FEASIBILITY STUDY

ON

NEW INTERNATIONAL AIRPORT CONSTRUCTION PROJECT

IN

EL SALVADOR

June 1971

OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO, JAPAN

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PREFACE

The Government of Japan, acting upon a request from the Government of El Salvador, took steps to cooperate in the survey and research for a new international airport construction project and commissioned the actual work to the Overseas Technical Cooperation Agency. Aware of the importance of the proposed international airport construction project, the Agency organized an Airport Survey Team of twelve members with Akira Takeda, Deputy Director-General of the Civil Aviation Bureau, Ministry of Transport, as its leader. On November 6, 1972 the Survey Team was despatched to El Salvador.

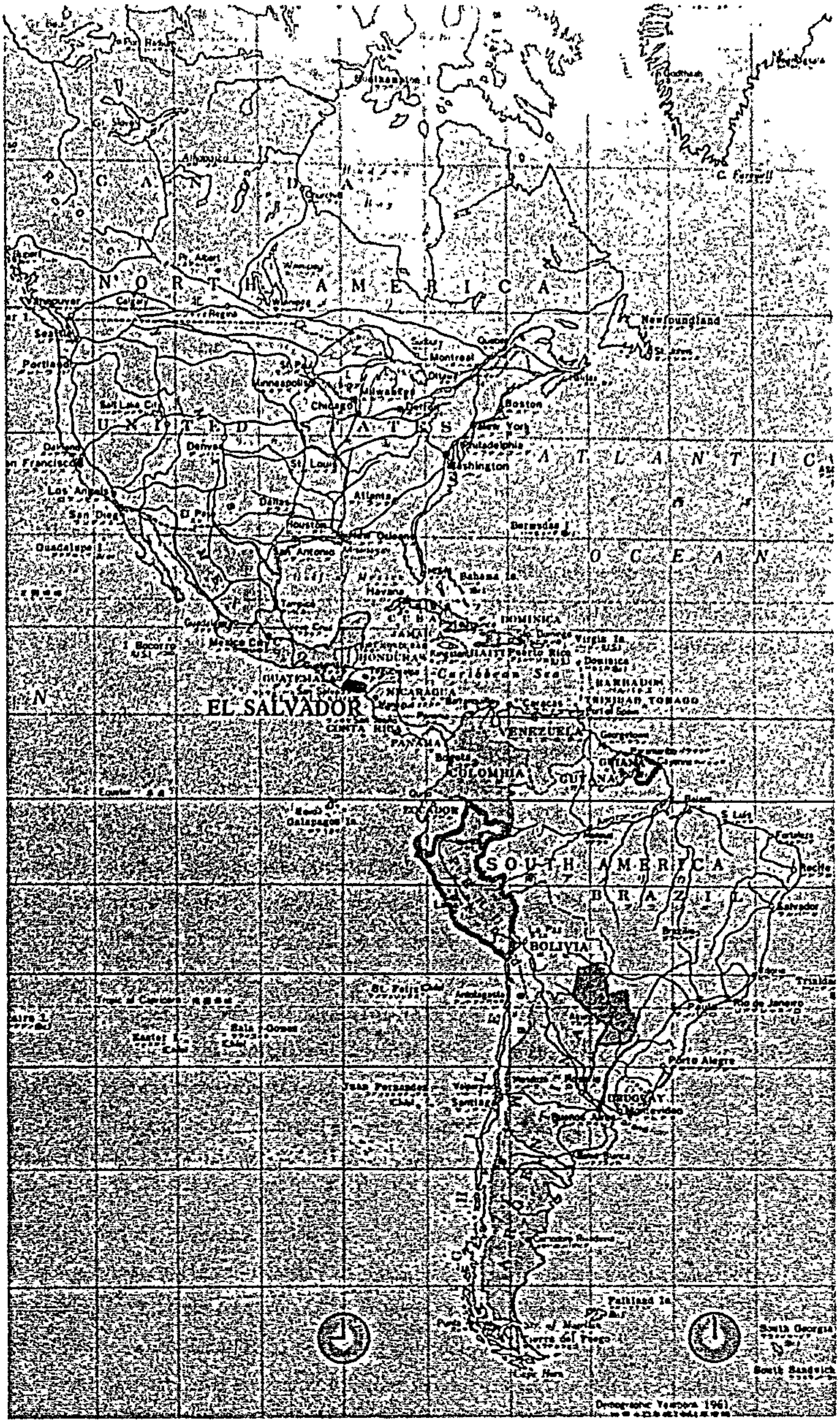
For fourty days the group conducted field surveys to select a suitable site for the new airport as well as area studies to gather data for a conceptual airport design. The following report brings together the results of this investigative work.

In presenting this report, we would like to express our hope that it may be of some assistance to the economic development of El Salvador and also serve as a positive contribution to amicable and fruitful ties between our two nations. Our most profound thanks and appreciation are due to the many agencies of the Salvadorian Government which so generously cooperated in the execution of our investigations, to the personnel of the Japanese Embassy in El Salvador, Ministry of Foreign Affairs and Ministry of Transport of Japan, as well as to the Japan Airport Consultants, Inc. and Japan Air Lines Company, Ltd. all of which together made the despatching of the Survey Team possible.

Overseas Technical Cooperation
Agency

K. Tatsuke

Kei-ichi Tatsuke
Director General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Porto Alegre
URUGUAY
Montevideo
Falkland Is.
Cape Horn

Executive Summary

To evaluate the feasibility of the project for the construction of a new international airport in the coastal area of Astoria, El Salvador, capable of handling flight operations of wide-bodied jet aircraft, Overseas Technical Cooperation Association of Japan dispatched a Survey Team to the country. This section summarizes the report of the Survey Team compiled on the basis of the findings of its on-the-spot survey and detailed analyses of these findings.

1. Economic and Social Conditions

Situated in the center of the five Central American countries, El Salvador of late has been making steady progress, political, economic and cultural, under conditions of economic stability, and now occupies an important point connecting North and South Americal countries. The development of her economy has been tied primarily to agriculture (cotton, coffee and sugar cane), but emphases have been shifting gradually to light industries. And the development of the manufacturing industry helped her achieve vigorous growth at an annual rate of 7%.

According to the CONAPLAN'S five-year economic development program, further efforts will be devoted to the improvement of her national income through increased production of agriculture, acceleration of industrialization and development of tourism, and it is foreseen that her economy will advance at an average annual rate of 10% and that the deficit in her balance of payments will be eliminated by the final year of the program.

Looking ahead, the volume of her export is expected to grow through introduction of techniques of processing her agricultural products, the level of her involvement in the Central American Common Market will rise and her fishery industry modernized. Technological development increasingly oriented toward heavier industries, as foreseen under the CONAPLAN, will enable her to make greater contribution to the Central America's region-wide economy and help her build up a growth momentum in her economy.

2. Civil Aviation, Present and Outlook

The air transportation industry of El Salvador has developed as a center of the Central American network of air routes, and at present, seven carriers (COPA, TACA, AVIATECA, LACSA, LANICA, SAM and PAA) operating on medium and short haul routes serve the Ilopango International Airport. All landing operations are visual and therfore, schedules tend to be less dependable.

In 1971, the Ilopango International Airport handled 666,000 passengers and this represents a 38% increase over the figure of 1966. The number of operations on a peak day was 30 flights and the number of passengers during a peak hour was 130 (both arrivals and departures), of which 65 were in-transit passengers. In terms of their origin, the number of passengers originating from the Central American countries was the largest, 52,827 out of the total of 78,497, or 67.3% and that from North American countries was 23,959.

As is evident from the peak-hour figures mentioned above, in-transit passengers accounted for one half of the total, and this suggests the necessity of terminal facilities exclusively devoted to serving them.

A large percentage of general aviation aircraft is employed for aerial spray of agricultural chemicals, and statistics show that its number is steadily on the rise. In the interest of safety of aircraft in the area, the existing airstrips on which these light aircraft are based must be discarded and their function integrated into the new airport, and this calls for a cross-wind runway.

Looking ahead over the next twenty years, with the round-the-clock operation of the new airport coming into existence, long-haul international flights based on, and those passing through, the airport will increase and the size and speed of the aircraft serving these new routes will grow, with resulting increase in the number of air passengers utilizing the airport. By 1980, the volume of passenger traffic is expected to grow to a minimum of 541,000 of which approximately 160,000 will be accounted for by those originating from North American countries. By 1990, they are expected to grow, respectively, to 1,420,000 and 420,000.

These forecasts do not include the transit passengers originating from the Far East, Southeast Asia, Europe, North and South America. They are estimated at 150,000 in 1980 and 430,000 in 1990.

As for the aircraft mix to serve the new airport, bulk of the operations will include B-747, B-707, BAC-111 and DC-8. By 1990, B-747 (1,000-seats) is expected to come into service and STOL or QSH may be commissioned to serve the inter-Central American routes.

3. Location and General Facility Requirements of the New International Airport

Under instructions given by the Government of El Salvador, search for a suitable site was confined to the coastal area of Astoria. Before proceeding to the designated area, the Survey Team selected eight candidate sites on the basis of available data (air space, meteorology, topography, geology, aircraft noise, access, local community development programs, etc.). Further analyses of the data reduced the number of candidate sites to five, and on the basis of on-the- spot surveys the three sites of Astoria, Carrizal and San Juan were selected. The Survey Team concluded that any one of these three sites meets the geographical and physical requirements of the proposed new international airport. And the plan calls for an area of 877 hectares.

Outline of the General Facility Requirements of the Proposed Airport

Location		Astoria
Reference point	Latitude Longitude Elevation	N 13° 26' 21" W 39° 03' 05" 26m
Runway Orientation		Main Runway N 70° E Sub Runway N 0° E
Airport Surface Area		877 ha
Runway		Main 3,200m x 60m Sub 1,900m x 45m
Taxiway		3,800m x 30m 2,700m x 23m
Main Facilities	Apron	Passenger Loading 8 berths (61,800m^2) Cargo Maintenance 3 berths (31,200m^2) General Aviation 70 berths (21,560m^2)
Main Facilities	Terminal Facilities	Passenger Terminal Bldg. 18,000m^2 Cargo Terminal Bldg. 10,000m^2 Fire Station 1,000m^2 Water Supply and Sewage Disposal Power Supply
Main Facilities	Nav-Aids and ATC Facilities, etc.	NDB, VOR/DME, ILS System Lighting Facilities Air Ground Comm., VHF Comm., HF Comm. etc.

4. Construction Schedule

In working out a construction shedule which is economical as well as adequate, three progressive construction stages are envisaged so as to keep pace with the projected growth in transport demand.

stage 1: To accommodate the transport demand forecast for 1980

stage 2: To accommodate the transport demand forecast for 1985

stage 3: To accommodate the transport demand forecast for 1990

5. Cost Estimate

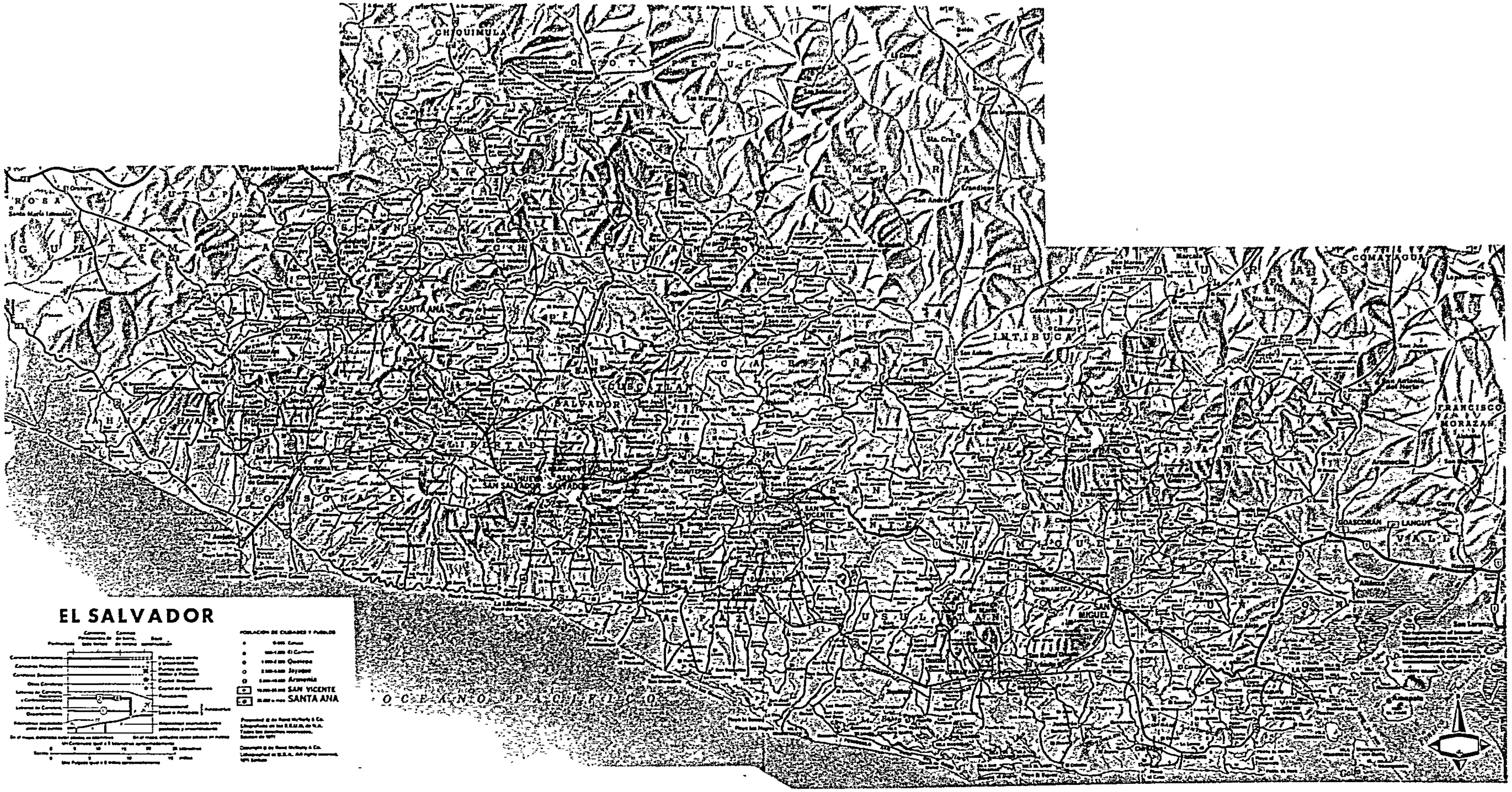
First stage construction cost including engineering fee, freight, insurance, contingency and land acquisition is estimated on the basis of the data currently available, amounting approximately to 13,100 million yen.

6. Cost-Benefit Analysis

Cost-Benefit Analysis of the proposed new international airport project has revealed that, based on the assumed project life of 30 years, the internal rate of return is projected to be in the environs of 8.5%, which is considered high enough to term the project justifiable.

To do justice to the overall economic evaluation of the proposed project, this rate of return should be understood in the light of the particular nature of a new airport construction project in general, major points of consideration being as follows:
Firstly, the overall benefits to be created by the construction of a new airport comprise a great portion of unmeasurable benefits to be derived from the various economic repercussion effects. Based on the theoretical assumption that these benefits of repercussion effects are properly measured in a tangible form, the projected internal rate of return of the proposed project may well show a considerably higher figure than herein projected. This rate of return does not necessarily reflect a very high rate in monetary terms, but it should be noted that the secondary or indirect benefits constituting a significant portion of the overall benefits of the project of this nature are to be derived over a long period of time through vast variety of economic and social activities of the nation, making it next to impossible to identify with reasonable degree of accuracy the potential payers of the money to constitute these secondary benefits.

In other words, it may be concluded that the proposed new international airport project is one of the typical examples of the projects that may not show a seemingly high profitability in terms of direct monetary rate of return but hold great potentiality of producing desirable effects on the economic and social life of the nation.


EL SALVADOR
SAN VICENTE
SANTA ANA
CHIQUIMULA
COMAYAGUA
INTIBUCA
FRANCISCO MORAZAN
GOASCORAN
LANGUE
SAN MIGUEL
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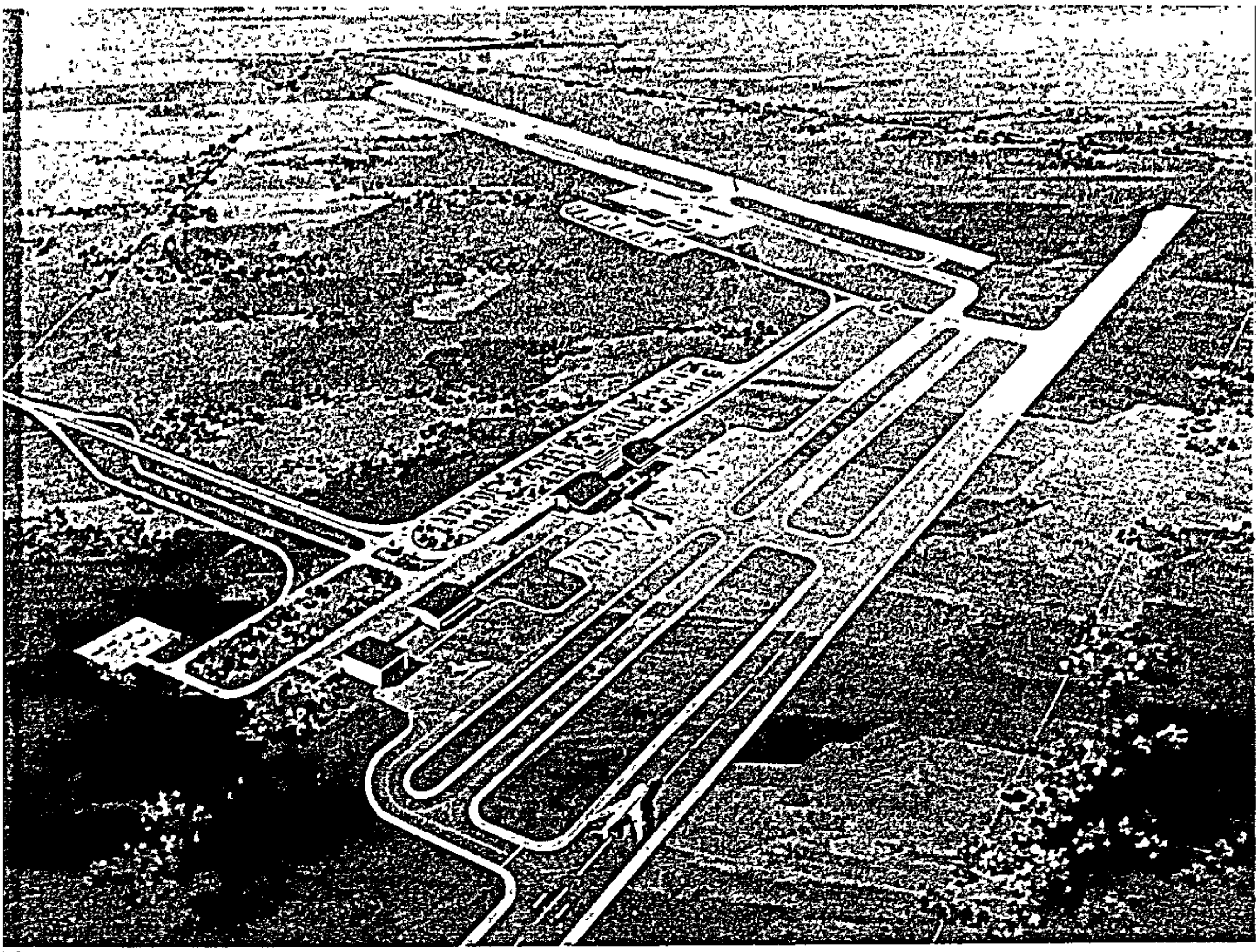
EL SALVADOR NEW INTERNATIONAL AIRPORT



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1. Introduction

1. Introduction

1.1 Background

The Government of El Salvador has for some time in the past been giving careful consideration to various studies on the improvement and expansion of the present Ilopango Airport as well as on the construction of a new international airport. On February 4, 1972 a special ministerial conference of air transport-related agencies was covened to review the overall situation. The outcome of the conference was an official decision to promote the construction of a new international airport and to ask the Japanese Government, through the good offices of the Japanese Embassy in El Salvador, to make a feasibility study.

Upon acceptance of this request, the Japanese Government commissioned a feasibility study to the Overseas Technical Cooperation Agency, and on November 6, 1972 the official Japanese Survey Team for New International Airport Construction Project in El Salvador was despatched to El Salvador.

1.2 Survey Objective

The objective of the survey was to collect data necessary to establish the feasibility study on the New International Airport construction project in El Salvador.

1.3 The Survey Team

Team Leader:	Akira TAKEDA (Airport Planner) Deputy Director-General of the Civil Aviation Bureau, Ministry of Transport
Deputy Team Leader:	Hiroshi IMAMURA (Economist) Deputy Director-General of the Secretariat to the Minister, Ministry of Transport
Team Members:	Shoichiro MAEDA (Flight Operation and Air Traffic Control Specialist) Special Assistant to the Director of Flight Standards Division Engineering Department, Civil Aviation Bureau, Ministry of Transport
	Kiyoshi KATANO (Radio Engineer and Communications Specialist) Special Assistant to the Director of the Radio Engineering Division, Air Traffic Services Department, Civil Aviation Bureau, Ministry of Transport

Captain Masao KIMURA

(Flight Operations Specialist Senior Flight Crew)

Japan Air Lines

Yoshihisa ISHIGAMI

(Airport Systems Specialist)

Executive Director, Japan Airport
Consulatant s, Inc.

Shigeru SHIBATA

(Architect)

Director, Planning Department, Japan Airport
Consultants, Inc.

Etsuji KAMIJO

(Transport Economist)

Economist
Japan Airport Consultants, Inc.

Genichiro KAYASHIMA

(Geologist)

Deputy Director, Planning Department,
Japan Airport Consultants, Inc.

Minoru MAEDA

(Civil Engineer)

Assistant to the Director, Planning Department.
Japan Airport Consultants, Inc.

Dr. Yoshiro TANIGUCHI

(Advisor)

Professor Emeritus Tokyo Institute of Technology
Advisor Japan Airport Consultants, Inc.

Eiichi MUTSURO

Staff

Overseas Technical Cooperation Agency

1.4 Survey Team Itinerary

November	6	Departed from Tokyo
	7	Arrived in San Salvador
	8	Visited the Japanese Ambassador and schedule liaison; called on officials of the Salvadorian Government
	9	Began area surface inspection
	10	First aerial survey
	13	Visited the Minister of Foreign Affairs; data collection at the National Council of Planning
	14	Surveying began
	15	Second aerial survey
	20	Data collection at the Department of Tourism
	21	Third aerial survey; briefing on survey progress to the Salvadorian Government
	22 - 24	Data collection and liaison with the Civil Aviation Bureau, Institute of National Geography, etc.
	26	Evaluation work for site selection
	28	Inspection tour of Ilopango Airport; soil sampling began
	29	Visited the President Molina; inspection of various construction sites
	30	Inspection tour of Pan-American Highway construction site
December	3	Inspection through the eastern region for tourism and regional development planning
	4	Drafting of interim report
	9	Consultation with the Japanese Ambassador
	11	Further discussion on interim report with the Salvadorian Government; called on the President
	13	Departed from San Salvador
	15	Arrived in Tokyo

Note: The period of the survey was 40 days, but some of the team members participated only for such duration as their presence was required.

2. The Economy and Society of El Salvador

2. The Economy and Society of El Salvador

2.1 Present State of her Economy and Society

2.1.1 Population

The total population of El Salvador stands at 3,647,000 in 1971 - - a 3.2% increase over the previous year. With her total area of about 21,393 square kilometers, her population density is as high as 170 persons per square kilometer, which is among the highest in Latin America. The population grew about 1.4 times during the past decade, with an annual average growgh rate of 3.8%.

The population of San Salvador with a density of 839 persons per square kilometer, accounts for 21% of the nation's total. This compares with the corresponding figures of 18% or 543 persons respectively of a decade ago, showing an accelerating concentration of population in the capital. While the nationwide age distribution is 46.2% for 0 to 14 years of age, 50.4% for 15 to 64 years (roughly equaling the working population), and 3.7% for over 65 years of age, the figures for the capital are 40.8% for the first age group (smaller than the national average) and 55.6% for the second age group (greater than the national average). These differences are due to greater employment opportunities in the capital than in other areas, and contributes to advancing population concentration in San Salvador.

2.1.2 Employment

The total number employment in 1970 was 992,000, or 64.8% of the total labor force potential. About one half of the total employed, 51.2%, are engaged in agriculture and fishery, followed by manufacturing (19.6%), various service industries (15.0%), and commerce (7.4%). Total employment is increasing yearly, and showed a 22.8% increase in 1970 over 1962. Among various sectors of the economy, manufacturing showed the greatest rate of increase, or 68.2%, followed by commerce (41.1%) and service industries (25.6%). We note, however, a low 0.83% increase for agriculture and fishery, the two main occupations of this country.

Of all the regions of El Salvador, San Salvador shows the highest employment rate, with 85.2% in 1971.

The distribution of employment as of 1971 by industry is as follows: Among the various sectors of the industry, primary sector occupies the greatest share, with 46.7%, followed by service industries with 13.0%, manufacturing 8.2%, and commerce 7.3%. In the capital of San Salvador, the primary sector occupies 11.8%, manufacturing 16.9%, commerce 15.1%, transportation and communication combined together 29.0%, and services 16.6%.

2.1.3 Per Capita Product

The 1971 Gross Domestic Product was 2,681 million colones, or up 21% above the 2,216 million colones in 1967. Agriculture weighs the heaviest, amounting to 27.1% of the total (or 726 Million colones). Main agricultural products are cotton and coffee. The next biggest industry is commerce yielding 581 million colones or 21.7% of the national total; followed by manufacturing 19.2% or 516 million colones. Combined together, these three biggest categories occupy 68% of the total. There is hardly any difference in the rate of increase among various industries, all being in the neighborhood of 20% over 1967.

The 1971 per capita product amounted to 635 colones (or about US $ 25), 1.04 times the 1967 figure.

2.1.4 Industry

The Salvadorian economy has been growing in recent years mostly at an annual rate of between 5 to 7 per cent, but in 1971 the growth rate remained as low as 3.5%, due partly to a decrease in incomes from coffee which had tended to be in over supply. In 1971, agriculture, the nation's principal industry, occupies as much as 27.7% of the total production, followed by commerce 22% and industry 19%.

(1) Agriculture, Forestry and Fishery

The 1970 product in this sector was 691 million colones, or 28% of the total with agriculture accounting for 75.5% (521.7 million colones), livestock 13.5%, and poultry 4.2%. Coffee is the principal product of El Salvador, occupying 53.2% of the total production. Production of cotton accounted for 10.7% and corn 9.9%.

In terms of cultivated area, coffee again ranked first as of 1971, occupying 146, 172 hectares, with cotton 72,552 ha, sugar cane 29,209 ha, and vegetables 8,902 ha.

(2) Manufacturing

The total product in manufacturing reached 491.6 million colones in 1970, amounting to 19% of the country's G.N.P. It increased 5.4% in 1970 over the previous year. The biggest item of production is foodstuffs, amounting to 135 million colones or 27.5% in 1970. Next in order are leather goods with 64.4 million colones (13.1%), cotton fabrics 56.3 million colones (11.5%), soft drinks 48 million colones (9.8%), and chemicals 35.8 million colones (7.3%).

Industrial development aimed at an annual growth rate of 5 to 6 per cent is being promoted in order to get the national economy to grow out of heavy dependency on agriculture.

Table 2-1-1 Import, Export

	Cargo (Unit: metric ton)			Value (Unit: 1000 colones)		
	Import	Export	Balance	Import	Export	Balance
1962	595,366	276,916	318,450	311,986	340,750	+28,764
63	971,072	517,206	453,866	379,365	384,609	+ 5,244
64	1,189,097	550,688	638,409	477,808	445,238	-32,570
65	1,042,807	515,793	527,014	501,396	471,771	-29,625
66	1,129,639	516,060	613,579	550,010	472,316	-77,694
67	1,205,754	566,383	639,371	559,818	518,080	-41,738
68	1,277,956	639,504	638,452	533,785	529,264	- 4,521
69	1,137,019	583,697	553,322	523,125	505,272	-17,853
1970	869,313	436,705	432,608	533,953	570,792	+36,839
71	1,268,065	490,992	777,073	618,317	569,492	-48,825

Table 2-1-2 Main Export Products

Unit: volume: metric ton
value: million colones

	coffee		cotton		other products
	volume	value	volume	value	value
1962	105	189	60	81	-
63	101	186	72	94	-
64	109	232	70	93	-
65	100	239	73	94	-
66	97	223	51	61	189
67	121	243	34	42	233
68	118	230	28	36	263
69	112	218	41	49	240
1970	111	278	50	58	235
71	98	229	56	73	201

2.1.5 Foreign Trade

The 1971 total exports amounted to 569.5 million colones while the total imports stood at 618.3 million colones, thus incurring a trade deficit of 48.8 million colones. Exports are increasing yearly, amounting in 1971 to 1.67 times the 1962 exports. Imports also are expanding, with the 1971 total imports being 1.98 times the 1962 figure, or almost doubling in a decade.

