Basic Design Study Report
Hospital Materno Infantil
Trinidad,
Republic of Bolivia

November 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of Bolivia, the Japanese Government decided to conduct a survey on the Establishment of the Trinidad Maternal and Children's Hospital Project and entrusted the survey to the Japan International Cooperation Agency (JICA). The JICA sent to Bolivia a survey team headed by Mr. Yutaka Hosono, Head Planning Division, Grant Aid Department, JICA from July 25 to August 14, 1981.

The team exchanged views with the officials concerned of the Government of Bolivia and conducted a field survey in Trinidad. After the team returned to Japan, further studies were made and the present report has been prepared.

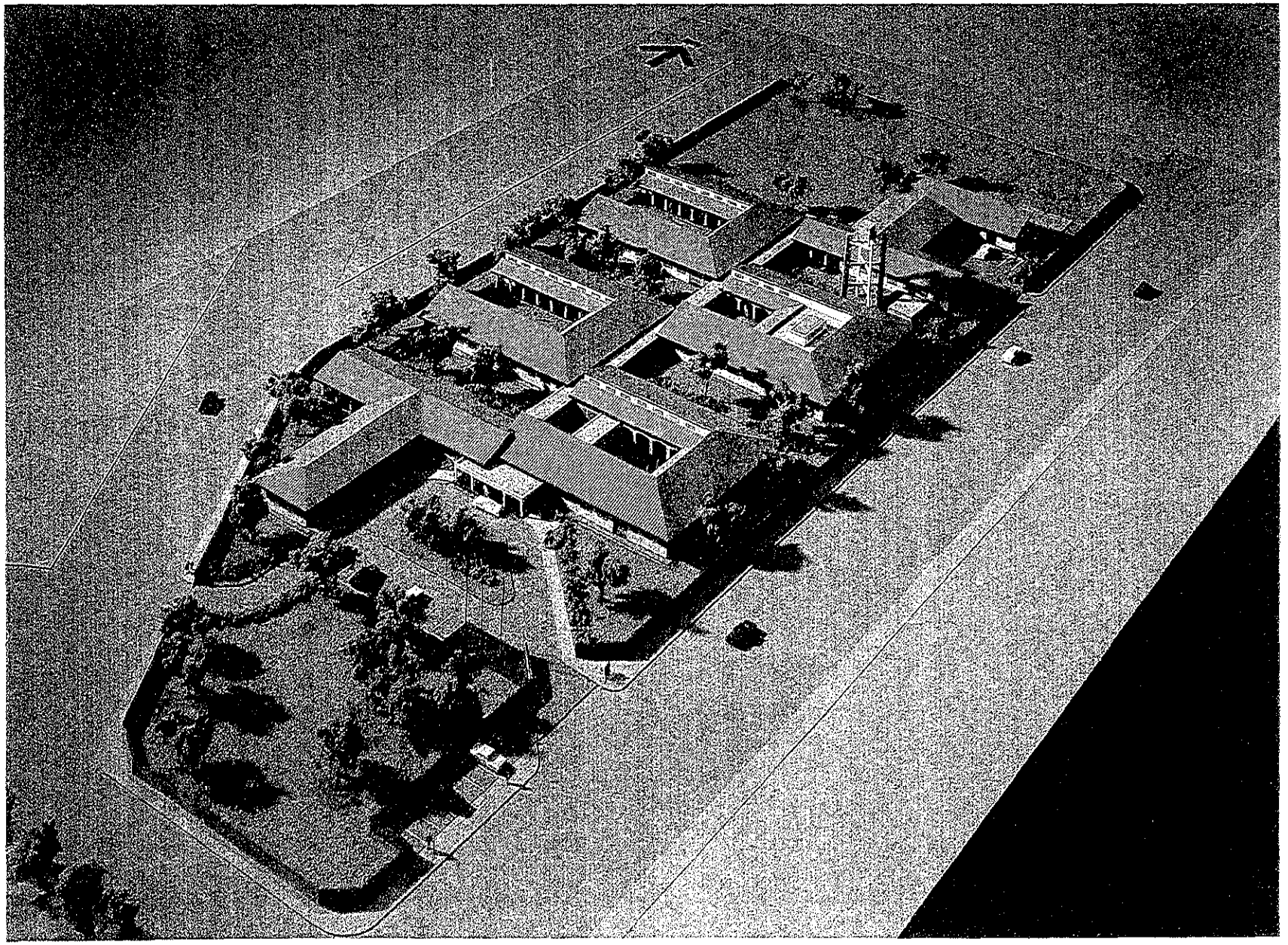
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Bolivia for their close cooperation extended to the team.

November, 1981.

Keisuke Arita

Keisuke ARITA
President
Japan International
Cooperation Agency



SUMMARY

Bolivia is characterized by a high infant mortality rate even among South American Countries. The Bolivian government has requested grant aid cooperation from the Japanese government for the construction of a medical facility which aims at reducing the infant mortality rate and improvement of peri-natal medical care.

1) Name of Hospital: Hospital Materno Infantil (Maternal and Children's Hospital)

2) Location: City of Trinidad, Beni State, Republic of Bolivia
The proposed site is owned by the city and located in the northern section of Trinidad. The site has an area of about 17,000m^2.

3) Purpose of the Hospital:

Treatment of maternal and children's diseases, maternal and children's health care.

The hospital will not provide rare or specialized medical care but will deliver primary care to maternity and child in the community.

4) Organization:

To accomplish these tasks, the hospital will be provided with the following departments and sections.

(1) Administration

(2) Maternal and Child Health Service

(3) Department of Pediatrics

(4) Department of Pediatric Surgery

(5) Department of Gynecology and Obstetrics

(6) Department of Medical Care Service

(7) Department of Nursing

5) Contents of Hospital:

The hospital is to consist of the following facilities;

(1) Administration Wing:

General reception, General office, Pharmacy,

Director's office, Medical office, Medical record library, Maternal and Child Health Service, etc.

(2) Outpatient Wing:

Pediatric and gynecological & obstetrics consultation rooms, Treatment rooms, X-ray room, Clinical laboratories, etc.

(3) Operation and Delivery Wing:

Operation rooms, Recovery rooms, Delivery rooms, Labor room, Newborn nursery with 20 cots, Neonatal room with 10 beds, Central sterilization and supply room, etc.

(4) Pediatric Ward:

Sickrooms (35 beds), Nurses station, Treatment room, Play area, etc.

(5) Obstetric and Gynecological Ward:

Sickrooms (30 beds), Nurses station, Treatment room, Day area, etc.

(6) Service Wing:

Cafeteria, Kitchen, Formula room, Laundry, Machine room, Mortuary, etc.

The total floor area of the hospital is to be approximately 4,000m^2. The hospital is to comprise single-story buildings.

6) Construction:

The construction of the hospital is expected to take at least about 18 months to complete.

In constructing the hospital the Bolivian side is to prepare or carry out the following works;

(1) Preparation of land and banking.

(2) Preparation and paving of the approach road to the site.

(3) Provision of land space adjacent to the site for the site office, a yard, workshops, etc. required during the construction.

(4) Installation of temporary electric power and water supply and telephone required during the construction.

(5) Preparation of drainage routes for sewers and rainwater from the site area.

(6) Power lead-in work up to the receiving and transforming unit and transformer installation.

(7) Water main lead-in work to the site area.

(8) Telephone line lead-in work up to the MDF unit in the building.

In addition, all the legal formalities required under Bolivian law are to be cleared by the Bolivian side.

7) Evaluation of the Project:

Trinidad and its surrounding area is characterized by a high occurrence of disease aggravated by high temperature and humidity. Despite this fact, medical facilities in the area are only very basic. The construction of a hospital such as described above would not only have a direct effect or the health of mothers and children; it would also have the indirect effect of propagating general medical knowledge and awareness to the inhabitants of the surrounding area.

Particular attention should be given to the following points:

(1) Nursing Personnel

It is particularly important to recruit an adequate number of qualified nurses and midwives. Presently there is an obvious shortage of such qualified staff in Trinidad.

(2) Hygiene

Unlike ordinary hospitals, this hospital will treat physically weak babies and infants. There is a special need to maintain a hygienic environment. It is important that all hospital staff including service staff are fully aware of this point.

(3) Technical Cooperation

In order to ensure that the hospital carries out its intended functions with maximum efficiency, it is desirable that there is some form of technical cooperation from the opening of the hospital until the time when it is operating smoothly.

(4) Maintenance and Management

In the design of the hospital, easy maintenance and management should be considered. A maintenance and control system supported by an adequate budget will be necessary.

CONTENTS

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

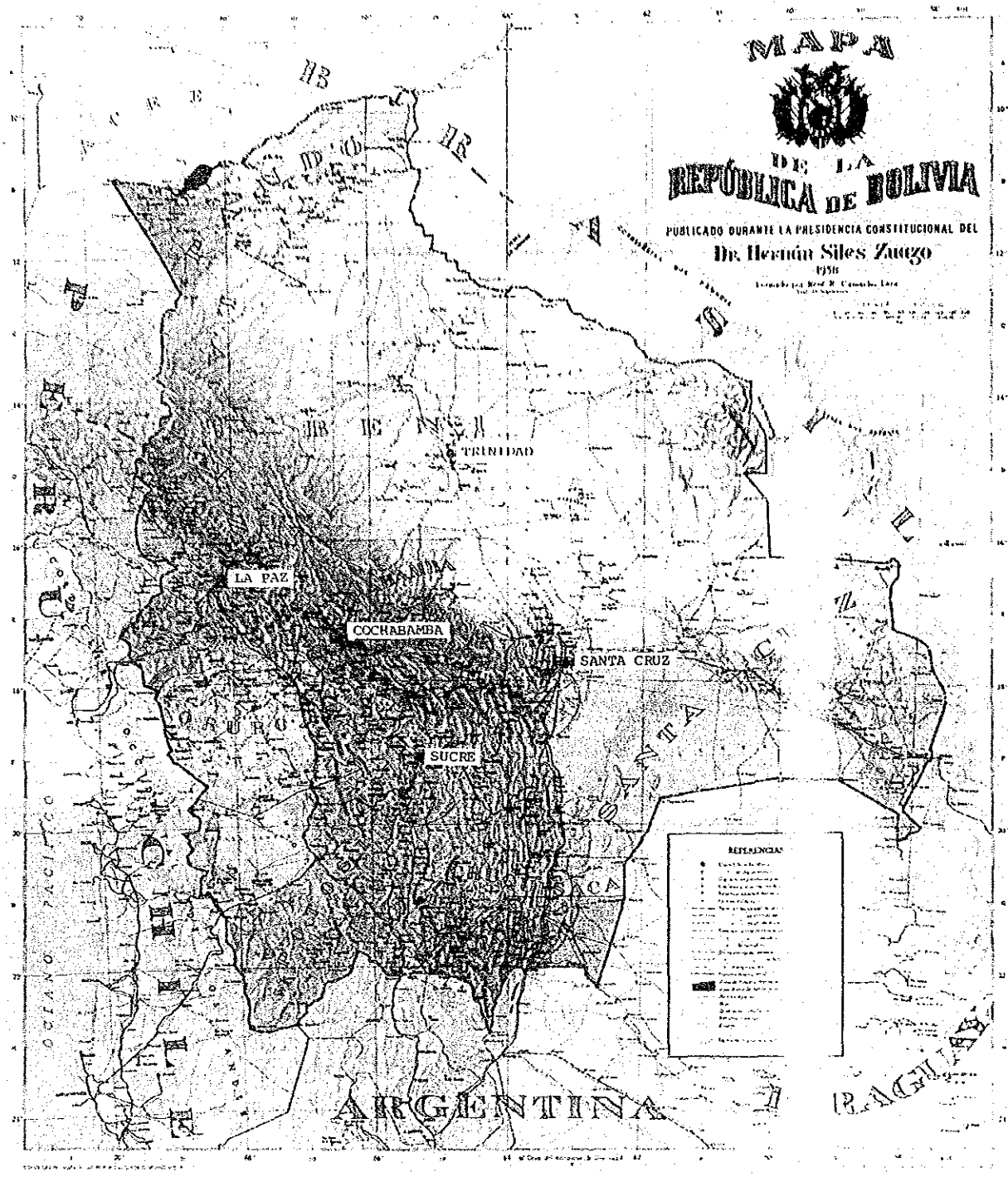
Even among South American countries, Bolivia is characterized by a high infant mortality rate. (Mortalidad en la infancia, según el Censo de 1976; - Instituto National de Estadistica, la Paz) On average 252 out of 1,000 newborns in Bolivia die before the age of five. This mortality rate is higher in the countryside than in urban areas.

