

THE REPUBLIC OF COSTA RICA

THE STUDY ON THE DEVELOPMENT
OF
THREE INTERNATIONAL AIRPORTS
IN
THE REPUBLIC OF COSTA RICA

FINAL REPORT

VOLUME 3 : APPENDICES

THE STUDY ON THE DEVELOPMENT OF THREE INTERNATIONAL AIRPORTS IN THE REPUBLIC OF COSTA RICA

FINAL REPORT VOLUME 3 : APPENDICES

NOVEMBER 1992

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

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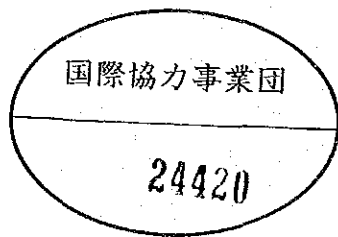
**THE STUDY ON THE DEVELOPMENT
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THE REPUBLIC OF COSTA RICA**

FINAL REPORT

VOLUME 3 : APPENDICES

NOVEMBER 1992

**JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)**



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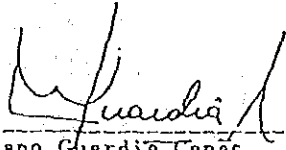
**APPENDIX-1.1.1 SCOPE OF WORK AGREED UPON
BETWEEN JICA AND MOPT**

SCOPE OF WORK
FOR
THE STUDY
ON
THE DEVELOPMENT OF THREE INTERNATIONAL AIRPORTS
IN
THE REPUBLIC OF COSTA RICA

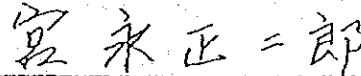
AGREED UPON BETWEEN
MINISTRY OF PUBLIC WORKS AND TRANSPORT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

SAN JOSE

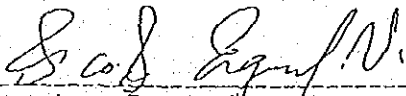
OCTOBER 10, 1990



Mariano Guardia Canas
Vice Minister,
Ministry of Public Works and
Transport



Shojiro MIYANAGA
Leader of the Japanese
Preliminary Study Team,
Japan International
Cooperation Agency



Francisco Esquivel
Vice Minister,
Ministry of National Planning and
Political Economy

I. INTRODUCTION

In response to the request of the Government of the Republic of Costa Rica (hereinafter referred to as "the Government of Costa Rica"), the Government of Japan decided to conduct the Study on the Development of Three International Airports in the Republic of Costa Rica (hereinafter referred to as "the Study"), in accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of Costa Rica signed on May 24, 1985 (hereinafter referred to as "the Agreement").

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Costa Rica.

The present document sets forth the scope of work with regard to the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are as follows:

- 2.1 To formulate the Master Plan for Long-Term Development of the Juan Santamaria, Liberia (Tomas Guardia) and Limon airports.
- 2.2 To evaluate technical, economic, and financial feasibility of Short-Term Development Plan to be formulated within the framework of the Master Plan.

III. SCOPE OF THE STUDY

In order to achieve the objectives mentioned above, the Study shall cover the following items;

3.1 Evaluation of Existing Situation

- (1) Review of available data and information relevant to the Study
- (2) Field surveys
- (3) Analysis of present air transport network and air transport demand, including the relation among the three airports
- (4) Evaluation of existing facilities and utilization of the three airports

3.2 Formulation of Master Plan

An appropriate Master Plan shall be prepared for the target year 2010.

- (1) Forecast of future air transport demand
- (2) Determination of expected roles and functions of the

- three airports
- (3) Formulation of Long-Term Development Strategy of the three airports
 - (4) Analysis of facilities requirements
 - (5) Airport facilities planning
 - (6) Preparation of preliminary cost estimates
 - (7) Recommendation on management and operation systems for the three airports
 - (8) Preparation of staged implementation plan
 - (9) Recommendation of the short term development plans

3.3 Feasibility Study on Short-Term Development Plan

Feasibility Study shall be conducted for a short term development plan to be formulated within the framework of Master Plan for the target year 2000 or other year which may be considered more appropriate and in consideration of environmental aspects.

- (1) Identification of projects
- (2) Preliminary design
- (3) Construction schedule
- (4) Cost estimates
- (5) Economic analysis
- (6) Financial analysis
- (7) Evaluation of projects
- (8) Implementation programmes for projects

IV. SCHEDULE OF THE STUDY

The Study will be carried out in accordance with the attached tentative schedule as shown in the Appendix. This schedule, however, is subject to change according to circumstances.

V. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Costa Rica.

5.1 Inception Report (20 copies)

This report is to describe the overall approach and implementation programme of the Study and to be submitted at the commencement of the Study.

5.2 Progress Report (20 copies)

This report will be submitted within 4 months after commencement of the Study and will contain the provisional outcome of the first field survey.

5.3 Interim Report (20 copies)

This report will be submitted within 7 months after the commencement of the Study and will include the Master

Plan.

5.4 Draft Final Report (20 copies)

This report will be submitted within 11 months after commencement of the Study and will contain all the results of the Study.

The Government of Costa Rica will provide comments on the Draft Final Report in English within 4 weeks after receipt of the report.

5.5 Final Report (30 copies)

This report will be submitted within 2 months after receipt of the above mentioned comments on the Draft Final Report.

VI. UNDERTAKING OF THE GOVERNMENT OF THE REPUBLIC OF COSTA RICA

6.1 To facilitate smooth implementation of the Study, the Government of Costa Rica will accord privileges, exemption and other benefits to the Japanese Study Team (hereinafter referred to as "the Team"), in accordance with the Agreement and shall take necessary measures :

- (1) To secure the safety of the members of the Team.
- (2) To permit the members of the Team to enter, leave and sojourn in Costa Rica for the duration of their assignment therein, and exempt them from alien registration requirements and consular fees.
- (3) To exempt the members of the Team from taxes, duties and any other charges on equipment, machinery and other materials brought into and out of Costa Rica for the implementation of the Study.
- (4) To exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study.
- (5) To provide necessary facilities to the Team for remittances as well as utilization of the funds introduced into Costa Rica from Japan in connection with the implementation the Study.
- (6) To secure permission for entry into private properties or restricted areas for the implementation of the Study.
- (7) To secure permission for the Team to take all data and documents (including photographs, maps) related to the Study out of Costa Rica to Japan.

(S) To provide medical services as needed and its expenses will be chargeable to the members of the Team.

6.2 The Government of the Republic of Costa Rica shall bear claims, if any arises against the members of the Team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

6.3 Ministry of Public Works and Transport (hereinafter referred to as "MOPT") shall act as the counterpart agency to the Team and also as the coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

6.4 MOPT shall, at its own expense, provide the Team with the following, in cooperation with other relevant organizations:

- (1) Available data and information related to the Study
- (2) Counterpart personnel
- (3) Suitable office space with necessary equipment in San Jose
- (4) Credentials or identification cards

VII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures:

- 7.1 To dispatch, at its own expense, the Team to Costa Rica
- 7.2 To pursue technology transfer to the Costa Rica counterpart personnel in the course of the Study.

VIII. OTHERS

JICA and MOPT shall consult with each other in respect of any matter that may arise from or in connection with the Study.

Appendix

TENTATIVE STUDY SCHEDULE

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Work in Costa Rica		[Bar]					[Bar]				[Bar]			
Work in Japan	[Bar]			[Bar]				[Bar]				[Bar]		
Submission of Report	▲ IC/R			▲ P/R			▲ IT/R				▲ DF/R			▲ F/R

[Legend]

- IC/R : Inception Report
- P/R : Progress Report
- IT/R : Interim Report
- DF/R : Draft Final Report
- F/R : Final Report

[Contents of Reports]

- IC/R : Study Methodology
- P/R : Provisional Outcome of First Field Survey
- IT/R : Master Plan
- DF/R : All the Results
- F/R : All the Results

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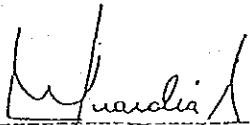
**APPENDIX-1.1.2 MINUTES OF MEETING AT THE TIME OF
S/W AGREEMENT**

MINUTES OF MEETING
OF
THE STUDY
ON
THE DEVELOPMENT OF THREE INTERNATIONAL AIRPORTS
IN
THE REPUBLIC OF COSTA RICA

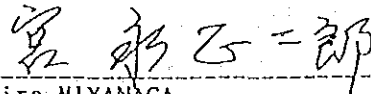
BETWEEN
MINISTRY OF PUBLIC WORKS AND TRANSPORT
AND
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SAN JOSE

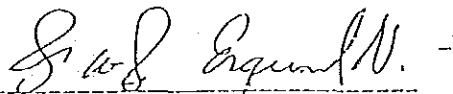
OCTOBER 10, 1990



Mariano Guardia Cañas
Vice Minister,
Ministry of Public Works and
Transport



Shojiro MIYANAGA
Leader of the Japanese
Preliminary Study Team,
Japan International
Cooperation Agency



Francisco Esquivel
Vice Minister,
Ministry of National Planning and
Political Economy

The Japanese Preliminary Study Team (hereinafter referred to as "the Team"), organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Mr. Shojiro MIYANAGA, visited Costa Rica from 29 September to 13 October, 1990, in connection with the Study on the Development of Three International Airports (hereinafter referred to as "the Study").

The Team made a courtesy call on Mr. Guillermo Madriz, the Minister for public works and transport on 1st of October. The Team had a series of discussions with officials of the Ministry of National Planning and Political Economy headed by Mr. Francisco Esquivel, the Vice-Minister, and the Ministry of Public Works and Transport headed by Mr. Mariano Guardia Canas, the Vice-Minister, during its stay in Costa Rica.

The Team also visited the Limon International Airport on 4th of October, the Juan Santamaria International Airport on 5th of October, and the Liberia International Airport (Tomas Guardia) on 6th of October.

1. In concluding the S/W of the Study, the both sides agreed that the Study will be conducted taking into consideration the previous studies, including the recent pre-feasibility study, as an urgent measure, of the Juan Santamaria International Airport, but subject to without prejudging those studies.
2. The Costa Rica side requested that the Scope of Works and Minutes of Meeting should be made not only in English but also in Spanish. The both sides agreed, in this respect, the English ones should be the original and the Spanish ones will be used for the reference for the Costa Rica side.
3. The both sides confirmed to use "Study on the Development of Three International Airports", as the title of the Study.
4. The both sides agreed that a steering committee or similar arrangement, among authorities concerned, will be readied to act as a coordinating body, by the Costa Rica side, to keep a smooth conduct of the Study.
5. In the developing of the Juan Santamaria International Airport, some relationships with the Tobias Bolanos International Airport should be taken into consideration in the Study.
6. The Costa Rica side requested a counterpart training should be carried out in Japan during the conduct of the Study. The Team replied to convey such request to JICA.
7. The Costa Rica side also strongly requested the Team that several vehicles to be provided by JICA in order to conduct the Study effectively and efficiently. The Team replied to convey such request to JICA.

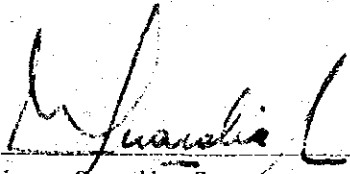
**APPENDIX-1.5.1 MINUTES OF MEETING ON THE
INCEPTION REPORT**

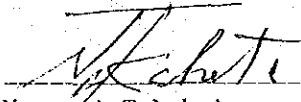
MINUTES OF MEETING
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OF
THREE INTERNATIONAL AIRPORTS
IN
THE REPUBLIC OF COSTA RICA

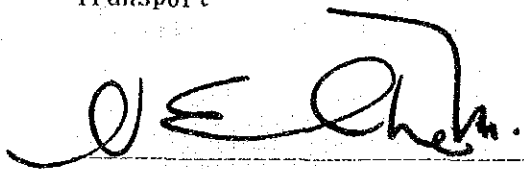
BETWEEN
MINISTRY OF PUBLIC WORKS AND TRANSPORT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

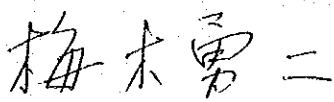
SAN JOSE

AUGUST 14, 1991


Mariano Guardia C.
Vice Minister.
Ministry of Public Works and
Transport


Naonori Takahata
Leader
JICA Study Team


Alvaro Escalante M.
Director General of Civil Aviation
Ministry of Public Works and
Transport


Yuji Umeki
Chairman
JICA Advisory Committee

A team organized by Japan International Cooperation Agency (Hereinafter referred to as "JICA") arrived in San Jose, Costa Rica on August 11, 1991. JICA team consists of JICA Advisory Committee headed by Mr. Yuji Umeki and Study Team headed by Mr. Naonori Takahata.

On August 12, 1991, the JICA team made courtesy calls on Ministry of Public Works and Transport (hereinafter referred to as "MOPT") and Ministry of National Planning and Political Economy. And it submitted twenty (20) copies of the Inception Report on the Study on the Development of Three International Airports in The Republic of Costa Rica (hereinafter referred to as "the Study").

From August 12 to 14, 1991, the JICA team held a series of meeting on the Inception Report with the Government of Costa Rica. The Government of Costa Rica (hereinafter referred to as "Costa Rica side") was headed by Mr. Mariano Guardia, Vice Minister of MOPT.

1. The Inception Report was in principle accepted and agreed upon by Costa Rica side.
2. Costa Rica side strongly requested that another member (two in total) will be accepted as counterpart trainee in Japan. The JICA team promised to convey this request to the headquarters of JICA.
3. Costa Rica side agreed to establish the Steering Committee and Counterpart Team. The member lists are indicated in Attachment - 1.

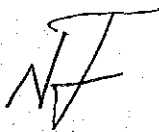
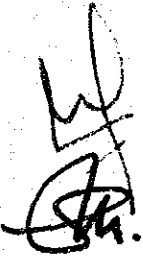
MEMBER LIST OF STEERING COMMITTEE AND COUNTERPART TEAM

(1) Steering Committee

1. Mr. Mariano Guardia : Vice Minister
(Chairman)
2. Mr. Mario Herrera : Director General of Planning
3. Mr. Alvaro Escalante : Director General of Civil Aviation
4. Mr. Rodolfo Monge : Deputy Director General of Civil Aviation
5. Mr. Fernando Mendez : Head of Infrastructure Department

(2) Counterpart Team

1. Mr. Fernando Mendez : Airport Planning/Civil Engineering
(Coordinator) Architecture
2. Ms. Isabel Lopez : Airport Planning/Civil Engineering
Architecture
3. Mr. Johnny Arrieta : Air Navigation System/Air Traffic
Control
4. Mr. Jose Escobar : Finance and Accounting/Economics
5. Mr. Mario Viquez : Mechanical and Electrical
Engineering/Airport Maintenance



List of Attendants

A. JICA Study Team

1. Mr. Naonori TAKAHATA : Team Leader/Airport Planner
2. Mr. Yaichi KOBAYASHI : Traffic Forecast/Economic Analyst
3. Mr. Niso WADA : Co-Airport Planner/Civil Engineer
4. Mr. Yasuro HAGIWARA : Topographic and Geotechnical Engineer

B. JICA Advisory Committee

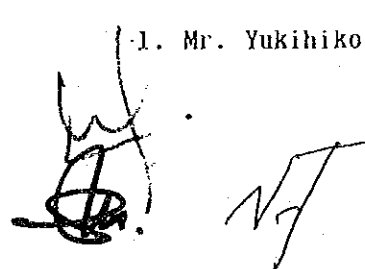
1. Mr. Yuji UMEKI : Deputy Director,
(Chairman) Construction Division,
Aerodrome Department,
Civil Aviation Bureau,
Ministry of Transport
2. Mr. Atsushi MATSUI : Chief,
Second International Affairs
Division
Transport Policy Bureau,
Ministry of Transport

C. Embassy of Japan

1. Mr. Tadayoshi MOCHIZUKI: Counsellor
2. Ms. Toyomi ISHII : Second Secretary
3. Mr. Noriyuki AYUKAWA : Assistant

D. JICA Coordinator

1. Mr. Yukihiro EJIRI : Project Officer,
First Development Study Division,
Social Development Study Department,
JICA

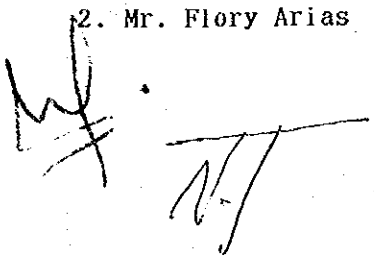


E. Ministry of Public Works and Transport

1. Mr. Mariano Guardia : Vice Minister
2. Mr. Mario Herrera : Director General of Planning
3. Mr. Alvaro Escalante : Director General of Civil Aviation
4. Mr. Fernando Mendez : Head of Infrastructure Department
5. Ms. Isabel Lopez : Sub-Head of Infrastructure Department
6. Mr. Johnny Arrieta : Sub-Head of Air Navigation Department
7. Mr. Jose Escobar : Head of Finance Department
8. Mr. Mario Viquez : Officer of Infrastructure Department

F. Ministry of National Planning and Political Economy

1. Mr. Francisco Esquivel : Vice Minister
2. Mr. Flory Arias : Officer of Analysis on Program and Project Department

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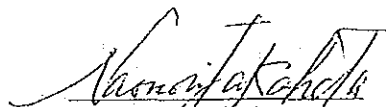
**APPENDIX-1.5.2 MINUTES OF MEETING OF THE
PROGRESS REPORT**

MINUTES OF MEETING
OF
THE PROGRESS REPORT ON THE STUDY ON THE DEVELOPMENT
OF
THREE INTERNATIONAL AIRPORTS
IN
THE REPUBLIC OF COSTA RICA
BETWEEN
MINISTRY OF PUBLIC WORKS AND TRANSPORT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

SAN JOSE, OCTOBER 25, 1991



Alvaro M. Escalante
General Director
of Civil Aviation
Ministry of Public
Works and Transports



Naonori Takahata
Leader
JICA Study Team

The Study Team completed "Step 2: First field survey in Costa Rica" in compliance with Work Flow Chart in the Inception Report approved on August 14, 1991.

The Study Team submitted 20 copies of Progress Report to Ministry of Public Works and Transport (hereinafter referred to as "MOPT") on October 21, 1991.

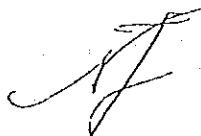
The Progress Report was explained to MOPT and discussed in the meetings held from October 22 to 24, 1991.
Attendance list is attached herewith as Attachment-1.

The progress report was in principle accepted and agreed upon by Costa Rica Side.

Through the series of meeting, the Study Team was given the comments or requirements on the further master plan study as shown in Attachment-2.

The Study Team replied that the Study Team will inform to the Advisory Committee of these comments and requirements on the further study.

The Costa Rica Side agreed with the Study Team's reply.




List of Attendant

- 1) Steering Committee
 1. Mr. Mariano Guardia : Vice Minister
 2. Mr. Mario Herrera : General Director of Planning
 3. Mr. Alvaro Escalante : General Director of Civil Aviation
 4. Mr. Rodolfo Monge : General Deputy Director of Civil Aviation
 5. Mr. Fernando Mendez : Head of Infrastructure Department
- 2) Counterpart Team
 1. Mr. Fernando Mendez : Airport Planning/Civil Engineering Architecture
 2. Ms. Isabel Lopez : Airport Planning/Civil Engineering Architecture
 3. Mr. Johnny Arrieta : Air Navigation System/Air Traffic Control
 4. Mr. Bernal Mesen : Air Navigation System/Air Traffic Control
 5. Mr. Mario Viquez : Mechanical and Electrical Engineering/Airport Maintenance
- 3) JICA Study Team
 1. Mr. Naoromi TAKAHATA : Team Leader/Airport Planner
 2. Mr. Tadamitsu ITO : Airways Planner/Airport Operations Planner
 3. Mr. Niso WADA : Co-Airport Planner/Civil Engineer
 4. Mr. Yoshiya NIINOMI : Air Navigation System Engineer
 5. Mr. Toshiro SATO : Mechanical and Electrical Engineer
- 4) Interpreter
 1. Mr. Simon URIBE



3



The following comments and requirements were given by Costa Rica Side.

- Consideration of the maximum utilization of the existing facilities and minimum investment for the development of Juan Santamaria International Airport so as to cope with the government policy about the new airport construction plan.
- Consideration of the application of FAA Standard and others so as to utilize the existing facility in maximum.
- No limitation or condition on the relocation of COOPESA's Hangar and RECOPE's Fuel Yard.
- No consideration of the diversion of the existing Highway adjacent to the east-north side of the Airport.