The principal export items of El Salvador are coffee and cotton, together occupying 53.1% of her total exports (or 302 million colones). Due to overproduction, the coffee market has been rather unstable, resulting in a 12% decrease in 1971 over 1970. On the other hand, cotton production has been growing rapidly, showing a 1.26-fold increase over the previous year.

2.1.6 Tourism

Blessed with 'sun and sea', El Salvador had an influx of as many as 167,000 visitors from abroad in 1971, 40% increase over 1967. Central American countries are the most important origin of these tourists, accounting for 68.6% of the total foreign tourists visiting El Salvador. The United States follows with 15.7%.

Among Central American countries, Guatemala leads the rest contributing 64.9% of the total visitors to El Salvador, followed by Nicaragua, contributing 20.9%, and Costa Rica with 12.0%. In terms of rat e of increase over 1968, Nicarague comes first with 1.85 times, followed by Costa Rica with 1.71 times, and Guatemala with 1.44 times. December and January are the busiest months, with the heaviest tourist traffic flowing in from Central America, accounting for 11.5% and 10.3% respectively of the total annual in-bound tourists. The third most popular month is April, with 10.2% of the total.

Table 2-1-3 Incoming Tourists

unit: person

	1967	1968	1969	1970	1971	1971/1967
Central America	75,419	91,911	84,279	93,978	114,711	1.521
U.S.A.	20,664	25,808	25,396	22,303	26,290	1.272
Canada	1,011	1,110	1,872	1,256	1,521	1.501
South America	4,689	4,780	4,899	4,525	5,431	1.158
Mexico	6,230	6,581	6,208	5,938	7,456	1.197
Espana	1,792	1,991	1,492	1,637	1,888	1.054
Germany	2,064	2,379	2,203	1,883	2,418	1.172
Other parts of Europe	4,941	4,902	5,699	4,221	4,957	1.003
San Andres	515	600	440	301	351	0.612
Asia	676	995	1,142	1,113	1,331	1.969
Others	432	522	530	649	875	2.025
Total	118,433	141,579	134,160	137,804	167,229	1.412

Table 2-1-4 Incoming Tourists from Central American Countries

	1968		1970		1971		1971/1968
	tourist pass.	ratio	tourist pass.	ratio	tourist pass.	ratio	
Guatemala	51,615	56.1	58,839	62.6	74,472	64.9	1.443
Honduras	17,515	19.1	7,518	0.1	82	0.1	0.005
Nicaragua	12,993	14.1	22,968	24.4	23,980	20.9	1.846
Costa Rica	8,058	8.8	10,291	11.0	13,752	12.0	1.707
Panama	1,720	1.9	1,757	1.9	2,378	2.1	1.383
Belize	20	0.0	47	0.0	47	0.0	2.350
Total	91,911	100.0	93,978	100.0	114,711	100.0	1.248

Table 2-1-5 Monthly Breakdown of Incoming Tourists from Central American Countries

	1968		1971	
	tourist pass.	ratio	tourist pass.	ratio
1	8,429	9.17	11,802	10.29
2	5,150	5.60	9,216	8 03
3	9.970	10.84	8,788	7.66
4	7,814	8.50	11.639	10.15
5	6,827	7.42	7.047	6 14
6	7,048	7.66	8.129	7.08
7	8,010	8.71	9,472	8.26
8	7,018	7.63	8,567	7.47
9	6,385	6.94	7.853	6.85
10	6.436	7.00	8,757	7.64
11	10,228	11.12	10,232	8.92
12	8,596	9.35	13,209	11.51
Total	91,911	100.00	114.711	100.00

Table 2-1-6 Gross Domestic Products

output: mit: million colon
ratio: %

	1967		1968		1969		1970		1971	
	output	ratio	output	ratio	output	ratio	output	ratio	output	ratio
Agriculture	600	27.1	603	26.3	607	25.5	725	28.3	726	27.1
Manufacture	422	19.0	448	19.6	466	19.6	485	18.9	516	19.2
Commerce	528	23.8	540	23.6	542	22.7	543	21.2	581	21.7
Others	666	30.5	701	30.5	767	32.2	812	31.6	858	32.0
Total	2,216	100.0	2,292	100.0	2,382	100.0	2,565	100.0	2,681	100.0
	1,000		1,034		1,075		1,157		1,210	

2.2 Relation with Other Central American Countries in Terms of Trades

Among the five Central American states, El Salvador is most densely populated and has the highest population growth rate. Let us review the economic relations of El Salvador with the rest of Central America, in terms of trades with her Central American trading (except Honduras, with whom diplomatic relationshave not been resumed since 1970).

With Nicaragua and Costa Rica, El Salvador has enjoyed a favorable trade relation ever since 1966: in 1971 exports to Nicaragua were 39 million colones, her imports from Nicaragua 26.4 million colones, with a resulting favorable trade balance of 12.6 million colones. To Costa Rica, El Salvador exports amounted to 52.3 million colones, while imports totaled 27.7 million colones, with a balance of 24.6 million colones in El Salvador's favor. El Salvador also maintained a favorable balance of trade with Guatemale in 1971 (exporting 110.8 million colones and importing 104.6 million, a gain of 6.2 million colones), but in 1969 it incurred a deficit of 57 million colones and in 1970 another deficit of 21.3 million colones.

2.3 Transportation Demand in the Past

2.3.1 Passenger Transportation Demand

The number of people traveling to and from El Salvador was 666,000 in 1971, or 1.375 times the volume of 1966, five years earlier.

For the number of in-coming and out-going passengers by international air routes see Table 2-3-1. In 1971, 23.9% (159,000) of the total number of travelers to and from El Salvador were air-borne which was 1.243 times those in 1966. What this means is that the general increase in those traveling to and from this country is steeper than the increase in those by air, and more and more passengers are utilizing transportation other than planes for traveling to and from this country.

Tables 2.3.1 and 2.3.2 show how air transportation demand changed. As for in-coming air passengers, nationals of neighboring Central American countries account for the largest portion, 66.5% in 1969 and 67.3% in 1971. Guatemala, Managua, San Jose, and Panama are particularly important points of origin of passengers, all of which lie to the south of El Salvador. Passengers from North America also maintain their percentage share on the order of 30%, falling slightly in 1971 to 30.5% from 32.3% in 1969.
Passengers originating from Miami, Washington, D.C., and New York account for more than half the total of North American visitors.

A similar trend can be seen also for out-going travelers; i.e., the importance of Central America is growing (62.3% in 1969 and 65.4% in 1971), while the position of North America as destination of passengers from El Salvador is sinking, from 36.9% in 1969 to 32.2% in 1971.

Table 2-3-1 Total International Passengers

Year	Incoming	Outgoing	Total
1962	171,972	175,342	347,314
1963	188,130	188,773	376,903
1964	209,681	208,644	418,325
1965	227,491	229,331	456,829
1966	244,542	240,060	484.602
1967	271,259	267,225	538,484
1968	311,421	308,348	619,769
1969	315,248	268,573	583,831
1970	296,703	295,444	592,147
1971	332,761	333,643	666,404

Table 2-3-2 Arriving and Departing Passengers at Ilopango International Airport

Unit: person

Origin/destination	Arrival Passengers			Departure Passengers		
	1969	1970	1971	1969	1970	1971
North America	20,293	24,164	23,959	24,053	28,141	26,231
Miami *1	11,176	12,975	13,163	13,284	15,835	15,030
New Orleans *2	2,874	3,502	3,196	3,792	4,079	3,687
Los Angeles *3	6,243	7,687	7,600	6,977	8,227	7,514
Central America	41,879	49,169	52,827	40,515	49,811	52,900
Mexico	7,407	9,198	8,316	8,459	10,134	9,671
Guatemala	16,997	18,066	19,089	15,709	17,589	18,475
Managua *4	17,475	21,905	25,422	16,347	22,088	24,754
Others *5	751	227	1,711	446	119	1,709
Total	62,923	73,560	78,497	65,034	78,071	80,840

Note: *1. includes Washington, D.C., New York and Belize.

*2. includes Merida.

*3. includes San Francisco and Houston.

*4. includes San Jose and Panama.

*5. includes Haiti, Jamaica and San Andres.

Table 2-3-3 Total Arriving and Departing Passengers by Year

	1969	1970	1971
Arrival	62,923	73,560	78,497
Departure	65,034	78,071	80,840
Total	127,957	151,631	159,337
Rate of Increase	1.000	1.185	1.2452

2.3.2 Cargo Transportation Demand

As has already been mentioned, El Salvador runs a trade deficit and has greater amounts of cargo arriving than leaving. In 1971, the total ship cargo, amounted to 1,410,000 metric tons, of which 77.3% was brought into El Salvador. In 1966, the total ship cargo handled were 1,545,700 metric tons, indicating a decrease of about 10% in 5 years. This is due to the decrease in out-going cargo(exports) from 495,500 metric tons in 1966 to 319,600 metric tons in 1971, or by about 35%, although arriving cargo (imports) showed a slight increase during the five-year period, from 1,050,200 metric tons in 1966 to 1,090,600 metric tons, or an increase of about 3.8%.

Air transportation of cargo is rather limited in volume, representing only 0.56% of the total in 1971, with the arrivals amounting to 4,210 metric tons and out bound cargo (exports) to 3,800 metric tons. In comparison with the respective 1966 figures of 3,610 metric tons and 1,300 metric tons, volume of air cargo increased 1.166 times for imports and 2.857 times for exports during the 5 year period (See Tables 2.3.4 and 2.3.5).

The volume of incoming air cargo amounted to 4,210 tons in 1971, of which 61.7% and 38.2% respectively was from North America and Central America. In 1969, it was 3,546 tons, with the percentage of North and Central Americas 61.1% and 38.2% respectively. While the total volume increased by 15% during the five-year period, the percentage shares of the two regions as origins of the cargo underwent little change. Turning to out bound cargoes, the total volume amounted to 3,797 tons in 1971, 1.176 times the volume of 2,956 tons in 1969. In 1971, North and Central Americas contributed 28.0% and 70.6% respectively,

Table 2-3-4 Ship Cargo

Unit: metric tons

Year	In	Out	Total
1962	475,858	178,837	654,695
1963	726,474	393,475	1,119,949
1964	1,060,139	492,337	1,552,476
1965	903,901	485,517	1,389,418
1966	1,050,194	495,517	1,545,711
1967	994,601	376,715	1,371,316
1968	1,133,680	447,611	1,581,291
1969	1,086,993	417,672	1,504,665
1970	1,090,075	356,989	1,447,064
1971	1,090,600	319,555	1,410,155

Table 2-3-5 Air Cargo

Unit: metric tons

Year	In	Out	Total
1962	3,555	1,382	4,937
1963	3,235	1,523	4,758
1964	3,992	1,512	5,504
1965	3,905	1,373	5,278
1966	3,613	1,327	4,940
1967	3,570	1,165	4,735
1968	3,188	1,554	4,742
1969	3,546	2,956	6,502
1970	3,988	5,729	9,717
1971	4,210	3,797	8,007

while in 1969 the rates were 31% for North America and 67% for Central America, indicating that the share of North America declined and that of Central America increased.

2.4 Tourism Development Plans

Along with her policy of industrialization, El Salvador has plans to promote tourism as part of the long-term development strategy of El Salvador. It will definitely constitute an essential contribution to the country's development to establish various facilities catering to potential tourists attracted to this country by the "sun, sea, and nature," and thus add to the national incomes through tourism. At present the following three programs are under plan. 1) Develop the La Union region as an international tourist site: 2) develop the Astoria region as a national tourist site; and 3) develop sight-seeing loop route around Santa Ana.

2.4.1 La Union Region

This region, meant to cater to international tourism, will be developed as follows.

(1) The Government will provide the infrastructure, including land procurement, public utility systems of electricity, water, etc., and private capital is induced to establish other facilities, such as hotels and restaurants;

(2) It will entail a Governmental investment of about 20 million dollars including the fund for development of access roads.

(3) Private capital should be invested to develop 3.2 square kilometers of land procured by the Government, and construct hotels to accommodate 5,000 persons per day.

(4) Transportation will not be limited to roads and light planes will also be employed for transportation from the international airport.

2.4.2 Astoria Region

This region is to be improved as a recreation park for the local population with the following features.

(1) Enable Salvadorians to enjoy 'the sun, sea, and nature' for about 10 colones a day.

(2) Private capital to furnish simple lodging facilities (hotels).

2.4.3 Santa Ana Region

This region will be developed into sight-seeing loop route.

(1) A loop connecting San Salvador, Lake Coatepeque, Cerro Verde, Santa Ana, etc., is being planned.

(2) On top of Cerro Verde a hotel with accommodations for 100 persons a day will be constructed.

3. Air Traffic Today

3. Air Traffic Today

3.1 General

Means of transportation connecting all the various Central American countries one another today are air and road, with railways serving between not all of these countries.

Table 3. 1. 1 shows the road distances connecting the Central American countries. The Pan American Highway is about the only trunk road, but this is neither completed nor is in satisfactory condition in places.

Located near the geographical center of all the Central American countries, El Salvador naturally has a good potentiality of becoming a hub of air traffic in this region.

Table 3-1-1 Inter-State Road Distances in Central America (km)

	Guatemala	Managua	Mexico	Panama	San Jose	San Salvador	Tegucigalpa
Guatemala		849	1648	2125	1304	259	618
Managua			2497	1276	455	590	469
Mexico				3773	2952	1907	2266
Panama					821	1866	1745
San Jose						1045	924
San Salvador							359
Tegucigalpa							

3.2 Air Traffic in El Salvador

Table 3-2-1 through Table 3-2-3 give the record of traffic at Ilopango Airport for the past several years.

Table 3-2-1 Annual Aircraft Movements at Ilopango Airport

	Total	General Aviation & Military	Commercial		
			Total	pax	Freighter
1964	21648	15099	6549	5894	655
65	27737	19918	7819	7037	782
66	24979	15659	9320	8388	932
67	24561	15940	8621	7759	862
68	25561	16281	9280	8352	928
69	26688	16576	10112	9101	1011
70	34505	24635	9870	8883	987
71	35588	25074	10509	9458	1051

Table 3-2-2 Annual Passenger Movements

	Arrival (A)	Departure (B)	Total(C)	Transit(D)	Ratio of Transit Passengers		Total (C+D)	A+D	B+D
					D/A+D	D/B+D			
1963	37,152	39,501	76,653	43,117	53.71	52.18	119,770	80,269	82,618
64	42,270	44,288	86,558	48,689	53.52	52.36	135,247	90,959	92,977
65	47,573	50,936	98,509	55,411	53.80	52.10	153,920	102,984	106,347
66	62,837	65,378	128,215	72,119	53.43	52.45	200,334	114,956	137,497
67	61,247	66,692	127,939	71,966	54.02	51.90	199,905	133,213	138,658
68	70,506	74,084	144,590	85,508	54.80	53.57	230,098	156,014	159,592
69	67,057	71,069	138,126	82,596	55.19	53.75	222,722	149,653	153,665
70	74,560	78,071	152,631	82,579	52.55	51.40	235,210	157,139	160,650
71	78,497	80,840	159,337	84,435	51.82	51.08	243,772	162,932	165,275

Table 3-2-3 Cargo Traffic

Unit: Kilogram

		1969			1970			1971		
		Export	Import	Total	Export	Import	Total	Export	Import	Total
North America	Washington	1,655	7,224	8,879	8,694	20,161	28,855	3,745	8,904	12,649
	New York	1,978	36,225	38,203	12,158	181,865	194,023	12,273	106,352	118,625
	Miami	705,541	1,646,146	2,169,687	725,709	1,598,913	2,324,622	659,746	1,730,997	2,390,743
	New Orleans	22,992	385,678	408,670	107,509	380,627	488,136	62,122	401,970	464,092
	Houston	44,870	107,630	152,500	13,274	87,047	100,321	6,335	99,089	105,425
	San Francisco	74,107	82,882	156,989	89,421	101,132	190,553	85,604	81,246	166,850
	Los Angeles	69,495	79,434	148,929	58,416	98,000	156,416	133,146	75,256	208,402
	Sub Total	920,638	2,163,219	3,083,857	1,015,181	2,467,745	3,482,926	962,971	2,503,814	3,466,785
Central America	Merida	979	1,329	2,308	53	153	206	76	1,615	1,691
	Mexico	43,273	365,072	408,345	75,515	316,678	392,1 3	49,899	400,063	449,962
	Belize	6,783	742	7,523	21,141	231	21,392	11,534	10,947	22,481
	Guatemala	14,059	115,924	189,983	60,624	94,954	155,578	57,190	193,953	251,143
	Tegucigalpa	23,202	6,495	29,697	-	-	-	-	-	-
	San Pedro Sula	24,434	18,706	43,140	-	-	-	-	-	-
	Managua	1,114,626	62,231	1,176,947	2,302,868	161,813	2,464,681	1,203,415	96,700	1,300,115
	San Jose	577,439	155,617	833,056	2,124,046	298,181	2,422,227	955,446	261,234	1,216,680
	Panama	71,287	656,523	727,810	129,045	639,471	788,516	188,639	607,592	796,231
	Sub Total	2,036,082	1,382,729	3,418,811	4,713,292	1,511,501	6,224,793	2,466,199	1,572,104	4,038,303
South America	Caracas	-	-	-	64	-	64	-	-	-
	Guayaquil	-	-	-	-	2,994	2,994	-	-	-
	Colombia	-	-	-	-	5,500	5,500	-	-	-
	Jamaica	-	-	-	-	-	-	4,408	326	4,734
	Puerto Rico	-	-	-	-	-	-	15,419	-	15,419
	San Andres	-	-	-	-	-	-	27,272	-	27,272
	Sub Total	-	-	-	64	8,494	8,558	47,099	326	47,425
	Total	2,956,720	3,545,948	6,502,668	5,728,537	3,987,740	9,716,277	3,476,269	4,076,244	7,552,513

4. Present Condition of the Existing Airport

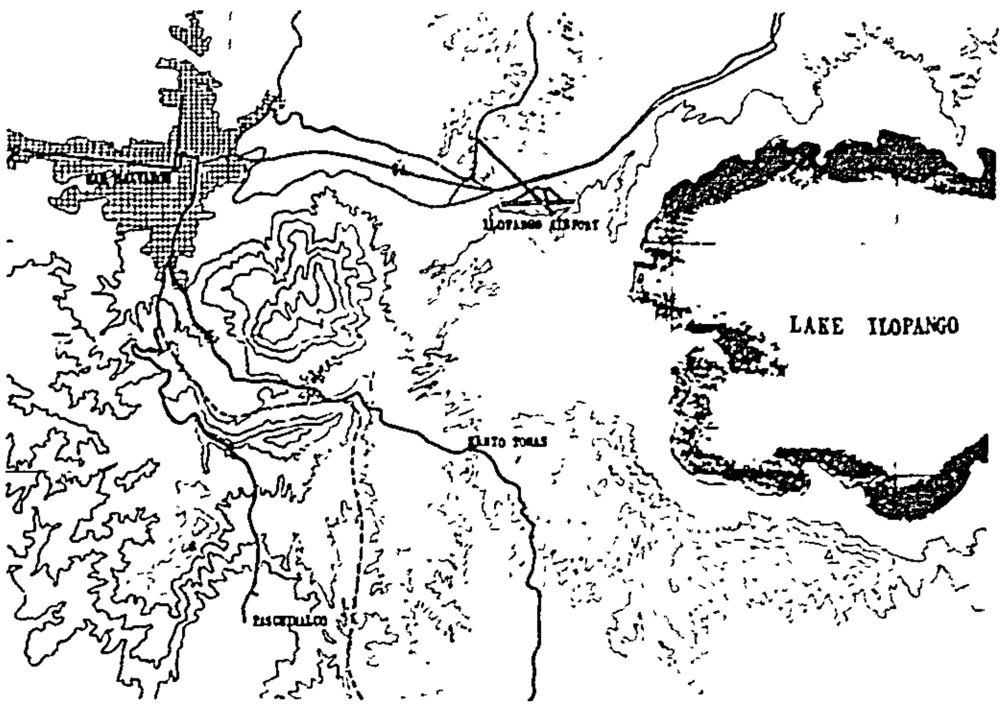
4. *Present Condition of* the Existing Airport

4.1 Location

The Ilopango Airport is located about 8.5 km east of central San Salvador, at a distance of a quarter of an hour drive by car, connected by a paved 4-lane road.

Location of the Aerodrome Reference Point is at Latitude 13°42' N and Longitude 89°07' W, with the elevation of 612m (MSL).

Fig. 4-1-1 Existing Airport Location



4.2 Runway, Taxiway, Apron, etc.

(1)	Runway:	2,240 m long and 45 m wide, paved with asphalt concrete 31.8 cm thick; subgrade CBR value of 25%; orientation in true bearing 152°-332°.
(2)	Landing Strip:	2,300 m long and 150 m wide.
(3)	Taxiway:	675 m long and 23 m wide, with the pavement of asphalt concrete.
(4)	Apron:	62,000 square meters paved with asphalt concrete.

4.3 Airport Lighting Facilities

The airport is equipped with the following lighting facilities: high intensity runway lights, runway-end lights, runway threshold lights, VASIS lights, taxiway lights, aerodrome beacon, and obstruction lights as well as hazard beacon placed on top of the mountation to the west of the airport.

(1) High intensity runway lights: one circuit of series distribution, for 74 lights of 6.6 A and 200 W, to be supplied by CCR of 30 KW, and adjustable in five degrees of intensity.

(2) Runway-end lights: On the same circuit as that of the runway lights, 12 lights of 6.6 A and 200 W.

(3) Runway threshold lights: flashing lights on both sides of the both ends of the runway.

(4) VASIS lights: regular VASIS lights are installed on both sides of the runway 15.

(5) Taxiway lights: 2 circuits of series distribution, 94 lights of 6.6 A, 30 W, intensity not adjustable during operation.

(6) Aerodrome beacon: a revolving aerodrome beacon is installed on the roof of the Control Tower.

(7) Obstruction lights: installed at such places as the radio antenna and the PAR station building.

(8) Hazard beacon: two units of code beacon of 300 W, 300 mm type of top of the mountation to the west of the airport.

(9) Power In-take and Distribution Facilities: The power is received at 3 ϕ, 3W, 4,160 V, its voltage is lowered to 2,400 V by a transformer of 3 ϕ, 150 KVA, and is then supplied to the CCR etc. In case of power failure, power generated by a stand-by generator of 3 ϕ, 440 V, 150 KVA is transformed into 2,400 V currency suitable for supply to the airport lighting facilities. Control of lighting facilities is provided at the Control Tower.

4.4 Navigation Aids

For radio communication and navigational aid services in Central America, the Central American Cooperation of Navigation Service (COCESNA) formed under agreement among the five Central American states plus British Honduras, is charged with the task of operation and maintenance of communications facilities as well as maintenance and management of air traffic control system and navigation aid facilities for the entire Central America.
This organization was formed to provide uniform and integrated navigational aid services in accordance with ICAO regional-air navigation plan to aircraft flying in this region, which is

made up of air space controlled by a number of different countries.

(1) Air Traffic Control Facilities

The Air Traffic Control Facilities comprise air-ground communications system necessary for the traffic control services (aerodrome traffic control and approach control) and the control console, special telephone connections with control units, weather station, and fire station, as well as supervision facilities for such Nav-Aid facilities as VOR, and other related equipment such as tape recorders.

Most of the facilities are housed in the Control Tower on the airport and in the mechanical room in the basement of the control tower, except for the air-ground radio facilities for approach control, which are installed at the Boqueron relay station situated at 1,800 meters above sea level on a volcano to the northwest of the airport, to enable the service to cover a wider area. Ilopango Airport presently is not equipped with radio circuit for communication with automobiles operating within the premises of the airport, and light-guns are substituting for this purpose.

Air traffic control facilities at Ilopango Airport are summarized as follows:

a. Air-Ground Communication Facilities

Table 4-4-1 Ilopango Airport Traffic Control Facilities

Purpose	Frequency	Equipments		Location
Tower (local)	118.3MHZ	transmitter receiver	MARC ITT Model CT-- 1 50W 2 units " CR - 7B 2 "	Tower
	3023.5KHZ	transmitter receiver	Communications Associates Inc. Model CT-11 " " CR-2	Tower "
Approach	119.5MHZ	transmitter receiver	Collins Model 242 F-2 200W 1 unit " " 51M8 1 "	Boqueron "
		transmitter receiver	MARC ITT Model CT-1 50W 2 " " " CR-7B 2 "	Tower "
Ground Control	121.9MHZ	transmitter receiver	MARC ITT Model CT-1 50W 1 " " " CR-7B 1 "	" "
Emergency	121.5MHZ	transmitter receiver	MARC ITT Model CT-1 50W 1 " " " CR-7B 1 "	" "

Other: One set of VHF Transceiver in ATC Console

In addition, a pair of emergency VHF tranceivers are located in the control console.

b. Air Traffic Control Console

It is made up of tables for local control, approach control, ground control, and flight progress, with the following instruments:

Local Control: speaker, volume control, clock panel, weather instrument panel, transmitter/receiver control panel, amplifier rack x 2, equipment rack

Approach Control: aeronautical chart frame, telephone set, intercom unit, speaker, volume control, clock panel, power supply, amplifier rack, equipment rack

Flight Progress: flight progress board x 2

Ground Control: speaker, volume control, clock panel, transmitter/receiver control panel, VOR remote control panel, recorder and NDB monitor panel, amplifier rack x 2, equipment rack

c. Others

Tape recorder Model 5CA

Tape recorder Model 5CB

Time signal generator Model DCTA

(2) Communication Facilities

Ilopango Airport has the following communication facilities at present.

a. Aeronautical Fixed Telecommunications Facilities

Ilopango Airport utilizes a branch circuit of the VHF/UHF FM multi-channel circuit provided throughout the Central American region by COCESNA through the Boqueron Relay Station.

The Boqueron Relay Station is equipped with a stand-by generator for power failure.

b. Teletype Facilities

The teletype and related instruments for aeronautical fixed telecommunications, aeronautical weather information and drop circuits to various airlines are housed in the COCESNA communications room on the third floor of the terminal building, and are used for AFTN circuit service, ATS circuit service, and circuit services to and from different airlines. The teletype is of older models (50 baud), such as the M-15 printers made by the Teletype Corporation.

c. Aeronautical Mobile Service Facilities

In order to insure safe and smooth operation of all aircraft flying in the FIR of Central America, necessary facilities for such aeronautical mobile service as position report and weather report are provided in the flight information office of each country in this region. Ilopango Airport in particular is equipped with a 126.9 MHZ tranceiver for use by Salvador Radio.

The following table shows the outline of the facility:

Table 4-4-2 Transceiver

Purpose	Frequency	Transceiver	Location
FIS	126.9MHz	transmitter Collins Model 242F2 200W 1 unit	Tower
		receiver " " 51N8 1 "	"

(3) Radio Navigational Aid Facilities

The Radio Navigational Aid Facilities (VOR/DME, NDB) of Ilopango Airport are as shown in Table 4.4.3 below.

The NDB is placed in Apopa town, about 6.5 nm away from the airport, and is also used for the airway.

All the facilities are provided with stand-by generator and monitored at the Control Tower site.

Table 4-4-3 Air Navigation Aids

Facilities	Identi-fication	Freq.	Equipment	Location
VOR (Ilopango)	YSV	114.7MHz	WILCOX Model 485A 200W 1 set	Airport
DME		94X	AEROCOM Model 5350 20W 1 set	VOR and COLOCATE
NDB (Apopa)	YSX	215KHz	ITT Model CB-3 1000W 1 set	R/W 15 aprox. 6.5nm

4.5 Electrical Power Facilities

Electric power is supplied mainly by a governmental organization of CEL (Comision Ejectiva Hidroelectrica del Rio Lempa). The National rural electrification plan, embarked by CEL in 1965, has progressed smoothly, and it is expected that the entire Salvador Region will be supplied with electric power in the near future. Rural electrification promotes industrialization at the same time and the annual power generation registered a 2.9-fold increase during the period of 1961 (213 MKWH) to 1969 (624 MKWH). The power supply capacity has always been ample, with 89,200 KW in 1961 and 206,800 KW in 1971, and there are plans for construction of a 33,000 KW gas turbine generating station by 1975.

El Salvador has abundant water resources, such as Rio Lempa, and hydroelectricity accounts for 60% of the total power generated in the country, with the rest generated by thermal power such as diesel, steam or gasoline.
Power frequency is 60 Hz throughout the country, and the voltages in transmitting and distributing the power are 115 KV, 69 KV, 44 KV, 35 KV, 22 KV, 13.2 KV, 4.2 KV, etc.

Ilopango Airport receives power at 4,160 V and is provided with one stand-by generator of 150 KVA for lighting facilities and two generators of 106 KVA for other facilities such as the terminal building, etc.

