3-1 Survey on Design and Construction Environment

3-1-1 Country and Natural Features of the City of La Paz

This section of the report mainly covers the items related to design and construction activities.

(1) General

Bolivia is an inland country located at from latitude 10 to 23 degrees south in the western region of the South American Continent. The total land area of the country is 1,090,000 square KM (approximately three times the size of Japan), and about one-third of the land consists of the Andes Plateau and Valley (huge basin of Altiplano) and two-thirds is made up of plains. The plateau has a cold climate (Tierra Fria), while the plains area is a lowland with a warm climate. The population is 5,600,000 (about 1/20 of that of Japan), and 55% of the population is composed of Indians of the Aymara and Quechua groups, 30% is of mixed blood and remaining 15% is Spanish white. The pattern of population distribution forms a pyramidal shape where people younger than 15 years of age total about 50%.

(2) Politics, Economy and Other Matters

This nation was politically unstable until 1971 but it became very stable after Banzer, the present President of Bolivia, took over this position in August of 1971, and also its economic structure has been gradually strengthened and stabilized on the basis of its rich natural resources and agriculture. The main goods for export which support the economy of Bolivia are mineral products such as tin, copper, zinc, antimony, etc. and exports of oil and natural gas have increased in recent years. On the other hand, Bolivia is greatly dependent upon imports of industrial products and garments.

For transportation, airways are well developed. The railways link the city of La Paz to various cities in the plateau region, and an international railway connects with Arica and Antofagasta, Chile, but very few trains run each day. Truck and bus routes are more developed nationwide, and buses and taxicabs are plentiful within the city of La Paz.

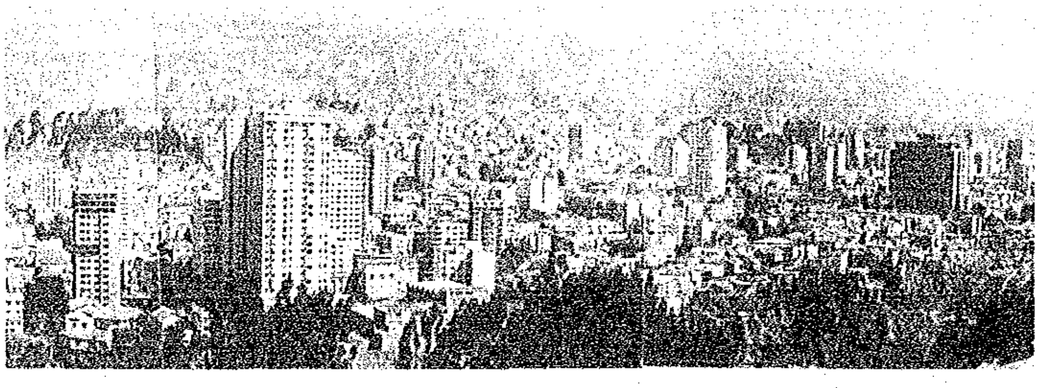
(3) Climate and Natural Features of the City of La Paz

La Paz is located at latitude 16 degrees south in the cold region 3,600 meters above sea level and is the largest city in Bolivia with a population of about 600,000.

1) Climate:

Annual variation in temperature and humidity is small, with a mean air temperature of 10°C and mean relative humidity of 50% but its temperature varies considerably each day. Heavy rainfall occurs during the rainy seasons in spring and summer but there is very littly rain during the dry seasons in autumn and winter.

General View of La Paz



Annual Climatic Data of La Paz
(Tabulated from data for 6 years from 1970 to 1975)

Temperature in °C:

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Monthly mean temperature	12.0	11.5	12.1	11.7	10.8	9.7	9.4	9.6	10.7	12.2	13.1	12.2
Monthly mean of daily maximum temperature	17.8	16.8	17.9	17.8	17.6	16.3	16.6	17.0	17.2	18.9	19.9	18.1
Monthly mean of daily minimum temperature	6.2	6.2	6.4	5.2	4.0	2.8	2.2	2.9	4.2	5.4	6.3	6.2
Maximum temperature over 6 year	24.7	23.5	23.6	22.0	21.5	22.2	20.9	21.0	22.4	24.2	24.8	23.6
Minimum temperature over 6 year	2.2	3.2	2.4	1.3	-0.5	-2.6	-2.8	-0.6	1.0	0.8	1.6	1.7

Relative humidity in %:

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Monthly mean humidity	73	69	63	60	47	42	44	49	51	55	55	68
Monthly mean of daily minimum humidity	30	28	23	18	16	15	15	13	15	15	16	18

Rainfall in mm:

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Number of days of rainfall per month	23	20	18	9	4	2	2	5	11	11	10	19
Cumulative monthly rainfall in mm	145.6	99.2	63.1	27.7	7.9	5.8	4.8	17.0	25.5	36.5	33.2	95.5
Mean daily rainfall in each rainy day in mm	6.3	5.0	3.5	3.1	2.0	2.9	2.4	3.4	2.3	3.3	3.3	5.0

Velocity and Direction of Wind in m/s:

Month		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Maximum velocity within 6 years	Wind direction	W	E	SW SE	NW	W	NW	NE	W	NE	N	SW	NW
	Wind velocity	20	20	20	20	20	20	20	30	20	20	20	20
Mean	Most frequent wind direction	SE	SE	SE	SE	SE	NW	NW	E	E	E	SE	SE
	Wind velocity	2.2	4	3.8	3.6	2.2	3.5	3.0	2.0	3.3	4.2	4.5	4.2

2) Geology:

La Paz City is located exactly in the middle of the huge plateau basin of Altiplano situated between the western Andes Mountains and the eastern Andes Mountains. The present mountain system comprises mostly synclinal deposits of the Jurassic Period, and it is assumed that the deposits were raised and curved by folding action in the Tertiary Period, turned into a peneplain by eroding action and finally elevated while being accompanied by faults. Many volcanoes are located near the national boundary where there is an orogenesic zone of the Tertiary Period. The stratum of the Cretaceous or Devonian Period is seen near the surface in the city of La Paz. This area is generally an alluvial formation made by glacial sediments, except for certain areas.

3) Disaster:

a) Earthquakes: Near the international boundary between Peru, Chile and Bolivia, many earthquakes occur since orogenesis is still active at the present time. Records of earthquakes are available for La Paz since the city is located near the boundary of Peru and Chile, but large-scale inland-type earthquakes have not occurred within La Paz.

A list of earthquakes that occurred near La Paz and recorder for the last 85 years was compiled by the San Charisto Meteorological Station and is shown as follows.

Record of earthquakes at La Paz (Data of San Charisto Meteorological Station)

Date of occurrence	Scale	Location and condition
1891	III-IV	Possibly Munekas Mountains
1896, Jun	II?	
1896, Jul	III-IV	
1908	II?	Felt in northern Chile and southern Peru
1909	"	Collapses in southern Bolivia
1913	"	Collapses in southern Peru
1920	"	Source at Consata-Mapiri
1923	"	Felt strongly in Consata
1928	III	Collapses in southern Peru
1929	II	Source near Antofargasta
1937	IV	Source at Consata
1947, Feb 24	V	Source at Consata; Possibly largest in the history of La Paz
1948	II	Peru southern coast
1952	II?	Southern Peru
1956	IV	Mapiri-Consata
1960, Jan 13	III-IV	Collapses in Alequipa
1960, Jan 15	II	Replica
1963	IV	Deep at border of Peru and Bolivia
1975, Jun 5	II-III	Border of Peru and Bolivia
1975, Jul 12	"	"
1976, Nov 30	"	Northern Chile
1976, Dec 28	II?	"

b) Fire Disasters; Fire disasters rarely occurred in the City of La Paz because the density of the air is about two-thirds that in the lowlands, so that combustion is more difficult. All buildings are made of adobe, brick or concrete and none are made of wood. It is said that unextinguished cigarette butts will not start a fire.

c) Floods: No flood is expected within the city of La Paz since continuous hours of rainfall seldom occur in the rainy season. The river running through the center of the city has a deep bed and many torrents and vallyes begin at the city of La Paz. However, road occasionally become like rivers with flood-water, since the city has topographically steep slopes to the river.

d) Damage by Wind: Damage by wind rarely occurs since the city of La Paz is within a hollow of valleys where the air moves slowly with very low wind velocity due to low air density.

4) Degree of Air Pollution: The air is not polluted since few factories are located within the city and the air density is low. Epidemics common in the lowlands rarely occur in this city. The dust occasionally rises during the dry season with little rain but it rarely rises high. Non-paved roads cause rising of dust due to automobile traffic.

5) Vegetation: Stunted trees and pampas are often seen in the highland region while many broadleaf trees grow in the valleys. Trees for gardening will grow there if watering and care are provided, since the annual air temperature is very stable.

3-1-2 Situation of the Construction Industry

(1) Contractors in Bolivia

The construction industry is one of the industries which has been considerably active and developed since 1972, and the construction of houses has been outstanding in the cities of La Paz, the most active of all, Santa Cruz, Cochabamba, Tarija and Trinidad. Owing to increases in the construction of public roads, houses and high-rise office buildings, the growth rate of construction reached 13.5% in 1975.

228 construction firms of various sizes are registered with the construction committee of Bolivia (Camara Bolivana de la Construccion) organized by membership fees paid by the Ministry of Construction, Ministry of Labor and many private construction firms. These construction firms are classified into 5 classes depending upon capital, number of engineers and amount of construction equipments owned. These five classes are detailed below.

Class	Capital	Numbers of Engineers & Architects	Percentage of Amount of Owned to Capital
1st Class	$b 2,000,000 min.	2 engineers min. and 2 architects min.	60%
2nd Class	$b 1,000,000 min.	2 engineers or architects min., or 1 engineer min. and 1 architect min.	50%
3rd Class	$b 500,000 min.	1 engineer or architect min.	40%
4th Class	$b 200,000 min.	1 engineer or architect min.	35%
5th Class	$b 50,000 min.	1 skilled construction worker min.	25%

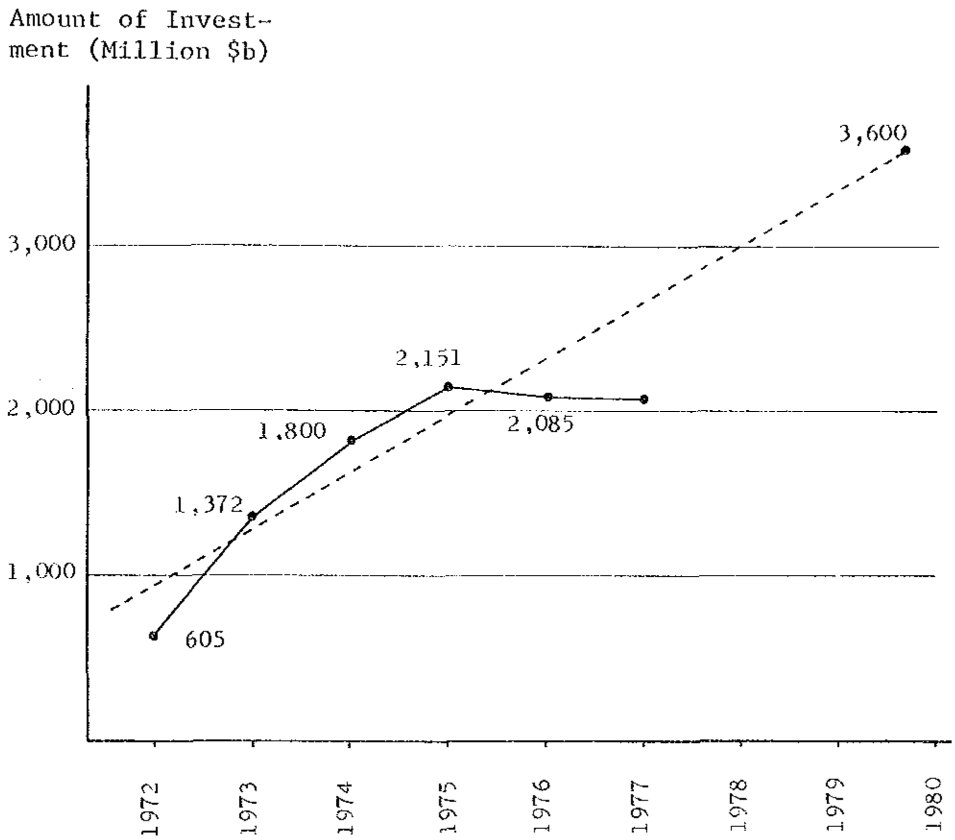
228 construction firms registered with the construction committee of Bolivia are shown by classes and by sections in table below.