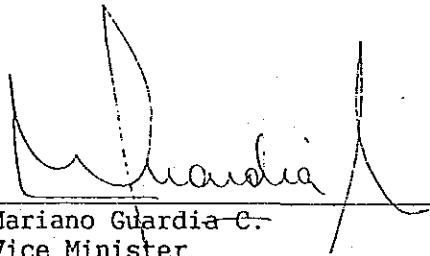
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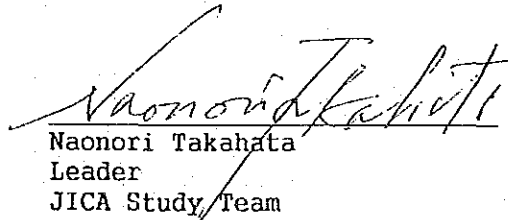
**APPENDIX-1.5.3 MINUTES OF MEETING
ON THE INTERIM REPORT**

MINUTES OF MEETING
OF
THE INTERIM REPORT ON THE STUDY ON THE DEVELOPMENT
OF
THREE INTERNATIONAL AIRPORTS
IN
THE REPUBLIC OF COSTA RICA
BETWEEN
MINISTRY OF PUBLIC WORKS AND TRANSPORT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

SAN JOSE, FEBRUARY 20, 1992



Mariano Guardia C.
Vice Minister
Ministry of Public Works and
Transport



Naonori Takahata
Leader
JICA Study Team

A team organized by Japan International Cooperation Agency (hereinafter referred to as "JICA") arrived in San Jose, Costa Rica on February 16, 1992. JICA team consists of the JICA Advisory Committee headed by Mr. Kozo Ota and the JICA Study Team headed by Mr. Naonori Takahata.

On February 17, 1992, the JICA team made courtesy call on Ministry of Public Works and Transport (hereinafter referred to as "MOPT"). And the JICA team submitted 20 copies of Interim Report on the Development of Three International Airports in The Republic of Costa Rica (hereinafter referred to as " the Study").

From February 18 to 20, 1992, the JICA team held a series of meetings on the Interim Report with the Government of Costa Rica. The Government of Costa Rica (hereinafter referred to as "Costa Rica side") was headed by Mr. Mariano Guardia, Vice Minister of MOPT.

As a result of the meeting, the Government of Costa Rica agreed to the following items:-

1. The Interim Report was in principle accepted and agreed upon by Costa Rica side including the following conditions:

- 1.1 Juan Santamaria International Airport

- a) Locations of some terminal facilities will be rearranged based on new information given by Costa Rica side due to the difficulties on the relocation of the existing facilities.
- b) Construction of new parallel taxiway in the short-term development will be studied from the viewpoint of taxiing configuration, its construction cost, aircraft operation cost and benefit obtained from its function.

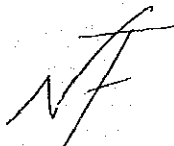
- 1.2 Liberia International Airport

- a) The further study will be made on the demand forecast of exported cargo based on the policies and conditions provided by Costa Rica side.
- b) A very long term master plan beyond year 2010 based on rough information will be prepared as reference.
- c) The route of access road will be relocated in accordance with new information on land acquisition by Costa Rica side.

2. Costa Rica side strongly requested an additional study in order to check the practicability of the proposed Master Plan in comparison with the possibility of a new airport.

The JICA team promised to convey this request to the headquarters of JICA.

List of Attendants is attached herewith as Attachment-1



2

List of Attendants

1) Steering Committee


- 1. Mr. Mariano Guardia : Vice Minister
- 2. Mr. Fernando Mendez : Head of Infrastructure Department

2) Counterpart Team

- 1. Mr. Fernando Mendez : Airport Planning/Civil Engineering Architecture
- 2. Ms. Isabel Lopez : Airport Planning/Civil Engineering Architecture
- 3. Mr. Bernal Mesen : Air Navigation System/Air Traffic Control
- 4. Mr. Alexis Navarro : Architecture
- 5. Mr. Luis Fernandez : Civil Engineering

3) JICA Study Team

- 1. Mr. Naonori TAKAHATA : Team Leader/Airport Planner
- 2. Mr. Yaichi KOBAYASHI : Traffic Forecast/Economic Analyst
- 3. Mr. Tadamitsu ITO : Airways Planner/Airport Operations Planner
- 4. Mr. Niso WADA : Co-Airport Planner/Civil Engineer
- 5. Mr. Fumitomi FUJITA : Architect



4) JICA Advisory Committee

1. Mr. Kozo OTA : Chief,
Construction Division, Aerodrome
Department, Civil Aviation Bureau,
Ministry of Transport

2. Mr. Norio MURAI : Special Assistant to the Director,
ATS System Planning Division,
Air Traffic Services Department,
Civil Aviation Bureau,
Ministry of Transport

5) Embassy of Japan

Mr. Noriyuki AYUKAWA : Assistant

6) JICA Coordinator

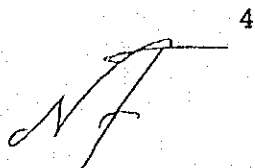
Mr. Yukihiro EJIRI : Project Officer,
First Development Study Division,
Social Development Study Development,
JICA

7) Interpreter

Mr. Simon URIBE



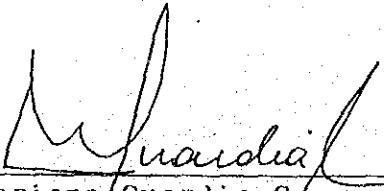
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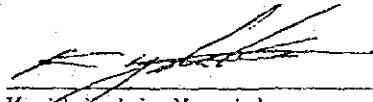


**APPENDIX-1.5.4 MINUTES OF MEETING ON
THE DRAFT FINAL REPORT**

MINUTES OF MEETING
OF
THE DRAFT FINAL REPORT FOR THE STUDY ON THE DEVELOPMENT
OF
THREE INTERNATIONAL AIRPORTS
IN
THE REPUBLIC OF COSTA RICA
BETWEEN
MINISTRY OF PUBLIC WORKS AND TRANSPORT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

SAN JOSE, SEPTEMBER 3, 1992


Mariano Guardia C.
Vice Minister
Ministry of Public Works
and Transport


Keikichi Yosida
Team Leader
JICA Study Team

A team organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") arrived in San Jose, Costa Rica on August 27 and 30, 1992, in two groups. The JICA Team consisted of the JICA Advisory Committee headed by Mr. Yuji Umeki and the JICA Study Team headed by Mr. Keikichi Yosida.

On August 31, 1992, the JICA Team made a courtesy call on Ministry of Public Works and Transport (hereinafter referred to as "MOPT") and submitted 20 copies of Draft Final Report for the study on the Development of Three International Airports in the Republic of Costa Rica (hereinafter referred to as "the Report").

From August 31 to September 3, 1992, the JICA Team held a series of meetings on the Draft Final Report with the Government of Costa Rica (hereinafter referred to as "the Government")

As a result of the discussions, the Draft Final Report was generally agreed on and accepted by the Government with the modifications as listed in Attachment-1.

The Final Report, which will incorporate the above modifications, will be submitted to the Government at the end of October, 1992.

Closing the meetings, the JICA Advisory Committee expressed thanks to the Government for kind cooperation extended to the Study Team during the study period.

List of Attendants is attached as Attachment-2.



Modifications of Draft Final Report

- 1) Inventory of Liberia International Airport shall be modified based on the latest situation of the ongoing Project to be informed by MOPT.
- 2) "Reserved area for fuel depot" shown in Figure 8.2.9 shall be indicated as the area for long-term development.
- 3) The apron and taxiway in front of the security and general aviation hangars shall be plotted in Figure 8.2.10 Alternative Terminal Area Development Plan (Alt,T-C).
- 4) Location of new cloud ceilometer planned in the preliminary design shall be changed from middle marker site to the area around the runway.
- 5) Description of 10.5.5 Telephone shall be eliminated since the telephone system for PABX will be introduced in the long-term development plan.
- 6) Appendix 10.3.2 Comparative Study of Improvement of the Existing Terminal Building by DGAC shall be replaced with the latest one.
- 7) "Air navigational aid department" in Figure 13.2.1 shall be deleted.
- 8) Description about revenue and expenditure in Section 13.3 shall be eliminated from the main report, but the Table 13.3.1 will be transferred to Appendix.
- 9) In section 13.4 Additional Airport Staff, the following explanation shall be added:
 - The additional airport staff required for short-term development is to be examined to obtain the additional personnel cost in economic and financial analysis.
 - The organization structure in year 2000 is assumed to be the same system as existing and to be expanded in proportion to the growth of air traffic volume.



List of Attendants

1) Steering Committee

- 1. Mr. Mariano Guardia : Vice Minister
- 2. Mr. Mario Herrera : Director General of Planning
- 3. Mr. Alvaro Escalante : Director General of Civil Aviation
- 4. Mr. Fernando Mendez : Head of Infrastructure Department

2) Counterpart Team

- 1. Mr. Fernando Mendez : Airport Planning/Civil Engineering /Architecture
- 2. Ms. Isabel Lopez : Airport Planning/Civil Engineering /Architecture
- 3. Mr. Bernal Mesen : Air Navigation System/Air Traffic Control

2) JICA Study Team

- 1. Mr. Keikichi Yosida : Team Leader
- 2. Mr. Niso Wada : Airport Planner/Civil Engineer
- 3. Mr. Yaichi Kobayasi : Traffic Forecast/Economic Analyst
- 4. Mr. Fumitomi Fujita : Architect

3) JICA Advisory Committee

- 1. Mr. Yuji Umeki : Director,
(Chairman) Airport Construction Division,
Public Works Department,
Fukushima Prefecture
- 2. Mr. Norio Murai : Special Assistant to the Director,
ATS System Planning Division,
Air Traffic Services Department,
Civil Aviation Bureau,
Ministry of Transport

4) Embassy of Japan

- Mr. Noriyuki Ayukawa : Advisor to the Ambassador

5) JICA Coordinator

- Mr. Hiroshi Tujino : Project Officer,
First Development Study Division,
Social Development Study Department,
JICA

6) Interpreter

- Mr. Simon Uribe




**APPENDIX-1.5.5 LIST OF DATA AND
INFORMATION COLLECTED**

1. GEOGRAPHY AND GEOLOGY

- 1.1 Geographic map covering all of the Country : 1:800,000
- 1.2 Geographic maps covering the Airport
1 : 1,000, 1 : 10,000, 1 : 15,000, 1 : 50,000, 1 : 200,000
- 1.3 Aerial photographs covering the Airport
- 1.4 Geological maps of the Region
- City map of San Jose
- 1.5 Publications defining geological data of the region.
- 1.6 Tourism and road maps
- Road map 1: 1,000,000

2. METEOROLOGY AND CLIMATOLOGY

- 2.1 Meteorological study of Liberia Airport
- 2.2 Frequency of wind direction and velocity for Limon Airport
- 2.3 Report of aeronautical climate in year 1990 prepared by Institute of National Meteorology
- 2.4 Data of wind velocity, direction, ceiling height and visibility in three airports

3. DEMOGRAPHY AND ECONOMY

- 3.1 Statistics of population, GDP, tourism and trade in Costa Rica
- 3.2 Tourism statistics (1984 ~ 1989)
- 3.3 Economical indices (1980 ~ 1990)
- 3.4 National strategy of tourism development for year 1984 ~ 1990, prepared by ICT in 1984, Part I and Part II
- 3.5 Industrial statistics (1980 ~ 1990)
- 3.6 Trade statistics
- 3.7 Tourism guidance of Costa Rica (Spanish and German)

4. NATIONAL, REGIONAL AND LOCAL DEVELOPMENT PLAN

- 4.1 National Development Plan of Year 1990 - 1994. The outline prepared by Ministry of National Planning and Economical Policy
- 4.2 National plan of agriculture and water resources
 - General information for the planning of water supply from year 1990 ~ 1995 prepared by SENARA
 - Precipitation map of Costa Rica prepared by SENARA
 - Agricultural development planned by SENARA
- 4.3 National plan of tourism
 - General information of Papagaya Gulf Project prepared by ICT
- 4.4 Guidance of free zone development, Zona Franca
- 4.5 Profile for the project of infrastructure in Costa Rica, MOPT

5. TRANSPORTATION (Other than air) AND COMMUNICATION

- 5.1 Public transportation related to the project and area served by it, including :
 - Bus service route, schedules and tariff
 - Railway service route, schedules and tariff
- 5.2 National vehicle traffic survey in 1985 and 1989

6. AIR TRANSPORT

- 6.1 Five (5) year plan of airport investment, DGAC
- 6.2 Air traffic statistics for local passenger (1981 ~ 1989) in Juan Santamaria and Tobias Bolanos Airports, DGAC
- 6.3 International flight schedule of Juan Santamaria Airport in 1990 September, DGAC
- 6.4 International cargo flight schedule of Juan Santamaria Airport in 1990 September, DGAC
- 6.5 Monthly aircraft movement of Juan Santamaria, Tobias Bolanos and Limon Airports (1989, 1990), DGAC
- 6.6 Aircraft movement and volume of cargo in Juan Santamaria Airport (Local and International, 1979 ~ 1989), DGAC
- 6.7 IATA Forecast (1990)

- 6.8 Statistic data for international air transport prepared in 1984, 1987 and 1989, DGAC
- 6.9 Air traffic statistics of Juan Santamaria Airport (Passenger, cargo mail) from 1986 to 1990, DGAC
- 6.10 Financial report of MOPT, 1990
- 6.11 Registered aircraft in Tobias Bolanos Airport, 1990
- 6.12 Landing charge and other charge
- 6.13 International and domestic air fare
- 7. AIRLINES
 - 7.1 Financial statement of airlines
- 8. THE EXISTING AIRPORT FACILITIES
 - 8.1 Description of airports in Costa Rica (112 airports), DGAC
 - 8.2 Existing layout plan of Juan Santamaria Airport. Scale 1:1,000 and 1:2,000, DGAC
 - 8.3 Development map of Liberia Airport. Scale 1:10,000, DGAC
 - 8.4 Review of the master plan for Juan Santamaria Airport, DGAC
 - 8.5 Report for the master plan of Liberia Airport, DGAC
 - 8.6 Report for the master plan of Juan Santamaria Airport prepared in year 1977, MOPT (Dixon)
 - 8.7 Report for the master plan of Juan Santamaria Airport prepared in year 1981, MOPT (PRC)
 - 8.8 Report for the revision of Master Plan of Juan Santamaria Airport in year 1990, MOPT (Bell)
 - 8.9 Feasibility study for cargo terminal facilities of Juan Santamaria Airport in 1988, DGAC
 - 8.10 Report of pavement condition in Juan Santamaria Airport in 1990, DGAC
 - 8.11 Drawings of passenger terminal building in Juan Santamaria Airport first floor, ground floor, basement, cross-section and elevation

- 8.12 Fire fighting equipment in Juan Santamaria Airport
- 8.13 Air navigational facilities in Juan Santamaria Airport
- 8.14 Drawings of existing airside facilities in Juan Santamaria Airport
- 8.15 Drawings of plan and profile of Tobias Bolanos
- 8.16 Drawings of development plan for Liberia Airport
- 8.17 List of buildings in Juan Santamaria Airport
- 9. AIRPORT ADMINISTRATION AND MANAGEMENT
 - 9.1 Organization chart of DGAC and Civil Aviation
 - 9.2 Annual revenue and expenditure of airport operation
 - 9.3 Operation cost of fire fighting
 - 9.4 Statistics of airport operation (1989 ~ 1990, IFR-VFR), MOPT
- 10. AIRSPACE USE
 - 10.1 Report of 30 years anniversary of COSESNA
 - 10.2 History of COSESNA
 - 10.3 Cooperation institution of COSESNA
 - 10.4 Report of COSESNA in 1985 (Situation of member countries)
 - 10.5 Operational navigation chart in the area controlled by COSESNA (K-25)
 - 10.6 AIP Costa Rica
 - 10.7 Obstruction maps, Scale 1:50,000 1:10,000
- 11. ENGINEERING
 - 11.1 Seismic condition of structure in Costa Rica
 - 11.2 Price of construction material and labor cost in Costa Rica, 1991
 - 11.3 Environmental profile of Costa Rica
 - 11.4 Geotechnical condition of Costa Rica

APPENDIX TO CHAPTER 2

APPENDIX-2.5.1 FUTURE FLIGHT PLANS OF AIRLINES

AIRLINE	ROUTE	PASSENGER OR FREITER	AIRCRAFT	FLIGHT	SCHEDULE	RESISTRATION
A. JUAN SANTAMARIA						
1. LACSA	(JUAN SANTAMARIA) - MAIAHI	PASSENGER	A-320	Daily 2 ----> Daily 2 + Weekly 3 (High season, Nov. - Jan. only)	1991 Nov.	SCHEDULED
2. LACSA	- PANAMA - LIMA	PASSENGER	B-727-200	No flight ----> Weekly 2	1991 Oct. 4	RESISTERED
3. AERO COSTA RICA (The establishment of this new costarican airline under processing)	- MAIAHI	PASSENGER	NOT CLARIFIED	No flight ----> Daily 1	NOT CLARIFIED	NOT CLARIFIED
4. AMERICAN AIRLINE	- MAIAHI	PASSENGER	B-727 B-757	Daily 2 ----> Daily 3	1991 Dec.	SCHEDULED
5. LTU (German)	- DUSSELDOLF	PASSENGER	B-767 B-757 L-1811	Present Charter ----> Weekly 1	1991 November 7	RESISTERED
6. IBERIA	- MADRID	CARGO	DC-8	No flight -> 1 flight each two weeks	1991 October	SCHEDULED
7. CONDOL	NOT CLARIFIED	PASSENGER	B-757	Charter ----> Weekly 2	1991 November	SCHEDULED
B. LIBERIA						
1. LACSA	(LIBERIA) - MAIAHI	PASSENGER	NOT CLARIFIED	NOT CLARIFIED	NOT CLARIFIED	SCHEDULED
2. AIR CANADA	- MONTRIAL	CHATER	NOT CLARIFIED	NOT CLARIFIED	NOT CLARIFIED	SCHEDULED
3. LTU	- DUSSELDOLF	CHATER	NOT CLARIFIED	NOT CLARIFIED	NOT CLARIFIED	SCHEDULED

APPENDIX TO CHAPTER 3

**APPENDIX-3.2.1 HISTORY OF JUAN SANTAMARIA
AIRPORT**

ITEMS	YEAR																																																
	BEFORE 1970	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95																						
1. CONSTRUCTION AND DEVELOPMENT	1955; Inaugulation of Juan Santa maria Airport	3,812m RWY Completed																																															
		Minor extension and renovation executed												Extension of PAX Building *1 RWY, TWY, APRON Overlay *2																																			
2. TENDERING														First Tender of Cargo Area Development *3												Second Tender of Cargo Area Development *4																							
3. STUDY AND PLANNING														MOPT Study *5												Review of MOPT Study *6												FDPM Study *7 CINDE Study *8 JICA Study *9 Facility Assessment of Earthquake Damage *10											

- Note :
- *1 ; Separation of Domestic PAX area from main building and renovation of Int'l PAX area.
 - *2 ; Airfield pavement overlay work started Nov.1990 and will complete by Dec.1990.
 - *3 *4 ; The development of cargo area tendered based on the FDPM study of cargo terminal area, but the works not commenced due to the problem of legal formalities.
 - *5 ; Master plan and feasibility study of all airport (Dixon)
 - *6 ; Review of the above Study (Dixon)
 - *7 ; Master plan and feasibility study of cargo terminal area (JAC)
 - *8 ; Master plan and feasibility study of all airport (Bell)
 - *9 ; This Study
 - *10 ; Assessment of airport facilities damaged by earthquake occurred on Dec.1990

**APPENDIX-3.2.2 WEEKLY FLIGHT SCHEDULE AT JUAN
SANTAMARIA AIRPORT**

THURSDAY

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
72 S						GUA 10:05		MIA 13:02	MIA 13:56										
72 S			MIA 8:30			MGA 737 PTY 10:00								MIA 18:33					72 S
72 S						GUA 10:00													
733		MIA 6:00																	72 S
A 320			MIA 8:00	GUA DIO 9:25		PTY 11:05		DIO 13:05											733
A 320						CUR 10:30													A 320
A 320						MIA 10:50													A 320
72 S																			72 S
72 S																			A 320
72 S																			72 S
735																			

A 320=AIRBUS INDUSTRIE A 320 72 M=BOEING 727 737=BOEING 737 707 =BOEING 707 735= BOEING 735
 D IO = McDONNELL DOUGLAS DC 10 72 S=BOEING 727 733=BOEING 733 767 =BOEING 767

FRIDAY

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
72S							MIA 13:02	72S 13:56	MIA 13:56									GUA 72S 23:19
72S													MIA 18:35					72S
72S																		
72S																		
72S																		
A320																		A320
A320																		MIA A320 23:45
A320																		A320
72S																		
735																		