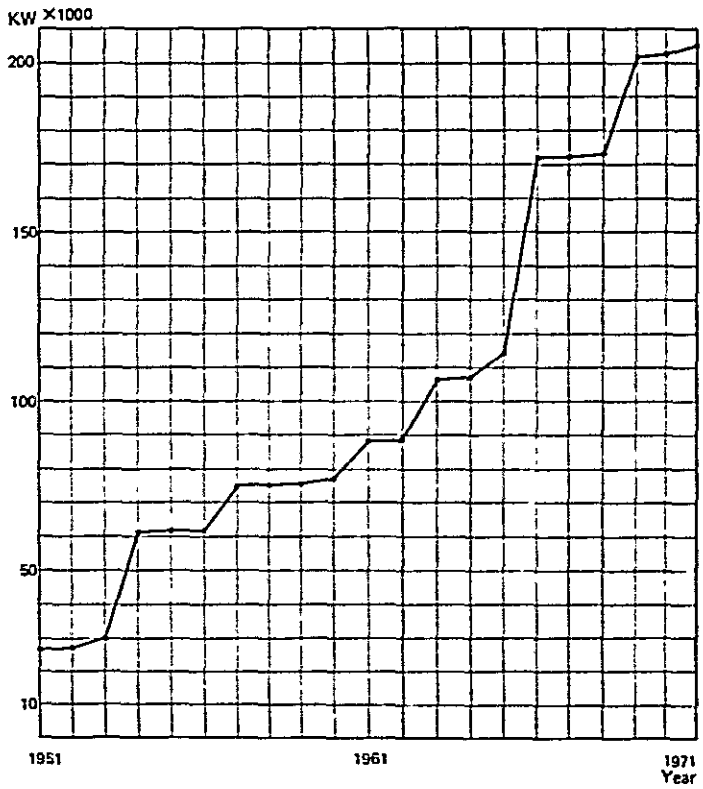


Fig. 4-5-1 Power Generating Plant Capacity of El Salvador

4.6 Buildings

(1)	Passenger terminal building:	built of reinforced concrete,	9,950 m^2
(2)	Cargo terminal building:	No. 1 and 2 Warehouses	3,274 m^2
		No. 3 and 4 Warehouses	2,047 m^2
		Through-cargo Warehouse	522 m^2
		Abundaned cargo Warehouse	207 m^2
		Total	6,050 m^2
(3)	Hangars for small craft, work shop, etc.		4,100 m^2
(4)	Fire station		200 m^2

(5) Other buildings: Weather Station, emergency power plant, and Armed Forces facilities

4.7 Fueling Facilities

Hydrant facilities are in service at seven loading berths at Ilopango Airport, of which four berths are equipped with both aviation gasoline and jet fuel distribution facilities with the rest equipped only with that of aviation gasoline. Two oil companies, TEXACO and ESSO own and operate these facilities.

5. Air Traffic Forecast

5. Air Traffic Forecast

5.1 Given Factors in Air Traffic Forecast

Various methods are conceivable for forecasting air traffic demand, among which the one by time series analysis is most popularly accepted. In forecasting international air traffic demand, it is desirable to take into account the trend of the world economy. Since, however, it is extremely difficult to predict the structural change of future status of the world economy, we will have to depend heavily and boldly on certain assumptions. The present forecast is, therefore, made by time series analysis based on an assumed development status of the world's economy. The assumed factors in this air traffic demand forecast are as follows:

(1) The current social and economic trend of the world will be maintained;

(2) The Salvadorian economy will move in a favorable direction as envisaged in the CONAPLAN's New 5-Year Plan toward 1980;

(3) The current tourism development plan of El Salvador government will be completely implemented by 1980;

5.2 Results of Air Traffic Forecast

The resulting forecast figures are given in Table 5-2-1 and Table 5-2-2.

Table 5-2-1 Projection of Arriving and Departing Passengers for the Proposed Airport

Origin/Destination	1980	1990	1980/1971	1990/1980
North America	180,682	477,568	3.771	2.643
Miami *1	92,460	232,090	3.512	2.510
New Orleans *2	23,110	58,052	3.615	2.512
Los Angeles *3	65,112	187,426	4.284	2.879
Central America	350,458	917,686	3.317	2.619
Mexico	50,458	101,546	3.034	2.012
Guatemala	115,080	308,556	3.014	2.681
Managua *4	184,920	507,584	3.637	2.745
Others *5	10,600	25,568	3.098	2.412
Total	541,740	1,420,822	3.400	2.623

Note: *1. includes Washington, D.C., New York and Belize.

*2. includes Merida.

*3. includes San Francisco and Houston.

*4. includes San Jose and Panama.

*5. includes Haiti, Jamaica and San Andres.

Table 5-2-2 Projection of Cargo for the Proposed Airport

	Origin/Destination	1971	1980	1990	1980/1971	1990/1980
Incoming Cargo		ton	ton	ton		
	North America	2,517	4,595	6,885	1.826	1.498
	Miami *1	1,857	3,796	5,950	2.044	1.567
	New Orleans *2	404	484	573	1.198	1.184
	Los Angeles *3	256	315	362	1.230	1.149
	Central America	1,560	2,488	3,539	1.595	1.422
	Mexico	400	441	506	1.703	1.147
	Guatemala	194	248	368	1.278	1.484
	Managua *4	966	1,799	2,665	1.862	1.481
	Others *5	-	-	-	-	-
	Total	4,077	7,083	10,424	1.737	1.472
Outgoing Cargo		ton	ton	ton		
	North America	974	1,222	1,489	1.255	1.226
	Miami *1	687	878	1,069	1.278	1.218
	New Orleans *2	62	89	108	1.435	1.213
	Los Angeles *3	225	255	312	1.133	1.224
	Central America	2,455	5,075	7,994	2.067	1.575
	Mexico	50	51	60	1.020	1.176
	Guatemala	57	108	171	1.895	1.583
	Managua *4	2,348	4,916	7,763	2.094	1.579
	Others *5	47	50	53	1.064	1.060
	Total	3,476	6,347	9,536	1.826	1.502

Note: *1. includes Washigton, D.C., New York and Belize.

*2. includes Merida.

*3. includes San Francisco and Houston.

*4. includes San Jose and Panama.

*5. includes Haiti, Jamaica and San Andres.

6. Bases for Facility Planning

6. Bases for Facility Planning

6.1 Aircraft Mix and Passenger Projection by Route

Although it is extremely difficult to forecast the types of aircraft to be in use in 1980 and 1990, we have made the following projection by route after taking note of the air traffic passenger forecast and the world trend for use of bigger aircraft.

Table 6-1-1 Aircraft Mix and Passenger Projection by Route

Route	1980		1990	
	Annual Number of Passengers	Type of Aircraft	Annual Number of Passengers	Type of Aircraft
New York Washington Miami	92,460	B-707(145 Seats)Class	232,090	B-747(360 Seats)Class
San Francisco Los Angeles	65,112	Same as above	187,426	Same as above
New Orleans Houston	23,110	BAC-111 Class	58,052	B-707(145 Seats)Class
Central America & Others	361,058	Same as above	943,254	B-707(145 Seats)Class and STOL(120 Seats)
Total	541,740		1,420,822	

6.2 Number of Landings and Take-Offs Per Year

International airports in El Salvador will have about the same number of transit passengers as those terminating in this country or those flying out of the country as the past record shows. If we assume on a load factor of 50% and a 1:1 ratio for transit passengers and in bound (or out-bound) passengers, the number of passengers for each aircraft of various types will be as follows:

Table 6-2-1 Number of Passengers per Aircraft by type

Class	Seats	Load Factor	Passenger per Aircraft
BAC-111 Class	100	50%	50
B-707 Class	145	50%	72
B-747 Class	360	50%	180
STOL(SQH) Class	120	50%	60

The number of landings and take-offs per year can be obtained through the following formula, with the results shown in Table 6-2-2

$$N_i = \frac{P_i}{\rho_i}$$

$$N = \Sigma N_i$$

N_i : Annual Operations by i class Aircraft

P_i : Annual Number of Passengers carried by i class Aircraft

ρ_i : Number of Departing (Arriving) Passengers per i class Aircraft

N : Total Annual Aircraft Operations

Table 6-2-2 Annual Landing and Take-Off Aircraft Operations by Type

Route	1980		1990	
	Type of Aircraft	Annual Aircraft Operations	Type of Aircraft	Annual Aircraft Operations
New York, Washington, Miami, San Francisco, Los Angeles	B-707 Class	4,377 times	B-747 Class	4,662 times
New Orleans, Houston, Central America & Others	BAC-111 Class	15,368 times	B-707 Class & STOL (SQH)	33,377 times
Total		19,745 times		38,039 times

6.3 Calculation of Peak Hour Passengers

The number of passengers in a peak month at Ilopango International Airport is estimated at 1.2 times the average figure for ordinary months, based on monthly survey materials from 1969 to 1971. The rate of concentration during the peak-hour is estimated at 1/4 from Table 6-3-2. Assuming on the validity of these figures being applied for 1980 and 1990, the number of air passengers during peak-hour can be obtained from the following formula:

$$P_2 = \frac{P_1}{365} \times A \times B$$

P_2 : Number of Passengers during Peak-hour

P_1 : Annual Number of Passengers

A : Peak Season Coefficient

B : Peak-hour Concentration Rate

Table 6-3-1 Number of Passengers during Peak-Hour

Unit: Person

Route	1980	1990
New York, Washington, Miami, San Francisco & Los Angeles	130	345
New Orleans, Houston, Central America & Others	316	823
Total	446	1,168

Table 6-3-2 Past Performance of Peak-Hour Concentration Rate

Day		7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00 Total
Sun.	Arrival		4	1	2		(2) 1		(3) 2		3	1	1		(17) 15
	Departure			4	4			1	(2) 1	(2) 1	2		2		(17) 15
	Total		4	5	6		(2) 1	1	(5) 3	(2) 1	5	1	3		(34) 30
Mon.	Arrival		2	(3) 2	2				1			3			(11) 10
	Departure			2	5	(1)				1		2	1		(12) 11
	Total		2	(5) 4	7	(1)			1	1		5	1		(23) 21
Tue.	Arrival		(3) 2	3	2	(1)			1	1	1	1	3		(14) 12
	Departure			2	5	1		(1)	(1)	1	2		2		(15) 13
	Total		(3) 2	5	7	(2) 1		(1)	(2) 1	2	3	1	3		(29) 25
Wed.	Arrival	1	2	2	(3) 2		(1)				1	3			(13) 11
	Departure		1	2	4		(1)				1	1	1		(11) 10
	Total	1	3	4	(7) 6		(2)				2	4	1		(24) 21
Thu.	Arrival	1	2	2	(3) 2		1		1	1	1	1	1		(14) 13
	Departure	(1)	1	2	4	1	(1)	1		1	2		2		(16) 14
	Total	(2) 1	3	4	(7) 6	1	(2) 1	1	1	2	3	1	3		(30) 27
Fri.	Arrival		3	2	(2) 1			(1)	1		1	4			(14) 12
	Departure			3	3				(2)	1		2	1		(12) 10
	Total		3	5	(5) 4			(1)	(3) 1	1	1	6	1		(26) 22
Sat.	Arrival		2	2	(3) 2	(1)				5		1	1		(15) 13
	Departure			5	2	1		(1)		(3) 2	2		1	1	(16) 14
	Total		2	7	(5) 4	(2) 1		(1)		(8) 7	2	1	2	1	(31) 27

Peak hour Concentration Rates of Passenger Aircraft

- Sunday - 6 flight/30 flight = 1/5.0
- Monday - 7 flight/21 flight = 1/3.0
- Tuesday . 7 flight/25 flight = 1/3.57
- Wednesday 6 flight/21 flight = 1/3.50
- Thursday . 6 flight/27 flight = 1/4.50
- Friday - 6 flight/22 flight = 1/3.66
- Saturday 7 flight/27 flight = 1/3.85

6.4 Landings and Take-Offs by Aircraft Type during Peak-Hour

The number of landings and take-offs expected during peak-hour can be projected from the following formula, with the results as shown in Table 6-4-1:

$$N_{ip} = \frac{N_i}{365} \times A \times B$$

N_{ip} : Number of Operations by i -class Aircraft

N_i : Annual Number of Operations by i -class Aircraft

A : Peak Season Coefficient

B : Peak-hour Concentration Rate

Table 6-4-1 Number of Operation During Peak-Hour

	Aircraft Type	Number of Operations	Total
1980	B-707 Class	4	17
	BAC-111 Class	13	
1990	B-747 Class	4	32
	B-707 Class	28	

6.5 Number of Berths Required

6.5.1 Berths for Passenger Aircraft Parking

Assuming the necessary parking time for B-747's to be 60 minutes and that for B-707's to be 40 minutes, the following formula will give the number of berths necessary for passenger aircraft:

$$S_i = \frac{N_{ip}}{2} \times \frac{T_i}{60}$$

S_i : Number of Berths Required for i -class Aircraft

N_{ip} : Number of Aircraft Operations by i -class Aircraft during peak-hour

T_i : Aircraft Parking Time of i -class Aircraft

(B-747: 60 min., Others: 40 min.)

Table 6-5-1 Number of Berths for Passenger Aircraft

1980				1990			
Aircraft Type	Number of berths required	Spare berth	Berths planned	Aircraft Type	Number of berths required	Spare berth	Berths planned
B-707 Class	2	0	2 for B-747 Class	B-747 Class	2	0	2 for B-747 Class
BAC-111 Class	5	1	6 for B-707 Class	B-707 Class	10	1	11 for B-707 Class
Total	7	1	8		12	1	13

6.5.2 Berths for Cargo Aircraft Parking

Estimates for the number of berths required for cargo aircraft are extremely difficult to make at this stage, but in view of the fact that TACA and PAA are the only airlines expected to operate cargo aircraft at the proposed airport, TACA possessing only 3 cargo aircraft, and also that only two cargo planes are parked simultaneously during the peak-hour according to the flight schedule of November 1972, the plan calls for two berths for the initial stage of construction to be completed by 1978, to satisfy the demand of up to 1980, with 3 more berths to be added to satisfy demand of up to 1990.

Note: Runway Length

Runway length is one of the most important factors of airport facility planning. The proposed International Airport will require a runway of 3,000 meters long to accommodate the larger aircraft expected to be in service in the projected period.

7. Site Selection

7. Site Selection

7.1 General

7.1.1 Area Surveyed

The area covered by the field survey for the site selection study of the proposed airport is in the Pacific coastal region about 30 to 40 km to the south of San Salvador (Fig. 7-1-1). It is a triangular area of about 200 km^2 bordered by the sea on the south, Rio Jiboa river on the east, and the road connecting La Libertad to Zacatecoluca.

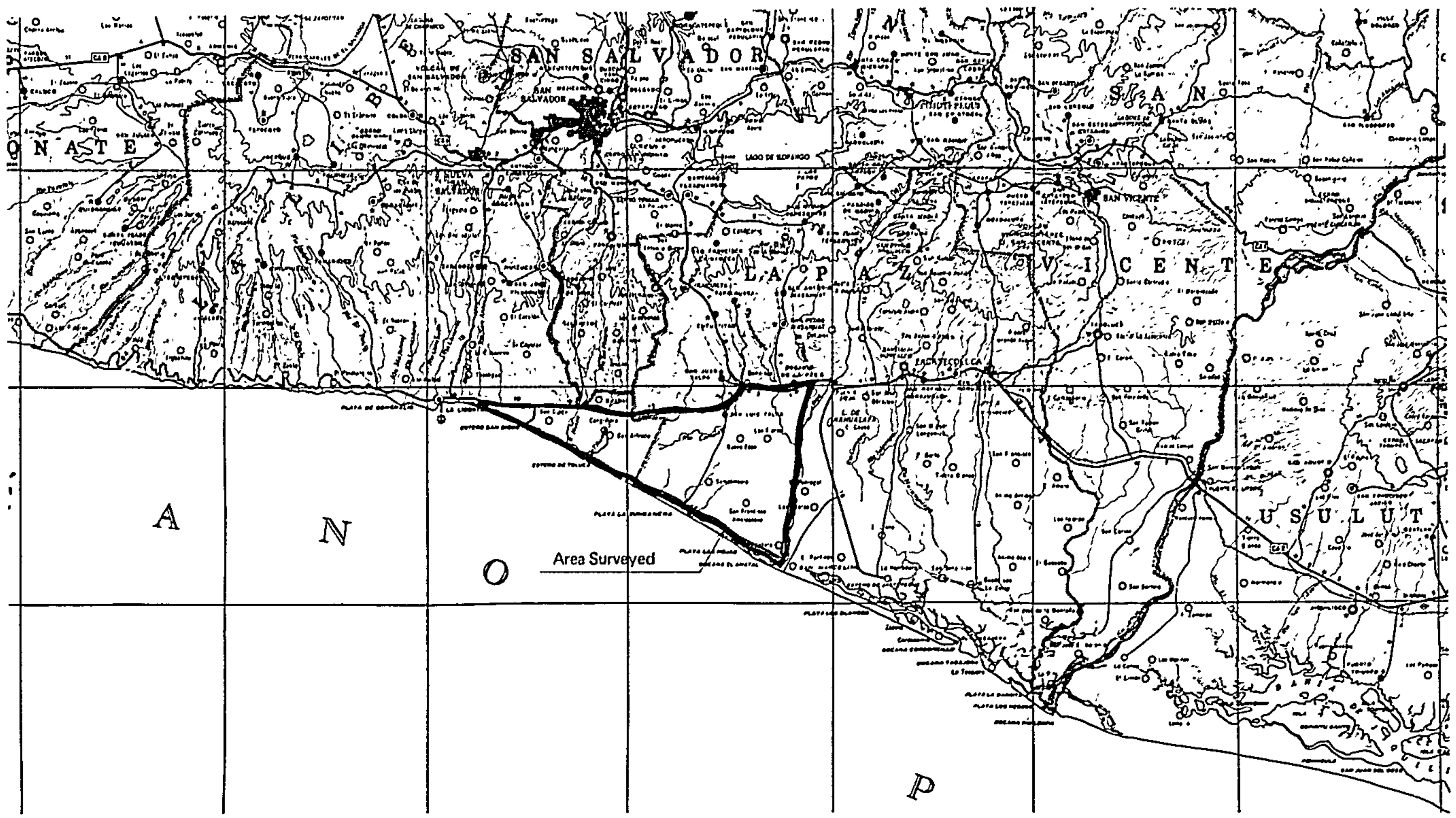


Fig. 7-1-1 Site Selection Study Survey Area

7.1.2 Meteorological Conditions

(1) The meteorological data obtained from sources around the surveyed area include:

a. Las Flores (Astoria) -- wind direction and velocity (June '70 - June '72)

b. Rosario de La Paz--rainfall ('67 - June/'72)

c. La Herradura -- rainfall ('67 - June/'72)

d. Santa Cruz Porrillo--temperatue; number of clear and rainy days; humidity; rainfall

(2) Below is a summary of the meteorological conditions for the surveyed area.

a. Temperature: The temperature over the period where data was available reached a low of 17.6°C in January of 1972, a high of 37.2°C in January of 1968, and showed a monthly average between 1967 and 1972 ranging from 25.1°C (February, 1968) to 28.8°C (April, 1970). The months from January through April show striking temperature variation while in other months the temperature is fairly constant.

b. Clear days: There are not many clear days. The average annual number of days with a cloud amount of 2/10 or less is from 6 to 16, and most of these days come in the dry season from November through March.

c. Rainy days: The average annual number of rainy days is between 100 - 130, about 1/3 of the year. From May through October rain falls on more than half of the days of each month.

d. Humidity: The average annual humidity falls between 70% - 75% and the most humid months, with humidity around 80%, come in the rainy season from June through October.

e. Rainfall: The annual rainfall is 1,163 mm - 2,110 mm. The greatest rainfall recorded in a single month was 750 mm at La Herradura in September of 1971. The months from May through October all register more than 100 mm rainfall and in many months the amount comes to around 300 mm.

f. Wind Direction and Velocity

Wind rose calculated on the basis of observation data of the 24 month period from June 1970 through May 1972 is shown in Figure 7-1-2 below. Judging from this wind rose, winds of 20 knots and above are most frequent in the direction of the north, while those of less than 20 knots are predominant in both northern and southern directions.

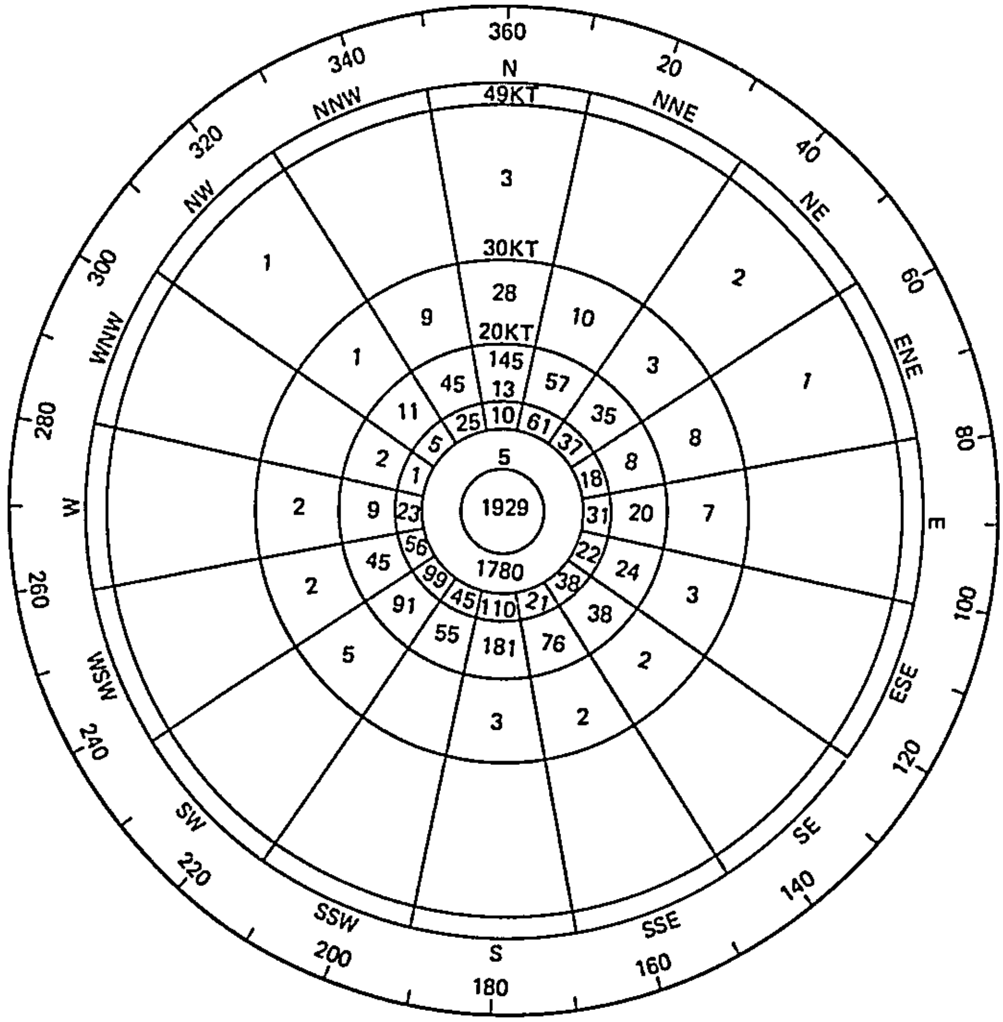


Fig. 7-1-2 Wind Rose Based on Meteorological Data of June 1970 - June 1972

7.1.3 Topographical and Geological Conditions

The area surveyed is the so-called La Paz coastal plain extending between the rivers Rio Huiza and Rio Jiboa. Topographically, the plain presents a number of alluvial fans formed from the detrital deposits of such waterways as the Rio Jiboa and the Rio Comalapa. The overall terrain slopes down toward the south, and the Pacific coastline is composed of sand dunes backed by marshes in the hinterland. As no particular watercontrol work has been undertaken on the rivers in the area, flooding appears to occur after heavy rains, a hypothesis that can be inferred from a comparison of topographic maps from different years as well as from aerial photographs. Additional support for this hypothesis was uncovered along a belt of the northeastern sector of the surveyed area where overturned rocks of 20 cm - 50 cm in diameter lay exposed on the earth's surface, attesting to recent flooding.

The characteristic soil within the area is, near the surface, a thick layer of such alluvial deposits as gravel, sand, and clay, which are spread by flooding and become finer in grain, generally speaking, the lower the terrain.

The source of the detritus deposited by the rivers is the relatively new andesite, tuffacious breccia, tuff, terrace gravel, volcanic ash, etc. which are found throughout the hills and mountains to the north (Fig. 7-4-1). Although the ground surface layer (within 3 m of the surface) presents variations caused by flooding, in general terms sandy soil characterizes the region around the Rio Jiboa and the Rio Comalapa, *and this turns to clayey soil as one* approaches the coast and to soft earth in the hinterland of the sand dunes.

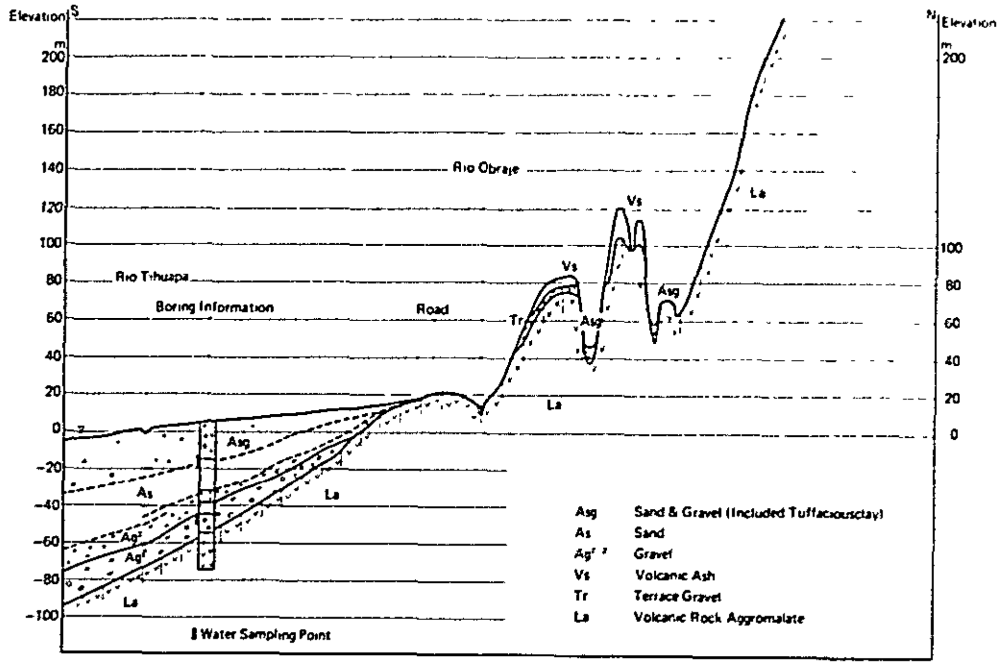


Fig. 7-1-3 Geological Cross-Section of Surveyed Area

7.1.4 Land Utilization

The area covered in the site selection study generally consitutes cotton fields, dotted by pastures and hamlets of indigenous agricultural population. Virgin forest is reserved in some parts of the swamp area along the coast.

7.1.5 Transportation

Transportation linking San Salvador, the capital, and the area under study solely depends on roads, namely one on the west side via La Liberted and another on the east side via Comalapa. The road distance in both cases is about 30 to 40 km, requiring approximately one hour by automobile.

7.2.1 Proposed Sites

Based on the preliminary studies made in Japan and on the results of the on-the-spot field survey, 6 possible sites in 5 districts, as shown in Table 7-2-1 and Figure 7-2-1, have been selected and evaluated.

Table 7-2-1 Proposed Sites

Proposed Sites	Runway Direction	Main/Sub	Identification Code
ASTORIA	N 70° E	Main	A
	N 0° E	Sub	A'
EL PORVENIR (I)	N 45° E	Main	B
" (II)	N 56° E	Main	B'
SAN JUAN	N 76° E	Main	D
	N 0° E	Sub	C
CARRIZAL	N 76° E	Main	D'
	N 0° E	Sub	C'
CANGREJERA	N 760° E	Main	E
	N 0° E	Sub	E'

7.2.2 Evaluation in Terms of Air Navigational Requirements

(1) Comparison by Wind Coverage

Comparison of the wind coverages of the main runway at each proposed site, with the cross wind component of 10 knots, 13 knots, and 20 knots respectively, are shown in Table 7-2-2 below. For some of the proposed sites a second runway is considered necessary for use by smaller aircraft vulnerable to cross wind, and such a sub-runway has been envisaged in a uniform orientation of N0°E in accordance with the wind rose calculated. The wind coverages of this sub-runway have been added at the bottom of the following table for easy comparison.