Sections	Total Numbers of Firms	1st Class	2nd Class	3rd Class	4th Class	5th Class	Building equipment contractors
La Paz Section	131	21	26	40	12	26	6
Cochabamba Section	28	5	9	9	1	1	3
Santa Cruz Section	35	10	5	8	5	1	6
Oruro Section	16	-	6	4	3	2	1
Trinidad Section	6	-	1	4	1	-	-
Sucre Section	5	-	4	1	-	-	-
Potoshi Section	3	-	2	1	-	-	-
Tarija Section	6	-	-	3	1	-	-
Total	228	36	53	70	23	30	16

As indicated in the table above, more than half of the contractors of Bolivia are concentrated in the capital city of La Paz, indicating a large demand for construction in this city.

(2) Construction Trend in La Paz

Construction activities in the City of La Paz have greatly increased in the last five years. A construction rush has taken place in this city since many new high-rise office buildings, large hotel buildings and other types of buildings are under construction or are being started at many job sites. Of buildings higher than 7 stories in the city, 73 buildings were completed after 1964 and 15 buildings are currently under construction. This directly reflects the economic growth of Bolivia, especially of La Paz, since there is a concentration of industry, the population has increased tremendously, and the floating population (foreign professionals staying one to two years for example) has also increased in the last few years. Progress of the amount of construction investment in La Paz is shown below.



This graph shows the growth rate of the construction industry by means of annual investment of the last several years and the assumed value in 1980, in which the assumed values for the years after 1977 were made on the basis of investments in public works designated by a 5-year plan of the government of Bolivia.

The growth rate in 1976 and 1977 was low mainly because of a cement shortage in La Paz. The actual decrease was about 3% compared to 1975.

It is assumed that construction investments will be considerably increased in the years 1978, 1979 and 1980. At the present time, Cemento Viacha, a cement manufacture, is working to triple its production capacity of cement (220,000 tons per year) and the problem of cement shortage is being solved.

(3) Population of Construction Workers in La Paz

The construction committee of Bolivia has not determined the number of skilled and semi-skilled construction workers in La Paz but it is said that about 12.8% of the labor population is working in the construction industry and construction-related manufacturing industries. From statistics, the total number of construction workers in La Paz is about 120,000. This figure means that more than half (about 65%) of the total of construction workers in Bolivia is concentrated within the city of La Paz. Nevertheless there is a shortage of skilled workers in all construction firms, and especially foremen, maintenance mechanics, electricians, welders, plumbers, and stone (or brick) layers are in short supply.

3-1-3 General Construction Methods in the City of La Paz

(1) Temporary Work

Temporary fences surrounding the job site are mostly made of wood painted vertically in two-tone color. Scaffolding is used in cantilevered form for the second floor for curing but is rearely used for exterior work. External work such as window installation, laying of concrete blocks for spandrel, plastering and finish painting are performed by simple light-weight suspended platforms which have been developed in this country probably because of the extremely low wind velocity peculiar to this country.

All materials for temporary facilities such as temporary fences, scaffolding, forms and supports for temporary structures are made of wood, and steel plates or pipes are not used. Work on site is mostly performed by men and more mechanization should be possible in the future.

(2) Earthwork

The soil in the City of La Paz consists of gravel formed near the ground surface in many places and often boulders 40 to 50 cm in size are mixed with the gravel. Occasionally rocks longer than 1 meter are found (this was found at the job site of Terre de Los Americas, Banko Central de Bolivia) and excavation presents special difficulties.

Excavation is performed by power shovel or back hoe, or by hand but excavation for independent footing is done only by hand. It is said that about 6 hours are required to excavate $1M^3$ of earth by one man. When machines are used, $6{,}000\ M^3$ of earth can be excavated in three months according to data obtained from the job site of the Holiday Inn. If 25 working hours are assumed for a month, earth excavated per day will the only $80\ M^3$.

This volume is about 1/3 to 1/4 of that expected in Japan. This slowness is mainly due to the condition of the soil which imposes extra difficulty in excavation as stated previously. Problems concerning ground water during the excavation rarely occur. The local government designates the places for dumping the excavated earth.

An earth-retaining wall during excavation is not required. Even an excavation of up to 15 meters in depth can be done without an earth-retaining wall. This may be because of the suitable soil condition, extremely low rainfal and low ground-water level. Elimination of earth-retaining walls and timbering will be very advantageous in conducting excavation and underground work.

(3) Reinforced Concrete Work

In constructing reinforced concrete structures, concrete for columns, floors and beams is poured at the same time in Japan except in special cases, but concrete is formed in two stages in La Paz. Concrete is poured only for the columns first, then the concrete for slabs and beams is poured in a subsequent stage. Form work and the placement of reinforcing bars are performed separately for columns, and slabs and beams. A reinforced concrete structure is built by repeating this two-stage operation.

Walls including exterior walls, low walls and interior partitions are in most cases built by stacking hollow bricks manufactured in Bolivia.

Slabs are mainly constructed by the following two methods:

1) Solid slab method

2) Grid and joist slab method

Method 1) is identical to the method practiced in Japan in which a solid floor slab is made by placing reinforcing bars on the wood forms first and then pouring concrete to a predetermined thickness.

According to method 2), precast mortar blocks are laid on a wood form first, reinforcing bars are placed next, and then concrete is poured on the form in order to construct the grid floor slab or joist floor slab.

Method 2) is more frequently used in La Paz since the amount of concrete for the floor can be reduced by this method. As a new type of floor system, joist slabs formed by combining both precast panels and blocks are being considered in this city.

A simple wooden lift equipped with a winch is used for conveying building materials to each floor level and for pouring concrete.

The standard time required for pouring concrete for one floor by the method stated above is about 15 to 20 days. In most cases the concrete is mixed at the job sites but a construction firm in La Paz owns a batcher plant and ready-mixed concrete can be purchased from this firm.

Usually 16 to 40 M^3 of concrete is poured per day using a 200-liter mixer for each batch. If used, ready-mixed concrete may be poured at the rate of 20 M^3 per hour.

(4) Architectural Finishing

Examples of finishes most frequently employed in La Paz are indicated below.

1) Interior Finishes:

a) Floors: Floor finished most commonly used are wooden mosaic flooring (Parquet) and terrazzo tiles (Mosaico), both being manufactured in this country and widely used. PVC tiles (vinilo) made in Brazil or Argentina are also used. Examples of stone finish and carpeting are also seen.

b) Walls: Walls are rarely built with concrete but most commonly the finishes are put on structural hollow brick walls (Ladrillo Huecos). The surface of the brick wall is finished by approximately 25mm thick plaster (Yeso) and frequently this plaster is covered again by paint or wallpaper. Also, ceramic tiles, stones, and plywood over wooden frames are occasionally seen.

c) Ceilings: The most common ceiling finish is plaster coating applied directly to the underside of concrete slab. In such case, all conduits for electrical wiring are buried in the concrete. Occasionally, acoustic panels are applied to wooden frames. Metal frames for ceiling finish have also been used in recent years.

d) Doors: Wood-veneered flush doors are mostly used with standard dimensions of 900mm width and 2,100mm height. Door hardware is mostly imported from Brazil, Argentina, the U.S.A., or Germany.

2) Exterior Finishes:

a) Exterior walls: Most commonly, about 50mm thick exterior plaster (Cal y Cemento) is coated on the structural hollow brick wall (at least 15cm thick for exterior walls) and it is finally finished with paint.

In recent years, buildings with exposed concrete exterior walls are occasionally seen and foreign-made aluminum or steel curtain walls are also used for exterior walls.

b) Windows: Steel window sashes finished with paint are most common, but wood sashes are also widely used.

Aluminum sashes are being increasingly used and sash materials are imported from Brazil, Argentina and the United States and assembled in Bolivia.

c) Roofs: Terra-cotta roofing tiles are widely used for sloped roofs. The roof structure for such sloped roofs is mostly of wood. For flat roofs of concrete slab, the parapet is generally raised and asphalt is used for waterproofing, whilst the top is finished with silver paint or poured concrete.

(5) Electrical Work

The power distribution system by the power company in the City of La Paz is as follows:

a) An underground cable system is employed and transformers for power distribution are also installed underground in the city area.

b) An aerial power distribution system is employed with transformers installed on poles in the suburbs.

Electricity for buildings within the city is generally installed by the following means:-

1) Pipes, conduits and boxes buried within the concrete structures are mostly made of PVC, and steel products are rarely used. Convenience outlets and telephone outlet boxes are mostly recessed in the wall and rarely installed on the floor.

2) Electric wires used are mostly PVC wires conforming to American Standards. They are occasionally buried directly in contact with concrete.

3) Distribution boards are made of covered knife switches mounted on wood bases in many existing buildings but moulded circuit breakers on steel frames are widely used in newly completed buildings.

4) For lighting fixtures, fluorescent lamps are widely used for office buildings while simple incandescent lamp fixtures are used for houses and hospitals.

5) Generally, electronic equipment and accident-preventive equipment are not used. Such equipment can, however, be found in special-purpose buildings such as hotels.

(6) Mechanical Equipment

1) Heating equipment: Heating is not required for rooms where there is heat by sunlight, but rooms in the shade or at night are relatively cold. Heating equipment, in the order of frequency of usage, are electric stoves, propane gas stoves, hot water or steam central direct

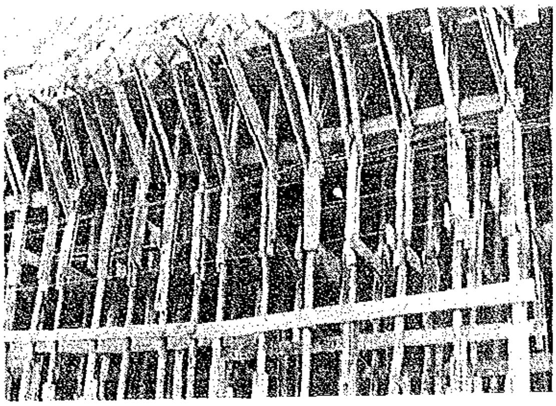
heating systems and hot air heating systems. The last two systems are used only in certain hotels, offices and hospitals.

2) Ventilating Equipment: Mechanical ventilation is rarely provided for general living quarters, and mechanical ventilation by exhaust fan is seen only in toilets, and mechanical and electrical rooms. Natural ventilation is widely used since most of mechanical devices and equipment are imported.

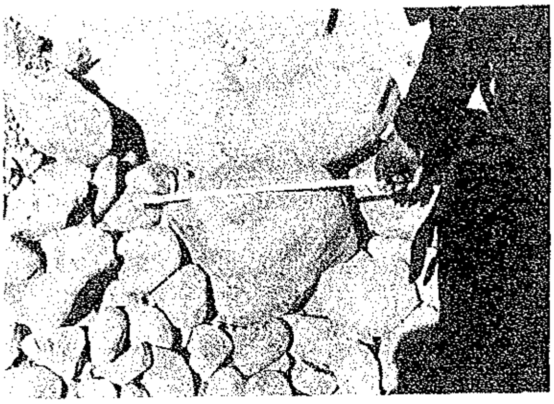
3) Air-conditioning Equipment: The climate in La Paz city does not require air-conditioning for buildings and the installation of cooling equipment is not seen in this city.

4) Water Supply and Drainage: The city water supply system is provided for each building by means of concrete receiving tanks or elevated water tanks. Waste water is mainly drained by lead pipes, and a central basin is installed in each toilet. Cast iron pipes are generally used for sewer drainage. Waste and sewer lines are connected to main public underground pipes without treatment and the drained water from the outlet of the city line is discharged into the river running through the city.

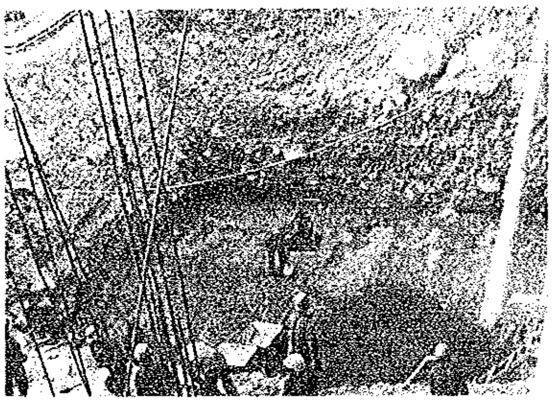
5) Fire Equipment: Carbon dioxide gas fire extinguishers are seen in some buildings in the City of La Paz but other types of fire extinguishing equipment are not used.