A 320=AIRBUS INDUSTRIE A 320 72 M=BOEING 727 737=BOEING 737 707=BOEING 707 735=BOEING 735

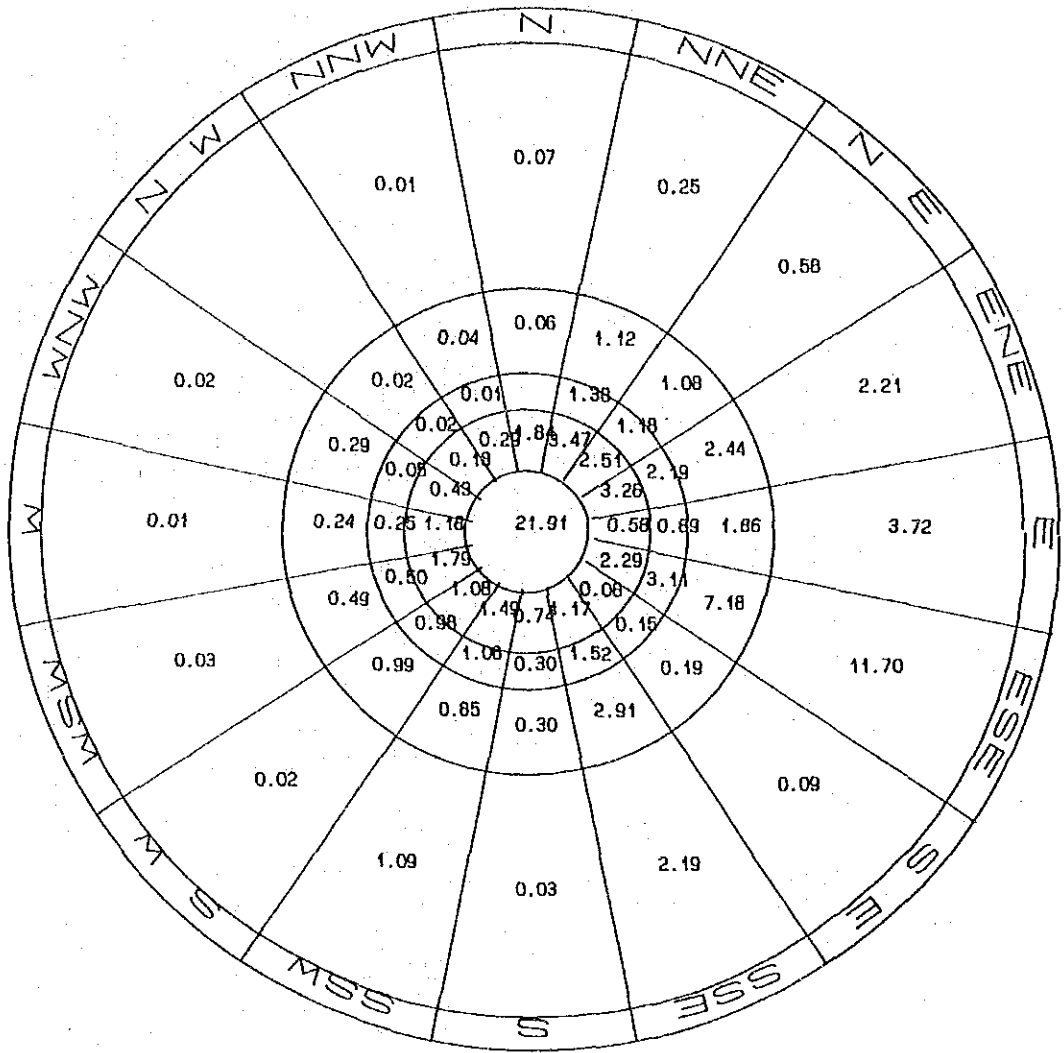
D 10 = McDONNELL DOUGLAS DC 10 72 S=BOEING 727 733=BOEING 733 767=BOEING 767

SATURDAY

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
72 S								MIA 13:02	MIA 13:56									GUA 23:19	72 S
72 S																			
72 S																			
A 320																			
A 320																			
A 320																			
A 320																			
72 S																			
735																			

A 320=AIRBUS INDUSTRIE A 320 72 M=BOEING 727 737=BOEING 737 707 =BOEING 707 735= BOEING 735
 D 10 = McDonnell Douglas DC 10 72 S=BOEING 727 733=BOEING 733 767 =BOEING 767

APPENDIX-3.2.3 WIND COVERAGE OF THE THREE AIRPORTS



SOURCE	: Costa Rica Meteorological Bureau
LOCATION	: Juan Santamaria
PERIOD	: 1986 ~ 1988
RUNWAY ORIENTATION	: N 70° E
WIND COVERAGE	: 78.01% (CROSS WIND 13kt)
	: 90.12% (CROSS WIND 20kt)

**APPENDIX-3.2.4 FLIGHT DIVERSION FROM JUAN
SANTAMARIA AIRPORT**

	Diverted to	Number
1.	Tocumen (Panama)	34
2.	San Andres (Colombia)	7
3.	Liberia (Costa Rica)	6
4.	Managua (Nicaragua)	7
5.	Guatemala (Guatemala)	5
6.	Tegucigalpa (Honduras)	3
7.	Quepos (Costa Rica)	2
8.	David (Panama)	1
9.	Limon (Costa Rica)	1
10.	San Salvador (El Salvador)	1
	Total	67

Source : MOPT Data, 1989

**APPENDIX-3.2.5 CEILING AND VISIBILITY TABLES OF THE
THREE AIRPORTS**

JUAN SANTAMARIA AIRPORT

Ceiling Height Visibility	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	Less than 478	Total	%
400	94	1	0	0	3	1	1	0	0	0	1	0	0	0	0	2	0	103	0.32
800	78	4	8	9	5	1	0	2	0	0	0	0	0	0	1	5	0	113	0.32
1,200	42	7	5	5	3	3	0	1	0	1	0	2	0	0	1	0	0	71	0.22
1,600	27	1	4	4	3	9	2	1	0	3	1	0	0	0	2	0	0	57	0.12
2,000	56	11	14	13	20	11	5	15	0	4	0	2	0	0	5	2	0	158	0.42
2,400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02
2,800	8	0	3	4	6	2	2	7	1	2	0	1	0	0	0	1	0	37	0.12
3,200	51	19	17	13	34	19	2	24	1	13	0	3	0	0	6	1	0	203	0.52
3,300	70	38	92	93	176	146	62	188	38	247	0	85	0	10	256	38,561	0	48,062	98.22
TOTAL	426	81	143	141	250	192	74	238	48	271	1	93	0	16	271	38,573	0	48,884	
%	1.02	0.22	0.42	0.32	0.62	0.52	0.22	0.62	0.12	0.72	0.02	0.22	0.02	0.02	0.72	94.52	0.02		100.02

LIBERIA AIRPORT

Ceiling Height Visibility	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	Less than 478	Total	%
400	9	8	0	0	0	0	0	1	0	1	0	0	0	0	0	3	0	22	0.12
800	6	1	0	0	2	0	0	1	0	2	0	0	0	0	0	3	0	15	0.12
1,200	7	0	1	2	1	0	0	6	3	8	0	0	0	1	17	0	0	46	0.22
1,600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02
2,000	5	2	0	1	0	0	0	2	2	4	0	1	0	0	4	24	0	45	0.22
2,400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02
2,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02
3,200	14	0	1	0	0	0	0	1	1	3	0	1	0	0	0	22	0	48	0.22
3,300	2	0	0	0	3	0	0	5	8	35	0	11	2	1	72	18,388	1,086	19,613	98.12
TOTAL	43	11	2	3	6	0	0	16	14	58	0	13	2	1	77	18,457	1,086	19,789	
%	0.22	0.12	0.02	0.02	0.02	0.02	0.02	0.12	0.12	0.32	0.02	0.12	0.02	0.02	0.42	93.32	5.52		100.02

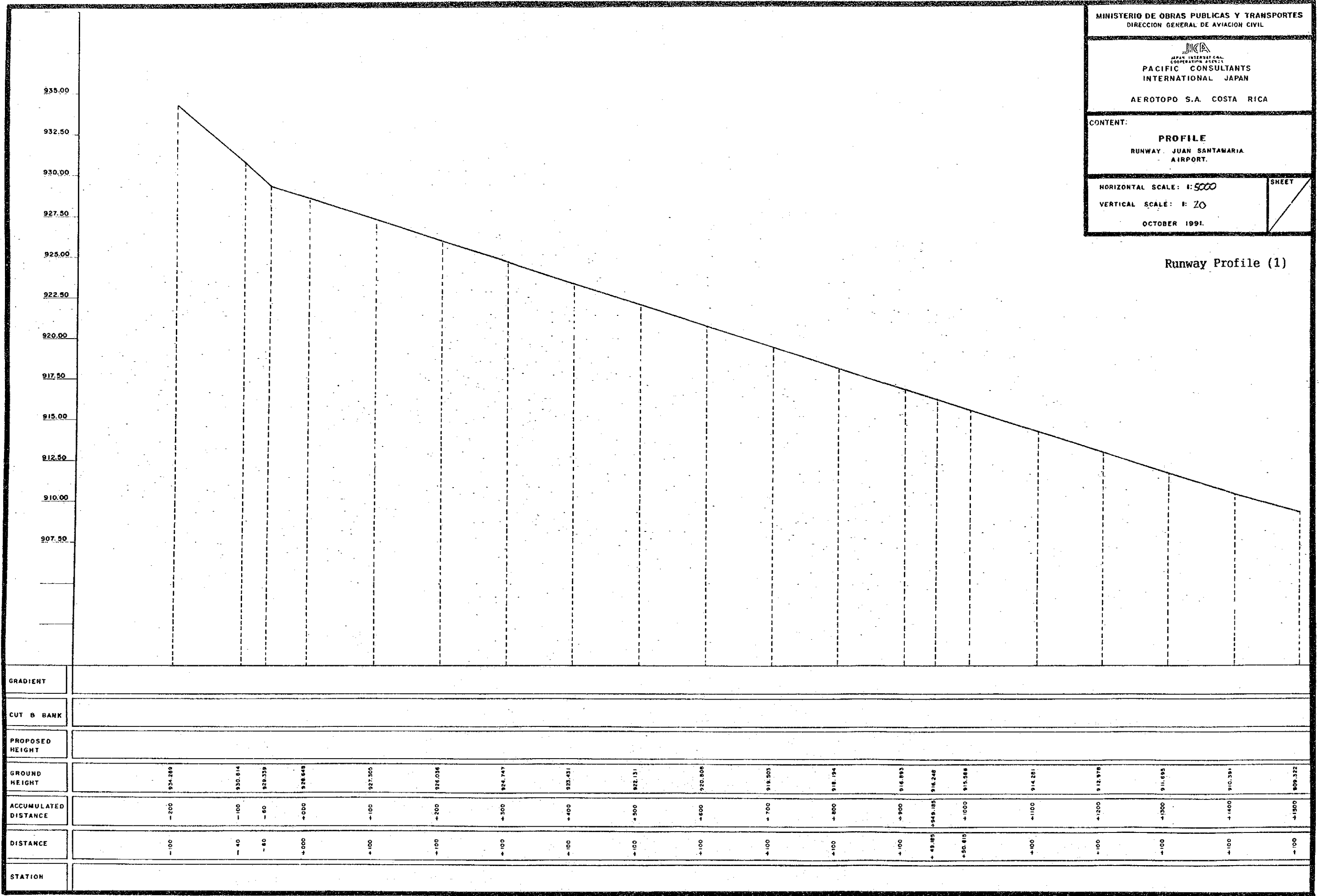
LIMON AIRPORT

Ceiling Height Visibility	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	Less than 478	Total	%
400	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4	0.02
800	0	0	0	1	0	0	0	0	0	0	0	2	1	0	0	0	6	10	0.02
1,200	0	0	1	0	3	2	0	0	1	1	0	1	1	0	3	2	0	15	0.12
1,600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02
2,000	0	6	3	1	5	0	0	2	0	1	0	6	1	0	7	0	0	32	0.22
2,400	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0.02
2,800	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0.02
3,200	0	4	3	2	5	0	0	0	1	2	0	2	3	0	6	1	0	29	0.12
3,300	1	21	36	18	19	12	16	37	4	124	1	166	45	53	297	20,198	0	21,048	98.62
TOTAL	1	33	44	22	32	14	16	39	6	139	1	180	51	53	313	20,203	6	21,143	
%	0.02	0.22	0.22	0.12	0.22	0.12	0.12	0.22	0.02	0.62	0.02	0.92	0.22	0.32	1.52	95.62	0.02		100.02

**APPENDIX-3.2.6 TOPOGRAPHIC SURVEY AT JUAN
SANTAMARIA AIRPORT**

CONTENT:	
PROFILE	
RUNWAY JUAN SANTAMARIA AIRPORT.	
HORIZONTAL SCALE: 1:5000	SHEET
VERTICAL SCALE: 1:20	
OCTOBER 1991.	

Runway Profile (1)



CONTENT:

PROFILE

RUNWAY, PUERTO SANTIAMARIA,
A REPORT.

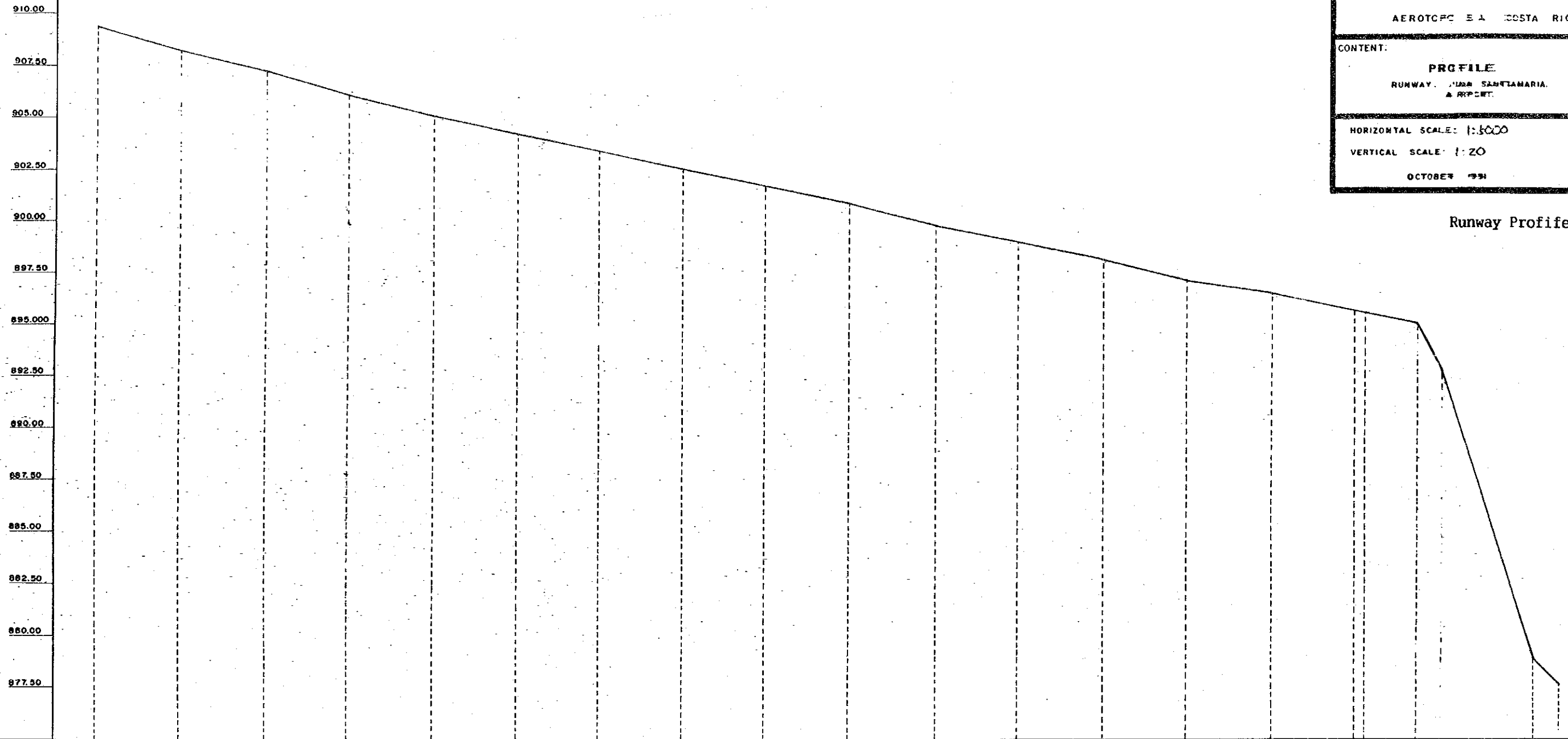
HORIZONTAL SCALE: 1:5000

VERTICAL SCALE: 1:20

OCTOBER 1991

SHEET

Runway Profile (2)



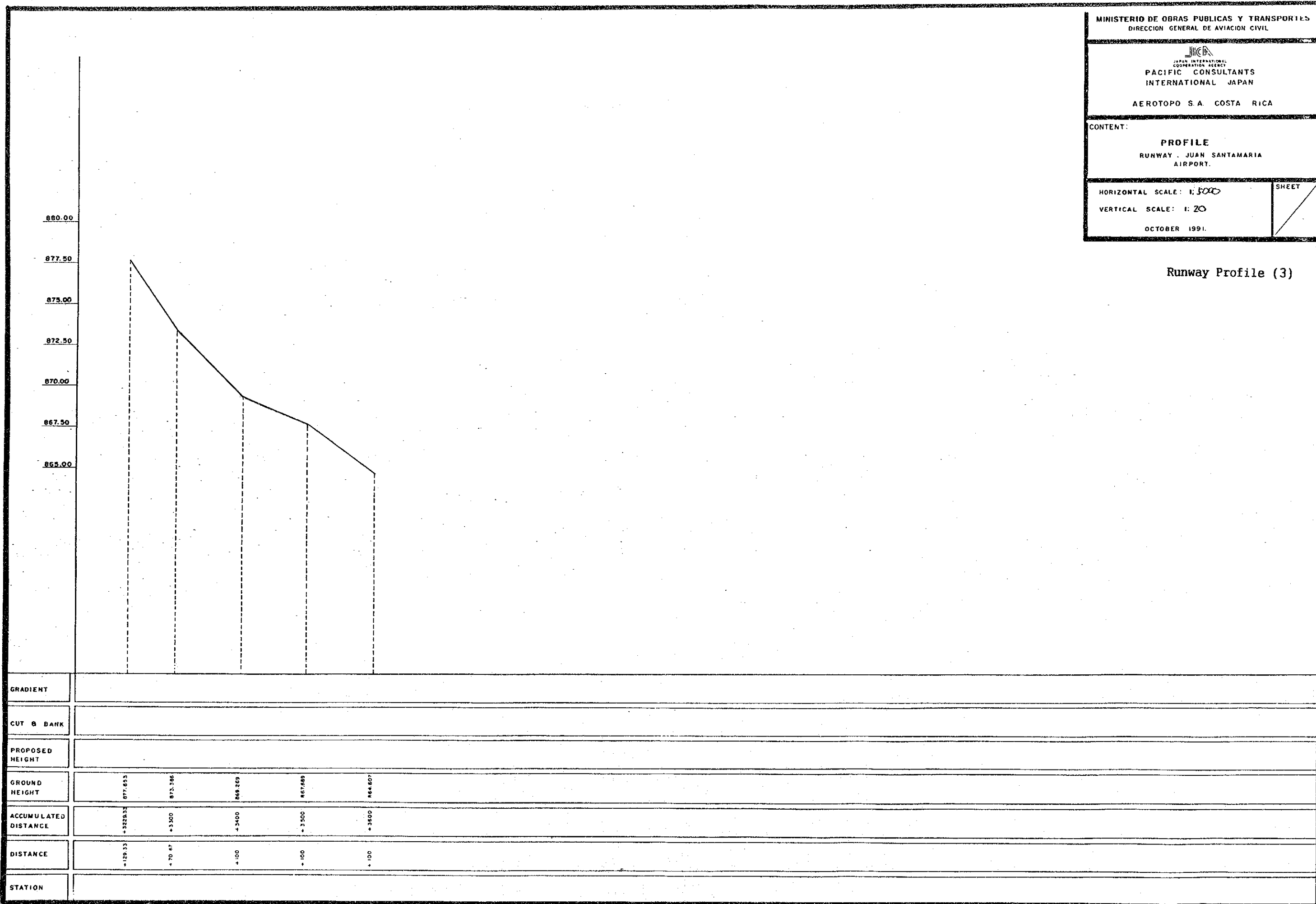
GRADIENT																					
CUT & BANK																					
PROPOSED HEIGHT																					
GROUND HEIGHT	909.322	908.210	907.167	906.073	905.024	904.164	903.335	902.463	901.403	900.756	899.693	898.904	898.040	897.206	896.106	895.603	895.340	894.976	892.887	876.845	877.653
ACCUMULATED DISTANCE	+100	+200	+300	+400	+500	+600	+700	+800	+900	+1000	+1100	+1200	+1300	+1400	+1500	+1600	+1700	+1800	+1900	+2000	+2100
DISTANCE	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100
STATION																					