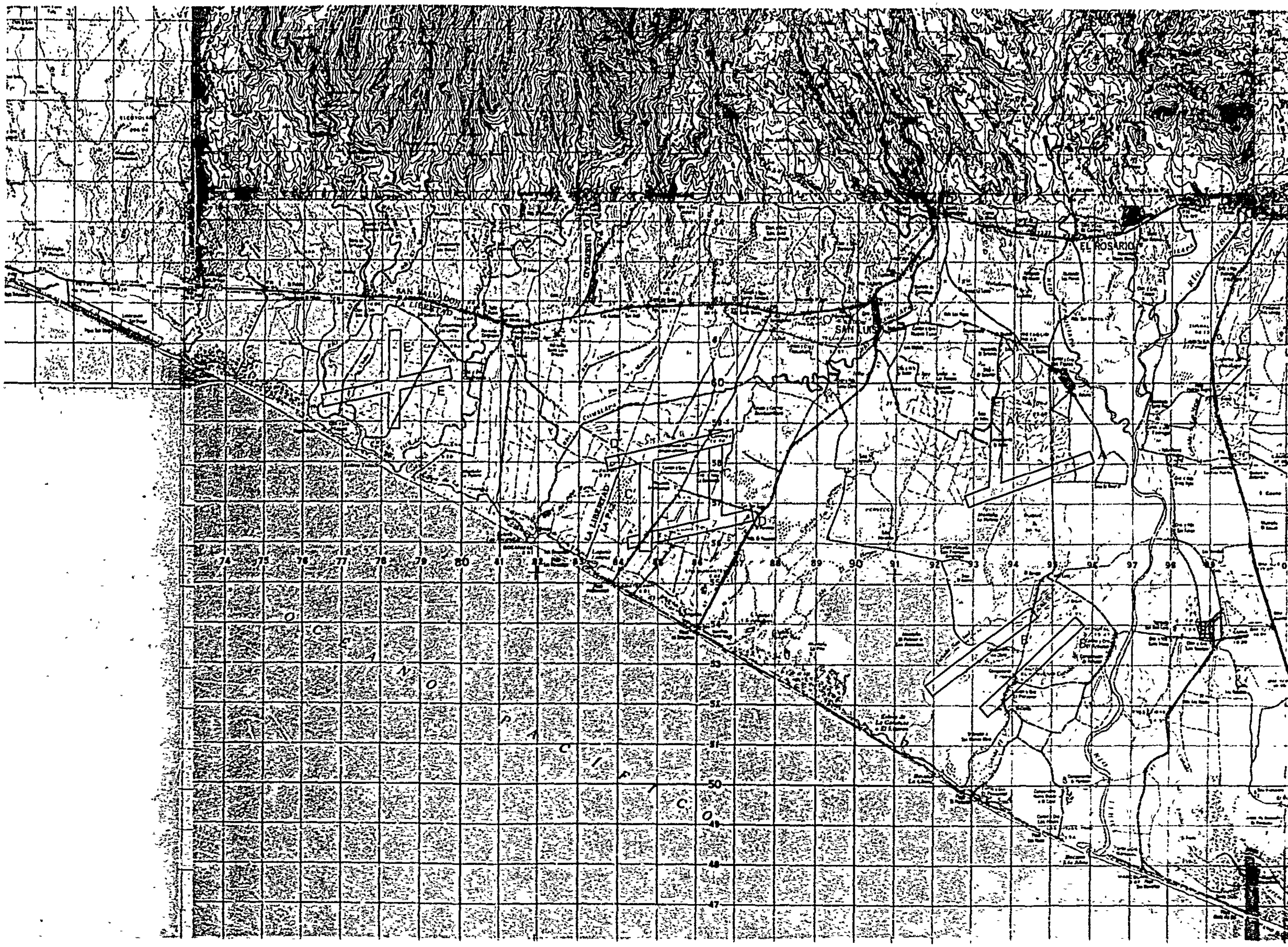


Fig. 7-2-1 Proposed Sites

Table 7-2-2 Wind Coverage

	Cross Wind Component (Knots)	Jan.	Feb	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
ASTORIA (N 70° E)	10	79.88	68.91	71.10	79.08	79.74	92.73	87.29	89.75	89.94	92.68	82.46	75.77	82.62
	13	89.79	78.89	79.46	85.45	80.88	96.76	93.31	94.85	95.24	96.91	90.62	85.62	89.66
	20	99.66	95.53	98.81	99.40	99.78	99.91	99.61	99.34	99.97	99.79	99.24	98.67	99.00
EL PORVENIR (N 45° E) 1	10	89.68	79.35	81.53	84.66	84.05	93.34	88.87	91.13	91.02	93.59	88.76	84.36	87.45
	13	95.63	88.44	92.29	90.84	91.64	99.69	95.17	95.31	95.23	96.78	94.56	92.06	94.01
	20	99.83	98.13	99.71	98.74	99.42	99.66	99.57	99.21	99.76	99.84	99.64	99.32	99.19
EL PORVENIR (N 56° E) 2	10	85.53	73.54	74.93	81.87	81.00	93.34	88.09	90.87	90.88	93.08	86.21	78.80	86.33
	13	92.61	83.01	84.81	87.98	89.48	96.89	94.42	95.33	95.13	96.65	92.46	.56	91.52
	20	99.79	97.28	99.48	98.13	99.34	99.84	99.58	99.59	99.86	99.87	99.42	.76	99.32
SAN JUAN (N 76° E)	10	78.40	67.24	69.86	78.15	86.35	92.30	88.39	89.55	90.12	92.52	80.96	71.15	81.52
	13	88.37	76.13	76.96	84.06	87.65	96.62	92.84	94.81	95.24	97.18	89.69	84.26	88.77
	20	99.67	95.62	98.84	97.40	99.81	99.52	99.64	99.26	99.98	99.79	99.14	98.70	99.01
CARRIZAL (N 76° E)	10	78.40	67.24	69.86	78.15	86.35	92.30	88.39	89.55	90.12	92.52	80.96	71.15	81.52
	13	88.37	76.13	76.96	84.06	87.65	96.62	92.84	94.81	95.24	97.18	89.69	84.26	88.77
	20	99.67	95.62	98.84	97.40	99.81	99.52	99.64	99.26	99.98	99.79	99.14	98.70	99.01
CANGREJERA (N 76° E)	10	78.40	67.24	69.86	78.15	86.35	92.30	88.39	89.55	90.12	92.52	80.96	71.15	81.52
	13	88.37	76.13	76.96	84.06	87.65	96.62	92.84	94.81	95.24	97.18	89.69	84.26	88.77
	20	99.67	95.62	98.84	97.40	99.81	99.52	99.64	99.26	99.98	99.79	99.16	98.70	99.01
(Note) SUB RUNWAY (N 0° E)	10	94.32	93.79	92.45	90.30	88.66	88.83	90.81	91.83	91.46	92.07	94.42	95.06	91.93
	13	98.30	98.21	97.66	95.24	94.45	94.28	95.35	95.71	95.86	96.81	98.00	97.34	96.55
	20	99.83	100	99.76	99.42	99.04	98.60	99.28	99.21	99.17	99.55	100	99.78	99.54

As shown in the above table, the sub-runway oriented north-south has the highest wind coverage of all, with the coverage diminishing as the orientation draws closer to the east-west direction. In other words, the main runway of the El Porvenir Site, - 1, code-named B,compares most favorably in terms of wind coverage, the second best being the El Porvenir Site - 2, coded B', with Astoria occupying the third place in advantage to the remaining 3 sites, i.e., San Juan, Carrizal, and Cangrejera, all having the identical wind coverages.

(2) Comparison in Terms of Operational Procedures

a. Main Runway

Practicability of ILS Approach, VOR Straight in Approach, and Take-off Climb was studied of the main runways of all proposed sites, with the results as shown in Table 7-2-3 below.

Table 7-2-3 Operational Practicability of Main Runways

Proposed Sites	Runway	I L S	V O R	Take-Off
ASTORIA	07	O	O	O
	25	O	O	O
EL PORVENIR 1	05	O△	O	O
	23	O	×	O
EL PORVENIR 2	06	O△	O	O
	24	O	×	O
SAN JUAN	08	O	O	O
	26	O	O	O
CARRIZAL	08	O	O	O
	26	O	O	O
CANGREJERA	08	O△	O	O
	26	O	×	O

Legend
O Practicable
O△ Practicable if provided with ILS/DME
× Not Practicable

Note Installation of ILS/DME is necessitated to avoid the difficulty of building an outer-marker which can only be placed on the sea in these cases.

The above comparison indicates that 3 sites of Astoria, San Juan and Carrizal with the identical results are in general advantage to the rest of the proposed sites, namely, the two sites of El Porvenir, and that of Cangrejera, again with identically inferior results.
Notwithstanding the fact that in terms of the wind coverage, El Porvenir and Cangrejera compare favorably, these sites are dropped at this stage from further considerations in the site selection study.
This is done on the strength of greater potential in air space enjoyed by the remaining 3 sites of Astoria, San Juan, and Carrizal, considering that a cross wind component of 20 knots is applicable in the case of large jets used in scheduled flights.

b. Sub-Runway

Operational practicability of the sub-runway for Astoria, San Juan, and Carrizal was studied with the following results as shown in Table 7-2-4.

Table 7-2-4 Operational Practicability of Sub-Runway

Proposed Sites	Runway	I L S	V O R	Take-off
ASTORIA	18	×	×	○
	36	△ Note 1	○	△ Note 3
SAN JUAN	18	×	×	○
	36	△△ Note 2	○	△ Note 3
CARRIZAL	18	×	×	○
	36	△△ Note 2	○	△ Note 3

Legend ○ Practicable

△ Practicable with limitations

△△ Practicable with limitations if provided with ILS/DME

× Not Practicable

Note 1. Because of the obstacle existing within the missed approach area, higher landing minimum than that designated under CAT-I is required.

Note 2. In addition to the limitations stipulated under Note 1 above, installation of ILS/DME is required to avoid the difficulty of building an outer-marker which can only be placed on the sea in these cases.

Note 3. To avoid the obstacle existing within the take-off climb area, limited climb procedures are applicable.

As the above table indicates, Astoria stands in slight advantage to the other two sites in view of the fact that it allows installation of an outer-marker on land.

(3) Results of Aerial Survey

With the cooperation of Direction General de Aeronautica Civil of El Salvador, several aerial surveys of the proposed sites were carried, and the flight paths of the first and the third flights are shown in Figures 7-2-2 and 7-2-3 respectively.

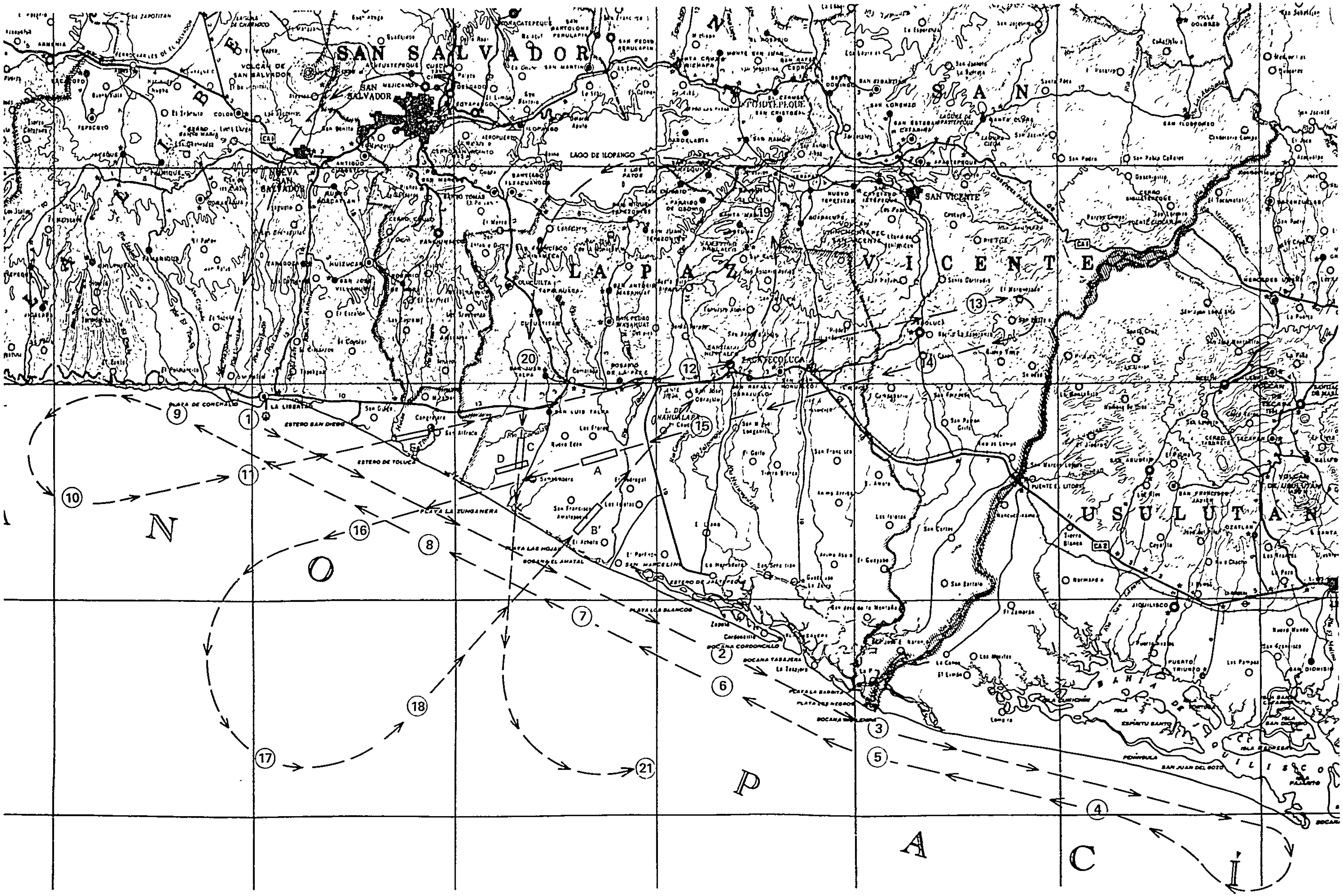


Fig. 7-2-2 First Aerial Survey

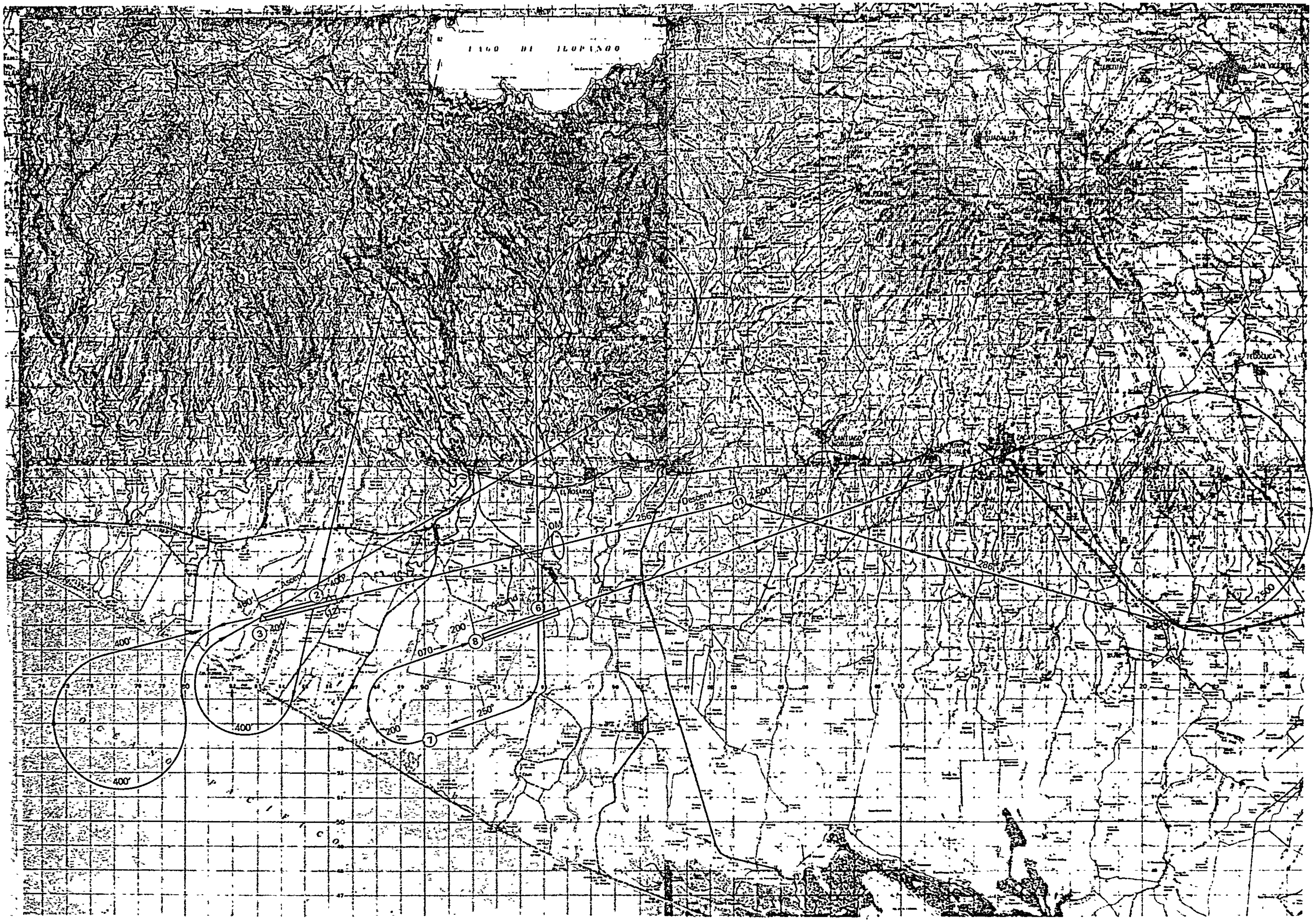


Fig. 7-2-3 Third Aerial Survey

No obstacles prohibiting siting of an airport were observed within the area surveyed, and consequently there are no particular remarks to be added that might contradict the on-the-desk evaluation of the sites made prior to the aerial survey.

7.2.3 Evaluation in Terms of Construct ion Requirements

(1) Geological and Geotechnical Considerations

Based on the findings of the geological survey conducted at the various points in Astoria, Carrizal and San Juan as shown in Figures 7-2-4 and 7-2-5, as well as on the results of the soil sample tests carried at Centro de Investigaciones Geotechicas (CIG), it is judged that the ground of all 3 sites have a CBR value of around 15%, thus offering no particular problems as far as sub-grade strength is concerned.

(2) Amount of Earth Work

All three sites generally are almost level, and no significant difference in the amount of required earth work is foreseen. San Juan and Carrizal sites, however, are dotted in parts with swamps along the coastal line, where some sort of correctional measures are expected necessary.

(3) Drainage

Underground water level of the 3 sites are similarly high, lying at around 0.5 m to 2.0 m from the surface, this feature getting worse in areas closer to the shoreline. Furthermore, the even topography of the area in general makes it difficult to obtain suitable heads for drainage. In these respects Astoria compares most favorably having the highest evaluation of all 3 sites.

(4) Other Considerations

In respect of such other requirements as clearing of trees, shrubs, or structures, etc., as well as in consideration of accessibility, all three sites have similar conditions and present no significant difference.

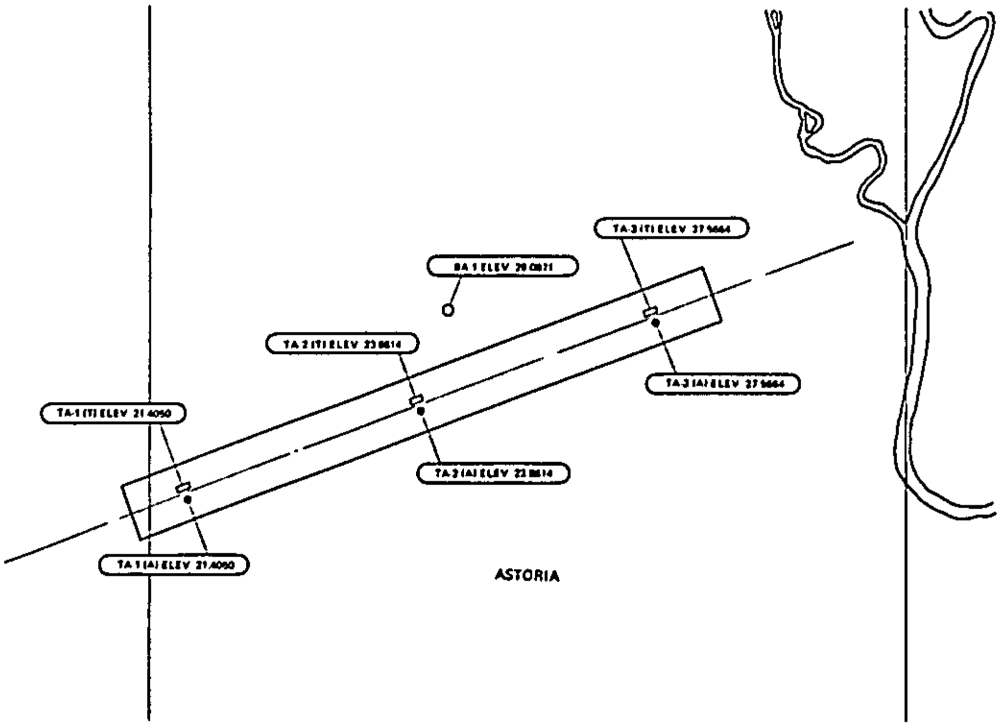


Fig. 7-2-4 Geological Test Locations (Astoria)

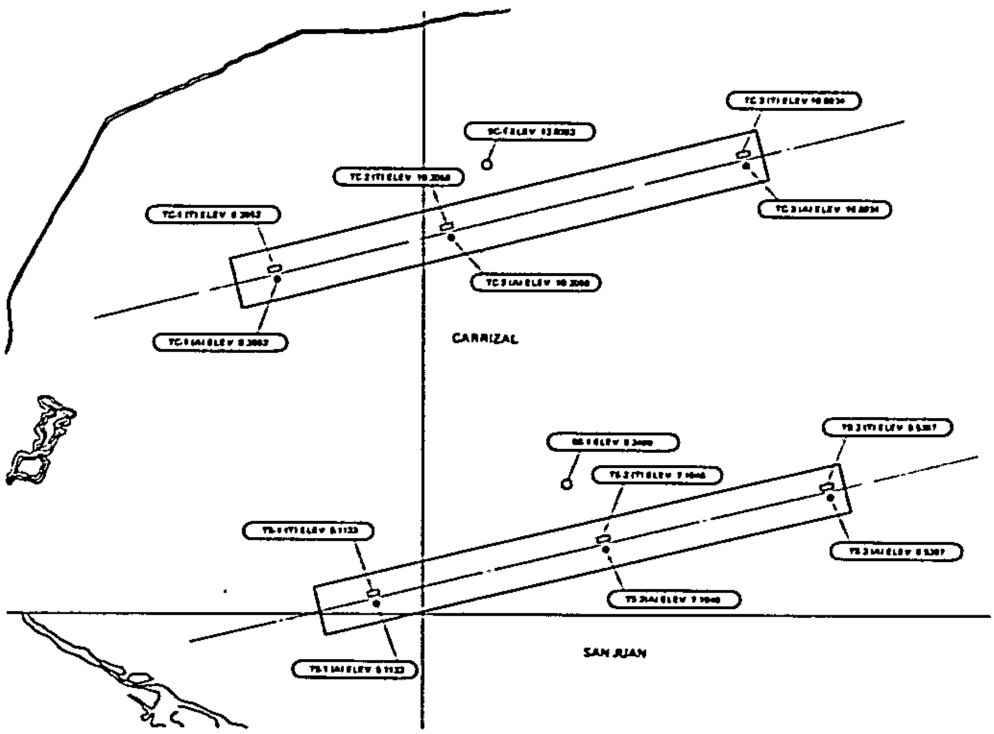


Fig. 7-2-5 Geological Test Locations (Carrizal, San Juan)

7.2.4 Overall Evaluation of Proposed Sites

Summarizing the evaluations as presented above, it may be concluded that the three proposed sites qualify more or less alike, with Astoria only slightly outstanding in terms of construction requirements.

Despite the fact that all plans and considerations presented hereinafter in this report concerns the Astoria site only, most of the contents are equally applicable to the other two sites as well.

8. Layout Plan

8. Layout Plan

8.1 Method of Layout Planning

Through the following processes of examination, the final version of the airport layout was completed.

(1) Proper Location of Runways

It is no exaggeration that the location of runways will determine the layout of the rest of the airport. Other points of consideration arise as subordinate issues to this principal aspect. The location of runways then is to be decided with due consideration for departure and approach procedures, as well as for the navigational safety, and capacity of air space, etc.

(2) Apron, Terminal Building and other Facilities

Based on the location of runways thus determined, relative position of apron, passenger terminal building, cargo building, access roads, location of curb front,etc., may then be envisaged bearing in mind the efficiency of ground operation of aircraft, smooth flow of passengers and cargo, approach to the airport by visitors, etc.

(3) Taxiways

Taxiways must be so designed as to facilitate integrated and efficient functioning of the runways and aprons to which they connect. Efficient ground routing of aircraft within the airport is also to be taken into consideration.

(4) Location of Control Tower

Location of the Control Tower, the nerve-center of air traffic control must be determined in strict conformity to all its siting requirements, especially the eye level determination. The orientation of the Tower should be so determined as to secure sufficient visibility under all conditions of weather and sunlight situation, with traffic patterns and ground operation duly taken into consideration.

8.2 Airport Layout

Runway layout is primarily determined by selection of the crossing point of the two runways, and two such points are conceivable in this particular case: one at the east and the other at the west end of the main runway. The corresponding layout plans are shown in Figures 8.2.1-8.2.2.

Plan A:

The crosswind runway crosses the main runway at the east end of the latter, and the terminal complex and the access road system are to be located together in the area surrounded by the runways crossing at an angle of 110°. The Control Tower is to be located within this same area on account of its accessibility and good command of view.

Plan B:

The crosswind runway is to cross the main runway at the west end of the latter, and the terminal complex and the access road system are to be located within the area surrounded by the two runways crossing at an angle of 70°. The Control Tower is to be constructed in this same area.

Neither of the two plans described above shows conspicuous advantages over the other in terms of runway usability and ground operation of aircraft. But from the view point of traffic control, access road system, and adaptability to future expansion, etc., Plan A is somewhat preferable to Plan B.

Table 8-2-1 Comparison of A Plan and B Plan

	A Plan	B Plan
Control Tower Function	Little interference from the setting sun	Big interference from the setting sun
Intra Airport Road System	Relatively simple and economical	Complicated and uneconomical
Future Airport Expansion	No problem either on the air-side or curb-side.	Adaptability of curbside road system.

Based on the above findings, Plan A is adopted, and the rest of the airport layout is determined on this basis.