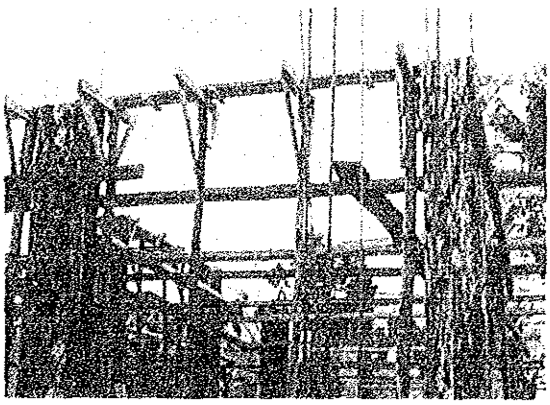
Wooden support and scaffolding



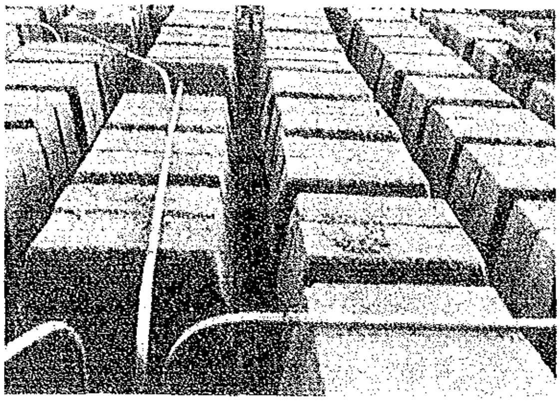
A number of big stones emerging in an excavation site



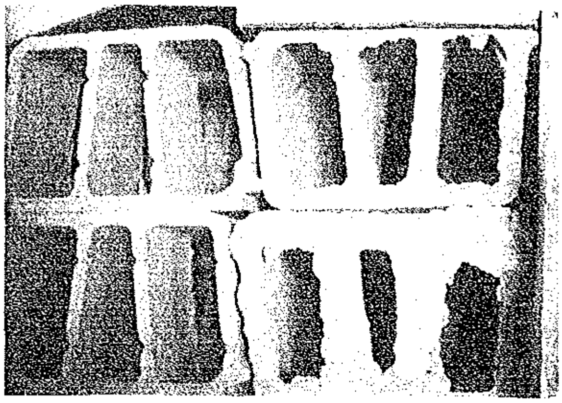
Excavation without soil retaining wall



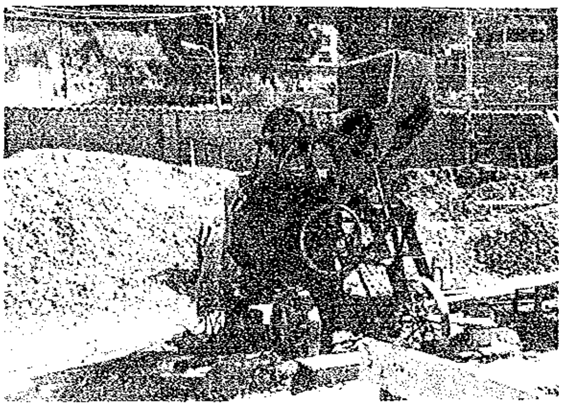
Forms for beams and floor being prepared after concrete work for column



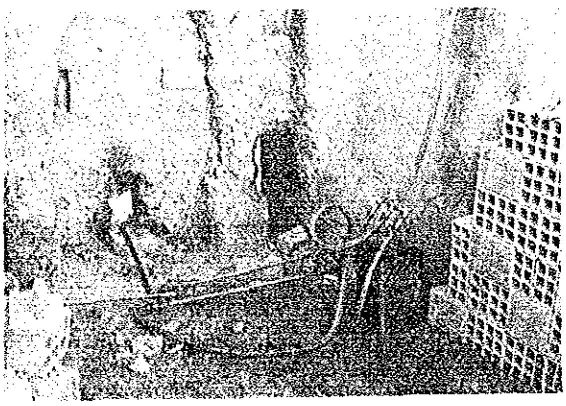
Joist slab method using floor blocks



Hollow blocks for floor slab



Concrete mixer in a job site



Factory of hollow bricks

3-1-4 Survey on Actual Examples of Construction Projects

(1) Survey on Actual Construction Examples in La Paz

A survey was made of existing buildings and buildings under construction based on: 1. size of building; 2. construction method; 3. amount of materials used; 4. construction duration; and 5. construction cost. In performing this survey, building data sheets (Hoja de Datos de Edificio - Reference Material-II) were produced and distributed to contractors, architectural design firms and architectural engineers in La Paz city requesting their cooperation in answering the questionnaires.

In order to avoid misunderstandings due to differences in terms and construction methods between Bolivia and Japan, each survey staff member met with engineers of Bolivia to obtain detailed explanations on each item on the building data sheet. Data recorded and tabulated from this survey are shown in the following table.

Name of Building	General and Scale of Building				Amount of Material Used						Construction Cost (US$)					Remarks
	Type of Building	Construction Duration	Total Floor Area	Number of Stories	Concrete		Reinforcing Bars		Concrete Form		Architecture (A)	Electrical (E)	Mechanical, Sewer (S)	Mechanical, H.A.&V(C)	Total (T)	
			m^2		m^3	m^3/m^2	ton	kg/cm^2	m^2	m^2/m^2						
1) APOLO	Apartment (Block of Flats)	72.5∿75.4 36M	3,748.3	17-B1	825	0.22	78	21.0	2,998	0.8	390,950 104.3/m^2	12,550 3.3/m^2	58,000 15.5/m^2	- -	461,500 123.1/m^2	A/T=84.7%
2) ESMERALDA	"	75.4∿77.3 24M	1,512.1	13-B1	350	0.23	28	18.5	1,255	0.83	290,180 191.9/m^2	9,750 6.4/m^2	30,570 20.2/m^2	- -	330,500 218.6/m^2	A/T=87.8%
3) ORQUIDA	"	71.6∿72.12 18M	1,160	5-0	220	0.19	21	18.1			116,780 100.7/m^2	8,500 7.3/m^2	11,100 9.5/m^2	- -	136,380 117.6/m^2	A/T=85.6%
4) HANSA	Office	76.10∿79.10 36M	17,700	23-B4	5,757	0.327	550	31.0			2,865,000 161.8/m^2	180,000 10.2/m^2	315,000 17.8/m^2	155,000 8.8/m^2	3,515,000 198.6/m^2	A/T=81.5%
5) B.I.S.A.	"	75.4∿78.7 40M	8,800	12-B1	2,740	0.311	264	30.0			2,075,000 235.8/m^2	170,200 19.3/m^2	144,600 16.4/m^2	170,000 19.3/m^2	2,559,800 290.9/m^2	A/T=81.1%
6) ENTEL	"	73.1∿77.8 44M	6,000	12-B1	1,385	0.23	70	12.0							890,000 148.3/m^2	
7) CAMARA NACIONAL DE COMERRCE	"			17-?											216.3/m^2	
8) BANCO CENTRAL DE BOLIVIA	"		33,000	32-B2	14,833	0.500	2,246	68.0							15,000,000 454.5/m^2	
9) TORRE DE LAS AMERICAS	Apartment (Block of Flats)		17,000	30-B2	4,250	0.25	370	20.6							3,000,000 176.5/m^2	
10) CAMPOS	"	74.6∿76.12 30M	3,543.01	18-B1	850.3	0.24	347.2	97.0	13,817	3.9						
11) ISABELITA	"	74.6∿77.3 33M	6,026.72	19-B1	1,386.15	0.23	602.6	100	22,901.5	3.8						
12) SHERATON	Hotel	74.12∿77.5 30M	27,700	14-B2	12,000	0.44	850	30.6			8,864,000 320/m^2	1,385,000 50/m^2	692,500 25/m^2	969,500 35/m^2	11,911,000 430/m^2	A/T=74.4%
13) HOLIDAY INN	"		14,500	16-B3	4,650	0.32	350 ∿ 400	24 ∿ 27.6							6,000,000 413.8/m^2	

(2) Summary Derived from the Survey by Building Data Sheets

1) Structure and Quantity of Materials Used

All buildings surveyed including high-rise buildings have reinforced concrete structures. A steel frame structure or steel frame with reinforced concrete structure is not used even for high-rise buildings.

Quantity of concrete used per 1 M^2 of floor area was 0.25 to 0.50 M^3 per 1 M^2. This is about 50 to 70% of that of reinforced concrete structure built in Japan. However, they cannot be directly compared since a high-rise building in Japan is usually built with a steel frame or a steel frame with reinforced concrete.

The following reasons for the use of less concrete in Bolivia are assumed:

1. Structural members for beams and columns are relatively smaller in Bolivia since earthquake precautions are not required.

2. Walls are mostly built with hollow bricks instead of using concrete.

The quantity of reinforcing bars was 18 to 100 kg per 1 M^2 of floor area. These quantities varied so widely that the mean value derived was considered to be meaningless.

2) Construction Duration

The length of time required to complete the buildings was surveyed. Considering factors of building scale and contents, the mean time required was about twice as long as in Japan.

Reasons for the longer time required to complete buildings in Bolivia are:

a. Most of building materials other than concrete, bricks and lumber are imported foreign products so that procurement of materials is frequently delayed especially in room finishing and equipment installation stages.

b. Construction work is greatly dependent on manpower.

c. Occasionally work is delayed owing to shortage of funds on the part of the owner.

3) Construction Cost

Refer to Paragraph 3-2-5.

3-1-5 Utilities and Other Services in the City of La Paz

(1) Electric Power

Most of the electric power supplied in La Paz is generated by water power stations.

Two large electric power supply companies are supplying electric power at the present time as indicated below.

1) A private enterprise "Compañia Boliviana de Energia Electrica" (COBEE) is supplying power in the states of La Paz and Oruro.

2) The other 7 states are supplied by the government-owned enterprise "Empresa National de Electrificación" (ENDE).

Power generated by COBEE in 1972 to 1976 is shown in the following table:

Year	Generated Power MWH	Consumed Power MWH	Difference MWH	Number of Users
1972	282,488	245,375	37,113	77,032
1973	284,409	238,706	45,703	80,803
1974	309,860	256,212	53,648	81,359
1975	321,738	269,723	52,015	83,784
1976	330,750	280,495	50,255	87,952

* Yearly average of increasing rate of power demand in last 5 years is about 3.6%.

Specification or ratings of power supplied by COBEE is shown below.

	Power Station	Substation	Distribution Transformer	Consumer
Voltage	66KV	6.6KV	220V 110V	
Frequency	50 Hz			
Voltage Regulation	±8%			
Frequency Regulation	±2%			

Power rates for high voltage, 6 KV commercial power, are shown in the table below.

	Japan (Tokyo)	COBEE (La Paz, Bolivia)
Basic Rate	1200 yen/kw	70 $b/kw (980 yen/kw)
Power Rate	15.18 yen/kwh	Up to 100 kwh 0.78 $b/kwh (10.92 yen/kwh) Exceeding 100 kwh 0.58 $b/kwh (8.12 yen/kwh)

Taxes for electric power in the City of La Paz are shown below.

Sales Tax	3%
City Tax	5%
Railroad Tax	0.8%
Total	8.8%

(2) Telephone Service

Toll lines of La Paz City are operated by the government-owned telephone and telegram enterprise "Empresa Nacional de Telecomunicaciones Bolivia "(ENTEL) and local lines in La Paz are operated by the private enterprise "Teléfonos Automaticos de La Paz Sociedad Anonima" (TASA).

At the present time, four local stations owned by TASA are automatically operated and a total of 32,500 subscribers are being serviced. A total of 13 local stations will be automated and 62,500 subscribers will be serviced by the fiscal year 1980.

Telephone rates in the City of La Paz are shown below.

Type of Telephone	Rate	Remarks
General Residential Telephone	$b 86.30	
Business Telephone	$b 215.00	No message rate, monthly fee only
Commercial (Direct)	$b 393.00	
Commercial (PBX)	$b 585.00	
Installation Fee for Subscriber	$b15,300.00 (US$750.00)	Initial installation only

(3) Radio and Television

Television broadcasting in the City of La Paz is operated in black and white by a government-owned station at the present time.

The radiowave specifications are:

Frequency	225 MHz
Picture output	2 kw, and
Voice output	1.8 kw

Time for broadcasts is between 17:00 and 24:00 during weekdays and between 10:00 and 24:00 during holidays. Color television broadcasting is presently being planned, but a definite schedule has not been established.

(4) City Water Supply

The city water supply system in the City of La Paz is fairly complete. Owing to increased demands on city water resulting from the construction rush, the City Water Department is rushing the replacement of existing water main pipes with larger pipes in many places as actually observed in June, 1977. Cast iron pipes are used for the main distribution system.

Carbon steel pipes are frequently used for water lines within buildings, but the reddish sign of rust is not seen, probably because the pH value is relatively high.

The quality of water is characterized by high total hardness and high sulphate ion.

Results of water examinations performed by the City Water and Sewer Service Department in March, 1977 are shown below.