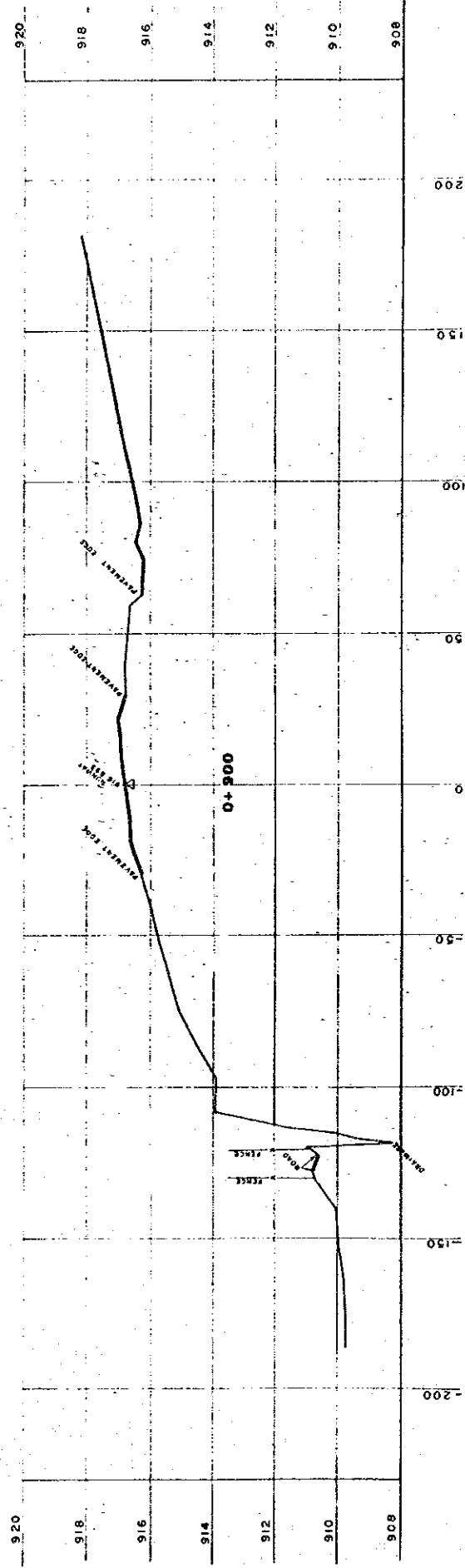
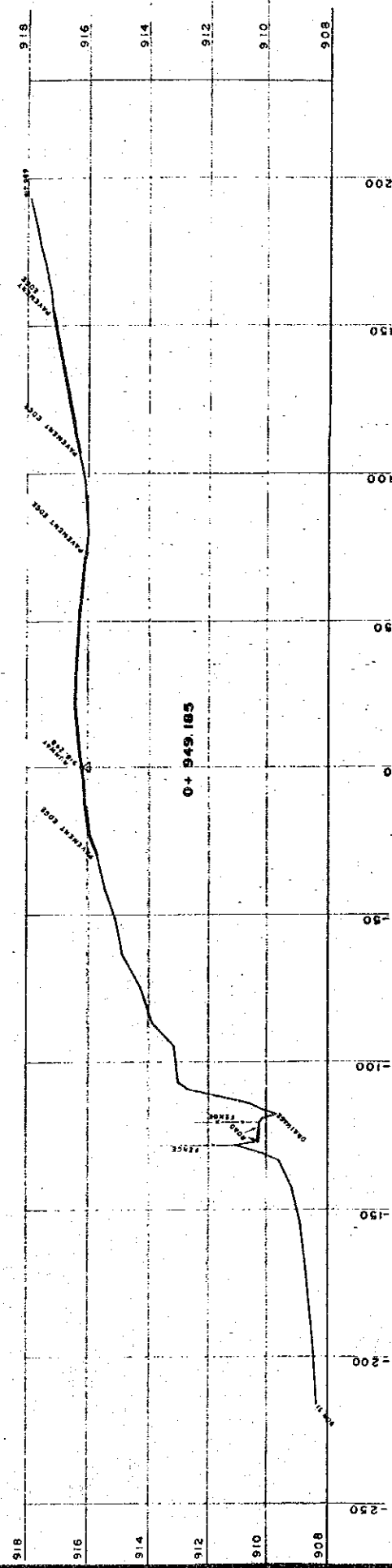
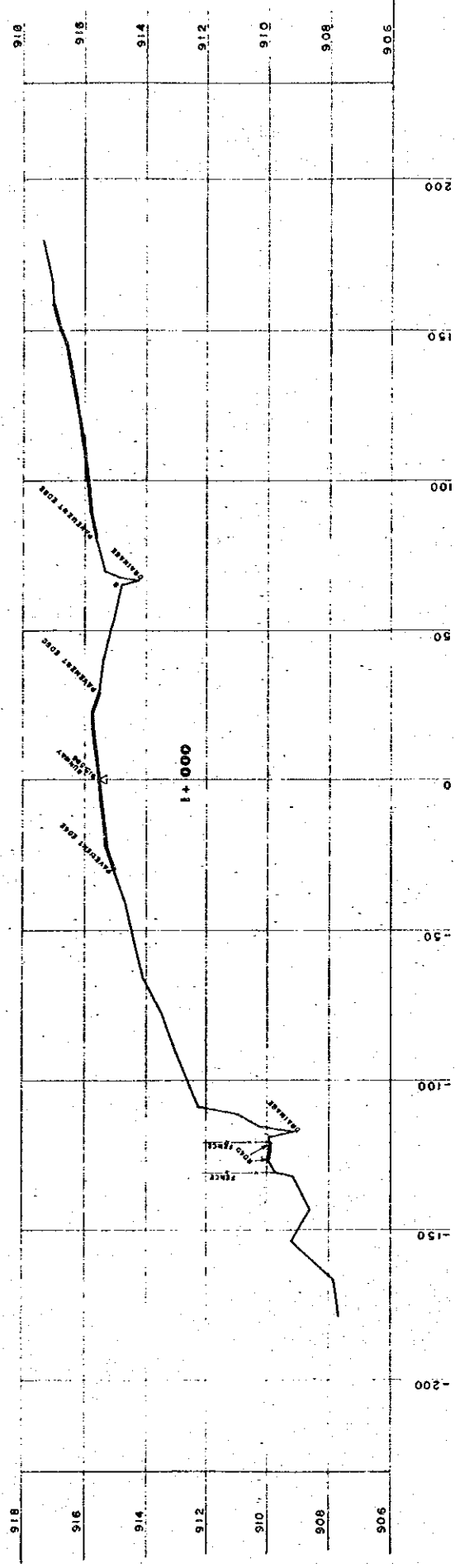
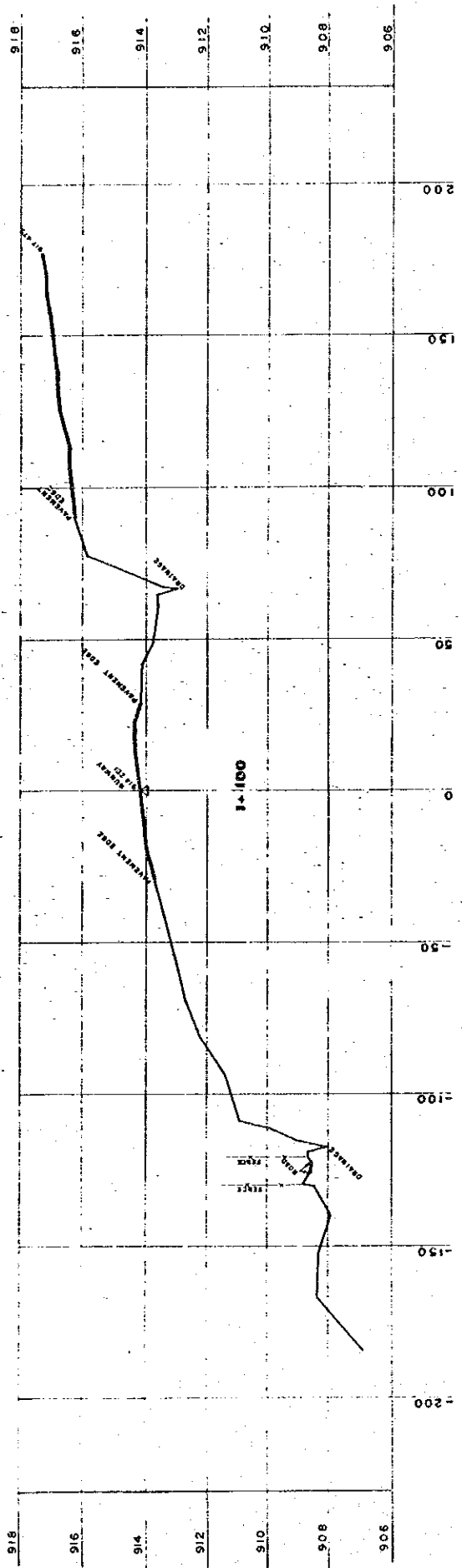
CONTENT:
PROFILE
RUNWAY : JUAN SANTAMARIA
AIRPORT.

HORIZONTAL SCALE : 1:5000
VERTICAL SCALE : 1:20
OCTOBER 1991

SHEET

Runway Profile (3)





Typical Cross Section (2)

MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTES
DIRECCION GENERAL DE AVIACION CIVIL

JICA
PACIFIC CONSULTANTS
INTERNATIONAL JAPAN

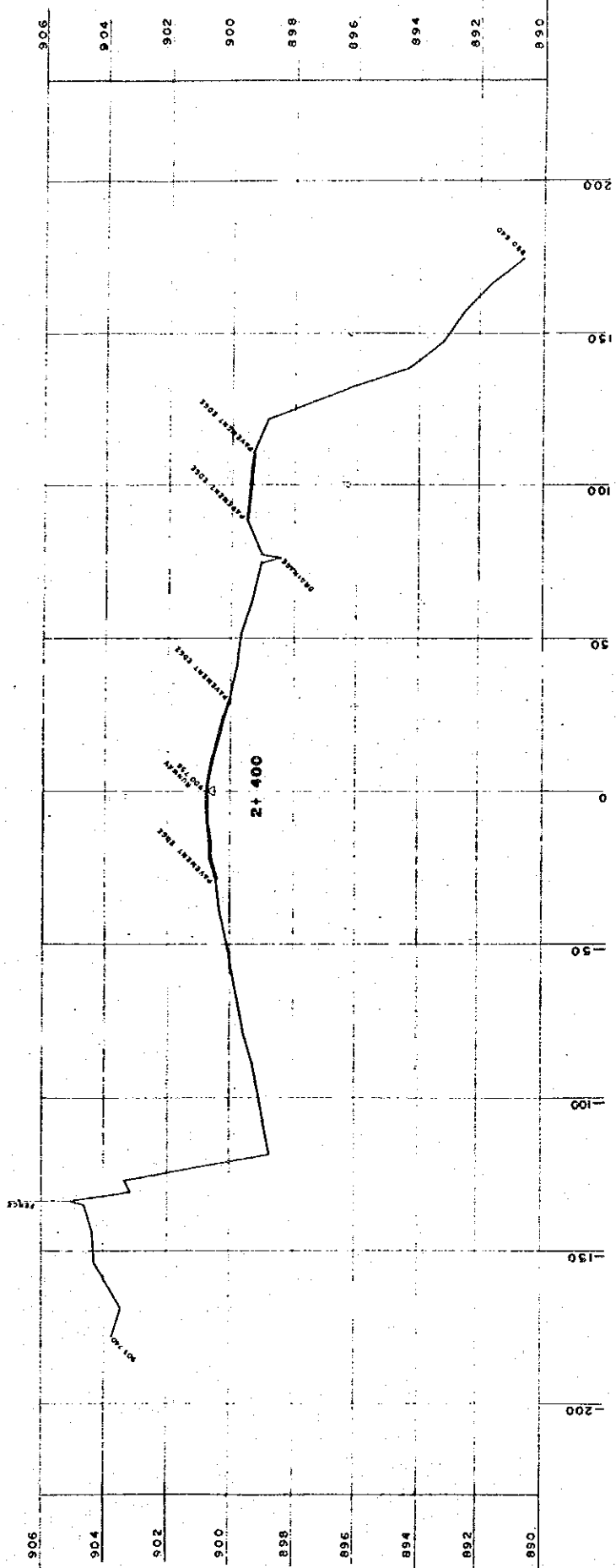
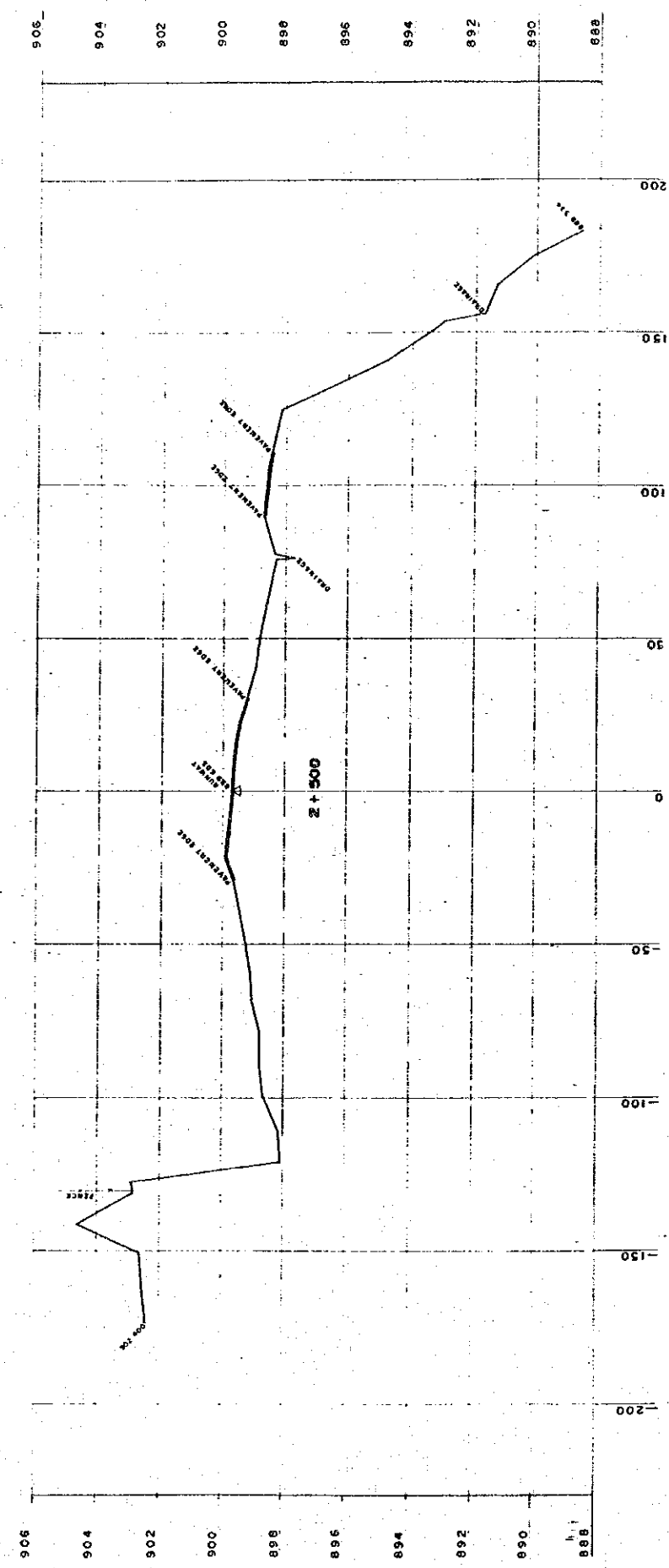
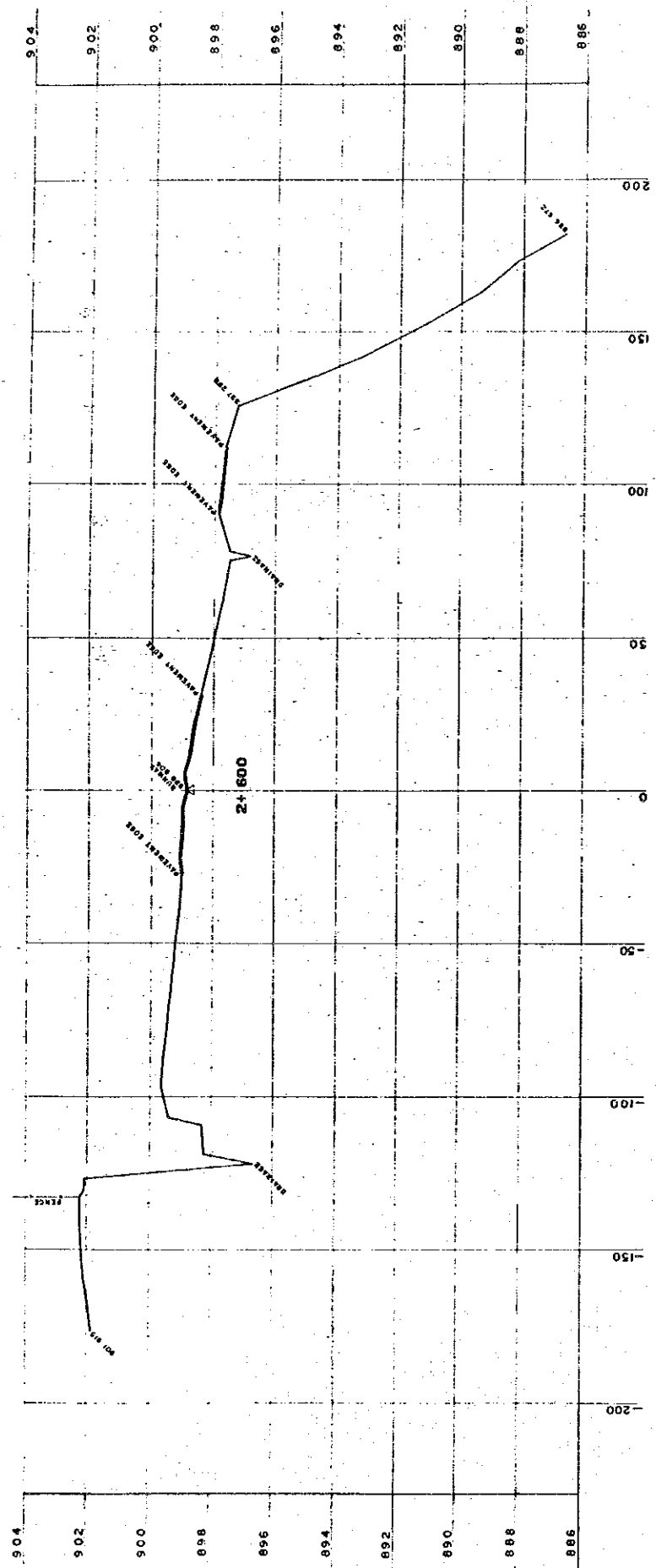
AEROTOPO S.A. COSTA RICA

CROSS SECTIONS
RUNWAY JUAN SANTAMARIA
AIRPORT

HORIZONTAL SCALE: 1:2000
VERTICAL SCALE: 1:200

OCTOBER 1991

SHEET



Typical Cross Section (3)

MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTES
DIRECCION GENERAL DE AVIACION CIVIL

