社会開発調査部報告書

REPUBLIC OF GUATEMALA

MINISTERIO DE COMUNICACIONES, TRANSPORTE Y OBRAS PUBLICAS

DIRECCION GENERAL DE AERONAUTICA CIVIL

STUDY ON THE DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS

FINAL REPORT

VOLUME - I : MAIN REPORT

MARCH 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF GUATEMALA

MINISTERIO DE COMUNICACIONES, TRANSPORTE Y OBRAS PUBLICAS

DIRECCION GENERAL DE AERONAUTICA CIVIL

STUDY ON THE DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS

FINAL REPORT

VOLUME - I : MAIN REPORT

MARCH 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of the Republic of Guatemala, the Japanese Government decided to conduct a study on the development project of La Aurora and Santa Elena Airports and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to the Republic of Guatemala a survey team, headed by Mr. Shoichiro Maeda, composed of members from Nippon Koei Co., Ltd. on three occasions : during the period from January to March 1989, from September to October 1989 and in January 1990.

The team held discussions with concerned officials of the Government of the Republic of Guatemala, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Guatemala for their close cooperation extended to the team.

March, 1990

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

SUMMARY

Air Transport

01 Air travel and transportation have been playing an increasingly significant role in the socio-economic development of Guatemala in recent years. Value added in the air transport sector increased by more than 25% in 1986-87. Air passenger travel through La Aurora airport rose by more than 20% per annum in 1987 and 1988, and it reached about 755,000 passengers (about 419,000 foreigners and 336,000 Guatemalans) in 1988. Air cargo movements at La Aurora also increased by 18% per annum in 1986-88, and they exceeded 18,000 tons (about 10,000 tons for exports and 8,000 tons for imports) in 1988. While only fragmentary data were available for the early months of 1989, the evidence suggested that demand for air travel and transportation at La Aurora remained strong. On the other hand, traffic at Santa Elena airport which serves for the tourist spot of the Mayan ruins at Tikal and the regional development of Petén Province, has been relatively small with slightly less than 100,000 passengers and 600 tons of cargo in 1988.

02 An improved, if not buoyant, Guatemalan economy is anticipated over the next decade, and the traffic at La Aurora and Santa Elena airports is expected to increase steadily. The traffic forecast indicates that the passengers at La Aurora would increase to reach 1,214,000 in the year 1995 and nearly 2,500,000 in 2005. La Aurora cargo movements would also increase up to around 23,000 tons in 1995 and 41,000 tons in 2005, incorporating a substantial increase in non-traditional exports. The traffic forecast at Santa Elena, on the other hand, indicates that the passenger traffic would reach 130,000 in 1995 and about 200,000 in 2005, if supporting touristic facilities are concurrently developed in the area.

03 The airport congestion and delays, as well as the justification for facility expansion, tend to occur at peak hour periods. The peak hour commercial operation at La Aurora was 10 flights in 1988. Generally, as airport passenger volume rises, the peak hour passenger flow tends to fall as a percent of total passenger volume, because rise in traffic volume and the resultant congestion tend to cause a spreading out of peak hour passenger flows and aircraft operations. At La aurora, however, only very

modest declines are anticipated in peak activities, because La Aurora is a hopping airport with least flexibility when it comes to re-arranging hourly operational activity. Analysis indicate that the peak hour commercial operations would be 14 flights per hour in 1995 and 22 flights in 2005. It is also estimated that the peak hour passengers in La Aurora terminal would reach around 1,090 in 1995 and 2,125 in 2005.

Status of Existing La Aurora Airport

04 La Aurora airport has a principal runway of 2,987 m in length and 60 m in width. The runway length is a great limitation. Located at 1,509 m above mean sea level, the runway length required for operations of the B-747s type aircraft is calculated to be 4,100 m, and the existing runway is far short of this ICAO recommendation. The maximum runway slope is as high as 1.786% and it does not meet the ICAO standards. To make matters worse, the parallel taxiway runs at a separation distance of 70 m from the runway centerline, far short of 150 m separation distance required for VFR operations and 180 m separation for IFR operations. This impedes safe operation of the aerodrome, especially in peak hour operations. Analysis indicate that the maximum peak hour commercial operations under the present runway-taxiway conditions would be practically limited to 10-11 flights per hour. Since the peak hour operation was 10 flights in 1988, the existing conditions of the runway and parallel taxiway have almost reached their full capacity.

05 The passenger terminal apron has a total area of 69,000 m^2 for 7 gates. Total hourly gate capacity at La Aurora is limited to slightly over 7 aircraft/hour. Some of the 10 peak hour operations in 1988 stayed overnight and loaded before the start of actual peak hour. Taking such overnight stays into account, La Aurora terminal apron and gates have nearly reached the full capacity under the present situations. Further, the total peak hour passengers at La Aurora terminal building was 725 (without transit passenger) in 1988. Since the capacity of the existing passenger terminal is estimated to be 850, the total terminal spaces are within the international standards of the terminal capacity. In the light of the anticipated peak hour terminal passenger (1,090 in the year 1995) and the design terminal capacity (930 or 85% of the peak hour passengers), the existing terminal capacity is expected to fall short of the requirements in or around 1994.

06 The passenger terminal presents various inconveniences for departing and arriving passengers. The problem areas in the terminal are multi-level circulation for departing passengers, enplanement and deplanement processes for wide-body aircraft, limited facilities for transit passengers, emigration and immigration procedures, etc. On the other hand, the cargo terminal of 8,100 m^2 in total area has been primarily used for imports, and outbound shipments have been stored on the apron outside. There is no refrigerated storage spaces available at La Aurora.

07 Airport and aviation support facilities are also problematic. The most notable is the old radar equipment. The ASR cathode ray is deteriorated or "burned", and the SSR cannot display aircraft identification. Safe operation of La Aurora airport is therefore critically hampered, and complete renewal of the ASR/SSR equipment is urgently required. The control tower is inadequately located and the tower height (12.8 m in the floor level) is too low to meet the FAA regulations. This also hampers safe operation of La Aurora airport. Further, CFR facilities are not in serviceable conditions. Such being the situation, safe operation of La Aurora airport is critically hampered, and it would not be a matter of surprise if an accident occurs in near future causing serious casualties. On all counts, it is better to prevent the first accident rather than the second.

Proposed Short Term Improvements to La Aurora

08 Since the densely urbanized areas developed adjacent to the Runway 19 threshold to the north and the steep cliff extended from the Runway 01 threshold to the south, the runway extension is impracticable at La Aurora. Take-off weight limitation will continue to be imposed as an operational penalty for flights of long air ranges. To enhance safe landing and take-off on the runway in the limited length, it is proposed to carry out the grooving on the full length of the runway. Relocation of the parallel taxiway is a fundamental requirement to secure safe operations and to enhance operational capacity. It is proposed that a new parallel taxiway with a separation distance of 180 m from the runway centerline is constructed for the section of 700 m from the Runway 19 threshold to the apron area in the short-term improvement stage. Combined with the proposed construction of a rapid-exit taxiway, the runway-taxiway capacity will be increased practically to 16 commercial aircraft operations per hour. This capacity would satisfy the peak hour operations towards the end of 1990's.

09 The apron berths and gates will be expanded to meet the requirements which are estimated to be 10 berths in 1995. A new international concourse is proposed to be constructed by extending the terminal to the north within the existing airport property boundary. The new concourse will accommodate 3 gates for wide-body jets. The area of apron expansion will be 23,900 m^2. At the same time, cargo terminal apron will be expanded by about 11,000 m^2 to accommodate 3 freighters in the short-term improvement stage. In addition, improvements are proposed for GSE services, airfield maintenance services and drainage system improvements.

10 The passenger terminal building is proposed to be improved to serve efficiently and functionally for the estimated passenger traffic in 1995 when the terminal space requirements would be increased to about 26,700 m^2. Basically, it is proposed to concentrate all expansion of departure and check-in activities on the second floor, which will avoid aggravating traffic flow between check-in on the third floor and departure on the second floor. Transition between the two areas will be facilitated with the installation of two new escalators. In addition to the new 3-gated international concourse on the north wing, a new domestic concourse to accommodate one boarding bridge is proposed to be constructed on the south wing. Further, improvements are proposed for separation of arrival and departure traffic, enclosure of mezzanine, baggage sorting and make-up, as well as installation of modern screening devices, to ensure security in the terminal areas. For the cargo terminal, rearrangement of space utilization and installation of refrigerated storage facilities will be envisaged in the short term improvements.

11 A new control tower is proposed to be installed at the north-eastern corner of the green near DGAC building. The tower height is proposed to be 34 m. A new ASR/SSR equipment is procured and installed, together with the off-aerodrome radio facilities to be located at Petepa (about 7,960 m from the Runway 01 threshold). Until the new radar system is installed, positive control by the existing radar should be refrained from in peak hours. For CFR facilities, installation of one rapid intervention vehicle and two major vehicles with slight modification of the CFR building is proposed in the short term. Likewise, relocation of fuel farm, procurement of maintenance shop equipment, improvements in power supply systems, airfield lighting and meteorological equipment are proposed to satisfy the minimum requirements in accordance with the ICAO standards.

12 To ensure safe airspace operations, it is proposed to clearly establish the obstruction limitation surfaces and to prohibit any invasion into these limitations. Some modification in Standard Instrument Departure Procedures (SIDs) and Standard Terminal Arrival Routes (STARs) is recommended, together with establishment of lost-communication procedures. Noise is the major environmental consideration associated with the airport operations. According to the measurements by the Weighted Equivalent Continuous Perceived Noise Level (WECPNL), the noise level of 1995 operations would not be aggravated substantially even though the 1995 daily traffic would be 2.6 times the 1988 traffic. It is primary attributable to the tendency that the flight schedule at La Aurora would continue to concentrate in the time range of 07:00 - 10:00 and 16:00 - 20:00 when less affect is expected on the weighted noise level.

13 To safely and efficiently operate the proposed facilities and services and to maintain a level of such services consistent with the traffic increase, the institutional improvements will also be proposed. It is envisaged that the DGAC will have a minimized function for making policies and overall supervision of La Aurora and other airports in Guatemala, and that a semi-autonomous and self-financing authority will be newly established for operation and management of La Aurora airport. Such an authority might be called the Guatemala International Airport Authority (GIAA). About 500 personnel required for GIAA will be organized under the Administrator and five Departments. Further, it is scheduled that the implementation of the proposed short-term improvements will take a period of 3 years for pre-construction services and construction works. Since the traffic demand is expected to outrun the runway-taxiway capacity, apron berth and gate capacity, and terminal capacity by 1994 or even before, it is scheduled that the implementation will start at the beginning of 1991 and complete by the end of 1993. The earliest financial arrangements would therefore be required.

14 The construction costs of La Aurora short-term improvements are estimated to be US$50.3 million equivalent. Inclusive of price escalation and interest during construction period, total fund requirements will amount to US$62.2 million. The economic benefits have been estimated in terms of the willingness to pay of the unrealized travellers or rejected passengers beyond the capacity of the airport facilities. The economic internal rate of return (EIRR) is calculated to be 56% for a 20 year analysis period. Even in the event that the traffic increase turns out to be lower than expected by

2%, EIRR would remain at 37%. The proposed short-term improvements to La Aurora are therefore evaluated to be economically feasible.

15 The revenue potential of La Aurora has been estimated on the basis of the normalized tariff for landing fees, departure taxes, terminal space rent, petroleum charges and other revenues. The operation and maintenance costs, as well as the replacement obligations, have also been estimated. On the basis of the financial inflows and outflows, the financial international rate of return (FIRR) is calculated to be 16%. The investments in La Aurora short-term improvements are therefore evaluated to be financially viable and highly profitable. The surplus after repayment of loans would exceed US$11 million in 1996 and US$14 million in 1999.

Further Long Term Improvements to La Aurora

16 The long-term improvements to La Aurora airport are planned to satisfy the traffic demand in the target year 2005, which is anticipated to be 2,500,000 annual passengers with 22 peak hour commercial operations, and 41,000 tons of cargo movements. Since the short-term improvements have been designed for the operational level of 16 practical operations in peak hours and 1,750,000 passengers in the terminal building, further expansion should be realized in the early years of 2000's. In the airside, it is proposed to extend the parallel taxiway to the southern part to complete the full length of 2,987 m. With this expansion, the runway-taxiway capacity would practically be increased to 24 operations in peak hours. Since the IFR operations with the installation of MLS are envisaged, a number of obstacles within a 300 m wide runway strip should be relocated and cleared off by that time.

17 In the new international concourse, it is proposed to additionally install 3 berths for large and medium jets (6 berths for wide-body in total in the short and long terms) and 2 berths for small jets (8 berths in total). Since the gate No. 7 in the central international concourse is abandoned at that time, a total of 14 berths will be in service for the international passengers. One boarding gate will also be added to the domestic concourse. The area of apron expansion in the long-term stage would be about 40,900 m^2. On the other hand, a new cargo apron will be designed to accommodate 4 positions for freighters in the area of about 26,900 m^2 extended to the north of the passenger terminal apron. Further, it is proposed to construct a new general aviation

hangar area of about 14 ha to the north of the new cargo terminal and relocate all the existing hangers scattered around the runway and taxiway. To realize the expansion of these facilities, it is indispensable to acquire a concession for the utilization of land used as the horse racetrack which is seldom open at present.

18 In addition to the expansion of departure gates in the new international concourse and domestic concourse, the passenger terminal building is proposed to be further improved, including a provision of the second floor passenger drop-off to enhance efficiency in passenger movements in the terminal. A new cargo terminal building of 13,100 m^2 in space is proposed for construction in the long term stage, together with the new access road to the terminal. The CFR building (600 m^2) and the maintenance shop (880 m^2) are also planned for reconstruction. The fuel farm of 8,000 m^2 is relocated to the northwestern corner of the expanded airport compound. The long-term improvements for navaids and telecommunications include the installation of MLS, replacement of VOR/DME, and replacement of AIS and airfield lighting systems. VOR and NDB approach procedures should also be established to secure safe and efficient airspace operations.

19 The environmental impacts might be a major concern for the long-term improvements to La Aurora, because the airport is located adjacent to the densely urbanized area and the substantial changes in landing and take-off procedures are impracticable due to the surrounding terrain configuration and difficulty in runway expansion. However, introduction of aircraft of quieter engines and other countermeasures are practicable. The WECPNL noise level analysis indicates that the introduction of the newer types of aircraft, such as B-737-400 instead of B-727, and the continued concentration of operations in the time range of 07:00 - 10:00 and 16:00 - 20:00 would result in substantial noise level improvements in the year 2005 if compared with the noise level in 1995 when operations of the old types of aircraft are assumed to continue. By the appropriate directions to introduce the newer types of aircraft, as well as to prohibit the midnight flights and to plan noise sensitive installations to be built outside the noise affected area or in the lower WECPNL level areas in the future, the continued and expanded operations at La Aurora is considered to be sustainable.

20 The additional costs required for La Aurora expansion in the long term are estimated to be around US$60.3 million equivalent, including costs of land

acquisition and physical contingencies. The economic benefits estimated to accrue from the unrealized travellers or rejected passengers would amount to US$185 million in the year 2005. It appears that, with the substantial traffic increase expected in the future, the long range plan proposed for La Aurora improvements will certainly prove to be economically feasible and financially justifiable. Decision on the investments in the long-term plan should be made after careful review of the traffic increase and the operational activities of the short-term improvements to La Aurora.

Proposed Short Term Improvements to Santa Elena

21 Santa Elena airport is a relatively new airport starting its operations in 1982. The concrete paved runway is 3,000 m in length and 45 m in width with 7.5 m shoulder on both side. The parallel taxiway is limited to only 188 m from Runway 10 to the apron. The apron area of 18,900 m^2 is capable to position one small jet, two STOL type aircraft and 12 small chartered aircraft. The runway, taxiway and apron will be serviceable with some repair of cracks developed on the concrete pavement. Such repair works of cracks are proposed for execution in two sections of the runway (100 - 150 m and 450 - 700 m from the Runway 10 threshold) and in a part of the apron area. The existing terminal building can also continue to serve. Improvements are, however, proposed with respect to the quality of spaces, both in function (distribution) and in quality (finishes, etc.). Such improvements will include linkage of arrival and departure buildings, elimination of dedicated international areas, better system in baggage area, etc.