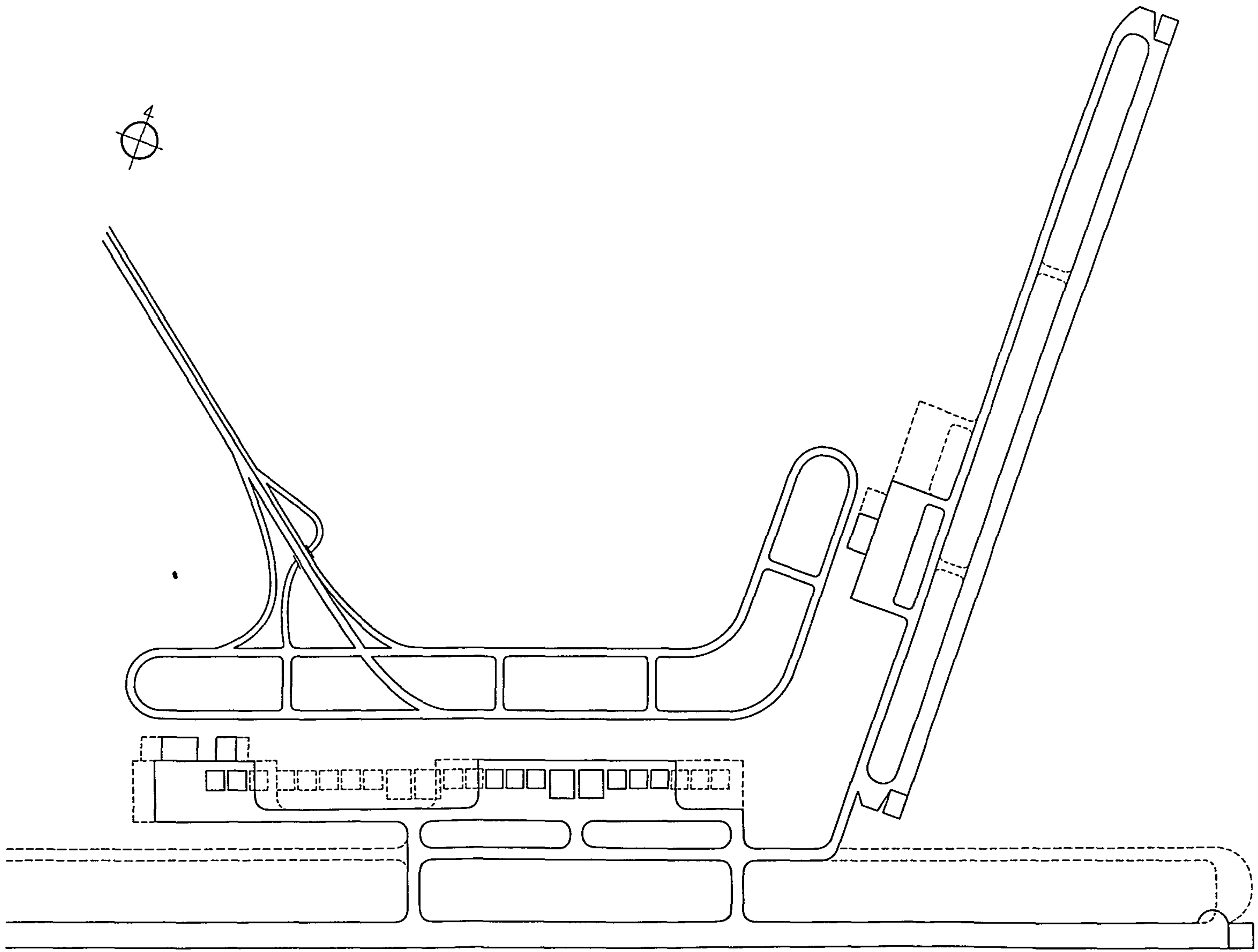


Fig. 8-2-1 Runway Layout Plan (A)

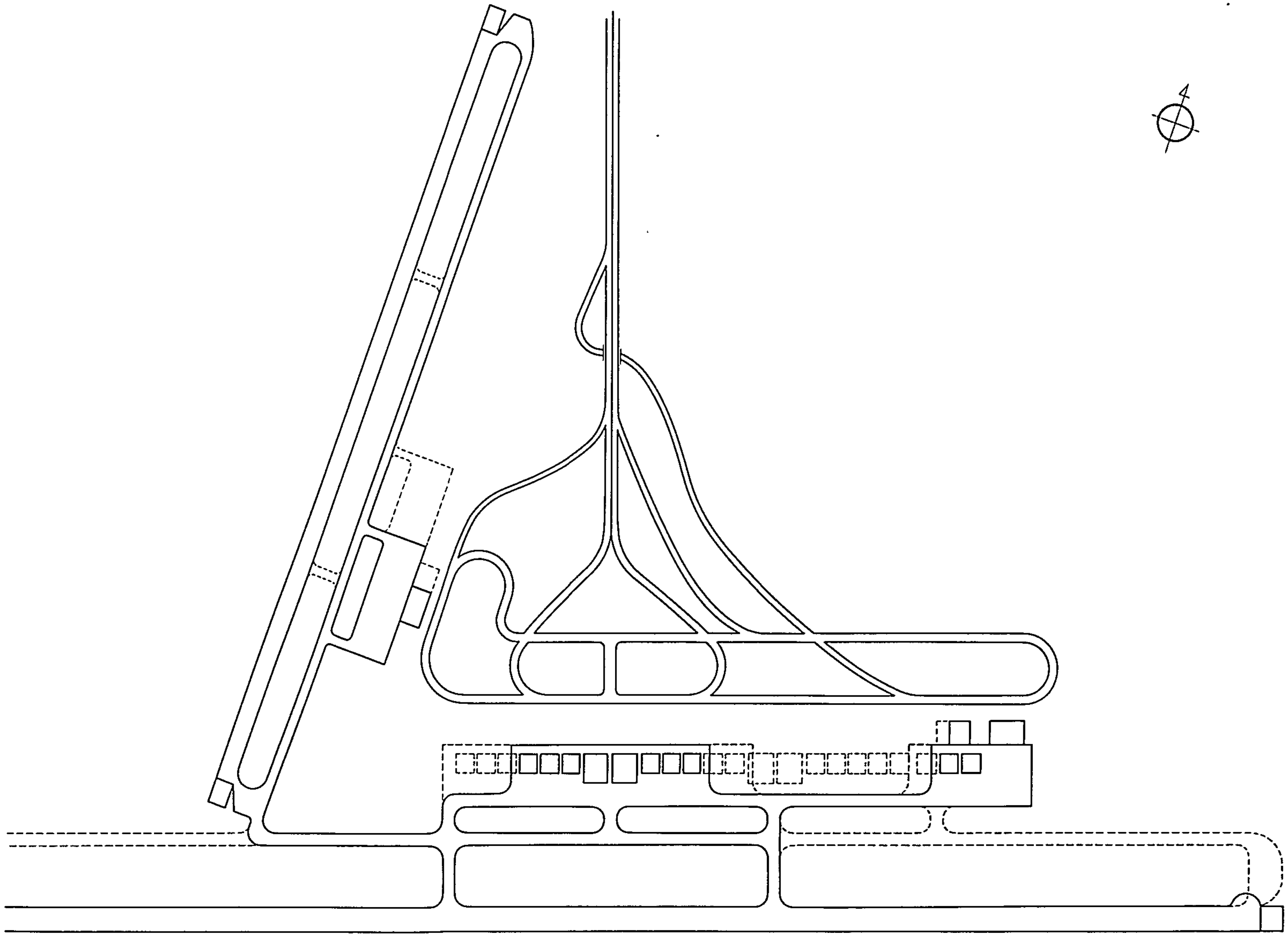


Fig. 8-2-2 Runway Layout Plan (B)

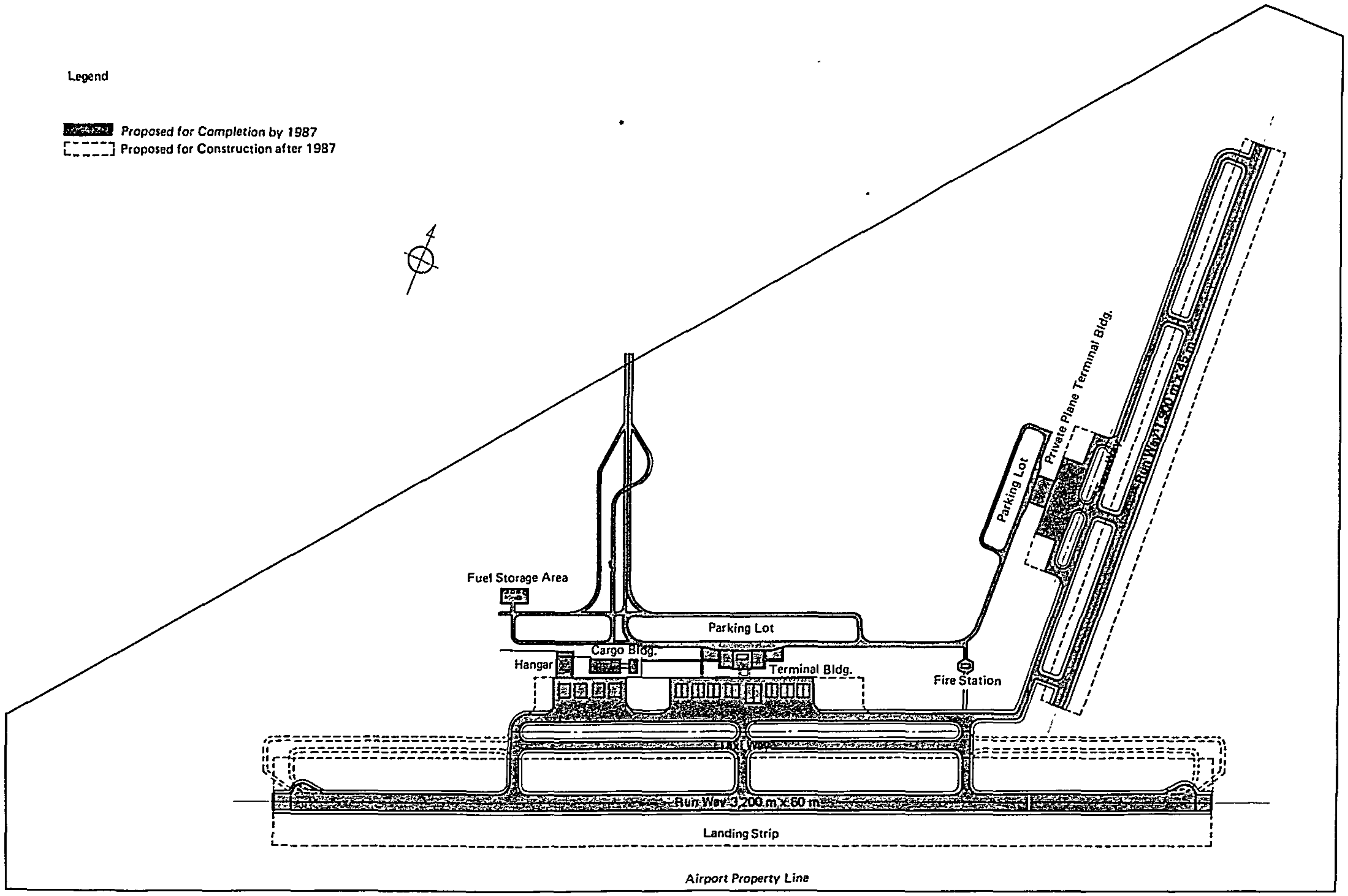


Fig. 8-2-3 Airport Layout Plan

9. Facility Planning

9. Facility Planning

9.1 Site Development, etc.

9.1.1 Pavement

(1) Design Factors

Design of asphalt pavement is based on following factors:

Aircraft; DC-8-63 for area related to Main runway,

VIS-828 for area related to Sub runway,

Coverage; 10,000 times

CBR value; 13%

(2) Depth of Aspalt Pavement

Unit: Cm

Area \ Type	I	II	III
Area related to Main Runway	80	72	40
Area related to Sub Runway	40	36	20

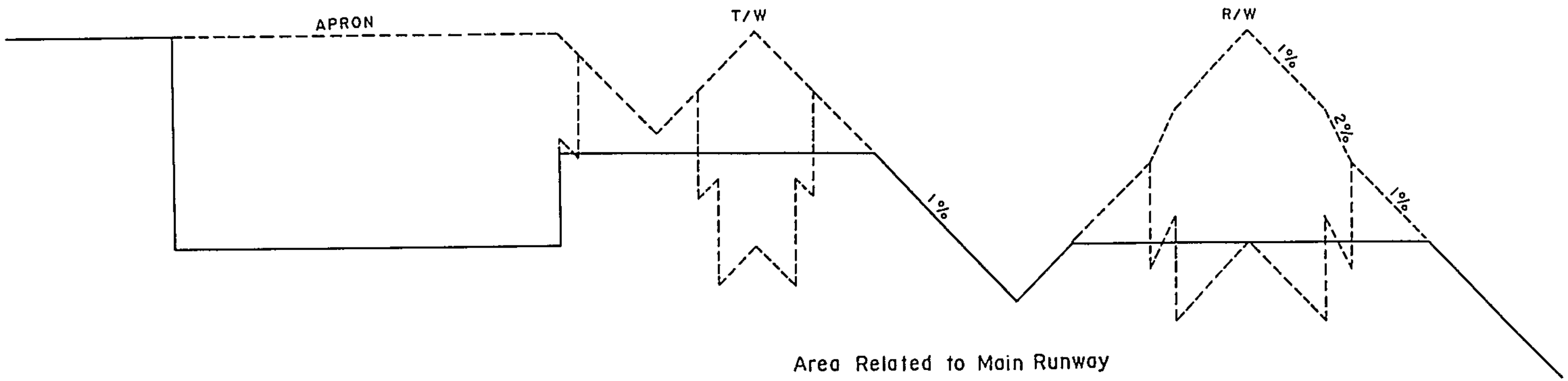
Note: Type I : Apron, taxiway and L/5 on either ends of runway
Type II : 3L/5 central portion of runway
Type III : Shoulder

9.1.2 Earthwork

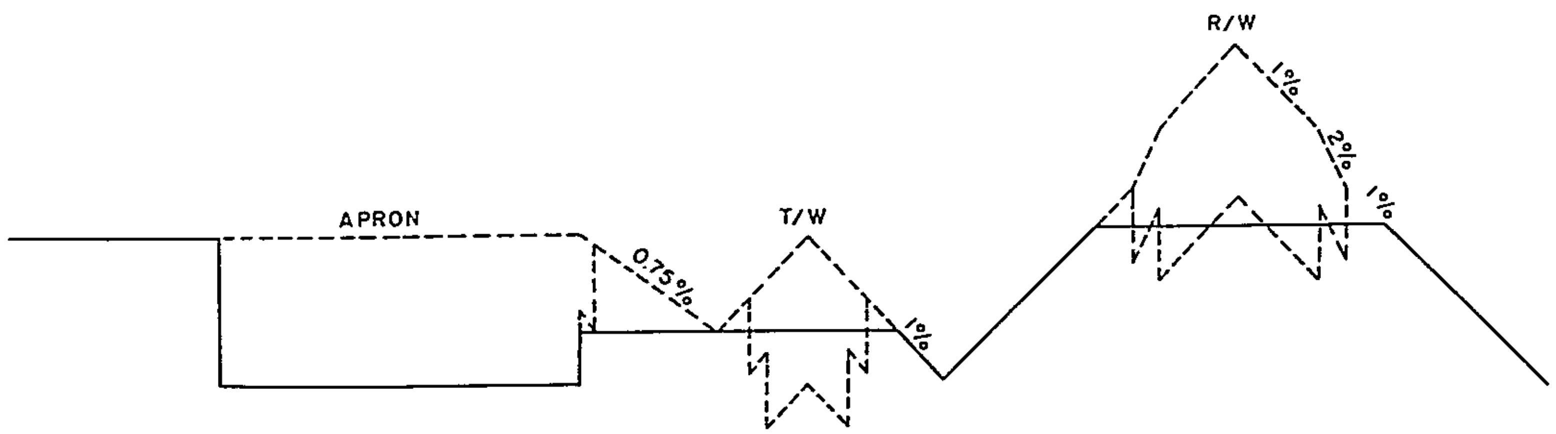
Grading formation is determined so as to equalize as much as possible the amount of earth to be excavated and banked to form the subgrade of pavement. (Fig. 9-1-1 Fig. 9-1-3)

9.1.3 Drainage System

The proposed airport site forms a general slope grading down toward southwest, and there is no river within or around the site with the potential of being used for the drainage system of the airport. It is not possible to effect drainage to Rio Jiboa which flows to the east of the site, because of the relatively high elevation of that river. Taking into account the fact that the ground water level around the airport site is high, construction of open ditches along the airport boundary is recommended to prevent water in-flow from surrounding areas, and to collect and lead all the drains to the swamp off the southeast boundary of the airport layout is determined on this basis.

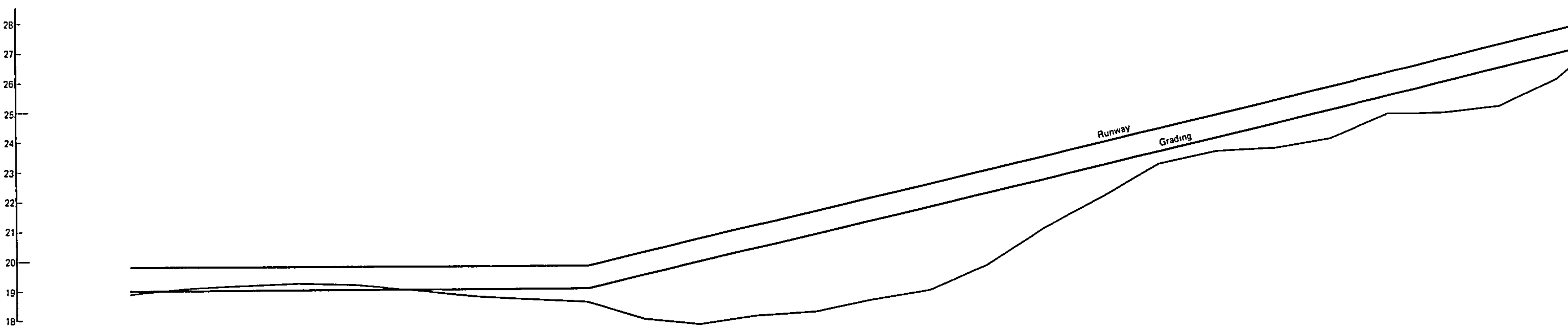


Area Related to Main Runway



Area Related to Sub Runway

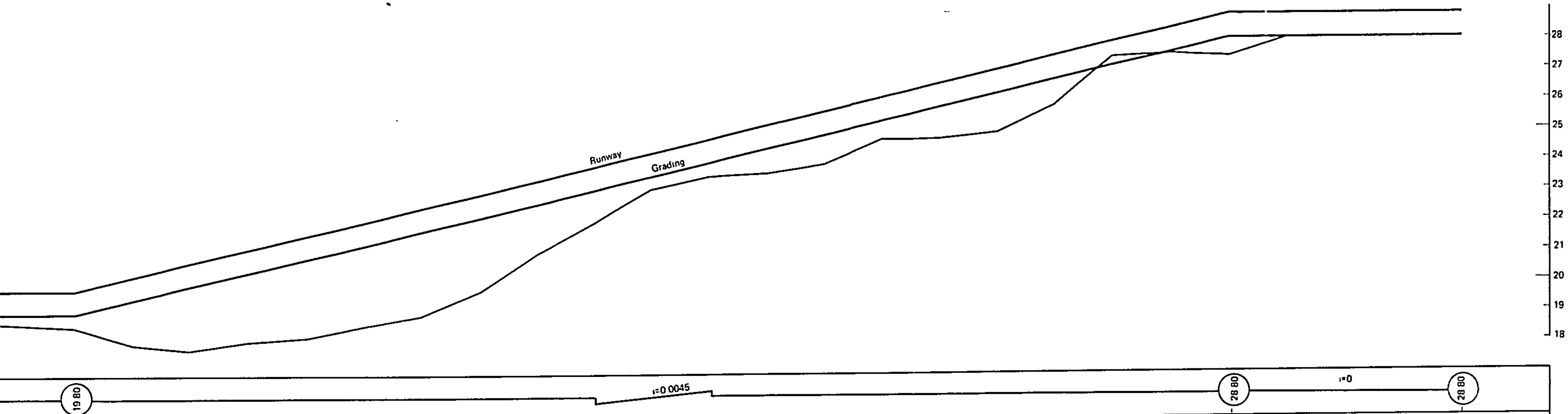
Fig. 9-1-1 Grading Standard Cross-Section



Gradient of R/W: (19.80) i=0 (19.80) — i=0.0045

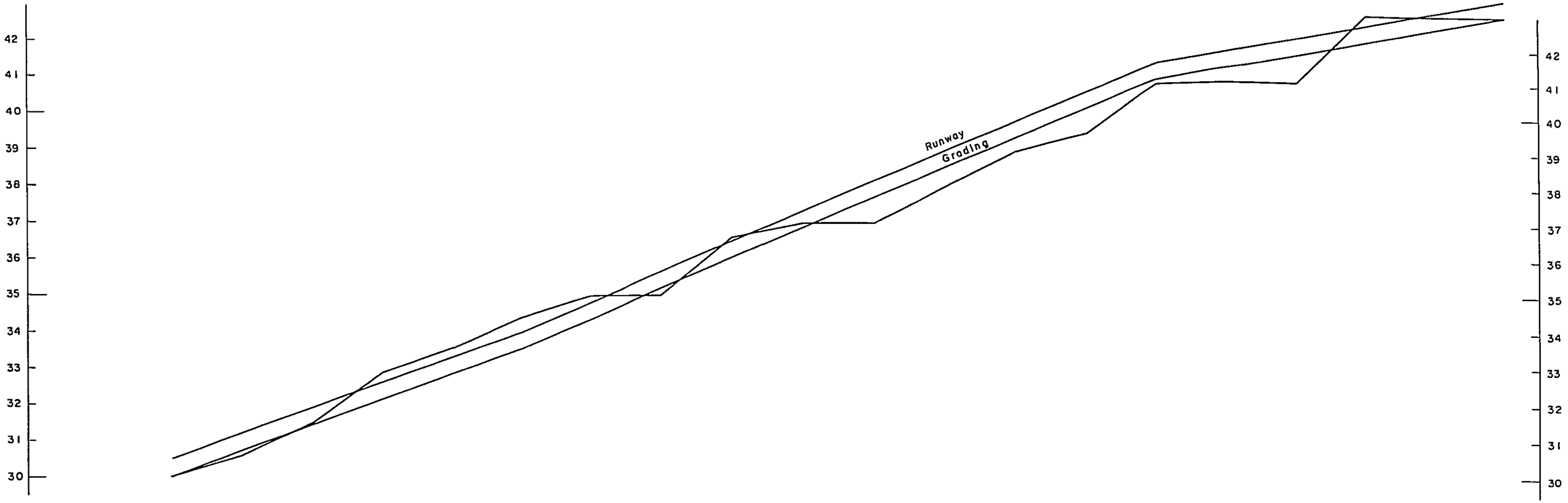
Point	Interval	Cumulative Distance	Ground Level	Formation	Elevation of R/W Pavement Surface
A 0		0	18.90	19.00	19.80
A 1	100	100	19.10	19.00	19.80
A 2	100	200	19.20	19.00	19.80
A 3	100	300	19.25	19.00	19.80
A 4	100	400	19.20	19.00	19.80
A 5	100	500	19.00	19.00	19.80
A 6	100	600	18.80	19.00	19.80
A 6 +50	50	650	18.75	19.00 (19.05)	19.80
A 7	50	700	18.70	19.05	19.80
A 8	100	800	18.60	19.05	19.80
A 9	100	900	18.00	19.50	20.25
A 10	100	1,000	17.80	19.95	20.70
A 11	100	1,100	18.10	20.60	21.15
A 12	100	1,200	18.20	20.85	21.60
A 13	100	1,300	18.60	21.30	22.05
A14	100	1,400	18.90	21.75	22.50
A 15	100	1,500	19.75	22.20	22.95
A 16	100	1,600	21.00	22.65	23.40
A 17	100	1,700	22.00	23.10	23.85
A 18	100	1,800	23.10	23.55	24.30
A 19	100	1,900	23.50	24.00	24.75
A 20	100	2,000	23.60	24.45	25.20
A 21	100	2,100	23.90	24.90	25.65
A 22	100	2,200	24.70	25.35	26.10
A 23	100	2,300	24.70	25.80	26.55
A 24	100	2,400	24.90	26.25	27.00
A 25	100	2,500	25.80	26.70	27.45

Fig. 9-1-2 Longitudinal Section along Center Line of Main Runway



A 7	50	700	18.70	19.05	19 80
A 8	100	800	18 60	19 05	19 80
A 9	100	900	18 00	19.50	20.25
A 10	100	1,000	17.80	19 95	20 70
A 11	100	1,100	18.10	20 60	21 15
A 12	100	1,200	18.20	20 85	21.60
A 13	100	1,300	18 60	21 30	22 05
A14	100	1,400	18.90	21.75	22 50
A 15	100	1,500	19 75	22 20	22 95
A 16	100	1,600	21.00	22 65	23.40
A 17	100	1,700	22 00	23 10	23 85
A 18	100	1,800	23.10	23 55	24 30
A 19	100	1,900	23.50	24 00	24 75
A 20	100	2,000	23 60	24.45	25.20
A 21	100	2,100	23.90	24 90	25 65
A 22	100	2,200	24 70	25.35	26 10
A 23	100	2,300	24.70	25.80	26 55
A 24	100	2,400	24 90	26 25	27 00
A 25	100	2,500	25 80	26 70	27.45
A 25 + 60	60	2,560	26 70	(26 97) 26 92	27 72
A 26	40	2,600	27.40	27.10	27 00
A 27	100	2,700	27 50	27.55	28 35
A 28	100	2,800	27 40	28 00	28 80
A 29	100	2,900	28 00	28 00	28 80
A 30	100	3,000	28 00	28 00	28 80
A 31	100	3,100	28 00	28 00	28 80
A32	100	3,200	28 00	28 00	28 80

Fig. 9-1-2 Longitudinal Section along Center Line of Main Runway



Point	Interval	Cumulative Distance	Ground Level	Formation	Elevation of R/W Pavement Surface	Gradient of R/W
B 0		0	30.00	30.00	30.48	(30.48)
B 1	100	100	30.60	30.70	31.18	i = 0.007
B 2	100	200	31.50	31.40	31.88	
B 3	100	300	32.90	32.10	32.58	
B 3 +20	80	380	35.40	32.66 (32.67)	33.14	
B 4	20	400	33.55	32.83	33.28	
B 5	100	500	34.40	33.53	33.98	(33.98)
B 6	100	600	35.00	34.36	34.81	i = 0.0083
B 7	100	700	35.00	35.20	35.65	
B 8	100	800	36.60	36.03	36.48	
B 9	100	900	37.00	36.86	37.31	
B10	100	1000	37.00	37.70	38.15	
B 11	100	1100	38.00	38.53	38.98	
B 12	100	1200	39.00	39.36	39.81	
B 13	100	1300	39.50	40.20	40.65	
B 14	100	1400	40.90	41.03	41.48	(41.48)
B 15	100	1500	41.00	41.43 (41.51)	41.88	i = 0.004
B 15 +20	20	1520	41.00	41.48	41.96	
B 16	80	1600	41.00	41.80	42.28	
B 17	100	1700	43.00	42.20	42.68	
B 18	100	1800	43.00	42.40	43.08	
B 19	100	1900	43.00	43.00	43.48	(43.48)

Fig. 9-1-3 Longitudinal Section along Center Line of Sub-Runway

Rainfall intensity likely to occur once in three to five years (five years according to the U.S. Federal Aviation Administration Standard), is needed for the drainage system design, but due to lack of pertinent meteorological data, this figure is not calculable, and therefore, the design rainfall intensity of the site calculated by the following table is assumed to be adequate judging from the available data on the annual rainfalls, monthly rainfalls, and the number of rainy days in the neighboring areas.

hourly rainfall ; taken to be 30 mm,

$i = \frac{3,600}{t + 60}$ (i = rainfall intensity in mm/h, t = *duration in minutes*).

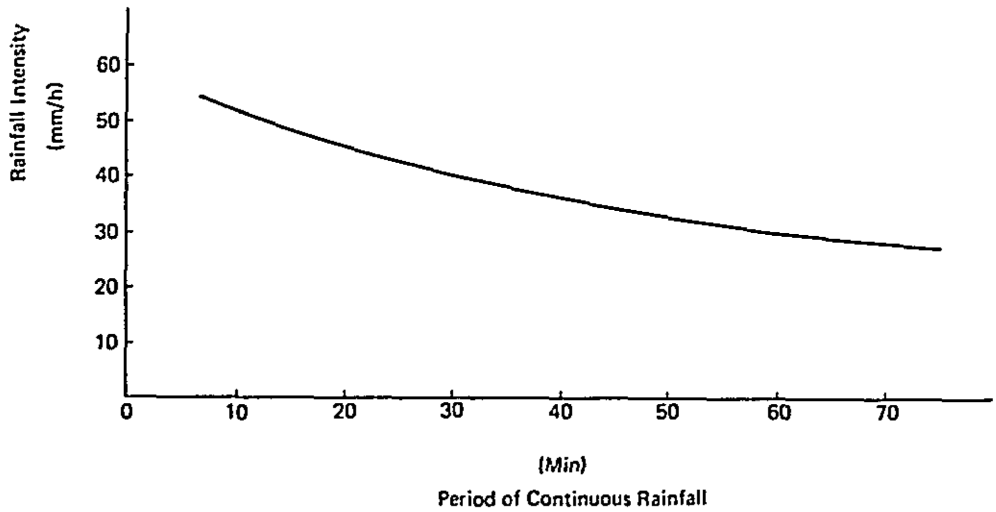


Fig. 9-1-4 Rainfall Intensity Curve

9.2 Runways, Taxiways and Aprons

9.2.1 Runways

(1) Main Runway

a. Length

Design Factors

o Longest route to be served: Los Angeles International, with San Francisco International as an alternative airport, has been chosen as destination of the longest route projected, hence the longest route distance of 2,300 NM is adopted for the purpose of this study.

o Projected Aircraft Mix: B-747B, DC-8-62, B-727-200

o Runway gradient: 0.3%

o Runway elevation: +28.8 m

o Reference temp: 31.0°C

(a) The B-747 B

Max. landing weight	564,000 lb.
Max. takeoff weight	774,000 lb.
Operating empty weight	365,800 lb.
Zero fuel weight	526,500 lb.

Runway length required for landing

Le == 2,400 m (wet condition)

(From the Boeing manual)

Runway length required for takeoff

Takeoff weight

Operating empty weight	365,800 lb.
Payload (374 passengers & full cargo)	120,000 lb.
Burnoff fuel (cruise alt. 31,000 ft; wind factor -50 kn.)	123,000 lb.
Alternate fuel	23,000 lb.
Holding fuel	10,000 lb.
Contingency	10,000 lb.
Total	651,800 lb.

Accordingly, Lt' == 2,400 m (standard condition), and correcting for gradient and temperature,

Lt == 2,900 m.

(b) The DC-8-62

Max. landing weight	240,000 lb.
Max. takeoff weight	350,000 lb.
Operating empty weight	143,255 lb.
Zero fuel weight	195,000 lb.