	City of La Paz	Japanese Standards for Supply Water	City of Tokyo (March, 1976)
Temperature	7~14°C	-	5~20°C
pH	7~8.8	5.8~8.6	6.8
Residue on Evaporation	140~390 mg/ℓ	500 mg/ℓ max.	130 mg/ℓ
Turbidity	1~4 mg/ℓ	2 max.	0
Color	0	5 max.	1.0
Free Chlorine	0.05~0.25 mg/ℓ	0.1 max.	0.6
Carbon Dioxide Gas	1~6 mg/ℓ	-	-
Total Alkali	7~26 mg/ℓ	-	30.8
Total Hardness	88~250 mg/ℓ	300 max.	69.8
Manganese Ion	0.1~0.4 mg/ℓ	0.3 max.	-
Sulphate Ion	64~150 mg/ℓ	-	6.5
Silicate Ion	2~5 mg/ℓ	-	14.26

(5) Fuels

Electric power, propane gas, kerosene, light oil and heavy oil can be considered as sources for heating and hot water supply in La Paz. In determining the type of heat source, low operating cost and stable supply should be taken into consideration. Generally, there is an over-supply of heavy oil, while kerosene and light oil are in short supply in La Paz. The Bureau of Petroleum, however, is hoping for more use of heavy oil for heating purposes.

Energy Costs for Producing 1000Kcal Hot Water

1$b=14 yen

	Energy Cost	Unit Cost of Energy per 1000 Kcal	Equipment	Equipment Efficiency	Running Cost per 1000 Kcal
Electric	$b 0.61/kwh	$b 0.71	Electric boiler	1.0	$b 0.71
Propane Gas	$b 2.0/kg	$b 0.19	Boiler	0.7	$b 0.28
Industrial Kerosene	$b 1.5/ℓ	$b 0.16	Boiler	0.6	$b 0.26
Heavy Oil	$b 1.1/ℓ	$b 0.11	Boiler	0.6	$b 0.19

For kitchen appliances, propane gas and electric cooking ranges are widely used. Propane gas used is highly pure gas with 30% propane mixed with 70% butane, and gas is supplied in 10.15 or 45 kg bombs.

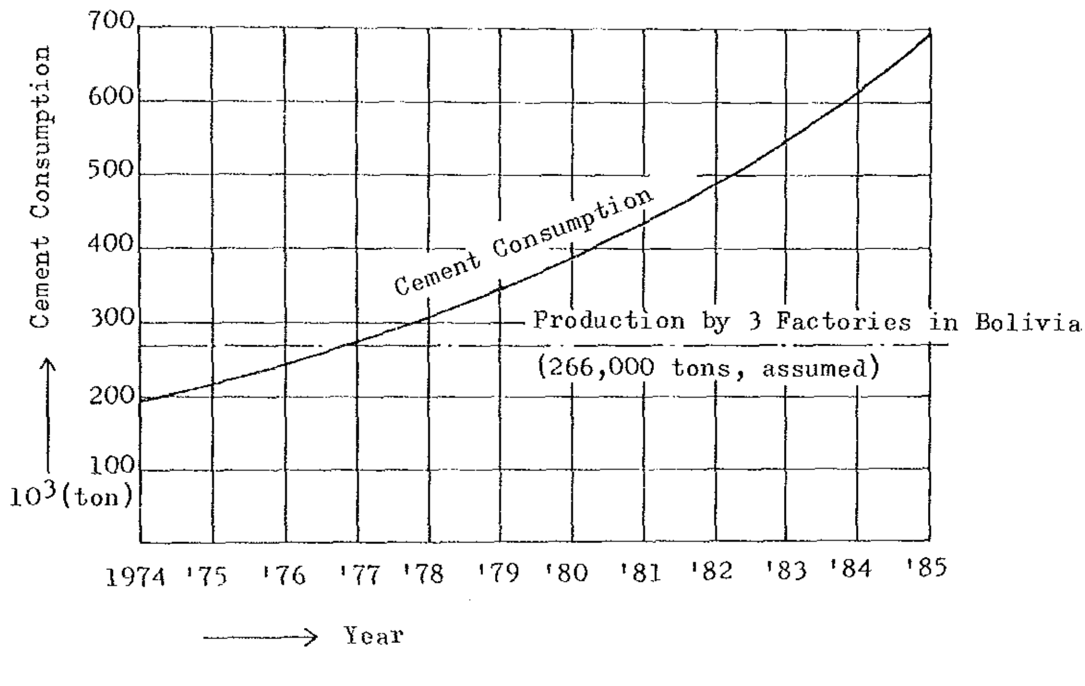
A gas distribution pipeline system with concentrated propane gas bombs is occasionally seen in buildings such as the Sheraton Hotel in La Paz, but generally this system is rarely seen in the city.

(6) City Sewerage

All sewage is disposed directly into a river running through the center of the city. Sewer pipe lines are buried under the public roads and existing lines are being replaced with larger pipes at present.

3-1-6 Situation of Construction Materials

Under the leadership of a stable government, Bolivia is now promoting its social and economic development under a new 5-year program from 1976 to 1980. As one of the projects under this 5-year program, construction work using programmed construction investment funds is actively under way and, accordingly, the consumption of construction materials is increasing each year. To prove this tendency by actual data, changes in cement consumption are shown in the graph below.



Graph for Forecasting Cement Consumption in Bolivia

Since cement consumption is proportional to the investment in construction, shortage in construction materials in the future should be taken into consideration. Hence, effective measures should be taken in advance for the construction of the Research Center.

In regard to construction costs, it is said that about 30% of the cost is for imported materials and 70% is for labor and cost of materials made in the country. The construction materials and equipment are classified into domestic products and imports as indicated below.

(1) Domestic Products

Cement, sand, gravel, concrete products, mortar products, bricks, tiles, terrazzo blocks, lumber, some reinforcing bars, PVC pipes and tubes for mechanical and electrical uses, PVC boxes, some types of vinyl electric wires, some types of lighting fixtures, some type of distribution boards, lead pipes, etc.

(2) Imported Materials

Steel products (reinforcing bars, steel beams, and other materials), steel sashes, aluminum sashes, glass, paint, PVC-tiles, wall paper, and electrical and mechanical equipment, devices, etc. They are imported mainly from the U.S.A., England, West Germany, Japan, Argentina, Brazil, and Italy.

In regard to cement, consumption was higher than the domestic production of 266,000 tons (total* of 3 factories) in 1977 as shown in the graph, and the importation of cement will become necessary very soon. Cement was also imported in the past owing to reduced supplies during rainy seasons. It was reported that approval was required from the factory for importing cement since domestic manufacturers are protected by government policies. Other construction materials are also in short supply occasionally.

According to this survey, main construction materials are mostly imported and, therefore, materials required for the construction of the Research Center should be basically obtained from Japan to complete the buildings within the scheduled time, except for materials which are domestically available, such as cement, sand, gravel, blocks, concrete products, lumber and pipes for electrical uses stated above, provided that customs duties and import licenses for import materials for this project are exempted.

Note: Daily production by three factories:

Coboce;	300 t/day
Fancesa;	300 t/day
Viacha;	200 t/day

3-1-7 Present Situation in Maintenance Management

More than 50 buildings higher than 7 storeys have been constructed in the last few years in the City of La Paz and each building is being controlled under the maintenance management plan.

(1) Cleaning of Building

Although machines are used for cleaning, they are not widely used, and cleaning is performed carefully and thoroughly. Windows that open are commonly used and, hence, gondolas for cleaning glass are unnecessary.

(2) Elevators

Each high-rise building is equipped with elevators imported from the U.S.A., Italy or Switzerland, and maintenance of the elevators is performed by the agencies of the manufacturers. Repair work for defects is smoothly carried out, but products imported from countries other than those listed above may create some problems in maintenance. For instance, Japanese products may be installed if a specific manufacturer provides the maintenance system.

(3) Water Supply and Drainage, Heating and Ventilating Equipment

Machines such as pumps and boilers are all imported products. Heating equipment is not widely used as yet, but its maintenance is being performed by people related to the selling and installation of the equipment. This can be performed smoothly as long as replacement parts are available.

(4) Electrical Equipment

Most electrical devices or materials are imported goods. If capacities are sufficiently large, high voltage devices are all installed and maintained by power companies. Maintenance for low voltage appliances is performed by those related to the installation of building equipment.

(5) Telephone Equipment

Most of the telephone exchanges used are imported from Japan and their maintenance management is also being performed by Japanese manufacturers.

3-1-8 Laws, Regulations and Engineering Standards

(1) Planning and Building Regulations

Zoning and parceling regulations which regulate the zones, building area allowable, height of building, etc. (Reglamento de Parcelacion y Zonificacion) are legislated by the City Planning & Adjustment Bureau of La Paz City (Municipalidad de La Paz Oficina del Plan Regulador).

According to the regulations, the proposed site of the Center is located in a residential area, but officials pointed out that these regulations are not applicable to this specific site since it is located within the grounds of the hospital. They are considering revising parts of the regulations and they will respect corresponding Japanese engineering standards as far as building regulations are concerned with relation to the proposed Research Center.

(2) Structural Standards

Regarding structural design, there are no special regulations for the design, and structural engineers are designing structures in conformity with American standards (ACI) or German standards (DIN) at the present time.

City officials pointed out that Japanese codes can be applied in designing the structural system for the proposed Research Center building.

(3) Electrical Work Standards

Regulations for electrical work have not been fully prepared and the work is usually done in conformity with those of the country from which materials are imported.

Norma Para Instalaciones Electricas . . .	By Ministry of City & Housing of Bolivia
NEC (National Electric Code)	U.S.A.
AWG (American Wire Gage)	U.S.A.
ABNT (Association Brazileas Normas Tecnicos)	Brazil

(4) Water Supply, Sewage and Other Standards

Regarding civil engineering, the engineering standards were established by the Sewerage Bureau of the City of La Paz in 1963 but they are being prepared for revision and are rarely enforced at this time.

City officials pointed out that Japanese engineering standards will be respected in regard to the design of the proposed Research Center.

In regard to drainage of waste water from medical activities, the Ministry of Health and Welfare is requesting the installation of a sewage treatment factility, but its engineering standards are not established as yet.

Regarding the installation of tanks for propane gas or oil, the Petroleum Bureau has adopted engineering standards for safe methods of installing these tanks.

(5) Approval of the Plans

In regard to submitting the plans for approval, the building permit must be issued by the City Office at the preliminary stage of the plan. Drawings to be submitted for this permit shall include electrical and mechanical drawings in accordance with forms established by the city office.

3-2 Survey on Construction Costs

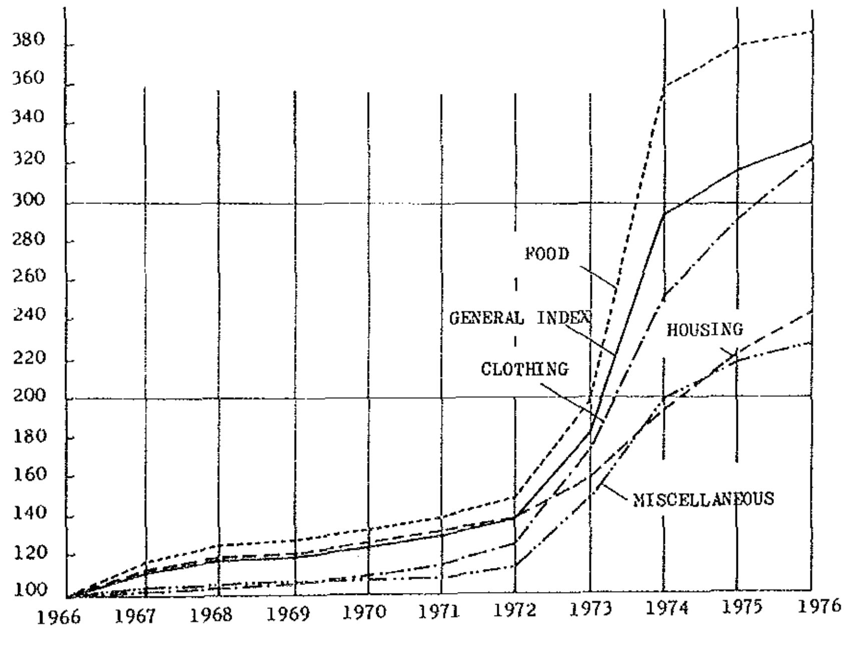
3-2-1 Increasing Rate of Prices

Prices of various commodities in the last several years in La Paz were surveyed to find the rising tendency of prices, especially the prices of construction materials, in the City of La Paz.

Changes in price indices for consumer goods after 1967 in La Paz were the subject of studies by the National Statistics Bureau (Instituto Nacional de Estadistica) for (1) general, (2) foods, (3) products related to houses, (4) clothing, and (5) others, as indicated below. (Figures are based on 100 in 1966).

(With the figures in 1966 taken as 100)

Category	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
General	111.18	117.28	119.88	124.53	129.11	137.51	180.81	294.43	317.92	337.20
Foods	116.09	124.65	127.27	133.09	138.37	147.20	198.65	360.98	380.19	389.35
House Products	112.32	118.01	120.45	125.21	130.70	138.05	158.64	193.89	221.26	243.81
Clothing	100.36	102.16	105.34	109.23	114.27	124.58	172.60	252.10	291.94	324.01
Others	102.14	103.78	105.92	106.96	107.62	113.82	147.48	199.73	219.54	228.86



The graph shown above indicates that price increases for various goods were high in 1972, 1973 and 1974. This happened presumably as a result of vital economic activities under the economic high growth in Bolivia after the new government was established in 1971 and of the influence of inflationary trends in foreign countries. However, this graph also shows signs of stabilization in prices after 1974 mainly due to appropriate policies of the government. Increasing rates of consumer prices compared to the previous year are indicated below.

