	1.34
B	0.96
C	0.29

5) Passenger Service Charges

Passenger service charges of US$10 is levied for each embarking passenger on international flights.

On the basis of the current airport charges at Lima International Airport, estimation is made on incremental airport revenues accruing from the foreign passengers and foreign aircraft movements to be accommodated by the Project. The results are shown in Table 9-3-3.

Table 9-3-3 Incremental Airport Operating Revenues

(In US$ thousand at 1985)

YEAR	Landing Charge	Lighting Charge	Parking Charge	Navigation Charge	Passenger Service Charge	Total Revenue
1991	899	58	125	1,296	601	2,979
1992	1,055	68	147	1,522	722	3,514
1993	1,239	80	173	1,787	867	4,146
1994	1,454	94	203	2,098	1,041	4,890
1995	1,711	111	237	2,466	1,250	5,775
1996	1,711	111	237	2,466	1,250	5,775
1997	1,711	111	237	2,466	1,250	5,775
1998	1,711	111	237	2,466	1,250	5,775
1999	1,711	111	237	2,466	1,250	5,775
2000	1,711	111	237	2,466	1,250	5,775
2001	1,711	111	237	2,466	1,250	5,775
2002	1,711	111	237	2,466	1,250	5,775
2003	1,711	111	237	2,466	1,250	5,775
2004	1,711	111	237	2,466	1,250	5,775
2005	1,711	111	237	2,466	1,250	5,775
2006	1,711	111	237	2,466	1,250	5,775
2007	1,711	111	237	2,466	1,250	5,775
2008	1,711	111	237	2,466	1,250	5,775
2009	1,711	111	237	2,466	1,250	5,775
2010	1,711	111	237	2,466	1,250	5,775
TOTAL	32,023	2,076	4,440	46,159	23,231	107,929

(3) Travel Time Saving

The Airport is at present heavily congested at night, unduly prolonging the processing of arriving passengers. This situation will be improved by the implementation of the Project. Theoretically speaking, such benefits could be expressed in monetary terms by using the concept of time value. However, such benefits, being so small in this case, are disregarded in the present study.

(4) Increase of Comfort and Convenience

Service level of the terminal area facilities will particularly be improved by the implementation of the Project, as compared with that of the Base Case. Air passengers should be able to enjoy increased comfort and convenience from the improved facilities in the passenger terminal building. For example, waiting time will be drastically reduced in the Customs, Immigration and Quarantine procedures, as well as at the arrival baggage claim area.
These advantages may well be termed direct benefits enjoyed by the airport users, but are not quantified in the present study as such exercise would be speculative at best.

9.3.2 Indirect Benefits

(1) Employment Effect

The Lima International Airport Development Project is expected to contribute to the national income of Peru by providing increased employment opportunities, both during and after the construction of the facilities. These benefits are quantifiable, but have been treated as indirect benefits according to the general practice. Consequently, they are not included in the present study.

(2) Economic Multiplier Effect

The Project will produce multiplier effects on the Peruvian economy as a whole, through increased procurement of goods and services required for the construction and maintenance of the facilities. These effects could be quantitatively identified through the input-output analysis. This is, however, considered to be outside the scope of the present study.

9.4 Economic Evaluation

9.4.1 Results of Economic Cost-Benefit Analysis

Cost-benefit analysis is made on the basis of the cash flow of economic costs and direct tangible economic benefits, obtained through comparison between the Base Case and the Project Case as discussed above.

The economic internal rate of return (EIRR) is 33.6% for the Project (Table 9-4-1). This figure indicates that the Project is economically feasible from the viewpoint of the Peruvian national economy, in which the social discount rate is understood to be 12% (estimated by Instituto Nacional de Planificacion).

Table 9-4-1 Cash Flow of Economic Cost and Benefits

(In US$ thousand at 1985)

YEAR	Economic Cost of The Project(A) Invest Cost	Economic Cost of The Project(A) Mainte Operat Cost	Economic Cost of Base Case (B) Invest Cost	Economic Cost of Base Case (B) Mainte Operat Cost	Incre-mental Cost (C=A-B)	Net Addition to GNP of Incremental T-Income	Economic Benefits Incremental Airport Revenue	Total Benefits (D)	Net Benefits (E=D-C)	Discounted Cash Flow at 15%	at 25%	at 35%
1987	4,983	25,306	0	25,306	4,983	0	0	0	-4,983	-3,768	-3,189	-2,734
1988	24,201	25,306	0	25,306	24,201	0	0	0	-24,201	-15,913	-12,391	-9,836
1989	35,674	25,306	0	25,306	35,674	0	0	0	-35,674	-20,397	-14,512	-10,740
1990	26,140	25,306	0	25,306	26,140	0	0	0	-26,140	-12,996	-8,566	-5,830
1991	0	28,007	0	25,306	2,701	27,609	2,979	30,588	27,887	12,056	7,310	4,607
1992	0	28,125	0	25,306	2,819	33,168	3,514	36,682	33,863	12,730	7,101	4,144
1993	0	28,252	0	25,306	2,946	39,697	4,146	43,843	40,897	13,369	6,861	3,707
1994	0	28,388	0	25,306	3,082	47,683	4,890	52,573	49,491	14,068	6,643	3,323
1995	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	15,053	6,539	3,029
1996	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	13,089	5,231	2,243
1997	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	11,382	4,185	1,662
1998	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	9,897	3,348	1,231
1999	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	8,606	2,678	912
2000	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	7,484	2,143	675
2001	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	6,503	1,714	500
2002	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	5,659	1,371	371
2003	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	4,921	1,097	275
2004	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	4,279	878	203
2005	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	3,721	702	151
2006	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	3,235	562	112
2007	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	2,813	449	83
2008	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	2,446	359	61
2009	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	2,127	288	45
2010	0	28,534	0	25,306	3,228	58,350	5,775	64,125	60,897	1,850	230	34
TOTAL	90,998	670,540	0	607,344	154,194	1,081,748	107,929	1,189,677	1,035,483	102,222	20,931	-1,774

(CASE 1)
Demand 0 %
Cost 0 %

EIRR = 33.5978304614

9.4.2 Sensitivity Analysis

Sensitivity analysis is made of the EIRR value for certain fluctuations in key factors of the economic costs and the direct tangible economic benefits. The results are shown below.

Assumed Fluctuation	EIRR
1) 10% decrease in demand	31.2%
2) 10% increase in demand	35.9%
3) 10% increase in costs	31.4%
4) 10% decrease in costs	36.1%
5) 10% decrease in demand and 10% increase in costs	29.1%

It will be seen that even the worst possible conditions still gives a favourable EIRR, well above 29.1%.

CHAPTER 10

FINANCIAL ANALYSIS

CHAPTER 10 FINANCIAL ANALYSIS

10.1 General

The purpose of this financial analysis is to examine the financial feasibility of the Lima International Airport Development Project based on the assumption that the airport would be administered on a self-supporting accounting principle.