Runway length required for landing

Le == 2,100 m (wet condition)

(From the DC-8 characteristics)

Runway length required for takeoff

Takeoff weight	
Operating empty weight	143,255 lb.
Payload (full capacity)	47,335 lb.
Burnoff fuel (cruise alt. 31,000 ft; wind factor -50 kn.)	65,000 lb.
Alternate fuel	10,000 lb.
Holding fuel	5,000 lb.
Contingency	4,000 lb.
Total	274,590 lb.

Accordingly, Lt' == 2,200 m (standard condition), and correcting for gradient and temperature,

Lt == 2,700 m.

(c) The B-727-200 (JT8D-15)

Max. landing weight	142,500 lb.
Max. takeoff weight	190,500 lb.

Runway length required for landing

Le == 1,750 m (wet condition)

(From the Boeing manual)

Runway length required for takeoff

As at maximum takeoff weight Lt' == 2,607 m, correcting for gradient and temperature,

Lt == 3,200 m.

From above, the length of the Main runway of the proposed airport is set at 3,200 meters.

(b) Width

The ICAO recommendations prescribe a minimum width of 45 meters and recommend an increase of this figure if large aircraft are to be accommodated. The FAA standards call for width of 45 meters or 60 meters, latter to be required for B-747 and other large carriers anticipated in the future. As B-747 tends to cause marked nose swing in a crosswind, it is said that pilots psycologically feel greater confidence in landing on a runway with the width of 60 meters than of 45 meters. From such considerations it is suggested that the Main runway width be 60 meters.

(c) Shoulder Width

Shoulder width is suggested to be 10 meters (3.5 meters paved + 6.5 meters turfed).

(d) Turning Pad

The proposed plan is based on the turning radius of B-747 B commencing at the runway center line.

(2) Sub Runway

a. Length

Design Factors

- o Longitudinal Gradient : 0.68%
- o Elevation : 35.0 m
- o Reference Temperature : 31.0°C
- o Aircraft to be accommodated :

All types of aircraft requring less than 1,500m of runway length at a maximum permissible crosswind component of 13kt/hr. Thus, L' = 1,500m, and correcting for gradient and temperature, the sub runway length is planned to be 1,900m.

b. Width

Sub runway width is suggested to be 45m, with shoulders of 7.5m width, of which 3.5m is to be paved and 4.0m turfed.

9.2.2 Taxiways

(1) Taxiways related to Main Runway

a. Width

In order to minimize the blast effects by larger aircraft, taxiway width is suggested to be 30m, with shoulders of 7.5m width, all paved.

(2) Taxiways related to Sub Runway

a. Width

Width is suggested to be 23m, with shoulders of 5.0m width, all paved.

9.2.3 Aprons

(1) Passenger Loading Apron

Area requirements and clearance based on the projected number of berths required for the proposed facility are illustrated in Figure 9-2-1.

(2) Cargo Loading Apron, Maintenance Apron

Shown in Fig. 9-1-2

(3) Private Plane Apron

Caluculation of the total area requirements was made on the basis of average 300 m^2 required per plane.

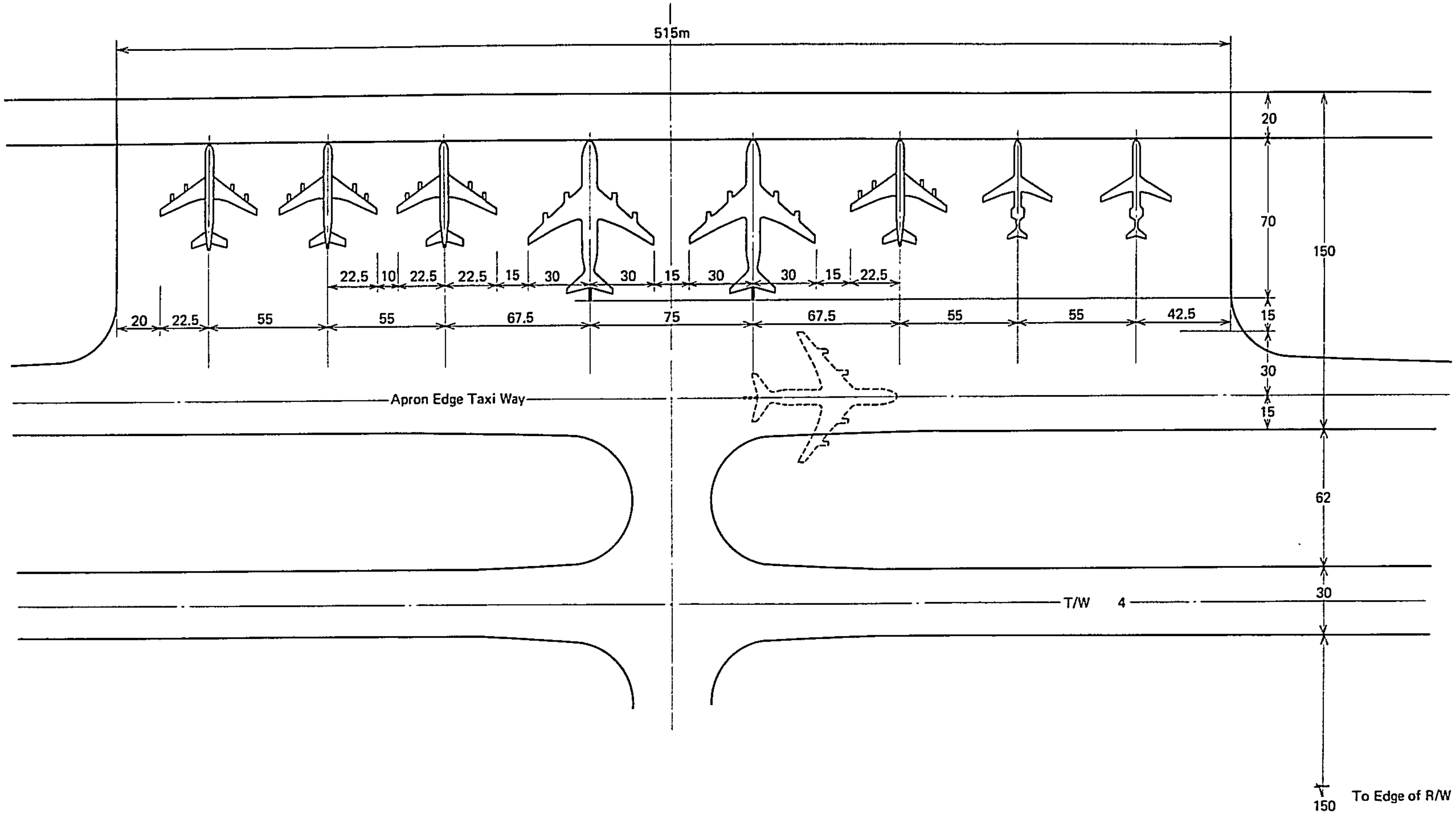


Fig. 9-2-1 Passenger Loading Apron

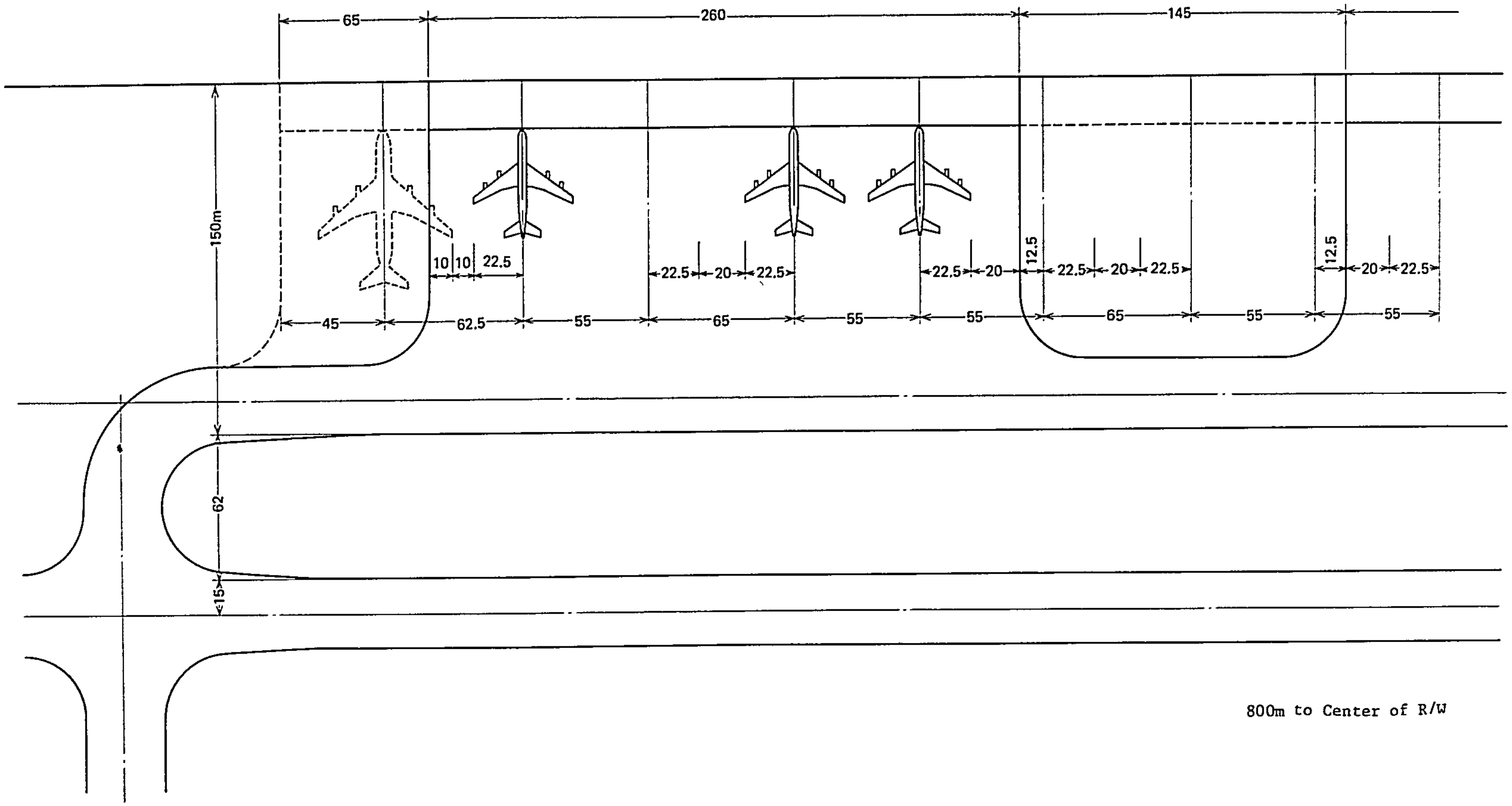


Fig. 9-2-2 Cargo and Maintenance Area Apron

9.3.1 Airspace Utilization Concept

(1) IFR Operation

a. ILS Approach

(a) ILS Runway

ILS installation is planned only for runway-06 for the initial stage of airport construction, on account of the runway usability of up to 73% for jet operation with 5 Knots tail wind component.

(b) Approach Procedures

Shown in Fig. 9-3-1

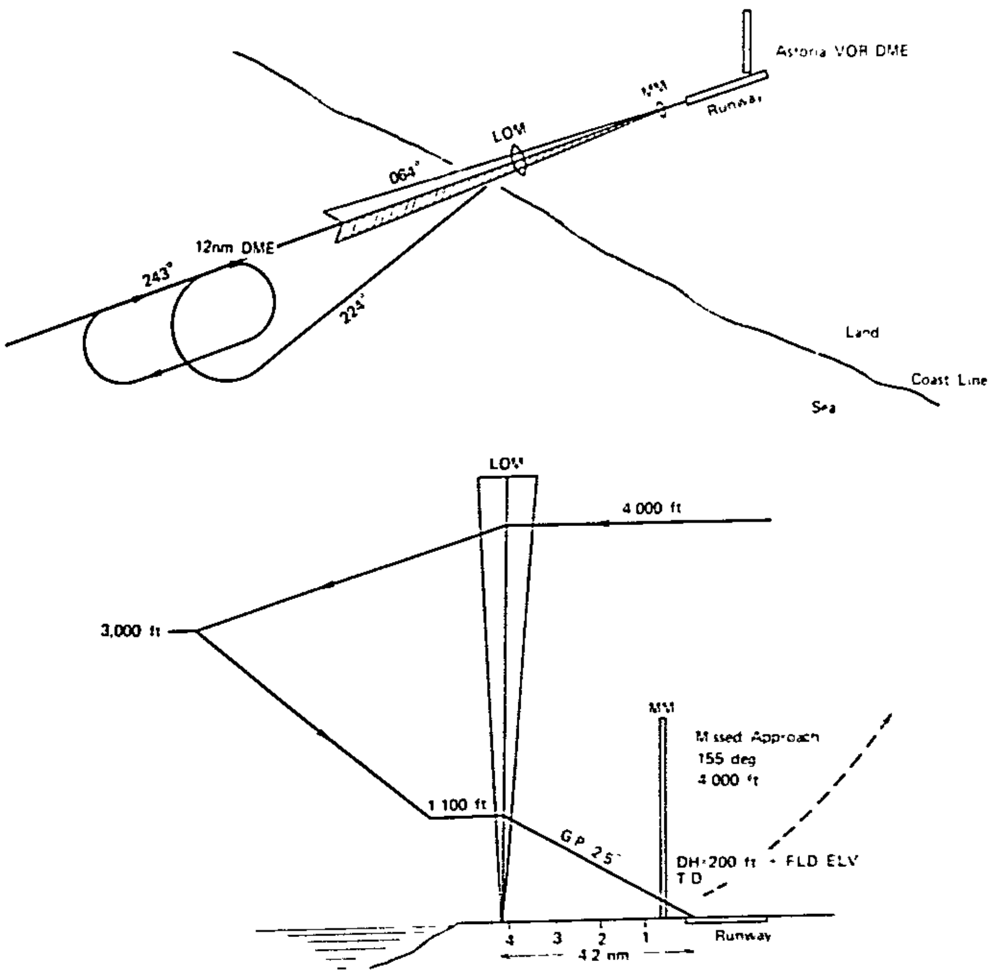


Fig. 9-3-1 ILS Approach Procedure Plan-View & Profile

(c) Missed Approach

Turn right and climb on radial 155 Astoria VOR/DME, maintain 4,000 ft., and hold at 12 nm DME.

b. VOR Approach

(a) Number of Procedures

Three approach procedures allowing straight-in approach from three directions are conceived.

(b) Approach Procedures

Shown in Fig. 9-3-3 through Fig. 9-3-5.

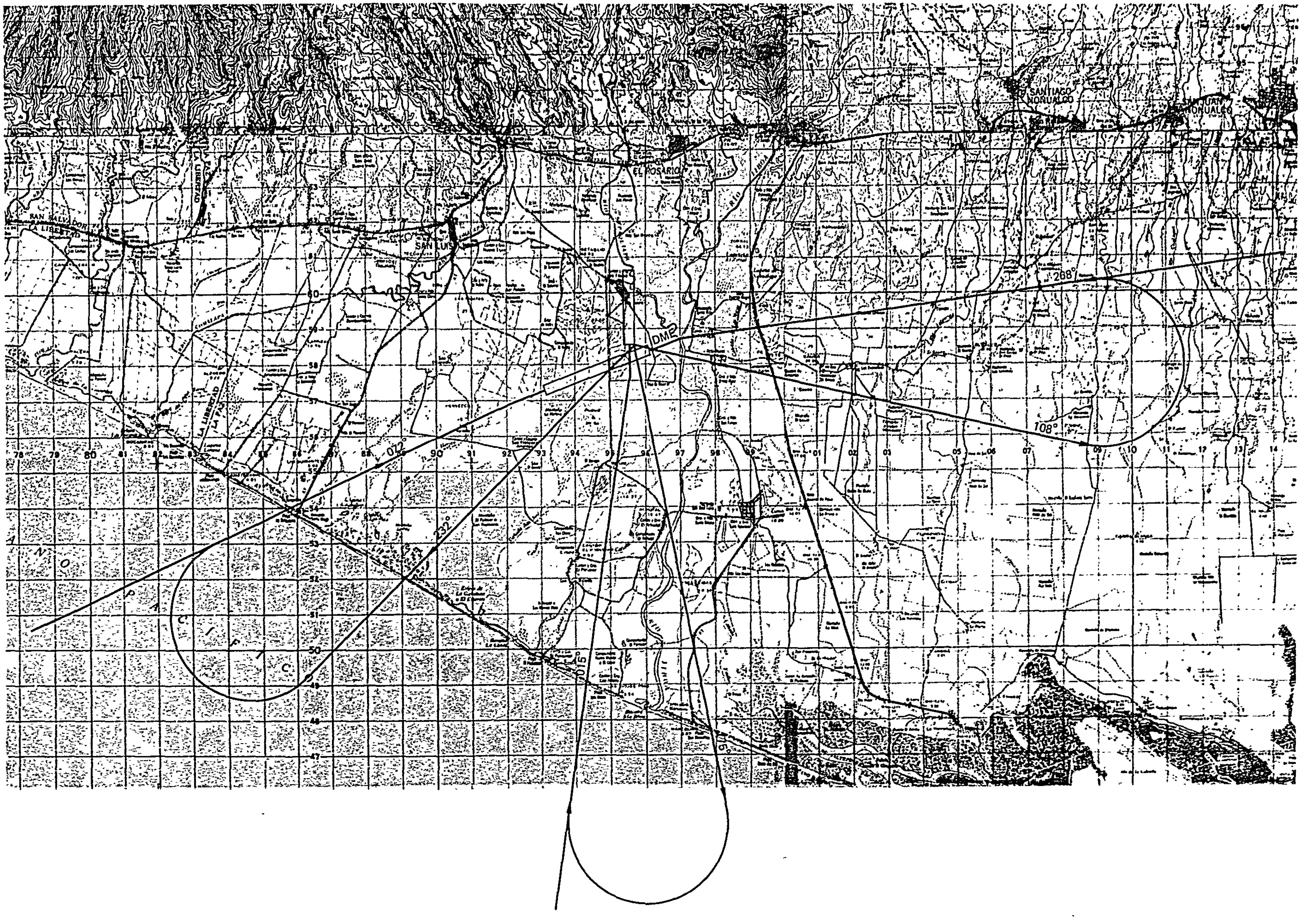


Fig. 9-3-2 VOR Procedures Plan-View

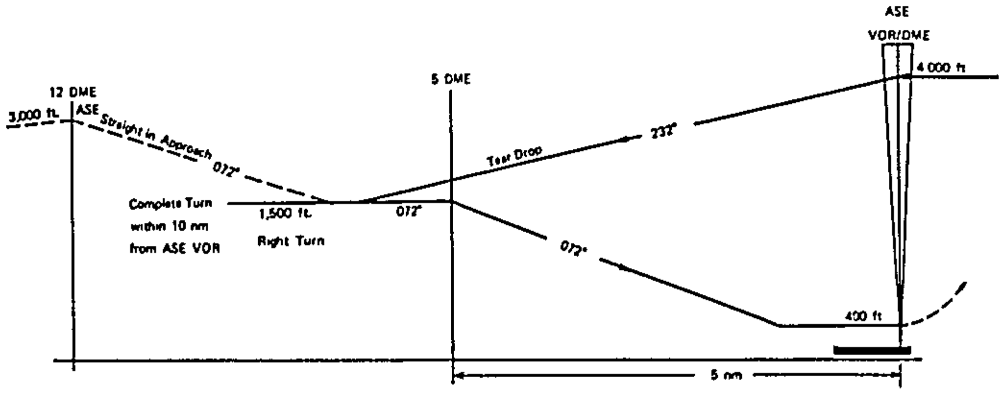


Fig. 9-3-3 VOR Approach Procedure, No. 1 Profile

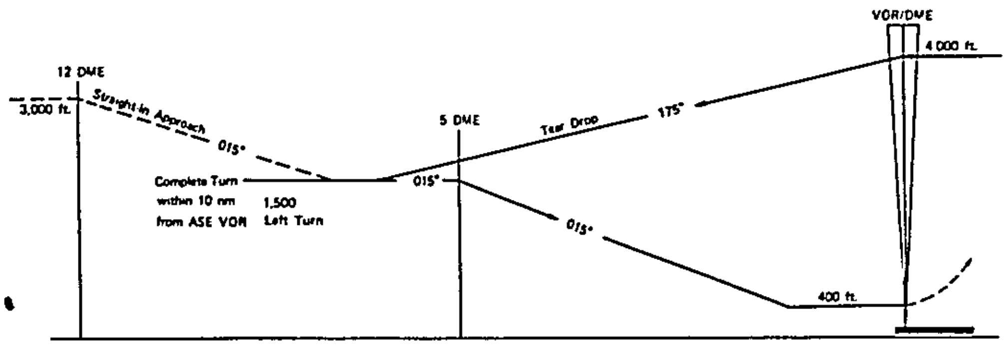


Fig. 9-3-4 VOR Approach Procedure, No. 2 Profile

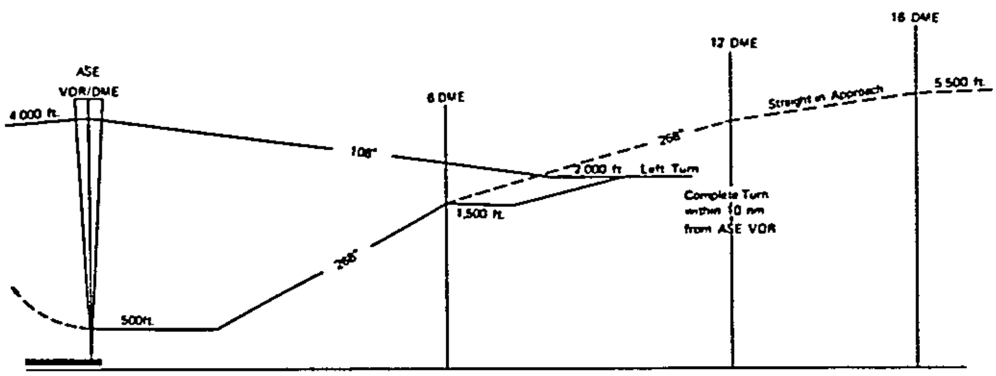


Fig. 9-3-5 VOR Approach Procedure, No. 3 Profile

(c) Missed Approach

a. VOR No.1; Turn right and climb on radial 155 Astoria VOR/DME, maintain 4,000 ft., and hold at 9 nm DME.

b. VOR No.2; Turn left and climb on radial 155 Astoria VOR/DME, maintain 4,000 ft., and hold at 9 nm DME.

c. VOR No.3; Turn left and climb on radial 155 Astoria VOR/DME, maintain 4,000 ft., and hold at 9 nm DME.

c. Departures

Concept of Instrument Departure Routes are shown in Fig. 9-3-6 and Fig. 9-3-7.

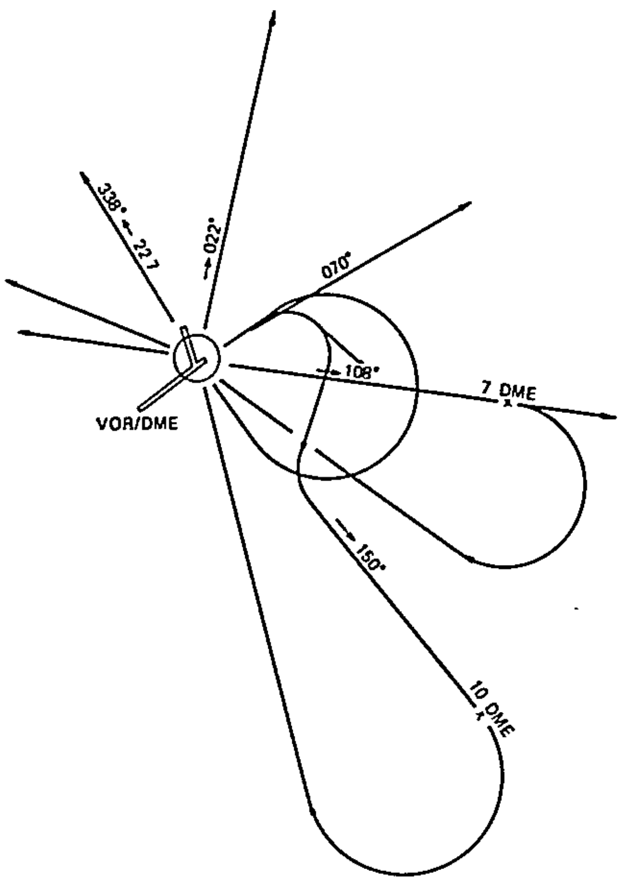


Fig. 9-3-6 Instrument Departure Route for Runway 24

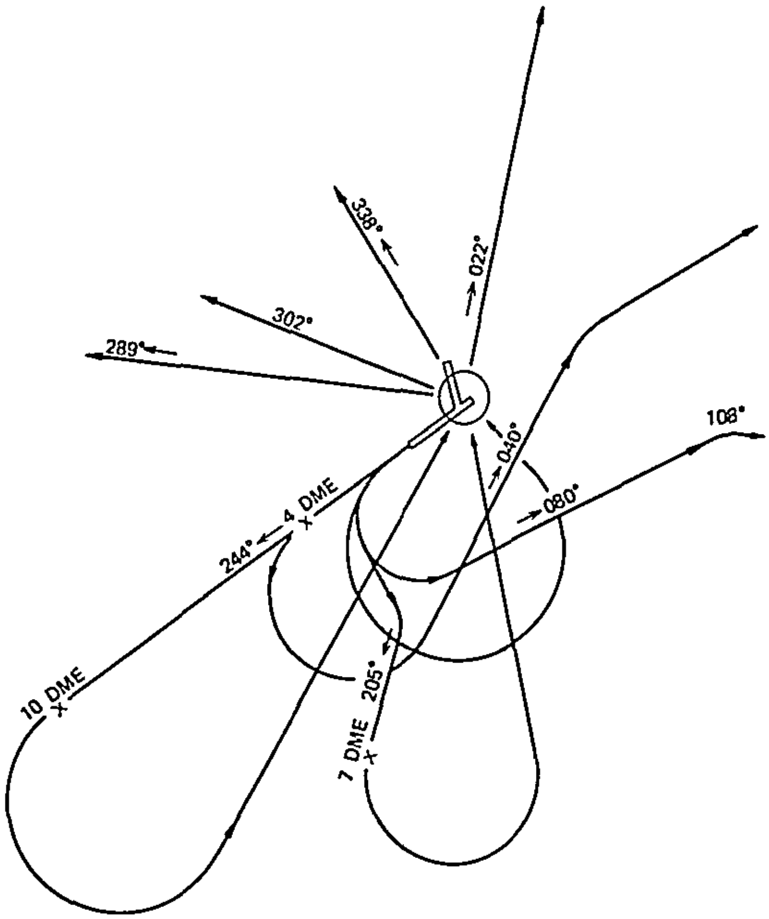


Fig. 9-3-7 Instrument Departure Route for Runway 06

(2) VFR Operation

a. Small Airstrips in the Vicinity of Astoria

It is imperative that all aircraft operations made on the various small airstrips in the vicinity of Astoria be controlled by Astoria ATC.

b. Positive Control Area

When traffic increases in future "Positive Control Area" should be established to protect IFR operations.

9.3.2 Air Traffic Control Facilities

In order to cope with growing volumes of air traffic and diversity of aircraft types to be accommodated in the terminal control area, reliability of air-ground telecommunications needs to be improved, thus calling for more sophisticated, instruments than those found at the exisiting airport. All of the existing functions of the present Ilopango Airport will have duplicated at the new airport, and to avoid confusion during the transfer of operations, all of the equipment at the new airport will have to be newly installed, with the exception of some of the Boqueron Relay Station facilities.

(1) Air-ground telecommunications facilities

VHF and HF radio-telephony transceivers, as detailed below, need to be installed for the purpose of executing approach control, local control, and ground control over aircraft within the terminal positive control area. It is felt that for some time to come a full operational program can be handled with the same frequency bands used at Ilopango Airport. It thus will be unnecessary to isolate the transmitting and receiving equipment in the Transmission Station; instead, it can all be installed in the same equipment room at a site near the Control Tower, and each channel will be integrated into duplex operation. Figures 9-3-8, 9-3-9 indicate the effective VHF coverage for local control (Control Tower) and approach control (Boqueron site).

a. VHF radio-telephony transceivers

For local control	50W	2 units (Cont. Tower)
For approach control	50W	2 units (Boqueron)
For ground control	50W	2 units (Cont. Tower)
For emergency	50W	2 units (Cont. Tower)

In addition, one portable VHF transceiver for emergency use will be integrated with the air traffic control console set.

b. HF radio-telephony

transmitter	500W	2 units
receiver		2 units
console		1 unit

(2) Air traffic control consoles

For the telephones, interphones, flight progress boards, etc. utilized in controlling the air-ground telecommunication facilities and for relaying communications among the concerned quarters, a set of consoles should be installed which embodies the same functions as the console set at Ilopango Airport. Full consideration of human engineering and of functionability should be exercised in the placement of send-receive control switches, main-standby select switches, interphones, local phone switches, wind direction and velocity indicators, digital clocks, etc.