At present, maternity care is one of the least developed sectors of medical care. Bolivia suffers from a shortage of manpower due to a low rate of increase of the population and therefore a reduction in the infant mortality rate has a high priority.

Medical care in the lowlands to the north of Bolivia is significantly less developed due to the regions high temperature and humidity. Well equipped medical facilities in that region have long been sought after. In Trinidad, included in this program, there are a national general hospital and a pediatric hospital, but their facilities have deteriorated considerably. Because of this situation, there have been calls for the construction of additional medical facilities. In particular, for the coming generation of Bolivia it is most important to provide total care and health maintenance of mother and child from pregnancy, through birth to childhood.

With these problems in mind, the Bolivian Government prepared plans for the establishment of a maternal and children's hospital and for their implementation, requested grant aid cooperation from the Government of Japan. In compliance with this request, the Government of Japan, through the Japan International Cooperation Agency, sent a basic design survey team from July 25 to August 14, 1981, for the purpose of a preliminary survey for the construction of a maternal and children's hospital in Trinidad (Ciudad de Trinidad) in the Beni State (Departamento del Beni).

This report contains the basic conception, basic building design, construction plan and appraisal of, and problems connected with, the basic plan based on an investigation of the present conditions in Trinidad and the surrounding area. Various additional details and data are added in the Additional Data Section.


MAPA
DE LA
REPÚBLICA DE BOLIVIA
PUBLICADO DURANTE LA PRESIDENCIA CONSTITUCIONAL DEL
Dr. Hernán Siles Zuazo
1956
TRINIDAD
LA PAZ
COCHABAMBA
SANTA CRUZ
SUCRE
REFERENCIAS
ARGENTINA

CHAPTER 2 PROJECT AREA

CHAPTER 2 PROJECT AREA

2-1 Brief Descriptions of Bolivia and Trinidad

(1) Brief Description of Bolivia

Bolivia is a land-locked country in the western region of the South American continent, between 10 degrees and 23 degrees south latitude and between 57 degrees and 69 degrees west longitude. Bolivia has a total area of 1,090,000 square kilometers (three times as large as Japan), about one-third of which is made up of highland valleys (the huge highlands of Altiplano) and about two-thirds of which consists of lowland plains. The highlands are arid and cool, whereas the lowlands are tropical or subtropical. Bolivia has a population of 5,570,000 (about 1/20 of Japan's population) of which Indians of Aymara and Quechua extraction account for 55%, mestizos 30% and Spaniards and other whites 15%. The age composition is pyramidal, young people forming the majority of the population. Of the total population, 20-year-olds and younger comprise 50%.

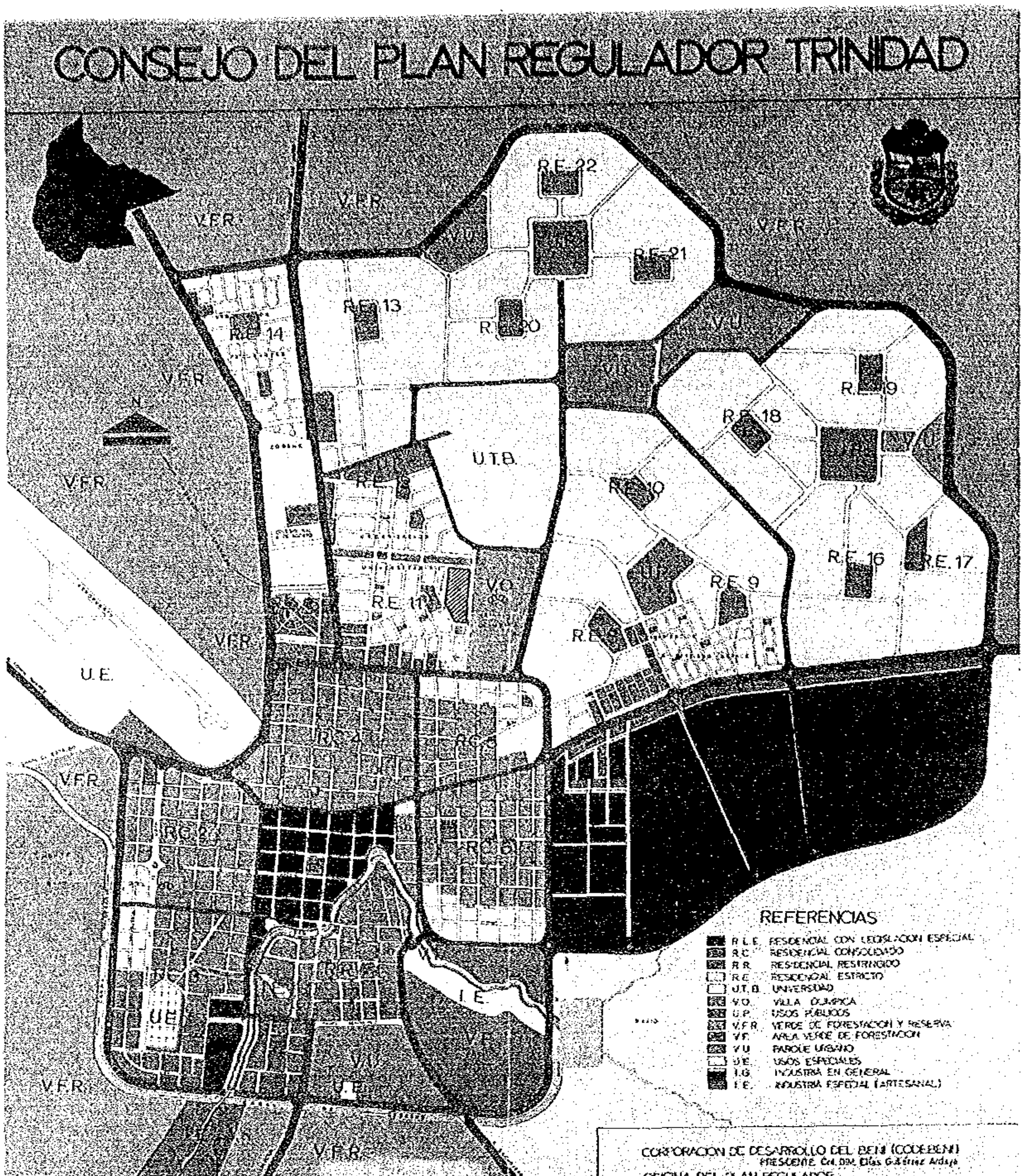
With abundant resources and an agricultural base, the economic structure is moving towards stability. Exports which support the economy include tin and other minerals, oil and natural gas. Almost all industrial products, clothing and other commodities are imported.

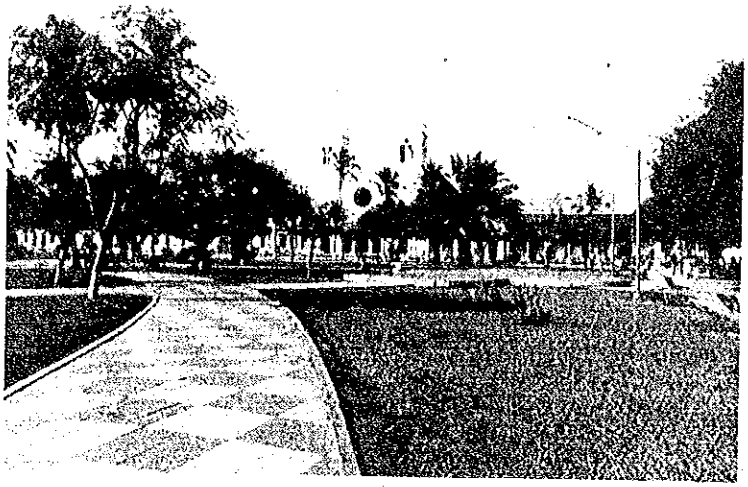
Transport facilities including railways and expressways are relatively well developed in the highlands. In the swampy lowlands situated along the upper reaches of the Amazon, there are no railways at all, and few roads have been developed. Instead, cargoes are transported by river boat, but no modern port and harbor facilities are available.

Domestic air routes are well developed. There are more than three regular flights a day linking such major cities as La Paz, Cochabamba and Santa Cruz; other provincial cities are connected by three or four flights a week. International airports are situated in La Paz and Santa Cruz.

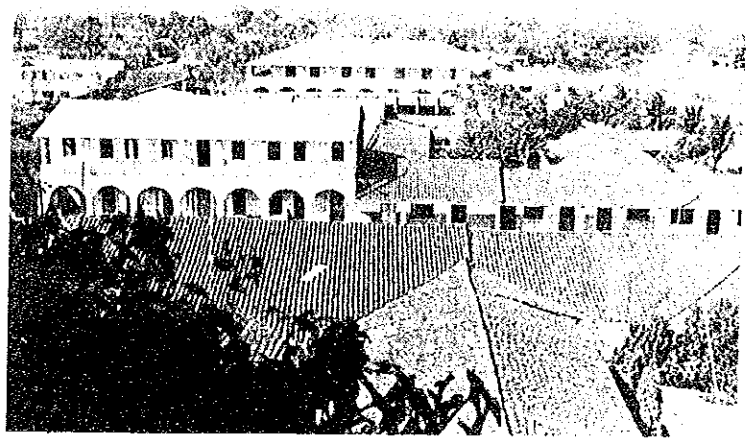
(2) Brief Description of Trinidad

Trinidad is the capital of the state of Beni which occupies the northeastern section of Bolivia. The population of the state of Beni is about 200,000 and Trinidad has a population of about 32,000. It is situated 230 meters above sea level at latitude 14 degrees 45 minutes south and longitude 64 degrees 48 minutes west and is developed along the Mamoré River, a tributary of the Amazon, producing 70% of Bolivia's beef cattle.