22 Airport and aviation support facilities are yet insufficient at Santa Elena. The CFR facilities (one rapid intervention vehicle and one major vehicle) and the fuel farm are proposed to be newly installed. Further, installation of the secondary power supply systems (a 250 kVA generator for the airport complex and a 7.5 kVA generator for the VHF station) is urgently required because frequent power failures are serious problem at Santa Elena. Installation of ATIS (automatic terminal information service) and PAPI (precision approach path indicator) is also recommended. In view of the future traffic increase at Santa Elena, a route with the protected airspace between Santa Elena and La Aurora is proposed to be properly established. This is particularly important when Santa Elena comes to play a role as an alternate airport to La Aurora. The air route of about 160 nautical miles has been elaborated in this Study, together with the specifications to

be defined and promulgated in AIP. Likewise, the procedures for SIDs and STARs at Santa Elena are proposed to ensure efficient and safer airspace operations.

23 The proposed short-term improvements at Santa Elena will cost about US$3.5 million equivalent, and the construction and installation works will be scheduled for 1993. Inclusive of price contingencies and interest during construction period, the total fund requirement will amount to about US$4.5 million equivalent. The investments in Santa Elena improvements should be evaluated in the framework of the Integrated Area Development Package, because the associated and supporting facilities are to be developed in an integrated manner. The average economic costs of the airport improvements, additional hotel rooms and other supporting facilities are estimated to be about US$12.5 million equivalent, and the present worth of the economic outflow calculated at the discount rate of 12% would amount to US$11 million. On the other hand, the 15,000 added visits or trips to Tikal and Santa Elena area is expected and it is anticipated to increase at the rate of about 4% per annum. If the annual benefits estimated in terms of increase in value added by the integrated area development are calculated at the discount rate of 12%, the present worth of the benefits would amount to US$12.1 million equivalent. This indicates that the implementation of the short-term integrated area development, including the short-term Santa Elena airport improvements, can be economically justified.

24 The financial inflow of the Santa Elena airport operations has been estimated in terms of the normalized tariff structure. The total revenues, however, remain still small to cover the operation and maintenance costs and the repayment obligations. It is primarily due to low traffic anticipated at Santa Elena. It is noted, however, that the combined financial performance of the short-term improvements to Santa Elena and La aurora airports should be considered to evaluate the improvements in the air transport sector. Through the consolidated financial statement of Santa Elena and LA Aurora operations, it is evaluated that the proposed investments on the consolidated basis are financially viable and self-liquidating. Such a consolidated surplus will exceed US$11 million in 1996 and US$13 million in 1999.

Further Long Term Improvement to Santa Elena

25 To satisfy the anticipated traffic in the year 2005, which is estimated at 200,000 passengers, further improvements to Santa Elena will be required. In the airside, the parallel taxiway is proposed to be extended up to the Runway 28 threshold, in conjunction with the provision of a pair of rapid-exit taxiways, in order to promote safer and more efficient operations. The terminal apron will be slightly extended (by about 4,500 m^2). Although the existing terminal apron and building are not ideally located, the expansion of these facilities in the long term is planned at such locations. The terminal building will be improved further by either interior modifications or small additions. The cargo terminal building on a modest scale (300 m^2) is newly provided in the long-term improvement stage.

26 Renovation of the control tower is recommended in view of the inadequate design and location of the existing tower. A new control tower of 28 m in height will be constructed at a site about 370 m from the runway on its eastern side. (As far as the financial situation permits, it is desirable that the relocation of the control tower be implemented in the short-term stage.) To grade up Santa Elena to be a precision approach Category-1 airport, installation of MLS and precision approach lighting system is envisaged in the long term. It is also envisaged to replace the other navaids and telecommunication facilities, as well as to provide passenger service electric facilities in Santa Elena airport. The construction and installation costs of the long-term Santa Elena improvements are estimated to be about US$18.8 million equivalent. Such an additional investment is preliminarily evaluated to be economically justifiable.

Recommendations

27 As noted in Paragraph 07 above, safe operation of La Aurora airport is critically hampered due to deteriorated radar equipment, and renovation of ASR/SSR equipment is urgently required. At the same time, CFR facilities are not in serviceable conditions and it is necessary to replace the rapid intervention vehicle and major vehicles. Likewise, in Santa Elena airport, frequent power failures cause serious problem in maintaining safe operation of the airport, as noted in Paragraph 22 above, and installation of the secondary power supply is urgently necessitated. To ensure safe operation of La Aurora and Santa Elena airports, it is recommended that the renovation and replacement

of these facilities be executed immediately as the "Emergency Programs" for improvements. Total costs of the Emergency Programs are estimated to be about US$10.1 million equivalent.

28 Implementation of the proposed short-term improvements to La Aurora airport has been evaluated to be technically sound, economically feasible and financially viable. On the other hand, the short-term improvements to Santa Elena airport has been evaluated to be economically feasible but their financial viability is rather marginal. It is now recommended that the short-term improvements to La Aurora and Santa Elena airports be taken up as a package program for the air transport sector development and be implemented at the same time. In this context, it is further recommended that the government authorities take necessary actions to raise funds for the implementation of the package program. The requirements for the external loans on concessional terms would be about US$56.7 million, and the local burrowing needed to cover the balance of fund requirements would amount to about US$10.0 million equivalent. It is also recommended that the Government authorities initiate studies on the normalization of the tariff structure and the establishment of a new organization, Guatemala International Airport Authority (GIAA). Some other recommendations are also presented in this Study for the efficient implementation of the short-term improvements.

29 This Study revealed that it is technically possible and economically justifiable to further expand La Aurora and Santa Elena airports in the long term to satisfy the traffic demand anticipated for the year 2005, only on the condition that a concession of the land presently used as a horse racetrack is granted to DGAC or GIAA. In this context, it is recommended that the Government authorities recognize the high economic and financial benefits to accrue from the expansion of the airport complex and the concession of the land property be granted to the airport authority by the time decisions must be made on the implementation of the long-term improvements.

30 Through the execution of this Study, the Study Team observed and took note of various suggestions which, if implemented, would contribute to the better management of civil aviation in Guatemala. Such suggestions and recommendations include strengthening of data processing and statistical systems, protection of the obstacle limitation surfaces, introduction of newer types of aircraft with quieter engines, strengthening of the airport security systems, limitation of the general aviation area to the

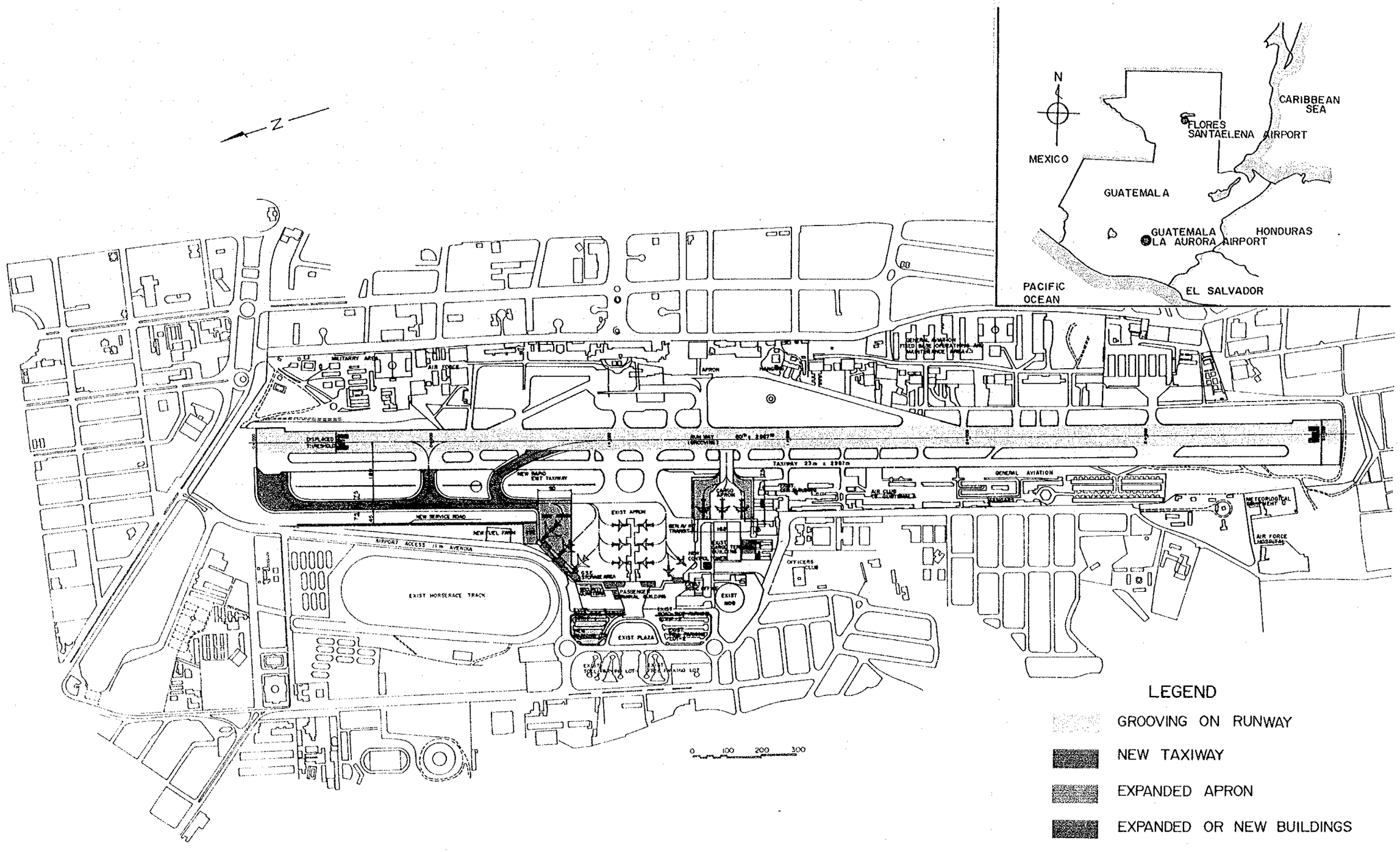
boundary of present location, arrangements to ensure execution of the minimum maintenance work, continuation of efforts for staff training, etc. These recommendations, as well as the recommendations on the project implementation, are presented in a summarized form in Part-4 of this Report.

Table 01 PROPOSED IMPROVEMENTS (LA AURORA)

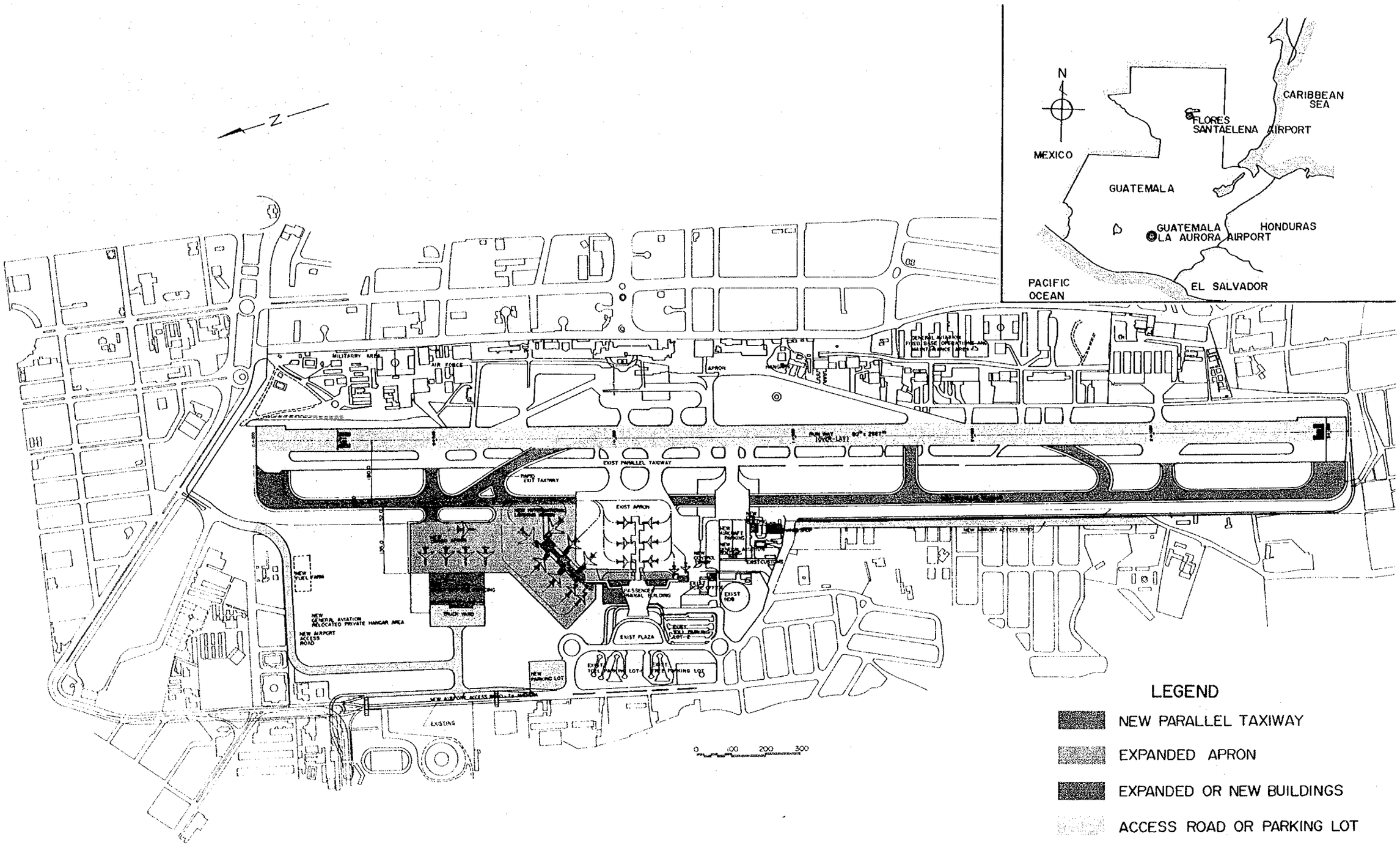
	Existing (1988)	Short Term Plan (1995)	Long Term Plan (2005)
Annual Passenger	754,876	1,214,000	2,500,000
Annual Cargo (t)	18,287	23,000	41,000
Peak Hour Comm. Operations	10	14	22
Peak Hour Passengers	725	1,092	2,125
Runway Strip	3,107 m x 50 m	3,107 m x 50 m	3,107 m x 300 m
Runway	2,987 m x 60 m	2,987 m x 60 m (Overall Grooving)	2,987 m x 60 m (Overlay, Grooving)
Parallel Taxiway	2,987 m x 23 m (70 m from RWY)	700 m x 23 m (180 m from RWY) 1,757 m x 23 m (70 m from RWY)	2,987 m x 23 m (180 m from RWY)
Runway-Taxiway Capacity	10	16	24
Passenger Terminal Apron	69,000 m2	(Exp) 92,900 m2	(Exp) 133,800 m2
International Gate	7	10	14
Domestic Gate	1	1	2
Cargo Terminal Apron	9,200 m2	(Exp) 20,300 m2	(Exp) 26,900 m2
(Position)	2	3	4
Passenger Terminal Building			
International	22,069 m2	(Exp) 26,700 m2	(Exp) 42,000 m2
Domestic	(193 m2)	(Exp) 1, 030 m2	(Exp) 1,670 m2
Passenger Terminal Capacity	850	930	1,810
Cargo Terminal Building	8,100 m2	8,100 m2	(New) 13,100 m2
Control Tower (height)	12.8 m	(New) 34 m	34 m
CFR Facilities	Not serviceable	Renew (Emergency)	-
Fuel Farm	1,230 kl	1,980 kl	3,480 kl
Navaids:			
ASR/SSR	Deteriorated	Renew (Emergency)	-
VOR/DME, NDB	Serviceable	-	Relocate
MLS	-	-	Install
Construction Period		1991 - 93	
Direct Construction Costs		$50,307 x 1,000	$60,261 x 1,000
Total Fund Requirement		$62,207 x 1,000	
External funds		$52,876 x 1,000	
Local Funds		$9,331 x 1,000	
Economic Feasibility		Feasible (EIRR = 56%)	
Financial Viability		Viable (FIRR = 16%)	

Table 02 PROPOSED IMPROVEMENTS (SANTA ELENA)