JICA
JAPAN INTERNATIONAL
COOPERATION AGENCY
PACIFIC CONSULTANTS
INTERNATIONAL JAPAN
AEROTOPO S. A. COSTA RICA

CROSS SECTIONS
RUNWAY JUAN SANTAMARIA
AIRPORT

HORIZONTAL SCALE: 1:2000
VERTICAL SCALE: 1:200
OCTOBER 1991

SHEET

**APPENDIX-3.2.7 LIST OF OBSTACLES TO ICAO
OBSTACLE LIMITATION SURFACES
AT JUAN SANTAMARIAAIRPORT**

RUNWAY 25 APPROACH SURFACE LIST OF OBSTACLES
WIDE 300a

NO	OBJECT	X (a)	Y (a)	ELEVATION (a)	ELEVATION OF THE SURFACE	ELEVATION TOTAL (a)	DEGREE OF INFRINGEMENT (b)
					(a)		
1	CLUSTER OF TREES	515230	220420	937.5	15.0	952.5	-2.46929
2	HOUSES	515235	220455	937.0	4.2	941.2	-0.65327
3	CLUSTER OF TREES	515265	220465	938.4	6.0	944.4	-0.95027
4	TREE	515280	220495	938.5	4.0	942.5	-0.58238
5	TREE	515235	220490	936.3	6.0	942.3	-0.74606
6	ELECTRIC LINE	515715	220510	938.9	8.2	947.1	-0.98250
7	TREE	515265	220560	937.5	10.0	947.5	-1.07616
8	HOUSES	515270	220535	936.8	4.2	941.0	-0.34653
9	HOUSES	515365	220520	938.0	4.2	942.2	-0.27970
10	CLUSTER OF TREES	515390	220465	939.0	12.0	951.0	-1.25864
11	ADVERTENCE SIGN	515370	220395	937.4	8.5	945.9	-0.83054
12	HOUSES	515395	220415	938.0	4.0	942.0	-0.30269
13	HOUSES	515445	220410	937.6	3.2	940.8	-0.06657
14	TREE	515472	220405	936.3	15.0	951.3	-1.02675
15	HOUSES	515335	220555	940.0	4.2	944.2	-0.50922
16	HOUSES	515472	220410	937.5	4.1	941.6	-0.07460
17	CLUSTER OF TREES	515205	220340	935.5	10.0	945.5	-1.03226
18	TREE	515480	220285	937.5	10.0	947.5	-0.59653
19	ELECTRIC LINE	515510	220450	934.5	8.5	943.0	-0.12250
20	ELECTRIC LINE	515540	220380	937.5	8.5	946.0	-0.36293
21	HOUSE	515565	220260	937.5	5.0	942.5	-0.10703
22	CLUSTER OF TREES	515510	220510	942.5	8.0	950.5	-0.72363
23	HOUSES	515490	220580	942.5	4.1	946.6	-0.36026
24	TREE	515485	220455	939.5	20.0	959.5	-1.67670
25	POLE LINE	516060	220480	947.5	8.2	955.7	-0.15033
26	TREE	515750	220690	948.6	10.0	958.6	-0.63441
27	HOUSE	515620	220310	939.5	3.1	942.6	+0.04753
28	TREE	515665	220340	942.5	8.0	950.5	-0.46007
29	GALLEY	515650	220345	940.5	6.2	946.7	-0.21234
30	BUILDING	515185	220590	952.5	9.0	961.5	-0.29004
31	BUILDING	515920	220375	943.6	8.2	951.8	-0.13000
32	BUILDING	516050	220400	943.5	8.2	951.7	+0.01245
33	BUILDING	516085	220420	946.2	8.2	954.4	-0.00009
34	BUILDING	516155	220430	947.3	8.2	955.5	-0.05935
35	BUILDING	516200	220465	948.2	8.2	956.4	-0.05565
36	BUILDING	516250	220400	946.3	10.2	956.5	-0.02246
37	CLUSTER OF TREES	516605	220580	954.3	12.0	966.3	-0.09210
38	ANTENNA	516275	220495	952.2	14.5	966.7	-0.40074
39	TREE	516330	220475	951.2	15.0	966.3	-0.37000
40	BUILDING(SILO)	516345	220405	952.1	7.8	959.9	-0.07240
41	BUILDING	516345	220405	951.5	8.4	959.9	-0.05434
42	TREE	516400	220470	949.3	15.0	964.3	-0.20406
43	TREE	516425	220530	952.5	15.0	967.5	-0.20447
44	BRIDGE	516185	220505	948.7	8.4	957.1	-0.09294
45	SMALL HOUSE(BUS STOP)	515820	220295	943.5	3.0	946.5	+2.04159
46	TREE	515085	220385	943.7	15.0	958.7	-0.72441
47	BUILDING	515870	220320	941.0	8.2	949.2	-0.10550

NO	OBJECT	X	Y	ELEVATION	ELEVATION		DEGREE
					OF THE	ELEVATION	
		(m)	(m)	(m)	SURFACE	TOTAL	INFRINGEMENT
					(m)	(m)	(°)
48	TREE	515788	228295	942.1	11.8	953.1	-8.5913'
49	GALLEY	515745	228375	941.7	5.3	947.0	-8.87784
50	ANTENNA	516625	228485	958.8	11.5	962.3	-8.25532
51	BUILDING	515788	228328	948.9	7.3	948.2	-8.24848
52	BUILDING	515755	228315	942.4	5.2	947.6	-8.11274
53	TREE	515785	228365	941.3	10.8	951.3	-8.43926
54	HOUSES	515948	228665	949.9	4.1	954.0	-8.14388
55	HOUSES	516838	228685	958.8	3.2	954.8	-8.84734
56	HOUSES	516878	228788	951.6	3.2	954.8	-8.84326
57	HOUSE	516178	228678	954.1	4.1	958.2	-8.11395
58	TREE	516848	228615	949.1	6.8	955.1	-8.11363
59	TREE	516115	228625	951.2	6.8	957.2	-8.13435
60	HOUSE	516885	228575	949.3	4.9	954.2	-8.83965
61	CLUSTER OF TREES	516855	228535	947.9	8.8	955.9	-8.16888
62	PALMS	515785	228555	945.8	10.8	955.8	-8.58479
63	SCHOOL	515885	228688	946.2	6.3	952.5	-8.25315
64	TREE	515768	228585	945.6	8.8	953.6	-8.39227
65	HOUSES	515758	228648	945.9	5.1	951.8	-8.21379
66	TREE	515755	228548	944.8	6.8	950.8	-8.25888
67	HOUSE	515758	228558	944.9	4.2	949.1	-8.14495
68	CLUSTER OF TREES	515685	228528	941.5	6.8	947.5	-8.14536
69	STOREROOM	515588	228498	948.5	5.8	946.3	-8.24431
70	CLUSTER OF TREES	515615	228585	948.6	13.8	955.6	-8.87135
71	CLUSTER OF TREES	515645	228578	944.2	12.8	956.2	-8.78538
72	CLUSTER OF TREES	515698	228685	945.6	8.8	953.6	-8.49218
73	CLUSTER OF TREES	515688	228648	945.1	8.8	953.1	-8.44823
74	HOUSES	515618	228645	944.6	5.1	949.7	-8.32619
75	HOUSES	515685	228588	944.2	4.2	948.4	-8.29555
76	CLUSTER OF TREES	515738	228498	942.5	15.8	957.5	-8.75382
77	BUILDING	515715	228468	942.3	8.2	950.5	-8.33189
78	TREE	515595	228438	948.7	8.8	948.7	-8.44897
79	CLUSTER OF TREES	515618	228418	948.3	6.8	948.3	-8.23249
80	CLUSTER OF TREES	515688	228488	942.5	15.8	957.5	-8.87154
81	TREE	515785	228488	943.5	15.8	958.5	-8.71227
82	HOUSES	515835	228515	944.9	4.1	949.8	-8.84643
83	HOUSES	515865	228568	946.7	5.1	951.8	-8.15478
84	POLE	515988	228588	947.3	6.4	953.7	-8.28984
85	HOUSES	515878	228585	945.6	5.2	950.9	-8.11194
86	CLUSTER OF TREES	515915	228475	944.7	8.8	952.7	-8.17212
87	CLUSTER OF TREES	515958	228515	941.6	15.8	956.6	-8.32479
88	HOUSES	515958	228598	947.5	4.2	951.7	-8.84482
89	HOUSES	515995	228738	952.3	4.2	956.5	-8.18143
90	HOUSE	516898	228735	952.5	5.8	958.3	-8.22931
91	CLUSTER OF TREES	516155	228785	954.5	12.8	966.5	-8.43612
92	TREE	516125	228798	953.2	8.8	961.2	-8.24839
93	CLUSTER OF TREES	516185	228735	952.5	10.8	962.5	-8.34195
94	CLUSTER OF TREES	516155	228738	954.7	12.8	966.7	-8.46892
95	CLUSTER OF TREES	516288	228768	956.1	8.8	964.1	-8.38192
96	HOUSES	516288	228798	956.1	5.2	961.3	-8.17692
97	CLUSTER OF TREES	516258	228688	954.6	6.8	960.6	-8.16189

NO	OBJECT	X	Y	ELEVATION	ELEVATION	ELEVATION	DEGREE
					OF THE		
		(m)	(m)	(m)	SURFACE	(m)	INFRINGEMENT
					(m)		(°)
98	HOUSE	516265	228568	954.2	4.2	958.4	-0.86677
99	ADVERTENCE SIGN	516318	228575	955.4	9.5	964.9	-0.29368
100	CLUSTER OF TREES	516330	228615	958.1	8.8	966.1	-0.38213
101	CLUSTER OF TREES	516320	228655	959.5	15.8	974.5	-0.62584
102	HOUSES	516358	228635	961.2	5.8	967.8	-0.31287
103	HOUSES	516275	228668	956.2	4.2	960.4	-0.11656
104	CLUSTER OF TREES	516248	228675	954.3	6.8	961.3	-0.13841
105	BUILDING	516195	228838	953.1	18.1	963.1	-0.32275
106	HOUSES	515868	228635	947.5	4.2	951.7	-0.12383
107	CLUSTER OF TREES	515848	228668	948.1	12.8	961.1	-0.68883
108	HOUSE	515858	228688	946.8	4.8	951.8	-0.89981
109	HOUSES	515958	228778	947.5	5.1	952.6	-0.81861
110	HOUSES	515575	228538	942.5	4.1	946.6	-0.24987
111	ADVERTENCE SIGN	516888	228498	946.2	8.3	954.5	-0.16283
112	ADVERTENCE SIGN	516185	228525	949.2	8.1	957.3	-0.17594
113	TREE	516725	228638	957.6	8.8	966.6	+0.81372
114	HOUSE	515695	228678	945.6	4.2	949.8	-0.19182
115	TREE	515795	228718	945.3	12.8	957.3	-0.47451
116	HOUSES	515888	228768	949.7	4.1	953.8	-0.15854
117	CLUSTER OF TREES	515848	228755	958.1	15.8	963.1	-0.79889
118	HOUSES	515988	228735	958.2	5.8	953.2	-0.21466
119	HOUSE	515985	228765	951.3	3.2	954.5	-0.88852
120	CLUSTER OF TREES	515998	228888	951.1	8.8	959.1	-0.27528
121	HOUSES	516845	228795	952.3	3.1	955.4	-0.83645
122	ELECTRIC LINE	517155	221838	969.1	6.3	971.4	+3.12286
123	ELECTRIC LINE	516298	228655	965.1	6.4	971.4	+0.21217
124	CLUSTER OF TREES	517168	228578	972.5	6.8	978.5	-0.18241
125	CLUSTER OF TREES	516678	228698	962.1	8.8	970.1	-0.15199
126	HOUSES	516678	228725	962.1	3.2	965.3	+0.82381
127	ELECTRIC LINE	516648	228675	962.1	7.1	969.2	-0.14694
128	CLUSTER OF TREES	516135	228948	955.9	15.8	970.9	-0.55784
129	CLUSTER OF TREES	515748	228818	942.5	18.8	952.5	-0.19838
130	HOUSES	515698	228788	944.5	4.1	948.6	-0.84691
131	HOUSES	515555	228755	941.9	4.2	946.1	-0.85278
132	HOUSES	516165	221155	957.1	4.1	961.2	-0.84774
133	ELECTRIC LINE	516298	228655	957.5	7.1	964.6	-0.27882
134	HOUSES	516385	228862	957.5	4.2	961.7	-0.88447
135	TREE	515158	228158	925.2	6.8	933.2	+0.16641
136	CLUSTER OF TREES	515298	228398	935.8	6.8	941.8	-0.64495
137	TANK	516248	228488	958.7	8.3	959.8	-0.12783
138	HOUSE	516875	228755	952.5	4.2	956.7	-0.18436
139	HOUSE	516198	228835	955.2	4.1	959.3	-0.12843
140	CLUSTER OF TREES	515968	228518	946.3	15.8	961.3	-0.55881
141	ELECTRIC LINE	515955	228438	944.1	8.2	952.3	-0.11359
142	ELECTRIC LINE	515975	228648	948.3	6.2	954.5	-0.14213
143	CLUSTER OF TREES	515815	228418	942.5	8.8	951.3	-0.19372
145	ADVERTENCE SIGN	515428	228488	937.5	18.1	947.5	-0.82739
146	ADVERTENCE SIGN	515675	228415	945.3	8.2	953.5	-0.63788
147	ELECTRIC LINE	515812	228455	948.8	8.3	949.1	-0.89979
149	ADVERTENCE SIGN	516388	228585	955.4	9.5	964.9	-0.28389

RUNWAY STRIP LIST OF OBSTACLES
 RUNWAY WIDE 300m

NO	OBJECT	X (m)	Y (m)	ELEVATION OF THE SURFACE (m)	ELEVATION OF THE SURFACE (m)	ELEVATION TOTAL (m)	DEGREE OF INFRINGEMENT (D)
150	TERRAIN	514540	220200	926.5	2.0	928.5	-4.47700
151	DEFLECTOR	514840	220060	926.5	2.0	928.5	-0.26000
152	FENCE	514630	220020	926.3	2.3	928.6	-1.26048
153	ELECTRIC LINE	514435	219930	920.0	7.8	927.8	-2.46765
154	WINDSOCK MAST	514485	220010	922.4	6.0	928.4	-4.76745
155	CLUSTER OF TREES	514385	219915	917.5	10.0	927.5	-2.56642
156	CLUSTER OF TREES	514345	219995	916.2	10.0	926.2	-2.24709
157	CLUSTER OF TREES	514295	219865	915.6	10.0	925.6	-2.20393
158	CLUSTER OF TREES	514050	219875	910.7	10.0	920.7	-4.63952
159	CLUSTER OF TREES	513880	219710	908.0	6.0	914.0	+0.20270
160	WINDSOCK MAST	513690	219700	912.0	6.0	918.0	-4.044620
161	CLUSTER OF TREES	513650	219715	907.6	8.0	915.6	-4.24203
162	CLUSTER OF TREES	513595	219590	905.0	8.0	913.0	-1.00017
163	CLUSTER OF TREES	513520	219465	902.0	10.0	912.0	-0.73001
164	CLUSTER OF TREES	513230	219450	898.0	10.0	908.0	-0.96195
165	CLUSTER OF TREES	513460	219400	899.2	10.0	909.2	-0.95105
166	TREE	512935	219350	896.5	8.0	904.5	-0.46103
167	TREE	512845	219015	896.1	8.0	904.1	-2.29301
168	CLUSTER OF TREES	512920	219300	898.0	8.0	906.0	-1.52405
169	METEOROLOGY ANTENNA	512830	219365	901.2	6.0	907.2	-2.03320
170	WINDSOCK MAST	512370	219140	901.5	6.0	907.5	-3.04126
171	METEOROLOGY ANTENNA	512395	219295	890.5	6.0	904.5	-4.02313
172	METEOROLOGY ANTENNA	512320	219170	897.0	6.0	903.0	-3.12000
173	METEOROLOGY TOWER	512350	219160	896.0	8.0	904.0	-3.35701
174	TERRAIN	513600	219030	914.0	3.0	917.0	-4.76745
175	CLUSTER OF TREES	512540	220220	925.0	6.0	931.0	-2.27960
177	CLUSTER OF TREES	514635	220000	924.7	6.0	930.7	-0.00167
178	CLUSTER OF TREES	514695	220020	920.6	10.0	930.6	-2.00351
187	ELECTRIC LINE	513400	219560	905.0	7.0	912.0	-0.00034
189	TERRAIN AND FENCE	512490	219220	903.0	2.2	905.2	-2.90000
220	HOUSES	514530	219935	922.1	4.1	926.2	-0.64262
223	HOUSES	514405	219910	917.0	3.0	921.0	+0.42139

NO	OBJECT	X (m)	Y (m)	ELEVATION (m)	ELEVATION OF THE SURFACE (m)	ELEVATION TOTAL (m)	DEGREE OF INFRINGEMENT (D)
149	ELECTRIC LINE	516465	220600	960.2	0.5	960.7	-0.36273
175	FENCE	514960	220200	927.5	2.3	929.8	+0.30694
179	CLUSTER OF TREES	516700	220810	964.5	10.0	974.5	-0.24311
180	CLUSTER OF TREES	517100	223050	971.0	6.0	977.0	+0.14939
181	HOUSE	517090	220660	962.3	5.2	967.5	+0.14939
182	TREE	517030	223190	970.3	8.0	978.3	+0.36300

TRANSITION SURFACE NORTH.
RUNWAY WIDE 300m

NO	OBJECT	X	Y	ELEVATION	ELEVATION	ELEVATION	DEGREE OF INFRINGEMENT (°)
		(m)	(m)	(m)	OF THE SURFACE (m)	TOTAL (m)	
190	BUILDING	514280	220215	924.2	6.8	930.2	-3.70525
191	BUILDING	514820	220140	921.5	28.5	950.0	-21.03551
192	SPEEDWAY	514855	220130	921.6	5.7	927.3	-4.28360
193	BUILDING	513865	220000	919.2	3.8	923.0	+2.18877
194	BUILDING	513840	220065	918.1	3.8	921.9	+1.66453
195	BUILDING	513805	220050	918.0	8.0	926.0	-1.71973
196	BUILDING	513825	220745	918.0	2.6	920.6	+7.81951
197	HANGAR	513625	219965	917.3	33.6	950.9	-51.34148
198	BUILDING	513460	219945	916.3	11.3	927.6	-4.62265
199	HANGAR	513520	220025	917.5	6.4	923.9	+2.83214
200	BUILDING	513725	220000	912.2	4.0	923.2	+3.55825
201	BUILDING	513820	220122	928.4	2.4	944.4	-6.87561
222	HANGAR	513290	220025	914.2	10.2	924.4	+3.83650
203	BUILDING	513170	219850	913.3	7.6	920.9	-0.41993
204	BUILDING	513200	219865	913.4	7.6	921.0	-0.12580
214	BUILDING	513135	220005	912.3	10.0	922.3	+6.89100
215	BUILDING	513385	220065	915.2	6.8	921.2	+5.29266
216	BUILDING	513445	220150	915.2	6.8	921.2	+6.17796
217	HANGAR	513540	220200	915.2	8.8	924.3	+5.75150
218	BUILDING	513730	220200	920.1	3.0	923.1	+5.99840
219	BUILDING	513820	220200	919.5	5.8	924.5	+5.56813

TRANSITION SURFACE SOUTH.
RUNWAY WIDE 300 m

NO	OBJECT	X	Y	ELEVATION	ELEVATION	ELEVATION	DEGREE OF INFRINGEMENT (°)
		(m)	(m)	(m)	OF THE SURFACE (m)	TOTAL (m)	
225	CLUSTER OF TREES	512790	219245	899.1	15.0	914.1	-8.80627
226	CLUSTER OF TREES	513039	219355	894.2	8.0	902.2	+12.46785
227	CLUSTER OF TREES	513225	219415	895.1	8.0	903.1	+13.94256
228	CLUSTER OF TREES	513295	219445	896.1	12.0	908.1	+6.24596
229	CLUSTER OF TREES	513500	219545	901.5	12.0	913.5	+3.27300
211	CLUSTER OF TREES	513760	219605	905.3	10.0	915.3	+6.84836
212	CLUSTER OF TREES	514059	219705	905.6	10.0	915.6	+9.43263
213	CLUSTER OF TREES	514390	219835	911.0	12.0	923.0	+19.41150
221	HOUSES	514520	219920	921.0	4.1	925.1	+3.63893
224	HOUSES	514820	219935	922.0	3.6	925.6	+7.88564

Note 1: This list of obstacles is produced for 300m. wide runway strip on ICAO recommendation.