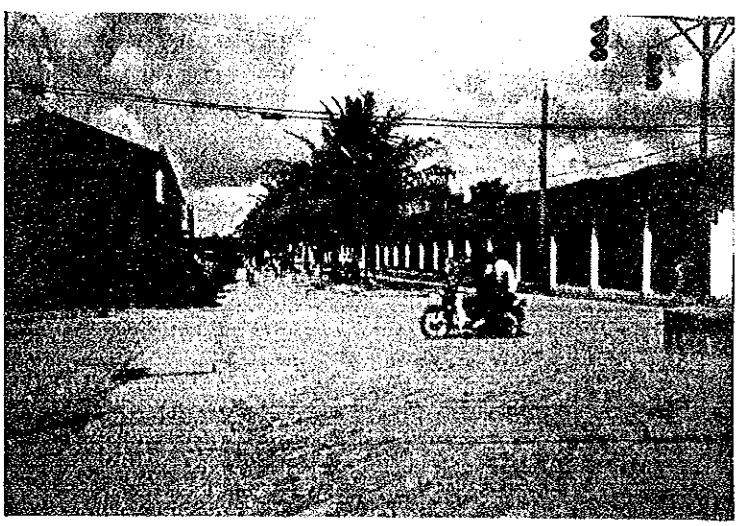

CONSEJO DEL PLAN REGULADOR TRINIDAD
R.E. 22
V.F.R.
R.E. 21
R.E. 13
R.E. 14
V.U.
R.E. 18
U.T.B.
R.E. 16
R.E. 17
R.E. 9
U.E.
V.O.
I.E.
REFERENCIAS
R.L.E. RESIDENCIAL CON LEGISLACION ESPECIAL
R.C. RESIDENCIAL CONSOLIDADO
R.R. RESIDENCIAL RESTRINGIDO
R.E. RESIDENCIAL ESTRICTO
U.T.B. UNIVERSIDAD
V.O. VILLA OLIMPICA
U.P. USOS PUBLICOS
V.F.R. VERDE DE FORESTACION Y RESERVA
V.F. AREA VERDE DE FORESTACION
V.U. PARQUE URBANO
U.E. USOS ESPECIALES
I.G. INDUSTRIA EN GENERAL
I.E. INDUSTRIA ESPECIAL (ARTESANAL)
CORPORACION DE DESARROLLO DEL BENI (CODEBENI)
OFICINA DEL PLAN REGULADOR



Central Plaza in Trinidad



General View of the City of Trinidad



View of the urban area in Trinidad

a) Situation of the Urban Area

The section which is enclosed within a loop road (circunvalacion), of about 1.5 km on each of four sides, forms an urban area, in which there are still many unused plots. As the urban area is frequently flooded in the rainy season, the foundation of the loop road is raised and the canal running into the city is equipped with floodgates to prevent floods in the rainy season. Existing city plans call for an extension of the urban area towards the northeast of the city, where the ground level is comparatively high and which is immune from flooding.

b) Traffic Situation

The city is so small that no mass transit system is available and only a limited number of taxis are in operation. Many motorcycles carrying passengers on their pillion seats are seen serving as "taxis".

For transportation from outside the city, jeeps and trucks are used in the dry season; river boats are used both in the dry and rainy seasons.

The runways at the airport are paved, enabling aircraft of the size of Boeing 727s to land and take off. In fact, aircraft have turned out to be an important means of transport of both personnel and commodities.

c) Climate

The annual mean temperature of Trinidad is 26.3 degrees centigrade. There is no significant difference in temperature throughout the year, as the maximum mean monthly temperature is 27.9 degrees centigrade in November and the minimum mean monthly temperature is 23.1 degrees centigrade in July. The mean annual rainfall of the city is registered at 1,770 mm which is much greater than in other parts of Bolivia. The rainy season starts in or about November and lasts for about half a year; the dry season extends from May to October. There is a great difference in rainfall between the dry and the rainy seasons. The monthly rainfall reaches a maximum of 307 mm in January and a minimum of 37 mm in August.

The climate of Trinidad is thus characterized by little temperature variation throughout the year but great variation in rainfall.

Northwinds and northwestwinds prevail for 85% of the year, southeastwinds for 11% and southwinds for 4%. The southwinds are especially cold as they blow directly from the polar region, and the temperature accordingly drops considerably.

Detailed climatic data are given in the following table.

	Jun.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1. Wind direction	NW	NW	NW	SE	NW	NE	NE	NW	NW	NW	NW	NW	NW
2. Wind velocity (m)	3.8	3.4	3.1	2.9	2.9	3.0	3.2	3.7	4.1	4.0	3.8	3.7	3.4
3. Days with windspeed greater than 10m	5.2	3.5	2.9	2.8	2.4	2.5	3.4	6.3	7.2	7.4	6.7	5.3	55.6/12
4. Number of days of rainfall per month	15.9	14.3	12.2	8.2	6.5	4.7	3.0	3.5	5.5	7.9	9.9	14.2	105.8/12
5. Number of days with more than 0.25 mm rainfall	15.8	14.2	12.0	8.1	6.4	4.5	2.9	3.4	5.3	7.8	9.7	13.0	103.1/12
6. Monthly rainfall	307.4	268.0	201.6	119.4	86.0	61.1	43.8	37.1	86.8	124.4	184.5	250.6	1,770.7/12
7. Atmospheric pressure	992.3	992.4	992.8	994.2	995.5	996.5	997.1	995.9	994.3	992.9	991.7	991.4	993.9
8. Mean temperature	27.2	27.1	27.2	26.5	25.2	23.9	23.1	25.7	27.4	27.8	27.9	27.6	26.3
9. Monthly mean of daily maximum temperature	31.2	30.8	31.0	30.6	29.3	28.6	29.6	31.0	32.5	32.5	32.1	31.5	30.8
10. Monthly mean of daily minimum temperature	22.0	22.2	21.9	20.7	18.7	16.8	16.1	16.8	18.8	20.7	21.2	21.7	19.8
11. Monthly maximum temperature	34.7	34.2	34.4	34.4	33.6	33.3	34.0	35.6	37.4	37.0	36.2	35.5	35.0
12. Monthly minimum temperature	19.2	19.2	17.4	15.7	12.6	10.2	9.6	10.5	12.3	14.8	16.9	17.6	14.6

One aspect of the climate of Trinidad is that rainy days are concentrated in the rainy season and during this period the water level of the surrounding swamps rises significantly. Topographically, the Beni state, in which Trinidad is situated, is linked to the Andean mountains in the west, south-west and south, and it is surrounded by mountains 3,000 m above sea level. It is also partly hemmed in by the foothills of the Parecis mountains along the border with Brazil to the east. Because of these topographical features, the rain which falls in the mountains and plateaus in the rainy season runs down to the flowlands around Trinidad in the south of the Beni state. The water level of the Mamoré river which passes close to Trinidad frequently rises 15-20 m, flooding the city.

2-2 Conditions of Local Medical Care

(1) Present Situation of Maternity Care

In Beni state, the capital of which is Trinidad, the infant mortality is high. In 1976 the mortality rate for infants of 1 year old or less was 111 per 1,000 birth; 168 out of 1,000 newborns die before the age of five. (Note 1)

The principal causes of death of patients at the Trinidad Hospital de Niños in 1978-79 were:

① Enteritis and diarrheal diseases,

② Pneumonias and other respiratory diseases, and

③ Measles.

Causes of death common to areas with poor sanitary conditions and poorly developed preventive medicine are prevelant.

The maternity death is recorded as 23 per 10,000 births (Note 2). Some physicians estimate that the mortality should potentially be much higher. Generally, there seems to be a lack of positive administration for public health, prenatal and postnatal medical care and medical care for children.

(Note 1) Infant mortality in Japan (per 1,000 births)

1935	107
1978	8.4

(Note 2) Maternity death in Japan (per 10,000 births)

1978	2.2

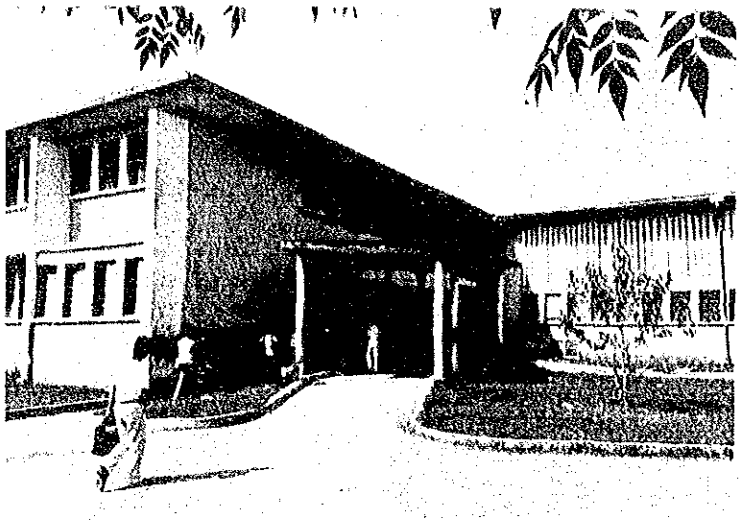
There are two hospitals in Trinidad; the Hospital de Clinicas German Busch and the Hospital de Niños with 80 and 36 beds, respectively.

About 3,700 outpatients annually are accepted by the Hospital de Clinicas German Busch and about 7,000 by the Hospital de Niños (1980).

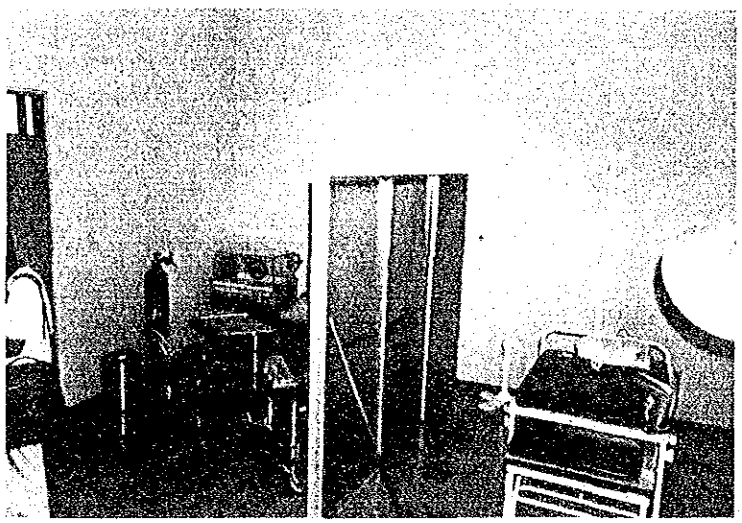
Also there are about 4,000 inpatients annually at the Hospital de Clinicas German Busch and about 1,100 at the Hospital de Niños (1980).

There are two other medical institutions in the city; the Unidad Sanitaria and the Centro de Salud. They are institutions for public health where only outpatients with minor diseases are treated.

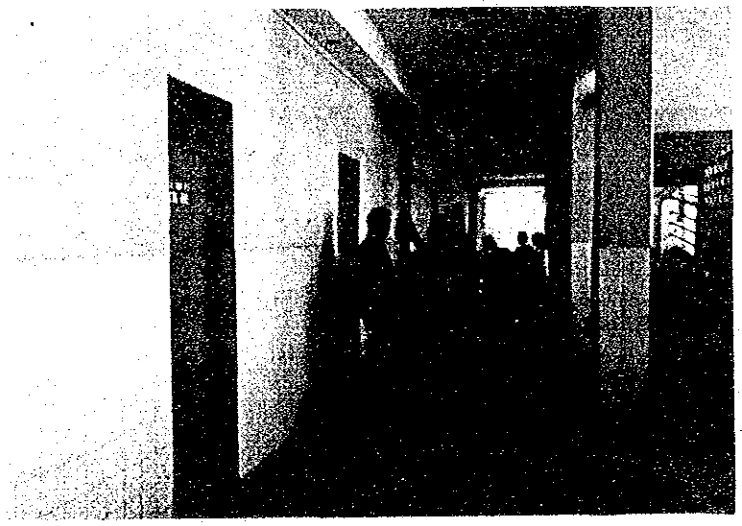
Trinidad has a total of 51 doctors, six qualified nurses, 51 assistant nurses and some medical technicians and auxiliaries.