Increasing rates of consumer prices compared to the previous year are indicated below.

Fiscal Year	General	Foods	House Products	Clothing	% Others
1973 ∿ 1974	62.84	81.71	22.20	46.06	35.43
1974 ∿ 1975	7.98	5.32	14.12	15.80	9.92
1975 ∿ 1976	4.49	2.41	10.19	10.99	4.25

This table shows that increasing rate of the price index for house products (or products related to houses) is greater than that of "general". From this data it is assumed that the yearly increasing rate of prices for construction materials will be about 10%, since the increasing rate of construction materials is closely related to that of house products and the demand for construction in La Paz has considerably increased in recent years and this growth will be continued in the future.

3-2-2 Present Trend and Changes of Construction Materials

Standard prices for basic building materials are shown below.

(Unit: $b)

Name of Material	Types of Size	Unit	First Part in 1976	Middle Part in 1977
Cement (1)	Cement Viacha 241103	50 kg	45.60	55.60
Cement (2)	Cement Viacha 241104	50 kg	42.75	53.88
Reinforcing bars (1)	Deformed, 3/8"	Kg	14.30	10.92
Reinforcing bars (2)	Regular, 1/2"	Kg	12.20	9.50
Steel angles	1-1/4"×1/8" German made	Kg	115.00	115.00
Cement blocks	15×20×30 cm	each	4.91	6.05
Hollow bricks	6-hole 15.5×25×10.5	each		1.85
Glass	Simple, clear	p^2	10.00	10.00
Lumber	Structural, Misc. trees	p^2	4.50	4.50
PVC pipe	4" dia., 6mm thick 6m long	m	180	180
Water closet	Low tank, domestic product	each	1,250	1,250
Lavatory	German made, with faucet & siphon	each	480	480
Paint	Oil paint, American made	gln	770	770
Finish tiles	15×15 cm, white	100	384	384
Waterproofing for roof	7-layer, 10-year guarantee	m^2	195	205

3-2-3 Survey on Labor Costs

(1) Wages of Construction Workers

Wages of construction workers, as surveyed by the Construction Committee of Bolivia, are indicated below.

	As of June, 1977
forman	$b 80 to 90
1st class specialized worker	$b 70
2nd class specialized worker	$b 60
stone or brick layer	$b 50
carpenter (formwork)	$b 50
1st class assistant	$b 43
2nd class assistant	$b 40
1st class misc. worker	$b 38
2nd class misc. worker	$b 35

Figures shown above are basic wages only and an employer must pay social security fees for long-term employment. Normally a bonus is paid twice a year (Easter and Christmas), each being equivalent to one month's salary. Thus, an employer (contractor) must assume an additional amount of 50 to 80% of the wages shown above, as direct personnel expenses.

(2) Work Efficiencies

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

Earthwork: 1 assistant class worker:
2.5 hours per 1 m^3 (soft soil)

Concrete placing: 1 specialized 1 assistant:
0.3 hour per 1 m^3

Ironwork (reinforcing bars): 1 specialized & 1 assistant:
4 hours per 1 m^3 (80 kg)

Formwork: 1 specialized & 1 assistant:
1 day per 70 m^3 of concrete

Bricklaying: 1 specialized & 1 assistant:
2.2 to 2.9 hours per 1 m^2
(12 cm thick)

Bricklaying: 1 specialized & 1 assistant:
3.4 to 4.1 hours per 1 m^2
(25 cm thick)

Hollow brick laying: 1 specialized & 1 assistant:
2.5 to 2.7 hours per 1 m^2
(25 cm thick)

Asphalt waterproofing: 1 specialized & 1 assistant:
5 hours per 1 m^2

Mortar coating: 1 specialized & 1 assistant:
0.5 hour per 1 m^2

Laying of terrazzo blocks: 1 specialized & 1 assistant:
3 hours per 1 m^2 (20 × 20 cm)

Laying of T & G wood flooring: 1 specialized & 1 assistant:
3 to 3.1 hours per 1 m^2

Painting: 1 specialized & 1 assistant:
0.15 hour per 1 m^2

Finishing exterior wall: 1 specialized & 1 assistant:
1.6 to 1.8 hour per 1 m^2
(Cal y Cemento)

Finishing interior wall: 1 specialized & 1 assistant:
1 hour per 1 m^2 (Yeso)

Glass installation: 1 worker:
0.2 hour per 1 m^2 (window)

The work efficiencies shown above for various types of work should be considered merely as standards. Normally the total working day is 8 hours, but several job sites with men working at night were also seen in La Paz. They work only in the morning on Saturday and do no work on Sunday and holidays.

3-2-4 Transporting of Building Materials

Transporting of construction materials will greatly affect the time of completion and construction costs in this project.

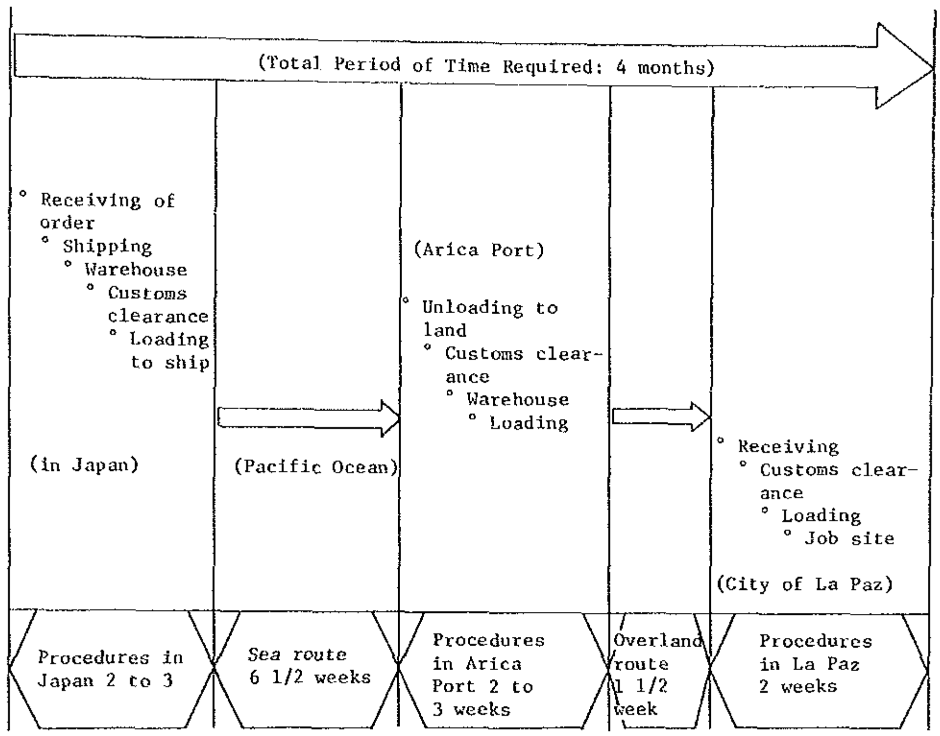
As described before, most of construction materials except cement, gravel, bricks, lumber and tiles must be imported from foreign countries. Considering the transporting of construction materials from Japan to the City of La Paz, (1) method and route, (2) time required, and (3) costs of transporting will be discussed in this paragraph.

(1) Method and Route of Transporting

When building materials are transported from Japan, ships will be used. (Airplanes may be considered but they are very costly. For example, $US 10,000 may be required for 1 flight carrying 22 tons.) Bolivia is an inland country in the South American Continent so that it has no port on the Pacific Ocean side. But the nearest ports to La Paz are (1) Arica, Chile, (2) Matarani, Peru, and Antofagasta, Chile. Of these three ports, Arica is the nearest and most realistic as a port for unloading the materials. From Arica to La Paz, goods can be transported by trucks or railroad. When shipping by trucks, it is said that a 10-ton truck is the maximum and that the roads are not suitable for larger trucks.

(2) Time Required

At least four months will be required from the time of ordering from Japan to the time of delivery to the job site in La Paz. The required number of days for various procedures and the number of days required for shipping from the date of order to delivery to the job site will be sequentially indicated below.



However, the minimum times are shown above as number of days required, and preparation for the required documents, procedures for customs clearance and other various arrangements must be completed smoothly to meet the above sample schedule. It should also be noted that occasionally the overland route from Arica Port to La Paz, if trucks are used, cannot be used during the rainy season (3 months from November to January).

(3) Costs of Transporting

Transporting costs and other related expenses required for transporting building materials from Japan to La Paz will be sequentially described as follows:-

a) Expenses in Japan

Charges for custody

Shipping charge:	approx. 5,000 yen/ton or m^3
Fee for customs clearance:	4,200 yen/each item

b) Ocean freight: $US 90 to 100 per ton or m^3

c) Port charge in Arica: approx. 1 % of CIF port value or $US 25/ton

d) Inland transportation

	Via Arica	Via Matarani
Railroad:	$US 20 to 28 per ton	$US 22 to 29 per ton
Truck:	$US 48 per ton	$US 40 per ton

There would be quantity discounts for railroad fees.

e) Fee for customs clearance: approx. 1% of CIF custom value

(CIF custom value = CIF port value + port charge + inland transport)

f) Transporting cost from customs to job site:

$US 14 to 15 per each of 5-ton truck

(4) Taxes

For importing goods from Japan to Bolivia, normally import taxes must be paid. Rates of import taxes are roughly outlined below for each import item.

	Articles	Tax Rate*	Remarks
1)	Reinforcing bars:	17.5%	
2)	Portland cement:	34.5%	52.5% for other cement
3)	Lighting fixtures:	79.5%	Regular metal products
4)	Glass:	22.5% + Kb×$b0.4	Regular plate glass for windows
5)	Aluminum sash:	17.5%	Completed
6)	Boiler:	11.5%	For hot water supply
7)	Plumbing fixtures:	12.5%	Metal and ceramic

* Note: Tax rate is on CIF La Paz Custom Value.
Tax rates shown above are for standard products only, and the tax rate will vary depending upon items in the same category.

In addition to the above import taxes, the following various taxes and expenses will be applied or charged for customs clearance at La Paz:

Added import taxes:	Varies depending upon import goods
AADAA* charge for custody:	approx. 2 to 8% of CIF custom value
AADAA expense:	approx. 0.5% of CIF custom value
Noroeste Development Tax:	approx. 1% of CIF custom value

In applying for tax exemption, stamp duty equivalent to 10% of exempted tax value must be also paid.

* Note: AADAA: Administracion Autonoma de Almacenes Aduaneros

3-2-5 Construction Costs

Unit prices obtained from the survey were corrected to establish prices as of the end of 1977 considering price rises after the start and completion of construction of each building surveyed (price index for end of 1977 is 350 to 370 compared to 100 for 1966). (Refer to Paragraph 3-1-4).

Average construction cost derived was $US 250 to 350 per square meter. This was $US 450 to 500 per square meter for a high-class hotel building and a high-class office building.

However, the type or degree of building equipment involved in building cannot be definitely conceived from this unit price alone. Customarily optional elements are more involved in this type of price and it may be dangerous to accept without reservations. Thus the prices should be used only as national ones.

Cost of electrical work, plumbing, heating and ventilating is about 15 to 20 % of the total construction cost. This percentage is relatively low compared to that of Japan. The following reasons are adduced for this relatively low percentage:

(1) Air conditioning, especially cooling, is not required in the City of La Paz owing to its climate.

(2) Very few existing buildings are heated. Buildings with heating facilities have begun to appear only recently.

(3) Equipment such as fire hydrants, sprinklers, smoke detectors, etc. which are demanded by building and fire codes in Japan, are not required at all in the City of La Paz.

3-3 Survey on Building Site

3-3-1 Outline of Building Site

The building site for the proposed Research Center is located within the site of the La Paz National Hospital (Hospital de Clinicas). Hospital de Clinicas is a general hospital in the Miraflores District located about 3 km, which is about a 10 minutes' drive by car, to the southeast of the center of downtown La Paz, which is 3,700 meters above sea level.

This general hospital is located on plateau 3,600 meters above sea level and surrounded by the Orkajahuira River and Choqueyapu River. The west side of the hospital is facing a street called "Avenida Saavedra" which has a sidewalk at each side of the road. This street slopes gently from north to south and traffic is relatively heavy.

Across this street, the high-rise building of the medical department of San Andres University is located on the west side of the road. Military facilities (Cuartel General) are located on the south side of the hospital.

Hospital de Clinicas is, as shown on the plot plan (Fig. 3), a pavillion hospital where each department of the hospital has its own wing, and a number of low-rise (one or two stories) buildings built in early 1900 are still in service. Among them, the Instituto de Torax (Chest Disease Center), Oftalmologia (Ophthalmic Center) and the Hospital del Niño (Pediatrics Center) are all functionally independent departments.