To ensure unobstructed execution of the air traffic control operation and to enhance a rational layout of the maintenance system, equipment and amplifier racks as well as interface equipment for the flight information consoles should be allocated to the equipment room. However, monitor and control panels for the ILS and VOR installations should be incorporated into the air traffic control console set along with the battery-operated VHF transceiver for emergency back-up operation.

i. Air traffic controlconsoles — 1 set (Cont. Tower)

ii. Equipment racks for the above — 1 set (Equip. Room)

iii. Multichannel taperecorders (16 channels, 24 hrs operation) — 1 set (Equip. Room)

(3) Other facilities

The electric power system supplying the terminal air traffic control facilities must be designed with the finest quality components for guaranteed reliability in monitoring air safety and in efficient operations. The system must incorporate a large size, high quality power generator for immediate back-up operation of the air traffic control facilities in the event of a failure in the commercial power supply.

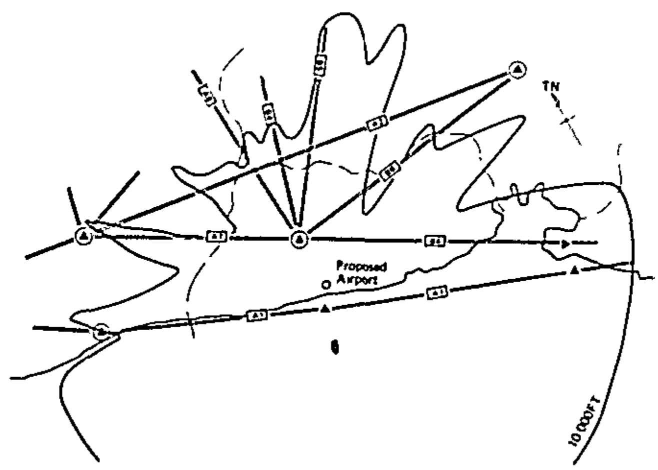


Fig. 9-3-8 Proposed Airport VHF Coverage

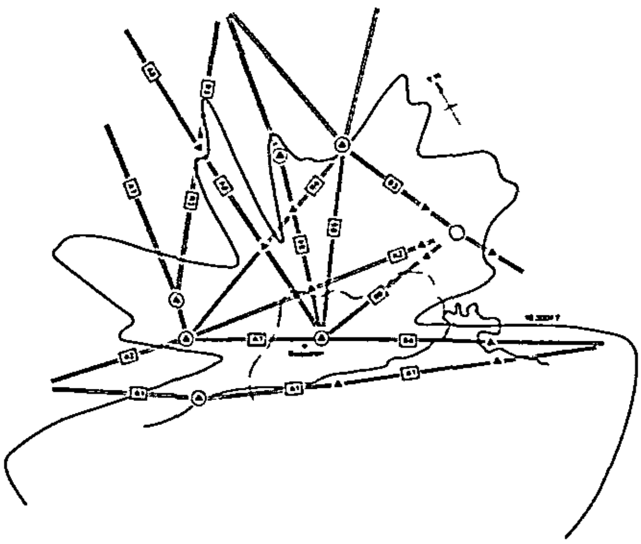


Fig. 9-3-9 Boqueron Site VHF Coverage

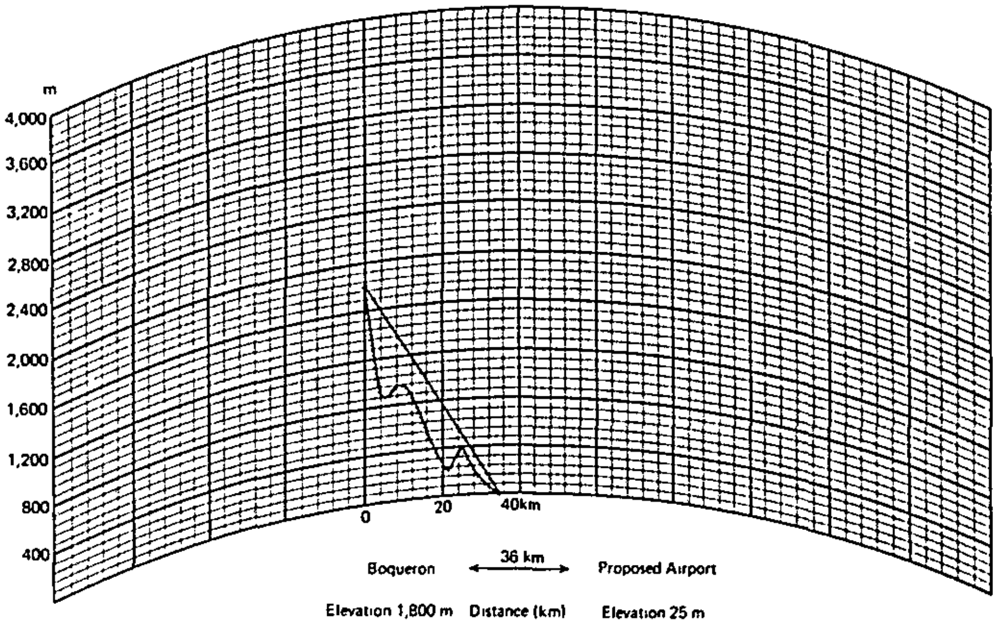


Fig. 9-3-10 VHF Link Profile

9.3.3 Aeronautical Telecommunication Facilities

All of the telecommunication functions performed at Ilopango Airport should be provided at the new airport both in the interest of supplying effective radionavigation and telecommunication services to aircraft using the new airport as well as in support of safe and smooth operation of aircraft within the Central American Flight Information Region (FIR). Furthermore, the Air Navigation Plan recommended by ICAO should be observed and HF radio-telephony equipment for the en-route network should be newly installed.

(1) Aeronautical fixed telecommunications facilities

The VHF and UHF multiplex channel repeating equipment at Boqueron Relay Station will need to be supplemented and a single span to the new airport established. The propagation path from Boqueron to the new airport, shown in Figure 9-3-11, appears to have adequate clearance with only one span, but in the actual designing stage further study in detail would be necessary. As the new relay equipment will be linked up with existing equipment presently in operation at Boqueron, sophisticated technical coordination will be essential with respect to compatibility of circuitry levels and carrier quality to avoid impaired operation of the interface equipment.

UHF FM multiplex circuit repeaters	1 set (Cont. Twr. & Boqueron)
UHF FM multiplex circuit terminals	1 set (Cont. Twr. & Boqueron)

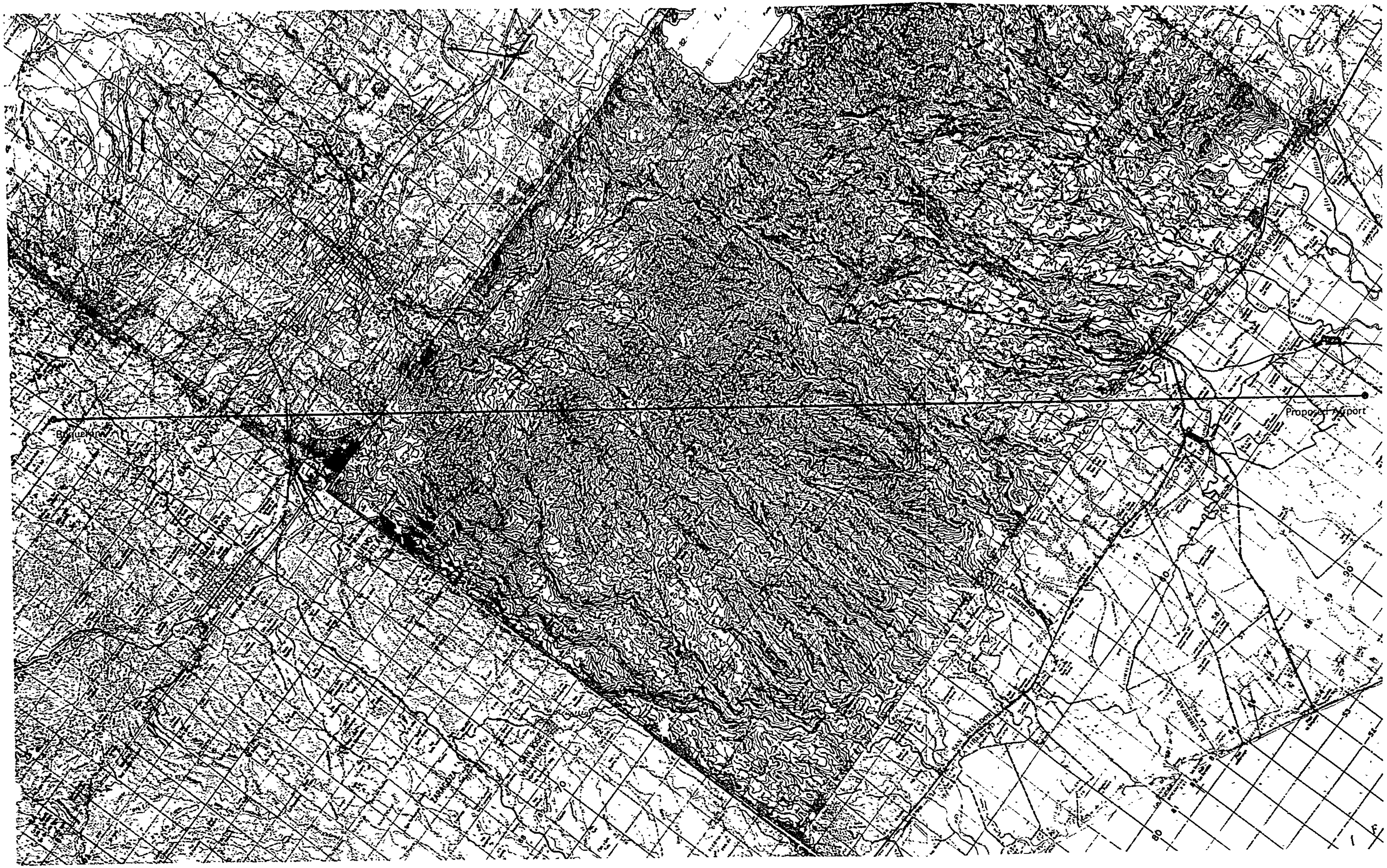


Fig. 9-3-11 VHF Link Route

(2) Teletype facilities

For the new airport's El salvador International Aeronautical Communication Station, one set of teletype units will need to be installed, as currently exists at Ilopange Airport, to carry out service for the circuits of the Aeronautical Fixed Telecommunication Network (AFTN), of the Air Traffic Service (ATS), and for data distribution to the airlines, etc.

(3) Aeronautical mobile service facilities

a. VHF facilities

Ilopango Airport currently has an air-ground telecommunications installation of Salvador Radio supplying radionavigation services to aircraft flying over El Salvador airspace, and the information provided includes traffic control information, position reports, and meteorological bulletins. Transmission from the proposed airport, however, would have a restricted coverage due to the low elevation of the La Paz plain site--only 25 meters or so above sea level--and the interference of surrounding mountains, so it is suggested that the transmission equipment be installed at the Boqueron Relay Station with its elevation of about 1,800 meters above sea level. As indicated in Figure 11.1.2 showing the area that can be served from Boqueron, it is apparent that high quality telecommunication services could be supplied over an expansive region.

VHF radio-telephony transceivers 50W 2 units (Boqueron)

b. HF facilities

HF air-ground radio-telephony
transmitter (5 channels) 2 sets (XMIT site)
HF air-ground radio-telephony
receiver (5 channels) 2 sets (Cont. Tower)

The ICAO Air Navigation Plan of April, 1972 recommends the services of the West Caribbean HF En-route Radio-telephony Network.

An air-ground communications console set, equipped with telephones, interphones, a SELCAL control panel, etc. for Air Traffic Service and for control of VHF and HF air-ground facilities, should be located in the communications room of the Terminal Building, and the information relayed should be recorded by multi-channel taperecorders.

Air-ground communications consoles	1 set (Com. Room)
SELCAL equipment	1 set (Com. Room)

(4) Automatic Terminal Information Service (ATIS)

The automatic terminal information service is a facility designed to relay tape playbacks on weather of navigational information aid facilities, aerodrome conditions, functioning etc. to aircraft flying around the airport or scheduled to land or take off. As this facility automatically feeds certain information to the pilot whenever he needs it, it reduces the call frequency to the air traffic controler and thus lightens the communication work load.

The proposed airport is centrally positioned both in respect to El Salvador itself and to Central America as a whole, and it is also well located for access to information from every quarter of the Aeronautical Fixed Telecommunication Network which traverses Central America. Accordingly, and ATIS facility at the airport site would serve effectively as a Central American aeronautical information transmission center.

The ATIS hardware would include a set of taperecorders to record essential information on altimeter settings, runway in use, navigational aid facilities, etc. and to transmit information from the VOR facility.

9.3.4 Radio Navigation Facilities

Navigation aids recommended for the new airport include both a VOR/DME facility as well as an ILS facility to aid landing under low visibility or to aid landing of aircraft equipped with the necessary instruments.

(1) VOR/DME

Standard type VOR/DME station internationally approved for en-route short-range, and approach/departure navigational aid is recommended. The suggested installation site has been selected close to the intersection of the two runways, and adequate clearance from all surrounding structures such as the terminal building, hangars, etc. should be secured to avoid possible disturbance of VOR radio wave by reflections from these obstructions within the airport premises. The proposed airport site lying on a coastal plain relatively distant from the northern mountaneous region. There is no need for concern over obstructions outside the premises.

Remote controls for the VOR/DME would be established within the Control Tower for monitoring and control over the equipment. The area of effective coverage from the VOR site is shown in Figure 9-3-8.

VOR unit	200W	1 set
DME unit	3KW	1 set

(2) ILS

Installation of a complete instrument landing system (ILS) facilities suitable for Category I procedures is recommended. It is desirable, however, that the initial system design be so planned as to facilitate future adaption to category II procedures as the need arises. For this reason the components planned in this study are to be of the quality worthy of the category II requirements.

The suggested direction of ILS approach to the main runway is from the west over the sea. Before the final design stage, however, the detailed meteorological observation under Instrument Meteorological Conditions and data analysis should be made tc reconfirm the feasibility of the ILS approach plan.

The compass locator is to be installed together with the outer marker, and it could also be used as an approach NDB for aircraft requiring ADF approach.

9.3.5 Other Considerations

(1) Maintenance personnel

Since the ILS facilities are to be newly introduced to El Salvador, maintenance personnel will have to be specially trained, through class-room training as well as on-the-job training during the instrument installation and adjustment. For the VOR and DME facilities, on-the-job training of the maintenance personnel during the instrument installation and adjusting is recommended.

(2) Supply of Parts

All of the parts and special electronic components for the radionavigational aid and telecommunication facilities will have to be imported, and sufficient stock will have to be maintained at all times and adequate replenishment procedures should be established.

9.4 Airport Lighting Facilities

9.4.1 Main Runway

(1) Approach Lights

Runway-07 Side: CAT I Precision Approach Facility;

ALPA Formula 900 m; two 6.6 A series circuits.

Due to the excellent meteorological conditions of the airport site, and non-existance of other misleading lights in the environs, sequenced flashing lights will not be necessary. A constant current regulator is designed for use for

either the east of the west side of the runway by switching.
Runway-25: Simple Formula 420 m; One 6.6 A series circuit.

(2) Approach Beacons

Since circling approach is required on Runway-25, two approach beacons should be installed at 600 m and 900 m from the end of the runway to provide guidance for circling aircraft and also to serve as additional extended approach lights.

(3) Visual Approach Slope Indicators

A 3-bar VASIS to be planned and installed in both directions of approach; 6.6A series circuit to be installed in each direction of approach; constant current regulator to be equipped with switching capabilities.

(4) Runway Edge Lights

High intensity lights: two 6.6 A series circuits, each circuit connecting every other light alternately.

(5) Runway Threshold Lights

High intensity flashing lights to be embedded below surface at intervals of less than 3 m between the runway edge lights; a 6.6A series circuit at each end of the runway.

(6) Additional Runway Threshold Lights

Use the same circuits as the approach lights.

(7) Runway end Lights

Runway end lights to be equipped with red filters on the inner side and to use also as additional runway threshold lights.

(8) Runway Center Line Lights

One 6.6A series circuit and filters to show remaining distance of the runway.

9.4.2 Sub Runway

(1) Runway Edge Lights

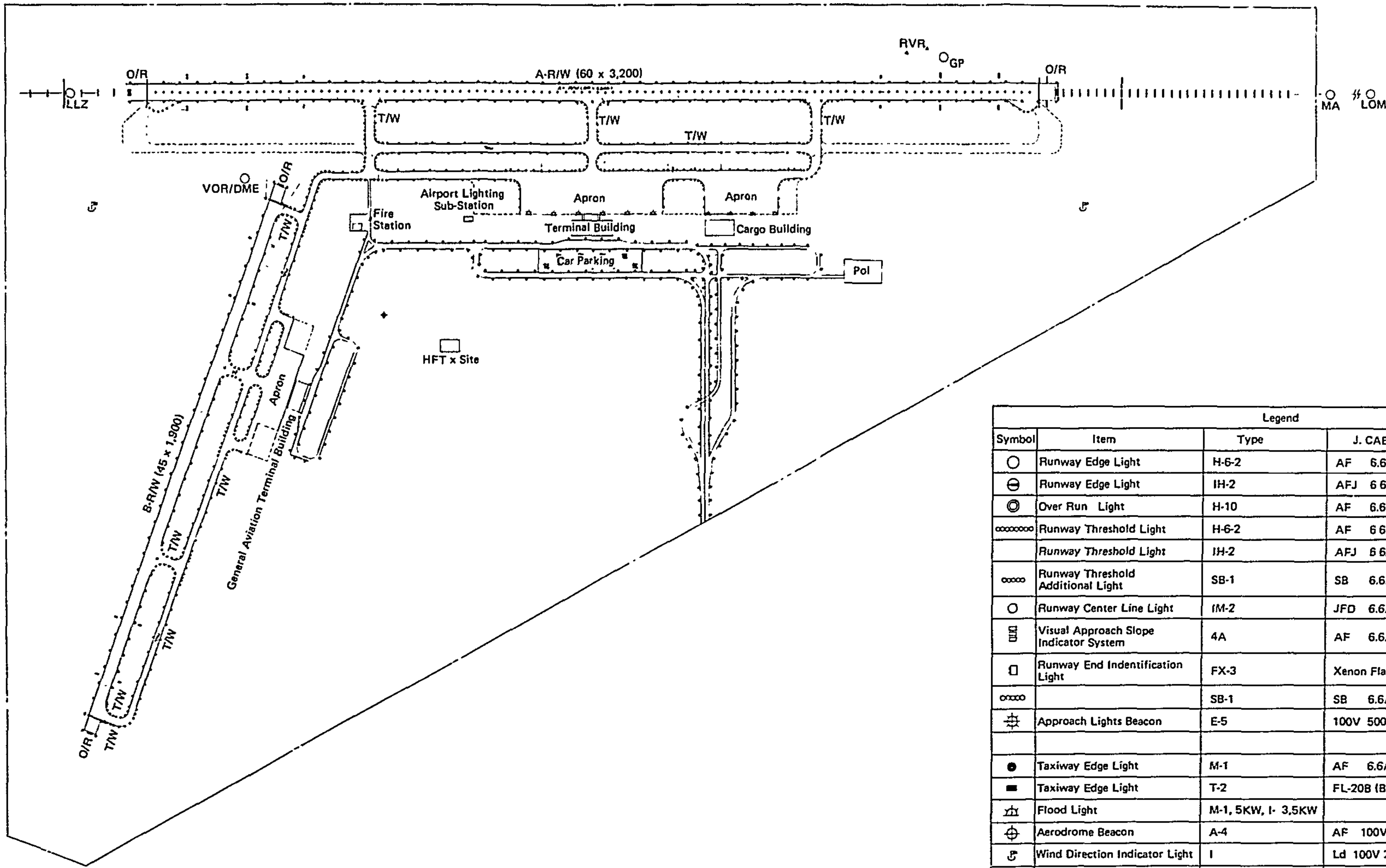
High intensity lights; one 6.6A series circuit.

(2) Runway Threshold Lights

High intensity flashing lights; one 6.6A series circuit.

(3) Runway End Identification Lights

Flashing lights to be installed at both edges of the runway end line, to be planned so that they will light only in the direction of approach.



Legend				
Symbol	Item	Type	J. CAB Standard	Units
○	Runway Edge Light	H-6-2	AF 6.6A 200W	159
⊖	Runway Edge Light	IH-2	AFJ 6 6A 200W	9
◎	Over Run Light	H-10	AF 6.6A 200W	20
oooooooo	Runway Threshold Light	H-6-2	AF 6 6A 200W	8
	Runway Threshold Light	IH-2	AFJ 6 6A 200W	70
ooooo	Runway Threshold Additional Light	SB-1	SB 6.6A 200W	20
○	Runway Center Line Light	IM-2	JFD 6.6A 200W	100
	Visual Approach Slope Indicator System	4A	AF 6.6A 200WGV	48
	Runway End Indentification Light	FX-3	Xenon Flashing	4
ooooo		SB-1	SB 6.6A 200W	228
	Approach Lights Beacon	E-5	100V 500W	2
●	Taxiway Edge Light	M-1	AF 6.6A 30W	480
▬	Taxiway Edge Light	T-2	FL-20B (Blue)	30
	Flood Light	M-1, 5KW, I- 3,5KW		10
	Aerodrome Beacon	A-4	AF 100V 2,500W	1
	Wind Direction Indicator Light	I	Ld 100V 200W x 4	3
⬭	Street Light	HF 400, HF 700		227

Fig. 9-4-1 Proposed Airport Navigational Aid Facility Plan

(4) Runway End Lights

The same as with Runway A

(5) Visual Approach Slope Indicator (VASIS)

A VASIS to be installed in both approach directions; the rest is the same as with Runway A.

9.4.3 Taxiway

Taxiway Edge Lights; medium intensity lights to be installed along the edges of the taxiways and of the apron; four to five 6.6A series circuits.

9.4.4 Others

(1) Aerodrome Beacon

Rotating beam to be installed at a place not constituting obstruction to either the Control Tower operations or to approaching aircraft.

(2) Wind Direction Indicator Lights

Three wind direction indicator lights to be installed between or around the ends of the runway and touch down point, not interfering with the transitional surface.

(3) Obstruction Lights

To be installed on top of tall structures within the airport premises.

(4) Apron Flood Lights

To be installed at the passenger apron and cargo apron, using high poles and quarts iodine lamp and metal halide lamps.

9.5 Terminal Facilities

9.5.1 Passenger Terminal Building

(1) Design Concept

Since El Salvador's new international airport will serve as the gateway to this country, the terminal building should be attractive in appearance to visitors from abroad but also to local residents.

Tropical features of the climate as well as topography of the proposed airport site should be taken to advantage in the terminal design. Buildings should be as open as possible and desirably be provided with broad canopies for protection against strong sunshine, and west side walls especially should be protected from strong afternoon sun by means of louver and/or hollow block material.

To enhance aesthetic quality of the terminal, ample tropical plants in and around the building may be placed. And aquarium with colorful tropical fish in the terminal building could be an added attraction to travelers and visitors.
Even though the building is to be of an open design, certain necessary areas in the core of the building should be properly airconditioned.
Functionability, needless to say, is the prerequisite to terminal design, which in this case is accomplished due regard, among other things, to keeping as low as possible the cost of construction as well as that of management and maintenance of the building. One such measure is utilization of maximum local material, which should also contribute to enhancing the beauty of local peculiarity in the building design, constituting added attraction to foreign visitors.

(2) Area Requirements

Calculation of the space required for the CAB and CIQ areas was based on the unit space of 15 m^2/peak hour passenger, and for all other areas, 24 m^2/peak hour passenger, in compliance with the standard of USA and that of IATA.

Table 9-5-1 Total Area of Passenger Terminal

	1980	1990	Unit: m^2
CAB, CIQ	6,700	17,600	15 m^2/PH.PAX
Lobby and Others	10,700	28,100	24 m^2/PH.PAX
Concourse	600	7,000	
Total	18,000	52,700	

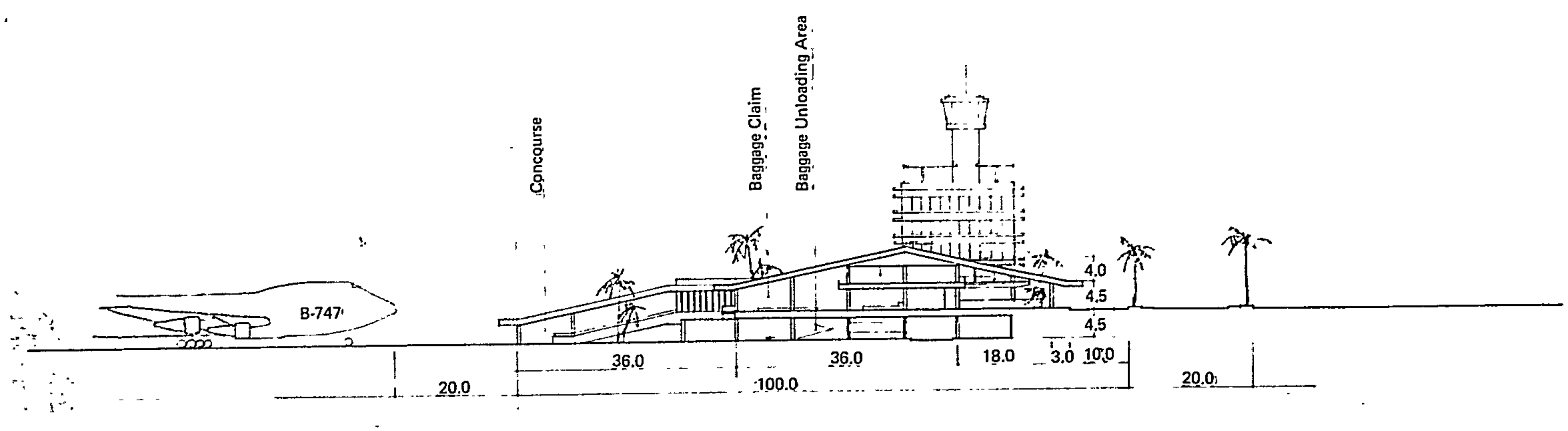


Fig. 9-5-1 Proposed International Airport Terminal Building Section

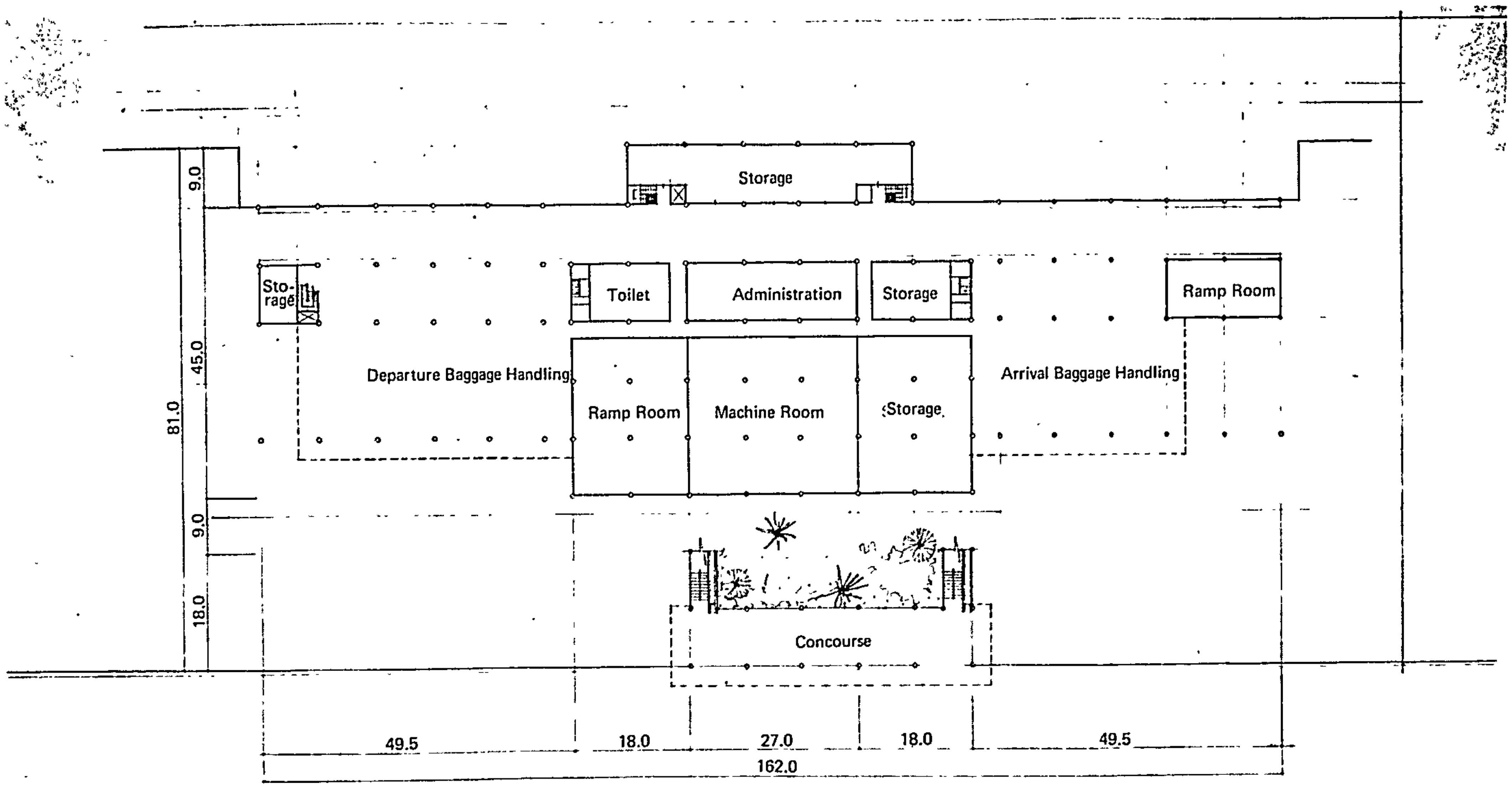


Fig. 9-5-2 **Proposed International Airport Terminal Building Basement Floor Plan**