The evaluation is made in terms of the financial internal rate of return (FIRR), which is derived from the financial cost-benefit analysis, by using the cash flow of the financial costs and the financial benefits, and by comparing the Project with the Base Case as defined in Chapter 9.

10.2 Estimate of Financial Costs

10.2.1 Investment Cost

The construction costs estimated in Chapter 8 are based on the market prices, and are, therefore, used as the financial costs of the investment in the Project. The financial cost of the Project Case, inclusive of indirect taxes, is estimated by means of the results shown in Table 8-4-1 in Section 8.4 of the preceding chapter.

10.2.2 Maintenance and Operation Costs

Estimates are made of the annual financial costs of maintenance and operaion of the airport in the Project Case for the assumed project life of 20 years, in the same manner as described in Section 9.2.2 of the preceding chapter. The results are shown in Table 10-2-1.

Table 10-2-1 Annual Financial Costs of Maintenance and Operation

(In US$ thousand at 1985 value)

Item	1991	1992	1993	1994	1995-2010
(1) Maintenance	1,428	1,428	1,428	1,428	1,428
(2) Operation					
1) Wages	1,552	1,668	1,793	1,927	2,070
2) Other	358	373	388	404	420
(3) Total	3,338	3,469	3,609	3,759	3,918

10.3 Estimate of Financial Benefits

Financial benefits of the Project are the airport revenue increments based on the present airport tariff and accruing from additional airport services.

10.3.1 Airport Tariff Revenue

The airport tariff revenues are based on the five charge items of landing, lighting, parking, navigation and passenger service, based on the current airport tariff structure of Peru. The tariff revenue increments are estimated for the Project case in comparison with the Base Case, not only from foreign users as described in Section 9.3.1, but from domestic users of the airport as set out below.

(1) Landing Charges

Day landing charges for domestic flights are levied on the basis of the aircraft type as follows:

Aircraft Type	Charges per landing (US$)
D	4
E	2
F	1

(2) Lighting Charges

For domestic users, lighting charges are not levied.

(3) Parking Charges

Parking charges for domestic flights are levied on the basis of the aircraft type and parking hours, and are calculated as follows:

Aircraft Type	Charges per hour (US$)
D	4.20
E	2.07
F	0.69

(4) Navigation Charges

Navigation charges for domestic flights are levied on the basis of the aircraft type and the flight distance, and calculated as follows:

Aircraft Type	Charges (US$/km)
D	0.003
E	0.002
F	0.001

(5) Passenger Service Charges

For embarking passenger on domestic flights, passenger service charges of US$10 is not levied.

Table 10-3-1 shows the annual airport tariff revenue increments estimated on the above conditions for the assumed project life of 20 years.

Table 10-3-1 Incremental Airport Operating Revenues

(In US$ thousand at 1985)

YEAR	Landing Charge	Lighting Charge	Parking Charge	Navigation Charge	Passenger Service Charge	Total Revenue
1991	1,203	78	164	1,734	946	4,125
1992	1,414	92	190	2,037	1,119	4,852
1993	1,661	108	221	2,393	1,324	5,707
1994	1,952	127	257	2,812	1,566	6,714
1995	2,291	148	298	3,300	1,850	7,887
1996	2,291	148	298	3,300	1,850	7,887
1997	2,291	148	298	3,300	1,850	7,887
1998	2,291	148	298	3,300	1,850	7,887
1999	2,291	148	298	3,300	1,850	7,887
2000	2,291	148	298	3,300	1,850	7,887
2001	2,291	148	298	3,300	1,850	7,887
2002	2,291	148	298	3,300	1,850	7,887
2003	2,291	148	298	3,300	1,850	7,887
2004	2,291	148	298	3,300	1,850	7,887
2005	2,291	148	298	3,300	1,850	7,887
2006	2,291	148	298	3,300	1,850	7,887
2007	2,291	148	298	3,300	1,850	7,887
2008	2,291	148	298	3,300	1,850	7,887
2009	2,291	148	298	3,300	1,850	7,887
2010	2,291	148	298	3,300	1,850	7,887
TOTAL	42,886	2,773	5,600	61,776	34,555	147,590

10.3.2 Additional Airport Service Revenues

Calculations of the additional airport service revenues are presented hereunder.

(1) Ramp Service

US$250/Aircraft landing

(2) Storage, loading and unloading

US$58/International and domestic cargo (kg)

(3) Sale of duty-free goods

US$1.166/International passenger

(4) Rentals

(US$/Month)

	International	Domestic
1. Office (Shops)	12/m^2	12/m^2
2. Counter	250/unit	125/unit
3. Warehouse	4/m^2	2/m^2
4. Grounds	0.3/m^2	0.15/m^2

(5) Other

US$0.652/Passenger

Table 10-3-2 shows the annual airport service revenue increments estimated on the above conditions for the assumed project life of 20 years.

Table 10-3-2 Annual Airport Service Revenue Increments

(In US$ thousand at 1985 value)

Year	Ramp Service	Storage, Load & Unload	Sale of Duty-free Goods	Rentals	Other	Total
1991	577	784	275	955	431	3,022
1992	629	930	325	955	491	3,330
1993	686	1,103	384	955	560	3,688
1994	748	1,308	454	955	638	4,103
1995	813	1,549	536	955	730	4,583
1996	813	1,549	536	955	730	4,583
1997	813	1,549	536	955	730	4,583
1998	813	1,549	536	955	730	4,583
1999	813	1,549	536	955	730	4,583
2000	813	1,549	536	955	730	4,583
2001	813	1,549	536	955	730	4,583
2002	813	1,549	536	955	730	4,583
2003	813	1,549	536	955	730	4,583
2004	813	1,549	536	955	730	4,583
2005	813	1,549	536	955	730	4,583
2006	813	1,549	536	955	730	4,583
2007	813	1,549	536	955	730	4,583
2008	813	1,549	536	955	730	4,583
2009	813	1,549	536	955	730	4,583
2010	813	1,549	536	955	730	4,583

10.4 Financial Evaluation

10.4.1 Results of Financial Cost-Benefit Analysis

Financial cost-benefit analysis is made on the basis of the cash flow of the financial costs and the financial benefits, by comparing the Project with the Base Case, in the same manner as in the economic analysis. The results are shown in Table 10-4-1.

The financial internal rate of return (FIRR) for the Project is 4.1%.

It is therefore concluded that the Project is financially feasible even under the current airport tariff structure, on the basis of the soft-loan interest rate (under 4.1%). In the event that the Project were implemented with financial assistance of a hard loan, it would become necessary to take certain effective measures to increase the airport operation revenues either by raising the level of the airport tariffs, or by governmental subsidy.