The gross site area is about 52,000 m^2 and a vacant lot almost in the center of Hospital de Clinicas was assigned as the construction site for the proposed research center. The east side of the site assigned for the Research Center, is occupied by the Cocina (central kitchen) and Traumatologia (orthopedics), and the south side by the Hospital del Niño (pediatrics). Cirugia Varones (surgical department) is located west of the site and the Instituto de Torax (chest disease center) is located at the north side across from basketball court.

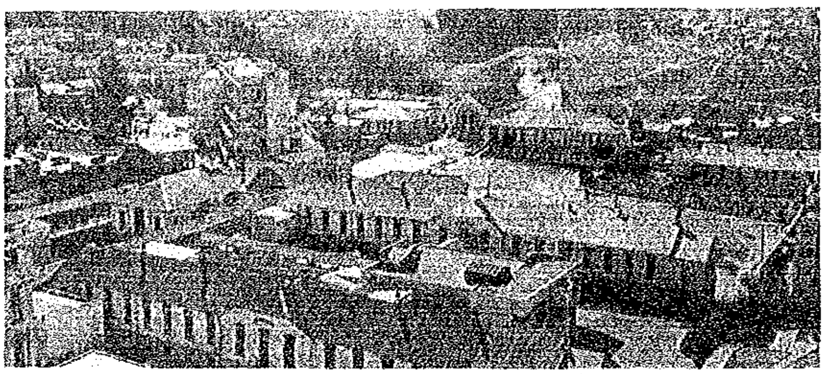
The site assigned is a vacant lot with an area of 3,000 m^2 which is about 70 meters long in the south-north direction and 45 meters long in the east-west direction, surrounded by these buildings. An area surrounded by this site and the surgical department building on the west side is assigned for the future burn treatment center.

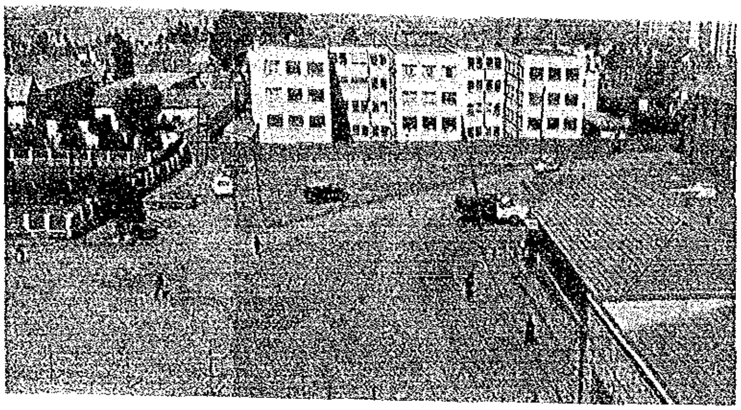
The site slopes gently from northwest to southeast and its grade is about 5% with about 4.5 meters in difference in elevation.

At the present time, this vacant lot is not being used for any particular purpose except for people going to each department and for cars going for services to the central kitchen (Cocina) and laundry (Lavanderia).

Southeast of the site, there is the front yard of the "Traumatologia" and an approximately 2-meter high fence surrounding the yard. This fence must be removed and some trees in the front yard must be relocated prior to the start of construction for the proposed Research Center.

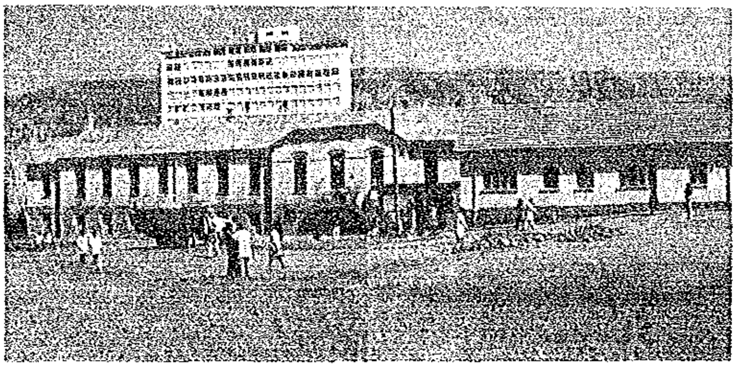
General View of the Hospital de Clinicas



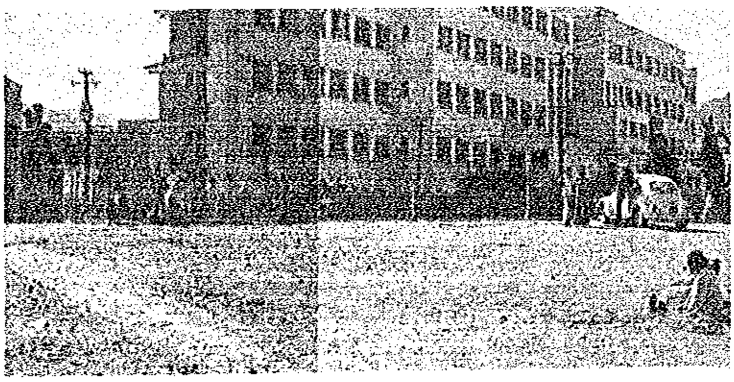


View of the Site
from north

East of the Site



West of the Site



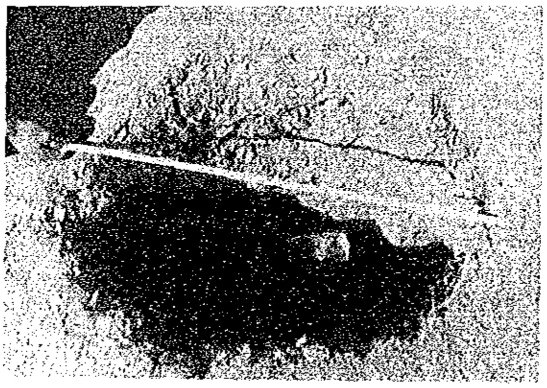
North of the Site

3-3-2 Soil Condition of Building Site

The soil condition was investigated by boring at two places in the site. Boring hole No.1 was 5.5 meters deep and No.2 was 4.5 meters deep, and soil was sampled for each 1-meter for each hole and a standard penetration test was also conducted. (Reference Material-I)

In general, this Miraflores district has excellent soil, even better than that in other areas within the City of La Paz. Results of tests indicated that extraordinarily excellent sandy gravel, called 'Miraflores Gravel Stratum', existed in the site and this was assumed to have been deposited during the glacial period. This sandy gravel stratum was about 20-meters deep and a number of boulders mainly composed of granite with a maximum diameter of 50cm were found in the stratum. A solidified clay stratum was laid underneath this gravel.

Boring for Soil Test of the Site



Bored Hall in the Site

Ground water was not seen in the depth of the bored holes, and the normal ground water level was probably deeper, since water was not seen in construction sites excavated deeper than 20 meters in the City of La Paz.

From the results of the test, the allowable bearing capacity of the ground is expected to be 2.2 kg/cm^2 at a point two meters below the existing ground surface in this site.

On the south-east side of the Hospital de Clinicas, where it faces the valley of the Orkojahuira river, the ground has begun to be eroded. If it is left as it is, the bank of the valley will be gradually washed away by rain water and eroded, and existing buildings on this side will be demolished. The river bank must therefore have proper measures taken to protect it, so as to prevent further erosion.

3-3-3 Present Condition of Utilities and Services at the Site

(1) Electricity

High voltage elevated lines of 3-phase, 3-wire, 6.6 KV are already at the site of the La Paz National Hospital and this power is reduced to 220 V and 110 V, 3-phase, 4-wire by transformer on poles for distribution to each facility. (Refer to Fig. 1)

A watt-hour meter is installed at each lead-in point of each facility and equipment at the primary side, including the watt-hour meter, is owned by the power company (COBEE), and the secondary side belongs to the hospital.

(2) Telephones

Telephones are brought to the lead-in point of each facility by elevated lines and installations, including office telephones, are all controlled by the La Paz Telephone Company.

(3) Water Supply

A two-inch main water supply pipe line is located underneath the public road at the west side in front of the hospital site. A new pipe line with required diameter (2" maximum) can be connected to this main line for storing water in a new receiving tank.

(4) Sewer Line

Existing sewer lines are old and their condition is unknown. Thus, it is desired to connect a new line directly to the existing main sewer line (8 to 10 inches) underneath the public road at the west side in front of the hospital. Sewers for buildings surrounding this hospital may be improved in the future.

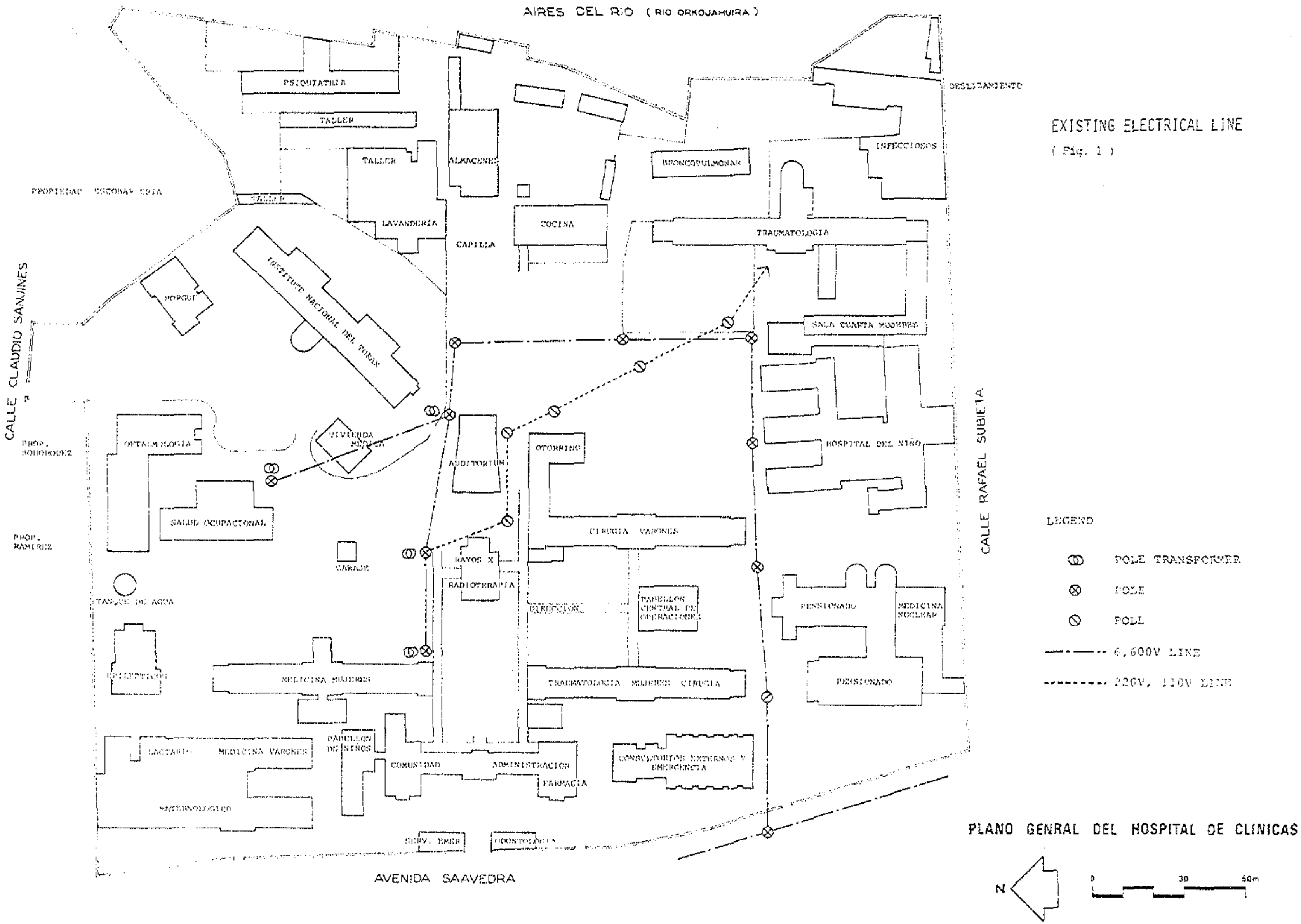
The site of the new building is reversely sloped by two meters for connecting a new line to the existing public sewer line and this may create a problem. The Ministry of Health and Welfare suggests that the sewage be discharged into the river at the east side as a solution to this problem. Since the work for an exterior sewer line for this new research center building is assigned to the Government of Bolivia, further consideration will be made by the Ministry of Health and Welfare. (Refer to Fig. 2)