	Existing (1988)	Short Term Plan (1995)	Long Term Plan (2005)
Annual Passenger	99,359	130,000	200,000
Annual Cargo (t)	571	905	1,335
Peak Hour Comm. Operations	3	3	4
Peak Hour Passengers	120	140	200
Runway Strip	3,120 m x 150 m	3,120 m x 150 m	3,120 m x 300 m
Runway	3,000 m x 45 m	3,000 m x 45 m (Crack Repair)	3,000 m x 45 m
Parallel Taxiway	188 m x 23 m	188 m x 23 m	3,000 m x 23 m
Terminal Apron	18,900 m2	18,900 m2	(Exp) 23,400 m2
Passenger Terminal Building	2,268 m2	2,268 m2 (Improve Interior)	2,268 m2 (Improve Interior)
Cargo Terminal Building	No	No	(New) 300 m2
Control Tower (height)	15.65 m	-	28 m
CFR Facilities	No	Install 2 vehicles	-
Fuel Farm	No	150 kl	200 kl
Electric Power	Secondary Power Not Serviceable	Install (Emergency) Secondary Power	-
Navaids:			
ASR/SSR	No	No	No
VOR/DME, NDB	Fair Reception	-	Replace
MLS	No	No	Install
Air Traffic	No	SIDs, STARs Air Route to and from La Aurora	
Construction Period		1991 - 93	
Direct Construction Costs		$3,598 x 1,000	$18,815 x 1,000
Total Fund Requirement		$4,538 x 1,000	
External funds		$3,857 x 1,000	
Local Funds		$681 x 1,000	
Economic Feasibility		Feasible	
Financial Viability		Marginal (to be consolidated with La Aurora)	



DEVELOPMENT PLAN OF LA AURORA AIRPORT
SHORT TERM PLAN



DEVELOPMENT PLAN OF LA AURORA AIRPORT
LONG TERM PLAN (INCL SHORT TERM PLAN)

STUDY ON DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS

Volume-I: Main Report

Table of Contents

Page

PART-2 LA AURORA AIRPORT IMPROVEMENTS

Page

PART-4 RECOMMENDATIONS

List of Appendices in Volume-II

Abbreviations

[Organizations]

ANACAFE	Asociación Nacional de Café
BAA	British Airport Authority
COCESNA	Corporación Centroamericana de Servicios de Navegación Aerea
DGAC	Direción General de Aeronáutica Civil
FAA	Federal Aviation Administration
FEGUA	Ferrocarril Nacional de Guatemala
GUATEL	Instituto Guatemalteco de Telecomunicación
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
INSIVUMEH	Instituto Nacional de Sismología, Meteorología e Hydrología
JICA	Japan International Cooperation Agency
MCTPW	Ministry of Communications, Transport and Public Works
SEGEPLAN	Secretaría General de Planificación Económica Nacional
USAID	United States Agency for International Development

[Airport Terminology]

AFL	Airfield Lighting
AFTN	Aeronautical Fixed Telecommunication Network
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
ASR	Airport Surveillance Radar
ATC	Air Traffic control
ATS	Air Traffic Services
CCR	Constant Current Regulator
CCTV	Closed Circuit Television
CFR	Crash, Fire and Rescue
CIQ	Custom, Immigration & Quarantine
DME	Distance Measuring Equipment
DVOR	Doppler Very-High-Frequency Omni Range

EPNL	Effective Perceived Noise Level
EQA	Equivalent Aircraft Factor
GSE	Ground Support Equipment
IFR	Instrument Flight Rule
ILS	Instrument Landing System
IMC	Instrument Meteorological Condition
MLS	Microwave Landing System
MOO	Meteorological Observation Office
NM	Nautical Mile
OLS	Obstruction Limitation Surface
PAPI	Precision Approach Path Indicator
PANCAP	Practical Annual Capacity
PAX	Passenger
PBX	Private Branch Exchange
PCN	Pavement Classification Number
PEBX	Private Automatic Branch Exchange
PHP	Peak Hour Passenger
RAPCON	Radar Approach Control
RIV	Rapid Intervention Vehicle
RWY	Runway
SID	Standard Instrument Departure Procedure
SSR	Secondary Surveillance Radar
STAR	Standard Terminal Arrival Route
T-DME	Terminal Distance Measuring Equipment
TMA	Terminal Area
TWY	Taxiway
TX	Transmitter
VASIS	Visual Approach Slope Indicator System
VFR	Visual Flight Rule
VHF	Very High Frequency
VMC	Visual Meteorological Condition
WECPNL	Weighted Equivalent Continuous Perceived Noise Level

PART 1

GENERAL

I. INTRODUCTION

1.1 Background of Study

In recent years, air travel and transportation have been playing an increasingly significant role in the socio-economic development of Guatemala. And there is a widely held view that a period of sustained economic growth lies ahead. Therefore, there appears to be a high probability that this Study on the Development Project of La Aurora and Santa Elena Airports can provide needed and important benefits to the national and regional economy.

At the request of the Government of the Republic of Guatemala, the Government of Japan agreed to cooperate in a study of required improvements for La Aurora and Santa Elena airports. The Government of Japan, through the Japan International Cooperation Agency (JICA), sent a preliminary study team to Guatemala. The Terms of Reference for the Study was agreed upon between JICA and the Ministry of Communications, Transports and Public Works (MCTPW) of Guatemala on August 25, 1988. The Study by the JICA Study Team was executed during the period from January 1989 through March 1990.

1.2 Scope of Study

Both La Aurora and Santa Elena airports have constraints which impede efficient and safe operation of the present facilities. Removing and correcting these constraints is an even more urgent matter when the anticipated traffic increases of future years are considered. Major impediments at La Aurora involve the airport layout such as a limited runway length, inadequate separation between the runway and taxiway, insufficient space for the apron and fingers and deficiencies in the air traffic control and navaids systems. Further, the existing terminal is already operating at near capacity levels. The constraints at Santa Elena include a limited taxiway, a narrow apron area and rudimentary terminal facilities.

Over the years, various studies have been conducted for the improvement of La Aurora airport. A major investigation conducted by a US consulting firm over the span 1974-1978 recommended relocation of the present La Aurora operation. Further, the consultants proposed that a separate airport be established for general aviation operations. These recommendations were not implemented by Guatemala and, except for some minor changes, the airport has remained largely unimproved.

The Terms of Reference concluded for this Study between JICA and MCTPW specified that short term and long term improvement plans would be proposed for both La Aurora and Santa Elena airports. More specifically, this Study sets forth:

i) Evaluation of existing La Aurora and Santa Elena airports,
ii) Formulation of a long term master plan for improvement for the target year 2005, and
iii) Study on technical, economic and financial feasibility of a short term improvement plan for the target year 1995

This Study focuses on the improvement of La Aurora and Santa Elena airports at their present locations. It has been clearly indicated that an investigation of the desirability of relocating the existing airports is beyond the scope of this Study.

1.3 Study Program

For the execution of the present Study, JICA assembled a team of eight experts (Study Team) as well as an Advisory Committee. On the Guatemalan side, the Dirección General de Aeronáutica Civil (DGAC) nominated the counterpart experts to jointly work with the JICA Study Team. The participants in this Study are listed in Table 1-1 attached.

The conduct of the Study involved periods of work in Guatemala and in Tokyo. The first study in Guatemala was initiated by submitting the Inception Report in January 1989 and ended by submitting the Progress Report in March 1989. The Study was followed by analysis and planning for the long term master plan improvements, formulation of a phased improvement plan and preparation of the Interim Report during the period from June through September 1989. The master plan and its stage-wise

improvements proposed in the Interim Report were discussed among JICA Study Team, JICA Advisory Committee, DGAC, MCTPW and SEGEPLAN (Secretaría General de Planificación Económica Nacional), during the second study in Guatemala in September-October 1989. Further, the Draft Final Report of the Project was submitted in January 1990, summarizing the findings of the entire investigation. After subsequent discussions among the parties concerned and a thorough review by DGAC, the Final Report of the Project has been elaborated.

At every stage, the Study has been executed in such a manner that the opinions and views of DGAC, MCTPW and other Guatemalan authorities are reflected in the short term and long term improvements proposed and evaluated in this Final Report.

1.4 Reports

As noted above, a series of reports have been prepared and submitted for discussion and review in the course of this Study. The Interim Report presented and discussed the long term master plan improvements for the two airports. The Final Report focuses on short term improvement plans and their feasibility and, subsequently, on the long term recommendations. The reason for this type of approach was to facilitate understanding of the sequential and stage-wise process of project implementation. The recommended short term improvement plans were formulated within a framework of a conceptually logical and balanced master plan.

The Final Report consists of four (4) parts. Part-1 presents the background of the Study and a brief sectoral review on transportation networks in Guatemala (Chapter I and II). Part-2 discusses the proposed improvement of La Aurora airport. Review and forecast of the air traffic at La Aurora is set forth in Chapter III. The evaluation of existing La Aurora airport is summarized in Chapter IV. In Chapter V, a short term improvement plan for La Aurora is proposed within the framework of an overall master plan. In Chapter VI economic and financial feasibility are evaluated. Finally, the elements in the master plan for La Aurora for the target year 2005 is presented in Chapter VII, entitled "Further Long-Term Improvement".

Part-3 deals with Santa Elena airport. After review of air traffic and existing airport conditions in Chapter VIII and IX, a short term improvement plan is proposed in Chapter X. Economic and financial viabilities of proposed improvements are evaluated in Chapter XI. A long term master plan improvement for Santa Elena is subsequently proposed in Chapter XII.

The Study developed a number of recommendations intended to assure efficient and safe operations at La Aurora and Santa Elena airports. These recommendations are presented in a summarized form in Chapter XIII and XIV of Part-4.

Supporting data and information, as well as detailed technical analysis on specific issues, are compiled separately in the Appendices of Volume-II of the Final Report. Reference to these Appendices is duly noted in the relevant section of the Main Report in Volume-I.

II. TRANSPORTATION NETWORK

2.1 Transportation Sector

The Republic of Guatemala, within its territory of 108,889 km^2, has a population of approximately 8.7 million. The population is estimated to be 12.2 million by the year 2000. Urbanization has been accelerating in recent years in major cities, located principally in valleys which extend along and on the outskirts of the central highlands. The Department of Guatemala which embraces the capital, Guatemala City, has a population of nearly 1.9 million or about 21% of total national population. On the other hand, Petén Province, where Santa Elena airport is located, has a population estimated to be only about 215,000 in 1988. (Refer to Table A-01 in Appendix A.) Geographic distribution of urban centers in the central highlands and farmlands mainly developed in the coastal plain areas has established the development pattern which the transportation sector must serve.

Contribution of the transportation sector to the national economy has been increasing in recent years. The transportation and communication sector accounted for 7.3% of the Gross Domestic Product (GDP) in 1988. The value added in the transportation sector consists of the following components: 4.2% in air transport, 78.1% in road transport, 2.4% in railway transport and 14.8% in marine transport. Although the value added in air transport is still relatively small, it increased by more than 25% in 1986-87 while the road transport increased by less than 3% in that same period. (Refer to Table A-02 and A-03 in Appendix A.)

Out of a total value of Guatemalan exports in 1987 amounting to US$980 million, about 4.6% was transported by air. Although it is still relatively small if compared with other modes of transport for exports, the air transport sector has contributed significantly to the export of non-traditional products which have been increasing at a higher rate than the export of such traditional products as coffee, banana, sugar and cotton. Increased export by air transport to Europe and other new markets has also been notable in recent years. (Refer to Table A-04 and A-05 in Appendix A.)

Tourism has significantly contributed to the foreign exchange earning of the Guatemalan economy. Although the total number of tourists has not as yet returned to the

level existing before the distortions in the early 1980's, it has been gradually recovering since 1985. According to INGUAT, tourists from North America accounted for 26%, Europe for 15%, Mexico for 9%, El Salvador and other Central America for 42% in 1987. (Refer to Table -06 in Appendix A.) A portion of the tourists and visitors are travelling by road, but the great majority travel by air.

A long term development plan for the transportation sector has not yet been formulated by the Government of Guatemala. Preparation of such a master plan is programed to begin in 1990 and is scheduled for completion two years later. In the absence of a sector wide development plan, this study on the improvement of La Aurora and Santa Elena airports has been oriented to the need to provide safe and efficient air traffic operations at each airport to meet its anticipated level of passenger and cargo traffic in 1995. A schedule for additional investments for a long term improvement plan, geared to anticipated traffic requirements in 2005, can be reviewed after a national long term transportation plan has been prepared.

2.2 Air Transport

Guatemala has a total of about 650 runways, ranging from 500 meter landing strips to the principal international airport at La Aurora, Guatemala City. The airport at Santa Elena also handles some international flights. In the main, however, it is a domestic airport, serving flights which originate at and return to La Aurora. Passengers arriving at Santa Elena are primarily interested in visiting the Mayan ruins at Tikal. Subsequent sections set forth descriptive and analytical data about facilities and operations at both La Aurora and Santa Elena airports.

2.2.1 International Aspect of Guatemalan Air Transport

The international aspects of air transport operations at La Aurora can be comprehended by reviewing the International Airlines Guide. Over 150 foreign cities are shown as having scheduled connections with La Aurora. To an extent, this is an understatement. Every airport in the world is--in a real sense--linked, via connecting flights, to La Aurora. By and large, La Aurora is dependent on multi-stop and connecting

flights to reach the large airports of the world. It is basically characterized as a hopping airport.

A total of 14 international and Guatemalan air companies are operating regular international commercial flights at La Aurora. Annual international flight operations increased from around 8,750 landings and take-off in 1986 to 11,500 in 1987. International passengers who arrived and departed through La Aurora increased from 500,000 in 1986 to 601,000 in 1987 and over 730,000 in 1988. (Refer to Table A-07 to A-11 in Appendix A.)

Miami and, to a lesser extent, Los Angeles are the principal major foreign urban centers linked by multiple, regular, non-stop service to La Aurora. Based on December 1989 airline schedules, Miami is served by three daily, morning non-stop flights from La Aurora. These flights are provided by Pan American, Eastern and Aviateca. Eastern and Aviateca use B-727's for their flights while Pan American uses an A-300, except on Wednesday when it switches to a B-727. Los Angeles receives daily non-stop service from La Aurora provided by Pan American and TACA. Pan American flies an A-300 while TACA uses a B-767 five days a week and a B-737 on the other two days. Aviateca--employing a B-727--provides a non-stop service four days a week. Mexicana provides a daily one-stop service with a B-727. New York is served by five flights a week from La Aurora, provided by LACSA which uses a B-727. Continental provides a daily service to Houston and Newark Airport, using a B-727 or B-737.

IBERIA and KLM offer flights to and from Europe. IBERIA-using a DC-10-provides services to Madrid via Panama City and Santo Domingo three days a week, while KLM flies a DC-10 to Amsterdam via San Jose and Curacao three days a week.

According to the available data in 1988, international passengers to and from airports in USA accounted for about 55% of total passengers at La Aurora, Mexican airports for about 10% and European airports for about 4%. (Refer to Table A-12 and A-13 in Appendix A.)

Increases in cargo traffic at La Aurora have also been significant in recent years. Total cargo volume increased from about 16,000 tons in 1985 to 23,500 tons in 1987. Although it dropped to 18,300 tons in 1988, it is basically on the upward trend. Freight

transported by international regular mixed flights is still playing a major role, because cargo flights have been predominantly operated by AVIATECA. Cargo movements to and from Europe, particularly the export of Guatemala's non-traditional products, have been significantly increased by IBERIA and KLM in recent years. (Refer to Table A-14 and A-15 in Appendix A.)

La Aurora, in brief, is a full scale international airport. But it is only by connecting flights that it can be considered a global facility. Figure 2-1 presents a simplified air route map showing the range of international services available from La Aurora.

2.2.2 Regional Aspect of Guatemalan Air Transport

The regional character of operations at La Aurora can be demonstrated by the fact that, out of the total air passengers moving through the airport in 1988, about 28% were going to and coming from a Central American nation. If passengers to and from Mexico are added, it represents about 38% of total air passengers at La Aurora.

La Aurora has five daily non-stop flights to San Salvador, offered by TACA, Pan American, Continental and COPA. Flying time is 30 - 40 minutes and B-767's and B-737's are used. Tegucigalpa is served from La Aurora by two daily one-stop flights offered by TACA and SAHSA. Trip time is between 75 - 90 minutes. San Jose has two daily non-stop flights from La Aurora provided by Mexicana and SAM. One stop service is provided by LACSA. The non-stop flight takes an hour and a half. The one-stop flight takes somewhat more than two hours. The B-727 is the principal aircraft used on this route. .

Guatemalan businessmen find it eminently practical to make a one day round trip to San Salvador or Tegucigalpa. It is not only distance and airline schedules that account for the important regional character of La Aurora, it is also the cultural and business ties spurred by long term efforts to develop a Central American Common Market. For the foreseeable future, it appears that La Aurora will maintain a significant regional orientation.