Table 10-4-1 Cash Flow of Financial Cost and Benefits

(In US$ thousand at 1985)

YEAR	Financial Cost of The Project (A) Invest Cost	Mainte Operat Cost	Financial Cost of Base Case (B) Invest Cost	Mainte Operat Cost	Incre-mental Cost (C=A-B)	Financial Benefits Land-ing Charge	Light-ing Charge	Park-ing Charge	Nav. Charge	Pass-enger Service Charge	Airport Service Revenues	Total Benefits (D)	Net Finance Benefits (D-C)
1987	5,423	25,306	0	25,306	5,423	0	0	0	0	0	0	0	-5,423
1988	25,937	25,306	0	25,306	25,937	0	0	0	0	0	0	0	-25,937
1989	39,413	25,306	0	25,306	39,413	0	0	0	0	0	0	0	-39,413
1990	28,229	25,306	0	25,306	28,229	0	0	0	0	0	0	0	-28,229
1991	0	28,644	0	25,306	3,338	1,203	78	164	1,734	946	3,022	7,147	3,809
1992	0	28,775	0	25,306	3,469	1,414	92	190	2,037	1,119	3,330	8,182	4,713
1993	0	28,915	0	25,306	3,609	1,661	108	221	2,393	1,324	3,688	9,395	5,786
1994	0	29,065	0	25,306	3,759	1,952	127	257	2,812	1,566	4,103	10,817	7,058
1995	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
1996	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
1997	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
1998	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
1999	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2000	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2001	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2002	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2003	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2004	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2005	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2006	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2007	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2008	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2009	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
2010	0	29,224	0	25,306	3,918	2,291	148	298	3,300	1,850	4,583	12,470	8,552
TOTAL	99,002	684,207	0	607,344	175,865	42,886	2,773	5,600	61,776	34,555	87,471	235,061	59,196

Airport Revenue 0 %

FIRR = 4.0905932852

10.4.2 Sensitivity Analysis

Sensitivity analysis is made of the FIRR value for certain fluctuations in key factors of the financial costs and benefits. The results are shown below.

Assumed Fluctuation	FIRR
1) 10% decrease in revenue	2.6%
2) 10% increase in revenue	5.4%
3) 10% increase in costs	2.8%
4) 10% decrease in costs	5.6%
5) 10% decrease in revenue and 10% increase in costs	1.3%

CHAPTER 11

PROJECT IMPLEMENTATION PROGRAMME

CHAPTER 11 PROJECT IMPLEMENTATION PROGRAMME

11.1 Airport Administration Organization

Airport administration is under the jurisdiction of the Ministry of Transport and Communications, and the Directorate General of Air Transport (DGTA) is in charge of the airport.

Commercial airports including Lima International Airport are managed and operated by CORPAC (CORPORACION PERUANA DE AEROPUERTOS Y AVIACION COMERCIAL S.A.). The purposes of CORPAC S.A. are:

(1) To operate, equip and maintain commercial airports

(2) To establish, manage, operate and maintain radio navigational-aids, communications and other technical services necessary for the safety of air operation in the country

(3) To establish the best communication systems required to regulate and control overflying air traffic.

In practising its objectives, CORPAC S.A. acts with economical, financial, technical and administrative independence, in accordance with the policy objectives approved by the Ministry of Transport and Communications.

The organizational structures of the Ministry of Transport and Communications, DGTA and CORPAC S.A. are shown in Fig. 11-1-1, 11-1-2 and 11-1-3 respectively.