General Hospital "German Busch" in Trinidad

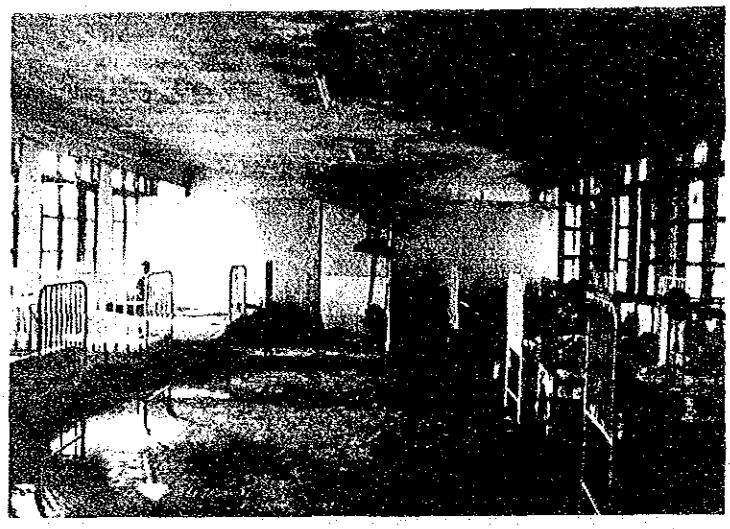


Delivery Room in the General Hospital, Trinidad

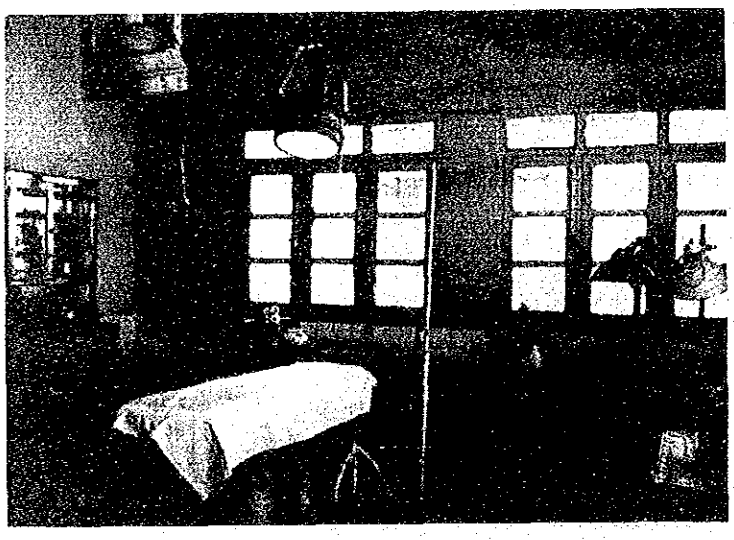


Interior View of the General Hospital, Trinidad

Children's Hospital
"Hospital de Niños"
in Trinidad



Ward in the Children's
Hospital, Trinidad



Operation Room in the
Children's Hospital,
Trinidad

One characteristic aspect of the hospital management is that very few doctors work full-day shifts but many work half-day shifts due to a budgetary limit set by the Ministry of Public Health. There is a significant lack of qualified nurses.

(Detailed data on local medical care are given in the Additional Data Section.)

(2) Present Situation of Existing Medical Care Facilities

In Trinidad, there are four institutions offering medical care; the Unidad Sanitaria of the Ministry of Public Health, Hospital de Clinicas German Busch, Hospital de Niños and Centro de Salud. During the latest visit, the Department of Gynecology and Obstetrics at the Hospital de Clinicas German Busch, Hospital de Niños and Centro de Salud were checked.

The Hospital de Clinicas German Busch is housed in a two-storied building which was completed about 5 years ago after more than 10 years of construction. Due presumably to poor maintenance, the building is already in a state of dilapidation, including rusty steel components, dirty walls, and torn and worn floors and medical equipment.

The Hospital de Niños was opened about 10 years ago, but it has already become insanitary. Because no action has been taken to maintain rooms free of moisture, some walls and ceilings are musty and several floors are dirty. Because no action has been taken against flooding some ceiling boards are apart. Particularly since these conditions have existed for a long time, it is considered that the hospital building is beyond repair. For this reason, there has been a drop in the number of inpatients receiving treatment or hoping to be hospitalized (the bed occupancy rate was 40.9% in 1980), and the number of outpatients has increased.

The Centro de Salud is situated in a convenient, urban area and housed in one part of a building in the area. Partly because it does not have its own building, the maintenance is just as poor as that of the Hospital de Niños. There are many signs of the aftermath of heavy rains and flooding.

2-3 Proposed Construction Site

(1) Selection of the Site

The Bolivian side prepared two possible construction sites and a briefing was carried out by the Minister of Public Health and other officials. Immediately after its arrival in Trinidad, the survey team visited both sites and were briefed by the State Governor, Municipal Mayor and President of the local Medical Association.

Site Ⓐ with an area of about 17,000 m^2 and Site Ⓑ with an area of about 10,000 m^2 were studied and details of assessment and problems were analyzed. As a result, the survey team concluded that Site Ⓐ was preferable, and a report to this effect was filed with the Minister of Public Health, officials of the Ministry of Public Health and local officials. All parties concerned agreed that the selection was a reasonable one.

The survey team compared Sites Ⓐ and Ⓑ and reached the following conclusions.

1. Site Ⓐ is sufficiently large to permit future hospital expansion.

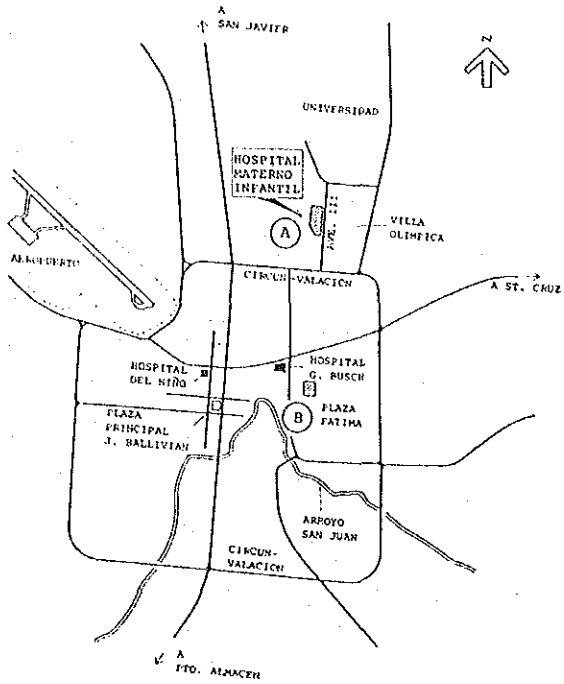
2. Site Ⓐ will permit easier maintenance of the hospital environment.

3. Because of the existing conditions of the sewers and drains, the hospital's environs may be accidentally polluted. It is therefore desirable that no dwellings should be adjacent to the hospital.

4. The period in which Site Ⓐ might be flooded is shorter, because the level of the surrounding roads is comparatively high.

5. The construction of a hospital (or some other public facility) at Site Ⓐ would enable it to serve as an important center for the execution of city planning.

6. Because of its location, Site Ⓑ could serve the local community better as a public park than as a hospital.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CIRCUN-VALACION
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HOSPITAL G. BUSCH
B
PLAZA FATIMA
PLAZA PRINCIPAL J. BALLIVIAN
ARROYO SAN JUAN
CIRCUN-VALACION
A PTO. ALMACEN

Site (A)

Site (B)

(2) Construction Site

a) Outline of the Construction Site

The proposed construction site of the hospital is in the northern section of Trinidad and faces Avenida III which extends out-ward from the Circunvalacion (loop road). The construction site has an area of about 17,000 m^2.

Owned by the city of Trinidad, this site has been kept for the construction of a hospital in the city planning zone.

The site measures about 220 m from north to south and about 80 m from east to west.

The city plan prepared by the City Planning Bureau (Consejo del Plan Regulador) calls for the construction of roads around the site and the development of a public park to the south, sport facilities (Villa Olympica) to the east, a university campus to the north and a housing project to the west.

At present, there is a simple road on the eastern side of the site; in other sections, there are no clear demarcation lines.

The site and its surrounding area are of uniform elevation. To prevent flooding of the site in the rainy season, it is necessary to raise the level of the site.

The site remains in a natural state. The site is dotted with palmeras (palm trees) and arbols latifoliados (broad-leaved trees), about 5-8 m tall.

b) Ground Conditions of the Site

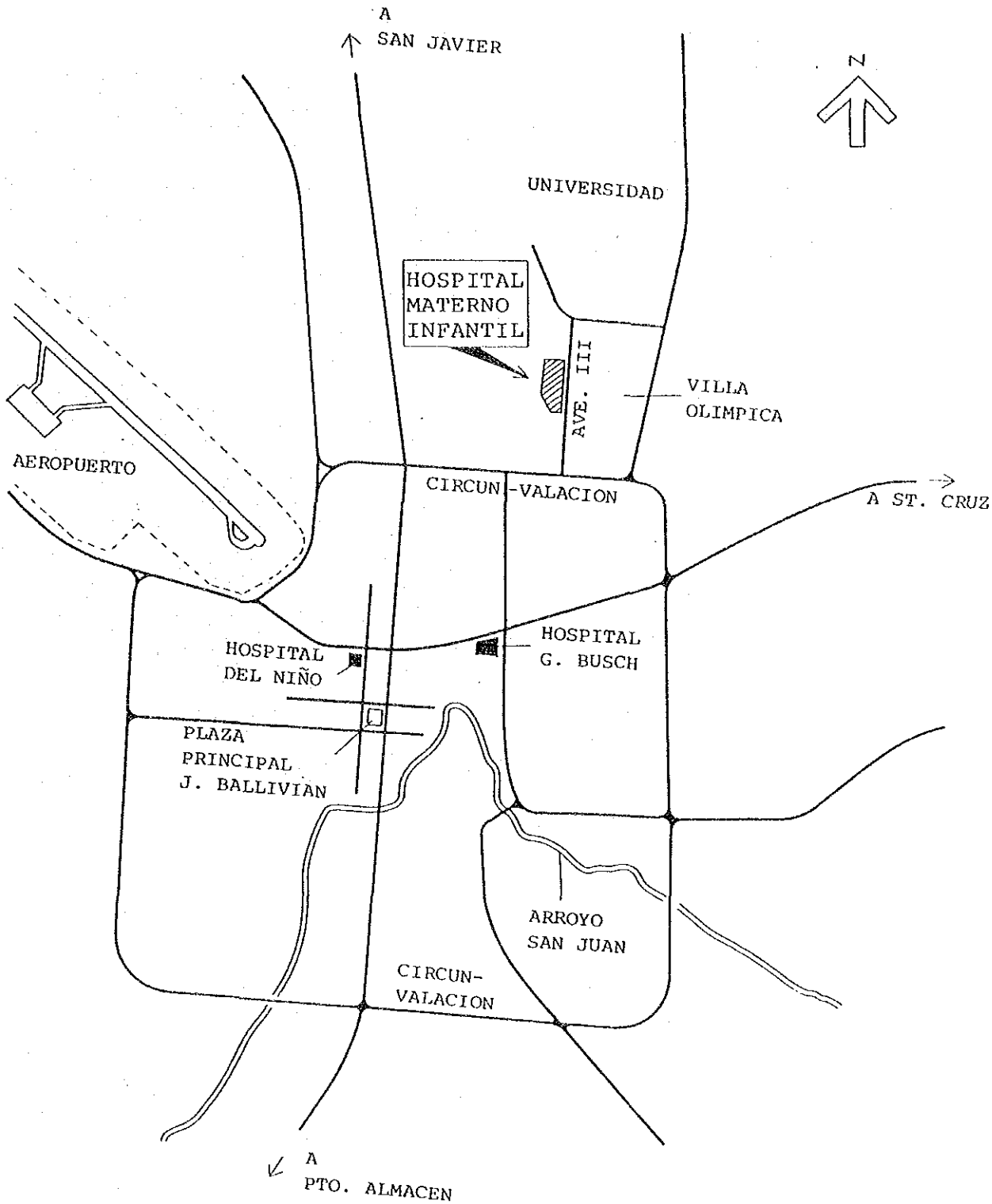
In order to provide information on the ground conditions of the proposed construction site, test pits about two meters deep were dug at the center of the site during the survey period. Moreover, a surveyor in La Paz was asked to carry out a detailed survey.