2.2.3 Domestic Aspect of Guatemalan Air Transport

More than 600 runways in Guatemala are used primarily for general aviation flights. Figure 2-2 shows the location of the most important of these many strips. These general aviation flights are overwhelmingly for business purposes. Recreational flying is almost non-existent. There are at present about 40,000 general aviation operations in the country. It is not expected that there will be any significant increase in these flights in the years ahead. Many of these flights were made because road conditions were bad or because telecommunication contact with other parts of the country was seriously deficient. As roads improve and the country becomes more stable, major reasons for general aviation flights will become less important. Similarly, as the Guatemalan Telecommunications Entity (GUATEL) strengthens its operations, there will be a reduced requirement for business trips by air.

It does not now appear that a significant pattern of scheduled domestic flights will develop in Guatemala, with the exception of travel between La Aurora and Santa Elena airports.

2.2.4 Present and Possible Future Relationship between La Aurora and Santa Elena Airports

At present Santa Elena is the airport serving those who wish to visit Tikal or come to Petén for family or business reasons. Its future potential role is a matter of considerable interest to Guatemalan planners and airport authorities. Tikal is a world class touristic attraction. It ranks with any archeological sites in Mexico, Honduras or elsewhere in Latin America. Clearly, Tikal has nowhere reached its potential as a tourist attraction. As traffic volumes increase, airport modernization and improvement will be needed.

It is expected by some Guatemalan authorities that Santa Elena will become a major international airport. A judgment on this matter cannot now be made. It remains to be seen to what extent the area tributary to Santa Elena will develop the hotels, restaurants and other recreational facilities needed to support and complement a major international airport. Even with such supporting facilities it is by no means certain that Santa Elena

will become a major gateway to the nation. International experience suggests that the national capital tends to be the principal point of entrance.

There is no compelling reason, of course, why visitors could not enter the country at Santa Elena and then fly down to La Aurora to continue their stay in the country. But that possibility cannot even be seriously considered until tens of millions of dollars are invested in Santa Elena and the Tikal area to build the facilities and infrastructures needed to attract huge volumes of foreign visitors.

Another role for Santa Elena is to serve as an alternate national airport. At present, if landings cannot take place at La Aurora, planes are diverted to El Salvador. According to air traffic records, about 20 flights a year are diverted to El Salvador due to foggy weather conditions at La Aurora, principally in April-May. This is a cost for Guatemala that could be reduced if an alternatie national facility was available. This role is a near term prospect. It requires only some improvements to Santa Elena airport, coupled with the establishment of an air route between La Aurora and Santa Elena and SIDs and STARs at Santa Elena, as well as completion of an improved road between the Petén and the capital.

The best present evidence seems to suggest that an improved Santa Elena airport, in concert with enhanced and expanded tourist facilities in the Tikal area, will serve primarily as an airport for travelers to Guatemala who wish to include a visit to the ruins during their stay in the country. For the foreseeable future it seems that those foreign passengers who wish only to visit Tikal will make use of international charter aircraft for their direct flight to Santa Elena. Another possibility is to travel by any newly established international flights linking Santa Elena with Mexico, US and any other foreign airports.

2.3 Land and Maritime Transport

2.3.1 Road Transport

There are about 12,400 km of roads in the nation, which are classified into 1,870 km of Central American highways, 2,120 km of national roads, 7,200 km of departmental roads and 1,250 km of rural roads. Paved roads are limited to about

3,100 km in total. (Refer to Table A-16 in Appendix A.) Figure 2-2 shows the major highway network in Guatemala.

The Pan American Highway, the Inter-Ocean and the Pacific Highways are the major elements of the system. The Pan American highway extends some 1,500 km and runs from the Mexican border to the Guatemalan frontier with El Salvador, passing through Guatemala City. The Inter-Ocean portion is almost 400 km in length and links the Atlantic Ports with San José on the Pacific. It accommodates about 470 million vehicle kilometers. The Pacific Highway is about 270 km in length and crosses the Pacific Coastal plains and connects Chiquimulilla, Escuintla, Mazatenango and Coatepeque.

At present, badly deteriorated roads connect Petén Province, where Santa Elena airport is located, with the rest of the nation. It is noted, however, that the improvement of Petén road along Fronteras - Modesto Mendez - Poputun - Flores/Santa Elena is scheduled to be implemented shortly. Other road improvement programs, assisted with loans from major international financial institutions and foreign governments are expected to upgrade present maintenance procedures, expand road penetration into rural areas and extend and improve major national highways. The improvement of the Petén road and other highways will be reflected in the traffic forecast both at La Aurora and Santa Elena.

2.3.2 Rail Transport

The national railroad of Guatemala (FEGUA) was established in 1968. FEGUA has a total length of tracks of 948 km, including yards, spurs and mainline. However, important lines have been closed and service tends to be irregular. Average speeds tend to be less than 40 km per hour and in some areas speed restrictions are as low as 8 km per hour.

According to FEGUA operating data for 1987, total volume of cargo was around 582,000 tons. Of this total, about half was for the transport of bananas between plantations and Puerto Barrios. Some 128,000 tons of cargo were transported on railway between Guatemala City and Escuintla. Railroad transport along the other routes was less significant. (Refer to Table A-18 in Appendix A.)

FEGUA has not been able to contribute significantly to the development of Guatemala for a number of years. In view of the fact that huge investments would be required for improvement and modernization of railroads, activities in the rail transport sector are not likely to have an impact on air transport operations in the foreseeable future.

2.3.3 Maritime Transport

Guatemala operates two principal ports, Santo Tomas de Castilla on the Atlantic and Puerto Quetzal on the Pacific. These facilities replaced older, smaller ports which have become outmoded, Puerto Barrios on the Atlantic and Puerto San Jose on the Pacific.

According to the available data in 1987, Puerto Santo Tomas de Castilla served mainly for the export of bananas, coffee and other traditional export products and the import of fertilizers, paper products, diesel and lubricants and other bulk products. Total volume handled at Santo Tomas de Castilla was about 1.1 million tons of exports and 1.4 million tons of imports. On the other hand, Puerto Quetzal on the Pacific served principally for the export of sugar (about 300,000 tons) and the import of fertilizers (about 240,000 tons). Puerto Champerico located to the west on the Pacific was utilized almost exclusively for the export of cotton. (Refer to Table A-19 in Appendix A.)

The ports of Santo Tomas de Castilla and Quetzal are run by semi-autonomous agencies under the direction of a "junta directiva". Puerto Quetzal is a relatively new facility and is still in the process of attracting maritime companies to make regular calls at the Port. Puerto Santo Tomas de Castilla, on the other hand, has been programed for expansion and improvement, including container terminals, but its implementation has been held in abeyance at present. Maritime transport will continue as the principal mode of transport for exports of traditional and bulk products, while air transport will generate exports of non-traditional, perishable or high-technical and high value products which are produced mainly in the central highlands of Guatemala.

PART 2

LA AURORA AIRPORT IMPROVEMENTS

III. LA AURORA AIR TRAFFIC FORECASTS

3.1 Historical Data on Air Traffic

The invariable principle that the preparation of an air traffic forecast for an existing airport complex begins with the collection and review of historical data, has been followed in the case of La Aurora airport. The historical air traffic statistics for La Aurora as far back as 1979 were obtained from the Planning and Statistic Section of DGAC and they are presented in a summarized form as follows:

Historical Traffic at La Aurora

Years	Total Passengers	Guatemalans	Foreigners
1979	664,919	219,628	445,291
1980	624,136	234,461	389,675
1981	526,686	239,187	287,499
1982	438,109	242,007	196,102
1983	457,209	241,397	215,812
1984	472,654	247,623	225,031
1985	489,719	259,920	229,799
1986	518,263	275,197	243,066
1987	621,898	284,754	337,144
1988	754,876	336,355	418,521

Note: Table A-09 and A-12 in Appendix-A present data on La Aurora international passenger level from 1982 to 1988 that are below the total traffic level shown in the Table above. The statistical difference is about 3% a year, and it may be due to domestic passenger movements between La Aurora and Santa Elena. It was not possible to obtain historical data on domestic regular flight passengers.

Over the entire span from 1979 through 1988, air passenger movements through La Aurora rose by almost 14%--an average annual rate of increase of less than 1.4%, while over the period 1980 through 1988, real Guatemalan Gross Domestic Product (GDP), expressed in millions of 1982 Quetzales remained stagnant (Refer to Table A-02 in Appendix A). Examination of the air traffic data reveals that the nine year period from 1979 through 1988 can be divided into two distinct segments; 1979 through to 1986 and 1987 to date.

3.1.1 Economic Background, 1979-1986

The period 1979 through 1986 was marked by instability and uncertainty. Investor confidence--especially for potential foreign investors--was low. The 1986 real GDP of Guatemala dropped by almost 5% below the 1980 level. The Table below summarizes actual data on Guatemalan GDP for the period 1980-1988, along with a preliminary estimate by Banco de Guatemala for 1989.

Gross Domestic Product (GDP)

Years	Real GDP (Millions of 1982 Quetzales)	Percent Change
1980	7,879	-
1981	7,932	+0.67
1982	7,652	+0.12
1983	7,446	-5.58
1984	7,475	+0.62
1985	7,475	0
1986	7,485	+0.13
1987	7,720	+3.14
1988	7,993	+3.50
1989 (Preliminary)	8,312	+4.00

In line with this period of instability and economic weakness, the number of air travellers moving through La Aurora actually declined from 1979 through 1986. The total 1986 passenger volume of 518,263 was 22 % below the the level that existed in 1979. Behind this decline in total passengers, it should be noted that there was an increase in the level of Guatemalan air travellers. In 1986 the Guatemalan total was 275,194 or almost 25% above the comparable 1979 level.

In marked contrast, was the trend of foreign travellers through La Aurora over this 1979-1986 period. Foreign passengers in 1986 totalled 243,066 or 45% below the 1979 level. In 1979 foreign air passengers were 2.03 times the total of Guatemalan air travellers. By 1986 this figure had fallen to 0.88 times.

3.1.2 Economic Background, 1987 to Date

Since 1987, socio-economic conditions in Guatemala have improved significantly. Establishment of a civilian government helped create a more stable socio-economic climate and business confidence rose. Foreign economic assistance increased and prospects for larger volumes of financial and technical aid improved. Reflecting this strengthening of the socio-economic outlook, real GDP in both 1987 and 1988 rose by more than 3% per annum, and GDP in 1989 is expected to grow by 4.0%.

Air passenger travel through La Aurora rose by more than 20% per annum during 1987 and 1988. Guatemalan air travellers increased by 18% and foreign air passengers in 1988 were up almost 25% over 1987. Foreign passengers rose to 1.24 time the number of domestic air passengers. While only fragmentary data were available for the early months of 1989, the evidence suggested that demand for air travel at La Aurora remained strong (Refer to Table A-11 in Appendix A).

3.2 Forecast Traffic Volumes at La Aurora

The process of preparing forecasts of air travel, as noted above, customarily starts with an analysis of historical data. The "Manual on Air Traffic Forecasting", Second Edition-1985, prepared by the International Civil Aviation Organization (ICAO) and Section 4 - Aviation Statistics from the Seminar on Aerodrome sponsored by the Japan International Cooperation Agency (JICA) and Civil Aviation Bureau of the Ministry of Transport both emphasize the importance of analyzing historical data.

In the case of La Aurora, however, the unusual nature of air traffic demand over the period 1979-1988 indicated that historical data could not serve as a guide to the future. Nevertheless, as a statistical exercise, the Study Team used four curve fitting models ; i) Linear Curve Fit, ii) Logarithmic Curve Fit, iii) Exponential Curve Fit, and iv) Parabolic Curve Fit.

Each of these statistical models yielded forecasts for 1995 equal to about 50% of the 1,214,000 forecast for 1995 selected by the Study Team. The inadequacy of the historical data as a forecast tool is further demonstrated by calculations of the coefficient

of correlation of the four forecast models. The coefficients of correlation ranged between 0.11 and 0.16. Figures of this magnitude indicate that the calculated forecasts fit very poorly with the basic historical data.

Inescapably, judgment is an element in all forecast preparation. In Guatemala, this is particularly true. As noted above, the past is a flawed guide to the future. And there are almost no forecasts of future economic activity available from Government institutions. Incorporating a substantial element of judgment in an air traffic forecast in no way indicates or suggests that the forecast has an unacceptable order of reasonableness. There should be clear, logical thinking behind the determination of an air transport forecast.

3.2.1 Air Passengers, Basis for Forecast

Table below sets forth the projection for air passenger traffic through La Aurora.

Projected Passenger Traffic at La Aurora

Years	Total Passengers	Guatemalans	Foreigners
1988	754,876	336,355	418,521
1995	1,214,000	506,000	708,000
2005	2,500,000	830,000	1,670,000
2015	5,000,000	1,670,000	3,330,000
Average Annual Rates of Increase in Total Passenger Volumes (rounded to nearest whole percentage)			
1988-1995	7%		
1995-2005	7%		
2005-2015	7%		

As will be discussed later in this Chapter, the anticipated 7% per year growth in passenger movements is conservative when related to World Bank long range economic projections for the overall Guatemalan economy and international evidence which indicates a very high--about 2--income elasticity of demand for air travel.

The Study Team prepared alternative traffic forecasts as an analytical exercise. These alternatives--one alternative is high and the other low with respect of the "best estimate" forecast--are shown in Figure 3-1 and Table below.

Alternative Traffic Projections

Year	Low Forecast (Approx 5%/yr)	"Best Estimate" (Approx 7%/yr)	High Forecast (Approx 9%/yr)
1995	1,060,000	1,214,000	1,380,000
2005	1,725,000	2,500,000	3,265,000
2015	2,800,000	5,000,000	7,730,000

The low forecast represents an average annual rate of growth some 2% below the "best estimate" rate. The high forecast is based on a growth rate about 2% higher than the "best estimate" rate. If Central America experiences an unparalled, extended economic and touristic boom, the "high forecast" might be realized. If regional growth falls below present expectations, the "low forecast" might come to pass. It is the judgment of the Study Team that the "best estimate" forecast has the highest order of reasonableness. Consequently, the "best estimate" projection will be used throughout most of this Report. The low forecast is in some instances employed in sensitivy tests to verify its impact on indicated project feasibility.

The reasoning at the base of the "best estimate" of anticipated air passenger flows at La Aurora is as follows:

1) An improved if not buoyant Guatemalan economy is anticipated by the Study Team over the next decade. This view is in line with a outlook set forth by the World Bank in 1987. This World Bank outlook anticipates an average annual rate of growth in the overall economy on the order of 4.5%. And an accelerating rate of growth is anticipated towards the end of the century, according to the Bank. The basic resource wealth of the country, the increase in political stability and business confidence, a supportive attitude by the United States and other

developed nations towards Guatemala, all contribute to a justification for accepting the World Bank optimistic point of view.

2) Global experience suggests that the income elasticity of demand for international air travel often exceeds 2. The World Bank estimated growth rate, in combination with such an income elasticity estimate, suggests a rise in air travel of as much as 10% a year. However, as a conservative judgment, the "best estimate" forecast shown above, employs an average annual growth rate in air passenger travel of about 7% per year over the forecast period. This takes account of the fact that some passengers come from areas with a less than 4% growth rate for personal income.

3) Promotional efforts by the Guatemalan private sector and the Institute of Guatemalan Tourism (INGUAT), as well as such international groups as the National Geographic Society, will generate added touristic travel to La Aurora and Santa Elena.

4) A major and promising policy objective in Guatemala is to stimulate the non-traditional sector. This policy will mean increased volumes of business travel as well as higher air cargo shipments. The essence of non-traditional activity is for a variety of small producers to work cooperatively to increase their penetration of overseas markets. This requires expanded air travel to explore, and promote profitable sales in these markets.

5) Guatemala, as noted above, has recently experienced nearly a decade of lateral movement in economic growth and air travel. The end of the century estimates shown in the travel forecast for La Aurora, merely represent a modest degree of "catching up" for this long span of no growth.

3.2.2 Air Cargo, Basis for Forecast

The Table below presents the Study Team forecast for cargo movements through La Aurora (For historical records, also refer to Table A-14 and A-15 in Appendix A).

Cargo Movements: Historical and Projected at La Aurora.