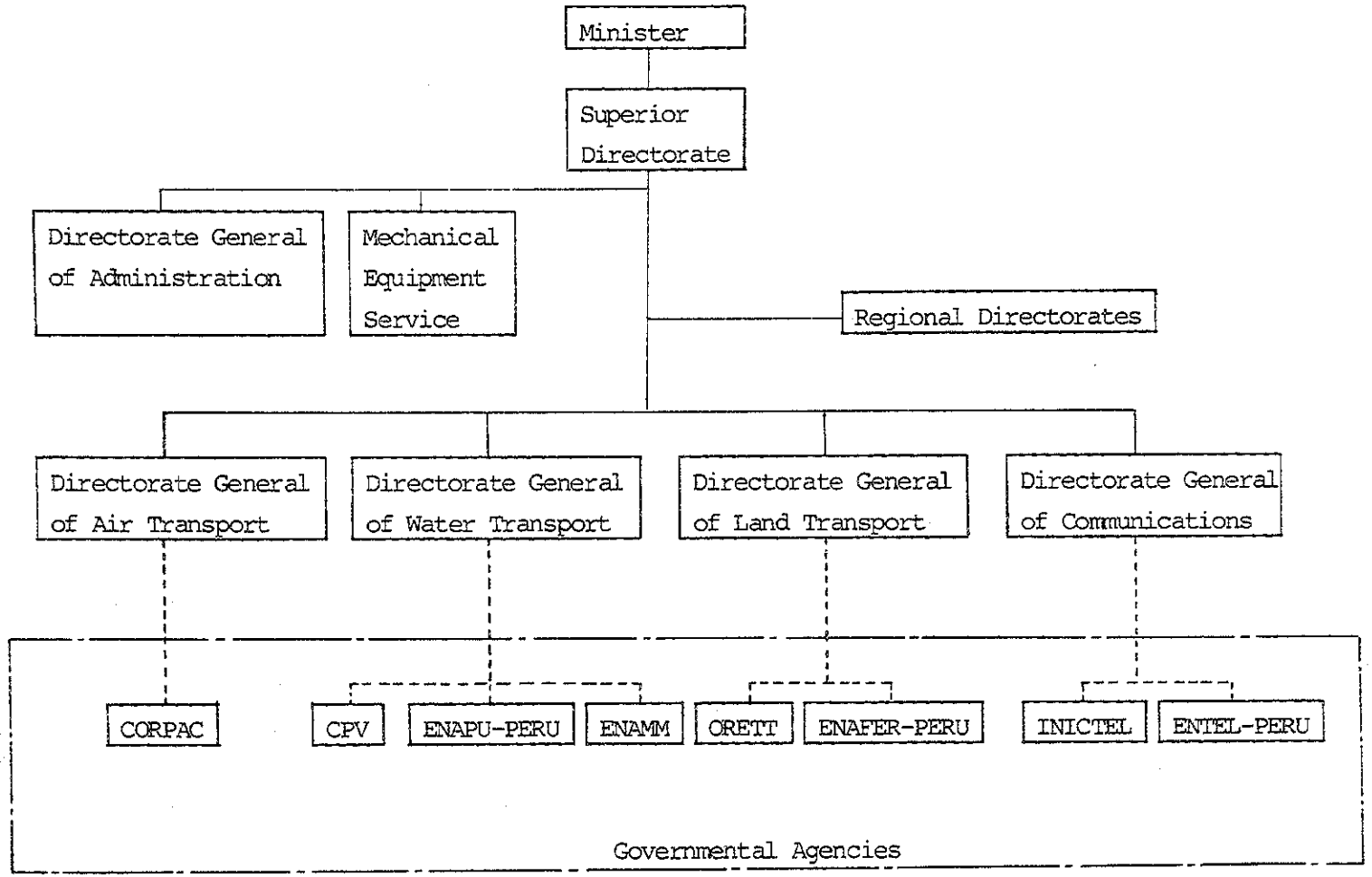


Fig. 11-1-1 Organization Chart of Ministry of Transport and Communications

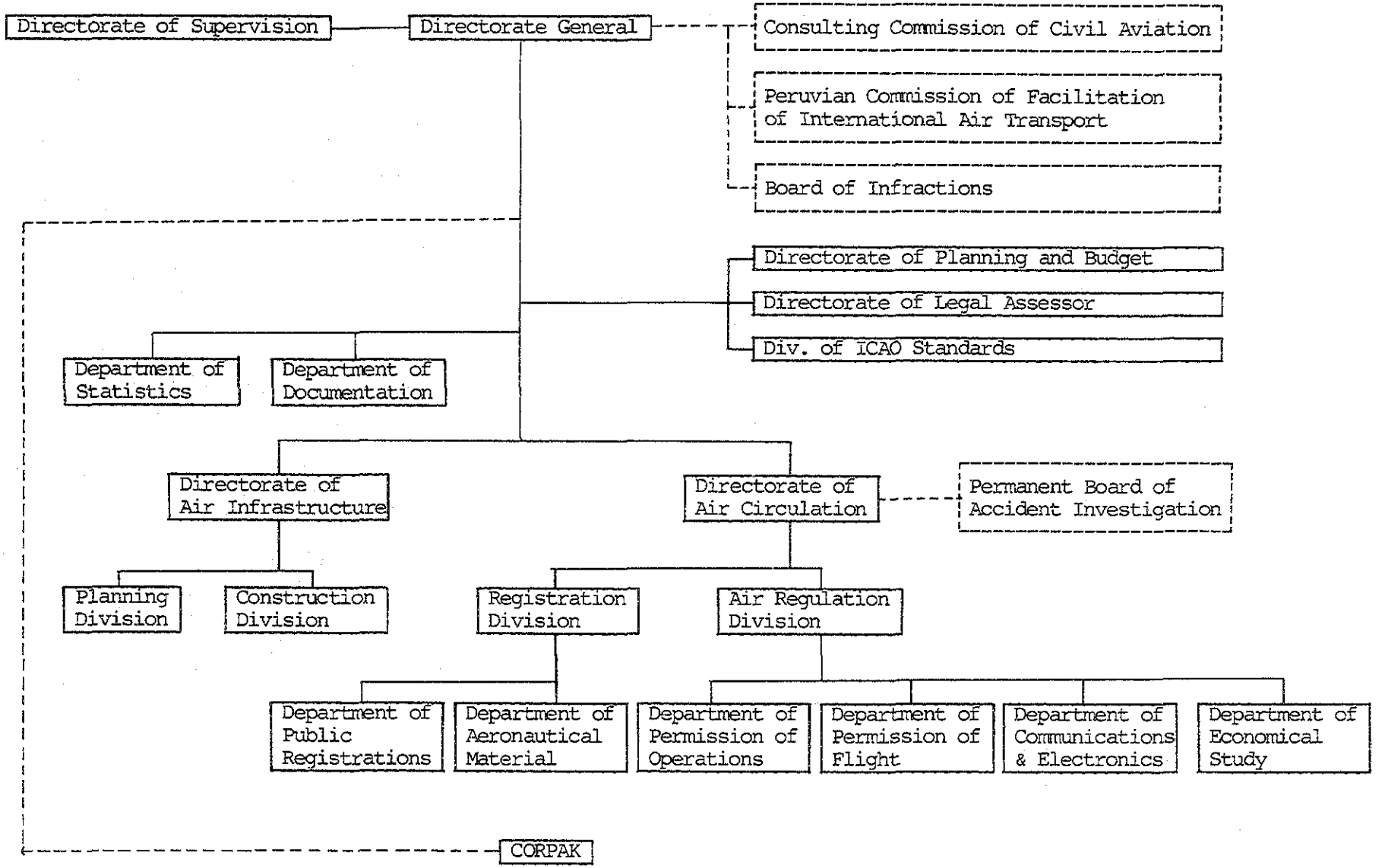


Fig. 11-1-2 Organization Chart of Directorate General of Air Transport

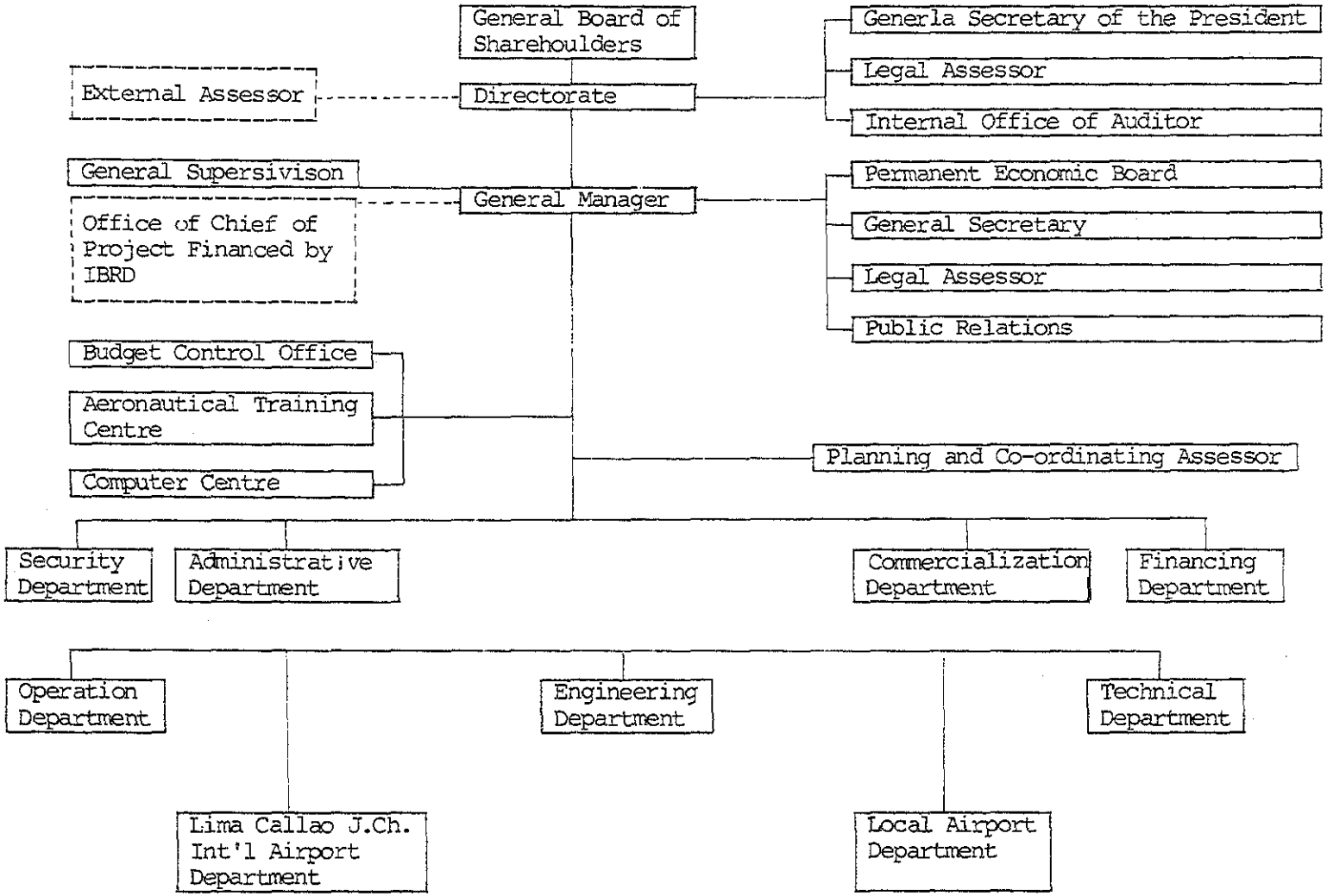


Fig. 11-1-3 Organization of CORPAC S.A.

11.2 Project Implementaion Organization

In order to ensure efficient implementation of the Lima International Airport Development Project, it is recommended that a special team exclusively in charge of the project implementation be established within DGTA and CORPAC.

It is also recommended that DGTA conclude either a single or separate contract(s) with some consultants suitably qualified and experienced in airport engineering for the design and supervision of construction.

Fig. 11-2-1 shows the outline of the recommended organization of the Project Implementation Office. Outlined below are the major tasks to be carried out either directly by the Project Implementation Office or through the consultants under appropriate consulting contract.

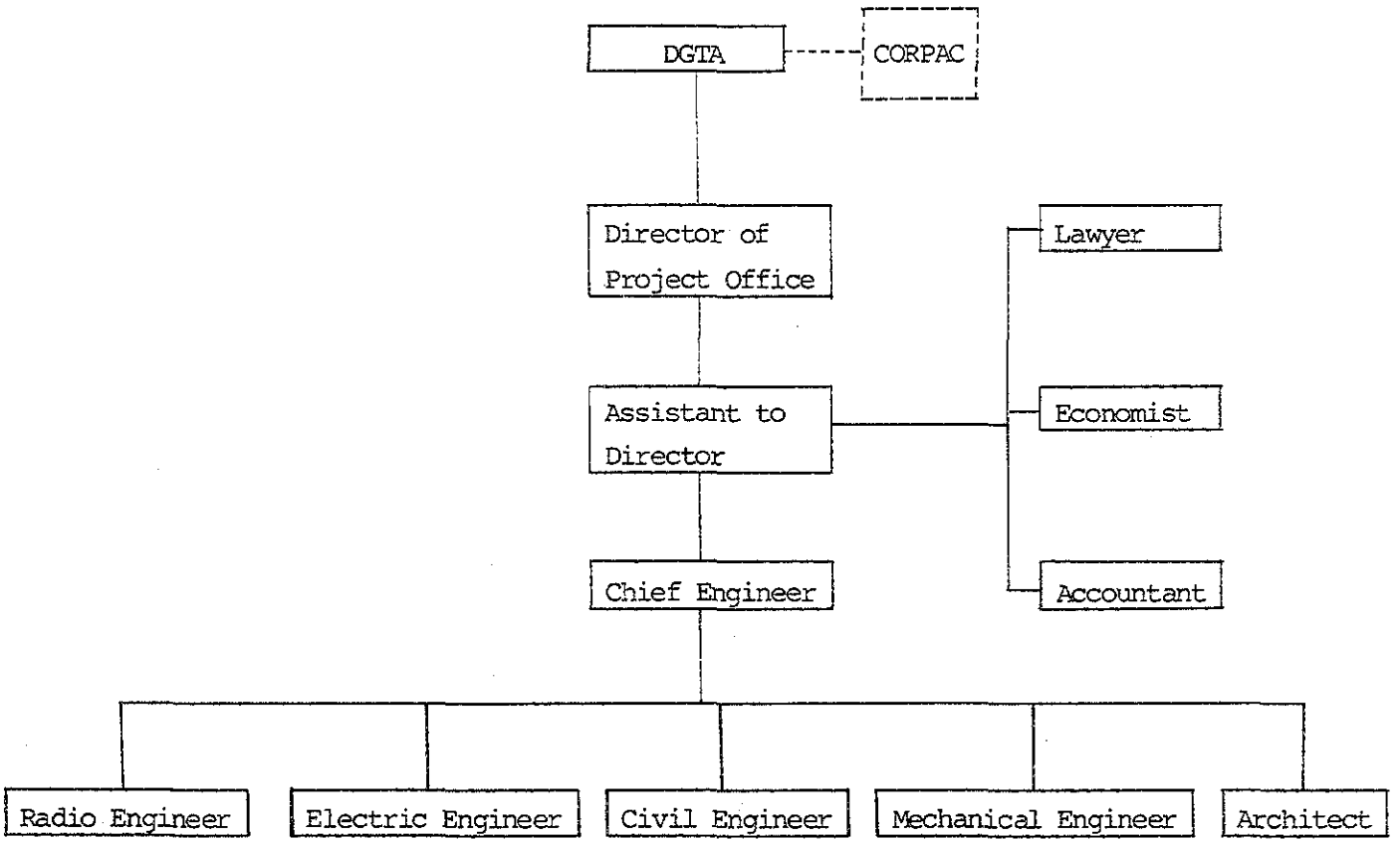


Fig. 11-2-1 Proposed Project Implementation Organization

(1) Preparations for Design Tender

The first thing to be done at this stage is to prepare the "Terms of Reference" for the design, describing the background and scope of works of the Project. To optimize the project management in terms of cost, schedule and quality control, it is desirable for the Project Implementation Office to conduct the necessary land survey and geological exploration at this stage, and supply the information obtained to the consultants.

(2) Selection of Consultants

When the design tenders are received, the Project Implementation Office should evaluate them, negotiate with the top-ranking consultants and enter into contracts with the consultants of its choice. It is recommended to include in the scope of consultancy services not only design and cost estimate of the Project but also tender assistance services including preparation of tender documents, evaluation of tenders and assistance in contract negotiation.

(3) Design

For the sake of satisfactory and on-schedule implementation of the project, the Project Implementation Office should be required to comment on and approve the consultant's works at successive design stages.

(4) Selection of Contractor

The Project Implementaiton Office should with the assistance of consultants, invite construction tenders, evaluate them, negotiate with top-ranking tenderer(s) and conclude a construction contract.