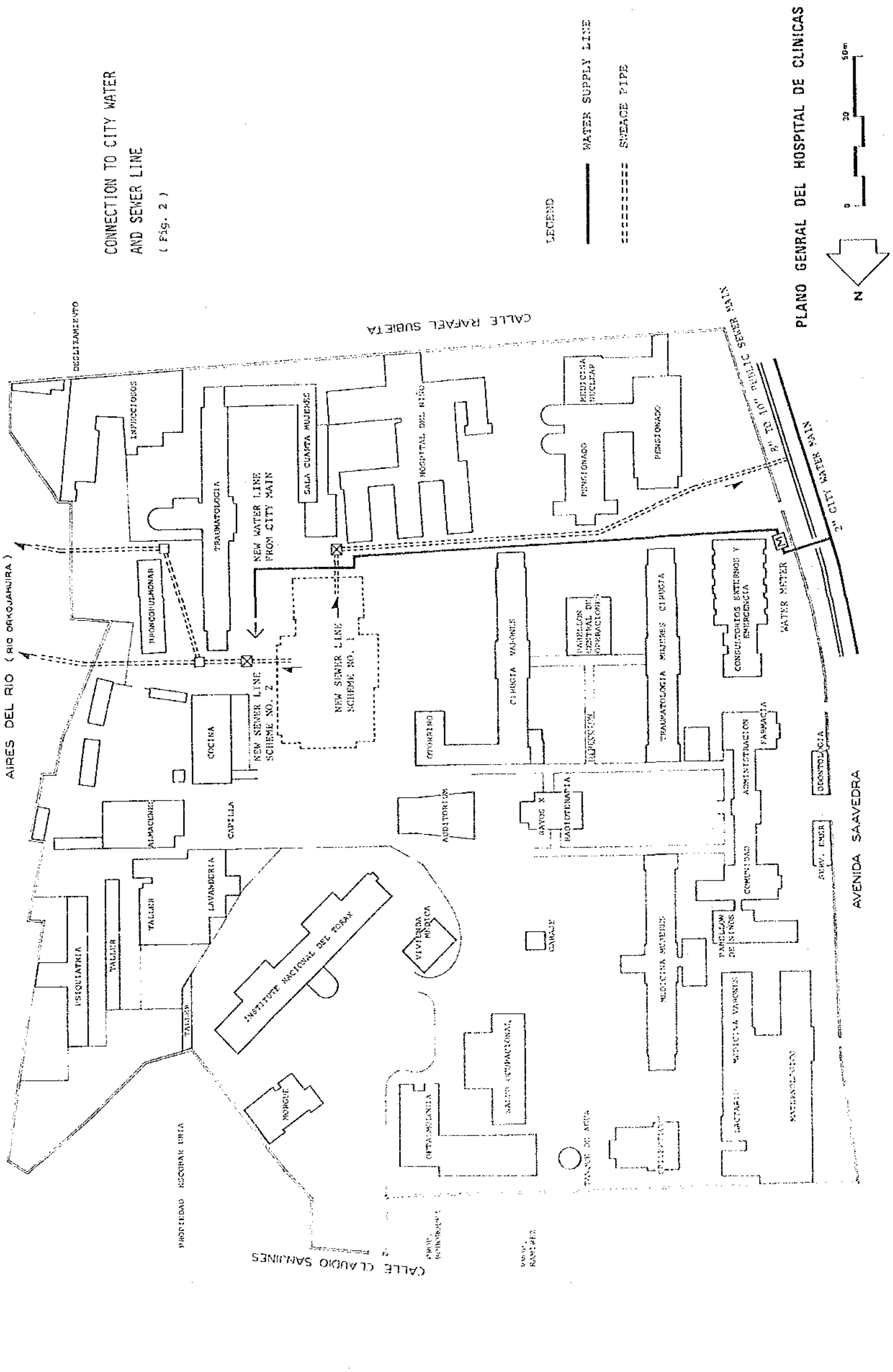
(5) Fuels (Propane Gas or Oil)

Propane-gas for use as fuel can be transported by trucks, and oil can be transported by tank lorry to the new research building.

EXISTING ELECTRICAL LINE

(Fig. 1)




CONNECTION TO CITY WATER
AND SEWER LINE
(Fig. 2)
LEGEND
WATER SUPPLY LINE
SEWAGE PIPE
PLANO GENRAL DEL HOSPITAL DE CLINICAS
N
0
30
50m
CALLE RAFAEL SUBIETA
AIRES DEL RIO (RIO ORKOJAHUIRA)
AVENIDA SAAVEDRA
CALLE CLAUDIO SANJINES
NEW WATER LINE FROM CITY MAIN
NEW SEWER LINE SCHEME NO. 1
NEW SEWER LINE SCHEME NO. 2
WATER METER
2" CITY WATER MAIN
8" TO 10" PUBLIC SEWER MAIN
INFECCIOSOS
TRAUMATOLOGIA
SALA CUARTA MUJERES
HOSPITAL DEL NIÑO
MEDICINA NUCLEAR
PENSIONADO
BRONCOPULMONAR
COCINA
CAPILLA
ALMACENES
LAVANDERIA
TALLER
PSIQUIATRIA
INSTITUTO NACIONAL DEL TORAX
VIVIENDA MEDICA
MORGUE
AUDITORIUM
RAYOS X
RADIOTERAPIA
CIRUGIA VARONES
PABELLON CENTRAL DE OPERACIONES
TRAUMATOLOGIA MUJERES CIRUGIA
CONSULTORIOS EXTERNOS Y EMERGENCIA
ADMINISTRACION
FARMACIA
ODONTOLOGIA
COMUNIDAD
PABELLON DE NIÑOS
MEDICINA MUJERES
MEDICINA VARONES
MATERNIDAD
LACTARIO
GARAGE
OFTALMOLOGIA
SALUD OCUPACIONAL
TANQUE DE AGUA
DESLIZAMIENTO
PROPIEDAD ESCOBAR URIA

Capter 4

Preliminary Design

4-1 Basic Design

The basic plans for the Research Center were based on the results of the survey conducted from June to July, 1977. The basic planning and the agreement (Acuerdo) were reached through several discussions between the Bolivian authorities concerned and the survey team.

The requirements or conditions made by the Bolivian authorities concerned with respect to the Research Center were shown in the preliminary design through analysis and adjustment upon the advice of the gastro-enterological technical cooperation project team of Japan.

4-1-1 Design Conditions

(1) The Research Center is being constructed for high level research and education activities concerning diseases of the digestive organs. It will serve as a strategic point for the medical technology cooperation project now in progress for the urban areas of La Paz, Sucre and Cochabamba, and will perform clinical research on about 600,000 citizens of La Paz.

(2) The Research Center will be constructed in the site of the La Paz National Hospital (Hospital de Clinicas) but will be operated on an independent basis.

(3) The Research Center will be operated initially in a proportion of 30 % for research and 70 % for clinics, but there is a plan to change these proportions to 50 % for research and 50 % for clinics.

(4) Outpatients are estimated to be about 40 to 50 persons a day, and the number of beds will be 25 to 30 designed mainly for short-term hospitalization.

(5) Assembly facilities designed for academic lectures and conferences will be provided.

(6) Personnel assignment of the Research Center will be:

Clinical doctors	6
X-ray engineers	3
Endoscopic engineers	3
Pathologists and chemists	6
Nurses	25
Clerks	4∿6

and also interns and janitors.

4-1-2 Design Concept

The Design Concept is prepared according to the following principles:-

(1) With the current status as well as the future of the overall operation of the Hospital de Clinicas duly taken into consideration, a facility will be constructed to meet advances or changes in the medical system.

(2) A plain functional building plan is to be employed. A simple design is intended to give a sense of cleanliness.

(3) Because of the topography of the site, the differences in the elevation of the site are to be utilized to enable separate access routes to different functions, such as the main entrance, the auditorium entrance and the service access.

(4) Adequate distance between the existing buildings will be maintained in the periphery of the Research Center.

(5) As much as practicable, the construction method for this building and building materials to be used should reflect the

construction procedures being used in La Paz, and the materials available there.

(6) The plans should give due consideration to the operation and management of the building.

(7) While there is substantially no legal restrictions imposed on building the Research Center at present, the plans will take into consideration the future, in compliance with Japanese rules, standards, etc., partially applied.

(8) In the construction of the Research Center, illustrations and reference will be made to matters concerning the work within the scope performed by the Bolivna side.

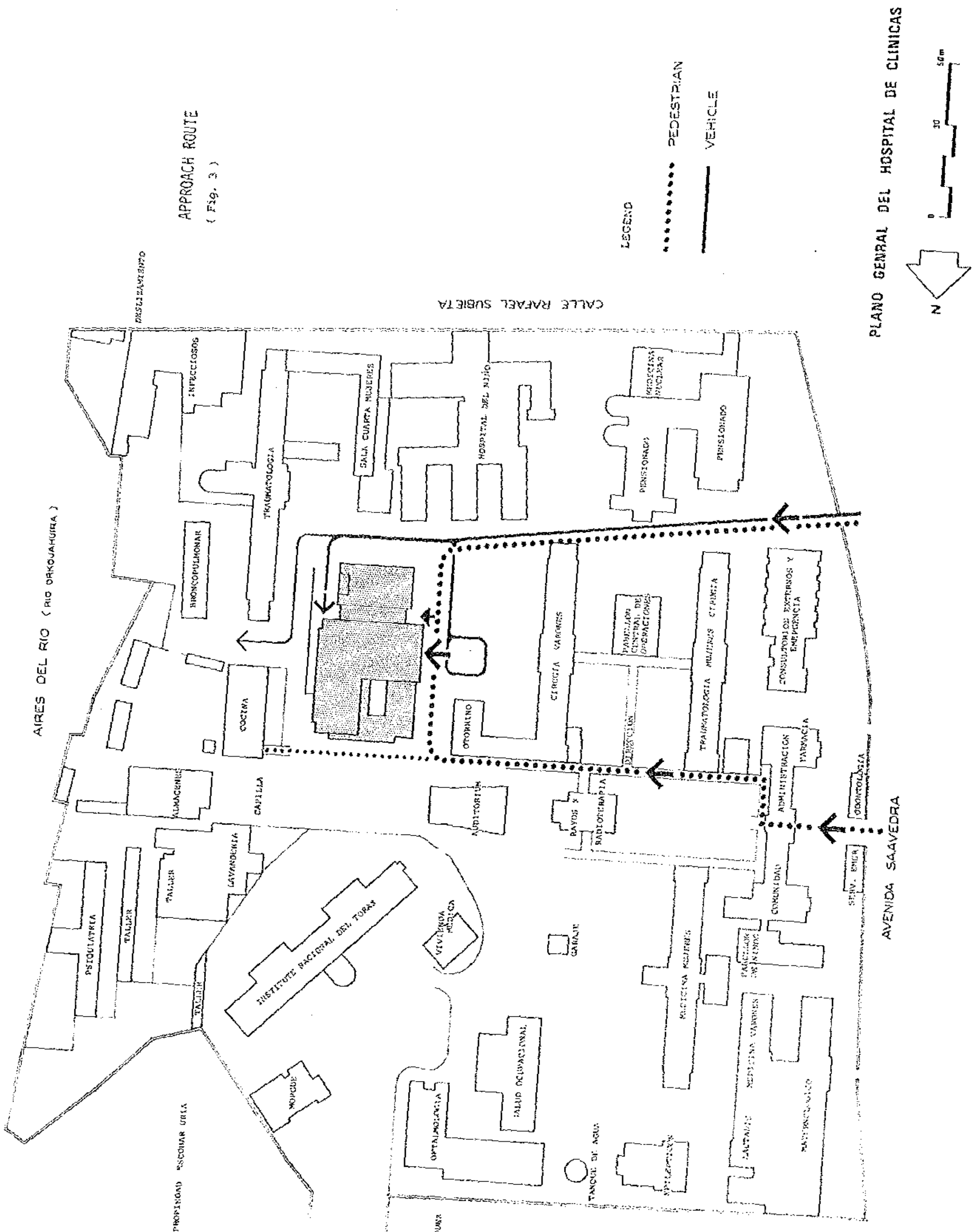
4-1-3 Layout Plan

(1) Effective use will be made of the main access road which will be constructed at the site of the hospital.

(2) The Research Center will be in harmony with the existing buildings, attaching importance to the co-relational function.

(3) The Center will be oriented in the same direction as the existing buildings and the projected area of the Center will be kept to a minimum within the limited site area so that the existing service route from the kitchen (Cocina) to the various wards will not be hampered. Also the environment in front of the chapel (Capilla) must be kept intact. Trees and shrubbery will be planted to enhance the environment.

(4) The patients' main entrance and the auditorium entrance will be on the west side for pedestrians and vehicles, while the service access will be on the east side to the basement, utilizing the difference in elevation of the ground, and the flow will thus be clearly separated into east and west.