Year	Exports	Imports	Total
1981	8,311	8,541	16,852
1982	7,747	6,309	14,056
1983	7,508	6,695	14,202
1984	11,470	7,551	19,021
1985	10,666	5,495	16,161
1986	8,123	5,080	13,203
1987	15,333	8,229	23,562
1988	10,180	8,107	18,287
1995	13,000	10,000	23,000
2005	23,000	18,000	41,000
2015	60,000	47,000	107,000
	Average Annual Rates of Growth (rounded to nearest percentage)		
1988-1995	4%	3%	
1995-2005	6%	6%	
2005-2015	10%	10%	

This forecast was developed after review of historical cargo statistics, interviews with airline cargo personnel and discussions with enterprises who are actual or potential users of air cargo.

At this moment there is some controversy about what steps are needed to stimulate air cargo flows. Many exporters say the present service is unreliable and that they run the risk of not being served, especially if their air cargo requirements coincide with a period of peak passenger movements. Airline officials, on the other hand, say their service is reliable and they are always prepared to expand capacity, using chartered aircraft if necessary.

The Study Team forecast anticipates accelerating growth in air cargo movements. The major reasons underlying this expectation are:

1) The Central America Regional Transportation Study initiated by USAID in 1987 is actively seeking to formulate programs and policies intended to stimulate the export of non-traditional products.

2) The non-traditional sector--the source of such exports as decorative plants, cut flowers and high value fruits and vegetables--is developing its ability to promote, market and transport cooperatively and efficiently. (The traditional sector--coffee, bananas, sugar, etc--already has these capabilities.) As these numerous small enterprises improve their ability to work together, air cargo exports are expected to grow at an increasingly rapid rate.

3) When refrigeration and storage facilities are made available at La Aurora, it is certain to produce a surge of new cargo export activity. There will likely be diversion to La Aurora of some shipments that now go by road or maritime transport.

4) Both air cargo officials and exporters are acutely aware that the development of cargo backhauls is the key to lower air cargo rates and to more profitable air cargo operations for all concerned. At present, the principal backhauls are spare parts and electronic equipment. The variety of such shipments is expected to increase as the air transport sector concentrates on generating and attracting these reverse cargo flows.

3.3 Forecast of Peak Hour and Transit Activity at La Aurora

For the purpose of preparing design concepts of recommended new airport facilities, it is necessary to start with peak hour data--both passenger flows and aircraft operations. Anticipated transit passenger use of terminal facilities must also be indicated.

The congestion and delays and the justification for facility expansion tend to occur at peak hour periods. Actually, peak data are usually the starting point for design. It is generally agreed that designing so as to eliminate all congestion at peak periods is simply too ambitious and too costly an effort. Accordingly, a factor reduction--usually on the

order of 10% to 15%--is used to arrive at design targets. These design targets are sometimes referred to as busy hours.

Developing peak hour data for La Aurora also involved a highly judgmental effort. The basic data were manual entries on logs by tower personnel. (In the case of transit data there was no information available. The Study Team used personal interviews with airline officials to generate transit estimates.) The information on hourly operations was not on computers and there were no meaningful, periodic summaries and tabulations available. Study Team interviews and experience indicated that December and the Easter holiday period were the periods of peak travel. Accordingly, the logs for these periods were taken from the voluminous 1988 files and subjected to a detailed manual analysis.

This analysis identified the period between 8:00AM and 9:00AM on December 15 as the peak hour for the year 1988. Figure 3-2 shows a graph of hourly operations on December 15, 1988. The data showed eight departing flights and two arriving flights in that time slot. When the details of these individual flights were examined, it was determined that there were 725 passengers in the peak hour, of whom 656 were enplaning and 69 deplaning. Analysis of these ten flights also revealed that in the peak hour some 295 transit passengers left their planes and entered La Aurora terminal. Peak hour passenger flows, therefore, are placed at 725 excluding transit, and 1,020 including transit.

Table below shows peak hour passengers, excluding and including transit, for 1988 and for the forecast years 1995, 2005 and 2015. Peak hour commercial operations are also shown for the same period. Other selected data on airport activity at La Aurora are included in the table as well.

Peak Hour and Selected Data at La Aurora

	1988	1995	2005	2015
Total Passengers	754,876	1,214,000	2,500,000	5,000,000
Total Transit Passengers	92,000	115,000	162,000	225,000
Total Commercial Ops*	18,962	27,000	48,000	63,000
Total Gen Aviation Ops	41,126	40,000	40,000	40,000
Total Other Ops	20,937	21,000	21,000	21,000
Total All Operations	81,025	88,000	109,000	124,000
Total Peak Hr Passengers (excluding transit)	725	1,092	2,125	4,000
Total Peak Hr Passengers (including transit)	1,020	1,450	2,610	4,650
Total Peak Hour Comm Ops	10	14	22	33
Peak Hr Pass, per Total Pass (excluding transit)	0.096	0.090	0.085	0.080
Pk Hr Pass per Pk Hr Comm Op (excluding transit)	73	78	96	121
Pk Hr Cm Ops per Total Cm Ops	0.0527	0.050	0.045	0.040

* Note: 1988 commercial operations were taken from DGAC records. An extensive analysis of tower logs revealed a discrepancy in total commercial operations. The magnitude of the discrepancy will influence the estimate of apron berth requirements, but will not affect recommendations with respect to the runway-taxiway complex or terminal facilities.

The key data in the above Table are the estimates for peak hour passengers, peak hour commercial operations and forecast transit passenger use of La Aurora terminal. The relationships between total passenger traffic and peak hour traffic in a variety of airports around the world were investigated. It was universally true that as airport total passenger volume rose the peak hour passenger flow tended to fall as a percent of total passenger volumes. As volumes rise the resulting congestion tends to cause a spreading out of peak hour passenger flows as well as aircraft operations. This principle was expected to occur in Guatemala. However, only very modest relative declines were anticipated in peak activities at La Aurora.

La Aurora is not a hub airport with a high degree of flexibility and control when it comes to re-arranging hourly operational activity. Passengers using La Aurora frequently want to make a one day trip to El Salvador, Honduras or other Central American countries. Hence, an early morning departure is strongly preferred. And passengers headed for trans-Atlantic or trans-Pacific flights, or just to other cities in North America, must leave early to make connecting flights in Miami or Los Angeles. Hence, the peak hour passenger and aircraft operation forecasts set forth above incorporate only a modest diminution of the relative importance of peak hour activity.

The projection of transit passenger use of La Aurora takes account of the fact that such passengers come from and are destined for a variety of countries. Because of their diversity, it was believed that they would increase in volume on the order of about 3% per year--close to an international average rate of increase for passenger volumes. Neither general aviation nor other flights were expected to occur in peak periods.

3.4 Air Traffic Route and Aircraft Type

For purposes of preparing design concepts of airport facility improvement at La Aurora, it is necessary to estimate the types of aircraft that will be using the airport, on the basis of possible traffic by air routes.

Due to lack of detailed historical records of traffic volume by air routes, international passengers by air routes in 1982-88 and origin-destination of passengers in 1988 (shown in Table A-12 and A-13 in Appendix A) have been analyzed to establish a trend of traffic increase by service regions and to estimate a growth rate to target years by means of regression analysis. The calculated growth rates are summarized hereunder.

International Passenger by Air Routes

	International Passenger		Annual Growth Rate		
	1982	1988	1982-88	1988-95	1995-2005
North America/Mexico	273,153	474,843	9.6	7.1	7.0
Central America	122,122	204,153	8.9	7.1	6.0
South America/Caribbean	7,626	22,474	19.7	13.0	14.9
Europe	12,549	29,371	15.2	11.7	11.3
Total International PAX	415,450	730,841	9.8	7.5	7.4
(Total La Aurora PAX)	(438,109)	(754,876)	(9.5)	(7.0)	(7.4)

Using these projected growth rates, distribution of international passengers by regions of air route has been estimated as summarized hereunder.

Distribution of International Passengers by Air Routes

	1988		1995		2005	
North America/ Mexico	474,843	(64.9%)	767,000	(63.1%)	1,510,000	(60.4%)
Central America	204,153	(27.9%)	330,000	(27.2%)	590,000	(23.6%)
South America/. Caribbean	22,474	(3.1%)	53,000	(4.4%)	213,000	(8.5%)
Europe	29,371	(4.1%)	64,000	(5.3%)	187,000	(7.5%)
Total	730,841	(100.0%)	1,214,000	(100.0%)	2,500,000	(100.0%)

International airlines presently serving La Aurora are composed of 14 companies, including 2 national airlines (Refer to Figure 2-1 in Main Text and Table A-09 in Appendix A). Main aircraft types in service are A-300 by PAN AM, DC-10 by IBERIA and KLM, B-767 by TACA and B-727, B-737 and B-720 by other airlines. Small jets (B-727 and B-737) are predominant, representing about 76% of total commercial operations, while Large and Medium jets such as DC-10, A-300 and B-767, account for 24% of operations.

The present aircraft mix is assumed to remain substantially unchanged in the foreseeable future, although the DC-10, B-727 and B-720 are gradually destined to be retired and B-747s, A-310, A-320, B-767, B-757 and MD80s will likely be employed in the future. In view of the runway length and weight limitation at La Aurora, flight distance, forecasted passenger traffic and load factors, and environmental considerations affecting aircraft noise, the following aircraft mix has been projected:

Future Aircraft Mix by Air Routes

Region	Presumed Air Route	Aircraft Mix
North America/Mexico	MIA-NYC	MJ (A-300) SJ (B-737, MD-80s)
	IAH, MSY	SJ (B-737, MD-80s)
	MEX-LAX-SFO	MJ (A-300, B-767) SJ (B-757, MD-80s)
Central America	SAL-MGA-SJO-PTY	MJ (B-767) SJ (A-320, B-737, B-757)
South America/Caribbean.	BOG, SDQ, CUR.	MJ (A-310, B-767) SJ (A-320)
Europe	MAD, AMS	LJ (B-747s, DC-10)

(LJ: Large Jets, MJ: Medium Jets, SJ: Small Jets)

The aircraft expected to be in service for the international passengers estimated for year 1995 and 2005 by air routes is summarized hereunder.

Aircraft Expected in Service

Region	1995				2005			
	Annual Passenger	Aircraft Mix (%) LJ	MJ	SJ	Annual Passenger	Aircraft Mix (%) LJ	MJ	SJ
North America/Mexico	767,000	-	25	75	1,510,000	-	40	60
Central America	330,000	-	13	87	590,000	-	18	82
South America/Caribbean.	53,000	-	15	85	213,000	-	20	80
Europe	64,000	100	-	-	187,000	100	-	-
Total	1,214,000	5	20	75	2,500,000	7	30	63

For domestic services, four airlines are presently operating (AVIATECA, AEROQUETZAL, AEROVIAS and TAPSA) between La Aurora and Santa Elena (Flores). The largest aircraft is B-727 at present. The forecast traffic to Santa Elena and possible aircraft mix for target year 1995 and 2005 are estimated as summarized hereunder.

Domestic Air Passenger and Aircraft Mix

Route	1995			2005		
	Annual Passenger	Aircraft Mix (%) SJ	Non-J	Annual Passenger	Aircraft Mix (%) SJ	Non-J
North America/Mexico via Santa Elena	117,000	30	70	180,000	50	50

Note: It was assumed that 90% of Santa Elena traffic was to La Aurora.

IV. STATUS OF EXISTING LA AURORA AIRPORT

4.1 Airside Infrastructures

The present La Aurora airport, originally a grass strip, was officially inaugurated in 1928. The initial terminal building, on the east side of the runway, was opened in 1936. In 1966 a new apron was completed, followed by a new passenger terminal in 1968. Further improvements, including enlargement of the primary runway to the present length, were made to the airport in 1972.

La Aurora airport is located at the coordinates of 14.34.52N and 90.31.40W, and at an elevation of about 1,509 m above mean sea level. Climate is semi-tropical, and the monthly average temperature varies slightly between 16.6°C in January and 19.1°C in July. The monthly average minimum temperature drops to 12.2°C. The aerodrome reference temperature is assessed to be 27.1°C. The relative humidity ranges from 72% in April to 85% in June (Refer to Table B-01 and B-02 in Appendix B).

Annual mean rainfall at La Aurora is about 1,100 mm. Approximately 94% of annual precipitation falls during the rainy season from May to October. Fog occurs principally in April to May, and the occurrence probability of low visibility of less than 5 km in distance is 21.2% in April and 26.1% in May (Refer to Table B-03 and B-04 in Appendix B).

The status of the existing runway, taxiway and apron is discussed hereunder in a summarized form.

4.1.1 Runway and Taxiway

The runway at La Aurora extends in a north-south direction. Winds are predominantly from the south, and the wind velocity is usually less than 10 knots (Refer to Table B-05 to B-07 in Appendix B). According to the wind records in 1982-88, the runway wind coverage of La Aurora airport is calculated to be 100%, as shown in Figure 4-1. The wind rose is also illustrated in the same Figure 4-1. Judging from the

wind coverage and wind rose, the orientation of the runway at La Aurora is evaluated to be appropriate.

The existing asphalt-paved runway is 2,987 m in length and 60 m in width. With the displaced threshold length of 225 m at Runway 19 to allow adequate clearance over the aqueduct and the urban area immediately north of the airport, Runway 19 has 2,762 m available for landing and 2,987 m for take-off. The full length of runway is available for landing and take-off at Runway 01. A paved stopway is provided at the northern end of the runway. This runway length is insufficient for operation of medium and large jets, as discussed further in Chapter 4.4, and an operational penalty is presently applied for take-off. Extension of the runway length, however, is topographically impractical, because the northern end of the runway is adjacent to the city, while an acute cliff and a deep recess of a densely inhabitated dwelling area extends to the south of the runway.

The threshold elevation is 1,509.372 m (AIP: 1,509.320 m) at Runway 19 and 1,487.117 m (AIP: 1,487.375 m) at Runway 01. The runway has various longitudinal slopes with the maximum at 1.786%. The effective longitudinal slope is 0.98%. It is noted that the effective and maximum longitudinal slopes do not satisfy the requirements under the ICAO standards and recommended practices. The transverse slopes on the other hand, are in the range of 0.5% - 2.0%. In the section between 2,150 m and 2,375 m from Runway 19, a one-sided transverse slope is observed. (Refer to the Runway Profile in Figure 4-2.)

The width of the runway strip zone is limited to 50 m at present, and does not satisfy the requirements under the ICAO standards and recommended practices (150 m) even for VFR operations. For instrument landing, it should be expanded to 300 m in width.

The strength of the existing runway has been tested in the course of the Study. As described in detail in Appendix-C, the pavement strength has been found to be PCN 46 FBXT. The present runway strength is therefore suitable for landings and take-offs of the DC-10 type aircrafts. It is noted, however, that no measures have been taken to avoid the aquaplaning incidents on the runway.

The asphalt-paved taxiway, parallel to the runway, was expanded to its present length of 2,987 m, with a width of 23 m without shoulders. Conventional exit taxiway "Q" is provided for aircraft landings on Runway 01 and "F" exit for Runway 19. Two high-speed exit taxiways are also provided. It is noted, however, that these high-speed taxiways are not connected with the commercial area, but are connected principally for services to other aviation areas.

The separation distance between the center lines of the parallel taxiway and the runway is only 70 m. The parallel taxiway is located within the runway strips. The minimum requirement for separation distance is 150 m for VFR operations and 180 m for instrument runway category, in accordance with the ICAO standards and recommended practices. This is one of the most serious constraints hindering safe operation of La Aurora airport. The narrow separation distance also limits runway-taxiway efficiency and operational capacity, as discussed further in Chapter 4.4.

From the viewpoint of air space operations, there exist several obstacles in the 1:50 approach surface and take-off surface, including high buildings and the Reformador Tower located to the north of the runway (Refer to Figure 4-3). Several mountain peaks located around the runway also fall within the obstacle limitation surfaces. Since the mountains running to the east and west of the runway are located much closer to the airport, the modification of runway direction is not possible from the viewpoint of air space operations.

4.1.2 Apron Area

The passenger terminal concrete apron was expanded in 1972 and again in 1980. It is located in the section between 890 m and 1,230 m from Runway 19, with an area of approximately 69,000 m^2. The passenger terminal apron has a one-sided slope. The pavement surface is generally in good condition, despite some cracks and deterioration in some expansion and construction joints. The concrete-pavement is 30 cm in thickness, with a pavement strength of PCN 40, as indicated in Appendix-C. The apron pavement has been designed basically for small jets.