(5) Construction Supervision

By the time the construction contract is concluded, a contract for the construction supervision should be concluded preferably with the consultants who prepared the design.

11.3 Financing Plan for the Project

11.3.1 General

The objective of this section is to produce a forecast of the cash flow during the period 1987 - 2010 for the implementation of the Project, based on the assumed conditions of the necessary financing.

11.3.2 Assumptions

The assumptions made for the forecast of the cash flow are as follows:

(1) Price Contingency

This is estimated at 3.8% per annum for the funds based on the past inflation rates in U.S.A.

(2) Conditions of Funds

The conditions of funds available are assumed as shown in Table 11-3-1.

Table 11-3-1 Conditions of Funds Available

Portion	Type of Funds	Interest Rate	Grace Period	Repayment Period
Foreign	Soft Loan	4.5%	5 years	20 years
	Hard Loan	9.0%	5 years	15 years
Local	Government Finance	0%	-	-

(3) Cases of Forecasting

Forecast of the cash flow is made for the three cases as shown in Table 11-3-2.

Table 11-3-2 Cases of Cash-flow Forecast

Case	Portion	Type of Funds	Ratio (%)
Case 1	Foreign	Soft Loan	100
		Hard Loan	-
	Local	Government Finance	100
Case 2	Foreign	Soft Loan	-
		Hard Loan	100
	Local	Government Finance	100
Case 3	Foreign	Soft Loan	50
		Hard Loan	50
	Local	Government Finance	100

11.3.3 Results of Forecast

Based on the above assumptions, the results of forecast are obtained as shown in Table 11-3-3.

Table 11-3-3 Forecast of Cash Flow

	Turning Point for Surplus	
Case	Annual Surplus	Cumulative Cash Surplus
1	Year 1991	Year 1994
2	Year 1998	Year 2005
3	Year 1992	Year 2000

Case 1 is shown in Table 11-3-4 (1), (2), (3).

Case 2 is shown in Table 11-3-5 (1), (2), (3).

Case 3 is shown in Table 11-3-6 (1), (2), (3).

It is concluded, therefore, that the Project should be financed by a soft loan for the bulk of the foreign portion, if it was to be implemented with the current tariff structure remaining as is.

Table 11-3-4 (1) Cash Flow Statement (Case 1)

(In Current US$ thousand)

		1987	1988	1989	1990	1991	1992	1993	1994
1.Funds Required									
Investment	FOREIGN	3,321	17,551	21,619	18,282	0	0	0	0
	LOCAL	2,102	8,386	17,794	9,947	0	0	0	0
	Sub total	5,423	25,937	39,413	28,229	0	0	0	0
Price Contingency	FOREIGN	256	2,071	3,481	3,748	0	0	0	0
	LOCAL	162	990	2,865	2,039	0	0	0	0
	Sub total	418	3,061	6,346	5,787	0	0	0	0
Total	FOREIGN	3,577	19,622	25,100	22,030	0	0	0	0
	LOCAL	2,264	9,376	20,659	11,986	0	0	0	0
	Sub total	5,841	28,998	45,759	34,016	0	0	0	0
2.Debt Service									
Soft Loan	Interest	161	1,044	2,173	3,165	3,165	3,157	3,105	2,996
	Repayment	0	0	0	0	0	179	1,160	2,415
	Sub total	161	1,044	2,173	3,165	3,165	3,336	4,265	5,411
Hard Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	161	1,044	2,173	3,165	3,165	3,157	3,105	2,996
	Repayment	0	0	0	0	0	179	1,160	2,415
	Subtotal	161	1,044	2,173	3,165	3,165	3,336	4,265	5,411
* Total Fund Required *		6,002	30,042	47,932	37,181	3,165	3,336	4,265	5,411
3.Funds Available									
Operating Revenues		0	0	0	0	8,597	9,843	11,303	13,014
Operating Expenses		0	0	0	0	4,022	4,180	4,349	4,529
Net Operating Surplus		0	0	0	0	4,118	5,097	6,259	7,637
Borrowing :Soft Loan		3,577	19,622	25,100	22,030	0	0	0	0
:Hard Loan		0	0	0	0	0	0	0	0
:Commercial loan		0	0	0	0	0	0	0	0
:Sub total		3,577	19,622	25,100	22,030	0	0	0	0
Government Finance		2,264	9,376	20,659	11,986	0	0	0	0
Total Funds Available		5,841	28,998	45,759	34,016	4,118	5,097	6,259	7,637
Annual Surplus(Deficit)		-,161	-1,044	-2,173	-3,165	953	1,761	1,994	2,226
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		-,161	-1,205	-3,378	-6,543	-5,590	-3,829	-1,835	390

Table 11-3-4 (2) Cash Flow Statement (Case 1)

(In Current US$ thousand)

		1995	1996	1997	1998	1999	2000	2001	2002
1.Funds Required									
Investment	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Price Contingency	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
2.Debt Service									
Soft Loan	Interest	2,838	2,679	2,521	2,363	2,205	2,046	1,888	1,730
	Repayment	3,516	3,516	3,516	3,516	3,516	3,516	3,516	3,516
	Sub total	6,354	6,196	6,038	5,879	5,721	5,563	5,405	5,246
Hard Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	2,838	2,679	2,521	2,363	2,205	2,046	1,888	1,730
	Repayment	3,516	3,516	3,516	3,516	3,516	3,516	3,516	3,516
	Subtotal	6,354	6,196	6,038	5,879	5,721	5,563	5,405	5,246
* Total Func Required *		6,354	6,196	6,038	5,879	5,721	5,563	5,405	5,246
3.Funds Available									
Operating Revenues		15,004	15,004	15,004	15,004	15,004	15,004	15,004	15,004
Operating Expenses		4,721	4,721	4,721	4,721	4,721	4,721	4,721	4,721
Net Operating Surplus		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Borrowing :Soft Loan		0	0	0	0	0	0	0	0
:Hard Loan		0	0	0	0	0	0	0	0
:Commercial loan		0	0	0	0	0	0	0	0
:Sub total		0	0	0	0	0	0	0	0
Government Finance		0	0	0	0	0	0	0	0
Total Funds Available		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Annual Surplus(Deficit)		2,901	3,059	3,217	3,375	3,534	3,692	3,850	4,008
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		3,291	6,350	9,567	12,942	16,476	20,168	24,018	28,026

Table 11-3-4 (3) Cash Flow Statement (Case 1)

(In Current US$ thousand)