APPROACH ROUTE
(Fig. 3)
LEGEND
PEDESTRIAN
VEHICLE
PLANO GENRAL DEL HOSPITAL DE CLINICAS
N
CALLE RAFAEL SUBIETA
AIRES DEL RIO (RIO ORKOJAHUIRA)
AVENIDA SAAVEDRA
CALLE CLAUDIO SANJINES
INFECCIOSOS
TRAUMATOLOGIA
SALA CUARTA MUJERES
HOSPITAL DEL NIÑO
PENSIONADO
BRONCOPULMONAR
COCINA
CAPILLA
ALMACENES
LAVANDERIA
TALLER
PSIQUIATRIA
INSTITUTO NACIONAL DEL TORAX
VIVIENDA MEDICA
AUDITORIUM
CIRUGIA VARONES
TRAUMATOLOGIA MUJERES CIRUGIA
CONSULTORIOS EXTERNOS Y EMERGENCIA
ADMINISTRACION
FARMACIA
ODONTOLOGIA
COMUNIDAD
RADIOTERAPIA
GARAJE
MEDICINA MUJERES
MEDICINA VARONES
SALUD OCUPACIONAL
OFTALMOLOGIA
MORGUE
TANQUE DE AGUA
PROPIEDAD ESCOBAR URIA

4-1-4 Architectural Design

(1) Function of the Center

The function of the Research Center will be divided largely into the following five departments:

Services (machine room, electrical room, kitchen and laundry);

Medical Examination (outpatient examination, endoscopy and radiotherapy);

Laboratory and Research (laboratories, offices for doctors and conference room);

Wards and Surgical operations (wards, operating rooms and sterilization room); and

Auditorium (auditorium and foyer)

The composition of the various floors will be adapted to the respective functions.

(2) Composition of Floors

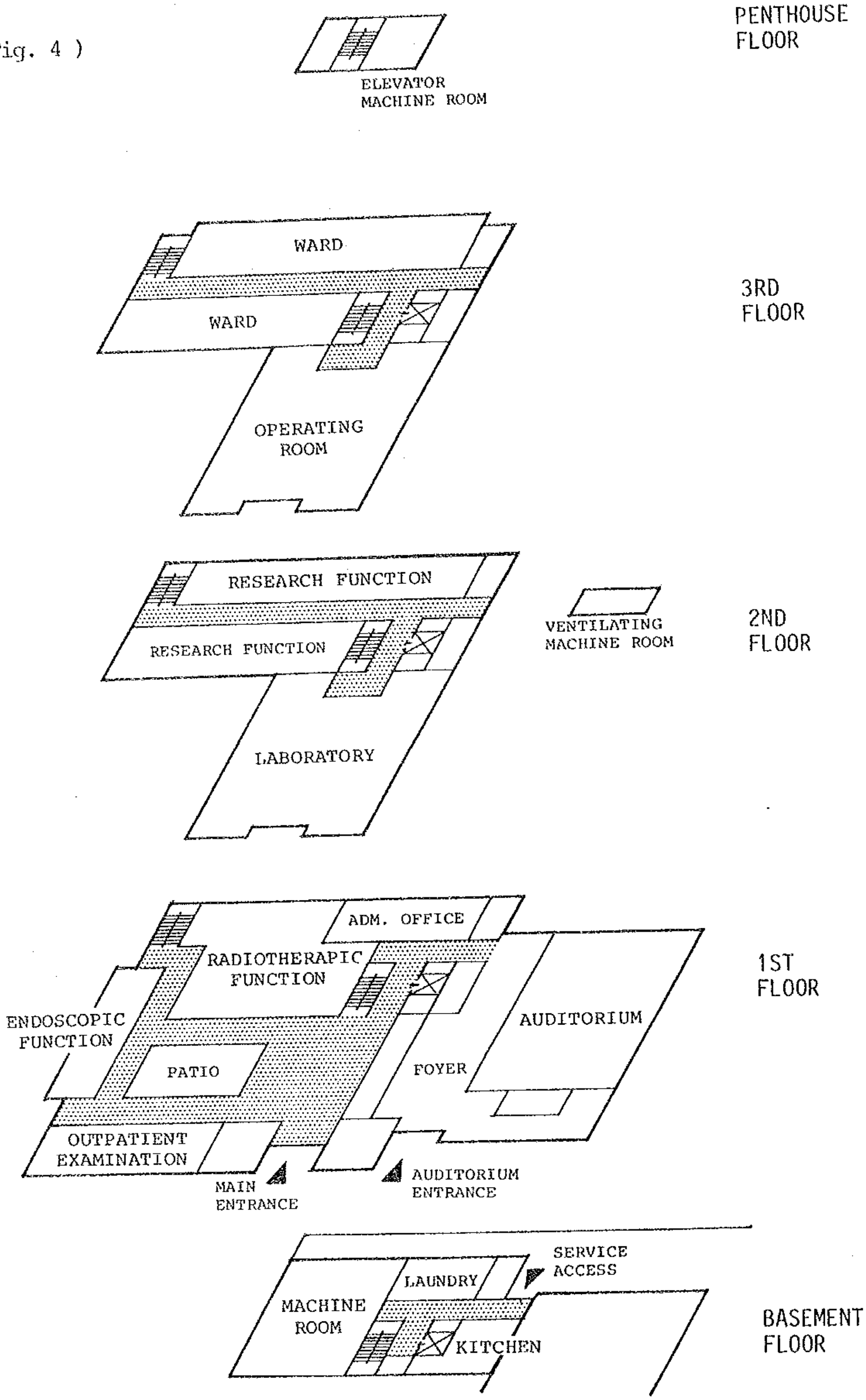
Considering the site area available and the limited time for construction and to insure that the flow to the respective departments does not cause congestion, a three-storied building with one basement will be planned.

1) Basement

The service department will be in the basement that can be approached by way of a ramp so that the service flow cannot be seen from the surrounding area.

COMPOSITION OF FLOORS

(Fig. 4)



2) First floor

The medical examination department will be on the first floor so that the outpatients can receive general examinations on this floor only.

A patio with a pleasant atmosphere will be provided to put the patients at ease, since they are generally in a distressed state. The waiting corridor will surround the patio.

The outpatient examination, endoscopic and radiotherapic functions will be concentrated in one group surrounding the patio, to insure unification of medical examinations.

3) Auditorium

For the auditorium, consideration will be made to secure independent flow lines, while the difference in the level of the site will be utilized for arranging the seats stepwise extending from the first floor to the basement.

Taking the multipurpose use of the auditorium into account, a spacious foyer will be provided.

4) Second floor

The laboratory and research functions will be provided on the second floor to insure a good environment for research activities without being bothered by the flow of the patients.

5) Third floor

The ward and surgical operation function will be arranged on the third floor.

Fully equipped operating rooms will be provided to permit a high level of surgery with effective cooperation with the recovery room in the ward area.

The wards will consist of two-bed rooms and five-bed rooms.

For going between floors, there will be stairways at two locations, and one elevator for stretchers and one dumb-waiter for servicing will be installed.

(3) Building Module

In the plain plan, a module unit of 6 meters will be used which is a standard span for hospitals, laboratories, etc. and also an economical span for reinforced concrete structures.

4-1-5 Selection of Building Materials

(1) Structural Framework

The structure shall be of reinforced concrete which is mostly used for modern buildings in La Paz.

(2) Floor Structure

As for floor structure, solid slabs will be used taking into consideration the number of equipment pipes to be used because of the specific requirement of the Research Center.

(3) Wall Structure

The walls will be made of hollow bricks to which the workers at the site are accustomed.

(4) Exterior Finish

The exterior wall will be finished with external plaster with coating or spray coating. Fixtures for the exterior are mainly of aluminum sashes.

(5) Interior Finish

The interior will be planned, so far as practicable, with clean and nonflammable materials.

1) Flooring: For the flooring, a PVC flooring material, terrazo tile (Mosaico tipo Granitico) will be used, depending on the particular use of the respective rooms.

2) Wall: The walls will mainly be of plaster with finish coating, and tile work is planned in some places, according to the particular use of the room.

3) Ceiling: For the ceiling, acoustic panel will be used, for concealing the service pipings. More important, because of acoustical requirements due to the character of the hospital, an asbestos molded cement board of high sound-absorbing quality will be used instead of the direct plaster finish generally used.

4-1-6 Exterior Design

(1) Efforts will be made to improve the environment by planting trees in the patio and surroundings of the buildings.

The selection of the trees to be planted will be so planned as to be appropriate to the landscape design, and to harmonize the shapes of the trees with the buildings.

(2) The land available for construction is relatively limited for the size of the Research Center. When the space allocated for a Burn Center to be constructed in the future is also taken into consideration, it is difficult to secure sufficient parking space for the facilities. In the compound of the hospital, the buildings are arranged here and there, and vehicles can park near the respective buildings. This is

by no means favorable for the hospital environment. It is desirable that a comprehensive plan will be formulated for parking at the Research Center along with parking for the buildings along the main entrance road.

4-1-7 Structural Design

(1) Basic lines of structural design

The country of Bolivia is not included in the circum-pan-Pacific earthquake belt, and according to the earthquake records during the past 85 years, earthquakes are small in scale, the largest recorded being V degree based to the MM seismic scale. For wind, a speed of 80 KM/h (22.2 M/sec) is taken as the design external force according to the survey results by the municipal office. Such horizontal force is far smaller than that in Japan and, in the structural plan, has little influence on the building plan. As a basic line of the structural plan, a rigid frame structure by means of pillars and beams alone will be used to process the vertical and horizontal forces.

According to field survey results, reinforced structures can be found all over the whole area of La Paz. Therefore, for the plan of the Research Center, a reinforced concrete structure is considered to be the best.

However, reinforced concrete buildings vary greatly in quality, and technical support is required.

(2) Policy of structural design

In Bolivia, there are no standards established for structural design, and the structural engineers use the standards of America (ACI) or West Germany (DIN). Therefore, the structural design is entrusted generally to qualified designers. Thus, the basic lines of structural design of the Center will be determined as set forth in the following.

1) The intensity of external forces and the assumed load acting upon the building will be determined by the weather, soil condition, and the ground at the site, and the purpose of the specific building.

2) Allowable stress intensities of materials specified in the various standards will be used, as a rule, but determined in accordance with the quality subject to the technical level.

3) Calculating the stress of the framework and estimating the strength of the cross-section will be based on the standards of the Building Society of Japan, but ACI and DIN will also be referred to in the design.

The external forces and loads acting upon the building are as follows:-

a) Dead load

The fixed load will be obtained from calculations of the materials used.

b) Live load

For the live load, the standard in the Building Standards Law of Japan or that by ASA (American Standard Association), whichever greater, will be used. For a room used for some special purpose, a value conforming to the actual condition will be used. Comparison between Japanese and American standards is shown below.

Comparison of the values of Live load in Japanese and American Standards

Building Type : Hospital, clinic

Room	Japan	America (ASA) (kg/m^2)
Operating room	-	290
Single room	180	200
Common sickroom	180	200
Public	180	390
Office	300	390

c) Wind pressure

The Center being a 2-3 storied reinforced concrete building, no problems are involved with respect to the wind pressure.

d) Seismic force

As stated in the foregoing, a big earthquake seldom occurs in Bolivia. A record of past earthquakes prepared by the Meteorological Agency in La Paz is shown in Paragraph 3-1-1, (3), 3), a).

As seen, an earthquake occurred in Consata, about 140 KM north of La Paz, on February 24, 1947. This is noted as the biggest earthquake in the history of La Paz. Its intensity was of V degree on the MM seismic scale. According to literature, this degree V represents "an intensity felt by almost all people, many people were awakened at night, some dishes and window panes were broken, swaying of trees and other tall objects was noted, and pendulum clocks stopped." This seems to correspond to a weak earthquake of the III degree when expressed according to the seismic scale of the Japanese Meteorological Agency.

In the following is shown the relation between the degrees of the MM seismic scale and the acceleration as reported by the U.S. Coast and Geodetic Survey in 1948. As seen, the MM seismic scale V corresponds to an acceleration range of 2~75 gal. or 13.3 gal. in mean maximum acceleration.

On the other hand, when the acceleration is assumed from the seismic intensity defined in the Building Standards Law of Japan, it is given as about 200 gal. and upon comparison with the acceleration at the MM seismic scale V, it is I/1000~1/2.7 in the acceleration range. Thus, for the seismic force of the Center, a 1/4 value of that in Japan is assuemd. In La Paz, designs are made generally without including the seismic load.

MM seismic degress versus acceleration
(according to U.S.C.G.S.)

MM seismic degrees	II	III	IV	V	VI	VII	VIII	IX
Acceleration range	1~5	1~8	2~46	2~75	5~175	180~140	51~350	250
Mean maximum	2.3	3.1	9.3	13.3	40	67	172	250

(3) Design strength of concrete

The design standard strength of concrete is: Fc = 210 kg/cm^2, and the deviation is within the range of 45~60 kg/cm^2, although it should be determined depending on the actual situation. Accordingly, the strength of mixture is: Fc = 255~270 kg/cm^2. Temperature compensation is required in winter.