The survey results indicate that the surface layer extending to a depth of about 40 cm comprises soft, dark brown organic soil laying above blackish, organic clay from 40-60 cm. Below that there are layers of clay, containing organic clay, from 60-90 cm and yellowish, firm clay, below 90 cm. These clay layers have been formed from very fine grained soil washed from the Andean mountains into the Mamoré basin.

The surface permeability of the site is poor and dust is stirred up in the dry season. Once it has absorbed water, the soil becomes soft and liquid.

The bearing capacity of the soil is estimated to be 8-10 tons/m^2 in the firm clay layer at a depth of about 90 cm.

(The detailed findings of the ground survey are given in the Additional Data Section.)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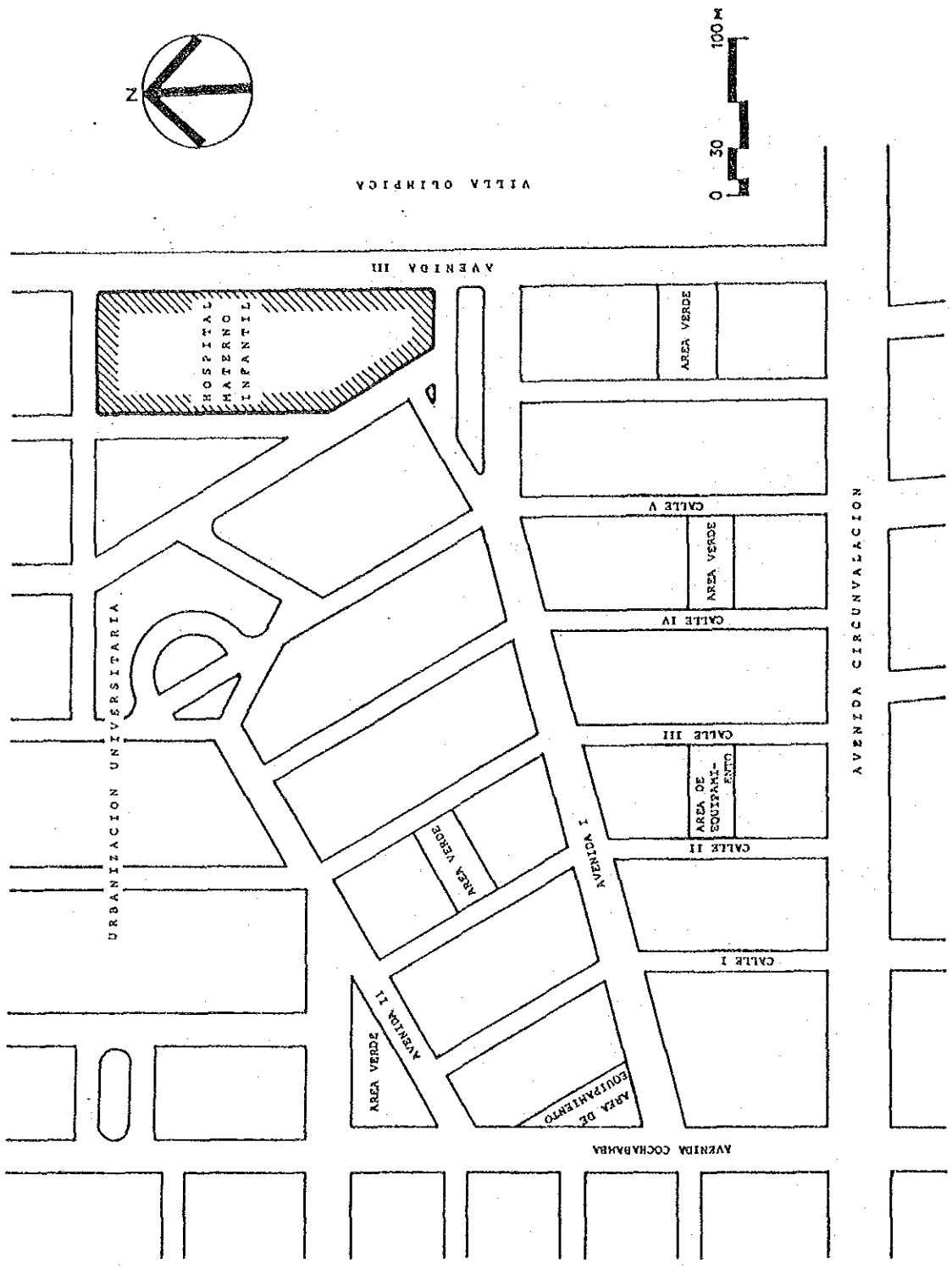
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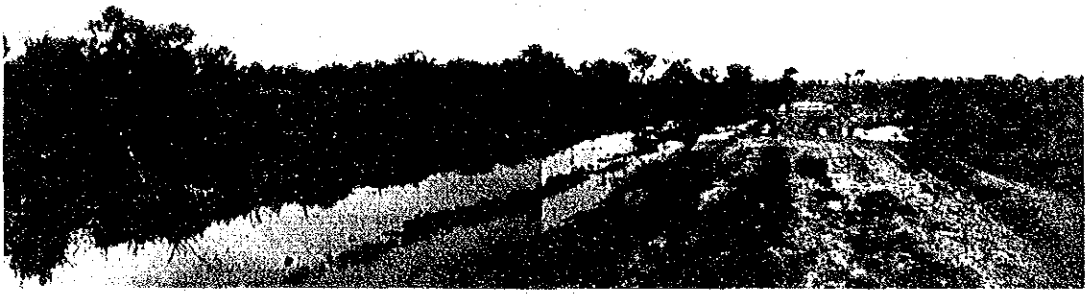
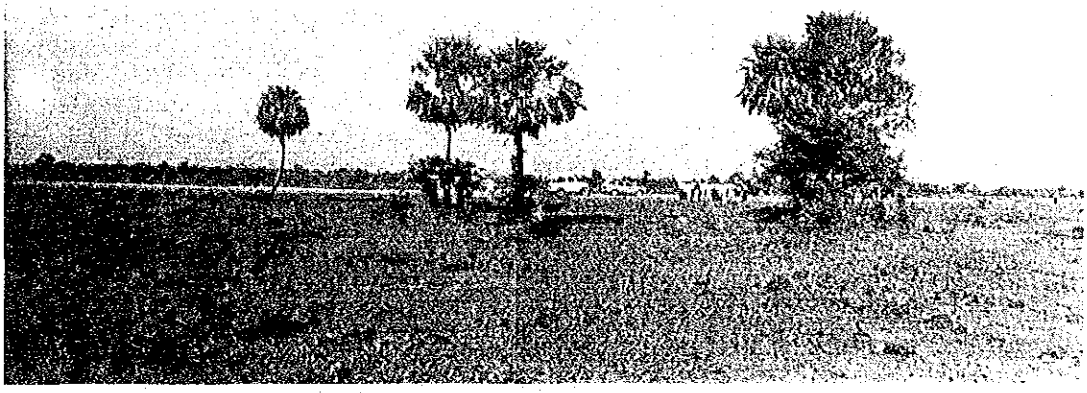


View of the Site (looking from Avenida III)



View of the Site (looking eastward)

(3) Infrastructure

a) Water Supply

Water supply is provided by the Municipal Water Bureau (Corpaguas). Water is obtained from several wells, 100 meters deep, in the city. Water is pumped and piped for supply. The water quality is good as indicated in the Table of Water Quality Tests given in the Additional Data Section. In areas with no public water supply, each household has its own shallow well. Water in the shallow wells is not drinkable as it is mixed with foul water from the sewer systems.

Water could be supplied to the proposed construction site from a nearby deep well of the Municipal Water Board. Water could be piped from a main in front of the site. It would be possible to supply adequate quantities of water to the hospital.

b) Foul and Waste Water

No public sewage treatment plants exist. Each household disposes of its own foul water from its toilet and kitchen. Foul water is held temporarily in a simplified purification tank. After solid substances have been precipitated and removed, a percolation well 7-10 m deep is used to percolate foul water downward through the soil. The capacity of this type of system is sufficient for a small family. However in the case of the extensive drainage and treatment requirements of a hospital and other large institutions, foul water cannot be percolated downward and the resultant overflow creates a very insanitary condition. In the case of this hospital a system other than such a percolation well system is required.

c) Rainwater Drainage

Rainwater is invariably discharged into the ditches adjacent to the roads. The side ditches are linked to a canal in the south of the city or to swampy lowlands on the edge of the city. From the proposed site, rainwater may be discharged into the frontal road.

d) Gas

No city gas facilities are available and propane gas cylinders are used in all cases. Propane gas is supplied by YPFB, a public oil corporation. It is supplied from Santa Cruz and Cochabamba by river boat and truck, and its supply is stable.

e) Electric Power

Electric power is supplied by the Cooperativo de Servico Electrico Trinida Ltda., a private electric power company. An electric power generation plant is situated on the western outskirts of the city. The plant is equipped with a diesel generator with a

total capacity of 3,340 kW. As the generator frequently breaks down and requires maintenance, the average output is low and is only one-third of capacity on average (1,100 kW). Because of this chronic shortage of electric power, the city is divided into four blocs and the power supply is suspended on two days for each bloc from 6 to 9 p.m.

To eliminate the shortage of electric power, the ENDE, a national electric power corporation, plans to supplement the facilities and raise capacity to 6,400 kW by the end of 1983. Should this capacity be attained, it would be possible to supply electric power to the hospital.

The distribution voltage of the city is 6,600 V for major consumers and 380 V and 220 V for minor consumers. Electric power is supplied by an overhead system of wires suspension from poles.

To the construction site, electric power could be supplied from an overhead wire three-phase, three-wire system of 6,600 V 50 Hz.

f) Oil

Gasoline, kerosene, etc., are produced at refineries of YPFB, a public oil corporation, in Cochabamba and Santa Cruz and transported to Trinidad.

Oil products are transported by river boat and truck in 200 litre drums.

Propane gas, electricity and oil are compared in the following table in terms of energy cost.

Type	Unit	Price (Peso)
Propane gas	Per 10 kg cylinder	50 Pesos
Electric power	1 kwH	4.5 Pesos (For minor consumers) 3.2 Pesos (For major consumers)
Gasoline	1 ℓ	6 Pesos
Diesel oil	1 ℓ	5 Pesos
Kerosene	1 ℓ	5 Pesos

g) Telephone Service

The telephone service is managed by the Cooperativo de Telefonos Automaticos Trinidad Ltda., a telephone company of a cooperative type sustained by subscribers. All telephones in the city use a dial system.