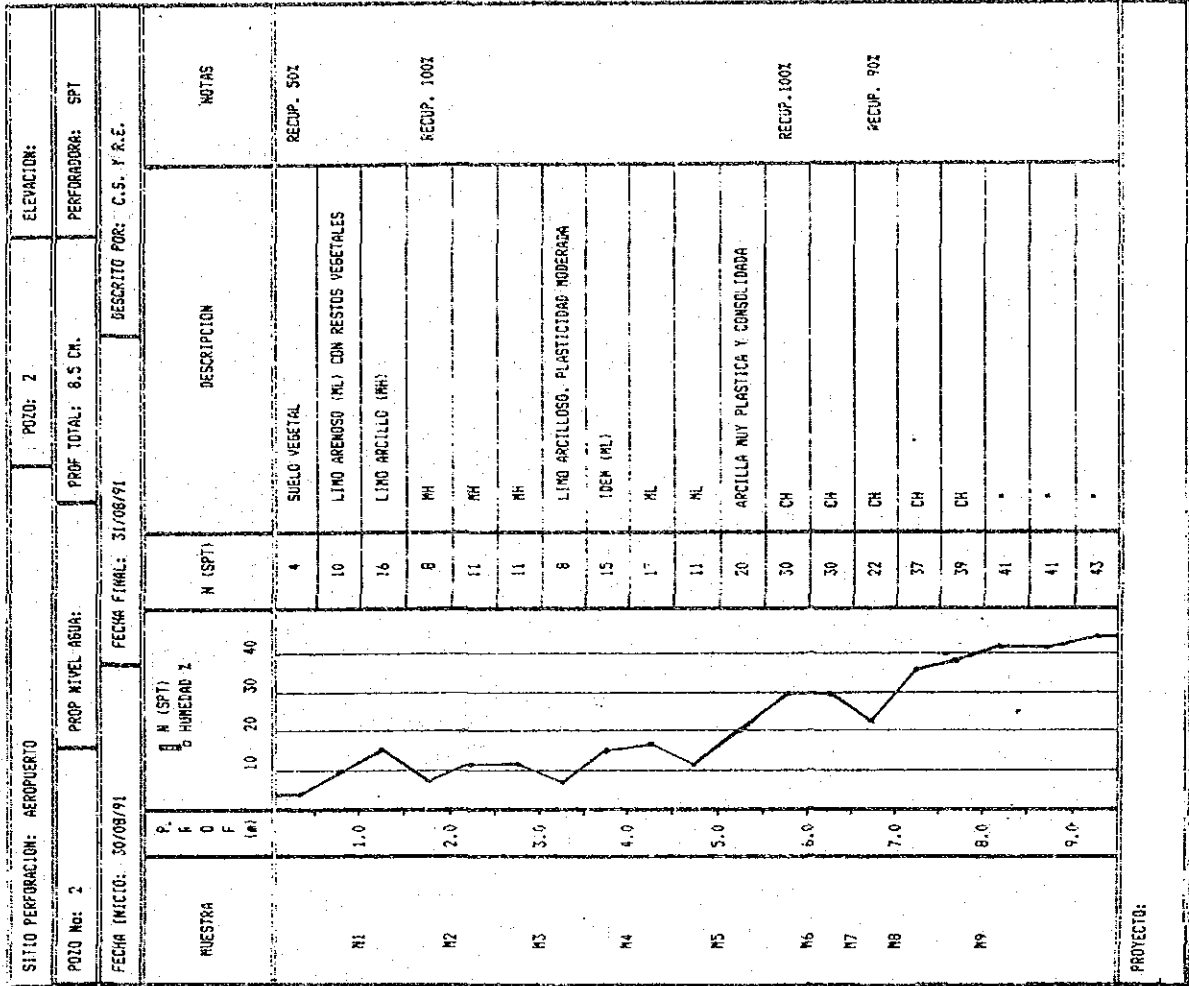
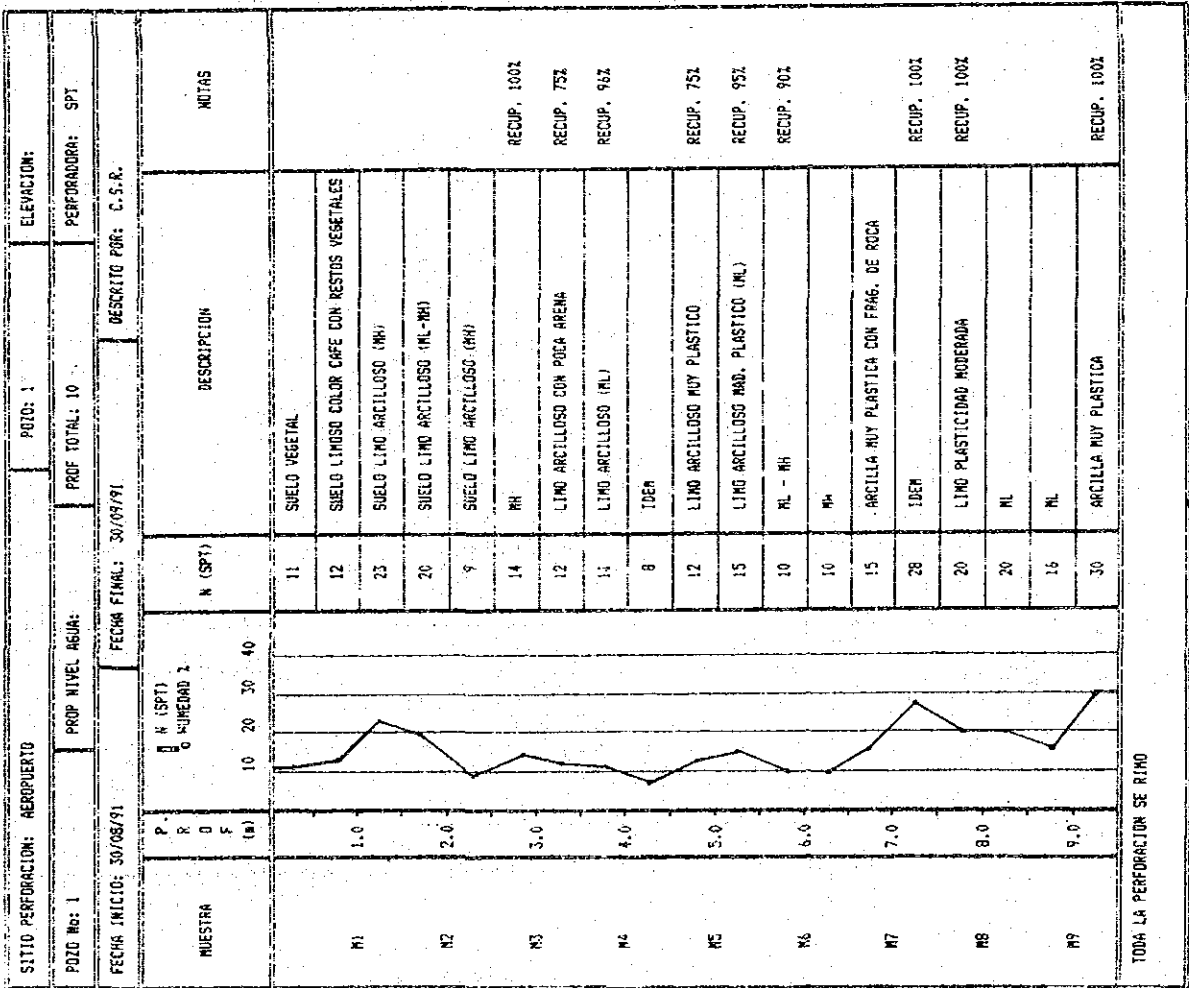
Note 2: Objects with "-" in degree of infringement are obstacles.

Note 3: Objects with "+" in degree of infringement are not obstacles they were surveyed in the field.

**APPENDIX-3.2.8 STANDARD PENETRATION TEST AT
JUAN SANTAMARIA AIRPORT**

Figure 3.3.7

Bore Hole Logs



TODA LA PERFORACION SE RINDO

**APPENDIX-3.2.9 PAVEMENT STRUCTURE
INVESTIGATION AT JUAN SANTAMARIA
AIRPORT**

SITIO PERFORACION: AEROPUERTO		POZO: 8		ELEVACION:	
POZO No: 8	PROP NIVEL AGUA: -	PROF TOTAL: m.	PERFORADORA: SPT		
FECHA INICIO: 18/09/91		FECHA FINAL: 18/09/91		DESCRITO POR: ING. R.E.B.	
MUESTRA	P R O F (m)	N (SPT)	DESCRIPCION	NOTAS	
	10 20 30 40				
	1.0	6	VEGETAL		
		6	VEGETAL		
M1	2.0	9	LIMO ARCILLOSO CAFE CLARO		
		8	LIMO ARCILLOSO CAFE		
M2	3.0	10	LIMO ARCILLOSO CAFE OSCURO		
		5	LIMO ARCILLOSO CAFE		
		14	ARCILLA LIMOSA CAFE OSCURO		
M3	4.0	27	ARCILLA LIMOSA CAFE OSCURO		
		33	ARCILLA LIMOSA CAFE OSCURO		
M4	5.0	53	ARCILLA LIMOSA CAFE OSCURO		
		52	ARCILLA LIMOSA CAFE OSCURO		
M5	6.0	60	ARCILLA LIMOSA CAFE OSCURO		
		63	ARCILLA LIMOSA CAFE OSCURO		
		62	ARCILLA LIMOSA CAFE OSCURO		
		61	ARCILLA LIMOSA CAFE OSCURO		
		65	ARCILLA LIMOSA CAFE OSCURO		
	9.0				

SITIO PERFORACION: AEROPUERTO		POZO: 7		ELEVACION:	
POZO No: 7	PROP NIVEL AGUA: -	PROF TOTAL: m.	PERFORADORA: SPT		
FECHA INICIO: 2/09/91		FECHA FINAL: 2/09/91		DESCRITO POR: ING. V.H.	
MUESTRA	P R O F (m)	N (SPT)	DESCRIPCION	NOTAS	
	10 20 30 40				
	1.0	14	SUELO VEGETAL	REC. 50%	
		14	SUELO VEGETAL		
M1	2.0	18	LIMO ARCILLOSO CAFE CLARO		
M2	3.0	12	CONDICION SECA CON PINTAS NEGRAS (ML)		
		12	CONDICION SECA CON PINTAS NEGRAS (ML)	REC. 70%	
M3	4.0	8	IDEM, CON MAYOR HUMEDAD	REC. 100%	
		9	IDEM	REC. 100%	
		4	IDEM	REC. 100%	
M4	5.0	16	IDEM, MENOS HUMEDAD		
		21	IDEM		
M5	6.0	29	ARCILLA LIMOSA CAFE OSCURO CON PINTAS NEGRAS		
		30	ARCILLA LIMOSA CAFE OSCURO CON PINTAS NEGRAS		
M6	7.0	52	IDEM	REC. 100%	
		52	IDEM		
M7	8.0	61	IDEM		
		62	IDEM		
		60	IDEM		
	9.0	62	IDEM		

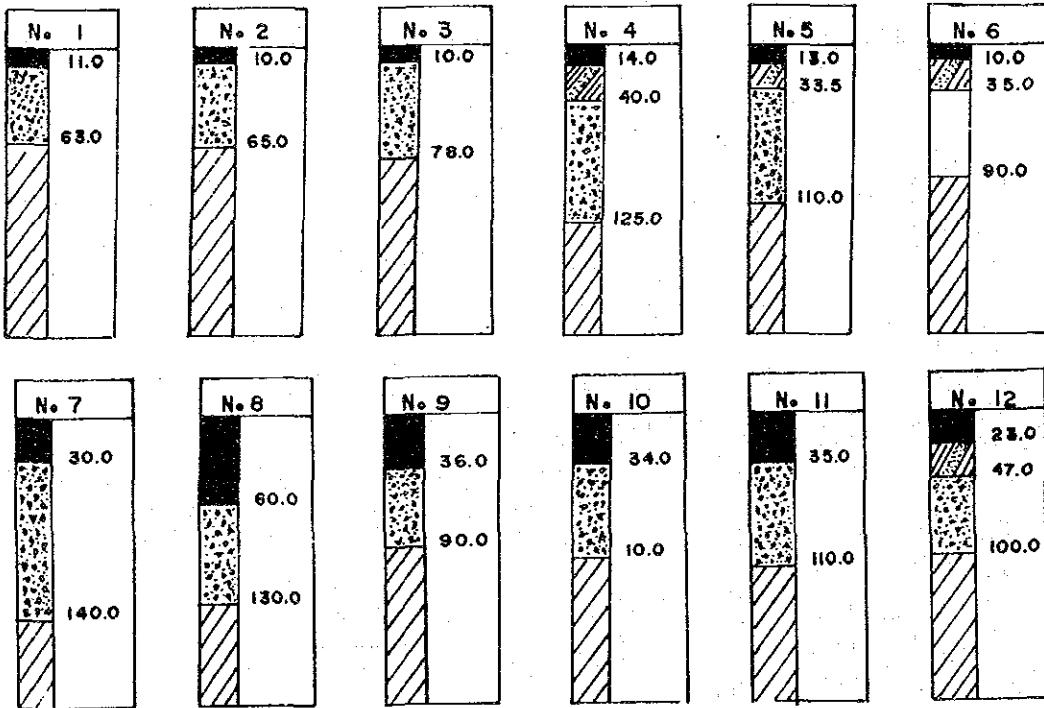
SE RING CADA METRO

PLACE	STATION	THICKNESS (cm.)			
		PAVEMENT	BASE [1]	SUB-BASE [2]	SOIL
1	aprox. ramp.	11	-	11-63	63-200
2	"	10	-	10-65	65-200
3	"	10	-	10-78	78-200
4	1+200N	14	14-40	40-125	125-200
5	1+900N	13	13-33	33-110	110-200
6	2+800N	10	10-35	35-90	90-200
7	2+900S	30	30-50	50-140	140-200
8	2+400S	60	-	60-130	130-200
9	1+800S	36	-	36-90	90-200
10	1+300S	34	-	34-100	100-200
11	0+700S	35	-	35-110	110-200
12	0+200S	23	23-47	47-100	100-200

NOTES:

[1] BASE: Type of material: crush rock stabilize with cement

[2] SUB-BASE: Type of material: sand with some coarse material



**APPENDIX-3.2.10 PHYSICAL PROPERTIES TEST AT JUAN
SANTAMARIA AIRPORT**

MUESTRA	PERFORACION	GS	%Wn	LL	LP	IP	%PAS.		
							10	40	200
1	1	2.45	39.0	70	51	19	100	96	78
2	1	2.70	56.0	97	57	40	100	94	85
3	1	2.78	71.0	80	55	25	100	99	93
4	1	2.66	69.0	74	60	14	100	98	80
5	1	2.65	69.0	79	64	15	100	100	84
6	1	2.72	64.0	64	56	8	100	99	82
7	1	2.77	48.0	62	42	18	100	100	95
8	1	2.70	53.0	67	46	21	100	95	95
9	1	2.72	49.0	62	42	20	100	98	92
10	1	2.66	49.0	59	40	19	100	95	89
1	2	2.71	45.0	79	45	34	100	92	81
2	2	2.65	65.0	77	50	27	100	100	95
3	2	2.66	75.7	78	48	32	100	99	91
4	2	2.70	64.0	77	56	20	100	96	80
5	2	2.71	50.0	74	46	28	100	92	86
6	2	2.72	48.0	69	59	10	100	100	96
7	2	2.68	52.0	67	57	10	100	100	95
8	2	2.70	48.0	70	61	9	100	96	96
9	2	2.70	46.0	68	59	9	100	100	94
10	2	2.71	47.0	69	60	9	100	100	96
1	3	2.73	49.0	75	44	31	100	100	86
2	3	2.70	62.0	92	57	35	100	97	85
3	3	2.69	55.0	90	56	34	100	99	94
4	3	2.44	40.4	89	54	35	100	92	84
5	3	2.70	43.0	63	38	24	100	100	94

MUESTRA	PERFORACION	GS	%Wn	LL	LP	IP	%PAS.		
							10	40	200
6	3	2.71	44.0	65	40	25	100	99	95
7	3	2.70	42.0	62	38	24	100	98	93
1	4	2.66	60.0	85	54	31	100	99	92
2	4	2.51	60.0	84	52	32	100	98	94
3	4	2.60	34.0	71	39	32	100	100	98
4	4	2.64	30.0	70	37	29	100	100	97
5	4	2.65	33.0	71	40	31	100	100	98
6	4	2.63	32.0	72	43	29	100	99	96
7	4	2.64	30.0	70	38	32	100	99	97
1	5	2.60	47.0	69	43	26	100	89	79
2	5	2.65	36.0	67	45	22	100	98	94
3	5	2.66	30.0	75	49	26	100	98	94
4	5	2.79	38.0	62	37	25	100	100	95
5	5	2.71	38.0	63	38	25	100	100	96
6	5	2.63	36.0	61	35	26	100	98	94
7	5	2.71	35.0	60	36	24	100	99	96
1	6	2.66	50.0	72	46	26	100	97	92
2	6	2.60	58.0	80	61	19	98	85	70
3	6	2.71	39.0	65	35	30	100	99	92
4	6	2.70	40.0	63	32	31	100	99	93
5	6	2.69	38.0	62	32	30	100	98	92
6	6	2.71	39.0	64	31	33	100	98	92
7	6	2.70	39.0	63	33	30	100	95	90
1	7	2.64	40.0	70	47	23	100	97	90
2	7	2.60	58.0	69	47	22	100	99	94

**APPENDIX-3.2.11 CONSOLIDATION TEST AND TRI-AXIAL
TEST AT JUAN SANTAMARIA AIRPORT**

1. Test Pit No. 1

$G_s = 2.55$
 $\%w = 49\%$
 $A = 50.27 \text{ cm}^2$
 $h = 19.5 \text{ mm}$
 $W_s = 114.1 \text{ gr}$
 $V_m = 98.03 \text{ cc}$
 $\gamma_m = 1.734 \text{ gr/cm}^3$
 $\gamma_s = 1.163 \text{ gr/cm}^3$

$$e_o = \frac{V_m - (W_s/G_s)}{W_s/G_s} = 1.19$$

$$H_s = 10 \times W_s / A \times G_s = 8.9 \text{ cm.}$$

1º CICLO: $\nabla = 1.3 \text{ t/m}^2$

$$H_1 = 19.5 - 0.11 = 19.39$$

$$C_1 = (19.39 - 8.9) / 8.9 = 1.18$$

2º CICLO: $\nabla = 3.1 \text{ t/m}^2$

$$H_2 = 19.39 - 0.12 = 19.27$$

$$C_2 = (19.27 - 8.9) / 8.9 = 1.17$$

3º CICLO: $\nabla = 7.3 \text{ t/m}^2$

$$H_3 = 19.27 - 0.36 = 18.91$$

$$C_3 = (18.91 - 8.9) / 8.9 = 1.12$$

4º CICLO: $\nabla = 13.3 \text{ t/m}^2$

$$H_4 = 18.91 - 6.50 = 18.26$$

$$C_4 = (18.26 - 8.9) / 8.9 = 1.05$$

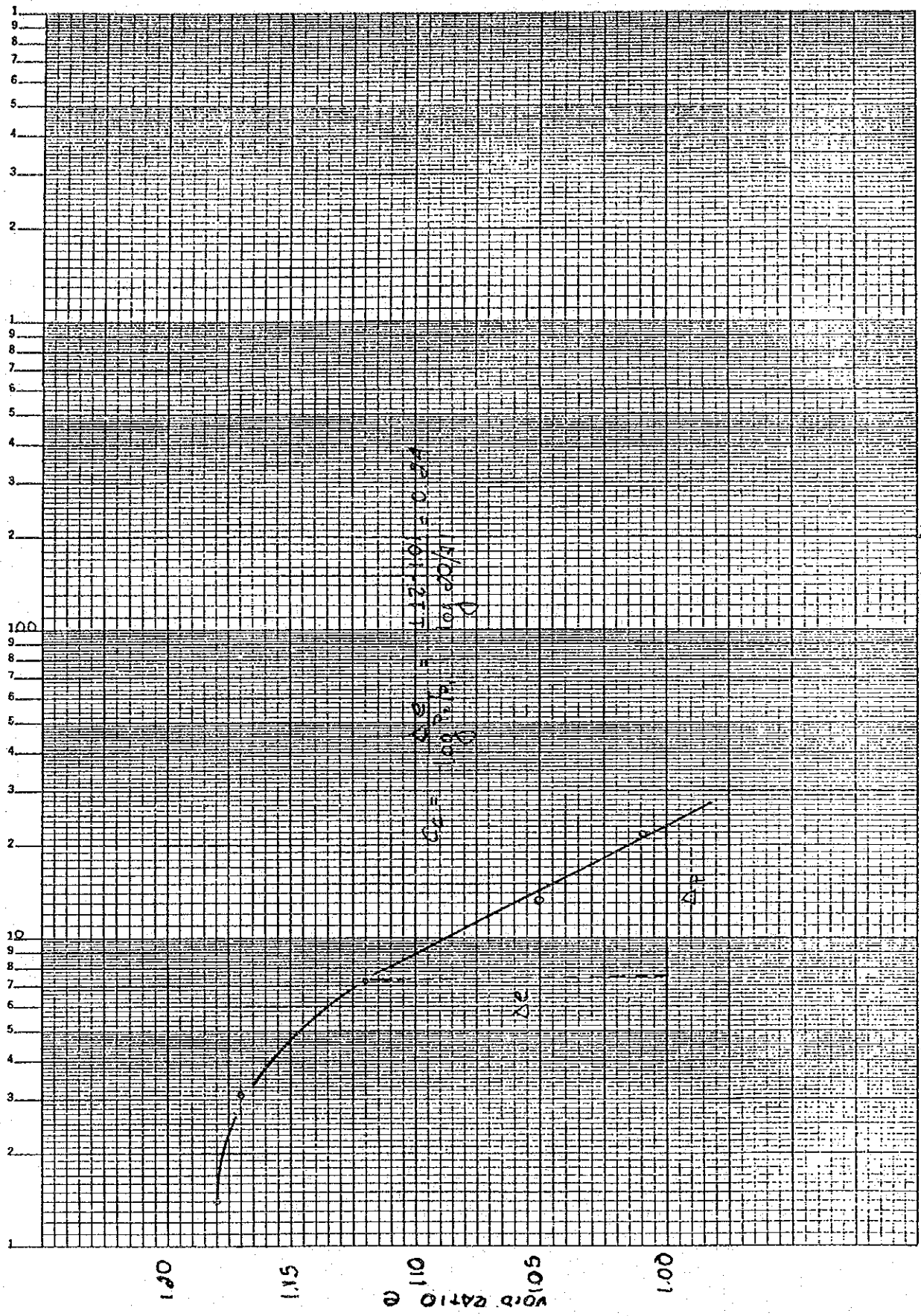
5º CICLO: $\nabla = 23.2 \text{ t/m}^2$

$$H_5 = 18.26 - 0.30 = 17.96$$

$$C_5 = (17.96 - 8.9) / 8.9 = 1.02$$

4 CICLOS X 70 DIVISIONES Hecho en Corta Rica

FORMA DE VOLVIMETRO



log P (1/m³)