		2003	2004	2005	2006	2007	2008	2009	2010
1.Funds Required									
Investment	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Price Contingency	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
2.Debt Service									
Soft Loan	Interest	1,572	1,413	1,255	1,097	939	781	622	464
	Repayment	3,516	3,516	3,516	3,516	3,516	3,516	3,516	3,516
	Sub total	5,088	4,930	4,772	4,613	4,455	4,297	4,139	3,980
Hard Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	1,572	1,413	1,255	1,097	939	781	622	464
	Repayment	3,516	3,516	3,516	3,516	3,516	3,516	3,516	3,516
	Subtotal	5,088	4,930	4,772	4,613	4,455	4,297	4,139	3,980
* Total Fund Required *		5,088	4,930	4,772	4,613	4,455	4,297	4,139	3,980
3.Funds Available									
Operating Revenues		15,004	15,004	15,004	15,004	15,004	15,004	15,004	15,004
Operating Expenses		4,721	4,721	4,721	4,721	4,721	4,721	4,721	4,721
Net Operating Surplus		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Borrowing :Soft Loan		0	0	0	0	0	0	0	0
:Hard Loan		0	0	0	0	0	0	0	0
:Commercial loan		0	0	0	0	0	0	0	0
:Sub total		0	0	0	0	0	0	0	0
Government Finance		0	0	0	0	0	0	0	0
Total Funds Available		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Annual Surplus(Deficit)		4,167	4,325	4,483	4,641	4,799	4,958	5,116	5,274
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		32,192	36,517	41,000	45,641	50,441	55,399	60,515	65,789

Table 11-3-5 (1) Cash Flow Statement (Case 2)

(In Current US$ thousand)

		1987	1988	1989	1990	1991	1992	1993	1994
1.Funds Required									
Investment	FOREIGN	3,321	17,551	21,619	18,282	0	0	0	0
	LOCAL	2,102	8,386	17,794	9,947	0	0	0	0
	Sub total	5,423	25,937	39,413	28,229	0	0	0	0
Price Contingency	FOREIGN	256	2,071	3,481	3,748	0	0	0	0
	LOCAL	162	990	2,865	2,039	0	0	0	0
	Sub total	418	3,061	6,346	5,787	0	0	0	0
Total	FOREIGN	3,577	19,622	25,100	22,030	0	0	0	0
	LOCAL	2,264	9,376	20,659	11,986	0	0	0	0
	Sub total	5,841	28,998	45,759	34,016	0	0	0	0
2.Debt Service									
Soft Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Hard Loan	Interest	322	2,088	4,347	6,330	6,330	6,309	6,169	5,879
	Repayment	0	0	0	0	0	238	1,547	3,220
	Sub total	322	2,088	4,347	6,330	6,330	6,547	7,716	9,099
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	322	2,088	4,347	6,330	6,330	6,309	6,169	5,879
	Repayment	0	0	0	0	0	238	1,547	3,220
	Subtotal	322	2,088	4,347	6,330	6,330	6,547	7,716	9,099
* Total Fund Required *		6,163	31,086	50,106	40,346	6,330	6,547	7,716	9,099
3.Funds Available									
Operating Revenues		0	0	0	0	8,597	9,843	11,303	13,014
Operating Expenses		0	0	0	0	4,022	4,180	4,349	4,529
Net Operating Surplus		0	0	0	0	4,118	5,097	6,259	7,637
Borrowing :Soft Loan		0	0	0	0	0	0	0	0
:Hard Loan		3,577	19,622	25,100	22,030	0	0	0	0
:Commercial loan		0	0	0	0	0	0	0	0
:Sub total		3,577	19,622	25,100	22,030	0	0	0	0
Government Finance		2,264	9,376	20,659	11,986	0	0	0	0
Total Funds Available		5,841	28,998	45,759	34,016	4,118	5,097	6,259	7,637
Annual Surplus(Deficit)		-,322	-2,088	-4,347	-6,330	-2,212	-1,450	-1,457	-1,463
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		-,322	-2,410	-6,757	-13,086	-15,298	-16,748	-18,205	-19,668

Table 11-3-5 (2) Cash Flow Statement (Case 2)

(In Current US$ thousand)

		1995	1996	1997	1998	1999	2000	2001	2002
1.Funds Required									
Investment	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Price Contingency	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
2.Debt Service									
Soft Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Hard Loan	Interest	5,457	5,035	4,613	4,191	3,769	3,347	2,925	2,418
	Repayment	4,689	4,689	4,689	4,689	4,689	4,689	4,689	4,450
	Sub total	10,146	9,724	9,302	8,880	8,458	8,036	7,614	6,868
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	5,457	5,035	4,613	4,191	3,769	3,347	2,925	2,418
	Repayment	4,689	4,689	4,689	4,689	4,689	4,689	4,689	4,450
	Subtotal	10,146	9,724	9,302	8,880	8,458	8,036	7,614	6,868
* Total Fund Required *		10,146	9,724	9,302	8,880	8,458	8,036	7,614	6,868
3.Funds Available									
Operating Revenues		15,004	15,004	15,004	15,004	15,004	15,004	15,004	15,004
Operating Expenses		4,721	4,721	4,721	4,721	4,721	4,721	4,721	4,721
Net Operating Surplus		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Borrowing :Soft Loan		0	0	0	0	0	0	0	0
:Hard Loan		0	0	0	0	0	0	0	0
:Commercial loan		0	0	0	0	0	0	0	0
:Sub total		0	0	0	0	0	0	0	0
Government Finance		0	0	0	0	0	0	0	0
Total Funds Available		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Annual Surplus(Deficit)		-,891	-,469	-47	375	797	1,219	1,641	2,387
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		-20,559	-21,028	-21,075	-20,700	-19,904	-18,685	-17,044	-14,657

Table 11-3-5 (3) Case Flow Statement (Case 2)

(In Current US$ thousand)

		2003	2004	2005	2006	2007	2008	2009	2010
1.Funds Required									
Investment	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Price Contingency	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
2.Debt Service									
Soft Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Hard Loan	Interest	1,546	661	0	0	0	0	0	0
	Repayment	3,142	1,469	0	0	0	0	0	0
	Sub total	4,688	2,130	0	0	0	0	0	0
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	1,546	661	0	0	0	0	0	0
	Repayment	3,142	1,469	0	0	0	0	0	0
	Subtotal	4,688	2,130	0	0	0	0	0	0
* Total Fund Required *		4,688	2,130	0	0	0	0	0	0
3.Funds Available									
Operating Revenues		15,004	15,004	15,004	15,004	15,004	15,004	15,004	15,004
Operating Expenses		4,721	4,721	4,721	4,721	4,721	4,721	4,721	4,721
Net Operating Surplus		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Borrowing :Soft Loan		0	0	0	0	0	0	0	0
:Hard Loan		0	0	0	0	0	0	0	0
:Commercial loan		0	0	0	0	0	0	0	0
:Sub total		0	0	0	0	0	0	0	0
Government Finance		0	0	0	0	0	0	0	0
Total Funds Available		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Annual Surplus(Deficit)		4,567	7,125	9,255	9,255	9,255	9,255	9,255	9,255
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		-10,090	-2,965	6,289	15,544	24,799	34,054	43,308	52,563

Table 11-3-6 (1) Cash Flow Statement (Case 3)

(In Current US$ thousand)