The telephone firm presently has 800 circuits. Construction is in progress to increase the number of circuits to 3,000 by the end of 1981. Telephone wires could be stretched from a telephone pole on the frontal road to the construction site. The necessary number of circuits could be fully obtained.

1. Costs of Telephone Installation

Subscription fee:	30,000 pesos/circuit
Construction cost:	3,000 pesos/circuit

2. Fees for Use (Fixed Amounts)

General	267.02 pesos/month/circuit
Commercial	463.06 pesos/month/circuit
Exclusive	361.50 pesos/month/circuit

Note: When the proposed 3,000 circuits are completed, the basic charge and the call rate will be changed.

h) Roads

The roads in the center of the city are paved with brick because it is difficult to obtain asphalt, gravel and cement. Bricks for the pavement of roads are locally produced. On both sides of each road, there are ditches, which serve for drainage of rainwater. The suburban roads are unpaved. After rain, the roads get slushy, allowing only the passage of jeeps and trucks. Bridges cross the city's canals, but there are no bridges over rivers within the city forcing vehicles to cross the rivers by ferry.

For the proposed construction site, one road runs along its eastern side. This road is unpaved and is 25 m wide. When the hospital is completed, the frontal road will be paved, and roads will be completed around the site.

(4) Disasters

a) Flood Damage

Floods are a major disaster for Trinidad, since there is heavy rain in the rainy season, the ditches do not drain well and Trinidad is situated in a plain. Flood damage is not sufficiently severe as to wash away houses but nevertheless damage results from water flooding into houses or over roads.

Apart from this direct flood damage, damage caused by high humidity in the rainy season materializes in the form of mold on the walls and ceilings of buildings and dew on their floors and walls.

b) Wind Damage

The wind velocity is not as high as in Japan. No buildings in the city are equipped with any specific protective measures against winds. Winds of more than 10 m/sec blow are relatively rare. The wind direction is mainly northwesterly.

c) Earthquakes

No earthquakes have ever been registered.

d) Fire Damage

No fires have ever been registered. This is because no combustible building materials are used for dwellings, etc., and there is no need to use any heating system in a climate with relatively high temperature and humidity.

e) Damage from Dust

In the dry season, dust is created by automotive traffic at times but no significant damage is caused. In everyday life, there is a need to prevent the inside of buildings from being damaged by sandstorms

f) Lightning

Lightning is relatively frequent. Electric power is often suspended due to lightning.

g) Damage by Animals and Insects

There are many flies, mosquitos, moths, and other insects and therefore the use of screen windows is necessary. Rats, bats, etc., frequently inhabit attics.

2-4 Local Construction Conditions

(1) Situation of Building Materials

a) Building Materials in Bolivia

Bolivia has to import all important materials for modern construction, including aluminum materials, PVC materials, machinery, facilities and various equipment. The building materials produced domestically include cement, lumber, bricks and tiles, terrazzo blocks, slates and other cement and asbestos goods, aluminum sashes and other processed metal goods, vinyl pipes and other processed PVC goods and sheet glass. As industrialization has progressed in recent years, there has been a rise in the share of domestic products used as building materials.

b) Building Materials in Trinidad

The availability of building materials in Trinidad is extremely limited. Materials which are available in the city and nearby include only bricks, terrazzo blocks and wooden items. In the rainy season, even their supply is sometimes suspended as no means of transport are available. Since the quality of sand for cement is poor and no gravel is available at all, bricks are crushed and used instead. The demand for building materials for houses is so msall that other building materials are sold in small quantities. The prices are very high. For the construction of a modern building in Trinidad, it is necessary to transport most of the building materials from other areas.

(2) Local Construction Methods in Trinidad

a) Temporary Construction

In general, the construction sites are large and it is normal practice to build one-storied houses, so that neither hoardings nor scaffolding are required. The scaffolds, frames, temporary poles and other temporary building materials used in the city are invariably wooden.

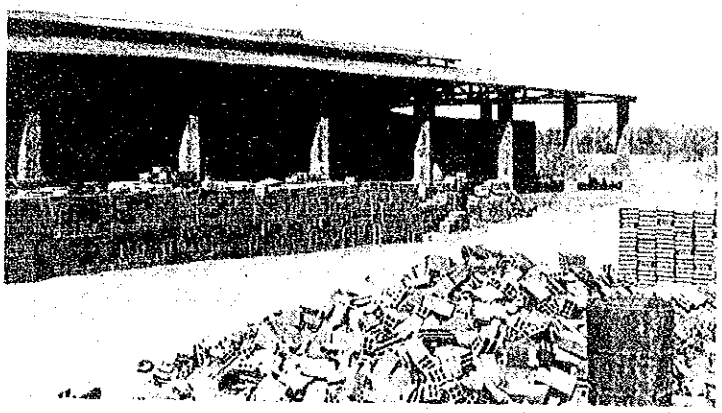
b) Earthwork

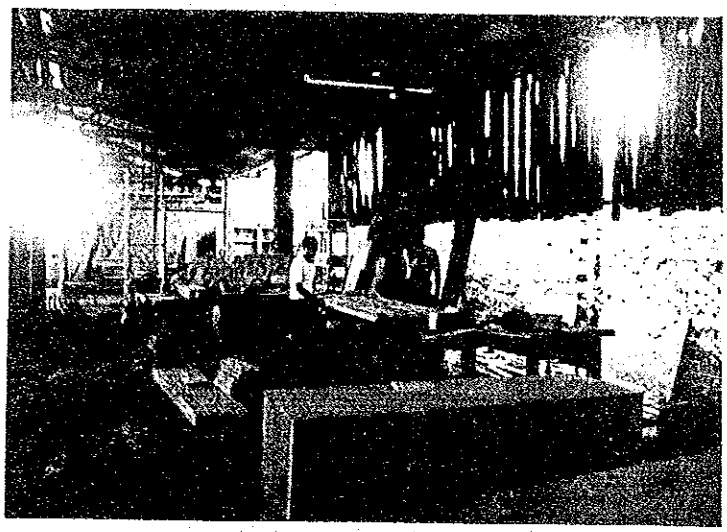
Excavation is done manually. They are done so without landslide protection walls because the ground is very firm clay. As the ditches do not drain well, drainage is necessary when it rains while excavation work is carried out.

c) Building Construction

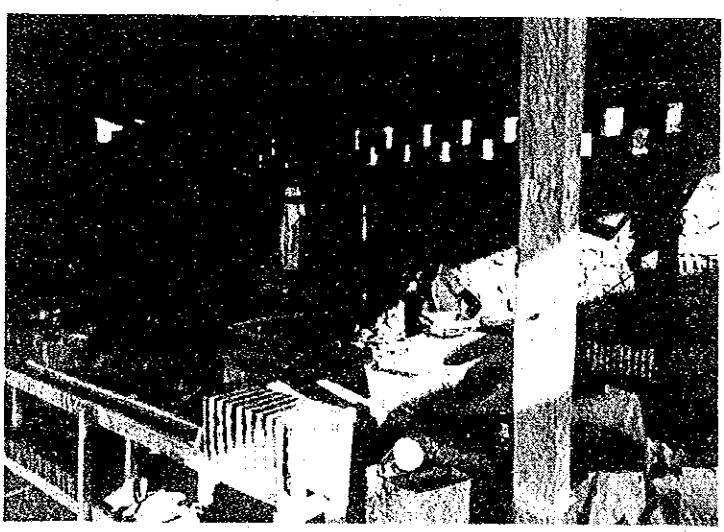
Except for a bank building under construction in the center of the city the walls of usual buildings were built with hollow bricks.

Brick Factory in the suburbs of Trinidad





Woodcraft work-shop in Trinidad



Terrazo block factory in Trinidad

For the construction of the floor slabs on the second story, specially shaped hollow bricks are joined with reinforcing rods to make slabs with small quantities of mortar. The walls made with hollow bricks are finished with mortar in many cases.

d) Finishing Work

① Interior Finishing

Floors: Normally, the floors are finished with terrazzo or colored concrete blocks. Wooden floors are not used due to the high humidity in the rainy season.

Walls: The hollow-brick walls are finished by plastering them with mortar.

Ceilings: Wooden frames are put together, wire nets stretched and then they are finished with plaster. A mixture of earth and grass stems in spread over the wire nets to act as heat insulation. In this aspect, this construction method works, but on the other hand, much moisture is absorbed, creating an exceedingly insanitary condition.

② Exterior Finishing

External walls: The most common practice is to stack hollow bricks one on top of another, grout them with mortar and finish them with paint.

Windows: It is a common practice to use wooden sashes. Wire nets are always built in. Recently, aluminum sashes have come into use.

Roofs: Spanish tiles are used. For the base, bamboo-like rattan is spread over the roof-top and then the tiles are fixed with clay. In this construction method, bats and insects live in the space between tiles, creating an insanitary condition. Recently, Spanish tiles have been replaced by slates for some buildings.

e) Others

To cope with a landscape with high temperature and humidity, emphasis is put on ventilation in the construction of ordinary buildings. Wide spaces are set aside for external corridors and terraces, which are used for dining and other purposes. Window air-cooling machines are often used for the guest rooms of hotels and

the operation rooms of hospitals. Large ceiling fans are also often used. Recently, two bank buildings with full-central air-cooling systems have been constructed.

(3) Actual Situation of Local Construction Firms

As most of the dwellings constructed in Trinidad are one-storied, there are no construction firms whose scale of business is significantly large. Recently, six-storied modern buildings have been constructed for a bank and a hotel and a two-storied building has been built for a bank by construction firms from La Paz.

Six construction firms are registered with the Construction Association; the results of a spot check indicate that the following three firms are in operation.

1. EDECON: has done many jobs, such as hospitals, cinemas, schools, dwellings, etc.

2. LEDEZMA: is engaged primarily in the construction of roads.

3. MODURO: is engaged primarily in the construction of houses.

Of the workers engaged in construction work in Trinidad, about 80% are from Trinidad and 20% come from Cochabamba, Santa Cruz and other cities. Skilled work is done by craftsmen from other cities.

The construction machinery includes dump trucks, trucks and concrete mixers, etc. but their number is only adequate for the construction of small projects.

(4) Construction Periods in Trinidad

The construction periods in Trinidad are apparently somewhat longer than in La Paz and Cochabamba for the same size of construction work. It is revealed by a survey that it requires three years eight months to construct a six-storied RC building with a floor space of 6,000 m^2, two years to erect a two-storied RC building with a floor space of 4,000 m^2 and four years to build a one-storied, 30-room suburban hotel with brick. These construction periods are twice as long as is normally required in Japan. Such long construction periods are required presumably for the following reasons.

① Obtaining building materials is difficult as they have to be transported from other areas.

② Skilled workers have to be imported from other major cities.

③ In the rainy season, construction is limited and the traffic conditions deteriorate badly in some cases.

Given these factors, it is always necessary to plan for the climatic conditions of the rainy and dry seasons by formulating programs for materials transportation, personnel and construction procedures, etc., when construction work is to be carried out in Trinidad. Local construction firms recommend completion of the foundation, building and roof in the dry season, carrying out of interior construction work in the rainy season and finishing of remaining phases of work in the next dry season.

(5) Laws and Regulations Related to Construction and Technical Standards

a) Construction

Parcels of land and zones in Trinidad are regulated by the City Planning Department (Oficina de Plan Regulador) of the Beni State Development Bureau (Corde Beni). Zones are designated and the building-plot size ratio, offset of wall surface line from the site border, etc., are determined.