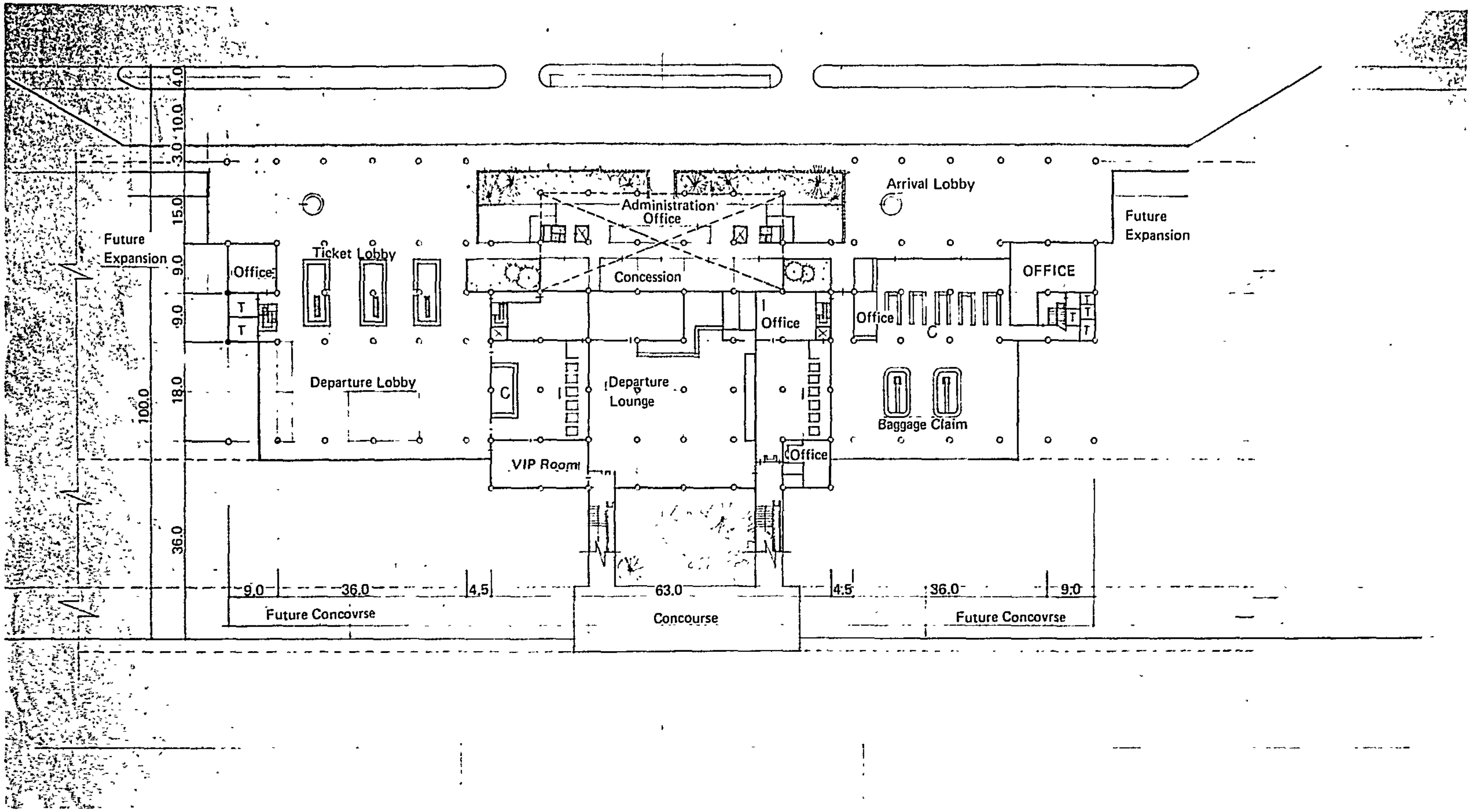


Fig. 9-5-3 · Proposed International Airport Terminal Building 1st Floor Plan

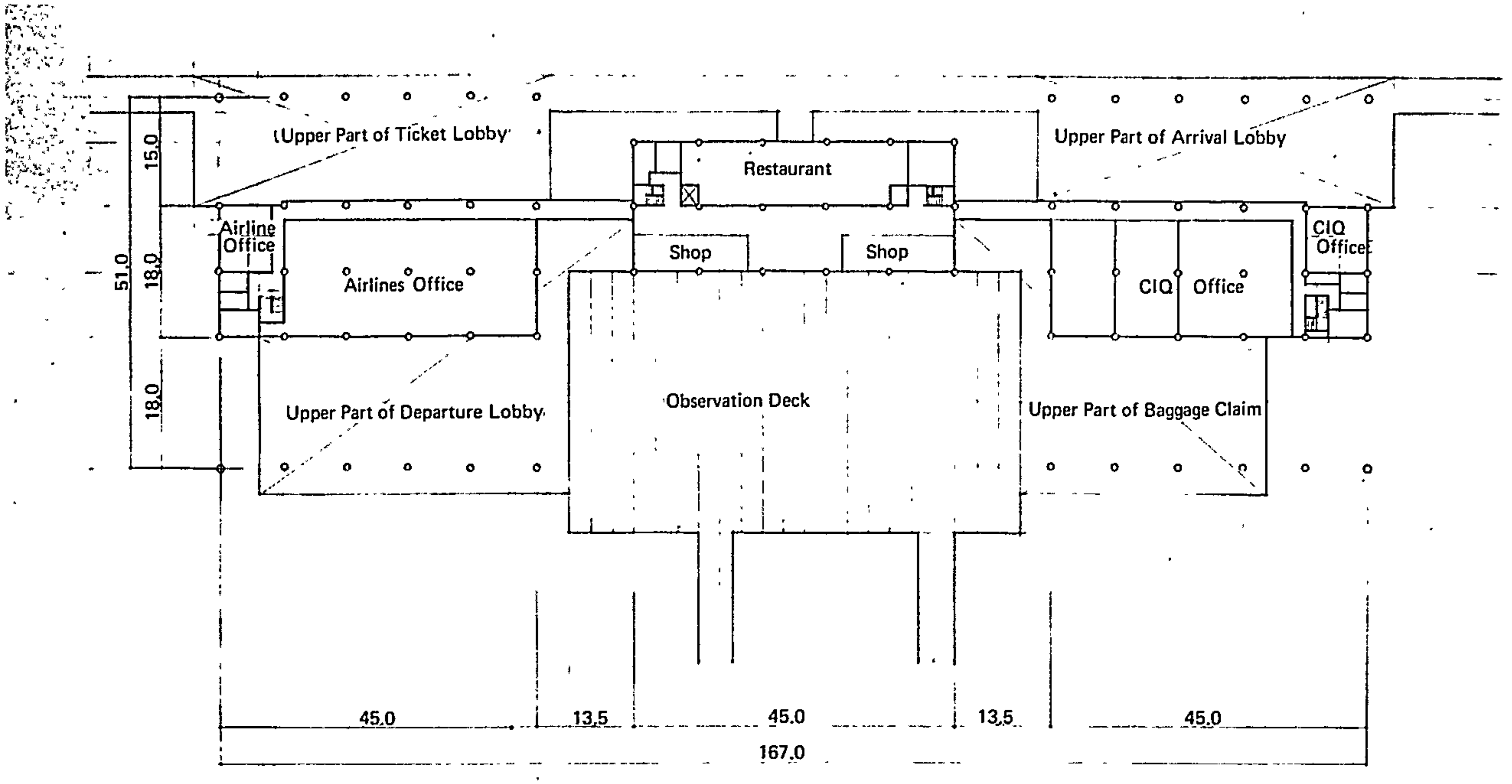


Fig. 9-5-4 Proposed International Airport Terminal Building 2nd Floor Plan

Table 9-5-2 Area Breakdown of Passenger Terminal

	Area	Remarks
Ticket Lobby	600 m^2	Length of Ticket Counter 75 m
Departure Lobby	1,400	2.5 m^2 per person, Number of Well-Wishers = 1.5 peak-hour departure passenger.
Departure Lounge	500	
Airlines Office	1,300	
Telecommunication Room	500	
Government Office	1,400	
CIQ Facilities		
Dep. Customs	300	
Dep. Immigration	300	
Arr. Immigration	300	
Baggage Claim	500	
Arr. Customs	600	
Arrival Lobby	600	
Restaurant	650	
VIP Room	200	
Machine Room	1,300	
Storage	1,000	
Dep. Baggage Sorting Room	700	
Arr. Baggage Handling Room	700	

(3) Building Layout

One of the most essential aspects of the passenger terminal building layout is to ensure simple and easy-to-understand movement of passengers without unnecessary ups and downs. The first floor plan for the initial construction calls for the arrival lobby with baggage claim area on one side of the departure lounge which also serve as the transit lounge and departure lobby with ticket counter to be placed on the other side of the departure lounge. Six floors to be built on the curb-side of the departure lounge will constitute the administration building with control tower, government offices, etc. and will also house restraunts and other concessions.

A concourse is to be expanded in the future between the Departure Lounge and the aircraft so that passengers may board the plane directly though the Boarding Bridge. However, for the 1980 plan sloping corridors and escalators are to serve the purpose.

9.5.2 Cargo Terminal Building

The space requirement of the proposed cargo terminal building is based on the cargo handling capability at the existing cargo terminal building at Ilopango Airport in 1971 (1.5 t/m^2), and the layout plan is established as shown in Fig. 9-5-5 and Fig. 9-5-6.

9.5.3 Fire Fighting Facilities

Fire Fighting Facilities are planned to be located close to the interesection of the main runway and the sub-runway, where best access to both runways can be expected, facilitating a the most effective functioning of the facilities.

On the basis of statistics made available in the study, the critical aircraft of the proposed airport in 1980 is projected to be B-707. This aircraft having the maximum fuel load capacity of 21,200 US gallons and passenger of 190, the proposed airport corresponds to category X (ten) aerodrome under ICAO Standard for Rescue and Fire Fighting, and the facilities are planned to meet the requirements recommended for this category aerodrome. (See ICAO Manual Part 5, "Equipment, Procedures and Services", Vol. I, Chapter 1, "Rescue and Fire Fighting").

The Fire Station is envisaged to have a total floor area of 1000 m^2, with an adjoining underground water storage tank of an appropriate size.

9.5.4 Aircraft Fuel Supply Facilities

In view of the fact that the fuel supply is established and operated by independent oil companies at the existing Ilopango Airport, the proposed new airport is planned to accommodate this requirement by similar arrangements. In this report, therefore, only the required space for establishment of the fuel storage and distribution system is secured and no planning of the system itself, nor its cost, has been included.

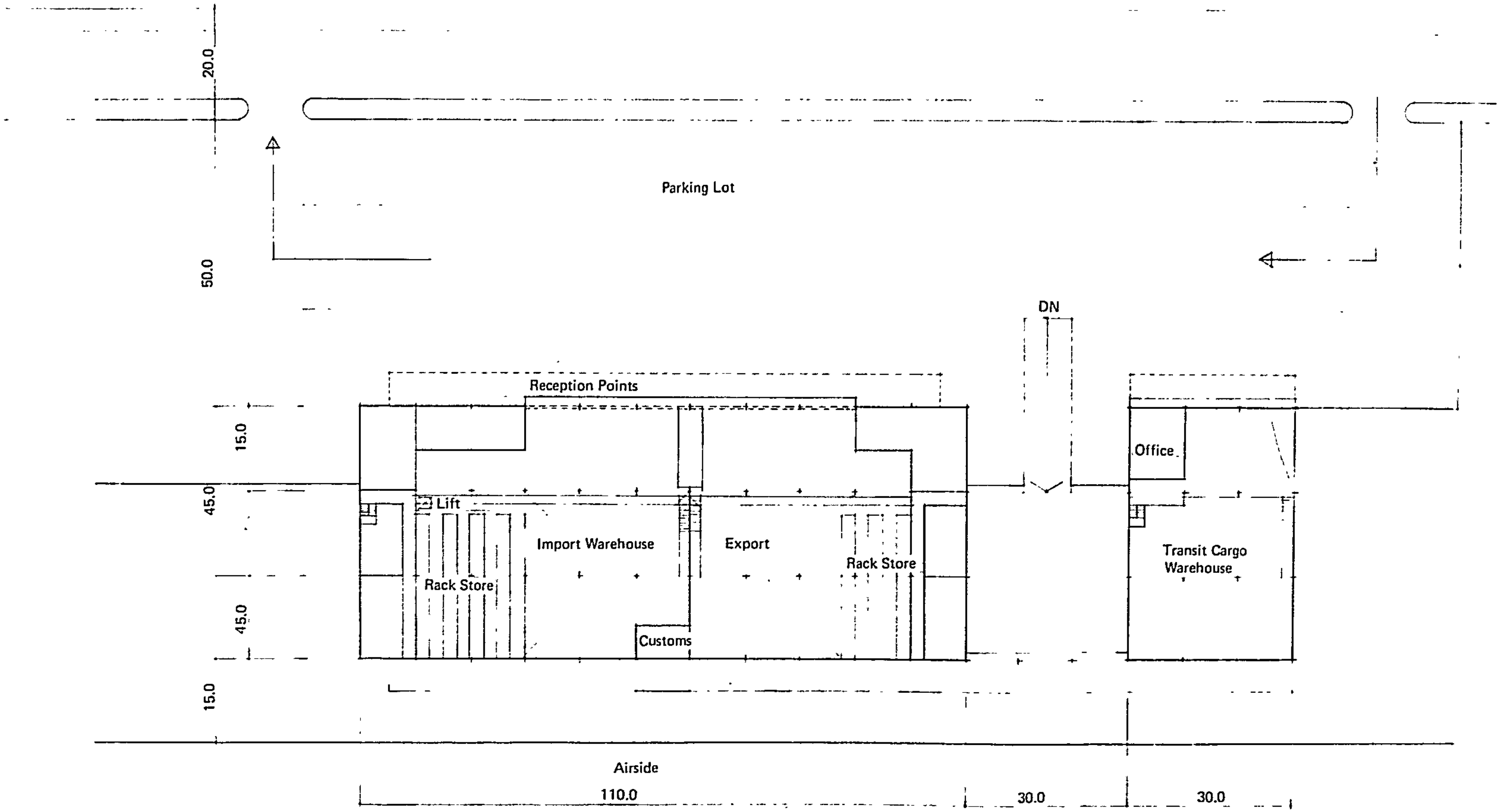


Fig. 9-5-5 Proposed Cargo Terminal Building Basement Floor Plan

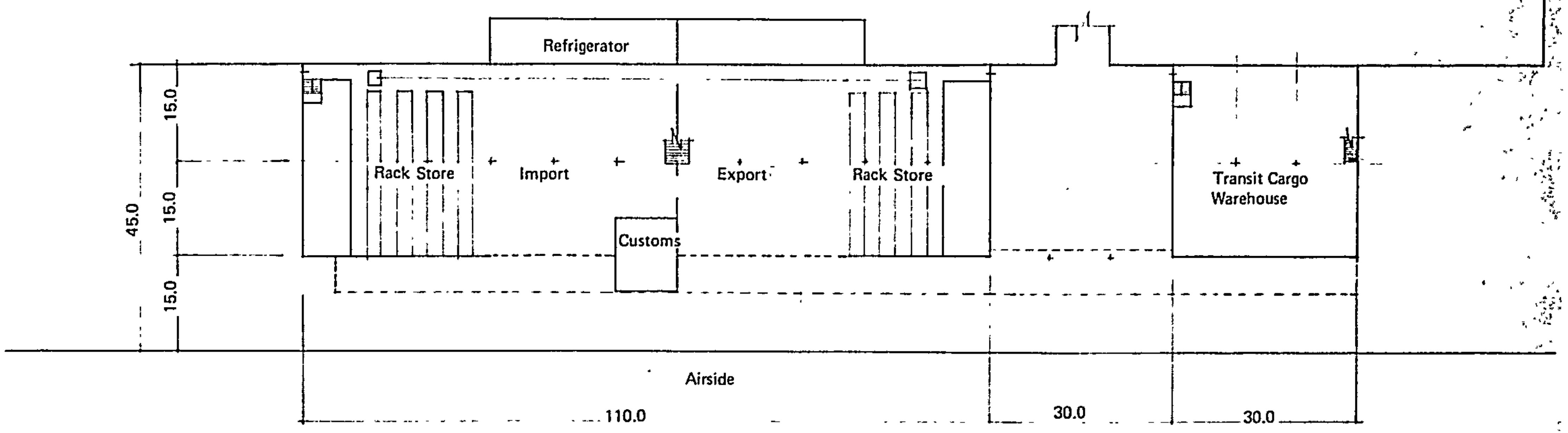


Fig. 9-5-6 Proposed Cargo Terminal Building 1st Floor Plan

10. Construction Cost Estimate

10. Construction Cost Estimate

10.1 Proposed Facilities

Various requirements of the proposed facilities as determined through considerations in this study are as summarized below:

Table 10-1-1 Proposed Facilities

	Item	1st stage	2nd & 3rd stage
Public Aircraft Facilities	Runways	3,200m x 60m	Same as left
		1,900m x 45m	
	Taxiways	3,800m x 30m	5,600m x 30m
		2,700m x 23m	Same as left
	Aprons		
	Passenger loading	8 berths(61,800m^2)	13 berths(95,400m^2)
	Cargo & Maintenance	3 berths(31,200m^2)	5 berths(43,800m^2)
	General Aviation	70 berths	
		(21,560m^2)	130 berths(38,500m^2)
Terminal Facilities	Passenger Terminal Bldg.	18,000m^2	33,000m^2
	Cargo Terminal Bldg.	10,000m^2	17,000m^2
	Fire Station	1,000m^2	Same as left
	Water Supply & Sewage	LS	"
	Power Supply	"	"
Lighting Facilities	Aerodrome Beacon	1 set	Same as left
	Precision Approach Lights	1 system	"
	Simple Approach Lights		
	VASIS	2 "	"
	Threshold Lights	2 "	"
	Threshold Identification		
	Lights	1 "	"
	Runway Lights	2 "	"
	Runway Centerline Lights	1 "	"
	Taxiway Lights	2 "	"
	Wind Direction Indicator	1 "	"
	Apron Flood Lights	"	"
	Street Lights	"	"
	Parking Lots Lights	"	"
	Sub Station	"	"

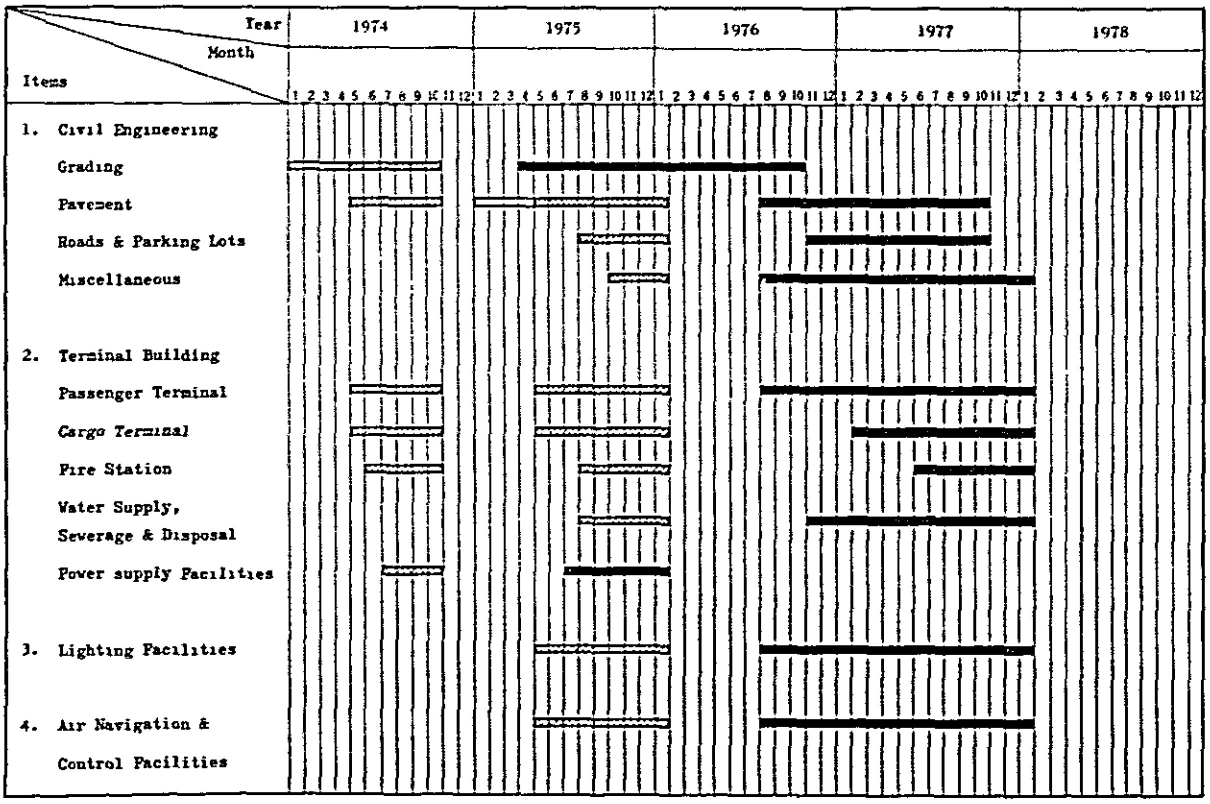
	Item	1st stage	2nd & 3rd stage
Air Navigation & Control Facilities	ATC Facilities	VHF (4 Frequencies)	Same as left
		HF (1 Frequency)	"
		Consoles	"
		Multi-Channel Tape -recorder	"
	Communication Facilities	UHF FM multiplex	"
		Teletype	"
		VHF, HF	"
		SELCAL	"
		Consoles	"
		ATIS	"
	Radio Navigational Facilities	NDB	"
		VOR/DME	"
		ILS	"
Others	Access Roads	9,000m	Same as left
	Parking Lots	30,000m²	50,000m²

10.2 Construction Schedule

New International Airport Construction Project assumed to begin at 1974, the first stage construction schedule is suggested as shown in Table 10-2-1.

Field Investigation
Basic Design
Detail Design
Construction

Table 10-2-1 Construction Schedule for the New Proposed Airport



10.3 Construction Cost Estimate

Total construction cost of the first stage is estimated as follows;

Table 10-3-1 Construction Cost Estimate

Unit: Million Yen

	Sub Total	Local Portion	Foreign Portion
Civil Engineering Works	4,163	3,237	926
Terminal Facilities	3,697	1,321	2,376
Lighting Facilities	1,081	356	725
Air Navigation & Control Facilities	650	52	598
Design & Supervision	1,351	320	1,031
Freight & Insurance	324	-	324
Contingency	1,532	740	792
Land Acquisition	277	277	-
Grand Total	13,075	6,303	6,772

Note. In the computation of the Local Portion, the exchange rate of 1₵ = ¥105 is applied.

11. Cost-Benefic Analysis

11. Cost-Benefit Analysis

11.1 Benefits and Costs

Analysis was made of the expected costs and benefits involved in and resulting from the construction of the proposed new international airport, in order to determine its economic effects quantitatively.

The benefits accounted for in this analysis are represented by benefits to air passangers in the form of reduced travel time as well as by operational revenues to be received by airport management, while the costs comprise the total cost of construction, depreciation cost, and overall operational cost of the airport.

11.1.1 Benefits

(1) Benefits of Reduced Travel Time

Measurement of this benefit was made through comparing the time requred by a traveler departing from El Salvador to reach a given destination in two assumed cases, namely one by air route directly from El Salvador, and the other by combination of road transportation up to Guatemala and air route from there to cities in the United States, or by road transportation throuthout the way for destinations of Central American cities.

Following is the equation used in the computation:

$$B = (C_R + v \cdot T_R) - (C_A + v \cdot T_A)$$

- B : benefits gained from reduced travel time
- C_R: car fares
- T_R: time required by car
- C_A: air fares
- T_A: time required by air
- v : value of time

(2) Airport Revenue

Following items have been accounted for in the airport revenue:

- Landing Charge
- Aircraft Parking Charge
- Passenger Terminal Building Rental
- Cargo Terminal Building Rental
- Taxes
- Income from Concessionnaires and Other Related Service Facilities

11.1.2 Costs

(1) Airport Construction Cost

Cost of Initial-phase Construction (1974 - 1978)

13,075 million Yen (See Chapter 10)

Cost of Second-and Third-phase Construction (1979 - 1986)

3,400 million Yen, estimated on the basis of facility requrements as tabulated in Table 10-1-1.

(2) Operational Cost

This constitutes all cost involved in the day-to-day operation and maintenance of the airport.

(3) Depreciation Cost

Cost of depreciation by fixed amount has been calculated for each of the planned facilities.

11.2 Computation of Benefits and Costs

11.2.1 Methods of Computation

Based on the project life of 30 years from 1978 through 2007, net benefits, ratio of benefits versus costs, and internal rate of return have been calculated. Three different discount rates, namely 8%, 6%, and 4%, were applied in the computation.

11.2.2 Results of Computation

Computation of benefits and costs as above has revealed that even at the discount of 8%, net benefit amounts to 9,700,000 Colones, benefit cost ratio to 1.046, and internal rate of return to 8.5% (See Table 11-2-1), indicating that the construction of the proposed new international airport is justifiable.

Table 11-2-1 Results of Computation

Discount Rate / Year	8%		6%		4%	
	Benefit	Cost	Benefit	Cost	Benefit	Cost
1972	-	2,638	-	2,638	-	2,638
1973	-	-	-	-	-	-
1974	-	1,692	-	1,756	-	1,824
1975	-	11,398	-	12,055	-	12,764
1976	-	15,461	-	16,661	-	17,980
1977	-	52,735	-	57,901	-	63,687
1978	5,163	9,532	5,776	10,665	6,475	11,957
1979	5,686	5,330	6,481	6,075	7,405	6,941
1980	5,949	10,608	6,908	12,319	8,046	14,346
1981	6,011	7,133	7,112	8,439	8,442	10,017
1982	6,088	4,743	7,340	5,717	8,880	6,917
1983	6,177	4,571	7,587	5,615	9,355	6,924
1984	6,280	4,416	7,859	5,526	9,877	6,946
1985	6,544	9,191	8,344	11,719	10.689	15.012
1986	6,663	5,691	8,656	7,394	11,302	9,654
1987	6,796	4,014	8,996	5,313	11,971	7.070
1988	6,945	3,901	9,366	5,260	12,704	7.135
1989	7,109	3,794	9,768	5,213	13,504	7,206
1990	7,289	3,695	10,204	5,174	14,377	7,289
1991	7,484	3,607	10,675	5,144	15,330	7,388
1992	7,561	3,524	10.989	5,121	16,084	7.496
1993	7,628	3,410	11,295	5,049	16,850	7.532
1994	7,695	3,299	11,610	4,977	17.653	7.568
1995	7,763	3,192	11,933	4.907	18.494	7.605
1996	7,832	3,087	12,266	4,837	19.375	7.641
1997	7,902	2,989	12,608	4,769	20,299	7,677
1998	7,972	2,892	12,960	4,701	21.267	7.714
1999	8,043	2,789	13,322	4,635	22.281	7.752
2000	8.186	2,620	14.077	4,505	23,344	7.789
2001	8,186	2,620	14.077	4,505	24.458	7,826
2002	8,205	2,535	14,375	4,441	25.455	7,864
2003	8,223	2.453	14.679	4,378	26.494	7.902
2004	8,242	2,373	14.991	4.316	27,576	7,940
2005	8,261	2,296	15.309	4,255	28,704	7.978
2006	8,281	2,222	15,634	4,195	29,878	8,016
2007	8,301	2,150	15,968	4,135	31,101	8,055
Total	218,393	208,697	330,782	264,374	517,670	348,050
Net Benefit (B-C) Benefit-Cost Ratio (B/C) Internal rate of Return	9,696 1.046		66,408 1.251		169.620 1.487	
	8.5%					