		1987	1988	1989	1990	1991	1992	1993	1994
1.Funds Required									
Investment	FOREIGN	3,321	17,551	21,619	18,282	0	0	0	0
	LOCAL	2,102	8,386	17,794	9,947	0	0	0	0
	Sub total	5,423	25,937	39,413	28,229	0	0	0	0
Price Contingency	FOREIGN	256	2,071	3,481	3,748	0	0	0	0
	LOCAL	162	990	2,865	2,039	0	0	0	0
	Sub total	418	3,061	6,346	5,787	0	0	0	0
Total	FOREIGN	3,577	19,622	25,100	22,030	0	0	0	0
	LOCAL	2,264	9,376	20,659	11,986	0	0	0	0
	Sub total	5,841	28,998	45,759	34,016	0	0	0	0
2.Debt Service									
Soft Loan	Interest	80	522	1,087	1,582	1,582	1,578	1,552	1,498
	Repayment	0	0	0	0	0	89	580	1,207
	Sub total	80	522	1,087	1,582	1,582	1,668	2,132	2,705
Hard Loan	Interest	161	1,044	2,173	3,165	3,165	3,154	3,084	2,940
	Repayment	0	0	0	0	0	119	773	1,610
	Sub total	161	1,044	2,173	3,165	3,165	3,273	3,858	4,550
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	241	1,566	3,260	4,747	4,747	4,732	4,637	4,438
	Repayment	0	0	0	0	0	209	1,353	2,817
	Subtotal	241	1,566	3,260	4,747	4,747	4,941	5,990	7,255
* Total Fund Required *		6,082	30,564	49,019	38,763	4,747	4,941	5,990	7,255
3.Funds Available									
Operating Revenues		0	0	0	0	8,597	9,843	11,303	13,014
Operating Expenses		0	0	0	0	4,022	4,180	4,349	4,529
Net Operating Surplus		0	0	0	0	4,118	5,097	6,259	7,637
Borrowing :Soft Loan		1,789	9,811	12,550	11,015	0	0	0	0
:Hard Loan		1,789	9,811	12,550	11,015	0	0	0	0
:Commercial loan		0	0	0	0	0	0	0	0
:Sub total		3,577	19,622	25,100	22,030	0	0	0	0
Government Finance		2,264	9,376	20,659	11,986	0	0	0	0
Total Funds Available		5,841	28,998	45,759	34,016	4,118	5,097	6,259	7,637
Annual Surplus(Deficit)		-,241	-1,566	-3,260	-4,747	-,630	156	269	382
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		-,241	-1,807	-5,068	-9,815	-10,444	-10,289	-10,020	-9,639

Table 11-3-6 (2) Cash Flow Statement (Case 3)

(In Current US$ thousand)

		1995	1996	1997	1998	1999	2000	2001	2002
1.Funds Required									
Investment	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Price Contingency	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
2.Debt Service									
Soft Loan	Interest	1,419	1,340	1,261	1,181	1,102	1,023	944	865
	Repayment	1,758	1,758	1,758	1,758	1,758	1,758	1,758	1,758
	Sub total	3,177	3,098	3,019	2,940	2,861	2,781	2,702	2,623
Hard Loan	Interest	2,729	2,518	2,307	2,096	1,885	1,674	1,463	1,209
	Repayment	2,344	2,344	2,344	2,344	2,344	2,344	2,344	2,225
	Sub total	5,073	4,862	4,651	4,440	4,229	4,018	3,807	3,434
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	4,147	3,857	3,567	3,277	2,987	2,697	2,407	2,074
	Repayment	4,103	4,103	4,103	4,103	4,103	4,103	4,103	3,983
	Subtotal	8,250	7,960	7,670	7,380	7,090	6,799	6,509	6,057
* Total Fund Required *		8,250	7,960	7,670	7,380	7,090	6,799	6,509	6,057
3.Funds Available									
Operating Revenues		15,004	15,004	15,004	15,004	15,004	15,004	15,004	15,004
Operating Expenses		4,721	4,721	4,721	4,721	4,721	4,721	4,721	4,721
Net Operating Surplus		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Borrowing	:Soft Loan	0	0	0	0	0	0	0	0
	:Hard Loan	0	0	0	0	0	0	0	0
	:Commercial loan	0	0	0	0	0	0	0	0
	:Sub total	0	0	0	0	0	0	0	0
Government Finance		0	0	0	0	0	0	0	0
Total Funds Available		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Annual Surplus(Deficit)		1,005	1,295	1,585	1,875	2,165	2,455	2,745	3,198
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		-8,634	-7,339	-5,754	-3,879	-1,714	741	3,487	6,684

Table 11-3-6 (3) Cash Flow Statement (Case 3)

(In Current US$ thousand)

		2003	2004	2005	2006	2007	2008	2009	2010
1.Funds Required									
Investment	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Price Contingency	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	FOREIGN	0	0	0	0	0	0	0	0
	LOCAL	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
2.Debt Service									
Soft Loan	Interest	786	707	628	549	469	390	311	232
	Repayment	1,758	1,758	1,758	1,758	1,758	1,758	1,758	1,758
	Sub total	2,544	2,465	2,386	2,307	2,228	2,148	2,069	1,990
Hard Loan	Interest	773	330	0	0	0	0	0	0
	Repayment	1,571	734	0	0	0	0	0	0
	Sub total	2,344	1,065	0	0	0	0	0	0
Commercial Loan	Interest	0	0	0	0	0	0	0	0
	Repayment	0	0	0	0	0	0	0	0
	Sub total	0	0	0	0	0	0	0	0
Total	Interest	1,559	1,037	628	549	469	390	311	232
	Repayment	3,329	2,493	1,758	1,758	1,758	1,758	1,758	1,758
	Subtotal	4,888	3,530	2,386	2,307	2,228	2,148	2,069	1,990
* Total Fund Required *		4,888	3,530	2,386	2,307	2,228	2,148	2,069	1,990
3.Funds Available									
Operating Revenues		15,004	15,004	15,004	15,004	15,004	15,004	15,004	15,004
Operating Expenses		4,721	4,721	4,721	4,721	4,721	4,721	4,721	4,721
Net Operating Surplus		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Borrowing :Soft Loan		0	0	0	0	0	0	0	0
:Hard Loan		0	0	0	0	0	0	0	0
:Commercial loan		0	0	0	0	0	0	0	0
:Sub total		0	0	0	0	0	0	0	0
Government Finance		0	0	0	0	0	0	0	0
Total Funds Available		9,255	9,255	9,255	9,255	9,255	9,255	9,255	9,255
Annual Surplus(Deficit)		4,367	5,725	6,869	6,948	7,027	7,106	7,185	7,264
Government Subsidy		0	0	0	0	0	0	0	0
Cumulative Cash		11,051	16,776	23,645	30,593	37,620	44,726	51,911	59,176

APPENDICES

LIST OF APPENDICES