According to these regulations, the proposed construction site is in a residential zone, but it is understood that these regulations are being amended at present. As far as this hospital project is concerned, the policy of the government agencies is to respect the Japanese technical standards for building restrictions.

b) Structures

In respect to structure design, the only requirement is to present data on the soil bearing capacity; no other standards are in force. Structural engineers use the American ACI standards or the West German DIN standards.

For the structure design of this hospital, we have been assured by the Bolivian authorities that Japanese standards may be used.

c) Electric Facilities

Full provisions have yet to be developed for electric work. The local standards of the countries from which materials are imported are used. Mainly, the following standards are used.

- Norma Para Instalaciones Electricas of the Bolivian Ministry of Urban Housing.
- NEC (National Electric Co., Ltd.) and AWG (American Wire Gauge) in the United States.
- ABNT (Asosiacion Brazileas Normas Tecnicos) of Brazil.

d) Water Supply and Drainage Facilities

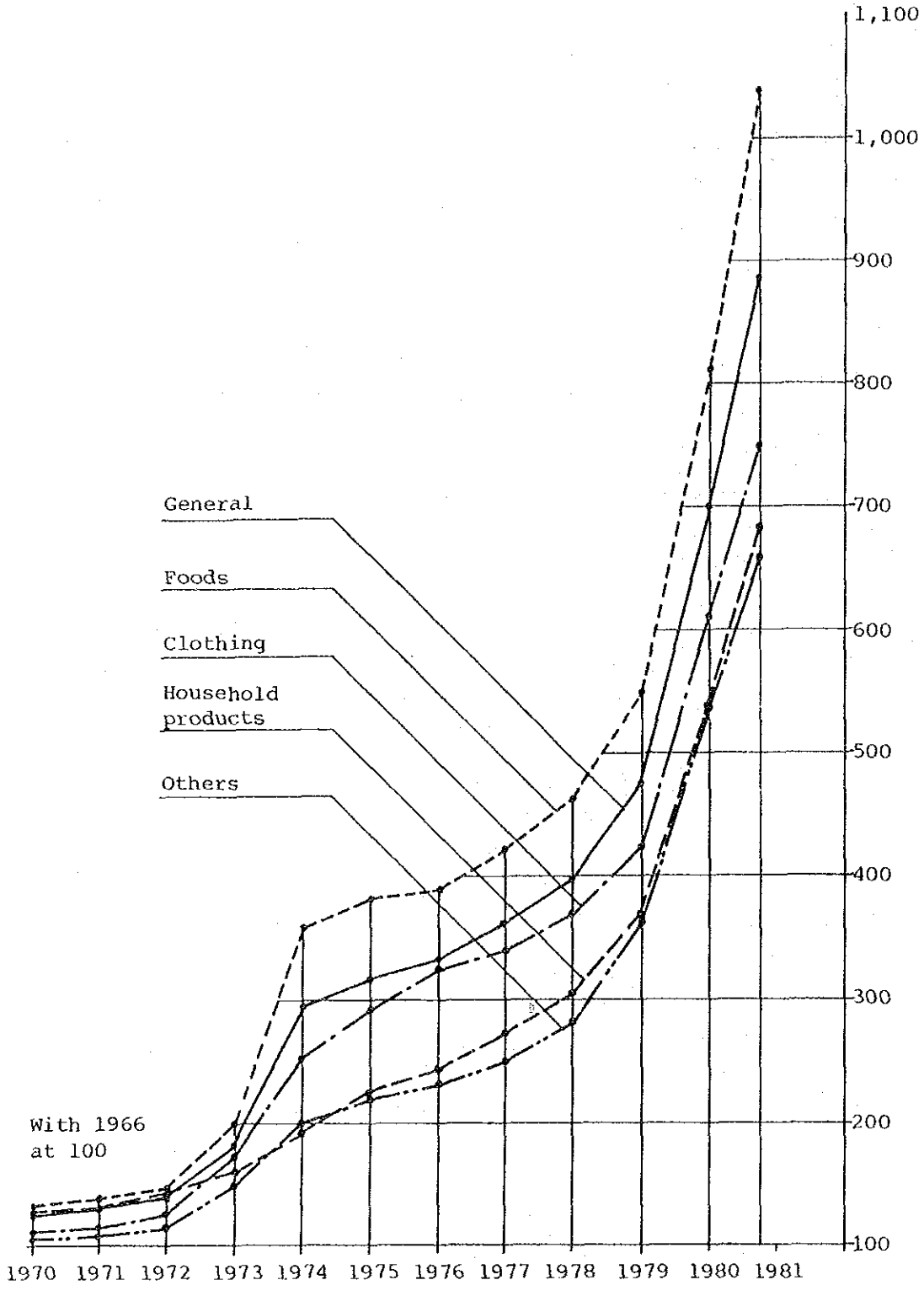
Water supply and drainage technique are determined by the Trinidad Water Bureau (Corpaguas). They are currently being revised and are seldom used at present. The policy of the Bolivian authorities is to respect Japanese technical standards.

2-5 Construction Cost

(1) Rate of Rise in Price

To recognize signs of a rise in price in Bolivia, the changes in the consumer price indices since 1970 as surveyed by the Instituto Nacional de Estadística in respect to ① general, ② foods, ③ household products, ④ clothing and ⑤ others are listed in the following table.

Category / Fiscal Year	Consumer Price Index (with 1966 at 100)				
	① General	② Foods	③ Household products	④ Clothing	⑤ Others
1970	124.53	133.09	125.21	109.23	106.96
'71	129.11	138.37	130.70	114.27	107.62
'72	137.51	147.20	138.05	124.58	113.82
'73	180.81	198.65	158.64	172.60	147.48
'74	294.43	360.98	193.89	252.10	199.73
'75	317.92	380.19	221.26	291.94	219.54
'76	322.20	389.35	242.31	324.01	228.86
'77	359.12	421.16	271.53	337.25	248.25
'78	396.32	463.42	302.23	367.17	280.74
'79	474.48	549.79	366.82	425.60	361.70
'80	698.63	811.45	542.48	607.23	540.85
'81 (Feb.)	883.49	1,037.41	685.90	750.29	659.67



Graph of Consumer Price Indices in Bolivia

The prices were stable in 1975-76 but showed signs of a rise in 1977. At the end of November, 1979, the Bolivian currency was devaluated by 25%, changing the exchange rate from 20.0 pesos to 24.51 pesos to US$1. After devaluation, the domestic price rises exceeded the margin of the devaluation, soaring to 47.2% in general in 1980. In February 1981, the prices were up 39% from the same month of the preceding year. The rates of rises in price from the previous years are shown in the following table.

Category / Fiscal Year	① General	② Foods	③ Household products	④ Clothing	⑤ Others
1975-1976	1.3	2.4	9.5	11.0	4.2
1976-1977	11.5	8.2	12.1	4.1	8.4
1977-1978	10.4	10.0	11.3	8.9	13.1
1978-1979	19.7	18.6	21.4	15.9	28.8
1979-1980	47.2	47.6	47.9	42.7	49.5
1980. Feb. -1981. Feb.	39.0	43.3	40.3	28.5	27.0

In recent years, the rise in prices has been conspicuous. Particularly in the last two years, the rate of price rise has remained in the order of 40%. Presumably, this is largely because the domestic political situation has been unstable since 1978, inflation is rampant in Brazil, Argentina, Peru and other neighboring countries and the Bolivian economy has been affected by fluctuations in the exchange rate to the U.S. dollar. Prices related to construction have also risen to the same degree as the above indices, and it is predicted that an annual rise of about 40% will continue for some time.

(2) Prices of Building Materials

ⓐ Prices of Building Materials in Major Cities

The prices of general building materials in a major city (Cochabamba) are shown below:

Name of material	Type	Unit	Mid-1981 (in pesos)	Mid-1977 (in pesos)
Cement	CEMENTO VIACHA 241103	50 kg	150.0	55.6
Reinforcing bars	Deformed 3/8"	kg	17.6	10.9
Reinforcing bars	Deformed 5/8"	kg	16.3	———
Glass	Transparent 3 mm	1 sq.ft.	27.0	10.0
PVC pipes	1/2"	m	6.7	———
PVC pipes	1"	m	18.3	———
Water closet	Low tank, high grade	1	2,550.0	1,250.0
Paint	Latex	4.5 ℓ	270.0	110.0

For other items, refer to the Additional Data Section.

ⓑ Prices of Building Materials Made in Trinidad

The prices of building materials produced in Trinidad are shown below.

Name of material	Type	Unit	Mid-1981 (in pesos)
Bricks	Hollow bricks (6-hole)	1	5.47
	21-hole bricks	1	5.09
	Paving bricks	1	6.65
	Hollow bricks for decoration	1	5.06
Terrazzo floors	Manually polished	m^2	500 - 600
	Color cement	m^2	300
Floor materials	Narrow wooden boards	m^2	420
Ceiling materials	Narrow wooden boards	m^2	300

Name of material	Type	Unit	Mid-1981 (in pesos)
Beam materials	2" × 6"	m	30
Doors	Wooden frames 0.9 × 20	1 set	1,920
Sewer pipes	2" × 75 cm	1 pcs	40
	4" × 75 cm	1 "	120
	8" × 75 cm	1 "	160

For other items, refer to the Additional Data Section.

(3) Labor Cost

ⓐ Wages for Labor

Labor wages are determined by the Beni State Development Bureau. Some typical ones are given below.

Line of work	Unit	Pesos
Manual excavation	m^3	100
Walling with hollow bricks	m^2	40
Building of poles with bricks, 25 cm square	m	50
Concrete	m^3	1,600
Tiling	m^2	140
Painting	m^2	14
Installation of hygienic utensils	1	400
Roofing with tiles	m^2	135

For other lines of work, refer to the Additional Data Section.

The average wages of construction workers in Bolivia are as follows:

	As of Aug., '81	As of Jun., '77
Foreman	200 pesos (a day)	80-90 pesos (a day)
Class I specialized worker	180	70
Class II specialized worker	150	60
Stone or brick layer (Mason)	125	50
Carpenter (framework)	125	50
1st class assistant	108	43
2nd class assistant	100	40
1st class misc. worker	95	38
2nd class misc. worker	90	35

The above figures are basic wages only and an employer must pay social security fees. A bonus equivalent to a month's pay is paid twice a year. An employer must assume an additional amount of 50-80% of the wages shown above, as direct personnel expenses.

It is obligatory to raise wages in conjunction with a rise in price in accordance with a Cabinet decision. On May 17, 1979, 500 pesos were added to the bonus. The wages were raised by 40% on November 30, 1980 and by 18% on July 2, 1981.

ⓑ Work Efficiencies

From statistics prepared by the Ministry of Urban Housing, data on work efficiencies and construction workers have been selected and indicated below.