In the center of the passenger terminal apron, a six-gate concourse is located. A 7th gate located at the end of the finger tip is the only area where a wide-bodied aircraft

can be accommodated. At present, the apron area is congested at peak periods. While total congestion may not be substantial, the inadequacy of the present apron area is a limiting factor during periods of peak demand. It is apparent that as traffic increases at La Aurora in the years ahead, the apron limitations will become an increasing restraint on airport efficiency.

Figure 4-4 shows the schedule configuration for February 2, 1989. This figure gives an indication of how high the peak demand was on that particular, typical day, especially between 6 AM and 9 AM. Further, Figure 4-5 demonstrates actual aircraft movements to and from the seven gates, as well as time spent at the gates. Peak use of gates--and apron area--is not only the result of airline schedules. Frequently, prolonged use of gates arises from mechanical problems, arrival or departure delays caused by conditions at origin or destination airports or unexpected diversions to La Aurora.

The cargo terminal apron is located to the south of the passenger terminal apron and has an area of about 9,200 m^2. The cargo apron is designed for two small jets, such as the DC-8 or B-707. At present, there are frequently 3 cargo movements scheduled for the same time. This means a cargo aircraft must be rejected by the apron area and must wait on the southeastern edge of the commercial apron, assuming a space is available at that time.

The drainage system of La Aurora airport is made up of 3 areas; the east side of the runway, the north side of the terminal, and the south side of the terminal. In the northern area, storm water is drained through 2 lines of ø1,000 mm pipe to the south of the terminal. Heavy storm water in the apron area sometimes flows into the terminal area due to insufficient collecting pits and a low drainage slope. Drainage run-off capacity of the existing ø1,000 mm pipe at the present slope of 0.56% is estimated to be 1,794 m^3/s. On the basis of the average run-off coefficient presently estimated at 0.55, the existing ø1,000 mm drainage pipe is effective up to the rainfall intensity of about 50 mm/h.

Principal conditions of the existing airside infrastructures are presented in a summarized form in Table 4-1.

4.2 Terminals

4.2.1 Passenger Terminal

The existing passenger terminal is located 1,060 m from the north end of the runway on its west side. It consists of a four level building attached to a single concourse, usually referred to as a "finger". The present conditions and problem areas in the terminal are described hereunder in a summarized form.

A brief floor-by-floor description of the existing passenger terminal building is presented below.

- Basement level (5,022 m^2): originally planned as a parking area, it is now used as an airlines export cargo storage area and offices.

- First level (3,907 m^2): on the same level as the lower level of the finger, this area serves arriving passengers and has immigration counters, baggage claim, customs, and a passenger pick-up area, through a lower level vehicle access.

- Second level (2,895 m^2): on the same level as the upper level of the finger, it serves departing passengers and contains various shops, snack facilities, a partially open mezzanine over the baggage claim area and an emigration departure area. Well wishers cannot enter the finger and can go no farther than the gate before the emigration counter area.

- Third level (3,544 m^2): contains the check-in area for departing passengers who must then use stairs or elevators to go down to the second floor emigration departure counters. It contains the main entrance doors of the terminal at the passenger drop-off (departure) area.

- Fourth level (2,797 m^2.): is an open mezzanine overlooking the passenger check-in area with balconies and contains some offices and restaurants open to the public.

- Concourse: The finger is a two story structure, with a length of 179 m. The second floor has six holding lounges with departure gates and boarding

bridges. A seventh remote position gate is located at the tip of the finger with its holding lounge on the first floor. The ground floor permits arrival traffic to enter the terminal complex segregated from departure traffic on the floor above. Access to this ground floor is by way of stairs located at each gate, directly after leaving the aircraft. Transit passengers are confined to the upper floor of the concourse.

The existing passenger terminal building has various problem areas. First, departing passengers are faced with the following inconveniences:

a) Multi-level Circulation: Because of the multi-level design of the terminal, departing passengers have to descend from the third level check-in area to the second level departure area in the finger. The only connections between levels are the elevators and the stairs. Since the elevators are small and of uncertain reliability, the stairs are the principal connecting link. This creates problem for handicapped passengers, families with infants and anyone with carry-on carts.

b) Baggage Belt Operation: Again, because of the multi-level design, checked baggage must descend two full floors to reach the apron. This is accomplished through two "drop chutes", one at each end of the terminal, shared by all the airlines. This causes congestion in the baggage make-up area. If the "drop chutes" become inoperative, the baggage must be hand-carried down two flights of stairs. In addition, four airlines (Eastern, Continental, Aeronica and Aeroquetzal) do not have belts behind their counters and must cart their luggage to the nearest belt outlet.

c) Emigration Procedures: The limited number of emigration personnel, and the fact that they run an entirely manual operation, contributes to a lengthy and tedious verification process. Accelerating passenger flow here can be achieved at modest cost.

d) Enplanement Process: The present boarding bridges cannot serve wide-bodied aircraft, though PAN AM, IBERIA, KLM and TACA regularly bring such aircraft into La Aurora. The absence of boarding bridges inconveniences all passengers, who must descend to the apron and then use stairs to board departing

aircraft. It is most burdensome in bad weather and means much discomfort for the elderly, the handicapped and families traveling with infants.

Arriving passengers, on the other hand, are inconvenienced by facilities and procedures at La Aurora. Some examples are shown below:

a) Deplanement Process: Arriving passengers on wide bodied aircraft face the same problems as enplaning passengers and must descend stairs and cross a section of the apron to the lower floor of the finger. Even if they can enter the finger directly by a boarding bridge--as in the case of B-727--they have to descend by stairs to the lower level.

b) Immigration Procedures: As in the case of the emigration procedures, lengthy time is often required for immigration formalities. As a result of these arrival delays, the baggage belt often gets backed-up with more than one flight. This means the luggage has to be pulled off the belt by handlers so that baggage from a succeeding flight can be brought into the terminal. This leads to congestion in the baggage claim area.

c) Limited Facilities for Transit Passengers in the Terminal: Transit passengers are confined to the second floor of the finger. Aside from the ANACAFE counter, which is not always open, there is no place for them to sit down and enjoy a refreshment or a snack. The shopping facilities in the area where transit passengers are confined are reasonably attractive but the range of goods offered for sale is limited. There is no dedicated transit area.

It is also noted that a general problem affecting arriving and departing passengers, transit passengers, well wishers and personnel working in the terminal is the limited number of toilet facilities, including poor upkeep in terms of cleanliness and supplies.

Capacity of the existing finger and the passenger terminal building is nearly saturated, as discussed further in Chapter 4.4.

4.2.2 Cargo Terminal

Located on the west side of the runway, south of the control tower and the main apron, the cargo terminal (also known as Express Aereo) has a total area of 8,100 m^2 divided in two separate warehouses. Although the building appears to have been conceived as two distinct facilities, one for import and the other for export, it has been solely used for imports by approximately fifteen cargo companies. Outgoing shipments have to be stored on a same-day basis on the apron. Cargo storage and processing systems require substantial improvements.

On-site observations, and preliminary computations, reveal the hangar size to be adequate for the volume of cargo now being handled. However, various conversations with airlines and cargo companies, have pointed out the inadequacy of the apron. This situation is caused not only by the size of the apron, but also by the storage problem for export merchandise. Many airlines and cargo companies have expressed a willingness to increase the number of cargo charters and to use larger aircraft; such actions are not possible with the size of the existing apron.

The majority of export cargo from La Aurora is made up of perishable items from Guatemala and other parts of Central America. Because of the absence of refrigerated storage spaces, the exporters must time their arrival with each flight departure in order to minimize losses. This causes a chaotic last minute rush of consolidation and palletization in the airport apron area.

4.2.3 General Aviation Facilities

Despite a quite large volume of general aviation operations, there are no centralized airport facilities for general aviation at La Aurora airport. The privately owned Aeroclub de Guatemala acts as the principal center for such activities. It rents out to private pilots, 183 hangars along the west side of the south threshold of the runway. On the east side of the same area, other private charter company hangars are located. It is estimated that there are some 350 general aviation airplanes using the airport facilities, out of a total of 375 airplanes registered in the country.

4.3 Support Activities

4.3.1 Airport Support Facilities

The existing facilities which contribute to the support of activities taking place on the ground (both airside and landside) are briefly described hereunder. These include the control tower, crash, fire and rescue (CFR) facilities, the maintenance building, and the fuel farm.

1) Control Tower:

The control tower is located between the passenger terminal apron and the cargo hangar. The floor level of the tower is 12.8 m and the height of VHF antenna is 20 m above the ground level, which does not meet the FAA regulations. In view of the inadequate location and height, the control tower should be totally improved for the safe operation of La Aurora airport.

On the second and third floor of the control tower, equipment rooms for tape recorder, PBX and VHF TX are installed. Since the rooms are quite small, equipment can not be operated and maintained properly unless the VHF TX rack is removed.

The equipment has been operating since 1976, and consequently, the life of equipment cannot be expected to extend beyond the mid 1990's. Noise is heard on the tape recorder. A 50 W radio is used for A/G communication. The transmitter is installed in the control tower, while the receiver is in a receiving station located at about 700 m from the tower.

The runway is surrounded by mountains located several kilometers away. Besides these, a mountain 1,000 m higher than the airport level is located at about 20 km to the south of an extended line of the runway. To solve the problem of obstacles in the coverage area, the transmitter/receiver is installed on top of Rabinal, a mountain located at about 48 km to the north of the airport, with frequencies at 118.1 MHz for local control and 126.9 MHz for Guatemala radio.

In the VFR room, there are consoles for Local Control, Ground Control, Flight Data and Supervisory. It has been observed that the control and monitor equipment for weather and airfield lighting are inadequate.

2) Crash, Fire and Rescue (CFR) Facilities

CFR facilities consist of a building and equipment. The existing CFR building is located to the south of the cargo apron area, and it is a 2-story, concrete block wall, steel structure roof and corrugated asbestos cement board covered building. The building has a total area of 480 m^2 and two covered garage areas. CFR station is manned by 14 personnel and operated in two shifts of 7 in each.

CFR equipment at La Aurora is composed of one (1) rapid intervention vehicle (RIV) with a capacity of 227 kg of dry chemical, and two (2) tank trucks with a capacity of about 20 kl of water. The existing vehicles are all very old, with an average model year of 1974, and are not in adequate operating order for emergencies. Some of the trucks do not even have their own batteries. CFR equipment should be renewed urgently to prevent casualty at La Aurora.

3) Maintenance Facilities

DGAC has a small maintenance facility with a maintenance shop building of 1,344 m^2 in total floor area, located directly south of the cargo terminal. The maintenance shop consists of a central maintenance area and a number of service compartments, such as body shop, parts shop, tire shop, electric shop, paint shop, carpentry shop, etc. Aircraft maintenance is now performed by Aviateca and routine maintenance by some of the airlines themselves.

The repair equipment at the shop is minimal, old and rudimentary, resulting in lengthy services of reduced scope. A particularly acute problem is the shortage of spare parts; many parts have to be hand-produced. The major equipment available at present includes a welder, metal lathe, air compressor, bench drills, battery chargers, oxy-acetylene cutters, disc grinder, hydraulic jack, etc.

4) Fuel Farm

The center for fuel storage and distribution (fuel farm) is located on the west side of the north threshold (Runway 19). It is managed exclusively by the two private oil companies. Esso has a storage capacity of 454 kl (120,000 gallons) of Jet A-1 and distributes the fuel by tank-truck to the airplanes. Texaco has a storage capacity of 454 kl (120,000 gallons) of Jet A-1 and has an underground direct connection to an apron hydrant system, supplemented with tank-trucks when needed. Both companies also supply Av-Gas to general aviation. Although Texaco has the hydrant system, Esso is the most-used brand because of a difference in prices.

The existing fuel farm is supplying 4,920 kl (1,300,000 gallons) a year on an average, or 1,230 kl a week. This implies that the existing storage facilities are equivalent to about 74% of the required capacity.

5) Electric Distribution in Terminal Area

A transformer of 1,000 kVA in capacity is placed in the basement of the terminal building. Two sets of 125 kVA diesel engine generators for emergency use are installed. The actual power load is estimated to be 350 kVA. However, overload is observed in a part of load systems and cables due to inbalanced capacity of breakers in the distribution panel. The electric distribution systems in the terminal area should therefore be rearranged and improved.

4.3.2 Aviation Support Services

Electrical and telecommunication facilities at La Aurora were improved and expanded between 1960 and 1988. An inventory of the existing facilities is shown for reference in Appendix-I. Most of these facilities, however, are old and do not satisfy ICAO standards. The present operational condition of these facilities is briefly summarized below.

1) Radar:

The transmitter/receiver for the ASR (Primary Radar) and the SSR (Secondary Radar) are located at the site on Runway 01 side. Antennas are located at 187 m away

from the runway center and 312 m from the Runway 01 threshold. In the light of the minimum detectable distance of ASR for identifying aircraft (0.5 nautical mile or 900 m), the location of existing antennas is unsuitable. The IFR (Instrument Flight Rule) room is located near the control tower and the cathode ray for monitoring is in the VFR room in the tower. It is noted that the IFR room is small and dusty without an air conditioner, and outside light and noise invasion occur whenever a door is opened. A new IFR room should be eventually installed.

The unit, which appears to be second hand, was installed in 1979. It is difficult to identify aircraft in the ASR cathode ray, and the SSR can not display aircraft identification. The Cathode Ray itself is deteriorated, or "burned". Therefore, the control relying on the display may cause a "near miss" or "crash" in the air. The monitor scope in the VFR room is unusable due to lack of spare parts, and its operation has been abandoned. Judging from the present conditions of ASR/SSR, safe operation of La Aurora airport is critically hampered, and renewal of the radar equipment is an absolute and urgent necessity.

2) Receiving Station:

The receiving station is located at about 700 m from the control tower. An aerodrome beacon is collocated on top of the antenna tower of the receiving station. It is operated at the same frequency as the control tower's transmitting frequency. A 7.5 kVA secondary power supply is made available from a commercial power grid. Consequently, it should be improved so that power can be led properly from the airport. The receiver should be operated from a DC source, and a floating system should be adopted.

3) VHF Equipment:

The VHF TX/RX, DVOR/DME and NDB were installed on Rabinal in 1987 for the coverage enlargement of the air to ground communication and navigation aids. For the remote control of this equipment, microwave links are connected from the antenna tower located beside the DGAC building. In addition to the remote control equipment for Rabinal VHF facilities, VHF FM transmitters/receivers are installed in the Technical Room on the third floor of DGAC building, for point to point and standby VHF radio (118.1, 121.9 and 120.7 MHz).

4) Radio Navigation Facilities:

Radio navigation facilities have been maintained by COCESNA (Corporación Centroamericana de Servicios de Navegación Aerea), including NDB, D-VOR, DME, Localizer and T-DME. They are generally in good operating conditions.

5) Aeronautical Information Service:

The Aeronautical Information Service (AIS) is installed on the first floor of DGAC building, serving AFTN (Aeronautical Fixed Telecommunications Network). Teletypes are equipped to connect to each airline and domestic airport, as well as to Houston, Washington and Central America countries via COCESNA. Existing teletypes and personal computers were manufactured between 1946 and 1986, and some teletypes should be replaced.

6) Meteorological Office and Observation Facilities:

A meteorological office of INSIVUMEH (Instituto Nacional de Sismología, Meteorología e Hidrología) is located next to the AIS room in the DGAC building, providing meteorological information in Guatemala. Field meteorological observation facilities of INSIVUMEH are located at the west side of the runway, including (i) teletype to connect control tower, radar, route control, COCESNA, AIS, Centralamerica, etc., (ii) VHF TX/RX and HF TX/RX to each airport, and (iii) meteorological sensor and indicator.

7) Visual Navaids:

Basic facilities for visual navaids are installed and include aerodrome beacon, aerodrome obstacle rotating beacon, VASI, simple approach lighting system, runway threshold lights, runway end lights, runway edge lights, and taxiway edge lights.

Lamps were replaced in and around 1979, though the cables have been used for more than 20 years. Most lamps, particularly simple approach lighting lamps, are damaged and spare parts have not been replenished. Since the wiring system for the runway lighting does not meet the ICAO standards, a series of lamps for about 1,500 m along the runway can not be used when one system is down. It appears desirable to install center line lightings in accordance with the ICAO recommendations. It is further

noted that street lightings on Calle 14 (Avenida Hincapie) along the runway may be confusing, and installation of centerline lightings at the airport would be desirable. Further, it will be necessary to install a PAPI system and to increase the power of the aerodrome beacon.

To provide power to each lamp for visual navaids, a CCR (Constant Current Regulator) and transformer in a regulator room near the control tower are required. Since some CCR are of insufficient capacity, new airfield lighting should be designed with a capacity adjusted to CCR.