2. Test Pit No. 2

$G_s = 2.66$
 $\%w = 53\%$
 $A = 50.27 \text{ cm}^2$
 $h = 19.5 \text{ mm}$
 $W_s = 111.0 \text{ gr}$
 $V_m = 98.03 \text{ cc}$
 $\gamma_m = 1.132 \text{ gr/cm}^3$

$$e_o = V_m - (W_s/G_s) / W_s/G_s = 1.35$$

$$H_s = 10 \times W_s / A \times G_s = 8.3 \text{ cm.}$$

1º CICLO: $\nabla = 1.0 \text{ t/m}^2$

$$H1 = 19.5 - 0.4 = 19.1$$

$$C1 = 1.30$$

2º CICLO: $\nabla = 3.0 \text{ t/m}^2$

$$H2 = 19.1 - 0.1 = 19.0$$

$$C2 = 1.29$$

3º CICLO: $\nabla = 7.0 \text{ t/m}^2$

$$H3 = 19.0 - 0.5 = 18.5$$

$$C3 = 1.23$$

4º CICLO: $\nabla = 12.9 \text{ t/m}^2$

$$H4 = 18.5 - 0.5 = 18.0$$

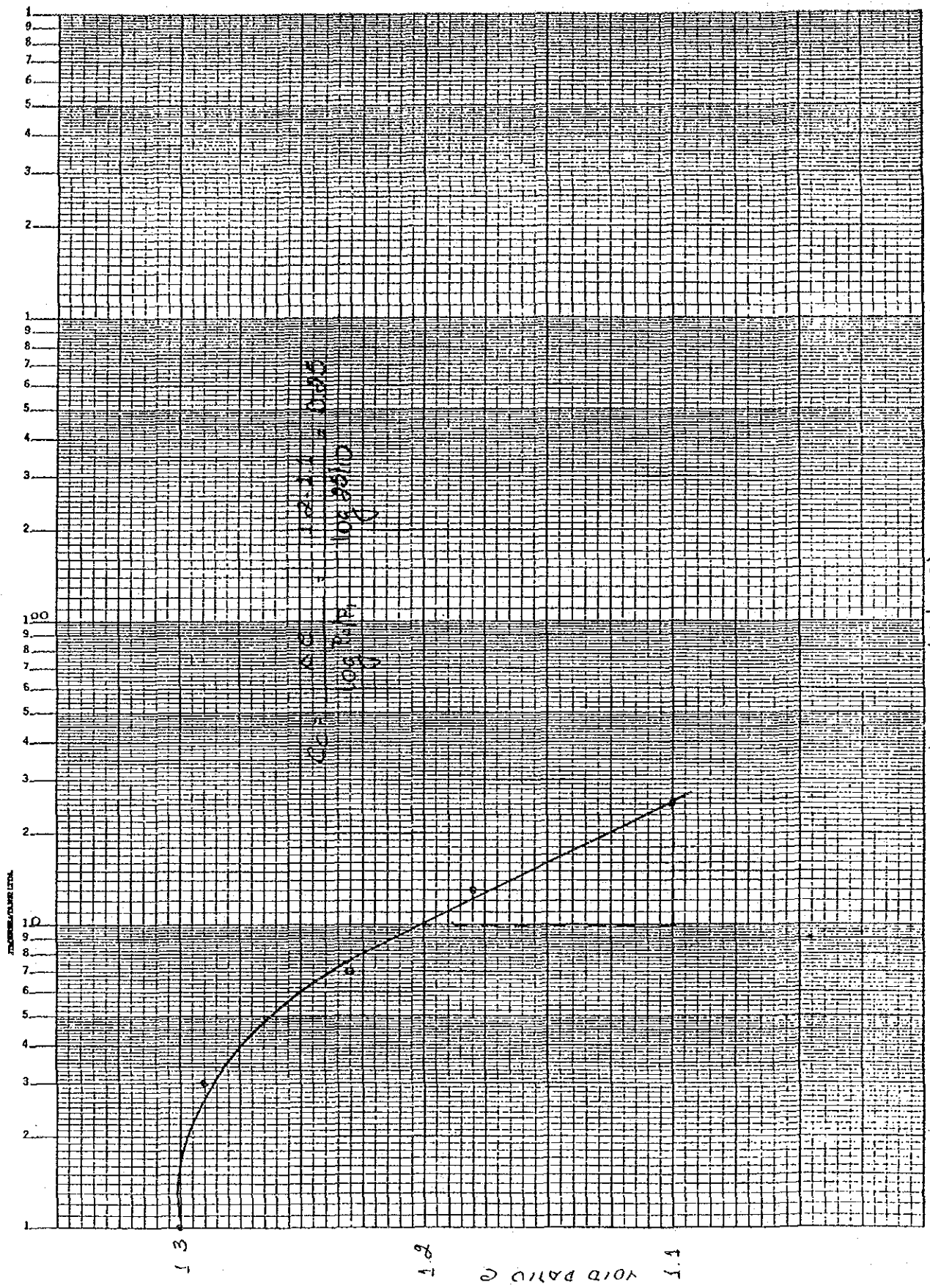
$$C4 = 1.17$$

5º CICLO: $\nabla = 25.0 \text{ t/m}^2$

$$H5 = 18.0 - 0.6 = 17.4$$

$$C5 = 1.10$$

4 CICLOS X 70 DIVISIONES Hecho en Costa Rica



LOG P (t/m²)

3. Test Pit No. 3

$G_s = 2.45$
 $\%w = 40\%$
 $A = 50.27 \text{ cm}^2$
 $h = 19.5 \text{ mm}$
 $W_s = 104.0 \text{ gr}$
 $V_m = 98.03 \text{ cc}$
 $\gamma_m = 1.068 \text{ gr/cm}^3$

$$e_o = V_m - (W_s/G_s) / W_s/G_s = 1.29$$

$$H_s = 10 \times W_s / A \times G_s = 8.5 \text{ cm.}$$

1º CICLO: $\nabla = 1.0 \text{ t/m}^2$

$$H_1 = 19.5 - 0.25 = 19.25$$

$$C_1 = 1.26$$

2º CICLO: $\nabla = 3.0 \text{ t/m}^2$

$$H_2 = 19.25 - 0.20 = 19.05$$

$$C_2 = 1.24$$

3º CICLO: $\nabla = 7.0 \text{ t/m}^2$

$$H_3 = 19.05 - 0.5 = 18.55$$

$$C_3 = 1.18$$

4º CICLO: $\nabla = 13.0 \text{ t/m}^2$

$$H_4 = 18.55 - 0.56 = 17.91$$

$$C_4 = 1.11$$

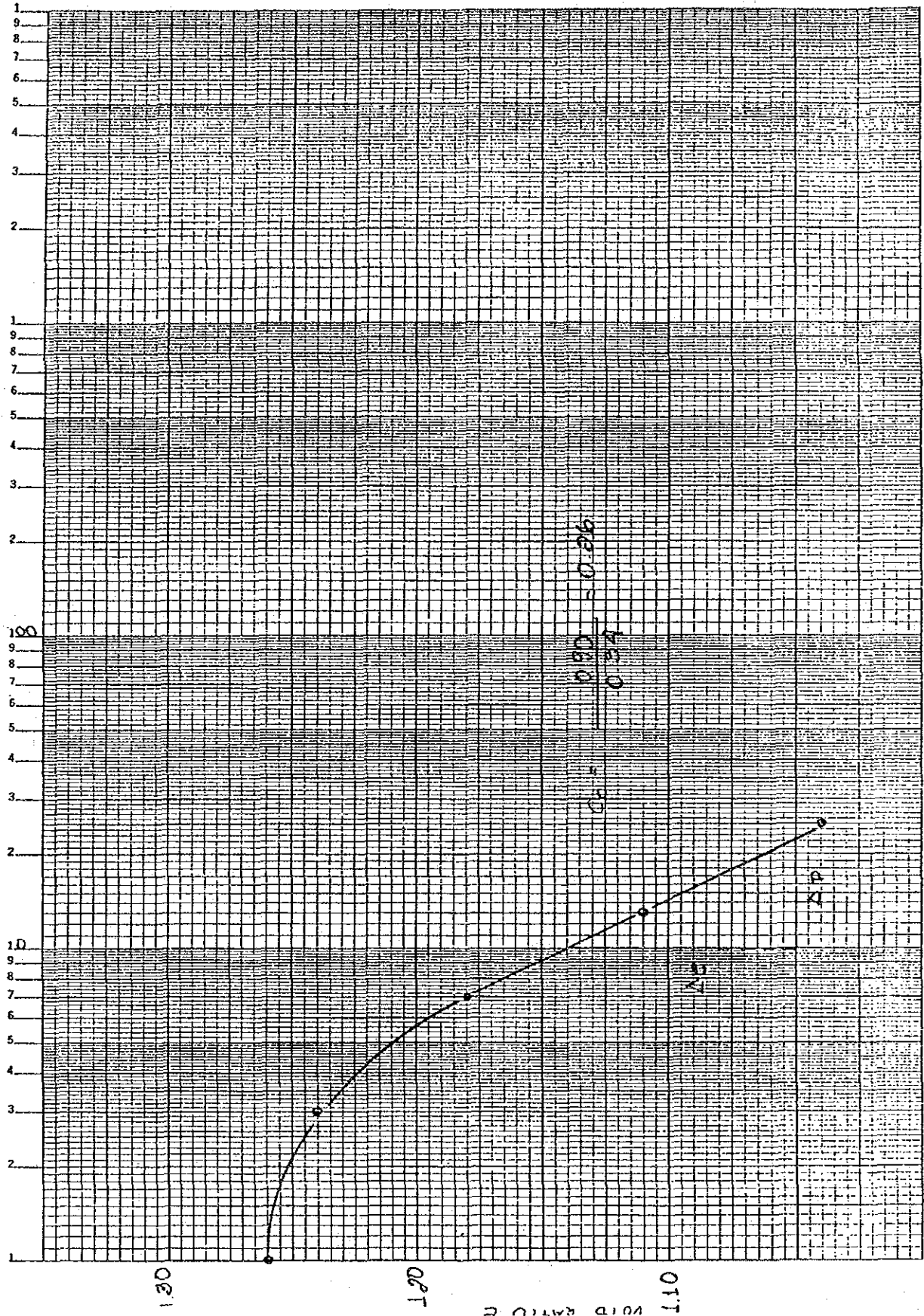
5º CICLO: $\nabla = 25.0 \text{ t/m}^2$

$$H_5 = 17.91 - 0.56 = 17.35$$

$$C_5 = 1.04$$

4 CICLOS X 70 DIVISIONES Hecho en Costa Rica

PROBABILIDAD DE FALLA



(2.46/1) 50%

CALCULO DE TRIAXIALES TIPO CU

Proyecto : AEROPUERTO
 Sitio :
 Localización: TEST PIT N°2
 Profundidad :
 Fecha : 09-OCT-91

Lo (mm) :	74.8	Ro (cm2) :	9.40	eo :	1.24
Do (mm) :	34.6	Vo (cm3) :	70.33	So (%) :	100.00
Wto (g) :	118.2	&to (k/m3) :	1680.64	w (%) :	54.31
Wt (g) :	120.5	&tf (k/m3) :	1600.4	ef :	1.40
Ws (g) :	76.6	&do (k/m3) :	1087.14	Sf (%) :	100.00
Gs :	2.44	&df (k/m3) :	1017.35	wf (%) :	57.31
A.carga :	0.14	PCT(kN/m2) :	140	Lc (mm) :	74.13
&Vcelda :	1.9	PCE(kN/m2) :	50	Ac(cm2) :	9.23
V (mm/')	0.05	CP (kN/m2) :	90	Vc(cm3) :	68.43
&Vcontrapr	4.4	V.aire cm3 :	-2.6629	&U(cm3) :	1.9

DEF	DIV.	U	DEF	CARGA	ESF	U	P1	P1'	P3'	P1'/P3'	E	ESF'	
mm-2	DIAL	kN/m2	(%)	kg	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	
0	0	92	*	0.00	0.00	0.00	0.00	0.51	0.51	0.51	1.00	---	0
50	21	100	*	0.67	2.94	0.32	0.08	0.83	0.74	0.43	1.74	46.9	0.235
100	35	105	*	1.35	4.90	0.52	0.13	1.03	0.90	0.38	2.39	38.8	0.391
150	40	110	*	2.02	5.60	0.59	0.18	1.10	0.92	0.33	2.82	29.4	0.411
200	45	114	*	2.70	6.30	0.66	0.22	1.17	0.95	0.29	3.33	24.6	0.44
250	50	118	*	3.37	7.00	0.73	0.27	1.24	0.98	0.24	3.99	21.7	0.468
300	55	119	*	4.05	7.70	0.80	0.28	1.31	1.03	0.23	4.41	19.8	0.525
400	63	121	*	5.40	8.82	0.90	0.30	1.41	1.12	0.21	5.22	16.7	0.606
500	69	121	*	6.75	9.66	0.98	0.30	1.49	1.19	0.21	5.56	14.5	0.68
600	74	121	*	8.09	10.36	1.03	0.30	1.54	1.25	0.21	5.82	12.7	0.736
700	79	118	*	9.44	11.06	1.08	0.27	1.59	1.33	0.24	5.43	11.5	0.82
800	83	116	*	10.79	11.62	1.12	0.24	1.63	1.39	0.27	5.24	10.4	0.878
900	88	115	*	12.14	12.32	1.17	0.23	1.68	1.45	0.28	5.26	9.7	0.938
1000	91	114	*	13.49	12.74	1.19	0.22	1.70	1.48	0.29	5.18	8.8	0.969
1100	93	112	*	14.84	13.02	1.20	0.20	1.71	1.51	0.31	4.93	8.1	0.997
1200	95	110	*	16.19	13.30	1.21	0.18	1.72	1.53	0.33	4.70	7.5	1.024
1300	96	108	*	17.54	13.44	1.20	0.16	1.71	1.55	0.35	4.46	6.8	1.037
1400	96	106	*	18.89	13.44	1.18	0.14	1.69	1.55	0.37	4.22	6.3	1.038
1500	96	106	*	20.24	13.44	1.16	0.14	1.67	1.53	0.37	4.16	5.7	1.018

CALCULO DE TRIAXIALES TIPO CU

Proyecto : AEROPUERTO
 Sitio :
 Localizacion:
 Profundidad :
 Fecha : 09-OCT-91

Lo (mm) :	74.8	Ao (cm2) :	9.51	eo :	1.26	*	*
Do (mm) :	34.8	Vo (cm3) :	71.15	So (%) :	100.00	*	*
Wto (g) :	119	δto (k/m3) :	1672.62	w (%) :	54.75	*	*
Wt (g) :	120.8	δtf (k/m3) :	1601.77	ef :	1.39	*	*
Ws (g) :	76.9	δdo (k/m3) :	1080.88	Sf (%) :	100.00	*	*
Gs :	2.44	δdf (k/m3) :	1019.67	wf (%) :	57.09	*	*
A.carga :	0.14	PCT(kN/m2) :	190	Lc (mm) :	74.06	*	*
ΔV Celda:	2.1	PCE(kN/m2) :	100	Ac (cm2) :	9.32	*	*
V (mm/')	0.05	CP (kN/m2) :	90	Vc (cm3) :	69.05	*	*
ΔVcontrapr	4.2	V.aire cm3 :	-2.4705	ΔV(cm3) :	2.1	*	*

DEF	DIV.	U	DEF	CARGA	ESF	U	P1	P1'	P3'	P1'/P3'	E	ESF'
mm-2	DIAL	kN/m2	(%)	kg	kg/cm2	kg/cm2	kg/cm2	k/cm2	kg/cm2		kg/cm2	kg/cm2
0	0	92	*	0.00	0.00	0.00	1.02	1.02	1.02	1.00	---	0
50	40	130	*	0.68	5.60	0.60	0.39	1.62	1.23	0.63	1.94	88.4 0.209
100	51	138	*	1.35	7.14	0.76	0.47	1.77	1.31	0.55	2.37	55.9 0.286
150	57	146	*	2.03	7.98	0.84	0.55	1.86	1.31	0.47	2.79	41.4 0.288
200	63	157	*	2.70	8.82	0.92	0.66	1.94	1.28	0.36	3.58	34.1 0.258
250	69	164	*	3.38	9.66	1.00	0.73	2.02	1.29	0.29	4.51	29.7 0.267
300	75	168	*	4.05	10.50	1.08	0.77	2.10	1.33	0.24	5.42	26.7 0.306
400	84	172	*	5.40	11.76	1.19	0.82	2.21	1.40	0.20	6.85	22.1 0.378
500	92	176	*	6.75	12.88	1.29	0.86	2.31	1.45	0.16	8.90	19.1 0.432
600	97	178	*	8.10	13.58	1.34	0.88	2.36	1.48	0.14	10.38	16.5 0.462
700	101	174	*	9.45	14.14	1.37	0.84	2.39	1.56	0.18	8.48	14.5 0.537
800	105	167	*	10.80	14.70	1.41	0.76	2.43	1.66	0.25	6.52	13.0 0.642
900	108	162	*	12.15	15.12	1.42	0.71	2.44	1.73	0.31	5.66	11.7 0.711
1000	110	157	*	13.50	15.40	1.43	0.66	2.45	1.79	0.36	5.00	10.6 0.766
1100	112	153	*	14.85	15.68	1.43	0.62	2.45	1.83	0.40	4.60	9.6 0.81
1200	112	151	*	16.20	15.68	1.41	0.60	2.43	1.83	0.42	4.37	8.7 0.808
1300	112	148	*	17.55	15.68	1.39	0.57	2.41	1.83	0.45	4.09	7.9 0.816
1400	112	148	*	18.90	15.68	1.36	0.57	2.38	1.81	0.45	4.04	7.2 0.793
1500	112	147	*	20.25	15.68	1.34	0.56	2.36	1.80	0.46	3.92	6.6 0.78