Earthwork	One assistant class worker	2.5 hrs per 1 m^3 (soft soil)
Concrete placing	One specialized and one assistant	0.3 hrs per 1 m^3
Reinforcing bars	One specialized and one assistant	4 hrs per 1 m^3 (80 kg)
Formwork	One specialized and one assistant	1 day per 70 m^3 of concrete

Brick laying	One specialized and one assistant	2.2-2.9 hrs per 1 m^2 (12 cm thick)
Brick laying	One specialized and one assistant	3.4-4.1 hrs per 1 m^2 (25 cm thick)
Hollow brick laying	One specialized and one assistant	2.3-2.5 hrs per 1 m^2 (18 cm thick)
Hollow brick laying	One specialized and one assistant	2.5-2.7 hrs per 1 m^2 (25 cm thick)
Asphalt waterproofing	One specialized and one assistant	5 hrs per 1 m^2
Mortar grouting	One specialized and one assistant	0.5 hrs per 1 m^2
Laying of terrazzo blocks	One specialized and one assistant	3 hrs per 1 m^2
Flooring with parquets	One specialized and one assistant	3-3.1 hrs per 1 m^2
Painting	One specialized and one assistant	0.15 hrs per 1 m^2
Finishing of exterior wall	One specialized and one assistant	1.6-1.8 hrs per 1 m^2 (Caly Cemento)
Finishing interior	One specialized and one assistant	1 hr per 1 m^2 (Yeso)
Glass installation	One specialized and one assistant	0.2 hrs per 1 m^2 (window)

The work efficiencies shown above should be considered merely as standards.

(4) Construction Cost

Judging from the interviews the survey team had with local construction firms in Trinidad, La Paz, Cochabamba and other major cities, the unit construction costs of construction firms in Trinidad are broadly as follows:

US$600-800/$m^2$	General detached houses
US$700-850/$m^2$	Office buildings
US$800-1,000/$m^2$	Hotel and bank buildings

These figures are just a guide. There is no detailed description about the substance of buildings signified by the above prices, and their facilities and equipment. There are many other construction costs which may be relevant depending on prevailing practice. It appears that there are many costs a client would have to bear separately.

Practically every building material required in Trinidad is transported from other major cities. Therefore the share of the transport cost in the construction cost is high. It is necessary to recruit skilled technicians from Cochabamba, Santa Cruz and other cities, thus raising the outlays related to the personnel cost.

The construction cost of general buildings in Trinidad is apparently 40-70% higher than in La Paz and Cochabamba.

2-6 Transportation

(1) Domestic Transportation

Bricks are the only building materials available in Trinidad; other materials including even sand and gravel are brought in from other areas.

The following transportation routes are available for bringing building materials from the major cities of La Paz, Cochabamba and Santa Cruz. Considering the place of purchase of materials, the time and the safety of the cargo, there is a need to select the optimum transportation route.

a) Transportation from La Paz

There is no road usable for the transportation of materials between La Paz and Trinidad. The only means of transport available between La Paz and Trinidad is aircraft. The standard air freight cost is 6-10 pesos per kg or 800-1,500 pesos per m^3 when the cargo holds of B-727s are used. Super Hercules transports charge US$12,000 per plane (up to 90 m^3 or 14,000 kg).

When aircraft is used, the transportation period is unaffected. In the rainy season, however, the runway of Trinidad Airport is frequently flooded, resulting in a suspension of air traffic.

Apart from using aircraft, commodities may also be transported between La Paz and Trinidad via Cochabamba.

b) Transportation from Cochabamba

For transportation from Cochabamba, the Mamoré River is used. Puerto Villarroel, about 250 km east to Cochabamba, is a loading port for the Mamoré River. It takes 7-8 hours to get to this port from Cochabamba by truck, and about 60% of the road linking both cities is paved; no problems are posed for traffic in the rainy season.

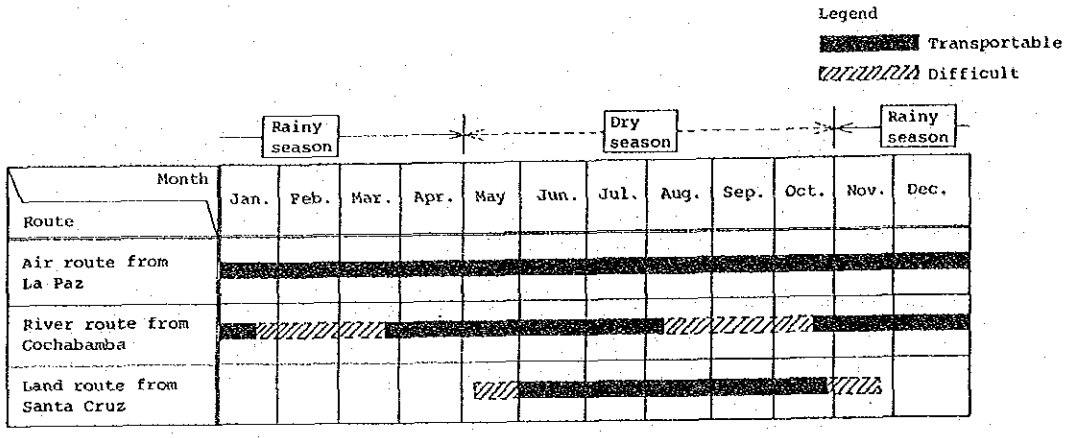
From Puerto Villarroel, river boats go down the Mamoré River (240 km as the crow flies) to Puerto Almacen adjacent to Trinidad. By river boat, it takes 4-5 days in the rainy season or 8-10 days in the dry season. The river is unnavigable at times as it sometimes rises in the rainy season and falls at the end of the dry season. The river boats' loading capacity is about 150 tons. The total transportation cost is US$64 per ton, including $25 for trucking from Cochabamba, $26 for transportation by river boat and $13 for trucking from the port to Trinidad.

At present, many of the building materials required for construction projects in Trinidad are transported through this route from Cochabamba.

c) Transportation from Santa Cruz

A simple road runs in the swampy lowland between Santa Cruz and Trinidad. In the dry season, 10-ton trucks are usable and it takes about 24 hours. This road, however, is unusable in the rainy season from early November to early May, as it is completely flooded. The period in which this road is usable as a supply route varies, depending on the weather conditions of a given year, but the road is roughly considered usable for five months from June to October. The transportation cost is US$90 per ton.

A comparison between the transportation routes and the transportation costs is shown below.



(2) Transportation from Japan

Building materials will be supplied from major cities in Bolivia. This section considers cases in which materials and equipment may need to be transported from Japan.

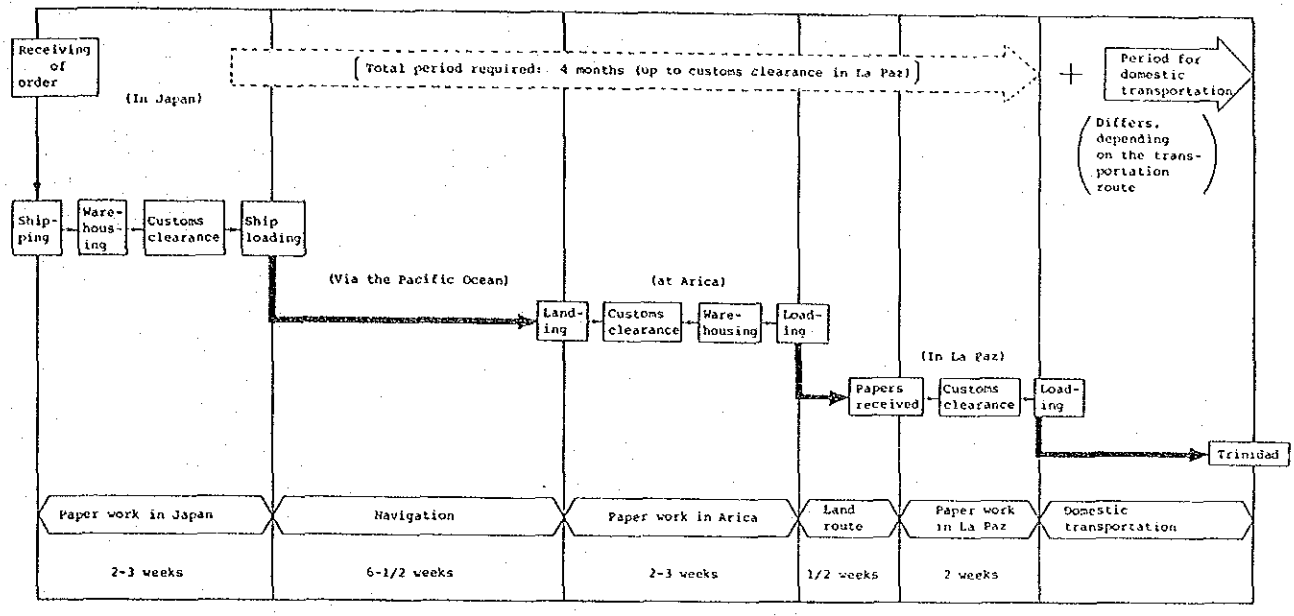
a) Transportation Method and Route

To transport building materials from Japan, a shipping service would be utilized (air freight could be used but is extremely expensive).

Bolivia is an inland country in the South American continent and does not have a port on the Pacific coast of South America. As the seaport for transportation to La Paz, (1) Arica (Chile), (2) Matarani (Peru) or (3) Antofagasta (Chile) might be used. Of these three ports, Arica is the closest and is therefore the most realistic landing port. From Arica to La Paz, materials and equipment could be transported by rail or truck. For their trucking, 10-ton trucks would be usable. It is understood that trucks larger in size are not passable.

b) Transportation Period

It would take at least four months from the placing of an order with Japan for products to their customs clearance in La Paz. The number of days required for various stages from the placing of orders to local delivery and the number of days for their transportation are shown below.



The above numbers of days required for the shipment are a minimum. To achieve this, it would be necessary to prepare necessary documents, go through customs clearance and follow other measures without hitch. Particularly in Bolivia, preferential measures would be desirable, such as smooth customs clearance and transportation arrangements.

c) Transportation Costs

Transportation costs and other related expenses required for transporting building materials from Japan to the La Paz Customs House are shown below.

1) Expenses in Japan

Export crating cost at the loading port	Approx. ¥18,000/m^3
Fee for warehousing and storage at the loading port	¥50/m^3/day
Fee for export customs clearance	¥4,600/cases
Shipping charge	¥4,300/m^3

2) Ocean freight — US$250-270/$m^3$ or ton

3) Port charge in Arica — Approx. 1% of CIF port value

4) Inland transportation

(Trucking from Arica Port to La Paz El Alto Customs House)

Approx. US$120/$m^3$ or ton

5) Expenses Customs Clearance in La Paz

Approx. 1% of CIF customs value

(CIF customs value = CIF port value + port charge + inland transportation)

Judging from the various transportation costs listed above, it would cost roughly US$480-520 per cubic meter or ton to transport materials and equipment from Japan to the Customs House in La Paz. It should be noted that these figures are only a guide. The actual costs would be greatly affected by the shapes of commodities, their crating, insurance and loading time.

(3) Transportation from Brazil

Because of the location of Trinidad, it would be necessary to consider the possibility of obtaining materials from Brazil which Bolivia adjoins in the deep Amazon Basin.

If Brazilian products are to be transported by river boat, the transportation route will be the Amazon River and its tributary, the Madeira River, in Brazil and the Mamoré River in Bolivia up to Trinidad.

In Brazil, Puerto Velho, on the Madeira River in the deep Amazon basin in the west of Brazil, would serve as the commodity supply center. The facilities at this port are well developed. To the Brazilian border town of Guajará Mirín 270 km southwest of Puerto Velho, a railway, a road and the waterway of the Madeira could be used. In the Bolivian border town of Guayaramerín, which faces Guajará Merin across the river, the cargoes would have to be transferred to another river boat, but it would be possible to pass through customs clearance there as there is a Bolivian customs house. Going up the Mamoré River southward, it would take 10-15 days by boat to get to Trinidad (about 800 km in a straight line).