8) Apron Flood Lighting:

These facilities are installed on the finger. It is observed, however, that the luminous intensity is insufficient for the aircraft parking on the apron. The luminous intensity should be improved to meet the ICAO recommendations.

9) Electric Distribution (DGAC):

A power receiving and distribution plant is located near the control tower. Receiving power capacity is 500 kVA. Besides, a 385 kVA diesel engine generator for emergency use is installed in the plant. The actual load is about 320 kVA, and it is serviceable. However, in accordance with the future load rearrangement, the power receiving facilities should be improved.

4.3.3 Airport Administration

DGAC, which is responsible for the administration of airports, has a total staff of about 630 at present, as shown in Table 4.3, and it is organized as shown in Figure 4-6. The administration of La Aurora Terminal is also organized as shown Figure 4-7. DGAC directly controls the aeronautic services at all the airports in Guatemala. En-route flights are controlled by Central American ACC and most of the telecommunication facilities are maintained by COCESNA. At present, La Aurora airport itself has the minimum organization and manpower to conduct the daily services to maintain the airport functions.

4.4 Overall Capacity Verification

La Aurora airport has various capacity limitations, as stated in the foregoing Chapters. Major limitations in the airport capacity have been identified and calculated as explained hereunder.

4.4.1 Runway Length

La Aurora has a runway of 2,987 m in length, which is insufficient for operations of medium and large jets. The correct runway length to satisfy the requirements for operation of large aircraft has been assessed first, and then the extent of operational penalty or limitation of take-off weight has been evaluated.

The requirements for runway length are usually determined on the basis of air route distances (route stage length), aircraft types in operation, aerodrome reference temperature, aerodrome elevation, etc. The stage length from La Aurora is 3,528 km (1,950 NM) to Los Angeles, 1,641 km (886 NM) to Miami, 2,263 km (1,222 NM) to Santo Domingo and 2,589 km (1,398 NM) to Caracas. The largest aircraft operated in the past is B-747s. The aerodrome reference temperature is 27.1°C and the temperature in standard atmosphere at the aerodrome elevation is 5.19°C. The aerodrome elevation is 1,509.64 m above mean sea level and the longitudinal runway slope is presumed to be improved up to 0.757%. Under these conditions, the runway length to be required in accordance with the ICAO standards is calculated to be 4,100 m.

Extension of La Aurora runway by more than 1,100 m is not feasible, due to topographic conditions to the south and urban areas to the north of the runway. If the existing length of the runway remains unchanged, the take-off weight limitations should be applied as an operational penalty of the aerodrome. In Appendix-D, the relation between air range and take-off weight is shown for each type of aircraft. The extent of take-off weight limitations are summarized in a matrix in Table 4.2. For instance, the take-off weight should be limited to 72% of maximum weight for operation of DC-10 flights and 73% for operation of A-300 flights non-stop to Los Angeles.

Judging from the difficulty in a runway extension at La Aurora and the extent of take-off weight limitations to the current and possible future air routes, La Aurora airport is proposed to be improved without extension of the existing runway.

4.4.2 Runway-Taxiway Capacity

As noted in Chapter 4.1.1, the separation distance of runway and parallel taxiway is limited to 70 m. This limitation is a major constraint. It impedes safe operation of the aerodrome, especially for aircraft operations in peak hours. Analysis has been made of the runway-taxiway capacity in the following cases:

a) Under the existing conditions of the runway-taxiway separation of 70 m

b) Under the conditions that the parallel taxiway is relocated to secure separation distance of 180 m in the northern part of the terminal apron (about 700 m)

c) Under the conditions that the parallel taxiway is relocated to secure separation distance of 180 m in the entire part (2,987 m)

Under the existing conditions, the operational capacity of the aerodrome is evaluated to be a maximum of 19 international commercial operations per hour, as estimated in detail in Appendix-E, Section E.3. This maximum capacity is theoretical. Due to limitations in aviation support facilities and operational capability, the practical runway-taxiway capacity is considered to be 10 to 11 commercial operations per hour. In the event that general aviation takes place in peak period, the practical capacity of commercial operations will be further decreased.

As reviewed in Chapter 3.3, the peak hour commercial operations at La Aurora was 10 flights in 1988. It is therefore evaluated that the existing conditions of the runway and parallel taxiway have almost reached their full capacity.

If and when the parallel taxiway is relocated to secure runway-taxiway separation distance of 180 m in the northern part of the terminal apron for about 700 m in length, the maximum theoretical capacity will be increased to 24 international commercial operations per hour (Refer to Appendix-E, Section E.4). In practical terms, the runway-

taxiway capacity will be improved to about 16 commercial operations per hour. The peak hour commercial operations in 1995 have been estimated to be 14 flights. Therefore, the partial improvement of the parallel taxiway would satisfy anticipated requirements under the short-term improvement plan.

In the event that the parallel taxiway is relocated in the entire part (2,987 m), the maximum theoretical capacity will be increased to 36 international commercial operations per hour (Refer to Appendix-E, Section E.5). The practical capacity will then be improved to about 25 commercial operations per hour. Consequently, such an improvement would meet the increased traffic operations in the year 2005 when the forecast peak hour commercial operations are expected to reach 22 flights per hour.

4.4.3 Apron Berth and Gate Capacity

The gate capacity is the ability to accommodate aircraft loading and unloading operations under continuous demand. It can be defined as the inverse of the weighted average gate occupancy time for all the aircraft served. Assuming that every gate serves all aircraft, the average gate has the following profile of utilization:

Aircraft Model	Aircraft Mix (%)	Average Occupancy Time in Minutes (Observed)
A-300, B-767	20	65
B-727, B-707, DC-8	60	55
B-737, DC-9-30	20	55

The single gate capacity (SGC) and total hourly gate capacity (HGC) at La Aurora are therefore calculated as follows:

$$SGC = \frac{1}{(0.20 \times 65) + (0.60 \times 55) + (0.20 \times 55)}$$

$$= 0.017 \text{ aircraft/min./gate}$$

$$HGC = 7 \times 0.017 \times 60$$

$$= 7.14 \text{ aircraft/hour}$$

The peak hour commercial operations reached 10 aircraft in 1988. At that time 4 out of 10 aircraft stayed overnight and loaded before the start of actual peak hour. Taking such overnight stays into account, it is evaluated that La Aurora airport with its 7 gates has nearly reached the full gate capacity under the present airport operations.

Possible requirements for apron berths to meet the peak hour demand in 1995 has been estimated at 9 berths for international commercial operations, as shown in Appendix-F. Furthermore, the apron berth requirement for 2005 passenger forecast would be around 14 berths. Consequently, the current apron berth and gate capacity is not sufficient to satisfy the future requirements, and the apron berths and gates should be improved to meet anticipated future requirements.

4.4.4 Passenger Terminal Capacity

Capacity of the existing passenger terminal has been evaluated in accordance with the FAA norms as follows:

$$\text{Peak Hour Passenger Capacity} = 1.15 \times \frac{\text{Floor Space}}{14\ m^2/\text{prs.}}$$

$$= 1.15 \times \frac{10{,}346\ m^2\ (\text{1st-3rd level})}{14\ m^2/\text{prs.}}$$

$$\fallingdotseq 850\ (\text{without transit passengers})$$

As noted in Chapter 3.3, the total peak hour passengers (excluding transit passengers) were estimated at 725 in 1988. This implies that the total existing space of the passenger terminal building has been within the international standards of the terminal capacity.

It is estimated that the peak hour passengers would reach around 1,092 in 1995, as noted in Chapter 3.3, and the design passenger terminal capacity should be over 930 (85 % of peak hour). The peak hour passenger would be increased to 2,125 in year 2005, with the design capacity of around 1,800. Judging from the forecast peak hour passenger capacity, the terminal capacity will be saturated well before 1995.

On the other hand, the current peak hour passenger capacity of 850 is estimated to be equivalent to around 1,140,000 passengers on an annual basis. According to the traffic forecast set forth in Chapter 3.2.1, annual passengers will reach around 1,134,000 in 1994. This indicates that the passenger terminal would reach its full capacity sometime in 1994.

4.4.5 Safety in Operations

As reviewed in the foregoing Chapters, La Aurora airport is reaching full capacity in terms of ground and air operations. Notwithstanding such situations, the existing control tower has various defects and out of date radars (ASR/SSR) that have not been functioning properly, as noted in Chapter 4.3.2. Furthermore, CFR facilities are not in adequate operating condition for emergencies, as noted in Chapter 4.3.1. It is emphasized that the safe operation of La Aurora airport is critically hampered. It would not be a matter of surprise if an accident occurred causing serious casualties.

It is better on all counts to prevent the first accident rather than the second. Proper and timely improvement should be carried out to secure safety in La Aurora airport.

V. PROPOSED SHORT-TERM IMPROVEMENTS OF LA AURORA

5.1 General

The existing La Aurora airport has a series of constraints to be improved in the short and long terms, as noted in the previous Chapter IV. For such improvements, a master plan was first formulated and it was discussed with the Guatemalan authorities concerned after the presentation of the Interim Report in September 1989. A improvement program by stages has also been discussed, and it was confirmed that a short-term improvement plan to satisfy the traffic demand in 1995 would be further defined and evaluated within the framework of the agreed-upon master plan. The short-term improvements proposed in this Chapter are, therefore, programs phased out of the longer term master plan. The short-term programs presented herein are geared to the longer term master plan discussed further in Chapter VII.

The short-term improvement programs respond to the need to meet the forecast traffic in 1995, as well as the economic and financial situation prevailing in Guatemala. The investments in the short-term improvements are minimized, in principle, to a level that will permit safe operations of the aerodrome.

Technically, the improvements are intended to eventually attain a major target that La Aurora airport will meet the requirements for a precision approach airport Category-1 under the ICAO classifications. This target is pursued throughout the stage-wise improvement programs. The limitations, if they are inevitable, will be identified and their influences will be evaluated accordingly.

It is added to note that the layouts and preliminary design proposed herein have been prepared on the basis of topographic maps on the scale of 1:2,500 prepared properly for the purpose of this Study covering the area in and around the aerodrome.

5.2 Proposed Airside Infrastructure Improvements

5.2.1 Runway and Taxiway Improvements

Under the short-term plan, it is proposed to improve the runway, parallel taxiway and exit taxiways as summarized hereunder.

1) Runway

The existing La Aurora runway has a principal limitation in its length (2,987 m), as noted in Chapter 4.4.1. Extension of the runway length to meet the ICAO standards (up to around 4,100 m) is not practically possible due to a steep cliff of about 160 m in depth at 700 m from the Runway 01 threshold to the south and densely urbanized areas adjacent to the Runway 19 threshold to the north. In view of such difficulties, as well as in the light of eventual aircraft mix and stage length, the runway length will not be extended under the proposed improvement plan. The extent of operational penalties in take-off weight, as reviewed in Chapter 4.4 and Appendix-D, will be in a tolerable range.

The deficiency in longitudinal slopes will be improved to some extent by the on-going overlay works executed by DGAC. Although such overlay works will not totally satisfy the ICAO standards (ICAO maximum slope change rate of 0.1% per 30 m), further improvement by additional overlay will not be proposed in the short-term improvement plan and it will be put forward for execution in the long-term improvement plan. Such a prolonged execution program will not hamper safe operations of the aerodrome.

To ensure safe landing and take-off on La Aurora runway, it is proposed to carry out the grooving of the runway in the short-term improvement plan. Judging from the rainfall pattern and intensity, grooving is necessary to prevent the aquaplaning phenomena on the runway under rainfall. Grooving is planned to be executed for the full length of runway (2,987 m) with a width of 30 m in the central part.

2) Parallel Taxiway

Improvement of the parallel taxiway is required to ensure safe operations at La Aurora, because the existing separation distance between runway and parallel taxiway (70 m) is too short for the present and future classification, as noted in Chapter 4.1.1.

Two alternative separation distance (150 m and 180 m) have been discussed for the relocation of the parallel taxiway. In view of the future requirements dictated by the installation of MLS under the long-term plan, it has been decided that the parallel taxiway will be relocated to run 180 m apart from the runway center line.

Under the short-term improvement plan, it is proposed that the new parallel taxiway at 180 m from the runway will be partly constructed in the northern section between Runway 19 end and the passenger terminal apron, for about 700 m in length (Refer to Drawing 5-1). Such a stage-wise construction of the parallel taxiway is proposed to postpone the relocation of existing hangers for general aviation in the southern section, as well as to direct the aircraft landing on Runway 01 to a rapid-exit taxiway to be newly constructed to the north-east of the apron. It will also minimize initial investment in the improvement works. With the construction of partial parallel taxiway of 700 m in length, the aerodrome safety and operational capacity will be drastically improved. As noted in Chapter 4.4, the runway-taxiway capacity will be practically increased to 16 commercial operations per hour and the operational difficulties experienced on the ground in the past would be prevented in the future.

The new parallel taxiway will be designed to be 23 m in width, with 10.5 m wide shoulders on both sides, as shown in Drawing 5-2, in accordance with the ICAO Aerodrome Design Manual which specifies that a total width of taxiway pavement and shoulders should be 44 m for a Code Letter-E airport.

Pavement structures of the parallel taxiway have been studied in the light of geotechnical investigations conducted in the course of this Study, as explained in detail in Appendix-C, as well as on the basis of the subgrade CBR (10%), design aircraft (B-747-SP), maximum take-off weight (600,000 lb) and equivalent annual departure design aircraft. The pavement structure of the parallel taxiway is designed to have a bituminous surface of 13 cm in thickness, bituminous treated base of 10 cm, base of graded aggregates of 22 cm and sub-base of crushed aggregate of 25 cm, totaling 70 cm in thickness, as shown in Drawing 5-2.

3) Exit taxiways

A rapid-exit taxiway is proposed in the short-term improved plan. Location of such a rapid-exit taxiway has been analysed as explained in Appendix-D. On the basis of

the analysis, it is determined that the rapid-exit taxiway will be constructed at a point 2,000 m from Runway 01 threshold. The alignment and preliminary design of the rapid-exit taxiway have also been prepared in accordance with the ICAO standards, as shown in Drawing 5-2. The provision of the rapid-exit taxiway will be particularly important to enhance the runway safety and operational capacity at La Aurora where increased commercial traffic is expected and a great number of general aviations are prevailing.

Two exit taxiways will be provided at Runway 19 end and at 490 m therefrom, as shown in Drawing 5-2. The preliminary design of the taxiway width and fillet is also illustrated in Drawing 5-2.

4) Service Road

Relocation of the existing gravel-paved service road from the terminal apron to the Runway 19 threshold is required. A new service road is designed to run at a distance of 46.5 m from the center line of the new parallel taxiway. The service road is 5.5 m in width and about 700 m in length.

5.2.2 Apron Area

As noted in Chapter 4.4.3, the current apron berth and gate capacity has nearly reached the full capacity and is causing a degree of congestion, particularly during peak hours. Through the in-depth study as presented in Appendix-F, the requirements for apron berth to meet the peak hour demand in 1995 has been estimated at 9 berths for international commercial operations and 1 berth for domestic operations.

For international operations, the aircraft mix for year 1995 has been presumed to be about 25% for large and medium jets and 75% for small jets as noted in Chapter 3.4. On the other hand, the aircraft mix for domestic operation is assumed to be 30% for small jets and 70% for non-jets. To be flexible for operations, the type and number of aircraft for berthing are envisaged for design purposes as follows:

		Large/Medium Jets	Small Jets	Total
Type	:	B-747s, DC-10 B-767, A-300	B-757 B-727, B-737	
Mix	:	3	7	10
Width	:	70 m x 2 60 m x 1	50 m x 1 45 m x 6	520 m

In the case of a terminal building with frontal system, the apron depth is required to be 190 m from the western edge of the proposed parallel taxiway to the terminal building. Thus, the apron dimensions are going to be 520 m x 190 m = 98,800 m^2 for 10 berths. However, the depth of 190 m can hardly be achieved because of insufficient space for expanding the air-side. Moreover, the existing distribution concept of the terminal building should be taken into account. It is therefore decided that a finger parking concept for expansion of the apron area will be used.

The existing finger is proposed to remain for services for small jets for international operations. Three new berths for large and medium jets for international operations are proposed to be constructed by extending a new finger to the north of the existing passenger terminal. One berth for domestic separation will be located south of the existing terminal.

The parking berth is designed under the condition that the aircraft tail height will not infringe on the transitional surface of 1/7 gradient from the runway strip edge. Basically, the dimension of aircraft and wing tip clearance on the apron is determined as noted hereunder. The ICAO standards for the minimum separation distances have been applied in determining criteria for the design of apron.