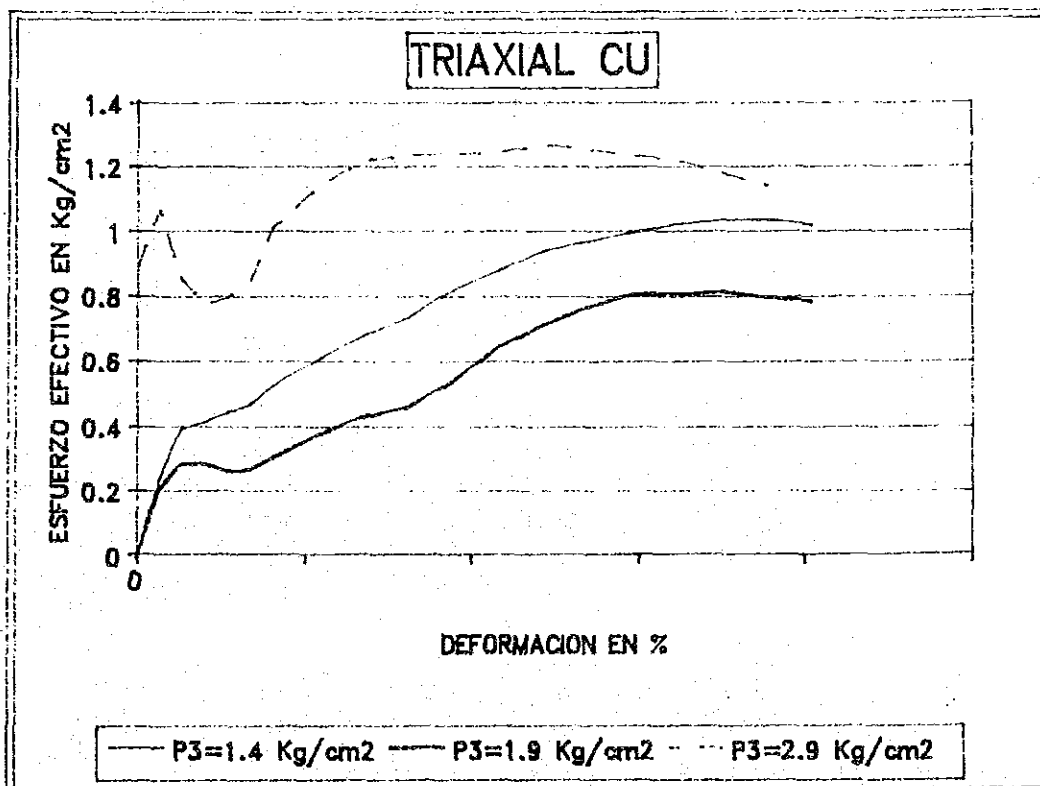
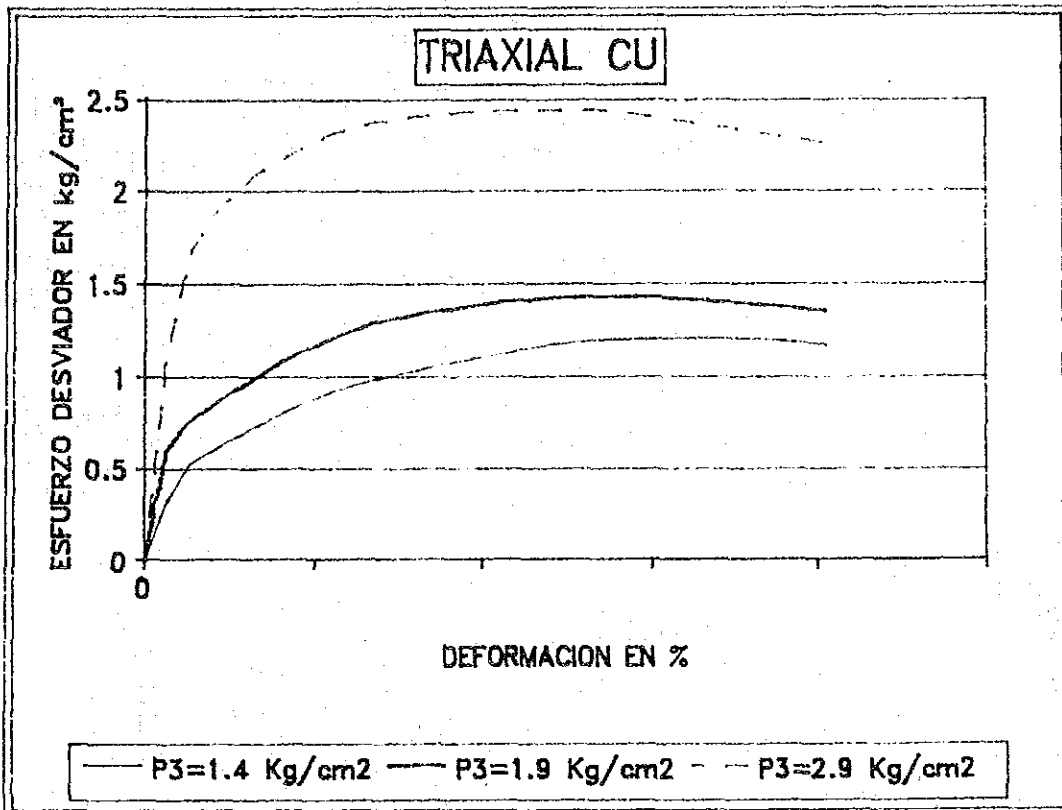
CALCULO DE TRIAXIALES TIPO CU

Proyecto : AEROPUERTO
 Sitio :
 Localizacion:
 Profundidad :
 Fecha : 09-OCT-91

Lo (mm) :	75.1	Ro (cm2) :	9.51	eo :	1.24	*	*
Do (mm) :	34.8	Vo (cm3) :	71.43	So (%) :	100.00	*	*
Wto (g) :	121	&sto (k/m3) :	1693.94	w (%) :	55.53	*	*
Wt (g) :	121.2	&tf (k/m3) :	1609.88	ef :	1.36	*	*
Ws (g) :	77.8	&do (k/m3) :	1089.16	Sf (%) :	100.00	*	*
Gs :	2.44	&df (k/m3) :	1033.4	wf (%) :	55.78	*	*
A.carga :	0.14	PCT(kN/m2) :	290	Lc (mm) :	73.77	*	*
&V Celda :	3.8	PCE(kN/m2) :	200	Ac(cm2) :	9.17	*	*
V (mm/') :	0.05	CP (kN/m2) :	90	Vc(cm3) :	67.63	*	*
&Vcontrapr :	4.2	V.aire cm3 :	-3.654	&V(cm3) :	3.8	*	*

DEF	DIV.	U	DEF	CARGA	ESF	U	P1	P1'	P3'	P1'/P3'	E	ESF'
	DIAL	KN/m2	(%)	kg	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2		kg/cm2	kg/cm2
0	0	91	*	0.00	0.00	0.00	2.04	2.04	2.04	1.00		0
50	75	115	*	0.68	10.50	1.14	0.24	3.18	2.93	1.79	1.63	167.7 0.892
100	111	150	*	1.36	15.54	1.67	0.60	3.71	3.11	1.44	2.16	123.3 1.069
150	125	191	*	2.03	17.50	1.87	1.02	3.91	2.89	1.02	2.83	91.9 0.849
200	135	212	*	2.71	18.90	2.00	1.23	4.04	2.81	0.81	3.49	73.9 0.771
250	143	220	*	3.39	20.02	2.11	1.31	4.15	2.83	0.72	3.91	62.2 0.793
300	149	222	*	4.07	20.86	2.18	1.34	4.22	2.88	0.70	4.10	53.6 0.846
400	160	218	*	5.42	22.40	2.31	1.29	4.35	3.05	0.74	4.10	42.6 1.015
500	167	212	*	6.78	23.38	2.38	1.23	4.41	3.18	0.81	3.95	35.1 1.142
600	172	208	*	8.13	24.08	2.41	1.19	4.45	3.26	0.85	3.85	29.6 1.219
700	176	208	*	9.49	24.64	2.43	1.19	4.47	3.28	0.85	3.87	25.6 1.238
800	179	208	*	10.84	25.06	2.44	1.19	4.47	3.28	0.85	3.88	22.5 1.243
900	182	208	*	12.20	25.48	2.44	1.19	4.48	3.28	0.85	3.88	20.0 1.246
1000	185	206	*	13.56	25.90	2.44	1.17	4.48	3.31	0.87	3.82	18.0 1.268
1100	185	204	*	14.91	25.90	2.40	1.15	4.44	3.29	0.89	3.71	16.1 1.25
1200	185	202	*	16.27	25.90	2.36	1.13	4.40	3.27	0.91	3.61	14.5 1.232
1300	185	200	*	17.62	25.90	2.33	1.11	4.36	3.25	0.93	3.51	13.2 1.215
1400	185	200	*	18.98	25.90	2.29	1.11	4.33	3.21	0.93	3.47	12.1 1.176
1500	185	200	*	20.33	25.90	2.25	1.11	4.29	3.18	0.93	3.42	11.1 1.138

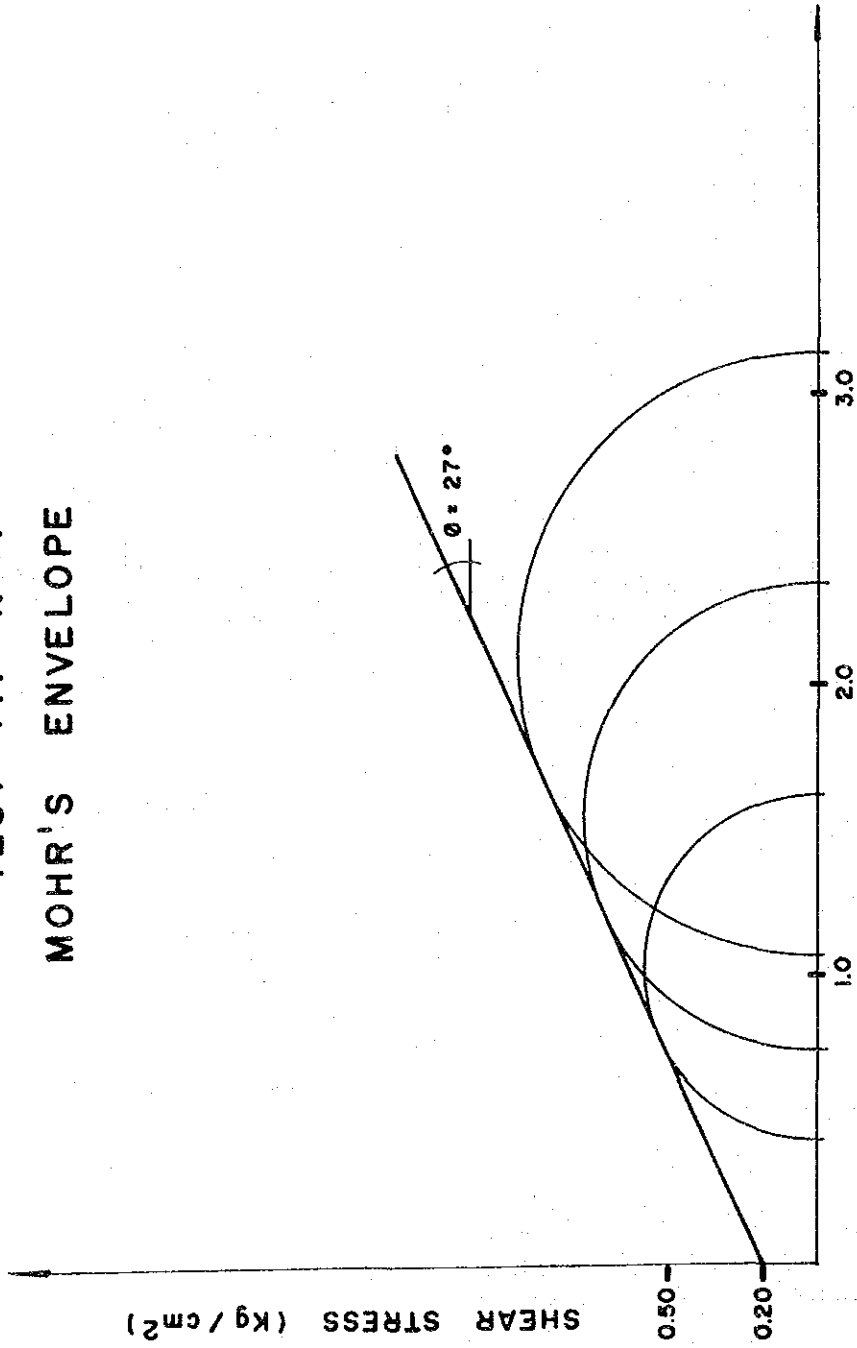
DEF %	CONES kg/cm ²	PHI deg
0.0		
0.7	0.07	12.20
1.4	0.02	16.23
2.0	0.03	17.57
2.7	0.04	18.22
3.4	0.06	18.55
4.1	0.09	18.57
5.4	0.12	18.79
6.8	0.15	18.67
8.1	0.18	18.48
9.5	0.20	18.19
10.8	0.22	17.86
12.2	0.24	17.46
13.5	0.25	17.30
14.9	0.26	16.83
16.2	0.27	16.43
17.6	0.27	16.13
18.9	0.27	15.93



JUAN SANTAMARIA AIRPORT

TEST PIT N° 1

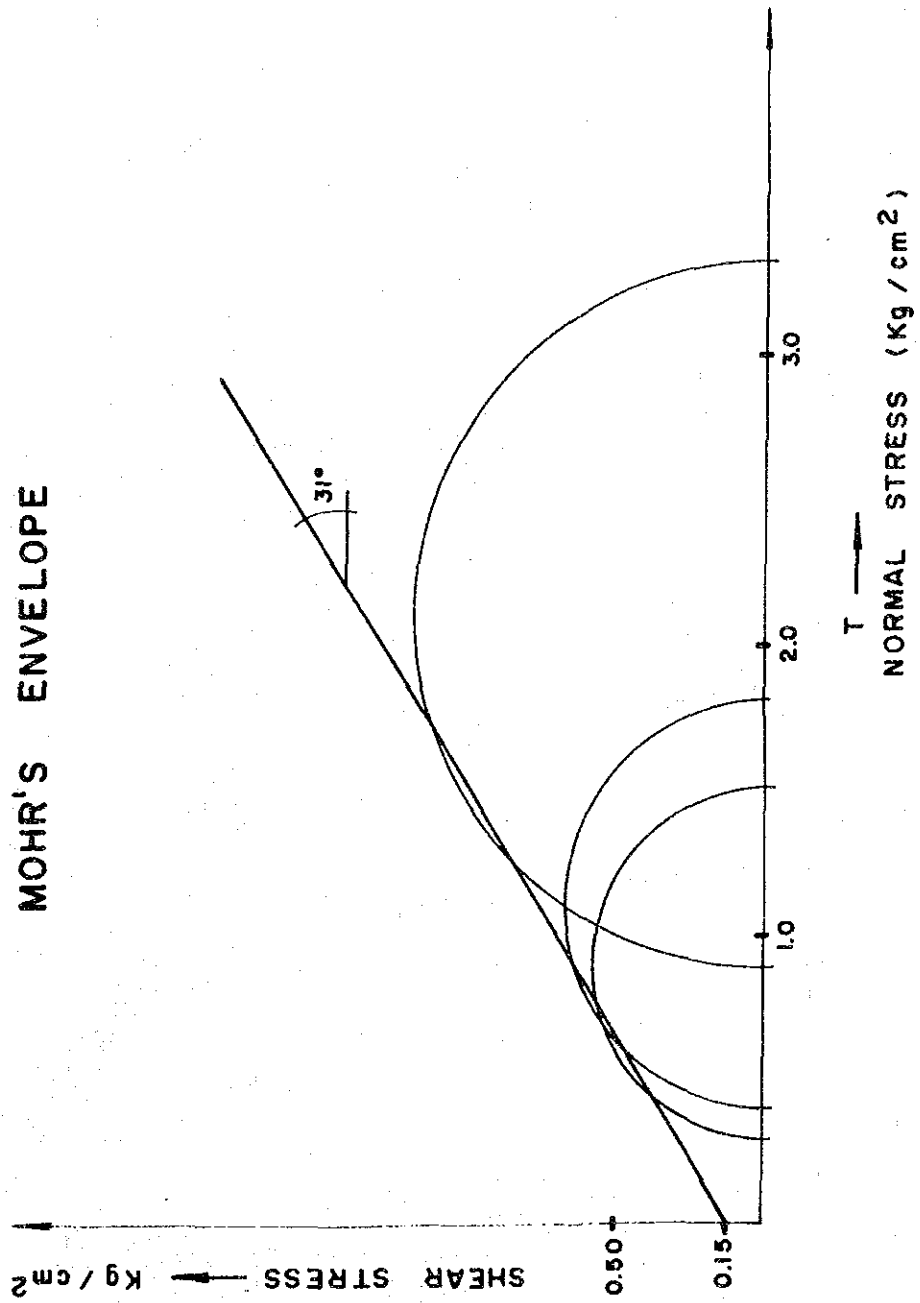
MOHR'S ENVELOPE



JUAN SANTAMARIA AIRPORT

TEST PIT N° 2

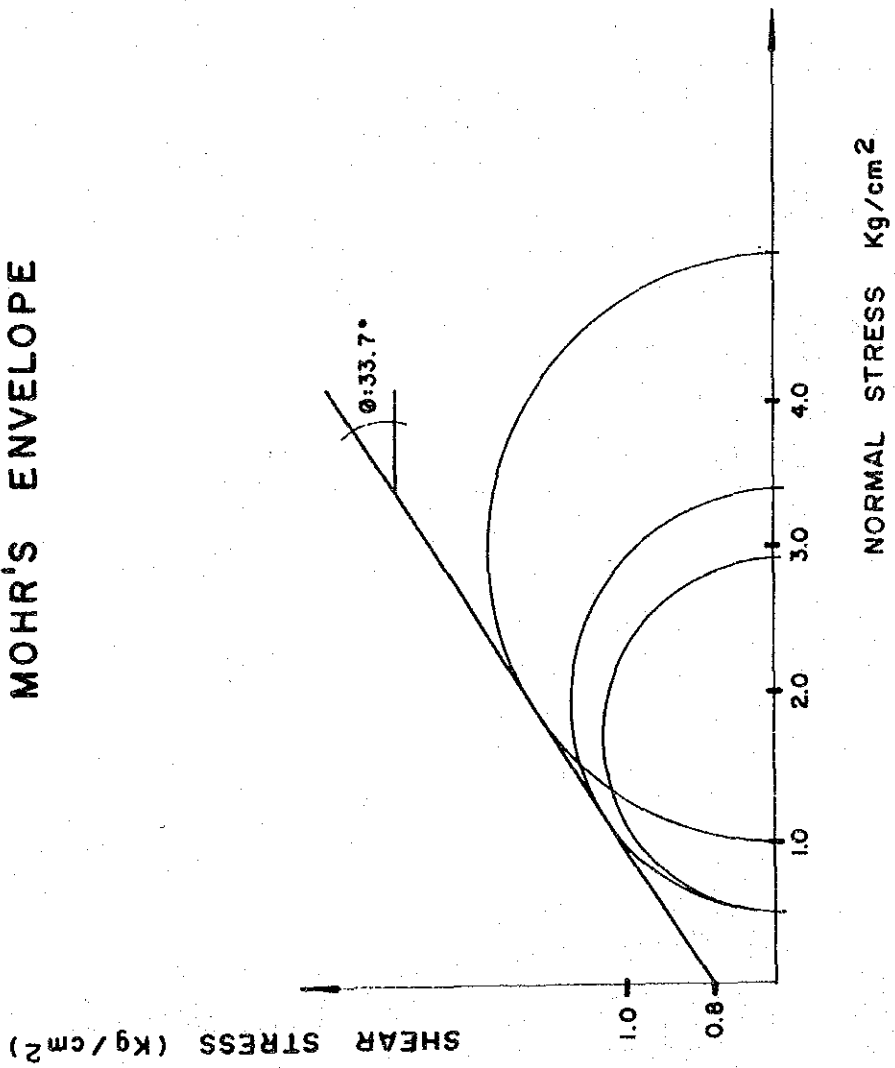
MOHR'S ENVELOPE



JUAN SANTAMARIA AIRPORT

TEST PIT N°3

MOHR'S ENVELOPE



**APPENDIX-3.2.12 MARSHALL STABILITY TEST AT JUAN
SANTAMARIA AND LIMON AIRPORTS**

NO. PASTILLA	W seco	Ws. s. s.	W sum.	VOLUMEN	GRAVEDAD ESPECIF.	ESTAB.	FACTOR CORREL.	ESTAB. CORREL.	FLUJO
1-1	1.121,3	1.121,7	631,3	490,0	2,288	1.525	1,09	1.662	29
1-2	1.126,6	1.127,6	628,0	499,6	2,255	2.353	1,04	2.447	25
1-3	1.132,5	1.133,9	635,1	498,8	2,270	1.958	1,04	2.036	25
2-1	1.106,0	1.114,3	614,2	500,1	2.212	2.222	1,04	2.311	22
2-2	1.143,0	1.147,9	642,2	505,7	2.260	2.283	1,04	2.374	24
2-3	1.138,8	1.144,4	637,9	506,5	2.248	2.240	1,04	2.330	26
3-1	1.129,5	1.132,8	635,8	491,0	2.273	1.672	1,04	1.739	22
3-2	1.102,5	1.110,7	619,1	491,6	2.243	1.423	1,09	1.551	15
3-3	1.115,7	1.123,2	624,2	499,0	2.236	2.080	1,04	2.163	18
4-1	1.103,7	1.105,1	596,3	508,8	2.169	1.842	1,04	1.916	21
4-2	1.119,3	1.121,3	613,4	507,9	2.204	1.735	1,04	1.804	24
4-3	1.120,4	1.122,0	615,2	506,8	2.211	1.761	1,04	1.831	27
5-1	1.112,3	1.113,5	609,7	503,8	2.208	1.916	1,04	1.993	27
5-2	1.096,1	1.098,8	593,8	505,0	2.170	1.557	1,04	1.619	21
5-3	1.114,2	1.118,2	610,4	507,8	2.194	1.780	1,04	1.851	16

OBSERVACIONES: AEROPUERTO JUAN SANTAMARIA