Aircraft Dimension and Clearance

(m)

Aircraft	Dimension			Clearance
	Wing-span /1	Length /1	Code Letter /2	
B-737-300	59.64 (60.0)	70.66 (71.0)	E	7.5
DC-10-30	50.39 (52.0)	55.35 (56.0)	D	7.5
B-727-200	32.92 (33.0)	46.68 (47.0)	C	4.5
DC-8-61	43.40 (44.0)	57.12 (58.0)	D	7.5
BAC-111	27.00 (27.0)	28.50 (29.0)	C	4.5

Note: /1 Figures in parentheses are design figure.
/2 Code letter specifies aircraft wing spans (ICAO Doc. 9157-AN/901)

On the basis of criteria explained hereinabove, a layout of the apron area has been prepared as illustrated in Drawings 5-2 and 5-4. The new apron area will be about 13,900 m^2.

For the cargo terminal apron, the cargo movement forecast discussed in Chapter 3.2.2 has been referred to. Further, the outbound (export) and inbound (import) movements analysed later in Chapter 5.3.5 are taken into account to predict cargo apron aircraft positions. In view of the annual outbound cargo volume estimated at about 13,000 tons in 1995, the requirements for apron aircraft positions are calculated as follows:

Daily outbound cargo volume : $\frac{13{,}000\ t}{52\ weeks \times 5\ days} = 50\ t/day$

Average load (B-707, DC-8 types) : 28 t/flight

Required positions for export : $\frac{50\ t/d}{28\ t/f} = 1.78$

In view of the possible arrival of inbound cargo aircraft when two aircraft are being loaded for departure, as well as in the light of currently observed congestion with two simultaneous aircraft on the apron, it is proposed to provide a third position in the cargo terminal apron under the short-term improvement plan.

two simultaneous aircraft on the apron, it is proposed to provide a third position in the cargo terminal apron under the short-term improvement plan.

The requirements for cargo apron space for three (3) aircraft is estimated to be 20,300 m^2. This area will be secured by expanding the existing apron (9,200 m^2) by about 11,100 m^2.

Concrete pavement design of the apron area is worked out on the basis of the design criteria as summarized below.

a)	Concrete Flexural Strength	711 psi (50 kgf/cm^2)
b)	Modulus of Subgrade Reaction "(K)" ..... (Refer to Appendix-C)	181 psi (5 kgf/cm^3)
c)	Modulus of Sub Base Reaction "(K)" ..... (Top of sub base course)	253 psi (7 kgf/cm^3)
d)	Modulus of Base Reaction "(K)" ..... (Top of base course)	361 psi (10 kgf/cm^3)

The apron pavement structure is proposed to consist of cement concrete surface of 38 cm in thickness, cement treated base of 17 cm and crushed aggregate sub-base of 30 cm.

5.2.3 Other Facilities

In line with the improvement of taxiways and terminal apron, it is proposed to improve some other airside infrastructures as noted hereunder.

1) GSE Parking Lot

The ground support equipment (GSE) are presently parked disorderly around the finger and northern corner of the apron. With the proposed expansion of the new finger and the terminal apron, it is proposed to provide two new GSE parking lots and locate them to the north of new apron area (about 2,500 m^2) and in front of the existing domestic finger (about 1,200 m^2), totaling about 3,700 m^2.

2) Drainage Systems

Since the existing airport drainage system is connected to the city drainage system and the run-off capacity from the airport has to be limited to the same capacity, the run-off volume from the north area of the terminal should be limited to the capacity of the existing ø1,000 pipes. The maximum rainfall intensity drainable by the existing pipes is estimated to be 40 mm/h. Excess water should be managed by some countermeasures.

In the short-term improvement plan, it is envisaged that a turf area between the existing taxiway and new parallel taxiway would be utilized as a retarding basin to control the flood drainage so that the drainage run-off will be limited to 1,790 m^3/s at the rainfall intensity of 40 mm/h. A preliminary design of retarding basin, drain pipe and ditch is shown in Drawing 5-3.

3) Airfield Maintenance Equipment

Airfield facilities such as the pavement of runway, taxiways and apron, storm drainage facilities etc., are mostly being maintained by the Airport Maintenance Department of DGAC. The Maintenance Department, however, has been suffering from a shortage of maintenance equipment and associated spare parts resulting in substandard services. In this regard, it is proposed that the short-term improvement plan will supply essential equipment to enable the Department to provide proper services.

The requirements for the airfield maintenance will include tire roller, asphalt compactor, loader, portable concrete mixer, joint filling machine, mowing machine, dump trucks, walkie-talkie, etc.

5.3 Passenger and Cargo Terminal Improvements

The requirements for improvement of the terminal areas are discussed first in the light of the traffic forecasts for the short-term target year of 1995. These requirements will, in turn, be compared to the existing conditions, as explained in Chapter 4.2, in order to determine the scope of works needed to satisfy the demand of the target year. Subsequently, the terminal building design concepts are discussed to work out a conceptual design for improvement works.

5.3.1 Terminal Facilities for International Passengers

Major characteristics of the peak hour passengers, at present and in the target year, have been further analysed to determine design standards and space requirements for the international traffic. The projected space requirements are compared with the existing conditions to obtain a clearer picture of the area of deficiency and quantify the needed improvements for the terminal facilities.

1) Peak Hour Passengers and Aircraft Mix

Peak hour passengers and operations, as well as the probable aircraft mix in the target years, have been established as discussed in Chapter III. Major factors determinant for terminal improvement plans are reiterated in a summarized form, as follows:

	1995	2005
Peak Hours (P.H.):		
P.H. Commercial Ops.	14	22
P.H. Passengers (w/o Transit)	1,092	2,125
P.H. Passengers (w/Transit)	1,450	2,610
Traffic Totals:		
Total Passenger Movements	1,214,000	2,500,00
Total Commercial Ops.	27,000	48,000
Average Passengers/Ops.	45	52
Peak Hour Aircraft Mix:		
Large Jets (B-747, DC-10)	2	2
Medium Jets (A-300, B-767)	3	6
Small Jets (B-757, B-707, B-727, B-737)	9	14

The components of peak arrival and peak departure have been analysed further on the basis of the control tower logs. The departure peak has already been found to be 8. The peak arrival during a one-hour interval is found at 7:00 p.m. on January 8, 1989, with a total arrival of 5 flights per hour. The arrival surge is usually at night. The arrival peak to the total peak is applied to determine a 50% arrival component and a 80% departure component.

2) Design Peak Hours and Concentration Factor

The absolute peak is a concept which materializes only once-a-year. It is customary to compute what is referred to as the Design Peak, which constitutes the percentage of the absolute peak most likely to occur on a regular basis; experience has shown that percentage to be about 85%. Consequently, the projected design peak passengers are determined as follows:

Design Peak Hour Passengers

	1995	2005
Passenger (without Transit)	928	1,806
Passenger (with Transit)	1,232	2,218

It is evident that during the peak hour, all the passengers will not be concentrated in the same space of the terminal. Therefore, the concept of the concentration (or distribution) factor is used for each space, to designate which percentage of the design peak load is likely to be in that space during that hour. These percentages are internationally recognized, but are sometimes modified to accommodate local conditions and customs.

3) Design Method and Standards

There are many methods used to compute terminal building requirements, the most common being the one in which standard unit area requirements per design peak hour passenger are used for each function of the terminal. This Study will follow the unit area method, because it can be better adapted to local conditions.

Through analysis of various design standards, including those of the British Airport Authority (BAA), IATA and FAA, it has been decided to adapt some of each of these standards most applicable to the local conditions. Various processing times were also computed locally. The design standards used in this Study are tabulated in Table 5.1.

4) Space Requirements

On the basis of the design standards and other parameters noted above, the required areas for all the important functions of the terminal have been computed as summarized in Table 5.2. Details of the space requirement computation are explained in Appendix-G.

For the anticipated international passengers in 1995, it is estimated that the terminal building space requirement will reach about 8,360 m^2 for functional areas and 18,320 m^2 for ancillary areas, totalling about 26,680 m^2. (The existing spaces are estimated to be about 22,070 m^2.)

5) Comparative Space Analysis

Through the analysis of space requirements presented in Table 5.2, it is possible to evaluate the needs and concepts for improvements. Major issues of evaluations are summarized hereunder.

a) The existing terminal has enough area for its actual (1988) level of traffic. The required spaces are relatively close to the existing spaces. The congestion observed during peak hour traffic must be remedied with organizational changes when possible, or tolerated temporarily, if not possible. The organizational changes which would insure an immediate improvement are the following:

- A better distribution of the check-in counters in terms of actual number of flights operated by the airlines. (For example, TACA operates twice as many flights as PANAM with only one third of their counter space).
- A better system of emigration and immigration processing with the use of automation and more qualified personnel
- Architectural improvements to existing spaces, such as notably, the check-in hall where a better system of baggage handling must be found.
- Improvements in toilet facilities, their maintenance and general upkeep
- Better maintenance of equipment in general, such as elevators and baggage belts

b) Because of the difference of levels in the building, the percentage of circulation space to functional space is very high. This is due in part to the many stairs needed to circulate and also to the formal stairs leading to the fourth floor.

c) The concept of "Functional Circulation" is incorporated in the comparative space analysis to designate areas (like the passenger concourse corridors and hallways) which are basically circulation space, not wasted space, but essential to the functioning of the terminal. These areas should not be determined by exact percentage of "functional spaces", but will depend on the design of the building.

d) Concessions and administrative areas also appear to be proportionately excessive. But this fact is due to a decision of the original planner to dedicate a full floor (the 4th level) to such use.

e) Service areas, such as toilets, are grossly inadequate for a building of that size as mentioned in Chapter 4.2.

f) The category titled "Apron Service Offices" is used to indicate that some private companies (such as the courier DHL) have offices on the apron at the present time. This situation is not in compliance with strict recent security procedures, and should be re-considered. Only companies servicing the airplanes should have offices on the apron.

g) The spaces considered as having excessive areas by 1988 requirements have not been subsantially increased for 1995 in order to bring them to standards for those years. The only exception will be the Functional Circulation which will continue to be increased for the reasons listed above.

5.3.2 Terminal Facilities for Domestic Passengers

La Aurora airport presents the peculiar characteristic of having a very low level of domestic traffic in proportion to its international traffic. Domestic traffic is presently treated almost as a semi-charter activity operating out of a 193 m^2 area, (or only approximately 2% of the total area of the terminal building). Because of these special characteristics, it will not be possible to use the same methodology that was used for the international traffic. Therefore, in some cases, judgemental decisions will be made.

1) Peak Hour Passengers and Aircraft Mix

It is assumed that 90% of the traffic projected for Santa Elena will come from La Aurora, and the other 10% will represent the flights between Santa Elena and Belice and other destinations. Consequently, the domestic traffic at La Aurora is anticipated as summarized below.

Summary Domestic Traffic Forecasts: La Aurora

Peak Hours	1995	2005
Total Annual Passengers	117,000	180,000
Peak Hour Operations	3	4
Peak Hour Passengers	140	200
Design Peak Hour Passengers	119	170
Aircraft Mix:		
Small Jets	1	2
Non-Jets	2	2

2) Design Standards and Space Requirements

The unit area requirements, presented in Table 5.1, are also applied for domestic traffic. The concentration factors are determined to be 75% at check-in hall, 50% at departure halls and 80% at holding rooms and baggage claim area. The space requirements for the domestic terminal are thus calculated to be about 1,030 m^2, as shown in Table 5.3.

3) Comparative Space Analysis

Through the analysis of space requirements, it is possible to evaluate the needs and concepts for improvements for domestic terminal plan as follows:

a) Number of Gates: Given the nature of the traffic, and of the aircraft mix, it is more logical to establish two types of gates, one of which will be with boarding bridge, and the other, serving a remote parking on the apron.

b) Holding Rooms: It is more logical to assume a single holding room feeding both gates, because of the relatively small volume of traffic, and also the flexibility offered by such an arrangement.

c) Concessions and Services: Concession areas will likely be blended together, without distinction between domestic and international. The only

difference will be that the Duty Free Shops cannot be used by domestic passengers, and they are located on the international departure side.

5.3.3 Passenger Terminal Building Design Concept

The existing passenger terminal building is difficult to expand, because of its many levels and the "closed, self-contained" nature of its floor plan. However, some factors tend to dictate a logical concept of expansion. First, the expansion of the apron toward the north. Second, the general symmetrical layout of the existing building would indicate that a symmetrical expansion would be preferable. However, the great imbalance between international and domestic traffic makes this approach difficult. This inevitably leads to a conflicting solution of a non-symmetrical expansion of a symmetrical building. Only a logical architectural treatment can resolve that conflict. The underlying principle will remain however to try to use the existing structure and systems as much as possible.

Basically, it is proposed to concentrate all expansion of departure and check-in activities on the second floor, now used as departure area only. This will avoid aggravating the existing problem of traffic flow between Check-in (3rd floor) and Departure (2nd floor). Transition between the two areas will be facilitated with the installation of two new escalators, in addition to the rehabilitation of all the existing elevators.

The floor plan for the target year 1995 is proposed as illustrated in Drawings 5-5 to 5-7. It must be noted that the floor plan might not adhere exactly to the requirements of the comparative space analysis as indicated in Table 5.2. This is due, in part, to the fact that some of the facilities for the year 2005 must already be built in 1995 because of their function; such is the case of the new concourse which must serve the three (3) new gates. The new layout can be explained in sequence of floor levels and by building, as follows:

1) Central (Main) Building:

- Level 4: The fourth level will not be altered and will remain as rentable area for concessions (restaurant, bar) and offices. Service areas (toilets, etc.) will be worked out in accordance with final subdivisions.

- Level 3: This level will not be expanded and will remain as Check-in Area No. 1. The airline offices and counters will be re-distributed on a modular unit space per airline. Each airline would be guaranteed to get at least one module and can rent additional modules, if desired. Additional toilet facilities will be built on this level. Transition to and from the level 2 will be made via two new escalators, and the existing elevators to be rehabilitated.

  The check-in counters for Eastern, Continental, Aeronica and Aeroquetzal will be removed from their present location underneath the staircase, which will result in opening a pleasant view toward the apron from the third floor. They can be relocated either on the second floor, or redistributed on the third.

- Level 2: This level will be expanded for the year 1995 and will contain the following functions:

  - Security Check No. 1 & 2 (International)
  - Check-in Area No. 2 with airline offices (International)
  - Departure Hall (International)
  - General circulation and required services (Toilets, etc.)
  - Emigration (No. 1 & No. 2)
  - Concessions

  In addition to the above-listed areas which will be expanded according to the requirements established in Table 5.2, some areas, which were previously non-existent, will be created:

  - Domestic Check-in with Airline offices
  - Domestic Departure Hall
  - Domestic Security Check

  Note: This new domestic area will be developed on the south side of the terminal, thereby generating a new "domestic wing" which, although much smaller, will counterbalance the international wing.

- Level 1: This floor will still accommodate all arriving international passengers. The baggage belts will be relocated from their congested area, now in conflict with customs, to a location where they can equally serve both international concourses. In order to avoid congestion, customs verification will be divided in two areas, each serving one particular concourse. Secondary functions, such as rent-a-car offices and others, will be distributed around these main functions.

  For 1995, there will also be a need to provide a separate domestic arrival area, with a distinct baggage pick-up. Because of the light traffic still forecast for this stage, a mechanized belt is not envisioned, but only a "pass-thru" window where the baggage is received. No custom inspection is assumed. The location of this new domestic area is such that the logical distribution between international and domestic is maintained.

- Basement: The basement will be rented to airlines for baggage service and storage areas. The outbound cargo storage facilities which occupied that space will be transferred to the cargo building.

2) Concourses

The expansion of the passenger terminal, though non-symmetrical, will incorporate three concourses.

- Existing (International) Central Concourse: The existing concourse will still remain for international traffic, and will be dedicated exclusively to small jets (B-727, B-737 and DC-9 types). Parking position No. 7 will not constitute an obstacle and might remain as additional or extra berth in the short-term improvement stage, because only one-third of the parallel taxiway will be built in this stage, and only small jets will be crossing to the south side of the concourse. For the same reasons, it will not be necessary to cut part of the building in 1995, as proposed in 2005, in order to achieve the 46.5 meters distance requirement between a taxiway and an obstacle.

  A ramp will replace the stairs at each gate for wheel chair passengers to reach the arrival corridor.